APPENDIX I

Geotechnical Report

Geotechnical Report

APN 780-010-014
Vista Santa Rosa, California

Prepared for:

Bravo Properties, Inc.
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LANDMARK
Geo-Engineers and Geologists

Prepared by:

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April 2022

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Mr. Pablo Bravo
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Geotechnical Report
APN 780-010-014
Vista Santa Rosa, California
LCI Report No.: LP22032

Dear Mr. Bravo:

As per your request, ***LandMark Consultants, Inc.*** is providing the following geotechnical report for the proposed single-family residential project located along Avenue 53, east of Monroe Street, Vista Santa Rosa, County of Riverside, California. The proposed development will consist of nine (9) new single-family residential homes that are planned to be one story, wood/metal-frame structures with shallow reinforced concrete foundations and slab-on-grade concrete floors.

Purpose of Work

The purpose of this study was to investigate the upper 50 feet of subsurface soil at selected locations within the site for evaluation of physical/engineering properties. From the analysis of the field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction.

Authorization

Mr. Pablo Bravo of MBG Construction, LLC provided authorization by written agreement to proceed with our work on February 3, 2022. We conducted our work in general accordance with our written proposal dated January 11, 2022.

Field Exploration

Initial subsurface exploration was performed on March 14, 2022 using Cal Pac Drilling of Yucaipa, California to advance five (5) borings to a depth of 20 to 50 feet below existing ground surface. The borings were advanced with a truck-mounted, Mobile B-61 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers. The approximate boring locations were established in the field and plotted on the site map by sighting to discernable site features. The boring locations are shown on the Site and Exploration Plan (Plate A-2).

Our geo-technician observed the drilling operations and maintained a log of the soil encountered and sampling depths, visually classified the soil encountered during drilling in accordance with the Unified Soil Classification System, and obtained drive tube and bulk samples of the subsurface materials at selected intervals. Relatively undisturbed soil samples were retrieved using a 2-inch outside diameter (OD) split-spoon sampler or a 3-inch OD Modified California Split-Barrel (ring) sampler. The samples were obtained by driving the sampler ahead of the auger tip at selected depths.

The drill rig was equipped with a 140-pound CME automatic hammer with a 30-inch drop for conducting Standard Penetration Tests (SPT) in accordance with ASTM D1586. The number of blows required to drive the samplers the last 12 inches of an 18-inch drive length into the soil is recorded on the boring logs as "blows per foot". Blow counts reported on the boring logs represent the field blow counts. No corrections have been applied for effects of overburden pressure, automatic hammer drive energy, drill rod lengths, liners, and sampler diameter. When samples were not able to be driven an 18 inches depth, sampler penetration depth was recorded for 50 blows with a 140-lbs drive hammer.

After logging and sampling the soil, the exploratory borings were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill.

The subsurface logs are presented on Plates B-1 thru B-5 in Appendix B. A key to the log symbols is presented on Plate B-6. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

Laboratory Testing

Laboratory tests were conducted on selected bulk soil samples to aid in classification and evaluation of selected properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Particle Size Analyses (ASTM D422)
- Unit Dry Densities (ASTM D2937)
- Moisture Contents (ASTM D2216)
- Moisture-Density Relationship (ASTM D1557)
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods)

The laboratory test results are presented on the subsurface logs (Appendix B) and Appendix C. Engineering parameters of soil strength, compressibility, and relative density utilized for developing design criteria provided within this report were extrapolated from data obtained from the field and laboratory testing program.

Site Conditions

The project site is rectangular shaped in plan view, elongated in the north-south direction, and is relatively flat-lying. The site currently is vacant. The project site is bounded by Avenue 53rd on the south. Adjacent properties are flat-lying and are approximately at the same elevation with this site. Vacant lots, farming and single-family residences are located to around the subject site. The Cahuilla Desert Academy is located to the northeast.

The project site lies at an elevation of approximately 25 to 30 feet below mean sea level (AMSL) in the Coachella Valley region of the California low desert. Annual rainfall in this arid region is less than 4 inches per year with four months of average summertime temperatures above 100 ºF. Winter temperatures are mild, seldom reaching freezing.

Geologic Setting

The project site is located in the Coachella Valley portion of the Salton Trough physiographic province. The Salton Trough is a geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone.

The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The surrounding regional geology includes the Peninsular Ranges (Santa Rosa and San Jacinto Mountains) to the south and west, the Salton Basin to the southeast, and the Transverse Ranges (Little San Bernardino and Orocopia Mountains) to the north and east. Hundreds of feet to several thousand feet of Quaternary fluvial, lacustrine, and aeolian soil deposits underlie the Coachella Valley. The southeastern part of the Coachella Valley lies below sea level. In the geologic past, the ancient Lake Cahuilla submerged the area. Calcareous tufa deposits may be observed along the ancient shoreline as high as elevation 45 feet above mean seal level (AMSL) along the Santa Rosa Mountains from La Quinta southward. Lacustrine (lake bed) deposits comprise the subsurface soils over much of the eastern Coachella Valley with alluvial outwash along the flanks of the valley.

Subsurface Soils

Subsurface soils encountered during the field exploration conducted on March 14, 2022 consist of surficial silty sand (SM), sandy silt (ML) and sand (SP) overlying medium dense to dense sands (SP) and silty sands (SM) to a depth of 50 feet, the maximum depth of exploration. The near surface soils are non-expansive in nature. The subsurface logs (Plates B-1 thru B-5) depict the stratigraphic relationships of the various soil types.

Groundwater

Groundwater was not encountered in the borings during the time of exploration. Groundwater well information collected near the subject site (Well 336848N1162328W001), indicated that the ground water level ranges from 79 feet to 80 feet below the ground surfaces in the last 5 years. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, drainage, and site grading. The groundwater level noted should not be interpreted to represent an accurate or permanent condition. Based on the regional topography, groundwater flow is assumed to be generally towards the southeast within the site area. Flow directions may vary locally in the vicinity of the site.

Faulting

The project site is located in the seismically active Coachella Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. We have performed a computer-aided search of known faults or seismic zones that lie within a 46-mile radius of the project site (Table 1). A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults.

The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along active or potentially active faults. An active fault is one that has ruptured during Holocene time (roughly within the last 11,000 years). A fault that has ruptured during the last 1.8 million years (Quaternary time), but has not been proven by direct evidence to have not moved within Holocene time is considered to be potentially active. A fault that has not moved during Quaternary time is considered to be inactive.

Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2000a) indicates that the nearest mapped Earthquake Fault Zone is the San Andreas – Coachella faults located approximately 5.4 miles northeast of the project site.

General Ground Motion Analysis

The project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

2019 CBC General Ground Motion Parameters: The California Building Code (CBC) requires that a site-specific ground motion hazard analysis be performed in accordance with ASCE 7-16 Section 11.4.8 for structures on Site Class D and E sites with S_1 greater than or equal to 0.2 and Site Class E sites with S_s greater than or equal to 1.0. ***This project site has been classified as Site Class D and has a S_1 value of 0.67, which would require a site-specific ground motion hazard analysis***. However, ASCE 7-16 Section 11.4.8 provides three exceptions which permit the use of conservative values of design parameters for certain conditions for Site Class D and E sites in lieu of a site-specific hazard analysis.

The exceptions are:

- Exception 1: Structures on Site Class E sites with S_s greater than or equal to 1.0, provided the site coefficient F_a is taken as equal to that of Site Class C.
- Exception 2: Structures on Site Class D sites with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient C_s is determined by Equations 12.8-2 for values of $T \leq 1.5T_S$ and taken as equal to 1.5 times the value computed in accordance with either Equation 12.8-3 for $T_L \geq T > 1.5T_S$ or Equation 12.8-4 for $T > T_L$.
- Exception 3: Structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_S and the equivalent static force procedure is used for design.

Based on our understanding of the proposed development, the seismic design parameters presented in Table 2 were calculated assuming that one of the exceptions listed above applies to the proposed structures at this site. **However, the structural engineer should verify that one of the exceptions is applicable to the proposed structures.** If none of the exceptions apply, our office should be consulted to perform a site-specific ground motion hazard analysis.

The 2019 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Web Application (SEAOC, 2020) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters.

Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for soil site class effects (PGA_M) value to be used for liquefaction and seismic settlement analysis in accordance with 2019 CBC Section 1803A.5.12 ($PGA_M = F_{PGA}*PGA$) is estimated at 0.79g for the project site. ***Design earthquake ground motion parameters are provided in Table 2.***

Seismic and Other Hazards

► **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the San Andreas fault. A further discussion of groundshaking mentioned above.

► **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone or County of Riverside Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the Coachella Valley as shown on USGS and CDMG maps. However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.

► **Liquefaction.** Liquefaction is a not a potential design consideration because of the depth to groundwater.

Other Potential Geologic Hazards.

► **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.

► **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.

► **Tsunamis, sieches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, sieches, or other seismically-induced flooding is unlikely.

► **Expansive soil.** The near surface soils at the project site consist of sands which are non-expansive.

Seismic Settlement

An evaluation of the non-liquefaction seismic settlement potential was performed using the relationships developed by Tokimatsu and Seed (1984, 1987) for dry sands. This method is an empirical approach to quantify seismic settlement using SPT blow counts and PGA estimates from the probabilistic seismic hazard analysis.

The soils beneath the site consist primarily of medium dense to dense sands. Based on the empirical relationships, total induced settlements are estimated to be less than ½ inch in the event of a MCE_G earthquake (0.79g peak ground acceleration). Should settlement occur, buried utility lines and the buildings may not settle equally. Therefore, we recommend that utilities, especially at the points of entry to the buildings, be designed to accommodate differential movement. The computer printouts for the estimates of induced settlement are included in Appendix D.

Hydroconsolidation

In arid climatic regions, granular soils have a potential to collapse upon wetting. This collapse (hydro-consolidation) phenomena is the result of the lubrication of soluble cements (carbonates) in the soil matrix causing the soil to densify from its loose configuration during deposition. Based on our experience in the vicinity of the project site, there is a slight risk of collapse upon inundation from at the site. Therefore, development of building foundation is not required to include provisions for mitigating the hydro-consolidation caused by soil saturation from landscape irrigation or broken utility lines.

Soil Infiltration Rate

A total of two (2) infiltration tests were conducted on April 14, 2022 at the proposed location for the on-site storm-water retention basin as shown on the Site and Exploration Plan (Plate A-2). The infiltration tests were performed to the guideline from Design Handbook for Low Impact Development Best Management Practices, prepared by Riverside County Flood Control and Water Conservation District, Appendix A, Section 2.3, dated September 2011.

The tests were performed using perforated pipes inside a 6-inch diameter hand auger borehole made to depths of approximately 5.0 feet below the existing ground surface, corresponding to the anticipated bottom depth of the stormwater retention basin. The pipes were filled with water and successive readings of drop in water levels were made every 10 minutes for a total elapsed time of 60 minutes, until a stabilization drop was recorded.

The test results indicate that the stabilized soil infiltration rate for the soil ranges from 4.8 to 5.8 inches per hour. A maximum soil infiltration rate of 4.8 inches per hour may be used for the on-site storm-water retention basin design. An oil/water separator should be installed at inlets to the stormwater retention basin to prevent sealing of the basin bottom with silt and oil residues. The field and conversion calculation worksheets are included in Appendix E.

We recommend additional testing should be performed after the completion of rough grading operations, to verify the soil infiltration rate.

Site Preparation

Pre-grade Meeting: Prior to site preparation, a meeting should be held at the site with as a minimum, the owner's representative, grading contractor and geotechnical engineer in attendance.

Clearing and Grubbing: Any surface improvements, debris or vegetation including grass, trees, and weeds on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic stripping should be hauled from the site and not used as fill.

Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations, un-controlled fills and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be dish-shaped to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

Mass Grading: Prior to placing any fills, the surface 12 inches of soil should be removed, the exposed surface should be scarified to a depth of 8 inches, uniformly moisture conditioned to ±2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density. Native soils may be used for mass grading, placed in 6 inches maximum lifts, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density

Building Pad Preparation: The existing surface soil within the proposed building pad areas should be removed to 18 inches below the original grade or 36 inches below the lowest foundation grade (whichever deeper), extending five feet beyond all exterior wall/column lines (including adjacent concrete areas). Exposed sub-grade should be scarified to a depth of 6 to 8 inches, uniformly moisture conditioned to at least 2% over optimum moisture content, and re-compacted a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have footings extended to a minimum of 18 inches below grade. The existing soil beneath the structure foundation prepared in the manner described for the house pad except the preparation needs only to extend 18 inches below and beyond the footing.

Sidewalk and Concrete Hardscape Areas: In areas other than the building pad which are to receive concrete slabs, the ground surface should be over-excavated to a depth of 8 to 12 inches, uniformly moisture conditioned to least 2% of optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

The on-site soils are suitable for use as compacted fill and utility trench backfill. Imported fill soil (if required) should be similar to onsite soil or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 6 inches and no less than 5% passing the No. 200 sieve. ***The geotechnical engineer should approve imported fill soil sources before hauling material to the site***. Native and imported materials should be placed in lifts no greater than 8 inches in loose thickness, uniformly moisture conditioned to ±2% of optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

Moisture Control and Drainage: The moisture condition of the house pad should be maintained during trenching and utility installation until concrete is placed or should be rewetted before initiating delayed construction. Adequate site drainage is essential to future performance of the project. Infiltration of excess irrigation water and stormwaters can adversely affect the performance of the subsurface soil at the site. Positive drainage should be maintained away from all structures (5% for 5 feet minimum across unpaved areas) to prevent ponding and subsequent saturation of the native soil.

Gutters and downspouts may be considered as a means to convey water away from foundations. If landscape irrigation is allowed next to the building, drip irrigation systems or lined planter boxes should be used. Drainage should be maintained without ponding.

Utility Trench Backfill

On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill. Backfill within roadway should, at a minimum, conform to County of Riverside Standard No. 818 – Utility Trench Backfill (Appendix F).

Backfill within roadways should be placed in layers not more than 6 to 8 inches in thickness, uniformly moisture conditioned to least 2% of optimum moisture and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 95%. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material.

Pipe envelope/bedding should be clean sand (Sand Equivalent SE>30). Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

Building Foundations and Settlements

Shallow Foundation: Shallow column footings and continuous wall footings are suitable to support the building structures provided they are founded on a layer of properly prepared and compacted soil as described above. The foundations may be designed using an allowable soil bearing pressure of 1,800 psf. The allowable soil pressure may be increased by 20% for each foot of embedment depth in excess of 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 2,800 psf.

All exterior and interior foundations should be embedded a minimum of 18 inches deep. Continuous wall footings should have a minimum width of 12 inches. Spread footings should have a minimum width of 24 inches and should not be structurally isolated. ***Recommended concrete reinforcement and sizing for all footings should be provided by the structural engineer.*** Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs.

Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 320 pcf to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.38 may also be used at the base of the footings to resist lateral loading.

Slabs-on-Grade

Concrete slabs and flatwork should be a minimum of 4 inches thick. The concrete floor slabs may either be monolithically placed with the foundation or dowelled after footing placement. The concrete slabs may be placed on granular subgrade that has been compacted at least 90% relative compaction (ASTM D1557). ***Slab thickness and steel reinforcement should be determined by the design engineer.***

American Concrete Institute (ACI) guidelines (ACI 302.1R-15 Chapter 5, Section 5.2.3) provide recommendations regarding the use of moisture barriers beneath concrete slabs. The concrete floor slabs should be underlain by a 10-mil polyethylene vapor retarder that works as a capillary break to reduce moisture migration into the slab section. All laps and seams should be overlapped 6-inches or as recommended by the manufacturer. The vapor retarder should be protected from puncture. The joints and penetrations should be sealed with the manufacturer's recommended adhesive, pressure-sensitive tape, or both. The vapor retarder should extend a minimum of 12 inches into the footing excavations. The vapor retarder may lie directly on the granular fill with 2 inches of clean sand cover.

Placing sand over the vapor retarder may increase moisture transmission through the slab, because it provides a reservoir for bleed water from the concrete to collect. The sand placed over the vapor retarder may also move and mound prior to concrete placement, resulting in an irregular slab thickness. For areas with moisture sensitive flooring materials, ACI recommends that concrete slabs be placed without a sand cover directly over the vapor retarder, provided that the concrete mix uses a low-water cement ratio and concrete curing methods are employed to compensate for release of bleed water through the top of the slab. The vapor retarder should have a minimum thickness of 15-mil (Stego-Wrap or equivalent). All independent concrete flatworks should be underlain by 12 inches of moisture conditioned and compacted soils. All flatwork should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-2). The native soils have low levels of sulfate and low chloride ion concentrations. Resistivity determinations on the soil indicate a moderate potential for metal loss because of electrochemical corrosion processes. A minimum of 2,500 psi concrete of Type II Portland Cement with a maximum water/cement ratio of 0.6 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including streets, sidewalks, driveways, hardscape, and foundations).

Landmark does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site.

Permanent Slopes

Cut and Fill slopes should be constructed generally no steeper than 3 (H):1(V) to permit slope maintenance with motor graders, and provide erosional stability from wind or rain while unprotected without landscape cover. Slopes with a 2(H):1(V) gradient are permitted, provided it is recognized that such slopes are more prone to erosion and do not permit maintenance by motorized riding equipment and require landscape cover to retard erosion.

Pavements

Pavements should be designed according to CALTRANS or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements. Based on the current State of California CALTRANS method, an estimated R-value of 50 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC) pavement sections.

PAVEMENT STUCTURAL SECTIONS

R-Value of Subgrade Soil - 50 (minimum) Design Method - CALTRANS 2020

Traffic Index (assumed)	Flexible Pavements		Rigid (PCC) Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)	Concrete Thickness (in.)	Aggregate Base Thickness (in.)
4.0	2.5	4.0	4.0	4.0
5.0	3.0	4.0	6.0	4.0
6.0	3.0	4.0	6.0	6.0

Notes:

1) Asphaltic concrete shall be Caltrans, Type B, ¾ inch maximum medium grading, (½ inch for parking areas) medium grading with PG70-10 asphalt concrete, compacted to a minimum of 95% of the 50-blow Marshall density (ASTM D1559).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 12 inches of moisture conditioned (at least 2% of over optimum) native soil compacted to a minimum of 95% of the maximum dry density determined by ASTM D1557, or the governing agency requirements.
4) Portland cement concrete for pavements should have Type V cement, a minimum compressive strength of 3,250 psi at 28 days, and a maximum water-cement ratio of 0.55.

Final recommended pavement sections may need to be based on sampling and R-Value testing during grading operations when actual subgrade soils will be exposed.

Observation and Density Testing

Site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Near full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "***geotechnical engineer of record***" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Closure

We did not encounter soil conditions that would preclude implementation of the proposed project provided the recommendations contained in this report are implemented in the design and construction of this project.

We recommend that ***Landmark Consultants, Inc.*** be retained to provide the tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

Landmark Consultants, Inc. *recommendations for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and foundation construction. Accordingly, the findings and professional opinions in this report are made contingent upon the opportunity for* ***Landmark Consultants, Inc.*** *to observe grading operations and foundation excavations for the proposed construction.*

If parties other than ***Landmark Consultants, Inc.*** *are engaged to provide observation and testing services during construction, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the recommendations in this report and/or by providing alternative recommendations.*

Additional information concerning the scope and cost of these services can be obtained from our office.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. If you have any questions or comments regarding our findings, please call our office at (760) 360-0665.

Respectfully Submitted,
LandMark Consultants, Inc.



Greg M. Chandra, P.E., M.ASCE
Principal Engineer

Attachments:

Appendix A: Vicinity and Site Maps
Appendix B: Subsurface Soil Logs and Soil Key
Appendix C: Laboratory Test Results
Appendix D: Settlement Calculations
Appendix E: Soil Infiltration Test Results
Appendix F: Utility Trench Backfill

TABLES

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
San Andreas - Coachella	5.4	8.6	7.2	96 ± 10	25 ± 5
Indio Hills *	6.3	10.1			
San Andreas - San Bernardino (South)	7.8	12.5	7.4	103 ± 10	30 ± 7
San Andreas - San Bernardino (North)	7.9	12.7	7.5	103 ± 10	24 ± 6
Blue Cut *	16.8	26.9			
Garnet Hill *	18.1	29.0			
San Jacinto - Anza	19.4	31.1	7.2	91 ± 9	12 ± 6
Eureka Peak	21.0	33.6	6.4	19 ± 2	0.6 ± 0.4
San Jacinto - Coyote Creek	22.3	35.7	6.8	41 ± 4	4 ± 2
Hot Springs *	28.4	45.4			
Burnt Mtn.	29.1	46.6	6.5	21 ± 2	0.6 ± 0.4
San Jacinto - Borrego	32.2	51.5	6.6	29 ± 3	4 ± 2
Morongo *	32.9	52.6			
Pinto Mtn.	33.0	52.8	7.2	74 ± 7	2.5 ± 2
Pisgah Mtn. - Mesquite Lake	33.5	53.6	7.3	89 ± 9	0.6 ± 0.4
Landers	36.2	58.0	7.3	83 ± 8	0.6 ± 0.4
Earthquake Valley	39.5	63.2	6.5	20 ± 2	2 ± 1
San Jacinto - San Jacinto Valley	41.9	67.0	6.9	43 ± 4	12 ± 6
Elsinore - Julian	43.2	69.1	7.1	76 ± 8	5 ± 2
S. Emerson - Copper Mtn.	43.5	69.6	7	54 ± 5	0.6 ± 0.4
Elmore Ranch	44.4	71.0	6.6	29 ± 3	1 ± 0.5
Johnson Valley (northern)	45.5	72.8	6.7	35 ± 4	0.6 ± 0.4

* Note: Faults not included in CGS database.

Table 2
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

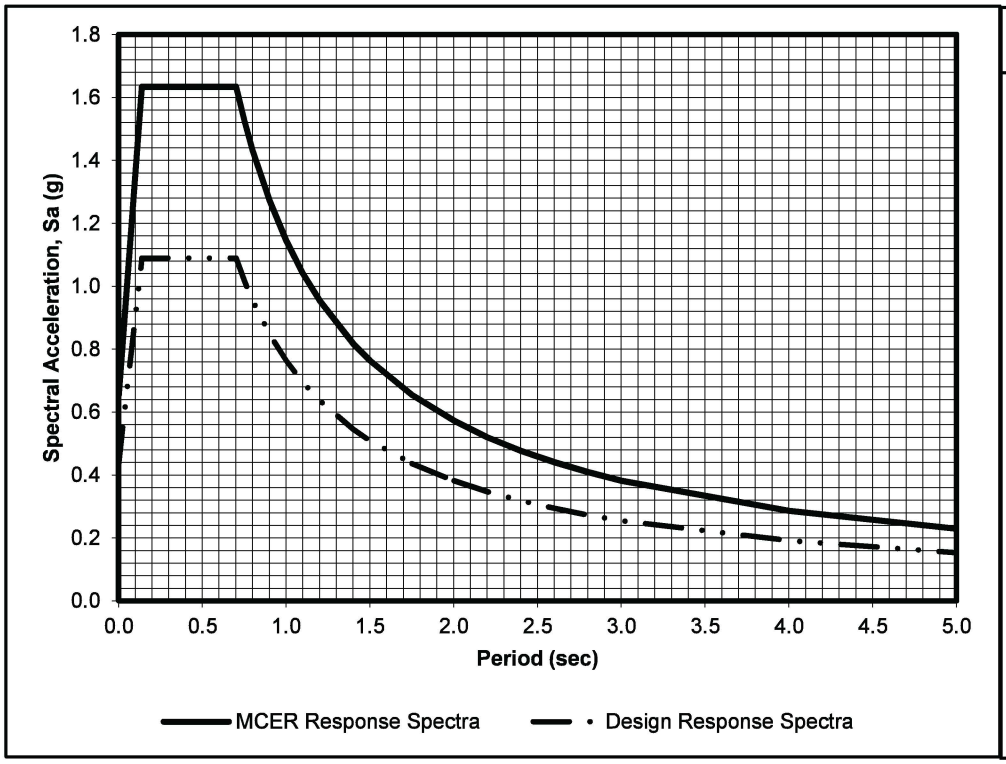
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	33.6657	N	
Longitude:	-116.2263	W	
Risk Category:	II		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.634 g	ASCE Figure 22-1	
Mapped MCE_R 1 second Spectral Response	S_1	0.673 g	ASCE Figure 22-2	
Short Period (0.2 s) Site Coefficient	F_a	1.00	ASCE Table 11.4-1	
Long Period (1.0 s) Site Coefficient	F_v	1.70	ASCE Table 11.4-2	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.634 g	= Fa * S_s	ASCE Equation 11.4-1
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.144 g	= Fv * S_1	ASCE Equation 11.4-2

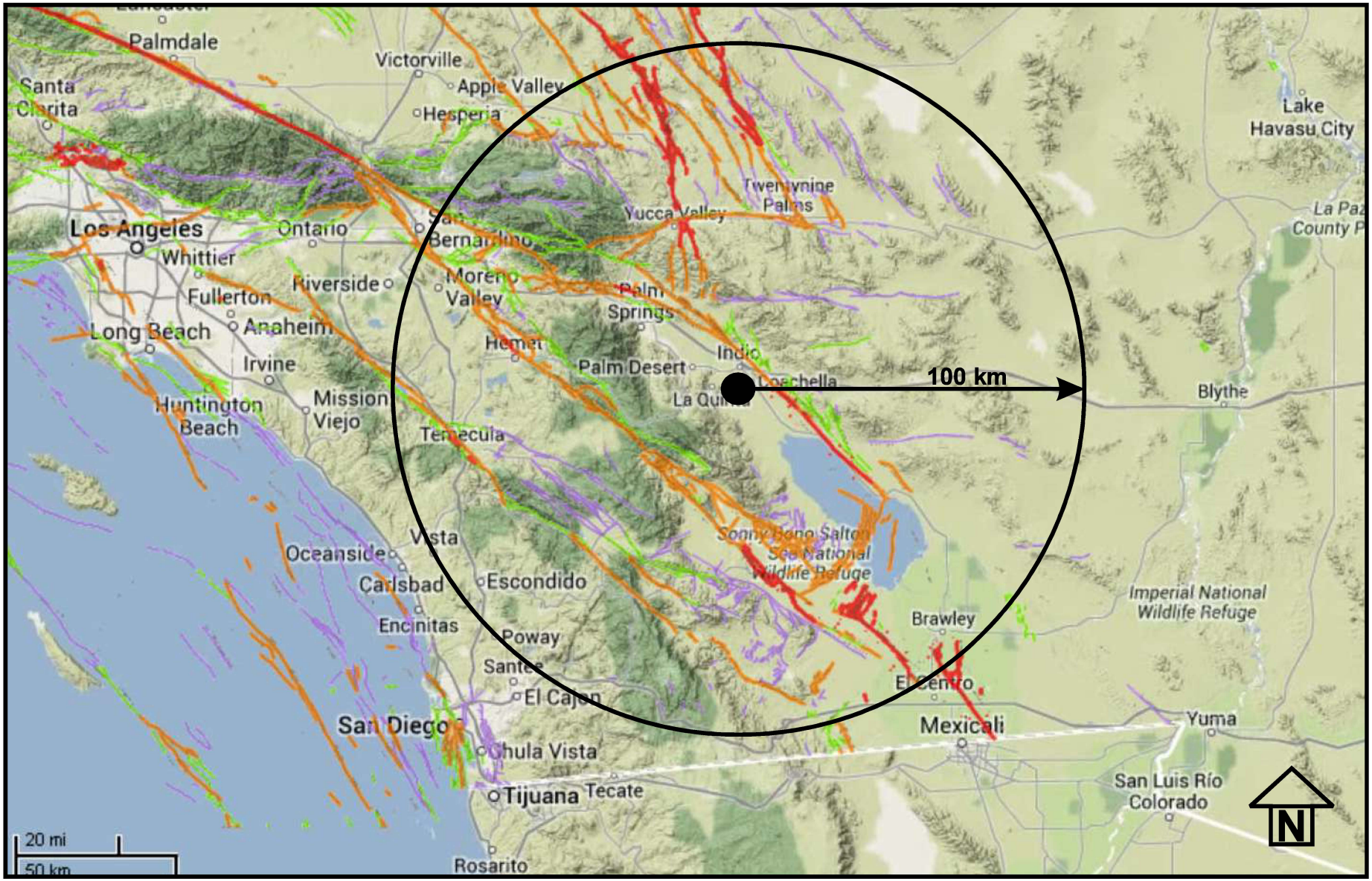
Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.089 g	= 2/3*S_{MS}	ASCE Equation 11.4-3
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.763 g	= 2/3*S_{M1}	ASCE Equation 11.4-4
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.897		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.883		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	=0.2*S_{D1}/S_{DS}	
	T_S	0.70 sec	=S_{D1}/S_{DS}	
Peak Ground Acceleration	PGA_M	0.79 g		ASCE Equation 11.8-1



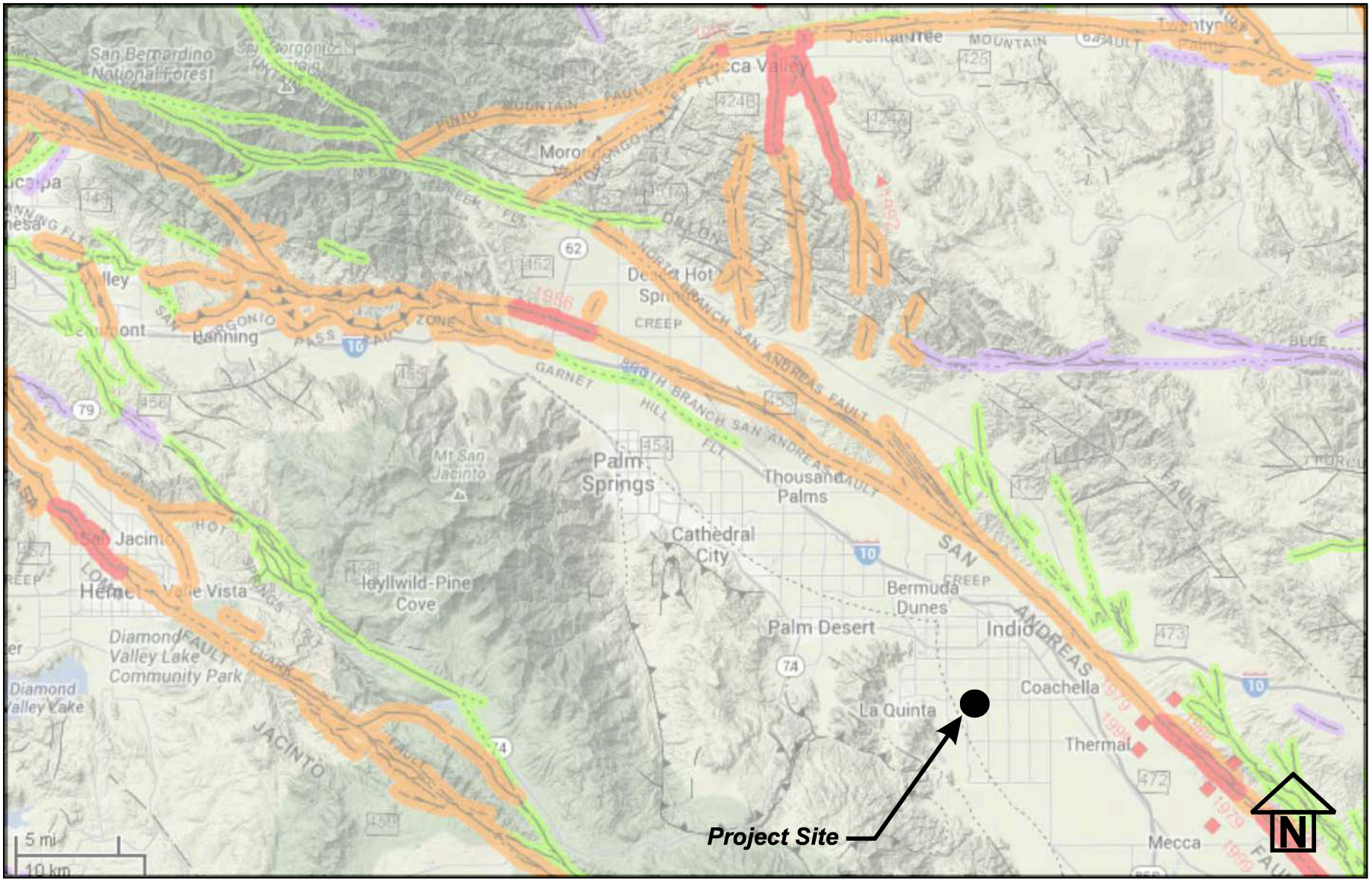
Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.44	0.65
0.14	1.09	1.63
0.70	1.09	1.63
0.75	1.02	1.53
0.80	0.95	1.43
0.90	0.85	1.27
1.00	0.76	1.14
1.10	0.69	1.04
1.20	0.64	0.95
1.20	0.64	0.95
1.40	0.54	0.82
1.50	0.51	0.76
1.75	0.44	0.65
2.00	0.38	0.57
2.20	0.35	0.52
2.40	0.32	0.48
2.60	0.29	0.44
2.80	0.27	0.41
3.00	0.25	0.38
4.00	0.19	0.29
5.00	0.15	0.23

FIGURES



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

LANDMARK Geo-Engineers and Geologists Project No.: LP22032	Regional Fault Map	Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

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Geo-Engineers and Geologists

Project No.: LP22032

Map of Local Faults

Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

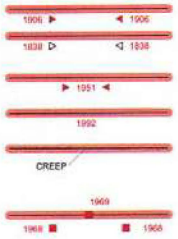
FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.



A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
						ON LAND	OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	200			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	11,700			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000			Undivided Quaternary faults – most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

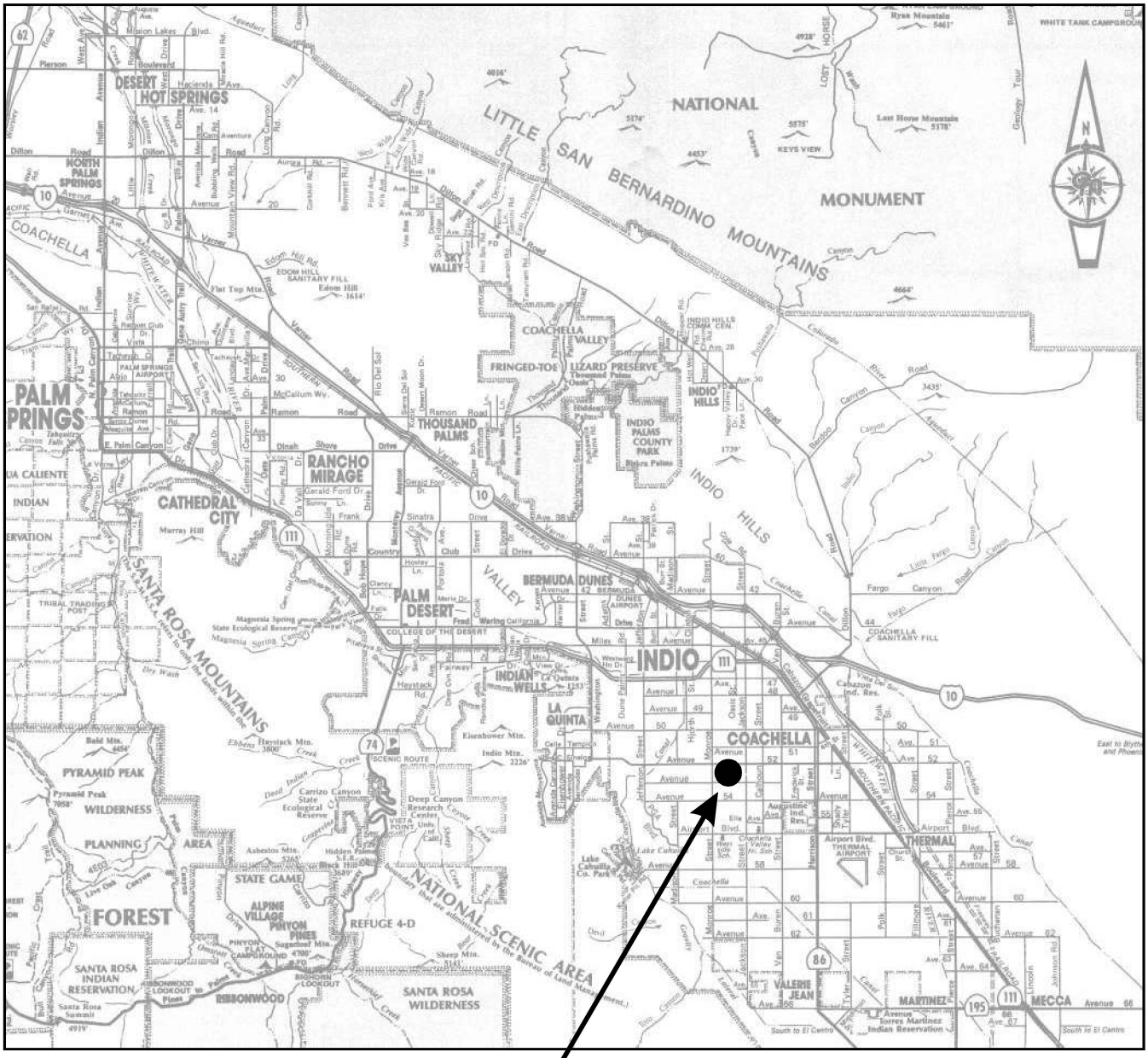
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Project No.: LP22032

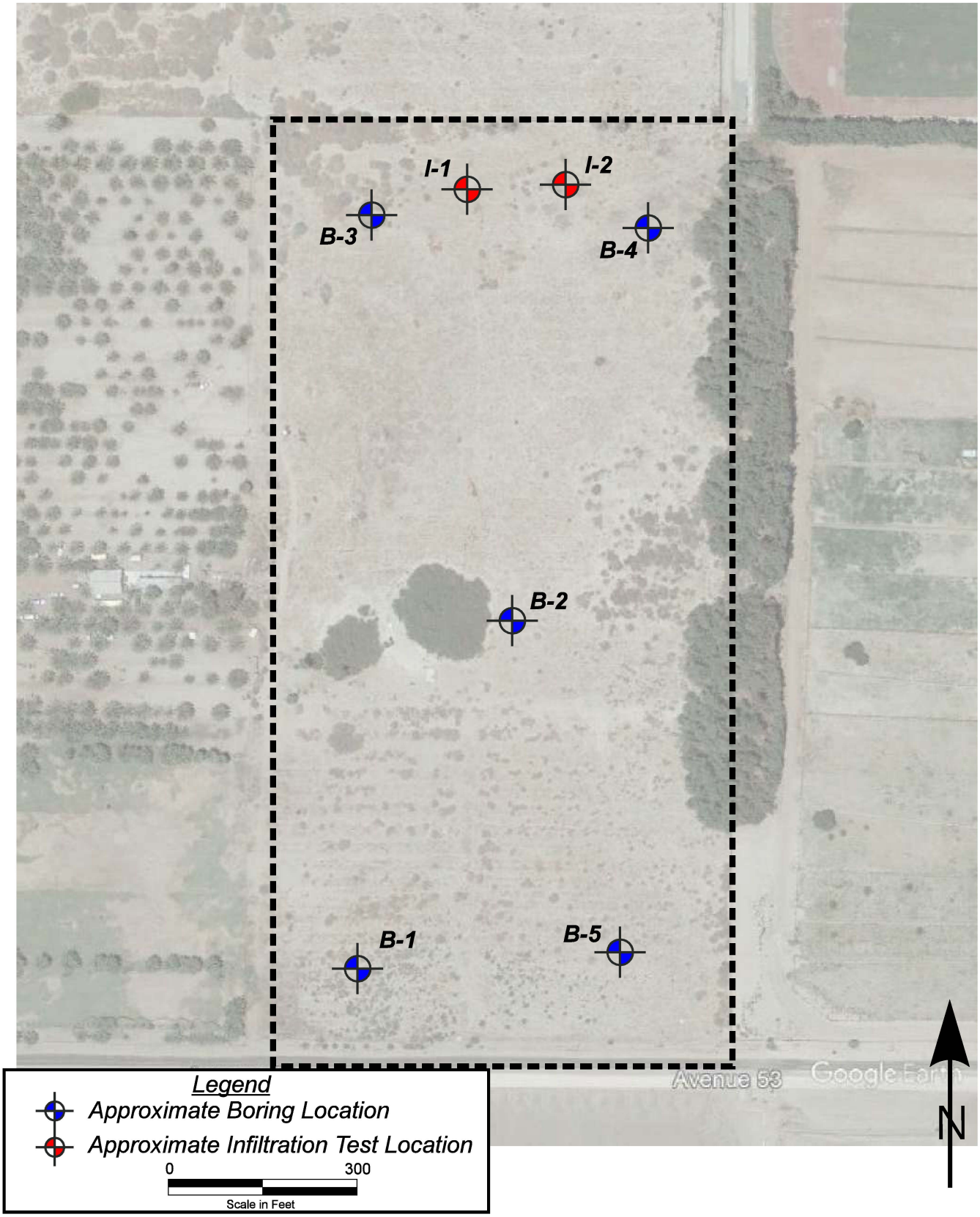
Fault Map Legend

Figure 3

APPENDIX A



LANDMARK Geo-Engineers and Geologists Project No.: LP22032	Vicinity Map	Plate A-1

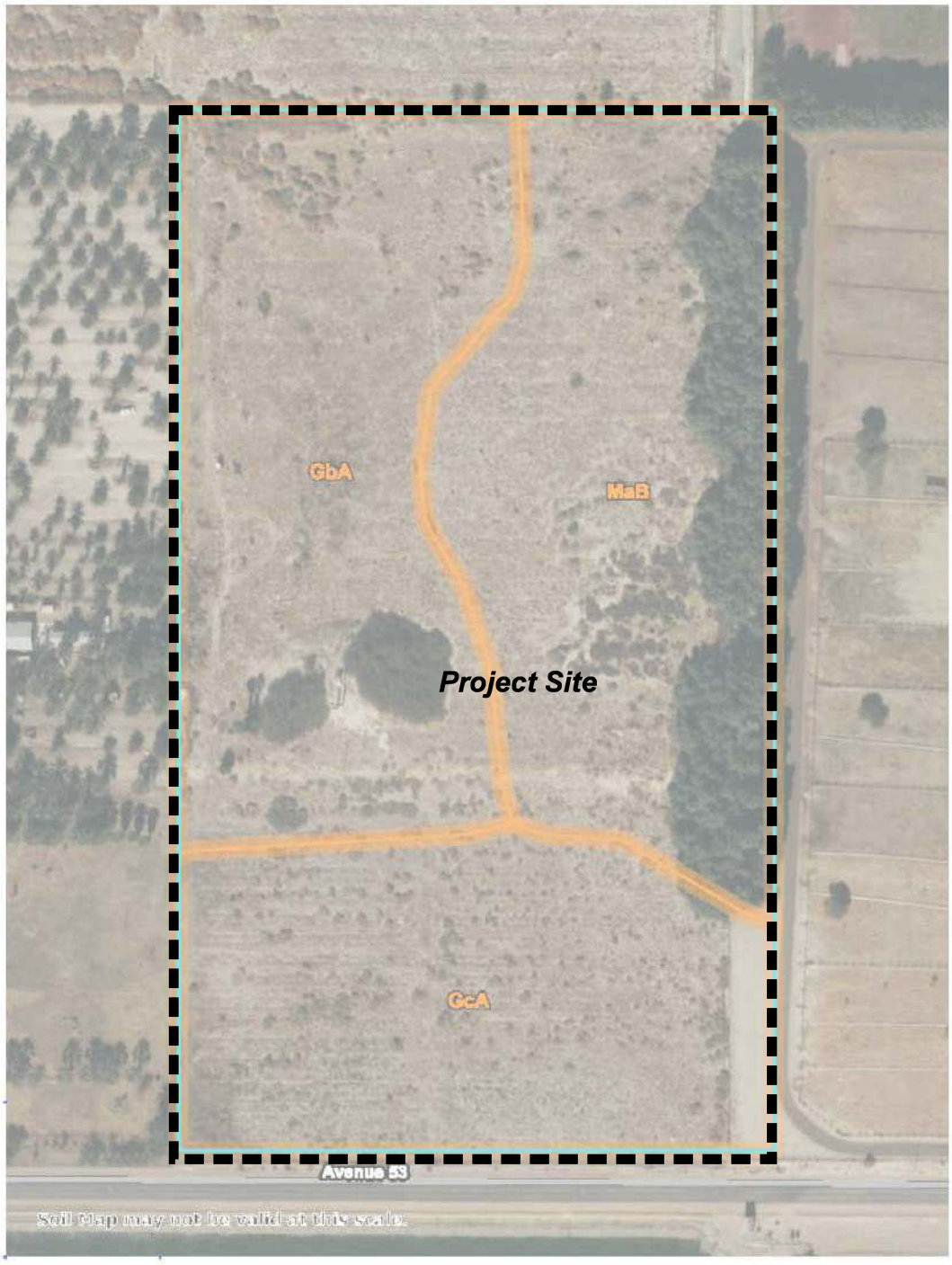


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Site and Exploration Plan

Plate
A-2



Map Scale: 1:2,250 f printed on A portrait (8.5" x 11") sheet.

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

4/21/2022
Page 1 of 3

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Project No.: LP22032

USDA Soil Conservation Soil Service Map

Plate A-3

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Riverside County, Coachella Valley Area, California
Survey Area Data: Version 13, Sep 15, 2021

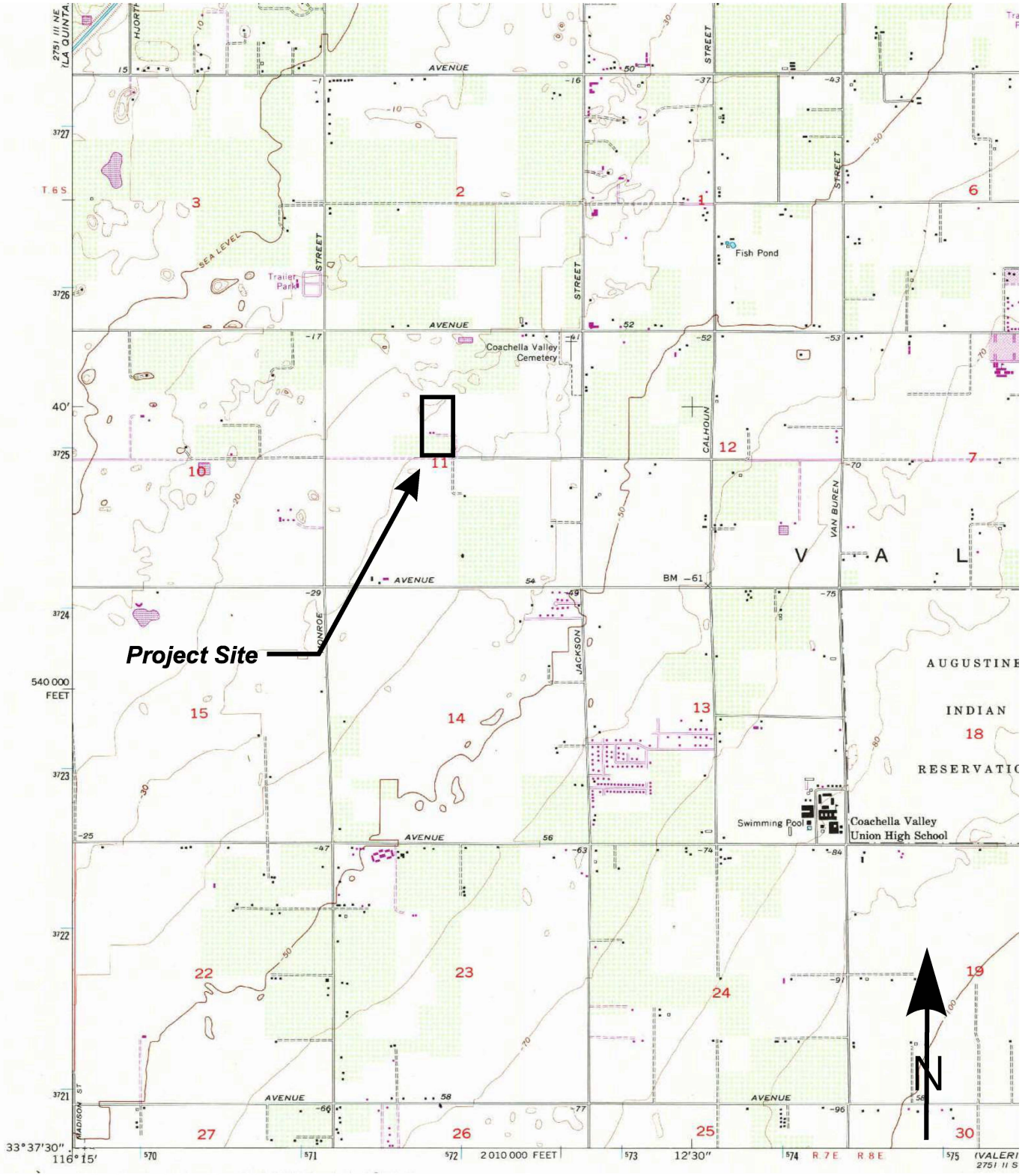
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 3, 2021—May 27, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GbA	Gilman fine sandy loam, 0 to 2 percent slopes	7.5	35.6%
GcA	Gilman fine sandy loam, wet, 0 to 2 percent slopes	6.1	28.8%
MaB	Myoma fine sand, 0 to 5 percent slopes	7.5	35.6%
Totals for Area of Interest		**21.0**	**100.0%**



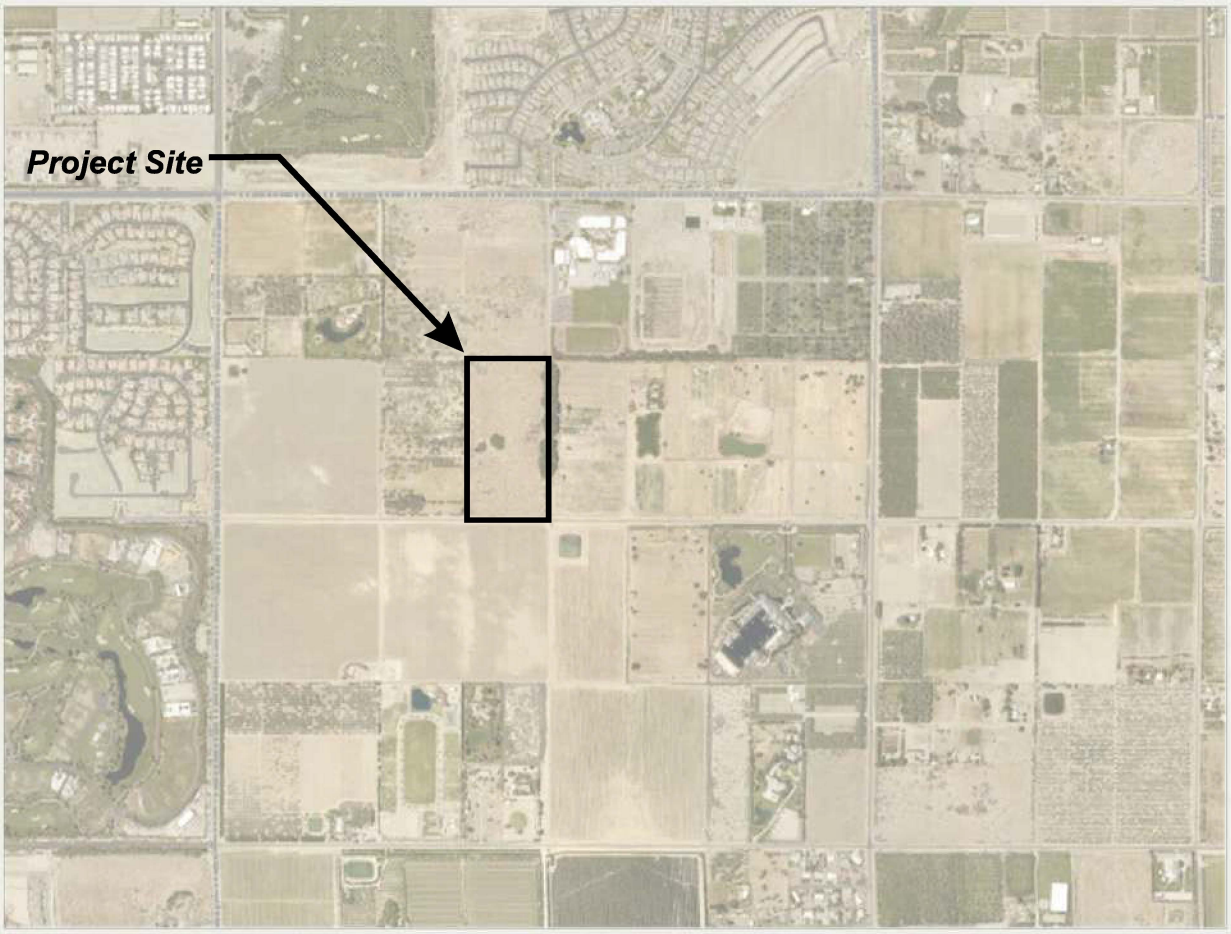
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Project No.: LP22032

Topographic Map

Plate A-4

Fault Map



Legend

Faults

- OTHER AUTHORITY
- ALQUIST-PRIOLO
- RIVERSIDE COUNTY

Notes

0 1,505 3,009 Feet

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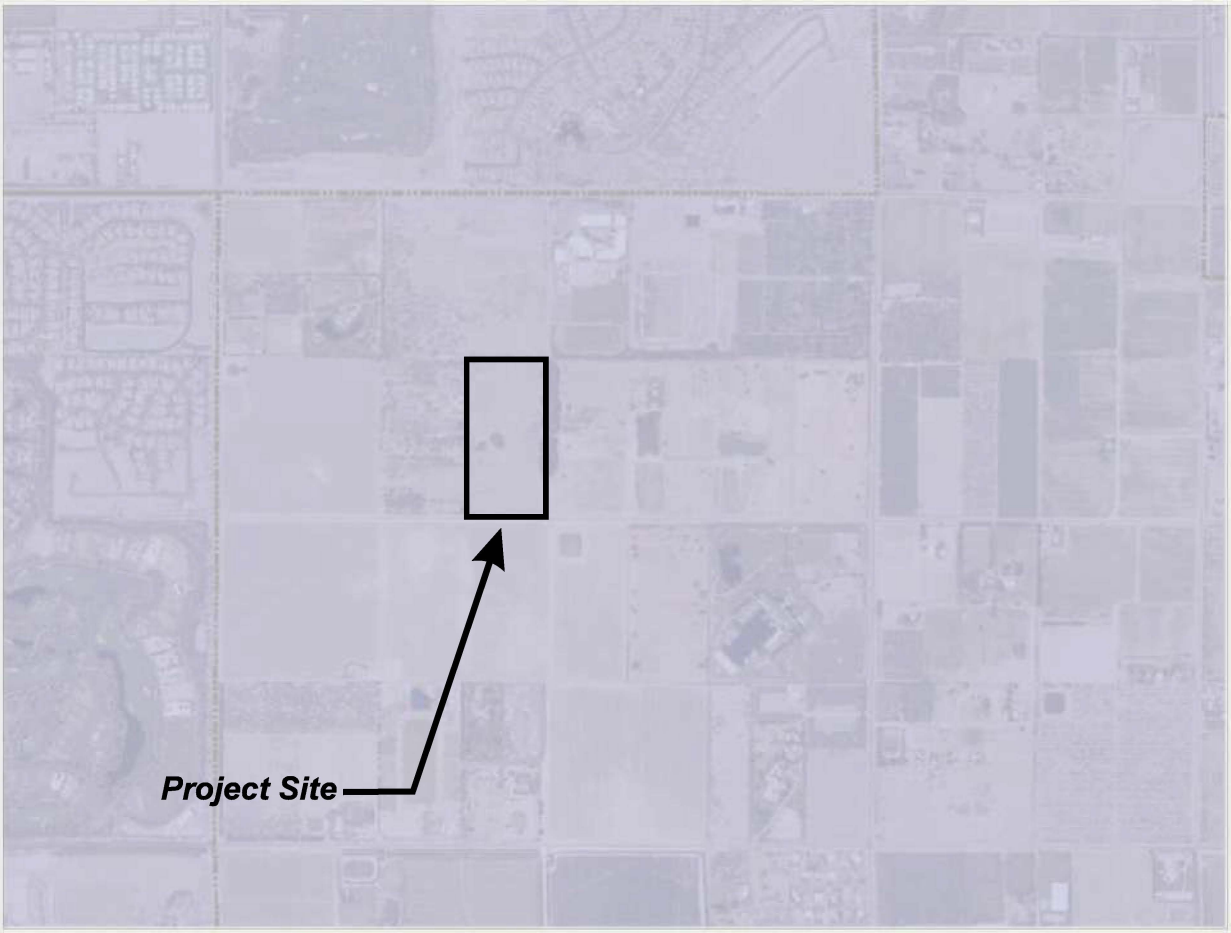
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Project No.: LP22032

Riverside County
Geographic Information System (GIS)
Fault Map

Plate
A-5

Subsidence Map



Legend

Subsidence

Other Susceptibility

Active

Susceptible

Notes

RCIT

0 1,505 3,009 Feet

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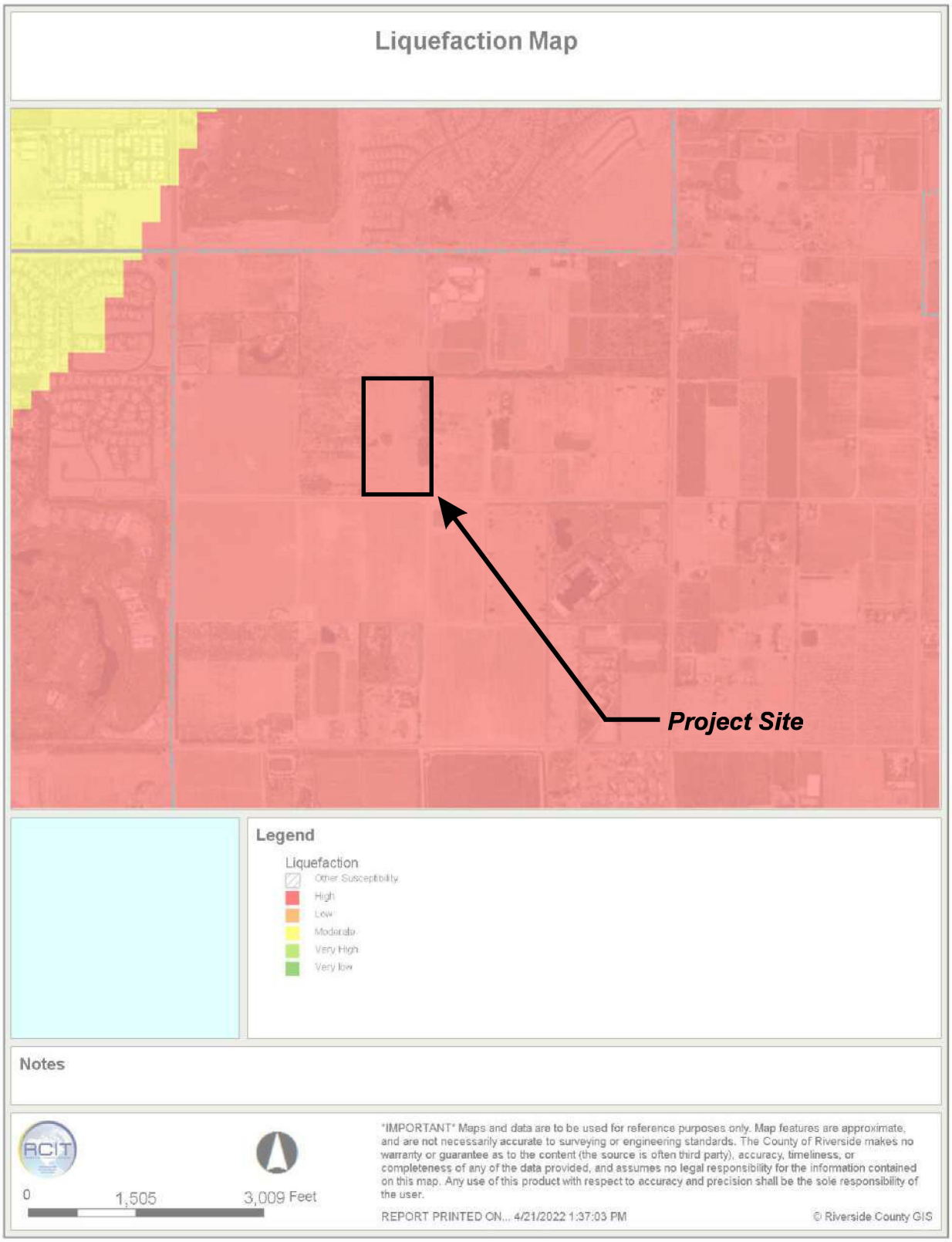
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Riverside County
Geographic Information System (GIS)
Subsidence

Plate
A-6

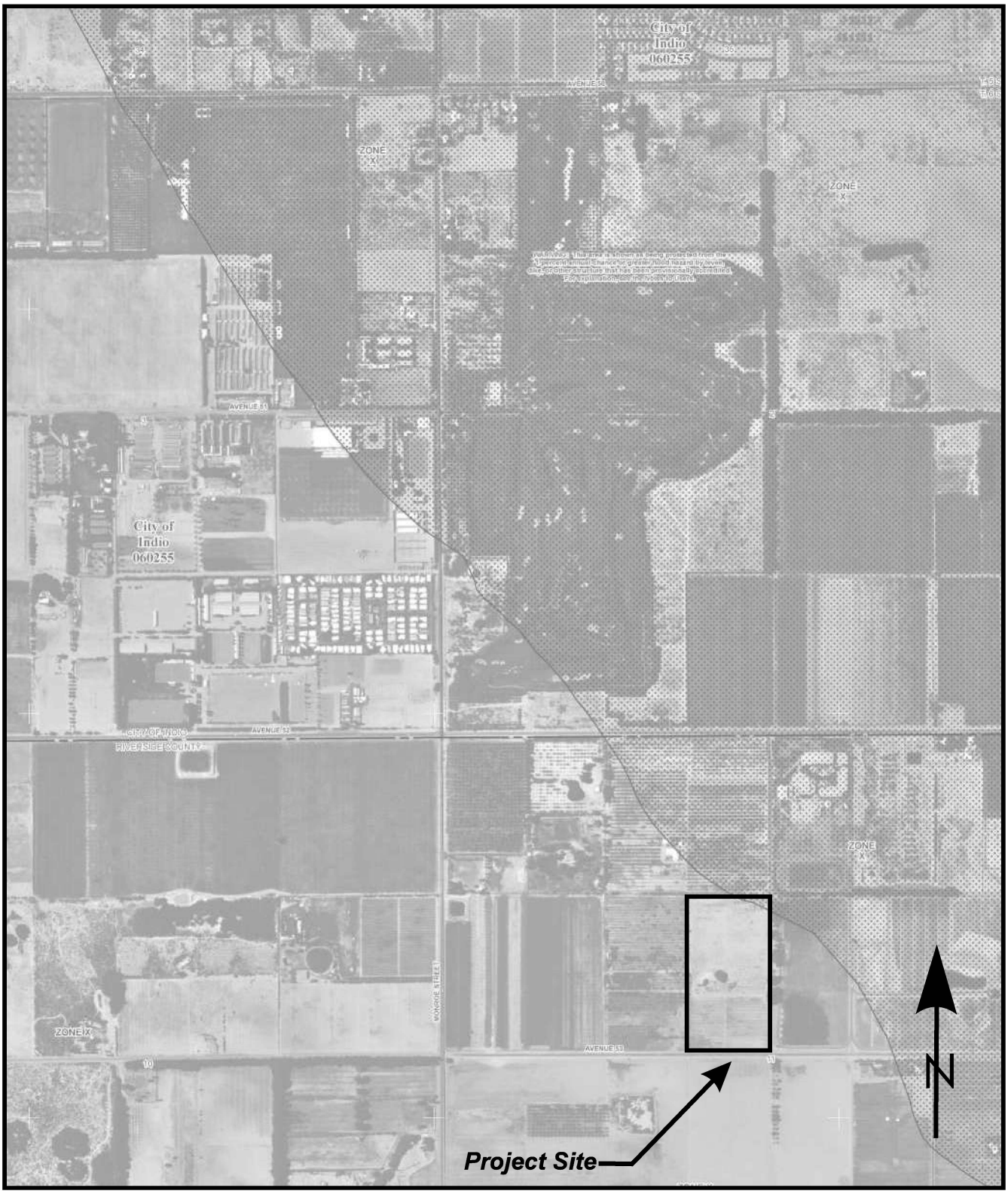


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Riverside County
Geographic Information System (GIS)
Liquefaction Zones

Plate
A-7



Reference: Federal Emergency Management Agency (FEMA)
Indio, California, Riverside County
Community-Panel Numbers 06065C 2261G

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Flood Insurance Rate Map (FIRM)

Plate A-8

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A — Cross section line

23 — 23 — Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

$^{24}76^{000m}$N — 1000-meter Universal Transverse Mercator grid values, zone 11N

600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

APPENDIX B

LOG OF BORING No. B-1

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			41		SILTY SAND (SM): Lt. brown, dry, dense, fine grained	103.8	1.7	Passing #200 = 47.6%
10			14		SAND (SP-SM): Lt. brown, dry, medium dense, fine grained		1.8	Passing #200 = 2.1%
15			29		SANDY SILT (ML): Lt. brown to gray brown, moist to very moist, medium dense, fine grained sand	97.0	8.7	
20			11				15.7	Passing #200 = 68.0%
25			29		some clay	93.7	28.9	
30								
35								
40								
45								
50								
55								
60								

Groundwater not encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.

DATE DRILLED: 3/14/22
LOGGED BY: L. Jackson
SURFACE ELEVATION: Approximately -25 ft

TOTAL DEPTH: 26.5 Feet
TYPE OF BIT: Hollow Stem Auger
HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA
DIAMETER: 8 in.
DROP: 30 in.

PROJECT NO. LP22032

LANDMARK
Geo-Engineers and Geologists

PLATE B-1

LOG OF BORING No. B-2

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			21		SANDY SILT (ML): Lt. brown, moist, medium dense, fine grained sand	78.2	7.2	Passing #200 = 63.1%
10			11		SILTY SAND (SM): Lt. brown, dry to damp, medium dense, fine grained		2.5	
15			26			101.0	2.2	Passing #200 = 13.6%
20			25				4.2	
25			30		SAND (SP-SM): Yellowish brown, dry, dense, fine grained	97.7	1.5	Passing #200 = 7.0%
30			27		SANDY SILT (ML): Lt. brown, moist, medium dense, fine grained sand		12.4	
35			23		SAND (SP-SM): Lt. brown, dry, medium dense, fine grained		2.0	Passing #200 = 6.9%
40			21		SILTY SAND (SM): Olive gray, moist, medium dense to dense, fine to medium grained		9.0	
45			39				7.7	Passing #200 = 25.0%
50			34				5.0	
55					Groundwater not encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			
60								

DATE DRILLED: 3/14/22

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately -25 ft

TOTAL DEPTH: 51.5 Feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP22032

LANDMARK Geo-Engineers and Geologists

PLATE B-2

LOG OF BORING No. B-3

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			20		SAND (SP-SM): Lt. brown, dry, medium dense, fine grained	91.2	1.4	
10			8		loose		1.9	Passing #200 = 8.6%
15			24		SILTY SAND (SM): Reddish brown to lt. brown, damp, medium dense to dense, fine grained sand	95.2	3.5	
20			23				4.7	Passing #200 = 33.1%
25			40			102.1	3.0	
30								
35								
40								
45								
50								
55								
60					Groundwater not encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED: 3/14/22

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately -25 ft

TOTAL DEPTH: 26.5 Feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP22032

LANDMARK Geo-Engineers and Geologists

PLATE B-3

LOG OF BORING No. B-4

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			23		SAND (SP): Lt. brown, dry, medium dense, fine grained	89.8	1.1	Passing #200 = 3.9%
10			10				1.5	
15			21		SILTY SAND (SM): Lt. brown, dry to damp, medium dense to dense, fine grained sand	86.5	1.9	Passing #200 = 18.5%
20			29				8.5	
25								
30								
35								
40								
45								
50								
55								
60								

Groundwater not encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.

DATE DRILLED: 3/14/22

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately -25 ft

TOTAL DEPTH: 21.5 Feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP22032

LANDMARK Geo-Engineers and Geologists

PLATE B-4

LOG OF BORING No. B-5

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			33		SAND (SP): Lt. brown, dry, dense to medium dense, fine grained	90.6	0.9	Passing #200 = 1.9%
10			17				1.0	
15			29		SILTY SAND (SM): Lt. brown, dry to damp, medium dense to dense, fine grained sand	92.8	2.2	Passing #200 = 30.9%
20			19				7.0	
25			36			94.7	2.5	Passing #200 = 25.7%
30								
35								
40								
45								
50								
55								
60								

Groundwater not encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.

DATE DRILLED: 3/14/22
LOGGED BY: L. Jackson
SURFACE ELEVATION: Approximately -25 ft

TOTAL DEPTH: 26.5 Feet
TYPE OF BIT: Hollow Stem Auger
HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA
DIAMETER: 8 in.
DROP: 30 in.

PROJECT NO. LP22032

LANDMARK
Geo-Engineers and Geologists

PLATE B-5

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS		SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger that No. 200 sieve	**Gravels** More than half of coarse fraction is larger than No. 4 sieve	Clean gravels (less than 5% fines)		**GW**	Well graded gravels, gravel-sand mixtures, little or no fines
				**GP**	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines		**GM**	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
				**GC**	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands More than half of coarse fraction is smaller than No. 4 sieve	Clean sands (less than 5% fines)		**SW**	Well graded sands, gravelly sands, little or no fines
				**SP**	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines		**SM**	Silty sands, sand-silt mixtures, non-plastic fines
				**SC**	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	**Silts and clays** Liquid limit is less than 50%			**ML**	Inorganic silts, clayey silts with slight plasticity
				**CL**	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
				**OL**	Organic silts and organic clays of low plasticity
	Silts and clays Liquid limit is more than 50%			**MH**	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
				**CH**	Inorganic clays of high plasticity, fat clays
				**OH**	Organic clays of medium to high plasticity, organic silts
Highly organic soils				**PT**	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		
200	40	10	4	3/4"	3"	12"	

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

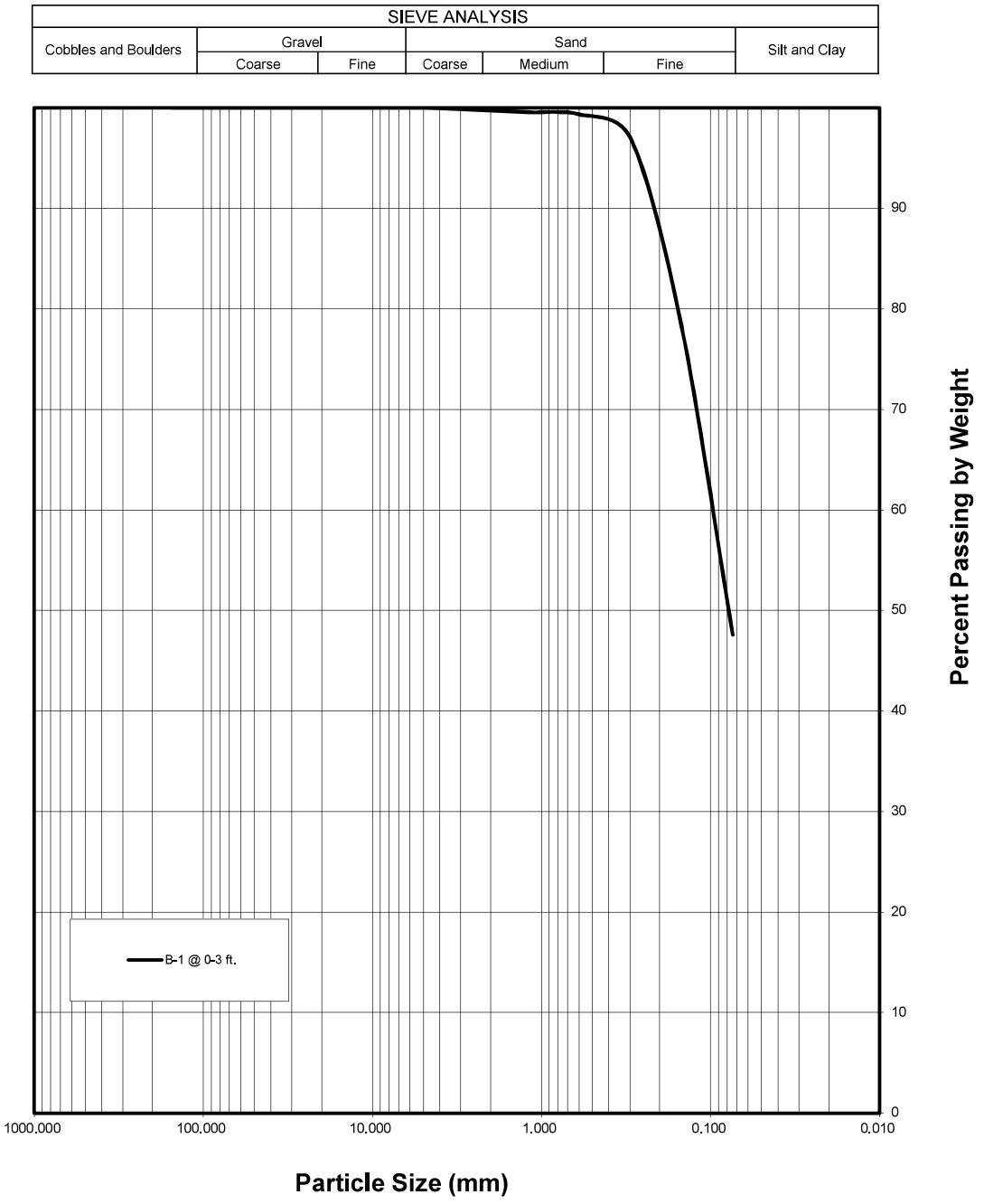
Type of Samples:

Ring Sample Standard Penetration Test Shelby Tube Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time.

APPENDIX C



LANDMARK
Geo-Engineers and Geologists

Project No.: LP22032

Grain Size Analysis

Plate
C-1

LANDMARK CONSULTANTS, INC.

CLIENT: MBG Construction, LLC
PROJECT: APN 780-010-014 -- La Quinta, CA
JOB No.: LP22032
DATE: 04/15/22

CHEMICAL ANALYSIS

	Boring: B-1	Caltrans Method
	Sample Depth, ft: 0-3	
pH:	7.9	643
Electrical Conductivity (mmhos):	--	424
Resistivity (ohm-cm):	2,400	643
Chloride (Cl), ppm:	80	422
Sulfate (SO4), ppm:	10	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK Geo-Engineers and Geologists

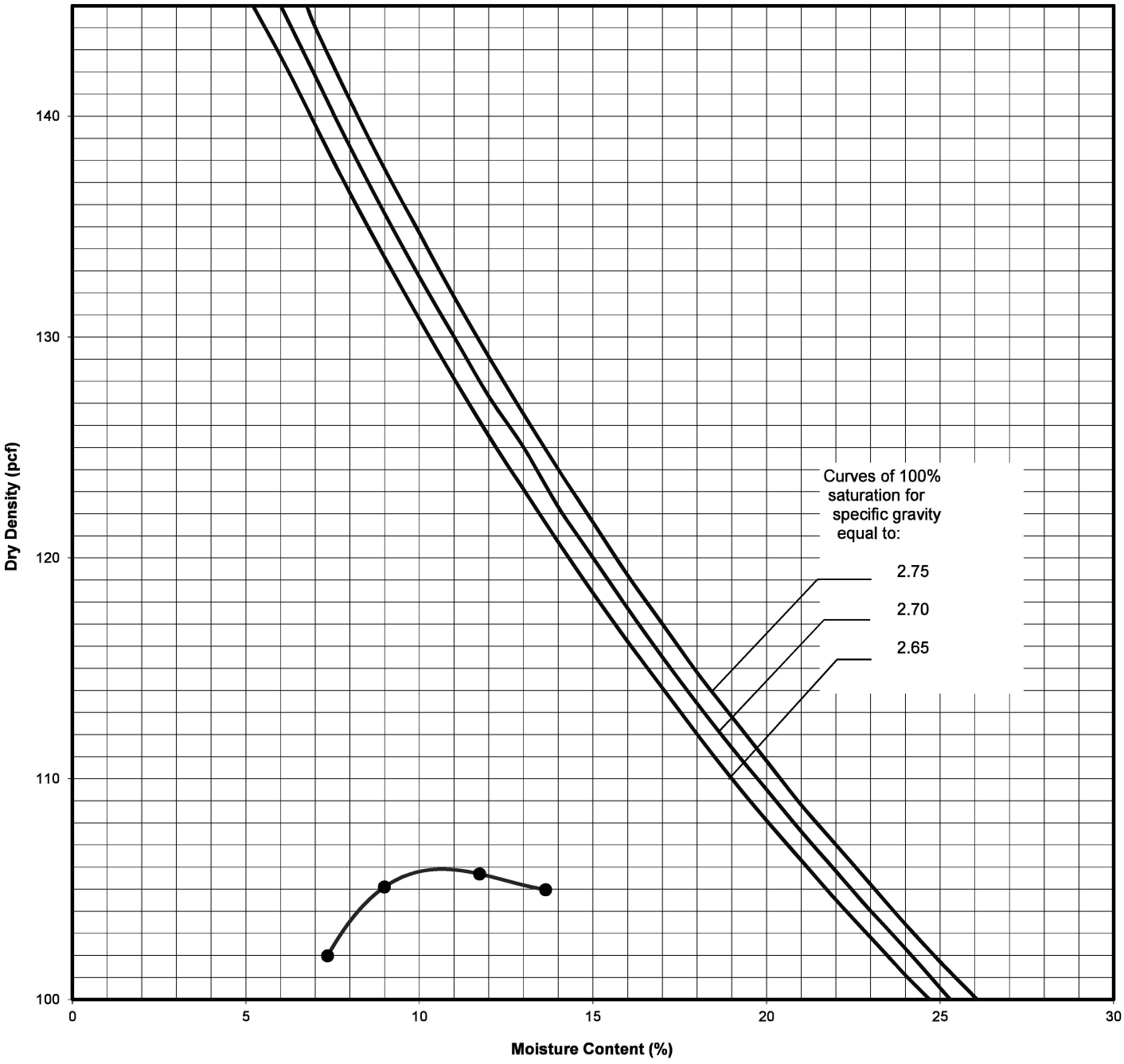
Project No.: LP22032

Selected Chemical Test Results

Plate C-2

Client: MBG Construction, LLC
Project: APN 780-010-014 -- La Quinta, CA
Project No.: LP22032
Date: 3/23/2022
Lab. No.: 0

Soil Description: Olive-Brown Silty Sand
Sample Location: B-1 @ 0-3 ft.
Test Method: ASTM D-1557 A
Maximum Dry Density (pcf): 105.9
Optimum Moisture Content (%): 10.6



LANDMARK
Geo-Engineers and Geologists

Project No.: LP22032

Moisture Density Relationship

Plate C-3

APPENDIX D

Seismic Dry Settlement Calculation

Project Name: APN 780-010-014 -- La Quinta, CA
Project No.: LP22032
Location: B-2

Maximum Credible Earthquake	7.5	
Design Ground Motion	0.79	g
Water Unit Weight,	62.4	pcf
Depth to Groundwater	80	ft
Hammer Effenciency	85	

15.2

Mod. Cal	SPT	DEPTH (ft.)	THICKNESS (ft.)	D_{50} (mm)	ϕ (°)	Density (pcf)	Total Pressure (tsf)	N1(60)	Relative Density	Fine Content	$N_{1(60)CS}$	Gmax	Shear Strain Gam-eff	E15	Enc	Settlement (in.)	TOTAL (in.)
21		6.00	6	0.25	25	82.8	0.248	35.6	89	70	47.7	653	1.03E-03	3.65E-04	3.66E-04	0.05	
	11	11.00	5	0.25	25	92.8	0.510	32.3	85	50	43.7	909	1.33E-03	5.19E-04	5.21E-04	0.06	
26		16.00	5	0.25	25	94.1	0.753	41.6	96	50	54.9	1190	1.11E-03	3.30E-04	3.32E-04	0.04	
	25	21.00	5	0.25	25	100	1.050	60.0	116	70	77.0	1572	8.71E-04	1.73E-04	1.74E-04	0.02	
30		26.00	5	0.25	25	100	1.300	44.5	100	70	58.4	1597	1.19E-03	3.29E-04	3.30E-04	0.04	
	27	31.00	5	0.25	25	100	1.550	58.2	114	70	74.9	1892	9.68E-04	1.99E-04	2.00E-04	0.02	
	23	36.00	5	0.25	25	110	1.980	46.2	102	70	60.4	1993	1.21E-03	3.22E-04	3.23E-04	0.04	
	21	41.00	5	0.25	25	110	2.255	36.2	90	70	48.5	1977	1.41E-03	4.86E-04	4.89E-04	0.06	
	39	46.00	5	0.25	25	110	2.530	69.3	125	70	88.1	2551	8.15E-04	1.37E-04	1.38E-04	0.02	
	34	51.00	5	0.25	25	110	2.805	57.4	113	70	73.8	2534	8.52E-04	1.78E-04	1.79E-04	0.02	
																	0.37

REFERENCES
(1) Tokimatsu and Seed, 1984. Simplified Procedures for the Evaluation of Settlements in Clean Sands.
(2) Seed and Idriss, 1982. Ground Motion and Soil Liquefaction During Earthquakes, EERI Monograph.
(3) Youd, Leslie, 1997. Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils
(4) Pradel, Daniel, 1998. JGEE, Vol. 124, No. 4, ASCE
(5) Seed, et.al., 2003, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework. University of California, Earthquake Engineering Research Center Report 2003-06, 71 p.

APPENDIX E

LANDMARK CONSULTANTS, INC

Project:	APN 780-010-014	Project No:	LP22032	Date:	04/19/2022
Test Hole No:	P-1	Tested By:	Alex A		
Depth of Test Hole, D_T:	60"	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	6"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:02	8:15	13.00	16.00	48.00	32.00	Yes
2	8:25	8:40	15.00	23.00	36.00	13.00	Yes

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Other wise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1	8:41	8:51	10.00	12.00	24.00	12.00	0.83
2	8:51	9:01	10.00	24.00	40.00	16.00	0.63
3	9:01	9:11	10.00	19.00	29.00	10.00	1.00
4	9:11	9:21	10.00	29.00	37.00	8.00	1.25
5	9:21	9:31	10.00	14.00	26.00	12.00	0.83
6	9:31	9:41	10.00	26.00	40.00	14.00	0.71
7							
8							
9							
10							
11							
12							

COMMENTS:

LANDMARK CONSULTANTS, INC

Project:	APN 780-010-014	Project No:	LP22032	Date:	04/0192022
Test Hole No:	P-2	Tested By:	Alex A		
Depth of Test Hole, D_T:	60"	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	6"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:04	8:19	13.00	16.00	48.00	32.00	Yes
2	8:27	8:42	15.00	10.00	44.00	34.00	Yes

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Other wise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1	8:41	8:51	10.00	11.00	33.00	21.00	0.48
2	8:51	9:01	10.00	33.00	47.00	14.00	0.71
3	9:01	9:11	10.00	12.00	29.00	17.00	0.59
4	9:11	9:21	10.00	29.00	41.00	12.00	0.83
5	9:21	9:31	10.00	19.00	32.00	12.00	0.83
6	9:31	9:41	10.00	32.00	42.00	10.00	1.00
7							
8							
9							
10							
11							
12							

COMMENTS:

PERCOLATION RATE CONVERSION

CLIENT:	**MBG Construction, LLC**
PROJECT:	**APN 780-010-014**
PROJECT NO.:	**LP22032**
DATE:	**4/19/2022**

TEST HOLE NO: P-1

Time interval, **Δt** = 10 inches

Initial Depth to Water, D_0 = 26 inches

Final Depth to Water, D_f = 40 inches

Total Depth of Test Hole, D_T = 60 inches

[2]Test Hole Radius, **r** = 4 inches

The conversion equation is used:

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

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ = 60 - 26 = 34 inches

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_0$ = 60 - 40 = 20 inches

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ = 34 - 20 = 14 inches

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o - H_f)/2$ = (34 + 20)/2 = 27 inches

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r+2H_{avg})} = \frac{(14\text{ in})(60\text{min/hr})(4\text{in})}{(10\text{ min})((4\text{ in}) + 2\ (27\text{ in}))} = 5.79\text{ in/hr}$$

LANDMARK Geo-Engineers and Geologists **Project No.: LP22032**	**Percolation Rate Conversion**	**Plate E-3**

PERCOLATION RATE CONVERSION

CLIENT:	**MBG Construction, LLC**
PROJECT:	**APN 780-010-014**
PROJECT NO.:	**LP22032**
DATE:	**4/19/2022**

TEST HOLE NO: P-2

Time interval, **Δt** = 10 inches

Initial Depth to Water, D_0 = 32 inches

Final Depth to Water, D_f = 42 inches

Total Depth of Test Hole, D_T = 60 inches

[2]Test Hole Radius, **r** = 4 inches

The conversion equation is used:

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

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ = 60 - 32 = 28 inches

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_0$ = 60 - 42 = 18 inches

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ = 28 - 18 = 10 inches

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o - H_f)/2$ = (28 + 18)/2 = 23 inches

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r+2H_{avg})} = \frac{(10\text{ in})(60\text{min/hr})(4\text{in})}{(10\text{ min})((4\text{ in}) + 2\ (23\text{ in}))} = 4.8\text{ in/hr}$$

LANDMARK Geo-Engineers and Geologists **Project No.: LP22032**	**Percolation Rate Conversion**	**Plate E-4**

APPENDIX F

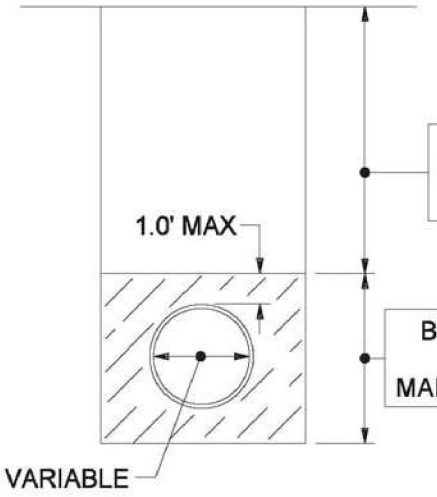
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Project No.: LP22032

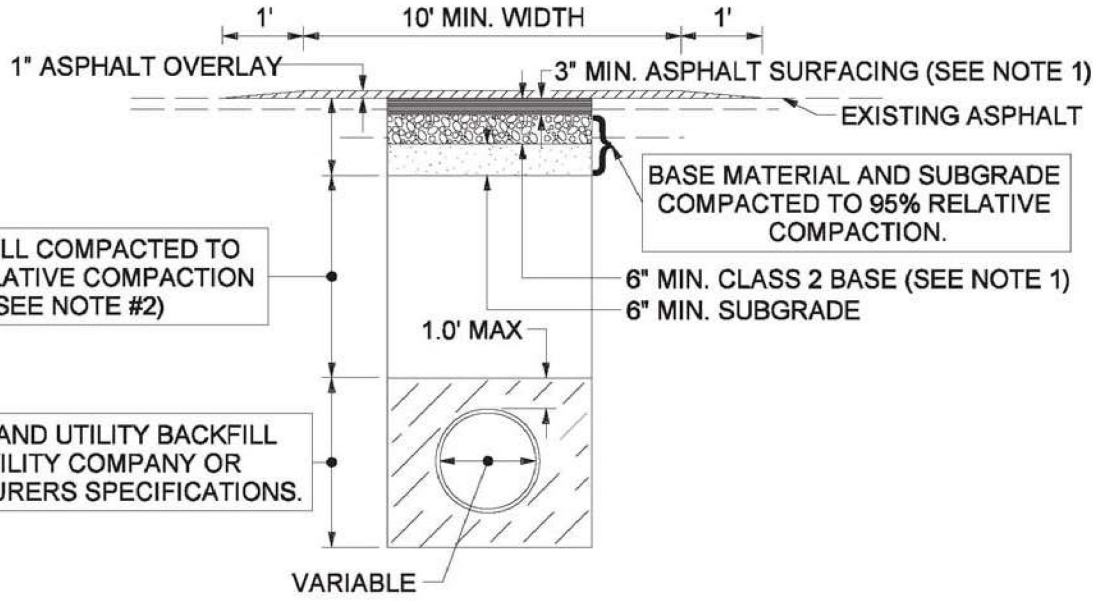
Riverside County Standard No. 818
Utility Trench Backfill

Plate
F-1

NON-ASPHALT SURFACED AREAS CASE 1

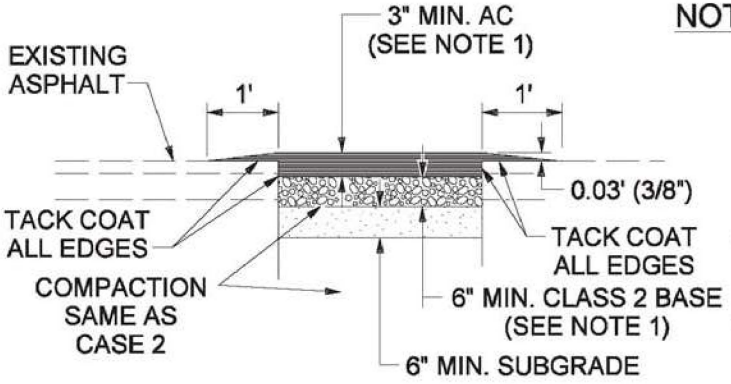


ASPHALT SURFACED STREETS WITH OVERLAY PARALLEL INSTALLATION CASE 2



NOT TO SCALE

ASPHALT SURFACED STREET WITHOUT OVERLAY PERPENDICULAR INSTALLATION CASE 3



NOTES:

1. REPLACE STRUCTURAL SECTION AS FOLLOWS:
   SURFACING: EXISTING THICKNESS; OR 3" MIN. A.C., TYPE B.
   BASE: CLASS 2 A.B. IN SAME THICKNESS AS EXISTING BASE MATERIAL, 6" MIN. AS DIRECTED BY THE INSPECTOR.
2. MAXIMUM LIFT THICKNESS IS 8 INCHES; MAXIMUM LIFT THICKNESS WHEN PONDING AND JETTING IS 4 FEET.
3. WHEN A FIRM FOUNDATION IS NOT ENCOUNTERED, DUE TO SOFT, SPONGY OR OTHER UNSUITABLE MATERIAL, SUCH MATERIAL SHALL BE REMOVED TO THE LIMITS DIRECTED BY THE DIRECTOR OF TRANSPORTATION OR AFFECTED UTILITY COMPANY AND THE RESULTING EXCAVATION BACKFILLED WITH PIPE BEDDING MATERIAL.