

**GEOTECHNICAL ENGINEERING REPORT,
PROPOSED MULTI-FAMILY RESIDENTIAL DEVELOPMENT,
APN 0479-140-022,
Cottonwood Avenue, Moreno Valley, California**

for

WJK Development Co.

April 29, 2024

W.O. 7907

MDN 24161



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WJK DEVELOPMENT CO.
28392 Airoso Street
Rancho Mission Viejo, California 92694

Attention: Grant Keene

Subject: Geotechnical Engineering Report, Proposed Multi-Family Residential Development, APN 0479-140-022, Cottonwood Avenue, Moreno Valley, California

Dear Mr. Keene:

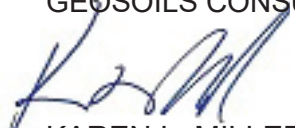
As requested, GeoSoils Consultants, Inc. (GSC) has prepared a geotechnical engineering report on the subject site. The purpose of this report is to provide geotechnical engineering recommendations for site grading and foundations. This report presents the results of our research, site reconnaissance, subsurface exploration, laboratory testing, and provides geotechnical engineering recommendations for site grading. Development of the site is considered feasible from a geotechnical engineering perspective, provided the recommendations presented herein are incorporated into the design and implemented during construction.

We appreciate this opportunity to be of service to you. If you have any questions regarding this report, or if we may be of further assistance to you, please do not hesitate to contact us.

Very truly yours,

GEOISOILS CONSULTANTS, INC.




KAREN L. MILLER
GE 2257


ROSS MILLER
Staff Engineer

cc: (1) Addressee

MDN 24161

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Plate MDD-1, Maximum Dry Density

Plate RV-1, R-Value Test Result

Plate MD-1, Moisture Content and Dry Unit Weight Results

cc: (1) Addressee

1.0 INTRODUCTION

The purpose of this report is to provide geologic and geotechnical engineering data and recommendations to aid in the development of the subject site. The following sections provide a summary of our subsurface exploration, laboratory testing, general geologic and geotechnical engineering conditions, and recommendations for site grading, fill placement, and foundations.

This report has been prepared in accordance with generally accepted geotechnical engineering practices in the City of Moreno Valley at the time it was prepared. The report presents a brief description of the site, the geotechnical engineering characteristics of the area, the seismicity of the area, an engineering analysis of the site characteristics, conclusions, and recommendations to develop the site.

Opinions presented in this report are based on an inspection of the site, a review of the regional geologic maps and seismic hazard reports, review of any previous consultant reports for the subject area, subsurface exploration and lab testing, and our general knowledge of the geologic and soils engineering conditions in the site area. The opinions presented have been arrived at through the exercise of the generally understood standard of care for our profession and standard of engineering practice for the City of Moreno Valley, as we understand it.

1.1 Site Description

The subject site is located north of Cottonwood Avenue and west of Patricia Lane. The subject site is approximately 9.39 acres, vacant, and predominantly flat covered with tall grass and shrubs. The site is surrounded by single-family homes to the west, north, and east.

1.2 Proposed Development

The proposed development of the site will consist of constructing 23 two-story multi-family residential buildings along with an administration building, swimming pool,

associated streets and parking. Five (5) underground basins are proposed throughout the property for LID purposes.

1.3 Previous Studies

Previous studies have been performed on the subject property by GeoTek, Inc. in April 2014, June 2014, and June 2021 (references).

The work by GeoTek included excavating, sampling, and logging of four (4) borings to a maximum depth of 50 feet. Additionally, one (1) backhoe test pit was dug in order to perform infiltration testing of the proposed basins. Boring log copies are included in Appendix A.

GSC has reviewed the reports prepared by GeoTek, Inc. and accepts their data.

1.4 Scope of Services

Our scope of services included the following:

- Site reconnaissance.
- Review of regional geologic maps and seismic hazard reports.
- Review of available geologic and geotechnical engineering reports.
- Excavated, sampled, and logged two hollow stem auger borings to a maximum depth of 50 feet at the locations shown on Plate 1, Boring Location Map.
- Laboratory testing.
- Engineering analyses.
- Preparation of this report.

1.5 Limitations

The findings and recommendations of this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice for the City of Moreno Valley at this time. We make no other warranty, either express or implied. The conclusions and recommendations contained in this report are based on-site conditions disclosed in our site inspection and the referenced reports. Since

our investigation was based on the site conditions observed and engineering analyses, the conclusions and recommendations contained herein are professional opinions. However, soil/rock conditions can vary significantly between borings; therefore, further refinements of our recommendations contained herein may be necessary due to changes in the building plans or what is encountered during site grading.

2.0 FIELD EXPLORATION

For our study, two borings to the maximum depth of 50 feet, were excavated on the site at the locations shown on Plate 1. Soil samples were obtained with a California ring sampler, SPT sampler and bulk samples. The hollow stem auger borings used the standard 140 lb. hammer with a 30-inch drop.

A representative from our firm continuously observed the borings excavations, logged the subsurface conditions, and collected representative soil samples. All samples were stored in watertight containers and later transported to our laboratory for further visual examination and testing, as deemed necessary. After the borings were completed, they were backfilled with soil cuttings.

The enclosed boring logs (Plates A-1 to A-3) describe the vertical sequence of soils and materials encountered in the borings, based primarily on our field classifications, and supported by our subsequent laboratory examination and testing.

3.0 LABORATORY TESTING

In Situ Moisture Content and Dry Unit Weight

In-place moisture content and dry unit weight of selected, relatively undisturbed ring soil samples were determined in accordance with the current version of the Test Methods ASTM D2216 and ASTM D7263, respectively. Once the dry unit weights had been determined, in-place densities of underlying soil profile were estimated. In those cases where ring samples were obtained, the moisture content and dry unit weights are presented in Appendix B.

Expansion Index

Expansion index testing was performed on selected bulk samples of the on-site soils in accordance with the current version of Test Method ASTM D4829-07. The test results are presented in Plate EI-1. Additional testing will be performed at the completion of grading. The test results indicate an expansion index of 11 (Very Low range).

Consolidation Test

Consolidation tests were performed on the selected ring samples. This test was performed in general accordance with Test Method ASTM D 2435-04. The samples were inundated at an approximate load of one ton per square foot to monitor the hydro-consolidation. Loads were applied to the sample in several increments in geometric progression and resulting deformations were recorded at selected time intervals. Results of the consolidation are presented on Plates C-1 to C-2.

Compaction Tests

Compaction tests were performed on a sample taken from the borings to determine moisture density relationships of the typical surficial soils encountered on the site. The laboratory standard used was in accordance with ASTM Test Designation D-1557-12.

TABLE 1 COMPACTION TEST RESULTS			
Sample	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-2 @ 0-5'	Brown, silty, very fine to fine SAND	131.0	8.5

R-Value

An R-value test was performed per Caltrans standard CA 301 on a surficial sample and the result is in Appendix B.

4.0 FINDINGS

4.1 Geologic Environment

Geologic conditions on the subject site were determined through research, field mapping, and subsurface exploration, and the results were superimposed on the Boring Location Map, Plate 1. During grading, a geologist should be present to confirm the geologic conditions encountered on the site are consistent with those presented herein. The following sections present our findings concerning subsurface and groundwater conditions.

4.1.1 Earth Materials

Alluvium (Qa)

Alluvial deposit was encountered in our borings to a maximum depth of 50 feet. The fill consists of light to reddish brown, silty sand with some clay.

4.1.2 Groundwater

Groundwater was encountered at depths of 19 and 25 feet in our borings on the site. Fluctuations in the level of ground water can occur due to seasonal climatic variations, changes in land use and other factors.

4.2 Faulting And Seismicity

The project site is not located within an Alquist-Priolo Earthquake Fault Zone and there are no active faults on or adjacent to the property. Although there are no faults on or adjacent to the property, there are faults near the site that can cause moderate to intense ground shaking during the lifetime of the proposed development. Therefore, earthquake resistant design is recommended.

4.2.1 Earthquake Characterization:

Earthquakes are characterized by magnitude, which is a quantitative measure of the earthquake strength, based on strain energy released during a seismic

event. The magnitude of an earthquake is constant for any given site and is independent of the site in question.

4.2.2 Earthquake Intensity:

The intensity of an earthquake at a random site is not constant and is subject to variations. The intensity is an indirect measurement of ground motion at a particular site and is affected by the earthquake magnitude, the distance between the site and the hypocenter (the location on the fault at depth where the energy is released), and the geologic conditions between the site and the hypocenter. Intensity, which is often measured by the Mercalli scale, generally increases with increasing magnitude and decreases with increasing distance from the hypocenter. Topography may also affect the intensity of an earthquake from one site to another. Topographic effects such as steep sided ridges or slopes may result in a higher intensity than sites located in relatively flat-lying areas.

4.2.3 2022 California Building Code (CBC) Seismic Design Criteria

The 2022 CBC (California Building Code) seismic coefficient criteria are provided in the table below for structural design consideration. Under the Earthquake Design Regulations of Chapter 16, Section 1613 of the CBC 2022, the following coefficients apply for the proposed Type II structures at the site. Site Class D-Default should be used for the site. The following seismic data is presented for preliminary design purposes. Ground motion parameters based on the Mapped Risk-Targeted Maximum Considered Earthquake (MCE_r) were determined and adhere to requirements discussed in ASCE 7-16 referenced by the 2022 California Building Code. The parameters include 5% critical damping for 0.2- and 1.0-second time periods. A summary of parameters is provided in the table below for a Site Class D designation. These values may only be used when the value of the seismic response coefficient C_s satisfies equations 12.8-2, 12.8-3, or 12.8-4 of the ASCE 7-16 Standard.

TABLE 2 SEISMIC PARAMETERS	
Description	Value
Mapped Response (0.2 second), S_s	1.707
Mapped Spectral Response (1.0 second), S_1	0.666
Short Period Site Coefficient, F_a	1.0
1-second Period Site Coefficient, F_v	Null
Adjusted Maximum Considered Earthquake Spectral Response (0.2 second), S_{MS}	2.048
Adjusted Maximum Considered Earthquake Spectral Response (1.0 second), S_{M1}	Null
5-percent Damped Design Spectral Response (0.2 second), S_{DS}	1.365
5-percent Damped Design Spectral Response (1.0 second), S_{D1}	Null
Maximum Considered Earthquake Geometric Mean Peak Ground Acceleration, PGA_M	0.867
*Site Coordinates: Latitude: 33.925547 °, Longitude: -117.223159°	

Conformance to the above criteria for seismic excitation does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a maximum level earthquake occurs. The primary goal of seismic design is to protect life and not to avoid all damage, since such design may be economically prohibitive. Following a major earthquake, a building may be damaged beyond repair, yet not collapse.

4.3 Secondary Earthquake Effects

Ground shaking produced during an earthquake can result in a number of potentially damaging phenomena classified as secondary earthquake effects. These secondary effects include ground rupture, landslides, seiches and tsunamis, seismically induced settlement, and liquefaction. Descriptions of each of these phenomena and how it could potentially affect the proposed site are described as follows:

4.3.1 Ground Rupture

Ground rupture occurs when movement on a fault breaks the ground surface and usually occurs along pre-existing fault traces where zones of weakness already exist. The State has established Earthquake Fault Zones for the purpose of mitigating the hazard of fault rupture by prohibiting the location of most human occupancy structures across the traces of active faults.

Earthquake fault zones are regulatory zones that encompass surface traces of active faults with a potential for future surface fault rupture. The site is not located within the State established Earthquake Fault Zone. The hazard associated with ground rupture for the site is considered low.

4.3.2 Landsliding

Landslides are slope failures that occur where the horizontal seismic forces act to induce soil and/or bedrock failures. The most common effect is reactivation or movement on a pre-existing landslide. Typically, existing slides that are stable under static conditions (i.e., factor-of-safety above one) become unstable and move during strong ground shaking. The site is relatively flat and not subject to landslide hazard.

4.3.3 Seiches and Tsunamis

A seiche is the resonant oscillation of a body of water, typically a lake or swimming pool caused by earthquake shaking (waves). The hazard exists where water can be splashed out of the body of water and impact nearby structures. No bodies of constant water are near the site, therefore, the hazards associated with seiches are considered low.

Tsunamis are seismic sea waves generated by undersea earthquakes or landslides. When the ocean floor is offset or tilted during an earthquake, a set of waves are generated similar to the concentric waves caused by an object dropped in water.

Tsunamis can have wavelengths of up to 120 miles and travel as fast as 500 miles per hour across hundreds of miles of deep Ocean. Upon reaching shallow coastal waters, the once two-foot-high wave can become up to 50 feet in height causing great devastation to structures within reach. Tsunamis can generate seiches as well. Due to the distance and elevation of the site relative to the ocean, seiches and tsunamis are not considered a hazard to the site.

4.3.4 Dry Sand Settlement

Dry sand settlement can occur during moderate and large earthquakes when loose, natural or fill sandy soils are densified and settle, often unevenly across a site. In order for dry sand settlement to occur, the following four factors are required: 1) Relatively dry soil or soil situated above the groundwater table; 2) undrained loading (strong ground shaking), such as by earthquake; 3) contractive soil response during shear loading, which is often the case for a soil which is initially in a loose or uncompacted state; and 4) susceptible soil type; such as clean, uniformly graded sands. Structures situated above seismically densifying dry sandy soils may experience settlement. Based on site exploration, this site is considered to have very low susceptibility to dry sand settlement.

4.3.5 Liquefaction

Liquefaction is a soil softening dynamic response, by which an increase in the excess pore water pressure results in partial to full loss of soil shear strength and post-liquefaction dissipation of this pore water pressure results in ground settlement shortly after the earthquake. In order for liquefaction to occur, the following four factors are required: 1) saturated soil or soil situated below the groundwater table; 2) undrained loading (strong ground shaking), such as by earthquake; 3) contractive soil response during shear loading, which is often the case for a soil which is initially in a loose or uncompacted state; and 4) susceptible soil type; such as clean, uniformly graded sands, non-plastic silts, or gravels. Based on site exploration, this site is considered to have very low susceptibility to liquefaction due to the very dense nature of the underlying soil.

4.4 Hydro Collapse

Hydro-collapse is a condition where dry or moist soils undergo settlement upon being wetted. In many cases no additional surcharge load is necessary to trigger the Hydro-collapse. The potential for Hydro-collapse has been evaluated based upon observations, the results of Swell/Collapse and Consolidation tests, and moisture-

density determinations for samples taken from the field. A general guideline, such as outlined by Los Angeles County, Department of Public Works, Materials Engineering Division, consider potentially collapsible soils as generally having (a) low moisture contents (<8%), (b) low in-situ density(<108pcf), and these soils can potentially be subject to 2% or greater collapse.

A total of 2 consolidation tests were performed and are presented within Appendix B. The samples have a range of -0.1% to 0.0% volume change. Therefore, it is our opinion that the subject site is not susceptible to hydrocollapse.

5.0 CONCLUSIONS

The development of the subject site is considered feasible from a geologic and geotechnical engineering viewpoint, provided that the recommendations presented in this report are followed during grading.

6.0 RECOMMENDATIONS

6.1 Removals

Removals shall extend a minimum of five (5) feet below existing ground surface or proposed grades in the building area, whichever is lower in elevation. Removals shall extend a minimum of five feet beyond the building footprint or equal to the depth of removal, whichever is greater. In the areas of streets and other miscellaneous structures, removals shall extend a minimum of 3 (three) feet below existing ground surface or proposed grades, whichever lower in elevation. All undocumented fill, if encountered, on the site shall be removed during grading and replaced as compacted fill. Deeper removals may be required if soft or dry soil conditions are observed during grading or if hardpan conditions are observed. Preparation of areas to receive fill and fill placement shall be performed as discussed under "*Grading section*".

6.2 Foundations

The following recommendations are provided for preliminary design purposes and the final expansion index should be determined following grading. In our opinion continuous footings may be used to support the proposed structures.

All foundations should meet current slope setback requirements. Foundations should be designed for low-expansive soil conditions. The proposed improvements should be found into the compacted fill with a minimum of three (3) feet of compacted fill below the bottom of footings. Under no circumstances should foundations be cast atop loose, soft, or slough, debris, existing artificial fill, topsoil, or surfaces covered by standing water. Prior to placing concrete in a foundation excavation, an inspection should be made by our representative to ensure that the foundation's subgrade is free of loose and disturbed soils and is embedded in the recommended material. We offer the following site-specific recommendations and comments for purposes of foundation design and construction.

6.2.1 Continuous Footings

The proposed structures may be supported on continuous footings. Exterior isolated pad footings should be connected to adjacent footings via tie beams at discretion of structural engineer.

Subgrade Preparation

All conventional footings should be constructed on firm, unyielding certified compacted fill. All compacted fills should be compacted to at least 90 percent of the Modified Proctor maximum laboratory density, as determined by ASTM D-1557-12 compaction method. Pre-moistening of all areas to receive concrete is recommended. The moisture content of the subgrade soils should be equal to or slightly greater than optimum moisture and verified by the Geotechnical Engineer to a depth of 12 inches below adjacent grade within 24 hours of concrete placement. Footing's subgrades shall be prepared in accordance with the *Grading* section of this report.

Minimum Dimensions

Continuous footings for the two-story structures should have a width of at least 15 inches. Interior and perimeter footings should extend at least 18 inches below the lowest adjacent grade. Exterior isolated pad footings intended for support of roof overhangs such as decks, patio covers, and similar miscellaneous construction should be a minimum of 18 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The building’s exterior isolated pad footings should be connected to adjacent footings via tie beams. For single-story structures, the minimum design requirements can be viewed in the table below.

TABLE 3 BUILDING’S CONTINUOUS FOOTINGS DIMENSIONS					
Number of Stories	Expansion Index	Footing Width, Inch	Depth Below the lowest adjacent final grade, inch		Reinforcement
			Perimeter Footings	Interior Footings	
1	Low	12	15	12	Four No. 4 bars; two top, two bottom
2	Low	15	18	18	
Exterior Pad Footing	Low	18	18		

Bearing Capacity

Footings with at least above minimum dimensions may be designed for a preliminary allowable bearing pressure of 1,500 pounds per square foot (psf) for dead plus live loads, with a one-third increase allowed when considering additional short-term wind or seismic loading. The allowable bearing value may be increased by 300 pounds per square foot per foot increase in depth or width to a maximum of 3000 psf. The weight of the footings may be neglected for design purposes. All footings located adjacent to utility lines should be embedded below a 1:1 plane extending up from the bottom edge of the utility trench.

Settlement

The footings should be designed based on a low-expansive soils condition. Differential settlement due to static loads is not expected to exceed about ½ - inch over 30 feet span for the proposed improvements supported on footings, provided that the foundations are designed and constructed as recommended.

Lateral Capacity

Lateral loads may be resisted by friction between the bottom of the footings and the supporting subgrade, and by passive soil pressure acting against the footings cast neat in foundation excavations or backfilled with properly compacted structural fill. A coefficient of friction of 0.4 may be assumed for design for footings supported on compacted fill. We recommend an equivalent fluid pressure of 300 pounds per cubic foot for ultimate passive soil resistance and not to exceed 3,000 pounds per cubic foot, where appropriate. The upper foot of passive soil resistance should be neglected where soil adjacent to the footing is not covered and protected by a concrete slab or pavement. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

General Structural Design

We recommend that foundations be reinforced with a minimum 2, No. 4 rebar both top and bottom steel, to provide structural continuity and to permit spanning of local irregularities.

6.2.2 Foundation General Recommendations

The above parameters are applicable provided structures have gutters and downspouts and positive drainage is maintained away from structures. Therefore, it is important that information regarding drainage and site maintenance be passed on to future owners.

The above recommendations assume, and GeoSoils Consultants, Inc. strongly recommends, that surface water will be kept from infiltrating into the subgrade adjacent to the building foundation system. This may include, but not be limited to rainwater, roof water, landscape water and/or leaky plumbing. The lots are to be fine graded at the completion of construction to include positive drainage away from the structure and roof water will be collected via gutters, downspouts, and transported to the street in buried drainpipes. Homebuyers should be cautioned against constructing open draining planters adjacent to the houses or obstructing the yard drainage in any way.

- Utility trenches beneath the slabs should be backfilled with compacted native soil materials, free of rocks.
- Standard City of Moreno Valley structural setback guidelines are applicable, except where superseded by specific recommendations by the Project Geologist and Geotechnical Engineer.
- Building or structure footings shall be set back a horizontal distance, x , from the face of adjacent descending slope, if any. The horizontal distance is calculated as $x=H/3$, where H is the height of slope. The distance x should not be less than 5 feet nor more than 40 feet. The distance x may be provided by deepening the footings.
- The ground immediately adjacent to the foundations shall be sloped away from the building at a slope of not less (5%-slope) for a minimum distance of 10' measured perpendicular to the face of the wall. Impervious surfaces within 10' of the building foundation shall be sloped a minimum of 2% away from the building.
- To help reduce humidity in the crawl space, if any, a high-quality vapor barrier should be installed across the soil surface within the crawl space.

The vapor barrier will help keep moisture content more consistent within the soils supporting the foundations. The vapor barrier should be kept relatively free of large wrinkles and folds, and individual adjacent pieces of vapor barrier should be overlapped and taped where this can be achieved.

6.3 Interior Slab-on-grade

General Recommendations

Interior concrete slab-on-grade may be used along with footings. Interior slabs on grade should be at least 4 inches thick, and they may be dwelled into the foundation system in habitable areas at discretion of structural engineer. Concrete slabs should be reinforced with at least No. 4 rebar at 16 inches on-center in both directions for very low expansive soil. All slab reinforcement should be properly positioned at mid-height in the slab during placement of concrete.

Thickness

The design engineer should determine the actual thickness of the slabs based on proposed loadings and use. However, minimum slab thickness of four inches is recommended.

Moisture Protection

Concrete slabs should be underlain with a vapor barrier consisting of a minimum of 10-mil polyvinyl chloride membrane with all laps overlain 12 inches in each direction. A two-inch layer of sand should overlie this membrane.

Slab Sectioning

To minimize transgression of shrinkage cracks, slabs must not exceed 20-foot sections. Expansion joints, plastic joints, saw cutting, or proper tooling may be used to create sectioning during concrete placement. It is suggested that slabs not be tied

structurally to heavily loaded walls or columns, until most of the dead loads are in place to permit minor differential settlement.

Subgrade Preparation

The subgrade soils below concrete flatwork areas to a minimum depth of 18 inches should be compacted to a minimum relative compaction of 90 percent at or slightly above the optimum moisture content. Pre-saturation of the subgrade below slabs will not be required; however, prior to placing concrete, the subgrade below all dwelling and garage floor slab areas should be thoroughly moistened to achieve a moisture content that is at least equal to or no more than 5 percent greater than optimum moisture content to a minimum depth of 18 inches below the bottoms of the slabs.

6.4 Exterior Slabs-on-grade

Subgrade Preparation

To reduce the potential for distress to exterior concrete flatwork, the subgrade soils below concrete flatwork areas to a minimum depth of 12 inches (or deeper, as either prescribed elsewhere in this report or determined in the field) should be moisture conditioned to at least equal to, or slightly greater than, the optimum moisture content and then compacted to a minimum relative compaction of 90 percent.

Flooding or ponding of the subgrade is not considered feasible to achieve the above moisture conditions since this method would likely require construction of numerous earth berms to contain the water. Therefore, moisture conditioning should be achieved with sprinklers, or a light spray applied to the subgrade over a period of few to several days just prior to pouring concrete. Pre-watering of the soils is intended to promote uniform curing of the concrete, reduce the development of shrinkage cracks and reduce the potential for differential expansion pressure on freshly poured flatwork. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth of moisture penetration prior to pouring concrete.

Drainage

Drainage from patios and other flatwork areas should be directed to local area drains and/or graded earth swales designed to carry runoff water to the adjacent streets or other approved drainage structures. The concrete flatwork should be sloped at a minimum gradient of one percent, or as prescribed by project civil engineer or local codes, away from building foundations, retaining walls, masonry garden walls and slope areas.

Thickened Edge

To improve performance, exterior slabs-on-grade may be constructed with a thickened edge to improve edge stiffness and to reduce the potential for water seepage under the edge of the slabs and into the underlying base and subgrade. In our opinion, the thickened edges should be at least 8 inches wide and ideally should extend at least 8 inches below the bottom of the slab.

6.5 Swimming Pool

Bearing Conditions

Based on the currently proposed pool location, the pool may be designed as a conventional pool shell founded on native alluvium. We anticipate entire pool bottom will be supported in competent alluvium. If this is not the case then the pool excavation shall be deepened to provide a uniform underlayment beneath the pool (Such as 3 feet of compacted fill across the entire pool). For the proposed spa, we anticipate it to be supported in compacted fill of a minimum thickness of 3 feet. The surface and near-surface materials in the area of the proposed swimming pool and spa have a low-expansion potential.

Lateral Earth Pressures

The pool walls should be designed assuming that an earth pressure equivalent to a fluid having a minimum density of 45 pounds per cubic foot. Pool walls should also

be designed to resist an additional uniform pressure equivalent to one-half of any surcharge loads applied within a 45-degree (1:1) plane from bottom of pool wall.

Underlayment

We recommend that a pressure relief valve(s) be placed in the bottom of the deep end of the pool to limit potential damage from hydrostatic (buoyant) pressure, a condition that could result if the pool were empty and the groundwater level outside of the pool were high.

Decking

Pool decking should be cast free of the swimming pool/spa and water stops should be provided between the bond beam and the deck. In the case of a spa being planned structurally continuous with the pool shell, the spa should either be designed to be entirely supported by the pool shell (i.e., cantilevered) or the spa support be derived at a depth comparable to that of the pool (i.e. deep). The Structural Engineer should exercise extreme care in this area. The transition area between the pool and spa is a common area for cracks to develop. Surface drainage around the pool should be provided to keep water from ponding and seeping into the ground. Surface water shall be collected and conducted through non-erosive devices to the street, storm drain, or other approved watercourse or disposal area.

Structural Design

In many cases, we have found pool contractors who commonly use standard pool detail sheets instead of having a Structural Engineer design a pool for the specific criteria recommended. These detail sheets usually incorporate details for several site conditions and can be confusing as to exactly which detail is appropriate. Typical “standard detail” may not conform to the criteria recommended. As such, we strongly discourage the use of standard detail sheets. Instead, the Structural Engineer should prepare a specific design and details to conform to the criteria presented in this report, as well as other structural criteria. The detail should also consider provisions for deck

construction. We further recommend that the Structural Engineer review steel once in-place and leave a memo at the job site indicating for the benefit of the concerned parties (e.g., owner and City) that it is appropriate to proceed further. Deputy inspection of gunite placement is advised. Prior to placement of steel, the pool plans should be reviewed by this office, and the pool excavation must be observed by a Geologist or Geotechnical Engineer.

Plumbing Fixtures

Leakage from the swimming pool or any of the appurtenant plumbing could create an artificial groundwater condition which could have a deleterious effect on the underlying soil. Therefore, it is imperative that all plumbing and pool features be absolutely leak-free. Should any subdrain pipes, (i.e., such as a yard drain system) be broken or impacted during construction of the pool system, or any structure, these pipes should be repaired and/or rerouted where necessary to restore their intended function (i.e., to provide proper drainage).

6.6 Pavement Sections

6.6.1 Asphalt Concrete

Based on the materials encountered in our borings and laboratory test results, it is our opinion that an R-value of 28, is appropriate for design of the parking area and drive isle pavements.

Using estimated Traffic Indices for various pavement loading conditions, we calculated the minimum pavement section thicknesses presented in table below based on the pavement design procedure described in Chapter 630 of the Caltrans Highway Design Manual for design life of 20-year. We note that it is the civil engineer's responsibility to choose an appropriate traffic index for various pavement systems. Any local jurisdiction minimum pavement sections should be followed.

TABLE 4 MINIMUM PAVEMENT SECTION THICKNESSES		
Traffic Index	Asphalt Thickness (in)	Aggregate Base Thickness (in)
4	3.00	4.00
4.5	3.00	4.00
5	3.00	6.00
5.5	3.00	7.50
6	3.50	8.00
7	4.00	10.00
8	5.00	11.00
9	5.50	13.50

If the pavements are constructed in two stages, the above table provides the minimum pavement section, and for any traffic index, pavements should not have less than 3 inches AC over 4 inches of AB, and the initial course graded AC (Binder) layer for construction traffic should not have less than 2.5 inches thickness, while the final fine-grained AC (Surface) layer, should not have less than 1.5 inches thickness. We note that constructing pavements in two stages may pose some hazards for the overall performance of pavement due to heavy construction equipment traffic on the relatively thin initial layer.

The Asphalt Concrete pavements may be underlain by approximately 3 feet of compacted fill to a minimum relative compaction of 90 percent. Subgrade soils immediately below the aggregate base, to a minimum depth of 12 inches, should be compacted to a minimum relative compaction of 95 percent based on ASTM D1557. Final subgrade compaction should be performed prior to placing base materials and after utility-trench backfills have been compacted and tested.

Asphalt concrete and aggregate base should conform to and be placed in accordance with the requirements of the Caltrans Standard Specifications, latest edition, except that compaction of subgrades and aggregate base material should be based on ASTM Test D1557. The base course should be compacted to 95 percent or more of the maximum dry density as evaluated by ASTM D1557. The base materials should also meet the specifications for

Crushed Aggregate Base, Crushed Miscellaneous Base or Processed Miscellaneous Base as defined in Section 200-2 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).

AC Paving:

Prime coat may be omitted if all of the following conditions are met:

1. The asphalt pavement layer is placed within two weeks of completion of base and/or subbase course.
2. Traffic is not routed over completed base before paving.
3. Construction is completed during the dry season of May through October.
4. The base is free of dirt and debris.

If construction is performed during the wet season of November through April, prime coat may be omitted if no rain occurs between completion of base course and paving, and the time between completion of base and paving is reduced to three days, provided the base is free of dirt and debris. Where prime coat has been omitted and rain occurs, traffic is routed over base course, or paving is delayed, measures shall be taken to restore base course, subbase course, and subgrade to conditions that will meet specifications as directed by the geotechnical engineer.

We recommend that measures be taken to limit the amount of surface water that seeps into the aggregate base and subgrade below vehicle pavements, particularly where the pavements are adjacent to landscape areas. Seepage of water into the pavement base material can soften the subgrade, thereby increasing the amount of pavement maintenance that is required and shortening the pavement service life. Deepened curbs extending 4-inches below the bottom of the aggregate base layer are generally effective in limiting excessive water seepage below the edges of pavement and into the subgrade.

Other types of water cutoff devices or edge drains may also be considered to maintain pavement service life.

6.7 Infiltration Testing

The proposed infiltration systems will consist of five underground basins as shown on Plate 1. The final design of the system should be reviewed by this office. Infiltration testing was performed by GeoTek, Inc. in June 2014. One backhoe test pit was excavated to a depth of five (5) feet below the existing grade at the location shown on Plate 1. Based on subsurface exploration, it is our opinion that the soil underlying the site is homogenous and the infiltration testing applies across the entire site. A double-ring infiltrometer test was performed in general conformance with ASTM D-3385 and the Riverside County of Flood Control and Water Conservation District Design Handbook for Low Impact Development Best Management Practices. The results are presented in Appendix A and the infiltration rate can be viewed in the table below.

The result of infiltration rate without factor of safety is included in the table below. A minimum factor of safety of 2 may be considered for design purposes.

TABLE 5 PERCOLATION TEST RESULTS	
TEST LOCATION	RATE (Inches per hour)
I-1	0.3
Note: This rate does not include the correction factor	

6.8 Grading

Grading of the site will consist of a cut/fill operation to create level pads and associated streets. The grading will involve the removing and recompacting of existing near surface material. We offer the following recommendations and construction considerations concerning earthwork grading at the site.

6.8.1 General

Monitoring: We recommend that all earthwork (i.e., clearing, site preparation, fill placement, etc.) should be conducted with engineering control under

observation and testing by the Geotechnical Engineer and in accordance with the requirements within the *Grading* section of this report.

Job Site Safety: At all times, safety should have precedence over production work. If an unsafe job condition is observed, it should be brought to the attention of the grading contractor or the developer's representative. Once this condition is noted, it should be corrected as soon as possible, or work related to the unsafe condition should be terminated.

The contractor for the project should realize that services provided by GSC do not include supervision or direction of the actual work performed by the contractor, his employees, or agents. GSC will use accepted geotechnical engineering and testing procedures; however, our testing and observations will not relieve the contractor of his primary responsibility to produce a completed project conforming to the project plans and specifications. Furthermore, our firm will not be responsible for job or site safety on this project, as this is the responsibility of the contractor.

6.8.2 Site Preparation

Existing Structure Location: The General Contractor should locate all surface and subsurface structures on the site or on the approved grading plan prior to preparing the ground.

Existing Structure Removal: Any underground structures (e.g., septic tanks, wells, pipelines, foundations, utilities, etc.) that have not been located prior to grading should be removed or treated in a manner recommended by the Geotechnical Engineer.

Clearing and Stripping: The construction areas should be cleared and stripped of all vegetation, trees, bushes, sod, topsoil, artificial fill, debris, asphalt, concrete, and other deleterious material prior to fill placement.

Removals: Please refer to the *Removals* section of this report for specific recommendations for removals.

Subgrade Preparation: We recommend that the subgrade for those areas receiving any fill be prepared by scarifying the upper 12 inches and moisture conditioning, as required to obtain at least optimum moisture, but not greater than 120 percent of optimum. The scarified areas shall be compacted to at least 90 percent of the maximum laboratory density, as determined by ASTM D-1557-12 compaction method. All areas to receive fill should be observed by the Geotechnical Engineer prior to fill placement.

Subgrade Verification and Compaction Testing: Regardless of material or location, all fill material should be placed over properly compacted subgrades in accordance with this section. The condition of all subgrades shall be verified by the Geotechnical Engineer before fill placement or earthwork grading begins. Earthwork monitoring and field density testing shall be performed during grading to provide a basis for opinions concerning the degree of soil compaction attained. The Contractor should be responsible for notifying the Geotechnical Engineer when such areas are ready for inspection. Inspection of the subgrade may also be required by the controlling governmental agency within the respective jurisdictions. Density tests should also be made on the prepared subgrade to receive fill, unless the areas are underlain by dense alluvium, as required by the Geotechnical Engineer.

6.8.3 Fill Placement

Laboratory Testing: Representative samples of materials to be utilized as compacted fill should be analyzed in a laboratory to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material should be conducted.

On-Site Fill Material: The on-site soils, in our opinion, are adequate for re-use in controlled fills provided the soils do not contain any organic matter, debris,

and that over-sized rocks are buried in accordance with the recommendations under *Rock Fragments*.

Rock Fragments: The alluvium on the site should be free of oversized rocks. Any rock fragments over 6 inches should be kept below a depth of 5 feet below proposed grade. Rocks greater than 6 inches in diameter should be taken off site or placed in accordance with the recommendations of the Geotechnical Engineer. Rocks greater than 6 inches in diameter shall be kept out of all street areas to a depth below the deepest proposed utility line. Rocks shall not be placed in concentrated pockets, shall be surrounded with fine grained material, and the distribution of the rocks shall be supervised by the Geotechnical Engineer. A sufficient amount of fine-grained material shall be placed around the rocks to prevent nesting and to fill all void space. An adequate amount of water will be required to force fines into any open voids.

Fill Placement: Approved on-site material shall be evenly placed, watered, processed, and compacted in controlled horizontal layers not exceeding eight inches in loose thickness, and each layer should be thoroughly compacted with approved equipment. The fill should be placed and compacted in horizontal layers, unless otherwise recommended by the Geotechnical Engineer.

Compaction Criteria - Shallow Fills: For fills less than 40 feet in vertical thickness, each layer shall be compacted to at least 90 percent of the maximum laboratory density for material used as determined by ASTM D-1557-12. The field density shall be determined by the ASTM D-1556-07 method or equivalent. Where moisture content of the fill or density testing yields compaction results less than 90 percent, additional compaction effort and/or moisture conditioning, as necessary, shall be performed, until the fill material is in accordance with the requirements of the Geotechnical Engineer.

Fill Material - Moisture Content: All fill material placed must be moisture conditioned, as required to obtain at least optimum moisture, but not greater

than 120 percent. If excessive moisture in the fill results in failing results or an unacceptable “pumping” condition, then the fill should be allowed to dry until the moisture content is within the necessary range to meet the required compaction requirements or reworked until acceptable conditions are obtained.

Keying and Benching: All fills should be keyed and benched through all topsoil, slopewash, alluvium or colluvium or creep material into firm material where the slope receiving fill is steeper than 5:1 (Horizontal: Vertical) or as determined by Geotechnical Engineer. The standard acceptable bench height is four feet into suitable material. The key for side hill fills should be a minimum of 15 feet within compacted fill or firm materials, with a minimum toe embankment of 2 feet into compacted fill, unless otherwise specified by the Geotechnical Engineer.

Slope Face - Compaction Criteria: The Contractor should be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes. This may be achieved by either overbuilding the slope a minimum of five feet, and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction. If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor should rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Geotechnical Engineer. Slope testing will include testing the outer 6 inches to 3 feet of the slope face during and after placement of the fill. In addition, during grading, density tests will be taken periodically on the flat surface of the fill three to five feet horizontally from the face of the slope.

Slope Face - Contractor’s Responsibility: The Contractor should prepare a written detailed description of the method or methods he would employ to obtain the required slope compaction. Such documents should be submitted

to the Geotechnical Engineer for review and comments prior to the start of grading.

Slope Face - Vegetation: All fill slopes should be planted or protected from erosion by methods specified in the geotechnical report or required by the controlling governmental agency.

Density Testing Intervals: In general, density tests should be conducted at minimum intervals of 2 feet of fill height or every 500 to 1,000 cubic yards. Due to the variability that can occur in fill placement and different fill material characteristics, a higher number of density tests may be warranted to verify that the required compaction is being achieved.

Grading Control: Earthwork monitoring and field density testing shall be performed by the Geotechnical Engineer during grading to provide a basis for opinions concerning the degree of soil compaction attained. The Contractor should receive a copy of the Geotechnical Engineer's *Daily Field Engineering Report* which will indicate the results of field density tests for that day. Where failing tests occur or other field problems arise, the Contractor shall be notified of such conditions by written communication from the Geotechnical Engineer in the form of a conference memorandum, to avoid any misunderstanding arising from oral communication.

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

6.8.4 Construction Considerations

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

Compaction Equipment: It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the project site to handle the amount of fill being placed and the type of fill material to be compacted. If necessary, excavation equipment should be shut down to permit completion of compaction in accordance with the recommendations contained herein. Sufficient watering devices/equipment should also be provided by the Contractor to achieve optimum moisture content in the fill material.

Final Grading Considerations: Care should be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.

6.8.5 Temporary Excavation

Where the necessary space is available, temporary unsurcharged embankments may be sloped back without shoring. The slope should not be cut steeper than the following gradient:

TABLE 6 TEMPORARY EXCAVATION SLOPE	
Height	Temporary Gradient (Horizontal:Vertical)
0 - 5'	Near Vertical
above 5'	1:1

In areas where soils with little or no binder are encountered, shoring or flatter excavation slopes shall be made. These recommended temporary excavation slopes do not preclude local ravelling or sloughing.

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act, and the Construction Safety Act should be met.

Where sloped embankments are used, the top of the slope should be barricaded to prevent equipment and heavy storage loads within five feet of the

top of the slope. If the temporary construction embankments are to be maintained for long periods, berms should be constructed along the top of the slope to prevent runoff water from eroding the slope faces. The soils exposed in the temporary backcut slopes during excavation should be observed by our personnel so that modifications of the slopes can be made if variations in the soil conditions occur. The temporary excavation slopes should be supported within three weeks.

6.8.6 Excavation Observation

All footing and other excavations should be observed by an Engineering Geologist or Geotechnical Engineering prior to placement of any steel to verify that the proper foundation material has been encountered. The City Inspector should also observe the excavation.

6.8.7 Utility Trenching and Backfill

Utility Trenching: Open excavations and excavations that are shored shall conform to all applicable Federal, State, and local regulations.

Backfill Placement: Approved on-site or imported fill material shall be evenly placed, watered, processed, and compacted in controlled horizontal layers not exceeding eight inches in loose thickness, and each layer should be thoroughly compacted with approved equipment. All fill material should be moisture conditioned, as required to obtain at least optimum moisture, but not greater than 120 percent of optimum moisture content. The fill should be placed and compacted on a horizontal plane, unless otherwise recommended by the Geotechnical Engineer.

As an alternative to on-site or imported fill material, for shallow trenches where pipe or utility lines may be damaged by mechanical compaction equipment, such as under building floor slabs, imported clean sand having a sand equivalent (SE) value of 30 or greater may be utilized. The sand backfill

materials should be watered to achieve near optimum moisture conditions and then tamped into place. No specific relative compaction will be required; however, observation, probing, and if deemed necessary, testing should be performed by a representative of the project geotechnical consultant to verify an adequate degree of compaction.

Backfill Compaction Criteria: Each layer of utility trench backfill shall be compacted to at least 90 percent of the maximum laboratory density determined by ASTM D-1557-12. The field density shall be determined by the ASTM D-1556-07 method or equivalent. Where moisture content of the fill or density testing yields compaction results less than 90 percent, additional compaction effort and/or moisture conditioning, as necessary, shall be performed, until the compaction criteria is reached.

Exterior Trenches Adjacent to Footings: Exterior trenches, paralleling a footing and extending below a 1H:1V plane projected from the outside bottom edge of the footing, should be compacted to 90 percent of the laboratory standard. Sand backfill, unless it is similar to the in-place fill, should not be allowed in trench backfill areas. Density testing, along with probing, should be accomplished to verify the desired results.

Pipe Bedding: We recommend that a minimum of 6 inches of bedding material should be placed in the bottom of the utility trench. All bedding materials shall extend at least 4 inches above the top of utilities which require protection during subsequent trench backfilling. All trenches shall be wide enough to allow for compaction around the haunches of the pipe.

Groundwater Migration: Backfilled utility trenches may act as French drains to some extent, and considerable groundwater flow along utility bedding and backfill should be expected. Wherever buried utilities, or structures which they may intersect, could be adversely affected by such drainage, provisions shall be made to collect groundwater migrating along the trench lines. These

situations include where buried utilities enter buildings, particularly where they enter below grade mechanical rooms, and where buried utilities enter junction boxes or switching stations that are intended to remain dry. Mitigation measures include, but are not limited to, placement of perforated drainpipes below and continuous with bedding materials, and placement of seepage barriers such as lean mix concrete or controlled density fill (CDF).

7.0 CLOSURE

We appreciate this opportunity to be of continued service to you. If you have any questions regarding the content of this report or any other aspects of the project, please do not hesitate to contact us.

April 29, 2024
W.O. 7907

REFERENCES

ACI 302.1R-15, Guide to Concrete Floor and Slab Construction.

ASCE/SEI 7-22, Minimum Design Loads and Associated Criteria For Buildings and Other Structures, American Society of Civil Engineers

California Building Code (CBC), 2022, California Code of Regulations, Title 24, Part 2, Volume I and II.

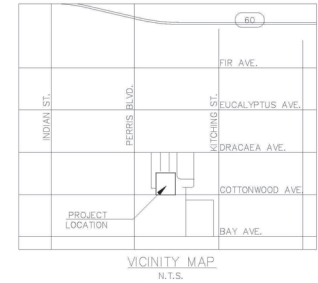
Hannigan, P. J., G. G. Goble, G. Thendean, G. E. Likins, and F. Rausche. Design and Construction of driven pile Foundation, FHWA-NHI-05-042 and NHI-05-043, Federal Highway Administration, U.S. Department of Transportation, Washington, DC, 2006. Vols. I and II.

Geotek, Inc. dated June 24, 2021, "Geotechnical Evaluation Update, Tract No. 34544, City of Moreno Valley, Riverside County, California."

Geotek, Inc. dated June 30, 2014, "Infiltration Evaluation, Proposed Residential Development, Tentative Tract Map No. 34544, City of Moreno Valley, Riverside County, California."

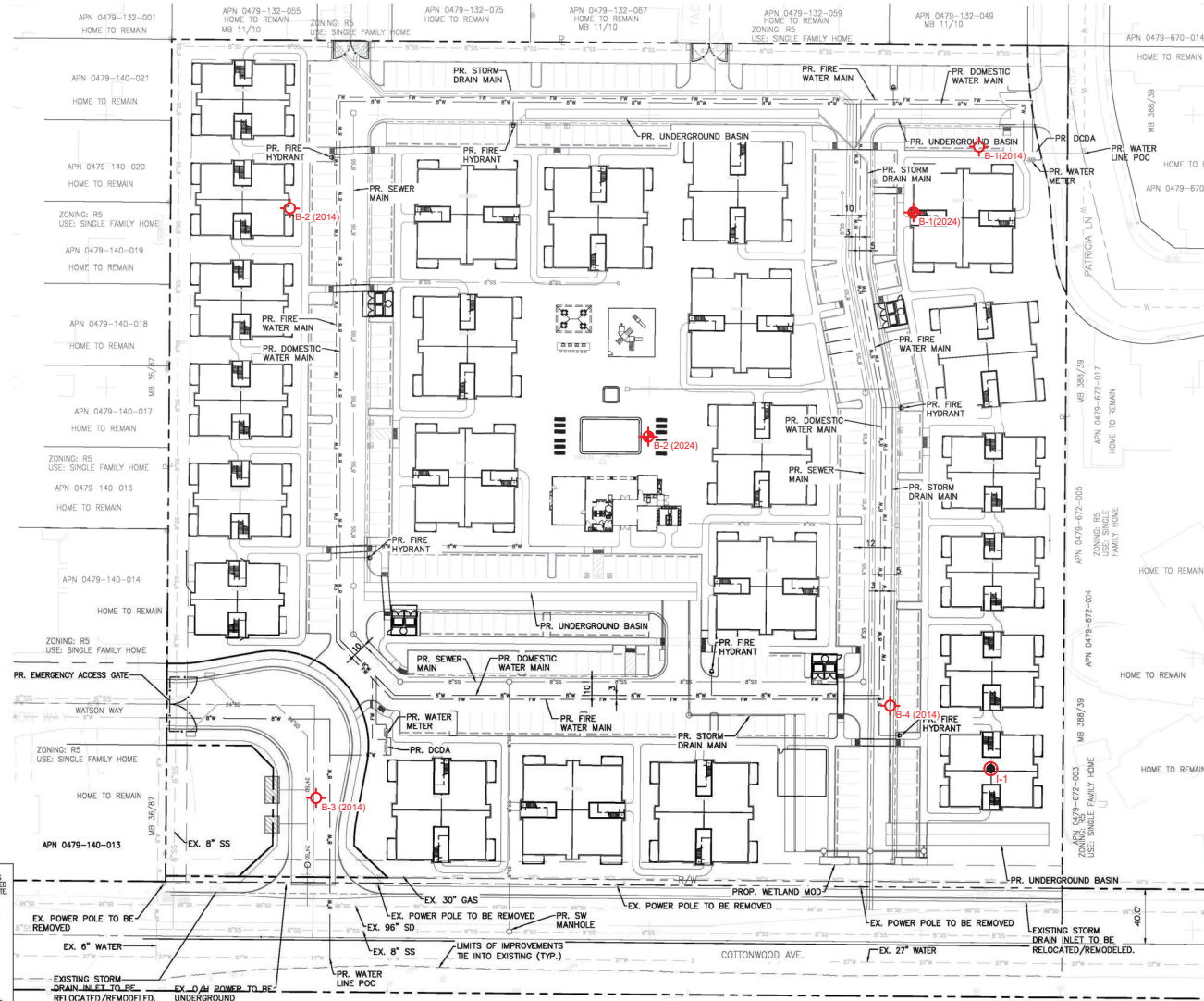
Geotek, Inc. dated April 10, 2014, "Geotechnical Evaluation, Proposed Single-Family Residential Development, APN 479-140-022, City of Moreno Valley, Riverside County, California."

MDN 24161



EXPLANATION

- B-1 APPROXIMATE LOCATION OF BORING (GEOTEK, INC. 2014)
- B-1 APPROXIMATE LOCATION OF BORING (GEOSOLS 2024)
- L-1 APPROXIMATE LOCATION OF INFILTRATION TEST (GEOTEK)



NO WORK SHALL BE DONE ON THIS SITE UNTIL BELOW AGENCY IS NOTIFIED OF INTENTION TO DIG OR LOCATE.

DIGALERT

CALL 811 or 1-800-422-4133 2 Working Days Before You Dig www.call811.com

GSC GeoSoils Consultants, Inc. 6634 Valjean Avenue Van Nuys, CA 91406

BORING LOCATION MAP
COTTONWOOD AVENUE
MORENO VALLEY, CALIFORNIA
WJK DEVELOPMENT CO.

WORK ORDER 7907	DATE 4/2024	SCALE AS NOTED
REVISED	PLATE 1	

MDN 24161

REVIEW BY CITY STAFF	BENCHMARK	BASIS OF BEARING	CITY OF MORENO VALLEY ACCEPTED BY:		ENGINEER OF RECORD'S SEAL
		THE BEARING OF N 89°33'40" W FOR THE CENTERLINE OF SHIRAZA AVENUE AS SHOWN ON TRACT NO. 7352-1 FILED IN BOOK 98 PAGES 15-17 OF RIVERSIDE COUNTY RECORDS, WAS USED AS THE BASIS OF BEARINGS FOR THIS SURVEY.			
			MARK	DATE	INITIAL
					DESCRIPTION
				REC.	APPR./DATE
					REVISION

BLUE ENGINEERING & CONSULTING, INC. 9318 MULLEN BLVD. SUITE 100, MORENO VALLEY, CALIF. 91730

UNDER THE SUPERVISION OF:

ANGEL CESAR RCE 87222 DATE

CITY OF MORENO VALLEY

CONCEPTUAL UTILITY PLAN
COTTONWOOD APARTMENTS
DEVELOPMENT

SHEET 6 OF 9
CITY ID No

A:\2024\100\gsc\cst\7907\4172-Document\BORING LOCATION MAP #11-24.dwg, 5/1/2024, 10:35:55 AM, AutoCAD PLOT (General) Document\plot32.ctb, Plot Size: 11.00 x 17.00 inches, Plot Date: 5/1/2024, 10:35:55 AM

April 29, 2024
W.O. 7907

APPENDIX A
EXPLORATION DATA

MDN 24161

GEOTECHNICAL BORING LOG

PROJECT NAME	WJK Development	W.O.	7907
DRILLING COMPANY	Choice	DATE STARTED	3/18/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RM
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-1
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:




Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			0-50', ALLUVIUM (Qa) 0-5', Brown sandy, silty CLAY, very moist, soft			
5	[California Ring]	31/50	5', Reddish brown to brown, silty fine to coarse SAND, with some clay, dry, very dense			
	[California Ring]	24/50	7.5', Reddish grey brown, silty coarse SAND, dry, very dense			
10	[California Ring]	36/39/ 50 for 5"	10', Reddish brown, silty fine to coarse SAND, with some clay, slightly moist, very dense			
15	[Standard Penetration Test]	11/9/11	15', Reddish brown, sandy SILT to silty fine SAND, slightly moist, firm/dense			
20	[Standard Penetration Test]	12/18/9	20', Light brown to reddish brown, silty fine to coarse SAND, slightly moist, very dense			
25	[California Ring]	45/50 for 4"	25', Reddish brown, silty coarse SAND, wet, very dense			
30	[Standard Penetration Test]	9/13/15	30', Reddish brown, silty coarse SAND, wet, very dense			

<p style="text-align: center;">LEGEND</p> <div style="display: flex; flex-direction: column; gap: 5px;"> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; border: 1px solid black; background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px);"></div> <div>Standard Penetration Test</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; border: 1px solid black; background: repeating-linear-gradient(-45deg, transparent, transparent 2px, black 2px, black 4px);"></div> <div>California Ring</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; border: 1px solid black; background: radial-gradient(circle, black 1px, transparent 1px); background-size: 4px 4px;"></div> <div>Rock Core</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; background-color: black;"></div> <div>Bulk Sample</div> </div> </div>	<p>SIEVE: Grain Size Analysis #200: Washed Sieve #200 MAX: Maximum Dry Density DS: Direct Shear C/S: Collapse/Swell CONS: Consolidation HYDR: Hydrometer Analysis EXPAN: Expansion Index CHEM: Chemical Tests R-V: R-Value PI: Atterberge Limits Tests</p>	<p>PLATE A-1</p> <div style="text-align: center;"> <p>GeoSoils Consultants Inc. GEOTECHNICAL · GEOLOGIC · ENVIRONMENTAL</p> </div>
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GEOTECHNICAL BORING LOG

PROJECT NAME	WJK Development	W.O.	7907
DRILLING COMPANY	Choice	DATE STARTED	3/18/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RM
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-1
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
35		13/15/21	35', Light brown, silty coarse SAND, wet, very dense			
40						
45		9/11/15	45', Light brown to brown, silty coarse SAND with some clay, wet, dense			
50		17/15/18	50', Gray brown , fine to coarse SAND with some gravel, wet, dense, transitions to reddish brown, sandy SLT, fine grained sand, moist, firm			
55			TD=50' Groundwater @ 25' No caving			
60						
65						

LEGEND

-  Standard Penetration Test
-  California Ring
-  Rock Core
-  Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-2**



GEOTECHNICAL BORING LOG

PROJECT NAME	WJK Development	W.O.	7907
DRILLING COMPANY	Choice	DATE STARTED	3/18/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RM
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-1
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			0-20', ALLUVIUM (Qa)			
		3/4/7	2.5', Brown, silty, clayey, fine to coarse SAND, moist, soft/loose with minor roots			
5		6/9/12	5', Brown, clayey, silty fine to coarse SAND, moist., dense			
		5/8/10	7.5', Reddish gray brown, silty fine to coarse SAND, moderately moist, dense			
10		43/40/50 for 4"	10', Reddish brown, silty fine to coarse SAND, slightly moist, very dense			
15		17/20/34	15', Reddish brown, silty coarse SAND with caliche, moderately moist, very dense			
20		19/34/50 for 2"	20', Reddish brown, silty coarse SAND, moist to very moist, very dense			
			TD=20'			
			Groundwater @ 19'			
			No caving			
25						
30						

<p style="text-align: center;">LEGEND</p> <div style="display: flex; flex-direction: column; gap: 5px;"> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; border: 1px solid black; background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px);"></div> <div>Standard Penetration Test</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; border: 1px solid black; background: repeating-linear-gradient(-45deg, transparent, transparent 2px, black 2px, black 4px);"></div> <div>California Ring</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; border: 1px solid black; background: radial-gradient(circle, black 1px, transparent 1px); background-size: 4px 4px;"></div> <div>Rock Core</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; background-color: black;"></div> <div>Bulk Sample</div> </div> </div>	<p>SIEVE: Grain Size Analysis #200: Washed Sieve #200 MAX: Maximum Dry Density DS: Direct Shear C/S: Collapse/Swell CONS: Consolidation HYDR: Hydrometer Analysis EXPAN: Expansion Index CHEM: Chemical Tests R-V: R-Value PI: Atterberge Limits Tests</p>	<p>PLATE A-3</p> <div style="text-align: center;"> <p style="font-weight: bold; font-size: 1.2em;">GeoSoils Consultants Inc.</p> <p style="font-size: 0.8em;">GEOTECHNICAL · GEOLOGIC · ENVIRONMENTAL</p> </div>
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GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Frontier Enterprises
PROJECT NAME: APN 479-140-022
PROJECT NO.: 1165-CR3
LOCATION: See Boring Location Map

DRILLER: 2R Drilling
DRILL METHOD: 8" Hollow Stem
HAMMER: Auto 140#/30"

LOGGED BY: AMS
OPERATOR: Jerry
RIG TYPE: CME 75
DATE: 3/24/2014

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-1	Laboratory Testing		
	Sample Type	Blow# / 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
MATERIAL DESCRIPTION AND COMMENTS								
0				SM	Alluvium: 0': Silty f-m SAND with some clay, red brown, slightly moist, loose to medium dense			SH, EI, MD, SR
5	35	50-4.5"	BI-1		5': Silty f-m SAND with some clay, red brown, slightly moist, dense	5.0	130.9	HC
10	50		BI-2		10': SAME	6.8	112.1	
15	11 19 22		BI-3		15': SAME	18.1	109.4	
20	50		BI-4		20': SAME	8.7	119.7	
25	43	50-5.5"	BI-5		25': Silty f-c SAND, gray brown to red brown, slightly moist, dense			
30	40	50-4.5"	BI-6	SP	30': m-c SAND with gravel, gray brown, wet, dense			

LEGEND	Sample type:	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	Lab testing:	AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test	SR = Sulfate/Resistivity Test	SH = Shear Test	HC = Consolidation

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Frontier Enterprises
PROJECT NAME: APN 479-140-022
PROJECT NO.: 1165-CR3
LOCATION: See Boring Location Map

DRILLER: 2R Drilling
DRILL METHOD: 8" Hollow Stem
HAMMER: Auto 140#/30"

LOGGED BY: AMS
OPERATOR: Jerry
RIG TYPE: CME 75
DATE: 3/24/2014

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-1 (continued) MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
35					Alluvium (continued)			
40	18 50-5.5"	BI-7	SM	40': Silty f-c SAND, gray brown to red brown, wet, dense				
45	36 50-5"	BI-8		45': SAME				
50	18 50-2.5"	BI-9		50': Silty f-c SAND with trace gravel, red brown to gray brown, wet, dense				
				BORING TERMINATED AT 50 FEET No groundwater encountered Boring backfilled with cuttings				
55								
60								

LEGEND	Sample type:		---Ring		---SPT		---Small Bulk		---Large Bulk		---No Recovery		---Water Table
	Lab testing:	AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test	SR = Sulfate/Resistivity Test	SH = Shear Test	HC = Consolidation	MD = Maximum Density				

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Frontier Enterprises
PROJECT NAME: APN 479-140-022
PROJECT NO.: 1165-CR3
LOCATION: See Boring Location Map

DRILLER: 2R Drilling
DRILL METHOD: 8" Hollow Stem
HAMMER: Auto 140#/30"

LOGGED BY: AMS
OPERATOR: Jerry
RIG TYPE: CME 75
DATE: 3/24/2014

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-2	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
MATERIAL DESCRIPTION AND COMMENTS								
0				SM	Alluvium: 0': Silty f-m SAND with some clay, red brown, slightly moist, loose to medium dense			
5		22 24 18	B2-1		5': Clayey silty f-c SAND, red brown, slightly moist, dense	7.9	130.0	
10		33 46 48	B2-2		10': Silty f-c SAND, gray to red brown, slightly moist, dense	10.7	127.9	
15		13 27 33	B2-3	SC	15': Clayey f-c SAND, red, slightly moist, dense	13.8	122.5	
20		16 22 25	B2-4		20': SAME	9.1	126.1	
BORING TERMINATED AT 21.5 FEET								
25					No groundwater encountered Boring backfilled with cuttings			
30								

LEGEND	Sample type:	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	Lab testing:	AL = Atterberg Limits	El = Expansion Index	SA = Sieve Analysis	RV = R-Value Test	SR = Sulfate/Resistivity Test	SH = Shear Test	HC = Consolidation

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Frontier Enterprises
PROJECT NAME: APN 479-140-022
PROJECT NO.: 1165-CR3
LOCATION: See Boring Location Map

DRILLER: 2R Drilling
DRILL METHOD: 8" Hollow Stem
HAMMER: Auto 140#/30"

LOGGED BY: AMS
OPERATOR: Jerry
RIG TYPE: CME 75
DATE: 3/24/2014

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-3	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
MATERIAL DESCRIPTION AND COMMENTS								
0				SM	Alluvium: 0': Silty f-m SAND with some clay, red brown, slightly moist, loose to medium dense			
5		15 14 16	B3-1		5': Silty fine SAND, medium brown, slightly moist, dense	9.6	109.7	
10		20 50-4.5"	B3-2		10': Silty fine SAND, orange brown mottled, slightly moist, dense	12.5	124.2	HC
15		24 47 50-5"	B3-3	SC	15': Silty clayey f-c SAND, red, slightly moist, dense	14.8	120.2	
20		21 50	B3-4		20': SAME	13.2	122.2	
BORING TERMINATED AT 20 FEET								
25	No groundwater encountered Boring backfilled with cuttings							
30								

LEGEND	Sample type:	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Frontier Enterprises
PROJECT NAME: APN 479-140-022
PROJECT NO.: 1165-CR3
LOCATION: See Boring Location Map

DRILLER: 2R Drilling
DRILL METHOD: 8" Hollow Stem
HAMMER: Auto 140#/30"

LOGGED BY: AMS
OPERATOR: Jerry
RIG TYPE: CME 75
DATE: 3/24/2014

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-4	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
MATERIAL DESCRIPTION AND COMMENTS								
5		18 27 28	B4-1	SM	Alluvium: 0': Silty f-m SAND with some clay, red brown, slightly moist, loose to medium dense			
5					5': Silty fine SAND, medium brown, slightly moist, dense	12.1	125.1	
10		24 43 50-5.5"	B4-2	SC	10': Silty clayey f-c SAND, red brown, slightly moist, dense			
10						10.4	128.1	
15		43 50-3"	B4-3		15': SAME			
15						13.1	122.0	
20		12 23 42	B4-4		20': SAME			
20						12.3	124.3	
BORING TERMINATED AT 21.5 FEET								
25					No groundwater encountered Boring backfilled with cuttings			
30								

LEGEND	Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table
	Lab testing: AL = Atterberg Limits EI = Expansion Index SA = Sieve Analysis RV = R-Value Test SR = Sulfate/Resistivity Test SH = Shear Test HC = Consolidation MD = Maximum Density

April 29, 2024
W.O. 7907

APPENDIX B

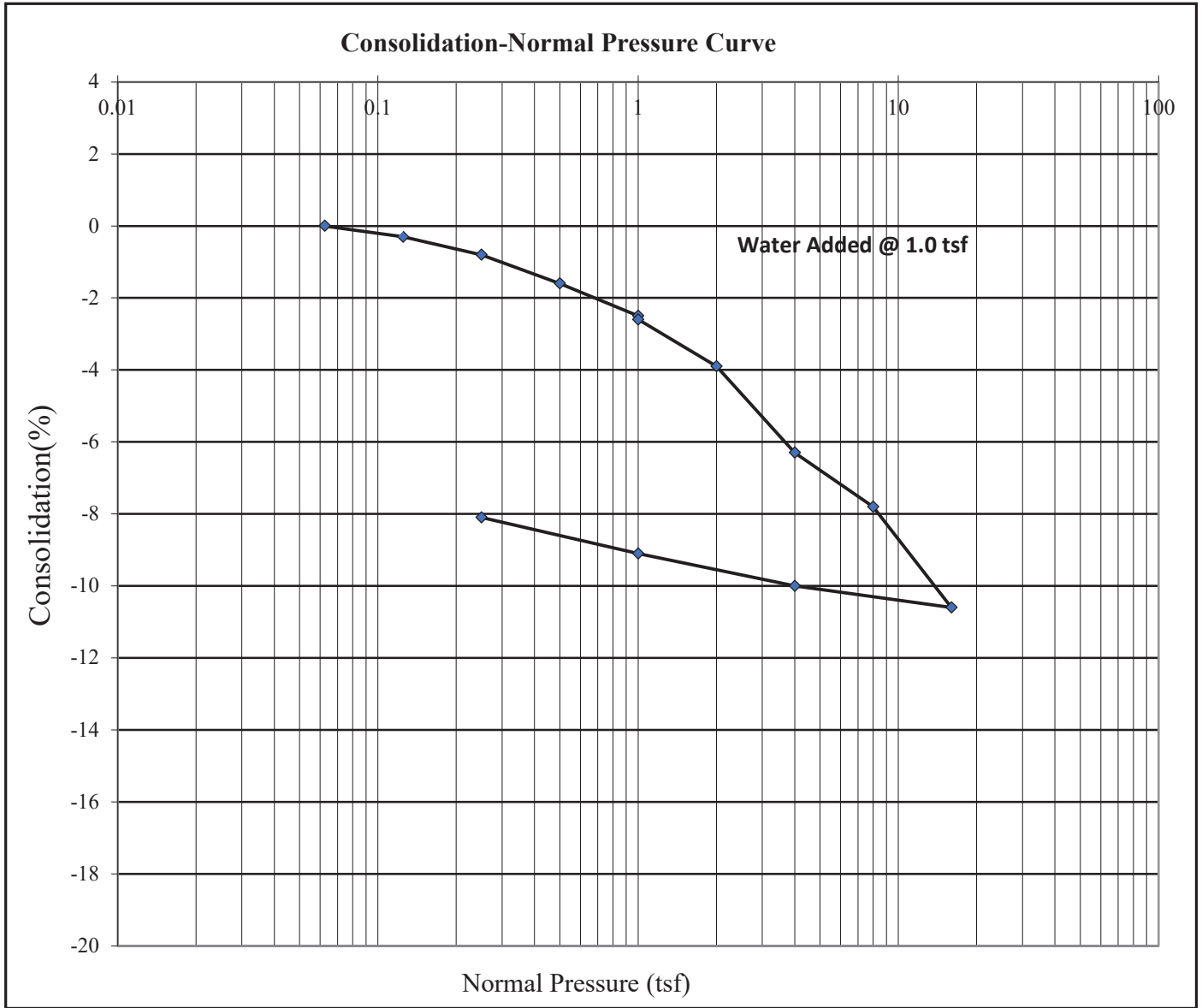
LAB DATA

MDN 24161



Client:
Work Order:
Test Date:
Sample:
Soil Classification:
Test Procedure:
Lab and QC By:

WJK
 7907
 4/19/2024
 B-2 @ 5.0'
 Brown slightly clayey sandy SILT.
 ASTM D 2435-04
 RA



Final Moisture Content (%)	13.69
Init. Dry Density (PCF)	119.2
Init. Void Ratio	0.42

% Hydroconsolidation:	-0.1
Total Consolidation @ 16 tsf	-10.6

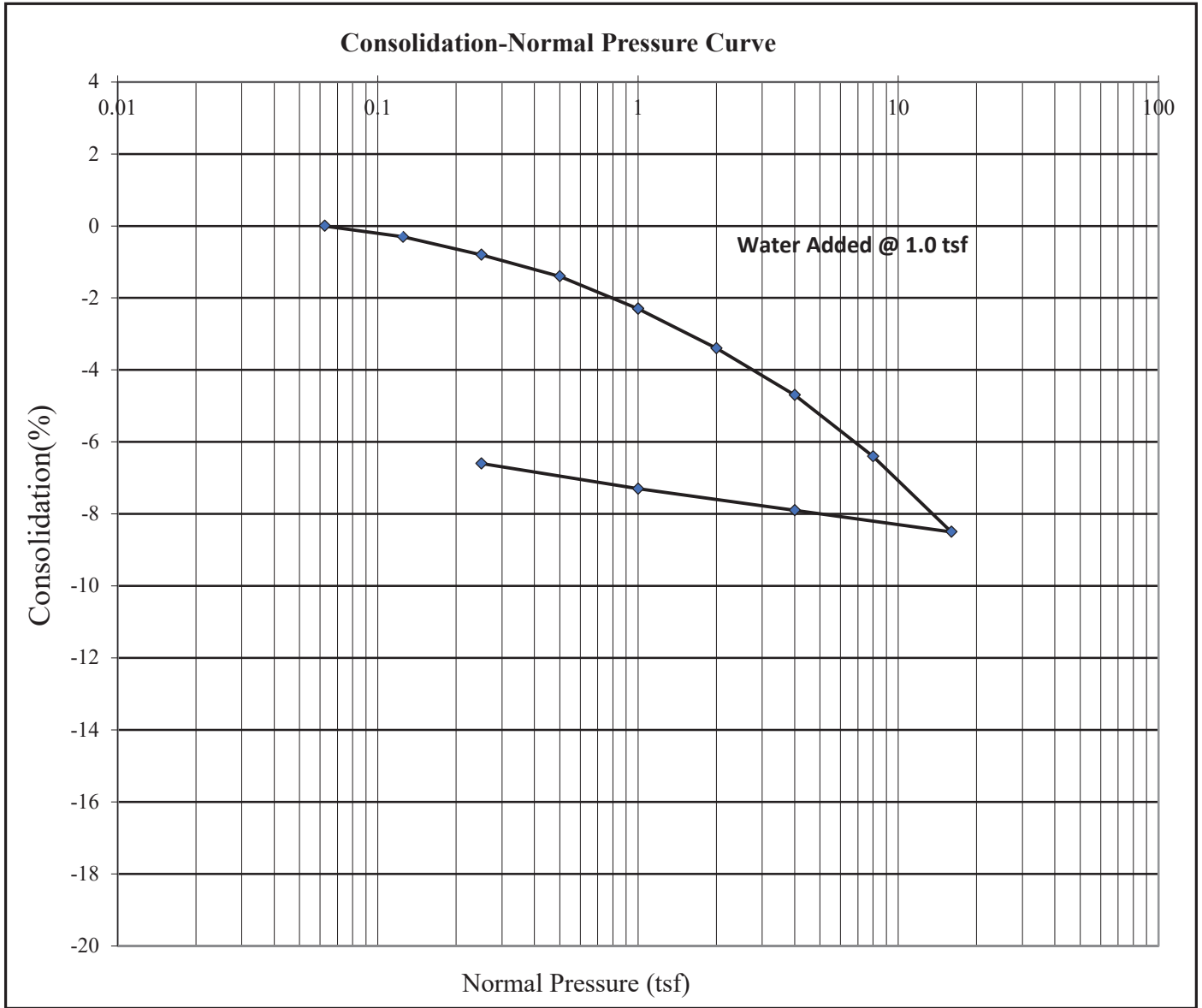
CONSOLIDATION TEST DIAGRAM

Plate: C-1



Client:
Work Order:
Test Date:
Sample:
Soil Classification:
Test Procedure:
Lab and QC By:

WJK
 7907
 4/19/2024
 B-2 @ 7.5'
 Brown clayey very fine to coarse SAND.
 ASTM D 2435-04
 RA



Final Moisture Content (%)	14.81
Init. Dry Density (PCF)	120.6
Init. Void Ratio	0.45

% Hydroconsolidation:	0.0
Total Consolidation @ 16 tsf	-8.5

CONSOLIDATION TEST DIAGRAM

Plate: C-2

EXPANSION INDEX TEST

ASTM D-4829

WJK

7907

Project Information	
Project Name:	WJK
Work Order No.:	7907
Date of Test:	15-Apr-24
Tract Number:	

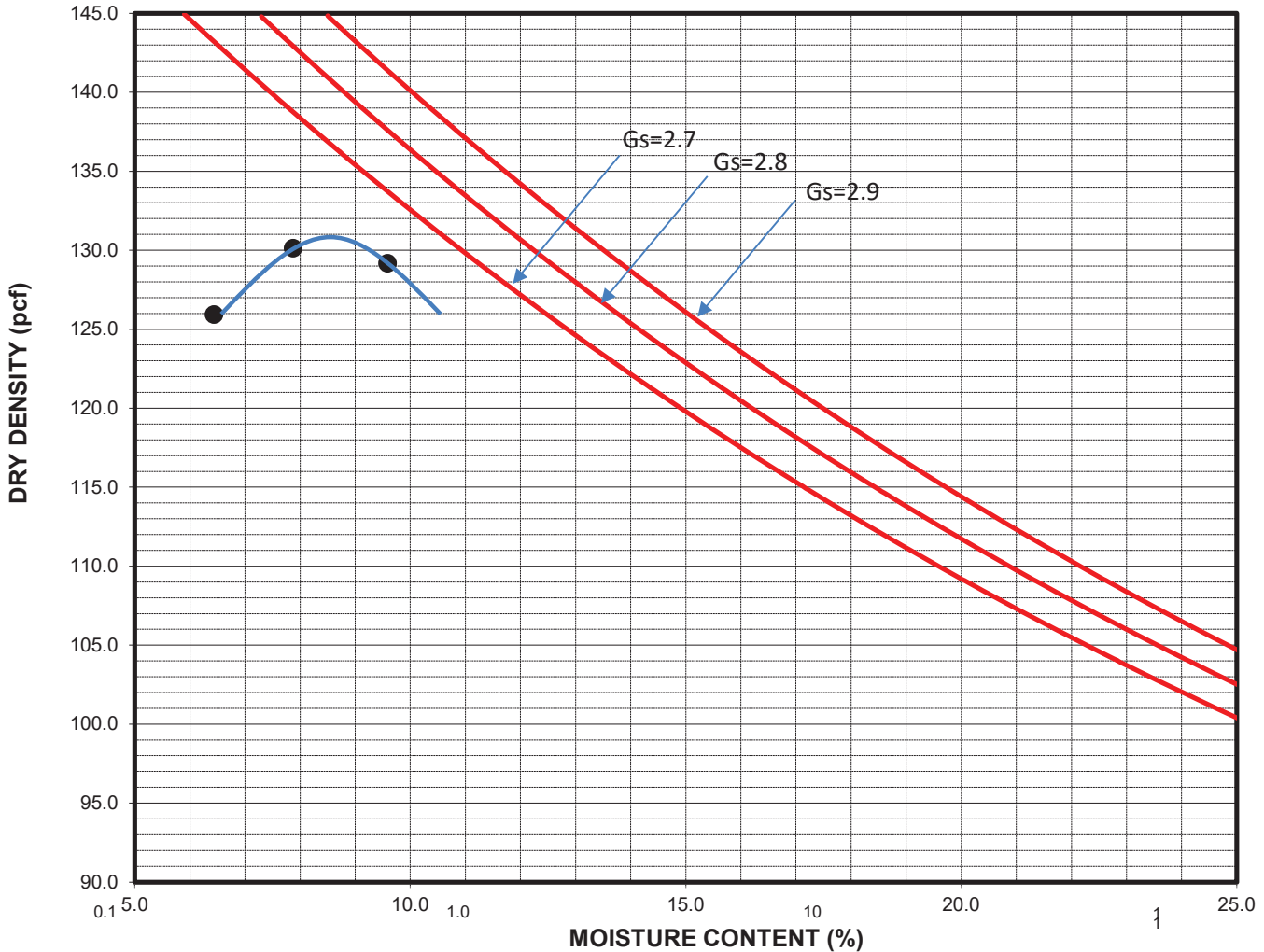
Calculations		Constants	
		Vol. wet soil (cf):	0.0073
		Specific Gravity:	2.70
Boring/Lot #:	B-2		
Depth of Test (ft):	0 - 5.0'		
Soil Classification:	Brown silty very fine to fine SAND.		
Wet Weight + Ring (lbs):	1.3650		
Ring Weight (lbs):	0.4280		
Wet Weight (lbs):	0.9370		
Wet Density (pcf):	128.4		
Moisture (%):	8.2		
Dry Density (pcf):	118.6		
Saturation (%):	52.7		
Initial Reading:	0.3720		
Final Reading:	0.3820		
Expansion, H, (inches):	0.0100		
Expansion Index:	11		
Expansion Potential:	Very Low		
After Test			
Wet Weight (g):	445.6		
Dry Weight (g):	390.7		
Water Loss (g):	54.9		
Moisture (%):	14.1		

Expansion Index Table: **0 - 20 = Very Low**
21 - 50 = Low
51 - 90 = Medium
91 - 130 = High
130 & Up = Very High



Client:
Work Order:
Test Date:
Sample:
Soil Classification:
Compaction Procedure:
Lab and QC by:

WJK
 7907
 4/15/2024
 B-2 @ 0-5.0'
 Brown silty very fine to fine SAND.
 ASTM D 1557 Method A
 RA



MAXIMUM DRY DENSITY:	131.0
OPTIMUM MOISTURE CONTENT (%):	8.5

A	Mold diameter (in)	4	4	4	4	4
B	Mold height (in)	4.581	4.581	4.581	4.581	4.581
C	Wt. of Mold (g)	4276	4276	4276	4276	4276
D	Moist Soil + Mold (g)	6305	6401	6419	0	0
E	Soil Wt. (g)	2029	2125	2143	-4276	-4276
F	Volume of mold (ft3)	0.0334	0.0334	0.0334	0.0334	0.0334
G	Volume of mold (cm3)	944.99	944.99	944.99	944.99	944.99
H	Moist Density (g/cm3)	2.14711	2.248701	2.267748865	-4.524916	-4.52492
M	Wt. of wet soil (g)	200	200	200	200	200
N	Wt. of dry soiltare (g)	187.9	185.4	182.5	176.1	175
O	Wt. of water (g)	12.1	14.6	17.5	23.9	25
P	Moisture Content (%)	6.4	7.9	9.6	#N/A	#N/A
Q	Dry Density (g/cm3)	2.0	2.1	2.1	#N/A	#N/A
R	Dry Unit Weight (pcf)	125.9	130.1	129.2	#N/A	#N/A

Plate: MDD-1

ANAHEIM TEST LAB, INC

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

GEOISOILS CONSULTANTS, INC.
6634 VALJEAN AVE.
VAN NUYS, CA 91406

DATE: 4/23/2024

P.O. NO.: Verbal

LAB NO.: C-7838

SPECIFICATION: CA 301

MATERIAL: Brown, Sandy Clay

Work Order No.: 7907
Client Name: WJK
Sample ID: B-2 @ 0-5'

ANALYTICAL REPORT "R" VALUE

BY EXUDATION

BY EXPANSION

28

N/A

RESPECTFULLY SUBMITTED



WES BRIDGER LAB MANAGER

"R" VALUE CA 301

Client: GeoSoils Consultanys, Inc.

ATL No.: C 7838

Date: 4/23/2024

Client Reference No.: 7907

Soil Type: Brown, Sandy Clay

Sample: B-2 @ 0-5'

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	80	200	150	
Initial Moisture Content	%	8.2	8.2	8.2	
Moisture at Compaction	%	10.0	9.1	9.5	
Briquette Height	in.	2.53	2.44	2.48	
Dry Density	pcf	128.2	130.2	129.1	
EXUDATION PRESSURE	psi	272	516	389	
EXPANSION PRESSURE	psf	0	95	43	
Ph at 1000 pounds	psi	46	38	43	
Ph at 2000 pounds	psi	102	68	81	
Displacement	turns	4.43	3.86	4.05	
"R" Value		24	47	38	
CORRECTED "R" VALUE		24	47	38	

Final "R" Value	
BY EXUDATION: @ 300 psi	28
BY EXPANSION: TI = 5.0	N/A

