NTS GEOTECHNICAL

September 14, 2022

Project No. 22424

Mr. Michael Ramirez
Beyond Food Mart
27278 Ethanac Road
Perris, CA

Subject: Preliminary Geotechnical Engineering Report
Proposed Carwash and Gas Station
27278 Ethanac Road, Perris, California

Dear Mr. Ramirez:

In accordance with your request and authorization, we are presenting the results of our geotechnical investigation for the proposed subject carwash and gas station development project located in the City of Perris, California. The purpose of this investigation has been to evaluate the subsurface conditions at the site and to provide geotechnical engineering recommendations for the proposed construction.

Based on our findings, the proposed project is geotechnically feasible, provided that the recommendations in this report are incorporated into the design and are implemented during construction of the project. This report was prepared in accordance with the requirements of the 2019 California Building Code and the City of Perris requirements.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned at (657) 888-4608 or info@ntsgeo.com.

Respectfully submitted,
NTS GEOTECHNICAL, INC.

REGISTERED PROFESSIONAL ENGINEER
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Principal Geotechnical Engineer

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INTRODUCTION

This report presents the results of our geotechnical engineering evaluation performed for the proposed Single Family Residences project located at 27278 Ethanac Road, in the City of Perris, California. See (Plate 1, Location Map). The purpose of this study has been to evaluate the subsurface conditions at the site and to provide geotechnical recommendations related to the design and construction of the proposed improvements.

SITE AND PROJECT DESCRIPTION

The subject site is located on at 27278 Ethanac Road in the City of Perris, California. The relatively flat vacant lot is bound by vacant land on the north and east by Trumble Road on the west, and Ethanac Road on the south.

It is our understanding that the subject project consists of construction of a Beyond Foods Mart service station consists of a 1-story C-store, gas pumps with overhead canopy, and a carwash tunnel. Additionally, site improvements such as new pavement, curbs and gutters, and trash enclosures are planned.

SCOPE OF WORK

As part of the preparation of this report, we have performed the following tasks:

Background Review

We reviewed readily available background data including in-house geologic maps and topographic maps relevant to the subject site in preparation of this report.

Field Exploration

The subsurface conditions were evaluated on August 24, 2022 by advancing four (4) hollow-stem-auger borings at various locations within the subject lot. The borings were advanced to a maximum depth of 30 feet below the existing grade. The approximate locations of the borings are shown on Plate 2, Geotechnical Map. Detailed exploration information of soils borings is presented in Appendix A, Field Exploration.

Geotechnical Laboratory Testing

Laboratory tests were performed on selected samples obtained from the boring in order to aid in the soil classification and to evaluate the engineering properties of the foundation soils. The following tests were performed in general accordance with ASTM standards:

- In-situ moisture and density;
- No. 200 sieve wash;
- Consolidation;
- Direct shear;
- Sieve analysis; and
- Corrosion.

A summary of the laboratory test results are presented in Appendix B of this report.

SUBSURFACE CONDITIONS

Subsurface Materials

Earth materials encountered during our subsurface investigation consisted of a thin layer of artificial fill overlaying the alluvium to the total depth of the exploration. In general, the fill consists of dark gray, damp, loose, silty sands.

The alluvium consists of orange brown to tan, moist to damp, medium dense to very dense, silty sands and sands.

Groundwater

Groundwater was not observed during our exploration to a maximum depth of 30 feet below the existing grade.

No groundwater data was found during a literature search pertaining to the subject property. There are no known shallow groundwater bearing soil or rock formations beneath the subject property. No evidence of onsite springs was found during the field study. Based on anticipated lot grading and the inferred groundwater depths, groundwater should not be a factor for project design or long-term performance.
Surface water was not observed on the subject site at the time the field study was performed for this report.

Based on results of our subsurface exploration and experience, variations in the continuity and nature of surface and subsurface conditions should be anticipated. Due to uncertainty involved in the nature and depositional characteristics of earth materials at the site, care should be exercised in extrapolating or interpolating subsurface conditions between and beyond the exploratory excavation locations.

Groundwater conditions may vary across the site due to stratigraphic and hydrologic conditions and may change over time as a consequence of seasonal and meteorological fluctuations, or activities by humans at this site and nearby sites. However, based on the above findings, groundwater is unlikely to impact the proposed development.

GEOLOGIC HAZARDS

Faulting and Seismicity

The site is not located within an Alquist-Priolo Earthquake Fault Zone, and no known active faults are shown on the reviewed geologic maps crossing the site, however, the site is located in the seismically active region of Southern California. The nearest known active fault is the Elsinore fault system, which is located approximately 9.6 miles from the site, and capable of generating a maximum earthquake magnitude of 7.3.

Liquefaction and Seismic Settlement

Liquefaction occurs when the pore pressures generated within a soil mass approach the effective overburden pressure. Liquefaction of soils may be caused by cyclic loading such as that imposed by ground shaking during earthquakes. The increase in pore pressure results in a loss of strength, and the soil then can undergo both horizontal and vertical movements, depending on the site conditions. Other phenomena associated with soil liquefaction include sand boils, ground oscillation, and loss of foundation bearing capacity. Liquefaction is generally known to occur in loose, saturated, relatively clean, fine-grained cohesionless soils at depths shallower than approximately 50 feet. Factors to consider in the evaluation of soil liquefaction potential include groundwater conditions, soil type, grain size distribution, relative density, degree of saturation, and both the intensity and duration of ground motion.

Based on our review of the County of Riverside Map My County website, the site is generalized to be within a low liquefaction susceptibility zone. Additionally, based on the lack of shallow groundwater, the dense nature of the subsurface soil, the relatively uniform soil stratum across the site, it is our professional opinion that the liquefaction potential at the site is low.

Landslides

Based on our review of the referenced geologic maps, literature, topographic maps, and our subsurface evaluation, no landslides or related features underlie or are adjacent to the subject site. Due to the relatively level nature of the site and surrounding areas, the potential for landslides at the project site is considered negligible.

Flooding

The Federal Emergency Management Agency (FEMA) has prepared flood insurance rate maps (FIRMs) for use in administering the National Flood Insurance Program. Based on our review of the FEMA flood map, the site is located within an Area of Minimal Flood Hazard (Zone X).

Tsunami and Seiches

Tsunamis are waves generated by massive landslides near or under sea water. The site is not located on any State of California – County of Riverside Tsunami Inundation Map for Emergency Planning. The potential for the site to be adversely impacted by earthquake-induced tsunamis is considered to be negligible because the site is located several miles inland from the Pacific Ocean shore, at an elevation exceeding the maximum height of potential tsunami inundation.

Seiches are standing wave oscillations of an enclosed water body after the original driving force has dissipated. The potential for the site to be adversely impacted by earthquake-induced seiches is considered to be negligible due to the lack of any significant enclosed bodies of water located in the vicinity of the site.

GEOTECHNICAL ENGINEERING FINDINGS

Expansive Soil

Based on our evaluation and experience with similar material types, and laboratory testing, the soils encountered near the ground surface at the site exhibit a very low expansion potential.

Soil Corrosion

The potential for the on-site materials to corrode buried steel and concrete improvements was evaluated. Laboratory testing was performed on representative soil samples to evaluate pH, minimum resistivity, and soluble chloride and sulfate contents. The results of our corrosivity testing is presented within Appendix B of this report. General recommendations to address the corrosion potential of the on-site soils are provided below. Imported fill materials, if used, should be tested to evaluate whether their corrosion potential is more severe than those assumed.

Structural Concrete

Laboratory tests indicate that the potential of sulfate attack on concrete in contact with the on-site soils is “negligible” or “S0” exposure in accordance with ACI 318, Table 19.3.1.1. Therefore, restriction on the type of cement, water to cement ratio, and compressive strength is not required.

Ferrous Metal

The results of the laboratory chemical tests performed on a sample of soil collected within the site indicate that the on-site soils are corrosive to ferrous metals. Consequently, metal structures which will be in direct contact with the soil (i.e., underground metal conduits, pipelines, metal sign posts, etc.) and/or in close proximity to the soil (wrought iron fencing, etc.) may be subject to corrosion. The use of special coatings or cathodic protection around buried metal structures has been shown to be beneficial in reducing corrosion potential. Additional provisions will be required to address high chloride contents of the soil per the 2019 CBC to protect the concrete reinforcement. The laboratory testing program performed for this project does not address the potential for corrosion to copper piping. In this regard, a corrosion engineer should be consulted to perform more detailed testing and develop appropriate mitigation measures (if necessary).

The above discussion is provided for general guidance in regards to the corrosiveness of the on-site soils to typical metal structures used for construction. Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements are beyond our purview. If detailed testing is required, a corrosion engineer should be consulted to perform the testing and develop appropriate mitigation measures.

Preliminary Infiltration Testing

Two (2) infiltration tests were performed in general conformance with the County of Riverside requirements. The borings were excavated to a depth of 5 and 10 feet below the existing grade using a hollow-stem-auger drill rig. Following the drilling, the borings were set up, presoaked, and testing was performed in general accordance with the County Riverside manual. The result of our infiltration testing is summarized in the table below, which includes a factor of safety of 2. Our infiltration testing calculations are presented in Appendix C of this report.

Preliminary Infiltration Rates Summary

Boring No.	Depth Below Existing Grade (feet)	Factored Infiltration Rate (inches/hour)
P-1	5	0.71
P-2	10	1.91

The infiltration test locations are shown on the attached Plate 2 –Geotechnical Map. Based on our infiltration testing, infiltration within the upper 10 feet of the site soils is deemed feasible from a geotechnical standpoint. Infiltration recommendations are presented in the Conclusion and Recommendations section of this report.

Hydroconsolidation

Based on our laboratory test results and dense nature of the underlying soils, the potential for hydrocollapse settlement to affect the proposed structures should be considered low.

Excavation Characteristics

The majority of the soil materials underlying the site can be excavated with excavators and other conventional grading equipment.

GEOTECHNICAL ENGINEERING CONLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results of our field exploration and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided that the recommendations in this report are incorporated into the design plans and are implemented during construction.

Based on the geotechnical findings, the following is a summary of our conclusions:

- The proposed structure may be supported on a shallow spread/continuous footing foundation system underlain by engineered fill.
- Groundwater is not anticipated to directly impact the planned precise grading or during the installation of shallow underground utilities.

- The site is not located within a fault zone, however, the site will experience strong ground shaking due to it's proximity to the Elsinore fault.
- Based on the lack of shallow groundwater and relatively dense nature of the subsurface soil, the liquefaction potential is considered low.
- The magnitude of total static settlements beneath the structure is expected to be less than 1.0 inch, with differential settlement on the order of ½ -inch over a span of 30 feet.
- The on-site soils has a negligible sulfate exposure to concrete (i.e., as defined by the CBC) and reinforcement, however is severely corrosive to ferrous metals.

Our geotechnical engineering analyses performed for this report were based on the earth materials encountered during the subsurface exploration for the site. If the design substantially changes, then our geotechnical engineering recommendations would be subject to revision based on our evaluation of the changes. The following sections present our conclusions and recommendations pertaining to the engineering design for this project.

Site Preparation

Site preparation should begin with the removal of utility lines, asphalt, concrete, vegetation, and other deleterious debris from areas to be graded. Tree stumps and roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside edges of the proposed excavation and fill areas. We recommend that unsuitable materials such as organic matter or oversized material be selectively removed and disposed offsite. The debris and unsuitable material generated during clearing and grubbing should be removed from areas to be graded and disposed at a legal dump site away from the project area.

Corrective Grading

Due to the dry / loose nature of the near surface soils, we recommend that the upper 3 feet of site soils be removed and recompacted to achieve a uniform blanket of properly moisture conditioned and compacted fill material.

It should be noted that the recommendations provided herein are based on our subsurface exploration and knowledge of the on-site geology. Actual removals may vary in configuration and volume based on observations of geologic materials and conditions encountered during grading. The bottom of all corrective grading removals should be observed by a representative of NTS to verify the suitability of in-place soil prior to performing scarification and recompaction. Corrective grading recommendations are outlined below.

Building Pads

In order to create a firm and stable platform on which to construct the new building pads, we recommend the following:

- The proposed building pads should be excavated to a depth of at least 3 feet from existing grade.
- The excavation should extend laterally a minimum of 3 feet from the edge of the proposed building.
- The bottom of the over excavation should then be scarified to a depth of at least 8 inches, thoroughly flooded to raise the moisture content of the underlying soils to at least 2 percent above optimum moisture content, and should be recompacted using heavy vibratory compaction equipment prior to placement of any fill.
- Following the approval of the over-excavation bottom by a representative of NTS, the onsite material may be used as fill material to achieve the planned pad grade.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to near optimum moisture content and compacted to achieve 90 percent relative compaction.

New Streets / Pavements / Hardscape

In order to create a firm and stable platform on which to construct the new vehicular pavement and non-vehicular pavement/hardscape, we recommend the following:

- The proposed pavement should be excavated to the planned subgrade (i.e., bottom of aggregate base for vehicular pavement).
- The bottom of the excavation should then be excavated to a depth of 18 inches below the planned subgrade.
- The bottom of the over excavation should then be scarified to a depth of at least 6 inches, moisture conditioned to 2 percent above optimum moisture content and recompacted to at least 90 percent relative compaction as determined in accordance with ASTM D1557.
- Following the approval of the over-excavation bottom by a representative of NTS, the onsite material may be used as fill material to achieve the planned pad grade.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to near optimum moisture content and compacted to achieve 90 percent relative compaction.

If the existing loose fill materials are found to be disturbed to depths greater than the proposed remedial grading, then the depth of over-excavation and recompaction should be increased accordingly in local areas as recommended by a representative of NTS.

Materials for Fill

On-site soils with an organic content of less than 3 percent by volume (or 1 percent by weight) are suitable for use as fill. Soil material to be used as fill should not contain contaminated materials, rocks, or lumps over 6 inches in largest dimension, and not more than 40 percent larger than ¾ inch. Utility trench backfill material should not contain rocks or lumps over 3 inches in largest dimension. Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or may be disposed offsite.

Any imported fill material should consist of granular soil having a “very low” expansion potential (that is, expansion index of 20 or less). Import material should also have low corrosion potential (that is, chloride content less than 500 parts per million [ppm], soluble sulfate content of less than 0.1 percent, and pH of 5.5 or higher). Materials to be used as fill should be evaluated by a representative of NTS prior to importing or filling.

Compacted Fill

Prior to placement of compacted fill, the contractor should request an evaluation of the exposed excavation bottom by NTS. Unless otherwise recommended, the exposed ground surface should then be scarified to a depth of at least 8 inches and watered or dried, as needed, to achieve generally consistent moisture contents 2 percent above optimum moisture content. The scarified materials should then be compacted to 90 percent relative compaction in accordance with the latest version of ASTM Test Method D1557.

Compacted fill should be placed in horizontal lifts of approximately 6 to 8 inches in loose thickness. Prior to compaction, each lift should be watered or dried as needed to achieve near optimum moisture condition, mixed, and then compacted by mechanical methods, using sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other appropriate compacting rollers, to a relative compaction of 90 percent as evaluated by ASTM D1557. Successive lifts should be treated in a like manner until the desired finished grades are achieved. Within pavement areas, the upper 12 inches of subgrade soil should be compacted to 95 percent relative compaction evaluated by ASTM D1557.

Personnel from NTS should observe the excavations so that any necessary modifications based on variations in the encountered soil conditions can be made. All applicable safety requirements and regulations, including CalOSHA requirements, should be met.

Temporary Excavations

Temporary excavations for the demolishing, earthwork, footing and utility trench are expected. We anticipate that unsurcharged excavations with vertical side slopes less than 4 feet high will generally be stable; however, sloughing of cohesionless sandy materials encountered at the site should be expected.

Where the space is available, temporary, unsurcharged excavation sides over 4 feet in height should be sloped no steeper than an inclination of 1.5H:1V (horizontal:vertical). Where sloped excavations are created, the tops of the slopes should be barricaded so that vehicles and storage loads do not encroach within 10 feet of the top of the excavated slopes. A greater setback may be necessary when considering heavy vehicles, such as concrete trucks and cranes. NTS should be advised of such heavy vehicle loadings so that specific setback requirements can be established. If the temporary construction slopes are to be maintained during the rainy season, berms are recommended to be graded along the tops of the slopes in order to prevent runoff water from entering the excavation and eroding the slope faces.

Where space for sloped excavations is not available, temporary shoring may be utilized. Recommendations for temporary shoring can be provided as requested. Personnel from NTS should observe the excavation so that any necessary modifications based on variations in the encountered soil conditions can be made. All applicable safety requirements and regulations, including CalOSHA requirements, should be met.

Excavations shall not undermine the existing adjacent building / wall footings. Where space for sloped excavations is not available, temporary shoring may be utilized.

Seismic Design

Based on subsurface investigation, the site is designated as Site Class D (“stiff” soil profile). The seismic design parameters based on ASCE 7-16 and 2019 CBC are listed in the following table.

2019 CBC and ASCE 7-16 Seismic Design Parameters

Seismic Item	Design Value	2016 ASCE 7-16 or 2019 CBC Reference
Site Class based on soil profile (ASCE 7-16 Table 20.3-1)	D[a]	ASCE 7-16 Table 20.3-1
Short Period Spectral Acceleration S_s	1.419 [a]	CBC Figures 1613.2.1 (1-8)
1-sec. Period Spectral Acceleration S_1	0.526[a]	CBC Figures 1613.2.1 (1-8)
Site Coefficient F_a (2019 CBC Table 1613.2.3(1))	1.000[a]	CBC Table 1613.2.3 (1)
Site Coefficient F_v (2019 CBC Table 1613.2.3(2))	1.800[b]	CBC Table 1613.2.3 (2)
Short Period MCE* Spectral Acceleration S_{MS} $S_{MS} = F_a S_s$	1.419[a]	CBC Equation 16-36
1-sec. Period MCE Spectral Acceleration S_{M1} $S_{M1} = F_v S_1$	0.947[b]	CBC Equation 16-37
Short Period Design Spectral Acceleration S_{DS} $S_{DS} = 2/3 S_{MS}$	0.946[a]	CBC Equation 16-38
1-sec. Period Design Spectral Acceleration S_{D1} $S_{D1} = 2/3 S_{M1}$	0.631[b]	CBC Equation 16-39
Short Period Transition Period T_S (sec) $T_S = S_{D1}/S_{DS}$	0.667[b]	ASCE 7-16 Section 11.4.6
Long Period Transition Period Tl (sec)	8[b]	ASCE 7-16 Figures 22-14 to 22-17
MCE[c] Peak Ground Acceleration (PGA)	0.50[a]	ASCE 7-16 Figures 22-9 to 22-13
Site Coefficient F_{PGA} (ASCE 7-16 Table 11.8-1)	1.100[a]	ASCE 7-16 Table 11.8-1
Modified MCE[c] Peak Ground Acceleration (PGA_M)	0.55[a]	ASCE 7-16 Equation 11.8-1

[a] Design Values Obtained from USGS Earthquake Hazards Program website that are based on the ASCE-7-16 and 2019 CBC and site coordinates of N33.743455° and W117.184533 °.
[b] Design Values Determined per ASCE Table 11.4-2 and CBC Equations 16-36 through 16-39.
[c] MCE: Maximum Considered Earthquake.

Since the Site Class is designated as D and the S1 value is greater than or equal to 0.2, the 2019 CBC requires either a site-specific seismic hazard analysis per Section 21.2 of ASCE 7-16 or the application of Exception 2 of Section 11.4.8 of ASCE 7-16. The project structural engineer should apply all requirements of Section 11.4.8 of ASCE 7-16 to determine if increases to the seismic response coefficient (i.e. increases to the loading of the structure) are required.

It should be recognized that much of southern California is subject to some level of damaging ground shaking as a result of movement along the major active (and potentially active) fault zones that characterize this region. Design utilizing the 2019 CBC is not meant to completely protect against damage or loss of function. Therefore, the preceding parameters should be considered as minimum design criteria.

Foundation Design and Construction

A shallow foundation system may be used for support of the proposed buildings, provided that all the footings are placed on engineered fill prepared as described in the “**Corrective Grading**” section of this report. Our geotechnical foundation design parameters are presented in the table below:

Foundation Design Parameters

Bearing Material	▪ Engineered Fill
Minimum Footing Size	▪ Width: 12 inches ▪ Depth: 18 inches below the lowest adjacent soil grade
Minimum Footing Reinforcement	▪ Footings reinforcement should consist of at least four No. 4 bars (two on top and two on bottom). ▪ Final reinforcement should be determined by the project structural engineer.
Allowable Bearing Capacity	▪ 2,500 psf for the minimum footing size given above. ▪ The above value may be increased by 1/3 for temporary loads such as wind or earthquake.
Static Settlement	▪ Total static settlement of 1 inch with differential settlement estimated to be approximately ½ inch over a span of 40 feet
Allowable Lateral Passive Resistance	• 300 pcf (equivalent fluid pressure)
Allowable Coefficient of Friction	• 0.35

Slab-On-Grade Design and Construction

The slab-on-grade should be designed and constructed with the minimum recommendations presented below, however, final design of the slab should be determined by the project structural engineer.

Minimum Thickness: The minimum slab thickness should be 5 inches.

Minimum Slab Reinforcement: Minimum slab reinforcement shall not be less than No. 4 bars placed at 18 inches on center. Welded wire mesh is not recommended. Care should be taken to position the reinforcement bars in the center of the slab.

Slab Subgrade:

- The upper 24 inches of the slab subgrade should be moisture conditioned to 2 percent above optimum moisture content and compacted to a minimum relative compaction of compacted to 90 percent relative compaction in accordance with the latest version of ASTM D1557 prior to placement of Moisture Vapor Retarder.

- A moisture vapor retarder should be placed in accordance with the “Moisture Vapor Retarder” section below.

Pole Foundations

It is expected that the canopy structures and light poles will be supported on pole foundations. As a minimum, the pole foundations should be at least 18 inches in diameter and at least 4 feet deep; however, the actual dimensions should be determined by the project structural engineer based on the following design parameters.

Bearing Materials: The pole foundations may bear into competent native soils approved by a representative from NTS.

Bearing Values: End-bearing capacity may be combined to determine the allowable bearing capacities of the pole foundations. An allowable bearing pressure of 3,000 pounds per square foot (psf) may be used for pole foundations at least 18 inches in diameter and embedded a minimum of 4 feet below the lowest adjacent grade.

Lateral Load Design: Lateral loads may be resisted by passive resistance within the adjacent earth materials. For passive resistance, an allowable passive earth pressure of 300 pounds per foot of pile diameter per foot of depth into competent bearing material may be used; however, passive resistance should be disregarded within the upper foot due to possible disturbance during drilling. The passive resistance value may be applied over an area equivalent to two pile diameters.

Moisture Vapor Retarder

A vapor retarder, such as a 15-mil-thick moisture vapor retarder that meets the requirements of ASTM E1745 Class C (Stego Wrap or equivalent) should be placed directly over the prepared soil subgrade to provide protection against vapor transmission through concrete floor slabs thatare anticipated to receive carpet, tile or other moisture sensitive coverings. The use of moisture vapor retarder should be determined by the project architect. At minimum, the vapor retarder should be installed as follows:

- Per the manufacture’s specifications as well as with the applicable recognized installation procedures such as ASTM E1643;
- Joints between the sheets and the openings for utility piping should be lapped and taped. If the barrier is not continuously placed across footings/ribs, the barrier should at minimum be lapped into the side of the footing/rib trenches down to the bottom of the trench; and,

- Punctures in the vapor retarder should be repaired prior to concrete placement.

It should be noted that the moisture retarder is intended only to reduce moisture vapor transmissions from the soil beneath the concrete and is consistent with the current standard of the industry in the building construction in Southern California. It is not intended to provide a “waterproof” or “vapor proof” barrier or reduce vapor transmission from sources above the retarder (i.e., concrete). The evaluation of water vapor from any source and its effect on any aspect of the proposed building space above the slab (i.e., floor covering applicability, mold growth, etc.) is beyond our purview and the scope of this report.

Structural Concrete

Based on laboratory test results for the site vicinity, the potential of sulfate attack on concrete in contact with the on-site soils is “negligible” based on ACI 318, Table 19.3.1.1.

The aforementioned recommendations in regards to concrete are made from a soils perspective only. Final concrete mix design is beyond our purview. All applicable codes, ordinances, regulations, and guidelines should be followed in regard to the designing a durable concrete with respect to the potential for sulfate exposure from the on-site soils and/or changes in the environment.

Drainage Control

The control of surface water is essential to the satisfactory performance of the building and site improvements. Surface water should be controlled so that conditions of uniform moisture are maintained beneath the improvements, even during periods of heavy rainfall. The following recommendations are considered minimal:

- Ponding and areas of low flow gradients should be avoided.
- If bare soil within 5 feet of the structure is not avoidable, then a gradient of 5 percent or more should be provided sloping away from the improvement. Corresponding paved surfaces should be provided with a gradient of at least 2 percent.
- The remainder of the unpaved areas should be provided with a drainage gradient of at least 2 percent.
- Positive drainage devices, such as graded swales, paved ditches, and/or catch basins should be employed to accumulate and to convey water to appropriate discharge points.
- Concrete walks and flatwork should not obstruct the free flow of surface water.
- Brick flatwork should be sealed by mortar or be placed over an impermeable membrane.

- Area drains should be recessed below grade to allow free flow of water into the basin.
- Enclosed raised planters should be sealed at the bottom and provided with an ample flow gradient to a drainage device. Recessed planters and landscaped areas should be provided with area inlet and subsurface drain pipes.
- Planters should not be located adjacent to the structures wherever possible. If planters are to be located adjacent to the structures, the planters should be positively sealed, should incorporate a subdrain, and should be provided with free discharge capacity to a drainage device.
- Planting areas at grade should be provided with positive drainage. Wherever possible, the grade of exposed soil areas should be established above adjacent paved grades. Drainage devices and curbing should be provided to prevent runoff from adjacent pavement or walks into planted areas.
- Gutter and downspout systems should be provided to capture discharge from roof areas. The accumulated roof water should be conveyed to off-site disposal areas by a pipe or concrete swale system.
- Landscape watering should be performed judiciously to preclude either soaking or desiccation of soils. The watering should be such that it just sustains plant growth without excessive watering. Sprinkler systems should be checked.

Preliminary Infiltration Design and Construction Recommendations

Infiltration Design

Based on our preliminary infiltration testing and our evaluation, we note that the installation of infiltration system within the subject property is feasible from a geotechnical standpoint provided that the recommendations presented in this section is considered during design and implemented during construction. On this basis we recommend the following:

- We recommend that a design infiltration rate of 0.71 inches and 1.91 inches per hour be used for design of the proposed infiltration system that is located within the upper 5 feet and at a depth of 10 feet of the site soils, respectively.

- The selected infiltration BMP should be designed and constructed in accordance with the minimum requirements presented below, the requirements of the City of Perris.

Minimum Setback Requirements

Any foundation	• A minimum of 10 feet setback or within 1:1 plane drawn up from the bottom of foundation, whichever is greater.
Water wells used for drinking water	• A minimum of 100 feet setback.

The final design and specification should be reviewed by the Geotechnical Engineer of Record prior to construction to verify compliance with the recommendations of this report and/or provide additional recommendations/revisions, if needed.

Utility Trench Backfill Considerations

New utility line pipeline trenches should be backfilled with select bedding materials beneath and around the pipes (pipe zone) and compacted soil above the pipe bedding. Recommendations for the types of the materials to be used and the proper placement of these materials are provided in the following sections.

Pipe Zone (Bedding and Shading)

The pipe bedding and shading materials should extend from at least 6 inches below the pipes to at least 12 inches above the crown of the pipes. Pipe bedding and shading should consist of either clean sand with a sand equivalent (SE) of at least 30, or crushed rock. If crushed rock is used, it should consist of ¾-inch crushed rock that conforms to Table 200-1.2.1 (A) of the 2018 "Greenbook." Pipe bedding and shading should also meet the minimum requirements of the City of Los Angeles. If the requirements of the City are more stringent, they should take precedence over the geotechnical recommendations. Sufficient laboratory testing should be performed to verify the bedding and shading meets the minimum requirements of the Greenbook and City of Perris grading codes.

Granular pipe bedding and shading material should be properly placed in thicknesses not exceeding 3 feet, and then sufficiently flooded or jetted in place. Crushed rock, if used, should be capped with filter fabric (Mirafi 160N, or equivalent; Mirafi 140N filter fabric is suitable if available) to prevent the migration of fines into the rock.

Trench Backfill

All existing soil material within the limits of the site are considered suitable for use as trench backfill above the pipe bedding and shading zone if care is taken to remove all significant organic and other decomposable debris, moisture condition the soil materials as necessary, and separate and selectively place and/or stockpile any inert materials larger than 6 inches in maximum diameter.

Imported soils are not anticipated for backfill since the on-site soils are suitable. However, if imported soils are used, the soils should consist of clean, granular materials with physical and chemical characteristics similar to or better than those described herein for on-site soils. Any imported soils to be used as backfill should be evaluated and approved by NTS prior to placement.

Soils to be used as trench backfill should be moistened, dried, or blended as necessary to achieve near optimum moisture content, placed in lifts which, prior to compaction shall not exceed the thickness specified in Section 306-12.3 of the 2018 "Greenbook" for various types of equipment, and mechanically compacted/densified to at least 90 percent relative compaction as determined by ASTM Test Method D 1557. Jetting is not permitted in this trench zone.

No rock or broken concrete greater than 6 inches in maximum diameter should be utilized in the trench backfills.

Asphalt Concrete Pavement Design

In accordance with Chapter 600 of the Caltrans Highway Design Manual, we have performed pavement structural design utilizing assumed traffic indices (TI) of 5.0, 6.0 and 7.0 and assumed R-value of 20. Based on our analysis, we have developed the pavement structural sections presented in the following table. We note that the assumed TI's should be reviewed by a traffic engineer to confirm their applicability to the project. The assumed R-value should be confirmed by testing at the completion of rough grading.

Asphalt Concrete Pavement Structural Sections

Location	Traffic Index	Asphalt Concrete (in.)	Aggregate Base (in.)*
Driveways	5.0	4.0	5.0
Private Streets	6.0	4.0	9.0
Fire lane	7.0	4.0	12.0

The planned pavement structural sections should consist of the following:

- Aggregate Base materials (AB) consisted of either Crushed Aggregate Base (CAB) or Crushed Miscellaneous Base (CMB).
- Asphalt Concrete (AC) material of a type meeting the minimum City of Menifee standards.
- The subgrade soils should be moisture conditioned to 2 percent above optimum moisture content to a depth of at least 18 inches and compacted to 90 percent relative compaction.
- The AB and AC should be compacted to at least 95 percent relative compaction.

Exterior Flatwork/Hardscape Design Considerations

For exterior flatwork and hardscape planned as part of the proposed development, the following design may be considered by the project civil engineer. These recommendations may be considered as minimal design based on the soils conditions encountered during our investigation. Final design of the proposed flatwork and hardscape area should be provided by the project civil engineer. Based on the conditions encountered, we recommend that the subgrade for the subject concrete flatwork and hardscape be moisture conditioned to near optimum to a depth of 18 inches below finish subgrade elevation and compacted to 90 percent relative compaction. A Type II/V cement may be used from a geotechnical perspective. Our flatwork and hardscape design considerations are presented in the table below.

Concrete Flatwork Table

Description	Subgrade Preparation [1]	Minimum Concrete Thickness	Cut-Off Barrier Or Edge Thickness	Joint Spacing (Maximum)	Concrete[3]
Concrete Sidewalks and Walkways [4]	1) 2 percent above optimum to 18"[1], 2) 2" of sand or well graded rock (i.e., Class II base or equiv.) above moisture conditioned subgrade.	4 inches	Not Required	5 feet	Type II/V
Concrete Driveways[4]	1) 2 percent above optimum to 18"[1], 2) 2" of sand or well graded rock (i.e., Class II base or equiv.) above moisture conditioned subgrade.	6 inches	Where adjacent to landscape areas – 12" from adjacent finish grade. Min. 8" width	10 feet	Type II/V

(1) The moisture content of the subgrade must be verified by the geotechnical consultant prior to sand/rock placement.
(2) Reinforcement to be placed at or above the mid-point of the slab (i.e., a minimum of 2.0 to 2.5 inches above the prepared subgrade).
(3) The site has negligible levels of sulfates as defined by the CBC. Concrete mix design is outside the geotechnical engineer's purview.
(4) Where flatwork is adjacent a stucco surface, a ¼" to ½" foam separation/expansion joint should be used.
(5) If dowels are placed in cored holes, the core holes shall be placed at alternating in-plane angles (i.e., not cored straight into slab).

Planters and Trees

Where new trees or large shrubs are to be located in close proximity to new concrete flatwork, rigid moisture/root barriers should be placed around the perimeter of the flatwork to at least 12 inches in depth in order to offer protection to the adjacent flatwork against potential root and moisture damage. Existing mature trees near flatwork areas should also incorporate a rigid moisture/root barrier placed at least 2 feet in depth below the top of the flatwork.

Plans and Specifications Review

The recommendations presented in this report are contingent upon review of final plans and specifications for the project by NTS. NTS Geotechnical, Inc. should review and verify in writing the compliance of the final grading plan and the final foundation plans with the recommendations presented in this report.

Construction Observation and Testing

It is recommended that NTS be retained to provide Geotechnical Consulting services during the earthwork operations and foundation installation process. This is to observe compliance with the design concepts, specifications and recommendations and to allow for design changes in the event that subsurface conditions differ from those anticipated during our subsurface investigation.

It is the responsibility of the owner and their representative to bring any deviations or unexpected conditions observed during construction to the attention of NTS Geotechnical, in order for supplemental recommendations can be made with a minimum delay to the project. Construction should be observed and/or testing at the following stages by NTS Geotechnical, Inc.:

- During all phases of precise grading, including over-excavation, temporary excavations, removals, scarification, ground preparation, moisture condition, proof-rolling, and placement and compaction of all fill material.
- All foundation excavation prior to placement of steel
- During backfill of underground utilities
- During placement of pavement structural section, including verifying the subgrade prior to placement of aggregate base, testing of aggregate base, and testing of asphalt concrete pavement.
- When unusual conditions are encountered.

If any of these inspections to verify site geotechnical conditions are not performed by NTS Geotechnical, liability for the safety and stability of the project is limited only to the actual portions of the project that is observed and approved by NTS Geotechnical.

LIMITATIONS

All parties reviewing or utilizing this report should recognize that the findings, conclusions, and recommendations presented represent the results of our professional geological and geotechnical engineering efforts and judgments. Due to the inexact nature of the state of the art of these professions and the possible occurrence of undetected variables in subsurface conditions, we cannot guarantee that the conditions actually encountered during grading and site construction will be identical to those observed, sampled, and interpreted during our study, or that there are no unknown subsurface conditions which could have an adverse effect on the use of the property. We have exercised a degree of care comparable to the standard of practice presently maintained by other professionals in the fields of geotechnical engineering and engineering geology, and believe that our findings present a reasonably representative description of geotechnical conditions and their probable influence on the grading and use of the property.

Our conclusions and recommendations are based on the assumption that our firm will act as the geotechnical engineer of record during construction and grading of the project to observe the actual conditions exposed, to verify our design concepts and the grading contractor's general compliance with the project geotechnical specifications, and to provide our revised conclusions and recommendations should subsurface conditions differ significantly from those used as the basis for our conclusions and recommendations presented in this report. Since our conclusions and recommendations are based on a limited amount of current and previous geotechnical exploration and analysis, all parties should recognize the need for possible revisions to our conclusions and recommendations during grading of the project.

It should be further noted that the recommendations presented herein are intended solely to minimize the effects of post-construction soil movements. Consequently, minor cracking and/or distortion of all on-site improvements should be anticipated.

This report has not been prepared for the use by other parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

REFERENCES

American Concrete Institute, 2014, Building Code Requirements for Structural Concrete (ACI 318-14).

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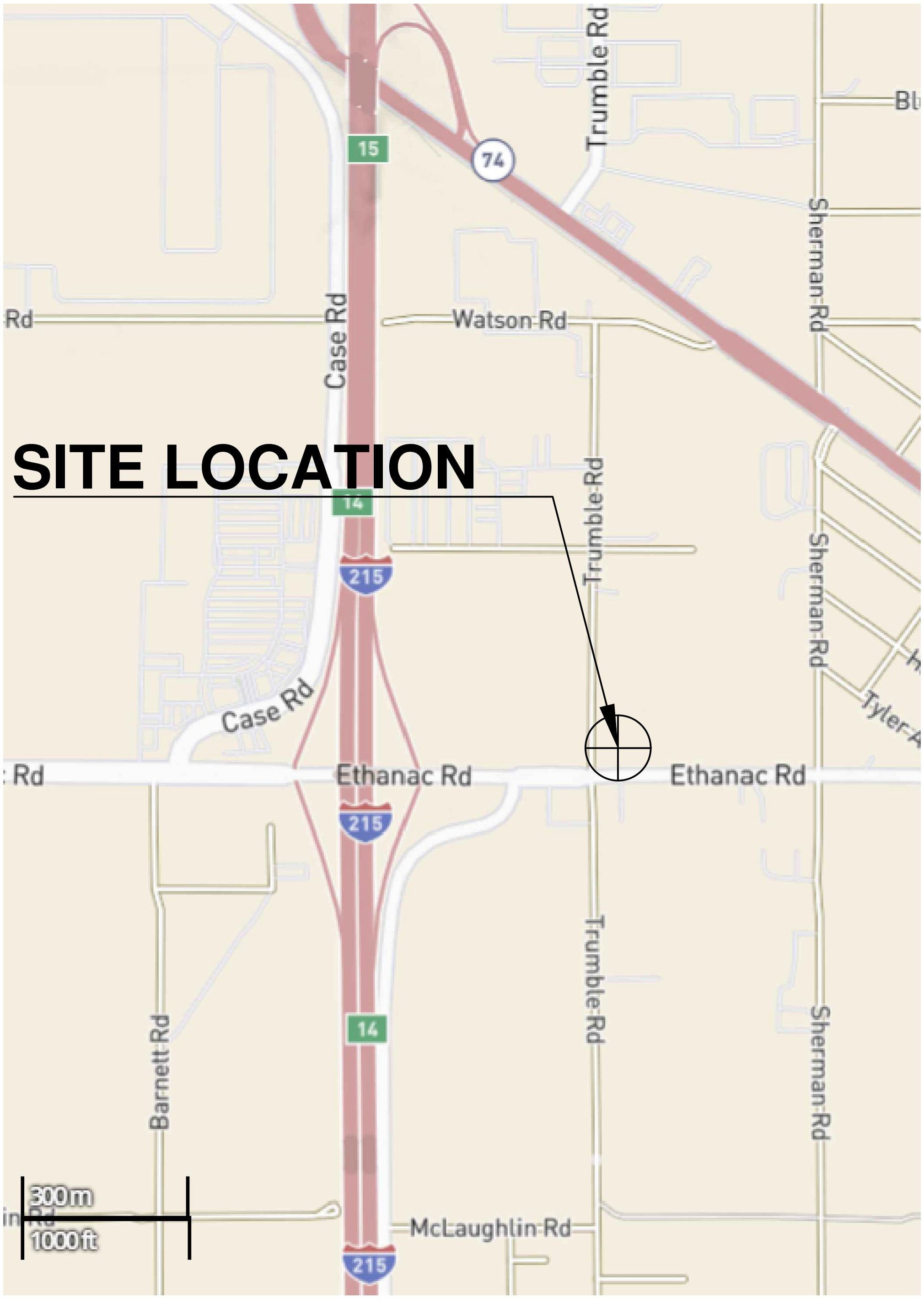
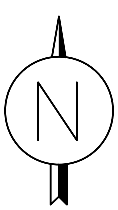
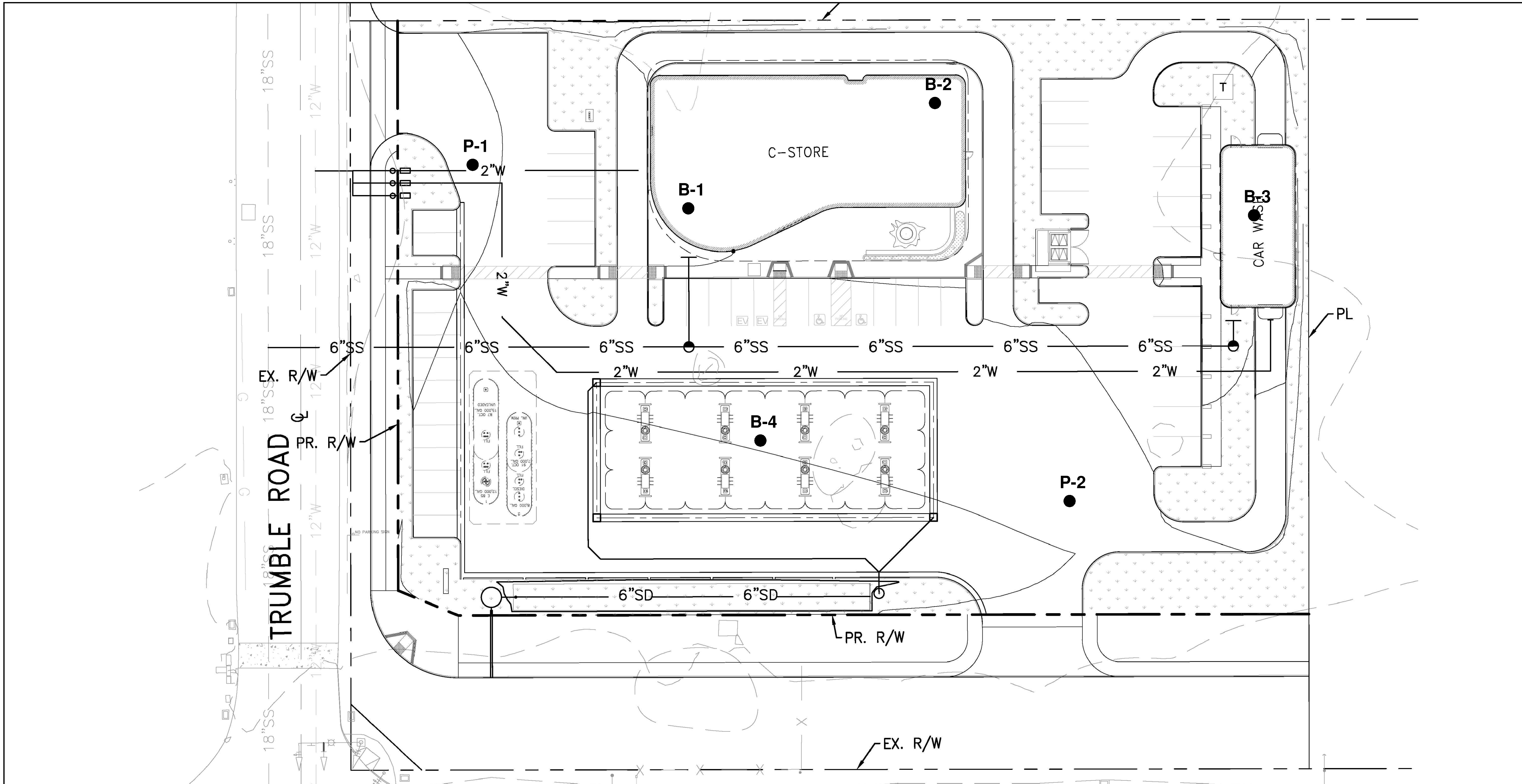




LOCATION MAP

NTS GEOTECHNICAL	Date: September 14, 2022	Plate 1
	Project No.: 22424	



NTS GEOTECHNICAL

GEOTECHNICAL LEGEND

B-1 ●	APPROXIMATE LOCATION OF BORING

0 10'

GEOTECHNICAL MAP

Date:	09/14/2022	**Project No.:**	22424	**Plate:** 2

NTS GEOTECHNICAL

APPENDIX A

Field Investigation

Appendix A
Field Exploration

The subsurface exploration program for the proposed project consisted of advancing six (6) 8-inch-diameter, hollow-stem-auger drill rig. The borings were advanced to depths ranging from 5 to 30 feet below the existing grade.

The Boring Logs are presented as Figures A-2 to A-3. The Boring Logs describe the earth materials encountered, samples obtained, and show the field and laboratory tests performed. The log also shows the boring number, drilling date, and the name of the logger and drilling subcontractor. The borings were logged by an engineer using the Unified Soil Classification System. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Drive samples of representative earth materials were obtained from the borings.

Disturbed samples were obtained using a Standard Penetration Sampler (SPT). This sampler consists of a 2-inch O.D., 1.4-inch I.D. split barrel shaft that is advanced into the soil at the bottom of the drilled hole a total of 18 inches. The number of blows required to drive the upper 12 inches of the sampler is presented on the boring logs. Soil samples obtained by the SPT were retained in plastic bags. A California modified sampler was used to obtain drive samples of the soil encountered. This sampler consists of a 3-inch outside diameter (O.D.), 2.4-inch inside diameter (I.D.) split barrel shaft that was driven a total of 18-inches into the soil at the bottom of the boring. The soil was retained in brass rings for laboratory testing. Additional soil from each drive remaining in the cutting shoe was usually discarded after visually classifying the soil. The number of blows required to drive the upper 12 inches of the sampler is presented on the boring logs.

Upon completion of the borings, the boreholes were backfilled with soil from the cuttings.

Project: **27278 Ethanac Rd**

Project Location: **27278 Ethanac Rd, Romoland**

Project Number: **22424**

NTS GEOTECHNICAL

Key to Log of Boring

Sheet 1 of 1

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9

COLUMN DESCRIPTIONS

1 Depth (feet): Depth in feet below the ground surface.

2 Sample Type: Type of soil sample collected at the depth interval shown.

3 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.

4 Material Type: Type of material encountered.

5 Graphic Log: Graphic depiction of the subsurface material encountered.

6 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.

7 Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.

8 Dry Unit Weight, pcf: Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.

9 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Silty SAND (SM)

Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler

CME Sampler

Pitcher Sample

Bulk Sample

Grab Sample

2-inch-OD unlined split spoon (SPT)

3-inch-OD California w/ brass rings

2.5-inch-OD Modified California w/ brass liners

Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)

Water level (after waiting, AW)

Minor change in material properties within a stratum

Inferred/gradational contact between strata

? Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

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Figure A-1

Project: **27278 Ethanac Rd**
Project Location: **27278 Ethanac Rd, Romoland**
Project Number: **22424**

NTS GEOTECHNICAL

Log of Boring B-1

Sheet 1 of 1

Date(s) Drilled **8/24/2022**	Logged By **ERL**	Checked By **NS**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **8"**	Total Depth of Borehole **20 feet**
Drill Rig Type **CME 75**	Drilling Contractor **OWD**	Approximate Surface Elevation **N/A**
Groundwater Level and Date Measured **Not Encountered**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140-lb autohammer**
Borehole Backfill **Native**	Location **27278 Ethanac Rd, Romoland**	

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
0			SM		Artificial Fill (Af):			
			SM		SILTY SAND, organics, pieces of debris, damp, dark grey			
					ALLUVIUM (Qa):			
		50			SILTY SAND, fine-grained sand, abundance of silt, few organics, moist, dense, light brown	8	106	
5		63	SM		fine to coarse-grained sand, very dense, orangish brown			
10		54	SM		coarse-grained sand, moist, dense	7	120	
15		23	SP-SM		SAND to SILTY SAND, few silt, medium dense, tan to orangish brown			
20		72	SP-SM		damp to moist, very dense	5	118	
					Total Depth = 20 feet Groundwater not encountered Backfilled with native			
25								
30								

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Figure A-2

Project: **27278 Ethanac Rd**		**Log of Boring B-2**
Project Location: **27278 Ethanac Rd, Romoland**	NTS GEOTECHNICAL	**Sheet 1 of 1**
Project Number: **22424**		

Date(s) Drilled **8/24/2022**	Logged By **ERL**	Checked By **NS**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **8"**	Total Depth of Borehole **15 feet**
Drill Rig Type **CME 75**	Drilling Contractor **OWD**	Approximate Surface Elevation **N/A**
Groundwater Level and Date Measured **Not Encountered**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140-lb autohammer**
Borehole Backfill **Native**	Location **27278 Ethanac Rd, Romoland**	

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
0			SM		Artificial Fill (Af):			
			SM		SILTY SAND, organics, pieces of debris, damp, dark grey			
					ALLUVIUM (Qa):			
	Modified California	43			SILTY SAND, fine-grained sand, few organics, moist, dense, light brown	7	115	
5	SPT	9	SM		some silt, loose, orangish brown			
10	Modified California	27	SM		numerous silt, fine-grained sand, moist, medium dense	8	122	
15	SPT	22	SM		medium dense, tan to orangish brown			
					Total Depth = 15 feet Groundwater not encountered Backfilled with native			
20								
25								
30								

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Figure A-3

Project: **27278 Ethanac Rd** Project Location: **27278 Ethanac Rd, Romoland** Project Number: **22424**	NTS GEOTECHNICAL	# Log of Boring B-3 **Sheet 1 of 1**

Date(s) Drilled **8/24/2022**	Logged By **ERL**	Checked By **NS**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **8"**	Total Depth of Borehole **15 feet**
Drill Rig Type **CME 75**	Drilling Contractor **OWD**	Approximate Surface Elevation **N/A**
Groundwater Level and Date Measured **Not Encountered**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140-lb autohammer**
Borehole Backfill **Native**	Location **27278 Ethanac Rd, Romoland**	

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
0			SM		Artificial Fill (Af): SILTY SAND, organics, pieces of debris, damp, dark grey			
			SM		ALLUVIUM (Qa): SILTY SAND, fine-grained sand, few organics, very moist, very dense, light brown to orangish brown			
		90/10"				13	102	
5		34	SM		fine to coarse-grained sand, few silt, dense, orangish brown			
10		50/5"	SM		moist, dense	7	110	
15		18	SM		few silt, few gravel, medium dense			
			SM		Total Depth = 15 feet Groundwater not encountered Backfilled with native			
20								
25								
30								

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Project: **27278 Ethanac Rd**	NTS GEOTECHNICAL	# Log of Boring B-4
Project Location: **27278 Ethanac Rd, Romoland**		**Sheet 1 of 2**
Project Number: **22424**		

Date(s) Drilled **8/24/2022**	Logged By **ERL**	Checked By **NS**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **8"**	Total Depth of Borehole **30 feet**
Drill Rig Type **CME 75**	Drilling Contractor **OWD**	Approximate Surface Elevation **N/A**
Groundwater Level and Date Measured **Not Encountered**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140-lb autohammer**
Borehole Backfill **Native**	Location **27278 Ethanac Rd, Romoland**	

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
0			SM		Artificial Fill (Af):			
			SM		SILTY SAND, organics, pieces of debris, damp, dark grey			
	Modified California	50/6"			ALLUVIUM (Qa): SILTY SAND, coarse-grained sand, some silt, moist, dense, orangish brown	8	117	
5	SPT	30	SM		few gravel, some silt, medium dense			
10	Modified California	85/11"	SM		damp to moist, very dense, tan to orangish brown	5	127	
15	SPT	20	SM		fine to coarse-grained sand, medium dense			
20	Modified California	73	SP-SM		SAND to SILTY SAND, coarse-grained sand, few silt, some gravel, dry to damp, very dense, tan to orangish brown	3	117	
25	SPT	47	SP-SM		dense			
30								

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Figure A-5

Project: **27278 Ethanac Rd**
Project Location: **27278 Ethanac Rd, Romoland**
Project Number: **22424**

NTS GEOTECHNICAL

Log of Boring B-4
Sheet 2 of 2

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
30	■	50/6"	SP-SM		moist, dense	8	109	
					Total Depth = 30 feet Groundwater not encountered Backfilled with native			
35								
40								
45								
50								
55								
60								
65								

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NTS GEOTECHNICAL

APPENDIX B

Geotechnical Laboratory Testing

Appendix B
Geotechnical Laboratory Testing

Laboratory Moisture Content and Density Tests

The moisture content and dry densities of selected driven samples obtained from the exploratory boring was evaluated in general accordance with the latest version of ASTM D 2937. The test results are presented on the log of the exploratory boring in Appendix A.

Wash Sieve

The number of fines passing the No. 200 sieve was evaluated by the wash sieve. The test procedure was in general accordance with ASTM D 1140. The results are attached to this Appendix B.

Corrosion Suite

The corrosion potential of typical on-site materials under long-term contact with both metal and concrete was determined by chemical and electrical resistance tests. The soluble sulfate test for potential concrete corrosion was performed in general accordance with ASTM D4327, the minimum resistivity test for potential metal corrosion was performed in general accordance with ASTM G187, and the concentration of soluble chlorides was determined in general accordance with ASTM D4327. The test results are attached to this Appendix B.

Direct Shear Tests

Direct shear tests were performed on selected remolded and relatively undisturbed soil samples in general accordance with ASTM D 3080 to evaluate the shear strength characteristics of the materials. The samples were inundated during shearing to represent adverse field conditions. Direct shear test results are attached to this Appendix B.

Consolidation Test

Consolidation tests was performed on a selected driven soil sample in general accordance with the latest version of ASTM D2435. The sample was inundated during testing to represent adverse field conditions. The percent consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. Consolidation testing results are attached to this Appendix B.

PROJECT NO.: 22424

PROJECT ADDRESS: 27278 Ethanac Road

LABORATORY RECAPITULATION 1

Explorations	Depth (ft)	Material	Dry Density (p.c.f.)	Moisture Content (%)
B-1	2.0	Qa	106	8
	10.0	Qa	120	7
	20.0	Qa	118	5
B-2	2.0	Qa	115	7
	10.0	Qa	122	8
B-3	2.0	Qa	102	13
	10.0	Qa	110	7
B-4	2.0	Qa	117	8
	10.0	Qa	127	5
	20.0	Qa	117	3
	30.0	Qa	109	8

LABORATORY RECAPITULATION 2

Explorations	Depth (ft)	pH	As-Is Soil Resistivity (ohm-cm)	Minimum Soil Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
B-3	5.0	8.22	8,000	2,600	50	60

Direct Shear Test Diagram (D-3080)

PLATE: S-1
P.N. 22424

Sample Description	Sample Identification	Test Type	Sample Test State	Number of Passes
Qa	B-1 @ 2.0'	Ultimate	Saturated	1

Soil Dry Density (PCF)	106	Shear Strength Values:	
Soil Moisture Content (%)	21	Phi (Degrees)	**26.0**
Soil Saturation (%)	99.4	Cohesion (PSF)	**350.3**

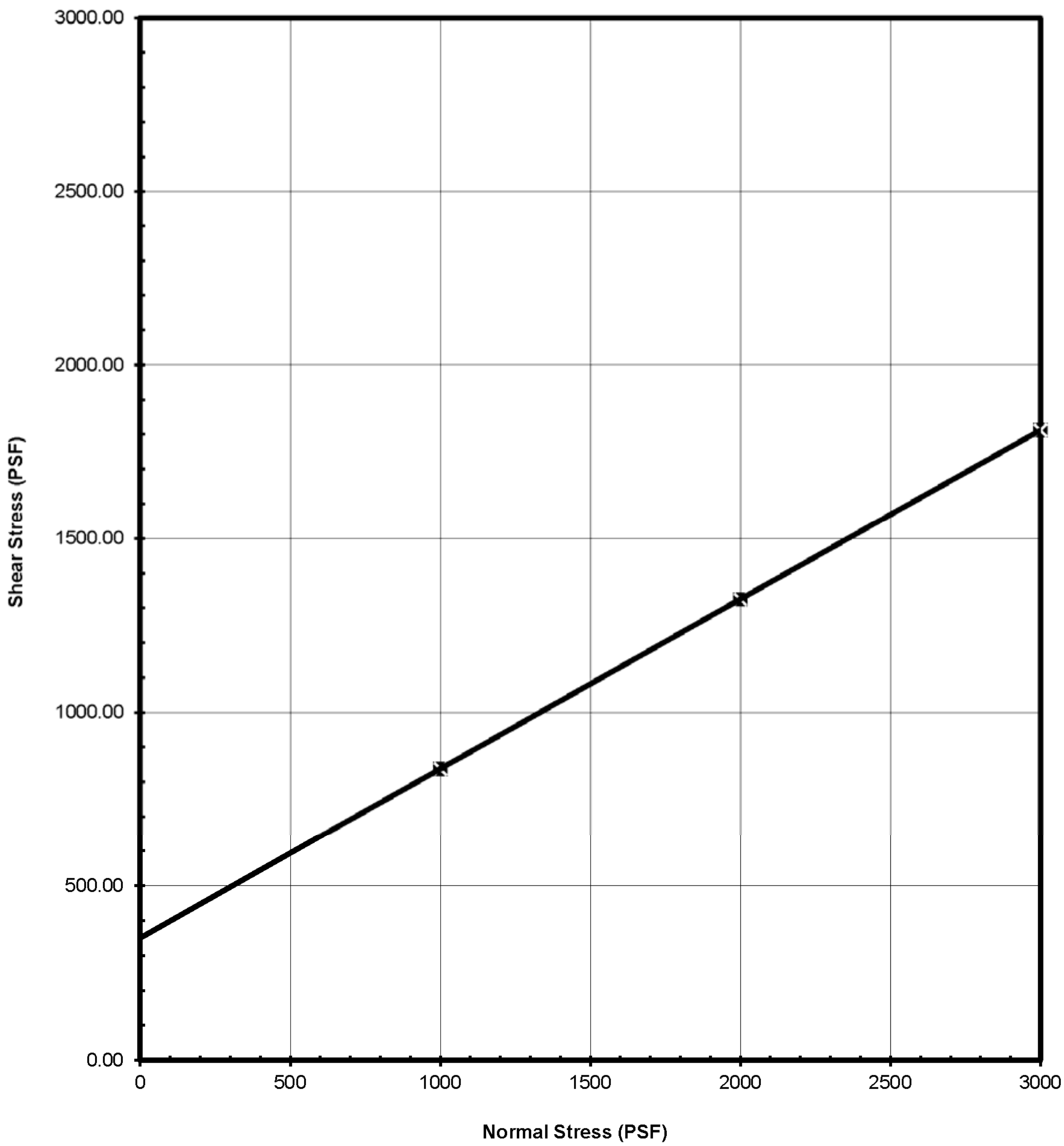
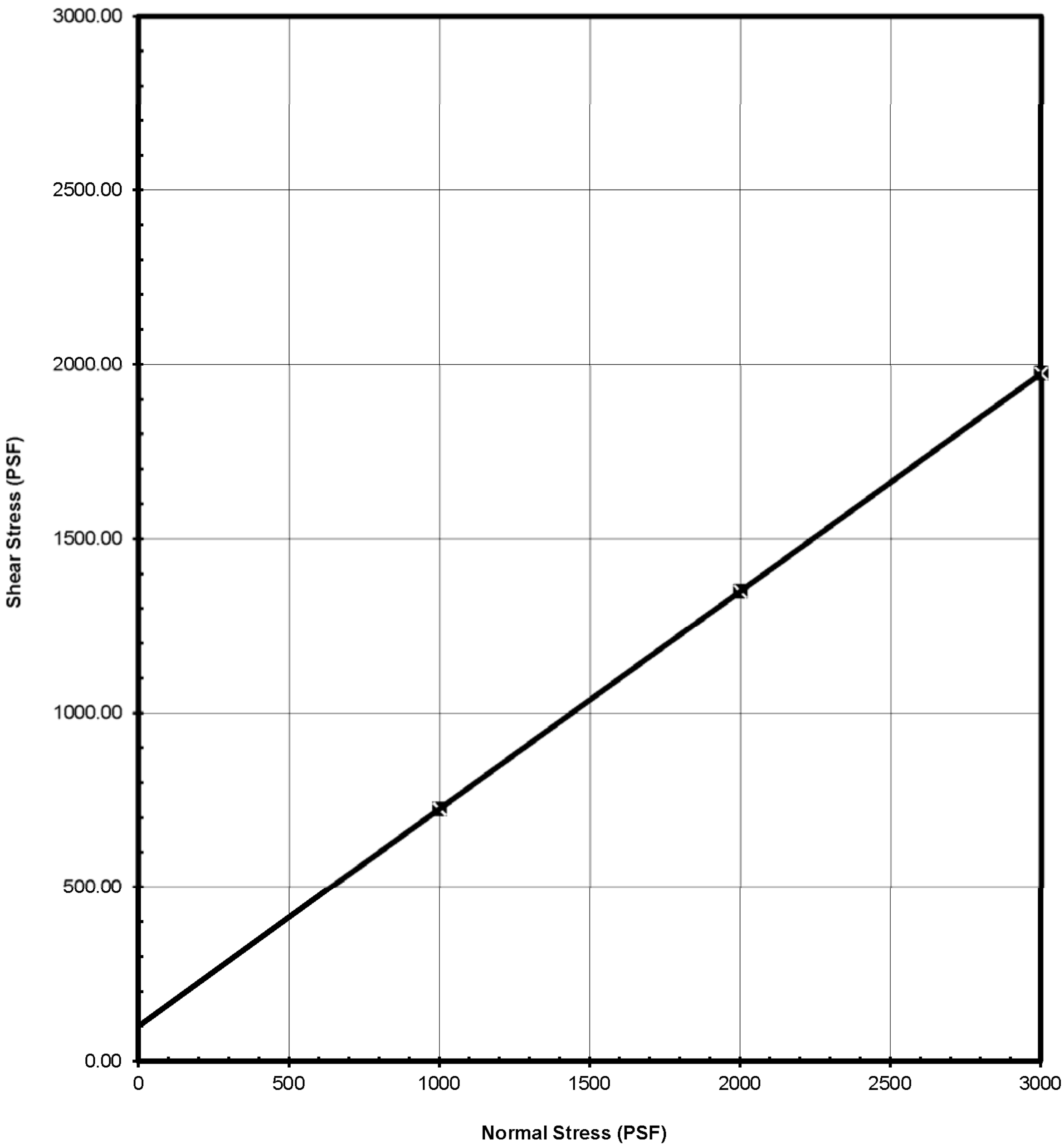


PLATE: S-2
P.N. 22424

Direct Shear Test Diagram (D-3080)

Sample Description	Sample Identification	Test Type	Sample Test State	Number of Passes
Qa	B-4 @ 10.0'	Ultimate	Saturated	1

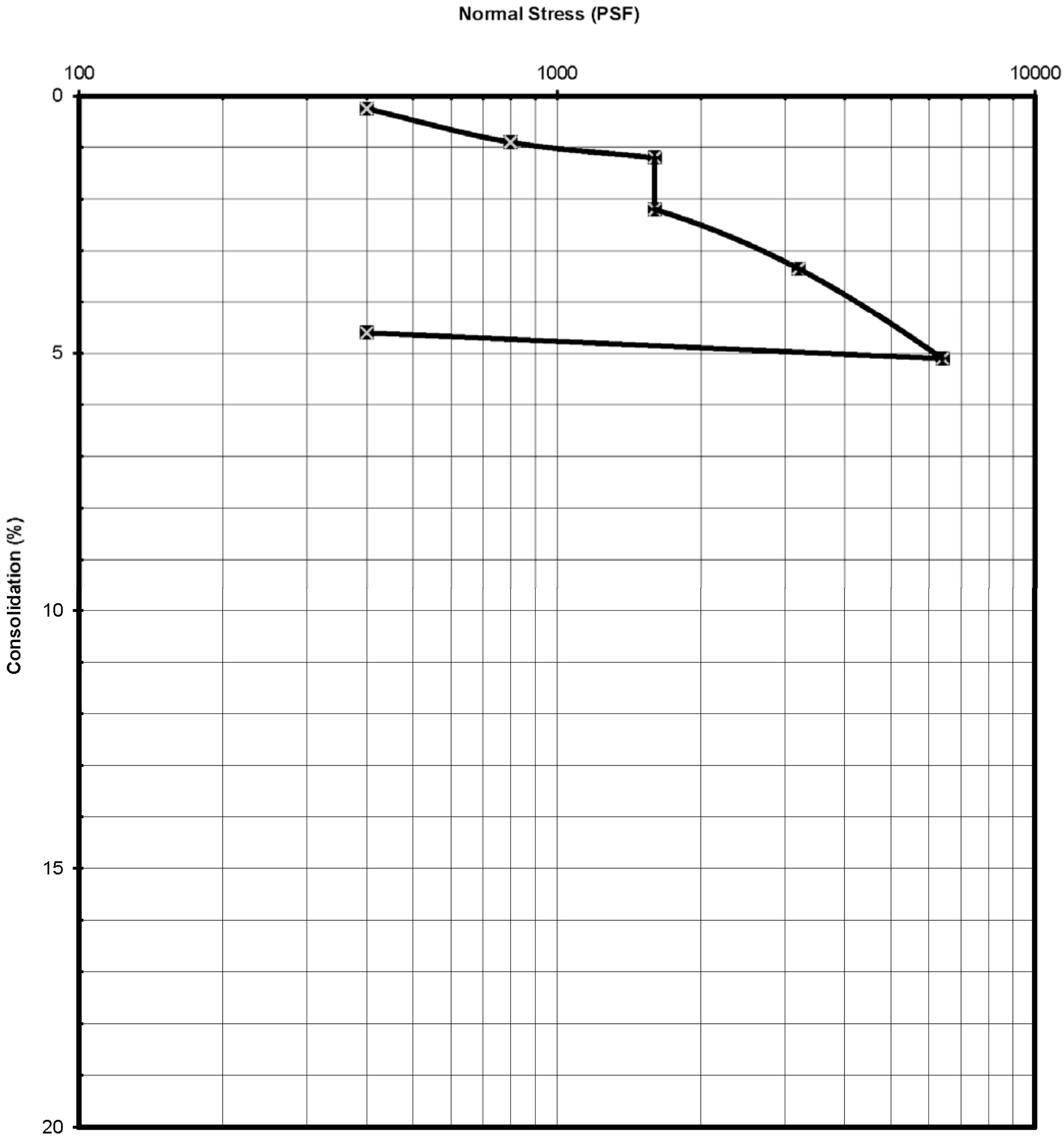
Soil Dry Density (PCF)	127	Shear Strength Values:	
Soil Moisture Content (%)	11.25	Phi (Degrees)	32.0
Soil Saturation (%)	98.7	Cohesion (PSF)	100.0



Consolidation Pressure Curve (D-2435)

Sample Identification	Sample Description
B-1 @ 10.0'	Qa

PLATE: C-1
P.N. 22424

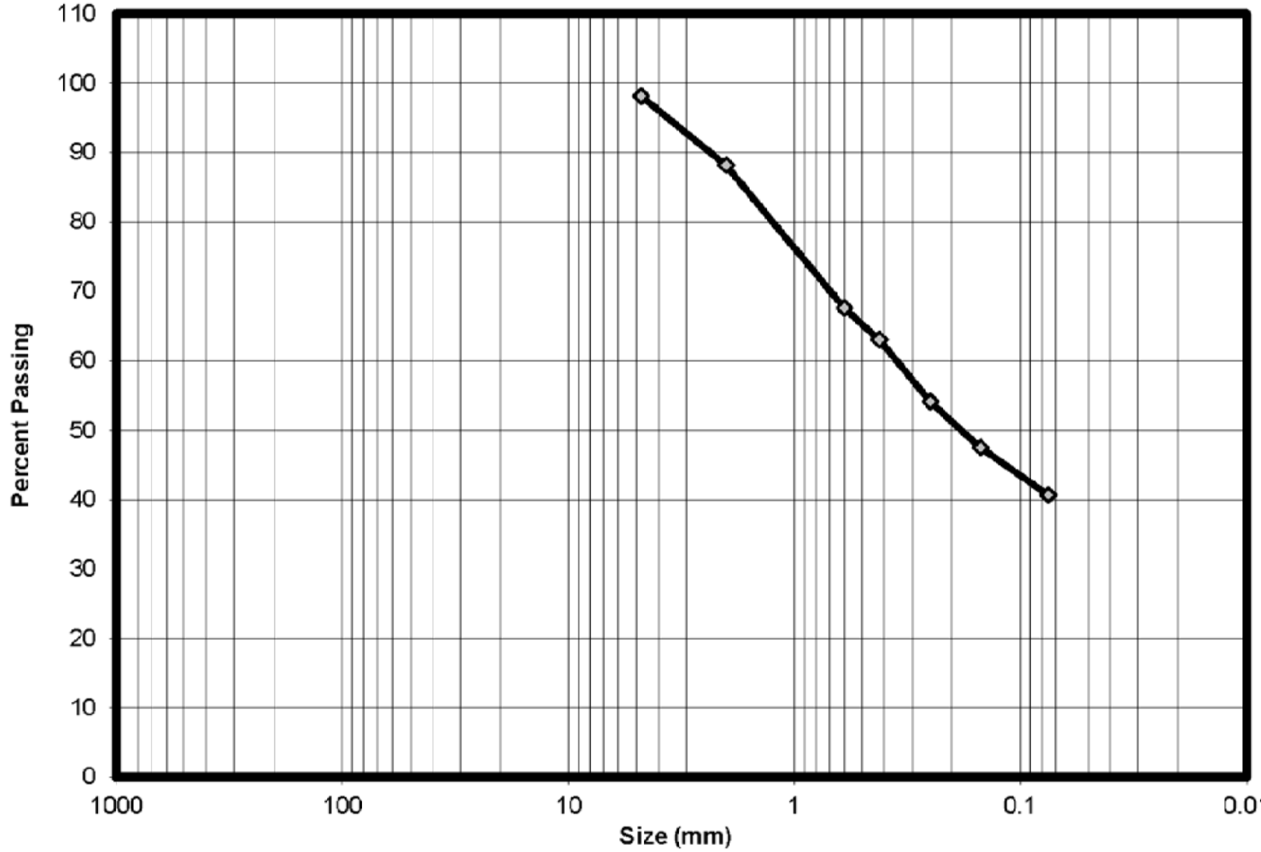


Grain Size Analysis (ASTM D422)

PLATE:	SV-1
P.N.	22424

Explorations	Sample Depth (ft)	Soil Description	% of Fines (-200)
B-1	5	Qa	49
	15	Qa	11
B-2	15	Qa	16
B-4	25	Qa	12

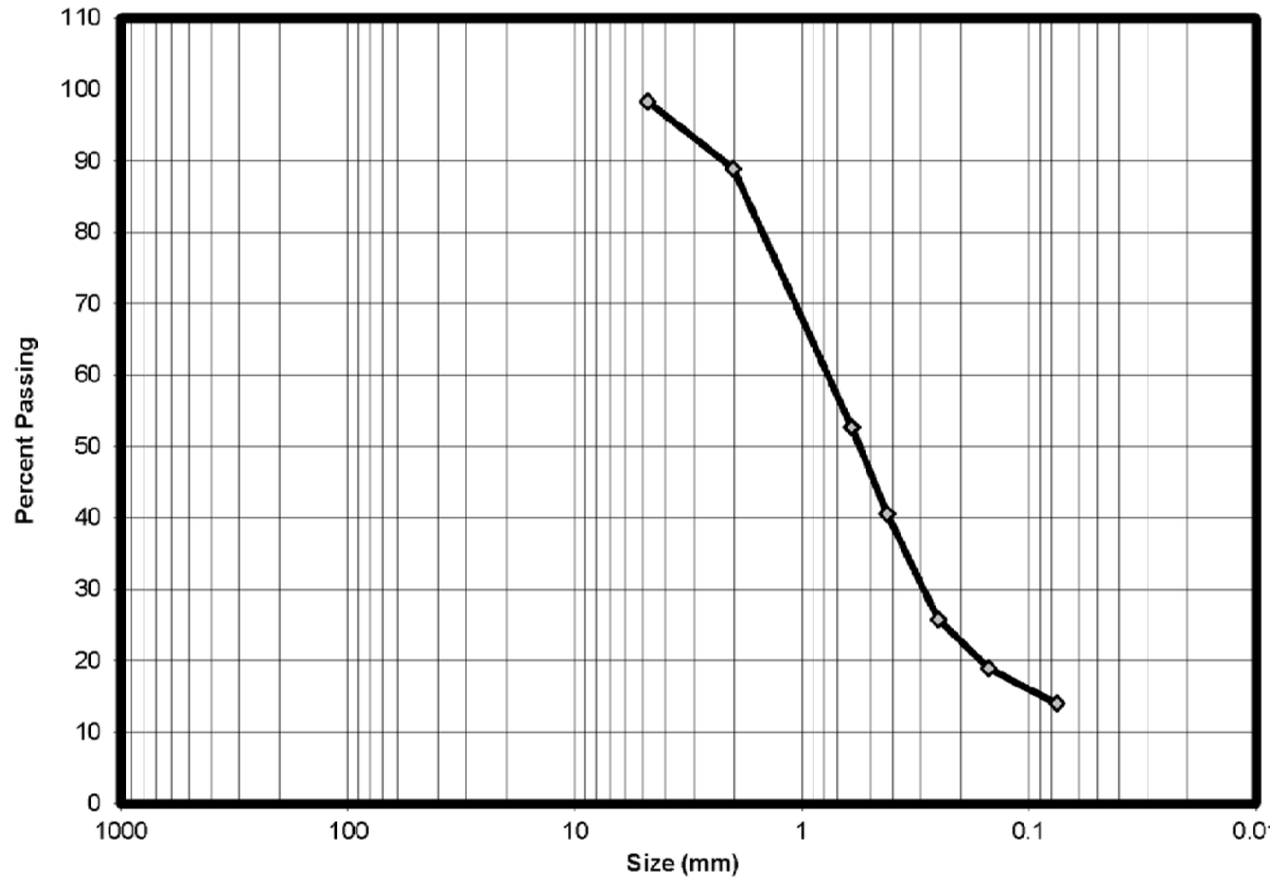
Sieve Size	Percent Passing
No. 4	98.18
No. 10	88.18
No. 30	67.64
No. 40	63.11
No. 60	54.14
No. 100	47.54
No. 200	40.68



Grain Size Analysis (ASTM D422)

Sample Identification	Sample Description	PLATE: G-1 P.N. 22424
P-1 @ 5.0'	Qa	

Sieve Size	Percent Passing
No. 4	98.35
No. 10	88.92
No. 30	52.69
No. 40	40.58
No. 60	25.77
No. 100	18.96
No. 200	14.00



Grain Size Analysis (ASTM D422)

Sample Identification	Sample Description	PLATE: G-1 P.N. 22424
P-2 @ 10.0'	Qa	

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APPENDIX C

Infiltration Testing Data

Falling Head Borehole Infiltration Test

Project Name:	27278 Ethanac Rd, Romoland		**Date:**	8/24/2022	
Project Number:	22424		**Tested By:**	ERL	
Test Hole Number:	P-1		**USCS Soil Classification:**	SM	
Total Depth :	5.00	feet	**Water Temperature:**	N/A	°F
Test Hole Diameter:	8.00 inches	radius= 4	inches		

Trial	Start Time	End Time	ΔT	Total Time	Initial Depth of Water	Final Depth of Water	H_0	H_f	ΔH	H_{avg}	Unfactored Percolati
			(min)	*(min)*	*(ft)*	*(ft)*	*(in)*	*(in)*	*(in)*	*(in)*	*(in/hour)*
1	10:31	11:01	30.0	30.0	4.00	4.48	12.00	6.24	5.76	9.12	2.07
2	11:02	11:32	30.0	60.0	4.38	4.68	7.50	3.84	3.66	5.67	1.91
3	11:33	12:03	30.0	90.0	4.58	4.80	5.04	2.40	2.64	3.72	1.85
4	12:04	12:34	30.0	120.0	4.80	4.93	2.40	0.84	1.56	1.62	1.72
5	12:35	1:05	30.0	150.0	4.00	4.41	12.00	7.08	4.92	9.54	1.71
6	1:06	1:36	30.0	180.0	4.41	4.67	7.08	3.96	3.12	5.52	1.66
7	1:37	2:07	30.0	210.0	4.67	4.84	3.96	1.92	2.04	2.94	1.65
8	2:08	2:38	30.0	240.0	4.84	4.95	1.92	0.60	1.32	1.26	1.62
9	2:39	3:09	30.0	270.0	4.00	4.37	12.00	7.56	4.44	9.78	1.51
10	3:10	3:40	30.0	300.0	4.37	4.63	7.56	4.44	3.12	6.00	1.56
11	3:41	4:11	30.0	330.0	4.63	4.80	4.44	2.40	2.04	3.42	1.51
12	4:12	4:42	30.0	360.0	4.80	4.91	2.40	1.08	1.32	1.74	1.41

SAFETY FACTOR*:	2
UNFACTORED INFILTRATION RATE (IN/HR):	1.41
FACTORED INFILTRATION RATE (IN/HR):	0.71

Factor Category	Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) = w x v
Suitability Assessment	Soil assessment methods	0.25	3	0.75
	Predominant soil texture	0.25	2	0.5
	Site soil variablity	0.25	1	0.25
	Depth to groundwater	0.25	2	0.5
		Geotechnical Factor of Safety (S_A):		2

Concern Level	Factor Value (v)
Low	1
Medium	2
High	3

***Factor of safety should not be less than 2. Additional factor of safety in accordance with Table D-7 of the South Orange County Technical Guidance Document should be applied by the project civil engineer.**

NTS GEOTECHNICAL

Falling Head Borehole Infiltration Test

Project Name:	27278 Ethanac Rd, Romoland		**Date:**	8/24/2022	
Project Number:	22424		**Tested By:**	ERL	
Test Hole Number:	P-2		**USCS Soil Classification:**	SM	
Total Depth :	10.00	feet	**Water Temperature:**	N/A	°F
Test Hole Diameter:	8.00 inches	radius= 4	inches		

Trial	Start Time	End Time	ΔT	Total Time	Initial Depth of Water	Final Depth of Water	H_0	H_f	ΔH	H_{avg}	Unfactored Percolati
			(min)	*(min)*	*(ft)*	*(ft)*	*(in)*	*(in)*	*(in)*	*(in)*	*(in/hour)*
1	9:24	9:34	10.0	35.0	8.08	8.66	23.04	16.08	6.96	19.56	3.87
2	9:34	9:44	10.0	45.0	8.66	9.07	16.08	11.16	4.92	13.62	3.78
3	9:54	10:04	10.0	55.0	9.07	9.36	11.16	7.68	3.48	9.42	3.66
4	10:04	10:14	10.0	65.0	9.36	9.53	7.68	5.69	1.99	6.68	2.75
5	10:14	10:24	10.0	75.0	9.53	9.66	5.64	4.14	1.50	4.89	2.61
6	10:24	10:34	10.0	85.0	9.66	9.78	4.14	2.64	1.50	3.39	3.34

SAFETY FACTOR*:	1.75
UNFACTORED INFILTRATION RATE (IN/HR):	3.34
FACTORED INFILTRATION RATE (IN/HR):	1.91

Factor Category	Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) = w x v
Suitability Assessment	Soil assessment methods	0.25	3	0.75
	Predominant soil texture	0.25	2	0.5
	Site soil variablity	0.25	1	0.25
	Depth to groundwater	0.25	1	0.25
			Geotechnical Factor of Safety (SA):	1.75

Concern Level	Factor Value (v)
Low	1
Medium	2
High	3

***Factor of safety should not be less than 2. Additional factor of safety in accordance with Table D-7 of the South Orange County Technical Guidance Document should be applied by the project civil engineer.**