Geotechnical Engineering Report

New Fire Suppression Water Storage Tank
Madrid, New Mexico
April 13, 2021
Terracon Project No. 66205185

Prepared for:
Tierra West, LLC
Albuquerque, New Mexico

Prepared by:
Terracon Consultants, Inc.
Albuquerque, New Mexico

April 13, 2021

Tierra West, LLC
5571 Midway Park Place NE
Albuquerque, New Mexico 87109

Attn: Mr. Assad Rizvi
P: (505) 858-3100
E: arizvi@tierrawestllc.com

Re: Geotechnical Engineering Report
New Fire Suppression Water Storage Tank
2801A NM14
Madrid, New Mexico
Terracon Project No. 66205185

Dear Mr. Rizvi:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P66205185 Revised dated January 28, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and utility line installation for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Stenson D. Lee
Staff Engineer

Michael E. Anderson, P.E.
Principal

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	Water storage tank Concrete Mat/Slab Foundation: 1,500 psf Wall loads: 2,00 to 3,000 pounds per lineal foot Up to about 4 to 6 feet of cut and 3 to 4 feet of fill to achieve final grade
Geotechnical Characterization	The site could be characterized generally by medium dense sand and gravel soils overlying hard to very hard sedimentary bedrock. Groundwater not encountered.
Earthwork	dense soils may require extra effort during utility and foundation excavations. Auger refusal was encountered on the sedimentary bedrock encountered at depths of about 9 feet to 22 feet below existing site grade. Bedrock was encountered as shallow as 4 feet below existing site grade. Excavations at or below these depths will require heavy-duty or specialized rock excavation equipment We recommend raising the site or limiting excavation depths to reduce potential impacts with rock excavation. Existing on-site soils and processed sandstone are suitable for us as structural fill. Caving and Loose soils may be encountered in shallow foundations.
Tank Foundation	Allowable bearing pressure = 3,500 psf Expected settlements: ■ Tank Walls: < 1 inch, < ½ -inch differential ■ Tank Floor: Up to 1 inch. Majority of settlement to occur instantaneously with tank loading. A hydrostatic loading test could be performed prior to utility connections to reduce post-construction settlements
Deep Foundations	Deep foundations are not necessary for this site.
Below-Grade Structures	Not Applicable
Pavements	Not Applicable
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

New Fire Suppression Water Storage Tank
2801A NM14
Madrid, New Mexico

Terracon Project No. 66205185
April 13, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed water tank to be located at 2801A NM14 in Madrid, New Mexico. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Tank floor slab construction
- Seismic site classification per IBC
- Lateral earth pressures

The geotechnical engineering Scope of Services for this project included the advancement of 2 test borings to depths ranging from approximately 9 to 22 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located near 2801A NM14 in Madrid, New Mexico.
Existing Improvements	Currently a vacant and undeveloped parcel
Current Ground Cover	Soil and vegetation
Existing Topography	The site slopes down to the east and southeast

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Information was provided by TW in an email received on September 24, 2020 and January 27, 2021 which included project information and the "Preliminary Engineering Report for the Community of Madrid, Santa Fe County Fire Suppression System" dated August 2016 and prepared by Occam Engineers, Inc.
Project Description	The project will include upgrades to the existing fire suppression system consisting of the following: ■ Extension of existing waterline ■ New waterline installation ■ New fire suppression water storage tank
Tank Construction	Bolted steel
Tank Foundation	Mat slab foundation
Finished Tank Floor Elevation	6122.50
Maximum Loads	■ Tank floor: 1,500 psf (assumed) ■ Tank walls: 2 to 3 kips per linear foot (klf) (assumed)
Grading/Slopes	Up to 7 feet of cut and 1 foot of fill may be required to develop final site grades.
Below-Grade Structures	N/A
Free-Standing Retaining Walls	N/A
Below-Grade Areas	N/A
Pavements	N/A
Estimated Start of Construction	2021 (assumed)

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Medium Dense Coarse Grained Soils**	Sand and gravel soils with variable amounts of clay and silt.
2	**Sedimentary Bedrock**	Sandstone bedrock with variable amounts of clay.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results** and are summarized below.

Groundwater was not observed in the borings while drilling, or for the short duration the borings could remain open. Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings. The site could be characterized generally by medium dense sand and gravel soils overlying hard to very hard sedimentary bedrock. Near surface native soils which show a low tendency for compression/collapse when elevated in moisture content and shallow bedrock will require particular attention in the design and construction.

Based on the geotechnical subsurface exploration, the laboratory test results, and our engineering analyses, the proposed tank can be supported on a mat foundation bearing on a zone of structural fill/recompacted native soils. On-site soils and processed bedrock are suitable for use as engineered fill beneath foundations. Any engineered fill required to raise the site to construction grade can be included in the recommended structural/engineered fill zone. Shallow foundation excavations into the subsurface soils are expected to be achieved with conventional earth moving equipment. Hard to very hard bedrock may require specialized or heavy-duty equipment during utility and foundation excavations. A qualified contractor with experience in the area and with similar subsurface conditions should review the information contained in this report and determine the means and methods required to advance excavations to planned construction depths. Loose, soft, or caving soils may

be encountered in shallow excavations such as foundations. Excavations will likely require bracing, sloping, and/or other means to create safe and stable working conditions.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in **Exploration Results**), engineering analyses, and our current understanding of the proposed project.

Design and construction of the tank should be performed in accordance with American Water Works Association (AWWA) Specifications.

Geotechnical engineering recommendations for earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendices A and B), engineering analyses, our current understanding of the proposed project, and the current issue of the New Mexico Standard Specifications for Public Works Construction (Specifications).

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork should be conducted in accordance with Section 200 of the Specifications

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of structural fills on the project. The recommendations presented for design and construction of earth supported elements including foundations and slabs are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of structural fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

Site Preparation

Site preparation should be performed in accordance with Sections 201, 202, and 701 of the Specifications.

Strip and remove existing vegetation (if applicable), debris, and other deleterious materials from the proposed structure area. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

The site should be initially graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath the proposed structure.

Evidence of underground facilities and utilities were observed adjacent to the site during the site reconnaissance. Therefore, such features may be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Excavation

Excavation should conform to Section 701 of the Specifications

We anticipate difficult excavation conditions will be encountered in areas of dense soils and hard to very hard shallow bedrock within the tank footprint that may require extra effort or heavy-duty equipment during excavation. Excavations into bedrock will likely require specialty excavation equipment such as mechanical rippers, pneumatic hammers or large rock trenchers. A qualified contractor experienced in the area and with similar bedrock conditions should review the information contained herein and determine the means and methods required to advance excavations to construction depths.

Based on the results from the soil borings, we do not anticipate groundwater control measures will be necessary in excavations up to about 22 feet below existing site grades. However, depending upon depth of excavation and seasonal conditions, groundwater may be encountered in excavations on the site. Pumping from sumps may be utilized to control water within excavations.

On-site soils may pump or become unstable or unworkable at high water contents. Workability may be improved by scarifying and drying. Overexcavation of wet zones and replacement with granular materials may be necessary. Lightweight excavation equipment may be required to reduce subgrade pumping.

Use of lime, fly ash, kiln dust, cement or geotextiles could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction.

Subgrade Preparation

Preparation of the subgrade should follow Section 701.12 of the Specifications.

Exposed areas which will receive fill (if applicable), once properly cleared, should be scarified to a minimum depth of 10 inches, conditioned to near optimum moisture content, and compacted.

Areas of loose soils may be encountered at foundation and tank floor bearing depth after excavation is completed for the tank foundations. When such conditions exist beneath the

planned tank area, the subgrade soils should be surficially compacted prior to placement of the foundation system. If sufficient compaction cannot be achieved in-place, the loose soils should be removed and replaced as structural fill. For placement of structural fill below the tank, the excavation should be widened laterally, at least eight (8) inches for each foot of fill placed below foundation.

Subgrade soils beneath exterior slabs (if applicable) should be scarified, moisture conditioned and compacted to a minimum depth of 10 inches. The moisture content and compaction of subgrade soils should be maintained until slab or pavement construction.

Pipe Embedment and Foundation Support Soils

Pipe embedment and support, soils should follow Section 701.13 of the Specifications.

Based on the most recent Specifications, Section 700, Table 701.3A, the soil materials encountered in the soil borings are generally classified as the following:

USCS Soil Classification	Embedment Soils Classifications, Table 701.3A
SM, GC	Class III

Class III soils are generally satisfactory for pipe embedment and foundation support. Sedimentary bedrock was encountered in both borings at depths starting from about 4 feet below existing ground surface.

Processed bedrock could be considered as pipe embedment and foundation support materials if adequately processed to meet the requirements of Class I Soils (1/4" to 1½" angular granular soils).

Water Pipeline Installation

Waterline pipeline and appurtenances installation should follow Sections 701, 801, and 802 of the Specifications.

Backfill Material Types and Placement

Preparation, fill thickness and compaction of the embedment and backfill materials should follow Section 701.13 of the Specifications.

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than six inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

On-site sand soils are suitable for use as pipe support, embedment, and backfill. Clean on-site sand soils or approved imported materials meeting the specification contained herein may be used as fill material for the following:

■ general grading	■ pipe embedment
■ pipe foundation areas	■ pipe backfill
■ foundation areas	■ foundation backfill
■ tank floor areas	■ exterior slab areas

Imported soils (if required) for use as backfill material should conform to relatively low volume change materials as indicated in the following specifications:

Soil Type [1]	USCS Classification	Acceptable Parameters (for backfill)
Granular	GW, GP, GM, GC, SW, SP, SM, SC	Less than 50% Passing No. 200 sieve
On-Site Soils	GC, SM	On-site soils are suitable for use as backfill

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Processed bedrock could be considered as backfill materials if adequately processed to meet the requirements of Class I Soils (1/4" to 1½" angular granular soils).

Structural fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed eight (8) inches loose thickness.

Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Material Type and Location	Per the Standard Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction	
		Minimum	Maximum
On-site sand or approved imported fill soils			
Beneath foundations/tank floors:	95	-3%	+3%
Pipe embedment:	95	-3%	+3%
Final backfill:	90	-3%	+3%
Aggregate base:	95	-3%	+3%

Material Type and Location	Per the Standard Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction	
		Minimum	Maximum
Miscellaneous backfill:	90	-3%	+3%

Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the structure. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. In areas where sidewalks or paving do not immediately adjoin the tank, we recommend that protective slopes be provided with a minimum grade of approximately 5 percent for at least 5 feet from the perimeter of the structure. Backfill against foundations and in utility line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration.

Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of the tank slab. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

FOUNDATION RECOMMENDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters

Item	Description
Foundation Type	Concrete slab/mat
Structure	Water Storage Tank
Bearing Material	Minimum one (1) foot thickness of structural fill below foundation
Allowable Bearing Pressure	3,500 psf
Minimum Embedment Depth Below Finished Grade	Exterior – 24 inches [1]
Total Estimated Movement	Up to about 1 inch
Estimated Differential Settlement	¾ inch or less

1. Thickened edges can be used at perimeter of tank foundation or aggregate base course used below tank slab/mat for frost protection

Finished grade is defined as the lowest adjacent grade within five (5) feet of the foundation. The allowable foundation bearing pressure applies to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

Foundations should be proportioned to reduce differential foundation movement. Proportioning on the basis of equal total settlement is recommended; however, proportioning to relative constant dead-load pressure will also reduce differential settlement between the center and perimeter of the tank. Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction.

Foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement

Foundation excavations and structural fill placement should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Foundation Construction Considerations

Structural fill should extend below proposed foundations to a minimum depth of one (1) foot. The structural fill should extend laterally a minimum distance of one (1) foot beyond the edges of foundations.

Areas of loose soils may be encountered at foundation and tank floor bearing depth after excavation is completed for the foundation/tank. When such conditions exist beneath the planned foundation area, the subgrade soils should be surficially compacted prior to placement of the foundation system. If sufficient compaction cannot be achieved in-place, the loose soils should be removed and replaced as structural fill.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is C**.

TANK FLOOR

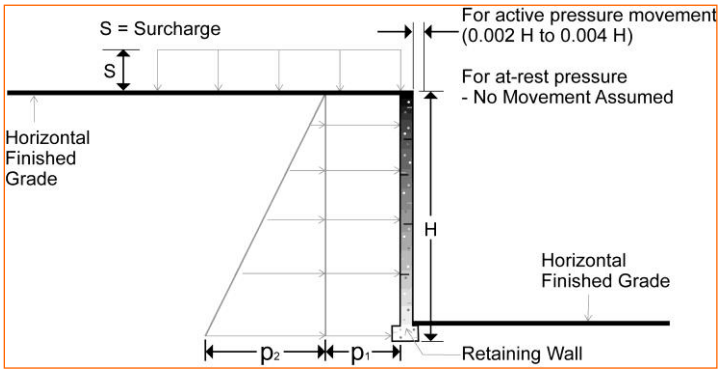
Tank floor installation should follow the manufacturer's recommendations and/or AWWA. Per AWWA, consideration should be given to the placement of a one-inch thick sand cushion or ½-inch thick cane-fiber joint filler between the flat bottom and concrete slab foundation.

In addition, per AWWA, consideration should be given to supporting the tank shell on grout or fiber joint filler. A minimum one-inch space between the tank bottom and the top of the concrete shall be filled with a 1:1.5 cement-sand grout. The grout shall fill the entire space beneath the tank from the outside edge of the tank bottom to the sand cushion. The minimum width of the grout placed under the tank bottom shall be six inches. The top of the foundation shall be thoroughly saturated with water before grout is placed.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The “at-rest” condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters			
Earth Pressure Condition [1]	**Coefficient for Backfill Type** [2]	**Surcharge Pressure** [3, 4, 5] **p_1 (psf)**	**Effective Fluid Pressures (psf)** [2, 4, 5] **Unsaturated** [6]
Active (Ka)	Granular – 0.29	(0.29)S	(35)H
At-Rest (Ko)	Granular – 0.42	(0.42)S	(50)H
Passive (Kp)	Granular – 3.54	---	(425)H

Lateral Earth Pressure Design Parameters			
Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]
			Unsaturated [6]

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95% of the ASTM D1557 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. To achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

CORROSIVITY

Laboratory test results indicate that on-site soils have a soluble sulfate concentration of 110 mg/kg, a pH value of 8.46, and a minimum resistivity value of 1,530 ohm-centimeters. These values should be used to determine potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Criteria published by the Cast Iron Pipe Research Institute indicates that the near surface subgrade soils generally have a moderate corrosive potential to cause corrosion to buried ferrous materials. Review of data published by the National Association of Corrosion Engineers indicates that the resistivity values concentrations places the soil in the moderately corrosive category. If there is concern regarding pipe corrosion, the use of PVC, poly-wrap, or surrounding pipe with 1 foot of clean imported sand should be considered.

Results of soluble sulfate testing indicate that ASTM Type I or I/II Portland cement is suitable for all concrete on and below grade. Foundation concrete should be designed for mild sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

- Use of Type I or I/II modified cement for sulfate resistance
- Cement should have a tricalcium aluminate content of not more than 8 percent.

- Concrete mixture should contain at least 20 percent Class F fly ash.
- Provide air-entrainment of 4 to 7 percent by volume.
- Lower the water to cement ratio to 0.4 to 0.45.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

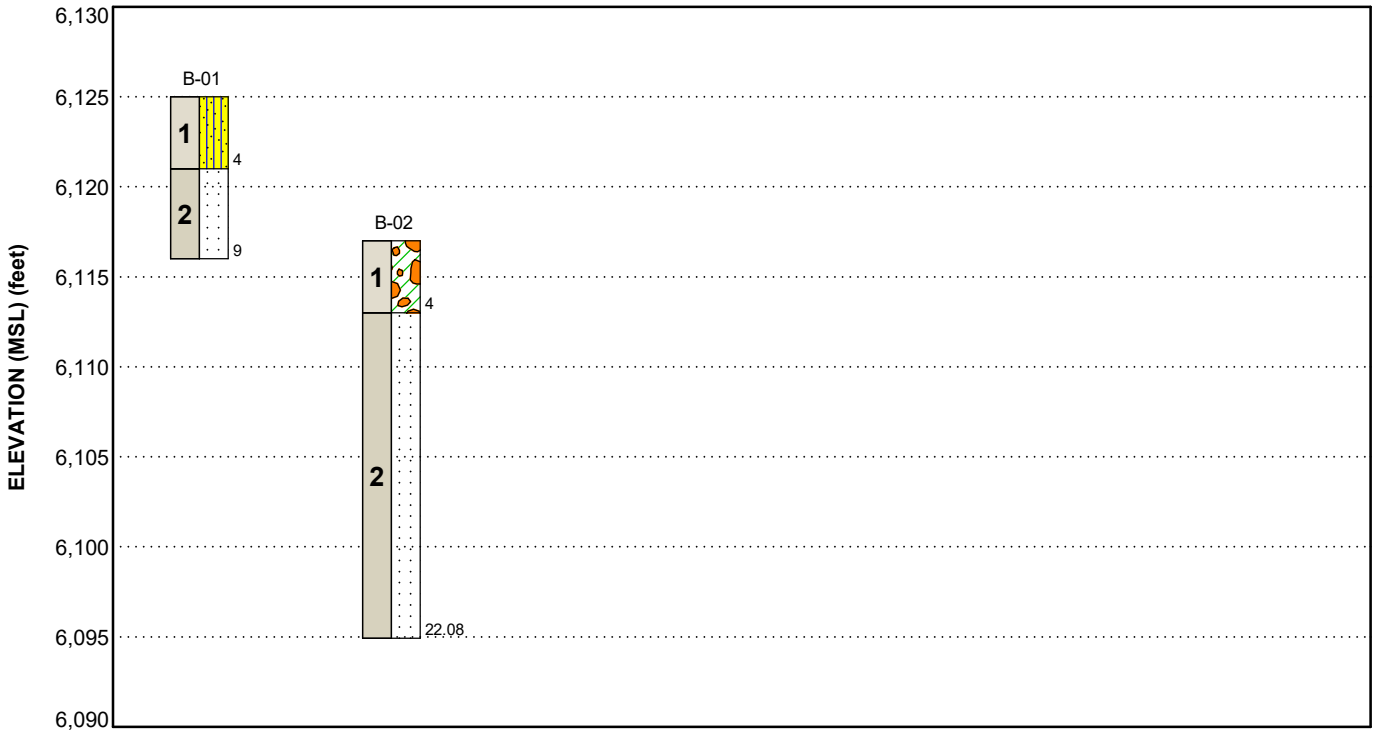
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

GEOMODEL

Madrid Water Tank ■ Madrid, NM
Terracon Project No. 66205185



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Medium Dense Coarse Grained Soils**	Sand and gravel soils with variable amounts of clay and silt, medium dense in relative density.
2	**Sedimentary Bedrock**	Sandstone bedrock with variable amounts of clay, with hard to very hard consistency.

LEGEND

Silty Sand

Sandstone

Clayey Gravel

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)[1]	Planned Location
2	9 to 22	Planned storage tank area

1. Auger refusal encountered in both borings at depths of approximately 9 and 22 feet below existing site grade.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from the handheld GPS devices and USGS Maps. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted rotary drill rig using continuous flight hollow stem augers (solid stem and/or, as necessary, depending on soil conditions). Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. A 3-inch O.D. split-barrel sampling spoon with 2.5-inch I.D. ring lined sampler was used for sampling in the upper 5 feet. Ring-lined, split-barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of SoilsEPA Method 300 Water soluble sulfates
- ASTM D4972 or EPA Method 9040C Standard Test Method for pH of Soils
- ASTM G187 Standard Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

New Fire Suppression Water Storage Tank ■ Madrid, New Mexico
April 13, 2021 ■ Terracon Project No. 66205185

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

New Fire Suppression Water Storage Tank ■ Madrid, New Mexico
April 13, 2021 ■ Terracon Project No. 66205185

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. B-01

PROJECT: Madrid Water Tank

CLIENT: Tierra West LLC
Albuquerque, NM

SITE: 2801A NM 14
Madrid, NM

LOCATION See Exploration Plan

Latitude: 35.4006° Longitude: -106.1577°

Surface Elev.: 6125 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1			**SILTY SAND (SM)**, trace gravel, light brown, medium dense								
							12-28	6.4	95	22-19-3	45
		4.0	6121								
2			**SANDSTONE**, gray and light brown, hard to very hard	5			14-23-32 N=55	6.9			
		9.0	6116					2.5			
			Auger Refusal at 9 Feet				50/0"				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
7" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6805 Academy Pkwy West NE
Albuquerque, NM

Boring Started: 02-05-2021 | Boring Completed: 02-05-2021

Drill Rig: CME 55 | Driller: Terracon ABQ

Project No.: 66205185

BORING LOG NO. B-02

PROJECT: Madrid Water Tank

CLIENT: Tierra West LLC
Albuquerque, NM

SITE: 2801A NM 14
Madrid, NM

LOCATION See Exploration Plan

Latitude: 35.4005° Longitude: -106.1576°

Surface Elev.: 6117 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0	6117								
							16-16	3.3	102	34-20-14	12
				5			8-33-27 N=60	5.8			
							28-50/5"	4.8			
				10			43-50/1"	5.6		32-16-16	23
2											
				15			35-50/2"	5.7		27-18-9	36
				20			50/3"	5.0			
		22.1	6095				50/1"				

CLAYEY GRAVEL (GC), trace sand, light brown, medium dense

4.0 6113

CLAYEY SANDSTONE, yellowish brown, white, and light gray, hard to very hard

Auger Refusal at 22.08 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
7" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6805 Academy Pkwy West NE
Albuquerque, NM

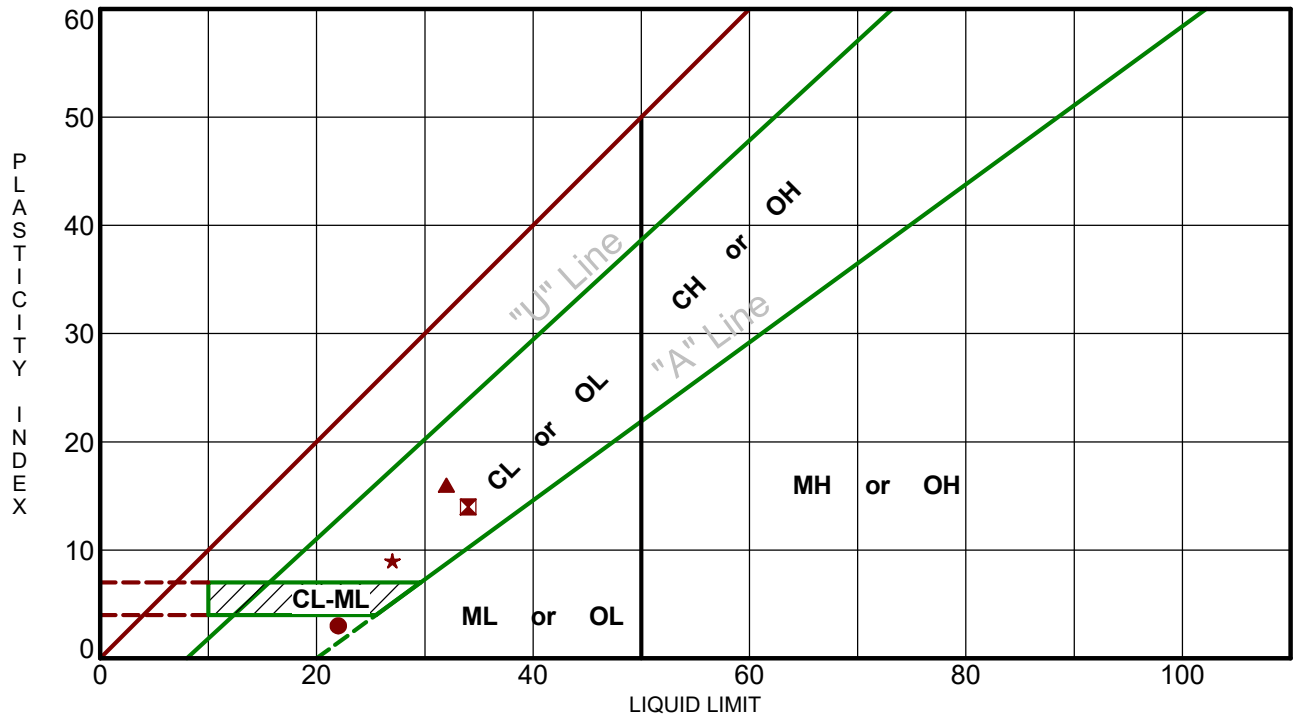
Boring Started: 02-05-2021 | Boring Completed: 02-05-2021

Drill Rig: CME 55 | Driller: Terracon ABQ

Project No.: 66205185

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	B-01	2.5 - 3.5	22	19	3	44.8	SM	SILTY SAND
⊠	B-02	2.5 - 3.5	34	20	14	12.2	GC	CLAYEY GRAVEL
▲	B-02	10 - 10.6	32	16	16	23.1	SC	CLAYEY SAND with GRAVEL
★	B-02	15 - 15.7	27	18	9	35.6	SC	CLAYEY SAND with GRAVEL

PROJECT: Madrid Water Tank

PROJECT NUMBER: 66205185

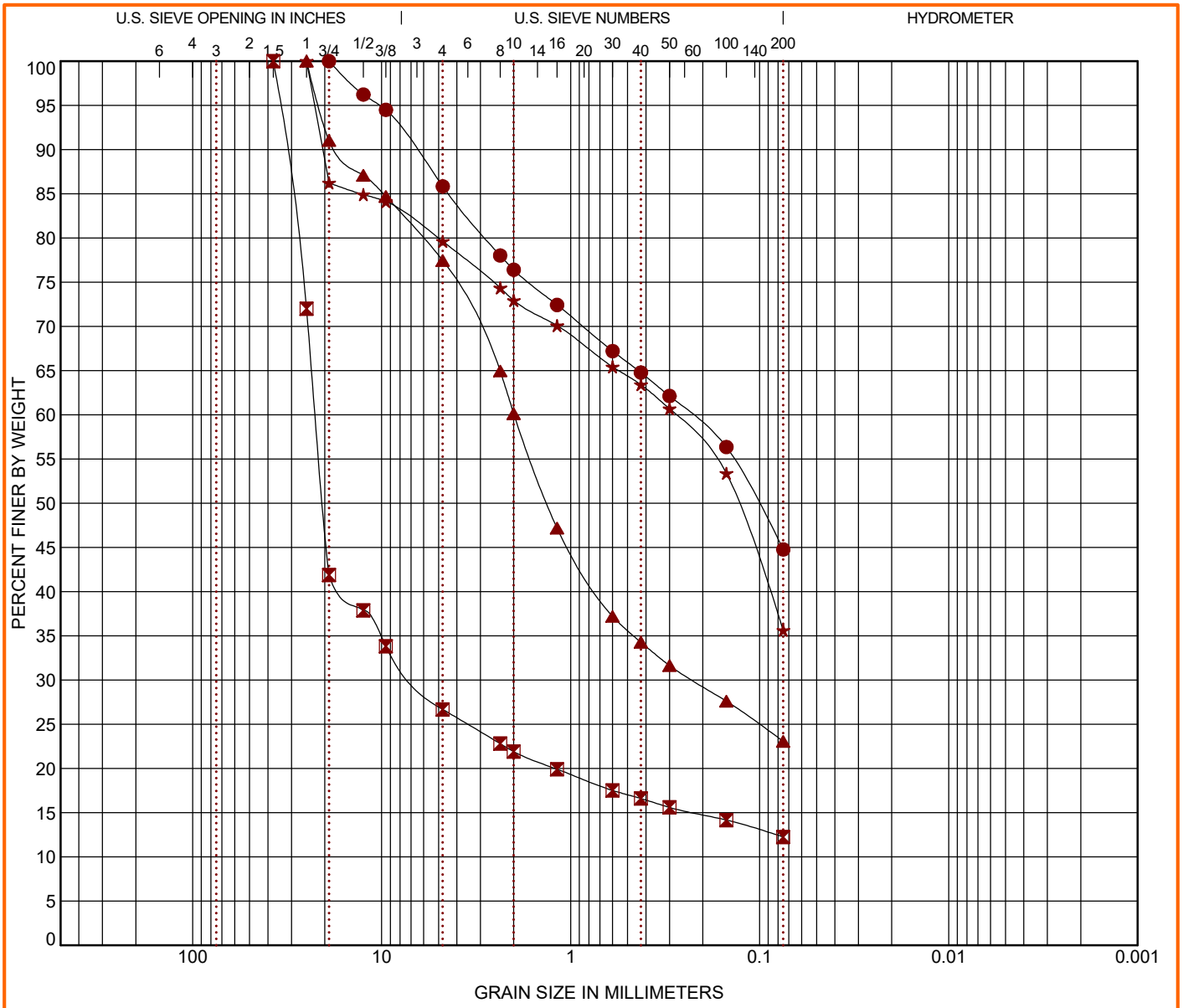
SITE: 2801A NM 14
Madrid, NM

Terracon
6805 Academy Pkwy West NE
Albuquerque, NM

CLIENT: Tierra West LLC
Albuquerque, NM

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-01	2.5 - 3.5	SILTY SAND (SM)	6.4	22	19	3		
⊠	B-02	2.5 - 3.5	CLAYEY GRAVEL (GC)	3.3	34	20	14	57.79	673.96
▲	B-02	10 - 10.6	CLAYEY SAND with GRAVEL (SC)	5.6	32	16	16		
★	B-02	15 - 15.7	CLAYEY SAND with GRAVEL (SC)	5.7	27	18	9		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-01	2.5 - 3.5	19	0.232			0.0	14.2	41.1		44.8	
⊠	B-02	2.5 - 3.5	37.5	22.411	6.562		0.0	73.3	14.4		12.2	
▲	B-02	10 - 10.6	25	1.99	0.226		0.0	22.5	54.4		23.1	
★	B-02	15 - 15.7	25	0.281			0.0	20.4	44.0		35.6	

PROJECT: Madrid Water Tank

PROJECT NUMBER: 66205185

SITE: 2801A NM 14
Madrid, NM

Terracon
6805 Academy Pkwy West NE
Albuquerque, NM

CLIENT: Tierra West LLC
Albuquerque, NM

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: clients.hallenvironmental.com

February 16, 2021

Mike Anderson

Terracon
6805 Academy Parkway West NE
Albuquerque, NM 87109
TEL: (505) 797-4287
FAX: (505) 797-4288

RE: Madrid Water Tank OrderNo.: 2102653

Dear Mike Anderson:

Hall Environmental Analysis Laboratory received 2 sample(s) on 2/11/2021 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0901

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Analytical Report
Lab Order **2102653**
Date Reported: **2/16/2021**

CLIENT: Terracon
Project: Madrid Water Tank
Lab ID: 2102653-001 **Matrix:** SOIL

Client Sample ID: B-01 @ 5'
Collection Date: 2/11/2021 12:00:00 PM
Received Date: 2/11/2021 4:51:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst: **VP**	
Sulfate	110	7.5		mg/Kg	5	2/13/2021 12:30:51 AM	58097
RESISTIVITY AND EC SOIL						Analyst: **JRR**	
Resistivity	1530	100		Ohms * c	1	2/16/2021 12:58:00 PM	58142
SM4500H+B/EPA 9040C						Analyst: **JRR**	
pH	8.46			pH Units	1	2/16/2021 12:26:00 PM	R75318

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Limit
S	% Recovery outside of range due to dilution or matrix		

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Terracon
Client Sample ID: B-02 @ 2.5'
Project: Madrid Water Tank
Collection Date: 2/11/2021 12:00:00 PM
Lab ID: 2102653-002 **Matrix:** SOIL **Received Date:** 2/11/2021 4:51:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 300.0: ANIONS						Analyst: **VP**	
Sulfate	200	7.5		mg/Kg	5	2/13/2021 1:20:29 AM	58097
RESISTIVITY AND EC SOIL						Analyst: **JRR**	
Resistivity	1370	100		Ohms * c	1	2/16/2021 12:58:00 PM	58142
SM4500H+B/EPA 9040C						Analyst: **JRR**	
pH	8.32			pH Units	1	2/16/2021 12:26:00 PM	R75318

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Limit
S	% Recovery outside of range due to dilution or matrix		

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **2102653**

16-Feb-21

Client: Terracon

Project: Madrid Water Tank

Sample ID: **MB-58097**	SampType: **MBLK**	TestCode: **EPA Method 300.0: Anions**
Client ID: **PBS**	Batch ID: **58097**	RunNo: **75256**
Prep Date: **2/12/2021**	Analysis Date: **2/13/2021**	SeqNo: **2659021** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	ND	1.5								

Sample ID: **LCS-58097**	SampType: **LCS**	TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSS**	Batch ID: **58097**	RunNo: **75256**
Prep Date: **2/12/2021**	Analysis Date: **2/13/2021**	SeqNo: **2659023** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	29	1.5	30.00	0	97.5	90	110			

Sample ID: **2102653-001AMS**	SampType: **MS**	TestCode: **EPA Method 300.0: Anions**
Client ID: **B-01 @ 5'**	Batch ID: **58097**	RunNo: **75256**
Prep Date: **2/12/2021**	Analysis Date: **2/13/2021**	SeqNo: **2659025** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	130	7.5	30.00	109.0	86.0	42.2	138			

Sample ID: **2102653-001AMSD**	SampType: **MSD**	TestCode: **EPA Method 300.0: Anions**
Client ID: **B-01 @ 5'**	Batch ID: **58097**	RunNo: **75256**
Prep Date: **2/12/2021**	Analysis Date: **2/13/2021**	SeqNo: **2659026** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	140	7.5	30.00	109.0	105	42.2	138	4.11	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.
D	Sample Diluted Due to Matrix
H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit
PQL	Practical Quanitative Limit
S	% Recovery outside of range due to dilution or matrix
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
P	Sample pH Not In Range
RL	Reporting Limit

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **2102653**

16-Feb-21

Client: Terracon

Project: Madrid Water Tank

Sample ID: **2102653-002ADUP** SampType: **DUP** TestCode: **Resistivity and eC Soil**

Client ID: **B-02 @ 2.5'** Batch ID: **58142** RunNo: **75319**

Prep Date: **2/16/2021** Analysis Date: **2/16/2021** SeqNo: **2661578** Units: **Ohms * cm**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Resistivity	1620	100						16.7	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.
D	Sample Diluted Due to Matrix
H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit
PQL	Practical Quanitative Limit
S	% Recovery outside of range due to dilution or matrix
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
P	Sample pH Not In Range
RL	Reporting Limit

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: clients.hallenvironmental.com

Sample Log-In Check List

Client Name: **Terracon** Work Order Number: **2102653** RcptNo: **1**

Received By: **Scott Anderson** **2/11/2021 4:51:00 PM**

Completed By: **Cheyenne Cason** **2/12/2021 8:19:40 AM**

Reviewed By: ENM 2/12/21

Chain of Custody

1. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
2. How was the sample delivered? Client

Log In

3. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
4. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
5. Sample(s) in proper container(s)? Yes ☑ No ☐
6. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
7. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
8. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
9. Received at least 1 vial with headspace <1/4" for AQ VOA? Yes ☐ No ☐ NA ☑
10. Were any sample containers received broken? Yes ☐ No ☑
11. Does paperwork match bottle labels? (Note discrepancies on chain of custody) Yes ☑ No ☐
12. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
13. Is it clear what analyses were requested? Yes ☑ No ☐
14. Were all holding times able to be met? (If no, notify customer for authorization.) Yes ☑ No ☐

# of preserved bottles checked for pH: _____ (<2 or >12 unless noted)

Adjusted? _____

Checked by: SPA 2.12.21

Special Handling (if applicable)

15. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: _____ Date: _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

16. Additional remarks:

17. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	16.8	Good				

Chain-of-Custody Record

Client: Terracon

Mailing Address: 6805 Academy Pkwy West NE
Albuquerque, Nm 87109

Phone #: 505-797-4287

email or Fax#: 505-797-4288

QA/QC Package:
☐ Standard ☐ Level 4 (Full Validation)

Accreditation: ☐ Az Compliance
☐ NELAC ☐ Other

☐ EDD (Type)

Turn-Around Time:
☐ Standard ☒ Rush ASAP

Project Name: Madrid Water Tank

Project #: 66205185

Project Manager: Mike Anderson

Sampler: SPA 2.11.21

On Ice: ☒ Yes ☐ No

# of Coolers: —

Cooler Temp(including CF): 16.9-0.1 (°C)

HALL ENVIRONMENTAL ANALYSIS LABORATORY
www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Date	Time	Matrix	Sample Name	Container Type and #	Preservative Type	HEAL No. 2102653	BTEX / MTBE / TMB's (8021)	TPH:8015D(GRO / DRO / MRO)	8081 Pesticides/8082 PCB's	EDB (Method 504.1)	PAHs by 8310 or 8270SIMS	RCRA 8 Metals	Cl, F, Br, NO_3, NO_2, PO_4, SO_4	8260 (VOA)	8270 (Semi-VOA)	Total Coliform (Present/Absent)	pH	Resistivity			
2/11/21	12:00	Soil	B-01 @ 5'			001							/				/	/			
2/11/21	12:00	Soil	B-02 @ 2.5'			002							/				/	/			

Analysis Request

Date:	Time:	Relinquished by:	Received by:	Via:	Date	Time
2/11/21	12:00		SPA	COO	2.11.21	1651
Date:	Time:	Relinquished by:	Received by:	Via:	Date	Time

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI_{50}	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
B-01	2.5 - 3.5	SM	95	6	45	22	19	3										1
B-01	5.0 - 6.5	SM		7										8.5	1530	110		2
B-01	8.5 - 9.0	SM		3														2
B-02	2.5 - 3.5	GC	102	3	12	34	20	14						8.3	1370	200		1
B-02	5.0 - 6.5	SC		6														2
B-02	8.0 - 8.9	SC		5														2
B-02	10.0 - 10.6	SC		6	23	32	16	16										
B-02	15.0 - 15.7	SC		6	36	27	18	9										
B-02	20.0 - 20.3	SC		5														2

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: Madrid Water Tank

SITE: 2801A NM 14
Madrid, NM

Terracon
6805 Academy Pkwy West NE
Albuquerque, NM
PH. 505-797-4287 FAX. 505-797-4288

PROJECT NUMBER: 66205185

CLIENT: Tierra West LLC
Albuquerque, NM

SUPPORTING INFORMATION

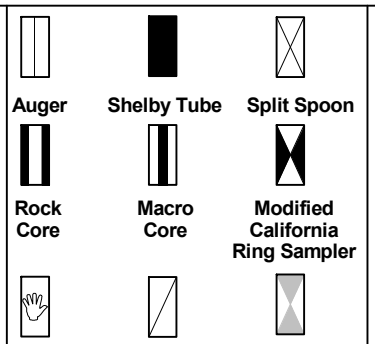
Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



WATER LEVEL

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.