Geotechnical Engineering Report

North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs, Colorado
February 20, 2023 (Revised August 2, 2024)
Terracon Project No. 23195091

Prepared for:
Wilson & Company
Colorado Springs, Colorado

Prepared by:
Terracon Consultants, Inc.
Wheat Ridge, Colorado

February 20, 2023 (Revised August 2, 2024)

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Attn: Mr. Vance Fossinger
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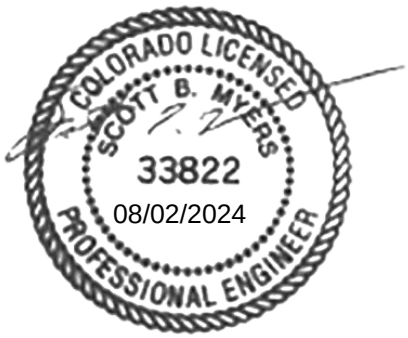
Re: Geotechnical Engineering Report
North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs, Colorado
Terracon Project No. 23195091

Mr. Fossinger:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Amendment No. 1 to Project No. 15-100-08101, dated October 24, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of new storm sewer system and water quality pond 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.



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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.

FIGURES

ATTACHMENTS

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

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	The project consists of constructing 2,700 linear feet of storm sewer line and associated 3.5-acre permanent water quality pond. The storm sewer alignment will begin near the intersection of Struthers Road and Shepard Heights, continuing south along Struthers Road before turning west along North Gate Boulevard. The sewer diameter ranges from 24 to 48 inches and will be installed at depths of approximately 5 to 15 feet below existing grades. There are several manhole structures planned along the alignment. The sewer line will terminate at a proposed permanent water quality pond between the north and south bound lanes of Interstate 25. The pond outlet will tie into an existing storm sewer west of the project site. The pond will have a rip-rap lined spillway as well as a concrete outlet structure. Slopes for the proposed pond are planned to be on the order of about 20 percent or 5H:1V (Horizontal to Vertical) or flatter.
Geotechnical Characterization – Sewer Line Alignment	Subsurface conditions encountered in the borings along the sewer line alignment (Boring Nos. B-1 to B-5) generally consisted of sand soils with varying amounts of clay, silt, and gravel and fat clay soils with varying amounts of sand to depths of about 12 feet and the maximum depth explored of about 20 feet in Boring Nos. B-1, B-2 and B-5. In Boring Nos. B-3 and B-4 the native soils were underlain by claystone bedrock to the maximum depths explored of about 20 feet. Existing fill material was encountered in Boring No. B-2. The existing fill materials were encountered to depths of about 2 feet. The existing fill materials generally consisted of sand soils with varying amounts of silt. Groundwater was encountered in four of the five borings during field exploration. Groundwater was encountered at depths ranging from 6 to 15 feet below the existing ground surface. The shallowest groundwater encountered was in Boring No. B-5 at a depth of about 6 feet below ground surface.
Geotechnical Characterization – Proposed Water Quality Pond	Subsurface conditions encountered in the borings in the area of the proposed water quality pond (Boring Nos. P-1 to P-3, PZ-1 to PZ-4, and S-1) generally consisted of 5 to 8 feet of existing fill materials underlain by native soils consisting of sand with varying amounts of silt and gravel to varying depths of about 12 to 23 feet. The existing fill materials generally consisted of sand soils with varying amounts of silt and clay. The native soils were underlain by bedrock consisting of claystone, siltstone, and sandstone to the maximum depths explored of about 25 to 30½ feet. Groundwater was encountered in all of the exploratory borings for the proposed water quality pond at varying depths of about 4 to 16 feet when the borings were drilled.
Earthwork	Areas of loose soil should be overexcavated and re-compacted as engineered fill. Onsite soils, including existing fill materials, are generally reusable as engineered fill for this project.

Topic [1]	Overview Statement [2]
Excavation Concerns	Temporary dewatering will be required to install the sewer line based on the groundwater levels encountered in our borings and the invert elevations interpolated from the provided drawings. Temporary dewatering may also be required for construction of the northern portion of the proposed pond. Based on the provided plans, groundwater in the northern portion of the pond around Boring No. P-1 was above the bottom of the proposed pond at the time of our field exploration. Conventional excavation equipment should be capable of completing the required excavations. Excavations are anticipated to reach as deep as 15 feet. Excavations within the native soils should be able to be accomplished with conventional excavation equipment. We do not anticipate excavations will extend into the underlying bedrock materials, but if excavations do extend into these materials heavy-duty excavation equipment may be required. Excavations should be properly constructed in compliance with Occupational Safety and Health Administration (OSHA) guidelines.
Pavements	This report includes recommendations for asphalt pavements for Struthers Road and North Gate Boulevard. At the time of this report, we understand a Traffic Study has not been performed for Struthers Road and North Gate Boulevard. The pavement thickness recommendations presented in this report are based on Struthers Road having a functional classification of Urban Principal Arterial, 4-lane, and North Gate Boulevard having a functional classification of Urban Expressway, 4-lane. The design life for the pavements is 20 years. The Equivalent Single Axle Load (ESAL) for the classifications is as follows: ■ Struthers Road: 5,256,000 ESALs ■ North Gate Boulevard: 7,884,000 ESALs
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

North Gate / Struthers PWQ Pond & Storm Sewer

Colorado Springs, Colorado

Terracon Project No. 23195091

February 20, 2023 (Revised August 2, 2024)

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed storm sewer and permanent water quality pond. The proposed storm sewer is to be constructed along the southern end of Struthers Road, along North Gate Boulevard between Struthers Road and the median of I-25. The proposed pond will be located in the median of I-25, south of North Gate Boulevard in Colorado Springs, Colorado.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater levels
- Earthwork
- Storm sewer line recommendations
- Lateral earth pressures
- Manhole foundation design and construction
- Pond design and construction
- Pavement design and construction

The geotechnical engineering Scope of Services for this project consisted of two phases of exploration. Terracon's initial investigation began with exploratory borings conducted within the general area of the proposed water quality pond. Terracon was later contacted to perform exploration and testing along Struthers Road and North Gate Boulevard, as well as additional exploration and installation of piezometers within the proposed pond area. Plans showing the site and boring locations are shown in the **Site Location and Exploration Plans** section. The results of the laboratory testing performed on soil and bedrock samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

A supplemental exploration was performed for the water quality pond to evaluate environmental and hydrologic conditions within the area of the proposed water quality pond. Results of the supplemental exploration are provided under a separate cover.

This report was revised on August 2, 2024 to provide alternate recommendations for the proposed storm sewer and the water quality pond.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration.

Item	Description
Existing Improvements	Struthers Road and North Gate Boulevard are paved with asphalt, and have concrete curb, gutters and sidewalks.
Existing Topography	Based on the provided 60% plans, existing grade along the alignment ranges from approximately 6,748.5 feet on the eastern end and falls to approximately 6,675 feet at the western end of the alignment.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning.

Item	Description
Information Provided	Wilson & Co provided the following PDF documents: ■ Struthers & North Gate_WQP_60%REV Plans Sheets 1 though 12 ■ El Paso County Engineering Criteria Manual, revision 6, dated December 13, 2016 (herein referred to as The Standards)
Project Description	The project consists of constructing 2,700 linear feet of storm sewer line and associated 3.5-acre permanent water quality pond. The storm sewer alignment will begin near the intersection of Struthers Road and Shepard Heights, continuing south along Struthers Road before turning west along North Gate Boulevard. The sewer diameter ranges from 24 to 48 inches and will be installed at depths of approximately 5 to 15 feet below existing grades. There are several manhole structures planned along the alignment. The sewer line will terminate at a proposed permanent water quality pond between the north and south bound lanes of Interstate 25. The pond outlet will tie into an existing storm sewer west of the project site. The pond will have a rip-rap lined spillway as well as a concrete outlet structure. Slopes for the proposed pond are planned to be on the order of about 20 percent or 5:1 (Horizontal to Vertical) or flatter.

Item	Description
Grading/Slopes	Final grades will match existing grades for the sewer line installation. No cut/fill is proposed for the sewer alignment. Cuts for the proposed pond are anticipated to be on the order of about 9 feet on the northern end of the pond and about 4 feet on the southern end of the pond. A 9 foot embankment will be constructed on the southern end of the pond. Slopes for the proposed pond are planned to be on the order of about 20 percent or 5:1 (Horizontal to Vertical) of flatter.
Maximum Excavation Depth	Sewer line installation: about 15 feet Water quality pond: about 9 feet
Pavements	This report includes recommendations for asphalt pavements to be reconstructed along Struthers Road and North Gate Boulevard after construction of the proposed storm sewer. At the time of this report, we understand a Traffic Study has not been performed for Struthers Road and North Gate Boulevard. The pavement thickness recommendations presented in this report are based on Struthers Road having a functional classification of Urban Principal Arterial, 4-lane, and North Gate Boulevard having a functional classification of Urban Expressway, 4-lane. The design life for the pavements is 20 years. The Equivalent Single Axle Load (ESAL) for the classifications is as follows: ■ Struthers Road: 5,256,000 ESALs ■ North Gate Boulevard: 7,884,000 ESALs

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 noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Subsurface Profile

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	**Asphalt**	Asphalt; about 4 to 6 inches
2	**Apparent Aggregate Base Course**	Apparent Aggregate Base Course; approximately 6 inches
3	**Fill Materials**	Fill materials consisting of sand soils with varying amounts of silt and clay
4	**Native Sand Soils**	Well to poorly graded sand; with varying amounts of silt and clay; loose to very dense
5	**Native Clay Soils**	Fat clay; with varying amounts of sand; high plasticity; stiff to hard
6	**Bedrock**	Bedrock consisting of claystone, siltstone and sandstone; firm to hard

Stratification boundaries on the boring logs represent the approximate location of changes in soil and material types; in situ, the transition between materials may be gradual. Further details of the borings can be found on the boring logs in the **Exploration Results**.

Based on the results of the laboratory testing and our experience in the area, the native clay soils have low to high expansive potential, while the sand fill materials and native sand soils are considered to have nil to low expansive potential. Based on our experience in the area, the claystone, siltstone and sandstone bedrock are considered to have nil to low expansive potential. A summary of laboratory test results is included in the **Exploration Results**.

Groundwater Conditions

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

Boring No.	Shallowest depth to groundwater encountered while or upon completion of drilling[1] (feet)	Shallowest elevation to groundwater encountered while drilling or upon completion of drilling (feet above Mean Sea Level)
B-1	None encountered to the maximum depth explored of 20 feet	--
B-2	16	6,707
B-3	14	6,699

Boring No.	Shallowest depth to groundwater encountered while or upon completion of drilling[1] (feet)	Shallowest elevation to groundwater encountered while drilling or upon completion of drilling (feet above Mean Sea Level)
B-4	8	6,682
B-5	6	6,675
S-1	16	6,660
P-1	6	6,670
P-2	16	6,664
P-3	13	6,661
PZ-1[2]	8	6,668
PZ-2[2]	4	6,673
PZ-3[2]	7	6,660
PZ-4[2]	16	6,651

1. Due to safety concerns, borings were backfilled immediately after completion in Boring Nos. B-1 to B-5, S-1, and P-1 to P-3. Therefore, subsequent groundwater measurements were not obtained.
2. Temporary piezometers were installed in Boring Nos. PZ-1 to PZ-4.

These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions.

GEOTECHNICAL OVERVIEW

Based on subsurface conditions encountered in the borings, the site appears suitable for the proposed construction from a geotechnical point of view, provided certain precautions and design and construction recommendations outlined in this report are followed. We have identified geotechnical conditions that could impact design and construction of the proposed storm sewer line, proposed water quality pond, and replacement pavements.

Temporary Dewatering

Groundwater was encountered as shallow as 4 feet below existing site grades in the exploratory borings during the field explorations. Based on the provided plans and measured groundwater

depths, a temporary dewatering system will be necessary for the installation of the proposed storm sewer and most likely the northern portion of the water quality pond.

Based on the subsurface conditions encountered in the exploratory borings, a temporary dewatering system consisting of well points could be considered. We recommend that a specialty dewatering contractor be contacted to consult on the most efficient temporary dewatering recommendations for the proposed project.

Shoring

Excavations as deep as 15 feet below existing grades are anticipated for the installation of the storm sewer line. If excavations slopes cannot be safely excavated in accordance with Occupational Health and Safety Administration (OSHA) requirements, shoring will be required to reach the planned excavation depths. The depth of excavations, adjacent utilities, and subsurface soils will influence the type of shoring system that may be used. A qualified shoring contractor should be contacted to design and install the shoring system for the installation of the sewer line.

Existing Fill Materials

Up to approximately 2 feet of fill materials were encountered in the borings drilled along the alignment of the storm sewer, while up to about 8 feet of existing fill was encountered in the area of the proposed pond. It should be noted that fill depths presented in the boring logs are approximate and the depth, lateral extents, and composition of fill should be expected to vary. The existing fill can be reused as engineered fill below pavements and for the pond construction, provided any deleterious materials are removed. New engineered fill should meet the requirements of imported soils in the **Material Types** subsection in **Earthwork**.

EARTHWORK

Earthwork is anticipated to include, removing portions of existing pavements, clearing and grubbing, excavations, and engineered fill placement. All earthwork on the project should be observed and evaluated by Terracon.

Site Preparation

Strip and remove existing pavements, vegetation, organics and other deleterious materials from proposed utility and pavement areas. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

Stripped materials consisting of vegetation, unsuitable fills and organic materials should be wasted from the site or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

Although evidence of underground facilities such as vaults, septic tanks, and foundations was not observed during the site reconnaissance, such features could 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.

Excavations within the native soils should be able to be accomplished with conventional excavation equipment. We do not anticipate excavations will extend into the underlying bedrock materials, but if excavations do extend into these materials heavy-duty excavation equipment may be required.

Based on the provided plans and measured groundwater depths, a temporary dewatering system will be necessary for the installation of the proposed storm sewer and most likely the northern portion of the water quality pond. We recommend that a specialty dewatering contractor be contacted to consult on the most efficient temporary dewatering recommendations for the proposed project.

The stability of subgrade soils may be affected by precipitation and seasonal groundwater conditions, repetitive construction traffic or other factors. Where unstable conditions are encountered or develop during construction, workability may be improved by overexcavation of wet zones and mixing these soils with crushed gravel or recycled concrete and recompaction.

Material Types

Fill for this project should be classified as engineered fill. Engineered fill is material that meets the criteria presented in this report and has been properly moisture conditioned, compacted and documented. Engineered fill should meet the following material property requirements:

Soil Type [1]	USCS and AASHTO Classification	Acceptable Locations for Placement
On-site sand soils	SM, SP, SW-SM, SC A-1 through A-3	The on-site sand soils are considered acceptable for use as engineered fill
On-site highly plastic clays	CH A-6 and A-7	Highly plastic clay soils should not be reused as engineered fill below pavements but may be used for construction of the proposed pond.
On-site claystone, siltstone and sandstone bedrock	N/A	Claystone, siltstone, and sandstone bedrock, if encountered, are not considered suitable for reuse as engineered fill.
Imported soils	Varies	Imported soils meeting the gradation outlined herein can be considered suitable for use as structural and/or general fill.

Soil Type [1]	USCS and AASHTO Classification	Acceptable Locations for Placement

1. Engineered 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.

Imported soils for use as engineered fill should conform to the following:

Gradation	Percent finer by weight (ASTM C136)
1”	100
No. 4 Sieve	50 - 80
No. 200 Sieve	<35

Soil Properties	Value
R-Value (below pavements)	50 (min.)
Liquid Limit	20 (max)
Plastic Index	10 (max)
Expansive Potential [1] (below pavements)	0 percent (max)

1. Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at one percent below optimum water content. The sample is confined under a 150 psf surcharge and submerged.

Fill Compaction Requirements

Engineered fill should meet the following compaction requirements.

Item	Structural Fill
Maximum lift thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack, plate compactor) is used
Minimum compaction requirements [1, 2, 3]	98% of the materials maximum dry density

Item	Structural Fill
Water content range [2, 4]	Within three percent of optimum water content

1. We recommend that engineered fill be tested for water content and compaction during placement. Should the results of the in-place density tests indicate the specified water or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified water and compaction requirements are achieved.
2. Maximum dry density and optimum water content as determined by the Standard Proctor test (D698).
3. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D4253 and D4254).
4. Moisture contents should be maintained low enough to allow for satisfactory compaction to be achieved without the compacted fill material becoming unstable under the weight of construction equipment or during proof-rolling. Indications of unstable soil can include pumping or rutting.

Grading and Drainage

All grades must be adjusted to provide positive drainage away from excavations during construction. Infiltration of water into utility excavations must be prevented during construction. Water permitted to pond near or adjacent to the perimeter of the utilities (either during or post-construction) can result in soil movements.

Exposed ground should be sloped at a minimum of 10 percent grade for at least 10 feet beyond the perimeter of above grade structures, where possible. Backfill against manhole structure walls and in utility trenches should be well compacted and free of all construction debris to reduce the possibility of water infiltration. To limit water infiltration, we recommend using flowable fill as backfill around the perimeter of the manhole structures. After construction and prior to project completion, we recommend that verification of final grading be performed to document that positive drainage, as described above, has been achieved.

Flatwork and pavements will be subject to post construction movement. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post-construction movement of flatwork, particularly if such movement would be critical.

Earthwork Construction Considerations

Excavations for the proposed sewer line and water quality pond are anticipated to be accomplished with conventional construction equipment. There is a potential for the on-site soils to become unstable near the level of groundwater, particularly under repetitive construction traffic.

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.

Care should be taken to maintain the moisture content of the subgrade prior to placement of the manhole structures, pipes, and earthen embankments. Construction traffic (if any) over prepared subgrade should be minimized and avoided to the extent practical. Construction traffic over the processed subgrade will eventually reduce the moisture content and increase the density of the subgrade. Subsequent wetting of these materials will result in undesirable movement.

The site should also be graded to prevent ponding of surface water on prepared subgrade or in excavations. In areas where water is allowed to pond over a period of time, the affected area should be removed and allowed to dry out.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer.

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. 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.

STORM SEWER RECOMMENDATIONS

We anticipate that the proposed storm sewer will be underlain by native soils and claystone bedrock. The following paragraphs present design and construction recommendations for the proposed storm sewer.

Deep Backfill Zones

The magnitude of settlement of the deep backfill zones associated with storm sewer installations will be directly related to the type of fill material used, the degree of compaction, and the thickness of the fill zone. The following table outlines the anticipated movement of backfill based on the depth of excavation and material type used.

Excavation Depth (feet)	Estimated Backfill Movement (inch)
10	Less than about 1 inch
15	About 1 inch

These estimates assume that the degree of compaction for fill zones is maintained in accordance with this report. Using clean gravel or controlled low-strength materials (CLSM) backfill could reduce settlement. The use CLSM should meet the requirements of the Colorado Department of Transportation specifications.

Storm Sewer Design Recommendations

Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results utilities may be constructed on the native soils and claystone, provided the owner is willing to risk some potential movement. Design recommendations for storm sewer are presented in the following table.

Description	Value
Bedding recommendations	4 inches of clean gravel bedding material should be placed below the bottom of new storm sewer pipe.
Storm Sewer Subgrade Preparation	Where bedrock or soft/loose unstable soils are exposed in the base of the excavation, these materials should be overexcavated to a depth of at least 12 inches below the bottom of the pipe and replaced with 4 inches of bedding below the pipe and 8 inches of ¾-inch angular stone wrapped in a geotextile below the bedding material.

Description	Value
Geotextile Fabric	A Class 3 geotextile fabric such as a Mirafi N140 or equivalent should be wrapped around the 8 inches of ¾ inch rock.

Manhole Structure Foundation Recommendations

Based on the subsurface conditions encountered in the exploratory borings at the proposed manhole structure locations and results of the laboratory testing, the proposed manhole structures may be constructed on a mat foundation system, provided some movement can be tolerated. The proposed manhole structures are assumed to be constructed of precast concrete, therefore the bottom of each precast manhole structure is anticipated to act as a mat slab foundation.

Design recommendations for mat foundation systems are presented in the following table and paragraphs.

Description	Value
Overexcavation/Modification Depth	Scarify the subgrade a minimum of 12 inches, moisture condition, and compact to subgrade.
Supporting Stratum	Native soils, claystone bedrock, or new engineered fill
Maximum Net Allowable Bearing Pressure [1,2]	2,000 psf
Modulus of Subgrade Reaction	130 pci
Approximate Total Movement from Foundation Loads [3]	About 1 inch

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This pressure assumes that any existing fill or lower strength soils, if encountered, will be excavated and replaced with engineered fill.
2. Maximum allowable soil bearing pressure can be increased by 1/3 for transient loading conditions.
3. Foundation movement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the thickness of engineered fill (if any), and the quality of the earthwork operations and footing construction.

POND DESIGN AND CONSTRUCTION RECOMMENDATIONS

The sewer line will terminate at a proposed permanent water quality pond between the north and south bound lanes of Interstate 25. The pond outlet will tie into an existing storm sewer west of the project site. The pond will have a rip-rap lined spillway as well as a concrete outlet structure. We understand that the pond is currently designed without a liner.

Cuts for the proposed pond are anticipated to be on the order of about 9 feet on the northern end of the pond and about 4 feet on the southern end of the pond. A 9 foot embankment will be constructed on the southern end of the pond.

Shallow Groundwater

Based on the groundwater elevation determined from our field exploration, as presented in the following table, groundwater will be encountered the northern portion of the proposed pond.

Boring No.	Shallowest elevation to groundwater encountered while drilling or upon completion of drilling [1] (feet)	Approximate bottom of pond elevation (feet)
P-1	6,670	6,667.5
P-2	6,664	6,666
P-3	6,661	6,665

1. Due to safety concerns, borings were backfilled immediately after completion. Therefore, subsequent groundwater measurements were not obtained.

The possibility of water seepage into the northern portion of the pond should be considered in the design of the proposed pond. Temporary dewatering will most likely be required to construct the northern portion of the pond. Based on the subsurface conditions encountered in the exploratory borings, a temporary dewatering system consisting of well points could be considered. We recommend that a specialty dewatering contractor be contacted to consult on the most efficient temporary dewatering recommendations for the proposed project.

Although groundwater is anticipated to be below the bottom of the majority of the pond, where water is in close proximity to the bottom of the pond unstable soil conditions may be encountered during construction. If unstable soil conditions are encountered, stabilization of these soils may be required. A stabilization technique commonly used in these soil conditions is to knead large angular rock into the loose soils. An alternative technique is to use a combination of a geogrid and granular fill materials. If unstable soil conditions develop during construction, we should be contacted to provide site specific stabilization recommendations at that time.

Pond Slopes

Slopes for the proposed pond are planned to be on the order of about 20 percent or 5:1 (Horizontal to Vertical) or flatter. Provided pond slopes consist of on-site sand soils or imported fill and are properly compacted, it has been our experience these materials are capable of maintaining 20 percent slopes. However, a formal slope stability analyses was not performed to assess the stability of the proposed pond slopes. In order to determine the anticipated factor of safety against slope failure for the proposed pond slopes, formal slope stability analyses should be performed.

Concrete Trickle Channel

Based on the results of our subsurface exploration, we anticipate the concrete trickle channel will be constructed on native sand soils and will have a low risk of movement. We recommend the subgrade soils below the trickle channel be scarified to a minimum depth of about 12 inches, properly moisture conditioned and compacted prior to concrete placement. If required, new fill materials beneath the trickle channel should be placed and compacted as outlined in the **Earthwork** section of this report.

Pond Construction

Up to about 8 feet of existing fill materials were encountered in the borings drilled in the proposed pond areas (Boring Nos. P-1 to P-3, PZ-1 to PZ-4, and S-1). We are not aware if the existing fill materials were properly moisture conditioned and compacted during placement and consider the fill to be uncontrolled. Structures constructed on uncontrolled fill could experience several inches of movement due to the settlement of the fill materials. Provided the owner is willing to accept the risk of movement, the proposed embankment may be constructed on the existing fill materials.

Prior to placing engineered fill for the proposed pond construction, the subgrade soils should be scarified a minimum of 12 inches, moisture conditioned and compacted as recommended in the **Earthwork** section of this report.

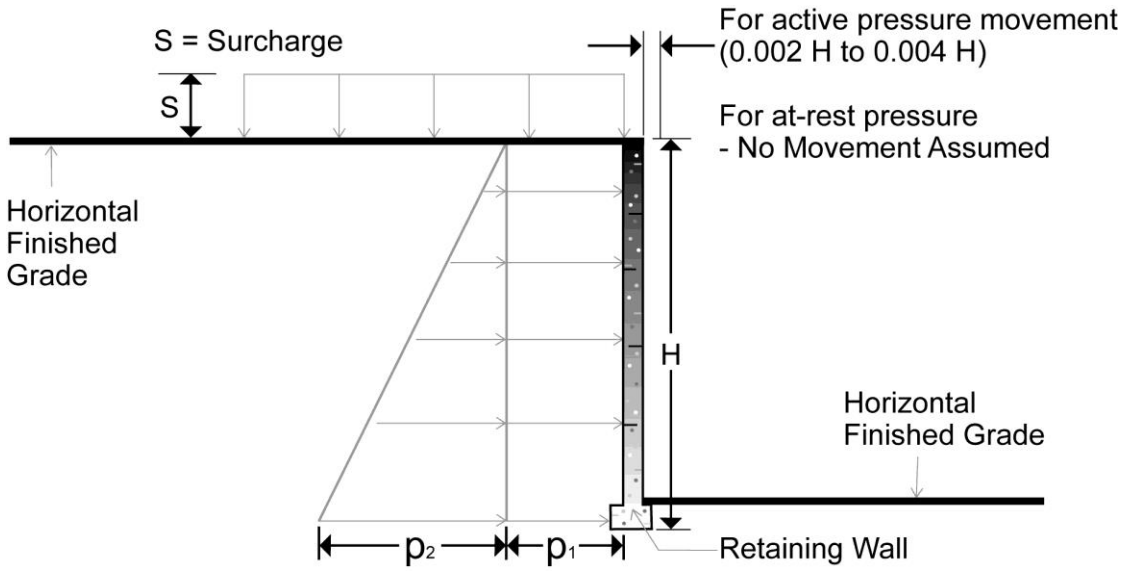
After preparing the pond embankment subgrade, the area of the embankment should be proof-rolled in order to identify soft, loose or unstable soils. If unstable soils are encountered, stabilization efforts will be required prior to construction of the embankment and placement of engineered fill. If unstable soil conditions are encountered during construction, we should be contacted to provide site specific stabilization recommendations at that time.

All finished surfaces of the proposed pond and the portion of the embankment to receive riprap, should be properly moisture conditioned and compacted. For cut slope areas of the pond, some benching, overbuilding and regrading may be required to achieve uniform compaction at final grade.

We recommend riprap for the spillway be designed and installed in general accordance with the Colorado Department of Transportation (CDOT) specifications.

LATERAL EARTH PRESSURES FOR TEMPORARY SHORING AND MANHOLE STRUCTURES

Temporary shoring and manhole structure walls with unbalanced backfill levels should be designed for earth pressures at least equal to those indicated in the following table. Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those 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. 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. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Earth Pressure Conditions	Lateral Earth Pressure Coefficient	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Sand – 0.33	40	(0.33)S	(40)H
At-Rest (Ko)	Sand – 0.50	60	(0.50)S	(60)H
Passive (Kp)	Sand – 3.00	300	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height

- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted to at least 95 percent of standard Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters

To control hydrostatic pressure behind below-grade walls we recommend that a drain be installed below the wall, with a collection pipe leading to a reliable discharge. If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 85 and 90 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment, or floor loading; these values should be added where applicable. Heavy construction equipment (such as cranes) should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

PAVEMENTS

General Pavement Comments

Design of pavements for the project have been performed in general accordance with the guidelines outlined by the *1993 Guideline for Design of Pavement Structures* by the American Association of State Highway and Transportation Officials (AASHTO) and El Paso County's *Engineering Criteria Manual (ECM) – Revision 6* (Standards).

Design Traffic

Traffic loads for Struthers Road and North Gate Boulevard were based on assumed functional classifications presented in the following table. We should be contacted to confirm and/or modify the recommendations contained herein if actual traffic volumes differ from the assumed values shown.

Road	Roadway Functional Classification	20 year EASLs
Struthers Road	Principal Arterial, 4-Lane	5,256,000
North Gate Boulevard	Urban – Expressway 4-Lane	7,884,000

Pavement Design Parameters

Laboratory test results indicate that the subgrade materials classify A-1-a, A-1-b and A-2-4, soils with a group index of 0 according to the American Association of State Highway and Transportation Officials (AASHTO) classification system. The majority of the subgrade soils classified as A-1-b, therefore that soil classification was used in pavement thickness design. A Hveem Stabilometer R-value test (AASHTO T-190) was performed on a bulk sample from Boring No. B-3 and resulted in an R-value of 52. based on our experience with similar subgrade soils and seasonal variations, an R-value of 52 was used for the pavement thickness design for the proposed roads. The R-value was used to calculate a resilient modulus (M_R) of approximately 14,000 psi based on the Standards.

Recommended Minimum Pavement Sections

The pavement thickness designs were performed using strength coefficients and minimum thicknesses in accordance with the Standards. The following strength coefficients were used for the pavement designs:

Pavement Component	Strength Coefficient
Hot Mix Asphalt (HMA)	0.44
Aggregate Base Course (ABC)	0.11

Using the traffic volume assumptions and resilient modulus of the A-1-b soils, structural numbers (SN) of 3.52 and 3.64 were calculated for Struthers Road and North Gate Boulevard, respectively. The recommended pavement thicknesses for hot mix asphalt (HMA) pavement using the traffic loading, subgrade soil strength, and the design parameters presented in the Standards are summarized in the table below:

Traffic Area	Alternative	Preliminary Pavement Thickness (Inches)		
		Asphalt Concrete (HMA)	Aggregate Base Course (ABC)	Total
Struthers Road	A	8	--	8
	B	6	6	12
North Gate Boulevard	A	8 ½	--	8 ½
	B	6	8	14

During construction, some existing pavement sections may be encountered that do not match the above recommended pavement section thicknesses. The above minimum section thicknesses

should be met, even if the existing sections encountered are less than the recommended thicknesses.

Materials Specifications

Pavement construction and materials should conform to the latest version of The Standards

For analysis of pavement costs, the following specifications should be considered for each pavement component:

Pavement Component	Colorado Department of Transportation Criteria
HMA	Grading S or SX
ABC	Class 5 or 6

Pavement Maintenance

Future performance of pavements constructed at this site will be dependent upon several factors, including:

- Maintaining stable moisture content of the subgrade soils both before and after pavement construction.
- Providing for a planned program of preventative maintenance.

The performance of all pavements can be enhanced by minimizing excess moisture, which can reach the subgrade soils. The following recommendations should be implemented:

- Site grading at a minimum 2 percent grade onto or away from the pavements.
- Water should not be allowed to pond behind curbs.
- Compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade.
- Sealing all landscaped areas in or adjacent to pavements, or providing drains to reduce the risk of moisture migration to subgrade soils.
- Placing compacted backfill against the exterior side of curb and gutter.
- Placing curb, gutter, and/or sidewalk directly on subgrade soils without the use of base course materials.

Preventative maintenance should be planned and provided for an ongoing pavement management program in order to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration.

Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program.

Pavement Construction Considerations

Site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, or rainfall. As a result, the pavement subgrade may not be suitable for pavement construction and corrective action will be required. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance or excessive rutting. If disturbance has occurred, pavement subgrade areas should be reworked, moisture conditioned, and properly compacted to the recommendations in this report immediately prior to paving.

We recommend the pavement areas be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading and paving. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving.

The placement of a partial pavement thickness for use during construction is not recommended without a detailed pavement analysis incorporating construction traffic. In addition, if the actual traffic varies from the assumptions outlined above, we should be contacted to confirm and/or modify the pavement thickness recommendations outlined above.

CORROSIVITY

The following table lists the results of laboratory water-soluble sulfate, pH, chlorides, and electrical resistivity testing performed on samples obtained during our field exploration. These values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Boring No.	Sample Depth (feet)	Water-Soluble Sulfate [1] (% by mass)	pH	Chlorides (mg/kg)	Electrical Resistivity (ohm-cm)
B-2	0 – 5	<0.10	7.38	130	2328
B-3	0 – 5	<0.10	7.46	200	1164

1. Results of water-soluble sulfate testing indicate that samples of the on-site soils have an exposure class of S0 when classified in accordance with Table 19.3.1.1 of the American Concrete Institute (ACI) Design Manual. The results of the testing indicate ASTM Type I Portland Cement is suitable for project concrete in contact with on-site soils. However, if there is no (or minimal) cost differential, use of ASTM Type II Portland Cement is recommended for additional sulfate resistance of construction concrete. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

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.

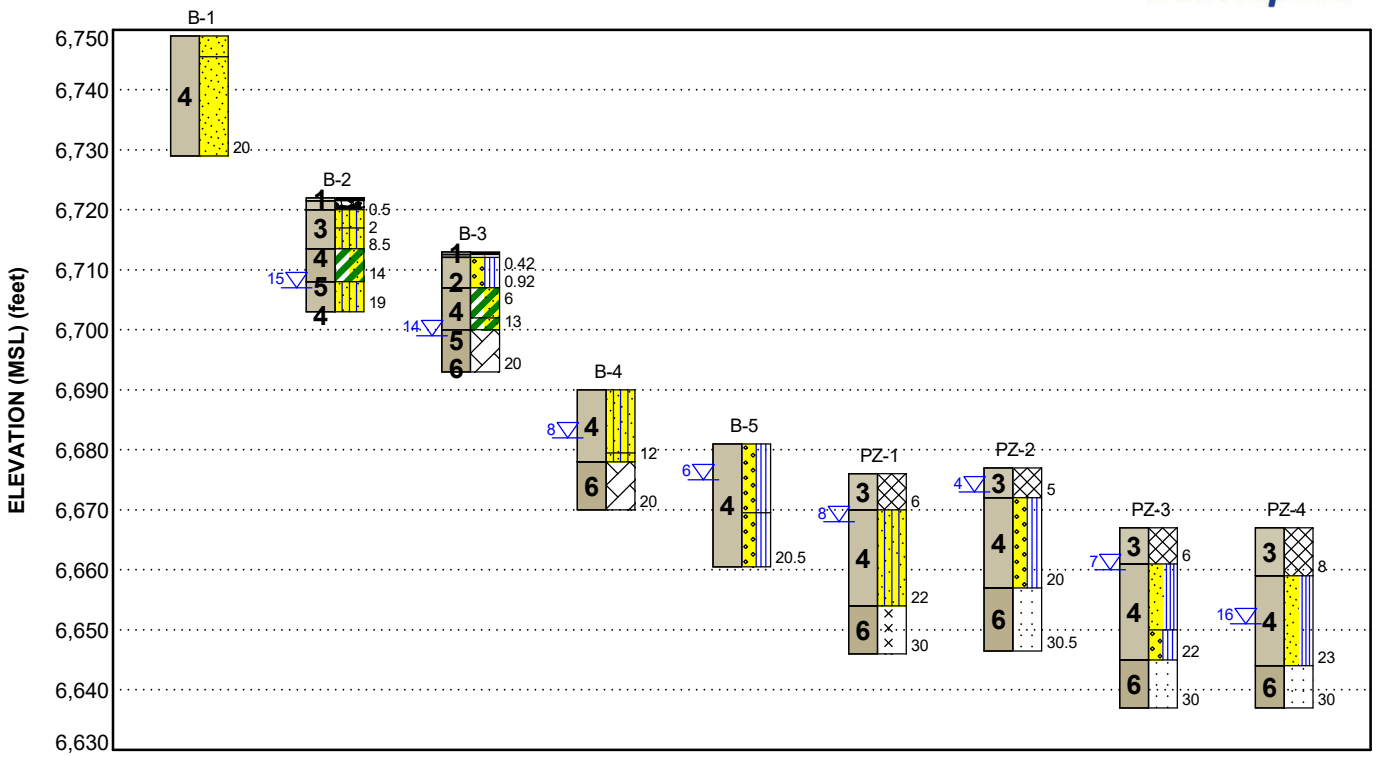
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation 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

North Gate / Struthers PWQ Pond & Storm Sewer ■ Colorado Springs, Colorado
Terracon Project No. 23195091



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	**Asphalt**	Asphalt; approximately 6 to 10 Inches
2	**Aggregate Base Course**	Aggregate Base Course; approximately 6 Inches
3	**Fill Materials**	Fill materials consisting of sand soils with varying amounts of silt
4	**Native Sand Soils**	Well to Poorly Graded Sand; with varying amounts of silt and clay; loose to very dense
5	**Native Clay Soils**	Fat Clay; with varying amounts of sand; high plasticity; stiff to hard
6	**Bedrock**	Bedrock consisting of claystone; firm to very hard

LEGEND

- Poorly-graded Sand
- Asphalt
- Fill
- Silty Sand
- Fat Clay with Sand
- Aggregate Base Course
- Well-graded Sand with Silt
- Claystone
- Fill
- Siltstone
- Sandstone
- Poorly-graded Sand with Silt

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.

▽ First Water Observation
▽ Second Water Observation

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring Layout and Elevations: The locations of the borings are presented in the **Site Location and Exploration Plans**. The borings were located in the field by overlaying the site plan on Bing Maps, recording the latitude and longitude coordinates, and staking the borings using a handheld, recreational-grade GPS unit. The accuracy of the latitude and longitude values is typically about +/- 25 feet when obtaining the values using this method. Elevations at the borings were interpolated to the nearest foot from the provided 60 percent drawings "North Gate/Struthers PWQ Pond Storm Sewer and Detention Plan" dated May 28, 2021. The accuracy of the boring locations and elevations should only be assumed to the level implied by the methods used.

Subsurface Exploration Procedures: The borings were drilled with CME-55 truck-mounted drill rig with hollow-stem augers. During the drilling operations, lithologic logs of the borings were recorded by the field engineer. Relatively undisturbed samples were obtained at selected intervals utilizing a 2-inch outside diameter standard split spoon sampler and a 3½-inch outside diameter modified Dames and Moore sampler. Bulk samples were obtained from auger cuttings. Penetration resistance values were recorded in a manner similar to the standard penetration test (SPT). This test consists of driving the sampler into the ground with a 140-pound hammer free falling through a distance of 30 inches. The number of blows required to advance the barrel sampler 12 inches (18 inches for standard split-spoon samplers, final 12 inches are recorded) or the interval indicated is recorded and can be correlated to the standard penetration resistance value (N-value). The blow count values are indicated on the boring logs at the respective sample depths, barrel sampler blow counts are not considered N-values.

An automatic hammer was used to advance the samplers in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The standard penetration test provides a reasonable indication of the in-place density of sandy type materials, but only provides an indication of the relative stiffness of cohesive materials since the blow count in these soils may be affected by the soils moisture content. In addition, considerable care should be exercised in interpreting the N-values in gravelly soils, particularly where the size of the gravel particle exceeds the inside diameter of the sampler.

Groundwater measurements were obtained in the borings at the time of drilling. Boring Nos. B-1 through B-5 were backfilled with auger cuttings and patched with cold patch asphalt after drilling. Some settlement of the backfill and patches may occur and should be repaired as soon as possible.

Laboratory Testing

Samples retrieved during the field exploration were returned to the laboratory for observation by the Geotechnical Engineer and were classified in general accordance with the Unified Soil Classification System presented in the **Supporting Information**.

At this time, an applicable laboratory-testing program was formulated to determine engineering properties of the subsurface materials. Following the completion of the laboratory testing, the field descriptions were confirmed or modified as necessary, and the boring logs were prepared. The boring logs are included in the **Exploration Results**.

Laboratory test results are included in the **Exploration Results**. These results were used for the geotechnical engineering analyses and the development of foundation, earthwork, and pavement recommendations. All laboratory tests were performed in general accordance with the applicable local or other accepted standards.

Selected soil samples were tested for the following engineering properties:

- Water content
- Dry density
- Grain size distribution
- Atterberg limits
- Swell/consolidation
- Water-soluble sulfate content
- Chlorides
- pH
- Electrical resistivity
- R-Value

SITE LOCATION AND EXPLORATION PLANS

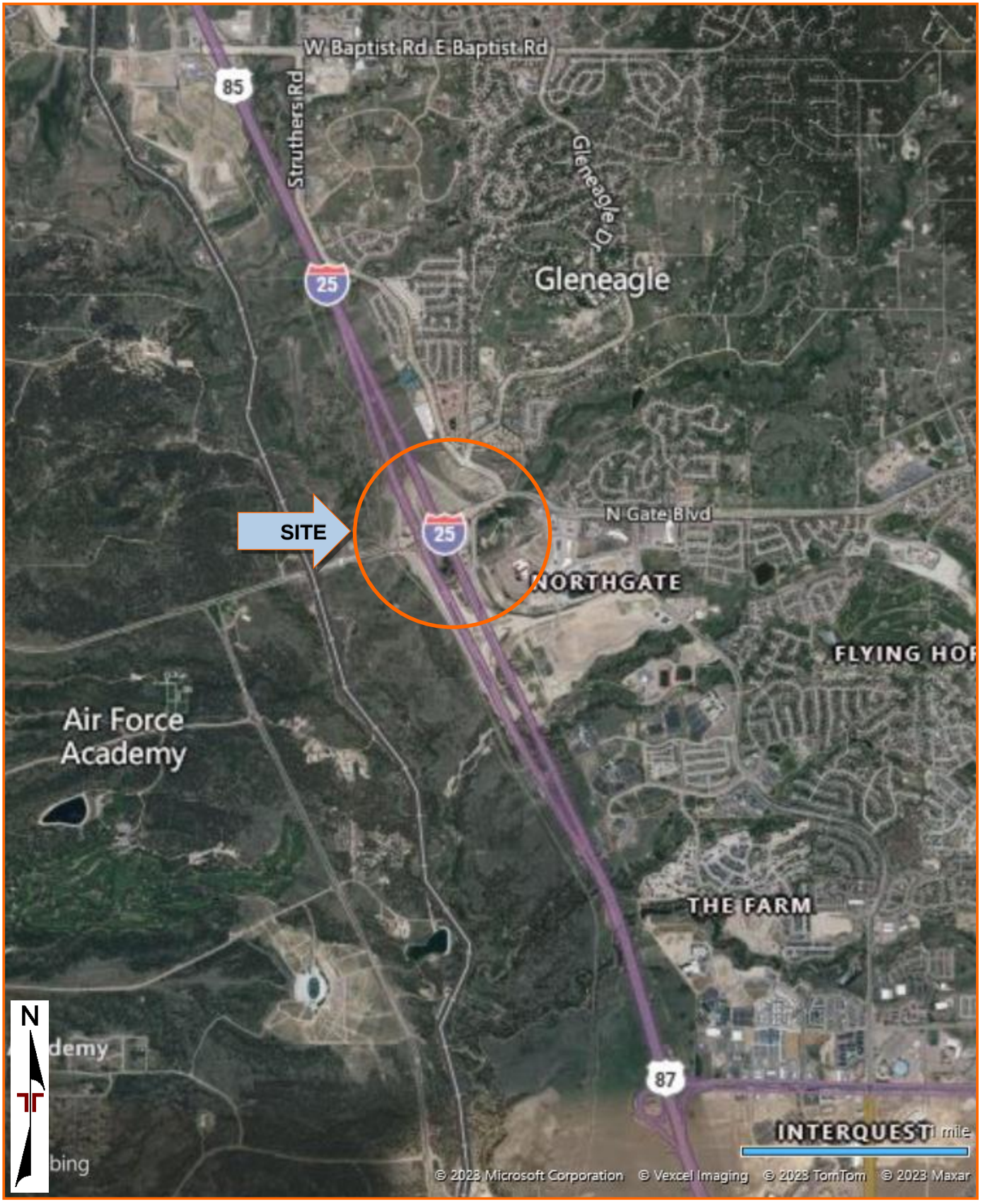
Contents:

Site Location Plan
Exploration Plan with Project Overlay
Exploration Plan with Soils Overlay
Pavement Thickness Plan

Note: All attachments are one page unless noted above.

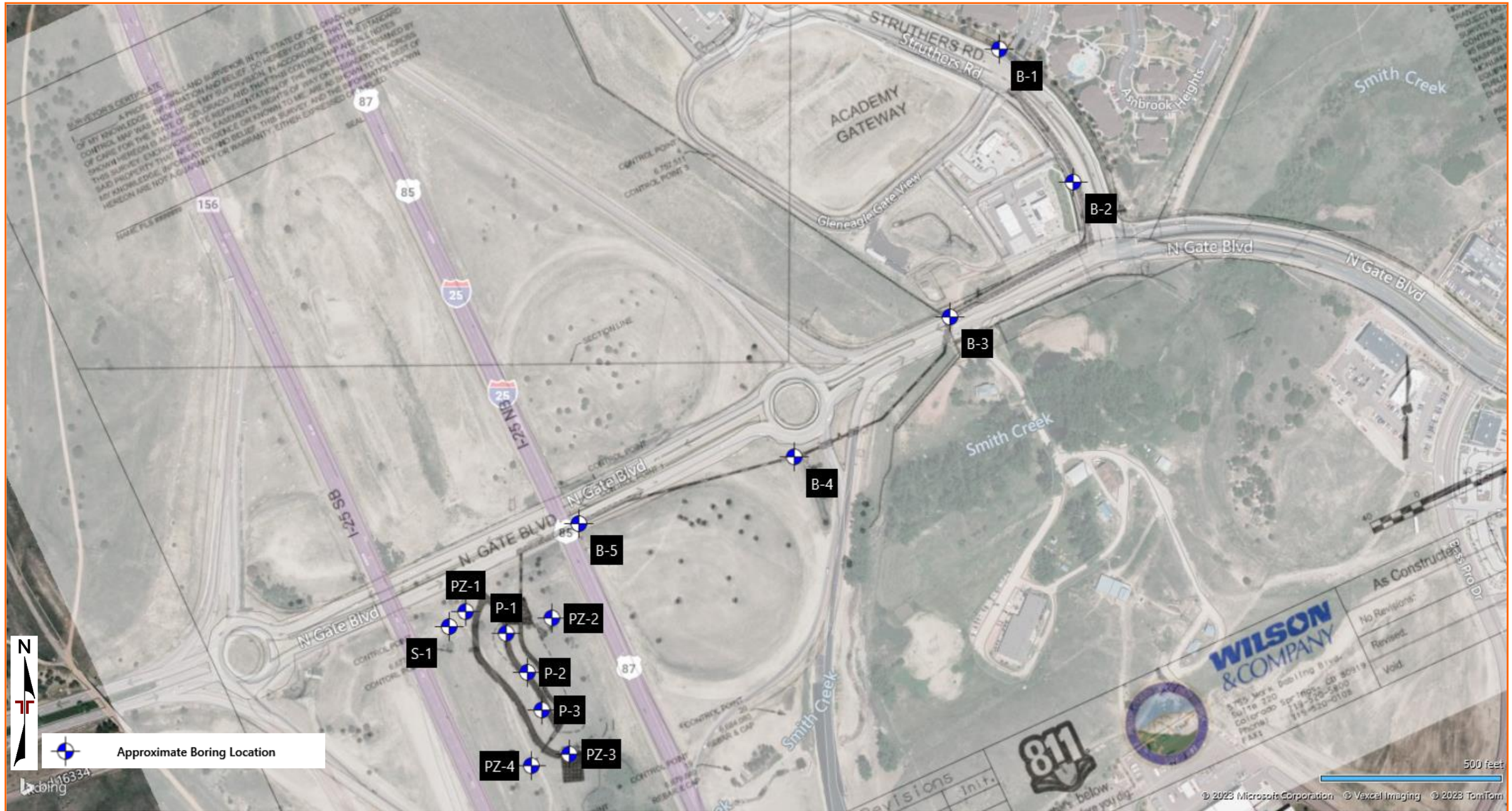
SITE LOCATION PLAN

North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs, Colorado
June 12, 2023 (Revised August 2, 2024) ■ Terracon Project No. 23195091



AERIAL PHOTOGRAPHY PROVIDED
BY MICROSOFT BING MAPS

EXPLORATION PLAN WITH PROJECT OVERLAY
North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs, Colorado
June 12, 2023 (Revised August 2, 2024) ■ Terracon Project No. 23195091



AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN WITH AASHTO SOIL CLASSIFICATIONS

North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs, Colorado
June 12, 2023 (Revised August 2, 2024) ■ Terracon Project No. 23195091

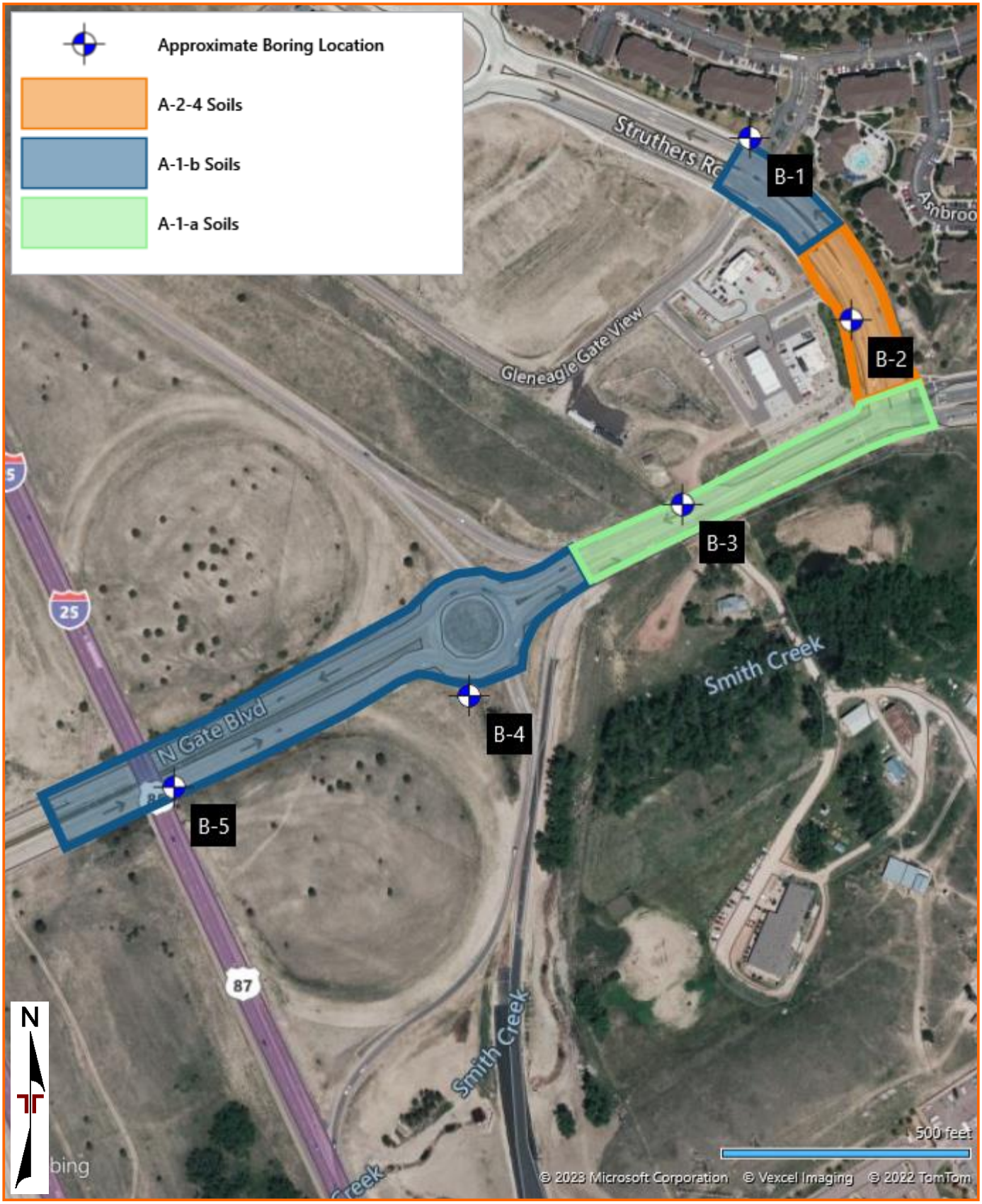


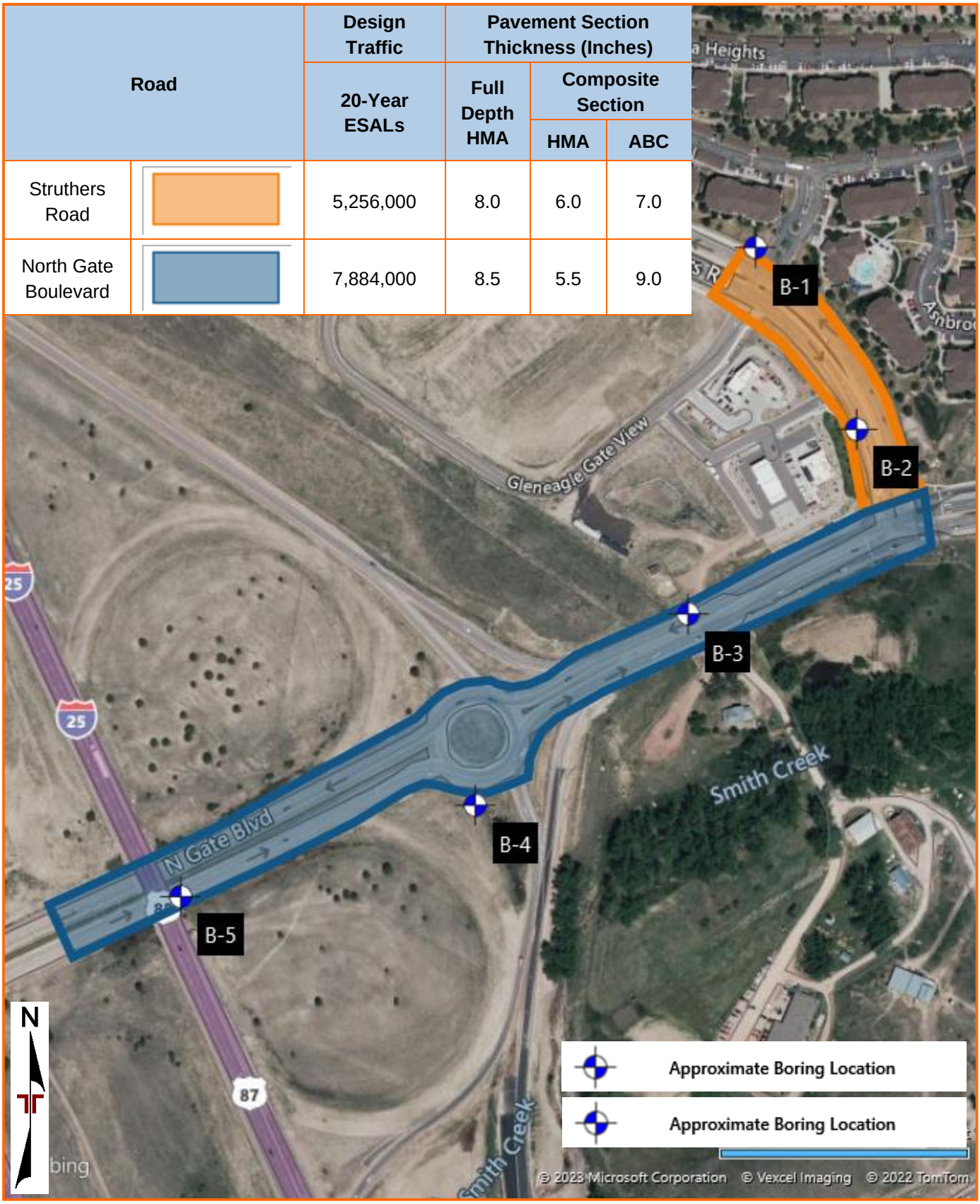
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN WITH PROJECT OVERLAY

North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs, Colorado
June 12, 2023 (Revised August 2, 2024) ■ Terracon Project No. 23195091

Road		Design Traffic	Pavement Section Thickness (Inches)		
		20-Year ESALs	Full Depth HMA	Composite Section	
				HMA	ABC
Struthers Road		5,256,000	8.0	6.0	7.0
North Gate Boulevard		7,884,000	8.5	5.5	9.0



AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan
Latitude: 39.0299° Longitude: -104.8290°
Station: STA 36+25
Approximate Surface Elev.: 6749 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4		0			0								
								9-13		3.7			
		3.5	6745.5+/-										
			Approximate elevation of bottom of Storm Sewer: 6745.5										
								8-16		5.3	116	NP	4
					5								
								7-14		6.3	109		
								17-16		4.9	108		
					10								
								12-19					
					15								
		20.0	6729+/-					10-21		6.9	111		
					20								

POORLY GRADED SAND (SP), A-1-b, fine to coarse grained, nonplastic, light brown to brown, moist, medium dense

Boring Terminated at 20 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Elevation of bottom of Storm Sewer: 6744ft

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

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
Not encountered

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-14-2022 | Boring Completed: 12-14-2022
Drill Rig: CME-55 | Driller: Site Services
Project No.: 23195091

BORING LOG NO. B-2

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0289° Longitude: -104.8283°

Station: STA 31+00

Approximate Surface Elev.: 6722 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.5	6721.5+/-	**ASPHALT**, approximately 6 Inches										
3		2.0	6720+/-	**FILL - SILTY SAND (SM)**, A-2-4 (0), fine to coarse grained, light brown, moist					14-15		8.4	107	NP	31
4		5.0	6717+/-	**SILTY SAND (SM)**, A-2-4 (0), fine to coarse grained, gray to very dark gray, moist, very loose to medium dense		5			2-4		5.7	109		
				Approximate elevation of bottom of Storm Sewer: 6717					7-11					
5		8.5	6713.5+/-	**FAT CLAY WITH SAND (CH)**, A-7-6 (22), high plasticity, gray to dark gray, moist, stiff		10			5-6	0.7 @ 500 psf	31.2	86	53-27-26	79
4		14.0	6708+/-	**SILTY SAND (SM)**, fine to coarse grained, light brown, moist to wet, medium dense		15			14-21		9.5			
		19.0	6703+/-	***Boring Terminated at 19 Feet***										

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

Elevation of bottom of Storm Sewer: 6719ft

Hammer Type: Automatic

Advancement Method:
4 Inch OD Solid Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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

▽ *Water observed at 15 feet while drilling*

Caved at 15 feet

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-14-2022 | Boring Completed: 12-14-2022

Drill Rig: CME-55 | Driller: Site Services

Project No.: 23195091

BORING LOG NO. B-3

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0279° Longitude: -104.8294°

Station: STA 25+80

Approximate Surface Elev.: 6713 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.4	6712.6+/-	**ASPHALT**, approximately 5 Inches
0.9	6712.1+/-	**FILL - AGGREGATE BASE COURSE**, approximately 6 Inches
		WELL GRADED SAND WITH SILT (SW-SM), A-1-a (0), fine to coarse grained, light brown to reddish brown, moist, loose
6.0	6707+/-	**FAT CLAY WITH SAND (CH)**, with clayey sand lenses, fine to coarse grained, reddish brown with gray streaks, moist, stiff to hard
11.0	6702+/-	Approximate elevation of bottom of Storm Sewer: 6702
13.0	6700+/-	**CLAYSTONE**, A-6 (8), gray with oxidation streaks, moist to wet, firm to hard
20.0	6693+/-	***Boring Terminated at 20 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		5-7	5.7	112	NP	1
5		6-8	3.2	113	NP	6
		4-11	15.6	110		
10		17-48				
		16-25	16.0		34-19-15	67
15						
		50/5"				
20						

Stratification lines are approximate. In-situ, the transition may be gradual.
Elevation of bottom of Storm Sewer: 6702ft

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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

▽ *Water observed at 14 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-14-2022 | Boring Completed: 12-14-2022

Drill Rig: CME-55 | Driller: Site Services

Project No.: 23195091

BORING LOG NO. B-4

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0269° Longitude: -104.8310°

Station: STA 19+25

Approximate Surface Elev.: 6690 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4			**SILTY SAND (SM)**, fine to coarse grained, brown to light brown to reddish brown, moist to wet, medium dense to very dense					10-15		3.8	114		
								10-11		4.1	116		
					5	▽		13-38		11.5	118		
								50/5"					
		10.5	6679.5+/-		10								
		12.0	Approximate elevation of bottom of Storm Sewer: 6679.5 6678+/-										
6			**CLAYSTONE**, A-6 (4), gray, moist to wet, hard					50-50/4"		1.6			
					15								
		20.0	6670+/-					15-50/5"				34-21-13	51
			Boring Terminated at 20 Feet		20								

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

Elevation of bottom of Storm Sewer: 6679ft

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

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

▽ *Water observed at 8 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-15-2022 | Boring Completed: 12-15-2022

Drill Rig: CME-55 | Driller: Site Services

Project No.: 23195091

BORING LOG NO. B-5

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0264° Longitude: -104.8331°

Station: STA 13+15

Approximate Surface Elev.: 6681 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4													
								12-21		6.6	118	NP	8
								16-23		8.5			
					5	▽							
								7-12					
								8-11					
					10								
		11.5	6669.5+/-										
								5-6-4 N=10		13.5			
					15								
								38-50/5"		12.8			
		20.5	6660.5+/-		20								

WELL GRADED SAND WITH SILT (SW-SM), A-1-b (0), fine to coarse grained, nonplastic, light brown, moist to wet, loose to very dense

Approximate elevation of bottom of Storm Sewer: 6669.5

with clayey sand horizons, light gray

Boring Terminated at 20.5 Feet

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

Elevation of bottom of Storm Sewer: 6669ft

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

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

▽ *Water observed at 6 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-14-2022 | Boring Completed: 12-14-2022

Drill Rig: CME-55 | Driller: Site Services

Project No.: 23195091

BORING LOG NO. S-1

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0256° Longitude: -104.8343°

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
3		0.0											
								7-8		4.9	107		
					5			5-6		5.2	108		
								7-13		6.2	106		
								7-9		10.3	111	NP	5
4					10								
								7-9		7.8	119		
					15	▽							
								6-8-14 N=22		17.5			
					20								
								20-30-50/4" N=80/10"		11.8			
6		22.0			25								
		25.5											

FILL - CLAYEY SAND (SC), fine to medium grained, dark brown, loose

POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained, light brown and orangish brown, loose to medium dense

WEATHERED CLAYSTONE, gray to dark gray, firm

CLAYSTONE, gray to dark gray, very hard

Boring Terminated at 25.5 Feet

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem auger

Abandonment Method:
Boring backfilled with auger 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.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 16 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 10-01-2019 | Boring Completed: 10-01-2019

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23195091

BORING LOG NO. P-1

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0255° Longitude: -104.8338°

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
3		0.0		**FILL - POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, dark brown, medium dense					13-16		7.4	121	NP	9
									10-13		8.4	111		
						5	▽							
									6-10		19.6	107		
									8-11					
4						10								
									5-3-7 N=10		12.3			
						15								
									9-10-20 N=30		12.0			
						20								
		22.0		**WEATHERED CLAYSTONE**, light gray, firm										
6									13-11-12 N=23		11.6			
		27.0		**CLAYSTONE**, gray, very hard		25								
									N=50/5"		24.0			
		30.0		***Boring Terminated at 29.5 Feet***										

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem auger

Abandonment Method:
Boring backfilled with auger 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.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 6 feet while drilling*

▽ *Water observed at 6 feet on 10/4/19*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 10-01-2019 | Boring Completed: 10-01-2019

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23195091

BORING LOG NO. P-2

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0252° Longitude: -104.8336°

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4	0		**FILL - CLAYEY SAND (SC)**, fine to medium grained, dark brown and gray, loose to medium dense, with silty sand lenses					18-19		3.2	114		
								16-20		8.0	104		
					5								
								3-4		9.2	116	32-25-7	35
	9.0					▽		7-13		32.6	79		
			POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained, light brown and gray, medium dense, with lenses of clay		10								
								20-31		13.3	117		
					15	▽							
	18.0												
6			**CLAYSTONE**, gray, hard to very hard, with oxidation staining		20			16-24-50 N=74		15.9			
	25.0												
			Boring Terminated at 25 Feet		25			30-50/5" N=50/5"		16.1			

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem auger

Abandonment Method:
Boring backfilled with auger 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.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 16 feet while drilling*

▽ *Water observed at 9 feet on 10/4/19*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 10-01-2019 | Boring Completed: 10-01-2019

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23195091

BORING LOG NO. P-3

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0250° Longitude: -104.8334°

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4		0											
								16-17		2.6	116		
					5			12-13		10.7	117		
								4-6		8.0	115		
					10	▽		2-4		12.2	105		
						▽							
					15			12-50/5" N=50/5"		15.4	119		
6													
					20			24-17-12 N=29		17.5			
					25			14-26-50/3" N=76/9"		15.6			
		12.0											
		25.5											

FILL - CLAYEY SAND, fine to medium grained, dark brown to varying shades of gray, very loose to medium dense

CLAYSTONE, gray, weathered to very hard

Boring Terminated at 25.5 Feet

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem auger

Abandonment Method:
Boring backfilled with auger 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.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 13 feet while drilling*

▽ *Water observed at 10 feet on 10/4/19*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 10-01-2019 | Boring Completed: 10-01-2019

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23195091

BORING LOG NO. PZ-1

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0257° Longitude: -104.8341°

Approximate Surface Elev.: 6676 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
3				**FILL - WELL GRADED SAND WITH SILT (SW-SM)**, fine to coarse grained, light to dark brown to brown, moist, loose to medium dense					11-14		5.2	115		
									5-6		5.3		NP	9
		6.0	6670+/-			5								
4				**SILTY SAND (SM)**, fine to coarse grained, nonplastic, light brown to brown, moist to wet, loose to very dense			▽		7-11					
									6-10					
						10								
									4-4-4 N=8					
						15								
									9-30-30 N=60					
						20								
6				**SILTSTONE**, gray with oxidation laminations, moist to wet, hard to very hard					28-50/4"				NP	67
						25								
		30.0	6646+/-						50/1"					
				Boring Terminated at 30 Feet		30								

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

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
A temporary piezometer was constructed in the boring.

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

▽ *Water observed at 8 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-15-2022 | Boring Completed: 12-15-2022

Drill Rig: CME-55 | Driller: Site Services

Project No.: 23195091

BORING LOG NO. PZ-2

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0256° Longitude: -104.8333°

Approximate Surface Elev.: 6677 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION
3		0.0	6677+/-	**FILL - SILTY SAND (SM)**, fine to coarse grained, gray, moist to wet, loose to medium dense
4		5.0	6672+/-	**WELL GRADED SAND WITH SILT (SW-SM)**, fine to coarse grained, tan to brown, moist to wet, medium dense
6		20.0	6657+/-	**SANDSTONE**, gray, moist to wet, hard
		30.5	6646.5+/-	***Boring Terminated at 30.5 Feet***

INSTALLATION DETAILS

WATER LEVEL OBSERVATIONS

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0							
		10-11					
5		7-8-9 N=17					
		7-8-9 N=17					
10		5-5-6 N=11				NP	9
15		3-4-6 N=10					
20		11-16-22 N=38				NP	39
25		10-25-50/4"					
30		19-38-35 N=73				NP	34

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

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
A temporary piezometer was constructed in the boring.

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

▽ *Water observed at 4 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-19-2022 | Boring Completed: 12-19-2022

Drill Rig: CME-75 | Driller: Terracon - Fort Collins

Project No.: 23195091

BORING LOG NO. PZ-3

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0246° Longitude: -104.8331°

Approximate Surface Elev.: 6667 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
3				**FILL - SILTY SAND (SM)**, fine to coarse grained, brown, moist, medium dense					9-7-7 N=14		4.1			
						5			3-3-9 N=12		11.8		NP	14
		6.0	6661+/-											
4				**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to coarse grained, light brown to brown, moist to wet, loose to medium dense			▽		2-1-4 N=5		27.2			
						10			2-4-6 N=10				NP	10
						15			4-6-4 N=10					
		17.0	6650+/-											
				WELL GRADED SAND WITH SILT (SW-SM), fine to coarse grained, light brown to brown, moist to wet, medium dense		20			8-12				NP	8
		22.0	6645+/-											
6				**SANDSTONE**, gray, moist to wet, hard to very hard		25			50/5"				NP	5
		30.0	6637+/-						50/3"					
				Boring Terminated at 30 Feet		30								

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

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
A temporary piezometer was constructed in the boring.

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

▽ *Water observed at 7 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-19-2022 | Boring Completed: 12-19-2022

Drill Rig: CME 75 | Driller: Terracon - Fort Collins

Project No.: 23195091

BORING LOG NO. PZ-4

PROJECT: North Gate / Struthers PWQ Pond & Storm Sewer

CLIENT: Wilson & Company Inc Engineers & Architects Colorado Springs, Colorado

SITE: Colorado Springs, Colorado

LOCATION See Exploration Plan

Latitude: 39.0245° Longitude: -104.8335°

Approximate Surface Elev.: 6667 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
3				**FILL - SILTY SAND (SM)**, fine to coarse grained, brown to black to light gray, moist, loose to medium dense					10-12		5.4	116		
									15-21		5.2	122		
		8.0	6659+/-			5			2-9		18.0	97	NP	14
4				**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to coarse grained, brown to black to light gray, moist to wet, loose to medium dense		10			7-9					
						15	▽		9-15		12.6			
						20			4-8				NP	6
6				**SANDSTONE**, gray, moist to wet, very hard		25			35-50/2"					
		30.0	6637+/-											
				Boring Terminated at 30 Feet		30								

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

Hammer Type: Automatic

Advancement Method:
6 Inch OD Hollow Stem Auger

Abandonment Method:
A temporary piezometer was constructed in the boring.

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

▽ *Water observed at 16 feet while drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 12-15-2022 | Boring Completed: 12-15-2022

Drill Rig: CME-55 | Driller: Site Services

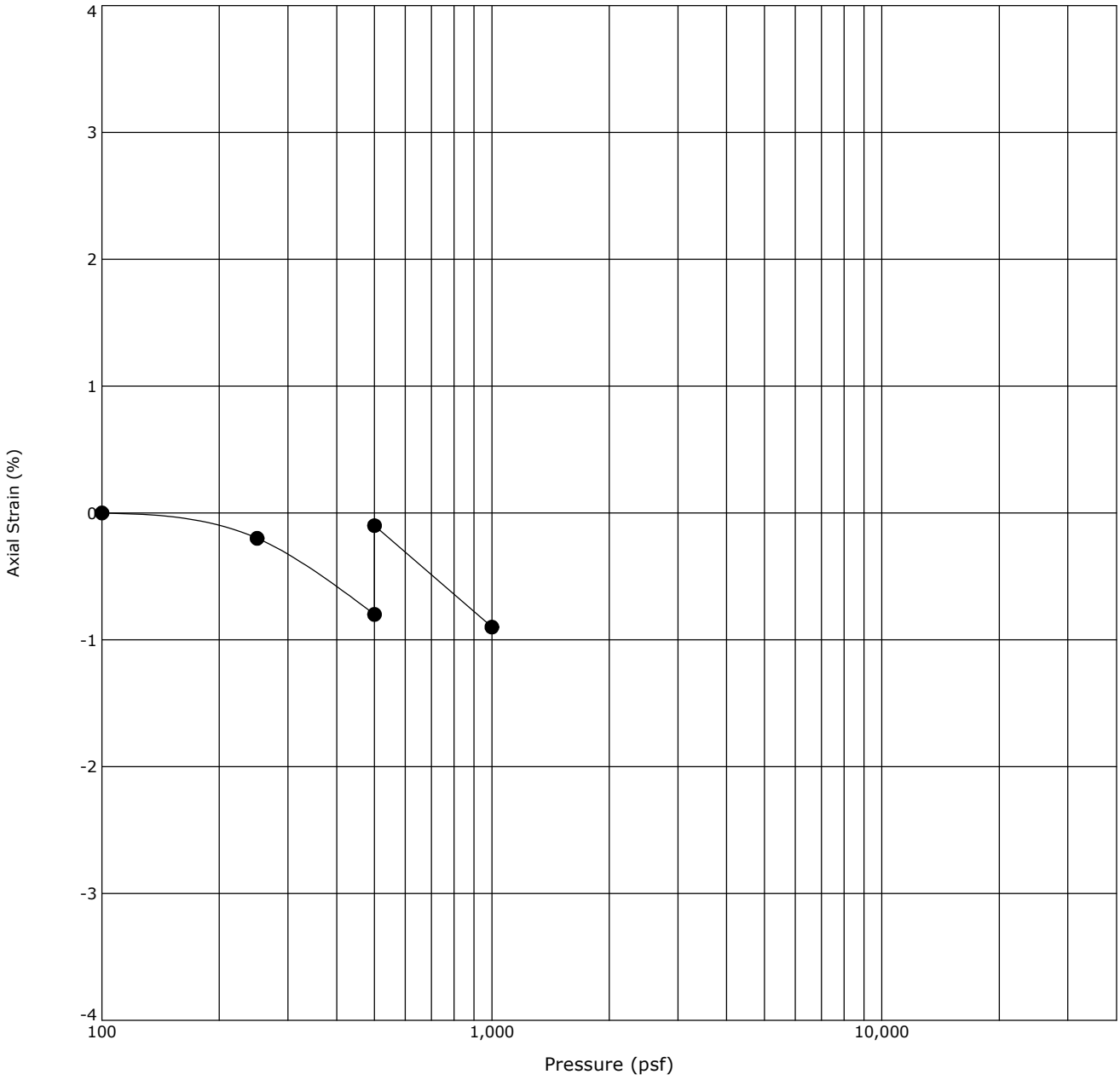
Project No.: 23195091

North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs | Colorado

Terracon Project No. 23195091

Terracon
4172 Center Park Dr
Colorado Springs, CO

Swell Consolidation Test

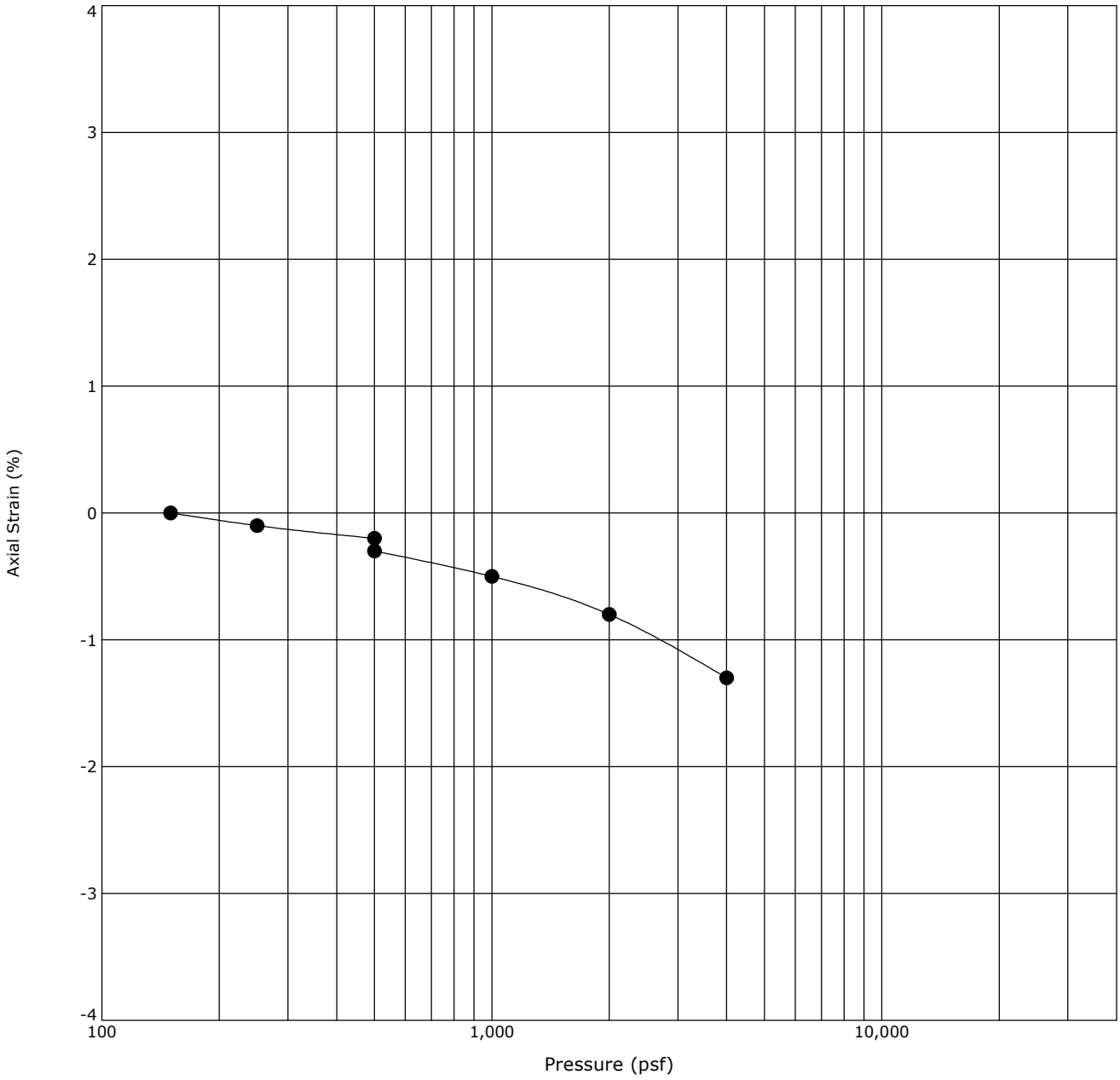


Boring ID	Depth (Ft)	Description	AASHTO	γ_d(pcf)	WC (%)
● B-2	9 - 10	FAT CLAY with SAND	A-7-6 (22)	86	31.2

Notes: Water added at 500 psf

Terracon
4172 Center Park Dr
Colorado Springs, CO

Swell Consolidation Test

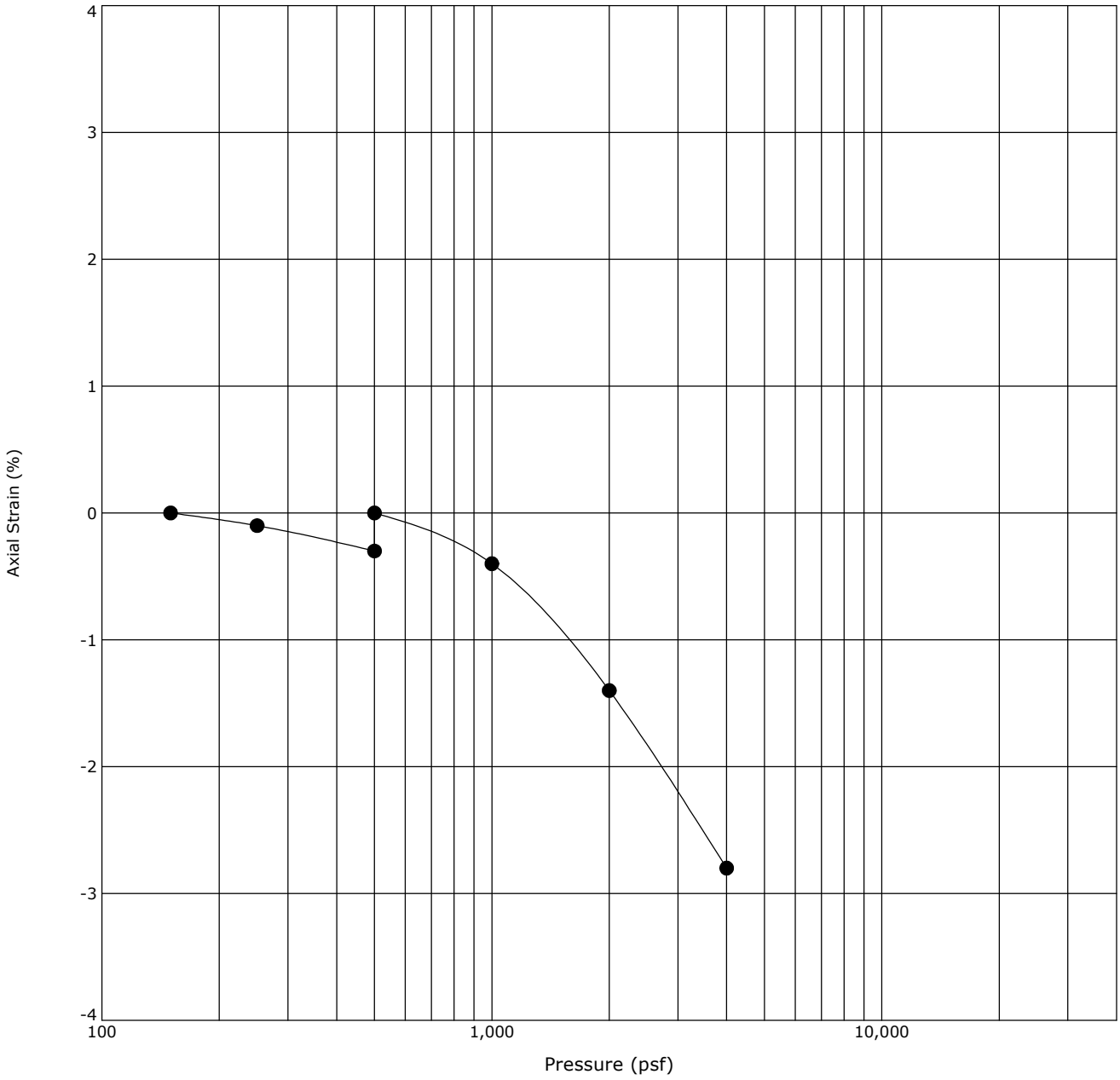


Boring ID		Depth (Ft)	Description	AASHTO	γ_d(pcf)	WC (%)
●	P-1	7 - 8			107	19.6

Notes: Sample inundated with water at 500 pounds per square foot (psf).

Terracon
4172 Center Park Dr
Colorado Springs, CO

Swell Consolidation Test

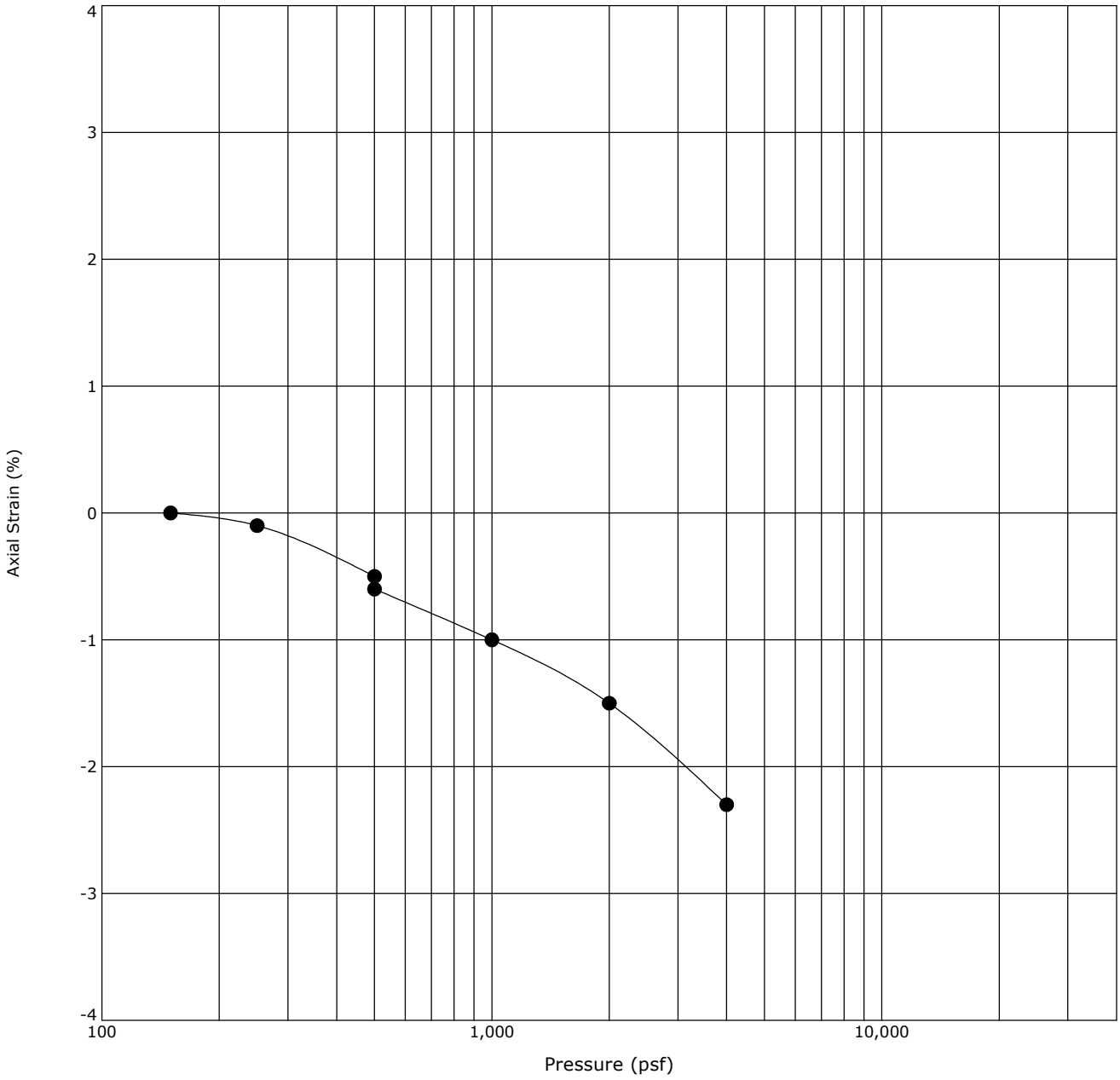


Boring ID		Depth (Ft)	Description	AASHTO	γ_d(pcf)	WC (%)
●	P-2	7 - 8	SILTY SAND	A-2-4 (0)	79	32.6

Notes: Sample inundated with water at 500 pounds per square foot (psf).

Terracon
4172 Center Park Dr
Colorado Springs, CO

Swell Consolidation Test



Boring ID		Depth (Ft)	Description	AASHTO	γ_d(pcf)	WC (%)
●	P-3	7 - 8			115	8.0

Notes: Sample inundated with water at 500 pounds per square foot (psf).

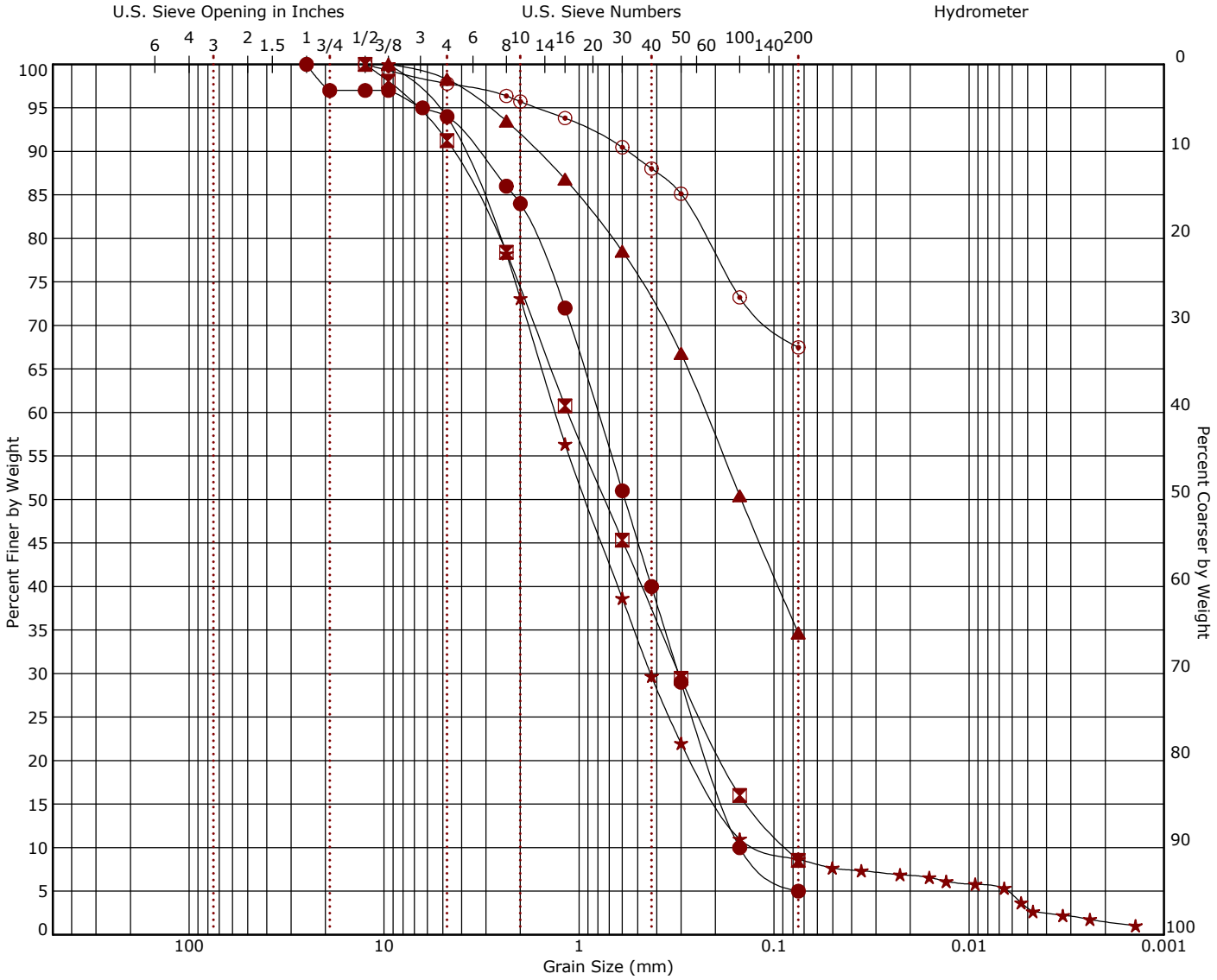
North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs | Colorado

Terracon Project No. 23195091

Terracon
4172 Center Park Dr
Colorado Springs, CO

Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Boring ID		Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
●	S-1	9 - 10	POORLY GRADED SAND with SILT	SP-SM	NP	NP	NP	0.80	5.34
⊠	P-1	2 - 3	POORLY GRADED SAND with SILT	SP-SM	NP	NP	NP	0.96	13.28
▲	P-2	7 - 8	SILTY SAND	SM	32	25	7		
★	PZ-1	4 - 5	WELL-GRADED SAND with SILT	SW-SM	NP	NP	NP	1.25	11.82
⊙	PZ-1	24 - 25	SANDY SILT	ML	NP	NP	NP		

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	S-1	9 - 10	25	0.802	0.31	0.15	0.0	6.0	89.0	5.0		
⊠	P-1	2 - 3	12.5	1.141	0.307	0.086	0.0	8.8	82.7	8.5		
▲	P-2	7 - 8	9.5	0.225			0.0	1.7	63.6	34.7		
★	PZ-1	4 - 5	9.5	1.323	0.43	0.112	0.0	6.1	85.3		5.5	3.1
⊙	PZ-1	24 - 25	12.5				0.0	2.2	30.3	67.5		

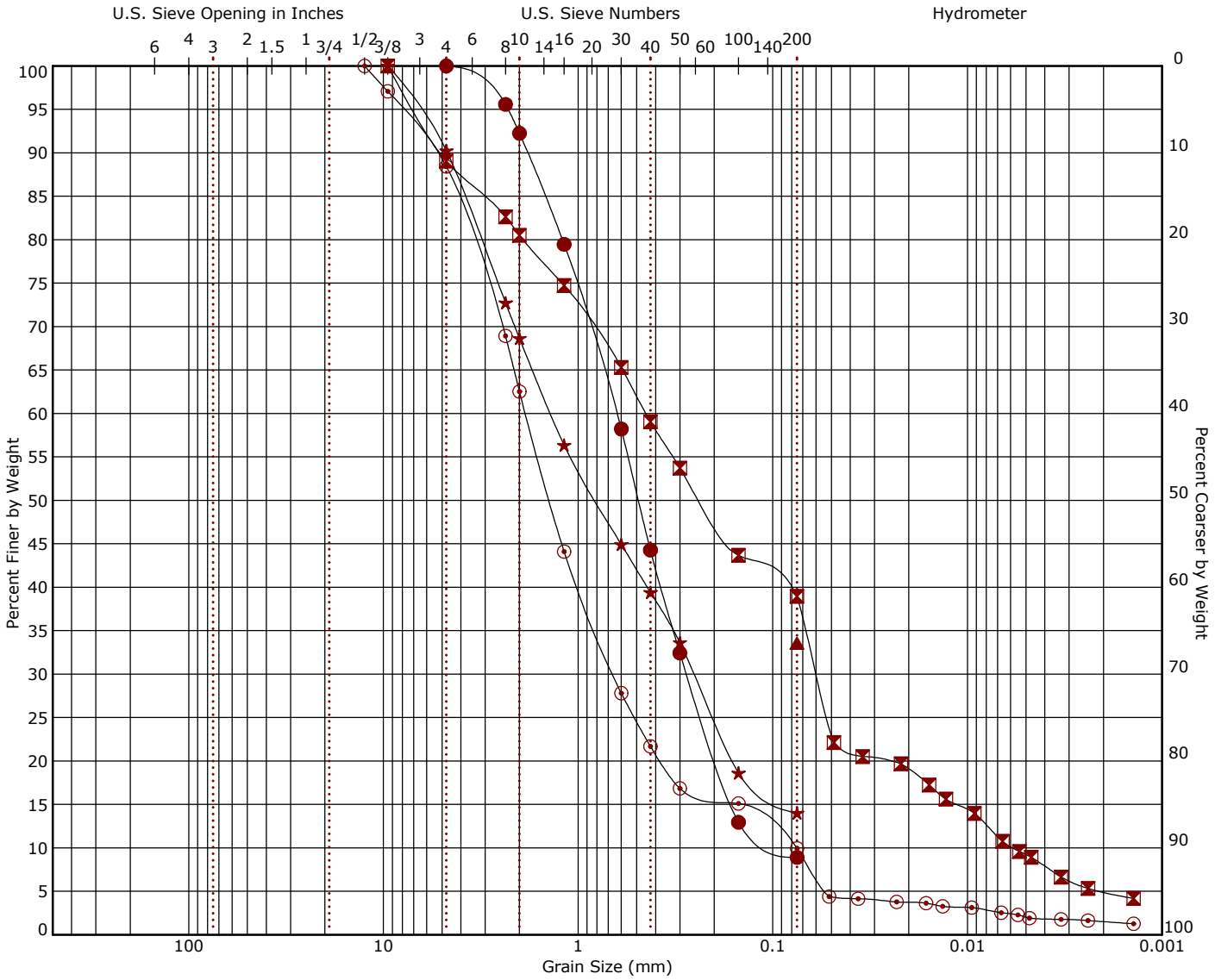
North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs | Colorado

Terracon Project No. 23195091

Terracon
4172 Center Park Dr
Colorado Springs, CO

Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Boring ID		Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
●	PZ-2	9 - 10.5	WELL-GRADED SAND with SILT	SW-SM	NP	NP	NP	1.32	7.02
⊠	PZ-2	19 - 20.5	SILTY SAND	SM	NP	NP	NP	1.36	77.31
▲	PZ-2	29 - 30.5	SILTY SAND	SM	NP	NP	NP		
★	PZ-3	4 - 5.5	SILTY SAND	SM	NP	NP	NP		
⊙	PZ-3	9 - 10.5	POORLY GRADED SAND with SILT	SP-SM	NP	NP	NP	3.07	24.62

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	PZ-2	9 - 10.5	4.75	0.635	0.275	0.09	0.0	0.0	91.1	8.9		
⊠	PZ-2	19 - 20.5	9.5	0.448	0.059	0.006	0.0	11.0	50.1		29.7	9.2
▲	PZ-2	29 - 30.5	0.075							33.6		
★	PZ-3	4 - 5.5	9.5	1.38	0.254		0.0	9.7	76.2	14.0		
⊙	PZ-3	9 - 10.5	12.5	1.86	0.657	0.076	0.0	11.6	78.5		7.9	2.0

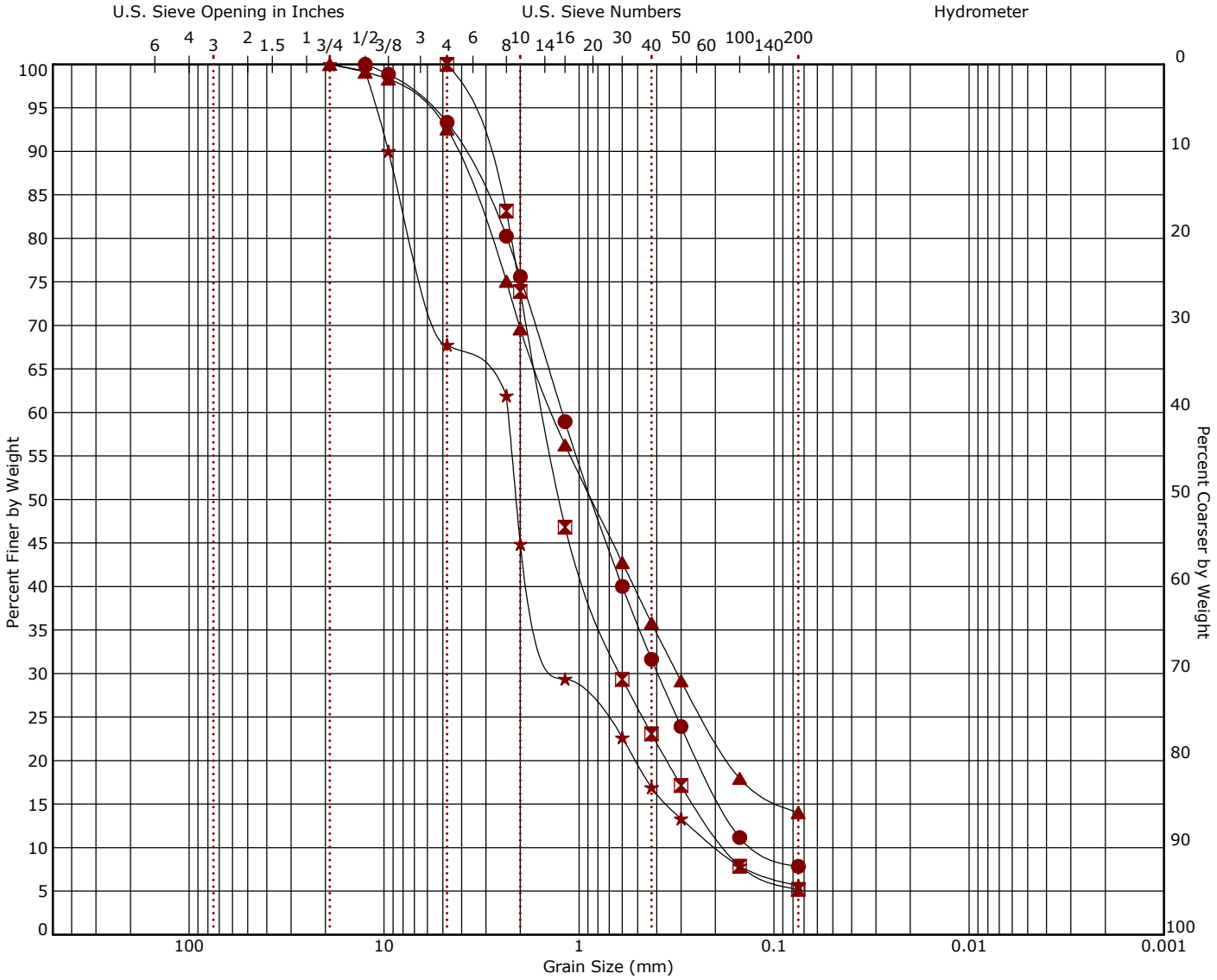
North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs | Colorado

Terracon Project No. 23195091

Terracon
4172 Center Park Dr
Colorado Springs, CO

Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Boring ID		Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
●	PZ-3	19 - 20	WELL-GRADED SAND with SILT	SW-SM	NP	NP	NP	1.09	10.37
⊠	PZ-3	24 - 25	WELL-GRADED SAND with SILT	SW-SM	NP	NP	NP	1.41	8.67
▲	PZ-4	7 - 8	SILTY SAND	SM	NP	NP	NP		
★	PZ-4	19 - 20	POORLY GRADED SAND with SILT and GRAVEL	SP-SM	NP	NP	NP	3.19	11.80

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	PZ-3	19 - 20	12.5	1.22	0.395	0.118	0.0	6.7	85.5	7.8		
⊠	PZ-3	24 - 25	4.75	1.525	0.616	0.176	0.0	0.0	94.8	5.2		
▲	PZ-4	7 - 8	19	1.367	0.313		0.0	7.4	78.5	14.0		
★	PZ-4	19 - 20	19	2.316	1.205	0.196	0.0	32.2	62.1	5.6		

North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs | Colorado

Terracon Project No. 23195091

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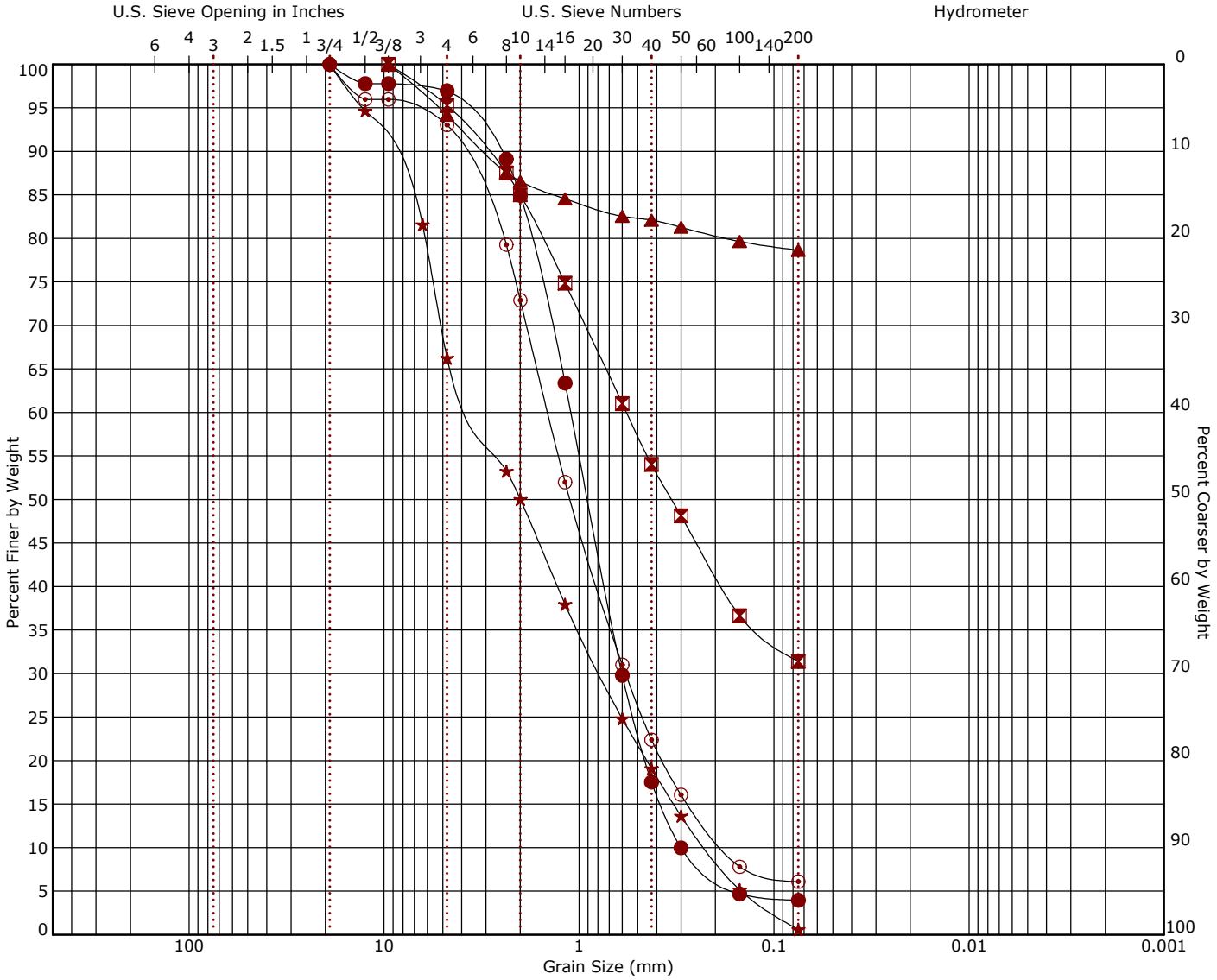
Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Boring ID		Depth (Ft)	Description	AASHTO	LL	PL	PI	Cc	Cu
●	B-1	4 - 5	A-1-b (0)	A-1-b (0)	NP	NP	NP	1.10	3.67
⊠	B-2	0 - 5	A-2-4 (0)	A-2-4 (0)	NP	NP	NP		
▲	B-2	9 - 10	A-7-6 (22)	A-7-6 (22)	53	27	26		
★	B-3	0 - 5	A-1-a (0)	A-1-a (0)	NP	NP	NP	0.81	15.23
⊙	B-3	4 - 5	A-1-b (0)	A-1-b (0)	NP	NP	NP	1.27	8.01

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	B-1	4 - 5	19	1.102	0.602	0.3	0.0	3.0	93.0	4.0		
⊠	B-2	0 - 5	9.5	0.57			0.0	4.7	63.9	31.4		
▲	B-2	9 - 10	9.5				0.0	5.8	15.5	78.6		
★	B-3	0 - 5	19	3.394	0.784	0.223	0.0	33.8	65.6	0.6		
⊙	B-3	4 - 5	19	1.444	0.576	0.18	0.0	7.0	86.9	6.1		

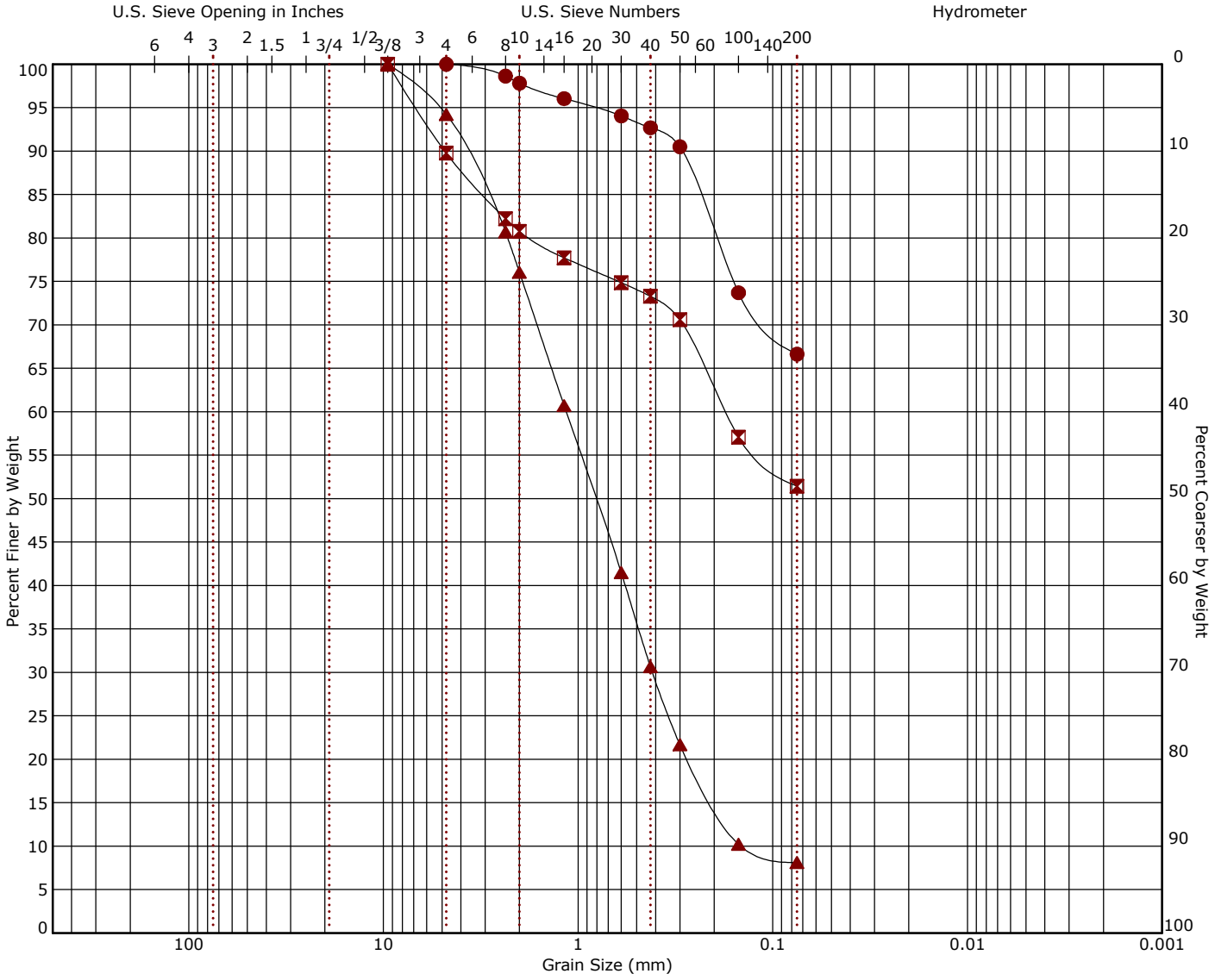
North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs | Colorado

Terracon Project No. 23195091

Terracon
4172 Center Park Dr
Colorado Springs, CO

Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Boring ID	Depth (Ft)	Description	AASHTO	LL	PL	PI	Cc	Cu
● B-3	14 - 15	A-6 (8)	A-6 (8)	34	19	15		
⊠ B-4	19 - 20	A-6 (4)	A-6 (4)	34	21	13		
▲ B-5	2 - 3	A-1-b (0)	A-1-b (0)	NP	NP	NP	1.07	8.24

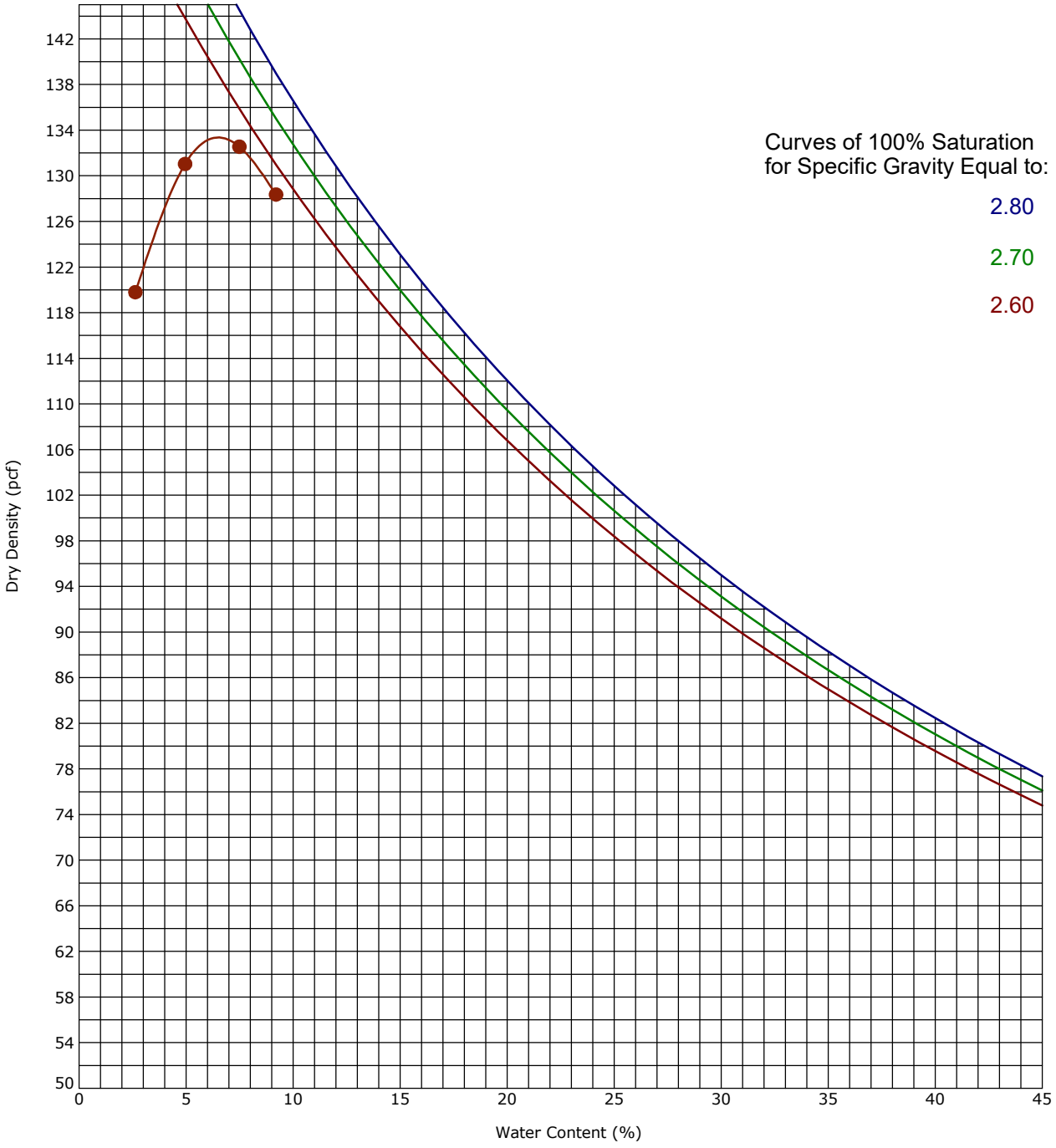
Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● B-3	14 - 15	4.75				0.0	0.0	33.4	66.6		
⊠ B-4	19 - 20	9.5	0.174			0.0	10.2	38.3	51.4		
▲ B-5	2 - 3	9.5	1.151	0.414	0.14	0.0	5.8	86.1	8.1		

North Gate / Struthers PWQ Pond & Storm Sewer
Colorado Springs | Colorado
Terracon Project No. 23195091

Terracon
4172 Center Park Dr
Colorado Springs, CO

Moisture-Density Relationship

ASTM D698/D1557



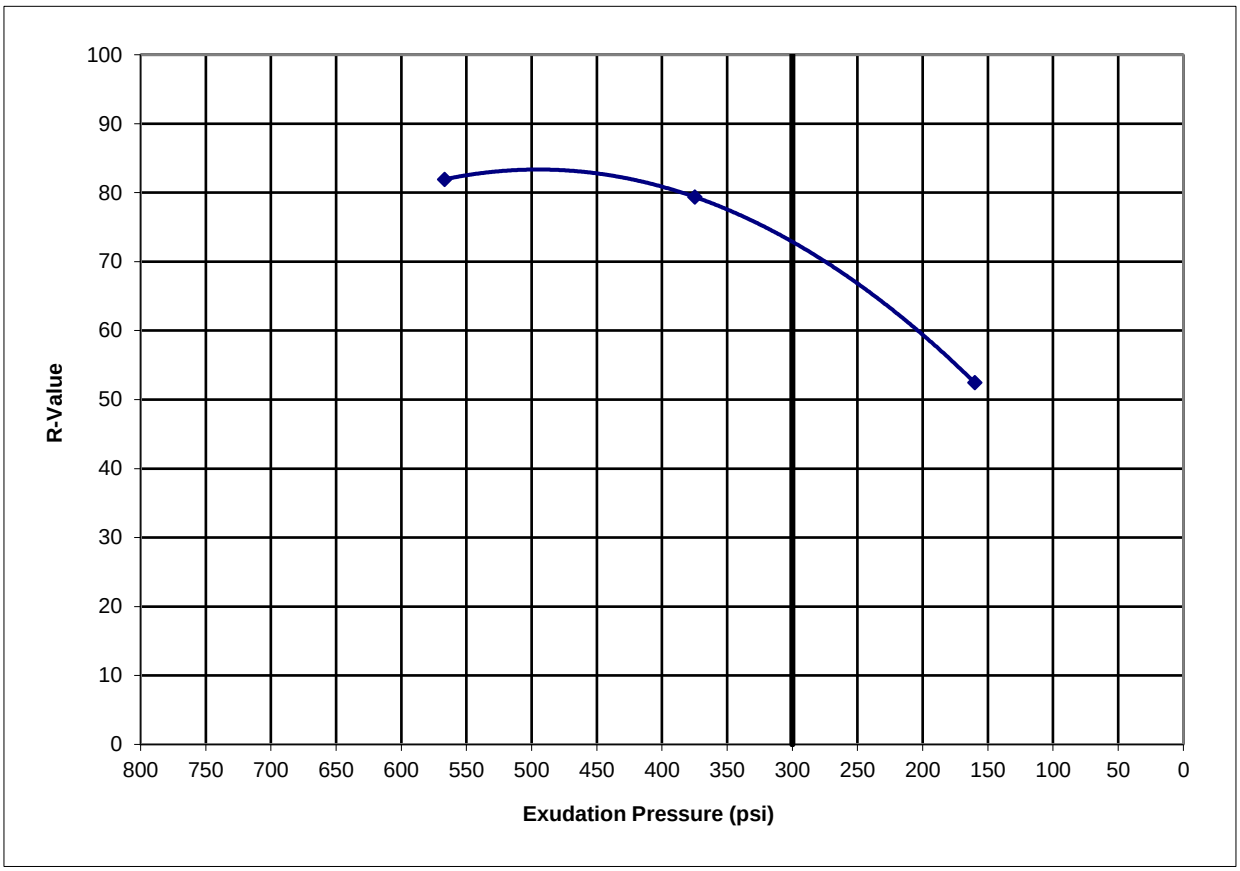
Boring ID	Depth (Ft)	Description of Materials
B-3	0 - 5	POORLY GRADED SAND with GRAVEL (SP)

Fines (%)	Fraction >19mm size (%)	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
1	99	NP	NP	NP	AASHTO T180 Method A	133.4	6.6

PROJECT:	North Gate / Struthers PWQ Pond &Storm Sewer	**JOB NO:**	23195091
LOCATION:	Colorado Springs, CO	**WORK ORDER NO:**	
MATERIAL:	A-1-a (0)	**LAB NO:**	B-3@0-5'
SAMPLE SOURCE:	B-3@0-5'	**DATE RECEIVED:**	01/05/23

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	9.0%	8.1%	7.7%
Compaction Pressure (psi)	100	350	350
Specimen Height (inches)	2.46	2.47	2.52
Dry Density (pcf)	134.7	135.5	136.3
Horiz. Pres. @ 1000lbs (psi)	28.0	12.0	11.0
Horiz. Pres. @ 2000lbs (psi)	54.0	21.0	19.0
Displacement	4.45	4.30	4.09
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	160	375	567
R Value	52	79	82



AASHTO R18

R Value at 300 PSI = 72.9

CHEMICAL LABORATORY TEST REPORT

Project Number: 23195091
Service Date: 10/14/19
Report Date: 10/23/19
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Wilson & Company Inc Engineers & Architects
Colorado Springs, Colorado

Project

North Gate / Struthers PWQ Pond & Storm Sewer

Sample Submitted By: Terracon (23) **Date Received:** 10/8/2019 **Lab No.: 19-1146**

Results of Corrosion Analysis

Sample Number	
Sample Location	S-1
Sample Depth (ft.)	1.0-5.0
pH Analysis, ASTM G 51	8.31
Water Soluble Sulfate (SO4), ASTM C 1580 (mg/kg)	132
Chlorides, ASTM D 512, (mg/kg)	42
Resistivity, ASTM G 57, (ohm-cm)	2134

Analyzed By: Trisha Campo

Trisha Campo
Chemist

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Wilson & Company Inc Engineer & Architects

Project

North Gate / Struthers PWQ Pond & Storm Sewer

Sample Submitted By: Terracon (23) **Date Received:** 1/9/2023 **Lab No.: 23-0035**

Results of Corrosion Analysis

Sample Number	--	--
Sample Location	B-2	B-3
Sample Depth (ft.)	0.0-5.0	0.0-5.0
pH Analysis, ASTM D4972	7.38	7.46
Water Soluble Sulfate (SO4), ASTM D516 (mg/kg)	162	151
Chlorides, ASTM D512, (mg/kg)	130	200
Saturated Minimum Resistivity, ASTM G 57, (ohm-cm)	2328	1164

Analyzed By

Nathan Campo
Engineering Technician II

SUMMARY OF LABORATORY TEST RESULTS

North Gate / Struthers PWQ Pond & Storm Sewer, Colorado Springs, Colorado

Terracon Project No. 23195091

Boring No.	Depth (ft)	USCS Class.	AASHTO Class. (Group Index)	Initial Water Content (%)	Initial Dry Density (pcf)	Swell/Consolidation		R-Value	Moisture-Density Relationship			Particle Size Distribution, Percent Passing by Weight					Atterberg Limits		Water Soluble Sulfates (mg/kg)	Sulfides (ppm)	Chlorides (mg/kg)	pH	Total Salts (mg/kg)	Red-Ox (mV)	Resistivity (ohm-cm)	Remarks
						Surcharge (ksf)	Swell (%)		Maximum Dry Density (pcf)	Optimum Water Content (%)	Test Method	3/4"	#4	#10	#40	#200	LL	PI								
B-1	2			4																						4
B-1	4	SP	A-1-b (0)	5	116							100	97	85	18	4	NV	NP								3,4
B-1	7			6	109																					4
B-1	9			5	108																					4
B-1	19			7	11																					4
B-2	0 - 5	SM	A-2-4 (0)									100	95	85	54	31	NV	NP	162		130	7.38			+2328	3
B-2	2			8	108																					4
B-2	4			6	109																					4
B-2	9	CH	A-7-6 (22)	31	86	0.5	0.7					100	94	87	82	79	53	26								3,4
B-2	14			10																						4
B-3	0 - 5	SP	A-1-a (0)					72.9	133.4	6.6	T180A	100	66	50	19	1	NV	NP	151		200	7.46			+1164	3,7
B-3	2			6	112																					4
B-3	4	SW-SM	A-1-b (0)	3	113							100	93	73	22	6	NV	NP								3,4
B-3	7-8			16	110																					4
B-3	14	CL	A-6 (8)	16								100	100	98	93	67	34	15								3,4
B-4	2			4	114																					4
B-4	4			4	116																					4
B-4	7			12	119																					4
B-4	14			2																						4
B-4	19	CL	A-6 (4)									100	90	81	73	51	34	13								3
B-5	2	SW-SM	A-1-b (0)	7	118							100	94	76	31	8	NV	NP								3,4
B-5	4			9																						4
B-5	14			14																						4
B-5	19			13																						4
S-1	2			5	107																					4
S-1	4			5	108																					4
S-1	7			6	106																					4
S-1	9	SP-SM		10	111							97	94	84	40	5	0	0								3,4
S-1	14			8	119																					4
S-1	19			18																						4
S-1	24			12																						4
P-1	2	SP-SM		7	121							100	91	75	38	9	NV	NP								3,4
P-1	4			8	111																					4
P-1	7			20	107	0.5	-0.1																			3,4
P-1	9			12																						4
P-1	14			12																						4
P-1	24			12																						4
P-1	29			24																						4
P-2	2			3	114																					4
P-2	4			8	104																					4

Notes:

Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

* = Partially disturbed sample

- = Compression/settlement

NV = no value

NP = non-plastic

Remarks:

1 Remolded Compacted density (about 95% of ASTM D698 maximum density near optimum moisture content)

2 Remolded Compacted density (about 95% of ASTM D1557 maximum density near optimum moisture content)

3 Water added to sample

4 Dry density and/or moisture content determined from one ring of a multi-ring sample

5 Minus #200 Only

6 Moisture-Density Relationship Test Method ASTM D698/AASHTO T99

7 Moisture-Density Relationship Test Method ASTM D1557/AASHTO T180

SUMMARY OF LABORATORY TEST RESULTS

North Gate / Struthers PWQ Pond & Storm Sewer, Colorado Springs, Colorado

Terracon Project No. 23195091

Boring No.	Depth (ft)	USCS Class.	AASHTO Class. (Group Index)	Initial Water Content (%)	Initial Dry Density (pcf)	Swell/Consolidation		R-Value	Moisture-Density Relationship			Particle Size Distribution, Percent Passing by Weight					Atterberg Limits		Water Soluble Sulfates (mg/kg)	Sulfides (ppm)	Chlorides (mg/kg)	pH	Total Salts (mg/kg)	Red-Ox (mV)	Resistivity (ohm-cm)	Remarks
						Surcharge (ksf)	Swell (%)		Maximum Dry Density (pcf)	Optimum Water Content (%)	Test Method	3/4"	#4	#10	#40	#200	LL	PI								
P-2	7	SM		9	116	0.5	0.3					100	98	92	73	35	32	7								3,4
P-2	9			33	79																					4
P-2	14			13	117																					4
P-2	19			16																						4
P-2	24			16																						4
P-3	2			3	116																					4
P-3	4			11	117																					4
P-3	7			8	115	0.5	-0.1																			3,4
P-3	9			12	105																					4
P-3	14			15	119																					4
P-3	19			18																						4
P-3	24			16																						4
PZ-1	2			5	115																					4
PZ-1	4	SW-SM		5								100	94	73	30	9	NV	NP								3,4
PZ-1	24	ML										100	98	96	88	67	NV	NP								3
PZ-2	9	SW-SM										100	100	92	44	9	NV	NP								3
PZ-2	19	SM										100	89	81	59	39	NV	NP								3
PZ-2	29	SM														34	NV	NP								3,5
PZ-2	2			4																						4
PZ-3	4	SM		12								100	90	69	39	14	NV	NP								3,4
PZ-3	9	SP-SM		27								100	88	63	22	10	NV	NP								3,4
PZ-3	19	SW-SM										100	93	76	32	8	NV	NP								3
PZ-3	24	SW-SM										100	100	74	23	5	NV	NP								3
PZ-4	2			5	116																					4
PZ-4	4			5	122																					4
PZ-4	7	SM		18	97							100	93	70	36	14	NV	NP								3,4
PZ-4	14			13																						4
PZ-4	19	SP-SM										100	68	45	17	6	NV	NP								3

Notes:

Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

* = Partially disturbed sample

- = Compression/settlement

NV = no value

NP = non-plastic

Remarks:

1 Remolded Compacted density (about 95% of ASTM D698 maximum density near optimum moisture content)

2 Remolded Compacted density (about 95% of ASTM D1557 maximum density near optimum moisture content)

3 Water added to sample

4 Dry density and/or moisture content determined from one ring of a multi-ring sample

5 Minus #200 Only

6 Moisture-Density Relationship Test Method ASTM D698/AASHTO T99

7 Moisture-Density Relationship Test Method ASTM D1557/AASHTO T180

PAVEMENT DESIGN CALCULATIONS

Contents:

Note: All attachments are one page unless noted above.

Pavement Thickness Design
Struthers Road

DESIGN DATA

Traffic Load - ESAL	=	5,256,000
Design Life - Years	=	20
Resilient Modulus - M_R (psi)	=	13,168
Reliability - R (%)	=	90
Initial Serviceability	=	4.5
Terminal Serviceability	=	2.0
Serviceability Loss - PSI	=	2.5
Overall Deviation - S_o	=	0.44

DESIGN CALCULATION RESULTS

Based on the following equation:

$$\log_{10}(18k\ ESAL) = Z_R x S_o + 9.36 x \log_{10}(SN+1) - 0.20$$
$$+\log_{10}(PSI/(4.2-1.5))/(0.4+(1094/(SN+1)^{5.19}))+2.32 x \log_{10}(M_R) - 8.07$$

Structural Number - SN	=	3.4

PAVEMENT THICKNESS DESIGN EQUATION

$$SN = C_1 D_1 m_1 + C_2 D_2 m_2$$

where

C_1 = Strength Coefficient - Asphalt	=	0.44
C_2 = Strength Coefficient - Aggregate Base Course	=	0.11
m_1 = Drainage Coefficient	=	1.0
m_2 = Drainage Coefficient	=	1.0

D_1 = Depth of Asphalt (inches)

D_2 = Depth of Stabilized Base (inches)

PAVEMENT THICKNESS RESULTS

Full Depth Asphalt

D_1	=	8.0 inches

Asphalt + Aggregate Base Course

D_1 (Asphalt)	=	6.0 inches
D_2 (Aggregate Base Course)	=	7.0 inches

Pavement Thickness Design
North Gate Boulevard

DESIGN DATA

Traffic Load - ESAL	=	7,884,000
Design Life - Years	=	20
Resilient Modulus - M_R (psi)	=	13,168
Reliability - R (%)	=	90
Initial Serviceability	=	4.5
Terminal Serviceability	=	2.0
Serviceability Loss - PSI	=	2.5
Overall Deviation - S_o	=	0.44

DESIGN CALCULATION RESULTS

Based on the following equation:

$$\log_{10}(18k\ ESAL) = Z_R x S_o + 9.36 x \log_{10}(SN+1) - 0.20$$
$$+\log_{10}(PSI/(4.2-1.5))/(0.4+(1094/(SN+1)^{5.19}))+2.32 x \log_{10}(M_R) - 8.07$$

Structural Number - SN	=	3.6

PAVEMENT THICKNESS DESIGN EQUATION

$$SN = C_1 D_1 m_1 + C_2 D_2 m_2$$

where

C_1 = Strength Coefficient - Asphalt	=	0.44
C_2 = Strength Coefficient - Aggregate Base Course	=	0.11
m_1 = Drainage Coefficient	=	1.0
m_2 = Drainage Coefficient	=	1.0

D_1 = Depth of Asphalt (inches)

D_2 = Depth of Stabilized Base (inches)

PAVEMENT THICKNESS RESULTS

Full Depth Asphalt

D_1	=	8.5 inches

Asphalt + Aggregate Base Course

D_1 (Asphalt)	=	6.0 inches
D_2 (Aggregate Base Course)	=	9.0 inches

SUPPORTING INFORMATION

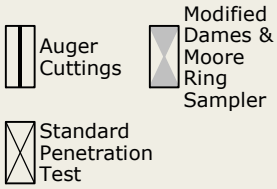
Contents:

Note: All attachments are one page unless noted above.

Terracon
4172 Center Park Dr
Colorado Springs, CO

General Notes

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

N	Standard Penetration Test Resistance (Blows/Ft.)
(HP)	Hand Penetrometer
(T)	Torvane
(DCP)	Dynamic Cone Penetrometer
UC	Unconfined Compressive Strength
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

Descriptive Soil Classicification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. 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			**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				**Bedrock**		
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (tsf)**	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**	**Standard Penetration or N-Value (Blows/Ft.)**	**Consistency**
Very Loose	0 - 3	0 - 6	Very Soft		0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium Stiff		4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	> 99	Very Stiff		15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 4.00	> 30	> 42			

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

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≥4 and 1≤Cc≤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≥6 and 1≤Cc≤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 above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					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:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					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] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[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.