Geotechnical Exploration Report

PARKER POINTE
SEC of Stroh Road and S Parker Road
Parker CO, 80134

Prepared for:
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February 21, 2024
Project No. 4430.2400002

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February 21, 2024

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Attention: Lisa Bouska
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Reference: Geotechnical Engineering Report
Parker Pointe
SEC of Stroh Road and S Parker Road
Parker CO, 80134
Project No: 4430.2400002

UES is pleased to submit this Geotechnical Engineering Report for the referenced project. This report includes the results from the field exploration and laboratory testing program, along with recommendations for use in the preparation of the appropriate design and construction documents for this project.

UES appreciates the opportunity to provide this Geotechnical Engineering Report and looks forward to continuing participation during the design and construction phases of this project. UES also has great interest in providing construction services, including materials testing and inspection services during the construction of this project, and will be glad to meet with you to further discuss how we can be of assistance as the project advances.

If there are questions pertaining to this report, or if UES may be of further service, please contact us at your convenience.

Respectfully,
UES

Trae D. Boman

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Geologist

Martin D. Jensen, P.E.
Principal Geotechnical Engineer

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1.0 INTRODUCTION

We have completed geotechnical engineering for the proposed project at an undeveloped lot at the Southeast corner of the Intersection of Stroh Road and S Parker Road in Parker Colorado. The purposes of this study have been to explore the existing soil, geologic, and groundwater conditions at the site, and to provide geotechnical engineering conclusions and recommendations for use by the other members of the design team for design and construction of the proposed project. This report presents the results of our study.

1.1 AUTHORIZATION

UES, Consultant, has completed a field exploration and geotechnical evaluation for the Parker Pointe project. Ms. Lisa Bouska, representing Quality Brand Group, authorized UES services on 1/24/24, by signing UES Proposal No. 4430.1023.00003

1.2 PROPOSED DEVELOPMENT

We understand the project will consist of the design and construction of a new slab-on-grade drive-thru restaurant. Review of Conceptual Site Plan C1 drawing dated October 2023 prepared by Galloway indicates the new restaurant building will have an approximate area of 1,800 square feet in plan area at the center of Lot 5A.

Associated improvements will consist of new asphalt concrete parking areas, exterior concrete flatwork, and underground utilities. We anticipate the buildings will develop relatively light to moderate structural loads based on this type of construction.

A grading plan was not available when this report was prepared. However, based on existing site topography and our understanding of the proposed construction, we anticipate cuts and fills on the order of about one to two feet will be required to establish final subgrade levels across the site.

1.3 SCOPE OF WORK

- Site reconnaissance
- Review of United States Geological Survey (USGS) topographic maps, and available groundwater data
- Review of geologic maps and fault maps
- Subsurface exploration, including the drilling and sampling of two borings to depths ranging from approximately 15 to 16½ feet below the ground surface (bgs).
- Laboratory testing of selected soil samples
- Engineering analyses
- Preparation of this report

1.4 FIGURES AND ATTACHMENTS

The following figures are included with this report:

1. Vicinity Map
2. Site Plan
3. Geologic Map
4. Fault Map
5. Logs of Soil Borings
6. United Soil Classification System

Appended to this report are:

- General information regarding project concepts, exploratory methods used during our field investigation and laboratory test results not included on the Logs of Soil Borings (Appendix A)

2.0 SITE INFORMATION

2.1 SITE DESCRIPTION

The building site is located at an empty lot, at the Southeast corner of the Intersection of Stroh Road and S Parker Road in Parker Colorado (Figure 1). The lot is bounded on the east and south by empty lots, on the west by S Parker Road and on the north by Stroh Road.

At the time of our field explorations on January 31, 2024, the building site is surrounded by other graded parcels. The plot was graded.

The topography of the site is relatively flat. The average surface elevation within the planned building areas is about 5,950 ft based on review of 2023 Google Earth Imagery.

2.2 GEOLOGICAL SETTING

The project site is in Parker, CO which is in the Great Plains physiographic region, just east of the Southern Rocky Mountains. It is in east-central Colorado 22 miles southeast of Denver and is approximately 5,450 feet in elevation. Parker, CO is bound by the Great Plains to the east; Denver to the north; Castlewood Canyon to the south; and the Front Mountain Range and Pikes Peak to the west. The Rocky Mountains were uplifted by the Laramide Orogeny during the late Cretaceous geologic period. The surficial geology of the Denver-Aurora area consists of Upper cretaceous bedrock covered by Quaternary coarse to fine grained alluvial and eolian deposits. The project site is located approximately 19 miles east from the Trans-Rocky Mountain fault zone.

The geology of the USGS Geologic Map of the greater Denver area, Front Range Urban Corridor, Colorado which includes the subject site, shows the surficial geology of the job site as the Paleocene Denver Formation, mapped TKd, is described as "Claystone, siltstone, sandstone, and conglomerate composed of altered andesite debris."[1]

The natural soils were covered with about a half a foot of uncontrolled fill. The natural soil is tan, brown sand with silt in generally dry conditions. The laboratory test results, and boring log presented in the Appendix should be referred to for more detailed information.

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[1] Bryant, Bruce, McGrew, L.W., and Wobus, R.A., 1981, Geologic map of the Denver 1 degree x 2 degrees quadrangle, north-central Colorado, Map I-1163. USGS. 1:250,000 scale.

2.3 SOIL SURVEY

The USDA Web Soil Survey, the onsite surficial soils are mapped as Bresser-Truckton sandy loams and Sampson loam. Sandy loams are approximately 15 percent clay, 71 percent sand, and 14 percent silt. Loam 22 percent clay, 35 percent sand, and 43 percent silt. This is what was observed in the boreholes.

2.4 SEISMIC DESIGN PARAMETERS

The 2021 International Building Code references the American Society of Civil Engineers (ASCE) Standard 7-16 for seismic design. Based on the borings performed at the site and our experience in the local area, in our opinion the site can be designated as Site Class D in determining seismic design forces for this project.

The Site Class was estimated using generalized soil characteristics given in Table 20.3-1 of ASCE Standard 7. The site is located at approximately the following latitude and longitude: 39.477565°, -104.757358°

A search of the USGS Earthquake Hazards Program's ASCE 7-16 data, as published by the ASCE 7 Hazard Tool (https://asce7hazardtool.online/), indicated the following spectral acceleration parameters for the location indicated above and a Site Class D:

Table 2-1: Ground Motion Values

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE$_R$ Spectral Response Acceleration (G)		Design Spectral Response Acceleration (g)	
0.2	S_s	0.201	F_a	1.6	S_{Ms}	0.322	S_{Ds}	0.215
1.0	S_1	0.056	F_v	2.4	S_{M1}	0.135	S_{D1}	0.09

3.0 FIELD EXPLORATION & LABORATORY PROGRAM

3.1 FIELD ACTIVITIES

The scope of our services for this project included a subsurface exploration program. The subsurface exploration program consisted of drilling six (6) borings to depths of approximately 10 to 25 feet below existing site grades. The borings were logged during drilling by a graduate geologist and samples were obtained to aid in material classification and for possible laboratory testing. The approximate locations of the borings are shown on Figure No. 2, Site Plan. The locations of the boring were determined in the field by using a tablet GPS. The locations of the borings should be considered accurate only to the degree implied by the method used. Results of the boring are presented in Appendix A.

3.2 LAB PROGRAM

The soil samples collected in the field as part of our field exploration were transported to our lab. Laboratory tests were conducted to determine certain physical and chemical properties of the soils. Further discussion of the laboratory testing and the laboratory testing result will appear later in this report.

3.3 SUBSURFACE CONDITIONS

Six (6) exploratory borings (BH-1 to BH-6) were performed on January 31, 2024, at the approximate locations shown on the attached Site Plan presented as Figure 2.

The soil conditions at the boring generally consist sandy clays and sandy silts, to the explored depths of about 5 to 20 feet below existing site grades.

The soil conditions described above are generally consistent with the mapped geology. At the completion of our field explorations, the borings were backfilled with cuttings.

For specific information regarding the soil conditions at a specific exploration location, please refer to the Logs of Soil Borings, Figures 3 through 8 included in the Appendix .

3.4 GROUNDWATER

Groundwater was not encountered within the explored 5 to 21½ foot depths of the borings performed on January 31st, 2024.

To supplement the groundwater data, we reviewed available groundwater data published by the Colorado Department of Water Resources (DWR) from a monitoring well (SC00606635CD LDAW 5) located about 0.3 miles northeast of the site[2]. DWR has water levels in the well from June 2011 to December 2023. Groundwater measurements at the USGS well are consistently between 190 to 222 feet below ground surface. Ground surface elevation at the well is indicated to be about 6021 feet above mean sea level which is close to the subject property's elevation. Regional geologic references from the early part of the 20th century are typically used for "historic high" groundwater elevations. In the area of the site vicinity, these records indicate a depth of approximately 10 feet bgs.

3.4.1 Groundwater Effect on Development and Seasonal Water

Based on our subsurface exploration, experience at the site, and review of groundwater information near the site, the permanent groundwater table will not be a factor in construction for excavations extending more than 50 feet below the ground surface. It is possible that perched groundwater may be encountered in excavations if construction begins in the winter and early spring months. If groundwater is encountered, the use of sumps, submersible pumps, deep wells or a well point system could be used as methods to lower the groundwater level. The dewatering method used will depend on the soil conditions, depth of the excavation and amount of groundwater present within the excavation. Dewatering, if required, should be the contractor's responsibility. The dewatering system should be designed and constructed by a dewatering contractor with local experience. We recommend the selected dewatering system lower the groundwater level to at least two feet below the bottom of the proposed excavations.

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[2] U.S. Geologic Survey, USGS Groundwater Data for Colorado, https://waterdata.usgs.gov/co/nwis/gw

3.5 CORROSION

3.5.1 Soil Corrosion Potential

One soil sample was tested to determine minimum resistivity, pH, total solids, chloride, and sulfate concentrations to help evaluate the potential for corrosive attack upon reinforced concrete and buried metal. Copies of the corrosion potential test results performed by ChemTech-Ford are presented in the Appendix.

A site is generally considered to be corrosive to foundation elements if one or more of the following conditions exists for the representative soil and/or water samples taken: has a chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 1500 ppm, or the pH is 5.5 or less. Based on this criterion, the on-site, near-surface soil should be considered damaging to normal strength concrete and corrosive to steel reinforcement properly embedded within PCC for the samples tested.

Table 19.3.1.1 – Exposure Categories and Classes, of American Concrete Institute (ACI) 318-19, Section 19.3 – Concrete Durability Requirements, indicates the severity of sulfate exposure for one of the samples tested is Exposure Class S0. Exposure Class S0 is assigned for conditions where the water-soluble sulfate concentration in contact with concrete is not severe and injurious sulfate attack isn’t a concern. The project Structural Engineer should review the requirements of ACI 318 and determine their applicability to the site.

UES are not corrosion engineers. Therefore, if it is desired to further define the soil corrosion potential at the site, a Corrosion Engineer should be consulted.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 GEOTECHNICAL DISCUSSION

Our recommendations assume that the soil conditions are similar to those disclosed by the explorations. If variations are noted during construction or if changes are made in the site plan, structural loading, foundation type or floor level, we should be notified so we can supplement our recommendations, as applicable.

The owner must recognize that this site has inherent risks to development due to the expansive nature of the on-site soils. Based on laboratory tests and our experience in the area, the on-site clayey and silty soils have a high expansion potential. The highly expansive clays have the potential to undergo relatively large movements due to increases in moisture content. Foundation designs presented in this report will reflect the potential for highly expansive clays. The recommendations provided in this report will reduce the potential for movement but will not eliminate it. For these recommendations to be effective, the recommendations presented in the Drainage and Moisture Protection section of the report must be strictly adhered to. In addition, the highly expansive clays should not be used as fill in structure areas**.**

4.2 SITE PREPARATION

Strip and remove existing vegetation, debris, uncontrolled fill, all loose or disturbed natural soils, and other deleterious materials from proposed building areas, adjacent walks, and slabs, and in areas to be paved.

Excavations should extend at least 5 feet beyond the areas to be improved in plan view. Uncontrolled fill is defined as any existing fill that was not properly placed, observed, and tested.

All exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

If unexpected fills or abandoned structures/improvements are encountered during site clearing, such features should be removed and the excavation thoroughly cleaned and backfilled. All excavations should be observed by the geotechnical engineer prior to backfill placement.

Demolition of existing structures/improvements should include removal of any foundation system and utilities. Any excavations due to demolition and removal should be properly filled.

All materials derived from the demolition of existing structures/improvements should be removed from the site, and not be allowed for use in any fills. In some cases, existing pavements, if properly broken up, can be used in required fills. The geotechnical engineer should determine the suitability for use based on conditions in the field.

4.3 EARTHWORK

All earthwork should be performed in accordance with the guidelines presented in *Chapter 18* of the *2021 IBC*, except where specific recommendations are presented in this report. It is recommended that contractors perform their own reconnaissance of the site. If the contractors have any questions regarding site conditions, site preparation, or recommendations in this report, they should contact a representative of UES.

4.3.1 Subgrade Preparation

Following site clearing activities, areas designated to receive fill, at-grade areas, or those achieved by excavation should be scarified to a depth of at least 12 inches, moisture conditioned and compacted as recommended in the *Fill Placement and Compaction* Section of this report.

Difficulty in achieving the recommended compaction may require drying the near-surface subgrade to a compactable moisture content, removal, and replacement. In addition, difficulty in subgrade compaction may be an indication of loose, soft, or unstable soil conditions that could require additional excavation. If these conditions exist, additional subgrade stabilization recommendations may be required at the time of construction.

Recommendations to achieve the recommended compaction can be made during construction and will depend on the conditions encountered in the field and other factors, such as project schedule and prevailing weather conditions.

Compaction of all subgrade soils should be performed using a heavy, self-propelled, sheepsfoot compactor capable of achieving the required compaction and must be performed in the presence of the Geotechnical Engineer's representative who will evaluate the performance of subgrade under compactive load. Difficulty in achieving subgrade compaction may be an indication of loose, soft, or unstable soil conditions that could require additional excavation. If these conditions exist, additional subgrade stabilization recommendations may be required at the time of construction.

4.3.2 Overexcavation

The on-site clay soils are high to critically expansive. These soils are not suitable for supporting foundations, floor slabs or paving. To provide improved support for foundations, floor slabs or paving, it will be necessary to overexcavate and replace the upper native soils.

Within the entire building area and 5 feet beyond the exterior footings and 2 feet beyond interior footings, block and retaining walls, overexcavate and replace the upper five feet of natural soils below the planned finished grade, or natural soils within five feet below the bottom of foundations, whichever is lower. In areas to be paved (including adjoining sidewalks, patios, and other concrete slabs) and at least 2 feet beyond in plan view, it will only be necessary to overexcavate and recompact three feet of natural soils below existing grade or final subgrade, whichever is lower.

It is important that the lower portion (at least 18 inches consists in structure areas and 1 foot in paved areas) of the fill material placed in the overexcavated area consist of the on-site or imported fine-grained low-expansive soils. This layer will act as a relatively impermeable blanket and help keep moisture from reaching any expansive materials below. If expansive soils below the compacted fill blanket experience an increase in moisture, additional foundation movement may occur.

It is important that the fill material placed in the overexcavated area consists of material having an expansion index of less than 20 and has at least 20 percent of the material passing the No. 200 sieve.

4.3.3 Engineered Fill Construction

On-site sand soils are considered suitable for use in engineered fill construction, if they do not contain significant concentrations of organic materials, rubble debris, or particles greater than six inches in maximum dimension. Imported fill materials, if required, should be granular, compactable materials with a Plasticity Index of 15 or less when tested in accordance with ASTM D4318; an Expansion Index of 20 or less when tested in accordance with ASTM D4829; an organic content less than four percent; do not contain particles greater than three inches in maximum dimension, and be within a compactable moisture content.

Imported fill should be observed and approved by the Geotechnical Engineer at least three business days prior to being transported to the site. Also, if import fills are required (other than aggregate base), the contractor must provide appropriate documentation that the import is clean of known contamination and within acceptable corrosion limits.

Engineered fill should be placed in lifts not exceeding eight inches in compacted thickness with each lift being uniformly moisture conditioned to at least the optimum moisture content and compacted to not less than 95 percent of the maximum dry density per ASTM D1557.

The upper six inches of pavement subgrade should be moisture conditioned to at least the optimum moisture content and compacted to no less than 95 percent relative compaction, regardless of whether final subgrade is achieved by excavation, filling or left at existing grade. Final pavement subgrade processing and compaction should be performed after completion of underground utilities and must be stable under construction traffic prior to aggregate base placement.

Permanent excavation and fill slopes should be constructed no steeper than two horizontals to one vertical (2H:1V) and should be vegetated as soon as practical following grading to minimize erosion. As a minimum, the following erosion control measures should be considered: placement of straw bale sediment barriers or construction of silt filter fences in areas where surface run-off may be concentrated. Slopes should be over-built and cut back to design grades and inclinations. The final decision of erosion control measures should be made by the Project Stormwater Pollution Prevention Plan Engineer.

We recommend the Geotechnical Engineer's representative be present on a regular basis during all earthwork operations to observe and test the engineered fill and to verify compliance with the recommendations of this report and the project plans and specifications.

Table 4-1: Compaction Criteria and Testing Frequency

Material Type (location)	Per Modified Proctor Test (ASTM D1557)			
	Minimum Compaction (%)	Moisture Content Range		Testing Frequency (min. 3 per lift)
		Minimum	Maximum	
Engineered Fill (Fine Grained)	90	Optimum	+3%	1 per 2,500 sf
Engineered Fill (Granular)	95	-2%	+2%	1 per 2,500 sf
Subgrade	95	-2%	+2%	1 per 5,000 sf
Aggregate base (pavements)	95	-3%	+3%	1 per 5,000 sf

4.3.4 On-site Soil Suitability for Use in Fill Construction

The on-site sand soils encountered in our borings are considered suitable for use in engineered fill construction, provided these materials do not contain rubble, rubbish, significant organic concentrations, and are at a workable moisture content appropriate for compaction. However, near-surface clays should not be used beneath interior and exterior slab-on-grade improvements. Imported materials, if necessary, should be granular and approved by our office prior to importing the materials to the site.

4.4 EXCAVATIONS

4.4.1 Excavation Conditions

The surface and near-surface soils at the site should be readily excavatable with conventional earthmoving and trenching equipment. Subsurface remnants from existing and/or previous development of the site, if any, may be encountered.

Based on our borings, excavations associated with building foundations, shallow trenches for utilities, and other excavations less than five feet deep associated with the proposed construction, should stand vertically for short periods of time (i.e., less than one day) required for construction, unless cohesionless, loose, saturated, or disturbed soils are encountered. These unstable conditions may result in caving or sloughing; therefore, the contractor should be prepared to brace or shore the excavations, if necessary.

Excavations deeper than five feet that will be entered by workers should be sloped, braced or shored in accordance with current OSHA regulations. The contractor must provide an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground.

Temporarily sloped excavations should be constructed no steeper than a one horizontal to one vertical (1H:1V) inclination. Temporary slopes likely will stand at this inclination for the short-term duration of construction, provided significant pockets of loose and/or saturated granular soils are not encountered. Flatter slopes would be required if these conditions are encountered.

Excavated materials should not be stockpiled directly adjacent to an open excavation to prevent surcharge loading of the excavation sidewalls. Excessive truck and equipment traffic should be avoided near excavations. If material is stored or heavy equipment is stationed and/or operated near an excavation, a shoring system must be designed to resist the additional pressure due to the superimposed loads.

4.4.2 Utility Trench Backfill

Utility trench backfill should be mechanically compacted as engineered fill in accordance with the following recommendations. Bedding and initial backfill around and over the pipe should conform to the pipe manufacturers recommendations for the pipe materials selected and applicable sections of the governing agency standards.

Utility trench backfill should be placed in thin lifts, thoroughly moisture conditioned to at least the optimum moisture content and compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. The lift thickness will depend on the type of compaction equipment used to backfill utility trenches.

Within the upper six inches of pavement subgrade soils compaction should be increased to at least 95 percent relative compaction at no less than two percent above the optimum moisture content.

We recommend that all underground utility trenches aligned nearly parallel with new foundations be at least three feet from the outer edge of foundations, wherever possible. Trenches should not encroach into the zone extending outward at a one horizontal to one vertical (1H:1V) inclination below the bottom of foundations. The intent of these recommendations is to prevent loss of both lateral and vertical support of foundations, resulting in possible settlement.

4.5 FOUNDATIONS

Based on the subsurface conditions encountered at the boring locations, the proposed building structures may be supported on deepened conventional foundations bearing on imported fill with a conventional interior slab-on-grade supported on at least 12 inches of non-expansive engineered fill.

4.5.1 Shallow Foundations

Conventional continuous perimeter foundations and isolated interior spread foundations should be embedded at least 24 inches below lowest adjacent soil grade. Continuous foundations should be at least 12 inches wide; isolated spread foundations should be at least 18 inches in plan dimension. Foundations so established may be sized based upon an allowable bearing capacity of 2,000 psf for dead load plus live loads, with a 1/3 increase to include the short-term effects of seismic or wind forces. The weight of foundation concrete extending below lowest adjacent soil grade may be disregarded in sizing computations.

We recommend that all foundations be adequately reinforced to provide structural continuity, mitigate cracking, and permit spanning of local soil irregularities. The structural engineer or civil engineering consultant should determine final foundation reinforcing requirements.

Resistance to lateral displacement of shallow foundations may be computed using an ultimate friction factor of 0.35 multiplied by the effective vertical load on each foundation. Additional lateral resistance may be achieved using an ultimate passive earth pressure against the vertical projection of the foundation equal to an equivalent fluid pressure of 360 psf per foot of depth. An appropriate factor of safety then should be applied to both frictional resistance and passive resistance. These two modes of resistance should not be added unless the frictional component is reduced by 50 percent since mobilization of the passive resistance requires some horizontal movement, effectively reducing the frictional resistance.

We estimate total settlement for shallow foundations using the recommended maximum net allowable bearing pressure and allowable capacities presented above, will be less than 1 inch. Differential settlements may be as much as ½ total settlement within 50 feet or the least dimension of the structure, whichever is less. The settlement estimates are based on the available soil information, our experience with similar structures and soil conditions, and field verification of suitable bearing soils during foundation construction.

4.6 INTERIOR FLOOR SLAB SUPPORT

Interior concrete slab-on-grade floors can be supported upon the soil subgrade prepared in accordance with the recommendations in this report and maintained in that condition (optimum moisture) and are protected from disturbance. Slabs-on-grade should be at least four inches thick, and final thickness, reinforcement and joint spacing should be determined by the slab designer. Proper and consistent location of the reinforcement near mid-slab is essential to its performance. The risk of uncontrolled shrinkage cracking is increased if the reinforcement is not properly located within the slab.

Interior floor slabs should be underlain by a layer of free-draining gravel/crushed rock, serving as a deterrent to migration of capillary moisture. The gravel/crushed rock layer should be between four and six inches thick and graded such that 100 percent passes a one-inch sieve and less than five percent passes a No. 4 sieve. Additional moisture protection may be provided by placing a plastic, water vapor retarder (at least 10-mils thick) directly over the gravel/crushed rock. The water vapor retarder should meet or exceed the minimum specifications for plastic water vapor retarders as outlined in ASTM E1745 and be installed in strict conformance with the manufacturer’s recommendations.

The recommendations presented above are intended to reduce significant soils-related cracking of slab-on-grade floors. Also important to the performance and appearance of a PCC slab is the quality of the concrete, the workmanship of the concrete contractor, the curing techniques utilized and the spacing of control joints.

4.6.1 Floor Slab Moisture Penetration Resistance

It is considered likely that floor slab subgrade soils will become wet to near saturated at some time during the life of structures. This is a certainty when slabs are constructed during the wet seasons, or when constantly wet ground or poor drainage conditions exist adjacent to structures. For this reason, it should be assumed that interior slabs intended for moisture-sensitive floor coverings or materials, require protection against moisture or moisture vapor penetration. Standard practice includes the gravel/crushed rock and vapor retarder as suggested above. However, the gravel/crushed rock and plastic membrane offer only a limited, first line of defense against soil-related moisture; they do not moisture-proof the slab.

Recommendations contained in this report concerning foundation and floor slab design are presented as minimum requirements, only from the geotechnical engineering standpoint.

It is emphasized that the use of gravel/crushed rock and plastic membrane below the slab will not “moisture proof” the slab, nor does it assure that slab moisture transmission levels will be low enough to prevent damage to floor coverings or other building components. If increased protection against moisture vapor penetration of slabs is desired, a concrete moisture protection specialist should be consulted. The design team should consider all available measures for slab moisture protection. It is commonly accepted that maintaining the lowest practical water-cement ratio in the slab concrete is one of the most effective ways to reduce future moisture vapor penetration of the completed slabs.

4.7 EXTERIOR FLATWORK CONSTRUCTION

The upper 12 inches of final soil subgrade for exterior concrete flatwork areas should consist of approved, compactable, very low-expansive (Expansion Index ≤ 20) granular soils placed and compacted in accordance with the Engineered Fill Construction recommendations included in this report. Exterior flatwork subgrade soils should be maintained in a moist condition and protected from disturbance. Exterior flatwork should be underlain by at least four inches of Class 2 aggregate base compacted to at least 95 percent relative compaction. The aggregate base can be included in the 12 inches of very-low expansive granular soils, or the very-low expansive layer can be completely composed off Class 2 aggregate base.

Proper moisture conditioning of the subgrade soils is considered important to the performance of exterior flatwork. Expansion joints should be provided to allow for minor vertical movement of the flatwork. Exterior flatwork should be constructed independent of the perimeter building foundation and isolated column foundations by the placement of a layer of felt material between the flatwork and the structural element.

Exterior flatwork concrete should be at least four inches thick in pedestrian traffic areas and underlain by at least four inches of aggregate base compacted to at least 95 percent of the ASTM D1557 maximum dry density.

Consideration should be given to thickening the edges of the slabs at least twice the slab thickness where wheel traffic is expected over the slabs. The slab designer should determine the final thickness, strength and joint spacing of exterior slab-on-grade concrete. The slab designer should also determine if slab reinforcement for crack control is required and determine final slab reinforcing requirements.

Our recommendations are intended to reduce the effects of variable soil subgrade conditions in exterior concrete flatwork areas. However, some seasonal movement of exterior flatwork should be anticipated where flatwork is adjacent to landscape areas.

Areas adjacent to the new exterior flatwork should be landscaped to maintain more uniform soil moisture conditions adjacent to and beneath flatwork. We recommend final landscaping plans not allow fallow ground adjacent to exterior concrete flatwork.

4.8 DRAINAGE CONSIDERATIONS

Final site grading should be accomplished to provide positive drainage of surface water away from buildings and prevent ponding of water adjacent to foundations or slabs. Subgrades adjacent to buildings should be sloped away from foundations at a minimum two percent gradient for at least 10 feet, where possible.

We recommend connecting all roof drains to solid pipes which are connected to available drainage features to convey water away from the structures, or discharging the drains onto paved, or hard surfaces that slope away from the foundations. Discharging or ponding of surface water should not be allowed adjacent to buildings, exterior flatwork or onto slope surfaces. Landscape berms, if planned, should not be constructed in such a manner as to promote drainage toward buildings.

4.9 RETAINING WALLS

For soils above any free water surface, with level backfill and no surcharge loads, we recommend the following equivalent fluid pressures and coefficient of friction:

SOIL PARAMETER	VALUE
Soil Unit Weight	120 pcf
Internal Angle of Friction	30°
Cohesion	0 psf
Coefficient of Friction	0.35

LOADING CONDITION	LATERAL EARTH COEFFICIENT		EQUIVALENT FLUID PRESSURES (PCF)
Horizontal backfill	K_0	.50	60
	K_a	.33	40
	K_p	3.00	360

Notes:

1. The above values do not include a factor of safety. The designer should employ an adequate factor of safety
2. The above values assume no hydrostatic pressure.
3. Active pressure assumes unrestrained (cantilever) wall and assumes no loading from heavy compaction equipment.
4. Passive pressure should not exceed a maximum of 2,500 psf. A one-third increase may be used for wind or seismic loads.
5. The passive pressure and the frictional resistance of the soils may be combined with a reduction of half of the frictional resistance in determining the total lateral resistance.
6. Passive earth pressures should be considered negligible for block or retaining walls within 5-feet of a descending slope.

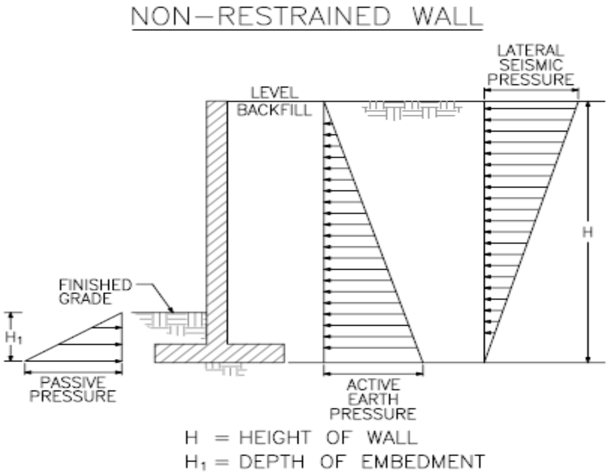
If required by the 2021 IBC, the lateral seismic pressure acting on an unrestrained wall can be estimated by the method presented in the following equation, where the dynamic (seismic) lateral thrust, ΔPAE, per linear foot of wall may be determined as follows:

$$\Delta P_{AE} = {}^{3}/_{8}(k_h)H^2\gamma$$

- k_h is equal to $S_{DS}/2.5$
- H is the height of the wall in feet
- γ is equal to the unit weight of the backfill material, in pcf

The resultant dynamic force acts at 0.6H above the base of the wall. This equation applies to level backfill and walls that retain no more than 15 feet.

Where the design includes unrestrained walls, above any free water, with level backfill and no surcharge loads, we recommend the wall be designed to resist an earth pressure with the distribution shown below:



Any surcharge from adjacent loadings should be added to the retaining wall pressures using the Ka factor for non-restrained walls. Ka is presented in the table above. As indicated, the pressures assume that there will be no build-up of hydrostatic pressure. Therefore, if walls are subject to saturated conditions, we recommend weep holes (if practical) and a wall drainage system. The wall drainage may consist of a minimum of 2 cubic feet of drain rock per foot of length of retaining wall wrapped in filter fabric, Mirafi 140N or equivalent, placed at the base of the wall and discharge to an appropriate outlet. Drain rock should consist of clean, uniformly sized gravel, ¾-inch in nominal size. Alternatively, a drainage system including perforated pipe with filter sock placed within the drain rock is also acceptable. The structural fill immediately behind retaining walls (6 to 12 inches) should be granular and free draining. The upper 2 feet of backfill should consist of compacted native soils. As an option, a prefabricated drain could be used behind the walls. The wall drainage system is an integral part of the retaining wall design. The retaining wall designer is ultimately responsible for the retaining wall design and shall ensure that the above recommended drainage system is compatible with the design of the wall or select a different drainage system at their discretion. All walls below grade should be waterproof or at least dampproof.

Fill against foundations, grade beams and retaining walls should be properly placed and compacted. Backfill should be mechanically compacted in layers (12 inches maximum thickness); flooding should not be permitted. Backfill within a lateral distance equal to the height of retaining walls should be compacted to at least 90 percent of the maximum dry density obtainable by the ASTM D1557 method. The backfill materials within this zone should consist of none too low expansive soils. If expansive soils are used within this backfill zone, the wall should be designed to resist the additional pressure that may be exerted by the expansive soils. Backfill outside this zone should be compacted as outlined in the Fill Placement and Compaction section of this report. Care should be taken when placing backfill so as not to damage the walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Over-compaction may cause excessive lateral earth pressures which could result in wall movements. Retaining walls should not be backfilled until the concrete or masonry has reached an adequate strength as specified by the wall designer.

4.10 PAVEMENT DESIGN

Based on laboratory test results for the surface and near-surface clay soils present at the site, we used a Resistance ("R") value of 20 for untreated pavement subgrades. Pavement sections presented in Table 4.2 have been calculated using the above R-values and traffic indices (TIs) assumed to be appropriate for this project. The project civil engineer should determine the appropriate traffic index for pavements based on anticipated traffic conditions. If needed, we can provide additional pavement sections for different traffic indices.

Table 4-2: Pavement Design Alternatives

Traffic Index (TI)	Pavement Use	Untreated Subgrades R-values = 20		
		Type A Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)	Portland Cement Concrete (inches)
4.5	Automobile Parking Only	2	10	--
		--	6	4
6.0	Automobile, Light to Moderate Truck Traffic, and Fire Lanes	3	11	--
		3½	10	--
		--	6	6
7.0	Moderate Truck Traffic, Trash Enclosures, Loading Areas, and Entryways	3	14	--
		4	12	--
		--	8	7

We emphasize that the performance of pavements is critically dependent upon uniform and adequate compaction of the soil subgrade, as well as all engineered fill and utility trench backfill within the limits of the pavements. We recommend that pavement subgrade preparation (i.e., scarification, moisture conditioning and compaction) be performed after underground utility construction is completed and just prior to aggregate base placement. The upper six inches of untreated pavement subgrade soils should be compacted to at least 95 percent relative compaction at the optimum moisture content. All aggregate base should be compacted to at least 95 percent of the ASTM D1557 maximum dry density.

In the summer heat, high axle loads coupled with shear stresses induced by sharply turning tire movements can lead to failure in asphalt concrete pavements. Therefore, we recommend that consideration be given to using the Portland cement concrete (PCC) pavements in areas subjected to concentrated heavy wheel loading, such as truck turning areas and in front of trash enclosures.

We suggest the concrete slabs be constructed with thickened edges in accordance with ACI design standards. Reinforcing for crack control, if desired, should consist of No. 4 reinforcing bars placed on maximum 24-inch centers each way throughout the slab. Reinforcement must be located at mid-slab depth to be effective. Joint spacing and details should conform with the current PCA or ACI guidelines. Portland cement concrete should achieve a minimum compressive strength of 3500 pounds per square inch at 28 days.

Pavement subgrades must be stable and unyielding under heavy wheel loads of construction equipment. A proof-roll test using a fully loaded water truck should be performed prior to placement of aggregate base to help identify areas that are unstable, as observed by our representative. Areas that are found to be unstable should be excavated to firm, undisturbed materials and restored to grade with compacted aggregate base.

It has been our experience that pavement failures may occur where a non-uniform or disturbed subgrade soil condition is created. Subgrade disturbances can result if pavement subgrade preparation is performed prior to underground utility construction and/or if a significant time passes between subgrade preparation and placement of aggregate base. Therefore, we recommend that final pavement subgrade preparation (i.e., scarification, moisture conditioning, and compaction) be performed just prior to aggregate base placement.

4.11 PLAN REVIEW

We recommend that our firm be retained to review the final plans and specifications to determine if the intent of our recommendations has been implemented in those documents. We would be pleased to submit a proposal to provide these services upon request.

4.12 CONSTRUCTION ITEMS

5.0 GEOTECHNICAL RISK AND LIMITATIONS

Our recommendations are based upon the information provided regarding the proposed construction, combined with our analysis of site conditions revealed by the field exploration and laboratory testing programs. We have used prudent engineering and geologic judgment based upon the information provided and the data generated from our investigation. This report has been prepared in substantial compliance with generally accepted geotechnical engineering practices that exist in the area of the project at the time the report was prepared. No warranty, either express or implied, is provided.

If the proposed construction is modified or relocated or, if it is found during construction that subsurface conditions differ from those we encountered at our boring and/or CPT locations, we should be afforded the opportunity to review the new information or changed conditions to determine if our conclusions and recommendations must be modified.

We emphasize that this report is applicable only to the proposed construction and the investigated site. This report should not be utilized for construction on any other site. This report is considered valid for the proposed construction for a period of two years following the date of this report. If construction has not started within two years, we must re-evaluate the recommendations of this report and update the report, if necessary.

FIGURES

🟥 Project Location

UES™

PROJECT:

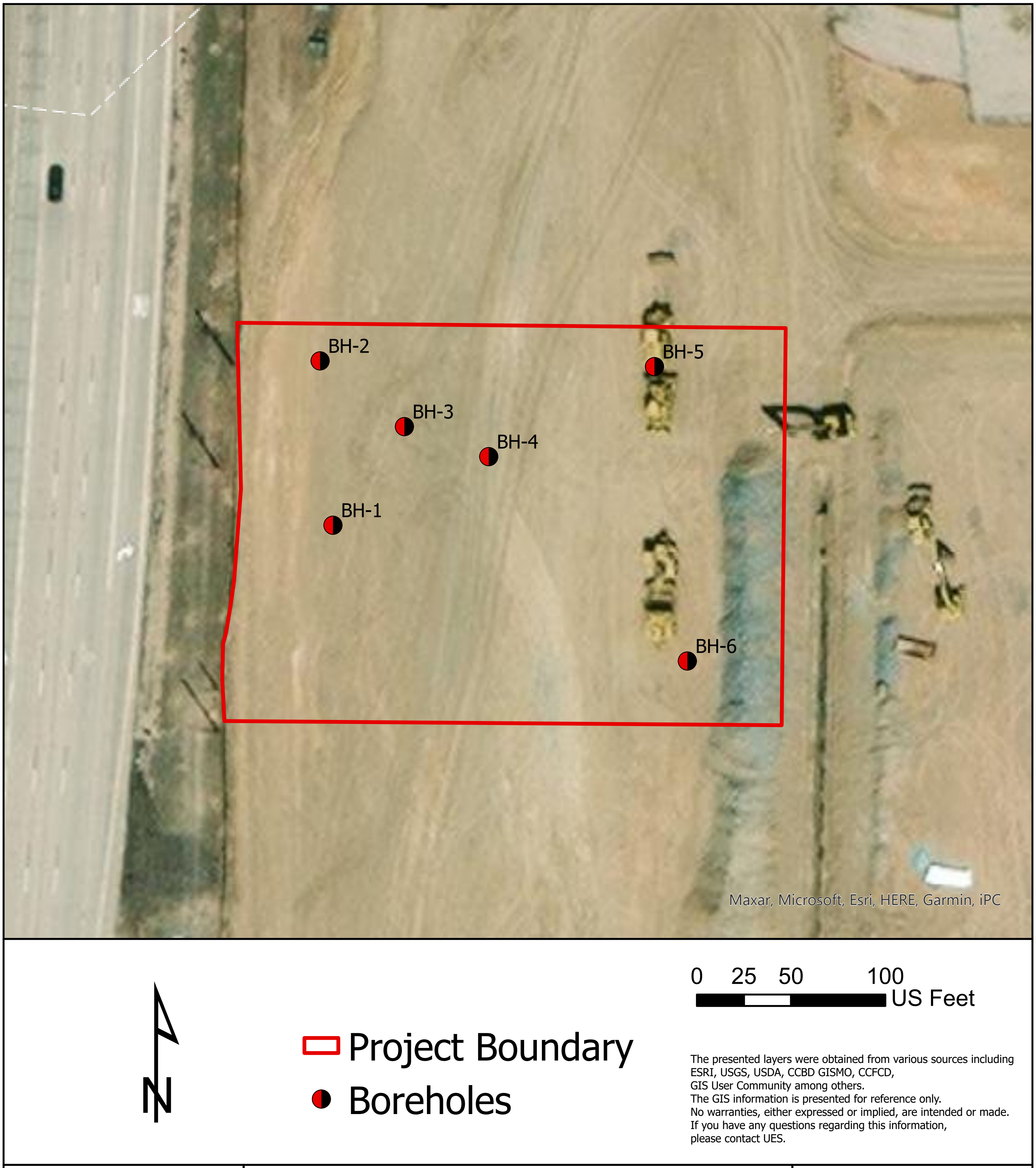
Parker Pointe

Site Vicinity Map

CLIENT:
Galloway US

PROJECT NO:
4430.2300002

FIGURE NO:
1



The presented layers were obtained from various sources including
ESRI, USGS, USDA, CCBD GISMO, CCFCD,
GIS User Community among others.
The GIS information is presented for reference only.
No warranties, either expressed or implied, are intended or made.
If you have any questions regarding this information,
please contact UES.

UES™

PROJECT:

Parker Pointe

CLIENT:

Galloway US

Project Site Plan

PROJECT NO:
4430.2300002

FIGURE NO:
2

477 Parkland Dr, Sandy, UT
84070, USA
Office: +1 (801) 448-0322

Parker Pointe Subdivision

Lat/Lon: 39.4775908/-104.7575507

SOIL BORING: BH1

Date Started:	01/31/24	Date Completed:	01/31/24	Location Accuracy:	Tablet GPS
Project No:	4430.2400002.0000	Client Name:	Galloway	Driller:	KC
Drilling Firm:	Axis Drilling Solution	Hammer Type:	Auto	Hammer Weight:	140
Logged By:	Trae Boman	Method:	Auger		

Rig Type Simco 2400 SK-1
Tooling 4" Solid Stem Auger
Surface Elevation N/A

● Moisture Content ● 0 50 100
▲ Plastic Limit ▲ 0 50 100
◆ Liquid Limit ◆ 0 50 100

Depth (ft)	Graphic Log	Visual Classification and Remarks		Samples: Depth of Sample	Samples: Sample Number	Samples: Blow Counts	Lab: % Fines	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Lab: Dry Density (PCF)
	▨	**FILL**, Silty Sand	0.5							
	▨	**Silty Sand**, medium dense, dry, tannish brown (SM)		2.5 ft	BH-1 2.5	8 11 10				
5	▨		6.5	5 ft	BH-1 5	7 9 8	21	NP	3.4	
		Terminated								
10										
15										
20										
25										
30										
35										

▨ SM	-

Depth	Comment
-	-
-	-

UES
477 Parkland Dr, Sandy, UT
84070, USA
Office: +1 (801) 448-0322

Parker Pointe Subdivision

Lat/Lon: 39.4777778/-104.7575561

SOIL BORING: BH2

Date Started:	01/31/24	Date Completed:	01/31/24	Location Accuracy:	Tablet GPS
Project No:	4430.2400002.0000	Client Name:	Galloway	Driller:	KC
Drilling Firm:	Axis Drilling Solution	Hammer Type:	Auto	Hammer Weight:	140
Logged By:	Trae Boman	Method:	Auger		

Rig Type: Simco 2400 SK-1
Tooling: 4" Solid Stem Auger
Surface Elevation: N/A

Depth (ft)	Graphic Log	Visual Classification and Remarks		Samples: Depth of Sample	Samples: Sample Number	Samples: Blow Counts	Lab: % Fines	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Lab: Dry Density (PCF)
0–0.5	☒	**FILL**, Silty Sand	0.5							
0.5–6.5	▨	**Silty Sand**, medium dense, dry, tannish brown (SM)	6.5	2.5 ft	BH-2 2.5	7 7 8				
				5 ft	BH-2 5	7 8 9				
		Terminated								

● Moisture Content ● 0 50 100
▲ Plastic Limit ▲ 0 50 100
◆ Liquid Limit ◆ 0 50 100

Depth (ft): 5, 10, 15, 20, 25, 30, 35

▨	SM	-

Depth	Comment
-	-
-	-

UES
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84070, USA
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Parker Pointe Subdivision

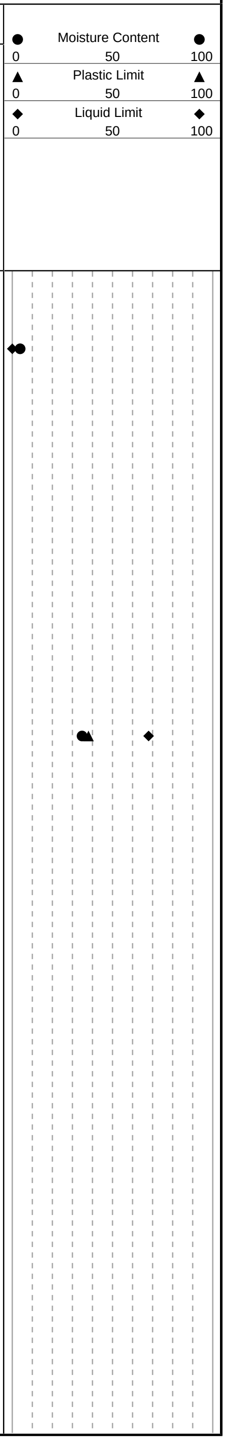
Lat/Lon: 39.4776847/-104.7574599

SOIL BORING: BH3

Date Started:	01/31/24	Date Completed:	01/31/24	Location Accuracy:	Tablet GPS
Project No:	4430.2400002.0000	Client Name:	Galloway	Driller:	KC
Drilling Firm:	Axis Drilling Solution	Hammer Type:	Auto	Hammer Weight:	140
Logged By:	Trae Boman	Method:	Auger		

Rig Type: Simco 2400 SK-1
Tooling: 4" Solid Stem Auger
Surface Elevation: N/A

Depth (ft)	Graphic Log	Visual Classification and Remarks	Samples: Depth of Sample	Samples: Sample Number	Samples: Blow Counts	Lab: % Fines	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Lab: Dry Density (PCF)
0.5		**FILL**, Silty Sand							
7.5	SM	**Silty Sand**, loose, tannish brown (SM)	2.5 ft	BH-3 2.5	5 5 4	20.5	NP	3.9	
			5 ft	BH-3 5	4 5 4				
9.0	SM	Medium dense	7.5 ft	BH-3 7.5	6 10 10				
15.0	MH	**Elastic Silt with Sand**, hard, brown (MH)	10 ft	BH-3 10	9 16 30				
20.0	MH	Very stiff	15 ft	BH-3 15	9 10 18	70.7	68-38-30	34.8	
21.5	MH	Hard	20 ft	BH-3 20	8 17 19				
		Terminated							



▨ SM	▥ MH

Depth	Comment
-	-
-	-

UES

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Office: +1 (801) 448-0322

Parker Pointe Subdivision

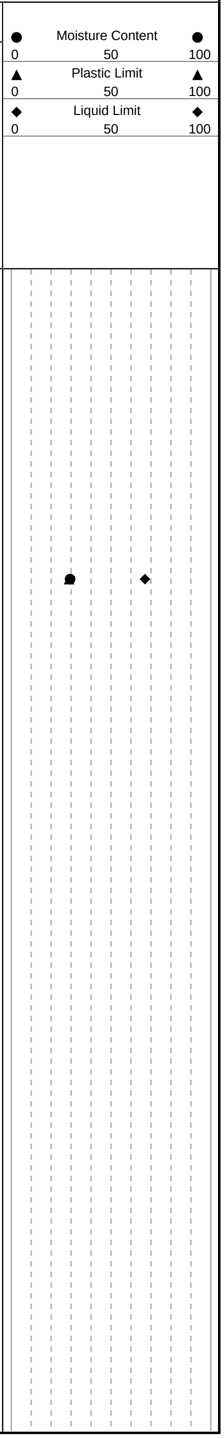
Lat/Lon: 39.4776733/-104.7573384

SOIL BORING: BH4

Date Started: 01/31/24
Date Completed: 01/31/24
Location Accuracy: Tablet GPS
Project No: 4430.2400002.0000
Client Name: Galloway
Driller: KC
Drilling Firm: Axis Drilling Solution
Hammer Type: Auto
Hammer Weight: 140
Logged By: Trae Boman
Method: Auger

Rig Type: Simco 2400 SK-1
Tooling: 4" Solid Stem Auger
Surface Elevation: N/A

Depth (ft)	Graphic Log	Visual Classification and Remarks	Samples: Depth of Sample	Samples: Sample Number	Samples: Blow Counts	Lab: % Fines	Lab: Atterberg Limits (LL-PL-PI)	Lab: Moisture Content (%)	Lab: Dry Density (PCF)
	☒	**FILL**, Fat Clay 0.5							
	▨	**Fat Clay**, very stiff, dry, dark brown (CH)							
	▨		2.5 ft	BH-4 2.5	9 15 17				
5	▨		5 ft	BH-4 5	7 13 12				
	▨		7.5 ft	BH-4 7.5	7 12 14				
10	▨		10 ft	BH-4 10	6 9 13	95.2	67-29-38	29.5	
15	▨	15.0	15 ft	BH-4 15	9 15 18				
	▨	Hard 16.5							
		Terminated							
20									
25									
30									
35									



▨	CH	-

Depth	Comment
-	-
-	-

UES

477 Parkland Dr, Sandy, UT
84070, USA
Office: +1 (801) 448-0322

Parker Pointe Subdivision

Lat/Lon: 39.4777965/-104.7570416

SOIL BORING: BH5

Date Started:	01/31/24	Date Completed:	01/31/24	Location Accuracy:	Tablet GPS
Project No:	4430.2400002.0000	Client Name:	Galloway	Checked By:	KC
Driller:	KC	Drilling Firm:	Axis Drilling Solution	Hammer Type:	Auto
Hammer Weight:	140	Logged By:	Trae Boman	Method:	Auger

Rig Type: Simco 2400 SK-1
Tooling: 4" Solid Stem Auger
Surface Elevation: N/A

			Samples			Lab				
Depth (ft)	Graphic Log	Visual Classification and Remarks	Depth of Sample	Sample Number	Blow Counts	% Fines	Atterberg Limits (LL-PL-PI)	Moisture Content (%)	Dry Density (PCF)	● Moisture Content ● 0 50 100 ▲ Plastic Limit ▲ 0 50 100 ◆ Liquid Limit ◆ 0 50 100
	⊠	**FILL**, Fat Clay with Sand 0.5								
	▤	**Fat Clay with Sand**, very stiff, dry, dark brown (CH)	2.5 ft	BH-5 2.5	6 11 11					
5	▤	6.5	5 ft	BH-5 5	5 10 10					
		Terminated								
10										
15										
20										
25										
30										
35										

▤	CH	-

Depth	Comment
-	-
-	-

UES

477 Parkland Dr, Sandy, UT
84070, USA
Office: +1 (801) 448-0322

Parker Pointe Subdivision

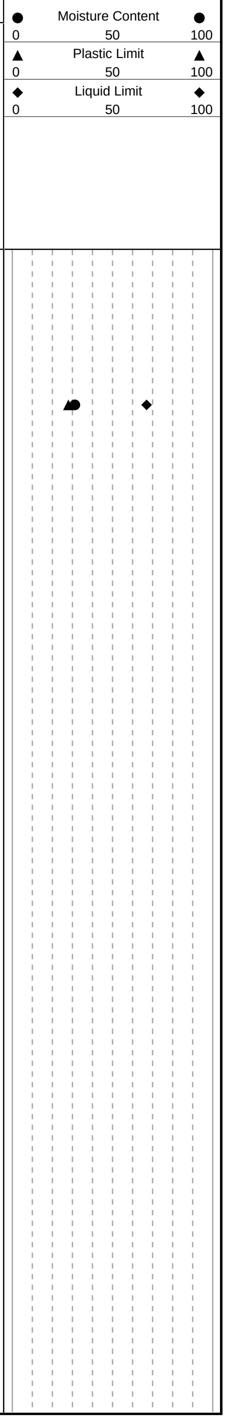
Lat/Lon: 39.4774294/-104.7569803

SOIL BORING: BH6

Date Started: 01/31/24
Date Completed: 01/31/24
Location Accuracy: Tablet GPS
Project No: 4430.2400002.0000
Client Name: Galloway
Driller: KC
Drilling Firm: Axis Drilling Solution
Hammer Type: Auto
Hammer Weight: 140
Logged By: Trae Boman
Method: Auger

Rig Type: Simco 2400 SK-1
Tooling: 4" Solid Stem Auger
Surface Elevation: N/A

Depth (ft)	Visual Classification and Remarks	Depth of Sample	Sample Number	Blow Counts	% Fines	Atterberg Limits (LL-PL-PI)	Moisture Content (%)	Dry Density (PCF)
0.5	**FILL**, Fat Clay with Sand							
5.0	**Fat Clay with Sand**, stiff, dry, dark brown (CH)	2.5 ft	BH-6 2.5	3 7 7				
6.5	Very stiff	5 ft	BH-6 5	6 7 12	71.3	67-28-39	31.2	
	Terminated							



CH	-

Depth	Comment
-	-
-	-

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	●	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			○	GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	●	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	⁘	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			⁖	SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	⁞	SM	SILTY SANDS, SAND - SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▥	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▤	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			≋	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			⁂	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

UNVIERSAL ENGINEERING SCIENCES

CLIENT:
Utah DFCM

PROJECT:
HMHI Translational Research Facility

Materials Classification

PROJECT NO.:
4430.2200005

PLATE NO.:

APPENDIX

Moisture and Unit Weight Determination

GERHART COLE

ASTM D2937 / D2216

Project: **Parker Pointe Subdivision**

No: **4430.2400002 (24-1755)**

Location: **-**

X:\PROJECTS\24-1755 Parker Pointe Subdivision\Reviewed\[2024-02-07_MD.xlsx]1

Sample Info.	Sample:		**BH-3**					
	Depth:		**10 ft**					
	Date Sampled:		**-**					
	Date tested:		**12-Feb-24**					
	Laboratory sample description:		**lt ol bn - ol bn clay**					
Unit weight data	Sample height, Hi (in)	0º	3.054					
		120º	3.081					
		240º	3.079					
	Avg. height, Havg (in)		3.071					
	Sample diameter, Di (in)	top	2.428					
		mid	2.426					
		bot	2.411					
	Average diameter, Davg (in)		2.423					
	Wt. rings + wet soil (g)		425.41					
	Wt. rings (g)		0.00					
	Wet soil, Ws (g)		425.41					
	Sample volume, V (in^3)		14.2					
	Sample volume, V (cm^3)		232.0					
	Sample volume, V (ft^3)		0.0082					
Moisture	Wet soil + tare (g)		496.44					
	Dry soil + tare (g)		424.08					
	Tare (g)		195.52					
	Moisture content, w (%)		31.7					
Phase Relationships	Gs, estimated		2.65					
	Mass total (g)		425.4					
	Mass of solids (g)		323.1					
	Volume (cm^3)		232.0					
	Volume of water (cm^3)		102.3					
	Volume of solids (cm^3)		121.9					
	Volume of voids (cm^3)		110.1					
	Volume of air (cm^3)		7.8					
	Void ratio, e		0.903					
	Porosity, n		0.474					
	Volumetric moisture, T		0.441					
	Saturation, S (%)		92.92					
	Dry density (gm/cm^3)		1.393					
	Wet unit wt., gm (pcf)		114.5					
	Dry unit wt., gd (pcf)		86.9					
QC/QA	Tested By:		AT					
	Reduced By:		AT					
	Reviewed By:		JC					

Comments:

g_m=Ws/453.6/V ; $g_d = g_m/(1+w)$

One-Dimensional Consolidation Properties of Soils

After ASTM D2435 and USBR 5700

GERHART COLE

Project: Parker Pointe Subdivision
No: 4430.2400002 (24-1755)
Location: -
Date: 12-Feb-24

TH/TP/Sample: BH-3
Depth: 10 ft
Laboratory sample description: lt ol bn - ol bn clay
USCS classification: not requested

Tested by: AT
Reduced by: AT
Checked by: JC
Comments:

Sample type: Rel. undisturbed, Shelby Tube
Inundation stress (psf): 100, beginning
Swell pressure (psf): 1807
Test method: B
Preparation procedure: trimmed

Phase Relationships

		Initial	Final
Height, H (in)	0°	1.000	-
	90°	1.006	-
	180°	1.003	-
	270°	1.002	-
Avg Height, Havg (in)		1.003	0.975
Height, H (cm)		2.547	2.476
Dia., D (in)	0°	2.417	-
	90°	2.415	-
Avg Dia., Davg (in)		2.416	2.416
Dia., D (cm)		6.137	6.137
Wt. rings + wet soil (g)		385.13	389.40
Wt. rings (g)		246.63	246.63
Wet soil + tare (g)		496.44	259.58
Dry soil + tare (g)		424.08	222.20
Tare (g)		195.52	117.23
Moisture cont., w (%)		31.7	35.6
Gs, assumed		2.70	2.70
Mass total (g)		138.5	142.8
Mass of solids (g)		105.2	105.2
Volume (cm^3)		75.3	73.2
Vol. of water (cm^3)		33.3	37.6
Vol. of solids (cm^3)		39.0	39.0
Vol. of voids (cm^3)		36.4	34.3
Vol. of air (cm^3)		3.1	-3.3
Area, A (cm^2)		29.6	29.6
Ht. solids, Hs (cm)		1.317	1.317
Void ratio, e		0.933	0.880
Porosity, n		0.483	0.468
Vol.moisture, T		0.442	0.513
Saturation, S (%)		92	110
Dry density (gm/cm^3)		1.396	1.436
Wet unit wt., gm (pcf)		114.8	121.6
Dry unit wt., gd (pcf)		87.2	89.7

Vertical Stress - Deformation Results

Vert. stress (psf)	Corr. Dial, dfc [a] (in)	Hc [b] (in)	Vert. strain, ev	Void ratio, e	Load duration (min)
Seating	0.0000	1.0028	0.0000	0.9335	0
1,807	0.0002	1.0026	0.0002	0.9332	240
3,200	0.0038	0.9989	0.0038	0.9261	480
6,400	0.0141	0.9886	0.0141	0.9062	270
12,800	0.0304	0.9723	0.0303	0.8749	246
25,600	0.0548	0.9479	0.0547	0.8278	480
51,200	0.0890	0.9138	0.0887	0.7620	480
25,600	0.0810	0.9217	0.0808	0.7773	120
6,400	0.0624	0.9404	0.0622	0.8132	240
1,600	0.0279	0.9748	0.0279	0.8796	1440

Data Interpretation Summary

Preconsolidation stress, s'p (psf)	---	
Compression ratio, CR	---	To be determined by the Geotechnical Engineer
Recompression ratio, RR	---	

Notes:

[a] Dfc = end of increment deformation corrected for machine, porous stone, and filter paper deformation

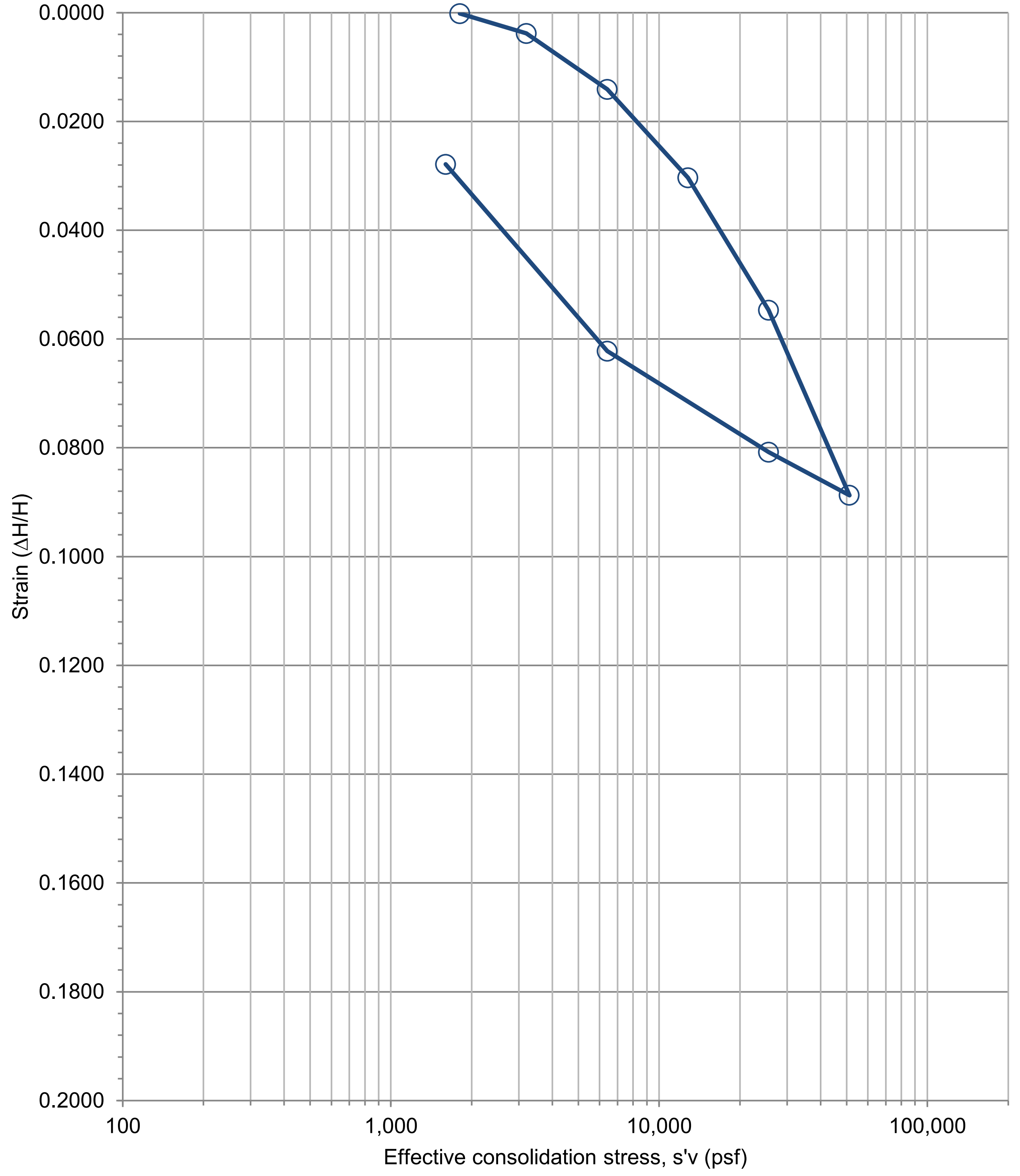
[b] Hc = height at end of consolidation of each vert. stress

Project: Parker Pointe Subdivision

No: 4430.2400002 (24-1755)

TH/TP/Sample: BH-3

Depth: 10 ft



Certificate of Analysis

Universal Engineering Science
Trae Boman
477 Parkland Drive
Sandy, UT 84070

PO#:
Receipt: **2/7/24 12:06 @ 17.1** °C
Date Reported: 2/15/2024
Project Name: **Parker Pointe**

Sample ID: **BH-5**

Matrix: **Solid**

Lab ID: **24B0510-01**

Date Sampled: **1/31/24 11:30**

Sampled By: **Trae Boman**

	Result	Units	Minimum Reporting Limit	Method	Preparation Date/Time	Analysis Date/Time	Flag(s)
Inorganic							
Chloride, Soluble (IC)	14	mg/kg dry	13	EPA 300.0	2/8/24	2/8/24	
pH	4.0	pH Units	0.1	EPA 9045D	2/8/24	2/8/24	
Resistivity	96.2	ohm m	1.0	SSSA 10-3.3	2/13/24	2/13/24	
Sulfate, Soluble (IC)	25	mg/kg dry	13	EPA 300.0	2/8/24	2/8/24	
Total Solids	78.3	%	0.1	CTF8000	2/7/24	2/8/24	

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Project Name: **Parker Pointe**

Report Footnotes

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit (MRL).
1 mg/L = one milligram per liter or 1 mg/kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/kg = one nanogram per kilogram = 1 part per trillion.
On calculated parameters, there may be a slight difference between summing the rounded values shown on the report vs the unrounded values used in the calculation.