Soils report does not address infiltration for underground WQ structure. It also doesn't address the impact this infiltration (and additional groundwater) will have on the surrounding soils and structures (including pavement). Address in here or in drainage report.

REPORT OF GEOTECHNICAL EXPLORATION

KUM & GO #2232

SECURITY BOULEVARD AND MAIN STREET
EL PASO COUNTY, CO

PREPARED FOR
ENTITLEMENT AND ENGINEERING SOLUTIONS, INC.

COLORADO LICENSED
LINDSAY A. TITA
54411
12/02/2021
PROFESSIONAL ENGINEER

December 7, 2021
Olsson Project No. 021-05598

olsson®

Table of Contents

LIST OF TABLES

APPENDICES

Kum & Go Fact Sheet

Store #	**2232**		
Project address:	**Security Boulevard and Main Street El Paso County, Colorado**	Date:	**12/6/2021**
Engineer:	**Lindsay Tita, P.E.**	Phone #:	**303-237-2072**

SITE PREPARATION

Is building demolition necessary (Y/N):	**Yes**	
Are below grade structures known to exist (basements, crawlspaces, UST's) (Y/N/U):	**No**	
Above or below ground utility demolition/relocation (Y/N/U):	**Unknown**	**See Report**
Is shoring anticipated during construction (Y/N):	**Yes**	**See Report**
Old fill encountered that will require rework (Y/N):	**No**	
Estimated topsoil stripping depth (in):	**3**	
Scarification thickness (in):	**12**	
Proofrolling (Y/N): Where feasible. Not recommended in areas of fuel lines or UST installation	**Yes**	**See Report**
Highest recorded groundwater depth from existing grade (ft):	**Not Encountered**	
Lowest recorded groundwater depth from existing grade (ft):	**Not Encountered**	
Unsuitable or unstable soil identified during exploration (Y/N):	**Yes**	**See Report**
Exterior pavement subgrade preparation thickness (in):	**12**	
Pavement underslab drainage system recommended (Y/N):	**No**	
Additional pavement subgrade recommendations neces	**Yes**	**4" ABC**
Do available reports indicate the site was utilized by others prior to Kum & Go (Y/N):	**Yes**	

Additional Comments: On-site sandy soils appear suitable for reuse as structural fill with proper preparation although limited cohesive binder may be encountered in some areas. Olsson should be contacted if the FFE varies from the assumed 5,727.0 feet.

STRUCTURAL FILL

On site soils suitable for reuse? (Y/N):	**Yes**	**See Report**
Import Fill Soils Maximum Liquid Limit (%):	**45**	
Import Fill Soils Maximum Plastic Limit (%):	**25**	
Maximum Swell Potential (%):	**1% at 500 psf Surcharge**	
Maximum Particle Size (in):	**3**	
Recommended lift thickness (in):	**4 to 8**	

FOUNDATION DESIGN/FLOOR SLAB

Recommended Building Foundation Type:	**Shallow Spread (or Trench Type) Foundations**
Finish Floor Elevation (ft): Assumed FFE, not provided	**5,727.0**
Recommended Frost Depth (in):	30
Are overexcavation and structural fill recommended below shallow foundations? (Y/N):	**No**
Is surcharge or preload necessary to prepare the building pad (Y/N):	**No**
Net allowable soil bearing pressure (psf):	**2,000**
Minimum column footing width dimensions (in):	**24**
Minimum continuous footing width dimensions (in):	**18**
Are perimeter foundation drains recommended for the building (Y/N)	**No**
Floor slab subgrade preparation thickness (in):	**12**

****This Fact Sheet only provides a limited overview of the report and is subject to any and all clarifications, conditions, contingencies, limitations and/or qualifications that may exist in the body of the report. The information contained in this Fact Sheet is provided pursuant to Client's request and is provided solely for the convenience of Client and neither Client nor any other party can rely solely on this Fact Sheet. Client and any other party using this report must review the entire report and interpret the information contained in this Fact Sheet in conjunction with the remainder of the report.**

Created by: Lindsay Tita, P.E.

1. Project Understanding

1.1. Geotechnical Scope

This Report of Geotechnical Exploration was requested and authorized by Mrs. Mary Kasal of Entitlement and Engineering Solutions Inc. for the purpose of evaluating existing subsurface conditions and providing geotechnical design recommendations for the new Kum & Go #2232 building, signs, and pavements.

The scope of this geotechnical exploration included:

- Site reconnaissance and review of soil and geologic subsurface information from the USDA Natural Resource Conservation Service (NRCS).
- Review of the Preliminary ALTA/NSPS Land Title Survey for the site entitled "Part of the Southeast Quarter of Section 11, Township 15 South, Range 66 West of the 6th P.M., County of El Paso, State of Colorado" completed by Foresight West Surveying, Inc. and dated 09/03/2021.
- Review of the project site concept plan entitled "Conceptual Site Plan" completed by EES and dated 7/14/2021.
- Drilling and sampling of ten (10) soil test borings extending to depths of approximately 10.5 to 30 feet below existing grades.
- Laboratory testing (as noted in the appendices) of soil samples obtained during the field operations.
- Preparation of this Report of Geotechnical Exploration presenting the soil test borings, laboratory test results, and a summary of our engineering evaluations and recommendations.

1.2. Site Location and Description

The 1.47-acre Kum & Go project site is situated in the north quadrant of the intersection of Main Street and Security Boulevard in El Paso County, Colorado. The ALTA survey indicates the site has about 3 feet of grade change, sloping from an elevation of 5,729 feet in the northeast corner to 5,726 feet in the southwest corner at a slope of approximately 1.5%. A grading plan was not provided at the time of this report but based on existing site grades we anticipate a finished floor elevation of 5,727.0 feet and cut/fill depths to be on the order of 1 foot or less to achieve final design grades. If the finished floor elevation varies from these assumptions, ***Olsson*** should be contacted immediately to review and/or revise the recommendations provided in this report.

From our review of readily available aerial images obtained from Historic Aerials and Google Imagery, this site was used for farming until the late 1950s. The site was then developed with a one-story structure southwest corner of the site. A second one-story building was constructed on the east side of the site sometime between 1969 and 1983. The site remained unchanged until the early 2000s when both buildings were removed. A small, drive-up coffee stand was constructed in recent years that still remains today. A majority of the site is still paved.

1.3. PROJECT INFORMATION

We understand the new Kum & Go facility will include an approximately 5,620-square foot, single-story, slab on grade building utilizing light gauge steel framework and brick veneer. As proposed, the new building will be located on the western portion of the lot facing east. Six (6) new automobile fuel pump islands with an overhead canopy will be positioned east of the new building. The new underground storage tanks (USTs) will be positioned east of the pump islands. Parking areas will be constructed north and east of the building. Access to the facility will be provided by four entrances, one at the southeast corner from Main Street, one at the northwest corner from Security Boulevard, and two along the north side from the existing parking lot. Monument signs are proposed in the southwest and northwest corners of the site.

Based on our experience with the Kum & Go V4 Marketplace building design, ***Olsson*** understands maximum live and dead loads for the new building will be on the order of 41 kips each for isolated columns, 1.5 klf for continuous walls, and 125 psf for floor slabs.

Olsson understands that the type and design of canopy support foundations will be determined by the Canopy Manufacturer/Installer based on their review of the contents of this geotechnical report and the soil conditions encountered at the time of foundation installation. ***Olsson*** will provide recommendations for canopy foundation design, subgrade improvements, or stabilization of canopy foundation subgrades if requested by Kum & Go.

2. Exploratory and Test Procedures

2.1. Field Exploration

A truck-mounted CME-55 drill rig utilizing solid-stem continuous augers was used to complete the 10 soil test borings for this project. Preliminary soil boring depths and locations were selected by ***Olsson*** and reviewed during the proposal phase of this project. The soil boring locations and depths may have been modified or shifted in the field, if necessary, to avoid known underground or overhead utilities, existing structures, site features, public right-of-way, or areas of limited access. Refer to the *Boring Location Map* in *Appendix A* and the *Boring Logs* in *Appendix B* for the final locations and depths of each boring.

Relatively undisturbed and split-barrel soil samples were obtained at 2.5- to 5-foot depth intervals during the drilling process. Soil samples designated as “SS” were obtained in general accordance with ASTM D1586 (Penetration Test and Split-Barrel Sampling of Soils). Soil samples designated as "MC" on the boring logs were obtained in general accordance with ASTM D3550 (Thick Wall, Ring-Lined, Split-Barrel, Drive Sampling of Soils) with a Modified California Barrel Sampler. The “MC” sampler was driven to a 12-inch depth, as it can only sample a maximum 16-inches of soil. Recovered samples were sealed in plastic containers or sampling tubes, labeled, and protected for transportation to the laboratory for testing.

2.2. Laboratory Testing

Per the laboratory scope and sample conditions, tests were completed to evaluate the engineering properties of recovered soil samples. Moisture content and density tests were completed to determine the existing moisture state and unit weight of subsurface soils. Full gradations and P-200s were completed to determine the ratio of fines (clay and silt) to sands and gravels. Atterberg Limits were completed to help classify cohesive samples and determine the soil plasticity. A corrosion series was performed to determine the potential for sulfate attack on concrete and corrosion of buried metal pipes. Proctor and R-value tests were performed on a bulk sample collected in pavement areas to determine pavement subgrade characteristics. Laboratory tests were conducted in general accordance with current ASTM test procedures. A summary of the laboratory test results is presented in *Appendix C*.

3. Subsurface Conditions

3.1. Area Geology

Based on the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) soil survey data, the project site is mapped in the Blendon sandy loam (0 to 3 percent slopes) soil complex. The Blendon sandy loam is described as alluvial fan terraces of sandy alluvium derived from the arkose with bedrock materials located at greater depths. The Blendon soil unit is categorized into hydrologic group B and the depth to the water table is reported to be greater than 80 inches.

Based on a review of USGS Geologic Mapping by Madole and Thorson (2002), the project site is most likely underlain by Middle Alluvium deposits that are described as poorly sorted sand and subordinate amounts of gravel. Nearby bedrock outcrops are mapped as Cone-in-cone zone of the Lavington which is described as clayey or silty shale containing ironstone concretions, limestone concretions, and thin bentonite beds. A review of Potentially Swelling Soil and Rock in the Front Range Urban Corridor mapping by Hart (1972), situates the project site in an area described as having low swell potential however, the site borders an area mapped as moderate swelling soils.

3.2. Test Borings and Laboratory Summary

Soil stratification, as shown on the boring logs, represents soil conditions at the specific boring locations; however, variations may occur between or beyond the borings. The stratification lines represent the approximate boundary between soil types, but the actual transition between soil layers may be gradual.

Borings B-1, B-2, and B-3 were drilled in the proposed building footprint. B-1 and B-2 encountered 3 to 4 inches of asphalt overlying 1.5 to 2.0 feet of firm to stiff lean to fat clay fill underlain by medium dense to dense well-graded sand with clay to the termination depths. B-3 encountered 2 inches of gravel overlying 11.5 feet of very loose to medium clayey sand fill underlain by medium dense to dense well-graded sand with clay to termination depth.

Borings B-4 and B-5 were drilled within the proposed pump station and canopy area and encountered approximately 5.5 to 7.0 feet of stiff to very stiff and medium dense clayey sand and lean to fat clay fill with varying sand and gravel contents. This material was underlain by medium dense to dense well-graded sand with clay to the termination depths.

Boring B-6 was drilled within the proposed UST excavation. 3 inches of asphalt were encountered overlying 7 feet of firm sandy clay underlain by medium dense to dense well-graded sand with clay to termination depth.

Boring B-7, near the southwest pole sign location, encountered 3 inches of asphalt overlying 3 feet of medium dense clayey sand underlain medium dense to dense well-graded sand with clay to termination depth.

Pavement borings B-8, B-9, and B-10 encountered 2 inches of asphalt overlying approximately 3 to 5.5 feet of loose to dense and firm sandy clays underlain by loose to dense well-graded sand with clay and clayey sand to the termination depths.

3.3. Soil Properties

Table 1: Summary of Soil Properties

Lean Clay to Fat Clay – with varying sand and gravel content, fine grained sand, 1/8 to 3/8-inch angular gravel, firm to stiff, brown, moist

USCS Classification	Dry Density (pcf)	Moisture Content (%)	Saturation (%)	LL / PI (%)	P-200 (%)	SPT "N" Values (bpf)
CL/CH [FILL]	112.2	13.1 – 39.1	70.3	24 / 9	58.4 – 88.6	2 - 10

Sand and Gravel – with varying amounts of clay, very loose to dense, brown, moist

USCS Classification	Dry Density (pcf)	Moisture Content (%)	Saturation (%)	LL / PI (%)	P-200 (%)	SPT "N" Values (bpf)
SPG, SC [FILL]	98.1 – 130.1	1.2 – 50.5	7.1 – 37.0	N/T	8.3 – 19.7	2 – 50

*N/T indicates no tests performed

3.4. Groundwater Summary

Free water was not encountered in any of the ten borings completed during this exploration, however, very moist soils were encountered near the surface in many of the borings. Considering the anticipated future site grades, perched groundwater may adversely impact site grading, earthwork, shallow building construction, or UST installation. If perched water is encountered during excavation, the contractor should be adequately prepared for dewatering. The design, operation, and maintenance of the dewatering system during construction is the responsibility of the contractor.

It should be noted that groundwater levels (perched or otherwise) typically fluctuate with seasonal variations in precipitation, runoff, snowmelt, irrigation demands, or other factors that may differ from those at the time of the drilling operations. *Section 4.4* of this report addresses general groundwater or drainage concerns as applicable to the site design and earthwork as we now understand them.

3.5. Corrosivity of Soils

The results of the water-soluble sulfate, pH, chloride, and resistivity testing are summarized as follows:

Table 2: Soil Corrosion Testing Summary

Test/Sample Location	Sulfate (% mass)	Relative Degree of Sulfate Attack	Chloride (% mass)	pH	Soil resistivity (ohms-cm)
B-3 GB-1 3-5'	N/D	Negligible	0.0105	8.08	2980

*N/T indicates no tests performed; N/D indicates levels below the equipment detection limit

The resistivity value indicates that the soils may be moderately corrosive to buried metal. A mechanical/electrical designer, experienced with local building code requirements and local practice, should review the laboratory test results presented above and determine if corrosion protection of buried utility lines is required and how it is to be implemented.

Laboratory results indicate a negligible risk of sulfate attack for concrete exposed to soils on this site. No specific cement type is required per ACI 201.2R, based on the sulfate levels less than 0.10 percent by mass. To help control superficial damage in concrete exposed to prolonged moisture or high groundwater, the water/cement ratio should not exceed 0.50. Refer to *Appendix C, Summary of Laboratory Test Results* for additional information. An experienced designer should review these results and evaluate the suitability of proposed designs based on the corrosivity test results.

4. Site Preparation

4.1. General Site Preparation

During our exploration, we drilled through the existing asphalt pavements and noted that the asphalt was on the order 3-inches thick. All existing pavements and structures should be removed from areas of new construction, as well as any topsoil, vegetation, major root systems, organic soils, and any loose, soft or otherwise unsuitable or deleterious material. If desired, suitable topsoil could be stockpiled on-site for later use in landscaping or non-loaded areas. Asphalt materials should not be incorporated into site fills. Site clearing, demolition, grubbing, and stripping should be completed during periods of dry weather. Operating heavy equipment on the site during periods of wet weather could result in excessive pumping and rutting of the subgrade soils. The base of new construction excavations should be evaluated by ***Olsson*** prior to the placement of new fill soils.

After stripping and rough grading, areas to receive new structural fill should be prepared by scarifying, moisture conditioning, and compacting the upper 12 inches as recommended in *Section 4.2*. After compaction, we recommend the subgrade be proofrolled wherever equipment access is feasible. Proofrolling may be accomplished with a fully loaded, tandem axle dump truck or other equipment with a minimum gross weight of 20 tons. Proofrolling aids in delineating soft or loose areas that may exist below subgrade level. Unsuitable areas identified by visual observation or proofrolling should be improved by compaction in-place or by overexcavation and replacement of the unstable soil with compacted structural fill. We recommend that a full-time ***Olsson*** representative be on-site during all earthwork operations and during construction to observe and document uniform and stable subgrade conditions prior to placing new structural fill, foundations, floor slabs, or pavements.

Very loose clayey sand fill materials were encountered in boring B-3 to an elevation of approximately 5,719 feet. ***Olsson*** recommends that these very loose soils be removed and replaced with structural fill as recommended in *Section 4.2*. The extents of these unstable soils may vary in the surrounding area. We recommend an ***Olsson*** representative observe the removal process and determine the bounds of the loose materials on-site. Shoring may be necessary in this area to prevent the deeper excavation from caving during construction. The contractor should review the subgrade conditions in this report and monitor the conditions during construction to determine if shoring is necessary.

The shallow foundations for the new Kum & Go building will bear within the native clayey sands which should be compacted prior to foundation construction. As an alternative to having the foundation contractor scarify and compact the exposed trench subgrades after excavating to design bearing depths, the earthwork contractor could consider cutting the foundation areas to bottom of footing elevation, scarifying, and compacting 12 inches of the exposed subgrade per the recommendations of this report, then proceeding with new structural fill placement across the site. *Section 5.1* of this report addresses these subgrade preparation options on greater detail.

Construction scheduling often involves grading and paving by separate contractors and can involve a time lapse between the end of grading operations and the commencement of paving. Disturbance, desiccation, or wetting of the subgrade soils between grading and paving can result in deterioration of the previously completed subgrade. The final prepared subgrade should be proofrolled again with a loaded dump truck or similar rubber-tired equipment with a minimum gross weight of 20 tons, immediately prior to placing new pavements. Proofrolling operations should be observed and documented by ***Olsson***. Unstable or unsuitable soils revealed by proofrolling should be reworked to provide a stable subgrade. More aggressive stabilization measures may be required if instability persists.

4.2. Structural Fill

Based on the results of our subsurface investigation, the on-site clayey sand and sandy clay soils are suitable for reuse as general fill, structural fill, or utility backfill on this site. Native sands with limited cohesive binder may require blending with more cohesive soils to produce a stable subgrade. Imported fill materials, if required, should be low plasticity, non-expansive, cohesive material with a liquid limit less than 45, a plasticity index less than 25, having at least 25 percent passing the #200 sieve, and having a maximum swell potential of 1% under a 500 psf surcharge. If alternate borrow materials are considered, we recommend the contractor provide supplier gradation and/or laboratory plasticity and swell documentation to ***Olsson*** for review and approval prior to site delivery. Additional laboratory testing and documentation by ***Olsson*** geotechnical engineers will be required prior to the consideration or acceptance of imported fill materials.

Suitable fill materials should be placed in thin lifts. Lift thickness depends on the type of compaction equipment, but in general, lifts of 4 to 8-inch loose measurement are recommended. Soils should be compacted using equipment of appropriate size and type to achieve the requirements of this report. A self-propelled, vibratory sheepfoot roller is generally recommended for compacting cohesive (clay and clayey) soils encountered on-site. For any cohesionless (sand or gravel) soils, a self-propelled, smooth drum roller is generally recommended for compaction. Wheel rolling using rubber-tired equipment is not an acceptable method of compaction and should not be allowed. Within small excavations, such as in footing trenches, utility trenches, or around manholes, “Wacker-Packers” or “Rammax” compactors for cohesive soils or vibrating plate compactors for granular soils (where allowed by the geotechnical engineer) can be used to achieve the specified compaction. Lift thicknesses should be reduced to 4 inches in small fill areas requiring hand-operated equipment. To achieve proper compaction of granular cushion materials, the stone should have the individual stone facets properly oriented using a plate compactor, jumping jack, or other vibratory compaction device.

During grading operations, representative samples of general and structural fill materials should be initially and periodically checked via laboratory testing to document that the previously mentioned soil parameters are maintained. An ***Olsson*** representative should regularly observe and monitor the excavation and grading operations and perform field density tests to document that the specified moisture and compaction requirements are being achieved. Full time field observation, moisture/density testing, and swell testing are recommended during the excavation, blending (if applicable), and replacement operations below and around the building, canopy, trash enclosure, and UST areas.

TABLE 3: STRUCTURAL FILL RECOMMENDATIONS

Areas of Fill Placement	Minimum Compaction (ASTM D698 Standard Proctor)	Moisture Content (Percent of Optimum)
Structural Fill – On-site granular or imported soils placed below and within 10 feet of the building (including entrance slabs and exterior slabs adjacent to the building), trash enclosure, retaining walls, signs, and pavements	95%	As necessary to obtain density for cohesionless gravelly soil, or -2 to +2 percent for cohesionless soils or -1 to +3 percent for non-expansive cohesive soil
Floor Slab Subgrade – Structural fill placed below the building floor slab or below the granular cushion layer, if utilized.	95%	
Utility Trenches – Cohesive backfill structural fill soils placed within new utility trenches	95%	
Underground Storage Tank Trench – On-site, on-site blended, or imported structural fill soils within the UST trench	95%	
Pavement Subgrade – On-site, on-site blended, or imported structural fill soils below areas of new pavement	95%	
Sidewalk Subgrade – Below grade-supported sidewalks	95%	
Non-Structural Fill – Beneath non-loaded landscape/grass areas	92%	

*May be substituted with 65% "relative density" in accordance with ASTM D4253 and D4252

Granular fill materials may not produce a definable moisture-density curve when tested in accordance with ASTM D698 (Standard Proctor). Such materials could alternatively be compacted to a minimum of 65 percent Relative Density as determined by ASTM D4253 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils Using a Vibratory Table) and D4254 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density).

The moisture content for imported fill soils at the time of compaction should generally be maintained between the ranges specified above. More stringent moisture limits may be necessary with certain soils, and some adjustments to moisture contents may be necessary to achieve compaction in accordance with project specifications.

4.3. Utilities

New underground utilities should be installed in accordance with local building codes. Utility trench backfill should consist of compacted structural fill placed in accordance with *Section 4.2* of this report. Where utilities will penetrate the footprint of the building, it is recommended that a utility trench "plug" be constructed that extends at least 5 feet beyond the building perimeter. The trench plug should consist of non-expansive backfill materials having at least 50 percent passing the #200 sieve, to provide a moisture barrier to the soils within the influence zone of the new building. In addition, flexible connections should be used wherever possible.

Granular pipe bedding for new utilities is acceptable, but the remaining trench should be backfilled and compacted using the pre-approved, imported cohesive structural fill soils or on-site cohesive soils (blended as necessary) originally removed from the trench.

Water should be prevented from entering utility trenches before, during, and after construction. Excavations should not remain open if rain is anticipated. Excavations should be backfilled as soon as possible with approved structural fill to reduce the potential for moisture infiltration or sidewall sloughing.

4.4. Drainage and Groundwater Considerations

Groundwater was not encountered during our field exploration; however, very moist soils were encountered near the surface in many of the borings. Considering the anticipated future site grades, perched groundwater may adversely impact site grading, earthwork, shallow building construction, or UST installation. If perched water is encountered during excavation, the contractor should be adequately prepared for dewatering. The design, operation, and maintenance of the dewatering system during construction is the responsibility of the contractor.

Water should not be allowed to collect near foundations, floor slabs, or in areas of new pavements, either during or after construction. As applicable, provisions should be made to quickly remove accumulating seepage water or storm water runoff from excavations. Undercut or excavated areas should be sloped toward one corner to allow rainwater or surface runoff to be quickly collected and gravity drained or pumped from construction areas. Subgrade soils that are exposed to precipitation or runoff should be evaluated by the geotechnical engineer prior to the placement of new fill, reinforcing steel, or concrete, to determine if corrective action is required.

To minimize concerns related to improper or inadequate drainage away from foundation bearing subgrades or from cohesive backfill materials used in utility or foundation trenches, we provide the following general recommendations:

- Site grading should provide efficient drainage of rainfall or surface runoff away from new structures and pavements.

- Roof drains from the new building and canopies should be collected and discharged directly to the storm sewer or directed to a down gradient location away from structures and pavements.
- External hose connections in unpaved areas should incorporate splash blocks to prevent localized flooding of foundation bearing or backfill soils. External hose connections should have cut-off valves inside the building to prevent accidental or unauthorized use.
- Maintenance personnel should be informed of the potential concerns associated with excessive watering near the building.

Although groundwater was not encountered during our field investigation, groundwater may fluctuate seasonally or with precipitation events. If groundwater is encountered during earthwork and/or construction activities the excavations will need to be adequately dewatered during these operations. The design, operation, and maintenance of the dewatering system during construction is the responsibility of the contractor.

4.5. CONSTRUCTION EQUIPMENT MOBILITY

On-site or imported soils may be susceptible to softening under construction equipment traffic during periods of wet weather. Reducing equipment mobility problems and managing soft surface soils will be dependent on the severity of the circumstances, the soil types, the season in which construction is performed, and prevailing weather conditions.

Some general guidelines for reducing equipment mobility problems and addressing potential soft and wet surface soils are as follows:

- Optimize surface water drainage at the site during construction.
- Whenever possible, wait for dry weather conditions to prevail and do not operate construction equipment on the site during wet conditions. Rutting the surface soils will aggravate the condition and accelerate subgrade disturbance.
- Disk or scarify wet surface soils during periods of favorable weather to accelerate drying. Temporarily compact loose subgrade soils if rain is forecast to promote site drainage and reduce moisture infiltration.
- Use construction equipment that is well-suited for the intended job under the existing site conditions. Heavy rubber-tired equipment typically requires better site conditions than light, track-mounted equipment.
- Implement a construction schedule that realistically allows for rain days. Pressure to perform earthwork under a tight schedule is frequently counterproductive.

If requested, ***Olsson*** can help determine a cost-effective approach for stabilizing unsuitable soils at the time of construction.

4.6. TEMPORARY SLOPES AND EXCAVATIONS

Construction site safety is the responsibility of the general contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequencing, and operations during construction. ***Olsson*** is providing the following information solely as a service to EES. Under no circumstances should ***Olsson***'s provision of the following information be construed to mean that we are assuming responsibility for construction site safety or the contractor's activities. Such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced, and if not followed, the owner, the contractor, or earthwork or utility subcontractors could be liable for substantial penalties. The contractor is responsible for reviewing this geotechnical report, determining the appropriate OSHA slope criteria for the soil conditions encountered, and implementing it during construction. Soils encountered in construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the widely spaced borings. The contractor should verify that similar soil conditions exist throughout the proposed areas of excavation. If different subsurface conditions are encountered at the time of construction, ***Olsson*** recommends that they be contacted to re-evaluate existing site conditions.

Temporary slopes steeper than 5H:1V should be properly benched prior to placement of new fill. As an alternative to flatter and benched temporary slopes, vertical excavations can be temporarily shored. The contractor should be responsible for the design of temporary shoring in accordance with applicable regulatory requirements. Permanent fill and cut slopes at the site should not exceed 3H:1V. Where steeper slopes are planned, additional analysis should be performed once grading plans have been developed.

Stockpiles of soils and equipment should not be placed within a horizontal distance equal to one-half the excavation depth, from the edge of the excavation. A professional engineer should design excavations deeper than 20 feet. If excavations, including utility trenches, are extended to depths of more than 20 feet, OSHA requires that the side slopes of such excavations be designed by a professional engineer registered in the state where construction is occurring.

5. Buildings and Structures

5.1. Shallow Foundation Design

The site appears suitable for supporting the lightly loaded Kum & Go building on conventional shallow spread or trench type foundations. During drilling the boreholes remained open without sloughing to the anticipated foundation depths; however, laboratory testing shows some on-site soils have low cohesion and high moisture contents. If inadequate cohesive binder and low moisture contents are encountered during foundation construction, foundation excavations may need to be formed in order to prevent sidewall sloughing or the on-site soils may need overexcavated and blended or replaced with soils that have adequate cohesive binder in order to maintain an open excavation. Ultimately the contractor should evaluate his means and methods for the soil types and conditions encountered or imported. Based on an assumed FFE of 5,727.0 feet, shallow foundations for the building will bear within the native clayey sands. After the footing excavations are complete and the base of the footings are observed and documented by an ***Olsson*** representative, the resultant subgrade should be scarified, moisture conditioned, and compacted in accordance with the recommendations discussed in *Section 4.2*.

An alternative to scarifying and moisture conditioning the base of the footings after excavation would be for the earthwork contractor to prepare the subgrade during the initial site grading. If this option is chosen, the contractor should excavate the foundation areas to the base of footing elevation (5,724.0 feet) prior to placing new structural fill across the building. The contractor should then scarify 12 inches and compact the resultant subgrade following the recommendations discussed in *Section 4.2*. If the base of foundation subgrade is not disturbed during excavation, no additional rework or preparation should be required prior to construction.

Footings supported on at least 12 inches of engineer observed and documented soils prepared as structural fill may be designed using a net allowable soil bearing pressure of up to 2,000 pounds per square foot (psf). The net allowable bearing capacity can be increased by 1/3 for transient loadings (short term loading such as wind load or seismic load) when used with the alternative basic load combinations of Section 1605.3.2 of IBC 2015. These design recommendations are based on the anticipated maximum structural loads noted in *Section 1.3* of this report. If the final FFE of the building varies from our assumptions, the recommended subgrade preparation and bearing capacity should be reviewed by ***Olsson*** prior to construction.

Building footings should have minimum dimensions in accordance with local building codes. ***Olsson*** recommends minimum dimensions of 18 inches for continuous footings and 24 inches for isolated column footings to minimize the potential for localized bearing failure. Perimeter footings and footings in unheated areas should bear at a minimum depth of 30 inches below the lowest adjacent final ground surface for frost protection per Pikes Peak Regional Building Department requirements. Interior footings in heated areas can bear as shallow as necessary below the floor slab.

The use of the recommended design bearing pressure is contingent on having prepared foundation subgrades observed by an ***Olsson*** geotechnical engineer or his/her authorized field representative prior to placing new structural fill, reinforcing steel, or concrete to document that the subgrade soils and conditions are consistent with the bearing subgrade requirements of this report. Additionally, we recommend bearing subgrades be hand probed before placing reinforcing steel or concrete to identify soft, loose, or otherwise unsuitable conditions.

The total post-construction settlement for the new Kum & Go building with foundations less than 5 feet wide designed and constructed as recommended above is anticipated to be 1-inch with differential movement limited to less than ½-inch over 50 feet or between adjacent columns. To reduce the effects of differential movement, floating floor slabs with expansion joints, independent from wall and column loads, will be important in minimizing the potential cracking that can occur along and around foundation systems. Floor slab control joints should be used to reduce potential damage due to shrinkage cracks. Additionally, exterior veneers should be installed to allow abutting pavements and sidewalks to move independently.

Lateral resistance of the foundations will be achieved through a combination of base shear resistance mobilized at the footing-subgrade interface and passive earth pressure acting on the vertical faces of the footings at right angles to the direction of applied load. A friction coefficient value of 0.35 can be used between the native soil and the foundation concrete for base shear and sliding resistance. Passive earth pressure resistance can be calculated using parameters provided in *Section 5.6*. For foundations subjected to both uplift and lateral forces, the base friction should be neglected in the calculations.

The uplift resistance for the shallow foundation is developed by the dead load at the footing, and the weight of the soil directly above the footing. The weight of the soil can be calculated using a unit weight of 120 pcf and the volume of a prismatic failure block with vertical faces above the footing edges.

After foundation subgrades have been observed and evaluated by an ***Olsson*** representative, concrete should be placed as soon as possible to avoid subjecting the exposed soils to drying, wetting, or freezing conditions. If foundation subgrade soils are subjected to such conditions, the geotechnical engineer should be contacted to reevaluate the foundation bearing materials. It will not be acceptable for the contractor to place lean concrete, flowable fill, or other types of “mud mat” below shallow foundations unless specifically directed by the geotechnical engineer.

5.2. MONUMENT SIGNS

Based on the results of our exploration, the native soils appear to be suitable for the support of shallow foundations for the monument signs in the southwest and northwest corners of the site. Boring B-2, near the southwest corner, encountered lean to fat clay fill underlying 3 inches of asphalt to a depth of approximately 2 feet, underlain by well graded sand with clay to the termination depth. Boring B-7, near the northwest corner, encountered clayey sand fill underlying 3 inches of asphalt to a depth of approximately 3 feet, underlain by gravel with varying amounts of clay to the termination depth. The upper 12 inches of subgrade at the bottom of the excavation should be moisture conditioned and recompacted to 95% of the materials standard proctor maximum dry density to provide a stable and uniform bearing surface. Shallow spread foundations bearing on new structural fill or native soils prepared as structural fill may be designed using a net allowable soil bearing pressure of up to 2,000 pounds per square foot (psf).

5.3. Seismic Classification

Per the International Building Code (IBC), soils within the upper 100 feet determine the seismic structural design criteria for the project site. The soil shear strengths and blow counts (N values) were estimated based on the results of the laboratory testing program, field exploration, and the assumed soil properties on the undocumented soils below the lowest boring. For this project site, we recommend using a Site Class D (stiff soil profile) in accordance with 2015 IBC. This recommendation is based on the soil conditions encountered in the borings during the exploration and our assumption that the encountered soils continue beyond the drilled depth to the full 100 feet. A seismic survey to 100 feet depth could be performed if the design engineers require a more site-specific seismic classification.

5.4. Floor Slab Design

We recommend the floor slab be supported by a minimum 12 inches of newly placed and compacted structural fill or native sandy clays or clayey sands that have been prepared and compacted as structural fill per the recommendations of this report. If this compacted 12-inch structural fill thickness is provided during site grading or earthwork, no additional subgrade preparation may be necessary. If the floor slab areas are disturbed by construction equipment traffic between the time of initial grading and concrete placement, rework and recompaction, following the recommendations of this report, will be required. This 12-inch compacted subgrade thickness is in addition to the granular cushion thickness typically provided below floor slabs. Additionally, the floor slab subgrade should be evaluated by proofrolling (if feasible) with an ***Olsson*** representative present, during the site grading or earthwork stages. If unstable soils are encountered which cannot be adequately densified in place, these soils should be removed and replaced with structural fill in accordance with the recommendations of this report. If these recommendations are followed and the subgrade soils are prepared and compacted as recommended, the building floor slab may be designed using a subgrade modulus (“k” value) of 150 psi/in.

We recommend a free draining, 4-inch thick granular leveling and drainage course consisting of No. 57 stone meeting ASTM C33 specifications, or equivalent, be installed beneath the concrete floor slab above the newly placed structural fill for uniform support and to act as a capillary break. Additionally, the floor slab subgrade should be evaluated by proofrolling (if feasible) with an ***Olsson*** representative present, during the site grading or earthwork stages. If unstable soils are encountered which cannot be adequately densified in place, these soils should be removed and replaced with structural fill in accordance with the recommendations of this report.

Lightly loaded interior partition walls (applying less than 0.75 klf) may be supported directly on the slab on grade floor, although, depending on the floor slab design and the specific wall loads, it may be appropriate to increase the floor slab reinforcement or provide a thickened slab cross section below interior walls. For interior walls with loads greater than 0.75 klf, ***Olsson*** recommends that a footing be installed, independent from the floor slab, to properly distribute the wall loads to the underlying soil and reduce the potential for floor slab damage.

Based on our experience with other Kum & Go projects, it may be appropriate to provide a sealed polyethylene vapor barrier between the new floor slab and granular drainage materials to reduce moisture infiltration. The decision to place a vapor barrier in direct contact with the slab or beneath the layer of granular fill should be made by the design engineer after considering the moisture sensitivity of new flooring materials or finishes and installed per the current American Concrete Institute standards and recommendations. The long-term performance of the slab-on-grade will greatly depend on the minimizing moisture variations in the subgrade soils, the recommendations provided in *Section 4.4* should be followed.

5.5. EXTERIOR SLABS AND SIDEWALKS

Considering the encountered conditions during our exploration below and around the building footprint, the standard Kum & Go “turn-down” design for approach and entrance slabs should be appropriate. The standard Kum & Go design for exterior sidewalks adjacent to the building includes 12 inches of compacted crushed aggregate directly below the slabs. Refer to the applicable Kum & Go construction or design drawings for specific details. To minimize future moisture accumulation within this granular layer, providing a panel or trench drain extending to a gravity discharge point away from the building or pavements could be considered. At a minimum, we recommend regularly scheduled crack and joint sealing between slabs, pavements, and the building to reduce potential moisture infiltration.

Olsson recommends that new sidewalks located away from the Kum & Go building be supported by a minimum 12 inches of structural fill or native soils prepared as structural fill. This recommendation can be achieved by scarifying the upper 12 inches of sidewalk subgrade, moisture conditioning as necessary, and compacting to a minimum 95 percent of the materials Standard Proctor maximum dry density at the applicable materials moisture content provided in *Section 4.2*. If this compacted 12-inch structural fill thickness is provided during site grading or earthwork, no additional subgrade preparation may be necessary. If the pavement areas are disturbed by construction equipment traffic between the time of initial grading and concrete placement, rework and recompaction, following the recommendations of this report, will be required.

Prepared subgrades should extend a minimum of 1-foot beyond each edge of sidewalk, where feasible. Improper subgrade preparation such as inadequate vegetation removal, failure to identify soft or unstable areas, and inadequate or improper compaction can also produce non-uniform subgrade support and cause unacceptable post-construction movement. Additionally, if clay is utilized as fill material, subgrades could be frost susceptible. If these soils become very moist or saturated and freeze, slab heaving is possible. Positive grading to direct surface drainage away from sidewalks will help limit the potential for moisture infiltration of slab subgrade soils and subsequent frost related heaving. At a minimum, we recommend regularly scheduled crack and joint sealing between slabs, pavements, and the building to reduce potential moisture infiltration.

5.6. LATERAL EARTH PRESSURES

The following soil parameters are provided for use in designing foundation or below grade retaining walls which are subjected to lateral earth pressures. The maximum toe pressure for below grade walls should not exceed the bearing capacity recommended in this report for shallow spread foundations. The parameters are based on the understanding that retained soils will be similar in composition to the on-site soils encountered during this exploration. The effects of lateral earth pressure should be considered during selection and installation of the underground fuel tanks.

Walls which are rigidly restrained at the top and are essentially unable to deflect or rotate should be designed for “at rest” earth pressure conditions. Walls that are unrestrained at the top and are free to deflect or rotate slightly may be designed for “active” earth pressure conditions. The “passive” earth pressure condition should be used to evaluate the resistance of soil to lateral loads. Equivalent fluid densities are provided in the table below, which are frequently used for the calculation of lateral earth pressures for the “at rest” and “active” conditions. The equivalent fluid densities below do not include the effects of surcharge loading.

TABLE 4: EARTH PRESSURE PARAMETERS

Condition	Soil Type	Equivalent Fluid Density*	
		Moist Condition	Saturated Condition**
Active (K_a)	Low plasticity cohesive materials	45 pcf	85 pcf
	Cohesionless granular materials	40 pcf	85 pcf
At Rest (K_0)	Low plasticity cohesive materials	70 pcf	100 pcf
	Cohesionless granular materials	60 pcf	95 pcf
Passive (K_p)	Low plasticity cohesive materials	350 pcf	240 pcf
	Cohesionless granular materials	410 pcf	270 pcf

* Assumed level backfill.

**Saturated equivalent fluid density values include hydrostatic pressure. Value would need to be adjusted if water is above ground surface.

These design recommendations are based on the following assumptions:

- For active earth pressure, the wall must rotate about its base, with top lateral movements 0.002 Z to 0.004 Z (granular) or 0.010 Z to 0.020 Z (clays), where Z is wall height. This is necessary to allow the active condition to develop.
- For passive earth pressure, the wall must rotate about its base, with top lateral movements 0.020 Z to 0.060 Z (granular) or 0.020 Z to 0.040 Z (clays), where Z is wall height. This is necessary to allow the passive condition to develop.
- Drained condition requires the walls have a permanent drainage system behind the wall that will prevent hydrostatic pressure from developing. Moisture collected in the drain system should be collected in a sump pit and pumped away from the structure or daylight to a location that will gravity drain. If permanent drainage is not provided, undrained condition should be used for design.
- The soil parameters provided above assume the backfill is level with the top of the wall. If a sloping backfill is utilized, the parameters will need to be reevaluated. In addition to a sloping backfill, the walls should be designed to resist surcharge loads, including nearby shallow foundations or other concentrated load components and traffic loads. Passive pressures are typically lower if the ground surface slopes downward away from the face of the wall.
- Passive resistance against horizontal movement within frost zone should be ignored.
- Backfill soils placed within the height of the retained wall should consist of well compacted selected granular soils or low-plasticity non-expansive cohesive soils. The cohesive soils should be tested to verify these soils can achieve a minimum friction angle of 28 degrees and a unit weight of 125 pcf. Backfilled granular materials should have a minimum friction angle of 32 degrees and a unit weight of 125 pcf. For the values to be valid, the backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.
- Uniform surcharge, heavy equipment and other concentrated load components are not included.
- Factor of safety is not included. The designer should use appropriate factors of safety for design.
- To calculate the resistance to sliding on native soil, a coefficient of friction value of 0.40 should be used where the footing is supported by engineer-approved bearing soil consisting of sandy clay soils or similar structural fill. A factor of safety of at least 1.5 should be applied to sliding calculations for the overall wall design.

5.7. UNDERGROUND FUEL TANKS

Due to the granular nature of the subsurface soils, shoring may be necessary to provide support during excavation or backfilling operations and provide sidewall stability. The contractor should review the subsurface conditions and soil properties to determine if shoring will be used on this site.

The native soils appear suitable to support the UST and associated components. Based on our laboratory results, soils removed from the UST excavation appear suitable to be reused as structural fill at the site.

- Excavated native soils and the overlying imported structural fill materials should be replaced with approved backfill of proper size and gradation. Granular backfill materials should meet ASTM C33 requirements for quality and soundness.
- Backfill suppliers should provide sieve analysis documentation that the materials meet these requirements.
- Backfill materials should be kept dry and free of ice or snow in freezing conditions.

Typical backfill material for new fuel tank installation consists of free-draining naturally rounded aggregates (pea gravel) with a maximum ¾-inch particle size and no more than 5 percent passing a #8 sieve. Crushed and washed stone with a maximum angular particle size of ½ inches and no more than 5 percent passing the #8 sieve can also be used. If material which meets these typical specifications is not locally available, the tank manufacturer should be contacted for information or approval of alternate materials and installation instructions.

Tank backfill materials should be compacted carefully to prevent tank damage; however, if new pavements will cover the backfill materials, adequate compactive efforts must be applied to prevent future settlement and pavement damage. If new pavements will be placed over the new underground fuel tanks, we recommend that the backfill be compacted to a minimum 95 percent of the materials Standard Proctor (ASTM D698) maximum dry density.

These backfill recommendations are provided as a general guideline for underground fuel tank applications. They are not intended to supersede the material recommendations or installation requirements of a specific tank manufacturer. We recommend that the manufacturer's recommendations be reviewed and followed, as appropriate, for the surface covering proposed, the tank type selected, and the site conditions anticipated by the installation contractor. In addition, since the UST is close to an overhead canopy, the excavations for the UST will affect the canopy and vice versa; therefore, the UST installation contractor and the canopy contractor should coordinate their excavation and construction activities.

Groundwater was not encountered during our field observation; however, very moist soils were encountered near the surface in many of the borings. Considering the anticipated future site grades, perched groundwater may adversely impact site grading, earthwork, shallow building construction, or UST installation. If free water is encountered during the tank excavation and subgrade preparation, the contractor should follow an applicable local and state dewatering plan. The installation contractor is responsible for the design of shoring or benching of excavation sidewalls as applicable for their selected means and methods. Depending on the amount of clay binder or cementation in the sandy layers encountered while drilling boring B-6, excavation sidewalls may potentially be unstable and could cave in during UST installation. The excavation and UST installation contractor should be aware of this.

6. PAVEMENTS

6.1. PAVEMENT SUBGRADE PREPARATION

It is important that pavement subgrade support be relatively uniform, with no abrupt changes in the degree of support. Non-uniform pavement support can occur at the transition from cut to fill areas, as a result of varying soil moisture contents or soil types, or where improperly placed utility backfill has been placed across or through areas to be paved. Improper subgrade preparation such as inadequate vegetation removal, failure to identify soft or unstable areas by proofrolling, and inadequate or improper compaction can also produce non-uniform subgrade support.

Surficial soils tested across the project site exhibited low swell potential. To reduce potential for movement of pavements, we recommend all pavements be supported on a minimum of 12 inches of structural fill or 12 inches of native soils that have been prepared as structural fill per *Section 4.2.* If this compacted 12-inch structural fill thickness is provided during site grading or earthwork, no additional subgrade preparation may be necessary. If the pavement areas are disturbed by construction equipment traffic between time of initial grading and concrete placement, rework and recompaction, following the recommendations of this report, will be required.

The final pavement subgrade should be tested for compaction and proofrolled immediately prior to pavement placement to detect localized areas of instability. Unsuitable or unstable areas should be reworked as necessary to provide a uniform, moisture conditioned, and compacted subgrade.

If soft areas are identified during the subgrade preparation or if the subgrade soils have been exposed to adverse weather conditions, frost, excessive construction traffic, standing water, or similar conditions, the geotechnical engineer or his authorized field representative should be consulted to determine if corrective action is necessary. Proofrolling operations are not recommended in areas of new underground fuel tanks, fuel delivery lines, or underground utilities. Granular subgrade soils lacking adequate cohesive binder may rut or roll under construction equipment traffic. In these areas, the geotechnical engineer may elect to eliminate the proofrolling requirement.

It is recommended the prepared subgrades extend a minimum of 12 inches outside the pavements, where feasible. A representative of the geotechnical engineer should be present during subgrade preparation to observe, document, and test compaction of the materials at the time of placement or rework. In order to minimize disturbance, heavy and/or repetitive construction traffic should be controlled, especially during periods of wet weather.

The final grades across this site should account for some post construction movement of exterior pavements due to moisture related shrink/swell or freeze/thaw cycles. To minimize this movement, it is recommended that the paved areas be designed with the maximum grades practical to further reduce the potential for ponding water. Our estimation of total movement is dependent on the grading plan incorporating positive drainage to reduce surface water infiltration of pavement subgrades. To increase pavement life and reduce the potential for heaving, a pavement maintenance program is recommended to regularly clean out and seal control joints and cracks that may develop.

6.2. PAVEMENT DESIGN – SITE PARKING AND DRIVE AREAS

For Kum & Go stores, the daily traffic is relatively consistent and predictable, and primarily consists of passenger cars, beverage, food, and fuel delivery trucks, and trash trucks. Based on the information provided by Kum & Go, the traffic volume for standard duty consists of 1,250 passenger cars and pickups per day, four (4) 3-axle, single-unit, delivery trucks per day, one (1) 3-axle, single-unit, trash truck every 2 days, and two (2) 5-axle, single trailer, fuel tanker per day. Based on this traffic volume, an 18-kip Equivalent Single Axle Load ($ESAL_{18}$) value of approximately 122,500 is estimated for the pavement design life of 20 years for rigid pavements.

The pavement section recommended here has been developed according to the AASHTO Guide for Design of Pavement Structures (1993) guidelines and is based on an estimated modulus of subgrade reaction (k) of 179 pci corresponding to a laboratory tested R-value of 36 for a clay soil subgrade and $ESAL_{18}$ value as indicated above. Other design parameters include reliability of 85 percent, combined standard error of 0.35 for concrete, initial design serviceability index of 4.2, and design terminal serviceability index of 2.25. In addition, we assumed drainage factor of 0.9 and load transfer factor of 3.6 assuming plain/unreinforced jointed concrete pavement.

Olsson recommends that rigid concrete pavement be used in areas designated for heavily loaded trucks, lanes, or concentrated lanes of repetitive traffic, or in non-designated areas that could experience turning truck traffic. For this project site, the following Portland cement pavement section is recommended. If the recommendations in this report are followed, a design life of 20 years should be anticipated.

TABLE 5: CONCRETE PAVEMENT

Depth (in)	Material Designation	Material Specification
6.0		Concrete: CDOT Section 412 Portland Cement Concrete Pavement
4.0		Aggregate Base: CDOT Class 6 specification compacted to a minimum of 95% of maximum dry density as determined by Standard Proctor (ASTM D698)
12.0		Minimum prepared subgrade thickness: In accordance with *Sections 4.1 and 4.2* of this report.

7. LIMITATIONS

The conclusions and recommendations presented in this report are based on the information available regarding the proposed construction, the results obtained from our soil test borings and sampling procedures, the results of the laboratory testing program, and our experience with similar projects. The soil test borings represent a very small statistical sampling of subsurface soils, and it is possible that conditions may be encountered during construction that are substantially different from those indicated by the soil test borings. In these instances, adjustments to design and construction may be necessary. This geotechnical report is based on the site plan and information provided to ***Olsson*** and our understanding of the project as noted in this report. Changes in the location or design of new structures and/or pavements could significantly affect the conclusions and recommendations presented in this geotechnical report. ***Olsson*** should be contacted in the event of such changes to determine if the recommendations of this report remain appropriate for the revised site design.

This report was prepared under the direction and supervision of a Professional Engineer registered in the State of Colorado employed by ***Olsson***. The conclusions and recommendations contained herein are based on generally accepted, professional geotechnical engineering practices at the time of this report, within this geographic area. No warranty, express or implied, is intended or made. This report has been prepared for the exclusive use of Entitlement and Engineering Solutions, Inc., and their authorized representatives for specific application to the proposed project. ***Olsson*** appreciates the opportunity to provide our services on this project and look forward to working with you during construction. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,

Olsson, Inc.

David Sydnor, E.I.
Assistant Geotechnical Engineer

Lindsay Tita, P.E.
Project Geotechnical Engineer

APPENDIX A

Site Location Plan
Boring Location Map

	Site Location Plan
Scale: nts Project: 021-05598 Approved by: MRF Date: 12/06/21	Kum & Go Store #2232 Security Blvd & Main Street Colorado Springs, CO

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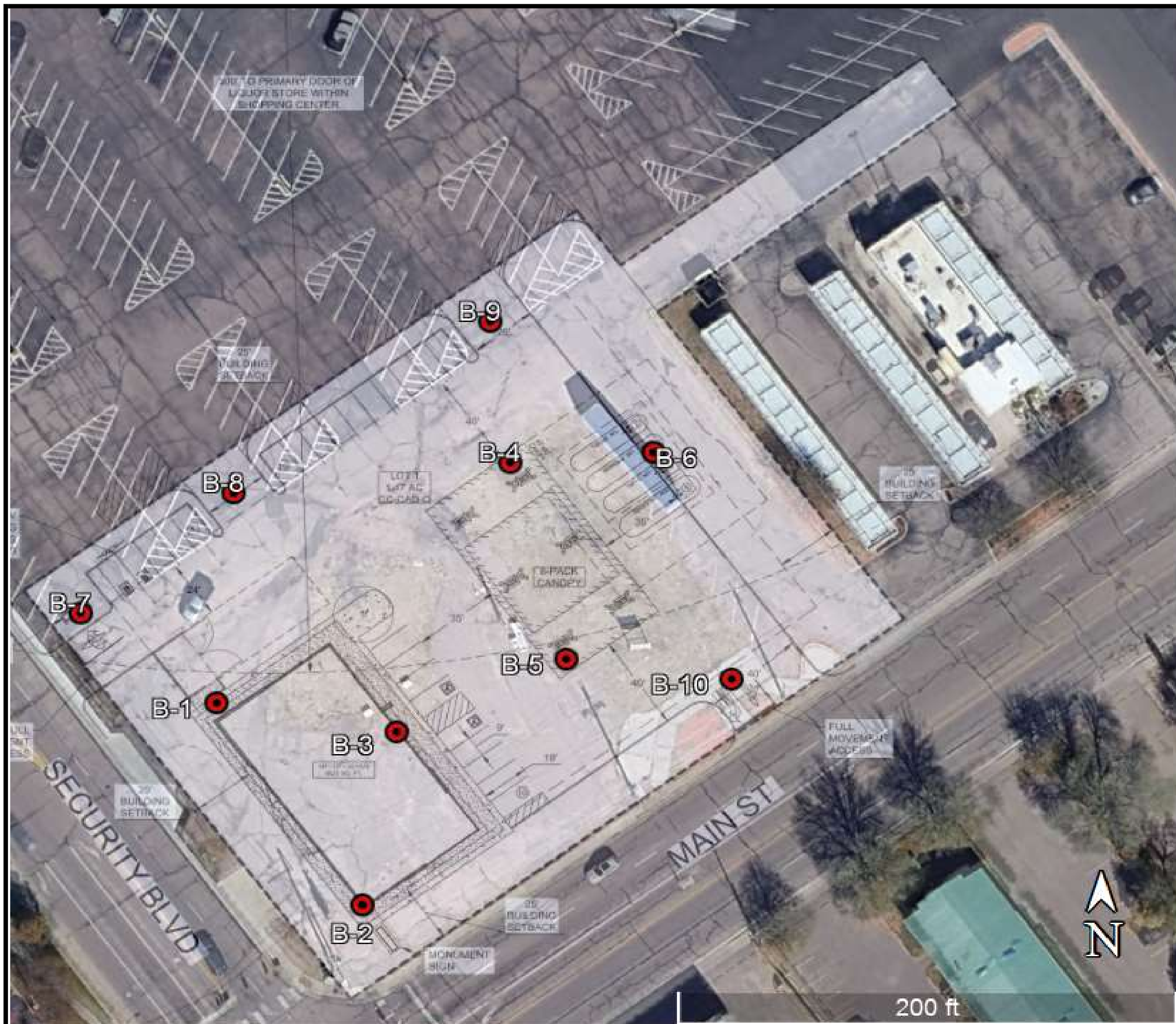

Boring	Depth	Approximate Coordinates	
B-1	25.5	38.752953°N	104.742264° W
B-2	25.0	38.752735° N	104.742055° W
B-3	25.5	38.752941° N	104.742007° W
B-4	25.0	38.753267° N	104.741830° W
B-5	25.5	38.753021° N	104.741751° W
B-6	25.5	38.753265° N	104.741647° W
B-7	20.5	38.753086° N	104.742435° W
B-8	10.5	38.75321° N	104.742236° W
B-9	10.5	38.753418° N	104.741876° W
B-10	10.5	38.752999° N	104.741538° W

Boring Location Plan

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Scale: nts
Project: 021-05598
Approved by: LAT
Date: 12/06/21

Kum & Go 2232
Security Boulevard & Main Street
El Paso County, Colorado

APPENDIX B

Symbols and Nomenclature

Boring Logs

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon Sample (1.375” ID, 2.0” OD)	HSA:	Hollow Stem Auger	NE:	Not Encountered
U:	Thin-Walled Tube Sample (3.0” OD)	CFA:	Continuous Flight Auger	NP:	Not Performed
CS:	Continuous Sample	HA:	Hand Auger	NA:	Not Applicable
BS:	Bulk Sample	CPT:	Cone Penetration Test	% Rec:	Percent of Recovery
MC:	Modified California Sampler	WB:	Wash Bore	WD:	While Drilling
GB:	Grab Sample	FT:	Fish Tail Bit	IAD:	Immediately After Drilling
SPT:	Standard Penetration Test Blows per 6.0”	RB:	Rock Bit	AD:	After Drilling
		PP:	Pocket Penetrometer	CI:	Cave-In

DRILLING PROCEDURES

Soil samples designated as “U” samples on the boring logs were obtained in using Thin-Walled Tube Sampling techniques. Soil samples designated as “SS” samples were obtained during Penetration Test using a Split-Spoon Barrel sampler. The standard penetration resistance ‘N’ value is the number of blows of a 140 pound hammer falling 30 inches to drive the Split-Spoon sampler one foot. Soil samples designated as “MC” were obtained in using Thick-Walled, Ring-Lined, Split-Barrel Drive sampling techniques. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Descriptions of the soils encountered in the soil test borings were prepared using Visual-Manual Procedures for Descriptions and Identification of Soils.

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (Qu) (tsf)
Very Soft	<0.25
Soft	0.25 – 0.5
Firm	0.5 – 1.0
Stiff	1.0 – 2.0
Very Stiff	2.0 – 4.0
Hard	> 4.0

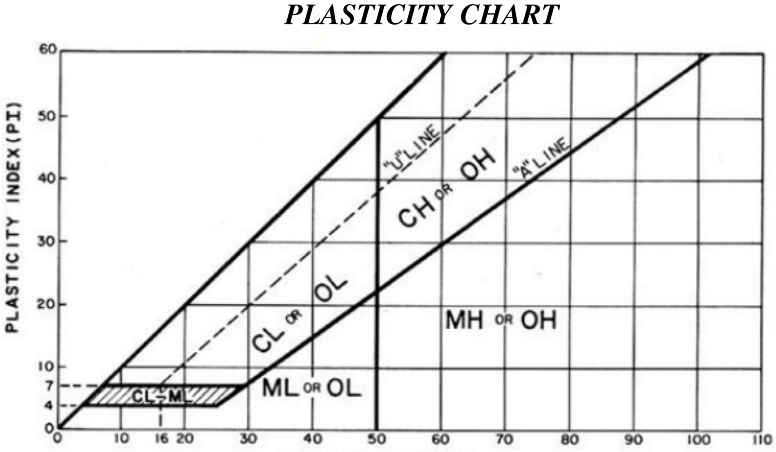
COHESIONLESS SOILS

Relative Density	‘N’ Value
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 49
Very Dense	≥ 50

COMPONENT %

Description	Percent (%)
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45
Mostly	50 - 100

PLASTICITY CHART



ROCK QUALITY DESIGNATION (RQD)

Description	RQD (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

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SOIL CLASSIFICATION CHART

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BOREHOLE REPORT NO. B-1

PROJECT NAME	CLIENT
Kum & Go Store #2232	Entitlement and Engineering Solutions
PROJECT NUMBER	LOCATION
021-05598	Colorado Springs, Colorado

Legend: Split Spoon; Modified California Sampler; Grab Sample

MATERIAL DESCRIPTION
: **X**: 3216088.2 **Y**: 1335822.63
LAT: 38.752953 **LONG**: -104.742264
APPROX. SURFACE ELEV. (ft):5727

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ASPHALT 2 inches of asphalt (0.2')	0								
5725	***FILL*** lean to fat clay, trace 1/8 inch angular gravel, firm, brown, moist (Fill) (1.5')		SS 1		3-3-3 N=6					
	WELL-GRADED SAND WITH CLAY		MC 2		3-6		5.4			
	1/8 inch sub rounded gravel, loose, brown, moist (SW/SC)	5	GB 1				37.6			P-200 = 9.8%
5720	*grades to 3/8 inch sub rounded gravel, dense*		SS 3		10-17-16 N=33					
		10	MC 4		17-21					
5715										
	grades to 1/8 inch sub rounded gravel, medium dense	15	SS 5		11-13-14 N=27		4.6			
5710	*Driller's Note: Cave in to 16.8 feet immediately following drilling*									
	grades to dense	20	MC 6		14-18					
5705										
	(25.5')	25	SS 7		12-17-21 N=38					

BASE OF BORING AT 25.5 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-2

PROJECT NAME: **Kum & Go Store #2232**	CLIENT: **Entitlement and Engineering Solutions**
PROJECT NUMBER: **021-05598**	LOCATION: **Colorado Springs, Colorado**

Legend: Modified California Sampler; Split Spoon

MATERIAL DESCRIPTION
: **X**: 3216148.463 **Y**: 1335743.736
LAT: 38.752735 **LONG**: -104.742055
APPROX. SURFACE ELEV. (ft): 5726.5

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
			0								
	ASPHALT	0.3'									
5725	*3 inches of asphalt*			MC 1		5-5		13.1	112.2		PP = 2.0
	FILL	2.0'									
	lean to fat clay, some 3/8 inch angular gravel, stiff, brown, moist (Fill)										
	WELL-GRADED SAND WITH CLAY										
			5	SS 2		8-10-13 N=23					
	1/8 inch sub rounded gravel, yellow brown, medium dense, moist (SW/SC)										
5720	*grades to 3/4 inch sub rounded gravel*			MC 3		10-15		5.1	122.7		
	grades to dense		10	SS 4		14-16-18 N=34					
5715											
			15	MC 5		14-21		4.3			
5710											
	Driller's Note: Cave in to 16.9 feet immediately following drilling										
	grades to 3/8 inch sub rounded gravel, medium dense		20	SS 6		11-12-13 N=25					
5705											
	grades to dense	25.0'	25	MC 7		10-28		5.1			

BASE OF BORING AT 25.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

olsson	BOREHOLE REPORT NO. B-3	Sheet 1 of 1

PROJECT NAME: **Kum & Go Store #2232**	CLIENT: **Entitlement and Engineering Solutions**
PROJECT NUMBER: **021-05598**	LOCATION: **Colorado Springs, Colorado**

Legend: Modified California Sampler; Grab Sample; Split Spoon

MATERIAL DESCRIPTION
: **X**: 3216161.525 **Y**: 1335818.871
LAT: 38.752941 **LONG**: -104.742007
APPROX. SURFACE ELEV. (ft): 5727

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	GRAVEL PARKING SURFACE *2 inches of loose sand and gravel* (0.2')		0								
5725	***FILL*** *clayey sand, with 3/8 inch angular gravel, loose, dark brown, moist (Fill)*			MC 1		3-5		6.1			
	grades to medium dense, gray			MC 2		9-8		57.1			P-200 = 19.7%
			5	GB 1							
5720	*grades to very loose, brown*			SS 3		2-1-1 N=2					
	grades to medium dense, brown		10	MC 4		7-13					
5715	***WELL-GRADED SAND WITH CLAY*** (11.5') *3/8 inch sub rounded gravel, medium dense, brown, moist (SW/SC)*										
			15	SS 5		15-11-11 N=22		3.3			
5710											
	grades to dense		20	MC 6		20-29					
5705	*Driller's Note: Cave in to 19.5 feet immediately following drilling*										
	(25.5')		25	SS 7		15-20-23 N=43		3.7			

BASE OF BORING AT 25.5 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-4

olsson

PROJECT NAME: **Kum & Go Store #2232**	CLIENT: **Entitlement and Engineering Solutions**
PROJECT NUMBER: **021-05598**	LOCATION: **Colorado Springs, Colorado**

Sampler legend: Modified California Sampler (MC); Split Spoon (SS)

MATERIAL DESCRIPTION
: **X**: 3216211.009 **Y**: 1335938.015
LAT: 38.753267 **LONG**: -104.74183
APPROX. SURFACE ELEV. (ft): 5727.5

ELEVATION (ft)	MATERIAL DESCRIPTION	Strata Depth	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE 3 inches of organic rich clayey sand	0.3'		0								
5725	***FILL*** clayey sand, with 3/8 inch angular gravel, medium dense, brown, moist (Fill)				MC 1		13-11		4.9			
		5.5'		5	SS 2		6-8-8 N=16					
5720	***FILL*** lean to fat clay, with 1/8 inch sub rounded gravel, very stiff, brown, moist (Fill)	7.0'			MC 3		14-18		19.3			P-200 = 88.6%
	WELL-GRADED SAND WITH CLAY 1/8 inch sub rounded gravel, dense, orangish brown, moist (SW/SC)			10	SS 4		10-17-19 N=36					
5715	grades to yellowish brown											
	grades to 3/8 inch sub rounded gravel			15	MC 5		18-32		2.5	130.1		
5710												
	Driller's Note: Cave in to 18.4 feet immediately following drilling			20	SS 6		15-15-17 N=32					
5705		25.0'		25	MC 7		15-20					

BASE OF BORING AT 25.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-5

PROJECT NAME: **Kum & Go Store #2232**

CLIENT: **Entitlement and Engineering Solutions**

PROJECT NUMBER: **021-05598**

LOCATION: **Colorado Springs, Colorado**

Legend: Split Spoon; Modified California Sampler; Grab Sample

MATERIAL DESCRIPTION
: **X**: 3216234.285 **Y**: 1335848.615
LAT: 38.753021 **LONG**: -104.741751
APPROX. SURFACE ELEV. (ft): 5727

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE 2 inches of organic rich clayey sand (0.2')	0								
5725	***FILL*** clayey sand, with 3/8 inch angular gravel, medium dense, brown, moist (Fill)		SS 1		8-8-6 N=14		3.2			
			MC 2		5-9					
	(5.5')	5	GB 1							
5720	***WELL-GRADED SAND WITH CLAY*** 3/8 inch sub rounded gravel, medium dense, yellow brown, moist (SW/SC)		SS 3		11-10-8 N=18					
		10	MC 4		13-13		3.0	111.2		
5715										
	grades to dense	15	SS 5		13-15-17 N=32					
5710										
	Driller's Note: Cave in to 17.9 feet immediately following drilling	20	MC 6		17-31		3.9	124.9		
5705										
	(25.5')	25	SS 7		12-17-19 N=36		3.2			

BASE OF BORING AT 25.5 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-6

olsson

PROJECT NAME: **Kum & Go Store #2232**

CLIENT: **Entitlement and Engineering Solutions**

PROJECT NUMBER: **021-05598**

LOCATION: **Colorado Springs, Colorado**

Legend: Split Spoon (SS); Modified California Sampler (MC)

MATERIAL DESCRIPTION
: **X**: 3216263.201 **Y**: 1335937.722
LAT: 38.753265 **LONG**: -104.741647
APPROX. SURFACE ELEV. (ft): 5727.5

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ASPHALT 3 inches of asphalt (0.3')	0								
5725	***FILL*** sandy clay, some 1/8 inch angular gravel, firm, brown, moist (Fill)		SS 1		2-3-3 N=6		31.7			P-200 = 67.6%
			MC 2		3-2					
		5								
5720	(7.0') ***WELL-GRADED SAND WITH CLAY*** 1/8 inch sub rounded gravel, medium dense, orangish brown, moist (SW/SC)		SS 3		2-3-9 N=12					
	grades to dense, yellowish brown	10	MC 4		19-25		3.7			
5715										
	grades to 3/8 inch sub rounded gravel	15	SS 5		19-20-12 N=32		50.5			P-200 = 8.3%
5710	Driller's Note: Cave in to 17.5 feet immediately following drilling									
		20	MC 6		18-21					
5705										
	grades to medium dense (25.5')	25	SS 7		14-14-15 N=29		4.9			

BASE OF BORING AT 25.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-7

PROJECT NAME: Kum & Go Store #2232	CLIENT: Entitlement and Engineering Solutions
PROJECT NUMBER: 021-05598	LOCATION: Colorado Springs, Colorado

Legend: Modified California Sampler; Split Spoon

MATERIAL DESCRIPTION
: **X**: 3216039.032 **Y**: 1335870.659
LAT: 38.753086 **LONG**: -104.742435
APPROX. SURFACE ELEV. (ft): 5727.5

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ASPHALT 3 inches of asphalt — 0.3'		0								
5725	***FILL*** clayey sand, with 3/8 inch angular gravel, medium dense, brown, moist (Fill) — 3.0'			MC 1		5-5					
	WELL-GRADED SAND WITH CLAY 3/8 inch sub rounded gravel, medium dense, yellowish brown, moist (SW/SC)		5	SS 2		3-5-14 N=19		3.0			
5720	*grades to dense*			MC 3		14-18		3.4	115.0		
			10	SS 4		14-16-16 N=32					
5715	*grades to increased fines content*		15	MC 5		13-26		9.8			
5710	*Driller's Note: Cave in to 16.8 feet immediately following drilling*										
	grades to medium dense — 20.5'		20	SS 6		7-10-14 N=24					

BASE OF BORING AT 20.5 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-8

Sheet 1 of 1

PROJECT NAME	CLIENT
Kum & Go Store #2232	Entitlement and Engineering Solutions
PROJECT NUMBER	**LOCATION**
021-05598	Colorado Springs, Colorado

Legend: Split Spoon; Modified California Sampler

MATERIAL DESCRIPTION
: X: 3216095.404 **Y**: 1335916.291
LAT: 38.75321 **LONG**: -104.742236
APPROX. SURFACE ELEV. (ft): 5728

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ASPHALT *2 inches of asphalt* (0.2')	0								
	FILL		SS 1		1-1-1 N=2		39.1			P-200 = 75.2%
5725	*sandy clay, 1/8 inch angular gravel, very loose, brown, moist (Fill)*									
	grades to loose		MC 2		3-6					
	(5.5')	5								
	WELL-GRADED SAND WITH CLAY		MC 3		5-9		3.5			
5720	*1/8 inch sub rounded gravel, medium dense, yellowish brown, moist (SW/SC)*									
	(10.5')	10	SS 4		11-14-14 N=28		3.5			

BASE OF BORING AT 10.5 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-9

PROJECT NAME	CLIENT
Kum & Go Store #2232	Entitlement and Engineering Solutions
PROJECT NUMBER	LOCATION
021-05598	Colorado Springs, Colorado

Legend: Modified California Sampler (MC); Split Spoon (SS)

MATERIAL DESCRIPTION
: **X**: 3216197.433 **Y**: 1335992.896
LAT: 38.753418 **LONG**: -104.741876
APPROX. SURFACE ELEV. (ft): 5728.5

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	FILL		0								
	sandy clay, firm, brown, moist (Fill)			MC 1	CL	3-3		34.9		24/9	P-200 = 58.4% PP = 1.5
	3.0'										
5725	***CLAYEY SAND***										
	3/8 inch sub rounded gravel, loose, yellowish brown, moist (SC)		5	SS 2		3-4-5 N=9					
	grades to medium dense, clayey			MC 3		9-13		39.8			P-200 = 16.7%
5720											
	10.5'		10	SS 4		9-9-14 N=23		3.1			

BASE OF BORING AT 10.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

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BOREHOLE REPORT NO. B-10

PROJECT NAME: **Kum & Go Store #2232**

CLIENT: **Entitlement and Engineering Solutions**

PROJECT NUMBER: **021-05598**

LOCATION: **Colorado Springs, Colorado**

Legend: Modified California Sampler; Split Spoon

MATERIAL DESCRIPTION
: X: 3216295.093 **Y**: 1335841.11
LAT: 38.752999 **LONG**: -104.741538
APPROX. SURFACE ELEV. (ft):5727

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
			0								
	ASPHALT *2 inches of asphalt* (0.2')										
5725	***FILL*** *clayey sand, some 1/8 inch angular gravel, dense, brown, moist*			MC 1		14-17		2.8	98.1		
	grades to loose		5	SS 2		7-4-4 N=8					
	(5.5')										
5720	***WELL-GRADED SAND WITH CLAY*** *3/8 inch sub rounded gravel, dense, yellowish brown, moist (SW/SC)*			MC 3		13-27		1.2	117.4		
	(10.5')		10	SS 4		10-19-21 N=40		3.3			

BASE OF BORING AT 10.5 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

STARTED:	8/26/21	FINISHED:	8/26/21
DRILL CO.:	ODELL	DRILL RIG:	CME 55
DRILLER:	ODELL	LOGGED BY:	M. ALMAND
METHOD: CONTINUOUS FLIGHT AUGER			

APPENDIX C
Summary of Laboratory Test Results

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

SUMMARY OF LABORATORY RESULTS

PROJECT NAME: Kum & Go Store #2232
PROJECT NUMBER: 021-05598
CLIENT: Entitlement and Engineering Solutions
PROJECT LOCATION: Colorado Springs, Colorado

BORING NUMBER	SAMPLE I.D.	SAMPLE DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SATURATION (%)	UNCONFINED STRENGTH (tsf)	STRAIN (%)	ATTERBERG LIMITS			P-200	USCS CLASS.
									LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX		
B-1	MC-2	3.5 - 4.5'	5.4										
B-1	GB-1	5.0 - 6.0'	37.6									9.8	
B-1	SS-5	14.0 - 15.5'	4.6										
B-2	MC-1	1.0 - 2.0'	13.1	112.2	0.502	70.3							
B-2	MC-3	6.0 - 7.0'	5.1	122.7	0.373	37.0							
B-2	MC-5	14.0 - 15.0'	4.3										
B-2	MC-7	24.0 - 25.0'	5.1										
B-3	MC-1	1.0 - 2.0'	6.1										
B-3	MC-2	3.5 - 4.5'	57.1									19.7	
B-3	SS-5	14.0 - 15.5'	3.3										
B-3	SS-7	24.0 - 25.5'	3.7										
B-4	MC-1	1.0 - 2.0'	4.9										
B-4	MC-3	6.0 - 7.0'	19.3									88.6	
B-4	MC-5	14.0 - 15.0'	2.5	130.1	0.296	22.4							
B-5	SS-1	1.0 - 2.5'	3.2										
B-5	MC-4	9.0 - 10.0'	3.0	111.2	0.516	15.6							
B-5	MC-6	19.0 - 20.0'	3.9	124.9	0.349	30.5							
B-5	SS-7	24.0 - 25.5'	3.2										
B-6	SS-1	1.0 - 2.5'	31.7									67.6	
B-6	MC-4	9.0 - 10.0'	3.7										
B-6	SS-5	14.0 - 15.5'	50.5									8.3	
B-6	SS-7	24.0 - 25.5'	4.9										
B-7	SS-2	3.5 - 5.0'	3.0										
B-7	MC-3	6.0 - 7.0'	3.4	115.0	0.466	19.5							
B-7	MC-5	14.0 - 15.0'	9.8										
B-8	SS-1	1.0 - 2.5'	39.1									75.2	
B-8	MC-3	6.0 - 7.0'	3.5										
B-8	SS-4	9.0 - 10.5'	3.5										
B-9	MC-1	1.0 - 2.0'	34.9						24	15	9	58.4	CL
B-9	MC-3	6.0 - 7.0'	39.8									16.7	

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

SUMMARY OF LABORATORY RESULTS

PROJECT NAME: Kum & Go Store #2232

PROJECT NUMBER: 021-05598

CLIENT: Entitlement and Engineering Solutions

PROJECT LOCATION: Colorado Springs, Colorado

BORING NUMBER	SAMPLE I.D.	SAMPLE DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SATURATION (%)	UNCONFINED STRENGTH (tsf)	STRAIN (%)	ATTERBERG LIMITS			P-200	USCS CLASS.
									LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX		
B-9	**SS-4**	9.0 - 10.5'	3.1										
B-10	**MC-1**	1.0 - 2.0'	2.8	98.1	0.717	10.6							
B-10	**MC-3**	6.0 - 7.0'	1.2	117.4	0.436	7.1							
B-10	**SS-4**	9.0 - 10.5'	3.3										

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

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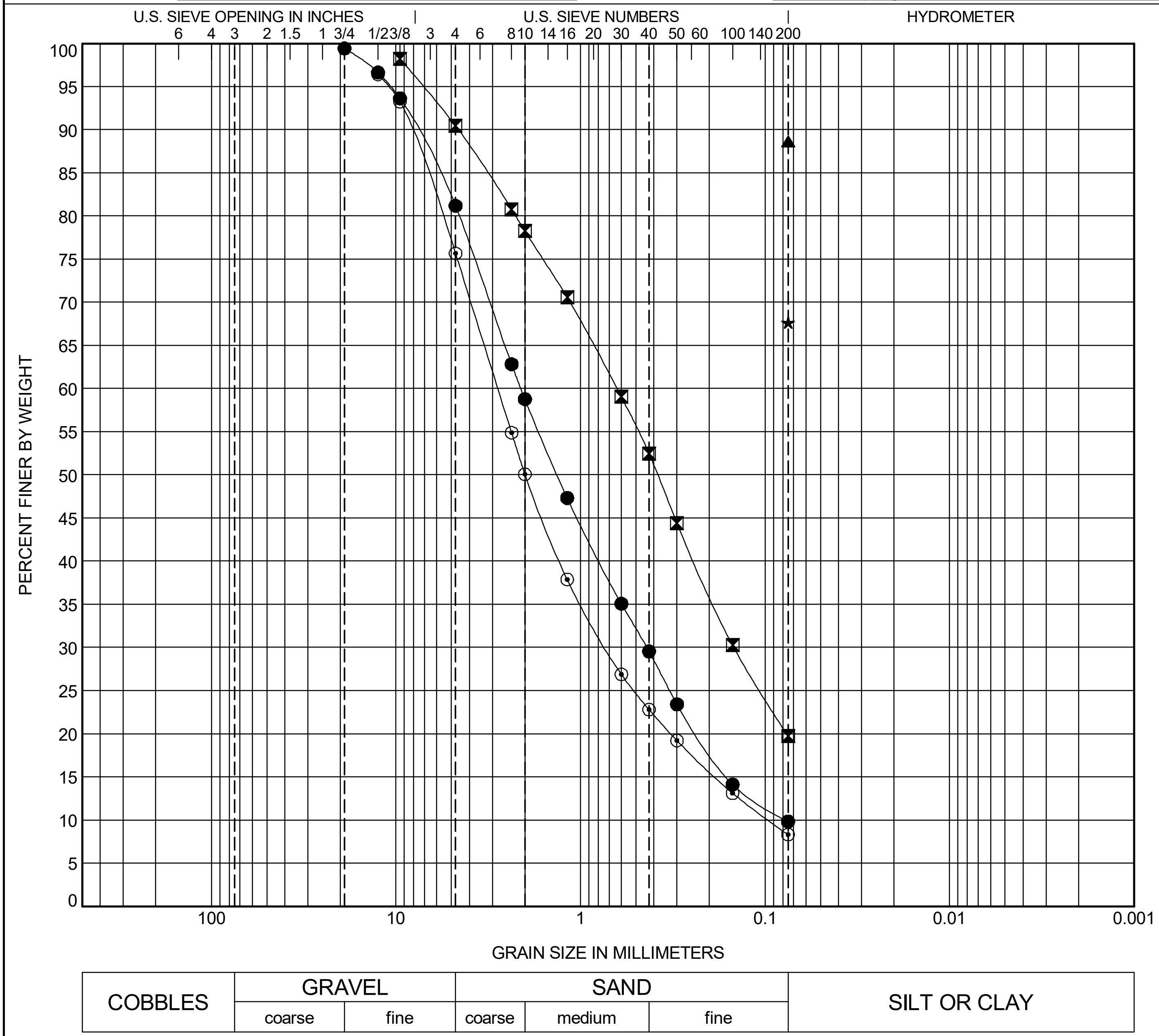
GRAIN SIZE DISTRIBUTION

PROJECT NAME: Kum & Go Store #2232 **CLIENT:** Entitlement and Engineering Solutions

PROJECT NUMBER: 021-05598 **PROJECT LOCATION:** Colorado Springs, Colorado



	Boring No.	Sample ID	Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**GB-1**	**5.0 - 6.5'**	**Well graded sand with clay and gravel (SW/SC)**				**1.18**	**27.23**
⊠	**B-3**	**MC-2**	**3.5 - 5.0'**	**Well graded sand with clay and gravel (SW/SC)**					
▲	**B-4**	**MC-3**	**6.0 - 7.5'**	**Lean clay (CL)**					
★	**B-6**	**SS-1**	**1.0 - 2.5'**	**Sandy lean clay (CL)**					
⊙	**B-6**	**SS-5**	**14.0 - 15.5'**	**Well graded sand with clay and gravel (SW/SC)**				**1.97**	**29.26**

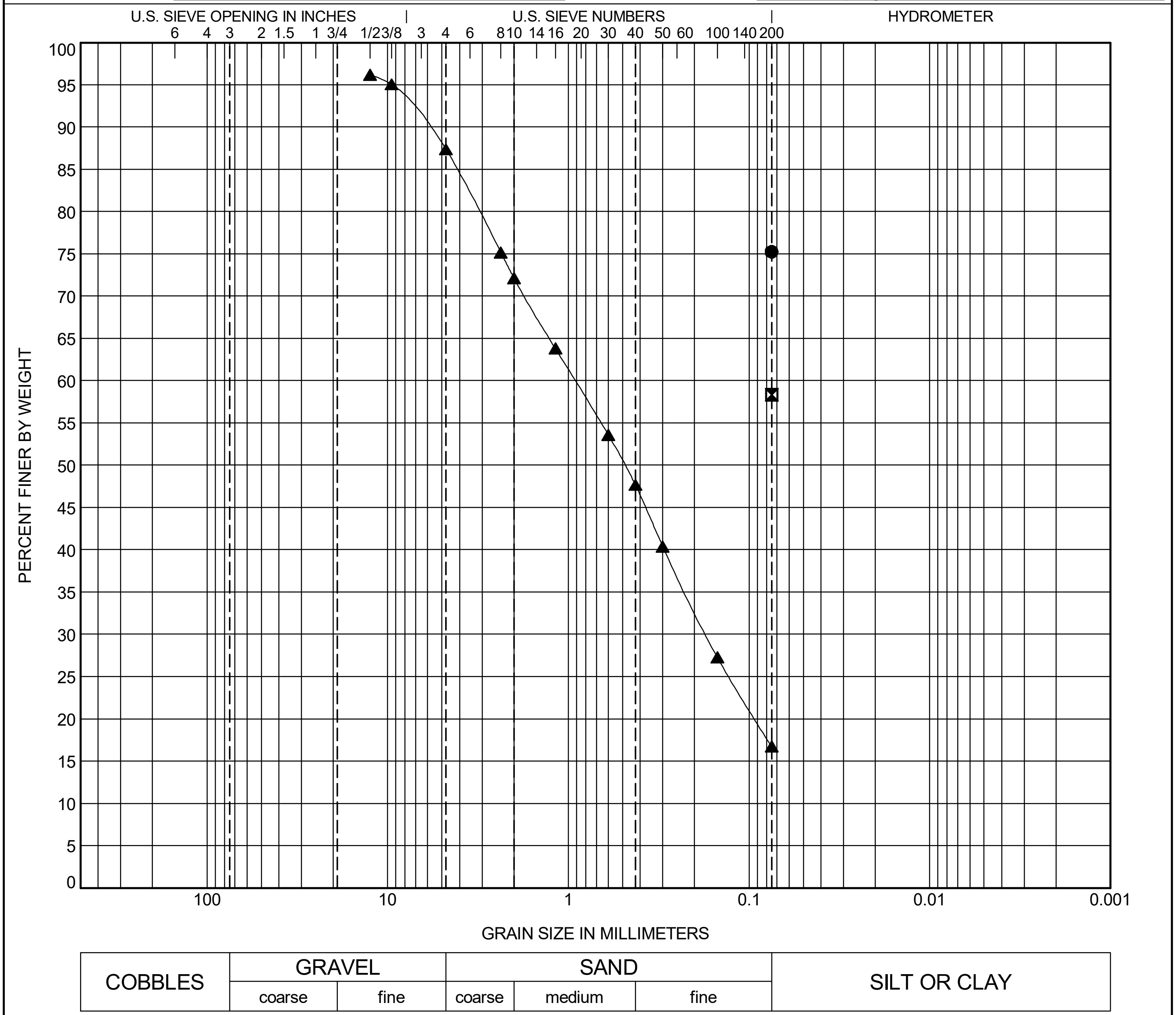
	Boring No.	Sample ID	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**GB-1**	**19**	**2.103**	**0.438**	**0.077**	**18.2**	**71.4**	**9.8**	
⊠	**B-3**	**MC-2**	**9.5**	**0.635**	**0.147**		**7.8**	**70.7**	**19.7**	
▲	**B-4**	**MC-3**	**0.075**						**88.6**	
★	**B-6**	**SS-1**	**0.075**						**67.6**	
⊙	**B-6**	**SS-5**	**12.5**	**2.804**	**0.727**	**0.096**	**20.7**	**67.4**	**8.3**	

OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Kum & Go Store #2232 **CLIENT:** Entitlement and Engineering Solutions

PROJECT NUMBER: 021-05598 **PROJECT LOCATION:** Colorado Springs, Colorado



	Boring No.	Sample ID	Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	**B-8**	**SS-1**	**1.0 - 2.0'**	**Sandy lean clay (CL)**					
⊠	**B-9**	**MC-1**	**1.0 - 2.0'**	**Sandy lean clay (CL)**	**24**	**15**	**9**		
▲	**B-9**	**MC-3**	**6.0 - 7.0'**	**Clayey sand (SC)**					

	Boring No.	Sample ID	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-8**	**SS-1**	**0.075**						**75.2**	
⊠	**B-9**	**MC-1**	**0.075**						**58.4**	
▲	**B-9**	**MC-3**	**12.5**	**0.917**	**0.173**		**8.8**	**70.7**	**16.7**	

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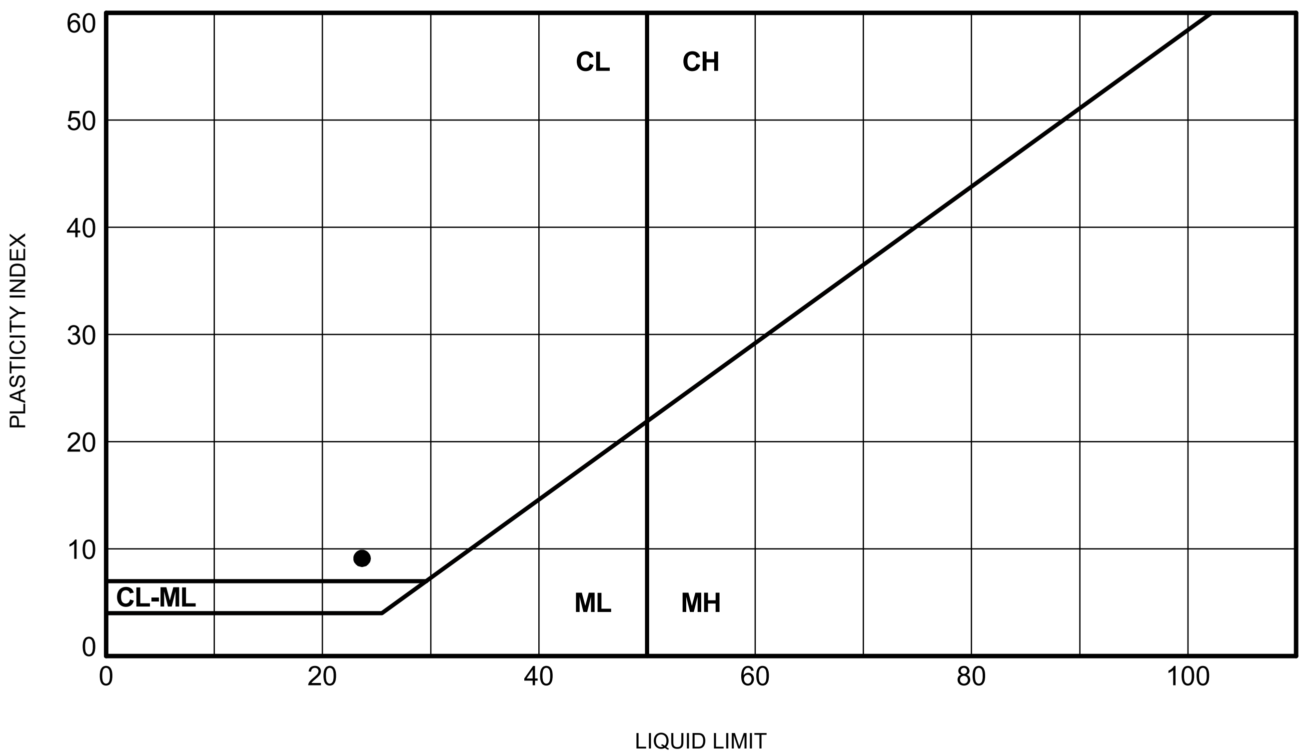
ATTERBERG LIMITS RESULTS

PROJECT NAME: Kum & Go Store #2232 **CLIENT:** Entitlement and Engineering Solutions

PROJECT NUMBER: 021-05598 **PROJECT LOCATION:** Colorado Springs, Colorado



Boring No.	Sample ID	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Fines (%)	Classification (USCS)
● **B-9**	**MC-1**	**1.0 - 2**	**24**	**15**	**9**	**58.4**	**CL**

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Denver, CO 80216 FAX 303.237.2659
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Soil Corrosion Suite

Project Information	
Project Name:	Kum & Go Store #2232
Project Number:	021-05598
Client Name:	Entitlement and Engineering Solutions
Project Location:	Colorado Springs, CO

Sample and Test Information	
Sample Location:	B-3 GB-1, 3-5'
Sample Description:	Brown clayey sand
Laboratory Technician:	TJ
Date Tested:	8/31/2021

Test Results

Water Soluble Sulfate (Colorado Procedure CP-L-2103)

Dilution	Reading	Concentration, mg/L	Concentration, % mass
100:1	0	N/D	N/D

*N/D - Not Detected - Concentration below equipment detection limit of 0.01% mass

Water Soluble Chloride (Colorado Procedure CP-L-2104)

Dilution	Concentration, ppm	Concentration, % mass
3	105	0.0105

pH (ASTM G51)

pH Meter Reading
8.08

Electrical Resistivity (ASTM G57, -#10)

Readings (ohm*cm)
7600
4210
2990
2980
3720

Lowest Resistivity (ohm*cm)
2980

Sample portion passing the #10 sieve used in testing. Each reading performed after additional water was added.

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

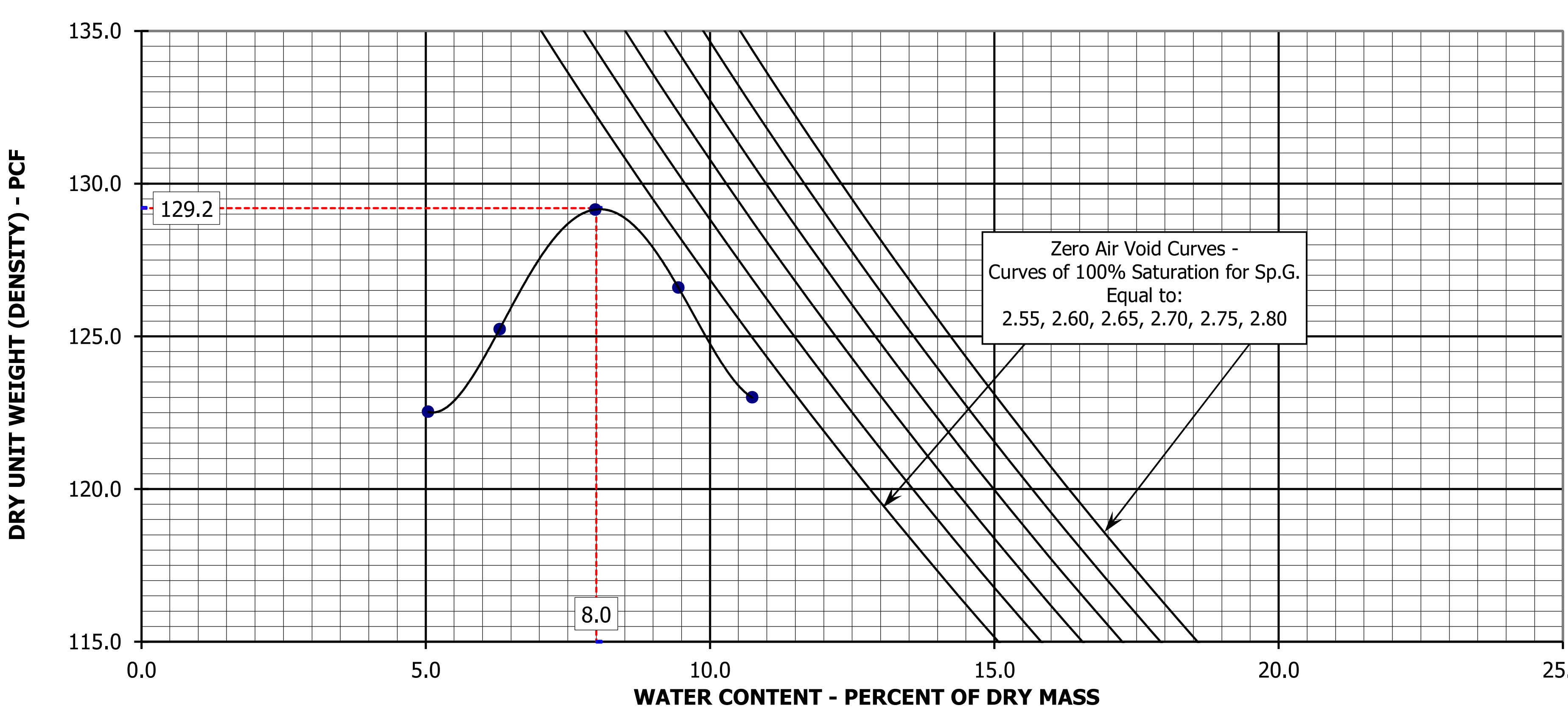
ASTM/AASHTO Compaction

Test Procedure Designation: ASTM D 698 (Standard)

Method: B

Laboratory Maximum Dry Unit Weight (Density): 129.2 pcf

Laboratory Optimum Moisture Content (OMC): 8.0 %



Sample Location	Elev. or Depth, ft	**LL**	PL	**PI**	**-#200, %**	Soil Description & Classification	
B8, B9, B10	1 to 5					Visual:	Sand, clayey, with gravel, brown
						AASHTO:	
						USCS:	

Moisture/Density Relationship (Proctor) Test

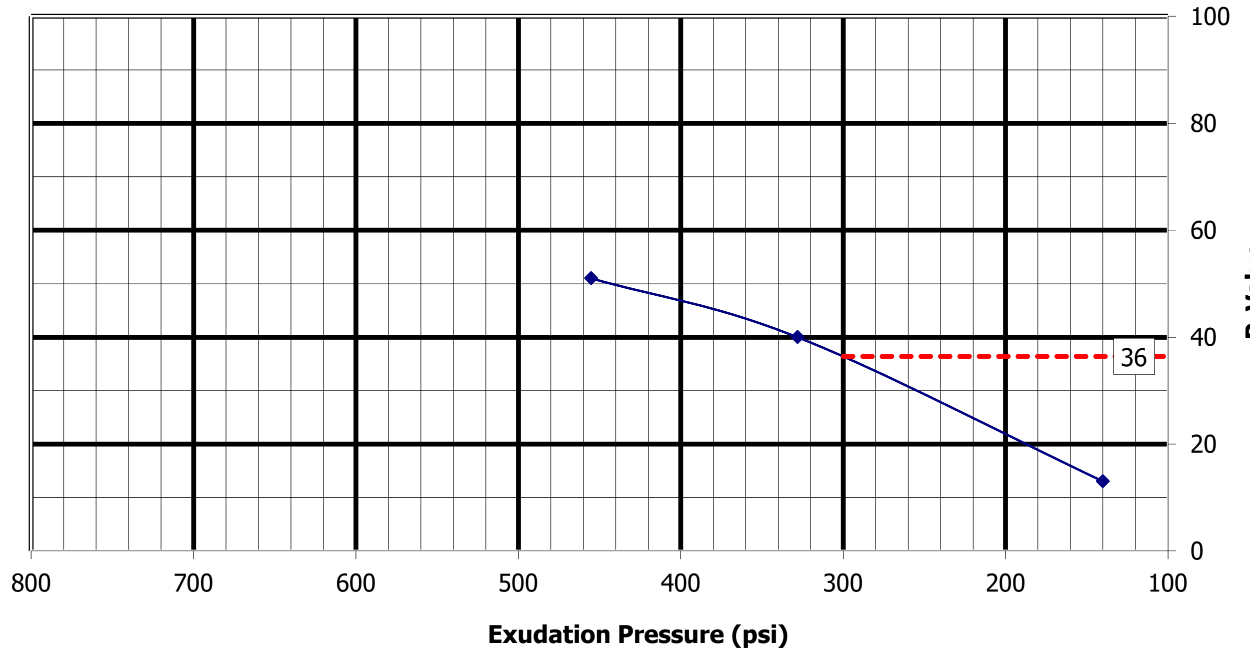
Project Number:	21.024, Olsson		
Project Name:	Kum & Go #2232 (Olsson Project No. 021-05598)		
Drawn By:	A. Wright	Tested by:	J. Holiman
Checked By:	G. Hoyos	Date:	26-Aug-21
Date:	8-Sep-21	Lab ID Number:	2121317

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

AASHTO ACCREDITED

R-VALUE TEST GRAPH (ASTM D2844)

Project Number:	21.024, Olsson	Date:	26-Aug-21
Project Name:	Kum & Go #2232 (Olsson Project No. 021-05598)	Technician:	J. Holiman
Lab ID Number:	2121317	Reviewer:	G. Hoyos
Sample Location:	B-8, B-9, and B-10 1' to 5'		
Visual Description:	SAND, clayey, with gravel, brown		



R-Value @ Exudation Pressure 300 psi:	**36**
Specification:	

CDOT Pavement Design Manual, 2011.
Eq. 2.1 & 2.2, page 2-3.

$S_1 = [(R-5)/11.29]+3$ **S_1 = 5.78**

$M_R = 10^{[(S_1+18.72)/6.24]}$ **M_R = 8,443**

M_R = Resilient Modulus, psi

S_1 = the Soil Support Value

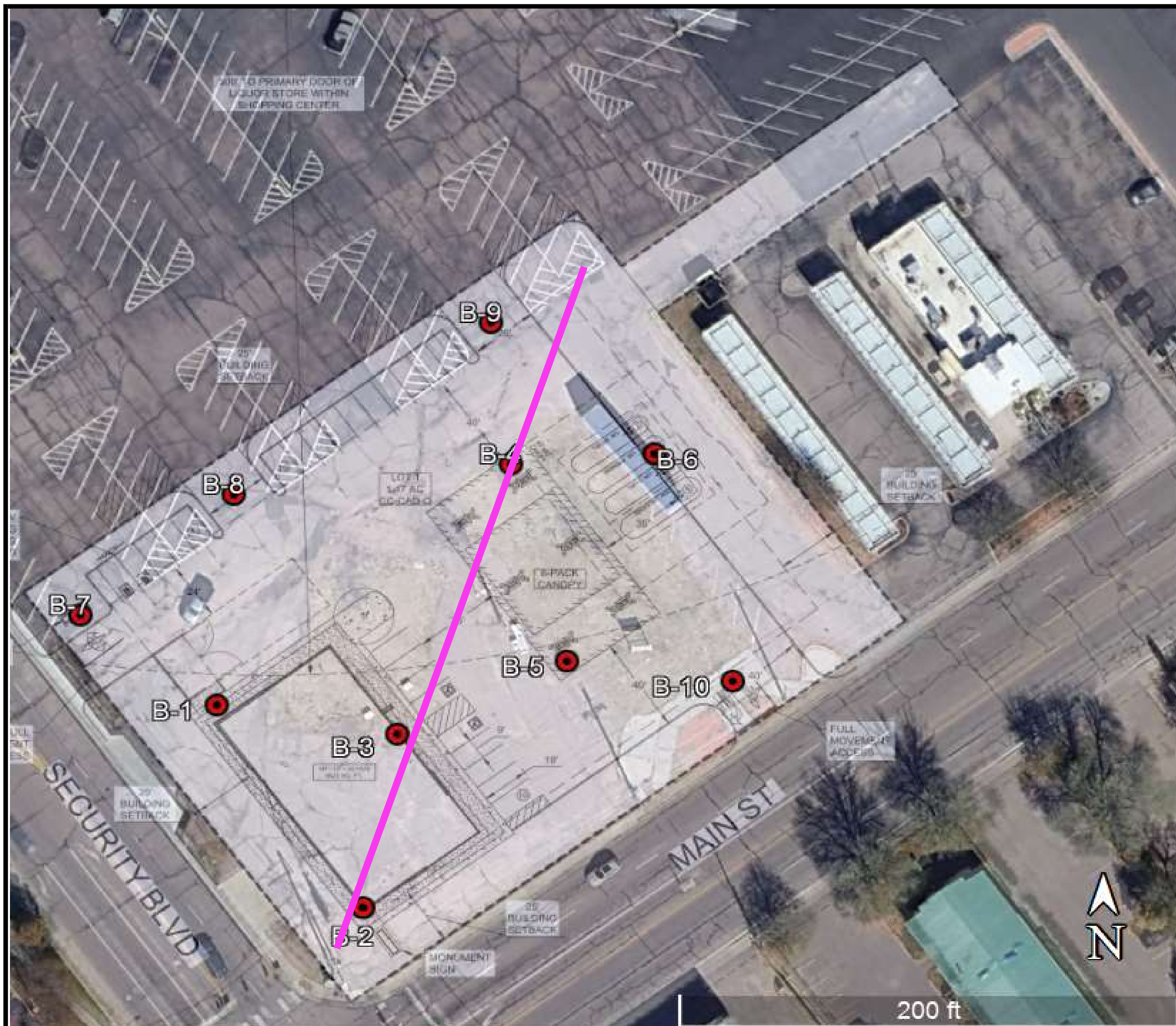
R = the R-Value obtained

Test Specimen:	1	2	3
Moisture Content, %:	7.2	7.9	9.4
Expansion Pressure, psi:	-0.12	-0.15	-0.27
Dry Density, pcf:	134.3	132.5	130.3
R-Value:	51	40	13
Exudation Pressure, psi:	455	328	140

Note: The R-Value is measured; the M_R is an approximation from correlation formulas.

APPENDIX D

Geologic Cross-Section Map
Geologic Profile



Boring	Depth	Approximate Coordinates	
B-1	25.5	38.752953°N	104.742264° W
B-2	25.0	38.752735° N	104.742055° W
B-3	25.5	38.752941° N	104.742007° W
B-4	25.0	38.753267° N	104.741830° W
B-5	25.5	38.753021° N	104.741751° W
B-6	25.5	38.753265° N	104.741647° W
B-7	20.5	38.753086° N	104.742435° W
B-8	10.5	38.75321° N	104.742236° W
B-9	10.5	38.753418° N	104.741876° W
B-10	10.5	38.752999° N	104.741538° W

Approximate location of geologic cross-section

Geologic Cross Section Location Plan

Scale: nts
Project: 021-05598
Approved by: LAT
Date: 11/16/2021

Kum & Go 2232
Security Boulevard & Main Street
El Paso County, Colorado

olsson

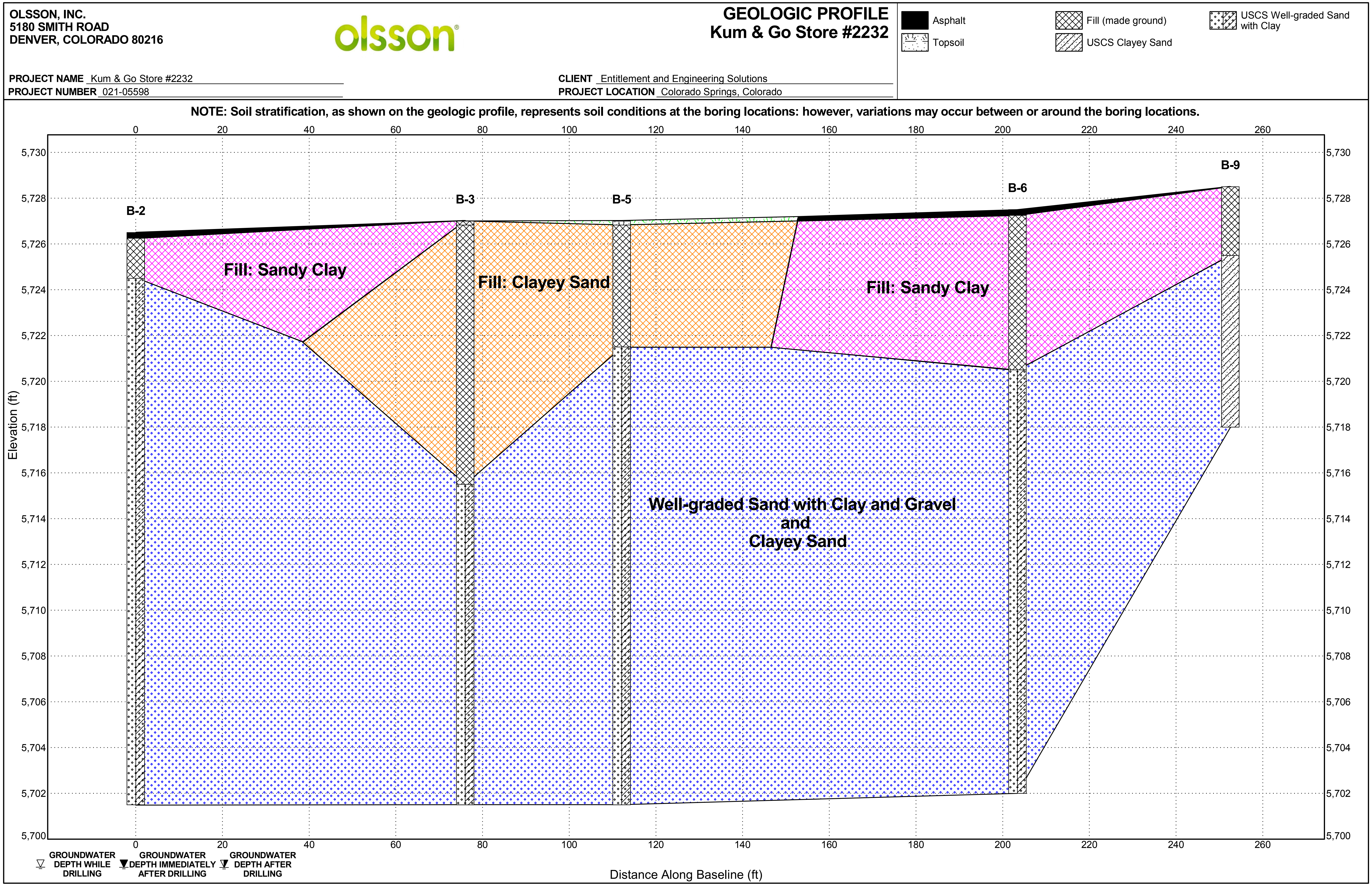
OLSSON, INC.
5180 SMITH ROAD
DENVER, COLORADO 80216

GEOLOGIC PROFILE
Kum & Go Store #2232

PROJECT NAME Kum & Go Store #2232
PROJECT NUMBER 021-05598

CLIENT Entitlement and Engineering Solutions
PROJECT LOCATION Colorado Springs, Colorado

NOTE: Soil stratification, as shown on the geologic profile, represents soil conditions at the boring locations: however, variations may occur between or around the boring locations.

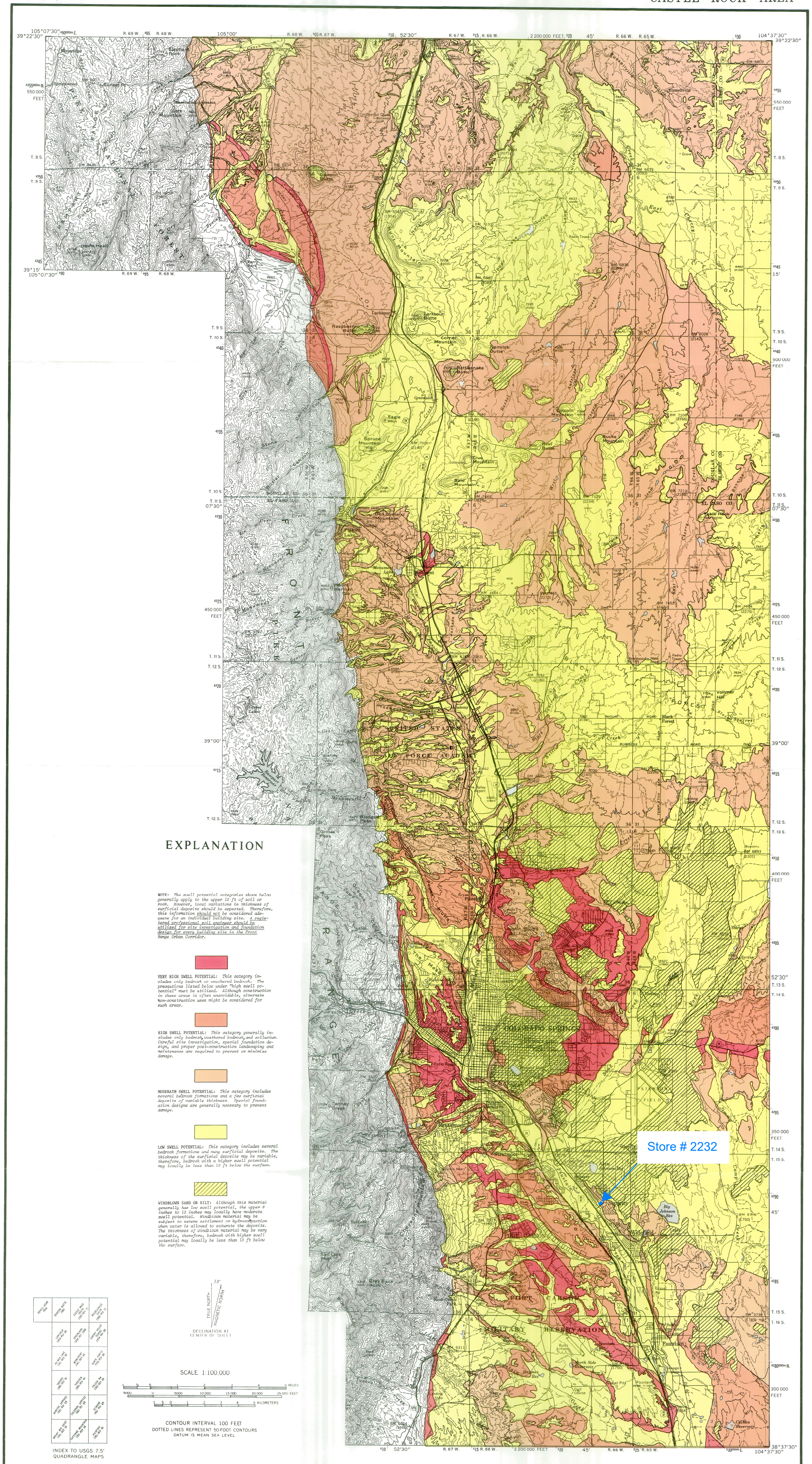


APPENDIX E
Potentially Swelling Soil and Rock Map

DEPARTMENT OF NATURAL RESOURCES
COLORADO GEOLOGICAL SURVEY
JOHN W. ROLD, DIRECTOR

Prepared in cooperation with the
UNITED STATES GEOLOGICAL SURVEY

COLORADO SPRINGS
CASTLE ROCK AREA



Map edited and published by the
Colorado Geological Survey, 1973-1974

Base map from U. S. Geological Survey, 1972

CARTOGRAPHICS: JAMES A. BARNES

POTENTIALLY SWELLING SOIL AND ROCK IN THE FRONT RANGE URBAN CORRIDOR, COLORADO

BY

Stephen S. Hart

FRONT RANGE URBAN CORRIDOR
SHEET 3 OF 4