

**GEOLOGIC HAZARDS EVALUATION AND
PRELIMINARY GEOTECHNICAL INVESTIGATION
WATERSIDE TOWNHOMES
SOUTHEAST OF WOODMOORE DRIVE AND
DEER CREEK ROAD
EL PASO COUNTY, COLORADO**

Prepared For:

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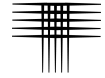


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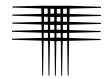
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NORTH BAY AT WOODMOOR

WOODMOOR, COLORADO

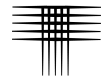


SCOPE

This report presents the results of our Geologic Hazards Evaluation and Preliminary Geotechnical Investigation for the proposed Waterside Townhomes, located southeast of the intersection of Woodmoor Drive and Deer Creek Road in the Woodmoor Community in El Paso County, Colorado. The investigated parcel is planned for development of single-family attached residential buildings. Our purpose was to evaluate the property for the occurrence of geologic hazards and to investigate subsurface conditions to assist in the due diligence and planning of site development. This report includes descriptions of our interpretation of site geology, a summary of subsurface and groundwater conditions found in our exploratory borings, a description of our engineering analysis of the geologic conditions at the site, our opinion of the potential influence of the geologic hazards on the planned structures and other site improvements, and preliminary geotechnical recommendations for the use in preliminary planning. The scope was described in our proposal (CS-21-0152) dated September 10, 2021.

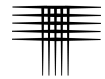
The report was prepared based on conditions interpreted from field reconnaissance mapping of the site, conditions found in our exploratory borings, results of laboratory tests, engineering analysis, and our experience. Observations made during grading or construction may indicate conditions that require revision or re-evaluation of some of the criteria presented in this report. The criteria presented are for the development as described. Revision in the scope of the project could influence our recommendations. If changes occur, we should review the development plans and their effect on our preliminary design criteria. Evaluation of the property for the possible presence of potentially hazardous materials (environmental site assessment) is beyond the scope of our investigation. Assessment of the site for the potential for wildfire hazards, corrosive soils, erosion problems, or flooding is also beyond the scope of this investigation.

The following section summarizes the report. A more complete description of the conditions found, our interpretations, and our recommendations are included in the report.



SUMMARY

1. No geologic hazards were identified that we believe preclude development of the site. Geologic hazards identified on this parcel include expansive or very hard, shallow bedrock, erosion potential, flood potential, and regional issues of seismicity as well as naturally-occurring radioactive materials. We suspect some level of past site development has taken place at the site. Although samples did not obviously reveal the presence of suspect quality fill, we believe suspect quality fill may be present in various areas at the site. We are not aware to the extent of prior development at the site. Existing underground utilities such as sanitary sewer and domestic water lines are present in various areas. These conditions can be mitigated with engineering design and construction methods commonly employed in the area.
2. The near-surface soils encountered in the nine exploratory borings drilled at the site consisted of natural, clayey to very clayey sand at the ground surface extending to depths of between 4 and 7 feet. We suspect undocumented fill may be encountered in various areas at the site. Sandstone and claystone bedrock was found underlying the natural soils in the borings at depths between 4 and 7 feet below the existing ground surface. The upper 2 to 4 feet of the bedrock was judged to be weathered in at least four of the borings. A sample of the natural, very clayey sands tested in our laboratory exhibited slight swell values when wetted under approximate overburden pressures (the weight of the overlying soil and bedrock layer).
3. Groundwater was not encountered in the nine exploratory borings during drilling. Groundwater was measured eight days after the completion of our drilling operation in one boring at a depth of 26.5 feet below the existing ground surface.
4. We believe site grading and utility installation across the majority of the site can be accomplished using conventional, heavy-duty construction equipment. Existing fill materials found at the site may be reused as back-fill materials if free from deleterious substances following our analysis and approval of fill materials found at the site.
5. Preliminary information suggests spread footing foundations as well as slab-on-grade floors will be appropriate for construction of the proposed structures. This foundation approach may be appropriate when underlain by natural sands, or new site grading fill. Slightly expansive claystone was encountered in our borings at 6 and 7 feet below existing grades. We do not believe it will present a significant impact to foundation design and construction unless grades at the site are significantly altered. If grades at the site are significantly changed and claystone is exposed at the ground surface or found within the excavation of new foundations, it will likely be necessary to sub-excavate this material and then replace the expansive



soils with moisture conditioned, densely compacted fill, prior to footing construction. Structurally supported floors are considered appropriate if the owner wishes to minimize potential floor movements.

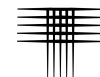
6. Irrigation of landscaping should be minimized to reduce problems associated with expansive soils. Overall plans should provide for the rapid conveyance of surface runoff to the storm sewer system.

SITE CONDITIONS

The investigated property consists of approximately 8 acres of vacant land situated southeast of the intersection of Woodmoor Drive and Deer Creek Road in the Woodmoor Community located in El Paso County, Colorado. The parcel is located in Section 11, Township 11 South, Range 67 West of the 6th Principal Meridian in El Paso County, Colorado. The site plan and a vicinity map are shown in Fig. 1.

Based on our site observations, review of historical aerial photography, review of utility mapping during scheduled site utility meetings with local utility locators, we believe the site has experienced some level development work prior to 1979. Some utilities appear to be present within the property and appear to be associated with prior development that was not completed. Existing utilities include sanitary sewer, domestic water lines, and communication utility easements. Two fire hydrants are present within the center of the site and one sewer main crosses the property from west to east, turning north along the east boundary of the property. A sewer manhole is present near the center of the east property boundary, at the turning point of the sewer main. Minor site grading also appears to exist across the site presenting the possibility for the presence of existing fill. Existing fill is likely to exist within utility easements/trenches as well as in the eastern portion of the site nearest to Lake Woodmoor.

The ground surface at the site generally slopes downward toward the east, becoming more steeply sloped along the eastern edges of the parcel. The high point is located at the northwest corner of the site, and the low point is located along the eastern edges of the site, along the banks of Lake Woodmoor. Elevations range from approximately 7,160 feet at the northwest corner of the parcel to about 7,100 feet along the bank of Lake Woodmoor and in the southeast corner of the site. Overall, the site generally slopes toward the lake at about 3 to 5 percent for the relatively flat and level areas



found in the western half of the parcel. The slopes become more steep, approaching 10 percent, for the eastern half of the parcel, sloping downward toward Lake Woodmoor. The flood plain encompassing Lake Woodmoor includes 40 to 140 feet of the eastern edge of the southeast corner of the site, along Lake Woodmoor. This area, as shown on Fig. No. 1, is not being considered for future development.

Vegetation on the site consists of grasses, weeds, and small to large shrubs and trees. Generally, the northern two thirds of the site is covered in grasses and weeds and the southern one-third of the site contains trees and shrubs. A soil stockpile is present in the southern portion of the site. The land surrounding the site to the north and south is developed with residential lots. Lewis Palmer Middle School is present to the west and Lake Woodmoor is present to the east. Woodmoor Drive bounds the site to the west and Deer Creek Road bounds the site on the north as shown on Fig. No. 1.

PROPOSED DEVELOPMENT

We understand the site is to be developed with single-family attached residences. We anticipate the buildings to be multi-story, wood-frame structures, possibly with habitable, below-grade areas (basements). Garages are to be incorporated into the construction of the buildings. Paved access roadways and parking areas will be constructed as part of the overall development.

No grading plans were available for our review at the time of this investigation. Based on existing topography at the site, we anticipate minor cuts and fills will be necessary for building pad construction. We anticipate the dwellings will be serviced by a municipal sanitary sewer and domestic water. Some utilities are currently present across the site.

SUBSURFACE INVESTIGATION

Subsurface conditions across the site were investigated on a preliminary basis by drilling nine, widely-spaced exploratory borings at the approximate locations shown in Fig. 1. Graphical logs of conditions found in our exploratory borings, the results of field



penetration resistance tests, and some laboratory data are shown in Appendix A. Swell-consolidation tests and grain size analysis test results are presented in Appendix B. Laboratory test data are summarized in Table B-1.

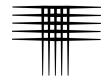
Soil and bedrock samples obtained during this study were returned to our laboratory and visually classified. Laboratory testing was then assigned to representative samples. Testing included moisture content and dry density, swell-consolidation, sieve analysis, Atterberg limits, and water-soluble sulfate content tests. The swell test samples were wetted under applied loads that approximated the overburden pressure (the weight of overlying soil and bedrock).

SUBSURFACE CONDITIONS

The near-surface soils encountered in the exploratory borings consisted of natural, clayey to very clayey sand underlain by weathered and intact bedrock to the maximum depths explored of 30 feet. The bedrock consisted of sandy claystone and silty to clayey sandstone. Although not encountered in the borings, we believe suspect quality fill may be encountered in various areas at the site. Some of the pertinent engineering characteristics of the soils and bedrock encountered, and groundwater conditions are discussed in the following paragraphs.

Existing Fill

Based on existing utilities present at the site and suspect indications of past development, we believe some suspect quality fill is present and will be encountered in various areas across the site, although not encountered in our exploratory borings. We have no knowledge about the origin of the fill material. The fill likely consists of clayey sand, similar to the on-site materials. We do not suspect a significant quantity of fill is present; however, suspect quality fill is not suitable to underlie the proposed structures, in its current condition.



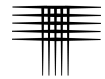
Natural Soil

Natural, clayey to very clayey and silty sand ranging in thickness from about 4 feet to up to 7 feet was encountered at the ground surface in each of the borings drilled during this study. The natural sand was medium dense to dense based on the results of field penetration resistance tests. Seven samples of the sand contained 16 to 38 percent clay and silt-size particles (passing the No. 200 sieve). One sample of the very clayey sand exhibited a low measured swell value of 2.2 percent when wetted under estimated overburden pressure.

Bedrock

Sandy to very sandy claystone and silty to clayey sandstone bedrock was encountered in the borings, beneath the natural soils, at depths ranging from 4 to 7 feet below the existing ground surface. The upper 2 to 4 feet of the bedrock was judged as weathered in four of the nine borings. Field penetration resistance test results indicated the weathered bedrock was medium hard. Two samples of the weathered bedrock were subjected to laboratory testing and contained 44 to 62 percent silt and clay-sized particles. One sample exhibited 2.8 percent swell when wetted under estimated overburden pressures.

Intact claystone and sandstone bedrock was found underlying the natural soils and weathered bedrock in the nine borings. The claystone and sandstone were judged to be hard to very hard based on field penetration resistance testing. Claystone was encountered at depths of between 6 and 11 feet below existing grades and extended to depths of 13 and 16 feet. Layers of claystone were found within the sandstone in at least two borings at depths of 17 and 23 feet and extended to the maximum depths explored of up to 30 feet. Two samples of the claystone contained 61 and 62 percent silt and clay-sized particles. Sandstone was encountered at depths ranging from 5 to 16 feet and extending to the maximum depths explored of up to 30 feet. Sieve analysis indicated eight samples of the sandstone tested in our laboratory contained 19 to 44 percent clay and silt-size particles (passing the No. 200 sieve).

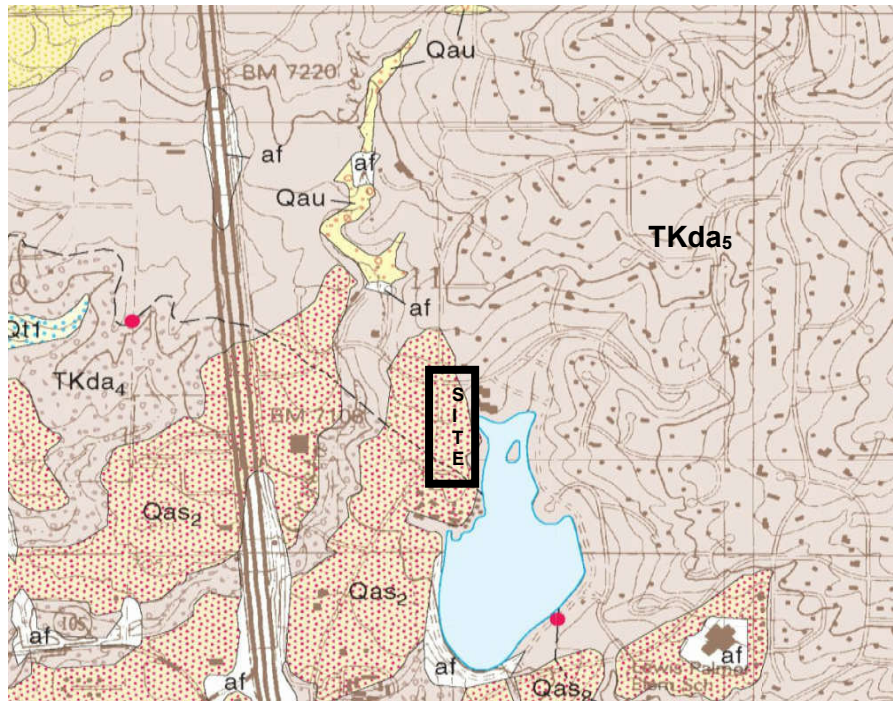
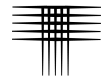


Groundwater

At the time of drilling, groundwater was not encountered in the borings drilled to depths of up to 30 feet. When groundwater levels were checked eight days after the completion of drilling operations, groundwater was measured in one boring (TH-1) at a depth of 26.5 feet below the existing ground surface. Our borings were drilled during a dry late summer to early fall season. Water storage levels observed within the adjacent Lake Woodmoor were observed as very low to nearly dry at the time of our drilling operation. Water levels should be expected to fluctuate in response to altered surface drainage patterns, seasonal precipitation, and irrigation of landscaping commonly associated with residential development as well as water storage levels in the adjacent lake, especially during wet years. Our borings were drilled in the fall season when groundwater levels and water levels of the lake are typically becoming lower.

SITE GEOLOGY

The geology of this parcel located north of Lake Woodmoor in Woodmoor, Colorado was evaluated through the review of published geologic maps, a field reconnaissance on October 11, 2021, and through the drilling of nine exploratory borings spread across the site. Information from these sources was used to produce our interpretation of surficial geologic conditions. An excerpt from the Colorado Geological Survey's "Geologic Map of the Monument Quadrangle, El Paso County, Colorado" (dated 2004) is presented below. We found the map to be generally accurate. A list of references is included at the end of the text of this report. The following sections discuss the mapped units.



Excerpt from CGS 2004 Geologic Map of the Monument Quadrangle

Surficial Deposits

Soil deposits of up to 7 feet in depth overlie bedrock of the Dawson Formation. The various deposits are described in more detail in the following sections.

Alluvium – Map unit Qs/Qc/Qas₂: The bedrock is covered by up to 7 feet of alluvium and colluvium, formed as sheetwash and stream deposits and residual weathering in place of the sandstone bedrock. The alluvium is silty and clayey with occasional clay layers. The above map suggests the site is located within this unit.

Bedrock

Dawson Sandstone – Map Unit TKda₅: Sandstone is present at the site below the surficial sand soils. The sandstone is comprised of fine to medium grained, poorly sorted, high clay content materials. Very thin claystone bedding can be found throughout this formation. The material is hard to very hard based on our field penetration resistance testing. Based on geologic mapping in the area, the



bedrock has a regional dip of about 5 to 12 degrees. Weathered lenses of the bedrock were noted for the upper 2 to 4 feet of the bedrock in our borings.

POTENTIAL GEOLOGIC HAZARDS AND ENGINEERING CONSTRAINTS

We did not identify geologic hazards that we believe preclude development of the site. The conditions identified at the site that may pose hazards or constraints to development include flooding, erosion, potentially expansive soil and bedrock, and shallow hard bedrock. Regional geologic conditions that impact the site include seismicity, flooding, and radioactivity. We believe each of these conditions can be mitigated with engineering design and construction methods commonly employed in this area. These conditions are discussed in greater detail in the sections that follow.

Our interpretation of the surficial geology and geologic hazards is presented in Fig. 2 and is described above. Our interpretation of the engineering geologic conditions is presented in Fig. 3. The site is shown as containing Map Units 1A and 3B per the classification system described in Robinson's "El Paso County, Colorado - Potential Geologic Hazards and Surficial Deposits, Environmental and Engineering Geologic Maps and Tables for Land Use," 1977.

Map Unit 1A: described stable alluvium, colluvium, and bedrock on flat to gentle slopes of 0 to 5 percent. The majority of the site lies on this unit.

Map Unit 3B: describes expansive and potentially expansive soil and bedrock on flat to moderate slopes of 0 to 12 percent. The northern portion of site lies on this unit.

Flooding

Flood Insurance Rate Maps prepared by FEMA were reviewed by CTL during the preparation of this report. Flood Insurance Rate Map (FIRM) 08041C0276G, panel 0276G of 1,300 dated December 7, 2018, was reviewed and flood plain boundaries are presented on our Fig. 1. The portion of the site considered for development does not lie within the area prone to surface flooding by a 100-year event; however, the eastern 40 to 140 feet of the southeastern corner of the site is located within the 100-year flood



plain as shown on Fig. 1. Preliminary development plans reviewed by CTL appear to take into account the 100-year flood event restraint.

Erosion

The site contains soil and bedrock that are susceptible to the effects of wind and water erosion. Concentrated water flow can result in erosion. The surficial soils on slopes less than 20 percent are relatively stable and resistant to erosion where vegetation is established. Disturbance of the vegetative cover and long-term exposure to the erosive power of wind and water increases the potential for erosion. Maintaining vegetative cover and providing engineered surface drainage will reduce the potential for erosion from wind and water.

Shallow Hard Bedrock

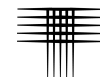
Bedrock is present across the site at depths of between 4 and 7 feet. We believe the materials at the site can normally be excavated using conventional heavy-duty equipment and should break down to a size suitable for use as grading fill. We did not identify cemented sandstone at the site.

Expansive Soil and Bedrock

The near-surface soils are sandy to clayey and are generally considered low-swelling or non-expansive. Problems associated with expansive materials are mitigated through engineered foundation and floor slab systems, sometimes in conjunction with ground modification such as sub-excavation and treatment or replacement. Geotechnical investigations conducted for each building site should address procedures for mitigating issues associated with expansive soils and bedrock, if they are encountered.

Economic Minerals

The site does not contain coal. Therefore, it is doubtful the parcel has been undermined. Other energy fuels such as uranium or oil and gas are considered not likely present in economic quantities. Although the site contains some sand and gravel, it is unlikely to be economically valuable in the foreseeable future, due to political considera-



tions, the size and shape of the parcel, the depth of the material, and the proximity to existing developments. The area is not expected to contain economic deposits of energy fuels or other valuable minerals.

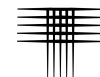
Seismicity

This area, like most of central Colorado, is subject to a degree of seismic activity. Geologic evidence indicates that movement along some Front Range faults has occurred during the last two million years (Quaternary). These includes the Ute Pass Fault and Rampart Range Fault, which are located several miles west of the site. We believe the soils on the property classify as Site Class C (dense soil and soft rock profile), according to the 2015 International Building Code (2015 IBC).

Radon and Radioactivity

We believe no unusual hazard exists from naturally occurring sources of radioactivity on this site. However, some of the materials found in our borings are often associated with the production of radon gas, and concentrations in excess of EPA guidelines can occur. Radon tends to collect in below-grade areas where there is limited outside air exchange and interior ventilation. Passive and active mitigation procedures are commonly employed in this region to effectively reduce the buildup of radon gas. Measures that can be taken after a building is enclosed during construction include installing a blower connected to the foundation drain and sealing the joints and cracks in concrete floors and foundation walls. If the occurrence of radon is a concern, we recommend buildings be tested after they are enclosed, and mitigation systems installed to reduce the risk.

Low-level gamma radiation levels were measured in the cuttings from our exploratory borings using a LUDLUM Micro R Meter (Model 19). The meter provides readings of low-level gamma radiation in terms of micro R/Hr (micro Roentgens per hour). Background readings which represent “means” ranged between 15 and 17 micro R/Hr. Readings on the drill cuttings also ranged between 18 and 20 micro R/Hr.



The “background” level of low-level gamma radiation in the state generally ranges from 15 to 20 micro R/Hr with the level of concern being established at about twice background. This would imply remediation should be performed for materials at this site that exceed about 30 to 40 micro R/Hr. Federal standards have been developed for uranium and thorium mill tailings that state that remediation is required when the concentration of radium-226 exceeds background levels by more than 5 pCi/g (picoCuries per gram). We understand this radium standard equates to a gamma reading of about 9 micro R/Hr above background. If the mill tailing standard is applied to the average of the background readings found across the site of about 15 micro R/Hr, remediation of material exhibiting gamma readings in excess of about 24 micro R/Hr would be required. Our readings were lower than the action level.

SITE DEVELOPMENT CONSIDERATIONS

From an engineering point-of-view, the more significant subsurface conditions impacting construction are the occurrences of potential existing fill, expansive materials, shallow bedrock, and erosion. The following sections discuss the impact of these conditions on development and possible methods of mitigation.

Site Grading

We believe the majority of site grading can be accomplished using conventional heavy-duty earthmoving equipment. We recommend grading plans consider long-term cut and fill slopes no steeper than 3:1 (horizontal to vertical). This ratio considers that no seepage of groundwater occurs. If groundwater seepage does occur, a drain system and flatter slopes may be appropriate.

Vegetation and organic materials should be removed from the ground surface of areas to be filled. Soft or loose soils, if encountered, should be stabilized or removed to stable material prior to placement of fill. Organic soils should be wasted in landscaped areas. If insufficient landscaped areas are planned, topsoil can be mixed with clean fill soils at a ratio of 15:1 (fill:topsoil).



If fill is to be placed on slopes exceeding gradients of 20 percent (5:1, horizontal to vertical), horizontal benches should be cut into the hillside. The benches should be at least 12 feet wide or 1-1/2 times the width of the compaction equipment and be provided at a vertical spacing of not more than 5 feet. Once the grading and development plans have been finalized, we should be contacted to confirm the criteria recommended above are appropriate or provide additional recommendations.

The ground surface in areas to receive fill should be scarified, moisture conditioned and compacted. If natural clays or excavated claystone are used for fill, they should be placed at high moisture content to help mitigate potential swell. The properties of the fill will affect the performance of foundations, slabs-on-grade, and pavements. We recommend grading fill composed of the granular materials (non-cohesive) be placed in thin, loose lifts, moisture conditioned to within 2 percent of optimum moisture content, and compacted to at least 95 percent of maximum modified Proctor dry density (ASTM D 1557). Clay soils (cohesive) should be moisture conditioned to between 1 and 4 percent above optimum moisture content and compacted in thin, loose lifts to at least 95 percent of maximum standard Proctor dry density (ASTM D 698). Placement and compaction of the grading fill should be observed and tested by our representative during construction. Guideline specifications for overlot grading are presented in Appendix C.

Buried Utilities

Over most of the site, we believe utility trench excavation can be accomplished using heavy-duty track hoes. The bedrock encountered in our borings was medium hard to very hard, but generally at least 4 feet deep at our boring locations. Bedrock could be more shallow in areas, but we do not believe excavation will be difficult. Based on groundwater measurements at the site, we do not believe groundwater will present a significant impact to buried utilities; however, our borings were drilled during a comparatively more dry season than a typical year, therefore, groundwater conditions may change and could be significantly different during wetter years. Additionally, the adjacent lake was nearly dry at the time of this study. Groundwater levels should be expected to increase when water storage levels in the lake are at or near capacity.



Excavations for utilities should be braced or sloped to maintain stability and should meet applicable local, state, and federal safety regulations. The contractor should identify the soils and bedrock encountered in trench excavations and refer to Occupational Safety and Health Administration (OSHA) standards to determine appropriate slopes. We anticipate the near-surface natural, granular soils and grading fill will classify as Type C materials. The bedrock classifies as Type A materials. Temporary excavations in Type A and Type C materials require a maximum slope inclination of 1:1 and 1.5:1 (horizontal to vertical), respectively, unless the excavation is shored or braced. If groundwater seepage occurs, flatter slopes will likely be required.

Water and sewer lines are usually constructed beneath paved roads. Compaction of trench backfill will have a significant effect on the life and serviceability of pavements. We recommend cohesive trench backfill be placed in thin, loose lifts, moisture conditioned to within 2 percent of optimum moisture content and compacted to at least 95 percent of maximum standard Proctor dry density (ASTM D 698). Non-cohesive materials should be compacted to at least 95 percent of maximum modified Proctor dry density (ASTM D1557). Personnel from our firm should periodically observe and test the placement and compaction of the trench backfill during construction.

Underdrain Systems

We believe use of underdrains incorporated with the design of sanitary sewer systems will provide a positive gravity outlet at individual structures for below-grade foundation drains and help control localized shallow groundwater conditions. The drain pipe should consist of smooth wall, rigid PVC pipe placed at a minimum slope of 0.5 percent. An “active” section of smooth, perforated or slotted, rigid PVC pipe should be placed for a minimum distance of one pipe length upstream of manholes. The perforated pipe should be encased in at least 6 inches of free-draining gravel, separated from the surrounding trench backfill by geotextile fabric. Seepage collars should be constructed at the manhole locations to force water flowing through pipe bedding into the underdrain. The seepage collars can be constructed of concrete or clay.



If wet conditions or free water are encountered in the sanitary sewer trenches, we recommend an active underdrain system with perforated or slotted pipe for these areas. A conceptual drain detail is shown in Fig. 4. A cutoff collar should be constructed around the sewer pipe and underdrain pipe immediately downstream of the point the underdrain pipe exits the sewer trench or changes from active to passive. Solid pipe should be used down gradient of this cutoff collar to the point of discharge. The underdrain should be maintained at least 3 to 5 feet below the lowest nearby foundation elevation. Where no groundwater is encountered in sanitary sewer excavations, passive underdrains may be used as presented on Fig. 5.

The design of the underdrain system should consider adjacent developments that will connect to the system. If a gravity outfall will be used for the underdrain system, the outfall point should be planned to not affect developments located down gradient. As-built plans of the underdrain system should be prepared including location, elevation, and cleanouts. The entity responsible for maintenance of the underdrain system should retain the as-built plans for future reference.

The appropriate sizes of underdrain pipe are dependent upon actual alignments, area served, and gradients. We can review grading, drainage, and underground utility plans and provide suggested pipe sizing recommendations, if requested. For preliminary planning purposes, we expect pipe diameters of 6 to 8 inches will be appropriate for drains for sixty dwellings or less. Where active seepage exists, 8-inch diameter or larger pipes will be appropriate for services to sixty dwellings or less. These pipe sizes consider an average gradient of 1 percent. We should review the design once sewer plans have been developed.

FOUNDATION AND FLOOR SYSTEM CONCEPTS

Preliminary information suggests spread footing foundations will be appropriate for construction of most of the proposed residential structures. This foundation approach may be appropriate where a thick layer of low-swelling, natural, clayey to very clayey sand is present, or where moisture conditioned, and densely compacted fill is constructed at shallow foundation elevations where suspect quality fill has been removed and



replaced as moisture conditioned and densely replaced or placement of new site grading fill. If more expansive natural clay and/or claystone that may not have been encountered in our borings near the ground surface or is exposed following completed site grading and/or exposed within foundation excavations, it will be necessary to sub-excavate this material and then replace the expansive soils with moisture conditioned, densely compacted fill, prior to footing and slab-on-grade construction. Sub-excavation depths of 3 to 5 feet are anticipated. A straight-shaft, drilled pier foundation bottomed in the bedrock may be an appropriate alternative to sub-excavation, if thicker zones of expansive bedrock occur at shallow depth.

Slab-on-grade floors will probably perform satisfactorily across most of the site where low-swelling, natural sand is present, or where moisture conditioned, and densely compacted fill or site grading fill is present at floor slab elevations following completed site grading. Generally speaking, the risk of slab movement and cracking is believed to be low at this site. Highly expansive materials were not encountered in our borings at the site. It is not anticipated at this site, but where moderately to highly expansive soils are present at or near finished floor elevations after grading, structurally supported floors (crawl space construction) or removal of a zone of expansive material and replacement with non-expansive fill below the slab may be appropriate alternatives to enhance floor system performance. Soil and foundation investigation reports prepared after completion of site grading should address appropriate foundation systems and floor system alternatives on a site-by-site basis.

PAVEMENTS

Clayey sand fill and natural clayey to very clayey sand soils are expected to be the predominant pavement subgrade material at this site. These clayey materials generally exhibit fair to good subgrade support characteristics for pavement systems, as compared to the poor subgrade support characteristics of more clayey soils. For the sandy materials, we anticipate asphalt concrete pavement sections on the order of 3 to 4 inches of asphalt over 6 inches of aggregate base course for the low volume streets is expected. These pavement thicknesses may not be sufficient for construction traffic and some maintenance and repair work may be needed prior to completion of the project. A



subgrade investigation and pavement design should be performed after site grading and utility installation are complete.

CONCRETE

Concrete in contact with soil can be subject to sulfate attack. We measured the water-soluble sulfate concentration in one sample of near surface soils from this site at less than 0.1 percent. Sulfate concentrations less than 0.1 percent indicate Class 0 exposure to sulfate attack for concrete in contact with the subsoils, according to ACI 201.2R-01, as published in the 2008 American Concrete Institute (ACI) *Manual of Concrete Practice*. For this level of sulfate concentration, the ACI indicates Type I cement can be used for concrete in contact with the subsoils. In our experience, superficial damage may occur to the exposed surfaces of highly permeable concrete, even though sulfate levels are relatively low. To control this risk and to resist freeze-thaw deterioration, the water-to-cementitious material ratio should not exceed 0.50 for concrete in contact with soils that are likely to stay moist due to surface drainage or high-water tables. Concrete subjected to freeze-thaw cycles should be air entrained.

SURFACE DRAINAGE AND IRRIGATION

The performance of structures, flatwork, and roads within the development will be influenced by surface drainage. When developing an overall drainage scheme, consideration should be given to drainage around each structure and from pavement areas. Drainage should be planned such that surface runoff is directed away from foundations and is not allowed to pond adjacent to or between structures or over pavements. Ideally, slopes of at least 6 inches in the first 10 feet should be planned for the areas surrounding buildings, where possible. Roof downspouts and other water collection systems should discharge well beyond the limits of all backfill around the structures. Proper control of surface runoff is also important to prevent the erosion of surface soils. Concentrated flows should not be directed over unprotected slopes. Permanent slopes should be seeded or mulched to reduce the potential for erosion. Backfill soils behind the curb and gutter adjacent to streets and in utility trenches within individual lots should be compacted. If surface drainage between preliminary development and construction



phases is neglected, performance of the roadways, flatwork, and foundations may be compromised.

RECOMMENDED FUTURE INVESTIGATIONS

Based on the results of this study, we recommend the following investigations and services be provided by our firm:

1. Soils and Foundation Investigations for individual buildings.
2. Subgrade Investigation and Pavement Design for on-site pavements.
3. Construction materials testing and observation services during site development and construction.

LIMITATIONS

The recommendations and conclusions presented in this report were prepared based on conditions disclosed by our exploratory borings, geologic reconnaissance, engineering analyses, and our experience. Variations in the subsurface conditions not indicated by the borings are possible and should be expected.

We believe this report was prepared with that level of skill and care ordinarily used by geologists and geotechnical engineers practicing under similar circumstances. No warranty, express or implied, is made.

Should you have any questions regarding the contents of this report or the project from a geotechnical engineering point-of-view, please call.

CTL | THOMPSON, INC.

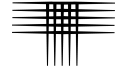

Patrick Foley, EI
Staff Engineer

Reviewed by:


Jeffrey M. Jones, P.E.
Associate Engineer

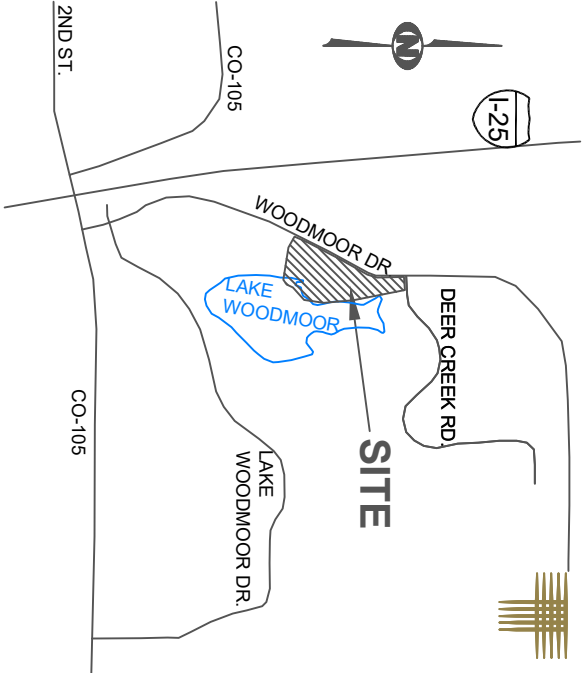
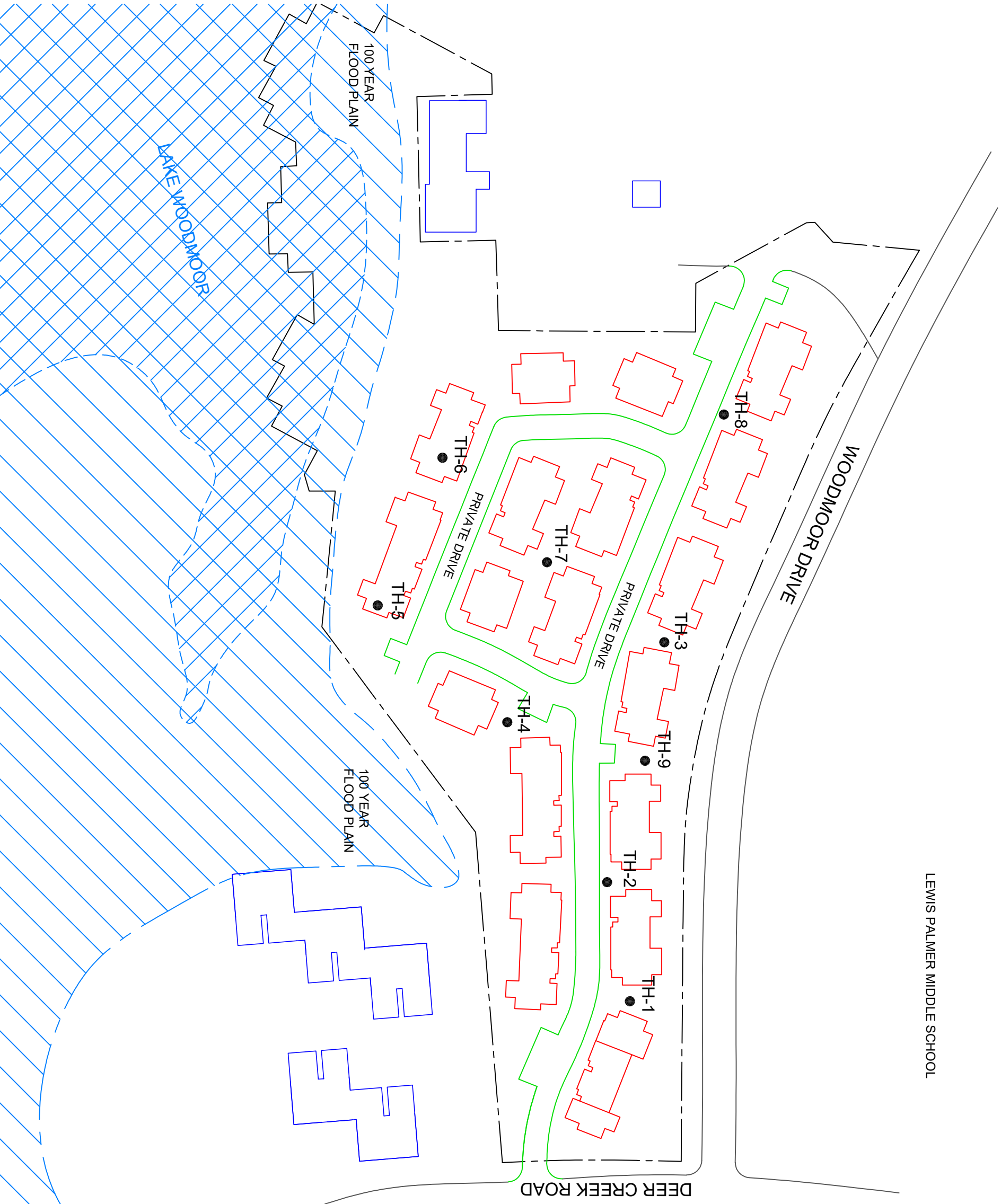


PF:JMJ:cw
(3 copies sent) Via Email: bdiana@laplatallc.com



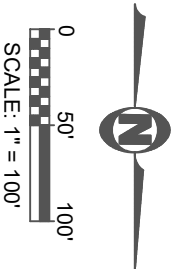
REFERENCES

1. Colorado Geological Survey. (1991). Results of the 1987-88 EPA Supported Radon Study in Colorado, with a Discussion on Geology, Colorado Geological Survey Open File Report 91-4.
2. Federal Emergency Management Agency, Flood Insurance Rate Map, Map Number 08041C0276G, Panel 276 of 1300, effective date December 7, 2018.
3. International Building Code (2015 IBC).
4. Kirkham, R.M. & Rogers, W.P. (1981). Earthquake Potential in Colorado. Colorado Geological Survey, Bulletin 43.
5. Robinson and Associates, Inc. (1977). El Paso County, Colorado - Potential Geologic Hazards and Surficial Deposits, Environmental and Engineering Geologic Maps and Tables for Land Use.
6. State of Colorado, Division of Mined Land Reclamation (April 1985). Prepared by Dames and Moore. Colorado Springs Subsidence Investigation.
7. Thorson, J.P., and Madole, R.F., 2003, Geologic Map of the Monument Quadrangle, El Paso County, Colorado: Colorado.



VICINITY MAP
(NOT TO SCALE)

- LEGEND:
- TH-1 ● APPROXIMATE LOCATION OF EXPLORATORY BORING.
 - PROJECT BOUNDARY
 - LOCATION OF EXISTING BUILDING FOOTPRINT.
 - LOCATION OF PROPOSED BUILDING FOOTPRINT.
 - LOCATION OF EXISTING 100 YEAR FLOODPLAIN.
 - ▨ LOCATION OF EXISTING LAKE WOODMOOR.



NOTE:
BASE DRAWING WAS PROVIDED BY N.E.S., INC.

Location of
Exploratory
Borings




LEGEND:

TH-1
● APPROXIMATE LOCATION OF EXPLORATORY BORING.

--- PROJECT BOUNDARY


— LOCATION OF PROPOSED BUILDING FOOTPRINT.

— LOCATION OF EXISTING BUILDING FOOTPRINT.

 LOCATION OF EXISTING 100 YEAR FLOODPLAIN.

 LOCATION OF EXISTING LAKE WOODMOOR.

GEOLOGIC UNITS AND (MODIFIERS)

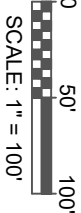
 SURFICIAL GEOLOGIC CONTACTS

qs
SLOCUM ALLUVIUM: POORLY SORTED STRATIFIED GRAVEL CONTAINING LAYERS OF CLAY, SILT, SAND, AND CLAY BALLS. BOULDERS ARE LARGER AND MORE ABUNDANT NEAR THE MOUNTAINS. EAST OF MONUMENT CREEK ALLUVIUM CONSISTS OF COARSE ARKOSIC SAND. THE TOP OF TERRACES IS 80 TO 120 FEET ABOVE MAJOR STREAMS.

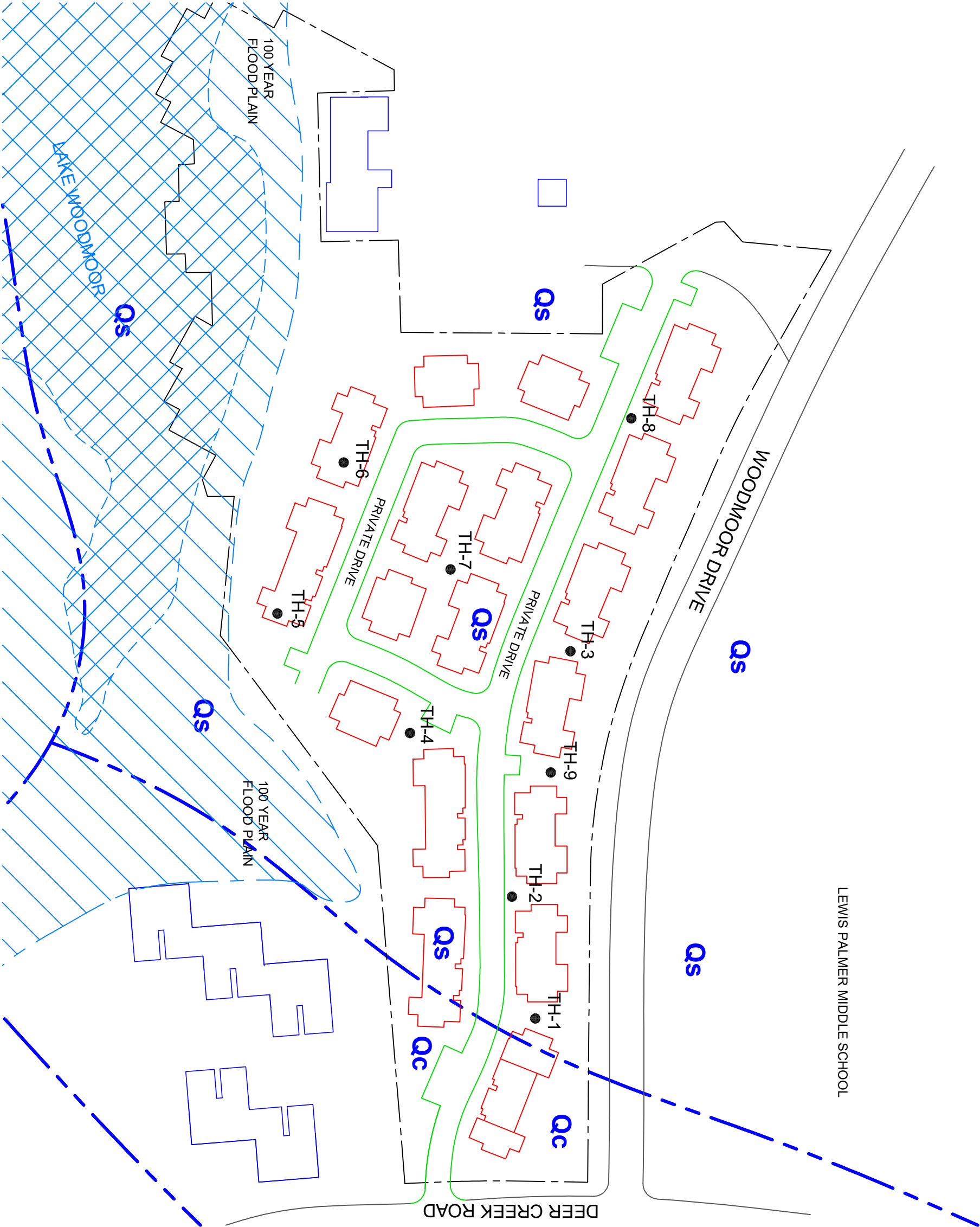
qc
COLLUVIUM: CLAYEY OR SILTY SAND, LOCALLY WITH BOULDERS DERIVED FROM IN-PLACE WEATHERING OF BEDROCK; IN AREAS MODIFIED BY SLOPEWASH.

NOTES:

1. BASE DRAWING WAS PROVIDED BY N.E.S., INC.
2. ALL BOUNDARIES SHOWN SHOULD BE CONSIDERED APPROXIMATE. THEY ARE BASED UPON A SUBJECTIVE INTERPRETATION OF PUBLISHED MAPS, AERIAL PHOTOGRAPHS AND AN INITIAL FIELD RECONNAISSANCE. CHANGES IN THE MAPPED BOUNDARIES SHOWN ARE POSSIBLE AND SHOULD BE EXPECTED WITH MORE DETAILED WORK AND FURTHER INFORMATION. ALL INTERPRETATIONS AND CONDITIONS SHOWN ARE PRELIMINARY AND FOR LAND-USE PLANNING ONLY.





**Surficial
Geologic
Conditions**






LEGEND:

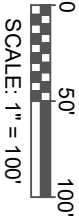
- TH-1
● APPROXIMATE LOCATION OF EXPLORATORY BORING.
- PROJECT BOUNDARY
- LOCATION OF PROPOSED BUILDING FOOTPRINT.
- LOCATION OF EXISTING BUILDING FOOTPRINT.
-  LOCATION OF EXISTING 100 YEAR FLOODPLAIN.
-  LOCATION OF EXISTING LAKE WOODMOOR.

ENGINEERING UNITS AND (MODIFIERS)

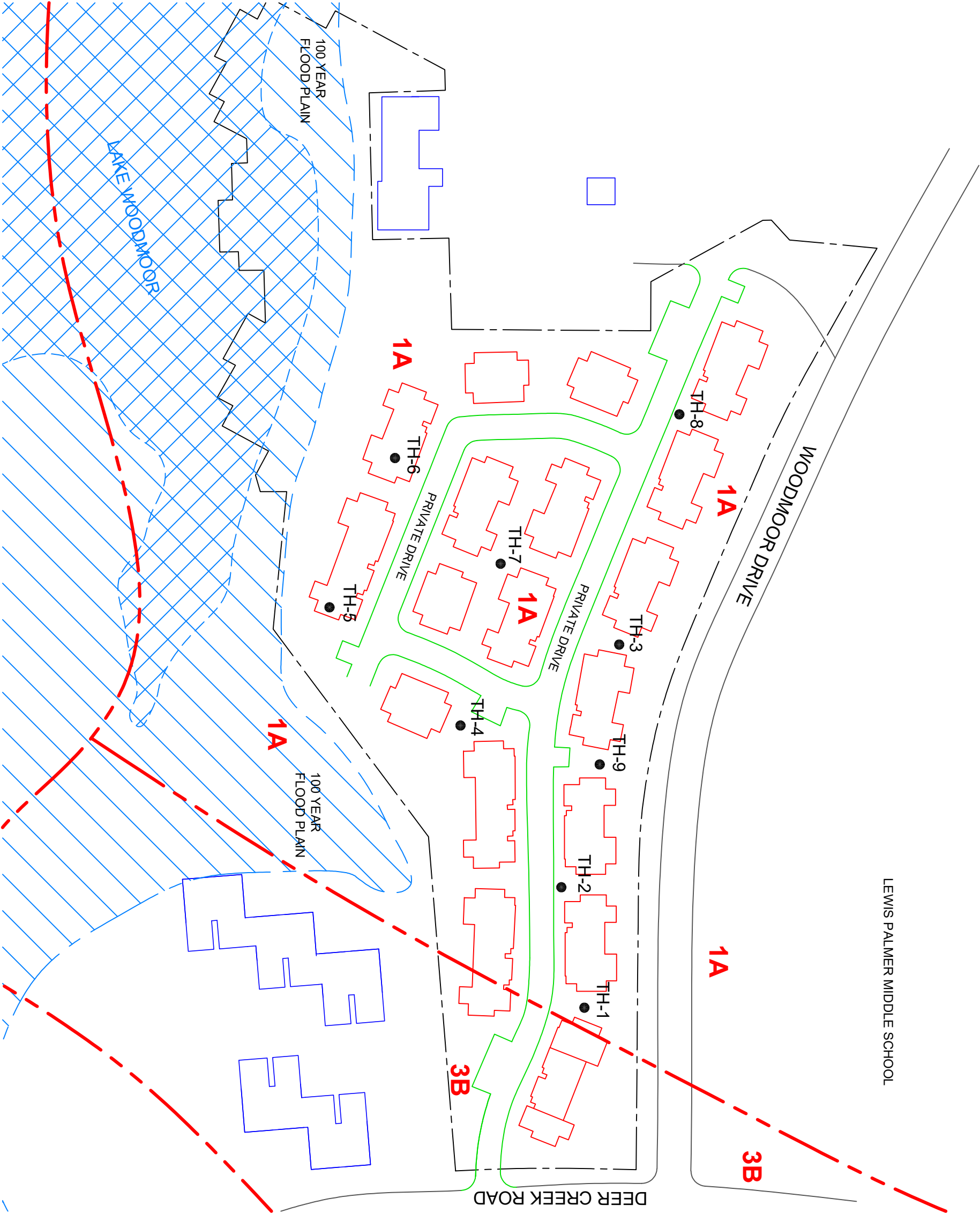
-  ENGINEERING CONTACTS
- 1A**
STABLE ALLUVIUM, COLLUVIUM, AND BEDROCK ON FLAT TO GENTLE SLOPES (0-5%)
- 3B**
EXPANSIVE AND POTENTIALLY EXPANSIVE SOIL AND BEDROCK ON FLAT TO MODERATE SLOPES (0-12%)

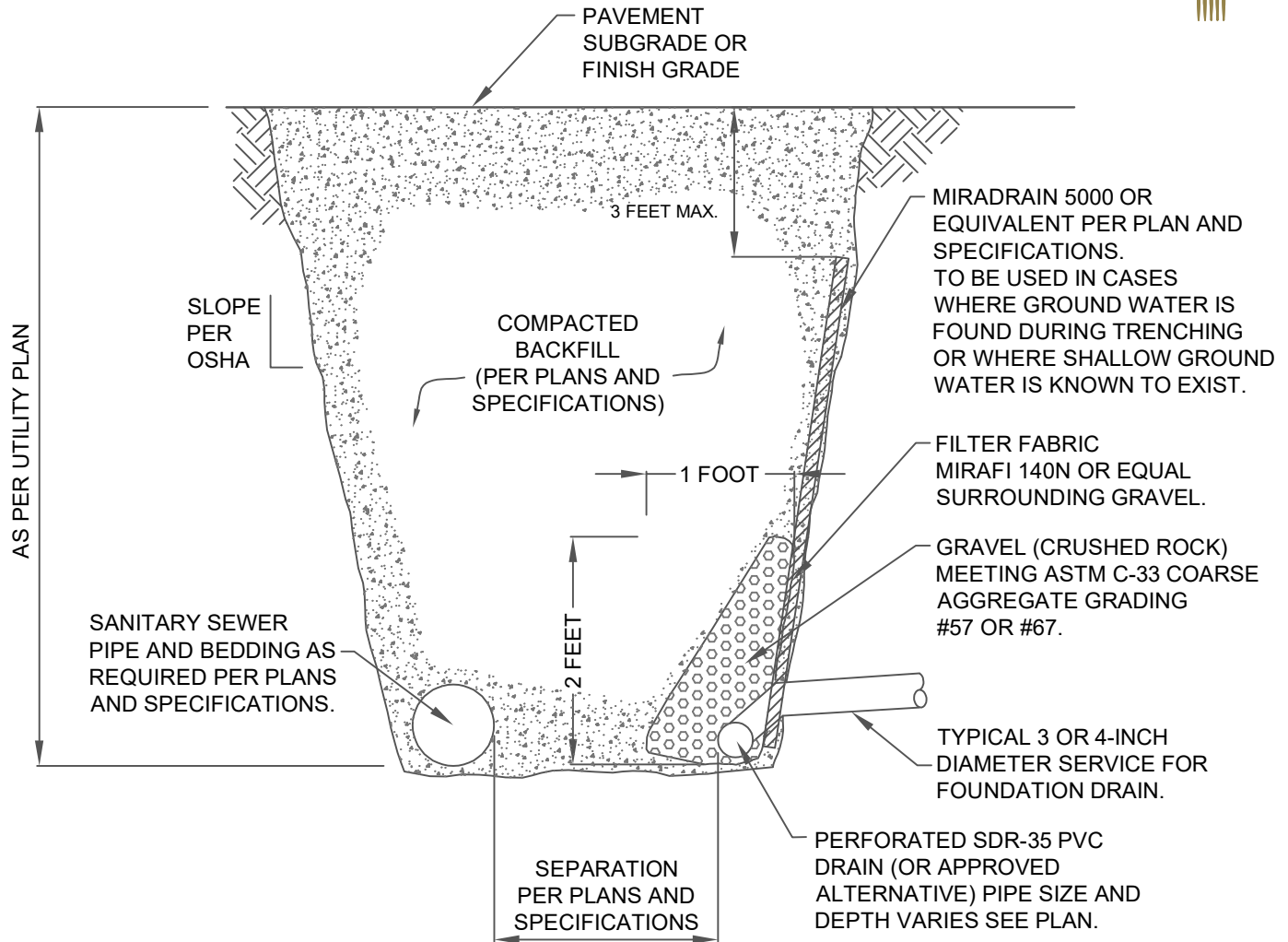
NOTES:

1. BASE DRAWING WAS PROVIDED BY N.E.S., INC., WATERSIDE CONCEPT DATED AUGUST 10, 2021.
2. ALL CONTACT BOUNDARIES SHOWN SHOULD BE CONSIDERED APPROXIMATE. THE BOUNDARIES ARE BASED UPON A SUBJECTIVE INTERPRETATION OF PUBLISHED MAPS, AERIAL PHOTOGRAPHS AND AN INITIAL FIELD RECONNAISSANCE. CHANGES IN THE MAPPED BOUNDARIES SHOWN ARE POSSIBLE AND SHOULD BE EXPECTED WITH MORE DETAILED WORK AND FURTHER INFORMATION. ALL INTERPRETATIONS AND CONDITIONS SHOWN ARE PRELIMINARY AND FOR INITIAL LAND-USE PLANNING ONLY.
3. MAP LEGEND IS MODIFIED FROM CHARLES S. ROBINSON & ASSOCIATES, INC., GOLDEN, COLORADO, DATED 1977.



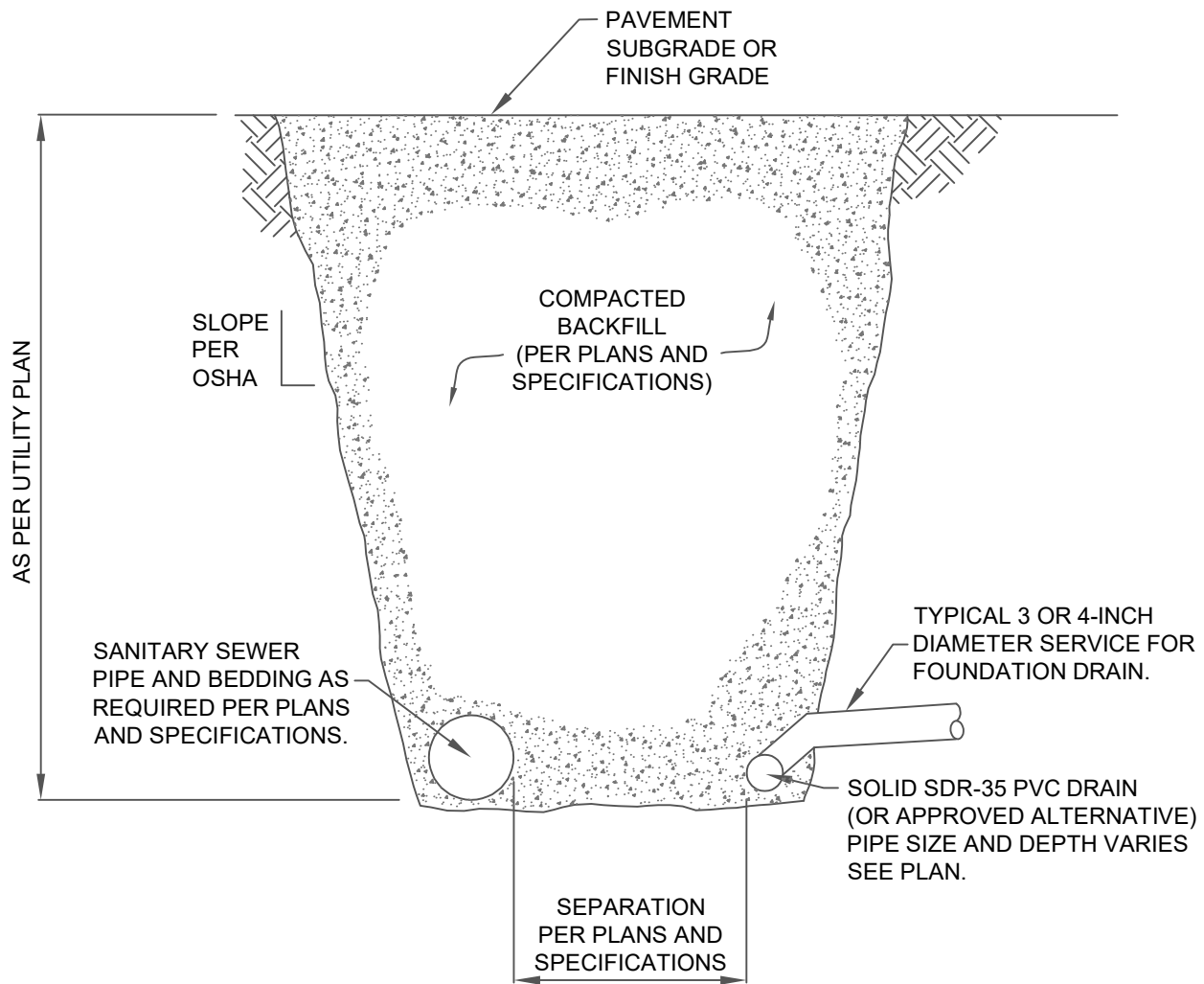
Engineering
Conditions





GRADING REQUIREMENTS FOR COARSE AGGREGATES PER ASTM C-33								
SIZE NUMBER	NOMINAL SIZE (SIEVES WITH SQUARE OPENINGS)	AMOUNTS FINER THAN EACH LABORATORY SIEVE (SQUARE OPENINGS), WEIGHT PERCENT						
		1 1/2 INCH (37.5 mm)	1 INCH (25.0 mm)	3/4 INCH (19.0 mm)	1/2 INCH (12.5 mm)	3/8 INCH (9.5 mm)	NO. 4 (4.5 mm)	NO. 8 (2.36 mm)
67	3/4 INCH TO NO. 4 (19.0 TO 4.75 mm)	--	100	90 TO 100	--	20 TO 55	0 TO 10	0 TO 5
57	1 INCH TO NO. 4 (25.0 TO 9.5 mm)	100	95 TO 100	--	25 TO 60	--	0 TO 10	0 TO 5

NOTE:
TO BE USED IN CASES WHERE GROUND WATER IS FOUND DURING TRENCHING OR WHERE SHALLOW GROUND WATER IS KNOWN TO EXIST, AND UPSTREAM OF MANHOLES.

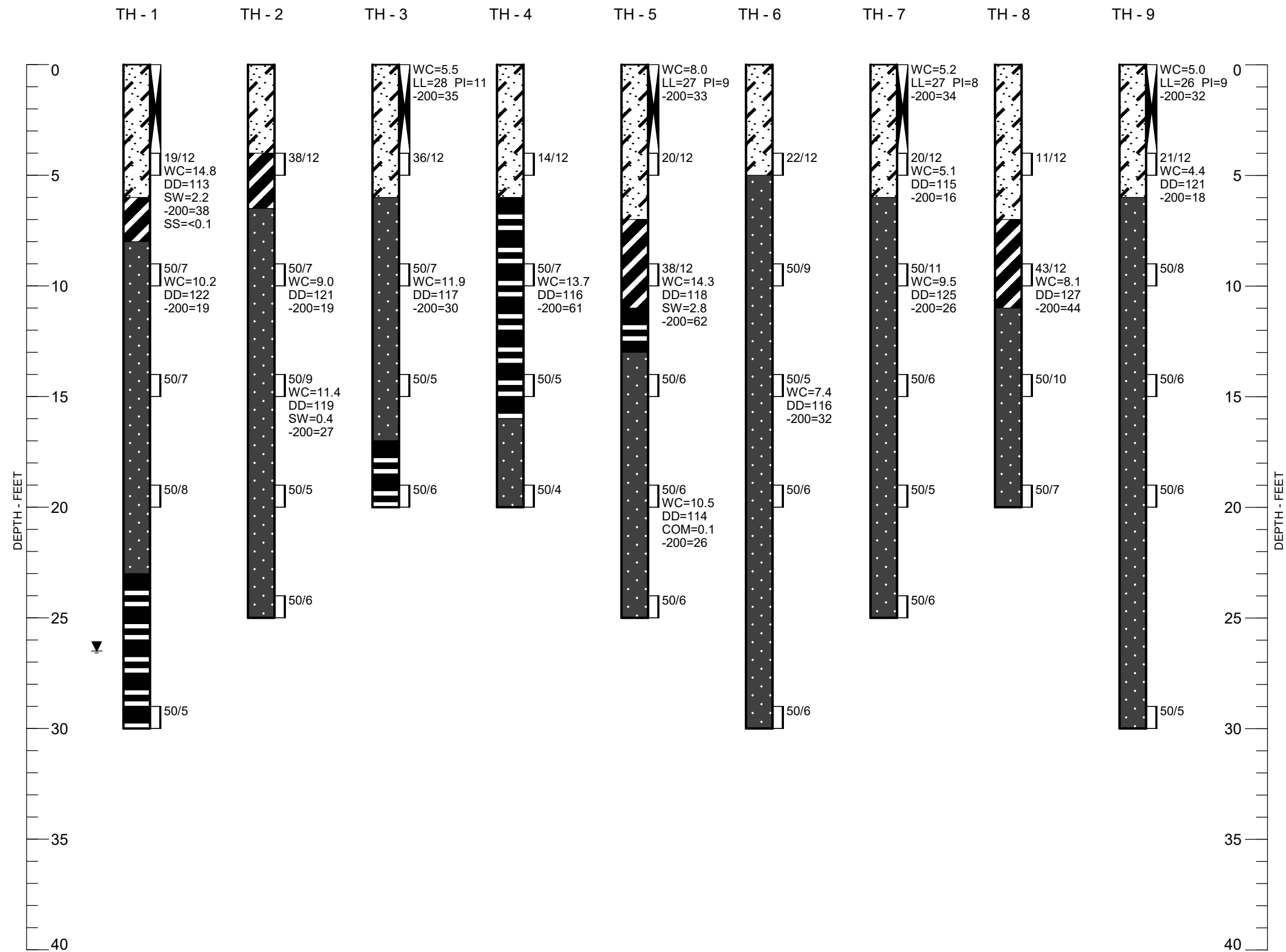


NOTE:
TO BE USED IN CASES WHERE NO
GROUND WATER IS KNOWN TO EXIST.



APPENDIX A

SUMMARY LOGS OF EXPLORATORY BORINGS



LEGEND:

- SAND, CLAYEY TO VERY CLAYEY, MEDIUM DENSE TO DENSE, SLIGHTLY MOIST TO MOIST, LIGHT BROWN TO BROWN, REDDISH BROWN, GRAY BROWN (SC).
- WEATHERED CLAYSTONE AND SANDSTONE BEDROCK, VERY SANDY (CLAYSTONE) AND VERY CLAYEY (SANDSTONE), MEDIUM HARD, MOIST, LIGHT BROWN TO OLIVE BROWN.
- BEDROCK. CLAYSTONE, VERY SANDY, HARD TO VERY HARD, MOIST, BROWN.
- BEDROCK. SANDSTONE, SILTY TO CLAYEY, HARD TO VERY HARD, MOIST, LIGHT BROWN TO BROWN AND LIGHT GRAY TO GRAY.
- DRIVE SAMPLE. THE SYMBOL 19/12 INDICATES 19 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- INDICATES BULK SAMPLE OBTAINED FROM AUGER CUTTINGS.
- GROUNDWATER LEVEL MEASURED EIGHT AFTER DRILLING.

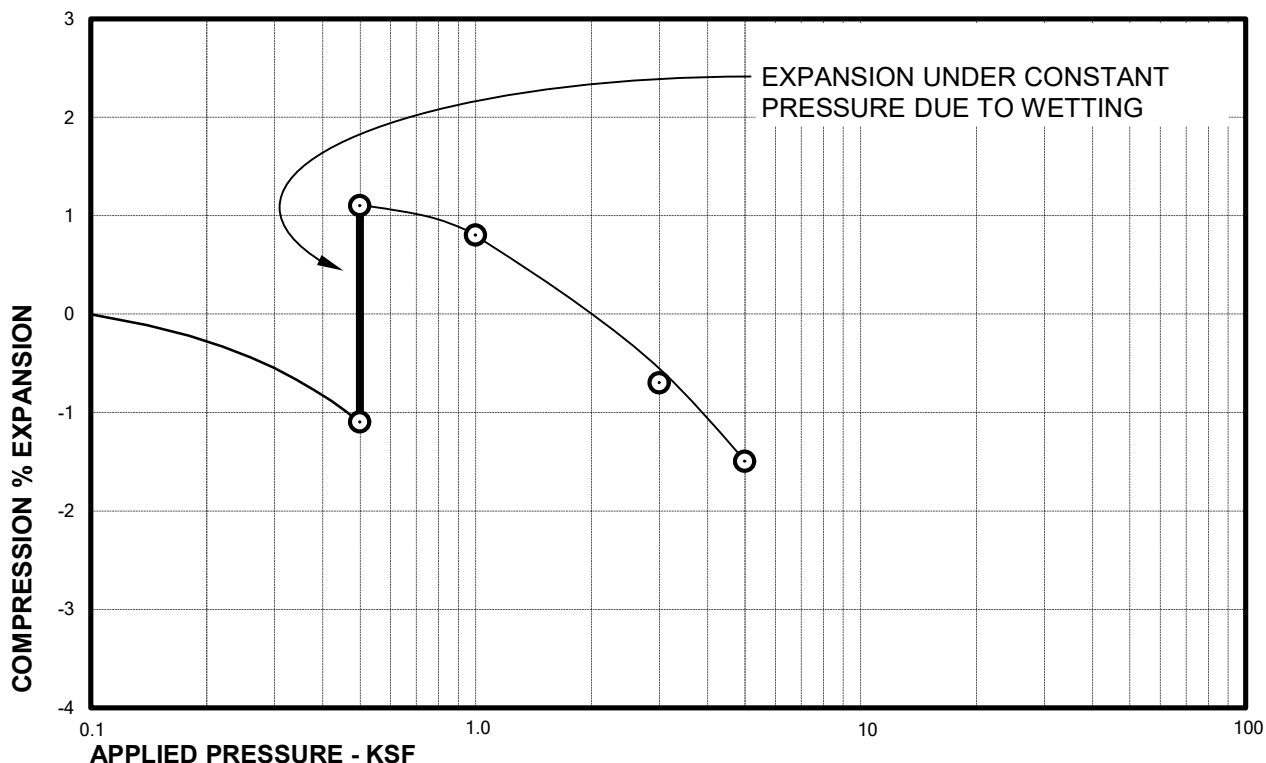
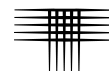
NOTES:

- THE BORINGS WERE DRILLED OCTOBER 4 AND 11, 2021 USING A 4-INCH DIAMETER, CONTINUOUS FLIGHT AUGER AND A CME-45, TRUCK-MOUNTED DRILL RIG.
- THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS, AND CONCLUSIONS AS CONTAINED IN THIS REPORT.
- WC - INDICATES MOISTURE CONTENT. (%)
DD - INDICATES DRY DENSITY. (PCF)
SW - INDICATES SWELL WHEN WETTED UNDER ESTIMATED OVERBURDEN PRESSURES. (%)
COM - INDICATES COMPRESSION WHEN WETTED UNDER ESTIMATED OVERBURDEN PRESSURES. (%)
LL - INDICATES LIQUID LIMIT. (%)
(NV : NO VALUE)
PI - INDICATES PLASTICITY INDEX. (%)
(NP : NON-PLASTIC)
-200 - INDICATES PASSING NO. 200 SIEVE. (%)
SS - INDICATES WATER-SOLUBLE SULFATE CONTENT. (%)



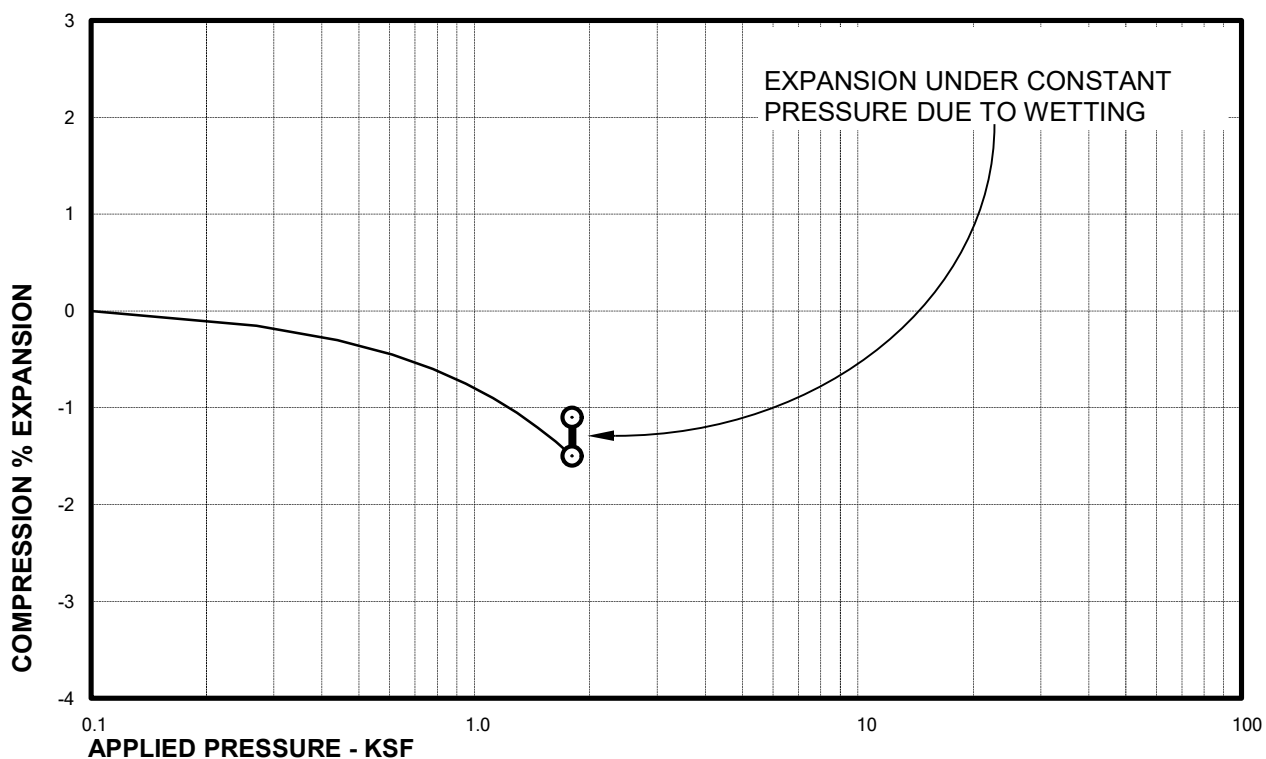
APPENDIX B

LABORATORY TEST RESULTS TABLE B-1: SUMMARY OF LABORATORY TESTING



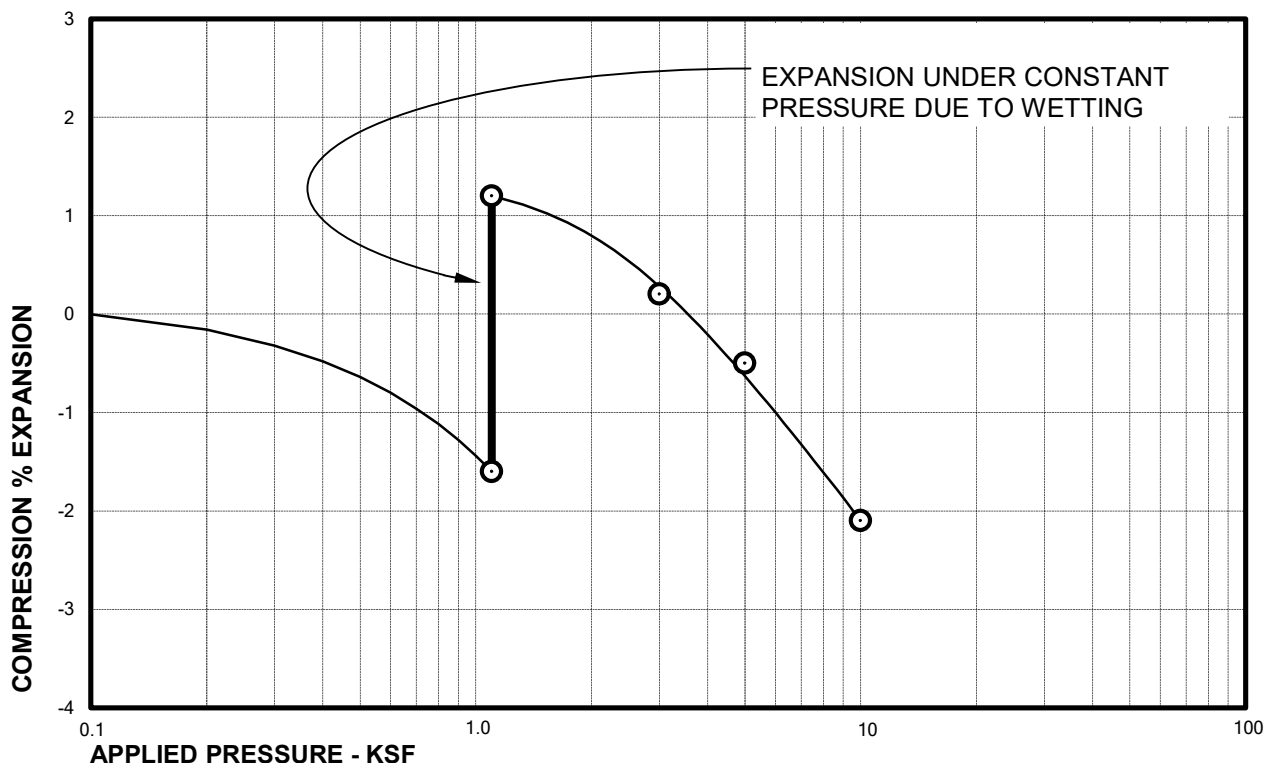
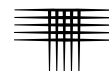
Sample of SAND, VERY CLAYEY (SC)
From TH-1 AT 4 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 14.8 %



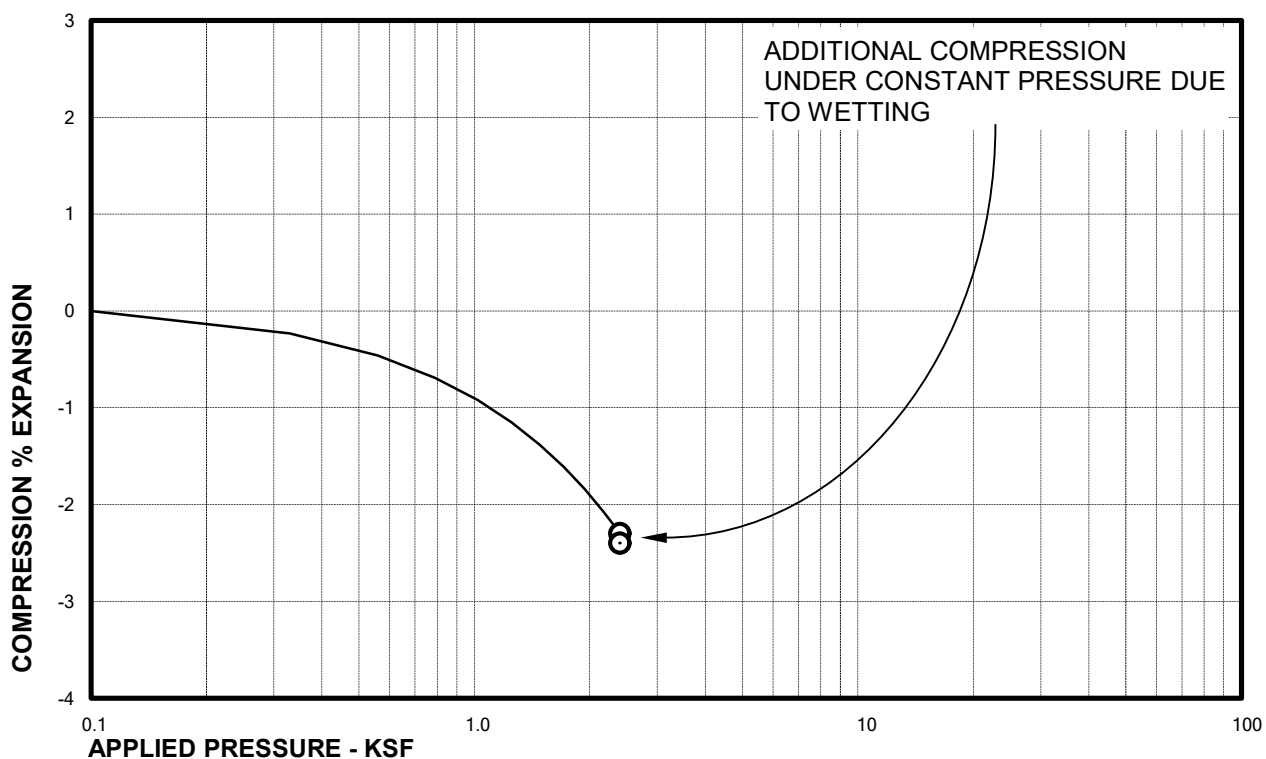
Sample of SANDSTONE, CLAYEY
From TH-2 AT 14 FEET

DRY UNIT WEIGHT= 119 PCF
MOISTURE CONTENT= 11.4 %



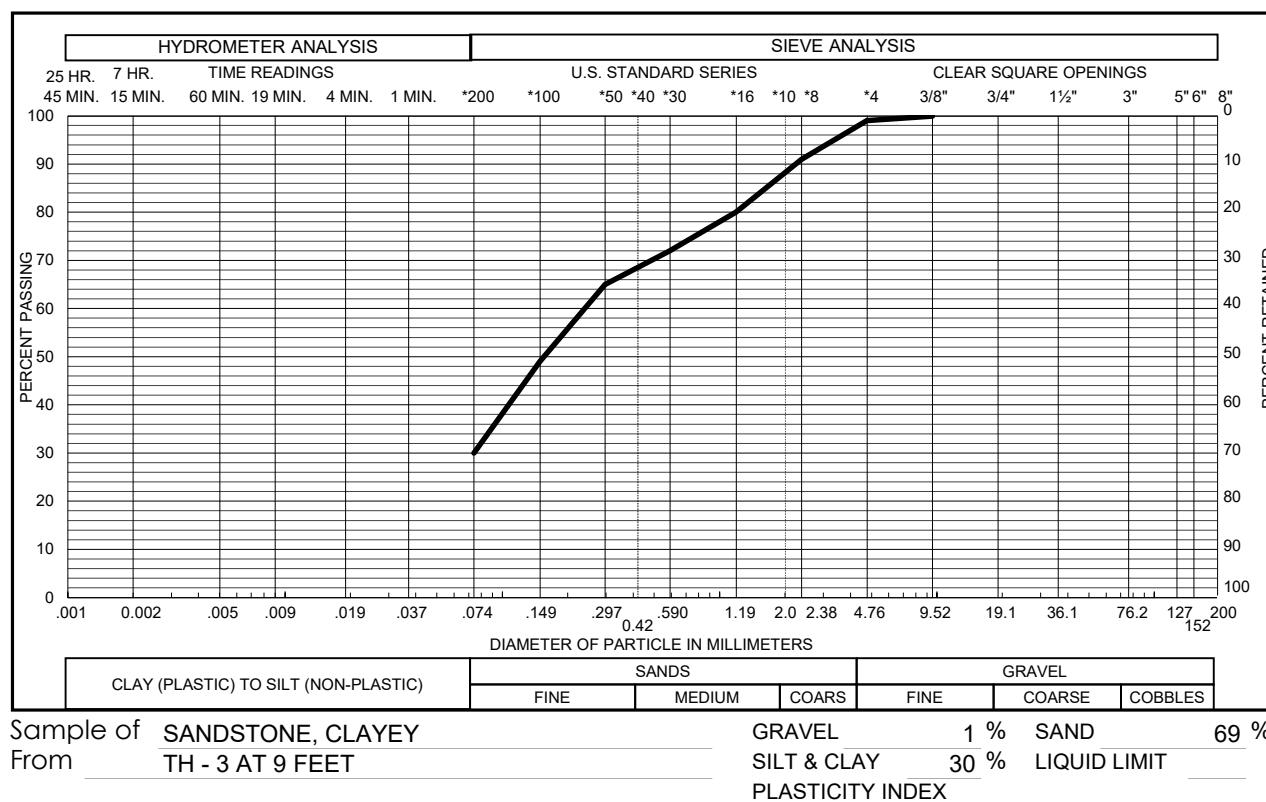
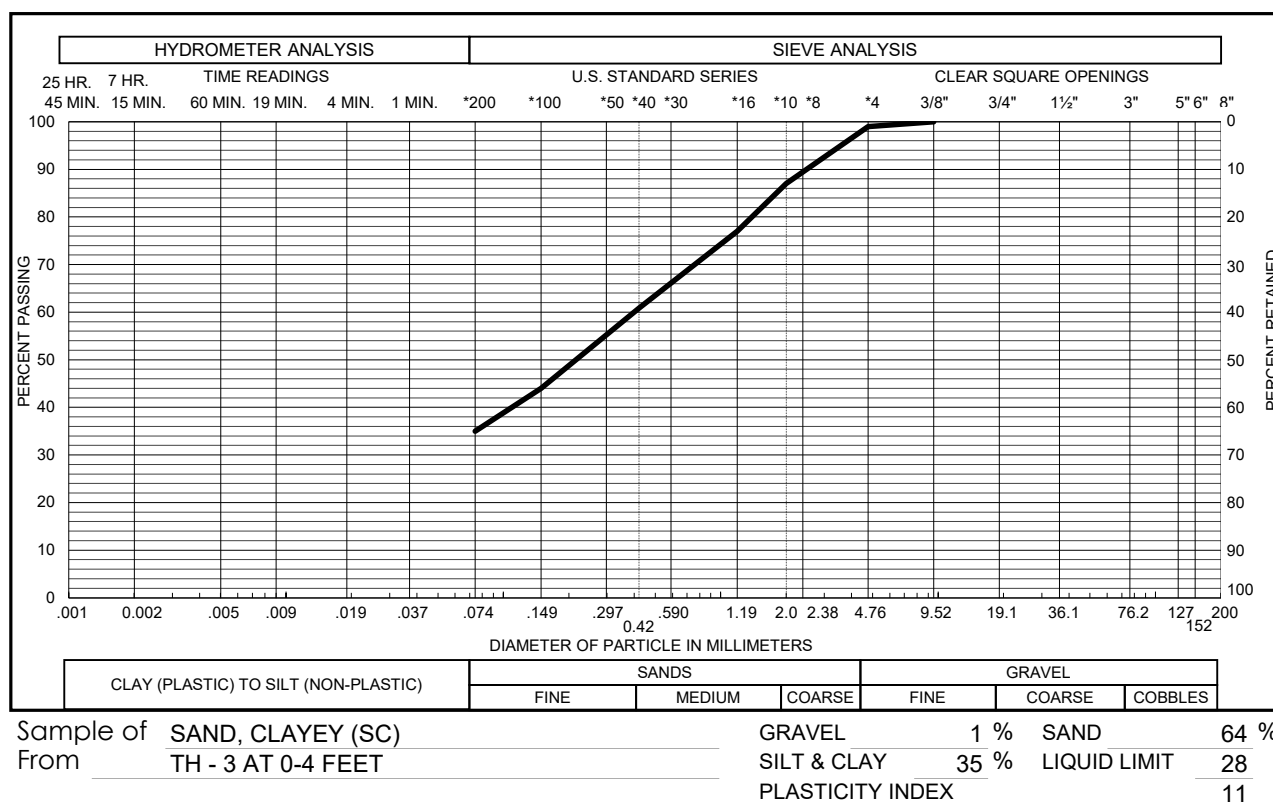
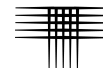
Sample of WEATHERED CLAYSTONE
From TH-5 AT 9 FEET

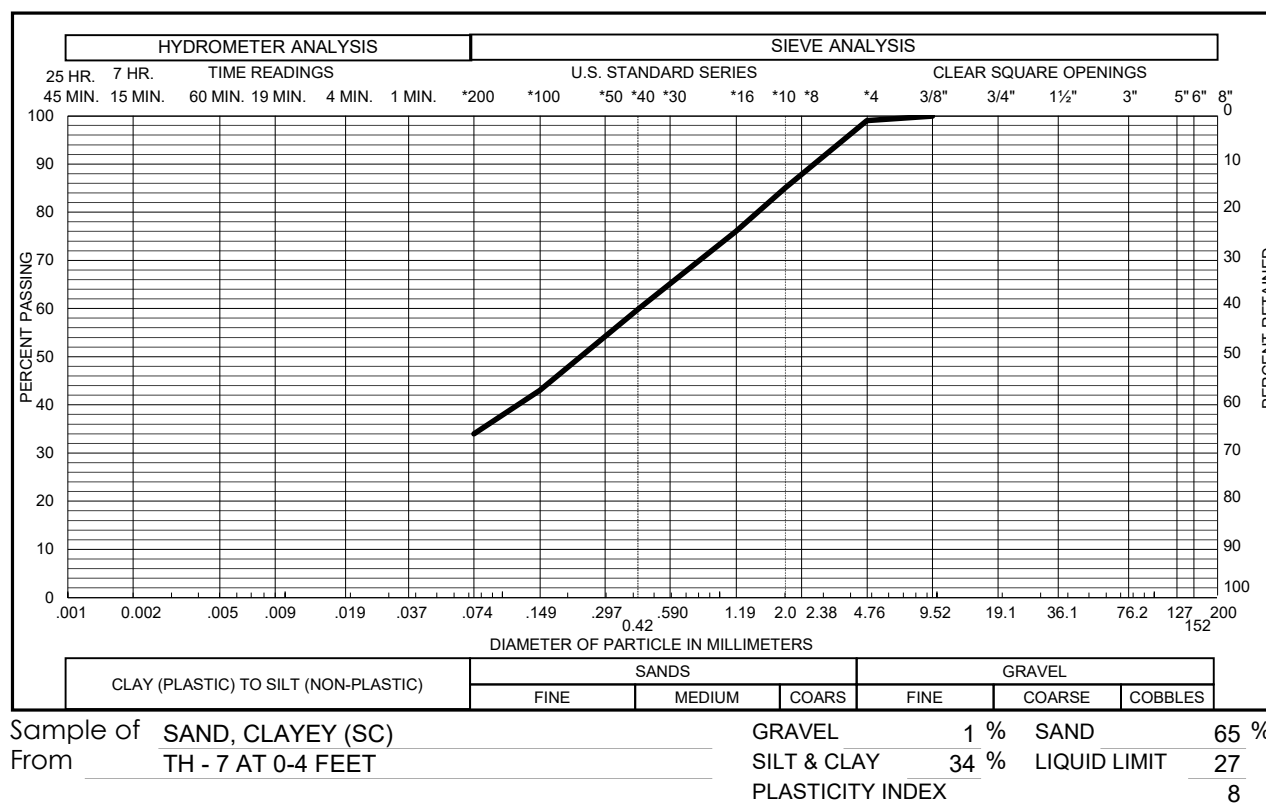
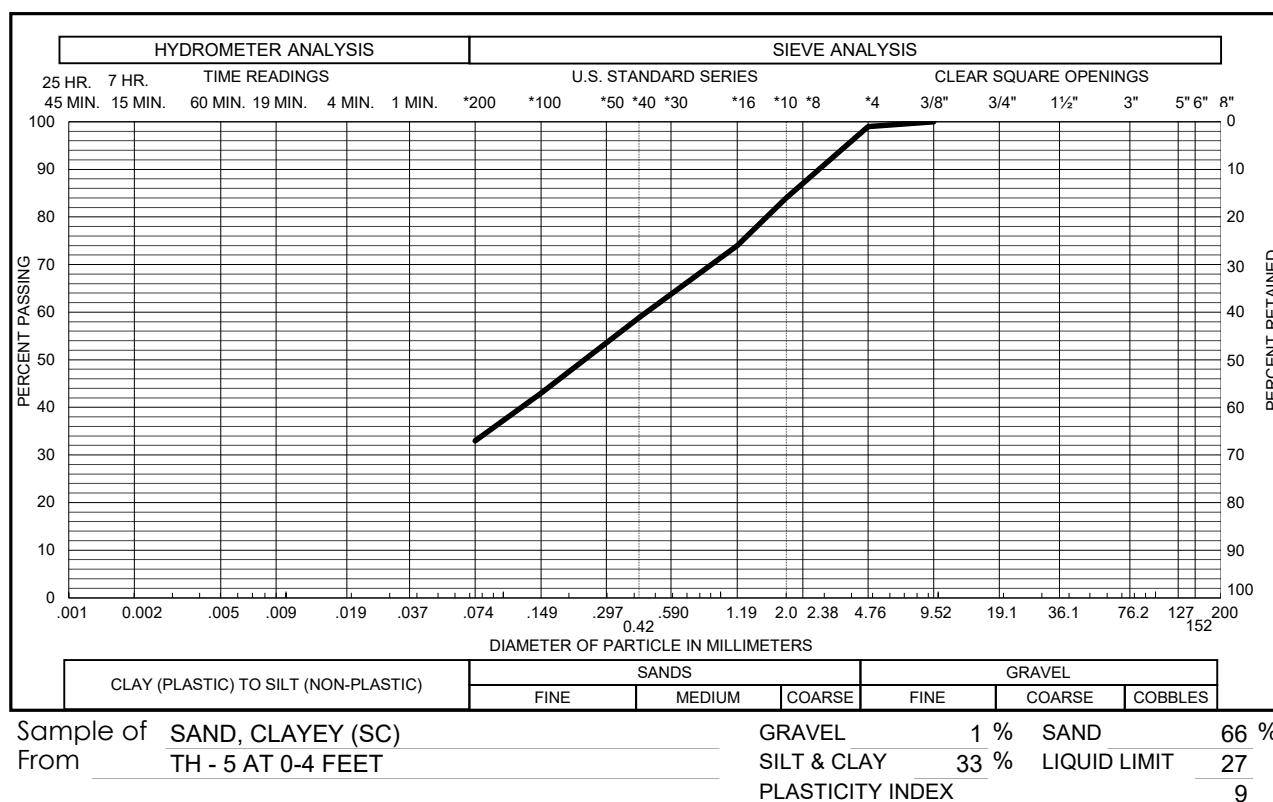
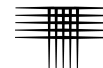
DRY UNIT WEIGHT= 118 PCF
MOISTURE CONTENT= 14.3 %

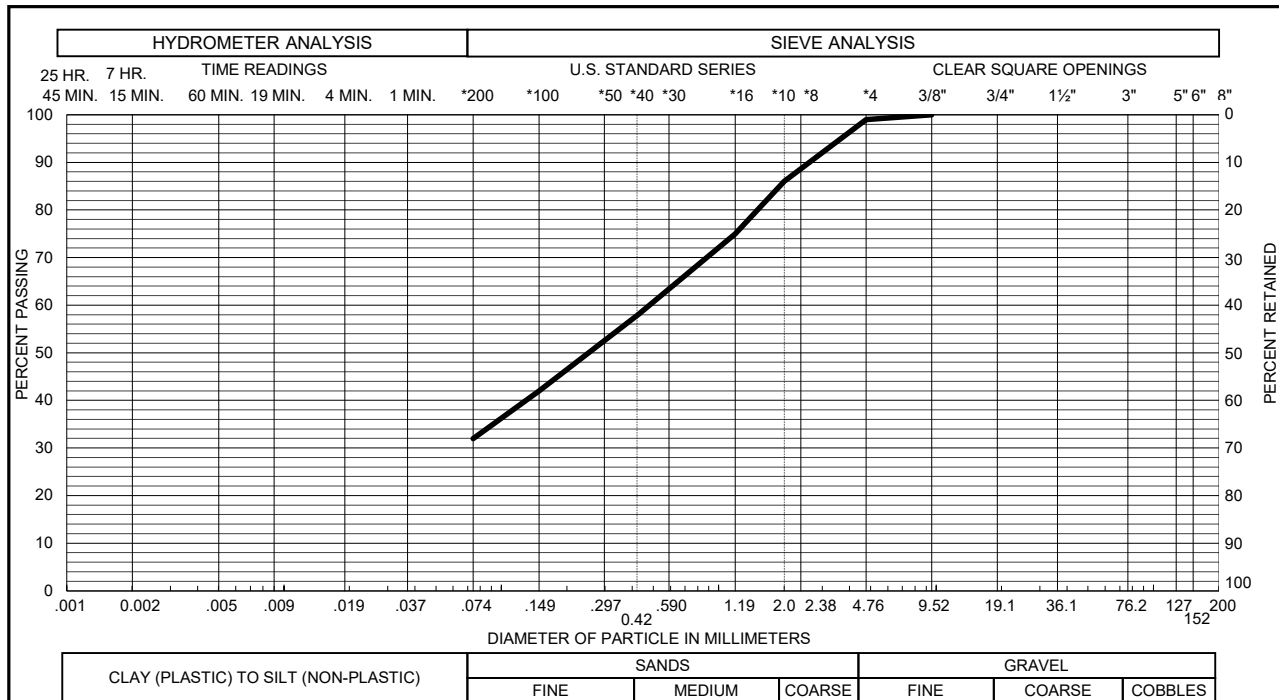
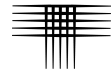


Sample of SANDSTONE, SILTY
From TH-5 AT 19 FEET

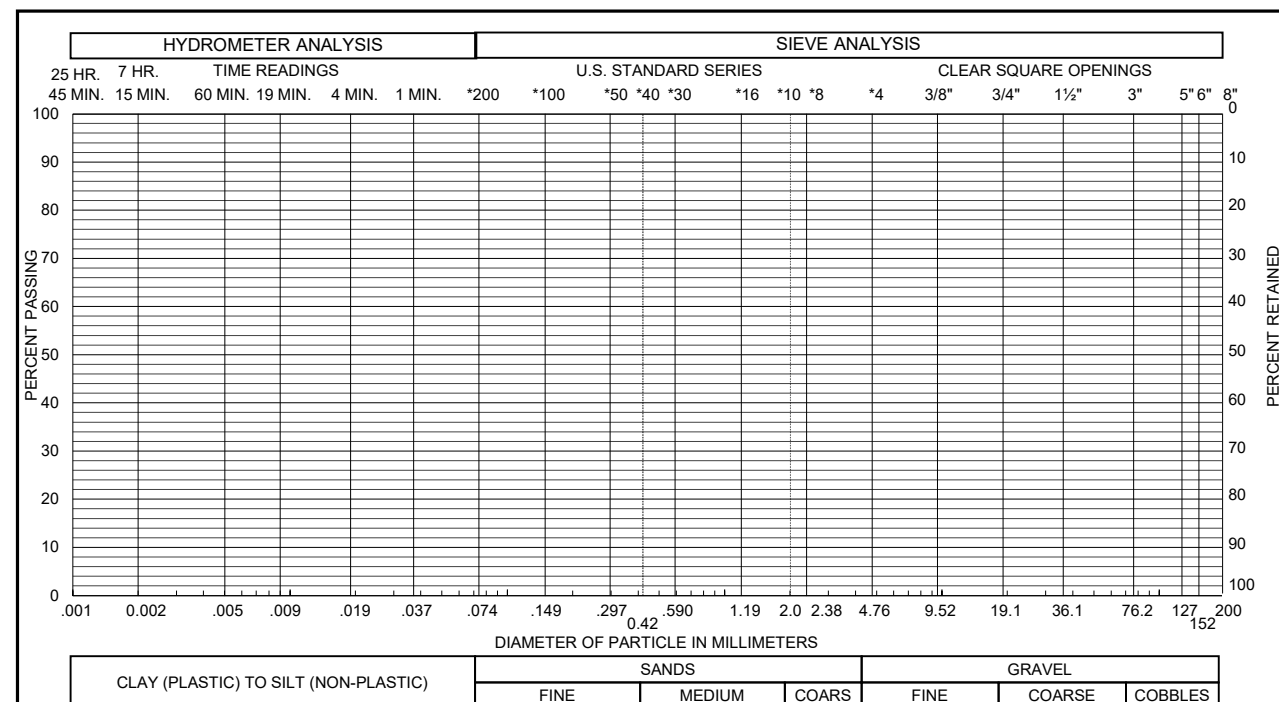
DRY UNIT WEIGHT= 114 PCF
MOISTURE CONTENT= 10.5 %







Sample of **SAND, CLAYEY (SC)** GRAVEL **1 %** SAND **67 %**
From **TH - 9 AT 0-4 FEET** SILT & CLAY **32 %** LIQUID LIMIT **26**
PLASTICITY INDEX **9**



Sample of _____ GRAVEL _____ % SAND _____ %
From _____ SILT & CLAY _____ % LIQUID LIMIT _____
PLASTICITY INDEX _____

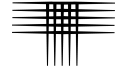
[illegible]

* SWELL MEASURED UNDER ESTIMATED IN-SITU OVERBURDEN PRESSURE.
NEGATIVE VALUE INDICATES COMPRESSION.



APPENDIX C

GUIDELINE SITE GRADING SPECIFICATIONS WATERSIDE TOWNHOMES COLORADO SPRINGS, COLORADO



GUIDELINE SITE GRADING SPECIFICATIONS WATERSIDE TOWNHOMES WOODMOOR, COLORADO

1. DESCRIPTION

This item consists of the excavation, transportation, placement and compaction of materials from locations indicated on the plans, or staked by the Engineer, as necessary to achieve preliminary pavement and building pad elevations. These specifications also apply to compaction of materials that may be placed outside of the project.

2. GENERAL

The Soils Engineer will be the Owner's representative. The Soils Engineer will approve fill materials, method of placement, moisture contents and percent compaction.

3. CLEARING JOB SITE

The Contractor shall remove all trees, brush and rubbish before excavation or fill placement is begun. The Contractor shall dispose of the cleared material to provide the Owner with a clean, neat appearing job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures of any kind.

4. SCARIFYING AREA TO BE FILLED

All topsoil, vegetable matter, and existing fill shall be removed from the ground surface upon which fill is to be placed. The surface shall then be plowed or scarified until the surface is free from ruts, hummocks or other uneven features that would prevent uniform compaction by the equipment to be used.

5. PLACEMENT OF FILL ON NATURAL SLOPES

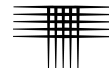
Where natural slopes are steeper than 20 percent (5:1, horizontal to vertical) and fill placement is required, horizontal benches shall be cut into the hillside. The benches shall be at least 12 feet wide or 1-1/2 times the width of the compaction equipment and be provided at a vertical spacing of not more than 5 feet (minimum of two benches). Larger bench widths may be required by the Engineer. Fill shall be placed on completed benches as outlined within this specification.

6. COMPACTING AREA TO BE FILLED

After the foundation for the fill has been cleared and scarified, it shall be disced or bladed until it is free from large clods, brought to a workable moisture content and compacted.

7. FILL MATERIALS

Fill soils shall be free from vegetable matter or other deleterious substances and shall not contain rocks or lumps having a diameter greater than six (6) inches. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer or imported to the site.



8. MOISTURE CONTENT

For fill material classifying as CH or CL, the fill shall be moisture treated to between 1 and 4 percent above optimum moisture content as determined by ASTM D 698, if it is to be placed within 15 feet of the final grade. For deep cohesive fill (greater than 15 feet below final grade), it shall be moisture conditioned to within ± 2 percent of optimum. Soils classifying as SM, SC, SW, SP, GP, GC and GM shall be moisture treated to within 2 percent of optimum moisture content as determined by ASTM D 1557. Sufficient laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered in borrow areas.

The Contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Soils Engineer, it is not possible to obtain uniform moisture content by adding water on the fill surface. The Contractor may be required to rake or disc the fill soils to provide uniform moisture content throughout the soils.

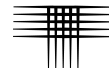
The application of water to embankment materials shall be made with any type of watering equipment approved by the Soils Engineer, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.

Should too much water be added to any part of the fill, such that the material is too wet to permit the desired compaction to be obtained, all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework wet material in an approved manner to hasten its drying.

9. COMPACTION OF FILL AREAS

Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density. Granular fill placed less than 15 feet below final grade shall be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D 1557. Cohesive fills placed less than 15 feet below final grade shall be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D 698. For deep, cohesive fill (to be placed 15 feet or deeper below final grade), the material shall be compacted to at least 98 percent of maximum standard Proctor dry density (ASTM D 698). Granular fill placed more than 15 feet below final grade shall be compacted to at least 95 percent of maximum modified Proctor dry density (ASTM D 1557). Deep fills shall be placed within 2 percent of optimum moisture content. Fill materials shall be placed such that the thickness of loose materials does not exceed 10 inches and the compacted lift thickness does not exceed 6 inches.

Compaction, as specified above, shall be obtained by the use of sheepfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment approved by the Soils Engineer for soils classifying as claystone, CL, CH or SC. Granular fill shall be com-



pacted using vibratory equipment or other equipment approved by the Soils Engineer. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area. Compaction equipment shall make sufficient trips to insure that the required density is obtained.

10 COMPACTION OF SLOPES

Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compaction operations shall be continued until slopes are stable, but not too dense for planting, and there is no appreciable amount of loose soil on the slopes. Compaction of slopes may be done progressively in increments of 3 to 5 feet in height or after the fill is brought to its total height. Permanent fill slopes shall not exceed 3:1 (horizontal to vertical).

11. DENSITY TESTS

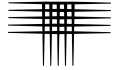
Field density tests will be made by the Soils Engineer at locations and depths of his/her choosing. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests will be taken in compacted material below the disturbed surface. When density tests indicate the density or moisture content of any layer of fill or portion thereof is below that required, the particular layer or portion shall be reworked until the required density or moisture content has been achieved. The criteria for acceptance of fill shall be:

A. Moisture

The allowable ranges for moisture content of the fill materials specified above in "Moisture Content" are based on design considerations. The moisture shall be controlled by the Contractor so that moisture content of the compacted earth fill, as determined by tests performed by the Soils Engineer, shall be within the limits given. The Soils Engineer will inform the Contractor when the placement moisture is less than or exceeds the limits specified above and the Contractor shall immediately make adjustments in procedures as necessary to maintain placement moisture content within the specified limits.

B. Density

1. The average dry density of all material shall not be less than the dry density specified.
2. No more than 20 percent of the material represented by the samples tested shall be at dry densities less than the dry density specified.
3. Material represented by samples tested having a dry density more than 2 percent below the specified dry density will be rejected. Such rejected materials shall be reworked until a dry density equal to or greater than the specified dry density is obtained.



12. SEASONAL LIMITS

No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Soils Engineer indicates the moisture content and density of previously placed materials are as specified.

13. NOTICE REGARDING START OF GRADING

The Contractor shall submit notification to the Soils Engineer and owner advising them of the start of grading operations at least three (3) days in advance of the starting date. Notification shall also be submitted at least three days in advance of any resumption dates when grading operations have been stopped for any reason other than adverse weather conditions.

14. REPORTING OF FIELD DENSITY TESTS

Density tests made by the Soils Engineer, as specified under "Density Tests" above, will be submitted progressively to the Owner. Dry density, moisture content and percent compaction will be reported for each test taken.