



**PRELIMINARY REPORT OF
GEOTECHNICAL EXPLORATION**

Proposed Maplewood Apartment Building
Maplewood, Minnesota

AET Project No. AET No. P-0013939

Date: September 6, 2022

Prepared for:

Enclave Development
300 23rd Avenue East
Suite 300
West Fargo, North Dakota 58078

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September 6, 2022

Enclave Development
300 23rd Avenue East, Suite 300
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Attn: Mr. Patrick Brama
Patrick.brama@enclavecompanies.com

RE: Preliminary Report of Geotechnical Exploration
Proposed Maplewood Apartment Building
3090 Southlawn Drive
Maplewood, Minnesota
AET Project No. P-0013939

Dear Mr. Brama:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for the Proposed Maplewood Apartment Building project in Maplewood, Minnesota. These services were performed according to our proposal dated June 3, 2022. We understand the project is currently in the preliminary design phase; therefore our findings and recommendations are also preliminary.

We are submitting an electronic pdf copy of this report to you. We can also provide you with hard copies of the report if needed.

Please contact me if you have any questions about the report. I can also be contacted for arranging construction observation and testing services during the construction phase.

Sincerely,
American Engineering Testing, Inc.

A handwritten signature in blue ink, appearing to read 'ASCHMID', is written over a light blue horizontal line.

Andrew T. Schmid, PE (MN, WI, ND, FL, GA)
Senior Engineer
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Preliminary Report of Geotechnical Exploration
Proposed Maplewood Apartment Building; Maplewood, Minnesota
September 6, 2022
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SIGNATURE PAGE

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Andrew T. Schmid, PE (MN, WI, ND, FL, GA)
Senior Engineer

Reviewed by:

A black ink signature of Mitchell G. Nelson, written in a cursive style.

Mitchell G. Nelson, PE (MN)
Staff Geotechnical Engineer

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under Minnesota Statute Section 326.02 to 326.15

Name: Andrew T. Schmid, PE

Date: 9/6/22 License #: 48982



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STANDARD SHEETS

Floor Slab Moisture/Vapor Protection
Basement/Retaining Wall Backfill and Water Control
Freezing Weather Effects on Building Construction

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APPENDIX A – Geotechnical Field Exploration and Testing

Boring Log Notes

Unified Soil Classification System

Figure 1 – Approximate Boring Locations

Subsurface Boring Logs

Gradation Curves

APPENDIX B – Geotechnical Report Limitations and Guidelines for Use



1.0 INTRODUCTION

It is our understanding that Enclave Development is planning to construct a new apartment building in Maplewood, Minnesota. To assist planning and design, you have authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services and provides our engineering recommendations based on this preliminary data. Once final plans are better established, we can review our data, but additional exploration might be required based on the site layout and design requirements. A final geotechnical report should be prepared once final design information and building loads are known.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal dated June 3, 2022, which was authorized on June 10, 2022. The authorized scope consists of the following:

- Drill ten (10) standard penetration test (SPT) borings to depths of about 10 to 35 feet below grade.
- Perform soil laboratory testing.
- Conduct a geotechnical engineering review based on the data and prepare this report.

These services are intended for geotechnical purposes. The scope to explore for the presence of environmental contamination was limited only to our field crew noting visual or olfactory evidence in the soil samples. A Phase 1 Environmental Site Assessment (ESA) report was also authorized via the project proposal; our environmental services team will deliver these services in a separate report.



3.0 PROJECT INFORMATION

3.1 Project Description

The Site is listed as the Myth night club and encompasses two occupied adjoining parcels located at the southeast corner of County Road D East and Southlawn Drive North in Maplewood, Ramsey County, Minnesota. We understand that you are planning the construction of a 4-story wood-framed apartment building with a possible below-grade parking level and paved surface parking lots. The two adjoining parcels are about 2.8-acres of paved parking, Parcel Identification Number (PID) 022922220016 (North Lot), and 2.1-acres of building and paved parking, PID 022922220017. We understand that the development is conceptual at this time and the exact location of the building and pavement areas are not known.

For preliminary purposes, we have assumed that the apartment building may have masonry or cast-in-place concrete foundations walls. There will likely be wood-frame construction above street level. Based on past similar projects, we have estimated maximum wall loads of approximately 15 to 20 kips per linear foot and maximum column loads of about 250 kips per column. Floor slab loads are estimated to be less than about 150 pounds per square foot (psf). These loads will need to be confirmed for the final report.

The above stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of drilling 10 standard penetration testing (SPT) borings. Enclave Development and the design team determined the number and locations of the borings, and AET proposed the depths. The logs of the borings/soundings and details of the methods used appear in Appendix A.



The boring logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

The approximate boring/sounding locations are shown on Figure 1 in Appendix A. The borings were located in the field by AET personnel by taping from nearby site features. AET field personnel recorded final boring locations using a field GPS unit with submeter accuracy. Ground surface elevations were recorded with a surveyor's elevation rod and level sight and correlated to existing elevations; the elevations are presented on the logs in Appendix A.

4.2 Laboratory Testing

Samples collected in the field were analyzed at the AET lab to provide a more detailed characterization of sample properties. The laboratory test program included testing for moisture content test on fine-grained soil samples. Laboratory review and characterization of soils samples also provided the Unified Soil Classification System (USCS) classification of materials encountered during site exploration. Additionally, organic content testing and grain-size analysis was performed to further characterize soil samples. The test results appear in Appendix A on the individual boring logs adjacent to the samples upon which they were performed.

5.0 SITE CONDITIONS

5.1 Surface Observations

The site is located at the southeast corner of County Road D East and Southlawn Drive in Maplewood, Minnesota. Most of the site of the planned building is currently used as an asphalt paved parking lot. An existing building occupied the southwest corner of the site. Ground surface elevations at the boring locations range from 924.7 feet at Boring B-3 to 927.5 feet at Boring B-1.



5.2 Subsurface Soils/Geology

The site geology consists primarily of variable thickness of fill underlain in many areas by swamp deposits which are in turn underlain by fine or coarse alluvium and glacial till. The composition of the fill varies considerably, but consists primarily of silty sand, clayey sand, sand with silt and sand with varying amount of gravel and ranging in color from black to brown. At some locations, organic fines, peat, cinders, brick, and wood were present within the fill. The swamp deposits consist of peat and organic clay. The fine alluvium consists of lean and fat clay, silt, and silty clay. The coarse alluvium consists of sand with silt, sand with gravel, silty sand, and sand. The till consists of clayey sand and sandy lean clay.

5.3 Groundwater

Groundwater measurements made in the borings at the time of drilling are presented on the attached boring logs and are summarized in Table A-1 in the report Appendix A.

Groundwater was measured at the borings at depths ranging from 7.6 to 13 feet at the time of drilling, corresponding to elevations between 917.1 to 912.9 feet. Where the primary soils encountered are slow draining materials, it takes an extended observation period to reliably establish the ground water level in the slower draining soils. Such an extended observation period is beyond the scope of this work. Where the predominate soils consisted of the relatively free draining coarse alluvial sands, the measured water levels should be representative of the water level at the time and location of drilling. At some locations, observations of samples retrieved indicate water may be present. Notations indicating the estimated depth of water based on sample observation are included on the boring logs. In soils such as those present at this site, it is likely perched water may at times be present within the interlayered soils or where sand lenses or laminations are present within the slower draining soils at variable depths.

Ground water levels fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors. The Twin Cities area has been in a low precipitation pattern for the last 2 years and the presently observed (or not observed) groundwater levels may be lower than normal



5.4 Review of Soil Properties

Based on the sample appearance and N-values, it appears most of the fill was not placed and compacted in a controlled manner. The fill is underlain by highly compressible swamp deposits at four of the ten boring locations. It is our judgment there is a significant risk of detrimental building settlement if the new construction is supported on the fill and/or swamp deposits. The fill in the area of the existing building may have been placed and compacted in a controlled manner. We understand that the existing structure has performed satisfactorily but is experiencing some settlement.

The swamp deposits are judged to be highly compressible materials. Significant total and differential settlement will likely occur where these materials are subjected to increased stresses due to building foundations, new fill placement, or underground utility construction. We estimate that most of the settlement will occur within about the first 3 months following the introduction of the increased stress (i.e., placement of fill). Based on soil conditions encountered at the borings, we estimate the settlement due to the weight of new fill required to establish planned finish grades could be up to several inches at the building and pavement areas, depending on actual building and traffic loads and anticipated fill volumes.

5.5 Frost Susceptibility

The primary near surface soils present at the site are moderately slow draining and are at least moderately frost susceptible. The coarse alluvial soils and the deeper portions of the in-place fills consisting of sand with gravel are relatively free draining and generally are not frost susceptible materials.

5.6 Permeability

Much of the on-site soils have low permeability. The silty and clayey sands have moderate to low permeability. The coarse alluvium soils, consisting of sand with varying amount of gravel have, higher permeability.

6.0 RECOMMENDATIONS

6.1 Discussion

No preliminary grading plans were available at the time of our analysis for this project. We anticipate the planned project grades will approximately follow existing site grades.

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Based on a review of the collected ground surface elevations, we estimate the finished project grade will be near an elevation of about 926 feet. We used this elevation as the basis for our recommendations. This will need to be confirmed for the final report.

The existing fill that is underlain by organic soils will continue to settle slowly over time due to secondary compression even if the site grades do not change. Increasing site grade elevations higher than current grades in areas where organic soils and soft soils exist will also cause settlement due to both primary compression and secondary compression.

The existing fill soils, buried organic soils, and soft soils are not suitable for foundation support. A conventional remove-and-replace soil correction would require dewatering and excavation depths as deep as 20 feet. The excavation would need to be completely dewatered to make sure that all organic and soft soils are removed and that the new fill is properly placed and compacted. In our opinion, the excavation depths required, the presence of shallow groundwater, and the proximity of the adjacent roadways would not make excavation and replacement a feasible option for this site. We assume that anticipated post construction settlements of the magnitudes discussed earlier are not acceptable for the planned construction. Therefore, special site preparation, construction techniques and foundation systems will be required.

For structural support of the planned apartment building, several soil correction and foundation system options have been considered by the project team. In summary, these consist of: (1) complete excavation of the existing fill and swamp deposits, followed by placement and compaction of new fill; (2) use of a deep foundation system such as driven piles for support of the floor and foundations; and (3) use of rammed aggregate/impact piers or rigid inclusion piles to support the foundations and the floor. Based on past site experience, the use of rammed aggregate/impact piers or rigid inclusion piles have been selected options. Based on prior discussion with the design team, it is our understanding that both rammed aggregate/impact piers or rigid inclusion piles are being considered. Should it be decided to consider another option please let us know and we can provide supplemental recommendations.



External structures, such as light poles and utilities, could be supported on helical piles or on rammed aggregate piers/impact piers or rigid inclusion piles. Because there are many different types of proprietary helical piles, with varying shaft diameters and helical configurations, we recommend that you contact the various helical pile contractors directly to determine estimated installation depths and helical configurations for their particular helical pile brand to support the design loads.

We are presenting recommendations for ground improvements of the existing fill and swamp deposits in the building area and leaving the existing fill (if not organic) in-place in pavement areas.

6.2 Building Grading

6.2.1 Excavation

The apartment building can be supported on spread footings, with an on-grade supported floor slab, after installing the rammed aggregate/impact piers or rigid inclusion piles. A local representative for rammed aggregate/impact piers or rigid inclusion piles should be contacted for design.

In order to install the rammed aggregate/impact piers or rigid inclusions, some site excavation and filling will be required. Depending on the time of year of construction, throughout the majority of the apartment building area, excavation could consist of removal of frozen soils. The existing subgrade soils are fine-grained and susceptible to freeze-thaw movements. We recommend replacing the upper 3 to 4 feet of the subgrade with non-frost susceptible sands to reduce the potential for floor slab distress.

Along the planned apartment building lines, existing pavement should be removed to promote easier installations or either system. The soil borings (Borings B-2, B-3, B-4, and B-7) indicate that swamp deposits are present beneath the fill. In areas where significant depths of fill will be required to establish planned finish elevations. Where the swamp deposits are present beneath the existing fill and grades are planned to be raised, excess consolidation of the swamp deposits may occur. The engineers at the local representative should design the ground improvement system to support the mass of the new fill system as well as the new apartment building construction.



The excavation recommendations are based on the soil condition at the specific boring locations. Since conditions will vary away from the boring location, it is recommended that AET geotechnical personnel observe and confirm the competency of the soils in the entire excavation bottom prior to new fill or footing placement.

6.2.2 Fill Placement and Compaction

Fill placed to attain grade for foundation support should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 98% of the standard maximum dry unit weight per ASTM: D698 (Standard Proctor test). Fill placed in floor slab areas can be compacted to a minimum compaction level of 95%. We recommend that fill be placed in lift thicknesses appropriate for the type of equipment used and the conditions at the time of the actual earthwork. The thickness should be such that the entire lift attains the minimum specified compaction level.

The fill should consist of a suitable inorganic granular soil consisting of sand (SP) or sand with silt (SP-SM). Most of the presently in-place fill at the borings in the building addition area will likely not be reusable within the compacted fill system due to the presence of organic fines and peat within the fill. We recommend the fill placed in foundation areas consist of sand (SP) and sand with silt (SP-SM).

If any excavation extends below the water level or if perched water which enters the excavation is encountered, the excavation should be dewatered during excavation and fill placement. If standing water or wet conditions exist in the bottoms of the excavations, we recommend the initial lifts of fill consist of free draining sands. These sands should have no more than 5% of the particles (by weight) finer than the #200 sieve and no more than 40% of the particles (by weight) finer than the #40 sieve.

If encountered, frozen soils should not be used within the compacted fill system and no fill should be placed upon frozen soils.

6.3 Rammed Aggregate/impact Pier Foundation Alternative

The structure can be supported on conventional spread foundations placed upon the compacted fill above the rammed aggregate/impact piers or upon in-place soils improved by the rammed aggregate/impact pier installation. We recommend perimeter foundations for heated building space be placed such that the bottom is a minimum of 42 inches below



exterior grade. We recommend foundations for unheated building space (such as canopy foundations) be extended to a minimum of 60 inches below exterior grade.

The specialty contractor will determine the allowable soil bearing pressure and settlement estimates depending on the system utilized, but we anticipate that the total settlements under loading should not exceed 1 inch. We also anticipate that differential settlements of conditions depicted by the borings should not exceed ½ inch. Based on the conditions encountered, our experience with rammed aggregate/impact piers, and the recommended fill compaction levels, we anticipate the building foundations will be designed based on a net maximum allowable soil bearing pressure of about 4,000 psf.

Rammed aggregate/impact piers (for example, “Geopiers”) may be a deep foundation (ground improvement) alternative, but because these are proprietary, we recommend that you contact the various design-build contractors directly that design and install them as to their viability at this site. There are three such design-build contractors in the Twin Cities area that design and install these types of foundations: Subsurface Constructors, Ground Improvement Engineering/Geopier, and Menard.

6.4 Rigid Inclusion Foundation Alternative

The rigid inclusion piles should be designed to transfer loads through the soft soils into underlying stiff or dense strata using high modulus concrete or grout columns. These are designed and installed by specialty geotechnical contractors, each with their own proprietary system. Rigid inclusion piles are vertical ground improvements constructed of drilled shafts of cement-sand grout using a soil displacement tool while drilling. Since rigid inclusion piles are installed using a displacement tool, they produce little or no spoils, because the cuttings are pushed back into the surrounding soils. They typically are designed to support a load transfer platform at the ground surface made of either compacted granular fill and geotextile fabric or a crushed aggregate base material, and the building or embankment is then supported on the load transfer platform.

This method also allows the structure to be supported on conventional spread foundations placed upon the compacted fill above the rigid inclusion piles or upon in-place soils improved by the rigid inclusion pile installation. Similar to other ground improvement methods, we recommend perimeter foundations for heated building space be placed such that the bottom is a minimum of 42 inches below exterior grade. We recommend



foundations for unheated building space (such as canopy foundations) be extended to a minimum of 60 inches below exterior grade.

The specialty rigid inclusion design contractor will determine the allowable soil bearing pressure and settlement estimates depending on the system utilized, but we anticipate that the total settlements under loading should not exceed 1 inch. We also anticipate that differential settlements of conditions depicted by the borings should not exceed ½ inch. Based on the conditions encountered, our experience with rigid inclusion, and the recommended fill compaction levels, we anticipate the building foundations will be designed based on a net maximum allowable soil bearing pressure of about 4,000 psf.

Because ridged inclusion pile systems are proprietary, we recommend that you contact the design-build contractors directly to discuss their viability at this site. Many specialty design-build firms that install ground improvement systems will also design and install rigid inclusion pile systems.

6.5 Floor Slab Design

The floor slab can be supported on rammed aggregate/impact piers or rigid inclusion piles if either option is selected. A slab supported over the existing fill and buried organic soils without ground improvement or foundation support is an option if the owner can accept an increased risk of settlement.

The existing fill soils would remain in place for both the rammed aggregate/impact piers or rigid inclusion piles. These soils are frost susceptible and would experience heave in the winter and loss of strength upon thawing. This could cause distress to the floor slab. We recommend that the surficial organic soil and existing fill be removed to a depth of 4 feet below the floor slab aggregate base and be replaced with non-frost susceptible (NFS) sand, classified as (SP) as a sand subbase. The sand should contain no more than 5% (by weight) passing the No. 200 sieve and no more than 40% (by weight) passing the No. 40 sieve. The sand should be drained to a stormwater system with draitile. The fill should be placed and compacted in thin lifts (12" thick or less) to at least 95% of the standard Proctor maximum dry density (ASTM: D698).



We recommend that a floor slab aggregate base of at least 5 inches in thickness be placed. This should consist of “trimmable” granular soils such as crushed limestone or crushed recycled concrete material meeting a MnDOT Class 5 gradation. Sand with a low percentage of fines should not be used as the aggregate base as this type of sand ruts easily under construction traffic. A rutted aggregate base can contribute to additional floor cracking as the floor slab cannot move uniformly when it shrinks. A vapor retarder should be placed directly under the floor slab where there are moisture sensitive floor coverings/coatings.

6.6 Exterior Entry Slabs and Appurtenant Structures

We anticipate that exterior entry slabs and sidewalks will be affected by both settlement of the underlying organic soils and could also be affected by frost heave. If these types of items are to abut the building and settlement would be a concern or problem, we recommend that the slabs and sidewalks be constructed as structural slabs, supported on rammed aggregate/impact piers, rigid inclusion piles, or helical piles. There should be a minimum air gap of 4 inches between the top of the subgrade and the bottom of the slabs.

As an alternative, provided some movement can be tolerated where slabs and sidewalks abut the building, to mitigate frost effects we recommend constructing a subgrade of non-frost susceptible (NFS) sand. The purpose of this is to reduce the potential for the characteristic heave that occurs when clayey or silty soils freeze in the winter. This heave can raise the slabs, causing jamming of doorways and possible damage to the building. The NFS sand should be a select granular soil with less than 5% passing the No. 200 sieve and less than 50% passing the No. 40 sieve. It should be placed at least 4 feet thick under the slab and at least 2 feet beyond the outside edges of the slab to minimize abrupt differential movement. This fill should be compacted to at least 95% of the maximum Standard Proctor dry density. Dependent on the soil encountered in these areas, drainpipes could be required at the base of the NFS sand, connected to the storm sewer, to remove infiltrating water.



For the slabs and sidewalks supported on grade, the design should also incorporate the potential for settlement of the soils surrounding the building. This can be performed by various details, including hinged slabs at entry points that connect to the building and are allowed to rotate with the “free-end” abutting the adjacent sidewalks or pavement areas. In this manner abrupt differential settlements can be reduced.

6.7 Exterior Underground Utilities

In our opinion, the non-settlement sensitive utilities can be supported (floated) in the existing surface fill soils. The connections of utilities to the building, which would be supported on either rammed aggregate/impact piers or rigid inclusion piles supported foundations, should be flexible to allow for some movement. Any new fill from site grading and also the existing fill will cause the underlying buried organic soils to continue to settle, which could damage utilities. This could also affect the flow of the sanitary sewer system. There should be enough elevation change in the sanitary sewer to account for some differential settlements, if the utilities will not have either rammed aggregate/impact pier or rigid inclusion pile foundations or helical pile support.

Consideration can be given to supporting utilities on rammed aggregate/impact pier or rigid inclusion pile foundations, or alternatively helical piles, if movement of utilities is not desired. However, in our experience, supporting utilities on pile foundations can create “hard spots” within pavement areas. The pavement will be supported over the organic and soft soils, with continued settlement anticipated while the pile-supported utilities are not expected to settle causing elevation differences in these areas. If possible, pile-supported utilities should be routed through a landscape area where future grading and leveling can be performed. We recommend that AET be contacted once the design is finalized for review of the utilities.

6.8 Pavements

Based on our understanding of the project, the proposed finish surface of the expanded pavement areas should be at or near existing grade. At the boring locations, the generalized soil profile consists of fill overlying compressible swamp deposits. Based on the conditions encountered, we estimate that total settlements due to the weight of compacted fill soils, aggregate base and bituminous could be up to several inches, again assuming that minimal additional fill is required to attain finished grade. We understand that some underground utilities would be present within the area of the expanded

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pavements. No information regarding the types of utilities or proposed depths are available. If these utilities were installed within or above the compressible swamp deposits, settlement of the existing utilities may also occur.

Our preferred recommendation for the pavement construction is to remove the existing fill and compressible swamp deposits and place new compacted fill to establish finish grades. The excavation and fill placement should be performed following the recommendations in Section 6.2 of this report.. Dewatering of the excavation during the earthwork would be required. Use of imported clean sand fill for at least lower portions of the fill placement would be required. Completion of the excavation and filling will require extensive earthwork and may not be feasible.

If the project owner is willing to accept a reduced level of pavement performance, alternative pavement construction procedures are feasible. If some settlement of the pavement is acceptable, the pavement could be constructed over the existing fill. If this alternative is selected, we recommend the surface vegetation be removed from the planned pavement areas. In addition, about 2 feet of the presently in-place fill should be removed. The excavation should extend 2 feet beyond the edge of pavements. A layer of geotextile fabric should then be placed over the bottom of the subcut excavation, suitable fill soils should then be placed upon the fabric to the base of the aggregate base (Class 5). To help further reduce possible settlements, a second layer of geotextile fabric could then be placed over the suitable fill followed by the base and bituminous sections.

The excavation, fill placement, and roadway thickness design should be performed according to the recommendations presented in Section 6.2. However, due to the magnitudes of anticipated settlements we do recommend that if this procedure is used, placement of the storm sewer, concrete curb and gutter, and bituminous should be delayed as long as possible (for about 6 months to 1 year if possible) following placement of the fill. Even with this delay, post construction settlement of up to a few inches should be expected. In addition, since the settlement will likely be differential, the settlement may result in poor surface drainage of the bituminous surface.

We recommend the upper portion of the pavement construction consist of a minimum of



5 inches of bituminous surfacing placed over at least 10 inches of 100% crushed limestone Class 5 aggregate base. For at least 10 inches between the Class 5 base and the surface of the suitable fill soils, we recommend a layer of Select Granular Borrow.

Depending on the option chosen, the bituminous pavement sections given above could have an estimated life of 20 years. However, the owner should not expect that the pavements would last 20 years without maintenance. Within one to three years after construction, cracks can appear in the bituminous mat due to thermal expansion and contraction, and due to the loss of volatiles from the bituminous cement. These cracks cannot be avoided; they should be cleaned annually and filled with a hot bituminous sealant. Within three to five years after construction, cracks and depressions may appear in heavily traveled areas. Such areas should be cut out and repaired expeditiously to extend the pavement life. Periodically during the pavement life, it may be necessary to apply a seal coat of hot bituminous and rock chips.

We anticipate that the pavements on this site will settle differentially with time, which will affect the surface drainage and runoff. Further, ridges or humps may develop in the pavements over the rammed aggregate/impaction piers, rigid inclusion piles, or helical pile-supported utility lines. Significant differential settlement may also occur where pavements abut pile-supported sidewalks and the buildings; these areas will likely require periodic filling or overlays.

6.9 Stormwater Management

The primary soil type at the location of the proposed stormwater feature, Boring B-10, is clayey sand with varying amount of gravel. Based on the Minnesota Storm Water Manual (MSWM) produced by the Minnesota Pollution Control Agency (MPCA), the infiltration rates for clayey sands are estimated to be 0.06 inches per hour.

More site-specific representative rates may be determined by performing in-situ testing via the Double-Ring Infiltrometer (DRI) method or Modified Phillip-Dunne (MPD) Infiltrometer method, if desired. This testing, if performed, should be conducted at or just below the bottom elevations of the proposed infiltration structures/devices. This testing should be used to document that the infiltration rates used by the design engineer are comparable with the in-place soils.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 *Water in Excavations*

Excavations at this site, for example for utility construction, could likely encounter groundwater. Water can also be expected to collect in excavation bottoms during times of inclement weather or snow melt. To facilitate construction operations, we recommend water be removed from within the excavation during construction. The selection and installation of the dewatering system, however, is solely the responsibility of the contractor. The type of system to use will be dependent in part on the prevailing groundwater conditions at the time of construction.

7.1.2 *Disturbance of Soils*

The on-site soils can become disturbed under construction traffic, especially if the soils are wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils. The subcut soils can then be dried and recompacted back into place, or they should be removed and replaced with drier imported fill.

7.1.3 *Cobbles, Boulders, and Debris Fill*

The soils at this site can include cobbles and boulders and possible debris in the existing fills. This may make excavating procedures somewhat more difficult than normal if they are encountered.

7.1.4 *Winter Construction*

If construction occurs during the winter, it is necessary for the contractor to protect the base soils from freezing each day and each night before new fill is placed. Fill should not be placed over frozen soils, snow, or ice, nor should the use of frozen fill soils be permitted. The contractor must protect base soils from freezing before and after fill placement, and before, during, and after concrete placement.



7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or running which could require slope maintenance.

7.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Because the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by AET geotechnical personnel during construction to evaluate the effect of these potential changes.

We recommend the soils in excavation bottoms be observed by an AET geotechnical engineer immediately prior to placing fill or forming for footings. Soil density testing should also be performed on fill placed at the site to document that our recommendations and the specifications for compaction and moisture have been satisfied. Where fill material type is important, laboratory sieve analyses should be performed to document that the actual fill meets the recommended gradation criteria. The building materials should also be tested in accordance with the project specifications and the building codes.

The rammed aggregate/impact pier or rigid inclusion pile installation operations should be conducted under the observation of a geotechnical engineer or technician. This observation is conducted to reduce the potential for short pile element installations and excessive aggregate lift thicknesses. Full-time observations may reduce risk and help confirm that the rammed aggregate or /impact pier or rigid inclusion pile elements are installed in general accordance with their intended design.

8.0 ASTM STANDARDS

When we refer to an ASTM Standard in this report, we mean that our services were performed in general accordance with that standard. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.



9.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either express or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled “Geotechnical Report Limitations and Guidelines for Use”.

Preliminary Report of Geotechnical Exploration
Proposed Maplewood Apartment Building; Maplewood, Minnesota
September 6, 2022
AET Project No. P-0013939



Standard Sheets

Floor Slab Moisture/Vapor Protection
Basement/Retaining Wall Backfill and Water Control
Freezing Weather Effects on Building Construction

FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-04, a “base material” is recommended over the vapor membrane, rather than the conventional clean “sand cushion” material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-04 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draitile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a “slip surface”, thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer’s system warranty.

The vapor membrane should be placed below the granular layer when:

- Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draitile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

BASEMENT/RETAINING WALL BACKFILL AND WATER CONTROL

DRAINAGE

Below grade basements should include a perimeter backfill drainage system on the exterior side of the wall. The exception may be where basements lie within free draining sands where water will not perch in the backfill. Drainage systems should consist of perforated or slotted PVC drainage pipes located at the bottom of the backfill trench, lower than the interior floor grade. The drain pipe should be surrounded by properly graded filter rock. A geosynthetic “filter fabric” should then envelope the filter rock. The drain pipe should be connected to a suitable means of disposal, such as a sump basket or a gravity outfall. A storm sewer gravity outfall would be preferred over exterior daylighting, as the latter may freeze during winter. For non-building, exterior retaining walls, weep holes at the base of the wall can be substituted for a drain pipe.

BACKFILLING

Prior to backfilling, damp/water proofing should be applied on perimeter basement walls. The backfill materials placed against basement walls will exert lateral loadings. To reduce this loading by allowing for drainage, we recommend using free-draining sands for backfill. The zone of sand backfill should extend outward from the wall at least 2 feet, and then upward and outward from the wall at a 30° or greater angle from vertical. The free-draining sand backfill should contain no more than 40% by weight passing the #40 sieve and no greater than 5% by weight passing the #200 sieve. The sand backfill should be placed in lifts and compacted with portable compaction equipment. This compaction should be to the specified levels if slabs or pavements are placed above. Where slab/pavements are not above, we recommend capping the sand backfill with a layer of clayey soil to minimize surface water infiltration. Positive surface drainage away from the building should also be maintained. If surface capping or positive surface drainage cannot be maintained, then the trench should be filled with more permeable soils, such as the Fine Filter or Coarse Filter Aggregates defined in MnDOT Specification 3149. You should recognize that if the backfill soils are not properly compacted, settlements may occur which may affect surface drainage away from the building.

Backfilling with silty or clayey soil is possible but not preferred. These soils can build-up water which increases lateral pressures and results in wet wall conditions and possible water infiltration into the basement. If you elect to place silty or clayey soils as backfill, we recommend you place a prefabricated drainage composite against the wall which is hydraulically connected to a drainage pipe at the base of the backfill trench. High plasticity clays should be avoided as backfill due to their swelling potential.

LATERAL PRESSURES

Lateral earth pressures on below grade walls vary, depending on backfill soil classification, backfill compaction and slope of the backfill surface. Static or dynamic surcharge loads near the wall will also increase lateral wall pressure. For design, we recommend the following ultimate lateral earth pressure values (given in equivalent fluid pressure values) for a drained soil compacted to 95% of the Standard Proctor density and a level ground surface.

Soil Type	Equivalent Fluid Density	
	Active (pcf)	At-Rest (pcf)
Sands (SP or SP-SM)	35	60
Silty Sands (SM)	45	65
Fine Grained Soils (SC, CL or ML)	70	90

Basement walls are normally restrained at the top which restricts movement. In this case, the design lateral pressures should be the “at-rest” pressure situation. Retaining walls which are free to rotate or deflect should be designed using the active case. Lateral earth pressures will be significantly higher than that shown if the backfill soils are not drained and become saturated.

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 40% by weight passing a #40 sieve and no more than 5% by weight passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded polystyrene insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence, or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.



Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Approximate Boring Locations Diagram
Subsurface Boring Logs
Gradation Curves

Appendix A
Geotechnical Field Exploration and Testing
Report No. P-0013939

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling 10 standard penetration test (SPT) borings throughout the site. The approximate locations of the borings and soundings appear on appended Figure 1.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

The most recent drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

Appendix A
Geotechnical Field Exploration and Testing
Report No. P-0013939

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- ♦ Date and Time of measurement
- ♦ Sampled Depth: lowest depth of soil sampling at the time of measurement
- ♦ Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- ♦ Cave-in Depth: depth at which measuring tape stops in the borehole
- ♦ Water Level: depth in the borehole where free water is encountered
- ♦ Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.5.2 Sieve Analysis of Soils (thru #200 Sieve)

Conducted per AET Procedure 01-LAB-040, which is performed in general conformance with ASTM: D6913, Method A.

A.5.3 Particle Size Analysis of Soils (with hydrometer)

Conducted per AET Procedure 01-LAB-050, which is performed in general accordance with ASTM: D422 and AASHTO: T88.

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
B,H,N:	Size of flush-joint casing
CA:	Crew Assistant (initials)
CAS:	Pipe casing, number indicates nominal diameter in inches
CC:	Crew Chief (initials)
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RD:	Rotary drilling with fluid and roller or drag bit
REC:	In split-spoon (see notes) and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
REV:	Revert drilling fluid
SS:	Standard split-spoon sampler (steel; 1-3/8" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and 140-pound hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
▽:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q _p :	Pocket Penetrometer strength, tsf (<u>approximate</u>)
q _c :	Static cone bearing pressure, tsf
q _u :	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remoulded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES

The standard penetration test consists of driving the sampler with a 140 pound hammer and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM:D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM:D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

**AMERICAN
ENGINEERING
TESTING, INC.**

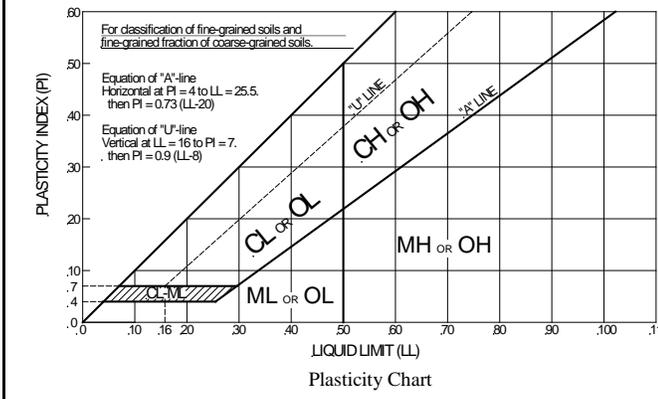
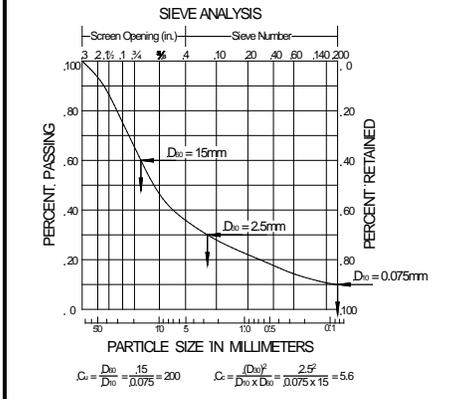


Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines ^C	$Cu \geq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

Notes
^ABased on the material passing the 3-in (75-mm) sieve.
^BIf field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
^CGravels with 5 to 12% fines require dual symbols:
 GW-GM well-graded gravel with silt
 GW-GC well-graded gravel with clay
 GP-GM poorly graded gravel with silt
 GP-GC poorly graded gravel with clay
^DSands with 5 to 12% fines require dual symbols:
 SW-SM well-graded sand with silt
 SW-SC well-graded sand with clay
 SP-SM poorly graded sand with silt
 SP-SC poorly graded sand with clay

$$C_u = D_{60}/D_{10}, \quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^FIf soil contains $\geq 15\%$ sand, add "with sand" to group name.
^GIf fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
^HIf fines are organic, add "with organic fines" to group name.
^IIf soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
^JIf Atterberg limits plot is hatched area, soil is a CL-ML silty clay.
^KIf soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.
^LIf soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.
^MIf soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.
^N $PI \geq 4$ and plots on or above "A" line.
^O $PI < 4$ or plots below "A" line.
^P PI plots on or above "A" line.
^Q PI plots below "A" line.
^RFiber Content description shown below.



ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Term	Grain Size	Term	Gravel Percentages	Term	Consistency of Plastic Soils	Term	Relative Density of Non-Plastic Soils
	Particle Size		Percent		N-Value, BPF		N-Value, BPF
Boulders	Over 12"	A Little Gravel	3% - 14%	Very Soft	less than 2	Very Loose	0 - 4
Cobbles	3" to 12"	With Gravel	15% - 29%	Soft	2 - 4	Loose	5 - 10
Gravel	#4 sieve to 3"	Gravelly	30% - 50%	Firm	5 - 8	Medium Dense	11 - 30
Sand	#200 to #4 sieve			Stiff	9 - 15	Dense	31 - 50
Fines (silt & clay)	Pass #200 sieve			Very Stiff	16 - 30	Very Dense	Greater than 50
	<u>Moisture/Frost Condition</u> (MC Column)		<u>Layering Notes</u>		<u>Peat Description</u>		<u>Organic Description (if no lab tests)</u>
D (Dry):	Absence of moisture, dusty, dry to touch.	Laminations:	Layers less than 1/2" thick of differing material or color.	Term	Fiber Content (Visual Estimate)		Soils are described as <i>organic</i> , if soil is not peat and is judged to have sufficient organic fines content to influence the Liquid Limit properties. <i>Slightly organic</i> used for borderline cases.
M (Moist):	Damp, although free water not visible. Soil may still have a high water content (over "optimum").	Lenses:	Pockets or layers greater than 1/2" thick of differing material or color.	Fibric Peat:	Greater than 67%	With roots:	Judged to have sufficient quantity of roots to influence the soil properties.
W (Wet/Waterbearing):	Free water visible, intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.			Hemic Peat:	33 - 67%	Trace roots:	Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.
F (Frozen):	Soil frozen			Sapric Peat:	Less than 33%		



Satellite imagery: Google Earth



PROJECT: Proposed Apartment Building
3090 Southlawn Drive; Maplewood, Minnesota

AET NO.:
P-0013939

SUBJECT:
Final SPT Soil Boring Locations

DATE:
July 18, 2022

SCALE:
As Shown

PREPARED BY
MN

FIGURE 1



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-1 (p. 1 of 1)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>927.5</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS							
							WC	DEN	LL	PL	%-#200			
1	4.5" Bituminous pavement	FILL			SU									
2	FILL, mostly clayey sand and silty sand, some gravel, trace roots, dark brown		22	M	SS	17	10							
3			13	M	SS	10	10							
4														
5	FILL, mixture of silty sand and clayey sand with organic fines, a little gravel, trace wood, dark brown to black	COARSE ALLUVIUM	5	M	SS	7	17							
6														
7	SAND, a little gravel, fine grained, brown, moist, medium dense (SP)		16	M	SS	8								6
8														
9														
10														
11														
12	SILTY SAND, a little gravel, fine to medium grained, wet, medium dense (SM)													
13			20	W	SS	3								
14														
15	SAND, a little gravel, fine to medium grained, brown, waterbearing, medium dense (SP)	TILL	15	W/M	SS	16	14							
16	CLAYEY SAND, a little gravel, brown, stiff to very stiff (SC)													
17														
18														
19														
20			18	M	SS	18	13							
21														
22														
23														
24														
25			28	M	SS	4	13							
26	END OF BORING													

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-24½'	3.25" HSA	7/8/22	12:30	16.5	14.5	15.3		14.0	
		7/8/22	12:50	16.5	14.5	14.0		12.8	
BORING COMPLETED: 7/8/22		7/8/22	1:15	26.5	24.5	25.1		24.0	
DR: DS LG: SB Rig: 1C									



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-2 (p. 1 of 2)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>926.3</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS							
							WC	DEN	LL	PL	%-#200			
1	3.5" Bituminous pavement	FILL			SU									
2	FILL, mostly silty sand with gravel, and crushed limestone, dark brown		24	M	SS	15	11							
3	FILL, mixture of silty sand and clayey sand with organic fines with gravel, a little concrete and brick, trace cinders, dark brown to black		16	M	SS	19	13							
4	FILL, mostly clayey sand, a little gravel, dark brown to reddish brown, concrete at 2' to 4'		17	M	SS	22	15							
7	SILTY SAND, a little gravel, fine grained, gray, moist, medium dense, lamination of clayey sand with organic fines (SM) (possible fill)	COARSE ALLUVIUM OR FILL	18	M	SS	19								
10	SAPRIC PEAT WITH SAND, black (PT)	SWAMP DEPOSIT	3	▼	SS	17	32							
12	SAND WITH SILT, a little gravel, fine grained, gray, wet, loose (SP-SM)	COARSE ALLUVIUM TILL	8	W/M	SS	18	15							
13	CLAYEY SAND, a little gravel, gray to reddish brown, firm to stiff (SC)		10	W/M	SS	22	13							
20	CLAYEY SAND, a little gravel, brown, hard (SC/SM) (A-2-6)		50	W/M	SS	17	10							
23	SAND, a little gravel, medium to fine grained, brown, waterbearing, medium dense (SP) (A-1-b)	COARSE ALLUVIUM	16	W	SS	23								

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-34½'	3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/8/22	2:30	16.5	14.5	16.0		15.9	
		7/11/22	7:59	16.5	14.5	14.3		11.3	
BORING COMPLETED: 7/8/22									
DR: DS LG: SB Rig: 1C									



SUBSURFACE BORING LOG

AET No: P-0013939

Log of Boring No. B-2 (p. 2 of 2)

Project: Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS								
							WC	DEN	LL	PL	%-#200				
29	SAND, a little gravel, medium to fine grained, brown, waterbearing, medium dense (SP) (A-1-b) <i>(continued)</i>	COARSE ALLUVIUM <i>(continued)</i>	16	W/M	SS	17									
30															
31	SILTY SAND, a little gravel, brownish gray, medium dense (SM) (A-2-4)	TILL	17	M/W	SS	22									
32															
33															
34															
35	END OF BORING														
36															

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-3 (p. 1 of 1)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>924.7</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
1	4" Bituminous pavement	FILL	9	M	SU	4					
2	FILL, mostly silty sand with crushed limestone, light to dark brown				SU		17				
3	FILL, mostly clayey sand with organic fines, a little gravel, black to dark brown, cinders at 2' to 4'			10	M	SS	14	10			
4											
5											
6				8	M	SS	15	14			
7											
8	FILL, mostly silty sand, a little gravel, trace roots, dark brown		57	M	SS	4					
9											
10	SILTY SAND, a little gravel, fine grained, gray, wet, medium dense (SM)	COARSE ALLUVIUM	29	M	SS	20					
11											
12	SAPRIC PEAT, black (PT)	SWAMP DEPOSIT									
13			4	M	SS	20	218	18			
14	ORGANIC SANDY LEAN CLAY, black, soft, laminations of sand (OL)										
15	CLAYEY SAND WITH ORGANIC FINES, a little gravel, black, very soft (SC)										
16	SILTY CLAY, trace roots, gray, soft, laminations of silt (CLM)	FINE ALLUVIUM	2	W/M	SS	24	16	29			
17											
18	SAND, a little gravel, fine to medium grained, gray, waterbearing, loose, laminations of silty sand (SP)	COARSE ALLUVIUM	11	W	SS	17					
19											
20			9	W	SS	6					
21											
22											
23											
24											
25	SAND, fine to medium grained, gray, waterbearing, medium dense, laminations of silt (SP)		23	W	SS	19					
26	END OF BORING										

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-24½'	3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/8/22	10:00	16.5	14.5	16.0		12.5	
		7/8/22	10:30	16.5	14.5	14.4		10.1	
BORING COMPLETED: 7/8/22		7/8/22	11:00	26.0	24.5	20.5		7.6	
DR: DS LG: SB Rig: 1C									



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-4 (p. 1 of 1)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>925.4</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS								
							WC	DEN	LL	PL	%-#200				
0	4" Bituminous pavement	FILL			SU										
1	FILL, mostly sand with gravel, and crushed limestone, light brown		35	M	SS	9									
2	FILL, mostly clayey sand with organic fines, a little gravel, dark brown to black														
3			19	M	SS	20	12								
4															
5			11	M	SS	10	11								
6															
7			16	M	SS	6	10								
8															
9															
10	SILTY SAND, a little gravel, trace roots, fine grained, gray, moist, dense (SM)	COARSE ALLUVIUM	35	M	SS	15									15
11															
12	SAPRIC PEAT, black (PT)	SWAMP DEPOSIT													
13	SILTY SAND WITH ORGANIC FINES, a little gravel, fine grained, dark brown, wet, loose, lamination of lean clay (SM)		9	M	SS	16	49								
14															
15	SILT, a little gravel, gray, very loose, lamination of lean clay (ML)	FINE ALLUVIUM													
16	SILTY SAND, a little gravel, fine grained, wet, very loose (SM)	COARSE ALLUVIUM	54	W/M	SS	14	31								
17															
18															
19															
20	CLAYEY SAND, a little gravel, dark brown, very stiff (SC)		19	M	SS	18									
21															
22															
23															
24															
25	SAND WITH SILT, a little gravel, coarse to medium grained, wet, loose, lamination of clayey sand (SP-SM)		7	W	SS	20									
26	END OF BORING														

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-24½'	3.25" HSA								
		7/7/22	1:40	16.5	14.5	14.3		13.3	
		7/7/22	2:15	26.5	24.5	20.5		14.4	
BORING COMPLETED: 7/8/22		7/8/22	8:00	26.5	24.5	19.4		11.6	
DR: DS LG: SB Rig: 1C									



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-5 (p. 1 of 2)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>925.9</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS								
							WC	DEN	LL	PL	%-#200				
1	3" Bituminous pavement	FILL													
2	FILL, mostly silty sand with crushed limestone, dark to light brown, a little brick		30	M	SS	15									
3	FILL, mostly clayey sand, a little gravel, dark brown, 8.5' bituminous		18	M	SS	19	12								
4															
5															
6															
7															
8			22	M	SS	17	11								
9															
10	FILL, mostly sandy lean clay, a little organic lean clay, a little concrete and cinders, dark brown to black		39	M	SS	12	16								
11															
12	CLAYEY SAND, a little gravel, trace roots, brown, soft to firm, lamination of silty sand from 14.5' to 15' (SC)	TILL	3	M	SS	24	17								
13															
14															
15															
16			6	M/W	SS	22	11 20								
17															
18	CLAYEY SAND, a little gravel, brown, stiff, lens of silt, lamination of lean clay (SC)		13	M/W	SS	23	12								
19	SILTY SAND, a little gravel, fine to medium grained, brown, wet, medium dense, lens of clayey sand (SM)	COARSE ALLUVIUM													
20															
21	CLAYEY SAND, a little gravel, brown, stiff, lamination of sand (SC)	TILL	14	M/W	SS	20	11								
22															
23															
24	SAND, a little gravel, medium to fine grained, brown, wet, medium dense, lenses of clayey sand (SP)	COARSE ALLUVIUM													
25															
26															
27			18	W	SS	24									

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH: DRILLING METHOD		WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-24½'	3.25" HSA								
24½'-34½'	RD w/DM	7/12/22	9:14	14.0	12.0	13.7		None	
		7/12/22	9:23	14.0	12.0	13.3		13.0	
BORING COMPLETED: 7/12/22									
DR: SD LG: AG Rig: 91C									



SUBSURFACE BORING LOG

AET No: P-0013939

Log of Boring No. B-5 (p. 2 of 2)

Project: Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS					
							WC	DEN	LL	PL	%-#200	
29	SANDY LEAN CLAY, a little gravel, brown, hard (CL)	TILL	42	M/W	SS	24	13					
30												
31	CLAYEY SAND, a little gravel, brown, hard (SC)		32	M/W	SS	24	14					
32												
33	END OF BORING											
34												
35												
36												

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-6 (p. 1 of 1)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>925.4</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS								
							WC	DEN	LL	PL	%-#200				
1	3.5" Bituminous pavement	FILL			[Symbol]										
2	FILL, mixture of clayey sand with organic fines and silty sand with crushed limestone, dark brown to light brown		16	M	[Symbol]	SS	9	11							
3	FILL, mostly clayey sand, a little gravel, dark brown		19	M	[Symbol]	SS	19	10							
4					[Symbol]										
5				15	M	[Symbol]	SS	17	17						
6						[Symbol]									
7	FILL, mostly clayey sand with organic fines and gravel, dark brown to black, 9.5' to 11.5' trace wood and cinders		24	M	[Symbol]	SS	11	13							
8			4	▼	[Symbol]	SS	10	15							
9					[Symbol]										
10					[Symbol]										
11					[Symbol]										
12	CLAYEY SAND, some gravel, dark brown to brown (SC) (possible fill)	TILL OR FILL	6	W/M	[Symbol]	SS	13	22							
13					[Symbol]										
14					[Symbol]										
15	CLAYEY SAND, a little gravel, brown, firm, lenses of silt (SC)	TILL	8	M	[Symbol]	SS	19	15							
16	END OF BORING														

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-14½'	3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/12/22	2:14	14.0	12.0	14.0		12.5	
		7/12/22	2:27	14.0	12.0	13.6		10.8	
BORING COMPLETED: 7/12/22		7/12/22	2:45	16.5	14.5	16.0		13.0	
DR: DS	LG: SG	Rig: 1C							



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-7 (p. 1 of 1)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>926.4</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS							
							WC	DEN	LL	PL	%-#200			
1	4" Bituminous pavement	FILL												
2	FILL, mostly silty sand with crushed limestone, light brown													
3	FILL, mixture of clayey sand and silty sand, a little gravel, dark brown		32	M	SS	20	12							
4														
5	FILL, mostly clayey sand, a little gravel, brown, organics at 5' - 6'		13	M	SS	24	12							
6														
7														
8				25	M	SS	24	11						
9														
10	FILL, mostly clayey sand, a little gravel, trace cinders and roots, grayish brown		14	M	SS	24	14							
11														
12														
13	SANDY LEAN CLAY, a little gravel, some organics, grayish brown, soft (CL) (possible fill)	FINE ALLUVIUM OR FILL	4	M/W	SS	20	3							
14														
15	SAPRIC PEAT, black, laminations of silty sand with organic fines (PT)	SWAMP DEPOSIT	5	M/W	SS	24	26							
16														
17	FAT CLAY, gray, very soft, laminations of silt (CH)	FINE ALLUVIUM	WH	M/W	SS	19	49							
18														
19														
20	SAND, a little gravel, fine to medium grained, dark gray, waterbearing, loose (SP)	COARSE ALLUVIUM	8	W	SS	7								
21														
22														
23	SAND WITH SILT, fine to medium grained, dark gray, waterbearing, dense, lenses of clayey sand (SP-SM)													
24														
25														
26	SAND, a little gravel, fine to medium grained, dark gray, waterbearing, dense (SP)		38	M/W	SS	17								
	END OF BORING													

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH: DRILLING METHOD		WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
DEPTH	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-24½'	3.25" HSA	7/12/22	12:56	14.0	12.0	12.0		11.8	
		7/12/22	1:09	14.0	12.0	12.0		11.7	
BORING COMPLETED: 7/12/22									
DR: SD LG: AG Rig: 91C									



SUBSURFACE BORING LOG

AET No: P-0013939

Log of Boring No. B-8 (p. 2 of 2)

Project: Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS						
							WC	DEN	LL	PL	%-#200		
29	SAND WITH SILT, medium to fine grained, grayish brown, very loose, laminations of silt with sand (SP-SM) <i>(continued)</i>	COARSE ALLUVIUM <i>(continued)</i>	4	W	SS	24							
30													
31													
32													
33	SILT WITH SAND, grayish brown, wet, medium dense (ML)	FINE ALLUVIUM	18	W	SS	17	21						
34													
35													
36													
END OF BORING													

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22



SUBSURFACE BORING LOG

AET No: **P-0013939**

Log of Boring No. **B-9 (p. 1 of 1)**

Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>926.8</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS								
							WC	DEN	LL	PL	%-#200				
1	3.5" Bituminous pavement	FILL													
2	FILL, mixture of silty sand and clayey sand with gravel, brown to dark brown		13	M	SS	15	12								
3			16	M	SS	17	10								
4															
5	FILL, mixture of clayey sand and silty sand, a little gravel, dark brown	COARSE ALLUVIUM	11	M	SS	16	11								
6															
7	SAND WITH SILT, a little gravel, fine to medium grained, brown, moist to waterbearing, loose to medium dense (SP-SM)		10	M	SS	11									
8															
9			15	M	SS	16									4
10															
11															
12															
13			11	W	SS	17									
14															
15	SAND, a little gravel, fine to medium grained, grayish brown, waterbearing, medium dense (SP)		22	W	SS	8									
16															
17															
18	CLAYEY SAND, a little gravel, brown, hard (SC)	TILL													
19															
20			14	M	SS	18	13								
21															
22															
23															
24															
25			34	M	SS	0									
26	END OF BORING														

AET_CORP_P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-24½'	3.25" HSA								
		7/11/22	10:39	14.0	12.0	12.4		11.7	
		7/11/22	11:15	14.0	12.0	12.1		11.4	
BORING COMPLETED: 7/11/22		7/11/22	11:43	26.0	24.5	24.2		20.2	
DR: DS LG: SG Rig: 1C									



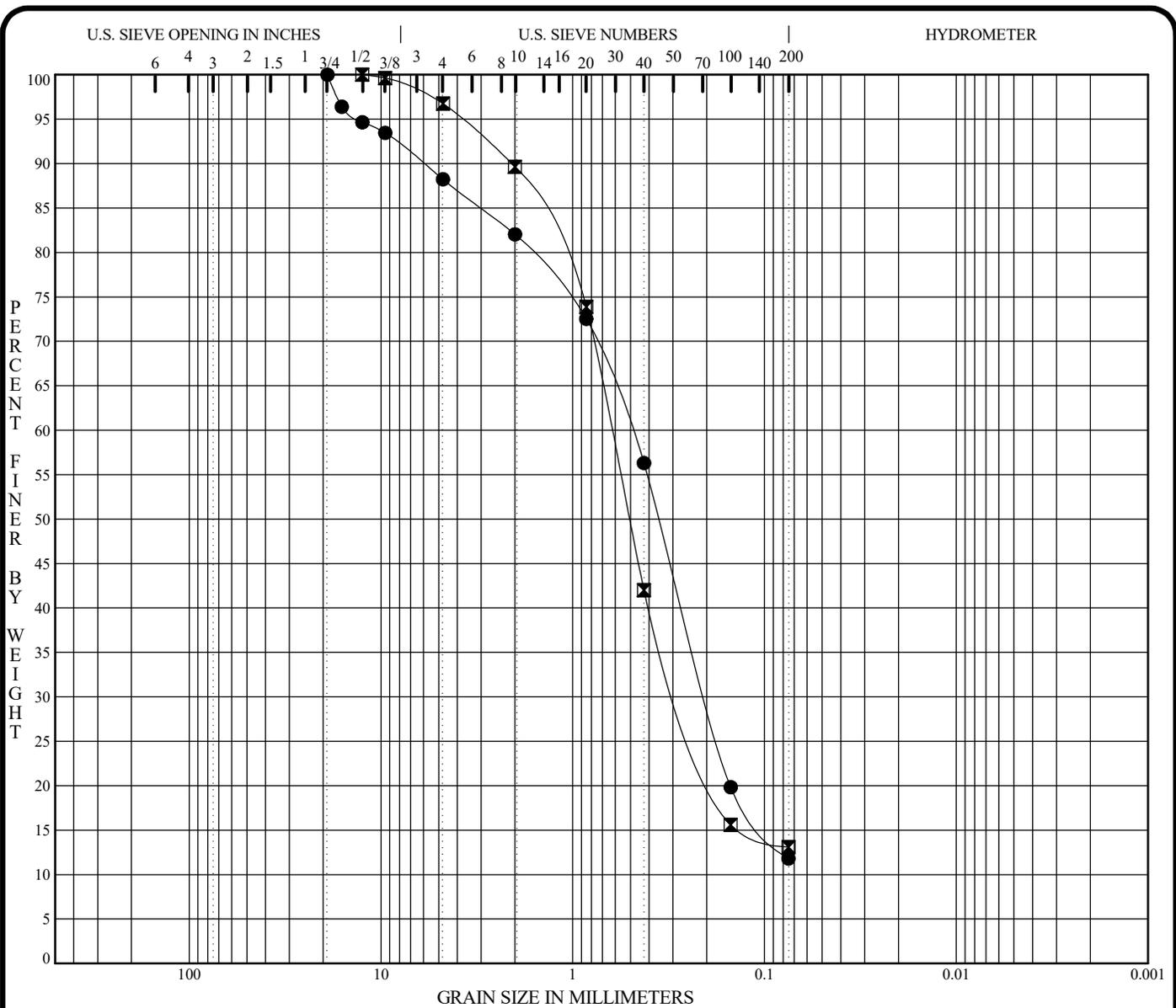
SUBSURFACE BORING LOG

AET No: **P-0013939** Log of Boring No. **B-10 (p. 1 of 1)**
 Project: **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN**

DEPTH IN FEET	Surface Elevation <u>926.5</u> MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS							
							WC	DEN	LL	PL	%-#200			
1	3.5" Bituminous pavement	FILL												
2	FILL, mostly clayey sand, a little gravel and cinders, gray to brown		15	M	SS	10	9							
3			14	M	SS	21	9							
4														
5														
6	CLAYEY SAND, a little gravel, grayish brown, very stiff, lamination of silt (SC)	TILL	16	M	SS	21	11 9							
7														
8	SAND WITH SILT, fine grained, gray, moist, medium dense to dense, lamination of clayey sand (SW/SM)		49	M	SS	23								12
9														
10														
11			17	W/M	SS	19								
END OF BORING														

AET_CORP P-0013939.GPJ AET+CPT+WELL.GDT 7/26/22

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-9½'	3.25" HSA	7/12/22	1:13	11.5	9.5	11.0		None	
		7/12/22	1:27	11.5	9.5	11.0		None	
BORING COMPLETED: 7/12/22									
DR: DS LG: SG Rig: 1C									



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● B-10 7.0'	WELL-GRADED SAND with SILT (SW/SM)					1.26	7.8
⊠ B-8 7.0'	SILTY SAND (SM)						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-10 7.0'	19.00	0.50	0.201		11.8	76.4	11.8	
⊠ B-8 7.0'	12.50	0.63	0.265		3.3	83.7	13.1	

PROJECT **Proposed Maplewood Apartment Building; 3090 Southlawn Drive; Maplewood, MN** AET JOB NO. **P-0013939**
 DATE **7/12/22**

GRADATION CURVES

Preliminary Report of Geotechnical Exploration
Proposed Maplewood Apartment Building; Maplewood, Minnesota
September 6, 2022
AET Project No. P-0013939



Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Report No. P-0013939

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by GBA¹, of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Understand the Geotechnical Engineering Services Provided for this Report

Geotechnical engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical engineering services is typically a geotechnical engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

B.2.2 Geotechnical Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client.

Likewise, geotechnical engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

¹ Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockville, MD 20850
Telephone: 301/565-2733; www.geoprofessional.org

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Geotechnical Report Limitations and Guidelines for Use

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B.2.3 Read the Full Report

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. Read and refer to the report in full.

B.2.4 You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, always inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

B.2.5 Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

B.2.6 This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

B.2.7 This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

B.2.8 Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you've included the material

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for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to and be sure to allow enough time to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

B.2.9 Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.10 Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical engineering study. For that reason, a geotechnical engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

B.2.11 Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.