

Water Withdrawal Permit Application

version 1.1

(Submission #: HQD-2R69-MXPGX, version 1)

Digitally signed by:
MiEnviro Portal
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Reason: Submission Data
Location: State of Michigan

Details

Submission ID HQD-2R69-MXPGX

Form Input

Applicant Information

Applicant Information:

First Name **Last Name**

Alex Summers

Organization/Company Name

Sorensen Gross Company

Phone Type **Number** **Extension**

Mobile

Email

Address

111 E COURT ST STE 1-S

FLINT, MI 48502-1649

Is the primary contact different than the applicant?

No

Are there additional property owners or other contacts you would like to add to the application?

No

Location of Proposed Water Withdrawal

Water Source Type (choose one):

Groundwater

Description of Project Boundary (if applicable):

Site for the new EQ basin located next to existing pump station just south of the grand river.

Water Withdrawal Location:

42.75413,-84.5656

1625 SUNSET AVE, LANSING, MI

Site Address:

[NO STREET ADDRESS SPECIFIED]

[NO CITY SPECIFIED], [NO STATE SPECIFIED][NO ZIP CODE SPECIFIED]

County

Ingham

Project Name (if applicable)

Lansing ave Pump station -Equalization Basin

Are there additional withdrawal locations?
No

Proposed Water Withdrawal Details

Total Maximum Pump Capacity (Million Gallons per Day):
2.40

Maximum Withdrawal per Month:

Month:	Maximum Withdrawal (Millions of Gallons):
January	2.00
February	2.00
March	0.00
April	0.00
May	0.00
June	0.00
July	2.00
August	4.00
September	2.00
October	2.00
November	2.00
December	2.00
	Sum: 18.00

Primary Purpose of Use:
Dewatering construction site

Proposed Return Flow Discharge Information

Name of Discharge Location:
into the grand river

Receiving Water Type (choose one):
Groundwater

Discharge Location:
42.75413,-84.5656

Return Flow Discharge

Provide the amount of water discharged after its use for the proposed withdrawal's purpose. Choose either the amount in millions of gallons per day, or as a percentage of the original withdrawal to be discharged.

Return Flow Discharge Amount

Type of Discharge Amount	Total (Number Only):	Unit
Percentage	100	Percentage of Proposed Withdrawal

Are there additional discharge locations?
No

Evaluation of Existing Hydrological and Hydrogeological Conditions

Evaluation of Existing Conditions Upload:
Pages from LAPS EQ - IFB Specs - For Constructionpdf.pdf - 06/03/2025 01:37 PM
Comment
Attached is the Geotechnical report that was received at the time of the bid

Private Property Conflict Contingency Plan

Private Property Conflict Contingency Plan Upload

Lansing EQ PPCCP.pdf - 06/06/2025 11:21 AM

Comment

NONE PROVIDED

Environmentally Sound and Economically Feasible Water Conservation Measures

Water conservation measures are available online at:

<https://www.michigan.gov/egle/about/organization/water-resources/water-use/water-conservation-measures>

Water Conservation Measures Upload

Lansing WCM.pdf - 06/06/2025 11:21 AM

Comment

NONE PROVIDED

I certify that I will be in compliance with the water conservation measures described above.

Yes

Decision-Making Standard of the Great Lakes ♦ St. Lawrence River Basin Water Resources Compact

Describe how all water withdrawn shall be returned, either naturally or after use, to the source watershed less an allowance for consumptive use.

The water will be returned entirely to the neighboring river after passing through a sediment filter bag that will be placed in a stone washout area with a riprap trough leading down the bank of the river. This will be done to minimize adverse effects on the riverbank and unnecessary sediment deposited into the river.

Describe how the withdrawal will be implemented so as to ensure it will not result in significant individual or cumulative adverse impacts to the quantity or quality of the waters and water dependent natural resources of the source watershed and the Great Lakes.

We will limit our dewatering activities to only the amount of time needed for construction as well as returning 100% of the water back to the the adjacent river.

Describe how the withdrawal will be implemented so as to incorporate Environmentally Sound and Economically Feasible Water Conservation Measures.

We are dewatering to the minimal depth needed for construction purposes and for the shortest amount of time possible to achieve completion or the project.

Describe how the withdrawal or consumptive use will be implemented so as to ensure that it is in compliance with all applicable municipal, State and federal laws as well as regional interstate and international agreements, including the Boundary Waters Treaty of 1909.

We are dewatering the most minimal area and depth as possible to complete construction activities, while ensuring that 100% of the water is returned back through our discharge. we are doing everything to provide the most minimal impact on the surrounding geography as possible.

Describe how the proposed use is reasonable under common law principles of water law in Michigan, based upon a consideration of whether the proposed withdrawal is planned in a fashion that provides for efficient use of the water, and will avoid or minimize the waste of water.

The dewatering measures being implemented are only to aid in the construction of a new EQ basin. Based on all available information, we are only dewatering the area on the construction site that should not affect neighboring properties (well depth is only 20ft). The actions of the withdrawal are not intended to use the water, and it is being discharged in its entirety back into the adjacent river.

Describe how the proposed use is reasonable under common law principles of water law in Michigan, based upon a consideration of if the proposal is for an increased withdrawal, whether efficient use is made of existing water supplies.

This question does not seem applicable to our dewatering as we are not using the water or increasing a withdrawal.

Describe how the proposed use is reasonable under common law principles of water law in Michigan, based upon a consideration of the balance between economic development, social development and environmental protection of the proposed withdrawal and use and other existing or planned withdrawals and water uses sharing the water source.

The dewatering measures being implemented are only to aid in the construction of a new EQ basin. Based on all available information, we are only dewatering the area on the construction site that should not affect neighboring properties (well depth is only 20ft). The actions of the withdrawal are not intended to use the water, and it is being discharged in its entirety back into the adjacent river.

Describe how the proposed use is reasonable under common law principles of water law in Michigan, based upon a consideration of the supply potential of the water source, considering quantity, quality, and reliability and safe yield of hydrologically interconnected water sources.

This withdrawal is of minimal depth(20ft) in a concentrated area focused on infiltrating groundwater for a construction project. The length of this withdrawal is only for the necessary duration of the activity, with all groundwater being returned to the neighboring river.

Describe how the proposed use is reasonable under common law principles of water law in Michigan, based upon a consideration of the probable degree and duration of any adverse resource impacts caused or expected to be caused by the proposed withdrawal under foreseeable conditions, to other lawful consumptive or non-consumptive uses of water or to the quantity or quality of the waters and water dependent natural resources of the Basin, and the proposed plans and arrangements for avoidance or mitigation of such impacts.

This withdrawal is of minimal depth(20ft) in a concentrated area focused on infiltrating groundwater for a construction project. The length of this withdrawal is only for the necessary duration of the activity, with all groundwater being returned to the neighboring river. Due to this, the shallow wells, the impact of the dewatering would be minimal if any.

Describe how the proposed use is reasonable under common law principles of water law in Michigan, based upon a consideration as to the need for the proposal to include restoration of hydrologic conditions and functions of the source watershed.

Due to the short duration, shallow wells, and the fact that 100% of the water is being returned, the assumed likelihood of hydrological restoration should not be needed, the system is only intended in design to affect our minimal area based upon soil reports and conditions.

Cooling Water Intake Structure

Does this facility hold a permit issued under Part 31 for a cooling water intake structure?

No

Application Fee

Amount Due:

\$2,000

Private Property Conflict Contingency Plan

In the event that Sorensen Gross's dewatering activities on the property at 1701 Lansing Ave. Lansing, Mi 48917 is the direct cause of a water well issue with a neighboring property. Our plan will be as follows:

- We will first investigate the issue to determine if the root cause is from our activities
- If the root cause is determined to be directly related to the dewatering wells placed onsite, corrective action will be taken.

This plan will be in place during the duration of the dewatering of the site for construction purposes, and we will do our best to monitor any adverse impacts during that time.

Water Conservation Measures

Sorensen Gross will strive to maintain the lowest amount of water withdrawn needed to keep the construction activities on our site at 1701 Lansing Ave. Lansing, MI 48917. We plan to have 13 dewatering wells around the perimeter of our excavation down to a depth of 20 ft. The water will be pumped out to a discharge site that is constructed to minimize any adverse impact on the geological landscape of the riverbank and to discharge the groundwater into the neighboring river (Grand River). We will continually monitor the discharge site and flow and make any adjustments and improvements needed during the duration of dewatering activities.



GEOTECHNICAL EVALUATION REPORT

LANSING AVENUE PUMP STATION EQUALIZATION BASIN
1711 LANSING AVENUE
LANSING, MICHIGAN

SME Project Number: 094161.00
May 28, 2024





2663 Eaton Rapids Road
Lansing, MI 48911-6310

T (517) 887-9181

www.sme-usa.com

May 28, 2024

Mr. Jeff Brown, PE
Senior Vice President
Fishbeck
5913 Executive Drive, Suite 100
Lansing, Michigan 48911

Via Email: jjbrown@fishbeck.com

RE: Geotechnical Evaluation
Lansing Avenue Pump Station Equalization Basin
1711 Lansing Avenue
Lansing, Michigan
SME Project No. 094161.00

Dear Mr. Brown:

We have completed the geotechnical evaluation for the subject project. This report presents the results of our observations and analyses, and our geotechnical engineering recommendations based on the information disclosed by the borings.

We appreciate the opportunity to be of service. If you have questions or require additional information, please contact me.

Very truly yours,

SME

Bradford L. Ewart, PE
Project Manager / Senior Consultant

Enclosure: SME Geotechnical Evaluation Report; Dated May 28, 2024

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APPENDIX A

- BORING LOCATION DIAGRAM (FIGURE NO. 1)
- BORING LOG TERMINOLOGY
- BORING LOGS (B1 THROUGH B5)

APPENDIX B

- IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT
- GENERAL COMMENTS
- LABORATORY TESTING PROCEDURES

1. INTRODUCTION

This report presents the results of the geotechnical evaluation performed by SME for the Lansing Avenue Pump Station Equalization Basin project in Lansing, Michigan. We performed this evaluation in general accordance with the scope of services outlined in SME Proposal No. P03216.23, dated August 24, 2023. Fishbeck authorized our services for this evaluation.

To assist with our evaluation and preparation of this report, SME reviewed a site plan drawing titled “Lansing Ave PS Equalization Basin – Figure No. 9 – Clean Water State Revolving Fund (CWSRF) Project Plan” prepared by Fishbeck (latest revision date of March 7, 2023), that included a layout of the existing site features, the proposed equalization basin footprint, and associated proposed utilities.

1.1 SITE CONDITIONS AND PROJECT DESCRIPTION

The project site is located at the dead end of Lansing Avenue and east of Roseneath Avenue on the north side of Lansing, Michigan. The site address is 1711 Lansing Avenue. The site currently consists of existing pump station buildings, paved parking areas, chain link fencing, grass covered areas, and the Grand River along the north side of the property. The approximate location of the site is depicted on the Location Map inset on the Boring Location Diagram (Figure No.1) included in Appendix A.

Existing ground surface within the proposed development area, based on the recorded boring locations, varies from an elevation of 818 feet to 825 feet. Based on information available online from the United States Geological Survey, the water level of the Grand River was at approximate elevation 809 to 810 feet (NAV 1988 datum) at the time of drilling.

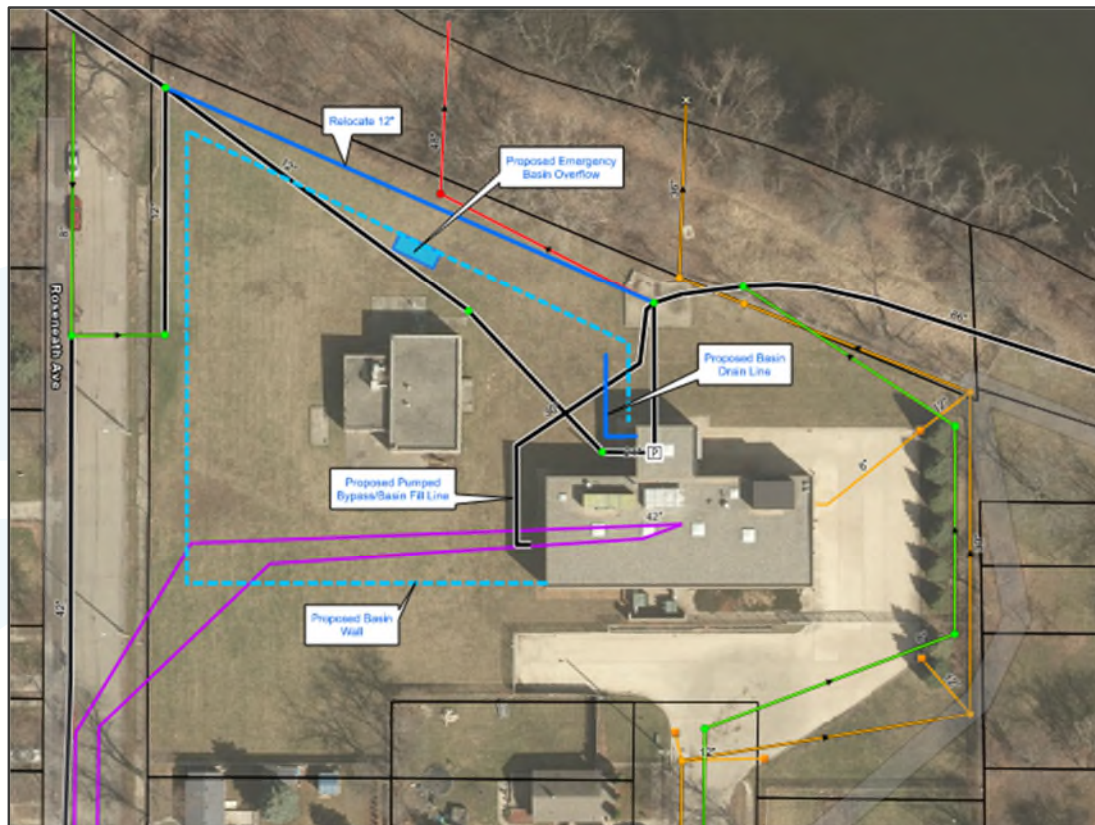


IMAGE 1: Proposed Project Site

We understand the project will consist of a 5-million-gallon equalization (EQ) basin consisting of cast-in-place concrete walls that will extend partially below-grade. The proposed footprint is depicted in the dashed, light-blue line in Image 1 above. The southern portion of the basin will be constructed into the slope and will bear about 8 to 10 feet below grade (at approximate elevation 815 feet). The northern portion of the basin will bear at frost depth or deeper. Based on the proposed capacity and footprint, we estimate a potential soil contact pressure at the base of the basin of about 1,500 pounds per square foot (psf). Based on the referenced meeting, we anticipate the basin will have a mat foundation unless soil conditions warrant an alternative foundation design.

2. EVALUATION PROCEDURES

2.1 FIELD EXPLORATION

SME completed five borings (B1 through B5) at the site on between April 24 and April 26, 2024. The boring depths ranged from 40 to 50 feet below the existing ground surface.

SME and Fishbeck jointly determined the planned number and locations of the borings. SME determined the planned depths of the borings. SME staked the boring locations and obtained the existing ground surface elevation at the boring locations using our Leica GPS unit with sub-foot accuracy.

The borings were drilled using a rotary drill rig and were advanced using continuous-flight augers. The borings included soil sampling based upon the Split-Barrel Sampling procedure. The N_{60} -values reported on the boring logs represent the Standard Penetration Test (SPT) resistances, normalized for drill rig hammer efficiency, which is also reported on the boring logs. Portions of recovered split-barrel samples were sealed in glass jars by the driller.

Groundwater level measurements in the boreholes were recorded during and immediately after completion of each boring. The driller backfilled the boreholes with the auger cuttings at completion of drilling. Therefore, long-term groundwater levels were not obtained from the borings.

Soil samples recovered from the field exploration were returned to the SME laboratory for further observation and testing.

2.2 LABORATORY TESTING

The laboratory testing program consisted of visual soil classification on recovered samples in general accordance with ASTM D-2488. Moisture content and hand penetrometer tests were performed on portions of cohesive samples obtained during drilling. Based on the laboratory testing, we assigned a group symbol to the various soil strata encountered based on the Unified Soil Classification System (USCS).

Upon completion of the laboratory testing, we prepared boring logs that include the soil descriptions, penetration resistances, pertinent field observations, and the results of the laboratory testing. Each log also includes the existing ground surface elevation as estimated by SME. The logs are included in Appendix A. Explanations of symbols and terms used on the logs are provided on the Boring Log Terminology sheet included in Appendix A.

Soil samples are normally retained in our laboratory for 60 days and are then disposed, unless instructed otherwise.

3. SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

The soil conditions encountered at boring locations B1 through B5 generally consisted of existing sand and clay fill underlain by natural sands, silts, and clays and overlying weathered sandstone that extended to the termination depths of the borings, except at borings B4 and B5 where strata of coal and siltstone were encountered below the sandstone.

Existing fill extended to depths ranging from 3 to 13.5 feet below the existing ground surface, corresponding to between approximate elevations 810.1 and 819.9 feet. The existing fill predominately consisted of sands. However, clay fill was encountered in boring B5. The existing sand fill was encountered in a loose to medium dense condition. The existing clay fill exhibited a very stiff consistency with moisture contents between about 9 and 11 percent.

Weathered sandstone was encountered at each of the boring locations beginning at depths ranging from about 19 to 32 feet below the existing ground surface (elevations 791.1 to 801.4 feet). Coal was encountered at borings B4 and B5 below the sandstone and overlying weathered siltstone to the explored depth of those borings. The coal layer was approximately 1.5 to 3.5 feet thick.

Thickness measurements of surficial materials (e.g., topsoil) should be considered approximate since mixing of these materials can occur in small diameter boreholes. Therefore, if accurate thickness measurements are required for inclusion in bid documents or purposes of design, additional evaluations such as shallow test pits or hand augers should be performed.

It is sometimes difficult to distinguish between fill and natural soils based on samples and cuttings from small-diameter boreholes, especially when portions of the fill do not contain man-made materials, debris, topsoil or organic layers, and when the fill appears similar in composition to the local natural soils. Therefore, the delineation of fill described above and on the boring logs should be considered approximate only.

The soil profile included on the boring logs is a generalized description of the conditions encountered. The stratification depths discussed in this report and shown on the boring logs indicate a zone of transition from one soil type to another and do not show exact depths of change from one soil type to another. The soil descriptions are based on visual classification of the soils encountered. Soil conditions may vary between or away from the boring locations. Refer to the boring logs for the soil conditions at the specific boring locations.

3.2 GROUNDWATER CONDITIONS

Groundwater was encountered during drilling in each of the borings at depths ranging from about 9 to 17 feet below the existing ground surface corresponding to elevations ranging from approximately 807.9 to 810.3 feet. Groundwater was encountered upon completion of drilling at boring B4 at a depth of 32 feet below the existing ground surface, corresponding to elevation 791.6. Groundwater level measurements were not obtained at borings B1, B2, B3, and B5 after completion of drilling due to the use of wash water during drilling.

The groundwater levels encountered during drilling approximate match the water level of the Grand River, which was about 809 to 810 feet at the time of drilling.

Hydrostatic groundwater levels, perched groundwater conditions, and the potential rate of infiltration into excavations should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, elevation of the nearby Grand River, and other factors. The groundwater levels indicated by the borings represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary from those conditions noted on the boring logs.

4. ANALYSIS AND RECOMMENDATIONS

4.1 SITE PREPARATION AND EARTHWORK

4.1.1 EXISTING FILL CONSIDERATIONS

The existing fill encountered at the borings is considered to be undocumented because we are not aware of records that document fill placement and compaction operations. Based on the variability of the existing fill, at least portions of the fill were likely not placed and compacted as engineered fill. Therefore, the existing fill is considered uncontrolled. We anticipate the fill is associated with previous developments that were located on the existing site including the construction of the existing pipes and structures.

Based on the information obtained regarding the existing fill, considering a significant portion of the existing fill will be removed to establish the basin bearing level, and based on the anticipated net bearing pressure below the basin mat, we anticipate the existing fill can generally be left in place below the mat foundation. Any unsuitable existing fill (if present) must be removed (undercut) from beneath the proposed mat foundation.

Existing fill to remain in-place beneath the proposed foundation should be of sufficient strength and free of deleterious materials, such as excessive debris and organics. Unsuitable existing fill that cannot be improved in-place should be removed (i.e., undercut) and replaced with engineered fill that is placed and compacted per the requirements outlined in Section 4.1.3 of this report. Additional recommendations for the basin foundation are provided in Section 4.2.

4.1.2 SITE SUBGRADE PREPARATION

Existing utilities within the proposed basin area should be rerouted around the proposed basin. We recommend abandoned utilities be removed and the excavations backfilled with granular engineered fill to establish the design subgrade level.

The proposed structure, and areas to receive engineered fill, should be cleared of surficial materials, vegetation, existing fill, and other deleterious materials to expose suitable underlying inorganic subgrade, which is expected to consist of natural sands and clays. The excavation for the proposed structure is anticipated to extend to an elevation of about 815 feet (about 8 to 10 feet below existing grade on the south side and to frost depth on the north side). Groundwater was encountered as high as about elevation 810 feet at the borings, which approximately matches the water level of the Grand River at the time of drilling. If sufficient setback from existing structures is not available to maintain safe and stable excavation sidewalls, an earth retention system (ERS) will be required. If required, the ERS must be designed by a licensed engineer with experience in ERS design.

4.1.3 ENGINEERED FILL REQUIREMENTS

Fill placed within structural areas, including utility trench backfill, should be an approved material, free of frozen soil, debris, particle sizes that will hinder compaction, and other deleterious materials. Fill should be compacted to a minimum of 95 percent of the maximum dry density determined in accordance with the Modified Proctor test. Fill should be spread in level layers with a loose thickness appropriate for the type of equipment used to obtain compaction. Thinner lifts will be required in confined spaces and where compaction is achieved with hand-operated equipment. Sand fill should be compacted with a smooth-drum vibratory roller or vibratory plate compactors, including either walk-behind types or plate compactors mounted on a backhoe or excavator (i.e., a hoe-pac). Clay fill should be compacted with a sheepfoot roller.

Based on the information from the borings, some of the existing sand fill and natural sands should be suitable for reuse as engineered fill, provided the material meets the requirements listed in the previous paragraph. We recommend imported fill consist of MDOT Class II granular material. We do not recommend silts and weathered sandstone for use as engineered fill for this project.

Portions of the site sands contained more than about 15 percent of silt as well as site clays (identified with USCS group symbol "SM" and "CL", respectively) have the following considerations:

- May require drying/aeration prior to use as engineered fill.
- Are difficult to compact in confined areas where compaction by hand-operated equipment is required.
- Should not be used where drainage is required.
- Should be re-used in open areas where large compaction equipment can operate.
- Will be dependent on the time of year for their success for reuse as engineered fill. During cold and wet periods of the year, these soils can become saturated and disturbed and are difficult to dry.

The need for moisture conditioning will be affected by seasonal weather conditions at the time the earthwork is performed, and the condition of the site soils. If the site silty sands and clays cannot be suitably moisture conditioned, it will be necessary for the contractor to import greater quantities of granular fill (sand) to use as engineered fill on the site, and it may be necessary to export the existing wet soils if suitable on-site disposal areas are not available. The project specifications should include provisions for moisture conditioning of soils to be placed and compacted on-site as engineered fill. Contractors should anticipate the need for moisture conditioning and structure their bids accordingly.

In utility trenches or basin excavations, and in other areas where compaction is accomplished primarily by smaller plate compaction equipment, an approved granular material containing relatively low amounts of silt or clay, such as MDOT Class II granular material, should be used as backfill. MDOT Class II granular material should also be used in areas requiring drainage or where the fill will serve as a capillary break.

Coarse crushed aggregate used to backfill undercuts or to stabilize subgrades should consist of a well-graded, crushed natural aggregate or crushed concrete ranging from 1 to 3 inches in size with no more than seven percent by weight passing the No. 200 sieve should be used. In cases where granular engineered fill will be placed over the crushed aggregate, the surface of the coarse crushed material should be choked with a layer of at least 6 inches of dense-graded aggregate, such as MDOT 21AA, or covered with a suitable non-woven geotextile, to mitigate the potential for migration of the granular materials into the coarser crushed aggregate.

4.2 FOUNDATIONS

4.2.1 SUBGRADE VERIFICATION

To verify the subgrade exposed at the foundation bearing surfaces is suitable for the recommended maximum net allowable soil bearing pressure, and to verify necessary improvements at or below the foundation subgrade have been performed properly, the final foundation subgrades should be evaluated and tested by SME during construction. By performing the geotechnical evaluation for this project, and preparing this geotechnical evaluation report, SME is the geotechnical engineer of record for this project and is best suited to verify the recommendations of this report, and the design requirements of this project, are in fact incorporated into the construction.

4.2.2 MAT FOUNDATIONS

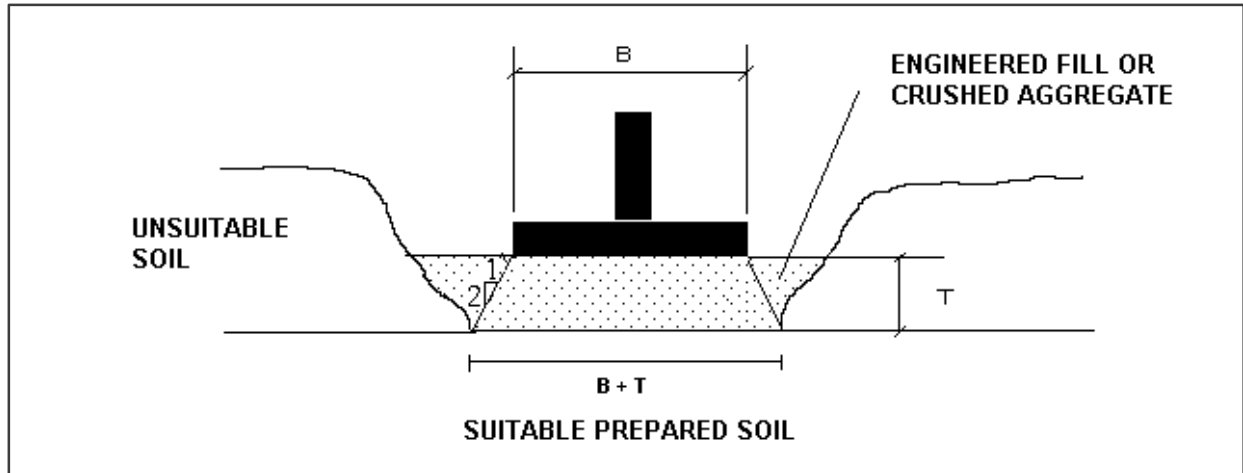
A mat foundation bearing on an approved aggregate, discussed below, overlying suitable existing fill or natural soils is recommended for support of the proposed basin. Suitable bearing soils were encountered at the proposed bottom of basin (approximate elevation 815 feet). For a mat foundation bearing on suitable soils discussed above, we recommend a maximum net allowable soil bearing pressure of 2,000 pounds per square-foot (psf) for design. The recommended design net allowable soil bearing pressure is based on a global safety factor of three or more (for general shear failure). For a mat foundation bearing on suitable soils discussed above, we recommend a vertical modulus of subgrade reaction of 150 kips per cubic-foot (kcf) be utilized in the analysis. The recommended value of subgrade modulus is expected to apply to the conditions below the mat and is based on correlations with soil type developed from plate load tests conducted using a 1-foot square plate.

The conditions at the bottom of the foundation excavations should be evaluated to verify the presence of suitable soils. We recommend mat foundations be supported on a crushed aggregate subbase to facilitate dewatering or perched groundwater and/or runoff and to limit disturbance to the subgrade during construction. We recommend the foundation subbase consist of a total of 12 inches of crushed material, composed of 9 inches of coarse, crushed aggregate or crushed concrete capped with 3 inches of dense-graded crushed aggregate (such as MDOT 21AA). The coarse, crushed aggregate or crushed concrete should range in nominal size from 1 to 3 inches and contain no more than seven percent passing the No. 200 sieve. The depth of the excavation for the mat foundations should account for the recommended thickness of aggregate subbase. The aggregate subbase should extend laterally at least 1 foot beyond the outside edges of the mat foundations. The aggregate subbase should be compacted by tamping the material with a backhoe bucket.

Based on the estimated net contact pressure on the mat foundation, we expect total settlement below the slab/mat foundation will be up to about 1 inch at the center of the basin and up to about 1/2-inch at the edge of the basin for uniform loading; thus, a differential settlement of up to about 1/2-inch between the center and edge of basin for uniform loading. If the basin is emptied, some portion of the settlement will rebound, and when the basin is re-filled, settlement will reoccur, although anticipated to match the initial settlement (provided similar fluid levels are achieved). We recommend connections to the basin be designed to accommodate the anticipated settlement. The above settlements are based on the boring information, our experience with similar structures and soil conditions, and field verification of suitable bearing soils by SME.

Deflections across the mat due to the loads implied by the basin and equipment are a function of the stiffness of the mat, the stiffness of the supporting subgrade, and the magnitude and locations of the applied loads. An analysis of the deflections across the mat due to the applied loads is typically performed by the structural engineer using an analytical computer program. SME can perform this analysis, if desired.

Once the foundation area is exposed, SME must observe and test the foundation subgrades to verify suitable bearing conditions are present. Soils that cannot be suitably improved in-place must be undercut to expose suitable natural soils below. Foundations can be constructed at this lower level where suitable subgrade is encountered, or the design foundation bearing level can be re-established using engineered fill or crushed aggregate placed as backfill in the undercut excavation. Where the undercut is backfilled to re-establish the design bearing level, the undercut excavation to remove unsuitable soils should extend laterally on a two vertical to one horizontal slope from the edge of the foundation. Refer to the following Typical Foundation Undercutting Diagram.



Foundations should be situated a minimum of 42 inches below final site grade for protection against frost action during normal winters. Foundations and proposed bearing soils should be protected from freezing during construction if work occurs in the winter months.

The natural sands and existing sand fill encountered in the borings are susceptible to sloughing and caving of foundation excavation sidewalls. For frost heave considerations, vertical foundation excavation sidewalls must be maintained during foundation concrete placement and not be allowed to “mushroom out” at the top. We recommend the foundation excavations be formed to maintain vertical faces for foundations and reduce the potentially adverse effects resulting from frost heave.

4.3 SEISMIC SITE CLASS

Based on the subsurface information obtained from the borings to a maximum depth of 50 feet, seismic site Class D applies to this site in accordance with the 2015 MBC referencing Table 20.3-1 in ASCE Standard ASCE/SEI 7-10.

4.4 BELOW-GRADE WALLS AND DRAINAGE

4.4.1 WALL BACKFILL

The below-grade walls will be constructed up to 10 feet below the existing ground surface. Walls should be backfilled with MDOT Class II granular material. Positive surface drainage should also be established away from exterior walls.

Backfill should be compacted to a minimum of 95 percent of the maximum dry density as determined by the Modified Proctor test. Care should be exercised during compaction of the wall backfill to avoid overstressing the walls. If required, walls should be designed to accommodate the additional stresses associated with operating compaction equipment adjacent to the wall.

4.4.2 LATERAL EARTH PRESSURES

The below-grade walls are expected to be rigid walls or restrained so they do not rotate sufficiently to permit the lower active earth pressure (K_a) condition to be reached. For rigid walls backfilled with a free-draining granular material and a level finish surface behind the wall, we recommend an at-rest lateral earth pressure coefficient (K_o) of 0.5 and an at-rest equivalent fluid pressure of 55 pounds per cubic foot (pcf) for design above the design groundwater level. We recommend the design groundwater level be established at the 100-year floor level or the Grand River, or higher. Below the design groundwater elevation, we recommend an equivalent lateral earth pressure of 90 psf per foot of embedment, which

includes hydrostatic groundwater pressure and the earth pressure using the buoyant unit weight of the soil.

Additional lateral pressures due to surcharge loading (nearby structures and equipment, roadway traffic, etc.) must be added to the above lateral earth pressures for design. Surcharge loads need to be modeled as a uniform pressure distribution applied to the entire wall height. We recommend using a horizontal coefficient for at-rest conditions, anticipating the below-grade walls will be held rigid, to calculate loads on walls due to surcharges.

The earth pressures presented above are for a drained backfill. To reduce the potential for the build-up of hydrostatic pressure behind below-grade walls, we recommend permanent edge drains be installed along the base of the perimeter of the below-grade walls. The perimeter edge drains should consist of a minimum 6-inch-diameter perforated plastic drain pipe, wrapped with a filter fabric and surrounded by 6 inches of filter material, such as pea gravel (MDOT 34G or MDOT 34R), wrapped with a filter fabric. The drains should be discharged into a sump and pumping system, or to a gravity drainage outlet if feasible. We recommend the design include provisions for access to the drains for cleaning and maintenance. In addition, positive surface drainage should be re-established away from the proposed building and from exterior below-grade walls.

Uplift pressure should be computed based on the unit weight of water multiplied by the difference between the design groundwater elevation and the elevation of the bottom of the basin. To resist the uplift pressures, the weight of the foundation and basin walls may be used.

Uplift anchors could be provided if additional uplift resistance is needed. Another method to increase uplift resistance is to enlarge the base of the basin mat beyond the outer edge of the walls and then to consider the weight of the soil backfill over the extended portion of the base. For this approach, we recommend a total unit weight for soil backfill of 120 pounds per cubic-foot (pcf) for soil above the design groundwater. The buoyant unit weight should be used for soil backfill below the design groundwater level.

Groundwater levels are expected to remain below the design bottom level of the mat foundation, unless groundwater levels are significantly higher than the levels encountered during drilling. However, groundwater seepage from perched sources and/or runoff should be expected.

Lateral pressures due to surcharge loading, such as surrounding development and traffic, must be added to the above lateral earth pressures for design. We recommend using horizontal coefficient of 0.5 for at-rest conditions to calculate loads on walls due to surcharges. Use of these values require a granular wall backfill. Surcharge loads should be modeled as a uniform pressure distribution applied to the entire wall height. The below-grade wall recommendations are based on properly placed and compacted granular backfill that meets the gradational requirements of MDOT Class II granular material.

4.5 CONSTRUCTION CONSIDERATIONS

Significant groundwater seepage is not expected to be encountered in excavations above elevation 810 feet. However, water from precipitation, surface runoff, or perched groundwater source(s) could be encountered at elevations above 810 feet. Where natural granular soils are exposed, perched groundwater may drain into the underlying subgrade. If water accumulates in excavations above elevation 810 feet, we expect these accumulations can be controlled using standard sump pit and pumping procedures. A working surface of either crushed aggregate or crushed concrete may be required to protect the exposed subgrade where seepage is encountered.

The contractor must provide safely sloped excavations or an adequately constructed and braced shoring system in accordance with federal, state and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, use appropriate shoring to resist the extra pressure due to the superimposed loads.

The contractor must take precautions to protect the adjacent existing structures and utilities during construction of the proposed tank. Care must be exercised during the excavating and compacting operations so that excessive vibrations do not cause settlement of the existing structures and utilities.

The contractor should remove ponded surface water and prevent run-off from reaching foundation excavations and areas of prepared subgrade. We recommend the contractor establish positive surface drainage at the onset of construction to mitigate the potential for subgrade disturbance.

The need for moisture conditioning (i.e., aerating and drying) clayey and silty soils, and the success of moisture conditioning, will be dependent on the weather conditions at the time of construction. During cold and wet periods of the year, the clayey and silty soils may become saturated and disturbed, and it may not be feasible to sufficiently dry the soils so that they are stable and can be adequately compacted. If these conditions occur, it will be necessary for the contractor to import greater quantities of clean granular fill (sand) to use as engineered fill on the site, and it would be necessary to export the clayey and silty soils if on-site disposal in non-structural areas is not feasible.

Handling, transportation and disposal of excavated materials and groundwater should be performed in accordance with applicable regulatory requirements.

5. SIGNATURES

PREPARED BY:

REVIEWED BY:

Alexandra R. Costanzo, PE
Project Engineer

Paul E. Anderson, PE
Senior Project Engineer

APPENDIX A

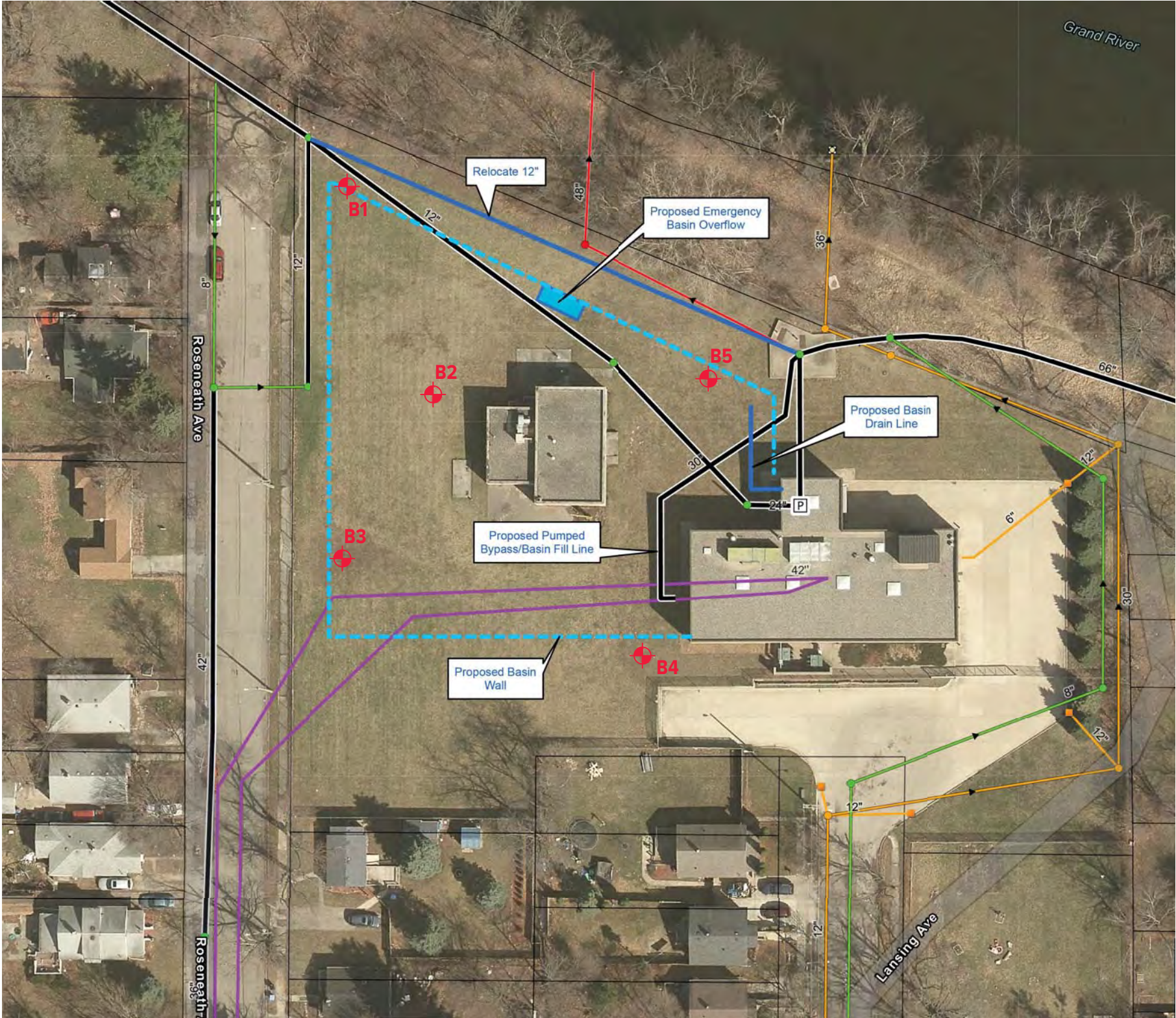
BORING LOCATION DIAGRAM (FIGURE NO. 1)

BORING LOG TERMINOLOGY

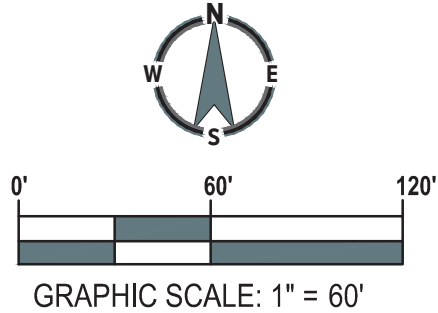
BORING LOGS (B1 THROUGH B5)

\\sme-inc\p2\WIP\094161.00\CAD\Design Files\BLD\Rev0\094161.00-BLD.dwg

PLOT DATE: May 28, 2024 - 2:10pm - julie.blake



- NOTES:
1. BASE DRAWING INFORMATION PROVIDED FROM A PDF/DRAWING TITLED "CLEAN WATER STATE REVOLVING FUND (CWSRF) PROJECT PLAN", WITH LATEST REVISION DATE OF MARCH 7, 2023 AND PREPARED BY FISHBECK.
 2. LOCATION MAP AERIAL IMAGE TAKEN FROM BING MAPS.



LEGEND

- [P] Pump Station
- [X] Outfall
- [Orange square] Storm Catch Basin
- [Red circle with cross] Combined Manhole
- [Green circle with cross] Sanitary Manhole
- [Yellow circle with cross] Storm Manhole
- [Red line with arrow] Combined Sewer
- [Green line with arrow] Sanitary Collector (< 12")
- [Black line with arrow] Sanitary Interceptor (>= 12")
- [Orange line with arrow] Storm
- [Red circle with cross] Approximate Boring Location



LOCATION MAP
NOT TO SCALE



Project
**LANSING AVENUE
PUMP STATION
EQUALIZATION BASIN**

Project Location
**1711 LANSING AVENUE
LANSING, MICHIGAN**

Sheet Name
**BORING LOCATION
DIAGRAM**

No.	Revision Date

Date	5-17-2025
CADD	JAB
Designer	ARC
Scale	AS NOTED
Project	094161.00

Figure No.
1

DRAWING NOTE: SCALE DEPICTED IS MEANT FOR 11" X 17"
AND WILL SCALE INCORRECTLY IF PRINTED ON ANY
OTHER SIZE MEDIA
NO REPRODUCTION SHALL BE MADE WITHOUT THE PRIOR
CONSENT OF SME
© 2024



BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART		
COARSE-GRAINED SOIL (more than 50% of material is larger than No. 200 sieve size.)		
Clean Gravel (Less than 5% fines)		
GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size		GW Well-graded gravel; gravel-sand mixtures, little or no fines
		GP Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)	
		GM Silty gravel; gravel-sand-silt mixtures
		GC Clayey gravel; gravel-sand-clay mixtures
Clean Sand (Less than 5% fines)		
SAND 50% or more of coarse fraction smaller than No. 4 sieve size		SW Well-graded sand; sand-gravel mixtures, little or no fines
		SP Poorly-graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)	
		SM Silty sand; sand-silt-gravel mixtures
		SC Clayey sand; sand-clay-gravel mixtures
FINE-GRAINED SOIL (50% or more of material is smaller than No. 200 sieve size)		
SILT AND CLAY Liquid limit less than 50%		ML Inorganic silt; sandy silt or gravelly silt with slight plasticity
		CL Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
		OL Organic silt and organic clay of low plasticity
		MH Inorganic silt of high plasticity, elastic silt
SILT AND CLAY Liquid limit 50% or greater		CH Inorganic clay of high plasticity, fat clay
		OH Organic silt and organic clay of high plasticity
		PT Peat and other highly organic soil
		PT Peat and other highly organic soil

OTHER MATERIAL SYMBOLS		

LABORATORY CLASSIFICATION CRITERIA	
GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3
GP	Not meeting all gradation requirements for GW
GM	Atterberg limits below "A" line or PI less than 4
GC	Atterberg limits above "A" line with PI greater than 7
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3
SP	Not meeting all gradation requirements for SW
SM	Atterberg limits below "A" line or PI less than 4
SC	Atterberg limits above "A" line with PI greater than 7
Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent.....GW, GP, SW, SP More than 12 percent.....GM, GC, SM, SC 5 to 12 percent.....Cases requiring dual symbols • SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel) • SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel) • GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand) • GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand) If the fines are CL-ML: • SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel) • SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel) • GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)	
PARTICLE SIZES	
Boulders	- Greater than 12 inches
Cobbles	- 3 inches to 12 inches
Gravel- Coarse	- 3/4 inches to 3 inches
Gravel- Fine	- No. 4 to 3/4 inches
Sand- Coarse	- No. 10 to No. 4
Sand- Medium	- No. 40 to No. 10
Sand- Fine	- No. 200 to No. 40
Silt and Clay	- Less than (0.074 mm)
PLASTICITY CHART	

VISUAL MANUAL PROCEDURE	
When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows: For soils where it is difficult to distinguish if it is a coarse or fine-grained soil: • SC/CL (CLAYEY SAND to Sandy LEAN CLAY) • SM/ML (SILTY SAND to SANDY SILT) • GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY) • GM/ML (SILTY GRAVEL to Gravelly SILT) For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay: • SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand) • SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand) • SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand) • SW/SP (SAND or SAND with Gravel) • GP/GW (GRAVEL or GRAVEL with Sand) • SC/SM (CLAYEY to SILTY SAND) • GM/GC (SILTY to CLAYEY GRAVEL) • CL/ML (SILTY CLAY) • ML/CL (CLAYEY SILT) • CH/MH (FAT CLAY to ELASTIC SILT) • CL/CH (LEAN to FAT CLAY) • MH/ML (ELASTIC SILT to SILT)	
DRILLING AND SAMPLING ABBREVIATIONS	
2ST	- Shelby Tube - 2" O.D.
3ST	- Shelby Tube - 3" O.D.
AS	- Auger Sample
GS	- Grab Sample
LS	- Liner Sample
NR	- No Recovery
PM	- Pressuremeter
RC	- Rock Core diamond bit. NX size, except where noted
SB	- Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	- Vane Shear
WS	- Wash Sample
OTHER ABBREVIATIONS	
WOH	- Weight of Hammer
WOR	- Weight of Rods
SP	- Soil Probe
PID	- Photo Ionization Device
FID	- Flame Ionization Device
DEPOSITIONAL FEATURES	
Parting	- as much as 1/16 inch thick
Seam	- 1/16 inch to 1/2 inch thick
Layer	- 1/2 inch to 12 inches thick
Stratum	- greater than 12 inches thick
Pocket	- deposit of limited lateral extent
Lens	- lenticular deposit
Hardpan/Till	- an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	- soil deposited by lake water
Mottled	- soil irregularly marked with spots of different colors that vary in number and size
Varved	- alternating partings or seams of silt and/or clay
Occasional	- one or less per foot of thickness
Frequent	- more than one per foot of thickness
Interbedded	- strata of soil or beds of rock lying between or alternating with other strata of a different nature
DESCRIPTION OF RELATIVE QUANTITIES	
The visual-manual procedure uses the following terms to describe the relative quantities of notable foreign materials, gravel, sand or fines: Trace - particles are present but estimated to be less than 5% Few - 5 to 10% Little - 15 to 25% Some - 30 to 45% Mostly - 50 to 100%	

CLASSIFICATION TERMINOLOGY AND CORRELATIONS			
Cohesionless Soils		Cohesive Soils	
Relative Density	N ₆₀ (N-Value) (Blows per foot)	Consistency	Undrained Shear Strength (kips/ft ²)
Very Loose	0 to 4	Very Soft	<2
Loose	5 to 10	Soft	2 - 4
Medium Dense	11 to 30	Medium	5 - 8
Dense	31 to 50	Stiff	9 - 15
Very Dense	51 to 80	Very Stiff	16 - 30
Extremely Dense	Over 81	Hard	> 30
Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted. N₆₀ values as reported on boring logs represent raw N-values corrected for hammer efficiency only.			

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BORING B 1

PAGE 1 OF 2

BORING DEPTH: 40 FEET

PROJECT NAME: Lansing Avenue Pump Station Equalization Basin

PROJECT NUMBER: 094161.00

CLIENT: Fishbeck

PROJECT LOCATION: Lansing, Michigan

DATE STARTED: 4/25/24

COMPLETED: 4/25/24

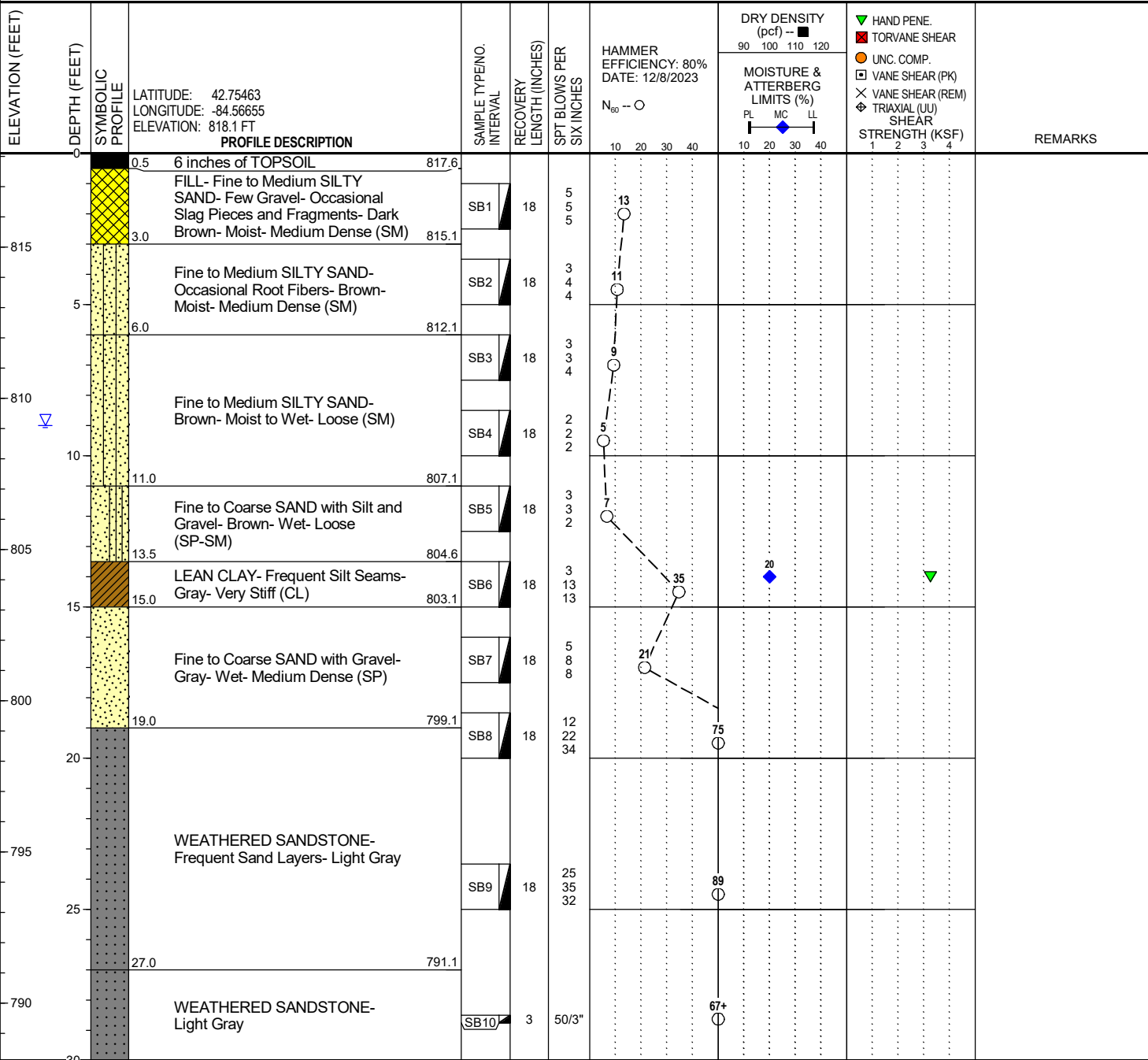
BORING METHOD: Hollow-stem Augers

DRILLER: RM

RIG NO.: 531 (CME55-ATV)

LOGGED BY: SMM

CHECKED BY: BLE



GROUNDWATER & BACKFILL INFORMATION

DEPTH (FT) ELEV (FT)

▽ DURING BORING: 9.0 809.1

▽ AT END OF BORING: Note 3

BACKFILL METHOD: Auger Cuttings

NOTES:

1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.

2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

3. Water was added to annulus of augers 15 feet below the ground surface. Therefore, a groundwater measurement was not obtained upon completion of drilling.

(Continued Next Page)



BORING DEPTH: 40 FEET

PROJECT NUMBER: 094161.00

PROJECT LOCATION: Lansing, Michigan

[illegible]

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BORING B 2

PAGE 1 OF 2

BORING DEPTH: 40 FEET

PROJECT NAME: Lansing Avenue Pump Station Equalization Basin

PROJECT NUMBER: 094161.00

CLIENT: Fishbeck

PROJECT LOCATION: Lansing, Michigan

DATE STARTED: 4/25/24

COMPLETED: 4/25/24

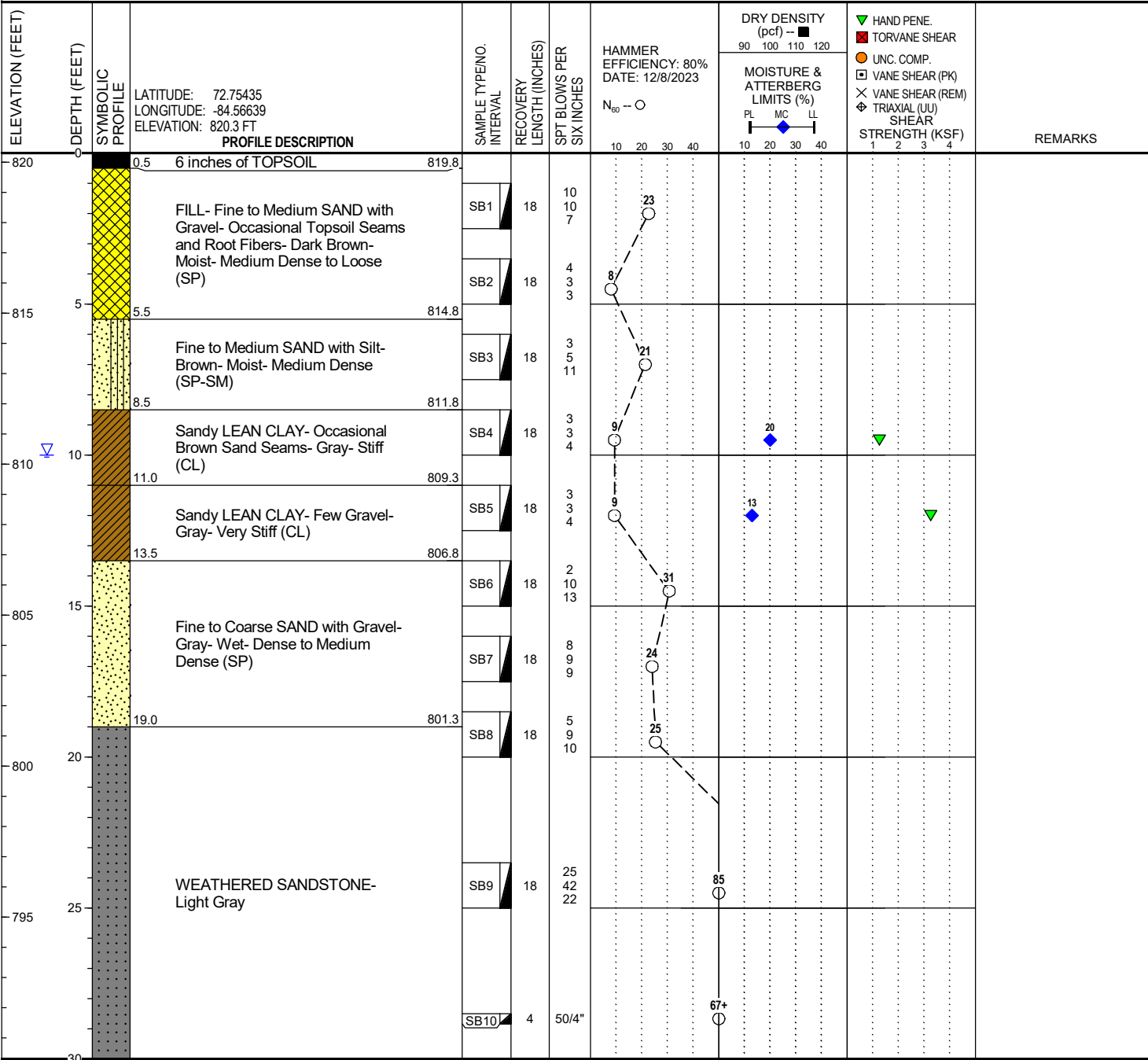
BORING METHOD: Hollow-stem Augers

DRILLER: RM

RIG NO.: 531 (CME55-ATV)

LOGGED BY: SMM

CHECKED BY: BLE



GROUNDWATER & BACKFILL INFORMATION

DEPTH (FT) ELEV (FT)

▽ DURING BORING: 10.0 810.3

▽ AT END OF BORING: Note 3

BACKFILL METHOD: Auger Cuttings

NOTES:

1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.

2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

3. Water was added to annulus of augers 15 feet below the ground surface. Therefore, a groundwater measurement was not obtained upon completion of drilling.



BORING DEPTH: 45 FEET

PROJECT NUMBER: 094161.00

PROJECT LOCATION: Lansing, Michigan

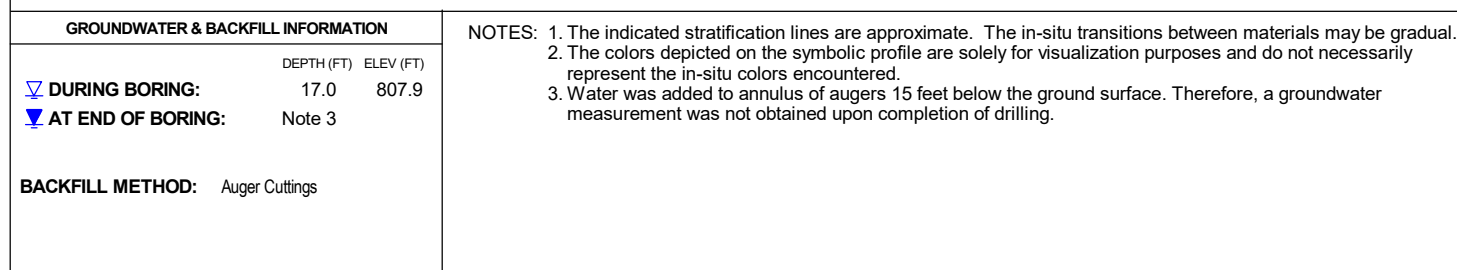
COMPLETED: 4/25/24

BORING METHOD: Hollow-stem Augers

RIG NO.: 531 (CME55-ATV)

LOGGED BY: SMM

CHECKED BY: BLE



(Continued Next Page)

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BORING B 4

PAGE 1 OF 2

BORING DEPTH: 50 FEET

PROJECT NAME: Lansing Avenue Pump Station Equalization Basin

PROJECT NUMBER: 094161.00

CLIENT: Fishbeck

PROJECT LOCATION: Lansing, Michigan

DATE STARTED: 4/24/24

COMPLETED: 4/24/24

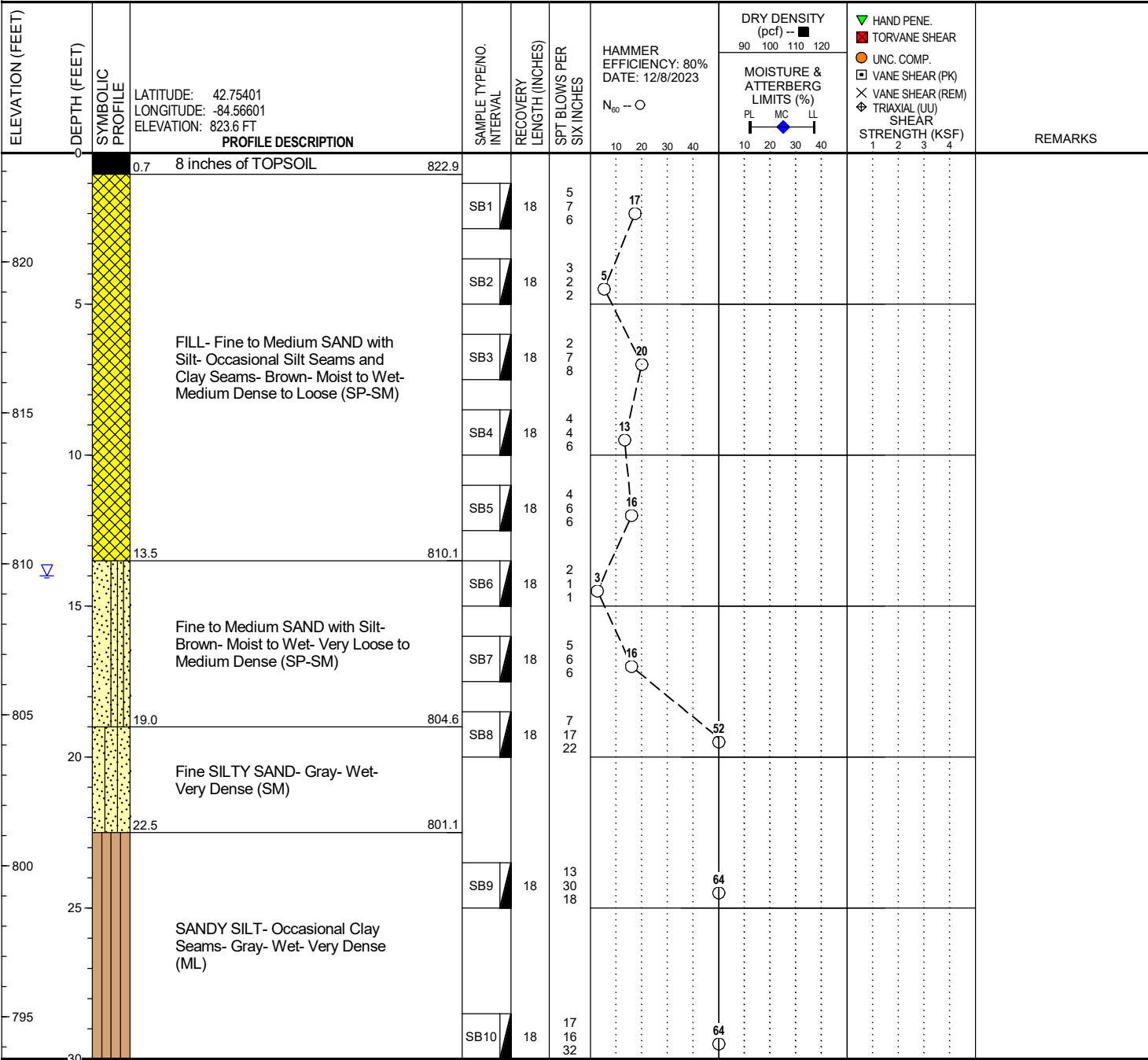
BORING METHOD: Hollow-stem Augers

DRILLER: RM

RIG NO.: 531 (CME55-ATV)

LOGGED BY: SMM

CHECKED BY: BLE



GROUNDWATER & BACKFILL INFORMATION

DEPTH (FT) ELEV (FT)

▽ DURING BORING: 14.0 809.6

▽ AT END OF BORING: 32.0 791.6

BACKFILL METHOD: Auger Cuttings

NOTES: 1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.

2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.



BORING DEPTH: 50 FEET

PROJECT NUMBER: 094161.00

PROJECT LOCATION: Lansing, Michigan

[illegible]

5/28/24 3:51:56 PM



BORING B 5

PAGE 1 OF 2

BORING DEPTH: 50 FEET

PROJECT NAME: Lansing Avenue Pump Station Equalization Basin

PROJECT NUMBER: 094161.00

CLIENT: Fishbeck

PROJECT LOCATION: Lansing, Michigan

DATE STARTED: 4/26/24

COMPLETED: 4/26/24

BORING METHOD: Hollow-stem Augers

DRILLER: RM

RIG NO.: 531 (CME55-ATV)

LOGGED BY: SMM

CHECKED BY: BLE

ELEVATION (FEET)	DEPTH (FEET)	SYMBOLIC PROFILE	LATITUDE: 42.75438 LONGITUDE: -84.56590 ELEVATION: 818.6 FT	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	HAMMER EFFICIENCY: 80% DATE: 12/8/2023 N ₆₀ -- O	DRY DENSITY (pcf) -- ■ 90 100 110 120	MOISTURE & ATTERBERG LIMITS (%) PL MC LL	▼ HAND PENE. ■ TORVANE SHEAR ● UNC. COMP. □ VANE SHEAR (PK) × VANE SHEAR (REM) ◆ TRIAXIAL (UU) SHEAR STRENGTH (KSF) 1 2 3 4	REMARKS
	0			4 inches of TOPSOIL								
					SB1	18	15 13 12	33	9		▼	
815	5			FILL- Sandy LEAN CLAY with Gravel- Occasional Topsoil Seams- Dark Brown- Very Stiff (CL)	SB2	18	12 12 11	31	9			Sample SB2 was too disturbed to perform a shear strength test.
					SB3	18	6 8 6	19	11			Sample SB3 was too disturbed to perform a shear strength test.
810	10			Fine to Medium CLAYEY SAND- Brown- Moist to Wet- Loose (SC)	SB4	18	5 4 3	9				
					SB5	18	3 3 1	5				
805	15			LEAN CLAY- Frequent Silt Seams- Gray- Very Stiff (CL)	SB6	18	2 2 3	7	33	▼		
				Fine to Medium SAND with Silt- Few Gravel- Gray- Wet- Medium Dense (SP-SM)	SB7	18	4 6 6	16				
800	20			SANDY SILT- Gray- Wet- Dense (ML)	SB8	18	12 14 10	32				
795	25			Fine to Medium SAND with Silt- Dark Gray- Wet- Medium Dense (SP-SM)	SB9	18	4 10 10	27				
790	30			WEATHERED SANDSTONE- Light Gray	SB10	18	17 18 23	55				

GROUNDWATER & BACKFILL INFORMATION

DEPTH (FT) ELEV (FT)

▼ DURING BORING: 9.5 809.1

▼ AT END OF BORING: Note 3

BACKFILL METHOD: Auger Cuttings

NOTES:

1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.

2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

3. Water was added to annulus of augers 15 feet below the ground surface. Therefore, a groundwater measurement was not obtained upon completion of drilling.



PROJECT NUMBER: 094161.00

PROJECT LOCATION: Lansing, Michigan

[illegible]

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

GENERAL COMMENTS

LABORATORY TESTING PROCEDURES

Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

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.

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.*

Read this Report in Full

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.*

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.

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.

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.*

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.

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 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.

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.

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.

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.*



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GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

LABORATORY TESTING PROCEDURES

VISUAL ENGINEERING CLASSIFICATION

Visual classification was performed on recovered samples. The appended General Notes and Unified Soil Classification System (USCS) sheets include a brief summary of the general method used visually classify the soil and assign an appropriate USCS group symbol. The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The soil descriptions developed from visual classifications are sometimes modified to reflect the results of laboratory testing.

MOISTURE CONTENT

Moisture content tests were performed by weighing samples from the field at their in-situ moisture condition. These samples were then dried at a constant temperature (approximately 110° C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample and the weight of the water that was expelled during drying. The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

HAND PENETROMETER TESTS

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength (based on the hand penetrometer test) presented on the boring logs is reported in units of kips per square-foot (ksf).

TORVANE SHEAR TESTS

In the Torvane test, the shear strength of a low strength, cohesive soil sample is estimated by measuring the resistance of the sample to a torque applied through vanes inserted into the sample. The undrained shear strength of the samples is measured from the maximum torque required to shear the sample and is reported in units of kips per square-foot (ksf).

LOSS-ON-IGNITION (ORGANIC CONTENT) TESTS

Loss-on-ignition (LOI) tests are conducted by first weighing the sample and then heating the sample to dry the moisture from the sample (in the same manner as determining the moisture content of the soil). The sample is then re-weighed to determine the dry weight and then heated for 4 hours in a muffle furnace at a high temperature (approximately 440° C). After cooling, the sample is re-weighed to calculate the amount of ash remaining, which in turn is used to determine the amount of organic matter burned from the original dry sample. The organic matter content of the specimen is expressed as a percent compared to the dry weight of the sample.

ATTERBERG LIMITS TESTS

Atterberg limits tests consist of two components. The plastic limit of a cohesive sample is determined by rolling the sample into a thread and the plastic limit is the moisture content where a 1/8-inch thread begins to crumble. The liquid limit is determined by placing a 1/2-inch thick soil pat into the liquid limits cup and using a grooving tool to divide the soil pat in half. The cup is then tapped on the base of the liquid limits device using a crank handle. The number of drops of the cup to close the gap formed by the grooving tool 1/2 inch is recorded along with the corresponding moisture content of the sample. This procedure is repeated several times at different moisture contents and a graph of moisture content and the corresponding number of blows is plotted. The liquid limit is defined as the moisture content at a nominal 25 drops of the cup. From this test, the plasticity index can be determined by subtracting the plastic limit from the liquid limit.