SOILS & STRUCTURES

REPORT OF THE GEOTECHNICAL INVESTIGATION FOR JACKSON (WEST) ARMORY

BLACKMAN CHARTER TOWNSHIP
JACKSON COUNTY
MICHIGAN

APRIL 04, 2025

Nowak & Fraus Engineers
46777 Woodward Avenue
Pontiac, Michigan 48342

Project No. 25MKG-02R

SOILS & STRUCTURES

April 04, 2025

Nowak & Fraus Engineers
46777 Woodward Avenue
Pontiac, Michigan 48342

Attention: Mr. Steve Sutton, P.E.

Regarding: Jackson (West) Armory
Geotechnical Report
Blackman Charter Township, Jackson County, Michigan
Project No. 25MKG-02R

Dear Mr. Sutton:

Soils & Structures is pleased to present this geotechnical investigation report for the Jackson (West) Amory project located at 2700 West Argyle Street in Blackman Charter Township, Jackson County, Michigan.

The investigation included ten (10) test borings drilled to depths ranging from 10.0 to 25.0 feet. The test borings were conducted in accordance with ASTM D 1586 procedures.

The report, test boring location plan, and test boring logs are enclosed. The report provides recommendations for site preparation, foundations, fill, floors, and pavement.

We appreciate the opportunity to provide engineering services to Nowak & Fraus Engineers.
If you have any questions regarding this report, please contact our office.

Sincerely,
Soils & Structures, Inc.

Madeline Czajka

Madeline-Rose E. Czajka, E.I.T.
MEC/mc

Reviewed by:

Vincent Oderah

Vincent O. Oderah, P.E.

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Location of Soil Investigation

The soil investigation was conducted at the site located at 2700 West Argyle Street in Section 29 of Blackman Township, Jackson County, Michigan. The parcel number for the site is 000-08-29-476-001-06.

Purpose of Investigation

The purpose of this investigation is to provide geotechnical engineering recommendations for the design and construction of the proposed building addition and pavement.

Design Information

The project consists of an addition to the existing building. The addition is anticipated to be a single or two-story steel-framed structure with a slab on grade floor. The addition will be constructed on the northeast side of the existing building. Pavement for the project will consist of new parking lots and driveways. The proposed parking will replace the existing parking lot which will be removed as part of site preparation.

The maximum column and wall loads are anticipated to be less than 50,000 pounds and 5,000 pounds per linear foot, respectively. Allowable settlements of 0.6 inches for total settlement and 0.4 inches for differential settlement are assumed. If the actual design is significantly different than assumed in this report, then Soils & Structures should be contacted so that the recommendations included in this report may be reviewed and revised if necessary.

The floor elevation of the addition has not been determined at the time of this report but is anticipated to match the existing building. The existing surface elevation in the area of the proposed addition ranges widely from 983.9 to 996.1 feet, increasing from north to south. Fill and excavation will be required to achieve the desired grade in the construction areas. Fill for this project will include backfill over foundations and utilities. The thickness of backfill over foundations and utilities is anticipated to be less than 4.0 feet. Groundwater controls and dewatering will probably be necessary to construct the foundation and utilities.

An equivalent single axle load (ESAL) of 250,000 was assumed for the design of the preliminary pavement sections. Pavement for this project is assumed to be subjected to both automobile and truck traffic. A service life of twenty years was assumed for the pavement subgrade recommendations. The subgrade is assumed to be prepared as recommended in this report. The final pavement design should be based on site-specific traffic conditions.

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Tests Performed

The investigation included ten (10) test borings drilled to depths ranging from 10.0 to 25.0 feet. The test borings are designated as Test Boring One (TB-01) through Test Boring Ten (TB-10). The locations were determined by Nowak & Fraus Engineers. Soils and Structures reviewed the locations for accessibility and revised as necessary. The test borings were conducted in accordance with ASTM D 1586 procedures. The ASTM D 1586 standard describes the procedure for sampling and testing soil using the Standard Penetration Test. An automatic hammer was used to obtain the soil samples.

The surface elevations at the test boring locations were obtained with a Global Navigation Satellite System (GNSS) Receiver. The receiver was connected to the local MDOT CORS base station. Through this system, vertical measurements are obtained and referenced to the North American Vertical Datum (NAVD88). Horizontal measurements are also obtained at the test boring locations which are referenced to the Michigan State Plane Coordinate System. Both the vertical and horizontal measurements typically have an accuracy of approximately 0.5 inches. The measured test boring locations and surface elevations can be found in Table 1.

Table 1: Measured Test Boring Locations and Surface Elevations

Test Boring / Location	Elevation (feet)	Northing (feet)	Easting (feet)	Surface Cover
Test Boring One	983.9	278314.3	13101915.9	Topsoil
Test Boring Two	996.1	278225.1	13101876.9	Topsoil
Test Boring Three	995.5	278103.9	13102087.6	Topsoil
Test Boring Four	996.7	278048.7	13101694.3	Asphalt
Test Boring Five	995.9	278047.4	13101915.4	Asphalt
Test Boring Six	995.2	277921.7	13101714.2	Asphalt
Test Boring Seven	994.1	277921.0	13101902.0	Asphalt
Test Boring Eight	992.0	277819.4	13101981.1	Topsoil
Test Boring Nine	993.2	277865.1	13101817.8	Topsoil
Test Boring Ten	992.6	277815.5	13101714.4	Topsoil
Base Setup	983.9	278314.3	13101915.9	-

Soil samples were classified according to the Unified Soil Classification System. This method is a standardized system for classifying soil according to its engineering properties. Please refer to the appendix of this report for the Unified Classification System Chart. The classification is shown in the "Material Description" column of the test boring logs.

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The soil strength and the allowable soil bearing value were evaluated using the "N" value. The "N" value is the number of blows required to drive a soil sampler one foot with a standard 140-pound drop hammer. The sampler is driven a distance of 18.0 inches. The number of blows for each 6.0-inch increment is recorded. The sum of the second and third intervals is the "N" value. The number of blows for each 6.0-inch interval is shown on the test boring logs under the column labeled "Blow Counts". The "N" value for each sample is shown in the adjacent column.

Laboratory testing consisted of particle size (sieve) analysis (ASTM D 6913), natural moisture content (ASTM D 2216), unconfined compression (ASTM D 2166), Atterberg limits (ASTM D 4318), and loss on ignition testing (ASTM D 2974). The tests were performed in accordance with the ASTM standards listed above. The tests were performed on representative soil samples. The sieve analysis determines the particle distribution which is used to classify the soil and estimate its properties. The moisture content documents the presence of groundwater in a soil sample. The unconfined compression and Atterberg limit testing aid in determining the properties of cohesive soils. The loss on ignition testing determines the amount of organic material within a soil sample.

The U.S. Geological Survey Topographic map and the Quaternary Geology map of Michigan were reviewed. These maps provide general geological information about the region. Publicly available well log records were reviewed to determine the depth of bedrock.

Description of Soil

The general soil profile consists of alternating layers of clay and clayey sand with occasional pockets of peat which extends to a depth of at least 25.0 feet. Pockets of peat are present between depths of 1.5 and 4.0 feet in the areas of Test Boring Eight through Test Boring Ten. The near-surface sand is probably fill placed during the construction of existing building and pavement. The underlying natural soil is a deposit of coarse-textured glacial till. A coarse-textured glacial till is a mixture of soil types in which sand is the primary soil type.

Topsoil is present at the surface in the areas of the majority of the test borings. The topsoil thickness ranges from 4.0 to 10.0 inches. The average topsoil thickness is 7.3 inches. Asphalt directly overlying sand and clay is present at the surface in the areas of Test Boring Four through Test Boring Seven. The asphalt thickness ranges from 3.0 to 5.0 inches.

A layer of sand is present below the topsoil and asphalt in areas of Test Boring One through Test Boring Four and Test Boring Six. The upper sand layer consists of brown, fine to medium clayey sand and extends to depths of 3.0 to 10.0 feet. In the area of Test Boring One, the sand contains trace amounts of organic material with organic and moisture contents within acceptable limits. The sand layer in the upper 7.0 feet may be fill placed during a previous stage of site development. The "N" values of the upper sand layer range from 2 to 7, indicating the sand is in a loose to slightly compact state. The "N" values correspond to an internal friction angle between 25 and 28 degrees.

A layer of clay underlies the topsoil and upper sand layer in the areas of the majority of the test borings. The clay layer consists of dark brown to brown and gray sandy clay. The clay layer contains pockets of organic material with organic contents within tolerable limits. The clay layer generally extends to depths of 5.5 to 10.0 feet. In the area of Test Boring Ten, the clay layer extends to a depth of at least 15.0 feet. The "N" values of the clay layer range widely from 2 to 39, indicating the clay is in a soft to very stiff state. The undrained shear strength of the clay layer ranges from 540 to 2,960 pounds per square foot, indicating the clay is in a firm to stiff state.

In the areas of Test Boring Eight through Test Boring Ten, pockets of peat depths are present above a depth of 4.0 feet. The peat pockets consist of black clayey peat. The "N" values of the peat pockets range from 3 to 6, indicating the peat is in a soft to firm state. The organic content of the peat ranges from 3.9 to 16.6 percent, and the moisture content ranges from 21.2 to 44.5 percent. The organic and moisture contents exceed the acceptable limits, indicating the peat is soft and highly compressible.

A second layer of sand underlies the clay and upper sand layers in the areas of Test Boring One and Test Boring Two. The lower sand layer consists of brown and gray fine to medium clayey sand and extends to a depth of at least 25.0 feet. In the area of Test Boring One, the sand contains trace amounts of peat with organic and moisture contents within the acceptable limits. The "N" values of the sand layer range from 4 to 13, indicating the sand is in a loose to compact state. The "N" values correspond to an internal angle of friction ranging from 28 to 31 degrees.

Bedrock is present below a depth of approximately 63.0 feet (Well ID: 38000016854). The bedrock is part of the Bayport Limestone formation which is composed of primarily limestone inter-bedded with sandstone and dolomite. The Bayport Limestone formation originated during the Mississippian period which ended approximately 323.2 million years ago.

Description of Groundwater Conditions

The water table is present at depths ranging widely from 4.5 to 16.0 feet. These depths correspond to elevations ranging from 988.7 to 967.9 feet, increasing from north to south. Perched groundwater was encountered at a depth of 2.0 feet in Test Boring Two and Test Boring Seven, corresponding to elevations of 998.1 and 992.1 feet, respectively. Due to the low permeability of clay and clayey sand, perched or ponded groundwater may be encountered at greater depths throughout the site. The water table elevation is anticipated to fluctuate based on seasonal changes. Long-term groundwater monitoring was not performed as part of this investigation.

Description of Site

The soil investigation was conducted at the site located at 2700 West Argyle Street in Blackman Charter Township, Jackson County, Michigan. The site consists of an existing building and parking lot. The northern portion of the site is vegetated and consists of a wetland. The site is bordered to the south by West Argyle Street. Commercial properties border the site to the east and west. The surface elevation in the areas of the test borings ranges widely from 983.9 to 996.7 feet. Photographs #1 and #2 show the condition of the site at the time of the investigation.

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Photograph #1: Northern portion of the site and view of existing building. View is to the west. (Project No. 25MKG-02R, Jackson (West) Armory, Blackman Charter Township, Jackson County, February 2025)

Photograph #1: View of existing parking lot and building. View is to the north. (Project No. 25MKG-02R, Jackson (West) Armory, Blackman Charter Township, Jackson County, February 2025)

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Recommendations

Site & Subgrade Preparation

Trees and vegetation in the building and pavement areas should be cleared and removed as part of subgrade preparation. Organic soil, including topsoil containing organic material, should be removed from the construction area. The topsoil should be removed to the extent that all soil with an organic content of 3.0 percent or greater is removed. Soil containing roots should be removed to the extent that the root content by volume is 5.0 percent or less. All roots over 0.5 inches in diameter should be removed. The average topsoil thickness to be removed is 7.3 inches.

The existing pavement should be entirely removed as part of subgrade preparation. Excavations resulting from removal should be backfilled as necessary.

The construction area should be excavated or backfilled to achieve the required subgrade level as necessary. The peat layer encountered in the areas of Test Boring Eight through Test Boring Ten should be removed to its full depth. The greatest depth of excavation to remove the peat is approximately 4.0 feet. Excavated soil may be retained for use as fill in areas where free-draining material or drainage is not a consideration. Excavated peat should not be used as fill. In-situ sand should be compacted to 95.0 percent of its maximum density prior to placement of fill. Exposed clay subgrade should be inspected and tested with a pocket penetrometer or torvane or probe rod to determine if it possesses the required shear strength prior to placement of fill. Clay exhibiting a shear strength of less than 1,500 pounds per square foot or providing minimal resistance to the probe rod should be excavated to its full depth and recompacted or replaced with sand meeting MDOT Class II specifications.

Excavation adjacent to the existing structures which extend deeper than 4.0 feet may require temporary earth retaining structures or underpinnings to support the existing foundations. The design of the temporary shoring should be performed as outlined in the “Lateral Earth Pressure” section of this report.

Precipitation or accumulation of surface runoff and perched groundwater may saturate the exposed clay at the surface. Saturated clay may inhibit equipment movement and become highly disturbed. The exposed subgrade should be graded to establish positive drainage. Subgrade soil that has become saturated or disturbed should be allowed to dry and recompacted prior to construction. If sufficient time to dry is not feasible or the saturated soil is not drying, the subgrade may be stabilized by undercutting the saturated soil and replacing it with clean sand or aggregate. The depth of undercutting required will depend on the degree of saturation and disturbance. A minimum of 6.0 inches of undercutting is recommended. Accumulation of surface water in excavations should be controlled using sumps and drainage ditches.

Soil brought to the site for fill should be clean sand meeting MDOT Class II specifications. Fill should be placed in accordance with the "Fill" section of this report. The fill should be compacted to 95.0 percent of its maximum density, as determined by the modified proctor method per the ASTM D 1557 standard. The soil which will be used for fill should be kept free of topsoil and other organic materials. Compaction tests are recommended to check the compaction of the new fill.

The pavement subgrade, subbase, and aggregate base should be proof-rolled using a fully loaded tri-axle dump truck prior to construction. The proof roll should consist of single, overlapping passes. Areas that experience yielding during the proof roll should be recompacted. Areas that continue to experience yielding following recompaction may require undercutting or the placement of a geogrid to stabilize the subgrade.

Foundations

Spread foundations are recommended to support the addition provided the subgrade is prepared as discussed in this section as well as the "Site & Subgrade Preparation" and "Fill" sections of this report including compaction. The foundations are anticipated to be supported on the in-situ soil or fill following site preparation.

Fill below the building should be compacted to 95.0 percent of the soil's maximum density to its full depth. In-situ sand below foundations should be compacted to 95.0 percent of the sand's maximum density to a minimum depth of 4.0 feet. Compaction tests should be performed in the foundation subgrade to verify these levels of compaction. Soils not exceeding the minimum density should be recompacted.

If foundations are constructed on clay, the in-situ clay should be dry and level to ensure proper contact between the subgrade and concrete. Prior to pouring the foundations, the clay should be tested with a pocket penetrometer or torvane to ensure adequate strength to support the foundations. If the clay exhibits a shear strength of less than 1,500 pounds per square foot, it should be excavated and replaced with MDOT Class II fill.

The recommended minimum cover over the bottom of exterior foundations is 42 inches for protection against frost heave. Foundations should not be constructed on frozen soil. During cold weather construction, the foundation subgrade and foundations should be protected from freezing with insulated blankets until backfill is placed over both sides of the foundation. Foundations that are damaged by frost heave should be replaced.

The site classification for seismic design is "D" based on ASCE-7. The final seismic design parameters including the risk category of the structure should be determined by the structural engineer.

Foundations may be designed using allowable bearing values of 2,500 pounds per square foot for isolated column footings and 2,000 pounds per square foot for wall foundations provided the recommendations for subgrade preparation in the previous section are followed including compaction. A minimum width of 16.0 inches is recommended for new foundations. The allowable bearing values may be increased 25.0 percent when considering transient loads such as earthquakes and wind.

Settlement

The maximum settlement of the addition is anticipated to be less than 0.5 inches provided the recommendations in this report are observed. Differential settlement will be approximately one half of the maximum value. These levels of settlement are within the recommended acceptable limits of 0.6 inches of total settlement and 0.4 inches of differential settlement.

Floors

A slab on grade is recommended for the floor. A modulus of subgrade reaction of 130 pounds per cubic inch is recommended for the design of slabs on grade. A base of 6.0 inches of clean sand is recommended under the floors. The sand should meet MDOT Class II specifications. Fill under floors should be compacted as specified in the "Fill" section of this report. The in-situ soil is not suitable for use as a base.

Lateral Earth Pressure

Foundation walls with different soil levels on either side should be designed as retaining walls. Sand should be used as backfill behind retaining and foundation walls. The sand should meet MDOT Class II specifications. The walls should be designed using a soil density of 120 pounds per cubic foot, a coefficient of active earth pressure of 0.35 for level sand backfill and a coefficient of at rest earth pressure of 0.50. The effects of any surcharge or sloping backfill should also be included in the design. Coefficients of passive earth pressure 2.7 and 1.0 may be used for the in-situ sand and clay, respectively.

Care should be taken when excavating near the existing building. Temporary earth retaining structures (TERS) or underpinning may be required for excavations that extend deeper than 4.0 feet and should be designed by a licensed engineer based on the recommendations discussed in the previous section.

Excavations

The in-situ soils are a mixture of OSHA type "B" and "C" soils. Excavations that will be entered by personnel should be based on OSHA requirements for a type "C" soil. Based on OSHA requirements, a maximum allowable side slope of 34 degrees (1.5H:1V) is recommended for excavations 4.0 to 15.0 feet deep. Excavations less than 4.0 feet deep may have vertical side slopes. Excavations adjacent to structures or property lines may require temporary shoring.

Fill

Fill, including the aggregate layers under pavement, should be compacted to a density of 95.0 percent of its maximum density. The maximum density should be determined in accordance with the ASTM D 1557 standard. A maximum thickness per lift of 6.0 inches is recommended. The maximum thickness may be increased to 12.0 inches if a vibratory roller or hoe-pack is used. Compaction tests are recommended to confirm that the fill is compacted to the required density and may be used as fill. For clay, the optimum method of placement will be to place the clay in 6.0-inch lifts and compact each layer with three to five passes with a sheepsfoot roller. Clay should be maintiained near optimum moisture during compaction.

Excavated soil may be retained for use as fill in areas where free-draining material or drainage is not required. Excavated organic soil should not be used as fill. Clean sand will have to be imported. Soil brought to the site for structural fill should be sand meeting MDOT Class II requirements or ASTM requirements for a SP or SW which are the designations for clean sand. If the amount of fill required to establish the final grade exceeds the amount of material available on site, additional material will have to be imported.

Fill should not be placed over frozen ground, snow, or ice. Soil which contains frozen material should not be used as fill. During winter construction, removal of frozen ground may be necessary prior to placing fill.

Groundwater Management

Groundwater controls and dewatering will probably be necessary for the construction of the foundations and utilities depending on the depth of excavation. If excavations encounter groundwater, the excavation bottom may be stabilized by placing a 6.0 to 8.0 inch layer of porous stone over the bottom of the excavation. The stone will stabilize the bottom of the excavation. Temporary sumps should be used to control perched groundwater, surface water, and dewater excavations extending below the water table as necessary.

A vapor barrier is recommended under the floor in areas that will be enclosed and heated. The vapor barrier should consist of a 10-mil polyethylene sheet and should be located immediately below the floor slab. The vapor barrier may be omitted in portions of the buildings that will not be heated.

The infiltration rate of the in-situ soil is anticipated to be low and not sufficient for internal drainage for the site.

Drains around the exterior foundations are recommended. The in-situ soil does not meet the exception for drains in Section 1805.4 of the Michigan Building Code. The drains should consist of a 4.0-inch diameter slotted plastic pipe wrapped in filter fabric. Pea gravel should be used for backfill within a 6.0 inch circumference of the drain. The drains should outlet a minimum of 30.0 inches below the lowest floor elevation.

Drains below the pavement are recommended and will improve the lifespan of the pavement. Pavement areas should be properly drained to minimize the effects of frost heaving and the loss of subgrade due to water infiltration. Parking areas should be sloped towards low points with catch basins or curb inlets.

Hot Mix Asphalt (HMA) Pavement

The recommended preliminary HMA pavement sections listed in Table 2 were developed based on the discussions and assumptions included in this report and the design procedures outlined in the "AASHTO Guide for Design of Pavement Structures." The subgrade should be prepared as described in the "Site & Subgrade Preparation" and "Fill" sections of this report. The recommended pavement section materials listed in Table 2 refer to and should comply with the standard material designations included in applicable MDOT specifications and guidelines including the 2020 MDOT "Standard Specifications for Construction."

The following recommendations assume that maintenance repairs such as joint sealing, patching, and overlays are regularly performed throughout the lifespan of the pavement and that proper drainage has been established throughout the site. Proper drainage may include the installation of stormwater controls, underdrains, and establishing positive drainage in the subgrade and pavement layers.

Table 2: Recommended Pavement Sections

Pavement Cross Section Materials	Standard Duty		Heavy Duty	
	Material	Thickness (in)	Material	Thickness (in)
HMA Wearing Course	4EML	2.0	4EML	2.5
HMA Base Course	4EML	2.0	4EML	2.5
Aggregate Base	21AA Crushed Limestone	8.0	21AA Crushed Limestone	10.0
Sand Subbase	Class II	12.0	Class II	12.0

The recommended asphaltic binder is PG 64-28. Tier 1 recycled asphalt (RAP) specifications may be used in combination with the PG 64-28 binder for the wearing course. Tier 2 RAP specifications may be used for the base course. A softer binder is required to achieve desired performance characteristics when utilizing Tier 2 RAP contents, per the MDOT Special Provision for Recycled Asphalt Pavement. The compacted asphalt should be between 94.0 and 97.0 percent of the Theoretical Maximum Density, as determined via the Superpave "Rice" Method. The target void content should be 3.5 percent for both the base and wearing course. A tack or "bond coat" of SS-1h emulsion shall be applied between the base and wearing course layers at a rate of 0.1 gallons per square yard.

The paving contractor should submit the proposed mix design to the owner for review and approval prior to placement. The HMA pavement should be placed in at least two lifts. The pavement section should be constructed in accordance with MDOT guidelines and specifications as well as applicable state and local requirements.

Paved areas that display poor workmanship, which may include segregation, “cold screed scrapes”, wearing courses not flush with curbs or rims, roller marks, shoving, smearing or tearing of the mat, flushing, or excessive cold joints should be repaired or replaced by the contractor immediately.

Pavement subgrade, subbase, and aggregate base should be proof rolled using a fully loaded tri-axle dump truck prior to aggregate base and pavement placement. The proof roll should be performed in accordance with the recommendations in the “Site& Subgrade Preparation” section of this report. The in-situ soil is not suitable for use as a subbase material. The site may require undercutting or subgrade stabilization prior to placing sand subbase and aggregate base layer.

The pavement section should be constructed in accordance with MDOT guidelines and specifications as well as applicable state and local requirements. Support conditions and compaction should be assessed during construction in accordance with the “Quality Control and Testing” section of this report. This assessment should occur prior to the installation of individual pavement layers.

Portland Cement Concrete (PCC) Pavement

The subgrade should be prepared in accordance with the “Site & Subgrade Preparation” and “Fill” sections of this report. A modulus of subgrade reaction of 130 pounds per cubic inch is recommended for the design of slabs on grade, provided the recommendations in this report are observed. The paving contractor should submit the proposed mix design to the owner for review and approval prior to concrete placement

A base of 12.0 inches of clean sand or aggregate is recommended under the slab on grade concrete pavement. The base thickness may be reduced to 6.0 inches for sidewalk slabs. The sand or aggregate should meet MDOT Class II or 21AA specifications, respectively. The in-situ soil is not suitable for use as a base material. A minimum slab on grade concrete pavement thickness of 4.0 to 6.0 inches is recommended for standard and heavy-duty concrete pavement. In areas of dumpster pads, the minimum recommended thickness should be increased to 8.0 inches. The final pavement design and reinforcing, if necessary, should be based on site-specific loading conditions. The recommended minimum concrete pavement thickness is 4.0 inches for sidewalks surrounded by greenbelt and 5.0 inches for revealed-face slabs.

Quality Control Testing

Compaction tests, in accordance with ASTM D 6938, are recommended to confirm that sand and fill are compacted to the specified density. While fill is being placed, compaction tests should be performed at the rate of one test per 400 cubic yards of fill and throughout the depth of the fill with a minimum of five tests at each 1.0-foot elevation interval. Full time inspection is recommended while sand and fill are compacted in the building area. Compaction tests should be performed under foundations at the rate of one test per 50 linear feet for wall foundations and one test per column foundation. The recommended testing frequency in the floor and pavement subgrade is one test per 2,500 square feet. Tests should also be performed in the backfill over foundations and utilities. The maximum density should be determined in accordance with ASTM D 1557 or ASTM D 4253 procedures.

Unless otherwise specified in the design documents, the following testing procedures and frequencies should be observed for HMA and slab on grade concrete. Both asphalt and concrete quality testing should adhere to the 2020 MDOT Standards for Construction.

Asphalt temperatures during placement should be at least 275 degrees Fahrenheit; material that arrives at temperatures below 250 degrees Fahrenheit shall be rejected. Asphalt density testing should be performed with a nuclear density gauge at a minimum rate of one test per 500 square feet of pavement. At least five total verification cores in each course are recommended to assess relative compaction, calibrate the nuclear density gauge, and evaluate thickness. A minimum of two loose mix samples per mix per day should be taken at the plant and delivered to the quality-assurance firm's laboratory for vacuum extraction-gradations. The asphalt contractor should provide a minimum of two (2) theoretical maximum density verifications per day.

Concrete testing should be performed by a certified concrete technician (MCA Michigan Level I or II). One set of concrete tests should be performed for every fifty (50) cubic yards of concrete placed. Concrete should be sampled in accordance with ASTM C172. A set of concrete tests should consist of a concrete slump, air content, and concrete temperature. Slump testing should be performed in accordance with ASTM C143. Air content testing should be performed in accordance with ASTM C231. Concrete temperature testing should be performed in accordance with ASTM C1064. Air temperature should also be recorded at the time of testing. At the time of testing, a set of test cylinders should be molded as well. A minimum of two (2) test cylinders should be molded per cylinder set for 28-day compressive strength testing. Test cylinders should be prepared in accordance with ASTM C31 and tested in accordance with ASTM C39.

A smooth 0.5 to 0.75-inch diameter rod should be used in conjunction with compaction tests to probe for loose areas under foundations, in fill, and under floors. A dynamic cone should not be substituted for compaction tests for evaluating fill. Testing should be performed by technicians supervised by a registered geotechnical engineer.

General Conditions & Reliance

The report was prepared in accordance with generally accepted practices of the geotechnical engineering profession. The scope of work consisted of performing ten (10) test borings and providing soil related recommendations for the design and construction of the proposed building addition and pavement. The scope of work did not include an environmental study or wetland determination.

The report and the associated test borings were prepared specifically for the previously described project and site. Soils & Structures should be consulted if a significant change in the scope of the project is made.

The test borings represent point information and may not have encountered all of the soil types and materials present on this site. This report does not constitute a guarantee of the soil or groundwater conditions or that the test borings are an exact representation of the soil or groundwater conditions at all points on this site.

The descriptions and recommendations contained in this report are based on an interpretation of the test borings and laboratory tests. The test borings should not be used independently of the report. If soil conditions are encountered which are significantly different from the test borings, Soils & Structures should be consulted for additional recommendations.

The report and test borings may be relied upon by Nowak & Fraus Engineers for the design, construction, permitting, and financing associated with the Jackson (West) Armory project located at 2700 West Argyle in Blackman Charter Township, Jackson County, Michigan. The use of the report and test borings by third parties not associated with this project or for other sites has not been agreed upon by Soils & Structures. Soils & Structures does not recommend or consent to third party use or reliance of the report or test borings unless allowed to review the proposed use of these materials. Unless obtained in writing, consent to third party use should not be assumed. Third parties using the report or test boring logs do so at their own risk and are offered no guarantee or promise of indemnity.

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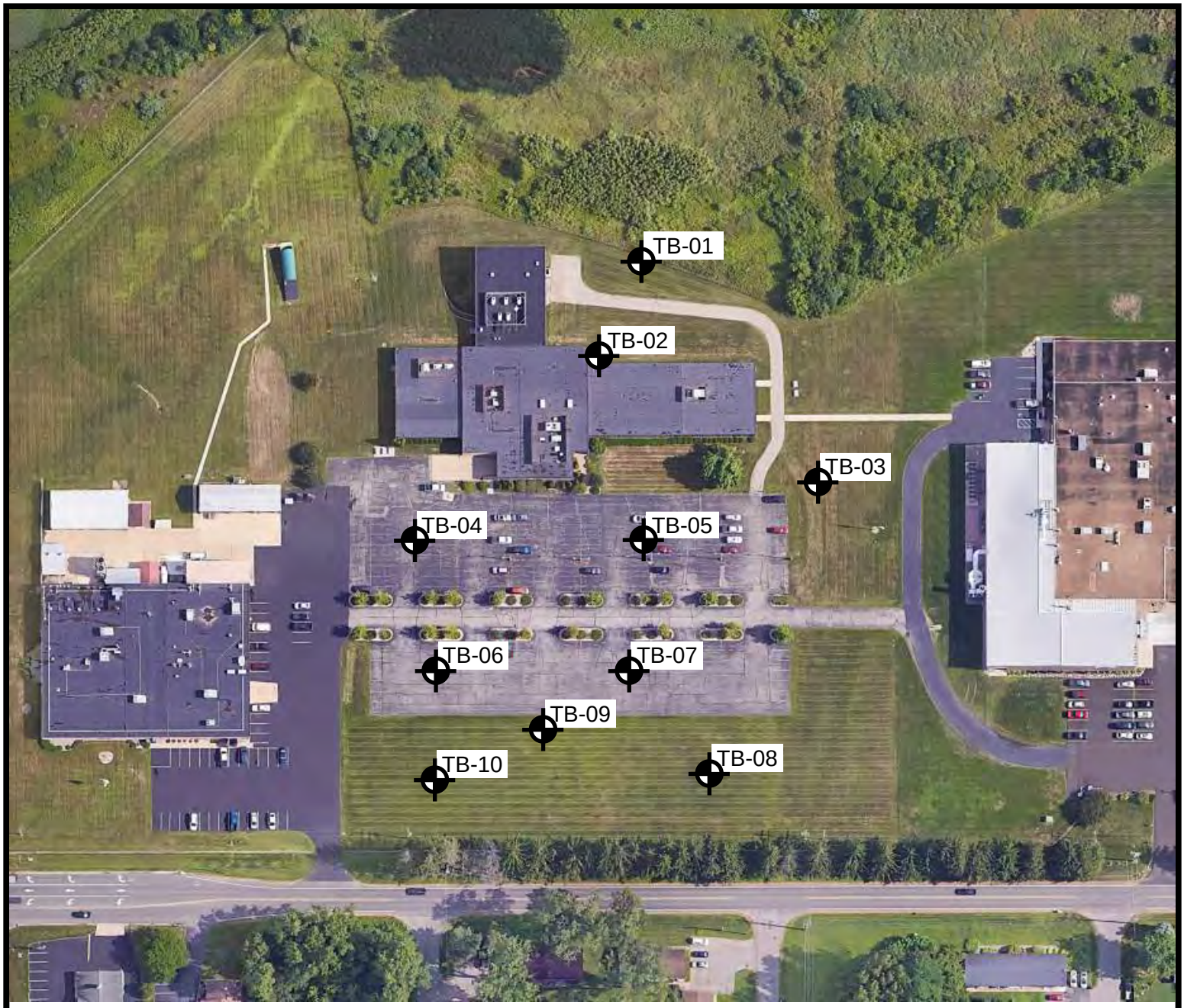
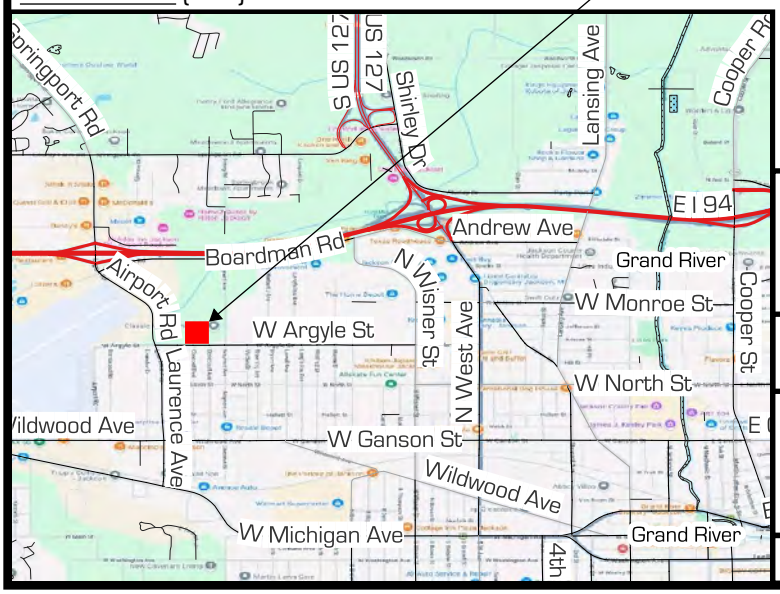
Appendix

Test Boring Location Plan
General Soil Profile
Test Boring Logs
Laboratory Tests
General Soil Information



VICINITY MAP (NTS)



TEST BORING LOCATION PLAN

NTS

Note: The background of the test boring plan is a portion of an aerial photograph from Google Earth.

Jackson (West) Armory

Blackman Charter Township, Jackson County, Michigan

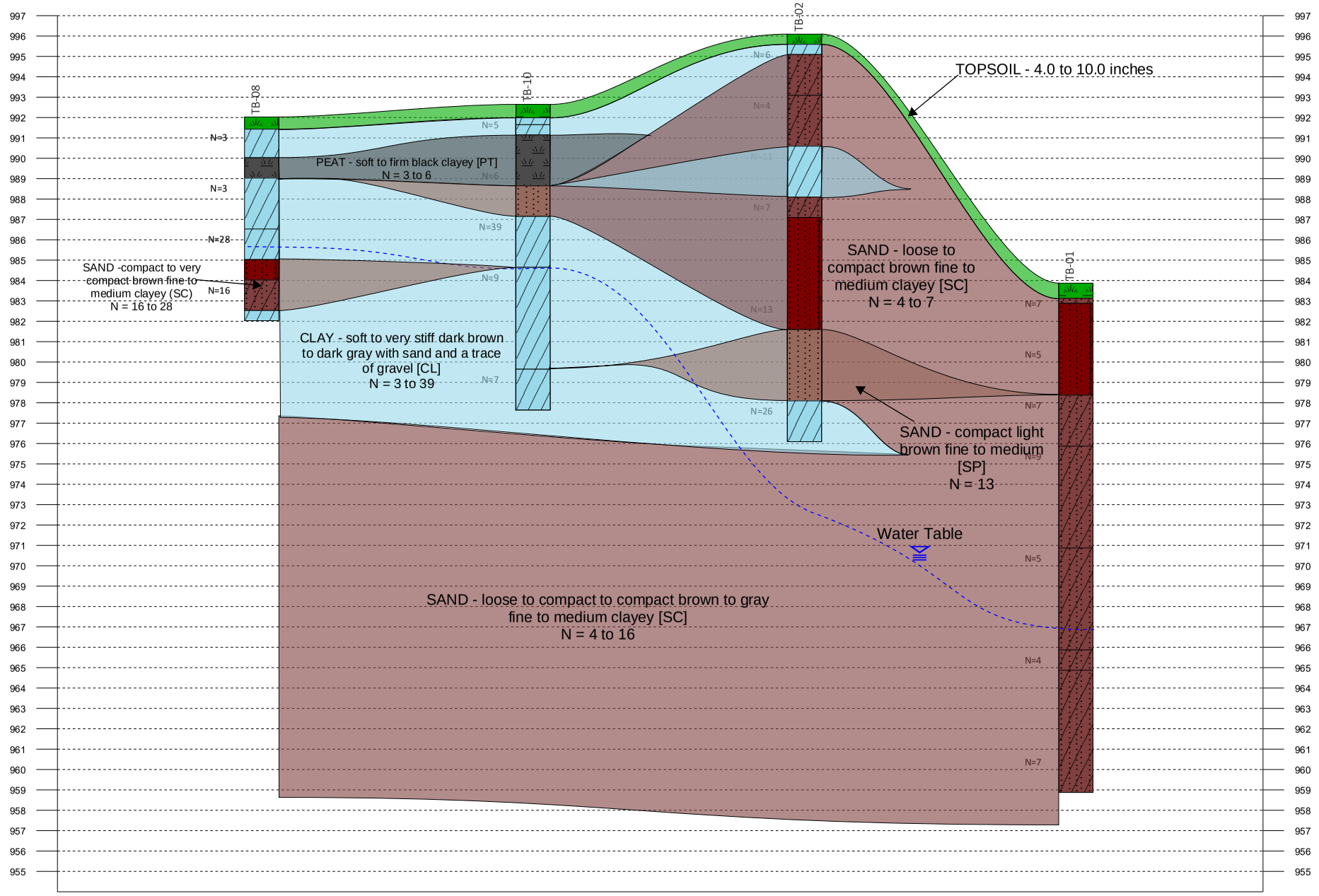
Soils & Structures, Inc.
6480 Grand Haven Road
Muskegon, Michigan 49441

JOB NO.: 25MKG-02R DATE: 03-03-2025

Project Id:	25MKG-02R	Title:	Section line 1
Project Title:	Jackson (West) Armory	Vertical Scale:	1:80
Location:	Jackson, Michigan	Horizontal Scale:	Not to scale
Client:	Nowak & Fraus Engineers	Engineer:	Madie Czajka, EIT

GENERAL SOIL PROFILE

NOTE: Groundwater encountered at depths ranging from 4.5 to 16.0 feet.



Legend Key

- Topsoil
- Lean CLAY
- CLAYEY SAND
- PEAT
- Poorly Graded SAND
- Poorly Graded SAND with CLAY

SOILS & STRUCTURES

Borehole ID: TB-01

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 25.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 278314.3
Easting: 13101915.9
Elevation: 983.87
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling 16.00' on Mar 06 2025
Notes:

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	TOPSOIL - dark brown sandy (9.0")												
1	SAND - slightly compact brown fine with clay and a trace of gravel												
2			SPT-A	100	8-4-3	7							
3													SP-
4			SPT-B	13	2-2-3	5			10.5				SC
5													
6	SAND - slightly compact gray fine to medium clayey with a trace of organics (roots)												
7			SPT-C	100	2-2-5	7			20.2				SC
8	Organic Content = 2.4% @ 6.0'												
9	SAND - compact brown fine clayey		SPT-D	100	5-5-4	9							
10													
11													SC
12													
13	SAND - slightly compact gray fine to medium clayey												
14			SPT-E	47	1-2-3	5			16.7				
15													
16													SC
17													
18	SAND - loose gray clayey with a trace of organics (peat)												SC
19			SPT-F	100	4-1-3	4			18.8				
20	Organic Content = 1.6% @ 18.5'												
21	SAND - loose to slightly compact gray fine to medium clayey with gravel												
22													SC
23													
24			SPT-G	100	7-2-5	7			14.7				
25													
26													
27													
28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-02

Sheet 1 of 1

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 20.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 278225.1
Easting: 13101876.9
Elevation: 996.09
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling: 2.00' on Mar 06 2025 - Perched Water Encountered
Notes:

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	TOPSOIL - brown clayey sandy (6.0")												
1	SAND - slightly compact gray fine to medium with lenses of clay	SPT-A	SPT-A	80	2-3-3	6			14.9				SC
2													
3	SAND - loose brown fine clayey with a trace of gravel	SPT-B	SPT-B	80	1-2-2	4							SC
4													
5													
6	CLAY - stiff brown sandy	SPT-C	SPT-C	80	4-5-6	11		0.27		18	11	7	CL
7													
8	SAND - slightly compact brown fine to medium clayey with a trace of gravel	SPT-D	SPT-D	80	5-5-2	7			13.5				SC
9													
10	SAND - slightly compact to compact brown fine to medium with clay												
11													
12													SP-SC
13													
14		SPT-E	SPT-E	80	7-5-8	13			11.0				
15	SAND - compact light brown fine to medium												
16													SP
17													
18	CLAY - very stiff gray sandy												
19		SPT-F	SPT-F	67	19-11-15	26	4.5	1.48					CL
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-03

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 278103.9
Easting: 13102087.6
Elevation: 995.48
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling: Mar 06 2025 - Water Not Encountered
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
		TOPSOIL - brown sandy (10.0")												
1		SAND - slightly compact brown fine clayey												
2				SPT-A	80	2-2-3	5			12.7				SC
3		CLAY - firm brown sandy												
4				SPT-B	100	3-2-3	5			11.3				CL
5														
6		CLAY - soft dark brown sandy with a trace of organics (roots)												
7				SPT-C	100	0-1-2	3			17.9				CL
8		Organic Content = 2.8% @ 6.0'												
9		SAND - loose to slightly compact brown fine with clay		SPT-D	100	2-2-3	5			16.1				SP-SC
10														
11														
12														
13														
14														
15														
16														
17														
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30														

SOILS & STRUCTURES

Borehole ID: TB-04

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 278048.7
Easting: 13101694.3
Elevation: 996.69
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling: Mar 06 2025 - Water Not Encountered
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0		ASPHALT - (5.0")												SP-SC
1		SAND - brown fine to medium with clay and a trace of gravel												
2				SPT-A	87	1-1-1	2			10.5				SC
3		SAND - loose brown fine clayey												
4		SAND - loose brown fine clayey with a trace of gravel		SPT-B	73	1-1-1	2			10.8				SC
5														
6		SAND - slightly compact brown fine to medium clayey												
7				SPT-C	80	2-3-4	7							SC
8		SAND - compact brown fine to medium clayey												
9				SPT-D	13	6-10-9	19			10.8				SC
10														
11														
12														
13														
14														
15														
16														
17														
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SOILS & STRUCTURES

Borehole ID: TB-05

Sheet 1 of 1

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 278047.4
Easting: 13101915.4
Elevation: 995.90
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling: Mar 06 2025 - Water Not Encountered
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0		ASPHALT - (7.0")												
1		CLAY - brown sandy with a trace of gravel												CL
2		CLAY - firm brown sandy		SPT-A	100	2-3-4	7	0.8						
3														CL
4				SPT-B	100	4-3-4	7			11.7				
5														
6		SAND - slightly compact brown fine to medium clayey												
7				SPT-C	80	2-2-5	7			12.3				SC
8		SAND - compact fine to medium with a trace of gravel												
9				SPT-D	80	4-6-7	13			4.5				SP
10														
11														
12														
13														
14														
15														
16														
17														
18														
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SOILS & STRUCTURES

Borehole ID: TB-06

Sheet 1 of 1

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 277921.7
Easting: 13101714.2
Elevation: 995.23
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling 8.50' on Mar 06 2025
Notes:

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	ASPHALT - (3.0")												SP-
1	SAND - brown fine to medium with clay and gravel (4.0")												SC
2			SPT-A	100	2-2-2	4			12.6				
3	SAND - loose to slightly compact brown fine to medium clayey												SC
4			SPT-B	100	4-3-2	5			12.7				
5													
6	CLAY - stiff gray sandy with a trace of gravel												CL
7			SPT-C	100	4-5-4	9							
8	SAND - compact brown fine to medium												SP
9	SAND - compact brown fine to coarse gravelly		SPT-D	100	4-5-5	10			10.8				SP
10													
11													
12													
13													
14													
15													
16													
17													
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27													
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29													
30													

SOILS & STRUCTURES

Borehole ID: TB-07

Sheet 1 of 1

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 277921.0
Easting: 13101902.0
Elevation: 994.15
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling: 2.00' on Mar 06 2025 - Perched Water Encountered
Notes:
End of Drilling: 5.50' on Mar 03 2025

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	ASPHALT - (3.0")												SP-
1	SAND - brown fine to medium with clay gravelly (5.0")												SC
2			SPT-A	100	1-2-2	4	0.1		14.2				CL
3	CLAY - gray gravelly with sand												CL
4	CLAY - soft brown sandy CLAY - firm brown sandy with lenses of sand		SPT-B	67	4-2-3	5			11.5				CL
5													
6	CLAY - stiff gray sandy												
7			SPT-C	87	5-7-6	13							CL
8													
9	SAND - compact brown fine to medium clayey		SPT-D	100	19-12-14	26			14.2				SC
10	SAND - compact brown fine to coarse clayey gravelly												SC
11													
12													
13													
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SOILS & STRUCTURES

Borehole ID: TB-08

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 277819.4
Easting: 13101981.1
Elevation: 992.03
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling 5.00' on Mar 06 2025
Notes:
End of Drilling 6.50' on Mar 06 2025

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1	TOPSOIL - brown clayey with a trace of sand (7.0")												
2	CLAY - soft sandy		SPT-A	73	2-1-2	3			44.5				CL
3	PEAT - soft black clayey												PT
4	Organic Content = 16.6% @ 2.0'		SPT-B	67	2-2-1	3							CL
5	CLAY - soft brown sandy												
6	CLAY - very stiff brown with a trace of gravel sandy												CL
7			SPT-C	73	7-12-16	28			19.5				
8	SAND - very compact brown fine to coarse with clay and a trace of gravel												SP-SC
9	SAND - compact brown fine to medium clayey		SPT-D	27	11-12-4	16			16.8				SC
10	CLAY - compact dark gray sandy												CL
11													
12													
13													
14													
15													
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SOILS & STRUCTURES

Borehole ID: TB-09

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka **Reviewed By:** K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 10.00
Date Started: Mar 06 2025 **Completed:** Mar 06 2025
Northing: 277865.1 **Easting:** 13101817.8 **Elevation:** 993.19
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
At Time of Drilling 4.50' on Mar 06 2025
Notes:
End of Drilling 8.50' on Mar 06 2025

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1	TOPSOIL - dark brown clayey (4.0")												
2	CLAY - soft brown sandy with a trace of organics	SPT-A	SPT-A	100	1-1-2	3	0.2		16.1				CL
3	Organic Content = 1.0% @ 1.0'												PT
4	PEAT - soft black clayey	SPT-B	SPT-B	80	1-2-2	4			27.9				CL
5	CLAY - soft brown with sand												SC
6	SAND - brown fine to medium clayey												
7	CLAY - very stiff dark brown sandy gravelly with a trace of organics (peat)	SPT-C	SPT-C	27	9-14-16	30			17.6				
8													CL
9	Organic Content = 2.2% @ 6.0'	SPT-D	SPT-D	0	6-8-11	19							
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
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28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-10

Project Name: Jackson (West) Armory
Project Number: 25MKG-02R
Project Location: Jackson, Michigan
Logged By: M Czajka
Reviewed By: K Martella
Client: Nowak & Fraus Engineers
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 15.00
Date Started: Mar 06 2025
Completed: Mar 06 2025
Northing: 277815.5
Easting: 13101714.4
Elevation: 992.65
Drilling Method: 3.25" Hollow Stem Auger
Frost Depth
Equipment:
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 8.00' on Mar 06 2025

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0		TOPSOIL - dark brown clayey (8.0")												
1		CLAY - firm brown sandy with a trace of organics (roots)												CL
2				SPT-A	80	1-2-3	5			21.2				
3		Organic Content = 3.9% @ 1.0'												PT
4		PEAT - firm black clayey		SPT-B	87	3-3-3	6			28.6				
5		SAND - slightly compact brown fine to medium with a trace of clay												SP
6		CLAY - very stiff dark brown sandy with gravel and a trace of organics (peat)		SPT-C	80	4-14-25	39			13.3				CL
7														
8		Organic Content = 1.8% @ 6.0'												
9		CLAY - stiff brown sandy with lenses of sand and a trace of organics (peat)		SPT-D	80	15-6-3	9			15.1				
10														CL
11														
12		Organic Content = 1.6% @ 8.5'												
13		CLAY - firm gray sandy												
14				SPT-E	80	3-2-5	7							CL
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

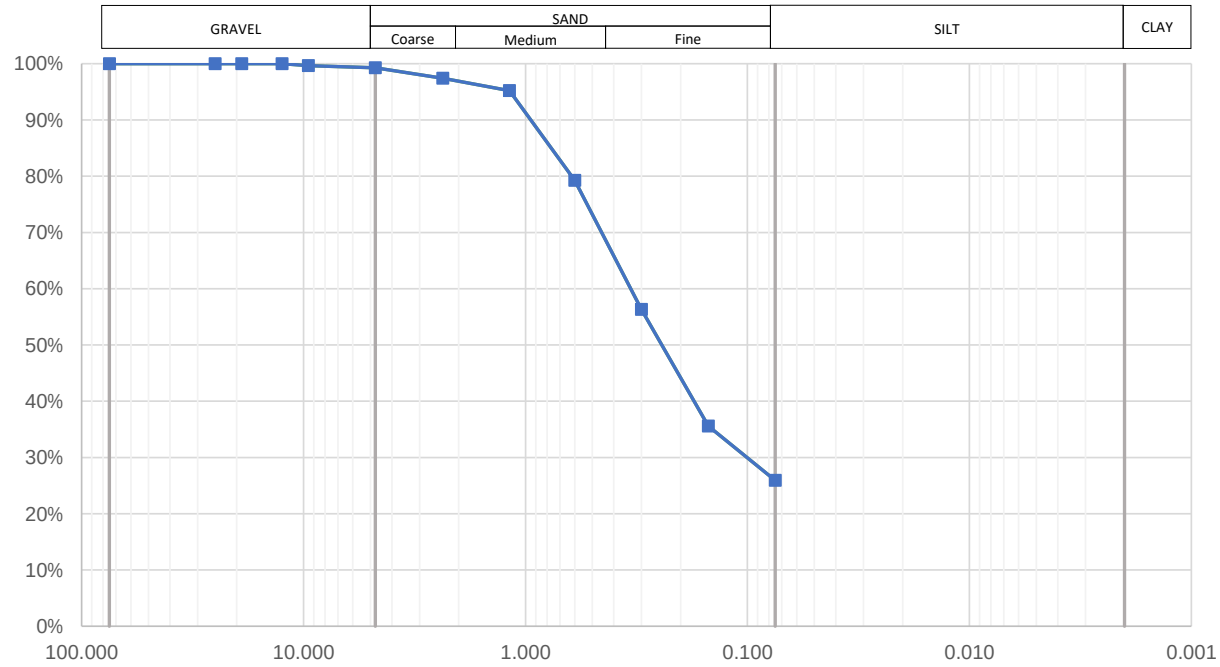
SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Jackson (West) Armory
Project Number	25MKG-02R
Client	Nowak & Fraus Engineers
Date	3/28/2025
Sample Location	TB-02

Sample ID A

Depth (ft) 1.0



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	0.7%	2.5%	30.9%	39.9%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
0.8091	0.3484	0.2545	0.1067	0.0434	0.0289	25.9%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	99%
No. 8	97%
No. 16	95%
No. 30	79%
No. 50	56%
No. 100	36%
No. 200	25.9%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description
Fine to Medium Clayey SAND (SC)

Remarks

Technician
bfritz

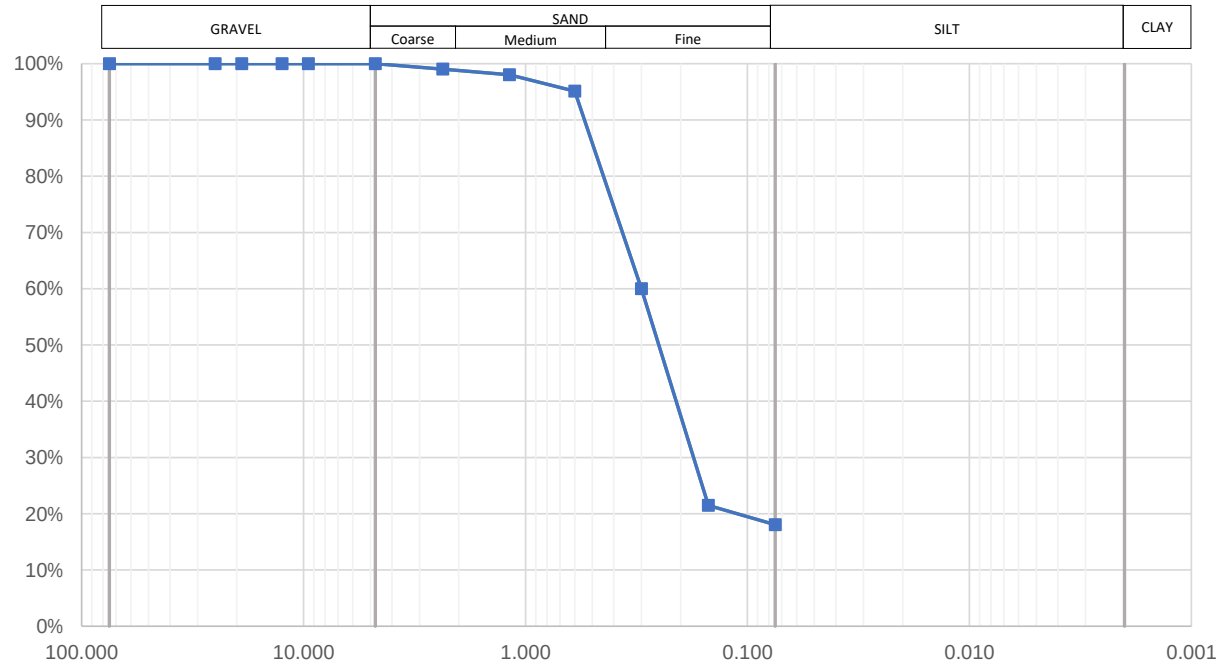
Checked

Approved
mvanweelden

SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Jackson (West) Armory				
Project Number	25MKG-02R				
Client	Nowak & Fraus Engineers				
Date	3/28/2025				
Sample Location	TB-06	Sample ID	B	Depth (ft)	3.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	0.0%	1.3%	24.1%	56.6%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
0.5135	0.3000	0.2611	0.1832	0.0623	0.0416	18.0%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	100%
No. 8	99%
No. 16	98%
No. 30	95%
No. 50	60%
No. 100	21%
No. 200	18.0%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description
Fine to Medium Clayey SAND (SC)

Remarks

Technician
bfritz

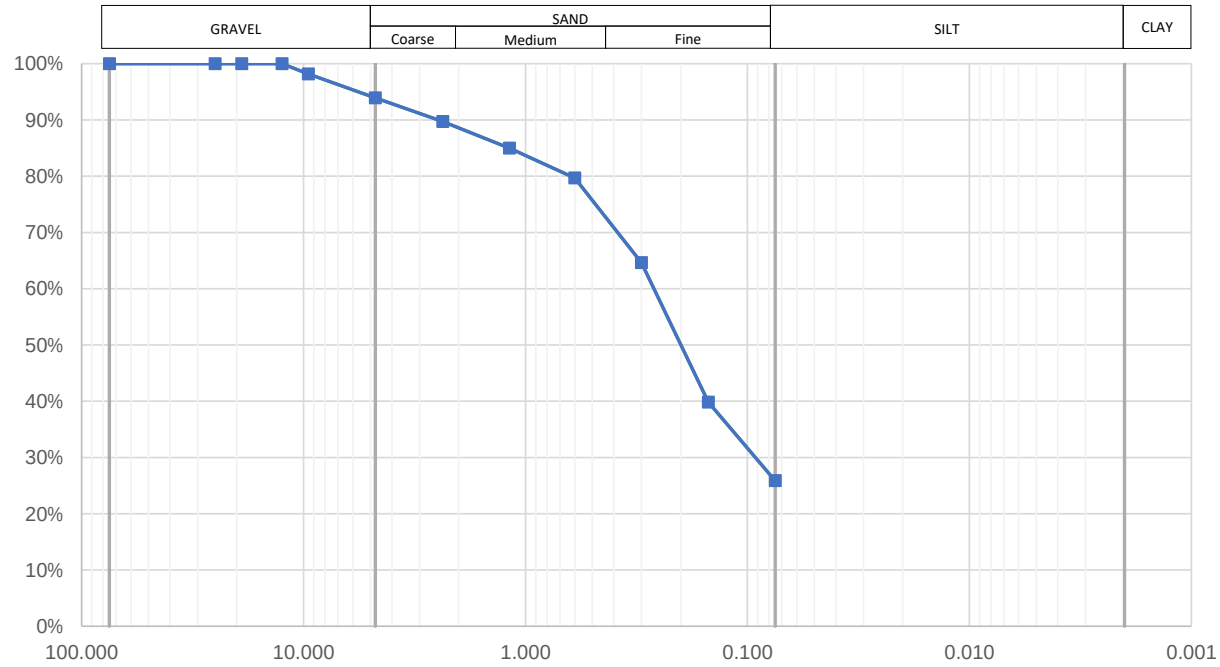
Checked

Approved
mvanweelden

SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Jackson (West) Armory				
Project Number	25MKG-02R				
Client	Nowak & Fraus Engineers				
Date	3/28/2025				
Sample Location	TB-02	Sample ID	D	Depth (ft)	8.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	6.1%	5.7%	17.4%	45.1%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
1.1898	0.2719	0.2114	0.0972	0.0435	0.0290	25.9%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	98%
No. 4	94%
No. 8	90%
No. 16	85%
No. 30	80%
No. 50	65%
No. 100	40%
No. 200	25.9%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description
Fine to Medium Clayey SAND with a Trace of Gravel (SC)

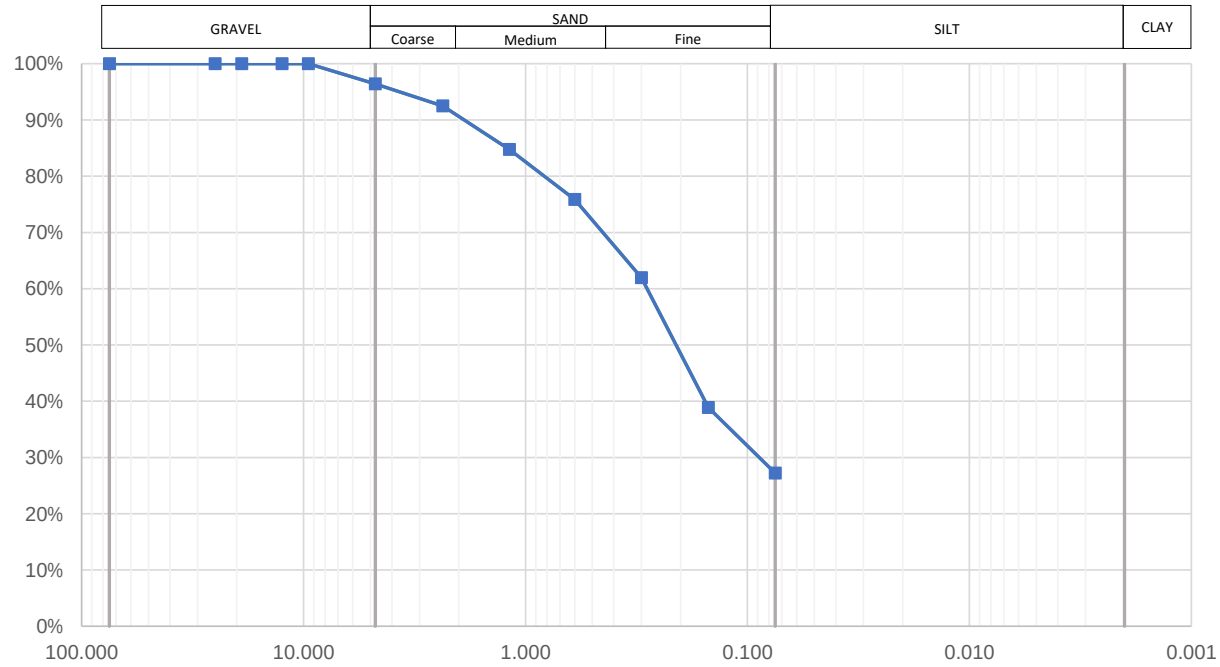
Remarks

Technician	Checked	Approved
bfritz		mvanweelden

SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Jackson (West) Armory				
Project Number	25MKG-02R				
Client	Nowak & Fraus Engineers				
Date	3/28/2025				
Sample Location	TB-01	Sample ID	E	Depth (ft)	13.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	3.6%	6.3%	22.4%	40.5%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
1.2221	0.2873	0.2223	0.0929	0.0413	0.0276	27.2%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	96%
No. 8	93%
No. 16	85%
No. 30	76%
No. 50	62%
No. 100	39%
No. 200	27.2%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description
Fine to Medium Clayey SAND (SC)

Remarks

Technician
bfritz

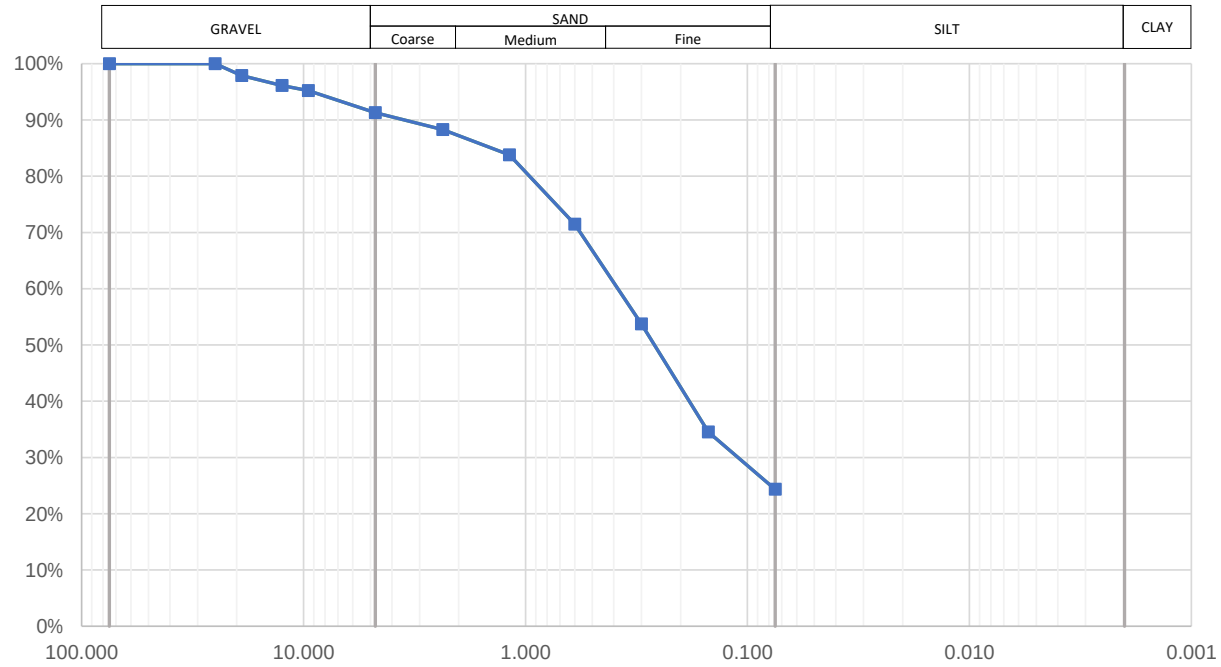
Checked

Approved
mvanweelden

SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Jackson (West) Armory				
Project Number	25MKG-02R				
Client	Nowak & Fraus Engineers				
Date	3/28/2025				
Sample Location	TB-01	Sample ID	G	Depth (ft)	23.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	2.1%	6.6%	4.4%	25.8%	36.8%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
1.4986	0.4058	0.2707	0.1167	0.0463	0.0308	24.3%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	98%
1/2 in.	96%
3/8 in.	95%
No. 4	91%
No. 8	88%
No. 16	84%
No. 30	71%
No. 50	54%
No. 100	35%
No. 200	24.3%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description
Fine to Medium Clayey SAND with Gravel (SC)

Remarks

Technician
bfritz

Checked

Approved
mvanweelden

SOILS & STRUCTURES

Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name	Jackson (West) Armory
Project Number	25MKG-02R
Client	Nowak & Fraus Engineers
Date	3/28/2025

Sample Location		TB-02	TB-03	TB-04	TB-06	TB-07
Sample ID		A	A	A	A	A
Depth	ft	1.0	1.0	1.0	1.0	1.0
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	388.70	10.70	10.54	10.61	10.52
Mass of Wet Soil and Container	g	699.10	82.89	82.30	82.58	82.34
Accepted Dry mass + container	g	658.80	74.75	75.50	74.54	73.41
Water Content	%	14.9	12.7	10.5	12.6	14.2
Remarks						

Sample Location		TB-10	TB-09	TB-07	TB-06	TB-05
Sample ID		B	B	B	B	B
Depth	ft	3.5	3.5	3.5	3.5	3.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.56	10.57	10.62	392.60	10.55
Mass of Wet Soil and Container	g	82.40	82.58	82.36	623.20	82.64
Accepted Dry mass + container	g	66.44	66.87	74.96	597.20	75.11
Water Content	%	28.6	27.9	11.5	12.7	11.7
Remarks						

Sample Location		TB-04	TB-01	TB-03	TB-05	TB-08
Sample ID		B	B	B	C	C
Depth	ft	3.5	3.5	3.5	6.0	6.0
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.42	10.51	10.62	10.62	10.50
Mass of Wet Soil and Container	g	82.39	82.54	82.28	82.24	82.42
Accepted Dry mass + container	g	75.39	75.69	75.00	74.41	70.70
Water Content	%	10.8	10.5	11.3	12.3	19.5
Remarks						

Technician
mvanweelden

Checked

Approved
mvanweelden

SOILS & STRUCTURES

Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name	Jackson (West) Armory
Project Number	25MKG-02R
Client	Nowak & Fraus Engineers
Date	3/28/2025

Sample Location		TB-08	TB-07	TB-05	TB-06	TB-04
Sample ID		D	D	D	D	D
Depth	ft	8.5	8.5	8.5	8.5	8.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.67	10.60	10.49	10.50	10.51
Mass of Wet Soil and Container	g	82.87	82.67	82.13	82.69	82.57
Accepted Dry mass + container	g	72.46	73.73	79.02	75.68	75.52
Water Content	%	16.8	14.2	4.5	10.8	10.8
Remarks						

Sample Location		TB-02	TB-03	TB-02	TB-01	TB-01
Sample ID		D	D	E	E	G
Depth	ft	8.5	8.5	13.5	13.5	23.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	382.50	10.68	10.37	386.80	357.40
Mass of Wet Soil and Container	g	812.20	82.72	82.39	807.40	739.40
Accepted Dry mass + container	g	761.10	72.71	75.25	747.10	690.40
Water Content	%	13.5	16.1	11.0	16.7	14.7
Remarks						

Sample Location						
Sample ID						
Depth	ft					
Sample Type						
Mass of Container	g					
Mass of Wet Soil and Container	g					
Accepted Dry mass + container	g					
Water Content	%					
Remarks						

Technician
mvanweelden

Checked

Approved
mvanweelden

SOILS & STRUCTURES

Organic Content

ASTM D2974

Project Name	Jackson (West) Armory
Job Number	25MKG-02R
Client	Nowak & Fraus Engineers
Date	4/1/2025

Sample Location		TB-08	TB-09	TB-10	TB-03
Sample ID		A	A	A	C
Depth	ft	1.0	1.0	1.0	6.0
Sample Type		SPT	SPT	SPT	SPT
Material Description		PEAT - soft black clayey	CLAY - soft brown sandy	CLAY - firm brown sandy with organics (roots)	CLAY - soft dark brown sandy with organics (roots)
Container Weight	g	325.2	302.0	379.0	312.6
Weight of Wet Soil & Container	g	412.2	572.7	688.4	513.1
Weight of Dry Soil & Container	g	385.4	535.1	634.3	482.7
Weight of Burnt Soil & Container	g	375.4	532.8	624.3	478.0
Weight of Wet Soil	g	87.0	270.7	309.4	200.5
Weight of Dry Soil	g	60.2	233.1	255.3	170.1
Weight of Burnt Soil	g	50.2	230.8	245.3	165.4
Percent Moisture		44.5%	16.1%	21.2%	17.9%
Organic Content		16.6%	1.0%	3.9%	2.8%
Remarks					

Sample Location		TB-09	TB-01	TB-10	TB-10
Sample ID		C	C	C	D
Depth	ft	6.0	6.0	6.0	8.5
Sample Type		SPT	SPT	SPT	SPT
Material Description		CLAY - very stiff dark brown sandy gravelly with organics (peat)	SAND - slightly compact gray fine to medium clayey with a trace of organics (roots)	CLAY - very stiff dark brown sandy with gravel and organics (peat)	CLAY - stiff brown sandy with lenses of sand and organics (peat)
Container Weight	g	324.4	390.2	313.9	390.3
Weight of Wet Soil & Container	g	576.3	736.3	675.7	735.7
Weight of Dry Soil & Container	g	538.6	678.1	633.2	690.3
Weight of Burnt Soil & Container	g	533.8	671.3	627.3	685.6
Weight of Wet Soil	g	251.9	346.1	361.8	345.4
Weight of Dry Soil	g	214.2	287.9	319.3	300.0
Weight of Burnt Soil	g	209.4	281.1	313.4	295.3
Percent Moisture		17.6%	20.2%	13.3%	15.1%
Organic Content		2.2%	2.4%	1.8%	1.6%
Remarks					

Technician	Checked	Approved
mvanweelden		mvanweelden

SOILS & STRUCTURES

Organic Content

ASTM D2974

Project Name	Jackson (West) Armory
Job Number	25MKG-02R
Client	Nowak & Fraus Engineers
Date	4/1/2025

Sample Location		TB-01			
Sample ID		F			
Depth	ft	18.5			
Sample Type		SPT			
Material Description		SAND - loose gray clayey with organics (peat)			
Container Weight	g	359.6			
Weight of Wet Soil & Container	g	798.1			
Weight of Dry Soil & Container	g	728.7			
Weight of Burnt Soil & Container	g	722.9			
Weight of Wet Soil	g	438.5			
Weight of Dry Soil	g	369.1			
Weight of Burnt Soil	g	363.3			
Percent Moisture		18.8%			
Organic Content		1.6%			
Remarks					

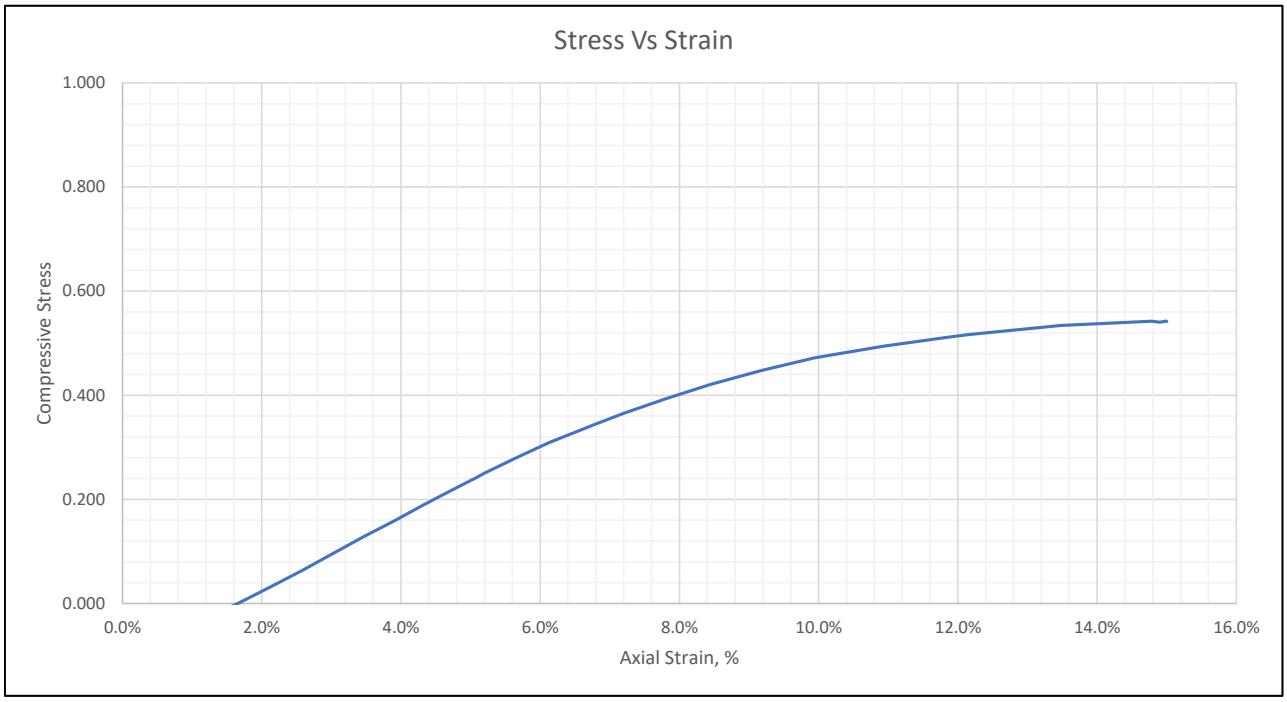
Sample Location					
Sample ID					
Depth	ft				
Sample Type					
Material Description					
Container Weight	g				
Weight of Wet Soil & Container	g				
Weight of Dry Soil & Container	g				
Weight of Burnt Soil & Container	g				
Weight of Wet Soil	g				
Weight of Dry Soil	g				
Weight of Burnt Soil	g				
Percent Moisture					
Organic Content					
Remarks					

Technician	Checked	Approved
mvanweelden		mvanweelden

SOILS & STRUCTURES

Unconfined Compressive Strength
ASTM D2166

Project Name	Jackson (West) Armory				
Project Number	25MKG-02R				
Date	3/28/2025				
Client	Nowak & Fraus Engineers				
Sample Location	TB-02	Sample ID	C	Depth (ft)	6.0



Sample ID	C
Unconfined Strength (tsf)	0.543
Undrained Shear Strength (tsf)	0.271
Failure Strain (%)	15.0%
Strain Rate, (in/min)	0.055
Moisture Content	14.6%
Wet Density (pcf)	137.0
Dry Density (pcf)	119.6
Void Ratio	0.3984
Saturation (%)	98.0%
Specimen Diameter (in)	1.46
Specimen Height (in)	3.00
Height/Diameter Ratio	2.05

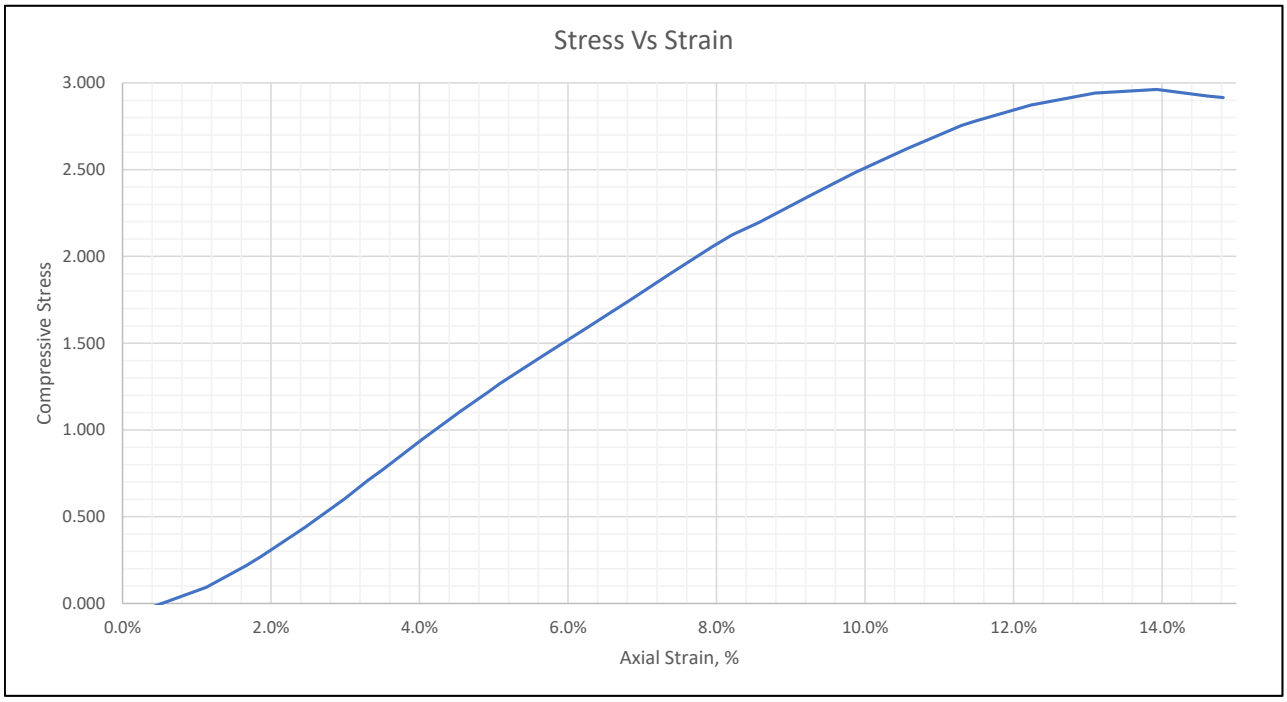
Remarks

Technician	Checked	Approved
mvanweelden		mvanweelden

SOILS & STRUCTURES

Unconfined Compressive Strength
ASTM D2166

Project Name	Jackson (West) Armory				
Project Number	25MKG-02R				
Date	3/28/2025				
Client	Nowak & Fraus Engineers				
Sample Location	TB-02	Sample ID	F	Depth (ft)	18.5



Sample ID	F
Unconfined Strength (tsf)	2.962
Undrained Shear Strength (tsf)	1.481
Failure Strain (%)	13.9%
Strain Rate, (in/min)	0.055
Moisture Content	9.5%
Wet Density (pcf)	145.1
Dry Density (pcf)	132.5
Void Ratio	0.2622
Saturation (%)	97.5%
Specimen Diameter (in)	1.44
Specimen Height (in)	3.09
Height/Diameter Ratio	2.15

Remarks

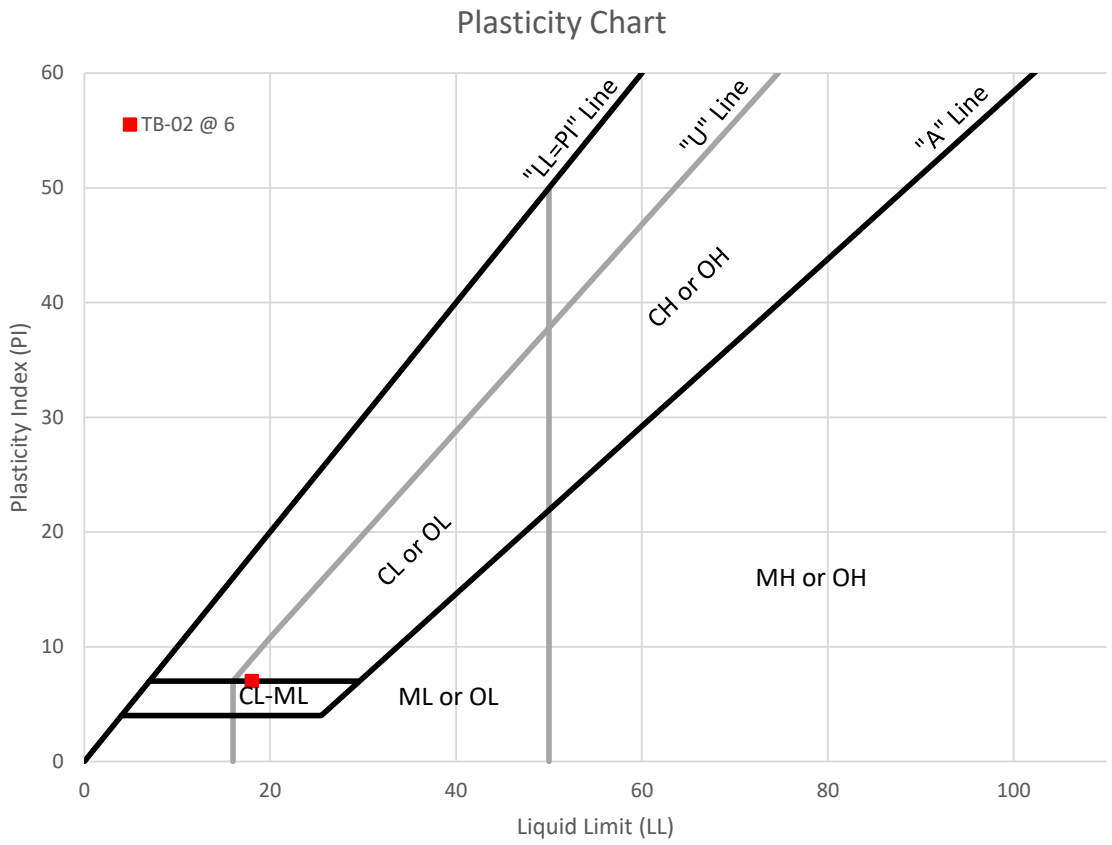
Technician	Checked	Approved
mvanweelden		mvanweelden

SOILS & STRUCTURES

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318-10, Multipoint Test

Project Name	Jackson (West) Armory				
Project Number	25MKG-02R				
Client	Nowak & Fraus Engineers				
Date	3/28/2025				
Sample Location	TB-02	Sample ID	C	Depth (ft)	6
Sample Description					

		Liquid Limit			Plastic Limit	
Mass of container	g	11.20	11.62	11.72	11.32	11.44
Mass of wet soil and container	g	30.74	33.20	38.78	18.42	18.28
Mass of dry soil and container	g	27.93	29.88	34.41	17.71	17.58
Water Content	%	16.80	18.18	19.26	11.11	11.40
					Average PL	
					11	
		25 - 35	20 - 30	15 - 25		
No. of blows, N		35	26	15		



Remarks

LIQUID LIMIT	**18**
PLASTIC LIMIT	**11**
PLASTICITY INDEX	**7**

Technician	Checked	Approved
mvanweelden		mvanweelden

SOILS & STRUCTURES

General Information for Method of Field Investigation

The soil investigation was performed in accordance with the American Society of Testing and Materials method ASTM D 1586, which is the "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". Samples of compressible clays or organic soils are obtained in accordance with ASTM D 1587, which is the "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes." Rock may be cored in conjunction with the above methods as specified in ASTM D 2113 which is the "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation."

Field Testing

Standard Penetration Tests (SPT) in accordance with ASTM D 1586 were generally performed at depths of 2.0', 4.5', 7.0', 9.5' and 5.0' intervals thereafter.

Laboratory Testing

Samples obtained from the Standard Penetration Test, ASTM D 1586 or thin walled tube method, ASTM D 1587, were tested in the laboratory for the moisture content and density and/or particle size, where applicable. When soils sampled possessed sufficient cohesive properties, it was tested for its compressive strength in the unconfined state.

Natural Percent Moisture content (N.P.M.) of the soil is the percentage by weight of water contained in the soil sample compared to the dry weight of the solids of which the soil is composed. The NPM of select samples is determined in accordance with ASTM D 2216.

Natural Density (N.D.) of soil as reported on the appended boring logs is the natural wet density of the soils expressed in pounds per cubic foot.

The unconfined compressive strength of cohesive soils is determined in the laboratory on "undisturbed" select samples in accordance with ASTM D 2166. This test determines the maximum load required at a specified rate to deform the cohesive soil specimen length twenty (20%) percent. The primary purpose of the unconfined compression test is to obtain approximate quantitative values of the compressive strength of soils possessing sufficient coherence to permit testing in the unconfined state. The shear strength of the cohesive soil can be calculated from the results of the unconfined compressive strength test.

Color

When the color of the soils is uniform throughout, the color recorded will be such as brown, gray, and black and may be modified by adjectives such as light and dark. If the soils predominant color is shaded by secondary color, the secondary color precedes the primary color, such as gray-brown, or yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled; such as mottled brown and gray.

Water Observations

Depth of water recorded in the test boring is measured from the ground surface to the water surface. Initial depth indicates water level during boring, completing depth indicates water level immediately after boring, and depth after "X" number of hours indicates water level after allowing the groundwater rise or fall over a period of time. Water observations in pervious soils are considered reliable groundwater levels for accurate groundwater measurements at the time the test borings were performed unless records are made over several days' time. Factors such as weather, soils porosity, etc., will cause the groundwater level to fluctuate for both pervious and impervious soils.

SOILS & STRUCTURES

Sample Type

If not otherwise indicated, the sample is a split-barrel liner sample ASTM D 1586.

"S.T.' – Shelby tube sample, ASTM D 1587
"A" – disturbed augered sample
"C" – rock core sampled ASTM D 2113
N.P.M. – Natural Percent Moisture of in-situ soils sample
N.D. – Natural Density of in-situ soils sample in pcf.
S.S. – Shear Strength of cohesive soils samples as determined by the Unconfined Compression tests in ksf.

Classification Data – Laboratory data to assist in classification of soils and classification of soils characteristics; i.e., plastic limit or liquid limit

Test Boring Logs

Particle Size	**Visual**
Boulders	Larger than 12" (300 mm)
Cobbles	12" to 3" (300 to 75 mm)
Gravel - Coarse	3" to ¾ " (75 to 19 mm)
Gravel – Fine	19.0 to 4.75 mm
Sand- Coarse	4.75 to 2.0 mm
Sand - Medium	2.0 to 0.425 mm
Sand - Fine	0.425 to 0.075 mm
Silt	0.075 to 0.002 mm
Clay	0.002 mm and smaller

Soils Components

Major Component	**Minor Component**
Gravel	Trace (1 - 10%)
Sand	Some (11 - 35%)
Silt/Clay	And (36 - 50%)

Condition of Soil Relative to Compactness

Granular Material	**"N" Value**
Loose	0 - 4
Slightly Compact	5 - 7
Compact	8 - 20
Very Compact	21 - 50
Extremely Compact	51 and above

Cohesive Material	**"N" Value**
Soft	0 - 4
Firm	5 - 7
Stiff	8 - 20
Very Stiff	21 - 50
Extremely Stiff	51 and above

"N" values in clay soils are not to be used as a measure of shear strength. However, they may be used as a general indication of strength.

SOILS & STRUCTURES

Unified Soil Classification System Chart

Major Divisions			Letter Symbol	Typical Descriptions
Coarse Grained Soils More than 50% of material is larger than No. 200 sieve size	Gravel – Gravelly Soils more than 50% of coarse fraction retained on No. 4 sieve	Clean gravels (little or no fines)	GW	Well-Graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-Graded gravels, gravel-sand mixtures, little or no fines
		Gravel with Fines (appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More than 50% of coarse fraction passing No. 4 sieve	Clean Sand (little or no fines)	SW	Well-Graded sands, gravelly sands, little or no fines
			SP	Poorly-Graded sands, gravelly sands, little or no fines
		Sand with Fines (appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine Grained Soils More than 50% of material is smaller than No. 200 sieve size	Silts and Clays Liquid limit less than 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays or low plasticity
	Silts and Clays Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays or medium to high plasticity, organic silts
	Highly organic soils		PT	Peat, humus, swamp soils with high organic contents

For Laboratory Classification of Fine Grained Soil
Plasticity Chart