



MATERIALS TESTING CONSULTANTS

**REPORT OF PAVEMENT INVESTIGATION
BAY CITY STATE PARK PAVEMENTS
BANGOR CHARTER TOWNSHIP, MICHIGAN**

Prepared For:

BECKETT & RAEDER, INC.

Prepared By:

MATERIALS TESTING CONSULTANTS, INC.

December 2022
MTC Project No. 221591



MATERIALS TESTING CONSULTANTS

December 16, 2022

Project No. 221591

Beckett & Raeder, Inc.
535 West William Street, Suite 101
Ann Arbor, Michigan 48103

Attention: Kristofer Enlow, P.E.

Reference: Report of Pavement Investigation
Bay City State Park Pavements
Bangor Charter Township, Michigan

Dear Mr. Enlow:

We have completed a pavement investigation for the above-referenced project. The purpose of this investigation has been to perform discrete pavement cores and test borings in the vicinity of the proposed parking lot rehabilitation, present the results and to provide recommendations for the design and rehabilitation of pavements. This work has been performed as described in our proposal dated November 16, 2022.

Presented herein are descriptions of our understanding of the design considerations, the geotechnical investigation, encountered conditions and engineering recommendations. The Appendix contains the report limitations and data collected during this investigation.

DESIGN CONSIDERATIONS

Available Information

We have been provided the following documents and information for use in this investigation:

- A map of the park area with the day-use area noted and pavement boring plan showing the requested boring locations, provided by Mr. Kristofer Enlow, P.E. of Beckett and Raeder, Inc. on November 8, 2022.
- Plan sheets for various historical construction activities at Bay City State Park, provided by Mr. Kristofer Enlow, P.E. of Beckett and Raeder, Inc. on November 21, 2022.
- Telephone and email correspondence with Mr. Kristofer Enlow, P.E. of Beckett and Raeder, Inc. regarding the project details, boring locations and scope of investigation.



Location and Type of Structure

The project will in general consist of pavement rehabilitation in the day-use area of Bay City State Park. The park is located at address 3582 State Park Drive in Bangor Charter Township, Michigan, and the day-use area includes all pavements north of State Park Drive. The area of investigation is shown in Figure No. 1.

Traffic is expected to consist of relatively light passenger vehicles with only occasional heavier axle wheel loading from trucks for deliveries, refuse pickup, etc. We have considered that parking lots and entry drives will experience a design loading of no more than 500 vehicles per day.

We should be informed of any changes between the actual design conditions and those described herein as this information may affect our recommendations.

INVESTIGATION METHODOLOGY

Pavement cores, hand auger soil borings and sampling along with field engineering reconnaissance were used to investigate the subsurface conditions. Boring locations are shown on Figure No. 1. Investigation procedures, soil classification information and boring logs are provided in the Appendix.

Number of Borings	16
Boring Depth Range, ft.	2.9-5.1

One of our engineers staked the approximate boring locations in the field. Boring elevations and coordinates were collected by GPS. The elevations used in this report are given in feet and are based on the NAVD 88 datum, with coordinates given in the Michigan State Plane South system. Site reconnaissance was performed by our field engineer.

Borings were performed at requested locations through 4-inch diameter cores using a 3 1/4-inch diameter hand auger. Borings were attempted to 5 ft deep but occasionally met shallow refusal due to possible coarse gravel, cobble and thick roots. Grab samples were recovered from the auger at regular intervals.

The boreholes were backfilled to the original ground surface and patched at the surface with cold patch after drilling completion, where necessary. Recovered samples were sealed, labeled and transported to our laboratory. All soil samples will be discarded after sixty days unless a longer hold time is specifically requested.

Borings were drilled and other sampling was conducted solely to obtain indications of subsurface conditions as part of a geotechnical exploration program. No services were performed to evaluate subsurface environmental conditions.



Soil samples were reviewed by one of our engineers and technically classified according to the methods of ASTM D 2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)". Calibrated penetrometer tests were performed on cohesive samples to obtain an indication of unconfined compressive strength values. The ASTM D2488 classifications are included on the boring logs.

INVESTIGATION RESULTS

In general, the investigation encountered HMA thicknesses ranging from 1 to 4 inches across the site. The encountered gravel base thicknesses generally ranged from 6 1/2 to 10 inches, except for Borings C-6 and C-9 which encountered 4 1/2 and 16 inches of gravel base, respectively. Based on visual observations, the gravel base encountered in the borings generally appeared to be a crushed limestone aggregate, with the exception of Boring C-9, which appeared to be a natural aggregate. The aggregate base in Borings C-1, C-2 and C-4 appeared to be stabilized with cement or lime. The following table lists the pavement section findings at each boring location.

Boring	HMA Thickness (in)	Gravel Base Thickness (in)
C-1	1	6*
C-2	1	6*
C-3	1.25	7 3/4
C-4	2	5*
C-5	2	10
C-6	3 1/2	4 1/2
C-7	3 1/2	6 1/2
C-8	2	8
C-9	4	16
C-10	2 1/4	7 3/4
C-11	1	9
C-12	1	9
C-13	2	8
C-14	2 1/2	7
C-15	2 3/4	7
C-16	2	8

* Possibly Cement- or Lime-Stabilized

Beneath the pavement sections, the subgrade generally consisted of poorly graded sand with varying amounts of clayey and silty fines (SP, SP-SC, SP-SM, SC) to the explored depths of 2.9 to 5.1 ft (els 579.3 to 582.1 ft), with the exception of Boring C-16, which encountered a layer of very stiff lean clay (CL) at depths ranging from 4.5 to 5.0 ft (els 580.4 to 580.9 ft).



Organic debris or organic soil were encountered at the following locations:

- Boring C-1 – Possible organic sand seams from 1.4. to 1.5 ft depth (els 583.4 to 583.5 ft)
- Boring C-2 – Possible buried topsoil from 1.4. to 1.7 ft depth (els 583.6 to 583.9 ft)
- Boring C-6 – Possible buried topsoil from 2.7. to 4.0 ft depth (els 582.4 to 583.7 ft)
- Boring C-7 – Fibrous peat (PT) at depths ranging from 3.8 to 4.5 ft (els 580.4 to 581.1 ft)
- Boring C-11 – Black poorly graded sand with silt (SP-SM) with fibrous peat and root fragments at depths ranging from 2.3 to 3.5 ft (els 581.7 to 582.9 ft)
- Boring C-12 – Dark gray poorly graded sand with silt (SP-SM) with fibrous peat and root fragments at depths ranging from 1.7 to 2.3 ft (els 582.7 to 583.3 ft)

Surface drainage throughout the area of park entrance appeared to be directed towards catch basins near the northern edges of the central entry drives. Surface drainage for the lots and drives at the east and west of the site appeared to be directed to vegetated areas at the north and south side. The pavement surfaces appeared to be relatively flat, with only minimal site grading to promote drainage. Original design plans were not provided for the site.

Listed below are summaries of the encountered subsurface conditions, as well as pavement observations, within each area of the site. The boring logs located in the Appendix should be reviewed for detailed soil descriptions. Some variation between boring locations is to be expected.

West Parking Lot – Borings C-1 to C-5

Existing Pavement

At the west parking lot, pavement in fair to poor condition was encountered. Occasional transverse and block cracking was generally observed across the entire lot and alligator cracking was generally observed near the entry drive as well as potholes in the southern section of the parking lot. Cracks were generally unsealed.

Subsurface Conditions

Borings C-1 to C-5 generally encountered 1 to 2 inches of HMA and 5 to 10 inches of aggregate base at the surface. The aggregate base in Borings C-1, C-2 and C-4 exhibited cohesion and appeared to be stabilized with cement or lime. Borings C-2 and C-3 generally encountered fill consisting of poorly graded sand with varying amounts of clay (SP-SC, SC) to depths ranging from 1.0 to 1.8 ft (els 583.2 to 584.3 ft).

Beneath the pavement section and fill, Borings C-1 to C-5 generally encountered poorly graded sand with varying amounts of silty fines (SP, SP-SM) to the explored depths of 5.0 ft (els 579.9 to 580.5 ft). A possible organic sand seam was encountered in Boring C-1 at depths ranging from 1.4 to 1.5 ft (els 583.4 to 583.5 ft) and possible buried topsoil was encountered at depths ranging from 1.4 to 1.7 ft (els 583.6 to 583.9 ft) in Boring C-2. Groundwater was



encountered during the drilling activities in Borings C-1 to C-5 at depths ranging from 3.5 to 4.0 ft (els 580.9 to 582.0 ft).

Entry Drive and Central Parking Lots – Borings C-6 to C-10

Existing Pavement

The entry drive was generally observed to be in fair condition with slight raveling and block cracking observed. The existing central parking lots appeared to be in fair to poor condition with moderate block cracking and cracking along construction joints generally observed within parking areas.

Subsurface Conditions

Borings C-6, C-7 and C-9, drilled in the central entry and connecting drives, generally encountered 3 1/2 to 4 inches of HMA and 4 1/2 to 6 1/2 inches of gravel base, with the exception of Boring C-9 which encountered 16 inches of gravel base. Borings C-8 and C-10, drilled within the central parking lot areas, generally encountered 2 to 2 1/4 inches of HMA and 7 3/4 to 8 inches of gravel base at the surface.

Borings C-6 and C-7 generally encountered fill consisting of poorly graded sand (SP) to depths ranging from 2.7 to 3.8 ft (els 580.7 to 583.7 ft). Beneath the pavement section and fill, the subgrade generally consisted of poorly graded sand with varying amounts of silty fines (SP, SP-SM) to the explored depths of 3.5 to 5.1 ft (els 579.3 to 581.5 ft). Boring C-6 encountered possible buried topsoil from depths ranging from 2.7. to 4.0 ft (els 582.4 to 583.7 ft) and a layer of fibrous peat (PT) was encountered in Boring C-7 at depths ranging from 3.8 to 4.5 ft (els 580.4 to 581.1 ft). Groundwater was encountered during the drilling activities in Borings C-6 to C-8 and C-10 at depths ranging from 2.7 to 4.5 ft (els 581.6 to 582.2 ft).

East Parking Lots and Drives – Borings C-11 to C-16

Existing Pavement

At the east of the site, pavement in fair to poor condition was encountered. Occasional transverse and block cracking was generally observed across the entire lot and alligator cracking was generally observed near the entry drive as well as potholes in the entry drive from the central part of the park.

Subsurface Conditions

Borings C-11 to C-16 generally encountered 1 to 2 3/4 inches of HMA and 7 to 9 inches of gravel base at the surface. Borings C-11 to C-13 generally encountered fill consisting of poorly graded sand with varying amounts of silty fines and gravel (SP, SP-SM) to depths ranging from 2.9 to 3.5 ft (els 581.7 to 582.1 ft).



Beneath the pavement section and fill, the subgrade generally consisted of poorly graded sand with varying amounts of clayey and silty fines (SP, SP-SM, SP-SC) to the explored depths of 2.9 to 5.1 ft (els 580.0 to 582.1 ft), with the exception of Boring C-16, which encountered a layer of very stiff lean clay (CL) at depths ranging from 4.5 to 5.0 ft (els 580.4 to 580.9 ft). Borings C-11 and C-12 generally encountered poorly graded sand with silt (SP-SM) with fibrous peat and root fragments at depths ranging from 1.7 to 3.5 ft (els 581.7 to 583.3 ft). Groundwater was encountered during the drilling activities in Borings C-14 and C-15 at a depth of 4.9 ft (els 580.0 to 580.3 ft).

The consistency of cohesive soil is based on estimates of the unconfined compressive strength obtained with a calibrated penetrometer.

Groundwater levels may fluctuate due to seasonal variations such as precipitation, snowmelt, nearby river or lake levels and other factors that may not be evident at the time of measurement. Groundwater levels may be different at the time of construction.

This section has provided a generalized description of the encountered subsurface soil conditions. The boring logs located in the Appendix should be reviewed for detailed soil descriptions. Some variation between boring locations may be expected.

PAVEMENT RECOMMENDATIONS

Due to the existing pavement conditions, a full-depth asphalt replacement is recommended. Full depth rotomilling of the existing asphalt should be performed until the gravel base is exposed. Prior to placing new asphalt, the existing gravel base should be inspected, with any areas of less than the recommended amount of gravel thickness augmented with MDOT 21AA aggregate. The aggregate base should be compacted and proof-rolled as described in the "Site and Subgrade Preparation" section of this report. Following aggregate compaction, the new HMA pavement should be installed.

We have considered the existing aggregate base will be largely suitable for re-use. Re-use of the existing aggregate base does present some risk of premature pavement deterioration due to potential variations in the aggregates and poor drainage beneath the pavement. If the owner can accept no risk of premature pavement deterioration, we recommend removal of existing aggregate base and replacement with MDOT 21AA aggregate. If poor quality aggregate base is suspected based on visual inspection or proof roll results after the HMA surface is removed, we recommend stockpiling and testing the material to determine the material's gradation and suitability for re-use.

Crush and shape (milling the existing asphalt into the existing aggregate base) and full-depth asphalt replacement is expected to result in a greater structural stability for the pavement section than simply reusing the existing aggregate base.



The pavement sections encountered in our investigation were variable between the sampling locations. If a pavement section is encountered during construction that is thinner than anticipated, pavement reconstruction may be required.

Several borings encountered relatively deep possible buried topsoil and organic materials. Where soil is present with a relatively low organic content (on the order of 5 percent or less), it is generally anticipated to present a relatively low risk of future settlement to the proposed parking lots and drives, considering it is adequately stable during proof rolling. If full-depth reconstruction of the asphalt sections is selected, test pits may be used to identify the extents and depths of the buried organic soil.

Pavement rehabilitation options such as a partial depth asphalt mill and overlay, chip sealing or any other nonstructural overlay are not expected to provide significant extension of the pavement life in areas of poor pavement condition. There is not expected to be sufficient pavement integrity in areas with less than 2 inches of existing asphalt to support a partial-depth asphalt mill and replacement. In addition, for any overlay, the cracking in pavement that is left in place would be expected to reflect upward through the overlay.

Our recommended options for addressing the primary deficiencies of the existing pavement section are described below, along with discussion of alternate options which will present varying degrees of pavement life. We have also included information for the design of a concrete pavement option below as requested.

It is important that the recommendations of this report, in particular those pertaining to subgrade preparation, construction observation and testing, be implemented during design and construction.

Recommended Option: Full-Depth Asphalt Removal and Replacement

Should the Owner accept the risk of possible poor performance of the pavement section due to variations in the existing aggregate base, the existing aggregate base may be used with the parameters of the following defined full-depth pavement section. Given that the proposed pavement thickness is generally greater than existing pavement thicknesses, we recommend the final grading minimize the amount of removal of existing gravel base, to the extent possible. If this option is selected, full depth rotomilling of the existing asphalt should be performed until the gravel base is exposed. The existing asphalt may be removed, or a crush-and-shape may be performed whereby the asphalt millings are mixed into the existing gravel in accordance with MDOT specifications. Prior to placing new asphalt, the existing gravel base should be inspected, with any areas of less than the recommended amount of gravel thickness augmented with MDOT 21AA aggregate. The aggregate base should be compacted and proof-rolled as described in the "Site and Subgrade Preparation" section of this report. Following aggregate compaction, the new HMA pavement should be installed.



Alternative Option: Full-Depth Reconstruction of Asphalt Pavement Section and Construction of New Pavements

Full-depth reconstruction involves removal of existing asphalt and aggregate base and replacement of the entire pavement section. Subgrade preparation in reconstructed and proposed pavement areas should be as described in the "Site and Subgrade Preparation" section of this report. The pavement sections recommended in this section are based on procedures contained in the 1993 AASHTO Guide for Design of Pavement Structures.

The design recommendations provided are based on the following:

Flexible Pavement Basis of Design

AASHTO design method	Low volume roads
Level of reliability	75 percent
Analysis period	15 to 25 years
Low traffic level, no. 18-kip ESAL	50,000 to 300,000
Number of rehabilitation periods during analysis period	1

The following flexible pavement sections are recommended:

Flexible Pavement Section

Traffic Condition	Standard Duty	Heavy Duty
Sand subbase thickness, inches	10	12
Aggregate base thickness, inches	6	10
Bituminous leveling course thickness, inches	2.0	3.0
Bituminous wearing course thickness, inches	1.5	2.0

The following materials are recommended:

Flexible Pavement Materials

Material	Standard Duty	Heavy Duty
Sand subbase	MDOT Class II granular	MDOT Class II granular
Aggregate base	MDOT 21AA	MDOT 21AA
Bituminous leveling	MDOT 13A	MDOT 3C
Bituminous wearing	MDOT 36A	MDOT 4C

Sand subbase material should be laboratory tested to confirm MDOT Class II grading requirement. The binder grade should be a minimum PG 58-28. MDOT standard specifications for materials and placement should be observed.

It is recommended that cracks that may develop in the pavement be quickly and properly sealed through a regular maintenance program. Also, the subgrade should be sufficiently sloped (2 percent minimum) to provide drainage within the sand subbase and underdrains should be provided within the subbase, around catch basins and pavement edges, to facilitate



drainage. At each catch basin, four underdrains with a watertight connection should extend out radially at least 20 ft. A suitable rubberized asphalt sealant should be placed between all concrete curb/HMA joints immediately after paving.

Alternative Option: Partial-Depth Replacement of Asphalt Pavement Section

We do not anticipate the pavement remaining after milling will have sufficient integrity to provide a stable base prior to application of the overlay. In most areas of the site, due to the existing pavement thicknesses and the poor condition of several pavement areas, a partial-depth replacement is not recommended. For portions of the site with more than 2 inches of existing asphalt and where pavement is in fair condition, it may be possible to utilize a partial-depth replacement of the existing asphalt, should a shorter pavement life span than our recommended section be acceptable to the Owner.

If partial depth replacement is selected for pavement in fair condition, we recommend replacing at least 1.5 inches of existing asphalt with an MDOT 36A wearing course with binder grade a minimum of PG 58-28. The wearing course lift should be placed and compacted in order to match the existing grades of the adjacent pavement surfaces.

Alternate Option: Asphalt Overlay or Chip Seal

An option for an asphalt overlay may be considered; however, it is not recommended as it is expected that an asphalt overlay will undergo early deterioration due to the poor condition of the existing pavement. Reflective cracking from the cracks already existing in the pavement is anticipated to appear within the overlay within 1 to 3 years after application.

Chip sealing is a type of overlay that involves placement of aggregate onto the pavement surface after it has been prepared with liquid asphalt binder. On a pavement in good to fair condition, a chip seal may extend the pavement life by 3 to 5 years; however, it is expected to have significantly less utility on pavements in poor condition such as those generally encountered in this investigation.

Site and Subgrade Preparation

All topsoil, vegetation, roots and any other miscellaneous debris should be removed from within the proposed construction areas. The limits of the proposed construction area, prior to the placement of any structures or engineered fill material, should be proof-rolled by the contractor and, where granular soil is present, compacted to at least 95 percent of the soil's maximum ASTM D 1557 dry density. Proof-rolling is defined as the passing of relatively heavy construction equipment over the soil subgrade under observation by the Geotechnical Engineer. The response of the soil, when subjected to the applied load, is subjectively evaluated by qualified geotechnical personnel with respect to its ability to support the overlying soil or structure. In areas where excessive deflection is observed, special subgrade preparation measures may be recommended to provide an acceptable subgrade condition.



These measures may consist of compaction of the subgrade at moisture contents close to the optimum value, undercutting affected areas and replacing with engineered fill, use of a geotextile separation fabric or some combination of these measures.

Organic debris or organic soil were encountered at the following locations:

- Boring C-1 – Possible organic sand seams from 1.4. to 1.5 ft depth (els 583.4 to 583.5 ft)
- Boring C-2 – Possible buried topsoil from 1.4. to 1.7 ft depth (els 583.6 to 583.9 ft)
- Boring C-6 – Possible buried topsoil from 2.7. to 4.0 ft depth (els 582.4 to 583.7 ft)
- Boring C-7 – Fibrous peat (PT) at depths ranging from 3.8 to 4.5 ft (els 580.4 to 581.1 ft)
- Boring C-11 – Black poorly graded sand with silt (SP-SM) with fibrous peat and root fragments at depths ranging from 2.3 to 3.5 ft (els 581.7 to 582.9 ft)
- Boring C-12 – Dark gray poorly graded sand with silt (SP-SM) with fibrous peat and root fragments at depths ranging from 1.7 to 2.3 ft (els 582.7 to 583.3 ft)

Borings C-2, C-3, C-6, C-7, C-11, C-13 generally encountered fill consisting of poorly graded sand with varying amounts of silty and clayey fines and gravel (SP, SP-SM, SP-SC, SC) to depths ranging from 1.0 to 3.8 ft (els 580.7 to 584.3 ft). Due to the miscellaneous fill and organic soil conditions encountered in the field investigation and due to variations that may exist between borings, it is possible that some form of subgrade improvement may be required. Fill or organic material may be acceptable to be left in place provided it is sufficiently stable during proof rolling and is free of large debris and significant organic material. If full-depth reconstruction of the asphalt sections is selected, test pits may be used to identify the extents and depths of the buried organic soil. Even after proof rolling and test pit exploration, some risk of future poor performance may still be present for pavements supported on the organic or possibly organic materials.

Engineered fill is approved on-site or imported soil placed in uniform layers and compacted to a minimum required density. Generally, on-site soil with group symbols of SP or SP-SM are expected to be suitable for engineered fill. Imported fill should meet the requirements for MDOT Class II granular material.

Granular engineered fill and backfill should be compacted to at least 95 percent of the soil's maximum dry density as determined by the Modified Proctor test (ASTM D1557). Vibratory compaction methods are typically found to be most effective in granular soils.

The fill should be placed and compacted in horizontal layers not exceeding 9 inches. Field density tests (ASTM D2922) should be taken on each lift, as the fill is being placed, to verify compliance with compaction specifications. If the earthwork takes place during winter months, fill must not be placed on frozen ground and fill with frozen conglomerations of soil must not be used.

Because the site has been previously developed, there may be buried items not encountered in our borings, such as utility conduit, which may cause settlement problems. The contract



documents should reflect that it is necessary to remove or relocate such structures and to fill the excavation with engineered fill. Large roots should also be removed from beneath new pavements, where encountered.

Groundwater

Groundwater was generally encountered in Borings C-1 to C-8, C-10, C-14 and C-15 at depths ranging from 2.7 to 4.9 ft (els 580.0 to 582.2 ft). The control of groundwater is generally not expected to be a concern for paving operations, but may be a concern if undercuts are performed. Suitable control of groundwater should be anticipated and planned for accordingly before the start of construction. The contractor should be responsible for selecting and implementing an appropriate groundwater control system. The contractor should have previous dewatering experience on sites with similar conditions. Suitable silt and sediment traps should be incorporated into the dewatering system.

CLOSURE

In this report, descriptions of the geotechnical investigation, encountered conditions and recommendations for pavement rehabilitation have been presented. The limitations of this study are described in the Appendix.

The recommendations presented in this report are based upon a limited number of subsurface samples obtained from various sampling locations. The samples may not fully indicate the nature and extent of the variations that actually exist between sampling locations. For that reason, among others, we strongly recommend that a qualified geotechnical firm be retained to observe earthwork construction. If variations or other latent conditions become evident during construction, it will be necessary for us to review these conditions and our recommendations as appropriate.



We appreciate the opportunity to provide this service to you on this project. Should you have any questions or require further assistance, please contact our office.

Sincerely,

MATERIALS TESTING CONSULTANTS, INC.

Ryan D. Starcher, E.I.T.
Project Engineer

Robert J. Warren, P.E.
Project Manager

Attachments: Figure No. 1 - Boring Location Plan
Appendix
- Limitations
- Test Drilling and Sampling Procedures
- Boring Log Terminology and Classification Outline
- Boring Logs
- Core Photo Logs

LEGEND

 BORING LOCATION (TYP)

NOTE: AERIAL IMAGE FROM GOOGLE EARTH



TITLE: CORING LOCATION PLAN

PROJECT: BAY CITY STATE PARK PAVEMENT

SCALE: AS SHOWN

DATE: 12/16/2022

PROJECT NO.: 221591

FIG. NO.: 1

DR. BY: KLV

REV. BY: RS



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LIMITATIONS

Soil Variations

The recommendations in this report are based upon the data obtained from the soil borings. This report does not reflect variations which may occur between these borings, and which would not become evident until construction. If variations then become evident, it would be necessary for a re-evaluation of recommendations of this report, after performing on-site observations.

Warranties

We have prepared this report in accordance with generally accepted soil and foundation engineering practices. We make no other warranties, either expressed or implied, as to the professional advice provided under the terms of our agreement and included in this report. This report is prepared exclusively for our client and may not be relied upon by other parties without written consent from our office.

Boring Logs

In the process of obtaining and testing samples and preparing this report, we follow reasonable and accepted practice in the field of soil engineering. Field logs maintained during drilling describe field occurrences, sampling locations, and other information. The samples obtained in the field are subjected to additional testing in the laboratory and differences may exist between the field logs and the final logs. The engineer reviews the field logs and laboratory test data, and then prepares the final boring logs. Our recommendations are based on the contents of the final logs.

Review of Design Plans and Specifications

In the event that any changes in the design of the building or the location, however slight, are planned, our recommendations shall not be considered valid unless modified or approved in writing by our office. We recommend that we be provided the opportunity to review the final design and specifications in order to determine whether changes in the original concept may have affected the validity of our recommendations, and whether our recommendations have, in fact, been implemented in the design and specifications.



TEST DRILLING AND SAMPLING PROCEDURES

Test Drilling Methods:

- ☐ Hollow stem auger, ASTM D6151
- ☐ Mud rotary, ASTM D5783
- ☐ Casing advancer, ASTM D5872
- ☐ Rock coring, ASTM D2113
- ☒ Core/Hand Auger

Note: Cone penetration test data can be used to interpret subsurface stratigraphy and can provide data on engineering properties of soils. The ASTM procedure does not include a procedure for determining soil classification from CPT testing. Soil classifications shown on CPT logs are based on published procedures and are not based on physical ASTM soil classification tests.

Sampling Methods:

- ☐ SPT, ASTM D1586, Auto hammer (140 lb., 30" drop, 2" OD split spoon sampler)
- ☒ Grab Samples

Note: The number of hammer blows required to drive the SPT sampler 12 inches, after seating 6 inches, is termed the soil N-value and provides an indication of the soil's relative density and strength parameters at the sample location. SPT blow counts in 6 inch increments are recorded on the boring logs.

Drill Rig:

- ☐ CME 55 LC (ATV)
- ☐ CME 750 Rubber tired (ATV)
- ☐ CME 95 Truck
- ☐ Geoprobe Direct Push
- ☐ Geoprobe Rotary Sonic

Boreholes Backfilled With:

- ☒ Excavated soil
- ☐ Cement bentonite grout
- ☐ Piezometer or Monitoring Well (see notes on logs)
- ☒ Concrete or asphalt patch where appropriate

Sample Handling and Disposition:

- ☒ Samples labeled, placed in jars, returned to MTC Laboratory
- ☒ Discard after 60 days



BORING LOG TERMINOLOGY AND ASTM D 2488 CLASSIFICATION OUTLINE

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE-GRAINED SOILS (major portions retained on No. 200 sieve): includes (1) clean gravel and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density as determined by laboratory tests or standard penetration resistance tests.

Descriptive Terms	Relative Density	SPT Blow Count
Very loose	0 to 15 %	< 5
Loose	15 to 35 %	5 to 10
Medium dense	35 to 65 %	10 to 30
Dense	65 to 85 %	30 to 50
Very dense	85 to 100 %	> 50

Per ASTM D2487, the following conditions must be met based on laboratory testing to justify the label 'well graded' in a soil description.

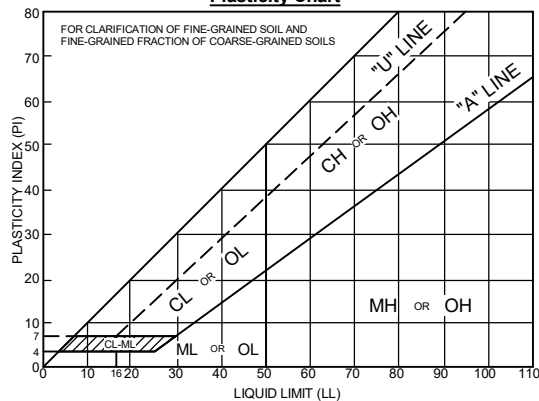
$$\text{Gravel: } C_u = \frac{D_{60}}{D_{10}} \text{ greater than 4; } C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ between 1 and 3}$$

$$\text{Sand: } C_u = \frac{D_{60}}{D_{10}} \text{ greater than 6; } C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ between 1 and 3}$$

FINE-GRAINED SOILS (major portions passing on No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings, SPT blow count, or unconfined compression tests.

Unconfined Compressive		
Descriptive Terms	Strength TSF	SPT Blow Count
Very soft	< 0.25	< 2
Soft	0.25 to 0.5	2 to 4
Medium stiff	0.5 to 1.0	4 to 8
Stiff	1.0 to 2.0	8 to 15
Very stiff	2.0 to 4.0	15 to 30
Hard	> 4.0	> 30

Plasticity Chart



MAJOR DIVISIONS					TYPICAL NAMES	
COARSE-GRAINED SOILS MORE THAN HALF IS COARSER THAN NO. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LESS THAN 15% FINES	GW		WELL-GRADED GRAVELS WITH OR WITHOUT SAND	
			GP		POORLY-GRADED GRAVELS WITH OR WITHOUT SAND	
		GRAVELS WITH 15% OR MORE FINES	GM		SILTY GRAVELS WITH OR WITHOUT SAND	
			GC		CLAYEY GRAVELS WITH OR WITHOUT SAND	
	SANDS MORE THAN HALF COARSE FRACTION IS FINER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 15% FINES	SW		WELL-GRADED SANDS WITH OR WITHOUT GRAVEL	
			SP		POORLY-GRADED SANDS WITH OR WITHOUT GRAVEL	
		SANDS WITH 15% OR MORE FINES	SP-SM		POORLY-GRADED SANDS WITH SILT WITH OR WITHOUT GRAVEL	
			SM		SILTY SANDS WITH OR WITHOUT GRAVEL	
			SC		CLAYEY SANDS WITH OR WITHOUT GRAVEL	
FINE-GRAINED SOILS MORE THAN HALF IS FINER THAN NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS	ML		INORGANIC SILTS OF LOW TO MEDIUM PLASTICITY WITH OR WITHOUT SAND OR GRAVEL		
		CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY WITH OR WITHOUT SAND OR GRAVEL		
		OL		ORGANIC SILTS OR CLAYS OF LOW TO MEDIUM PLASTICITY WITH OR WITHOUT SAND OR GRAVEL		
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%	MH		INORGANIC SILTS OF HIGH PLASTICITY WITH OR WITHOUT SAND OR GRAVEL		
		CH		INORGANIC CLAYS OF HIGH PLASTICITY WITH OR WITHOUT SAND OR GRAVEL		
		OH		ORGANIC SILTS OR CLAYS OF HIGH PLASTICITY WITH OR WITHOUT SAND OR GRAVEL		
	HIGHLY ORGANIC SOILS		PT/OL		PEAT AND OTHER HIGHLY ORGANIC SOILS	

GENERAL NOTES

- Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
- "Grades with" or "Grades without" may be used to describe soil when characteristics vary within a stratum.
- Preserved soil samples will be discarded after 60 days unless alternate arrangements have been made.

GROUNDWATER OBSERVATIONS:

During - indicates water level encountered during the boring
End - indicates water level immediately after drilling
Date and Depth - Measurements at indicated date

SAMPLE TYPES AND NUMBERING

S	SPT, split barrel sample, ASTM D1586
U	Shelby tube sample, ASTM D1587
R	Rock core run
*S	Other than 2" split barrel sample
L	SPT with liner, ASTM D1586
A	Auger cuttings
G	Geoprobe liner

MINOR COMPONENT QUANTIFYING TERMS

Less than 5%	TRACE
5 to 10%	FEW
15 to 25%	LITTLE
30 to 40%	SOME
50 to 100%	MOSTLY

GRAIN SIZE

BOULDER	>12"
COBBLE	12" to 3"
COARSE GRAVEL	3" to 0.75"
FINE GRAVEL	0.75" to No. 4
COARSE SAND	No. 4 to No. 10
MEDIUM SAND	No. 10 to No. 40
FINE SAND	No. 40 to No. 200



LOG OF BORING

Project No.: 221591

Boring No.: C-1

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=791105.4 E=13243983.8 (MI South 1ft)

Elevation: 584.9 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/05/2022

Date End: 12/05/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	4.0
Sampler			End	4.0
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.7	0.25	A-1				1" HMA	0.1			
584.4	0.50					6" Aggregate Base (Possibly Cement or Lime-Stabilized)	0.7			
584.2	0.75									
583.9	1.00	A-2				Dark brown poorly graded SAND with clay; mostly coarse to fine sand, few clayey fines, moist				
583.7	1.25				SP-SC					
583.4	1.50									
583.2	1.75	A-3				Grades light brown at 1.8'	1.6			Possible organic sand seams from 1.4' to 1.5', organic odor
582.9	2.00					Brown poorly graded SAND; mostly coarse to fine sand, moist				
582.7	2.25									
582.4	2.50									
582.2	2.75									
581.9	3.00									
581.7	3.25									
581.4	3.50				SP					
581.2	3.75									
580.9	4.00									
580.7	4.25					Grades wet at 4.0'				
580.4	4.50									
580.2	4.75									
579.9	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-2

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790899.2 E=13244134.4 (MI South 1ft)

Elevation: 585.3 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/05/2022

Date End: 12/05/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	4.0
Sampler			End	4.0
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
585.1	0.25	A-1				1" HMA	0.1			Fill: 0' to 1.0' Organic odor from 1.4' to 1.7'; Possible Buried Topsoil
584.8	0.50					6" Aggregate Base (Possibly Cement or Lime-Stabilized)	0.6			
584.6	0.75				SC	Dark brown clayey SAND; mostly medium to fine sand, little clayey fines, moist, Fill	1.0			
584.3	1.00	A-2			SP	Brown poorly graded SAND; mostly coarse to fine sand, moist with root fragments	1.7			
584.1	1.25									
583.8	1.50									
583.6	1.75	A-3				Brown poorly graded SAND; mostly coarse to fine sand, moist				
583.3	2.00					Grades light brown at 1.8'				
583.1	2.25									
582.8	2.50	A-4			SP					
582.6	2.75									
582.3	3.00									
582.1	3.25									
581.8	3.50									
581.6	3.75									
581.3	4.00					Grades wet at 4.0'				
581.1	4.25									
580.8	4.50									
580.6	4.75									
580.3	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-3

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790827 E=13244466.5 (MI South 1ft)

Elevation: 585.0 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/05/2022

Date End: 12/05/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	3.5
Sampler			End	3.5
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.8	0.25	A-1				1 1/4" HMA	0.1			Fill: 0' to 1.8'
584.5	0.50					7 3/4" Aggregate Base				
584.3	0.75						0.8			
584.0	1.00	A-2				Brown poorly graded SAND with clay; mostly coarse to fine sand, few clayey fines, moist, Fill				
583.8	1.25				SP-SC		1.5			
583.5	1.50						1.8			
583.3	1.75	A-3			SP	Light brown poorly graded SAND; mostly medium to fine sand, moist, Fill				
583.0	2.00					Brown poorly graded SAND with silt; mostly coarse to fine sand, few silty fines, trace coarse to fine gravel, moist with root fragments				
582.8	2.25				SP-SM		2.5			
582.5	2.50	A-4				Light brown poorly graded SAND; mostly medium to fine sand, moist				
582.3	2.75									
582.0	3.00									
581.8	3.25									
581.5	3.50									
581.3	3.75					Grades wet at 3.5'				
581.0	4.00				SP					
580.8	4.25									
580.5	4.50									
580.3	4.75									
580.0	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-4

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790583.1 E=13244647.6 (MI South 1ft)

Elevation: 585.5 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/05/2022

Date End: 12/05/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	3.5
Sampler			End	3.5
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
585.3	0.25	A-1				2" HMA	0.2			
585.0	0.50					5" Aggregate Base (Possibly Cement or Lime-Stabilized)				
584.8	0.75						0.7			
584.5	1.00				SP-SC	Dark brown poorly graded SAND with clay; mostly coarse to fine sand, few clayey fines, moist	0.9			
584.3	1.25									
584.0	1.50					Brown poorly graded SAND; mostly coarse to fine sand, moist				
583.8	1.75					Grades light brown at 1.6'				
583.5	2.00									
583.3	2.25									
583.0	2.50									
582.8	2.75	A-2			SP					
582.5	3.00									
582.3	3.25									
582.0	3.50									
581.8	3.75									
581.5	4.00									
581.3	4.25									
581.0	4.50					Grades wet at 3.5'				
580.8	4.75									
580.5	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-5

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790571.8 E=13244863.2 (MI South 1ft)

Elevation: 585.1 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/05/2022

Date End: 12/05/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	3.5
Sampler			End	3.5
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.9	0.25	A-1				2" HMA	0.2			
584.6	0.50					10" Aggregate Base				
584.4	0.75									
584.1	1.00	A-2								
583.9	1.25				SP-SM	Brown poorly graded SAND with silt; mostly coarse to fine sand, few silty fines, moist	1.0			
583.6	1.50					Light brown poorly graded SAND; mostly medium to fine sand, moist	1.1			
583.4	1.75	A-3								
583.1	2.00									
582.9	2.25									
582.6	2.50	A-4								
582.4	2.75									
582.1	3.00				SP					
581.9	3.25									
581.6	3.50									
581.4	3.75					Grades wet at 3.5'				
581.1	4.00									
580.9	4.25									
580.6	4.50									
580.4	4.75									
580.1	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-6

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790281.7 E=13244896.9 (MI South 1ft)

Elevation: 586.4 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/05/2022

Date End: 12/05/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	4.5
Sampler			End	4.5
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.1 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
586.2	0.25	A-1				3 1/2" HMA	0.3			Fill: 0' to 2.7'
585.9	0.50					4 1/2" Aggregate Base				
585.7	0.75						0.7			
585.4	1.00	A-2			SP	Light brown poorly graded SAND; mostly coarse to fine sand, moist, Fill				Possible buried Topsoil
585.2	1.25									
584.9	1.50									
584.7	1.75									
584.4	2.00									
584.2	2.25									
583.9	2.50									
583.7	2.75									
583.4	3.00	A-3			SP-SM	Light brown poorly graded SAND with silt; mostly medium to fine sand, few silty fines, moist with root fragments and organic fibrous peat				
583.2	3.25									
582.9	3.50									
582.7	3.75	A-4			SP	Gray poorly graded SAND; mostly coarse to fine sand, moist with fibrous peat				Organic odor
582.4	4.00									
582.2	4.25									
581.9	4.50									
581.7	4.75					Grades wet at 4.5'				
581.4	5.00						5.1			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-7

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790381.6 E=13245258.4 (MI South 1ft)

Elevation: 584.9 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/06/2022

Date End: 12/06/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	2.7
Sampler			End	2.7
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.7	0.25	A-1				3 1/2" HMA	0.3			Fill: 0' to 3.8'
584.4	0.50					6 1/2" Aggregate Base				
584.2	0.75						0.8			
583.9	1.00	A-2				Brown poorly graded SAND; mostly medium to fine sand, moist, Fill				
583.7	1.25									
583.4	1.50									
583.2	1.75	A-3			SP					
582.9	2.00									
582.7	2.25									
582.4	2.50	A-4					2.6			
582.2	2.75									
581.9	3.00				SP	Gray poorly graded SAND; mostly coarse to fine sand, wet, Fill with leaves and root fragments				
581.7	3.25									
581.4	3.50									
581.2	3.75						3.8			
580.9	4.00	A-4			PT	Brown fibrous PEAT (mulch); wet				
580.7	4.25									
580.4	4.50						4.5			
580.2	4.75				SP	Gray poorly graded SAND; mostly coarse to fine sand, wet				
579.9	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-8

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790374.5 E=13245464.3 (MI South 1ft)

Elevation: 584.3 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/06/2022

Date End: 12/06/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	2.7
Sampler			End	2.7
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.1	0.25	A-1				2" HMA	0.2			Fill: 0' to 1.5'
583.8	0.50					8" Aggregate Base				
583.6	0.75						0.8			
583.3	1.00									
583.1	1.25	A-2			SP-SM	Light brown poorly graded SAND with silt; mostly coarse to fine sand, few silty fines, moist, Fill				
582.8	1.50						1.5			
582.6	1.75									
582.3	2.00				SP-SM	Gray poorly graded SAND with silt; mostly coarse to fine sand, few silty fines, moist with few organics				
582.1	2.25	A-3					2.5			
581.8	2.50									
581.6	2.75					Light brown poorly graded SAND; mostly coarse to fine sand, wet				
581.3	3.00									
581.1	3.25									
580.8	3.50									
580.6	3.75				SP	Grades wet with root fragments, fibrous peat from 3.5' to 4.7'				
580.3	4.00									
580.1	4.25									
579.8	4.50									
579.6	4.75									
579.3	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-9

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790236 E=13245646.6 (MI South 1ft)

Elevation: 584.4 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/05/2022

Date End: 12/05/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	None
Sampler			End	NA
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 2.9 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.2	0.25	A-1				4" HMA	0.3			
583.9	0.50					16" Natural Aggregate Base				
583.7	0.75									
583.4	1.00									
583.2	1.25									
582.9	1.50	A-2				Gray poorly graded SAND with silt; mostly coarse to fine sand, few silty fines, moist	1.7			
582.7	1.75									
582.4	2.00									
582.2	2.25									
581.9	2.50				SP-SM					
581.7	2.75						2.9			
						End of Boring				Auger refusal at 2.9' due to possible coarse gravel / COBBLE

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-10

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790180.9 E=13245949.8 (MI South 1ft)

Elevation: 585.1 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/06/2022

Date End: 12/06/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	3.0
Sampler			End	3.0
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.9	0.25	A-1				2 1/4" HMA	0.2			
584.6	0.50					7 3/4" Aggregate Base				
584.4	0.75						0.8			
584.1	1.00	A-2			SP	Light brown poorly graded SAND; mostly medium to fine sand, moist				
583.9	1.25									
583.6	1.50									
583.4	1.75									
583.1	2.00									
582.9	2.25	A-3			SP	Grades wet at 3.0' Grades dark gray at 3.2'				
582.6	2.50									
582.4	2.75									
582.1	3.00									
581.9	3.25									
581.6	3.50	A-4			SP	Grades light gray at 4.0'				
581.4	3.75									
581.1	4.00									
580.9	4.25									
580.6	4.50									
580.4	4.75									
580.1	5.00						5.0			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-11

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=790125.3 E=13246135.8 (MI South 1ft)

Elevation: 585.2 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/07/2022

Date End: 12/07/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	None
Sampler			End	NA
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 3.5 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
585.0	0.25	A-1				1" HMA	0.1			Fill: 0' to 3.5'
584.7	0.50					9" Aggregate Base				
584.5	0.75						0.8			
584.2	1.00	A-2				Light brown poorly graded SAND; mostly coarse to fine sand, moist				
584.0	1.25				SP					
583.7	1.50						1.6			
583.5	1.75	A-3				Gray poorly graded SAND with gravel; mostly coarse to fine sand, little coarse to fine gravel, moist				
583.2	2.00				SP					
583.0	2.25						2.3			
582.7	2.50	A-4				Black poorly graded SAND with silt; mostly coarse to fine sand, few silty fines, moist with organic fibrous peat and root fragments				
582.5	2.75				SP-SM					
582.2	3.00									
582.0	3.25	A-5								
581.7	3.50						3.5			
						End of Boring				Auger refusal at 3.5' due to possible coarse gravel or thick roots

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-12

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=789974.1 E=13246281.3 (MI South 1ft)

Elevation: 585.0 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/07/2022

Date End: 12/07/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	None
Sampler			End	NA
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 2.9 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.8	0.25	A-1				1" HMA	0.1			Fill: 0' to 2.9'
584.5	0.50					9" Aggregate Base				
584.3	0.75						0.9			
584.0	1.00									
583.8	1.25	A-2			SP	Light brown poorly graded SAND; mostly fine sand, moist				Strong organic odor
583.5	1.50						1.7			
583.3	1.75									
583.0	2.00	A-3			SP-SM	Dark gray poorly graded SAND with silt; mostly medium to fine sand, few silty fines, moist with root fragments and fibrous peat	2.3			
582.8	2.25									
582.5	2.50	A-3			SP	Gray gravelly SAND; mostly coarse to fine sand, little coarse to fine gravel, moist	2.9			Auger refusal at 2.9' due to possible coarse gravel / COBBLE
582.3	2.75									
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-13

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=789957.8 E=13246483.3 (MI South 1ft)

Elevation: 584.9 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/07/2022

Date End: 12/07/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	None
Sampler			End	NA
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 3.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION		QP tsf	MST %	DD pcf	REMARKS										
584.7	0.25	A-1					2" HMA	0.2			Fill: 0' to 3.0'										
584.4	0.50						8" Aggregate Base														
584.2	0.75						0.8														
583.9	1.00	A-2			SP		Light brown poorly graded SAND; mostly medium to fine sand, moist														
583.7	1.25																				
583.4	1.50																				
583.2	1.75	A-3											Grades gray at 2.0' with organic odor Grades with organic fibrous peat at 2.2'								
582.9	2.00																				
582.7	2.25																				
582.4	2.50	A-4			SP		Gray gravelly SAND; mostly coarse to fine sand, little coarse to fine gravel, moist	2.5													
582.2	2.75																				
581.9	3.00																				
						End of Boring					Auger refusal at 3.0' due to possible coarse gravel / COBBLE										

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-14

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=789804.4 E=13246603.9 (MI South 1ft)

Elevation: 585.4 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/07/2022

Date End: 12/07/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	4.9
Sampler			End	4.9
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
585.2	0.25	A-1				2 1/2" HMA	0.2			
584.9	0.50					7" Aggregate Base				
584.7	0.75						0.8			
584.4	1.00	A-2				Light brown poorly graded SAND; mostly medium to fine sand, moist				
584.2	1.25				SP					
583.9	1.50									
583.7	1.75	A-3								
583.4	2.00									
583.2	2.25						2.2			
582.9	2.50	A-4			SP-SC	Light brown poorly graded SAND with clay; mostly medium to fine sand, few clayey fines, moist				
582.7	2.75									
582.4	3.00						3.0			
582.2	3.25	A-5			SP-SM	Gray poorly graded SAND with silt; mostly fine sand, few silty fines, moist				
581.9	3.50						3.5			
581.7	3.75									
581.4	4.00	A-6				Gray poorly graded SAND; mostly medium to fine sand, moist				
581.2	4.25				SP	Grades with organic silt from 3.9' to 4.2'				
580.9	4.50									
580.7	4.75	A-5				Grades with clay lenses from 4.4' to 4.8'				
580.4	5.00						5.0			
						Grades wet at 4.9'				
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-15

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=789770.6 E=13246836.6 (MI South 11)

Elevation: 585.1 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/07/2022

Date End: 12/07/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	4.9
Sampler			End	4.9
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.1 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
584.9	0.25	A-1				2 3/4" HMA	0.2			
584.6	0.50					7" Aggregate Base				
584.4	0.75						0.8			
584.1	1.00	A-2				Light brown poorly graded SAND; mostly medium to fine sand, moist				
583.9	1.25									
583.6	1.50									
583.4	1.75									
583.1	2.00									
582.9	2.25									
582.6	2.50									
582.4	2.75									
582.1	3.00									
581.9	3.25									
581.6	3.50	A-3				Grades gray at 3.0'				
581.4	3.75									
581.1	4.00						4.0			
580.9	4.25	A-4			SP-SC	Gray poorly graded SAND with clay; mostly coarse to fine sand, few clayey fines, moist				
580.6	4.50						4.5			
580.4	4.75				SC	Gray clayey SAND; mostly coarse to fine sand, some clayey fines, moist with clay lenses				
580.1	5.00						5.1			
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



LOG OF BORING

Project No.: 221591

Boring No.: C-16

Sheet: 1 of 1

Project: Bay City State Park Pavements

Client: Beckett & Raeder, Inc.

Location: Bangor Charter Township, Michigan

Drill Type: Hand Auger

Crew Chief: Field Eng.: IA

Rev. By: RS

Coordinates: N=789632.5 E=13246958 (MI South 1ft)

Elevation: 585.4 ft Datum: NAVD 88 (GPS Observation)

Notes:

Plugging Record: Backfilled borehole with compacted cuttings, patched pavement with cold patch.

Date Begin: 12/07/2022

Date End: 12/07/2022

Tooling	Type	Dia.	Groundwater, ft.	
Casing	Hand Auger	3 1/4"	During	None
Sampler			End	NA
Core			Seepage	
Tube			Date	Depth, ft.
SPT Hammer				

Depth Drilled: 5.0 ft.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer (tons/sq. ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Dyn. Cone Eq. "N": ASTM STP 399	*USCS Group Symbol	*DESCRIPTION	QP tsf	MST %	DD pcf	REMARKS
585.2	0.25	A-1				2" HMA	0.2			
584.9	0.50					8" Aggregate Base				
584.7	0.75						0.8			
584.4	1.00	A-2			SP	Light brown poorly graded SAND; mostly medium to fine sand, moist				
584.2	1.25									
583.9	1.50									
583.7	1.75									
583.4	2.00									
583.2	2.25									
582.9	2.50									
582.7	2.75	A-3			SP	Gray poorly graded SAND; mostly coarse to fine sand, moist with leaves				
582.4	3.00									
582.2	3.25									
581.9	3.50									
581.7	3.75									
581.4	4.00									
581.2	4.25									
580.9	4.50	A-4			CL	Gray lean CLAY; mostly clayey fines, trace fine gravel, moist	3.5			
580.7	4.75									
580.4	5.00									
						End of Boring				

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed. Stratification changes are approximated between samples.



MATERIALS TESTING CONSULTANTS

Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-1



BORING C-2



MATERIALS TESTING CONSULTANTS

Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-3



BORING C-4



MATERIALS TESTING CONSULTANTS

Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-5



BORING C-6



MATERIALS TESTING CONSULTANTS

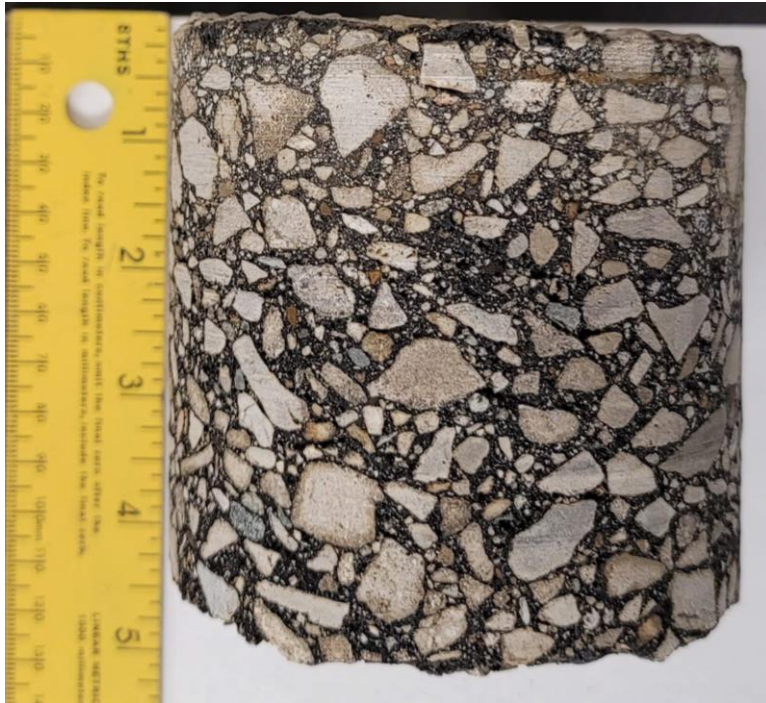
Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-7



BORING C-8



MATERIALS TESTING CONSULTANTS

Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-9



BORING C-10



MATERIALS TESTING CONSULTANTS

Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-11



BORING C-12



MATERIALS TESTING CONSULTANTS

Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-13



BORING C-14



MATERIALS TESTING CONSULTANTS

Project Name: BAY CITY STATE PARK PAVEMENTS

Client: BECKETT & RAEDER, INC.

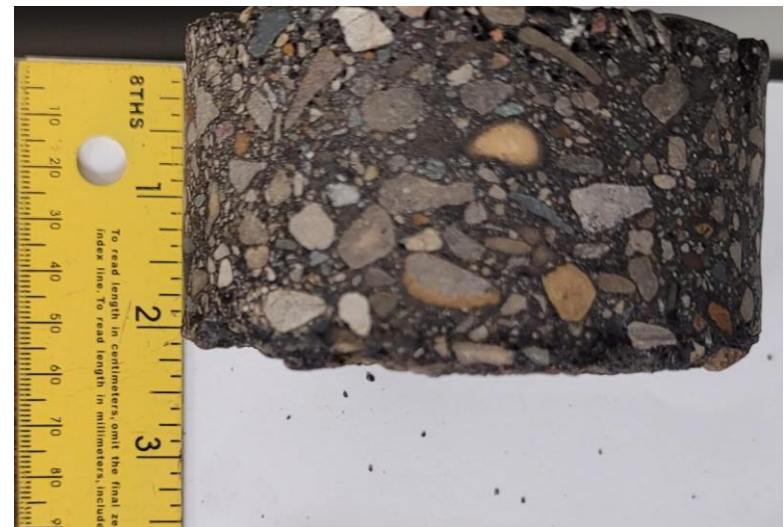
Project No.: 221591

Recorded By: RS

Date: 12/12/2022



BORING C-15



BORING C-16