GEOTECHNICAL REPORT

BUSCHMANN ROAD IMPROVEMENTS

NELSON ROAD – COUNTY ROAD 11 | BREEZY POINT, MINNESOTA

June 2, 2023

Prepared for:
City of Breezy Point
8319 County Road 11
Breezy Point, MN 56472

WSB PROJECT NO. 022038-000

wsb

GEOTECHNICAL REPORT

BUSCHMANN ROAD IMPROVEMENTS
NELSON ROAD – COUNTY ROAD 11

FOR
CITY OF BREEZY POINT

June 2, 2023

CERTIFICATION

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Mark W. Osborn, PE

Date: June 2, 2023 Lic. No. 41362

June 2, 2023

Mr. Joe Zierden
Public Works Supervisor
8319 County Road 11
Breezy Point, MN 56472

Re: Geotechnical Report
Buschmann Road Improvements
Nelson Road – County Road 11
Breezy Point, Minnesota
WSB Project No.: 022038-000

We have conducted a geotechnical subsurface exploration program for the above referenced project. This report contains our soil boring logs, an evaluation of the conditions encountered in the borings and our recommendations for subgrade improvements, pavement design, and other geotechnical related design and construction considerations.

If you have questions concerning this report or our recommendations, or for construction material testing for this project, please call us at 952.737.4660.

Sincerely,

WSB

Mark Osborn, PE
Senior Geotechnical Engineer

Mark Watson, PE
Geotechnical/Materials Engineer

Attachment:
Geotechnical Report

MWO/tw

540 GATEWAY BLVD | BURNSVILLE, MN | 55337 | 952.737.4660 | WSBENG.COM

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1. INTRODUCTION

1.1 Project Location

The site is located along Buschmann Road between Nelson Road and County Road 11 in Breezy Point, Minnesota. This report also includes improvements for Ranchette Drive from Buschmann Road to Fallen Leaf Circle. The approximate soil boring locations can be found on the Soil Boring Exhibit in ***Appendix A***.

1.2 Project Description

It is proposed to reconstruct the above mentioned roadways to improve the horizontal and vertical alignments as well as proposed widening of the roadways.

WSB has developed recommendations for this project in consideration of the proposed layout, loadings, and configurations as understood at this time. When the designer develops additional information about final design and configuration, or other significant factors, the recommendations presented herein may no longer apply. WSB should be made aware of the revised or additional information in order to evaluate the recommendations for continued applicability.

1.3 Purpose and Project Scope of Services

Mr. Joe Zierden with the City of Breezy Point (City) authorized this scope of service. In order to assist the design team in preparing plans and specifications, we have developed recommendations for subgrade improvements and pavements. As such, we have completed a subsurface exploration program and prepared a geotechnical report for the referenced site. This stated purpose was a significant factor in determining the scope and level of service provided. Should the purpose of the report change the report immediately ceases to be valid and use of it without WSB's prior review and written authorization should be at the user's sole risk.

Our authorized scope of work has been limited to:

1. Clearing underground utilities utilizing Gopher State One Call.
2. Mobilization / demobilization of a truck mounted drill rig.
3. Drilling 29 standard flight auger 10 foot depths.
4. Sealing the borings per Minnesota Department of Health procedures.
5. Perform soil classification and analysis.
6. Review of available project information and geologic data.
7. Providing this geotechnical report containing:
    a. Summary of our findings.
    b. Discussion of subsurface soil and groundwater conditions and how they may affect the proposed excavations and pavements.
    c. Estimated R-value of the soils.
    d. Recommended pavement section.
    e. A discussion of soils for use as structural fill and site fill.

2. PROCEDURES

2.1 Boring Layout and Soil Sampling Procedures

WSB completed 29 flight auger soil borings at the project site. WSB recommended the boring depths and selected the desired locations. Our survey staked the borings using survey level GPS equipment for horizontal locations and vertical elevations. The approximate boring locations are shown on the Soil Boring Exhibit in ***Appendix A*** which is an aerial photo.

We completed the borings on May 3 and 4, 2023 with a truck-mounted CME-55 drill rig operated by a two-person crew. The drill crew advanced the borings using continuous hollow stem augers. The drilling information is provided on the boring logs.

Generally, the drill crew sampled the soil from the flight augers. The materials encountered were described on field logs and representative samples were containerized and transported to our laboratory for further observation and testing.

The samples were visually observed to estimate the distribution of grain sizes, plasticity, consistency, moisture condition, color, presence of lenses and seams, and apparent geologic origin. We classified the soils according to type using the Unified Soil Classification System (USCS). A chart describing the USCS is included in ***Appendix A***.

2.2 Groundwater Measurements and Borehole Abandonment

The drill crew observed the borings for free groundwater while drilling and after completion of the borings. These observations and measurements are noted on the boring logs. The crew then backfilled the borings to comply with Minnesota Department of Health regulations.

2.3 Boring Log Procedures and Qualifications

The subsurface conditions encountered by the borings are illustrated on the Logs of Test Borings in ***Appendix A***. Similar soils were grouped into the strata shown on the boring logs, and the appropriate estimated USCS classification symbols were also added. The depths and thickness of the subsurface strata indicated on the boring logs were estimated from the drilling results.

The transition between materials (horizontal and vertical) is approximate and is usually far more gradual than shown. Information on actual subsurface conditions exists only at the specific locations indicated and is relevant only to the time exploration was performed. Subsurface conditions and groundwater levels at other locations may differ from conditions found at the indicated locations. The nature and extent of these conditions would not become evident until exposed by construction excavation. These stratification lines were used for our analytical purposes and due to the aforementioned limitations, should not be used as a basis of design or construction cost estimates.

3. EXPLORATION RESULTS

3.1 Site and Geology

The borings were completed within the existing roadway pavement section.

Boring elevations ranged from about 1234.77 feet to 1338.27 feet and indicate an undulating terrain.

Geologic origins can be difficult to determine solely from boring samples. We referenced online geologic data of the area and used our experience to help determine geologic origin of the soils, however only a detailed geologic exploration would accurately determine the geologic history of the site.

The Crow Wing County Geologic Atlas indicates the surficial geology of the area includes glacial outwash, ice contact stratified materials, and glacial tills. The Atlas also indicates that peat deposits are also found within this area of Crow Wing County.

The glacial outwash generally consists of sand and gravelly sands. The glacial tills include clayey or silty sands interbedded with sand and gravel deposits. The ice contract stratified materials are generally intermixed or interbedded layers of sand, gravelly sand, clayey or silty sands, or silt.

3.2 Subsurface Soil and Groundwater Conditions

The boring profile generally consisted of the pavement section materials overlying glacial deposits.

Pavements

The borings generally encountered about 2 to 4 inches of bituminous asphalt overlying 1 to 12 inches of base materials. The bituminous had transverse cracking. The base materials generally consisted of sands with gravel that were brown in color.

Glacial Deposits

The soils encountered in the borings generally consisted of sand, clayey sand, or silty sands consistent with glacial deposits in this area. These soils were generally brown in color.

Boring Profiles

Table 1 below presents the existing roadway pavement section and subgrade profiles.

Table 1: Existing Profiles

Boring No.	Bituminous Thickness (inches)	Aggregate Base Thickness (inches)	Subgrade Soils (Upper 4 feet)
B-1	4	3	Silty Sand, Clayey Sand
B-2	3	4	Silty Sand
B-3	2	2	Clayey Sand
B-4	2.5	5	Silty Sand, Clayey Sand
B-5	2.5	3	Sand
B-6	2.5	7	Sand with Gravel, Clayey Sand
B-7	3	4	Sand with Gravel, Clayey Sand
B-8	2.5	2	Sand
B-9	2	3	Sand

B-10	2	3.5	Sand
B-11	2.5	4	Clayey Sand
B-12	2.5	2	Sand
B-13	2	3.5	Sand
B-14	2	4	Clayey Sand
B-15	2	2.5	Clayey Sand
B-16	2	3	Sand
B-17	2	3	Sand
B-18	2	4	Sand
B-19	2	4	Sand
B-20	2	3	Sand
B-21	2	4	Sand
B-22	2	3.5	Sand
B-23	4	12	Sand
B-24	4	12	Sand
B-25	3	5.5	Sand
B-26	2	1	Clayey Sand
B-27	2	2.5	Sand
B-28	2	2	Sand
B-29	2.5	2.5	Clayey Sand
B-30	3	2	Sand

3.3 Groundwater Conditions

WSB took groundwater level readings in the exploratory borings, reviewed the data obtained, and discussed its interpretation of the data in the text of the report. Note that groundwater levels may fluctuate due to seasonal variations (e.g. precipitation, snowmelt and rainfall) and/or other factors not evident at the time of measurement.

Table 2 below is a summary of the estimated water levels at our borings.

Table 2: Groundwater Measurements

Boring No.	Ground Surface Elevation	Estimated Depth to Groundwater	Estimated Groundwater Elevation
B-1	1234.77	3.5	1231 ½
B-2	1240.78	n/a	Below 1231
B-3	1246.34	n/a	Below 1236
B-4	1249.95	n/a	Below 1240

B-5	1246.20	n/a	Below 1236
B-6	1243.56	n/a	Below 1234
B-7	1260.43	n/a	Below 1250
B-8	1288.89	n/a	Below 1279
B-9	1248.61	n/a	Below 1239
B-10	1237.23	n/a	Below 1227
B-11	1250.88	n/a	Below 1241
B-12	1256.66	n/a	Below 1247
B-13	1286.15	n/a	Below 1276
B-14	1305.13	n/a	Below 1295
B-15	1331.49	n/a	Below 1321
B-16	1338.27	n/a	Below 1328
B-17	1329.09	n/a	Below 1319
B-18	1302.25	n/a	Below 1292
B-19	1277.67	n/a	Below 1268
B-20	1258.80	n/a	Below 1249
B-21	1251.56	n/a	Below 1242
B-22	1249.58	n/a	Below 1240
B-23	1237.29	n/a	Below 1227
B-24	1239.57	n/a	Below 1230
B-25	1235.72	7.5	1228 ½
B-26	1253.64	n/a	Below 1244
B-27	1275.47	n/a	Below 1265
B-28	1275.55	n/a	Below 1266
B-29	1264.56	n/a	Below 1255
B-30	1258.66	n/a	Below 1249

n/a – indicates ground water was not encountered. Elevations are rounded to the highest ½ foot.

Groundwater was encountered in borings B-1 and B-25 at elevations of about 1231 ½ and 1228 ½. We also noted several borings where no groundwater was encountered to elevations of 1227 feet.

The site is located less than 500 feet west of Shaffer Lake in Breezy Point. According to online data from the Minnesota Department of Natural Resources, Shaffer Lake has an ordinary high water (OHW) level of 1211.7 feet and the highest recorded reading of 1211.82 feet. Groundwater encountered above these elevations in our borings likely corresponds to perched groundwater trapped within clayey sands.

The bore holes were only left open a short period of time, and groundwater levels may not have stabilized.

4. ENGINEERING ANALYSIS AND RECOMMENDATIONS

4.1 Discussion
Based on the results of our borings, the glacially deposited soils generally appear capable of supporting the pavement areas including widened lanes and changes to the horizontal or vertical alignment.

4.2 Backfill and Fill Selection and Compaction
The on-site non-organic soils may be reused as backfill and fill provided they are moisture conditioned and can be compacted to their specified densities. Wet soils that are excavated would need to be dried before reuse as an engineered fill. We recommend use of a minimum of 2 feet of clean coarse sand with less than 50 percent passing the #40 sieve and less than 5 percent passing the #200 sieve when backfilling the bottom of a wet excavation.

Gravel or cobbles larger than 2 inches in diameter should not be placed within 2 feet of grading grade or utilities. We recommend that clayey soils be moisture conditioned to within +/-2 percent of the optimum moisture content as determined from their standard Proctor tests (ASTM D-698). Granular fills should be moisture conditioned to between -4% and +2% of the optimum moisture content. Fill should be spread in lifts of 6 inches, depending on the size and type of compaction equipment used.

Table 3 provides the recommended compaction levels.

Table 3: Recommended Level of Compaction for Backfill and Fill

Area	Percent of Standard Proctor Maximum Dry Density
Pavement: Within 3 feet of bottom of aggregate base and any area where total depth of fill exceeds 10 feet	100
Pavement: Greater than 3 feet below aggregate base	95
Utility Trench and Utility Structure Backfill	100
Landscaping (non-structural)	90

4.3 Pavement Subgrade Preparation and Stability
We recommend excavation of organics below the pavement areas.

The soils at the bottom of the excavation should be prepared in accordance with MnDOT Specification 2112, Subgrade Preparation. Before placement of the sand subbase, the final subgrade should have proper stability within three vertical feet of grading grade (grade which contacts the bottom of the aggregate base). This will generally be achieved in fill areas with proper compaction of embankment materials and in cut areas through proper subgrade preparation. The stability of the pavement subgrade should be evaluated prior to placement of the sand subbase using the test roll procedure (MnDOT 2111), except a fully loaded tandem axle dump truck or a full water truck should be utilized for the test roll. If unstable soils are found under the test roll, these soils should be improved by means of scarification, moisture conditioning, and re-compaction, or by subcutting and replacement.

Where roadways are widened we recommend the subgrade soils consist of materials similar to the existing pavement subgrade to reduce risk of differential settlements between the pavement sections.

4.4 Pavement Area
Once the site has been prepared as recommended, we anticipate the prepared subgrade soils will consist mostly of sands, clayey sands, silty sands, and silts. Based on the MnDOT Flexible Pavement Guide from 2020, the R-values of the subgrade soils would range between 20 and 70. Based on the presence

of clayey sands within many of the subgrade swe recommend using a design R-value of 20 for the roadway.

We reviewed some existing traffic data from 2008 and 2022 from reports by Landecker and Associates and Bolton and Menk. Our design is based on a standard twenty (20) year design life of a rural pavement section and a 10-ton road design. We understand that heavy commercial traffic along the roadway makes up about 24% of the traffic and that much of that traffic is split between 2 axle – 6 tire vehicles and 5 axle vehicles. Based on the above information we estimated the Equivalent Single Axle Loads (ESAL's) for roadway design to be approximately 675,000. Based on our calculations, a minimum granular equivalent of 23.25 is required for pavement design.

Based on MnDOT's FlexPave excel design utilizing granular equivalent charts, we recommend the pavement section indicated below in Table 4.

Table 4: Recommended Flexible Pavement Section

Section	Thickness (inches)	Granular Equivalent
Bituminous Course, MnDOT 2360 SPWEA340C	2	4.5
Bituminous Course, MnDOT 2360 SPWEA340C	3	6.75
Aggregate Base, MnDOT 3138 (Class 5)	12	12
TOTAL	-	23.25

Aggregate base placement for pavement support should meet the gradation and quality requirements for Class 5 per MnDOT specification 3138. Aggregate base material should be compacted to 100 percent of its standard Proctor maximum dry density.

Within several years after initial paving, some thermal shrinkage cracks will develop. We recommend routine maintenance be performed to improve pavement performance and increase pavement life. Pavement should be sealed with a liquid bitumen sealer to retard water intrusion into the base course and subgrade. Localized patch failures may also develop where trucks or buses turn on the pavement. When these occur, they should be cut out and patch repaired.

The pavement sections above provide options to meet the ESAL requirements. Other pavement design options would be acceptable as well as long as they meet the minimum requirements for bituminous thickness, aggregate base thickness, and can meet the ESAL requirements.

4.5 Optional Frost Free Pavement Design

Optionally, the use of a non-frost susceptible sand cushion below a bituminous or concrete section will help reduce the effects of frost heave. In our opinion, placement of 12 inches of select granular fill below the Class 5 Aggregate Base should generally provide for a non-frost susceptible subgrade per MnDOT guidelines. It should be noted that any sand cushion placed below the pavement section will provide positive benefits for reduced potential frost heave. The owner and/or design team should evaluate the costs and benefit of this option to determine if it should be incorporated into the pavement design.

Drainage of the sand cushion is recommended. Drainage of the sand cushion may be accomplished by daylighting to adjacent ditches or the use of drain tile. Drain tile wrapped in a sock should be placed at the base of the sand cushion and tied into catch basins. We recommend the sand cushion contain a select granular sand with less than 12% passing the #200 sieve. Alternately, a 3 inch minus rock fill could be placed instead of a select granular sand and drain tile.

For transitioning the thickness of the sand subbase along the profile of the roadway, we recommend the thickness have a longitudinal taper of no steeper than 10H:1V. A taper of 4H:1V can be used perpendicular to the centerline for cross street/driveway connections. The placement of the sand

subbase should extend slightly beyond the outer edge of the curbs to maintain subgrade uniformity for frost movement.

4.6 Trails

We understand bituminous trails may be constructed along the road ROW areas. We recommend removal of organic soils or unsuitable materials from below the trail areas (debris, etc.). Table 5 below presents our recommendations for trail pavement sections.

Table 5: Recommended Trail Pavement Section

Section	Thickness (inches)	Granular Equivalent
Bituminous Course, MnDOT 2360 SPWEA230B	1.5	3.375
Bituminous Course, MnDOT 2360 SPWEA230B	1.5	3.375
Aggregate Base, MnDOT 3138 (Class 5)	6	6
TOTAL	-	12.75

4.7 Construction Considerations

Good surface drainage should be maintained throughout the work so that the site is not vulnerable to ponding during or after a rainfall. If water enters the excavations, it should be promptly removed prior to further construction activities. Under no circumstances should fill or concrete be placed into standing water.

Soil corrections at this site for pavement subgrades may not be continuous. We recommend tapering the fills back to native soils at a ten to one (10:1) slope.

4.8 Construction Safety

All excavations should comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P "Excavations and Trenches". This document states that excavation safety is the responsibility of the contractor. Reference to this OSHA requirement should be included in the job specifications.

The responsibility to provide safe working conditions on this site, for earthwork, building construction, or any associated operations is solely that of the contractor. This responsibility is not borne in any manner by WSB.

4.9 Cold Weather Construction

It is our understanding that construction is unlikely to occur during the winter months. However, if the construction does continue into the winter months we recommend the following guidelines.

Roadbeds should not be constructed during periods when the material freezes while being placed and compacted, nor should material be placed on soil that is frozen to a depth greater than 4 inches. When the soils are frozen to a depth exceeding 4 inches, at a time when weather conditions are such that construction could be continued without the material freezing as it is being placed and compacted, the contractor may be permitted to excavate the frozen soil and proceed with the construction for so long as the weather will permit. The frozen soils should be pulverized or replaced with other suitable soils. Only unfrozen fill should be used.

4.10 Field Observation and Testing

The soil conditions illustrated on the Logs of Test Borings in ***Appendix A*** are indicative of the conditions only at the boring locations. For this reason, we recommend that excavations at this site be observed by a soil engineer or technician prior to fill or backfill placement or construction of foundation elements to determine if the soils are capable of supporting the fill backfill and/or foundation loads. These observations are recommended to judge if the unsuitable materials have been removed from within the planned construction area and an appropriate degree of lateral oversize has been provided.

WSB also recommends a representative number of field density tests be taken in engineered fill and backfill placed to aid in judging its suitability. Fill placement and compaction should be monitored and tested to determine that the resulting fill and backfill conforms to specified density, strength or compressibility requirements. We recommend at least one compaction test for every 150 feet of utility trench at a vertical interval of two (2) feet. Prior to use, proposed fill and backfill material should be submitted to the WSB laboratory for testing to verify compliance with recommendations and project specifications.

Dynamic Cone Penetrometer (DCP) tests can be completed in the aggregate base in lieu of density testing. We recommend following MnDOT Specification 2211.3.D.2.c.

WSB would be pleased to provide the advised field observation, monitoring and testing services during construction.

4.11 Plan Review and Remarks

The observations, recommendations and conclusions described in this report are based primarily on information provided to WSB, obtained from our subsurface exploration, our experience, several assumptions and the scopes of service developed for this project and are for the sole use of our client. We recommend that WSB be retained to perform a review of final design drawing and specifications to evaluate that the geotechnical engineering report has not been misinterpreted. Should there be changes in the design or location of the structures related to this project or if there are uncertainties in the report we should be notified. We would be pleased to review project changes and modify the recommendations in this report or provide clarification in writing.

The entire report should be kept together; for example, boring logs should not be removed and placed in the specifications separately.

The boring logs and related information included in this report are indicators of the subsurface conditions only at the specific locations indicated on the Soil Boring Exhibit and times noted on the Logs of Test Boring sheets in ***Appendix A***. The subsurface conditions, including groundwater levels, at other locations on the site may differ significantly from conditions that existed at the time of sampling and at the boring locations.

The test borings were completed by WSB solely to obtain indications of subsurface conditions as part of a geotechnical exploration program. No services were performed to evaluate subsurface environmental conditions.

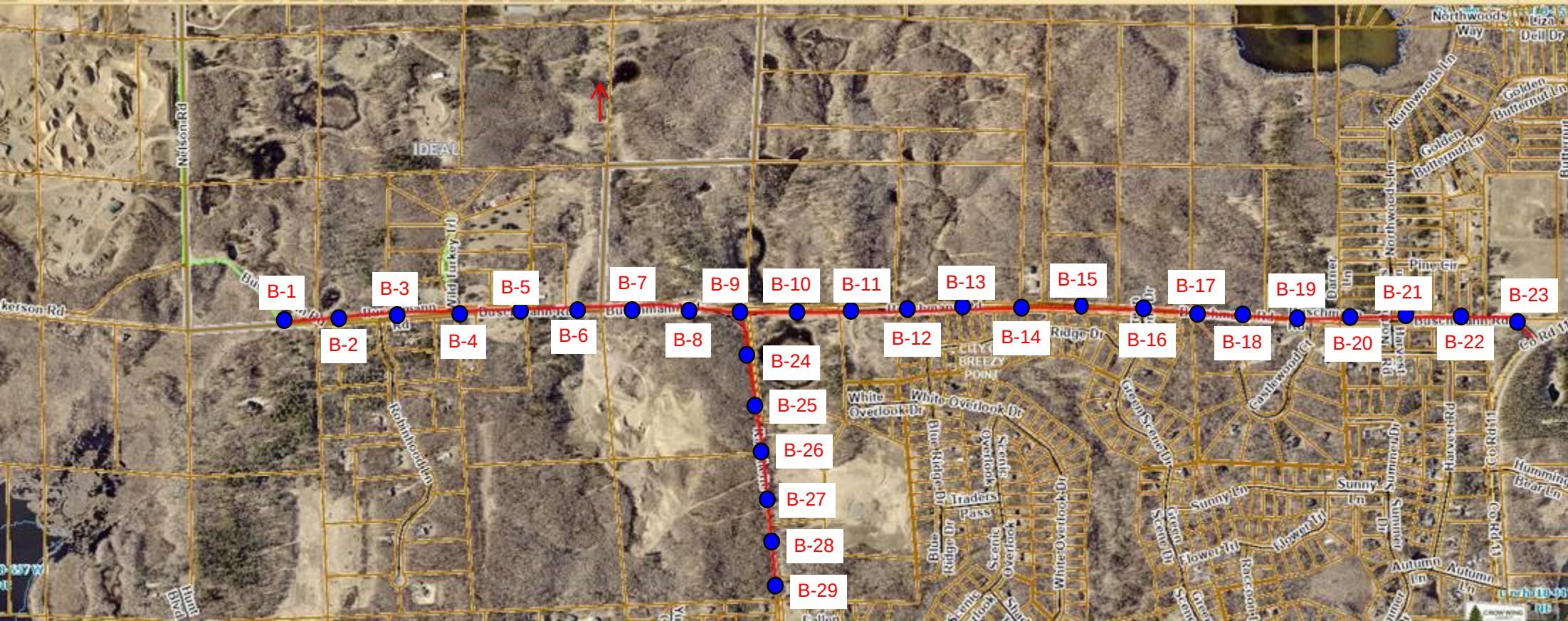
WSB has not performed observations, investigations, explorations, studies or testing that are not specifically listed in the scope of service. WSB should not be liable for failing to discover any condition whose discovery required the performance of services not authorized by the Agreement.

5. STANDARD OF CARE

The recommendations and opinions contained in this report are based on our professional judgment. The soil testing and geotechnical engineering services performed for this project have been performed with the level of skill and diligence ordinarily exercised by reputable members of the same profession under similar circumstances, at the same time and in the same or a similar locale. No warranty, either expressed or implied, is made.

APPENDIX A

Soil Borings Exhibit
Logs of Test Borings
Symbols and Terminology on Test Boring Log
Notice to Report Users Boring Log Information
Unified Soil Classification Sheet (USCS)


B-1
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IDEAL
Nelson Rd
Wild Turkey Trl
Robinhood Ln
Ridge Dr
White Overlook Dr
Blue Ridge Dr
Scenic Overlook
Traders Pass
Green Scene Dr
Sunny Ln
Flower Trl
Northwoods Ln
Golden Buttermut Ln
Pine Cir
Harvest Rd
Autumn Ln
Co Rd 11
Humming Bird Ln

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1234.773 ft

BORING NUMBER B-1
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		4" BITUMINOUS 3" SAND WITH GRAVEL, dark brown, moist		Pavement Section			FA	1			
		SILTY SAND WITH GRAVEL, brown, moist		Fill							
1	1234						FA	2			
2	1233	CLAYEY SAND, brown, wet									
3	1232				▽		FA	3			
4	1231										
5	1230	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, waterbearing	SP	Glacial Outwash							
6	1229										
7	1228						FA	4			
8	1227										
9	1226										
10	1225	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION
5/03/2023	8:30 am	10		4.5	3.5	1231.273

START: 5/03/2023 END: 5/03/2023

METHOD: Flight Auger 0' - 10'

Crew Chief: J. Sharp

Logged By: P. Solie

Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1240.777 ft

BORING NUMBER B-2
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	SAMPLE TYPE	SAMPLE No.	MC %	%Fines
		3" BITUMINOUS 4" SAND WITH GRAVEL, brown, moist		Pavement Section	FA	1		
		SILTY SAND, light brown, moist		Fill				
1	1240							
2	1239				FA	2		
3	1238							
4	1237							
5	1236	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist	SP	Glacial Outwash				
6	1235							
7	1234				FA	3		
8	1233							
9	1232							
10	1231	End of Boring 10.0 ft.						

N-Value Plot: 0

WL: Drilling Operation

WATER LEVEL MEASUREMENTS

START: 5/03/2023 END: 5/03/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/03/2023	9:00 am	10		5	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes: Boring moved 3' south.

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1246.34 ft

BORING NUMBER B-3
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 2" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		CLAYEY SAND WITH LITTLE GRAVEL, fine to medium grained, brown, moist	SC	Glacial Till							
1	1245										
							FA	2	9		
2	1244										
3	1243	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist	SP	Glacial Outwash							
4	1242										
5	1241										
6	1240										
							FA	3			
7	1239										
8	1238										
9	1237										
10	1236	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/03/2023 END: 5/03/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief:	Logged By:
								J. Sharp	P. Solie
5/03/2023	9:30 am	10		5.5	None		Flight Auger 0' - 10'	Notes:	

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1249.947 ft

BORING NUMBER B-4
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2.5" BITUMINOUS 5" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
1	1249	SILTY SAND WITH LITTLE GRAVEL, dark brown, moist		Fill			FA	2			
2	1248										
3	1247	SAND WITH CLAY AND LITTLE GRAVEL, brown, wet					FA	3			
4	1246										
5	1245										
6	1244	SAND, fine to coarse grained, brown, moist	SP	Glacial Outwash			FA	4			
7	1243										
8	1242										
9	1241										
10	1240	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/03/2023 END: 5/03/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/03/2023	10:00 am	10		7.25	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes: Boring moved 15' east.

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1246.198 ft

BORING NUMBER B-5
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2.5" BITUMINOUS 3" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH LITTLE GRAVEL, brown moist		Fill							
1	1245										
2	1244										
3	1243										
4	1242										
5	1241	SAND, fine to medium grained, brown, moist	SP	Glacial Outwash			FA	2			
6	1240										
7	1239										
8	1238										
9	1237										
10	1236	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/03/2023 END: 5/03/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/03/2023	10:30 am	10		7.25	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1243.558 ft

BORING NUMBER B-6
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2.5" BITUMINOUS 7" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
1	1243	SAND WITH LITTLE GRAVEL, brown, moist		Fill			FA	2			
		- [Cobbles at 1.5 feet]									
2	1242	SAND WITH CLAY, dark brown, wet									
3	1241						FA	3	16		
4	1240	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist	SP	Glacial Outwash							
5	1239										
6	1238										
7	1237						FA	4			
8	1236										
9	1235										
10	1234	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS | START: 5/03/2023 | END: 5/03/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief:	Logged By:
								J. Sharp	P. Solie
5/03/2023	11:00 am	10		5.5	None		Flight Auger 0' - 10'	Notes:	

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1260.43 ft

BORING NUMBER B-7
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		3" BITUMINOUS 4" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
1	1259	SAND WITH LITTLE GRAVEL, brown, moist		Fill							
2	1258						FA	2			
3	1257	CLAYEY SAND, fine to medium grained, brown, wet	SC	Glacial Outwash							
4	1256						FA	3	8	23	
5	1255										
		SAND WITH GRAVEL, fine to coarse grained, brown, moist - [Cobbles at 6 feet]	SP								
6	1254										
7	1253										
8	1252						FA	4			
9	1251										
10	1250	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS							START: 5/03/2023	END: 5/03/2023
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief: J. Sharp / Logged By: P. Solie
5/03/2023	12:00 pm	10		6.5	None		Flight Auger 0' - 10'	Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1288.886 ft

BORING NUMBER B-8
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 2.5' SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH LITTLE GRAVEL, light brown, moist		Fill							
1	1288										
2	1287	- [Cobbles at 2 feet]									
3	1286										
4	1285										
5	1284	SAND, fine to coarse grained, brown, moist	SP	Glacial Outwash			FA	2			
6	1283										
7	1282										
8	1281										
9	1280										
10	1279	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS							START: 5/03/2023	END: 5/03/2023
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief: J. Sharp / Logged By: P. Solie
5/03/2023	1:30 am	10		5	None		Flight Auger 0' - 10'	Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1248.614 ft

BORING NUMBER B-9
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS		Pavement Section			FA	1			
		3" SAND WITH GRAVEL, brown, moist									
		SAND WITH LITTLE GRAVEL, brown, moist		Fill							
		- [Cobbles at 0.75 feet]									
1	1248										
2	1247						FA	2			
3	1246										
4	1245										
		CLAYEY SAND, dark brown, wet									
5	1244						FA	3			
6	1243										
		SAND, fine to coarse grained, brown, moist	SP	Glacial Outwash							
7	1242										
8	1241						FA	4			
9	1240										
10	1239										
		End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS							START: 5/03/2023	END: 5/03/2023	
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief: J. Sharp	Logged By: P. Solie
5/03/2023	2:15 pm	10		8	None		Flight Auger 0' - 10'	Notes: Boring moved 5' west.	

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1237.225 ft

BORING NUMBER B-10
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 3.5" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH LITTLE GRAVEL, fine to medium grained, light brown, moist	SP	Glacial Outwash							
1	1236										
2	1235										
3	1234										
4	1233						FA	2			
5	1232	- [Cobbles at 5 feet]									
6	1231										
7	1230										
8	1229	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, waterbearing	SP								
9	1228						FA	3			
10	1227	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION
5/03/2023	3:00 pm	10		6.5	None	

START: 5/03/2023 END: 5/03/2023

METHOD: Flight Auger 0' - 10'

Crew Chief: J. Sharp

Logged By: P. Solie

Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN

BORING NUMBER B-11

CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1250.883 ft

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2.5" BITUMINOUS 4" SAND WITH GRAVEL, brown, moist - [Cobbles at 0.5 feet]					FA	1			
1	1250	CLAYEY SAND WITH LITTLE GRAVEL, light brown and brown, moist		Fill							
2	1249										
3	1248						FA	2			
4	1247										
5	1246										
6	1245										
7	1244	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist - [Cobbles at 6.5 feet]	SP	Glacial Outwash							
8	1243						FA	3			
9	1242										
10	1241	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS							START: 5/03/2023	END: 5/03/2023
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief: J. Sharp / Logged By: P. Solie
5/03/2023	3:30 pm	10		4.5	None		Flight Auger 0' - 10'	Notes:

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1256.663 ft

BORING NUMBER B-12
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2.5" BITUMINOUS 2" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH LITTLE GRAVEL, fine to medium grained, brown, moist - [Cobbles at 0.5 feet]	SP	Glacial Outwash							
1	1256										
2	1255										
3	1254										
4	1253	SAND WITH GRAVEL, fine to coarse grained, brown, moist	SP								
5	1252						FA	2			
6	1251										
7	1250										
8	1249										
9	1248										
10	1247	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION
5/03/2023	4:00 pm	10		1	None	

START: 5/03/2023 END: 5/03/2023

METHOD: Flight Auger 0' - 10'

Crew Chief: J. Sharp

Logged By: P. Solie

Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1286.154 ft

BORING NUMBER B-13
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 3.5" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND, fine to medium grained, light brown, moist	SP	Glacial Outwash							
1	1285										
2	1284										
3	1283										
4	1282						FA	2			
5	1281										
6	1280										
7	1279	- [Cobbles at 7 feet]									
8	1278	SILTY SAND, fine to medium grained, olive, moist	SM						7		
9	1277						FA	3			
10	1276	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS							START: 5/03/2023	END: 5/03/2023	
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief: J. Sharp	Logged By: P. Solie
5/03/2023	4:30 am	10		6.5	None		Flight Auger 0' - 10'	Notes:	

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1305.131 ft

BORING NUMBER B-14
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 4' SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		CLAYEY SAND, fine to medium grained, light brown, moist to wet	SC	Glacial Till							
1	1304										
2	1303										
							FA	2		21	
3	1302										
4	1301										
5	1300	SAND, fine to coarse grained, brown, moist	SP	Glacial Outwash							
6	1299										
7	1298										
							FA	3			
8	1297										
9	1296										
10	1295	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/03/2023 END: 5/03/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/03/2023	5:00 pm	10		8	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1331.495 ft

BORING NUMBER B-15
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 2.5" SAND, brown, moist		Pavement Section			FA	1			
		CLAYEY SAND, fine to medium grained, brown, moist	SC	Glacial Till							
1	1330										
2	1329						FA	2			
3	1328	- [Cobbles at 3 feet]							9	30	
		SAND WITH LITTLE GRAVEL, fine to coarse grained, light brown, moist	SP	Glacial Outwash							
4	1327										
5	1326										
6	1325										
7	1324						FA	3			
8	1323										
9	1322										
10	1321	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/03/2023	5:15 pm	10		8	None		Flight Auger 0' - 10'

START: 5/03/2023 END: 5/03/2023

Crew Chief: J. Sharp
Logged By: P. Solie

Notes: Boring moved 5' west.

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1338.274 ft

BORING NUMBER B-16
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 3" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH LITTLE GRAVEL, brown, moist		Fill							
1	1337										
2	1336										
3	1335										
4	1334										
5	1333	SAND, fine to medium grained, light brown, moist	SP	Glacial Outwash			FA	2			
6	1332										
7	1331										
8	1330										
9	1329										
10	1328	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS | START: 5/03/2023 | END: 5/03/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief:	Logged By:
								J. Sharp	P. Solie
5/03/2023	5:45 am	10		8	None		Flight Auger 0' - 10'	Notes:	

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1329.088 ft

BORING NUMBER B-17
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 3" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND, fine to medium grained, light brown, moist	SP	Glacial Outwash							
1	1328										
2	1327										
3	1326						FA	2			
4	1325										
5	1324										
		SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist	SP								
6	1323						FA	3			
7	1322										
8	1321										
9	1320						FA	4			
10	1319	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION
5/03/2023	6:00 pm	10		7.25	None	

START: 5/03/2023 END: 5/03/2023

METHOD: Flight Auger 0' - 10'

Crew Chief: J. Sharp

Logged By: P. Solie

Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1302.254 ft

BORING NUMBER B-18
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 4" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH LITTLE GRAVEL, fine to medium grained, brown, moist	SP	Glacial Outwash							
1	1301										
2	1300										
3	1299						FA	2			
4	1298										
5	1297										
6	1296										
		SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist	SP								
7	1295										
8	1294						FA	3			
9	1293										
10	1292										

End of Boring 10.0 ft.

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	8:30 am	10		8	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1277.67 ft

BORING NUMBER B-19
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 4" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH SILT, fine to medium grained, brown, moist	SP-SM	Glacial Outwash							
1	1277										
2	1276						FA	2		7	
3	1275										
4	1274										
5	1273	SAND, fine to coarse grained, brown, moist	SP								
6	1272									3	
7	1271						FA	3			
8	1270										
9	1269										
10	1268	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS							START: 5/04/2023	END: 5/04/2023
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief: J. Sharp / Logged By: P. Solie
5/04/2023	8:50 am	10		8.5	None		Flight Auger 0' - 10'	Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1258.796 ft

BORING NUMBER B-20
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 3" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND, brown, moist		Fill							
1	1258										
2	1257						FA	2			
3	1256										
		CLAYEY SAND, dark brown, wet									
4	1255								15	33	
							FA	3			
5	1254										
6	1253	SAND, fine to medium grained, brown, moist	SP	Glacial Outwash							
7	1252										
8	1251						FA	4			
9	1250										
10	1249	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	9:10 am	10		8.5	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1251.56 ft

BORING NUMBER B-21
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	SAMPLE TYPE	SAMPLE No.	MC %	%Fines
	1251	2" BITUMINOUS 4" SAND WITH GRAVEL, brown, moist		Pavement Section	FA	1		
1		SAND, pieces of silt, brown to dark brown, moist		Fill				
2	1250							
3	1249				FA	2		
4	1248							
5	1247	SAND, fine to medium grained, brown, moist	SP	Glacial Outwash				
6	1246							
7	1245				FA	3		
8	1244							
9	1243							
10	1242	End of Boring 10.0 ft.						

N-Value Plot: 0

Drilling Operation

WL

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	9:30 am	10		8.25	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes: Boring moved 10' southeast.

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1249.579 ft

BORING NUMBER B-22
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 3.5" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND, pieces of silt, brown to dark brown, moist		Fill							
1	1249										
2	1248						FA	2			
3	1247										
4	1246										
		SAND, fine to medium grained, brown, moist	SP	Glacial Outwash							
5	1245										
6	1244										
7	1243						FA	3			
8	1242										
9	1241										
10	1240	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	9:55 am	10		8	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1237.287 ft

BORING NUMBER B-23
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		4" BITUMINOUS 12" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
1	1236										
		SAND, fine to medium grained, brown, moist	SP	Glacial Outwash							
2	1235										
3	1234										
4	1233										
5	1232	SAND, fine to medium grained, brown, moist	SP				FA	2			
6	1231										
7	1230										
8	1229										
9	1228										
10	1227	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	10:20 am	10		7.5	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes: Boring moved 15' east.

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1239.574 ft

BORING NUMBER B-24
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		4" BITUMINOUS		Pavement Section							0
1	1239	12' SAND WITH GRAVEL, brown, moist					FA	1			
		SAND WITH LITTLE GRAVEL, light brown, moist		Fill							
2	1238	- [Cobbles at 2 feet]									
3	1237										
4	1236						FA	2			
5	1235										
6	1234										
7	1233	CLAYEY SAND, brown to dark brown, wet									
							FA	3			
8	1232										
		SAND, fine to medium grained, brown, moist	SP	Glacial Outwash							
9	1231						FA	4			
10	1230	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	10:45 am	10		6	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes: Boring moved 15' east.

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1235.718 ft

BORING NUMBER B-25
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		3" BITUMINOUS 5.5" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
1	1235	SAND, brown, moist		Fill							
2	1234						FA	2			
3	1233										
4	1232	CLAYEY SAND, brown to dark brown, wet									
5	1231						FA	3	13		
6	1230	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, waterbearing	SP	Glacial Outwash							
7	1229	- [Cobbles at 7.5 feet]			▽						
8	1228						FA	4			
9	1227										
10	1226	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	12:00 pm	10		6.5	7.5	1228.218	Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1253.636 ft

BORING NUMBER B-26
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS		Pavement Section			FA	1			
		1" SAND WITH GRAVEL, brown, moist	SC	Glacial Till							
		CLAYEY SAND, fine to medium grained, brown, moist									
1	1253										
2	1252										
3	1251						FA	2		24	
4	1250										
5	1249										
6	1248	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist - [Cobbles at 6 feet]	SP	Glacial Outwash							
7	1247										
8	1246						FA	3			
9	1245										
10	1244	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	12:20 pm	10		6	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1275.472 ft

BORING NUMBER B-27
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	SAMPLE TYPE	SAMPLE No.	MC %	%Fines
		2" BITUMINOUS 2.5" SAND WITH GRAVEL, brown, moist		Pavement Section	FA	1		
		SAND WITH LITTLE GRAVEL, fine to coarse grained, light brown, moist	SP	Glacial Outwash				
1	1274							
2	1273							
					FA	2		
3	1272							
4	1271							
5	1270	SAND WITH GRAVEL, fine to coarse grained, brown, moist - [Cobbles at 5 feet]	SP					
6	1269							
7	1268							
					FA	3		
8	1267							
9	1266							
10	1265	End of Boring 10.0 ft.						

N-Value Plot: 0

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	12:45 pm	10		2.75	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes: Boring moved 10' north.

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1275.551 ft

BORING NUMBER B-28
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		2" BITUMINOUS 2" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	.33			
		SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist	SP	Glacial Outwash							
1	1275										
2	1274										
3	1273										
4	1272										
5	1271	SAND WITH GRAVEL, fine to coarse grained, brown, moist	SP				FA	10			
6	1270										
7	1269										
8	1268	- [Cobbles at 8 feet]									
9	1267										
10	1266	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	1:25 am	10		5.5	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1264.559 ft

BORING NUMBER B-29
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.		MC %	%Fines	N-Value Plot
		2.5" BITUMINOUS 2.5" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1				0
		CLAYEY SAND, dark brown, wet		Fill								
1	1264											
2	1263											
3	1262						FA	2		11		
4	1261											
5	1260											
		SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist - [Cobbles at 5.5 feet]	SP	Glacial Outwash								
6	1259											
7	1258											
8	1257						FA	3				
9	1256											
10	1255											
		End of Boring 10.0 ft.										

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/04/2023	1:45 pm	10		6.5	None		Flight Auger 0' - 10'

Crew Chief: J. Sharp
Logged By: P. Solie
Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Buschmann Road & Ranchette Drive PROJECT LOCATION: Breezy Point, MN
CLIENT/WSB #: 022038-000 SURFACE ELEVATION: 1258.665 ft

BORING NUMBER B-30
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	MC %	%Fines	N-Value Plot
		3" BITUMINOUS 2" SAND WITH GRAVEL, brown, moist		Pavement Section			FA	1			
		SAND WITH LITTLE GRAVEL, fine to medium grained, light brown, moist	SP	Glacial Outwash							
1	1258										
2	1257										
3	1256										
4	1255										
5	1254						FA	2			
6	1253										
7	1252										
8	1251										
9	1250	- [Cobbles at 9 feet]									
10	1249	End of Boring 10.0 ft.									

WATER LEVEL MEASUREMENTS

START: 5/04/2023 END: 5/04/2023

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief:	Logged By:
								J. Sharp	P. Solie
5/04/2023	2:10 am	10		5.5	None		Flight Auger 0' - 10'	Notes:	

GEOTECHNICAL N-PLOT - WSB.GDT - 5/16/23 15:44 - K:\022038-000\GEOTECH-CMT\GEOTECH\BREEZY POINT - BORING LOG.GPJ

SYMBOLS AND TERMINOLOGY ON TEST BORING LOG

SYMBOLS

Drilling and Sampling

Symbol	Description
HSA	3 1/4" LD. Hollow Stem Auger
FA	Flight Auger
HA	Hand Auger
RC	Size A, B, or N rotary casing
CS	Continuous split barrel sampling
DM	Drilling Mud
JW	Jetting Water
SB	2" O.D. split barrel sampling
_L	2 1/2" or 3 1/2" OD split barrel liner sampler
_T	2" or 3" thin walled tube sample
W	Wash sample
B	Bag sample
P	Test Pit sample
_Q	BQ, NQ, or PQ wire line system
_X	AX, BX, or NX double tube barrel
N	Standard penetration test, blow per foot
CR	Core recovery, percent
WL	Water level
n/a	no measurement recorded

Laboratory Testing

Symbol	Description
MC	Moisture content, % (ASTM D2216)
DD	Dry Density, pcf
LL	Liquid Limit (ASTM D4318)
PL	Plastic Limit (ASTM D4318)
	- Inserts in last column
Qu	Unconfined compressive strength, psf (ASTM D2166)
Pq	Penetrometer Reading, tsf (ASTM D1558)
Ts	Torvane Reading, ts
G	Specific Gravity (ASTM D854)
SL	Shrinkage limits (ASTM D427)
OC	Organic Contenct (ASTM D2974)
SP	Swell Pressure, tsf (ASTM D4546)
PS	Percent swell under pressure (ASTM D4546)
FS	Free swell, % (ASTM D4546)
SS	Shrink swell, % (ASTM D4546)
pH	
SC	Sulfate content, parts/million or mg/l
CC	Chloride content, parts/million or mg/l
C	One dimensional consolidation (ASTM D2435)
Qc	Triaxial compression (ASTM D2850 and D4767)
DS	Direct Shear (ASTM D3080)
K	Coefficient of permeability, cm/sec (ASTM D2434)
P	Pinhole Test (ASTM D4647)
DH	Double hydrometer (ASTM D4221)
MA	Particle size analysis (ASTM D422)
R	Laboratory electreical resistivity, ohm-cm (ASTM G57)
VS	Field vane shear (ASTM D2573)
RQD	Rock quality designation, percent
IR	Infiltration Test (ASTM D3385)

TERMINOLOGY

Particle Sizes

Type	Size Range
Boulders	> 12"
Cobbles	3" - 12"
Coarse gravel	3/4" - 3"
Fine gravel	#4 sieve - 3/4"
Coarse sand	#4 sieve - #10 sieve
Medium sand	#10 sieve - #40 sieve
Fine sand	#40 sieve - #200 sieve
Silt	100% passing #200 sieve, and > 0.002mm
Clay	100% passing #200 sieve, and < 0.002mm

Soil Layering and Moisture

Term	Visual Observation
Lenses	Small pockets of different soils
Lamination	< 1/4" thick stratum
Layer	1/4" - 12" thick stratum
Stratified	Altering lenses of varying materials or colors
Varved	Altering laminations of clay, silt, fine sand, or colors
Dry	Powdery, no noticeable water
Moist	Damp, below saturation
Wet	MC above plastic limit
Waterbearing	Pervious soil below water table
Saturated	Cohesive soil with MC above liquit limit

Gravel Content

Coarse-Grained Soils

% Gravel	Description
2 - 15	A little gravel
16 - 30	With gravel
31 - 49	Gravelly

Fine-Grained Soils

% Gravel	Description
2 -5	Trace of gravel
5 -15	a little gravel
16 - 30	with gravel
31 - 49	Gravelly

Standard Pentration Resistance (N-value)

Cohesionless Soils

N-Value	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
>50	Very dense

Cohesive Soils

N-Value	Consistency
0 - 4	Very soft
5 - 8	Soft
9 - 15	Firm
16 - 30	Hard
>30	Very hard

NOTICE TO REPORT USERS BORING LOG INFORMATION

Subsurface Profiles

The subsurface stratification lines on the graphic representation of the test borings show an approximate boundary between soil types or rock. The transition between materials is approximate and is usually far more gradual than shown. Estimating excavation depths, soil volumes, and other computations relying on the subsurface strata may not be possible to any degree of accuracy.

Water Level

WSB & Associates, Inc. took groundwater level readings in the exploratory borings, reviewed the data obtained, and discussed its interpretation of the data in the text of this report. The groundwater level may fluctuate due to seasonal variations caused by precipitation, snowmelt, rainfalls, construction or remediation activities, and/or other factors not evident at the time of measurement.

The actual determination of the subsurface water level is an interpretive process. Subsurface water level may not be accurately depicted by the levels indicated on the boring logs. Normally, a subsurface exploration obtains general information regarding subsurface features for design purposes. An accurate determination of subsurface water levels is not possible with a typical scope of work. The use of the subsurface water level information provided for estimating purposes or other site review can present a moderate to high risk of error.

The following information is obtained in the field and noted under "Water Level Measurements" at the bottom of the log.

Sample Depth:	The lowest depth of soil sampling at the time a water level measurement is taken.
Casing Depth:	The depth to the bottom of the casing or hollow stem auger at the time of water level measurement.
Cave-in Depth:	The depth at which a measuring tape stops in the bore hole.
Water Level:	The point in the bore hole at which free-standing water is encountered by a measure device from the surface.

Obstruction Depths

Obstructions and/or obstruction depths may be noted on the boring logs. Obstruction indicates the sampling equipment encountered resistance to penetration. It must be realized that continuation of drilling, the use of other drilling equipment or further exploration may provide information other than that depicted on the logs. The correlation of obstruction depths on the log with construction features such as rock excavation, foundation depths, or buried debris cannot normally be determined with any degree of accuracy. For example, penetration of weathered rock by soil sampling equipment may not correlate with removal by certain types of construction equipment. Using this information for estimating purposes often results in a high degree of misinterpretation.

Accurately identifying the obstruction or estimating depths where hard rock is present over the site requires a scope of service beyond the normal geotechnical exploration program. The risk of using the information noted on the boring logs for estimating purposes must be understood.

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more 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 of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART