MONTANA FISH, WILDLIFE & PARKS

ADDENDUM NO. 1

MAKOSHIKA STATE PARK WATER SUPPLY
MONTANA FISH, WILDLIFE & PARKS
GLENDIVE, MONTANA
FWP #76652
I.E. #S19-00-115

DATE ISSUED: July 1, 2020

BID OPENING: Time and place of bid opening remains the same.

THE FOLLOWING ADDITIONS, CORRECTIONS AND/OR CLARIFICATIONS SHALL BE MADE TO THE SPECIFICATIONS, DRAWINGS, AND/OR CONTRACT DOCUMENTS:

SUMMARY

Item 1: Bid Proposal has been revised to omit Item's with zero (0) quantity and to increase quantity of Item #117 to three (3).

Item 2: Standard Form of Contract Between Owner and Contractor, Form 110, has been revised to reflect Contract Time as stated in Section 01 88 13 - Special Construction Performance Requirements, SP-5.

Item 3: Section 8.1.8. of the General Conditions has been revised to reflect Contract Time as stated in Section 01 88 13 - Special Construction Performance Requirements, SP-5.

Item 4: Contractor may work greater than 50 hours per week without being assessed liquidated damages if coordinated with the Owner and Engineer.

Item 5: Minimum in-place density for embankment of unimproved areas shall be 90%.

Item 6: 3" HDPE Pipe shall be Iron Pipe Size (IPS).

Item 7: A 6" vertical 45-degree bend has been added at STA 11+51.

Item 8: Val-Matic 201C.2 Combination Air Valve is an approved equal to the GA Industries Model 945 Combination air release/vacuum valve.

Item 9: Wager 1700 Inverted Vent Check Valve is an approved equal to the Val-Matic Floodsafe Inflow Preventer.

Item 10: Minimum in-place density for embankment of unimproved areas shall be 90%.

Item 11: Prebid Meeting Minutes

- Attached are the Prebid Meeting Minutes and Attendance Sheet from the Prebid Meeting held on June 24, 2020.

Item 12: Geotechnical Report

- At the request of potential Bidders, a geotechnical report for the project has been made available and is attached.

THE FOLLOWING ADDITIONS, CORRECTIONS AND/OR CLARIFICATIONS SHALL BE MADE TO THE SPECIFICATIONS:

SECTION 01 21 43 – TIME ALLOWANCES

Add the following:

01.1.06.G.1. Contractor shall coordinate weekly with the Owner and Engineer on a work schedule. Contractor will not be assessed liquidated damages for work in excess of 50 hours per week if coordinated with the Owner and Engineer.

SECTION 01 45 16 – FIELD QUALITY CONTROL PROCEDURES

Revise the following:

01.3.03.G.2. Type B – 90%

SECTION 33 14 19 – VALVES AND HYDRANTS FOR WATER UTILITY SERVICE

Revise the following:

33.2.05.G.1.a. GA Industries Model 945, Val-Matic 201C.2, or approved equal.

SECTION 33 05 33.23 – POLYETHYLENE PRESSURE PIPE AND TUBING

Revise the following:

33.2.02.G.2. High density polyethylene (HDPE) pipe as specified in this subsection with diameter 4" and larger shall be manufactured to ductile iron pipe sizes (DIPS). HDPE pipe as specified in this subsection with diameter 3" and smaller shall be manufactured to iron pipe size (IPS).

THE FOLLOWING ADDITIONS, CORRECTIONS AND/OR CLARIFICATIONS SHALL BE MADE TO THE DRAWINGS:

Sheet D-2

Refer to Detail D. Wager 1700 Inverted Vent Check Valve is an approved equal to the Val-Matic Floodsafe Inflow Preventer.

Sheet D-4, D-5, S-1, S-2, E000, E100, E200

Refer to Section 33 14 19 – Packaged Pumping Systems for Water Utility Service for more information on the Booster Station.

Sheet C-2

Please see Revised Sheet C-2.

NOTE: THE CONTRACTOR IS REQUIRED TO ACKNOWLEDGE THE RECEIPT OF EACH ADDENDUM IN THE PROPOSAL AND ON THE OUTSIDE OF THE BID ENVELOPE.

Issued by:
Interstate Engineering, Inc.

Jordan Mayer, P.E.

END OF ADDENDUM NO. 1

PROPOSAL

FWP# 76652

Montana Fish, Wildlife & Parks
Design and Construction
PO Box 200701
1522 Ninth Avenue
Helena, Montana 59620-0701

The undersigned, having familiarized himself with the conditions of the work and the contract documents as prepared by **Interstate Engineering, Inc; P.O. Box 2236; Williston, ND 58802; Phone 701-774-3637**, agrees to furnish all labor, materials, equipment, and services necessary to complete all general construction work, as bid herein, for a project entitled **Makoshika State Park Water Supply Project, FWP # 76552** in accordance with the Contract Documents including all Addenda. The bidder agrees to perform all the work described below at the price shown as follows:

Reminder To Contractors: All Unit Prices must be filled in on the Bid Form for a valid bid (18-2-303 MCA).

Base Bid:

Item #	Description	Estimated Quantity	Unit Measure	Unit Price	Amount
101	Mobilization, Taxes, Bonds and Insurance (12%)	1	L.S.		
102	Prefabricated Booster Station - Installed	1	L.S.		
103	Booster Station - Electrical	1	L.S.		
104	Booster Station - Site Improvements	1	L.S.		
105	6" HDPE DR17 Water Main (HDD)	134	LF		
106	6" HDPE DR17 Water Main (Any Method)	6	LF		
107	6" DIP Water Main (Open Cut)	8	LF		
108	4" DIP Water Main (Open Cut)	15	LF		
109	4" HDPE DR17 Water Main (HDD)	1570	LF		
110	4" HDPE DR17 Water Main (Any Method)	1152	LF		
113	Connect to Existing Main	1	EA		
114	6" Gate Valve & Riser	1	EA		
115	4" Gate Valve & Riser	5	EA		
117	6" 45° Bend	3	EA		
118	4" Tee	1	EA		
119	4" Cap	2	EA		
123	Utility Marker	10	EA		

124	Tracer Wire	2885	LF		
125	Air-Vacuum Assembly	3	EA		
126	2" Flushing Hydrant Assembly	1	EA		
132	Gravel Restoration	48	S.Y.		
133	Grass Restoration	1519	S.Y.		
134	Exploratory Excavation	10	HR		
135	Imported Backfill (10% of Any Method LF)	109	C.Y.		
136	Type II Bedding (10% of Any Method LF)	56	C.Y.		
137	Traffic Control	1	LS		
138	Miscellaneous Work	7500	EA		
139	Material Testing Allowance	5000	EA		
		Total: $_____			

BASE BID:_____

_____ AND /100 DOLLARS ($_____).

ADDITIVE ALTERNATE #1:

Item #	Description	Estimated Quantity	Unit Measure	Unit Price	Amount
201	Mobilization, Taxes, Bonds and Insurance (12%)	1	L.S.		
211	3" HDPE DR17 Water Main (HDD)	760	LF		
212	3" HDPE DR17 Water Main (Any Method)	740	LF		
216	3" Gate Valve & Riser	2	EA		
220	4" x 3" Reducer	1	EA		
222	3" Cap	1	EA		
223	Utility Marker	3	EA		
224	Tracer Wire	1500	LF		
225	Air-Vacuum Assembly	1	EA		
227	Frost-Free Hydrant Assembly	1	EA		

228	1" Water Service Connection	1	EA		
229	1" Service Line	125	LF		
230	1" Curb Stop	1	EA		
233	Grass Restoration	989	S.Y.		
234	Exploratory Excavation	10	HR		
235	Imported Backfill (10% of Any Method LF)	68	C.Y.		
236	Type II Bedding (10% of Any Method LF)	35	C.Y.		
237	Traffic Control	1	LS		
238	Miscellaneous Work	2500	EA		
239	Material Testing Allowance	2500	EA		
			Total: $_____		

ADDITIVE ALTERNATE # 1: _____

_____AND _____/100 DOLLARS ($_____).

ADDITIVE ALTERNATE #2:

Item #	Description	Estimated Quantity	Unit Measure	Unit Price	Amount
301	Mobilization, Taxes, Bonds and Insurance (12%)	1	L.S.		
311	3" HDPE DR17 Water Main (HDD)	605	LF		
312	3" HDPE DR17 Water Main (Any Method)	1360	LF		
316	3" Gate Valve & Riser	4	EA		
321	3" Tee	1	EA		
322	3" Cap	2	EA		
323	Utility Marker	6	EA		
324	Tracer Wire	1965	LF		

325	Air-Vacuum Assembly	2	EA		
327	Frost-Free Hydrant Assembly	2	EA		
328	1" Water Service Connection	1	EA		
329	1" Service Line	102	LF		
330	1" Curb Stop	1	EA		
331	Asphalt Restoration	26	S.Y.		
332	Gravel Restoration	47	S.Y.		
333	Grass Restoration	1742	S.Y.		
334	Exploratory Excavation	15	HR		
335	Imported Backfill (10% of Any Method LF)	124	C.Y.		
336	Type II Bedding (10% of Any Method LF)	63	C.Y.		
337	Traffic Control	1	LS		
338	Miscellaneous Work	5000	EA		
339	Material Testing Allowance	5000	EA		
			Total: $_____		

ADDITIVE ALTERNATE # 2:_____

_____AND_____/100 DOLLARS ($_____).

ADDITIVE ALTERNATE #3:

Item #	Description	Estimated Quantity	Unit Measure	Unit Price	Amount
401	Mobilization, Taxes, Bonds and Insurance (12%)	1	L.S.		
411	3" HDPE DR17 Water Main (HDD)	300	LF		
412	3" HDPE DR17 Water Main (Any Method)	480	LF		
416	3" Gate Valve & Riser	2	EA		

423	Utility Marker	3	EA		
424	Tracer Wire	780	LF		
425	Air-Vacuum Assembly	1	EA		
427	Frost-Free Hydrant Assembly	1	EA		
428	1" Water Service Connection	1	EA		
429	1" Service Line	13	LF		
430	1" Curb Stop	1	EA		
433	Grass Restoration	641	S.Y.		
434	Exploratory Excavation	10	HR		
435	Imported Backfill (10% of Any Method LF)	44	C.Y.		
436	Type II Bedding (10% of Any Method LF)	22	C.Y.		
437	Traffic Control	1	LS		
438	Miscellaneous Work	5000	EA		
439	Material Testing Allowance	2500	EA		
			Total: $_____		

ADDITIVE ALTERNATE # 3: _____

_____ AND _____ /100 DOLLARS ($_____).

TOTAL BASE BID: _____

_____

_____ AND _____ /100 DOLLARS ($_____).

TOTAL BASE BID + ADD ALT #1: _____

_____

_____ AND _____ /100 DOLLARS ($ _____).

TOTAL BASE BID + ADD ALT #1 + ADD ALT #2: _____

_____

_____ AND _____ /100 DOLLARS ($ _____).

TOTAL BASE BID + ADD ALT #1 + ADD ALT #2 + ADD ALT #3: _____

_____

_____ AND _____ /100 DOLLARS ($ _____).

And certifies that he is a duly and regularly licensed contractor registered with the Montana Department of Labor and Industry:

FIRM NAME: _____ _____

TELEPHONE #: _____ FAX#: _____

BY: _____

REGISTRATION # : _____

BUSINESS ADDRESS: _____

_____

E-MAIL ADRESS: _____

This bidder acknowledges receipt of the following addenda:

ADDENDUM NO. _____ DATED

ADDENDUM NO. _____ DATED

ADDENDUM NO. _____ DATED

MONTANA FISH, WILDLIFE & PARKS

GENERAL OUTLINE FOR PRE-BID MEETING MINUTES

PROJECT: Makoshika State Park Water Supply

OWNER: Montana Fish, Wildlife & Parks

ENGINEER: Interstate Engineering, Inc.

CONTRACT S19-00-115

DATE: June 24, 2020 @ 10:00 AM (Local Time)

SIGN IN

All Attendees should sign the sheet. Please be sure to include an e-mail address and phone number for future correspondence.

INTRODUCTIONS

Engineer's team:

- Jordan Mayer, PE – Interstate Engineering Project Engineer
  Office (406) 433-5617 / Cell (406) 480-2889
- Kaden Bedwell – Interstate Engineering Staff Engineer
  Office (406) 526-3577 / Cell (406) 390-2170

Owner's team:

- Paul Valle – MFWP Design & Construction Supervisor
  Office (406) 841-4013
- Darcy Yakoweshen – MFWP Project Manager
  Office (406) 841-4019
- Chris Dantic – Makoshika State Park Manager
  Office (406) 377-6256

PROJECT DESCRIPTION AND SCOPE OF WORK

- The work generally consists of:
  - **Base Bid** generally consists of a watermain extension from the Visitor's Center to the Rifle Range and a prefabricated booster station. Water improvements include ±130 LF of 6-inch and ±2,700 LF of 4-inch HDPE water main installed via HDD and approved alternative methods and associated appurtenances.
  - **Additive Alternate #1** generally consists of a watermain extension from the Rifle Range to the Buccaneer Shelter. Water improvements include ±1,500 LF of 3-inch HDPE water main installed via HDD and approved alternative methods and associated appurtenances.
  - **Additive Alternate #2** generally consists of a watermain extension from the Buccaneer Shelter to Cain's Campground, including connection into the existing private water distribution system. Water improvements include ±1,900 LF of 3-inch HDPE water main installed via HDD and approved alternative methods and associated appurtenances.
  - **Additive Alternate #3** generally consists of a watermain extension within Cain's Campground. Water improvements include ±780 LF of 3-inch HDPE water main installed via HDD and approved alternative methods and associated appurtenances.

BID ADDENDUM

- If the Bidder recognizes irregularities in preparing the Bid, please address to Engineer so Addenda can be issued
- The Bidder shall acknowledge receipt of all addenda on the Bid Proposal and bid envelope. Refer to Section Instruction to Bidders, Subsection 4.5 and 4.8.
- Addenda will be available on the Website. Bidders are encouraged to reference this site to ensure that all Addenda are received.
  - http://fwp.mt.gov/doingBusiness/designAndConstruction/upcomingBidOpenings.html
- Questions received less than ten (10) days prior to the date of Bid Opening may not be answered. Only questions answered by formal written Addenda will be binding.
- Addendum No. 1 will be issued June 30, 2020.

BID ENVELOPE

- Bidders shall refer to Instruction for Bidders for Bid Submittal requirements.
    - Bid envelope must contain:
        - Fully Executed Bidders Proposal
        - Acknowledgement of Addendum on Bid Proposal
        - Bid Bond (10%)

BID OPENING

- Sealed bids will be received up to and including 3:00 PM Local Time on July 9th and will be publicly opened and read aloud in the office of Design and Construction, 1522 Ninth Avenue, P.O. Box 200701, Helena, MT 59620-0701.
- MFWP has no control over the Central Mail service. Bidders are solely responsible for insuring bids are received by the deadline.
- FedEx or UPS may not reach Design & Construction by the time of bid opening unless morning delivery is specified. FedEx or UPS bids need to be sent to the physical address.

BID ACCEPTANCE

- The Owner has the right to reject any and or all bids and to waive any informality or irregularity in the bid received.

COMPLETION TIME AND PROJECT SCHEDULE

- All Construction Schedules shall be substantially complete and ready for OWNER's use and pre-final inspection by March 31, 2021. A winter shutdown is expected in 2020 with a resume work order to be issued in 2021 for the booster station installation/start-up, at a minimum
- Substantial Completion
    - **Base Bid** shall be substantially complete and ready for Owner use and pre-final inspection within seventy-five (75) calendar days from the Notice to Proceed.
    - **Additive Alternate #1** shall be substantially complete and ready for Owner use and pre-final inspection within an additional fifteen (15) calendar days from the time allotted in the Base Bid.
    - **Additive Alternate #2** shall be substantially complete and ready for Owner use and pre-final inspection within an additional twenty (20) calendar days from the time allotted in Additive Alternate #1.

- **Additive Alternate #3** shall be substantially complete and ready for Owner use and pre-final inspection within an additional ten (10) calendar days from the time allotted in Additive Alternate #2

- Final Payment
  - All Schedules shall be ready for final payment within thirty (30) calendar days from Substantial Completion
- Liquidated Damages for this project is $500.00/day for each day that expires after the time specified for Substantial Completion.

WARRANTY

- A one-year warranty period will begin after Substantial Completion.

OBTAINING PLANS AND SPECIFICATIONS

- Digital copies of the Bidding Documents are available at the following locations:
  - Montana Bidders Exchange
  - http://fwp.mt.gov/doingBusiness/designAndConstruction/upcomingBidOpenings.html

BID SECURITY

- A Bid security of ten percent (10%) of the Bidder's maximum bid price shall be included with each Bid.

SURVEY

- Available survey information is provided on the construction plan drawings. Topographic elevations are included in the Drawings.
- Engineer can provide construction staking, if requested by the Contractor, on an hourly fee basis, at the expense of the Contractor.

STAGING MATERIALS

- Material storage and staging shall be the responsibility of the Bidder.
  - Across from Buccaneer Shelter is an approved staging area (Sheet C-13)
  - Locations and agreements shall be provided to the Engineer upon request.

AIS REQUIREMENTS

- This project is not subject to American Iron and Steel (AIS) requirements.

WAGE REQUIREMENTS

- The project is subject to Montana Prevailing Wage Rates for Heavy Construction Services 2020, Effective January 2, 2020

SPECIAL CONSTRUCTION PERFORMANCE REQUIREMENTS – SECTION 01 88 13

- Controlling Documents Precedence
  - Revised drawing after bidding period
  - Addenda
  - Plan Sheets
  - Section 01 88 13
  - Technical Provisions
  - Specifications
  - General Conditions
  - MPWSS
- City of Glendive Bulk Water
  - Available for purchase for construction water
  - Contact Jack Rice, Glendive Public Works Director
- Geotechnical Report dated March 18, 2020

PLAN SHEETS

- G-3: Unit Quantity Summary Table
- D-1: Restoration
  - Trench Backfill Detail depends on construction means/methods
    - Existing sand material may be suitable for bedding material
  - Minimum 3” topsoil required; import if necessary
- D-4 & D-5: Booster Station
  - Note contractor responsibilities for complete installation
  - Floor drain
  - Pipe outlet splash block
  - Concrete stoop & gravel walkway
- S-2: Foundation
  - Excavation & Backfill
- E100: Electrical
  - Supply power from existing Main Distribution Panelboard inside Visitor Center
  - Route to booster station to minimize disturbance
  - Make final connections within pre-wired booster station
  - Two (2) conduits subbed out for future access into booster station
- C-1: Overview
  - Staging Area
  - Base Bid & Alternate start/stop locations
- C-2: P&P

  - Existing gate valve installed in 2020
  - HDPE wall anchors
  - Ductile Iron Pipe between gate valves
  - Will add a 6" 45-degree vertical bend at STA 11+51 in Addendum No.1
- C-4 to C-20: P&P
  - Note Directional Drill locations
  - Contractor to choose installation method between drills
  - Flexibility in alignment
    - Minimum 5-foot clearance between top of new main and bottom of culverts at all crossings
    - Air-Vac Assembly at field-installed highpoints
  - Flushing Hydrant
    - Only one (1) will be installed on the project. Location dependent on Award
- C-12: P&P
  - Frost Free Hydrant Location
- C-17: P&P
  - Walking Path & Cain's Campground Entrance
- C-18: P&P
  - Existing Well Service
- C-19: P&P
  - Frost Free Hydrant Replacement

SPECIFICATIONS

- Section 01 21 19 Testing and Inspecting Allowances
  - Allowance included in the Bidder's Proposal
    - Refer to Section 01 45 16 Field Quality Control Procedures
  - Non-eligible testing costs:
    - Mix designs and job mix formulas
    - Source and quality
    - Non-compliance
    - Retesting
    - Code compliance
    - Convenience

- Section 01 21 43 Time Allowances
  - 50 hour work week per crew with maximum of two (2) crews
    - Will omit in Addendum No. 1
  - Rain days in 0.5 day increments
  - Weather shutdown
- Section 01 22 19 Measurement and Payment
  - Use to prepare Bidder's Proposal
  - Booster Station Items 102-104
    - Includes everything for a complete and operable lift station, including startup/training and any necessary site and utility work
  - XX" HDPE DR17 Water Main – (Any Method)
    - Pre-approved methods
  - Restoration X31-X33
    - Maximum pay limits
- Section 01 31 00 Project Management and Coordination
  - A minimum of one lane and/or entrance shall be open across the Project at all times throughout the construction day. Both lanes shall be opened to traffic by the end of the day.
- Section 01 41 00 Regulatory Requirements
  - Contractor shall obtain all necessary local and/or state permits for Booster Station
  - Contractor shall be responsible for determining if construction operations/dewatering warrant any permits
    - Erosion control plan and installation of BMPs are required, regardless if SWPPP is warranted
    - Disturbance area is dependent on Contractor's choice of installation method
  - Archaeological monitoring is provided by the Owner
- Section 01 52 00 Construction Facilities
  - Cost or use charges for temporary facilities is incidental to the cost for other items of work
- Section 01 79 00 Demonstration and Training
  - Start up and Eleven Month Warranty Training for Booster Station
- Section 32 92 19 Seeding
  - Seed mixes provided. Execute during allowable seeding months
  - Contractor shall install erosion control mats after seed application. Straw-type blankets are not approved

- Section 33 01 12 Inspection and Testing of Water Utilities
    - City water provided for testing purposes
- Section 33 05 07.13 Utility Directional Drilling
    - All directional drilling operations shall be performed by a qualified directional drilling Contractor with at least ten (10) years of continuous experience with involving similar work required of this project
- Section 33 14 43 Packaged Pumping Systems for Water Utility Service
    - Alternate manufacturers submitting on alternate equipment shall furnish Pre-Bid Submittal documents 14 days prior to the bid date (June 25, 2020)
    - Correspond with packaged booster station supplier on installation requirements and what's provided by Contractor and what isn't

ADDENDUM NO. 1 ITEMS

- Possible material substitutions relating to Air-Vacuum Assembly
- 3" HDPE pipe clarification
- Omit 50hr work week
- Add 6" vertical 45-degree bend
-
-

QUESTIONS

- Are electrofusion fittings/saddles allowed?
  No
- Are ball valves allowed in lieu of gate valves?
  No
- What is required experience of Heat Fusion Technicians/Operators?
  10,000 feet of documented HDPE pipe fusion experience.
-
-
-

SITE TOUR

Makoshika State Park Water Supply
Montana Fish, Wildlife & Parks
Glendive, Montana
Attendance Log - Pre-Bid Meeting - June 24, 2020

i.e. #S19-00-115

	Name	Company	Contact Numbers
1	Jordan Mayer	Interstate Engineering	Work # 406.433.5617 Email jordan.mayer@interstateeng.com
2	Les Klaudt	Fusion Tech Inc.	Work # 406-239-7624 Email les@fusiontechnologies.com
3	Ty Kuehn	Kuehn Trenching	Work # 406-377-3849 Email kuehntrenching@gmail.com
4	Jerry L.	Kuehn Trenching	Work # 406-359-916 Email
5	Kari Buechler	Millennium Construction	Work # 406-694-3946 Email kari@millenniumconstruct.com
6	Tyler Youderian	Youderian Construction	Work # 406-490-7708 Email Tyler@youderianconst.com
7	Darcy Yakoweshen	FWP	Work # 406-841-4019 Email dyakoweshen@mt.gov
8	Paul Valle	FWP	Work # 406-844-4013 Email pvalle@mt.gov
9	Erik Dion	FWP	Work # 406-939-0260 Email edion@mt.gov
10	Casey Britton	Fusion Tech Inc.	Work # 406-598-3351 Email c.britton@fusiontechnologies.com
11			Work # Email
12			Work # Email
13			Work # Email
14			Work # Email
15			Work # Email
16			Work # Email
17			Work # Email

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

REPORT OF GEOTECHNICAL EXPLORATION

Makoshika State Park Waterline Extension

Makoshika State Park
Glendive, Montana

AET No. 37-20547

Date:

March 18, 2020

Prepared for:

Interstate Engineering, Inc.
2177 Lincoln Avenue Southeast
Sidney, Montana 59270

www.amengtest.com

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

March 18, 2020

Interstate Engineering, Inc.
2177 Lincoln Avenue Southeast
Sidney, Montana 59270

Attn: Mr. Jordan Mayer, P.E.

RE: Geotechnical Exploration
Makoshika State Park Waterline Extension
Makoshika State Park
Glendive, Montana
AET No. 37-20547

Greetings Mr. Mayer:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for your Makoshika State Park Waterline Extension project near Glendive, Montana. These services were performed according to our proposal to you dated January 24, 2020, and the change order dated March 2, 2020.

We are submitting one electronic copy of the report to you. Additional copies can be sent out at your request.

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

Sincerely,
American Engineering Testing, Inc.

Harvey T. Fitzgerald, P.E.
Engineer II
Phone: (701) 572-3324
hfitzgerald@amengtest.com

322 47th Street West | Williston, ND 58801
Phone (701) 572-3324 | www.amengtest.com | AA/EEO

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

SIGNATURE PAGE

Prepared for:

Interstate Engineering, Inc.
2177 Lincoln Avenue Southeast
Sidney, Montana 59270

Attn: Mr. Jordan Mayer, P.E.

Prepared by:

American Engineering Testing, Inc.
322 47th Street West
Williston, North Dakota 58801
(701) 572-3324/www.amengtest.com

Authored by:

Harvey T. Fitzgerald, P.E.
Engineer II

Reviewed by:

Jon C. Howell, M.S., P.E.
Senior Geotechnical Engineer
Gillette Manager

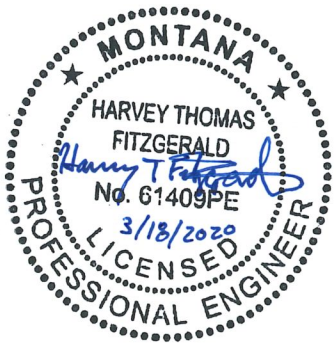


TABLE OF CONTENTS

TABLE OF CONTENTS

1.0 INTRODUCTION

Interstate Engineering, Inc. is proposing to construct a new waterline and a pump house in Makoshika State Park near Glendive, Montana. To assist planning and design, you have authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET performed their services according to our proposal sent to you, dated January 24, 2020, which you authorized on January 28, 2020, and the Change Order dated March 2, 2020, which you authorized on March 4, 2020. The authorized scope consists of the following.

- 28 standard penetration test borings to depths ranging from 12 to 46.5 feet below existing grade.
- Soil laboratory testing
- Geotechnical engineering review based on the data and preparation of this report

These services are intended for geotechnical purposes only. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or groundwater.

3.0 PROJECT INFORMATION

The project site is located in Makoshika State Park near Glendive, Montana. Specifically, the waterline extension alignment runs parallel to Makoshika State Park Road from the entrance of the park to Cains Coulee Campground. The proposed pump house will be located southeast of the Welcome Center. The pipeline crosses the road at several locations. The road runs from the northwest to the southeast following Cains Coulee and an intermittent stream.

The pipeline will be about 6,500 linear feet and will have a minimum burial depth of about 8 feet. We understand the pipeline will be constructed via open-cut trenching methods and will be horizontally directional drilled in several locations; however, we understand an alternative is being considered for horizontal directional drilling the entire route, and may be included in the bidding process

The pump house will be approximately 15 feet by 20 feet and supported on shallow spread footings. The anticipated design loads and finished floor/footing elevations for the pump house have not been provided at the time of this report. We assume that wall loadings will be less than 4 kips per lineal foot and column loads, if present, will be less than 50 kips. Additionally, we estimate that floor slab loadings will be less than 100 pounds per square foot. Our foundation design assumptions include a minimum factor of safety of 3 with respect to the ultimate bearing

capacity. We assume the structure will be able to tolerate total settlements of up to 1 inch, and differential settlements over a 30-foot distance of up to ½ inch.

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

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of twenty-eight (28) standard penetration test borings. Interstate Engineering, Inc. determined the number of borings and the locations. Borings B-3 and B-14 were moved during our field exploration due to utility locates and site access. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic origins, and moisture condition. A density description or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

4.2 Laboratory Testing

The laboratory test program included natural moisture contents and densities, Atterberg limits, consolidation tests, unconfined compression tests, sieve analysis, water soluble sulfates, resistivity, and pH. The test results appear in Appendix A on the individual boring logs adjacent to the samples upon which they were performed, or on the data sheets following the logs.

5.0 SITE CONDITIONS

5.1 Surface Observations

At the time of our subsurface exploration, snow covered the project area. Beneath the snow, the ground surface consisted of native prairie grasses, with a few locations with little to no vegetation. Topsoil typically extended 2 to 6 inches; however, several areas had little to no topsoil. The project area is located in Makoshika State Park and the route of the waterline parallels Makoshika State Park Road through Cains Coulee. The terrain varies across the route, with several large coulees and plateaus.

5.2 Subsurface Soils/Geology

The site geology consists primarily of coarse to fine alluvial deposits overlying very dense sand, claystone, siltstone, and sandstone from the Hell Creek Formation. Topsoil typically extended 2 to 6 inches; however, several areas had little to no topsoil. The subsurface soil generally consisted of clay and sandy soils. We encountered weakly-cemented sandstone bedrock in

Borings B-6A, B-8A, B-11, and B-26. In addition, we encountered trace lignite in several of the borings.

5.3 Groundwater

We encountered groundwater in Borings B-23 to B-26 at depths ranging from 25 to 35 feet below the existing ground surface. It should be noted our exploration occurred in January and February and groundwater levels fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors. The evaluation of these factors is beyond the scope of this report.

6.0 RECOMMENDATIONS

6.1 Approach Discussion

AET presents the following geotechnical recommendations to assist the planning, design, and construction of the waterline extension and the pump house at Makoshika State Park near Glendive, Montana. Our recommendations are based on the results of our boring-based field exploration, field and laboratory testing, our experience in the area with similar soil conditions, and our understanding of the proposed construction. We specifically outline geotechnical design criteria, opinions, and recommendations regarding the soil conditions encountered. We also rely on a geotechnical continuity, communication between all project team members specific to risk- and cost-based decisions, and good construction practices to achieve the desired project outcome for Interstate Engineering, Inc., and Makoshika State Park. Therefore, our recommendations must be reviewed at the time civil design and construction plans are finalized to verify their applicability to the proposed project.

Exploration only allows observation of a small portion of the site subsurface conditions. Subsurface variations are possible between exploration locations and may not be apparent until construction. Where such variations exist, they may impact the opinions and recommendations presented in this report, as well as construction timing and costs. If design plans change, or if the subsurface conditions encountered during construction vary from those observed during our field evaluation, we must be notified to review the report recommendations and make necessary revisions.

6.2 Utility Construction

6.2.1 Discussion

We understand utility construction will consist of open-cut excavations and horizontal directional drilling. We understand there is a possibility the entire length of the waterline is horizontal directionally drilled. Excavations up to 12 feet in depth may be required for the proposed utility work. At this depth, the utilities will be primarily in sandy soils. We provide detailed subsurface soil conditions on the boring logs in Appendix A.

Conventional construction equipment such as tracked excavators should be able to make the required trench excavations within the site soils along the proposed utility alignments; however, we did encounter sandstone bedrock in Boring B-11. Conventional construction equipment may have difficulties excavating through the sandstone bedrock.

We encountered groundwater at depths of 25 to 35 feet below existing grade during our subsurface exploration. It should be noted that our exploration occurred in January and February, and seasonal changes and locally heavy precipitation could change groundwater conditions. The earthwork contractor should be prepared for dewatering the excavations and have equipment available that will lower and maintain the groundwater level at least 2 feet below the base of the excavations.

6.2.2 Trench Excavation

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, surface runoff or water seepage due to the sandy soil can potentially induce side slope erosion or running which could require slope maintenance. The contractor shall be prepared to address surface runoff and should be prepared to slope the excavation walls or provide trench shoring.

The site sandy soil classifies as a Type C soil under the OSHA guidelines. Temporary excavation slopes may be required for utility trenches. Excavations less than 20 feet in depth shall have a maximum allowable slope of 1½H:1V. Deeper excavations and/or in saturated soils or below the groundwater table should be considered on an individual basis. Water levels, due to climatic conditions should be evaluated at the time of construction. Construction vibrations can cause excavations to slough or cave. If the above trench layback recommendations are not feasible, due to space limitations or other factors, the OSHA rules should be consulted for alternative trench stabilization methods. Trench boxes or shoring in compliance with OSHA rules may be acceptable alternatives and is common practice in utility projects.

6.2.3 Utility Subgrade Preparation

We understand excavations up to 12 feet in depth will be required for the proposed utility work. At this depth, the utilities will be in sandy soils. We provide detailed subsurface soil conditions on the boring logs in Appendix A.

Excavate soil to the proposed utility subgrade elevations with a smooth blade. Remove any unsuitable soils, including soft and/or organic soil, if encountered. Soil disturbance negatively impacts the soil's performance. Remove any disturbed soil below the proposed utilities. If soil is disturbed, moisture condition and recompact the top 12 inches of soil as General Structural

Fill as described in Table 2. Materials and Compaction Specifications located in Section 6.8 Materials and Compaction.

6.2.4 Utility Backfill Considerations

We anticipate that the site soil excavated for utility construction will be re-used for trench backfill. The subsurface soil generally consisted of sandy lean clay and sandy soils. At the time of our subsurface exploration, the natural moisture contents of the clayey soil were at or above the likely optimum moisture content. The moisture content of the sandy soil was near or below the likely optimum moisture content. Based on our experience with similar soils in the area, the excavated site soils for the new utility lines will require processing and moisture conditioning to bring the trench spoils close to the optimum moisture content before their reuse as trench backfill. Compact utility trenches in accordance with Table 2. Material Specifications and Compaction Specifications.

6.2.4 Pipe Bedding and Backfill

The on-site sand may be used as pipe bedding, if the material is free from clods, frozen material, or stones larger than 1 inch in their maximum dimension. Pipe bedding in areas below the water table shall consist of free draining, non-plastic, imported or on-site sand material. In addition, we recommend the following:

- Place utility pipes on at least 6 inches of bedding placed over firm, undisturbed native soil, controlled fill, stabilization bedding, or as specified by the pipe manufacturer's specifications.
- Place pipe bedding and compact it from the pipe invert to 6 inches above the top of the pipe with tamping bars and/or plate compactors to render the backfill in a firm and unyielding conditions. Backfill and compact around each side of the pipe simultaneously to minimize lateral shifting.
- Thoroughly place and compact bedding below pipe haunches or the zone between the pipe invert and the spring line. To accomplish backfilling, the distance between the side of the pipe at the spring line and the trench wall should be at least 12 inches.

6.3 Horizontal Directional Drilling

6.3.1 Discussion

This project will include horizontal directional drilling at several locations to cross the Makoshika State Park Road and to cross the coulees and plateaus (between Borings B-1/B-2, B-2/B-3, B-4/B-5/B-6, B-7/B-21/B-8, B-9/B-10, B-12/B-13/B-26, B-14/B-15, B-17/B-18, and B-22/B-23/B-24/B-25). We understand Interstate Engineering, Inc. may include an option in the bidding process to include horizontal directional drilling the entire route of the waterline. At the time of this report, the depths and sizes of the borings is not known.

6.3.2 Soil Conditions and Suitability of Horizontal Directional Drilling

ASTM F 1962 *Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings* provides guidance for the suitability of soils for horizontal directional drilling. The following table, taken from ASTM F 1962, classifies suitability based on soil type.

Table 1 – Soil Types vs. Horizontal Directional Drilling Suitability

Soil Conditions	Generally Suitable	Difficulties May Occur	Substantial Problems
Soft to very soft clays, silts, and organic deposits		X	
Firm to very stiff clays and silts	X		
Hard clays and highly weathered shales	X		
Very loose to loose sands above and below the water table (not more than 30% gravel by weight)		X	
Medium to dense sands above and below the water table (not more than 30% gravel by weight)	X		
Very loose to dense gravelly sand (30% to 50% gravel by weight		X	
Very loose to dense gravelly sand (50% to 85% gravel by weight)			X
Very loose to very dense gravel			X
Soils with significant cobbles, boulders, and obstructions			X
Weathered rocks, marls, chalks, and firmly cemented soils	X		
Slightly weathered to unweathered rocks		X	

The subsurface soil primarily consisted of loose to medium dense sandy soil and soft to stiff clayey soil within the upper 15 feet. Below 15 feet, the soil primarily consisted of very dense sands and hard clay. The relative consistency and density of the soil can be found on the Boring Logs in Appendix A. Difficulties with horizontal directional drilling may occur in very loose to loose sands and soft to very soft clays due to the potential collapse of the boring. Firm to hard clays and highly weathered shales and medium dense to dense sands are generally suitable for horizontal directional drilling.

It should be noted we encountered weakly-cemented sandstone bedrock in Borings B-6A, B-8A, B-11, and B-26. The weakly-cemented sandstone encountered within the borings is generally suitable for horizontal directional drilling.

6.4 Pump House Construction

6.4.1 Discussion

The pump house will be located north of Makoshika State Park Road and east of the parking lot for the Visitor Center near Boring B-2. The area is about 45 feet long (north-south) and 65 feet wide (east-west). Directly northeast of this area is a coulee, with a vertical bank on the order of 10 to 12 feet in height. We understand the pump house will be oriented so that the building will be ten feet from the existing sidewalk to meet the American with Disabilities Act of 1990 (ADA) standards. Due to the proximity of the pump house to the coulee, we recommend maintaining a minimum of 15 feet between the edge of the pumphouse and the edge of the coulee. It should be noted that erosion of the wall of the coulee near the pumphouse could present slope stability and foundation concerns. To prevent erosion, a retaining structure or rip rap could be placed along the wall of the coulee. Recommendations for a retaining structure is beyond the scope of this report.

We anticipate the pump house will be supported on conventional shallow foundations and the site grading will be minimal. Structural loads for the pump house have not been provided; however, we anticipate the wall loads will be less than 4 kips per lineal foot, and column loads, if any, will be less than 50 kips. To prepare the building area for foundation and slab support, we recommend complete excavation of the topsoil thereby exposing the sandy lean clay and silty sand.

Since conditions may vary away from the boring location, it is recommended that AET geotechnical personnel observe and confirm the competency of the soils in the entire excavation bottom prior to new fill or footing placement.

Where the excavation extends below foundation grade, the excavation bottom and resultant engineered fill system must be oversized laterally beyond the planned outside edges of the foundations to properly support the loads exerted by that foundation. This excavation/engineered fill lateral extension should at least be equal to the vertical depth of fill needed to attain foundation grade at that location (i.e., 1:1 lateral oversize).

6.5 Foundation Design

The structure can be supported on conventional spread foundations placed below frost depth. We recommend perimeter foundations for heated building space is placed such that the bottom is a minimum of 60 inches below exterior grade. We recommend foundations for unheated building space (such as canopy foundations) be extended to a minimum of 72 inches below exterior grade.

Based on the conditions encountered, it is our opinion the building foundations can be designed based on a net maximum allowable soil bearing pressure of 2,000 pounds per square foot (psf). It is our opinion this allowable bearing pressure is based on a factor of safety of at least 3 as

compared to the ultimate bearing capacity. We estimate that total settlements under this loading should not exceed 1 inch and that differential settlements of conditions depicted by the borings should not exceed ½ inch.

6.6 Floor Slab Design

The on-site soils are suitable for slabs-on-grade construction. We recommend placing a minimum of 6 inches of granular material directly below the concrete slabs-on-grade. For concrete slab design, we estimate the sandy lean clay and silty sand should provide a Modulus of Subgrade Reaction (k-value) of at least 100 and 150 pounds per cubic inch (pci), respectively.

For recommendations pertaining to moisture and vapor protection of interior floor slabs, we refer you to the attached standard sheet entitled "Floor Slab Moisture/Vapor Protection."

6.7 Exterior Building Backfilling

Many of the on-site soils are at least moderately frost susceptible. Accordingly, we recommend, certain design considerations to mitigate these frost effects. For details, we refer you to the attached sheet entitled "Freezing Weather Effects on Building Construction."

6.8 Materials and Compaction

The native soils and existing pavement materials can be reused during construction. We provide materials and compaction specifications in the table below.

Table 2. Materials and Compaction Specifications

Material	Allowable Use	Material Specifications	Minimum Compaction Requirements (ASTM D1557)	Moisture Content (% of optimum)
General Structural Fill	Subgrade preparation and embankment	• Soil classified as GM, GW, GC, SM, SC, SW, CL, or ML according to the USCS • May not contain particles larger than 6" in median diameter • Soil must be reasonably free from deleterious substances such as wood, metal, plastic, waste, etc.	92%	± 3%

Material	Allowable Use	Material Specifications	Minimum Compaction Requirements (ASTM D1557)	Moisture Content (% of optimum)
Utility Trench Backfill	Utility Trench Backfill	• Soil classified as GM, GW, GC, SM, SC, SW, CL, or ML according to the USCS • May not contain particles larger than 6" in median diameter • Soil must be reasonably free from deleterious substances such as wood, metal, plastic, waste, etc.	88% (non-structural fill areas, native grass areas) 90% (below the walking path) 95% (below pavements)	± 4% ± 4% ± 3%
Granular Structural Fill	Over-excavations and general structural fill	• Soil classified as GM or GW according to the USCS • May not contain particles larger than 4" in median diameter • Soil must contain less than 3% (by weight) of organics, vegetation, wood, metal, plastic, or other deleterious substances	98%	-4% to +2%

6.9 Testing Frequencies

We recommend performing the following tests at the recommended frequencies.

- **Utility Trench Backfill Below Pavements & Structures** – one (1) compaction test every 150 linear feet, or 2 per trench, whichever results in the greater number of tests, per each 8-inch lift of backfill.
- **Utility Trench Backfill in Non-Structural Areas (Native Grass Areas)** – one (1) compaction test every 1,000 linear feet, per each 3 feet of backfill.
- **Foundation Wall Backfill** – one (1) compaction test every 100 linear feet of wall, or two (2) tests per wall line (interior and exterior sides), whichever results in the greater number of tests, per each 8-inch lift of backfill.

To verify that construction conforms to the intent of this report, we recommend American Engineering Testing, Inc. be retained to observe, test, and record the following.

- Earthwork Observations – including monitoring and recording deviations from subsurface soil conditions as presented in the Boring Logs in Appendix A.
- Observe and approve all excavations and over-excavations prior to placing backfill/fill materials
- Approve additional excavation, replacement, or stabilization if unsuitable soil as identified by the geotechnical engineer during excavation.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 Runoff Water in Excavation

Water can be expected to collect in the excavation bottom during times of inclement weather or snow melt. To allow observation of the excavation bottom, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavation during construction. Based on the soils encountered, we anticipate the groundwater can be handled with conventional sump pumping.

7.1.2 Disturbance of Soils

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

7.1.3 Site Grading Recommendations

The on-site sandy soils have the potential to collapse 0.6% to 1.0% when exposed to water. To reduce the risk of collapse, we recommend sloping the ground surface adjacent to the pump house at a minimum of 5% away from the foundations a minimum of 10 feet from the structure. Slope the ground surface beyond 10 feet of the pump house to at least 2% away. Improper management of near-surface water, by not providing an effective grading and drainage design, can result in moisture entering the building subgrade soil. Possible sources of near-surface water include rainwater, snowmelt, roof drains, or leaking water lines. Providing good drainage as discussed can be supplemented by using impermeable aprons adjacent to at-grade structures. Impermeable aprons may consist of asphalt or Portland cement concrete pavement that is placed directly adjacent to the foundation walls.

7.1.4 Wet Weather/Soil Construction

The lean clay subgrade soil may be susceptible to pumping or rutting from heavy loads such as rubber-tired equipment or vehicles any time of the year when it becomes wet. Ideally, perform earthwork construction during dry weather conditions; however, if wet soil conditions occur during construction, we recommend the following.

- Earthwork should not be performed immediately after rainfall or until soil can dry sufficiently to allow construction traffic without disturbing the subgrade.
- If the foundation subgrade becomes wet or if areas begin to "pump", it may be necessary to over-excavate the soil. Over-excavation criteria shall be determined during construction with American Engineering Testing, Inc., Interstate Engineering, Inc., and the contractor.

Based on our laboratory testing, the natural moisture content of the subsurface soil varied across the site. Moisture conditioning and soil processing might be necessary during construction.

7.1.5 Soil Chemistry Information

AET analyzed soil samples for water soluble sulfates, resistivity, and pH. Sulfate attack is a deterioration resulting from chemical reactions occurring when concrete components react with sulfate ions (SO42-) present in solution in contact with concrete. Table 3 below summarizes the soil chemistry information.

Table 3. Soil Chemistry Information

Boring # (depth)	Water Soluble Sulfates (ppm)	Resistivity (ohm-cm)	pH
B-2 (7.5'-9')	5,360	1,080	8.3
B-15 (5'-6.5')	5,520	1,700	8.1

Based on the results shown in the table above, concrete in contact with the on-site soil classifies as exposure class S2 according to ACI 318 Table 19.3.1.1. To achieve the required protection against sulfate related corrosion, we recommend specifying Type V cement, a maximum water-to-cement ration of 0.45 (by weight, normal weight concrete), and a minimum compressive strength, f'_c, of 4,500 pounds per square inch (psi). Details can be found in the above ACI reference and in the Portland Cement Association publication "Design and Control of Concrete Mixtures".

According to *Corrosion Life of Steel Foundation Products*, the soil at the site is corrosive to steel. We recommend buried metals be designed for corrosion.

7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Details for trenching excavations are provided in Section 6.2.2 Trench Excavation. Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or sloughing which could require slope maintenance. It should be noted the presence of sandy soils at the site allows the elevation of groundwater to fluctuate, which can create seepage in excavations. The contractor shall be

prepared to address sideslope erosion or sloughing caused by seepage.

7.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

8.0 LIMITATIONS

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

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

Standard Data Sheets

EARTHWORK QUALITY CONTROL INFORMATION

Excavation Base Evaluation

Judgments of supporting soils are based on soils exposed, and on local samples of soils retrieved by hand auguring and probing. Because conditions in the subsurface are hidden, it is not possible to fully characterize the subsurface conditions. Therefore, the client must accept that our judgments are limited to those soils which are directly observable to us.

As soil conditions may be variable at depth, it is best that excavation base observation be aided by deeper exploratory test borings (usually done prior to construction). Although these deeper borings may not totally reveal what is in the subsurface they greatly reduce the risk of deeper poor soils going undetected.

The presence of ground water within the excavation can also limit the supporting soil evaluation process. Also, if standing ground water is present, there is a risk to the client that soft or loose compressible soils may not be observed and that these soft or loose compressible may potentially remain beneath the water during excavation. The compressible materials can become trapped beneath or within the subsequently placed fill; thus, allowing adverse movements to occur in structures and fill materials placed over these materials.

Filling

Structural fill placement is commonly monitored by performing local compaction tests, which entails comparing a field density test to a laboratory Proctor test to arrive at a percent compaction. Field Density tests of fill only provide the compaction level of the fill at the location and elevation of the test. As many factors control compaction, such as fill lift thickness, moisture content, material type and compactive effort, compaction variation within fill materials can exist that may not be represented by the tests. Field Density (compaction) tests are considered representative when used in a conscientious program of controlled fill placement, where the factors influencing compaction are closely monitored. Conclusions about fill suitability to support structural loadings from the results of a limited number of compaction tests includes increased risk, unless the individual drawing the conclusions has complete knowledge of the afore-mentioned variables during placement. For this reason, part-time testing on a "trip" basis includes more risk to the client than "full-time" monitoring/testing.

Oversizing

Structural elements also exert loadings laterally; and because of this, the excavation and subsequent fill system needs to be oversized to accommodate these loadings. The extent of lateral oversizing is normally associated with the movement sensitivity of the structure and the strength/compressibility properties of the soils remaining along the excavation sidewalls. Oversizing on the order of 1H (horizontal):1V (vertical) is typically provided for foundations in "normal" conditions. However, oversizing on the order of 12H:1V or more is oftentimes needed in highly compressible situations such as swamp deposits.

AET does not practice in the field of surveying and must rely on location and elevation staking of proposed construction by the client or their representative. Our measurements in the field are made in relation to those stakes or other location and elevation information provided to us. The reliability of AET's opinions, conclusions and recommendations based on those measurements is dependent on the accuracy of the staking or information provided by the client or their representative.

Freezing Weather

Soils that are allowed to freeze will heave & lose density. Upon thawing, these soils will not regain their full original strength & density. The extent of heave and density/strength loss depends on the soil type and moisture condition; and is usually more pronounced in finer grained soils, and particularly silty soils. Foundations, slabs, and other improvements affected by such frost movements should be protected from frost intrusion during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from all areas to be filled prior to new fill placement; and the new fill should not be allowed to freeze during or after placement. For this reason, it is usually more beneficial to perform excavate/refill operations during freezing weather in smaller plan areas where grade can be attained quickly rather than working larger areas where a large amount of frost stripping is needed.

Structural Support on Uncontrolled Fill

Risks are associated with supporting structures on fill which has not been placed in a controlled and well documented manner. Even where existing fill appears to be well compacted (including when soil borings have been performed), hidden poorer or looser soils can potentially exist below or within the fill; or previous excavation and extension of the compacted fill may be have been provided with sufficient oversize in all directions to accommodate the new lateral loadings. Risks can be reduced by means of increasing the amount of testing and observations.

FLOOR SLAB MOISTURE / VAPOR PROTECTION

GENERAL

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

GRANULAR LAYER

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

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

VAPOR MEMBRANE

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

VAPOR MEMBRANE / GRANULAR LAYER PLACEMENT

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

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

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

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

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

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

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

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

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

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

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

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 12% passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

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

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

CONSTRUCTION CONSIDERATIONS

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

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs
Sieve Analysis Tests
Atterberg Limit Tests
Consolidation Tests
Unconfined Compression Tests

Appendix A
Geotechnical Field Exploration and Testing
Report No. 37-20547

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling of twenty eight (28) standard penetration test borings. The locations of the borings appear on Figure 1, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

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

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

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

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

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

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

A.2.3 Sampling Limitations

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

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

A.3 CLASSIFICATION METHODS

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

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

A.4 WATER LEVEL MEASUREMENTS

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

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

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

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests
Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.5.2 Atterberg Limits Tests
Conducted per AET Procedure 01-LAB-030, which is performed in general accordance with ASTM: D4318 and AASHTO: T89, T90.

A.5.3 Sieve Analysis of Soils (thru #200 Sieve)
Conducted per AET Procedure 01-LAB-040, which is performed in general conformance with ASTM: D6913, Method A.

A.5.4 One-Dimensional Consolidation of Soils Using Incremental Loading
Conducted per AET Procedure 20-SOI-014, which is performed in general accordance with ASTM: D2435.

A.5.5 Unconfined Compressive Strength of Cohesive Soil
Conducted per AET Procedure 01-LAB-080, which is performed in general accordance with ASTM: D2166 and AASHTO: T208.

A.6 TEST STANDARD LIMITATIONS

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

A.7 SAMPLE STORAGE
Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
AR:	Sample of material obtained from cuttings blown out the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125-inch OD outer casing with an inner 1½ inch ID plastic tube is driven continuously into the ground.
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RDA:	Rotary drilling with compressed air and roller or drag bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94-millimeter wireline core barrel
▼:	Water level directly measured in boring

TEST SYMBOLS

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

STANDARD PENETRATION TEST NOTES
(Calibrated Hammer Weight)

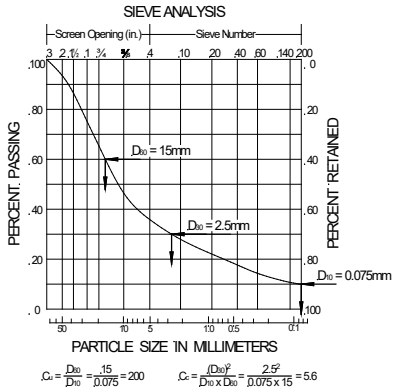
The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide N_{60} values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

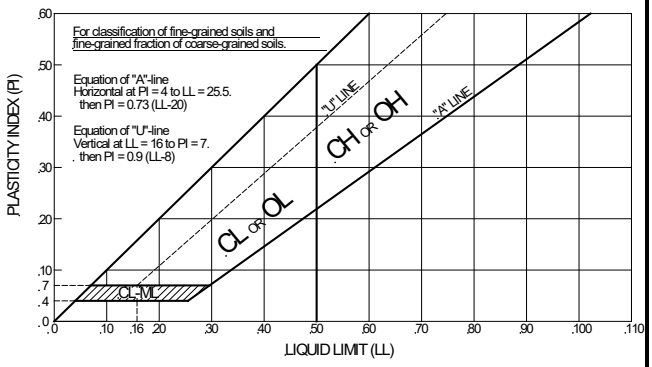
The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered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

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

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





Plasticity Chart

Notes

[A]Based on the material passing the 3-in (75-mm) sieve.

[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C]Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E]$Cu = D_{60} / D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.

[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H]If fines are organic, add "with organic fines" to group name.

[I]If soil contains ≥15% gravel, add "with gravel" to group name.

[J]If Atterberg limits plot is hatched area, soil is a CL-ML silty clay.

[K]If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.

[L]If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N]PI≥4 and plots on or above "A" line.

[O]PI<4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.

[R]Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition

(MC Column)

D (Dry): Absence of moisture, dusty, dry to touch.

M (Moist): Damp, although free water not visible. Soil may still have a high water content (over "optimum").

W (Wet/ Waterbearing): Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.

F (Frozen): Soil frozen

Layering Notes

Laminations: Layers less than ½" thick of differing material or color.

Lenses: Pockets or layers greater than ½" thick of differing material or color.

Fiber Content of Peat

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic/Roots Description (if no lab tests)

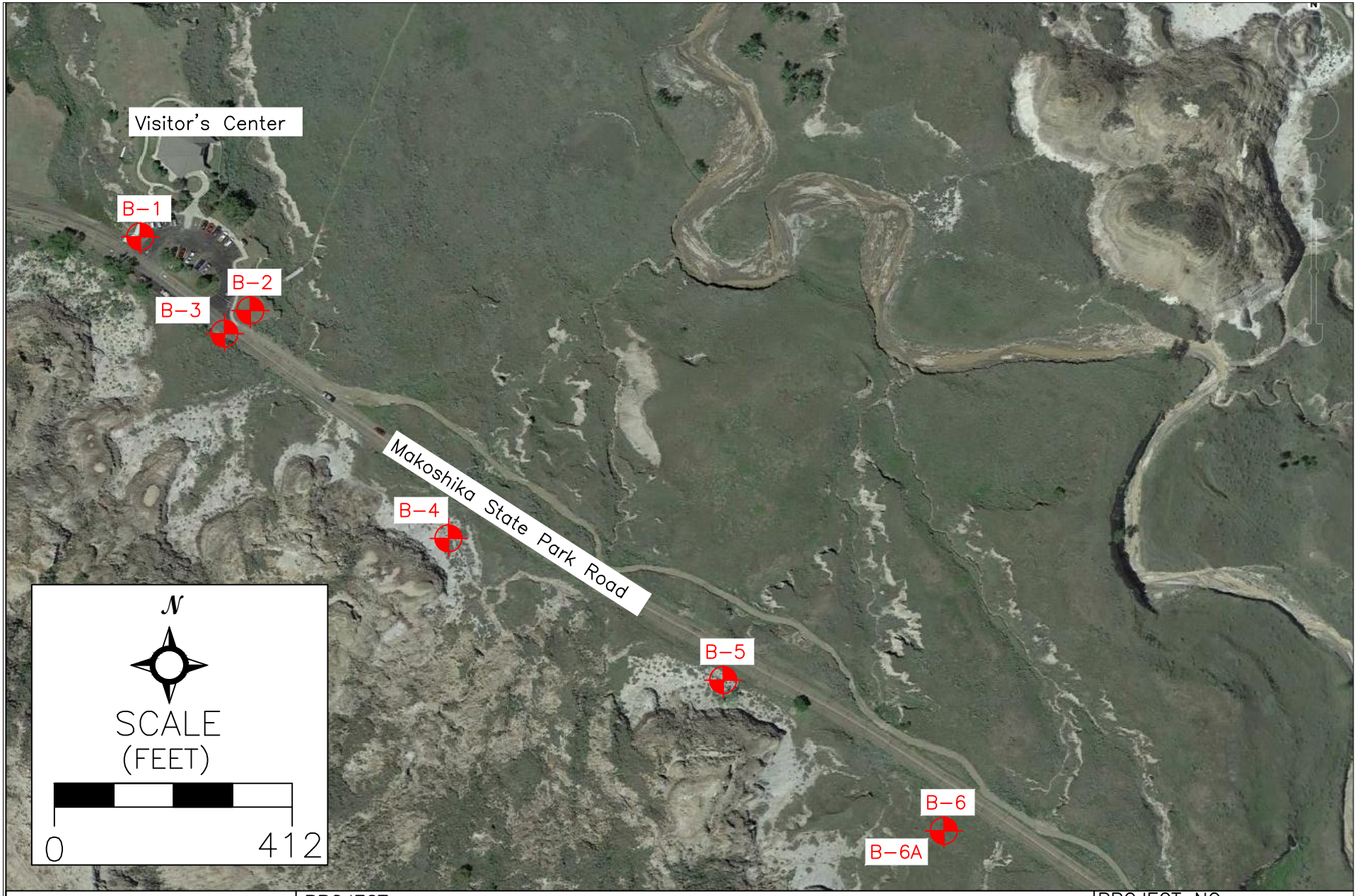
Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the soil properties. *Slightly organic* used for borderline cases.

With roots: Judged to have sufficient quantity of roots to influence the soil properties.

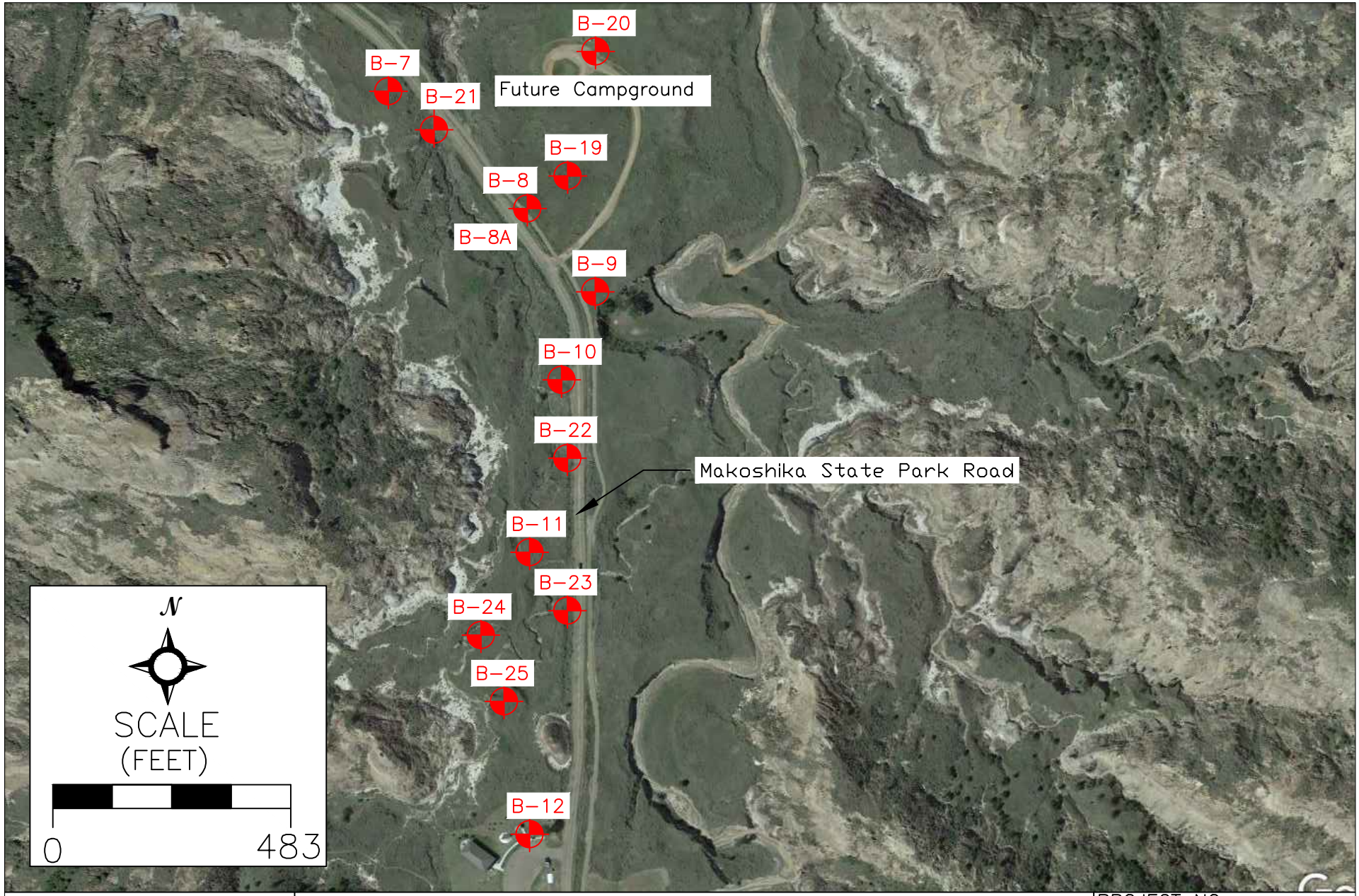
Trace roots: Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.

AMERICAN ENGINEERING TESTING, INC.

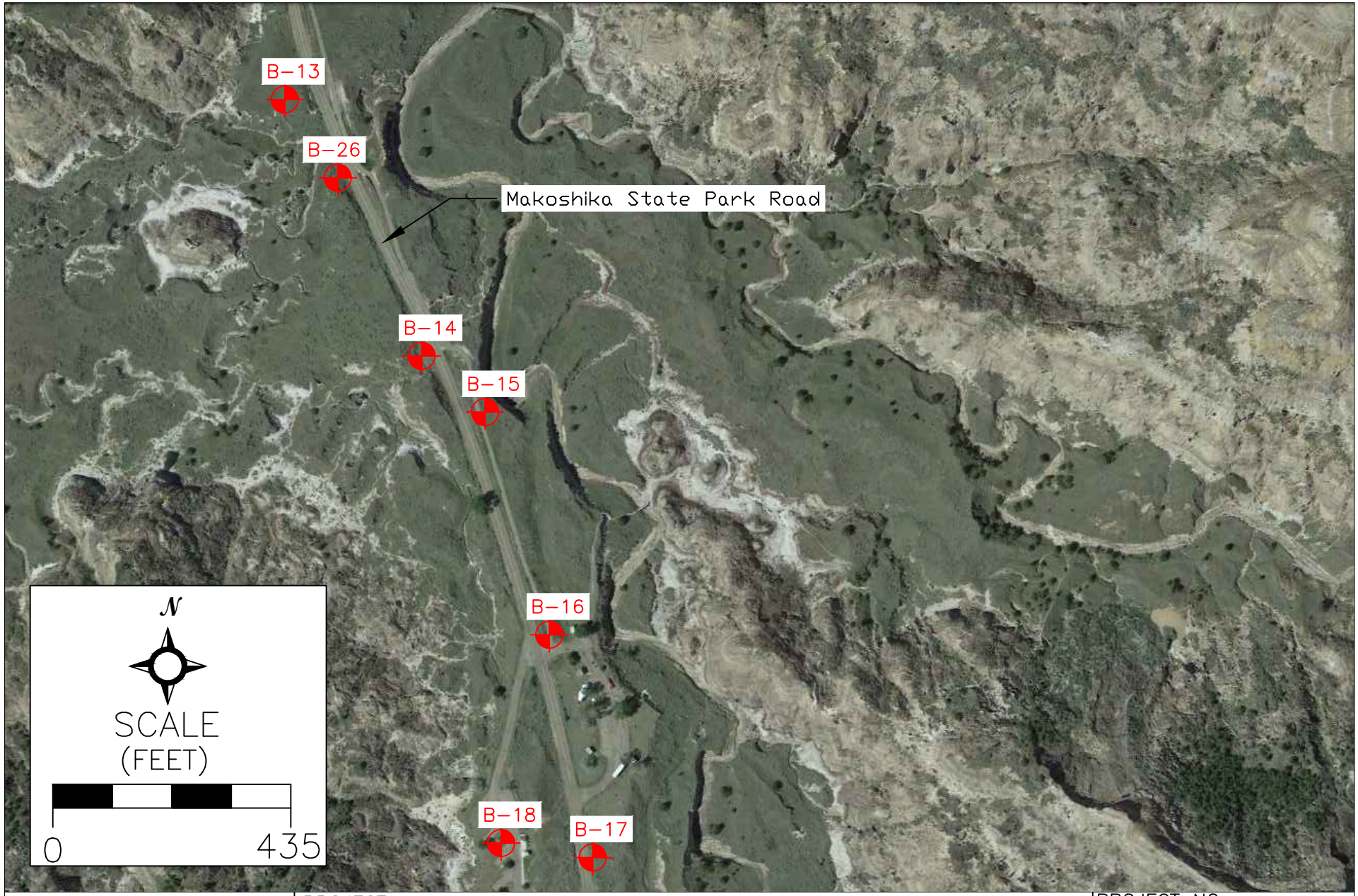
PROJECT: Makoshika State Park Waterline Extension			PROJECT NO. 37-20547
SUBJECT: Site Location Map			DATE: March, 2020
SCALE: Not To Scale	DRAWN BY: WCD		REVIEWED BY: HTF



AMERICAN ENGINEERING TESTING, INC.	PROJECT: Makoshika State Park Waterline Extension		PROJECT NO. 37–20547
	SUBJECT: Boring Location Map B1,B2,B3,B4,B5,B6		DATE: March, 2020
	SCALE: As Shown	DRAWN BY: WCD	REVIEWED BY: HTF



AMERICAN ENGINEERING TESTING, INC.	PROJECT: Makoshika State Park Waterline Extension		PROJECT NO. 37–20547
	SUBJECT: Boring Location Map B7–B12, B19–B25		DATE: March, 2020
	SCALE: As Shown	DRAWN BY: WCD	REVIEWED BY: HTF



AMERICAN ENGINEERING TESTING, INC.	PROJECT: Makoshika State Park Waterline Extension		PROJECT NO. 37-20547
	SUBJECT: Boring Location Map B13-B18, B-26		DATE: March, 2020
	SCALE: As Shown	DRAWN BY: WCD	REVIEWED BY: HTF

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-1 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2115.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	Base Course - brown, frozen (18 inches)	PARKING LOT	50/6"	F	SS	12					
2	**SILTY SAND**, loose, brown, moist, trace lignite (SM)	MIXED ALLUVIUM									
3			5	M	SS	15	18				
4											
5	**SILTY CLAY with Sand**, soft, brown, wet (CL-ML)	FINE ALLUVIUM									
6			3	W	SS	18	32		24	17	72.8
7	**SILTY SAND**, loose, brown, moist (SM)	HELL CREEK FORMATION									
8			5	M	SS	15	9				
9											
10											
11			5	M	SS	15	12				
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-2 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2121.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL**, Sandy lean clay, brown, frozen (3 inches)	TOPSOIL									
1	**Sandy LEAN CLAY**, soft, brown, moist (frozen to 1.5 feet) (CL)	FINE ALLUVIUM	31	F	SS	18					
2	Silty sand lense at 1 foot										
3	**SILTY SAND**, very loose to loose, light brown, moist (SM)	HELL CREEK FORMATION	5	M	SS	18	7				
4											
5											
6			6	M	SS	15	6				
7											
8	**CLAYEY SAND**, very loose, brown, moist (SC)		5	M	MC	15	25	95			
9											
10											
11			3	M	SS	18	22				42.4
12											
13	**SILTY SAND**, loose, brown, moist (SM)		7	M	SS	18					
14											
15											
16			6	M	SS	18	9				
17											
18			7	M	SS	18					
19											
20	Becomes medium dense at 20 feet										
21			11	M	SS	18					
	End of Boring										

DEPTH:	DRILLING METHOD
21.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**21.5**	**20.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-3 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2119.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	Asphaltic Concrete Pavement (4 inches)	ROAD									
	SILTY SAND, loose, brown, frozen to 8 inches, moist (SM)	MIXED ALLUVIUM									
1			44	F	SS	18					
2											
3			6	M	SS	18	16				
4											
5											
6	Lense of wet sandy lean clay at 5.5 feet		5	M	SS	18	14				
7											
8			5	M	SS	18	24				
9	Lense of very wet clayey sand at 8.5 feet										
10	Becomes very loose at 10 feet										
11			3	M	SS	18					
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
11.5	**3.25" HSA**	**1/24/20**		**11.5**	**10.0**	**NA**	**NA**	**None**	
BORING COMPLETED:	**1/24/20**								
DR: **IDS**	LG: **WD** Rig: **D 50**								

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-4 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2113.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**SILTY SAND**, medium dense to loose, light brown, frozen to 12 inches, moist (SM)	MIXED ALLUVIUM	22	F	SS	18					
3			7	M	SS	18	6				
6			10	M	SS	18	5				
8	**SILTY SAND,** very dense, brown, moist (SM)	HELL CREEK FORMATION	71	M	SS	18	5			NP	15.1
11			50/6"	M	SS	12					
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/24/20		**11.0**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/24/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-5 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2115.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**SILTY SAND**, medium dense, light gray, frozen to 12 inches, moist (SM)	MIXED ALLUVIUM	12	F	SS	18					
2	**LEAN CLAY with Sand**, stiff, tan, moist (CL)	FINE ALLUVIUM									
3			13	M	SS	18	8		30	20	72.5
4											
5											
6	**SILTY SAND**, dense, light brown, moist (SM)	HELL CREEK FORMATION	28	M	SS	18	5				
7											
8			43	M	SS	18					
9											
10											
11			44	M	SS	18	8				
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-6 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2122.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL**, Sandy lean clay, brown, frozen (3 inches)	TOPSOIL									
	SILTY SAND, very loose, light brown, moist (SM)	HELL CREEK FORMATION	21	F	SS	18					
2											
3			3	M	SS	16	19				
4											
5											
6			3	M	SS	18	19				
7											
	Becomes loose at 7.5 feet										
8			5	M	SS	18	9				
9											
10											
11			5	M	SS	18					
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-6A (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2123.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL,** lean clay, brown, frozen, roots extended full depth (6 inches)	TOPSOIL	8	M	SS	18					
2	**LEAN CLAY**stiff, brown, moist (frozen to 8 inches) (CL)	HELL CREEK FORMATION									
3	**SILTY SAND** loose, brown, moist, (become light brown at 7.5 feet) (SM)		4	M	SS	6					
6			4	M	SS	12					
8			6	M	SS	10					
11			5	M	SS	14					
16			51	M	SS	18	10				
21	**LEAN CLAY** with trace lignite. very stiff, moist		54	M	SS	20	14				
26	**SANDSTONE** weakly cemented, fine grained, light brown, moist (becomes gray at 30 feet) (SANDSTONE)		77	M	SS	22					
31			86	M	SS	20					
	End of Boring										

DEPTH:	DRILLING METHOD
31.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
3/6/20		**31.5**	**30.0**	**NA**	**NA**	**None**

BORING COMPLETED: **3/6/20**

DR: **IDS** LG: **HTF** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-7 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2126.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	**TOPSOIL**, Sandy lean clay, brown, frozen (3 inches)	TOPSOIL									
1	**SILTY CLAYEY SAND**, loose, brown, moist (SC-SM)	MIXED ALLUVIUM	17	F	SS	18					
2											
3			6	M	SS	18	21		27	22	47.7
4	Trace lignite from 3.5 to 5.5 feet										
5											
6	**SILTY SAND**, loose, light gray, moist (SM)	HELL CREEK FORMATION	6	M	SS	18	18				
7											
8	Becomes brown at 7.5 feet		10	M	SS	18					
9											
10	Becomes medium dense at 10 feet										
11			28	M	SS	18	14				
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-8 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2132.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	**TOPSOIL**, Sandy lean clay, brown, frozen (3 inches)	TOPSOIL									
1	**Sandy LEAN CLAY**, firm, brown, moist (CL)	FINE ALLUVIUM	16	F	SS	18					
2	**SILTY SAND**, loose, light brown, moist (SM)	HELL CREEK FORMATION									
3			5	M	SS	15	21				
4	Lense of silt at 4 feet										
5											
6			4	M	SS	18	13				
7											
8			11	M	SS	16	8				
9											
10											
11			10	M	SS	18					
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-8A (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2133.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL,** lean clay, brown frozen (roots extending throughout sample) (6 inches)	TOPSOIL	12	M	SS	18					
2	**LEAN CLAY,** stiff, brown, moist (frozen to 8 inches) (CL)	FINE ALLUVIUM									
3	**SILTY SAND,** loose, brown, moist (becomes light brown at 7.5 feet) (SM)	HELL CREEK FORMATION	5	M	SS	18					
4											
5											
6			7	M	SS	18					
7											
8			9	M	SS	18					
9											
10											
11			11	M	SS	18	6				
12											
13											
14											
15											
16			20	NR	SS	NR					
17											
18											
19											
20											
21	**LEAN CLAY,** with trace lignite, very stiff, brown, moist (CL)		17	M	SS	18	32				
22											
23											
24											
25											
26	**SANDSTONE,** weakly cemented, fine grained, light brown, moist (becomes gray at 30 feet)		47	M	SS	20					
27											
28											
29											
30											
31			62	M	SS	24					
	End of Boring										

DEPTH:	DRILLING METHOD
31.5	**3.25" HSA**

BORING COMPLETED: **3/6/20**

DR: **IDS** LG: **HTF** Rig: **D 50**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
3/6/20		**31.5**	**30.0**	**NA**	**NA**	**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-9 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2133.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	TOPSOIL, Sandy lean clay, brown, frozen (4 inches)	TOPSOIL									
1	**Sandy LEAN CLAY**, firm, brown, moist (CL)	FINE ALLUVIUM	12	F	SS	18					
2											
3	**SILTY SAND**, very loose, brown, moist (SM)	HELL CREEK FORMATION	3	M	SS	18	14				
4											
5											
6			4	M	SS	18	13				
7											
8			2	M	SS	18	10				35.4
9											
10	Becomes loose at 10 feet										
11			5	M	SS	18	12				
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
11.5	**3.25" HSA**	**1/23/20**		**11.5**	**10.0**	**NA**	**NA**	**None**
BORING COMPLETED:	**1/23/20**							
DR: **IDS**	LG: **WD** Rig: **D 50**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-10 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2136.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	TOPSOIL, Sandy lean clay, brown, frozen (4 inches)	TOPSOIL									
1	**Sandy LEAN CLAY**, firm, brown, moist (CL)	FINE ALLUVIUM	13	F	SS	18					
2											
3	**SILTY SAND**, loose, brown, moist (SM)	HELL CREEK FORMATION	6	M	SS	15	31				
4											
5											
6	Becomes light brown at 5.5 feet		6	M	SS	18	7				
7											
8			8	M	SS	18	12				
9											
10											
11			5	M	SS	18					
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-11 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2140.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	Topsoil Silty sand with roots extending to 6 inches, brown, frozen (8 inches)	TOPSOIL									
1	**SILTY SAND**, brown, frozen to 2 feet (SM)	MIXED ALLUVIUM	20	F	SS	20					
2	Becomes medium dense and moist at 2 feet										
3	**POORLY-GRADED SAND**, fine grained, medium dense, light brown, moist (SP)	HELL CREEK FORMATION	13	M	SS	18	5				
4											
5											
6	**POORLY-GRADED SAND** coarse grained with trace gravel, medium dense, brown, moist (SP)		11	M	SS	18	4				
7											
8			25	M	MC	18	7	93			
9											
10	Varies between silty sand and poorly-graded sand and becomes dry at 10 feet										
11	3-inch seam of weakly-cemented sandstone at 10.5 feet		29	D	SS	15	7				
12											
13											
14											
15	**POORLY-GRADED SAND with Gravel**, trace lignite, very dense, light brown, moist (SP)										
16			50/5"	M	MC	17	11	112			
	SANDSTONE, very hard, light brown, moist End of Boring										

DEPTH:	DRILLING METHOD
16.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/10/20		**16.5**	**15.0**	**NA**	**NA**	**None**

BORING COMPLETED: **2/10/20**

DR: **ES** LG: **HF** Rig: **CME 55**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-12 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2146.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	**LEAN CLAY** with sand, brown, frozen (CL)	FINE ALLUVIUM									
1	**Sandy LEAN CLAY**, firm, brown, frozen to 12 inches, moist (CL)		30	F	SS	18					
2											
3	**SILTY SAND**, loose, brown, moist (SM)		3	M	SS	18	21				
4	**Sandy LEAN CLAY**, firm, brown, very moist (CL)										
5											
6	**SILTY SAND** with trace lignite and lenses of clay, loose, brown, moist (SM)	HELL CREEK FORMATION	7	W	SS	18	15		31	23	43.2
7											
8			6	M	SS	18	12				
9											
10	Becomes medium dense at 10 feet										
11			12	M	SS	18	6				
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
11.5	**3.25" HSA**	**1/23/20**		**11.5**	**10.0**	**NA**	**NA**	**None**
BORING COMPLETED:	**1/23/20**							
DR: **IDS**	LG: **WD** Rig: **D 50**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-13 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2152.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	**TOPSOIL**, Sandy lean clay, brown, frozen (3 inches)	TOPSOIL									
1	**Sandy LEAN CLAY**, stiff, brown, moist (CL), trace roots	HELL CREEK FORMATION	12	F	SS	18					
2											
3			14	M	SS	18	21				
4	**SANDY SILT** with lenses of clay, stiff, light brown, moist (ML)										
5											
6	**SILTY SAND**, medium dense, light brown, moist (SM)		13	M	SS	18	5				
7											
8			17	M	MC	12	3	93			
9											
10	Becomes loose at 10 feet										
11			6	M	SS	18	6				
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-14 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2143.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	TOPSOIL, Silty sand, brown, frozen	TOPSOIL									
1	**SILTY SAND**, light brown, frozen to 1.5 feet (SM)	MIXED ALLUVIUM									
2	Becomes medium dense and moist at 1.5 feet										
3			18	M	SS	18	22				
4											
5	**SILTY SAND**, very dense, brown, moist (SM)	HELL CREEK FORMATION									
6			60	M	SS	20	20				39.8
7											
8			66	M	SS	18	19				
9											
10											
11			58	M	SS	14	17				
12											
13											
14											
15											
16			50/6"	M	SS	12	15				
	End of Boring										

DEPTH:	DRILLING METHOD
16.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
2/10/20		**16.5**	**15.0**	**NA**	**NA**	**None**

BORING COMPLETED: **2/10/20**

DR: **ES** LG: **HF** Rig: **CME 55**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-15 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2155.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	**Base Course** brown, frozen, (walking path) (3 inches)	WALKING PATH									
1	**Sandy LEAN CLAY**, firm, brown, frozen to 12 inches, moist (CL)	FINE ALLUVIUM	24	F	SS	24					
2											
3	**SILTY SAND**, medium dense, brown, moist (SM)	HELL CREEK FORMATION	5	M	SS	18	19				
4											
5											
6			17	M	MC	12	7	92			
7											
8	Becomes light brown with trace lignite at 7.5 feet		10	M	SS	18	11				
9											
10	Becomes loose at 10 feet										
11			6	M	SS	18	16				
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-16 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2160.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL**, Sandy lean clay, brown, frozen (2 inches)	TOPSOIL									
	Sandy LEAN CLAY, very stiff, brown, frozen to 12 inches (CL)	FINE ALLUVIUM	17	F	SS	24					
2	**SILTY SAND**, very loose, brown, moist, trace roots (SM)	HELL CREEK FORMATION									
3			3	M	SS	18	16				
4											
5											
6			4	M	SS	18	14				39.7
7											
8	Becomes medium dense at 7.5 feet		14	M	SS	6	14				
9	**POORLY-GRADED SAND with Silt**, medium dense, gray to brown, moist (SP-SM)										
10											
11			10	M	SS	18	13				9.0
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
11.5	**3.25" HSA**	**1/23/20**		**11.5**	**10.0**	**NA**	**NA**	**None**
BORING COMPLETED:	**1/23/20**							
DR: **IDS**	LG: **WD** Rig: **D 50**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-17 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2164.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	TOPSOIL, Sandy lean clay, brown, frozen (6 inches)	TOPSOIL									
1	**LEAN CLAY**, firm, brown, frozen to 12 inches (CL)	HELL CREEK FORMATION	18	F	SS	24					
	SILTY SAND, loose, light brown, moist (SM)										
3			6	M	SS	18	12				
5			6	M	SS	18	24				
8	**SILTY SAND with Gravel**, loose, light gray, moist (SM)		5	M	SS	18	16				
10			5	M	SS	18	28				
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
11.5	**3.25" HSA**	**1/23/20**		**11.5**	**10.0**	**NA**	**NA**	**None**
BORING COMPLETED:	**1/23/20**							
DR: **IDS**	LG: **WD** Rig: **D 50**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-18 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	MATERIAL DESCRIPTION (Surface Elevation **2168.0**)	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**Sandy LEAN CLAY with Gravel**, very stiff, brown, frozen (CL)	FINE ALLUVIUM	35	F	SS	24					
	Becomes gray at 1.5 feet										
2	**SILTY SAND**, medium dense, gray, moist (SM)	MIXED ALLUVIUM									
3			7	M	SS	24	14				
4											
5	**Sandy LEAN CLAY**, stiff, gray, moist (CL)										
6			9	M	SS	18	19		35	15	52.7
7											
8	**SILTY SAND**, dense, light gray, moist, trace lignite (SM)	HELL CREEK FORMATION	59	M	SS	18	14				
9											
10											
11	**POORLY-GRADED SAND**, dense, light brown, moist, trace iron oxide staining (SP)		51	M	SS	18	13				
	End of Boring										

DEPTH: **11.5** DRILLING METHOD: **3.25" HSA**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-19 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2132.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	**TOPSOIL**, Sandy lean clay, brown, frozen (3 inches)	TOPSOIL									
1	**CLAYEY SAND**, loose, brown, moist (SC)	HELL CREEK FORMATION	15	F	SS	18					
2											
3			5	M	SS	18	23				47.9
4	**SILTY SAND**, loose, gray, moist, trace iron oxide stains (SM)										
5											
6			6	M	SS	18	9				
7											
8			7	M	SS	18	4				
9											
10	Becomes medium dense at 10 feet										
11	**SILTY SAND with Gravel**, medium dense, gray, moist, trace iron oxide staining (SM)		11	M	SS	18	5				
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-20 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2125.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	**TOPSOIL**, Sandy lean clay, brown, frozen (3 inches)	TOPSOIL									
1	**LEAN CLAY**, very stiff, dark brown, frozen to 12 inches, moist (CL)	FINE ALLUVIUM	22	F	SS	18					
2	**LEAN CLAY** with lenses of silty sand, firm, brown, moist (CL)	HELL CREEK FORMATION									
3			5	M	SS	18	23				93.0
4											
5											
6	**SILTY SAND**, medium dense, light brown, moist (SM)		8	M	SS	18	16				
7											
8			15	M	SS	18	10				
9											
10	**LEAN CLAY** with seams of silt, very stiff, light brown, moist (CL)										
11			19	M	SS	18	14				
	End of Boring										

DEPTH:	DRILLING METHOD
11.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/23/20		**11.5**	**10.0**	**NA**	**NA**	**None**

BORING COMPLETED: **1/23/20**

DR: **IDS** LG: **WD** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-21 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2121.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL,** lean clay, frozen (6 inches)	TOPSOIL	12	F/M	SS	18					
2	**LEAN CLAY,** stiff, brown, moist (frozen to 10 inches) (CL)	FINE ALLUVIUM									
3	**SILTY SAND,** medium dense, brown, moist (SM)	MIXED ALLUVIUM	11	M	SS	18					
4											
5	**LEAN CLAY,** with trace lignite, very stiff, brown, moist	FINE ALLUVIUM									
6			17	M	SS	18					
7											
8			25	M	SS	18					
9											
10	Lenses of lignite and gypsum at 10 feet										
11			21	M	SS	18	30				
12	**FAT CLAY**, hard, dark brown, moist (CH)	HELL CREEK FORMATION									
13											
14											
15											
16			34	M	SS	19			55	24	96.8
17											
18											
19											
20	**SILTSTONE,** weakly cemented, hard, gray, moist										
21			56	M	SS	15					
22											
23											
24											
25											
26	**POORLY GRADED SAND,** very dense, gray, moist (SP)		59	M	SS	24					
27											
28											
29											
30											
31			70	M	SS	24					
32											
33											
34											
35	**CLAYSTONE,** hard, gray, moist										
36			71	M	SS	22					
	End of Boring										

DEPTH:	DRILLING METHOD
36.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
3/6/20		**36.5**	**35.0**	**NA**	**NA**	**None**

BORING COMPLETED: **3/6/20**

DR: **IDS** LG: **HTF** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-22 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2136.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL,** silty sand, brown, frozen (roots extended throughout) (4 inches)	TOPSOIL									
1	**SILTY SAND,** loose, brown, moist (frozen to 8 inches) (SM)	MIXED ALLUVIUM	8	F/M	SS	18					
3			3	M	SS	18					
4	**CLAYEY SAND,** loose, brown, moist (SC)										
6	**SILTY SAND,** loose, brown, moist (SM)		4	M	SS	18	17				
8	**POORLY GRADED SAND,** with iron oxide staining, loose, brown to reddish, moist (SP)	HELL CREEK FORMATION	7	M	SS	18					20.3
11			8	M	SS	18					
16			11	M	SS	18					
17	**LEAN CLAY,** with trace lignite, stiff, brown, moist (CL)										
21			13	M	SS	18					
	End of Boring										

DEPTH:	DRILLING METHOD
21.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
3/6/20		**21.5**	**20.0**	**NA**	**NA**	**None**

BORING COMPLETED: **3/6/20**

DR: **IDS** LG: **HTF** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-23 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2133.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL,** lean clay, brown, frozen to 8 inches	TOPSOIL	23	F/M	SS	18					
2	**SILTY SAND,** loose, brown, moist (SM)	MIXED ALLUVIUM									
3			6	M	SS	18					
4											
5											
6			6	M	SS	18	14				
7											
8	**SILTY SAND,** with gravel, medium density, brown to red, moist (SM)		16	M	SS	14					21.1
9											
10	**SILTY SAND,** medium dense to dense, brown, moist (SM)	HELL CREEK FORMATION									
11			50/6"	M	SS	18	15				
12											
13											
14											
15											
16			59	M	SS	18					
17											
18											
19											
20	Becomes gray and very moist at 20 feet										
21			80	M	SS	18					
22											
23											
24											
25	**POORLY-GRADED SAND,** very dense, gray, wet (SP)		50/5.5"	W	SS	20					
26											
27											
28											
29											
30											
31			50/5"	W	SS	20					
32											
33											
34											
35											
36			50/5"	W		18					
	End of Boring										

DEPTH:	DRILLING METHOD
36.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
3/5/20	**16:25**	**36.5**	**35.0**	**NA**	**NA**	**25.0**

BORING COMPLETED: **3/5/20**

DR: **IDS** LG: **HTF** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-24 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2137.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL,** silty sand, brown frozen	TOPSOIL									
2	**SILTY SAND,** loose to medium dense, brown, moist (frozen to 8 inches) (SM)	MIXED ALLUVIUM	10	M	SS	18					
3											
4			5	M	SS	18					
5											
6			13	M	SS	18	12				
7											
8	**SILTY SAND**, very dense, brown, moist (SM)	HELL CREEK FORMATION	50/5"	M	SS	18	11				
9											
10											
11			50/3"	M	SS	18					
12											
13											
14											
15											
16			50/6"	M	SS	15					
17											
18											
19											
20											
21			50/5"	M	SS	24					
22											
23											
24											
25				▽							
26	**POORLY-GRADED SAND,** very dense, gray, wet (weak sandstone) (SP)		50/6"	W	SS	18					
27											
28											
29											
30											
31			50/5"	W	SS	18					
32											
33											
34											
35											
36			50/5.5"	W	SS	24					
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
36.5	**3.25" HSA**	**3/5/20**	**15:45**	**36.5**	**35.0**	**NA**	**NA**	**25.0**
BORING COMPLETED: **3/5/20**								
DR: **IDS** LG: **HTF** Rig: **D 50**								

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-25 (p. 1 of 1)**

Project: **Makoshika Waterline Extension; Makoshika State Park**

Surface Elevation **2144.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1–2	**TOPSOIL,** sandy lean clay, stiff, brown, moist	TOPSOIL	13	M	SS	18					
2–3	**Sandy LEAN CLAY,** stiff, brown, moist (CL)	FINE ALLUVIUM									
3–5	**SILTY SAND,** loose to medium dense, brown, moist (SM)	MIXED ALLUVIUM	7	M	SS	16					
5–7			8	M	SS	18	8				
7–9			12	M	SS	18	7				
9–11			11	M	SS	18					
11–15											
15–20	**SILTY SAND,** very dense, brown, moist (SM)	HELL CREEK FORMATION	77	M	SS	22					
20–25			50/5"	M	SS	20					
25–30			50/3"	M	SS	20					
30–31			50/5"	M	SS	20					
31–35	**POORLEY-GRADED SAND,** very dense, gray, very moist (SP)										
35–36	Becomes dark gray and wet at 35 feet		50/5"	W	SS	20					
36–40											
40–41			50/4"	W	SS	3					
41–45											
45–46			74	W	SS	12					
	End of Boring										

DEPTH:	DRILLING METHOD
46.5	**3.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
3/5/20	**13:45**	**46.5**	**45.0**	**NA**	**NA**	**35.0**

BORING COMPLETED: **3/5/20**

DR: **IDS** LG: **HTF** Rig: **D 50**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **37-20547** Log of Boring No. **B-26 (p. 1 of 1)**

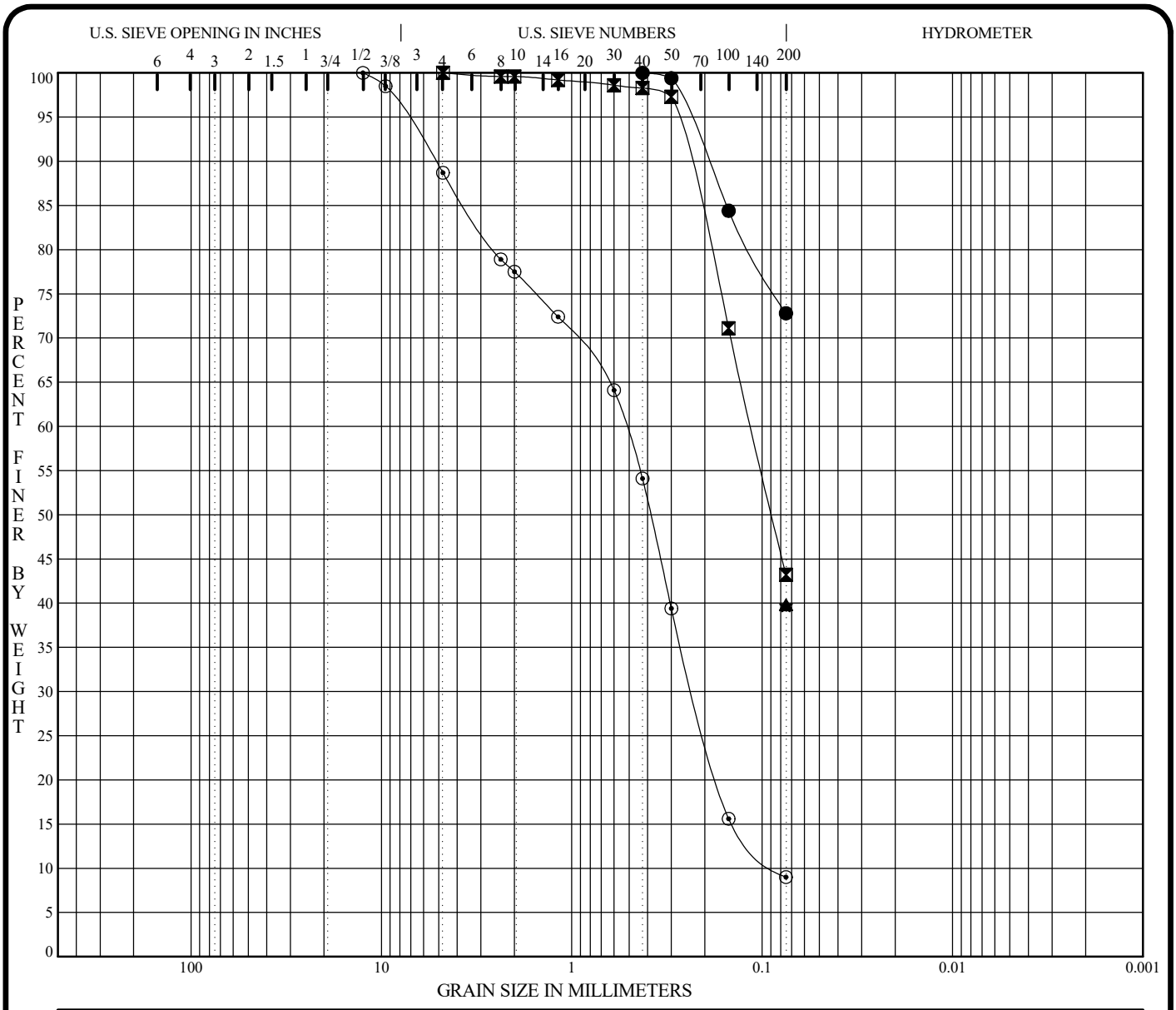
Project: **Makoshika Waterline Extension; Makoshika State Park**

DEPTH IN FEET	Surface Elevation **2140.0** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL** silty sand, brown (SM)	TOPSOIL									
2	**SILTY SAND,** medium dense, brown, moist (SM)	MIXED ALLUVIUM	13	M	SS	18					
3	Seam of 3" of aggregate base course at 1.5 feet		9	M	SS	18					
4											
5											
6	**SANDSTONE,** weakly cemented, light brown, moist	HELL CREEK FORMATION	20	M	SS	18					
7											
8			33	M	SS	18	17				
9											
10											
11			39	M	SS	20	15				
12											
13											
14											
15											
16	**POORLY-GRADED SAND,** very dense, light brown, moist (SP)		50/6"	M	SS	20					
17											
18											
19											
20											
21			35	M	SS	18					
22											
23											
24											
25											
26	Becomes gray at 26 feet		50/6"	M	SS	20					
27											
28											
29											
30	Becomes wet at 30 feet			▽							
31			50/5"	M	SS	W					
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
31.5	**3.25" HSA**	**3/6/20**	**10:00**	**31.5**	**30.0**	**NA**	**NA**	**30.0**
BORING COMPLETED: **3/6/20**								
DR: **IDS** LG: **HTF** Rig: **D 50**								

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-20547 LOGS.GPJ AET+CPT+WELL_20181012_JG.GDT 3/16/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-1**	**5.0'**	**SILTY CLAY with SAND**	**32**	**24**	**17**	**7**		
⧓	**B-12**	**5.0'**	**SILTY SAND**	**15**	**31**	**23**	**8**		
▲	**B-14**	**5.0'**		**20**					
★	**B-16**	**5.0'**		**14**					
⊙	**B-16**	**10.0'**		**13**				**1.20**	**6.3**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**5.0'**	**0.43**				**0.0**	**27.2**	**72.8**	
⧓	**B-12**	**5.0'**	**4.75**	**0.11**			**0.0**	**56.8**	**43.2**	
▲	**B-14**	**5.0'**	**0.08**				**0.0**	**0.0**	**39.8**	
★	**B-16**	**5.0'**	**0.08**				**0.0**	**0.0**	**39.7**	
⊙	**B-16**	**10.0'**	**12.50**	**0.52**	**0.228**	**0.0833**	**11.3**	**79.7**	**9.0**	

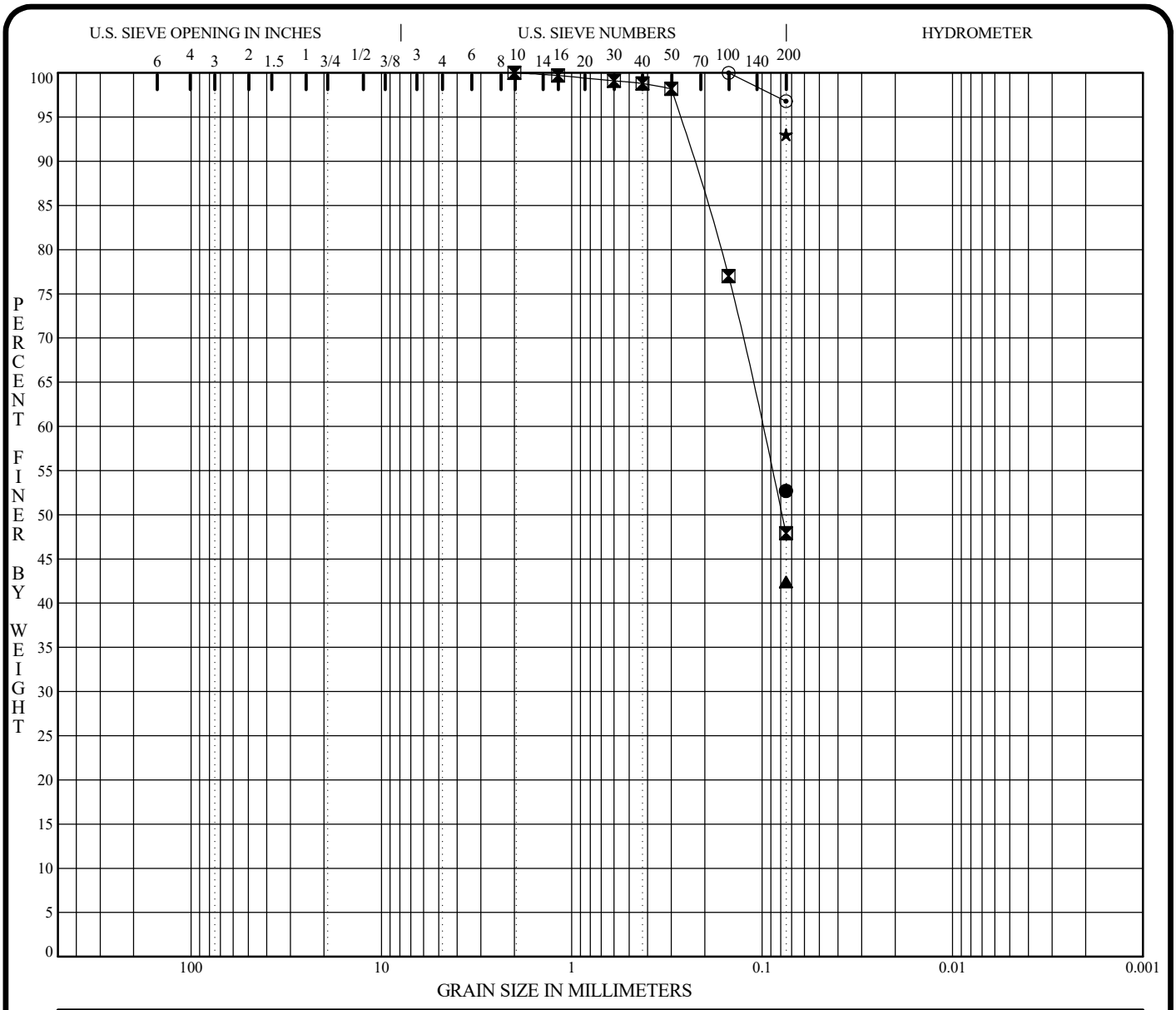
PROJECT **Makoshika Waterline Extension; Makoshika State Park**

AET JOB NO. **37-20547**

DATE **1/23/20**

AMERICAN ENGINEERING TESTING, INC.

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-18**	**5.0'**	**SANDY LEAN CLAY**	**19**	**35**	**15**	**20**		
⊠	**B-19**	**2.5'**		**23**					
▲	**B-2**	**10.0'**		**22**					
★	**B-20**	**2.5'**		**23**					
⊙	**B-21**	**15.0'**	**FAT CLAY**		**55**	**24**	**31**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-18**	**5.0'**	**0.08**				**0.0**	**0.0**	**52.7**	
⊠	**B-19**	**2.5'**	**2.00**	**0.10**			**0.0**	**52.1**	**47.9**	
▲	**B-2**	**10.0'**	**0.08**				**0.0**	**0.0**	**42.4**	
★	**B-20**	**2.5'**	**0.08**				**0.0**	**0.0**	**93.0**	
⊙	**B-21**	**15.0'**	**0.15**				**0.0**	**3.2**	**96.8**	

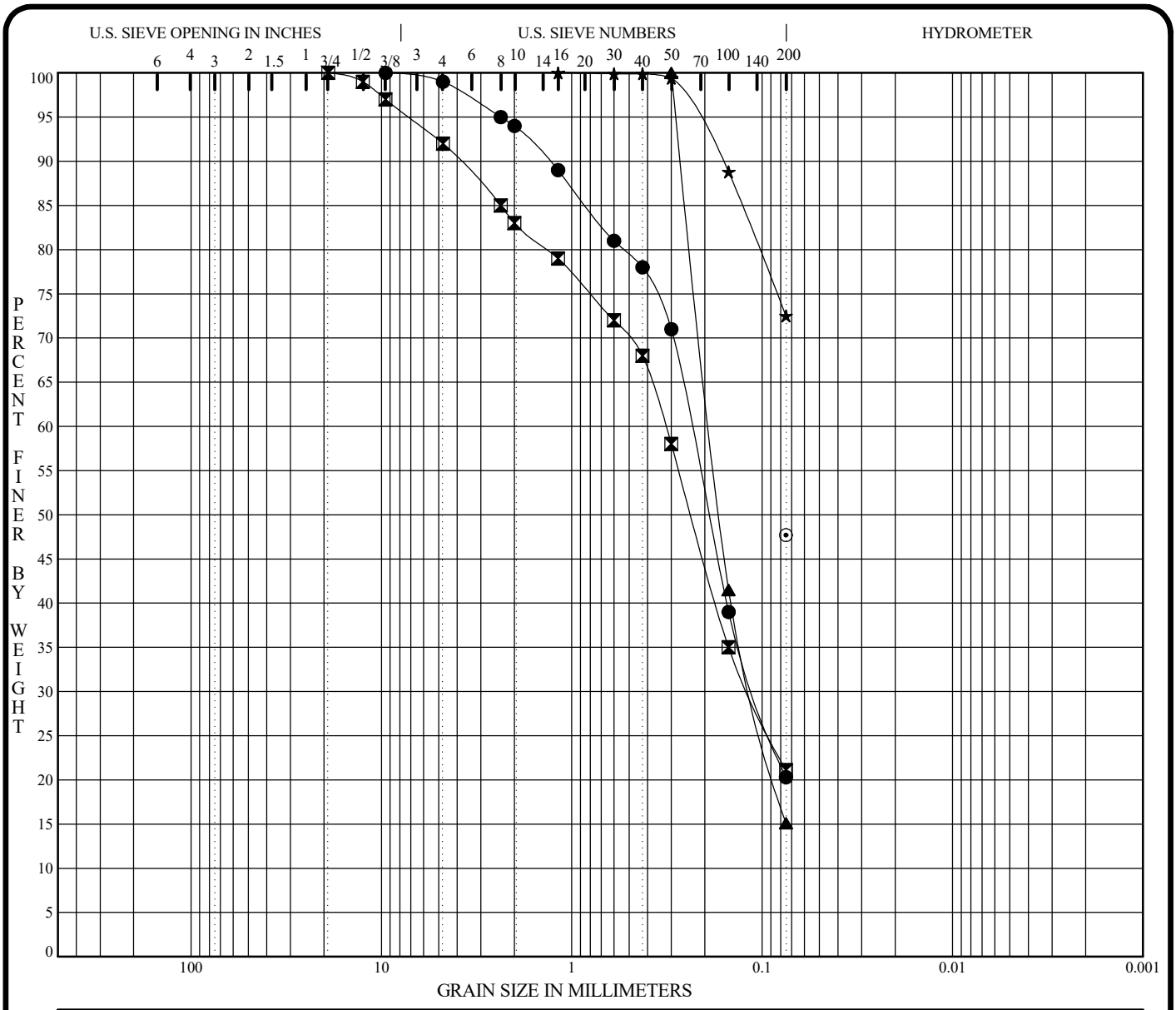
PROJECT **Makoshika Waterline Extension; Makoshika State Park**

AET JOB NO. **37-20547**

DATE **3/6/20**

AMERICAN ENGINEERING TESTING, INC.

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
● B-22	7.5'							
⧓ B-23	7.5'							
▲ B-4	7.5'		5		NP			
★ B-5	2.5'	LEAN CLAY with SAND	8	30	20	10		
⊙ B-7	2.5'	SILTY CLAYEY SAND	21	27	22	5		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-22	7.5'	9.50	0.24	0.107		1.0	78.7	20.3	
⧓ B-23	7.5'	19.00	0.32	0.117		8.0	70.9	21.1	
▲ B-4	7.5'	0.30	0.19	0.111		0.0	84.9	15.1	
★ B-5	2.5'	1.18				0.0	27.5	72.5	
⊙ B-7	2.5'	0.08				0.0	0.0	47.7	

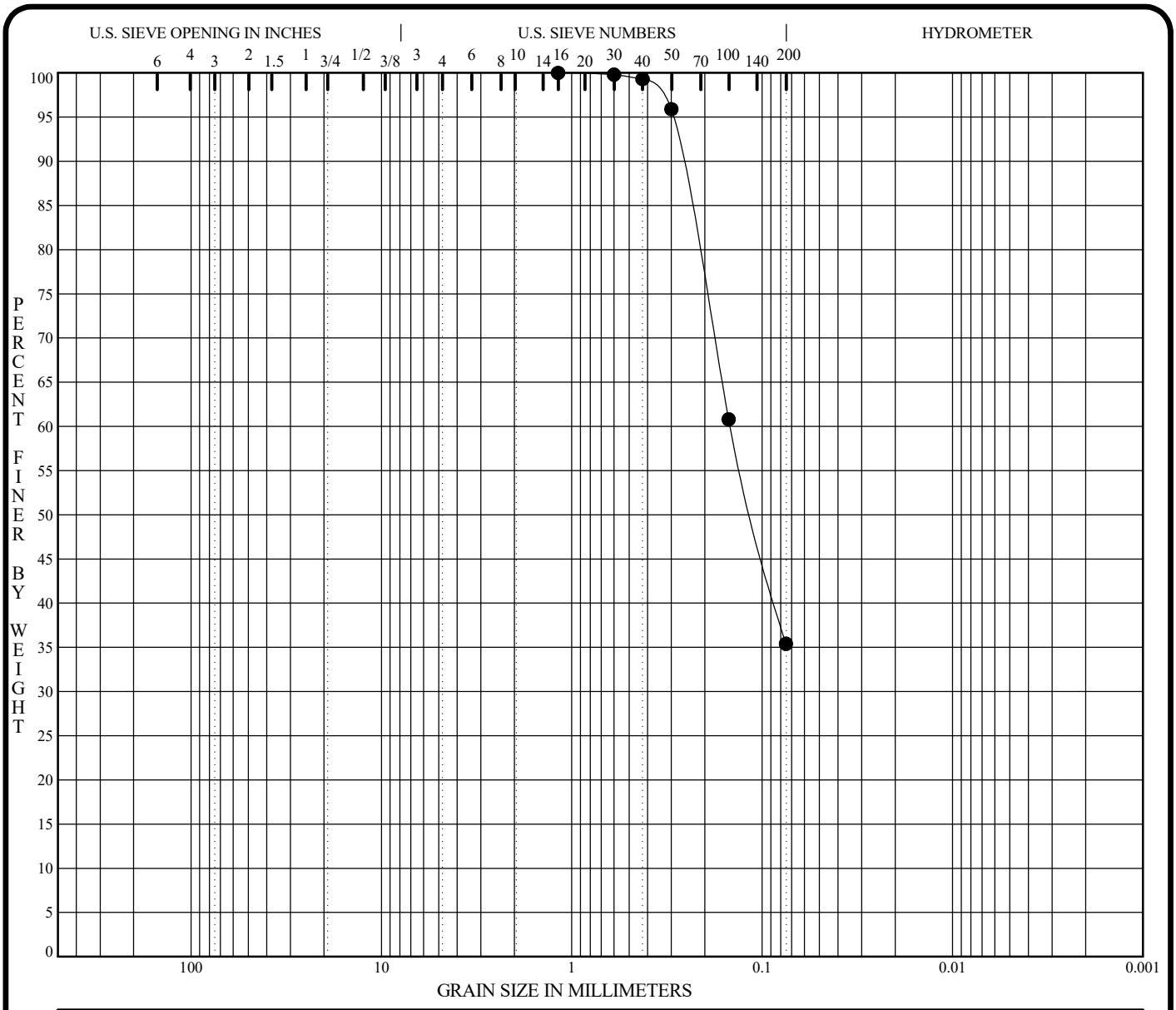
PROJECT **Makoshika Waterline Extension; Makoshika State Park**

AET JOB NO. **37-20547**

DATE **1/23/20**

AMERICAN ENGINEERING TESTING, INC.

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
● **B-9**	**7.5'**		**10**					

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-9**	**7.5'**	**1.18**	**0.15**			**0.0**	**64.6**	**35.4**	

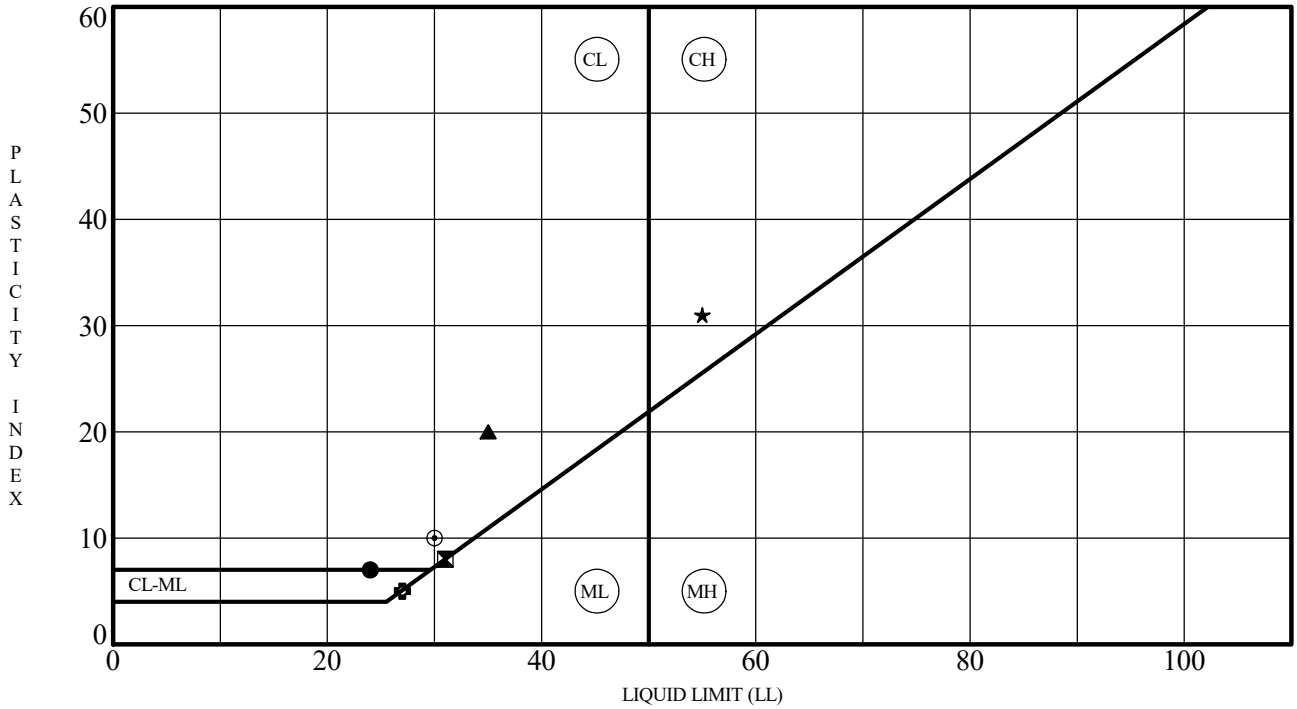
PROJECT **Makoshika Waterline Extension; Makoshika State Park**

AET JOB NO. **37-20547**

DATE **1/23/20**

AMERICAN ENGINEERING TESTING, INC.

GRADATION CURVES



Specimen Identification			LL	PL	PI	Fines	Classification
●	B-1	5.0'	24	17	7	72.8	SILTY CLAY with SAND
⊠	B-12	5.0'	31	23	8	43.2	SILTY SAND
▲	B-18	5.0'	35	15	20	52.7	SANDY LEAN CLAY
★	B-21	15.0'	55	24	31	96.8	FAT CLAY
⊙	B-5	2.5'	30	20	10	72.5	LEAN CLAY with SAND
✿	B-7	2.5'	27	22	5	47.7	SILTY CLAYEY SAND

PROJECT **Makoshika Waterline Extension; Makoshika State Park**

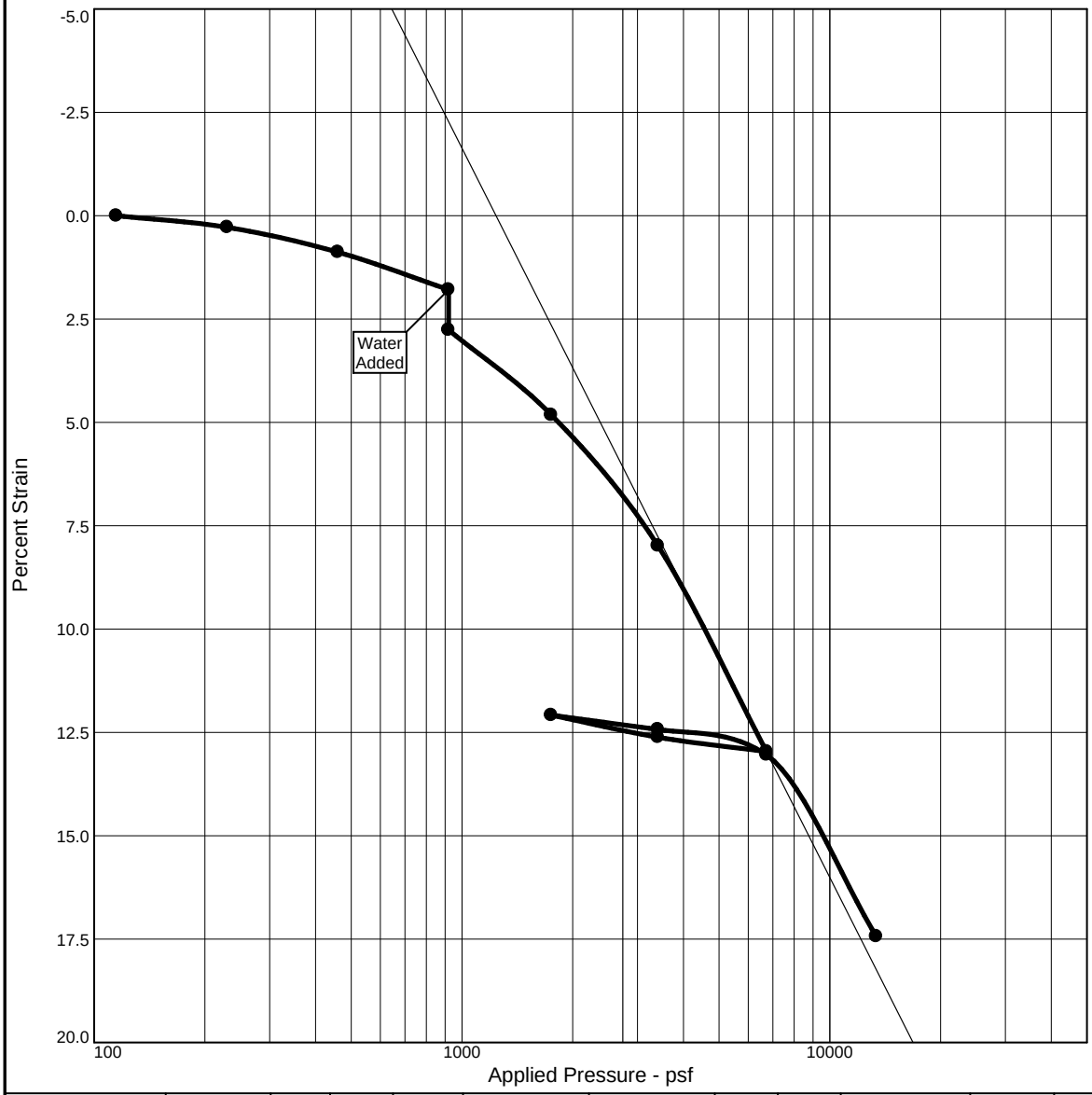
AET JOB NO. **37-20547**

DATE **1/23/20**

AMERICAN ENGINEERING TESTING, INC.

ATTERBERG LIMITS RESULTS

CONSOLIDATION TEST REPORT



Natural Sat.	Natural Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_s	Swell Press. (psf)	Clpse. %	e_o
87.2 %	24.5 %	94.8			2.65	920	3109	0.31	0.03		1.0	0.745

MATERIAL DESCRIPTION	USCS	AASHTO
Grey/Brown Clayey Sand	SC	

Project No. 37-20547 **Client:** Interstate Engineering, Inc.

Project: Makoshika Waterline

Location: B-2 **Depth:** 7.5

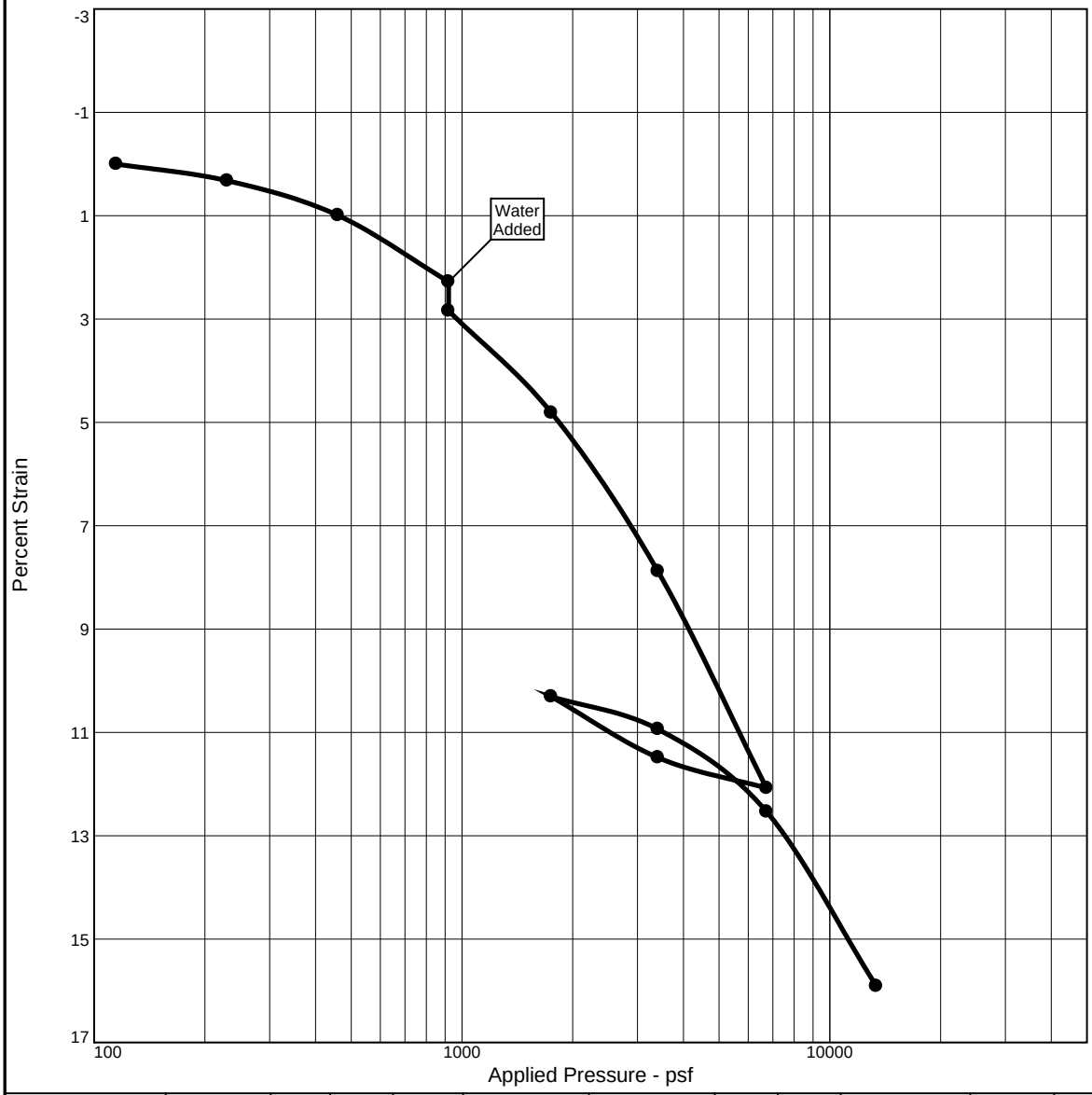
Remarks:

American Engineering Testing, Inc.

Figure

Tested By: JF

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_s	Swell Press. (psf)	Clpse. %	e_o
Sat.	Moist.											
112.0 %	30.9 %	95.5			2.65	920			0.05		0.6	0.732

MATERIAL DESCRIPTION	USCS	AASHTO
Grey/Brown Silty Sand	SM	

Project No. 37-20547 **Client:** Interstate Engineering, Inc.

Project: Makoshika Waterline

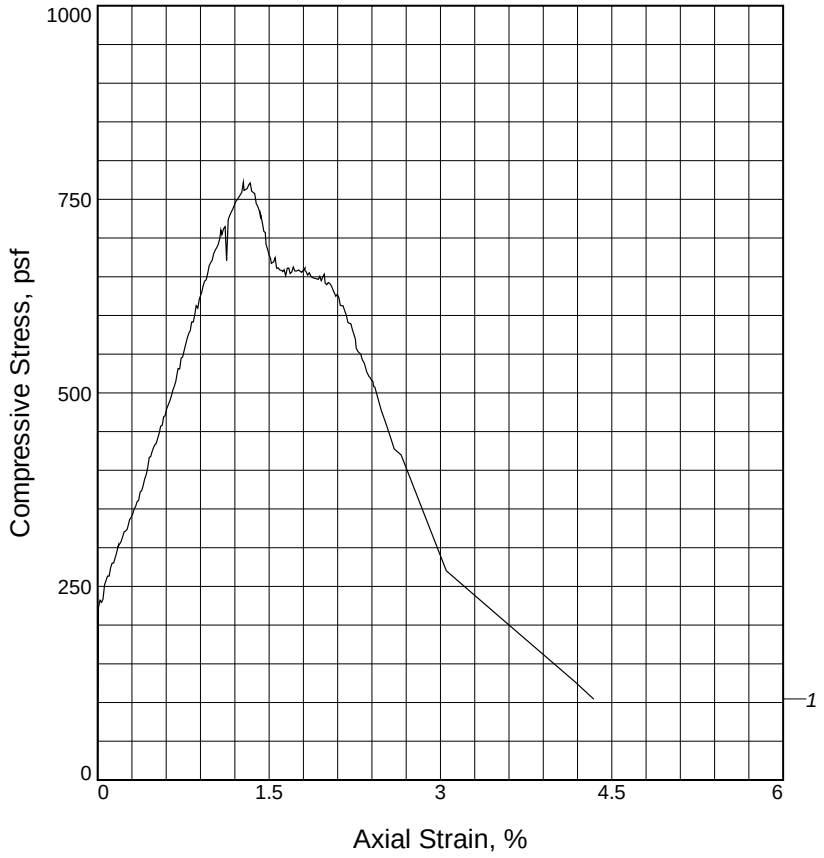
Location: B-2 **Depth:** 15

American Engineering Testing, Inc.

Figure

Tested By: JF

UNCONFINED COMPRESSION TEST



Sample No.	1
Unconfined strength, psf	772
Undrained shear strength, psf	386
Failure strain, %	1.3
Strain rate, in./min.	N/A
Water content, %	7.2
Wet density, pcf	99.8
Dry density, pcf	93.1
Saturation, %	24.5
Void ratio	0.7779
Specimen diameter, in.	1.90
Specimen height, in.	5.01
Height/diameter ratio	2.63
Description: Brown Clayey Sand	

LL =	**PL =**	**PI =**	**Assumed GS=** 2.65	**Type:** California Ring

Project No.: 37-20547

Date Sampled: 1/21/2020

Client: Interstate Engineering, Inc.

Project: Makoshika Waterline

Location: B-11

Depth: 7.5

UNCONFINED COMPRESSION TEST

American Engineering Testing, Inc.

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. 37-20547

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by GBA[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

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

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

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

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

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

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

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

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

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

1 Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockville, MD 20850
Telephone: 301/565-2733: www.geoprofessional.org, 2019

B.2.3 Read the Full Report
Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. Read and refer to the report in full.

B.2.4 You Need to Inform Your Geotechnical Engineer About Change
Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

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

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

B.2.5 Most of the "Findings" Related in This Report Are Professional Opinions
Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

B.2.6 This Report's Recommendations Are Confirmation-Dependent
The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

B.2.7 This Report Could Be Misinterpreted
Other design professionals' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

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

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

B.2.8 Give Constructors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you've included the material for information purposes only. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about

specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they prefer and be sure to allow enough time to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

B.2.9 Read Responsibility Provisions Closely

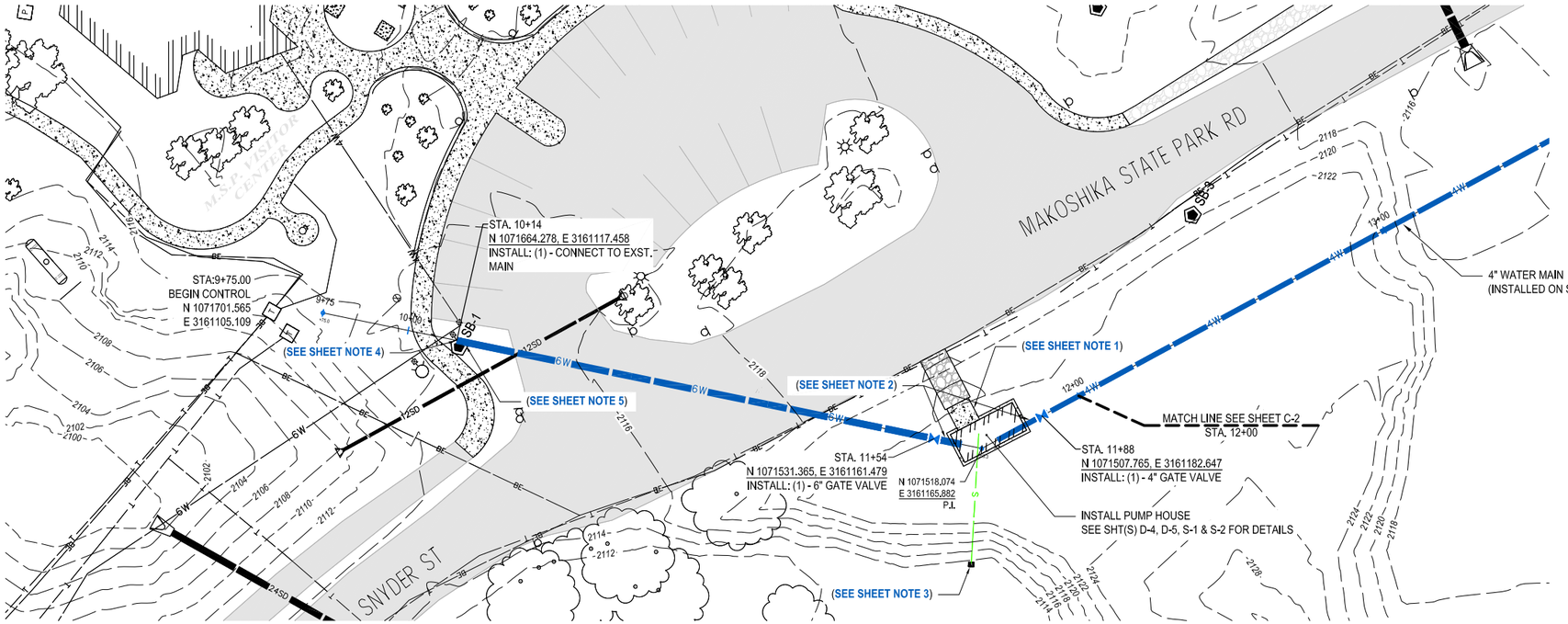
Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined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

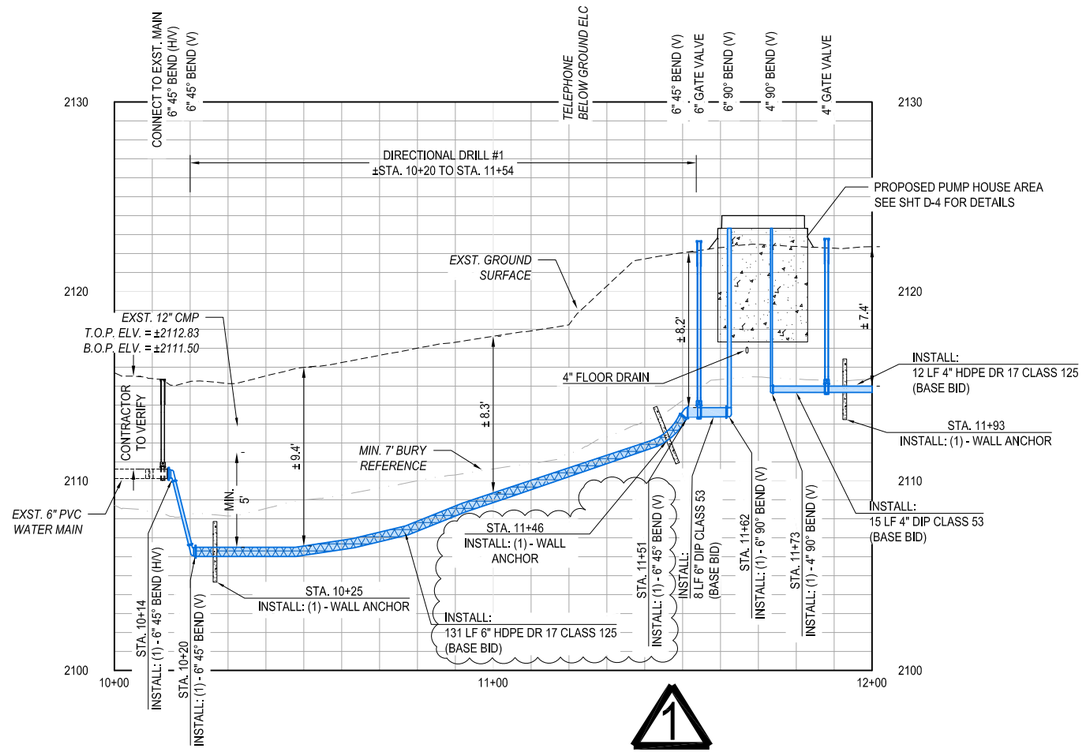
B.2.10 Geoenvironmental Concerns Are Not Covered

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

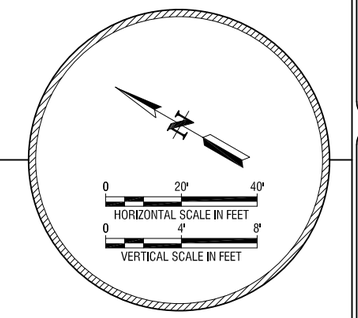
B.2.11 Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

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





1



SHEET NOTES:

1. FOR PUMP HOUSE SITE DETAILS, SEE SHT D-5.
2. INSTALL DIP A MINIMUM OF 5' OUTSIDE OF THE PUMP HOUSE. THE DIP SHALL TRANSITION TO HDPE AT THE GATE VALVE OF THE SUCTION AND DISCHARGE LINES.
3. DAYLIGHT 4" Ø PUMP HOUSE FLOOR DRAIN TO THE SOUTH WEST. SLOPE DRAIN AT A MINIMUM 1/4" / FT. SEE SHT D-3 FOR OUTFALL STRUCTURE DETAIL.
4. THE EXISTING 6" WATER MAIN HAS 0.5' OF C900 DR 18 PVC WITH AN MJ CAP OUT OF A 6" MJ GATE VALVE & RISER. EXACT LOCATION AND ANGLE OF EXISTING WATER MAIN IS UNKNOWN. CONTRACTOR SHALL FIELD VERIFY EXISTING LOCATION PRIOR TO INSTALLATION. THE CONTRACTOR SHALL HAVE ON HAND THE NECESSARY FITTINGS AND MATERIAL TO TIE ONTO THE EXST. WATER MAIN.
5. ALL EXPOSED EXISTING AND PROPOSED PIPING IN TRENCH AT TIE IN POINT SHALL BE INSULATED WITH 6" MINIMUM TOTAL THICKNESS OF INSULATION BOARD AT A MINIMUM WIDTH OF 3' ON EACH SIDE FROM THE CENTERLINE OF THE PIPE. INSULATION BOARD SHALL BE ENVELOPED IN A 2" MINIMUM THICK SAND BEDDING ON ALL SIDES. EXTEND THE INSULATION OVER THE PROPOSED PIPING UNTIL A MINIMUM OF 7' BURY DEPTH IS ACHIEVED BY THE VERTICAL BENDS.

CONSTRUCTION NOTES:

1. EXACT DEPTH AND LOCATION OF ELECTRICAL AND TELEPHONE UTILITIES ARE UNKNOWN. CONTRACTOR SHALL FIELD VERIFY EXISTING MATERIAL AND LOCATION PRIOR TO CONSTRUCTION.
2. AIR-VAC ASSEMBLY, CURB STOP & YARD HYDRANT LOCATIONS SHALL BE FIELD VERIFIED AND APPROVED BY ENGINEER PRIOR TO PLACEMENT.
3. CONTRACTOR SHALL NOTIFY LOCAL DISPATCH, FIRE DEPARTMENT, EMERGENCY SERVICES, AND M.S.P. VISITOR CENTER OF ROAD CLOSURES AND DETOURS REQUIRED DURING THE COURSE OF CONSTRUCTION. UPDATES SHALL BE GIVEN AS REQUIRED TO STAY CURRENT WITH TRAFFIC CONTROL PLAN. SEE SPECIFICATIONS 01 55 26 & 01 31 00.
4. ALL DISTURBED LANDSCAPED AND UNIMPROVED AREAS SHALL BE RESTORED WITH AN EROSION CONTROL BLANKET. SEE SPECIFICATIONS 32 92 19.

Revision No.	Date	By	Description
---	6/8/2020	KKB	DEQ APPROVAL (E.Q. 20-2254)
---	6/9/2020	KKB	CONSTRUCTION PLANS
1	6/30/2020	JK	ADDENDUM NO. 1

MAKOSHIKA WATER LINE EXTENSION
MONTANA FISH, WILDLIFE AND PARKS
GLENDIVE, MONTANA

Project No.: S19-00-115
Date: MAY 26, 2020

Drawn By: KKB
Checked By: JLM

PLANS - UTIL

Interstate Engineering, Inc.
P.O. Box 648
2177 LINCOLN AVE. SE.
Sidney, Montana 59270-0648
Ph (406) 433-5617
www.interstateeng.com
Other offices in Minnesota, North Dakota and South Dakota

INTERSTATE ENGINEERING
Professionals you need, people you trust

C-2