

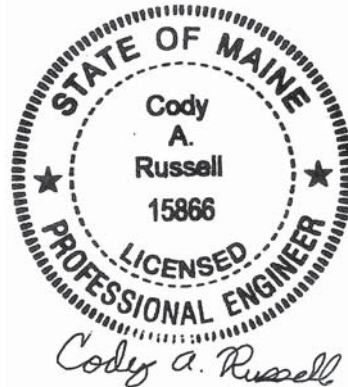
**MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE**

GEOTECHNICAL DESIGN REPORT

For the Reconstruction of:

**US ROUTE 1
VAN BUREN, MAINE**

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Soils Report 2020-12
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Table of Contents

1.0 INTRODUCTION	3
2.0 GEOLOGIC SETTING	3
3.0 SUBSURFACE INVESTIGATION.....	3
4.0 LABORATORY TESTING.....	4
5.0 SUBSURFACE CONDITIONS.....	4
5.1 PAVEMENT AND FILL SOILS	4
5.2 NATIVE SOILS	5
5.3 GROUNDWATER.....	8
6.0 GEOTECHNICAL RECOMMENDATIONS	8
6.1 LARGE CULVERTS	8
6.2 SETTLEMENT	12
6.3 SCOUR AND RIPRAP	12
6.4 SEISMIC DESIGN CONSIDERATIONS	12
6.5 PEAT.....	12
6.6 ADDITIONAL CONSTRUCTION CONSIDERATIONS	13
7.0 CLOSURE.....	13

Sheets

Sheet 1 - Location Map

Sheets 2 through 23 – Boring Location Plans

Sheets 24 through 28 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs

Appendices

Appendix A – Boring Logs

Appendix B – Laboratory Test Results

Appendix C – Calculations

1.0 INTRODUCTION

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical design and construction recommendations for the reconstruction of an approximately 2.75-mile portion of US Route 1 in Van Buren, as shown on Sheet 1 – Location Map. The project is needed to address poor pavement and subgrade conditions, drainage, and unpaved shoulders. The scope includes reconstruction of the existing travel lanes and shoulders and five (5) large culvert replacements. US Route 1 is a Highway Corridor Priority 1 road.

2.0 GEOLOGIC SETTING

According to the Surficial Geology Map entitled Surficial Geology of the Stockholm Quadrangle, Maine, Open File No. 78-8 (1978) published by the Maine Geological Survey (MGS), the surficial soils along the project length primarily consist of Stream Alluvium and Till, with small areas of Swamp and Marsh Deposits. Stream Alluvium consists of sand, gravel, and silt. Till consists of a mixture of sand, silt, clay, and stones. Swamp and tidal deposits consist of peat, silt, clay and sand.

According to the MGS map titled Bedrock Geologic Map of Maine (1985) the bedrock along the project consists of interbedded pelite and sandstone of the Jemmland Formation and calcareous pelite of the New Sweden Formation.

3.0 SUBSURFACE INVESTIGATION

Subsurface conditions at the site were explored by drilling a total of fifty-six (56) test borings and forty-one (41) probes.

Borings HB-VANB-101 through HB-VANB-121 were drilled on July 22, 2014. Borings HB-VANB-201 through HB-VANB-231 and thirty-six (36) unnamed probes were drilled between June 10, 2015 and June 15, 2015. Boring HB-VANB-223 was not drilled. Borings HB-VANB-301, HB-VANB-303, HB-VANB-305, HB-VANB-307, and HB-VANB-309 and probes HB-VANB-302, HB-VANB-304, HB-VANB-306, HB-VANB-308, and HB-VANB-310 were drilled on October 15 and 16, 2018. All explorations were drilled by the MaineDOT drill crew. The borings were drilled to depths ranging from approximately 4.0 to 22.0 feet below ground surface (bgs) using solid stem auger and cased wash boring techniques. The probes were drilled to depths ranging from approximately 9.5 to 20.5 feet bgs using solid stem auger drilling techniques. Boring and probe locations are shown on the Sheets 2 through 23 Boring Location Plans. The boring logs, 300-series probe logs, and an auger probe summary sheet are presented in Appendix A.

Soil samples were obtained off the auger flights in most 100- and 200-series borings. Soil descriptions were recorded but no soil sampling was done in a number of 100- and 200-series borings. Continuous soil samples were collected in two (2) 200-series boring using Standard Penetration Testing (SPT). Soil samples were obtained in the 300-series borings at standard 5-foot intervals using SPT. No soil sampling was done in the 300-series and unnamed probes and no soil descriptions were recorded.

The MaineDOT drill rig is equipped with an automatic hammer to drive the split-spoon for soil sampling. The automatic hammer is calibrated each year and is typically found to deliver more energy during driving than the standard rope and cathead system. All N-values discussed in this report are corrected N-values (N_{60}) computed by applying a hammer efficiency factor to the raw field N-values. Since the borings for this project were conducted over several years, two (2) hammer efficiency factors were used to correct the raw field N-values. Both the raw field N-value and the corrected N_{60} -values are shown on the boring logs. The table below lists the hammer information and efficiency factors that were applied to the raw field N-values for each year.

Boring Series	Drill Rig	Hammer Type	Calibration Year	Hammer Efficiency Factor
200-series	CME 45C	Automatic	2014	0.908
300-series	CME 45C	Automatic	2018	0.928

Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are shown in the Boring Logs in Appendix A. The MaineDOT Geotechnical Team member selected the boring locations, drilling methods, designated type and depth of sampling, reviewed field logs for accuracy and identified field and laboratory testing requirements. A North East Transportation Training and Certification Program (NETTCP) certified subsurface inspector logged the subsurface conditions encountered. The boring and probes were located in the field by taping to site features after completion of the drilling program.

4.0 LABORATORY TESTING

A laboratory testing program was conducted on select soil samples obtained in the test borings to assist in soil classification, evaluation of engineering properties of the soils and geologic assessment of the project site. Laboratory testing consisted of ninety-eight (98) standard grain size analyses and natural water content, one (1) grain size analyses with hydrometer and natural water content, eight (8) Atterberg Limits tests, and four (4) organic content /Loss on Ignition tests. The results of the laboratory tests are in Appendix B – Laboratory Test Results. Laboratory test results are also summarized on the boring logs in Appendix A.

5.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered at the test borings and probes generally consisted of pavement and fill soils underlain by of layers of native sand, silt, and gravel. The boring locations are shown on Sheets 2 through 23 - Boring Location Plans. The boring logs, 300-series probe logs, and an auger probe summary sheet are in Appendix A – Boring Logs.

5.1 Pavement and Fill Soils

The subsurface investigations found areas of pavement and roadway fill soils along the project. Where present, the pavement thickness ranged from approximately 4.0 to 8.0 inches. The fill soils consisted of:

- Brown, dry to damp, fine to coarse sand, trace to some silt, trace to some gravel, occasional cobble.
- Brown, damp to moist, gravelly fine to coarse sand, little to some silt, occasional cobble.
- Brown, moist, fine to coarse sandy gravel, trace silt, occasional cobble.
- Brown, damp, gravel, some fine to coarse sand, little silt.
- Brown or grey, damp to wet, silty fine to coarse sand, little gravel.
- Brown, dry, fine to coarse sandy silt, trace gravel.

The thickness of the fill ranged from approximately 0.8 to 10.0 feet. The full depth of the fill was not penetrated in all of the explorations. SPT N_{60} -values obtained in the granular fill layers ranged from 11 to 57 blows per foot (bpf) indicating that the granular fill is medium dense to very dense in consistency. One SPT N_{60} -value obtained in the sandy silt fill was 14, indicating that the sandy silt is stiff.

Water contents from thirty-nine (39) sand and gravel fill samples obtained within the fill layer range from approximately 3% to 23%. Grain size analyses conducted on thirty-nine (39) samples of the sand and gravel fill resulted in the soil being classified as an A-1-a, A-1-b, or A-2-4 under the AASHTO Soil Classification System and an SM, SW-SM, GW-GM, or GM under the Unified Classification System. Water contents from two (2) silt samples obtained within the fill layer range from approximately 12 to 21%. Grain size analyses conducted on two (2) samples of the silt fill resulted in the soil being classified as an A-4 under the AASHTO Soil Classification System and an ML or CL under the Unified Classification System.

5.2 Native Soils

The fill soils are underlain by layers of native soils consisting of sand, silt, and gravel. Peat was encountered in several locations.

5.2.1 Native Sand

The native sand layers encountered in the borings consisted of:

- Olive-brown, olive, brown to dark brown, and grey to dark grey, dry to wet, fine to coarse sand, some silt, trace to some gravel, trace organics, occasional cobble.
- Brown, light brown, olive, and grey, moist to wet, silty fine to coarse sand, trace to little gravel.
- Brown, wet, gravelly fine to coarse sand, little silt.
- Brown to dark brown, damp to moist, fine to coarse sand, some organic silt, some gravel, some peat, occasional cobble.
- Brown, wet, silty fine to coarse sand, trace gravel, some roots, trace peat.

In some locations, sand layers were identified in the field as till.

The thickness of the native sand layers ranged from approximately 0.7 to 11.0 feet. The full depth of the native sand was not penetrated in all of the explorations. SPT N-values obtained in the native sand ranged from approximately 9 to 71 bpf indicating that the sand is dense to very dense in consistency.

Water contents from thirty-three (33) samples obtained within the native sand layers range from approximately 4% to 51%. Grain size analyses conducted on thirty-three (33) samples of the native sand resulted in the soil being classified as an A-1-b, A-2-4, or A-4 under the AASHTO Soil Classification System and an SM or ML under the Unified Classification System.

Atterberg Limits testing conducted on one (1) sample of sand (HB-VANB-101, S2) determined that the sand is non-plastic.

5.2.2 Native Silt

The native silt layers encountered in the borings consisted of:

- Brown, grey, and olive, moist to wet, silt, trace to some fine to coarse sand, trace to little clay, trace to some gravel.
- Light to dark brown, olive-brown, olive, and grey, moist to wet, fine to coarse sandy silt, trace to little gravel, trace organics.
- Peat with silt, some fine to coarse sand, trace gravel.

In some locations, silt layers were identified in the field as alluvium or till.

The thickness of the native silt layers ranged from approximately 0.4 to 9.0 feet. The full depth of the native silt was not penetrated in all of the explorations. SPT N-values obtained in the native silt ranged from approximately 17 to 63 bpf indicating that the native silt is very stiff to hard in consistency.

Water contents from twenty-one (21) samples obtained within the native silt layers range from approximately 10% to 54%. Grain size analyses conducted on twenty-one (21) samples of the native silt resulted in the soil being classified as an A-4 under the AASHTO Soil Classification System and an ML, SM, CL, or OL under the Unified Classification System.

A total of seven (7) samples (4 of sandy silt and 3 of silt) were submitted to the lab for Atterberg Limits testing. The four (4) sandy silt samples were determined to be non-plastic. The following table summarizes the results of the three (3) silt samples Atterberg Limits tests:

Boring No. and Sample No.	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
HB-VANB-104 S7	30.0	31	26	5	0.80
HB-VANB-219 2D/A	21.5	26	24	2	-1.25
HB-VANB-219 3D	34.2	31	24	7	1.46

Interpretation of these results indicates that the silt varies from being slightly plastic to having low plasticity. The silt in boring HB-VANB-104, sample S7 is normally consolidated, meaning it is currently experiencing its highest stresses. The silt in boring HB-VANB-109, sample 2D/A is overconsolidated, meaning it has experienced higher stresses in the past. The silt in boring HB-VAN-219 sample 3D is on the verge of being a viscous liquid if disturbed. Overburden pressure and interparticle cementation is providing stability to keep the soil in its current state, but the slightest disturbance causing remolding could convert the soil into a viscous fluid.

5.2.3 Native Gravel

In some locations, gravel layers were identified in the field as till. The gravel consisted of:

- Olive brown and brown, moist to wet, gravel, some fine to coarse sand, little to some silt.
- Brown, wet, fine to coarse sandy gravel, little silt.
- Brown, damp, silty gravel, some fine to coarse sand.

The thickness of the native gravel layers ranged from approximately 1.7 to 11.0 feet. The full depth of the native gravel was not penetrated in all of the explorations. SPT N-values obtained in the native gravel ranged from approximately 25 to 57 bpf indicating that the gravel is medium dense to very dense in consistency.

Water contents from four (4) samples obtained within the native gravel layers range from approximately 7% to 18%. Grain size analyses conducted on four (4) samples of the native gravel resulted in the soil being classified as an A-1-a, A-1-b, A-2-4, or A-4 under the AASHTO Soil Classification System and an GM under the Unified Classification System.

5.2.4 Peat

Peat was encountered in sand and silt layers at several locations. The following table provides the locations of borings where peat was encountered and summarizes the results of organic content/Loss on Ignition (LOI) Tests performed on four (4) soil samples:

Boring No. and Sample No.	Approximate Station	Loss on Ignition (%)	Water (%)
HB-VANB-104 S6	30+10	6	53
HB-VANB-105 N/A	30+10	Not Tested	Not Tested
HB-VANB-108 S15	50+10	15	41
HB-VANB-217 S16*	27+10	1	0
HB-VANB-219 2D	31+10	18	62
HB-VANB-220 N/A	33+10	Not Tested	Not Tested

*No peat was identified. LOI testing was performed due to the presence of trace organics.

5.3 Groundwater

Groundwater levels were observed in seven (7) borings. The measured groundwater levels in the borings where groundwater was observed ranged were approximately 6.5 and 10.0 feet bgs. The water levels observed are indicated on the boring logs in Appendix A. Note that in some cases water was introduced into the boreholes during the drilling operations. Groundwater levels can be expected to fluctuate subject to seasonal variations, local soil conditions, topography, precipitation, and construction activity.

6.0 GEOTECHNICAL RECOMMENDATIONS

The following sections discuss the geotechnical-related design features of this project. Areas of geotechnical concern are:

- Large Culvert at approximate Station 33+63
- Large Culvert at approximate Station 50+35
- Large Culvert at approximate Station 118+38
- Large Culvert at approximate Station 135+33
- Large Culvert at approximate Station 140+76

6.1 Large Culverts

6.1.1 General Information

Large Culvert at approximate Station 33+63 – The existing structure (Asset ID# XC-48108) at approximate Station 33+63 is a 42-inch corrugated metal pipe (CMP) culvert. The proposed replacement structure is a 7-foot span by 6-foot rise, 96-foot long precast concrete box culvert on an approximately 18-degree skew to the roadway centerline with an inlet elevation of approximately 447.5 feet and an outlet elevation of approximately 447.0 feet.

One (1) boring (HB-VANB-301) and (1) probe (HB-VANB-302) were drilled at opposite, diagonal corners of the proposed structure. The boring locations and the interpretive subsurface profile are shown on Sheet 24 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. The boring logs are also provided in Appendix A – Boring Logs.

Boring HB-VANB-301 was drilled to a depth of approximately 22.0 feet bgs without encountering a refusal surface. The subsurface conditions encountered in the boring consisted of fill consisting of sandy and sandy silt underlain by till consisting of sand and silt. One (1) SPT N_{60} -value obtained in the sand fill was 28 bpf indicating that the sand fill is medium dense in consistency. One (1) SPT N_{60} -value obtained in the silt fill was 14 bpf indicating that the silt fill is stiff in consistency. SPT N_{60} -values in the sand till ranged from 12 bpf to 43 bpf indicating that the sand till is medium dense to dense in consistency. One (1) SPT N_{60} -value obtained in the silt till was 51 bpf indicating that the silt till is hard in consistency. Probe HB-VANB-302 was drilled to a depth of approximately 20.5 feet bgs without encountering a refusal surface.

Large Culvert at approximate Station 50+35 – The existing structure (Asset ID# XC-48109) at approximate Station 50+35 is a 36-inch CMP culvert. The proposed replacement structure is an 8-foot span by 8-foot rise, 93-foot long precast concrete box culvert on an approximately 14-degree skew to the roadway centerline with an inlet elevation of approximately 462.8 feet and an outlet elevation of approximately 459.0 feet.

One (1) boring (HB-VANB-303) and one (1) probe (HB-VANB-304) were drilled at opposite, diagonal corners of the proposed structure. The boring locations and the interpretive subsurface profile are shown on Sheet 25 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. The boring logs are also provided in Appendix A – Boring Logs.

Boring HB-VANB-303 to drilled to a depth of approximately 22.0 feet bgs without encountering a refusal surface. The subsurface conditions encountered in the boring consisted of fill consisting of sand and gravel underlain by native sand underlain by alluvium consisting of silt and sandy silt. SPT N_{60} -values in the fill ranged from 11 to 17 bpf indicating that the fill is medium dense in consistency. One (1) SPT N_{60} -value obtained in the native sand was 20 bpf indicating that the native sand is medium dense in consistency. SPT N_{60} -values in the alluvium ranged from 34 bpf to 36 bpf indicating that the alluvium is hard in consistency. Probe HB-VANB-304 was drilled to a depth of approximately 20.5 feet bgs without encountering a refusal surface.

Large Culvert at approximate Station 118+38 – The existing structure (Asset ID# XC-48119) at approximate Station 118+38 is a 36-inch CMP culvert. The proposed replacement structure is an 8-foot span by 6-foot rise, 82-foot long precast concrete box culvert on an approximately 6-degree skew to the roadway centerline with an inlet elevation of approximately 479.0 feet and an outlet elevation of approximately 477.2 feet.

One (1) boring (HB-VANB-305) and three (3) probes (HB-VANB-306 and 2 unnamed probes) were drilled at each corner of the proposed structure. The boring locations and the interpretive subsurface profile are shown on Sheet 26 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. The boring logs are also provided in Appendix A – Boring Logs.

Boring HB-VANB-305 to drilled to a depth of approximately 22.0 feet bgs without encountering a refusal surface. The subsurface conditions encountered in the boring consisted of fill consisting of sand and silty sand underlain by till consisting of sand and sandy silt. SPT N_{60} -values in the fill ranged from 19 to 57 bpf indicating that the fill is medium dense to very dense in consistency. One (1) SPT N_{60} -value obtained in the native sand was 20 bpf indicating that the native sand is medium dense in consistency. SPT N_{60} -values in the till ranged from 60 bpf to 63 bpf indicating that the till is very dense in consistency. Probe HB-VANB-306 was drilled to a depth of approximately 20.5 feet bgs without encountering a refusal surface. Two (2) unnamed probes were drilled to depths of 15.0 feet bgs without encountering a refusal surface.

Large Culvert at approximate Station 135+33 – The existing structure (Asset ID# XC-48121) at approximate Station 135+33 is a 36-inch CMP culvert. The proposed replacement structure is a 7-foot span by 6-foot rise, 84-foot long precast concrete box culvert on an approximately 0-degree skew to the roadway centerline with an inlet elevation of approximately 473.5 feet and an outlet elevation of approximately 471.5 feet.

Three (3) borings (HB-VANB-307, HB-VANB-230, and HB-VANB-231) and one (1) probe (HB-VANB-308) were drilled in the vicinity of the proposed and existing structures. The boring locations and the interpretive subsurface profile are shown on Sheet 27 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. The boring logs are also provided in Appendix A – Boring Logs.

Boring HB-VANB-307 to drilled to a depth of approximately 22.0 feet bgs without encountering a refusal surface. The subsurface conditions encountered in the boring consisted of fill consisting of sand and silty sand underlain by native silty gravel underlain by alluvium consisting of sandy silt and silt. SPT N_{60} -values in the fill ranged from 28 to 31 bpf indicating that the fill is medium dense to dense in consistency. One (1) SPT N_{60} -value obtained in the native silty gravel was 25 bpf indicating that the silty gravel is medium dense in consistency. SPT N_{60} -values in the alluvium ranged from 25 bpf to 31 bpf indicating that the alluvium is very stiff to hard in consistency. Borings HB-VANB-230 and HB-VANB-231 were drilled through fill sand and silty sand to depths of 9.0 feet and 9.5 feet, respectively, without encountering a refusal surface. No soil samples were taken in these borings. Probe HB-VANB-308 was drilled to a depth of approximately 20.5 feet bgs without encountering a refusal surface.

Large Culvert at approximate Station 140+76 – The existing structure (Asset ID-XC-48122) at approximate Station 140+76 is a 24-inch CMP. The proposed replacement structure is a 6-foot span by 6-foot rise, 93-foot long precast concrete box culvert on an approximately 8-degree skew to the roadway centerline with an inlet elevation of approximately 477.5 feet and an outlet elevation of approximately 473.8 feet.

One (1) boring (HB-VANB-309) and three (3) probes (HB-VANB-310 and 2 unnamed probes) were drilled in the vicinity of the proposed and existing structures. The boring locations and the interpretive subsurface profile are shown on Sheet 28 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. The boring logs are also provided in Appendix A – Boring Logs.

Boring HB-VANB-309 to drilled to a depth of approximately 22.0 feet bgs without encountering a refusal surface. The subsurface conditions encountered in the boring consisted of fill sand underlain by till consisting of gravel and gravelly sand. One SPT N_{60} -value obtained in the fill was 22 bpf indicating that the fill is medium dense in consistency. SPT N_{60} -values in the till ranged from 25 bpf to 71 bpf indicating that the till is medium dense to very dense in consistency. Probe HB-VANB-310 was drilled to a depth of approximately 20.5 feet bgs without encountering a refusal surface. Two (2) unnamed probes were drilled to depths of 15.0 feet without encountering a refusal surface.

6.2.2 Design and Construction – The proposed precast concrete box culverts shall be constructed in accordance with MaineDOT Standard Specification Section 534 and the Contract Plans. To facilitate fish passage, Habitat Connectivity Design elements will be used inside all of the proposed precast concrete box culverts as shown on the Box Culvert Details Sheets in the Contract Plans.

The proposed precast concrete box culverts can be bedded on a 1-foot thick layer of Granular Borrow, Material for Underwater Backfill (MaineDOT Item 203.25, Granular Borrow). The bedding material should be placed in lifts of 6 to 8 inches loose measure and compacted to at least 95 percent of the AASHTO T-180 maximum dry density. The exposed subgrade shall be free of ponded water so that bedding material placement and compaction can be completed in the dry. The entire culvert bedding subgrade should be proof-rolled with multiple passes of a static roller to identify loose or weaving areas that require over-excavation and replacement and to achieve a firm and stable surface for construction. All subgrade surfaces shall be protected from any unnecessary construction traffic.

The full nature of the culvert bearing surface will not become evident until the culvert excavation is made. The bottom elevation of the excavation shall take into account the wall thickness of the box culvert and the required 1-foot layer of bedding material. Any loose soils or soft or unsuitable materials (peat) encountered in the excavations shall be removed and replaced with Granular Borrow Material for Underwater Backfill (MaineDOT 703.19) or Crushed Stone ¾-Inch (MaineDOT 703.13). Any cobbles or boulders encountered in excess of 6 inches shall be removed and replaced with compacted Granular Borrow Material for Underwater Backfill or Crushed Stone ¾-Inch.

The soil envelope and backfill shall also consist of Granular Borrow (703.19) with a maximum particle size of 4 inches. The granular borrow backfill material shall be placed in lifts of 6 to 8 inches loose measure and compacted to the manufacturer's specifications or, in the absence of manufacturer's specifications, the bedding and backfill soil shall be compacted to at least 92 percent of the AASHTO T-180 maximum dry density.

Bearing Resistance - The factored bearing resistances for the proposed precast concrete box culverts bearing on compacted granular bedding placed on till at the service and strength limit states are presented in the table below. Supporting calculations in accordance with AASHTO LRFD Bridge Design Specifications 8th Edition 2017 (LRFD) are provided in Appendix C – Calculations.

Structure	Limit State	Resistance Factor ϕ_b	AASHTO LRFD Reference	Factored Bearing Resistance (ksf)
Large Culvert @ Sta. 33+63	Service	1.0	Article 10.5.5.1	5.0
	Strength	0.45	Table 10.5.5.2.2-1	4.5
Large Culvert @ Sta. 50+35	Service	1.0	Article 10.5.5.1	5.0
	Strength	0.45	Table 10.5.5.2.2-1	5.0
Large Culvert @ Sta. 118+38	Service	1.0	Article 10.5.5.1	5.0
	Strength	0.45	Table 10.5.5.2.2-1	5.0
Large Culvert @ Sta. 135+33	Service	1.0	Article 10.5.5.1	10.0
	Strength	0.45	Table 10.5.5.2.2-1	4.5
Large Culvert @ Sta. 140+76	Service	1.0	Article 10.5.5.1	10.0
	Strength	0.45	Table 10.5.5.2.2-1	4.0

Modulus of Subgrade Reaction - The modulus of subgrade reaction for the proposed precast concrete box culverts bearing on compacted granular bedding placed on till at the service and strength limit states are presented in the table below. See Appendix C – Calculations for supporting documentation.

Structure	Modulus of Subgrade Reaction (pci)
Large Culvert @ Sta. 33+63	500
Large Culvert @ Sta. 50+35	475
Large Culvert @ Sta. 118+38	450
Large Culvert @ Sta. 135+33	560
Large Culvert @ Sta. 140+76	680

6.2 Settlement

No settlement issues are anticipated for either the roadway or the proposed structures. The installation of the larger proposed culverts will result in a net unloading of the site soils at the structure locations. Placement of fill soils at the location of the existing structures and in areas where the proposed roadway grade is higher than existing is not anticipated to exceed the past loading condition of the site soils.

6.3 Scour and Riprap

Both the inlet and outlet of the proposed precast concrete box culverts shall be armored with riprap conforming to MaineDOT Standard Specification Section 703.26 Plain and Hand Laid Riprap. Riprap slopes shall not be steeper than 2H:1V. The riprap on the slopes shall be underlain by a non-woven Class 1 erosion control geotextile that meets the requirements for MaineDOT Standard Specification 722.03 that is underlain by a 1-foot layer of protective aggregate cushion conforming to MaineDOT Standard Specification 703.19 Granular Borrow Material for Underwater Backfill.

6.4 Seismic Design Considerations

In conformance with LRFD Article 3.10.1, seismic analysis is not required for buried structures, except where they cross active faults. There are no known active faults in Maine; therefore, seismic analysis is not required.

6.5 Peat

If encountered, peat should be over excavated to be completely removed and replaced by Granular Borrow, Material for Underwater Backfill or Crushed Stone $\frac{3}{4}$ -Inch.

6.6 Additional Construction Considerations

Construction of the proposed precast concrete box culverts will require soil excavation. Earth support systems will be required if laying back slopes is not feasible. Regardless of the method of excavation, all excavations and earth support systems shall meet all applicable OSHA regulations.

The Contractor shall control groundwater and surface water infiltration using temporary ditches, sumps, granular drainage blankets, stone ditch protection or hand-laid riprap with geotextile underlayment to divert groundwater and surface water to allow construction in the dry.

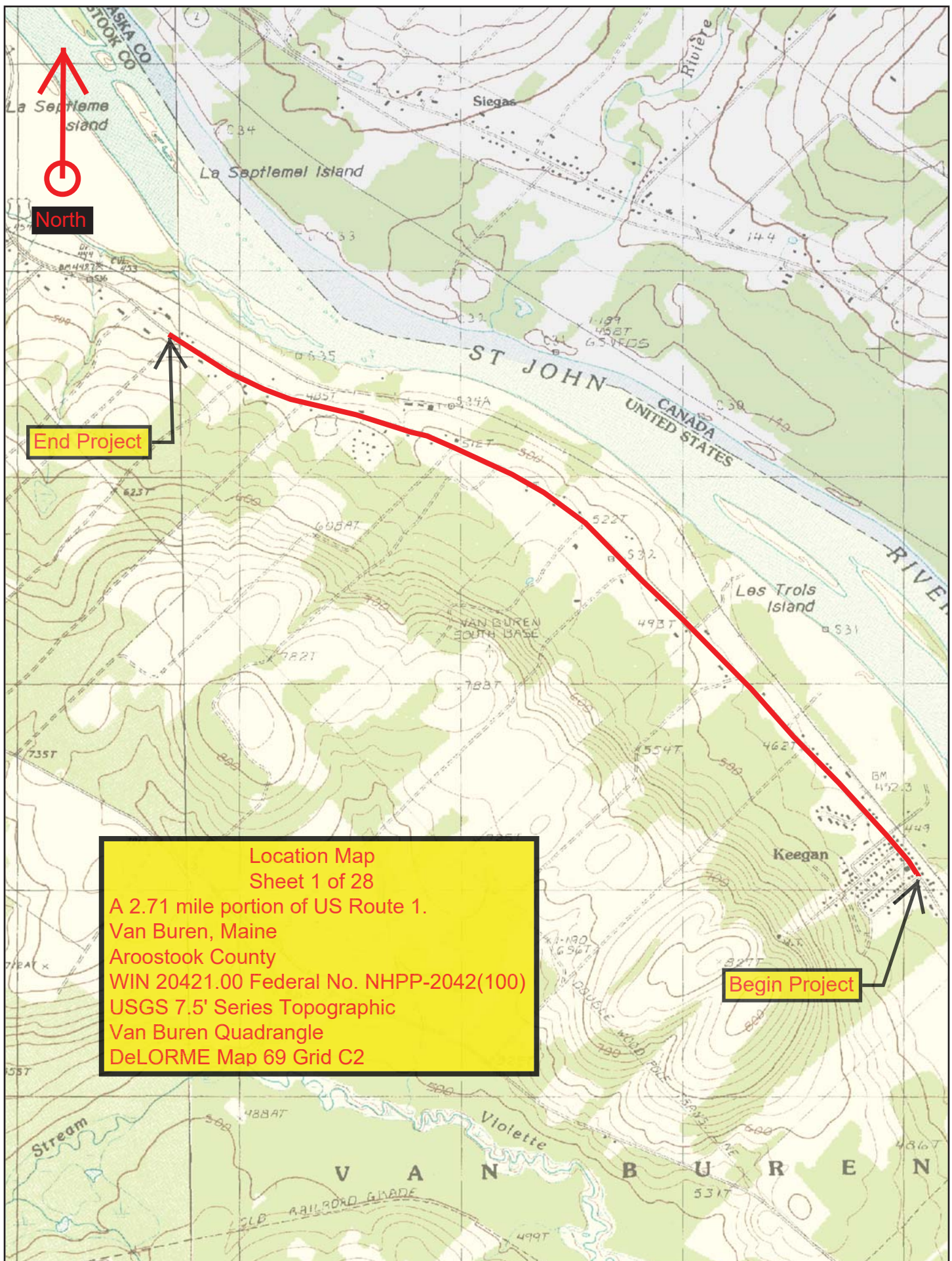
7.0 CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program for specific application to the proposed reconstruction of U.S. Route 1 in Van Buren, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

In the event that any changes in the nature, design, or location of the proposed project are planned, this report should be reviewed by a geotechnical engineer to assess the appropriateness of the conclusions and recommendations and to modify the recommendations as appropriate to reflect the changes in design. These analyses and recommendations are based in part upon a limited subsurface investigation at discrete exploratory locations completed at the site. If variations from the conditions encountered during the investigation appear evident during construction, it may also become necessary to re-evaluate the recommendations made in this report.

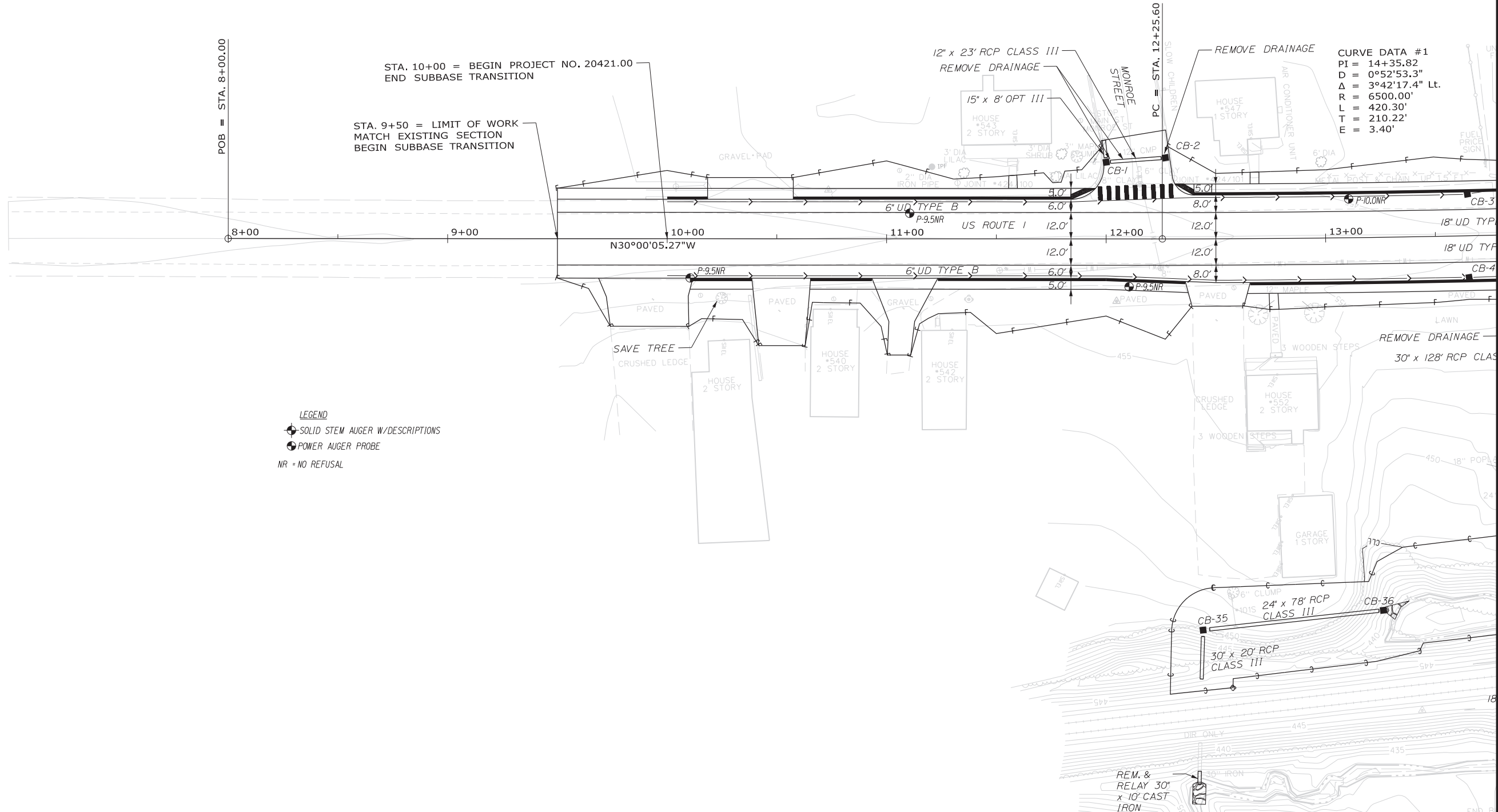
It is recommended that a geotechnical engineer be provided the opportunity for a review of the design and specifications in order that the earthwork and foundation recommendations and construction considerations presented in this report are properly interpreted and implemented in the design and specifications.

Sheets



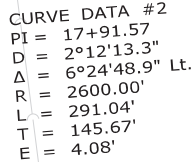
Map Scale 1:24000

The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch. Road names used on this map may not match official road names.



2 OF 28	SHEET NUMBER 2	VAN BUREN U.S. ROUTE 1 BORING LOCATION PLAN	PROJ. MANAGER DESIGN-DETAILED DESIGN2-DETAILED2 DESIGN3-DETAILED3	BY T. WHITE	DATE APR 2020	STATE OF MAINE DEPARTMENT OF TRANSPORTATION NHPP-2042(100) WIN 020421.00 HIGHWAY PLANS
			SIGNATURE P.E. NUMBER			
			DATE			

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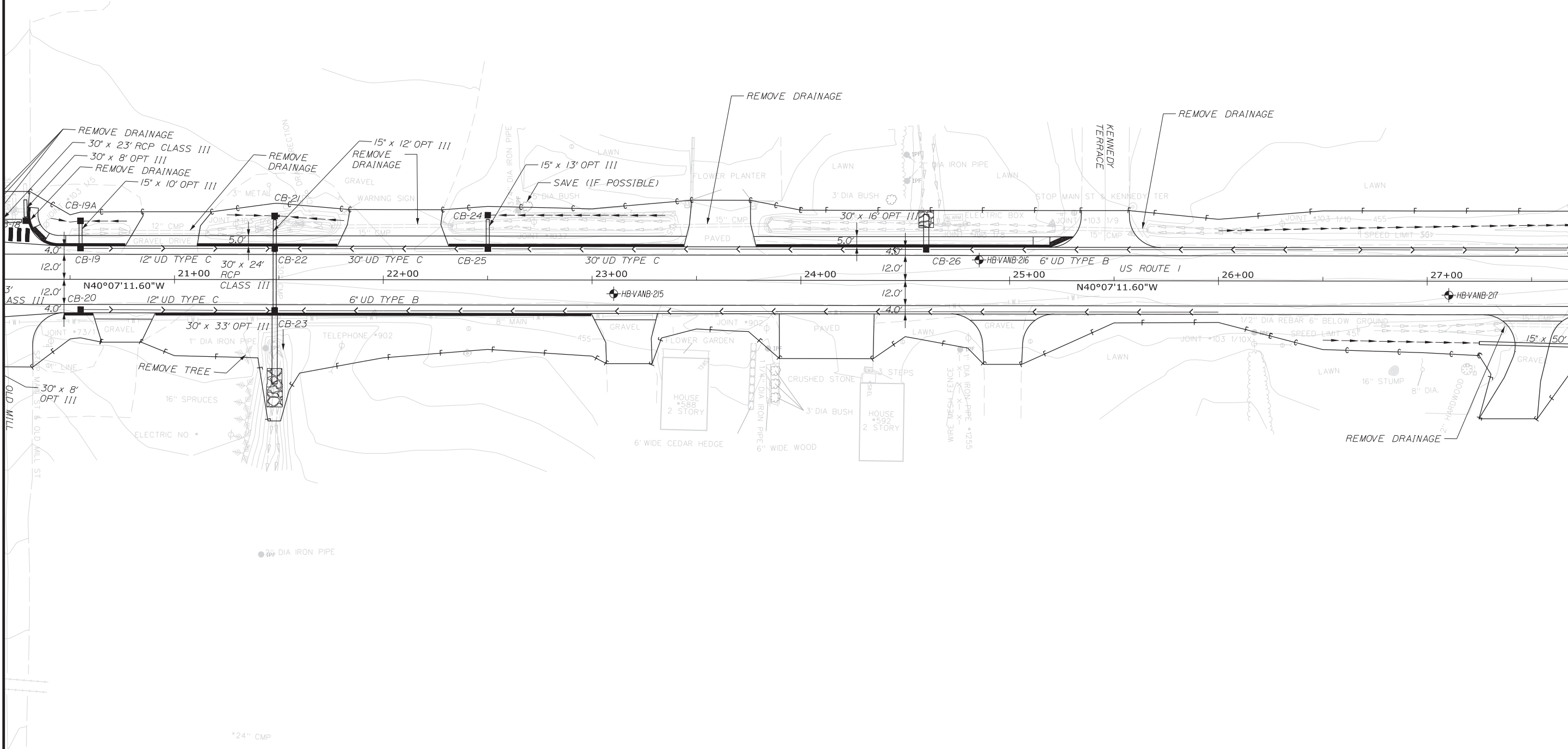


3 OF 28	SHEET NUMBER VAN BUREN U.S. ROUTE 1	PROJ. MANAGER DESIGN-DETAILED CHECKED-REVIEWED DESIGN2-DETAILED2 DESIGN3-DETAILED3 REVISIONS 1 REVISIONS 2 REVISIONS 3 REVISIONS 4 FIELD CHANGES	BY DATE	DATE SIGNATURE P.E. NUMBER DATE	STATE OF MAINE DEPARTMENT OF TRANSPORTATION NHPP-2042(100) WIN 020421.00 HIGHWAY PLANS
		BORING LOCATION PLAN			

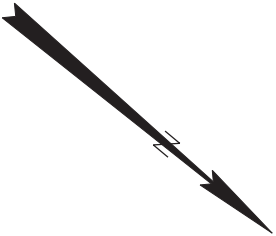
Username: Cody A.Russell

Date:4/23/2020

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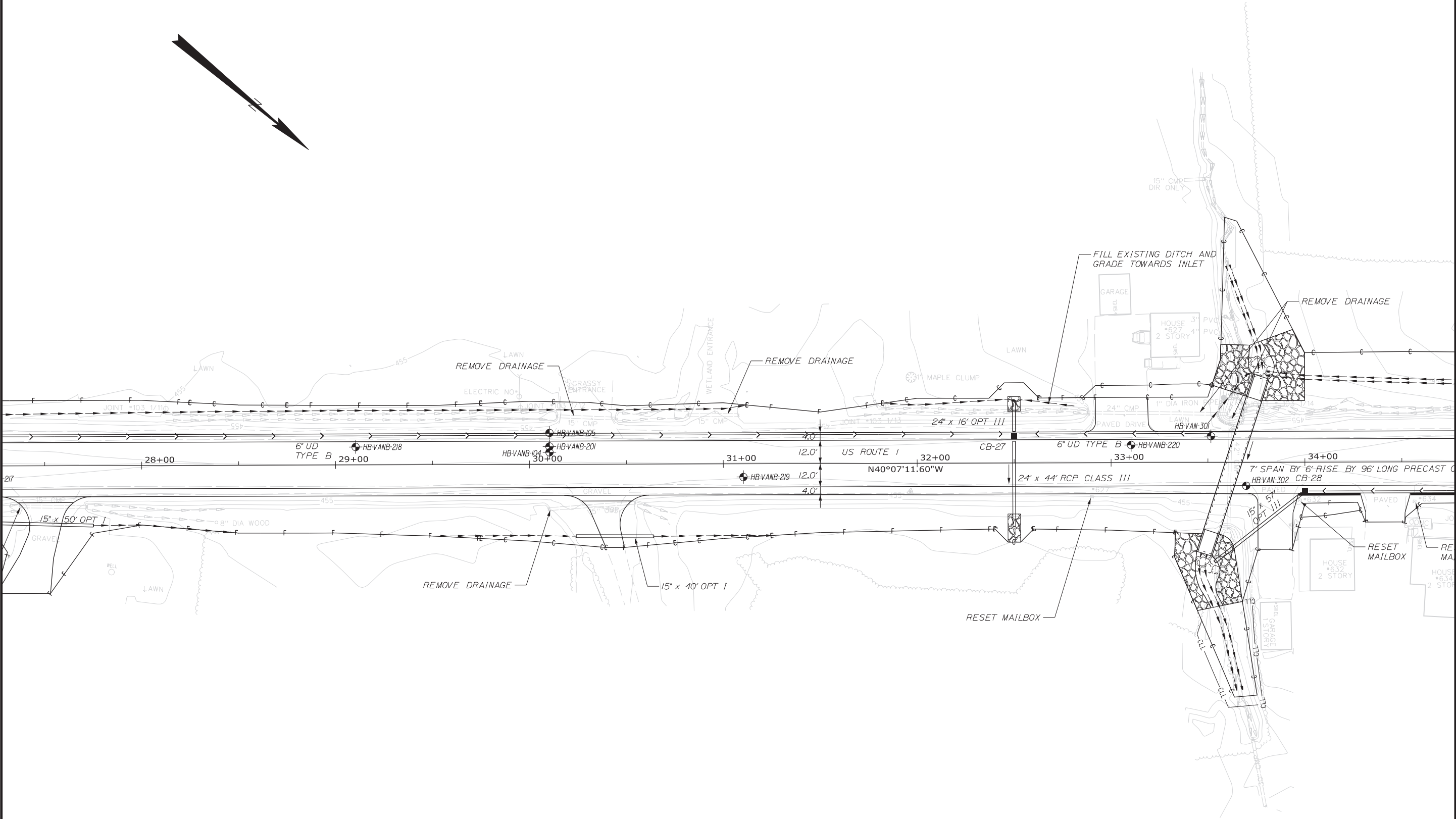
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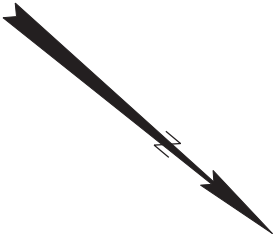
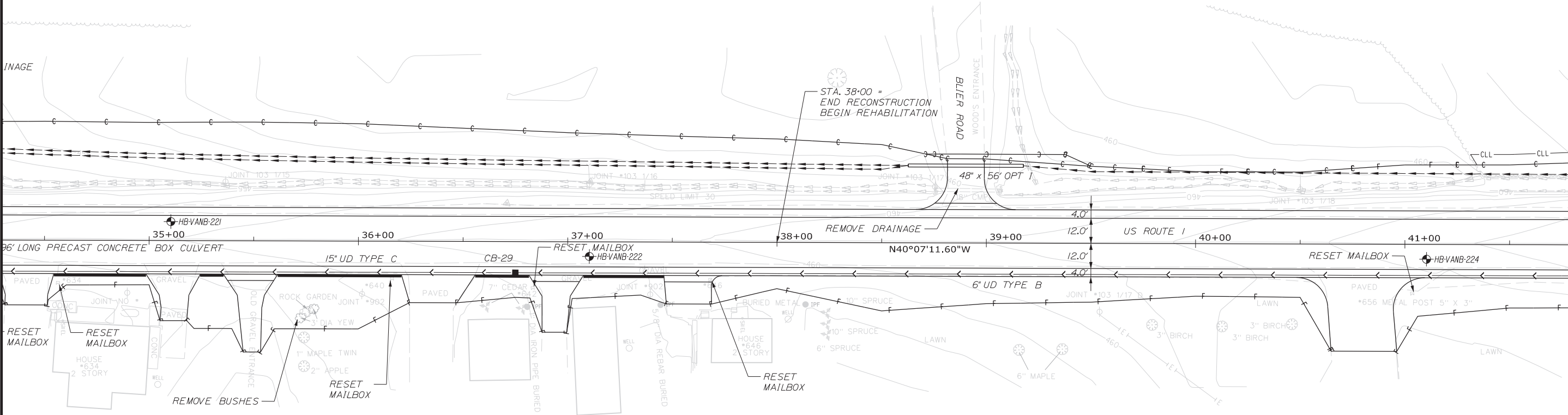
PROJ. MANAGER	BY	DATE	SIGNATURE
CHECKED-REVIEWED	T. WHITE	APR 2020	
DESIGN-DETAILED	C. RUSSELL		
DESIGN-DETAILED			P.E. NUMBER
REVISIONS 1			DATE
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

VAN BUREN
U.S. ROUTE 1

BORING LOCATION PLAN



STATE OF MAINE		DEPARTMENT OF TRANSPORTATION	
NHP-2042(100)		WIN	
020421.00		HIGHWAY PLANS	
VAN BUREN U.S. ROUTE 1		BORING LOCATION PLAN	
SHEET NUMBER		5	
OF 28			
PROJ. MANAGER	BY	DATE	SIGNATURE
CHECKED-REVIEWED			APR 2020
DESIGN-DETAILED	T. WHITE		
DESIGN-DETAILED	C. RUSSELL		
REVISIONS 1			P.E. NUMBER
REVISIONS 2			DATE
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

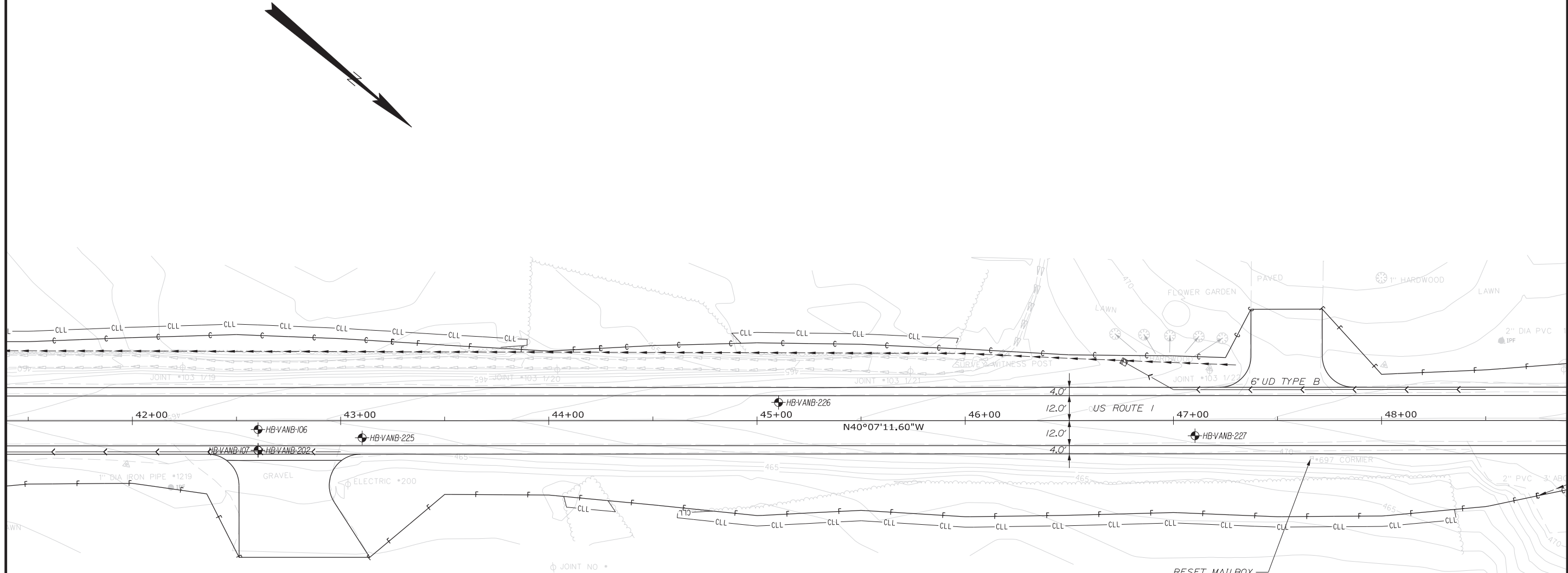


STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
NHPP-2042(100)
WIN 020421.00
HIGHWAY PLANS

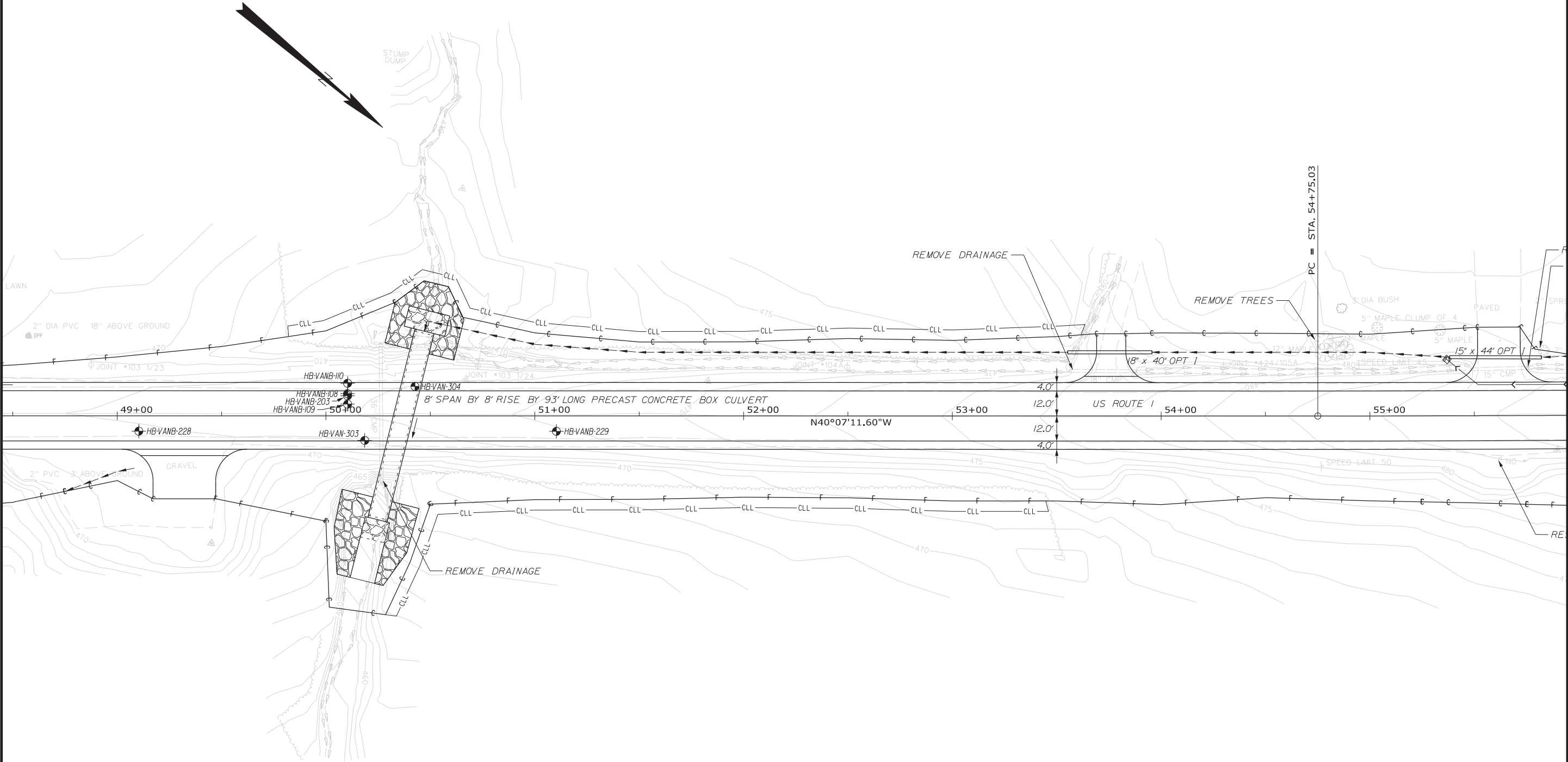
PROJ. MANAGER	BY	DATE
DESIGN-DETAILED		
CHECKED-REVIEWED		
DESIGN2-DETAIL02	T. WHITE	APR 2020
DESIGN3-DETAIL03		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		
SIGNATURE		
P.E. NUMBER		
DATE		

VAN BUREN U.S. ROUTE 1
BORING LOCATION PLAN

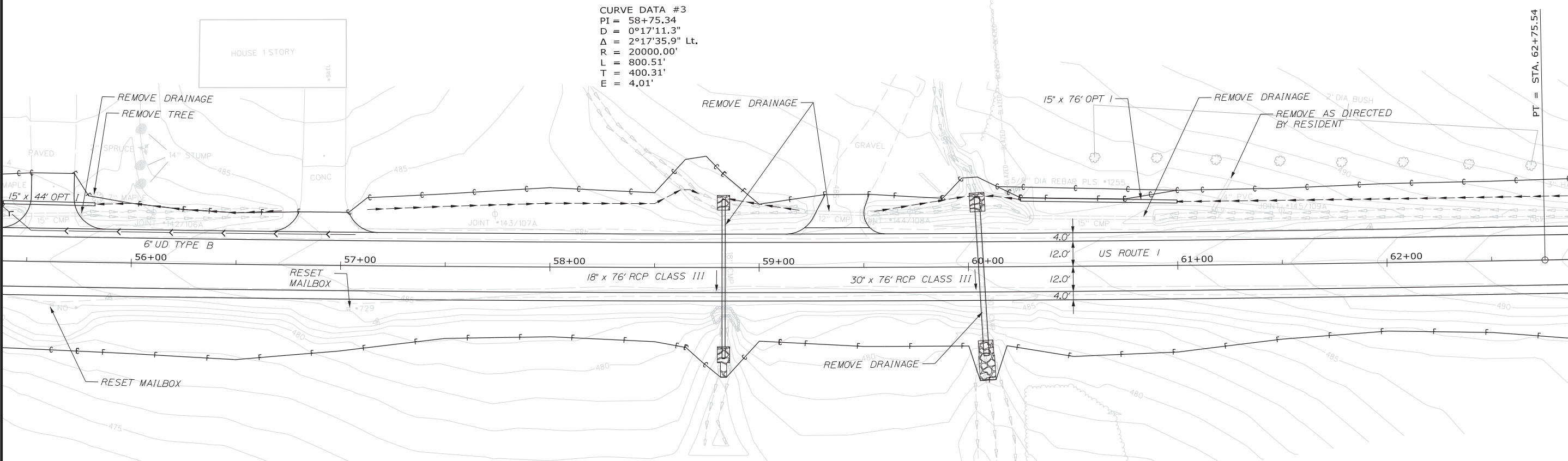
SHEET NUMBER
6
OF 28



SHEET NUMBER	VAN BUREN U.S. ROUTE 1		PROJ. MANAGER		BY	DATE	STATE OF MAINE DEPARTMENT OF TRANSPORTATION	
			DESIGN-DETAILED	CHECKED-REVIEWED				SIGNATURE
BORING LOCATION PLAN			DESIGN2-DETAILED2	C RUSSELL	T. WHITE	APR 2020	NHPP-2042(100)	
			DESIGN3-DETAILED3					P.E. NUMBER
			REVISIONS 1					
			REVISIONS 2					
			REVISIONS 3					
			REVISIONS 4				WIN 020421.00	
			FIELD CHANGES				HIGHWAY PLANS	



STATE OF MAINE DEPARTMENT OF TRANSPORTATION		SIGNATURE		P.E. NUMBER		DATE	
NHP-2042(100)		WIN		020421.00		HIGHWAY PLANS	
VAN BUREN U.S. ROUTE 1		PROJ. MANAGER		BY		DATE	
BORING LOCATION PLAN		DESIGN-DETAILED		CHECKED-REVIEWED		APR 2020	
		DESIGN2-DETAILED2		C RUSSELL		T. WHITE	
		DESIGN3-DETAILED3					
		REVISIONS 1					
		REVISIONS 2					
		REVISIONS 3					
		REVISIONS 4					
		FIELD CHANGES					
SHEET NUMBER		8		OF 28			



CURVE DATA #3
PI = 58+75.34
D = 0°17'11.3"
Δ = 2°17'35.9" Lt.
R = 20000.00'
L = 800.51'
T = 400.31'
E = 4.01'

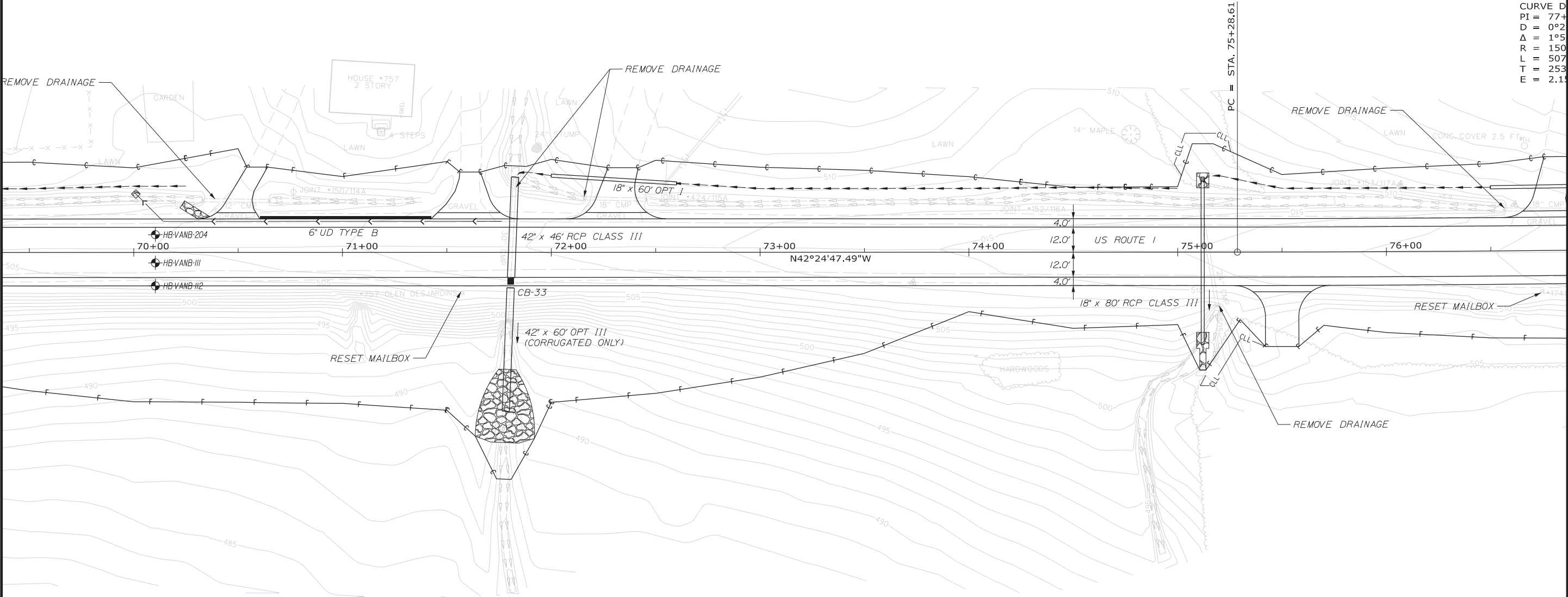
STATE OF MAINE		DEPARTMENT OF TRANSPORTATION	
NHP-2042(100)		WIN 020421.00	
HIGHWAY PLANS			
VAN BUREN U.S. ROUTE 1		BORING LOCATION PLAN	
SHEET NUMBER		9	
OF 28			
PROJ. MANAGER	BY	DATE	SIGNATURE
CHECKED-REVIEWED			APR 2020
DESIGN-DETAILED	C. RUSSELL	T. WHITE	
DESIGN-DETAILED			P.E. NUMBER
REVISIONS 1			DATE
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

Date:4/23/2020

Username: Cody A.Russell

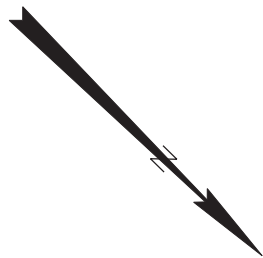
Division: GEOTECH

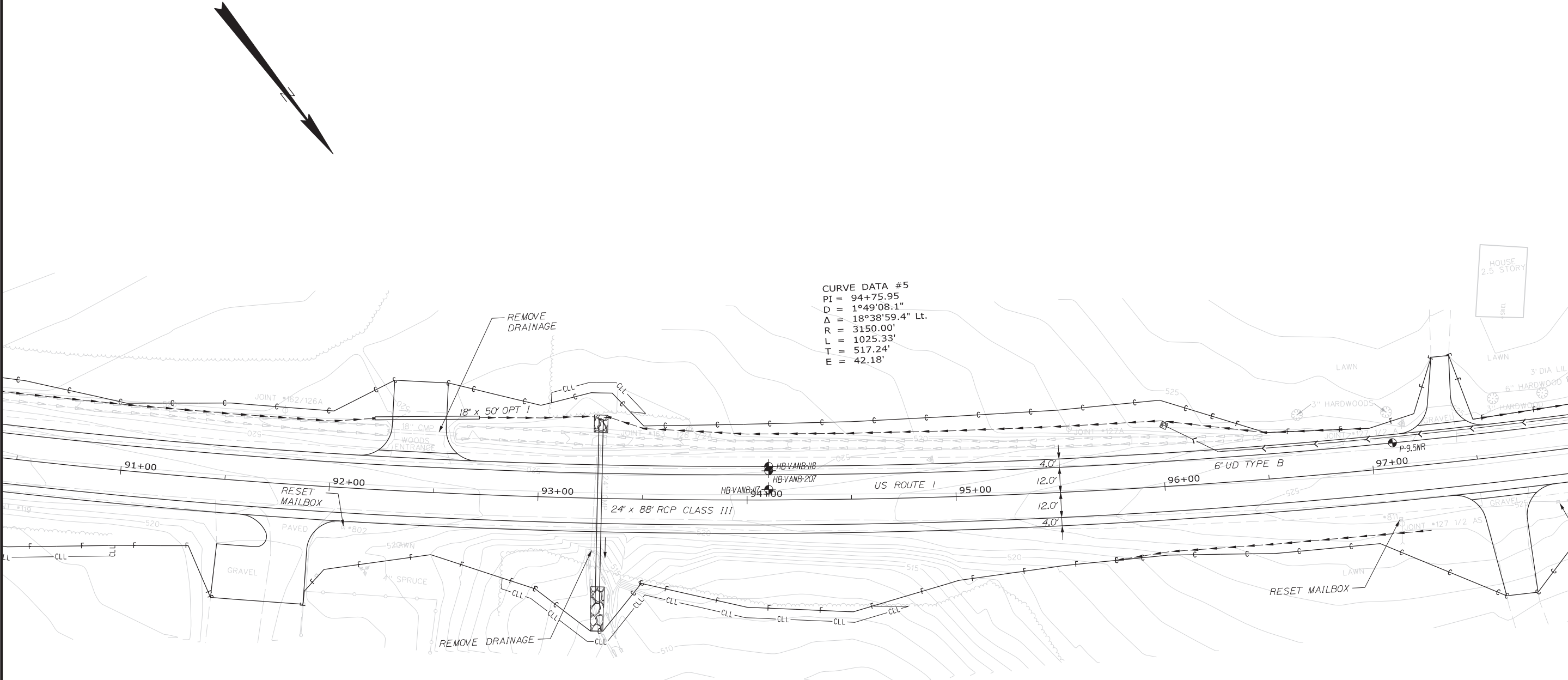
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CURVE DATA
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 Δ = 1°53'00"
 R = 150.00'
 L = 507.00'
 T = 253.00'
 E = 2.11'

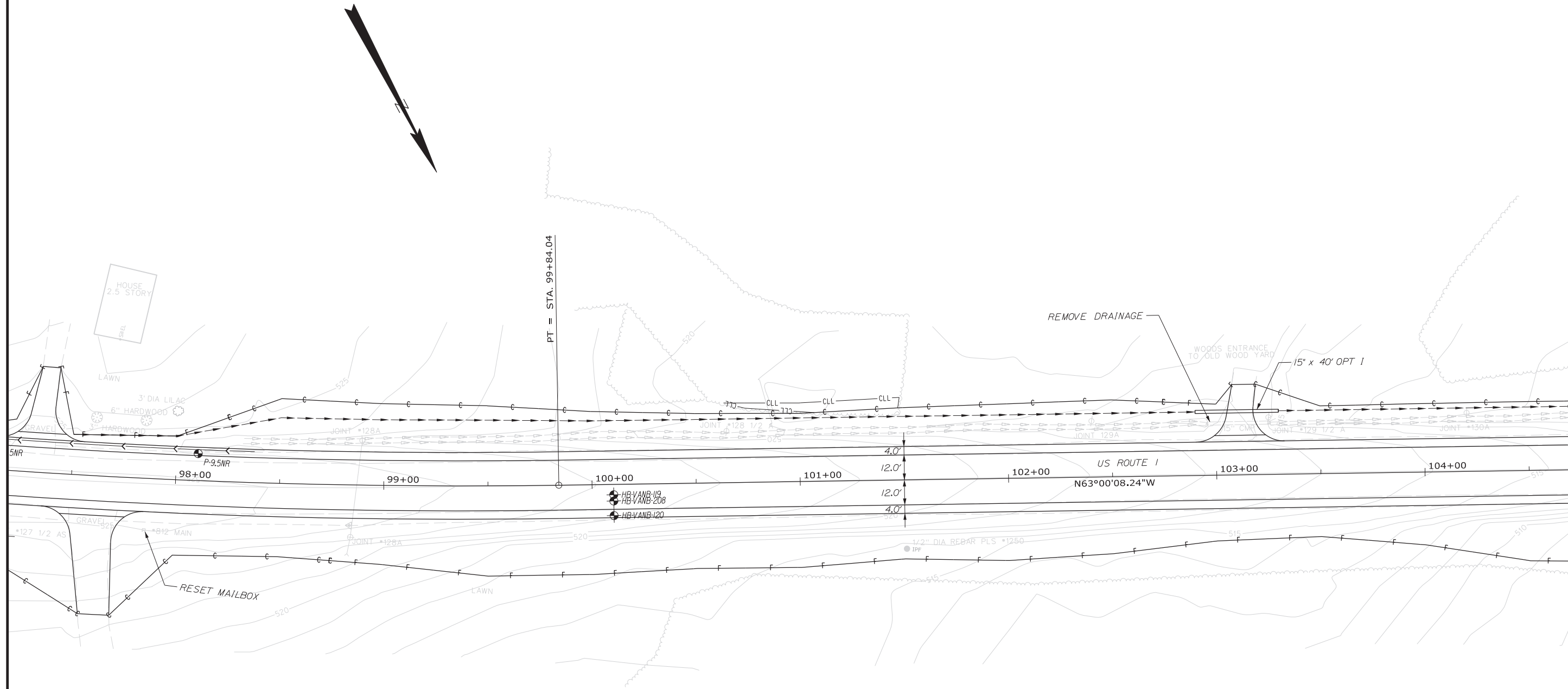
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			NHP-2042(100)		
			WIN 020421.00		
			HIGHWAY PLANS		
VAN BUREN U.S. ROUTE 1 BORING LOCATION PLAN			PROJ. MANAGER	BY	DATE
			CHECKED-REVIEWED		SIGNATURE
			DESIGN-DETAILED	C. RUSSELL	APR 2020
			DESIGN-DETAILED	T. WHITE	P.E. NUMBER
			REVISIONS 1		DATE
SHEET NUMBER			REVISIONS 2		
11			REVISIONS 3		
			REVISIONS 4		
OF 28			FIELD CHANGES		

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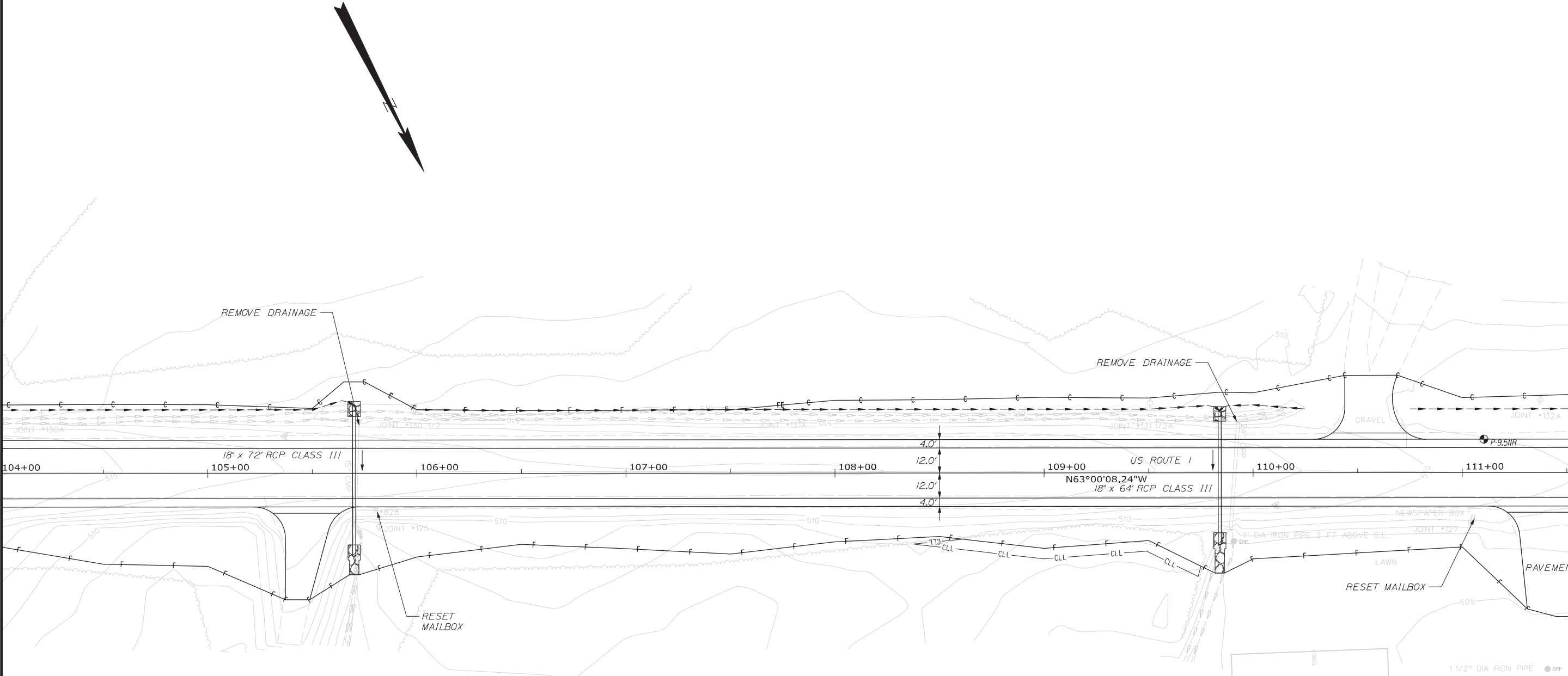


CURVE DATA #5
PI = 94+75.95
D = 1°49'08.1"
Δ = 18°38'59.4" Lt.
R = 3150.00'
L = 1025.33'
T = 517.24'
E = 42.18'

STATE OF MAINE		DEPARTMENT OF TRANSPORTATION	
NHP-2042(100)		WIN	
020421.00		HIGHWAY PLANS	
VAN BUREN U.S. ROUTE 1		BORING LOCATION PLAN	
SHEET NUMBER		14	
OF 28			
PROJ. MANAGER	BY	DATE	SIGNATURE
CHECKED-REVIEWED	T. WHITE	APR 2020	
DESIGN-DETAILED	C. RUSSELL		P.E. NUMBER
DESIGN-DETAILED			DATE
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			



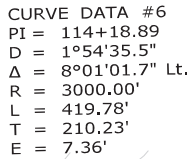
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					CHECKED-DESIGNED	CHECKED-REVIEWED			
					DESIGNER-DETAINED2	C. RUSSELL	T. WHITE	APR 2020	
					DESIGNER-DETAINED3	P.E. NUMBER			
					REVISIONS 1				
OF 28					REVISIONS 2				
					REVISIONS 3				
					REVISIONS 4				
					FIELD CHANGES				



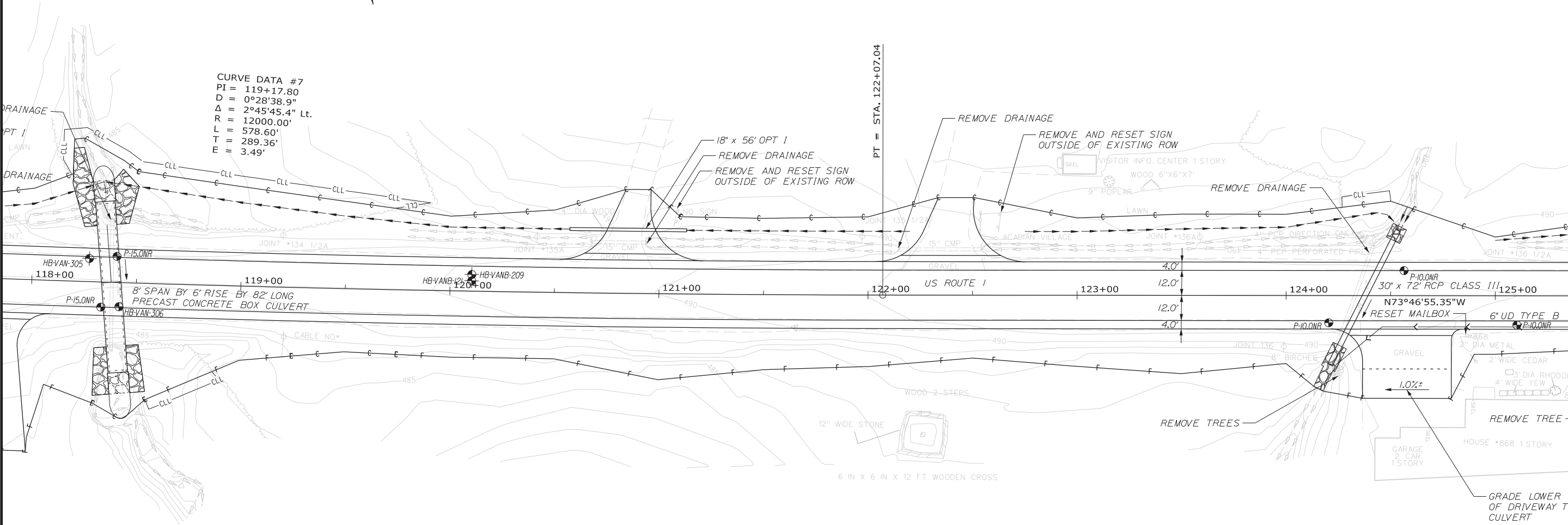
PROJ. MANAGER	BY	DATE
CHECKED-REVIEWED		SIGNATURE
DESIGN-DETAILED	T. WHITE	APR 2020
DESIGN-DETAILED	C. RUSSELL	
REVISIONS 1		P.E. NUMBER
REVISIONS 2		DATE
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

VAN BUREN
U.S. ROUTE 1

BORING LOCATION PLAN

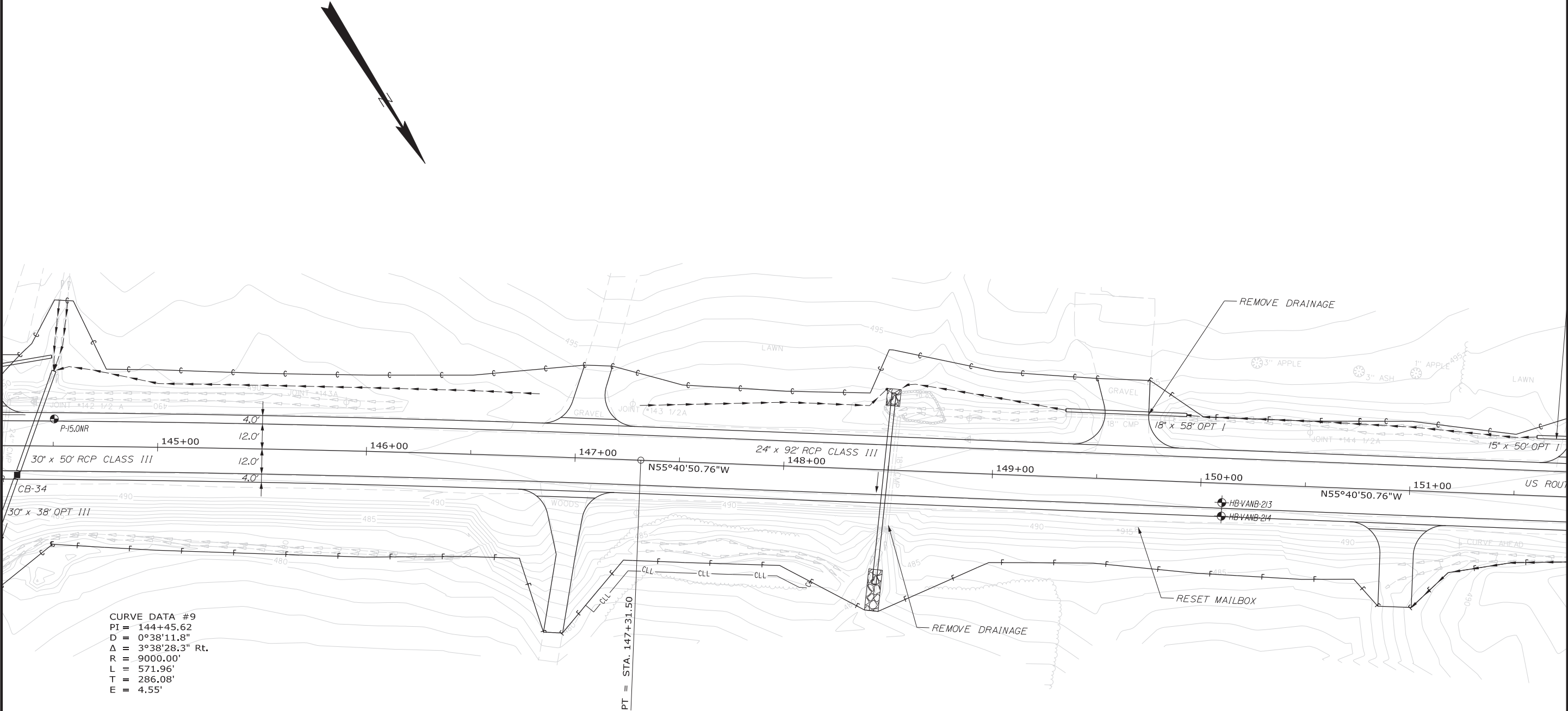


17	SHEET NUMBER	VAN BUREN U.S. ROUTE 1		PROJ. MANAGER	BY	DATE	STATE OF MAINE DEPARTMENT OF TRANSPORTATION NHPP-2042(100) WIN 020421.00 HIGHWAY PLANS
		DESIGN-DETAILED					
		CHECKED-REVIEWED					
		DESIGN/2 DETAIL/02		C. RUSSELL	T. WHITE	APR 2020	
		DESIGNS DETAIL/03					
BORING LOCATION PLAN		REVISIONS 1		P.E. NUMBER			
		REVISIONS 2					
		REVISIONS 3					
		REVISIONS 4					
		FIELD CHANGES				DATE	



STATE OF MAINE		DEPARTMENT OF TRANSPORTATION	
NHP-2042(100)		WIN	
020421.00		HIGHWAY PLANS	
VAN BUREN U.S. ROUTE 1		BORING LOCATION PLAN	
SHEET NUMBER		18	
		OF 28	

PROJ. MANAGER	BY	DATE	SIGNATURE	P.E. NUMBER	DATE
CHECKED-REVIEWED					
DESIGN-DETAILED	T. WHITE	APR 2020			
DESIGN-DETAILED	C. RUSSELL				
REVISIONS 1					
REVISIONS 2					
REVISIONS 3					
REVISIONS 4					
FIELD CHANGES					



CURVE DATA #9
PI = 144+45.62
D = 0°38'11.8"
Δ = 3°38'28.3" Rt.
R = 9000.00'
L = 571.96'
T = 286.08'
E = 4.55'

PT = STA. 147+31.50

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
NHP-2042(100)
WIN 020421.00
HIGHWAY PLANS

PROJ. MANAGER	BY	DATE	SIGNATURE	P.E. NUMBER	DATE
CHECKED-REVIEWED					
DESIGN-DETAILED	T. WHITE	APR 2020			
DESIGN-DETAILED					
REVISIONS 1					
REVISIONS 2					
REVISIONS 3					
REVISIONS 4					
FIELD CHANGES					

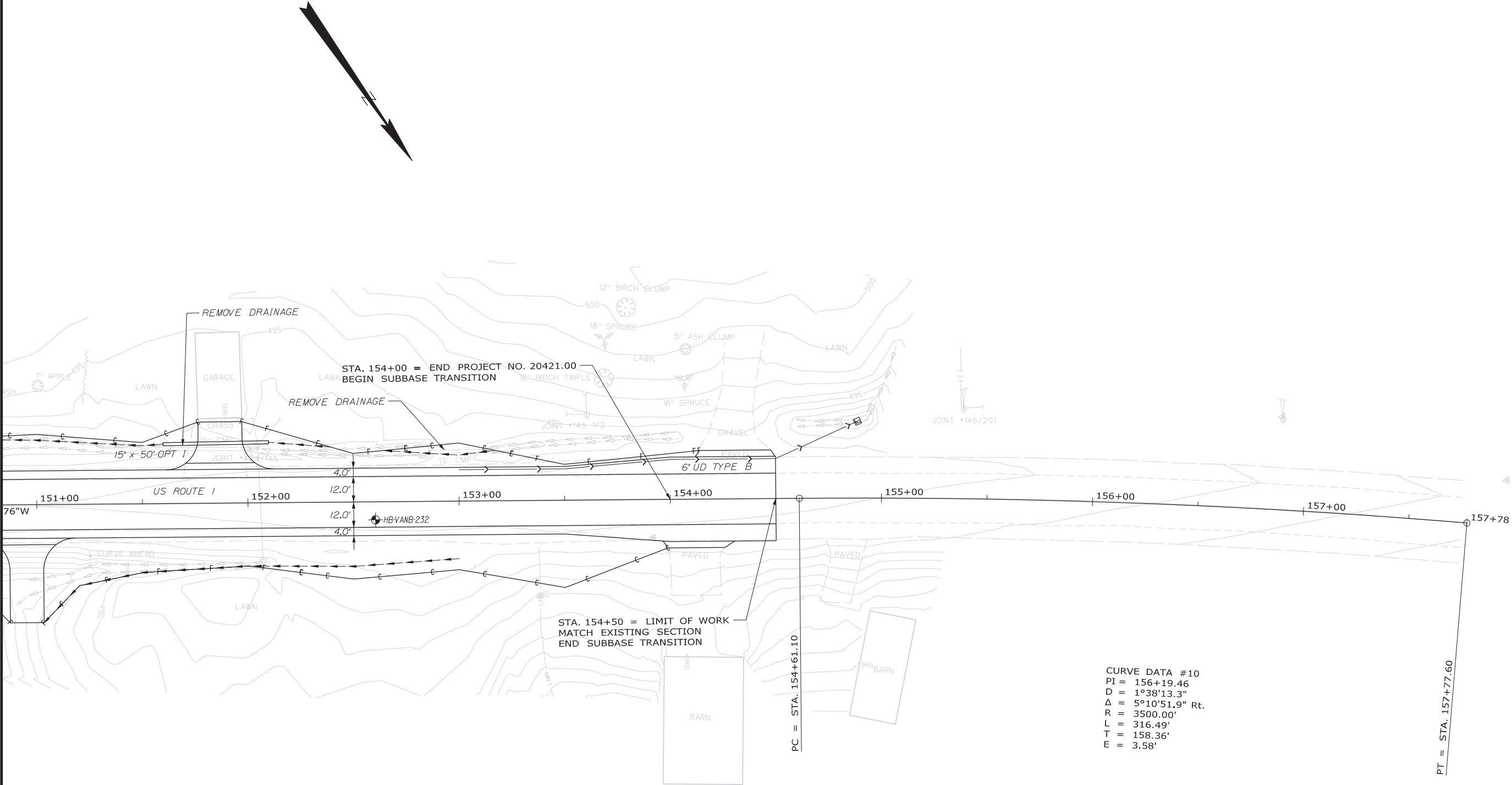
VAN BUREN
U.S. ROUTE 1

BORING LOCATION PLAN

SHEET NUMBER

22

OF 28

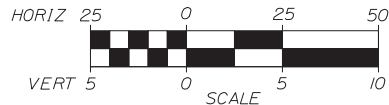
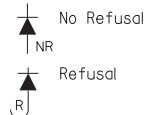
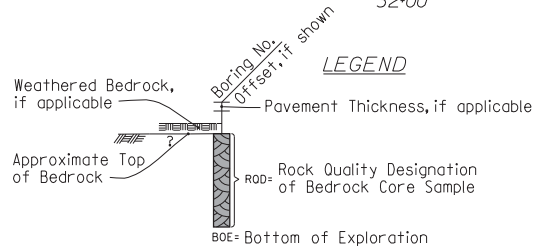
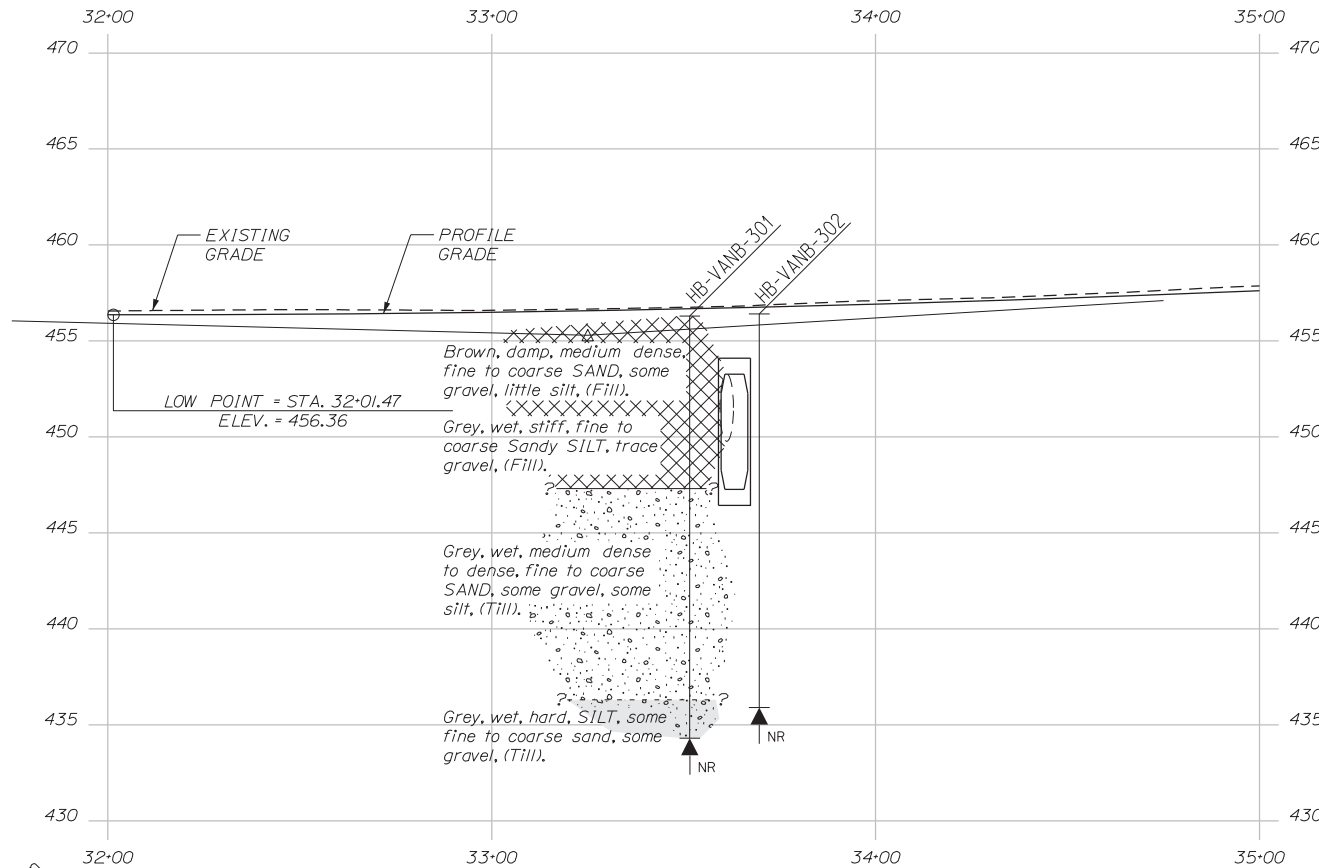
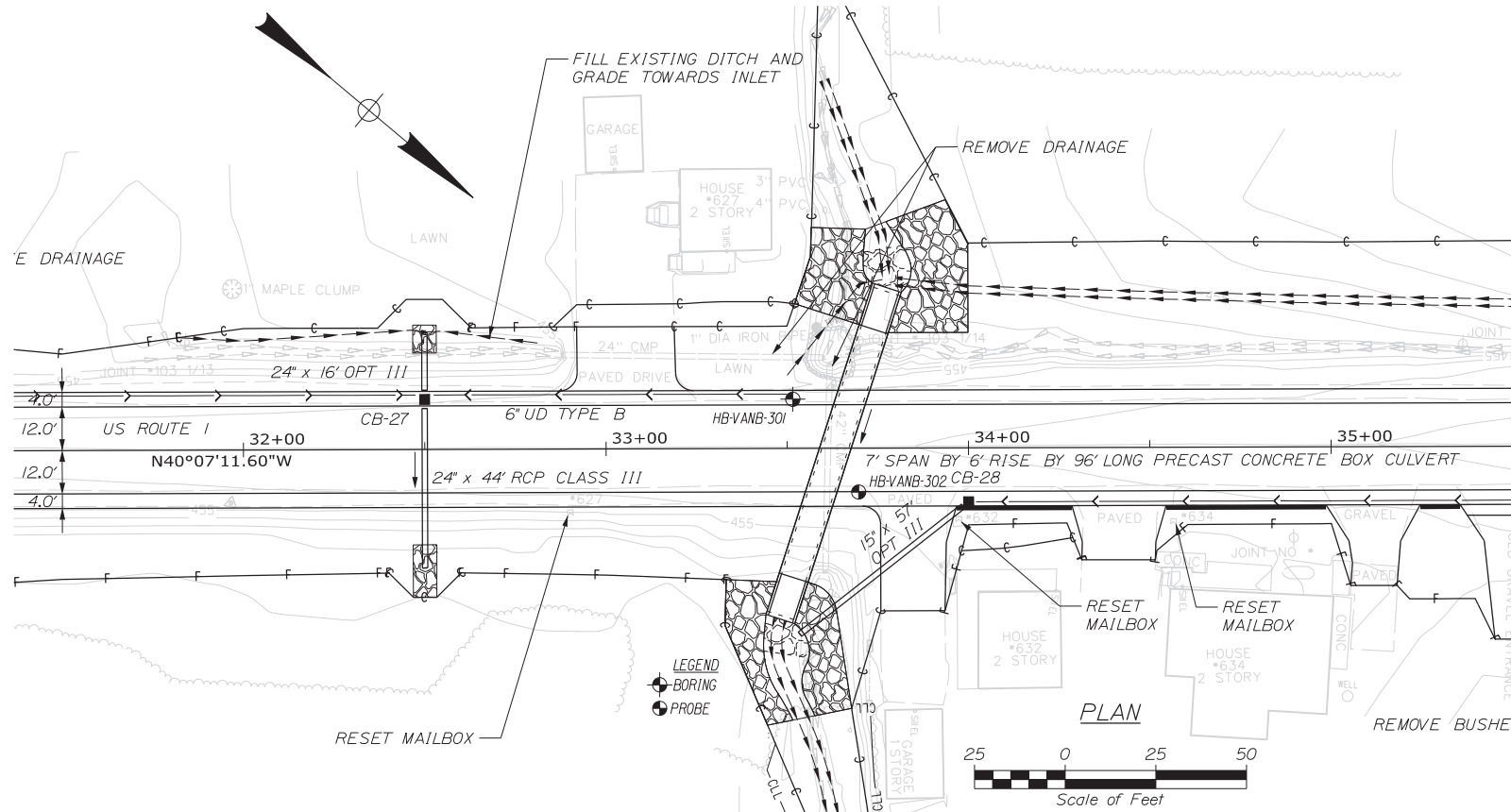


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PI = 156+19.46
D = 1°38'13.3"
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R = 3500.00'
L = 316.49'
T = 158.36'
E = 3.58'

PT = STA. 157+77.60

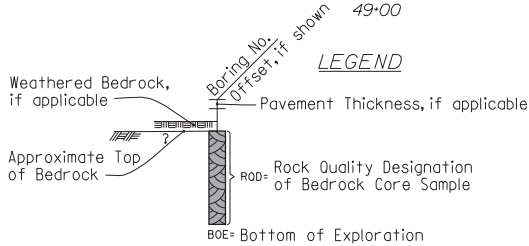
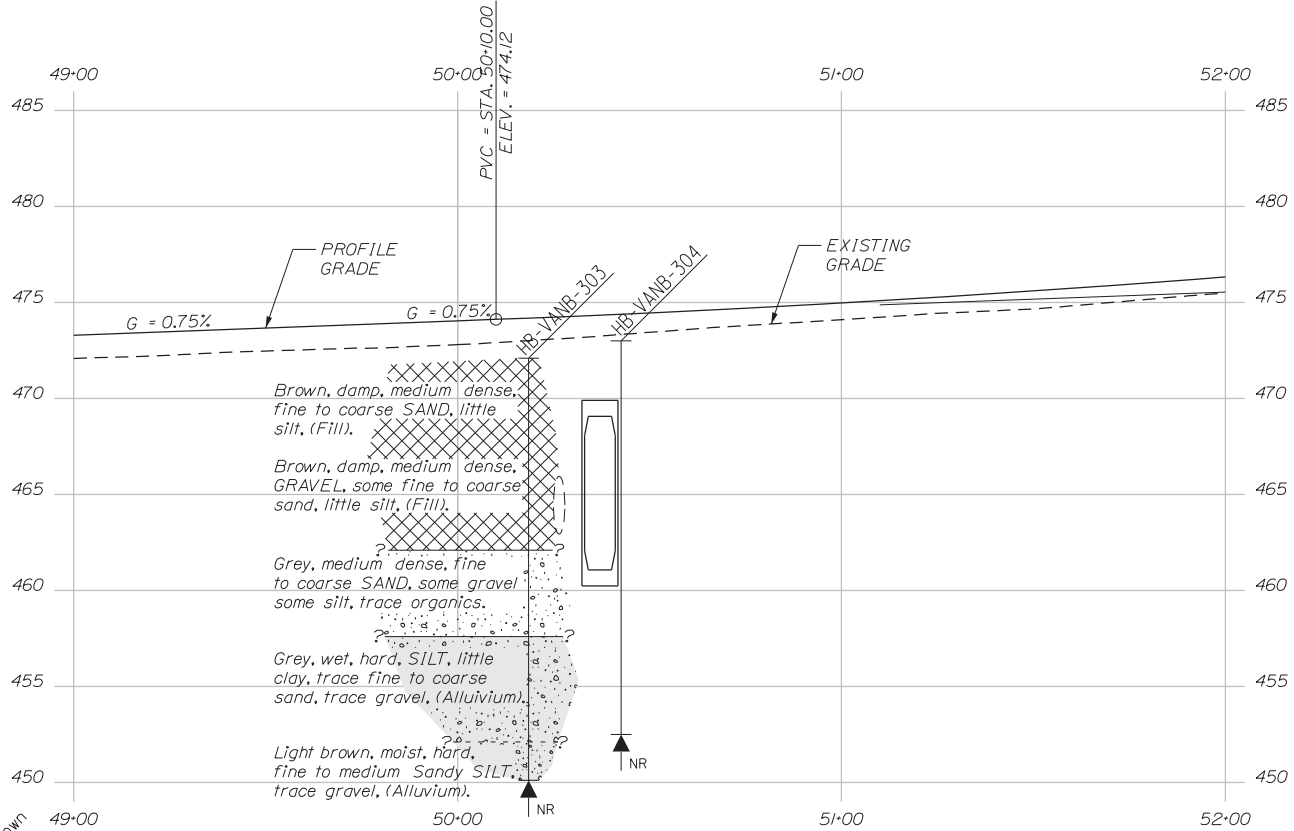
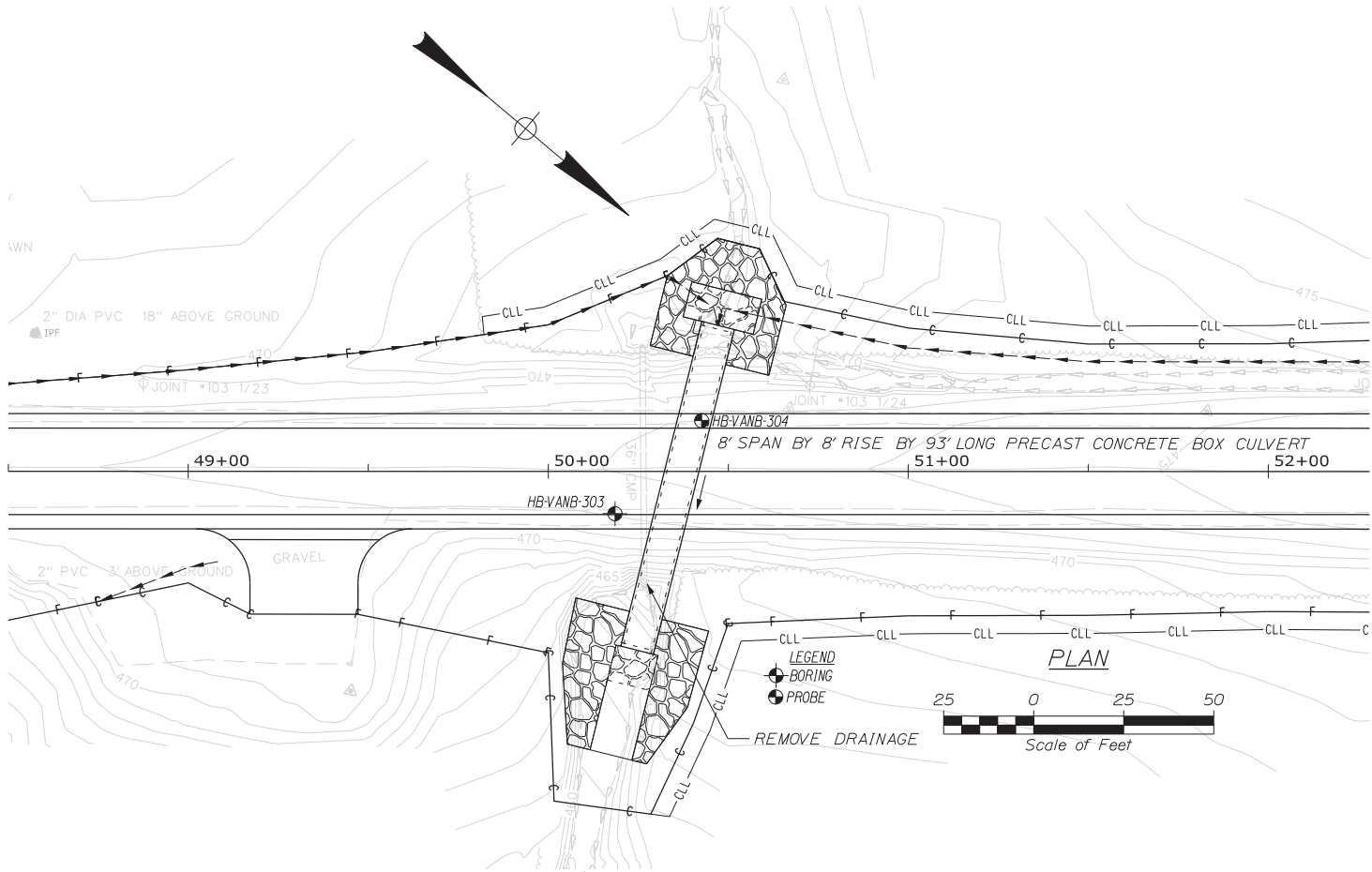
STATE OF MAINE DEPARTMENT OF TRANSPORTATION		BY		DATE	SIGNATURE
NHP-2042(100)				P.E. NUMBER	
WIN 020421.00				DATE	
HIGHWAY PLANS					

VAN BUREN U.S. ROUTE 1		BORING LOCATION PLAN	
SHEET NUMBER		23	
OF 28			



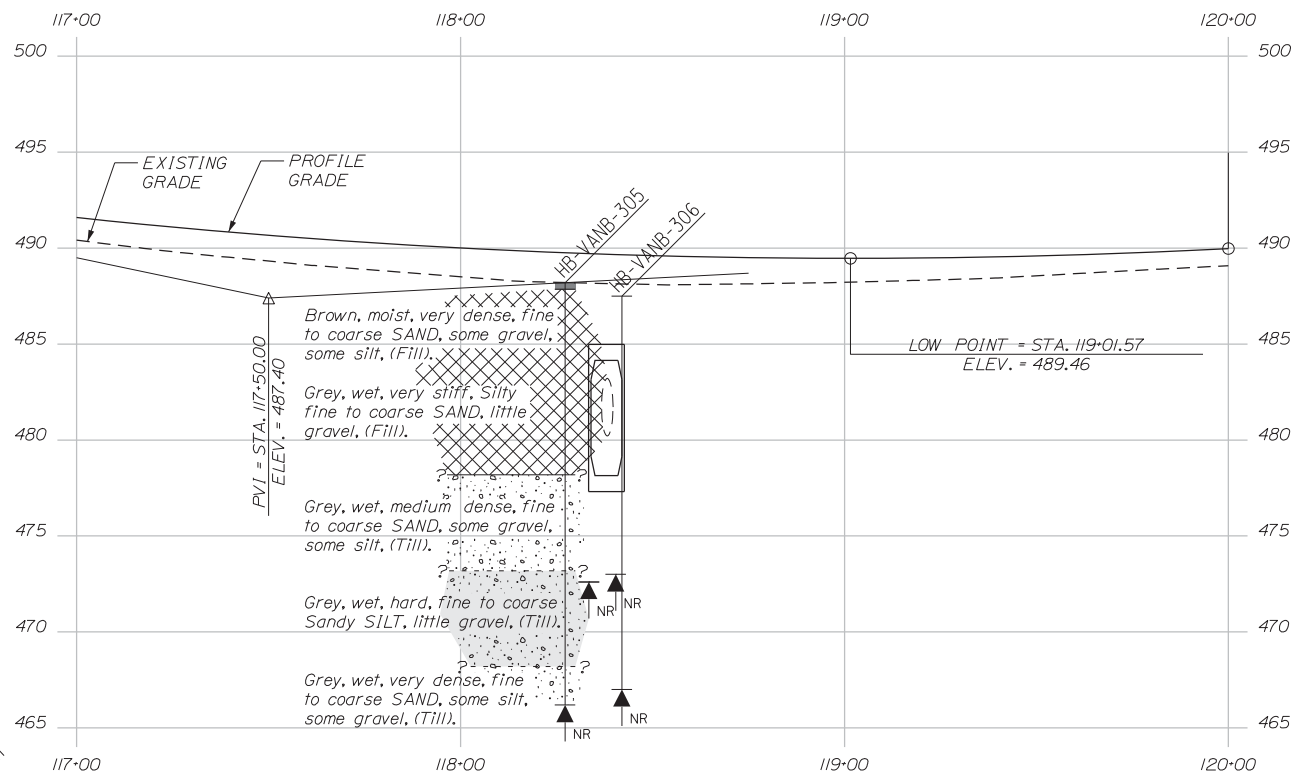
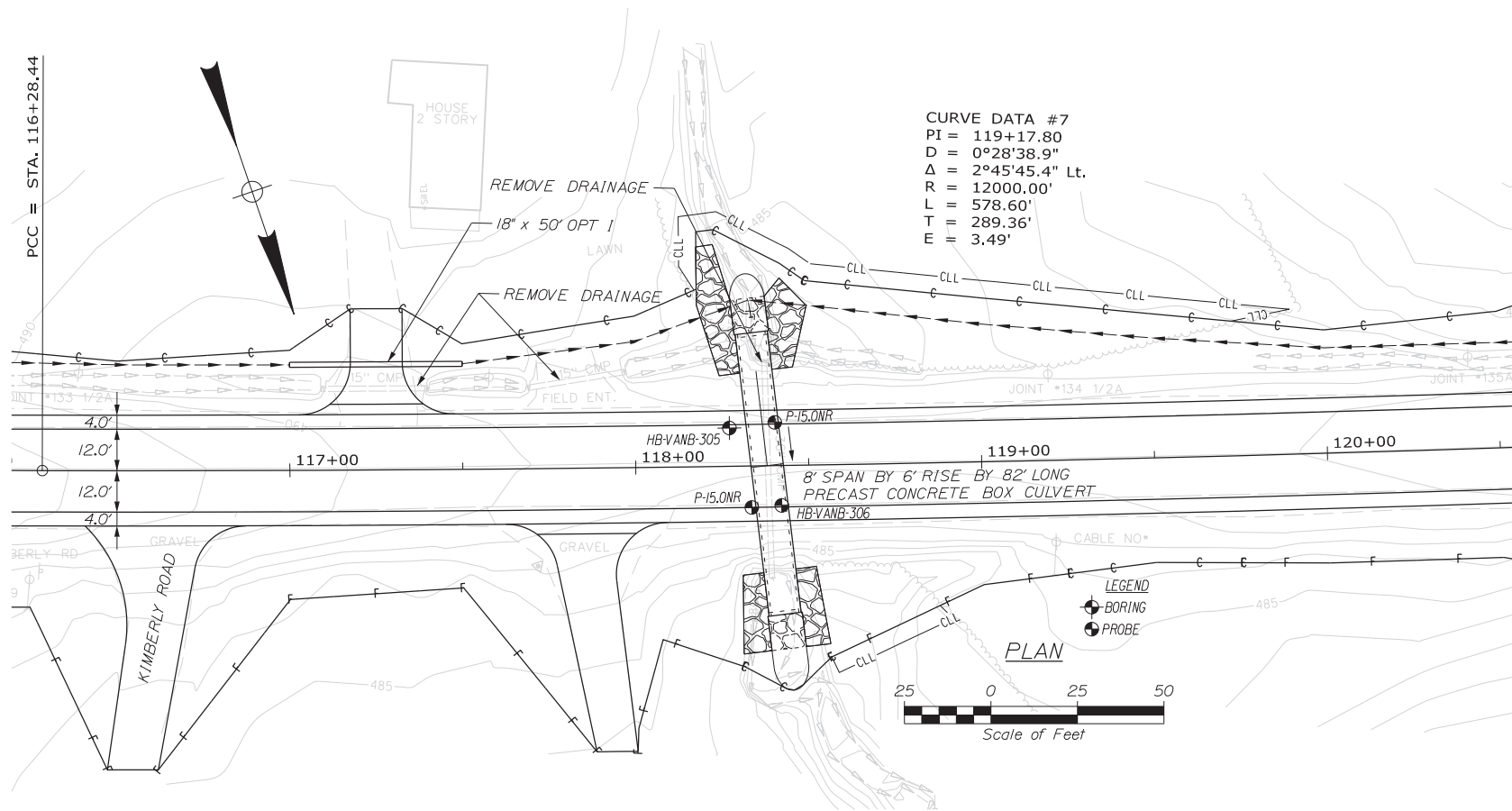
Note: This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

Maine Department of Transportation				Project: Reconstruction of 2.14 mile portion of US Route 1		Boring No.: HB-VANB-301	
Soil/Bore Exploration Log				Location: Van Buren, Maine		WIN: 20421-00	
US CUSTOMARY UNITS							
Driller:	MohrDOT	Elevation (ft.):	456.3	Auger ID/OD:	5" Dia.		
Operator:	Daggett/Hiles	Operator:	NAVDB	Sampler:	Standard Split Spoon		
Logged By:	B. Wilder	Rig Type:	CME 45C	Hammer Wt./Fall:	140lb/30"		
Date Start/Finish:	10/15/2018: 08:00-10:00	Drilling Method:	Solid Stem Auger	Core Barrel:	N/A		
Boring Location:	33+61.6x 13.5 ft Lt.	Coring ID/OD:	N/A	Water Level#:	10.0 ft bgs.		
Hammer Efficiency Factor:	0.928	Hammer Type:	Automatic B Hydraulic C	Rope & Connector:			
Terminations:							
S = Split Spoon Sample				Su = Peak/Retained Field Vane Undrained Shear Strength (psf), Pocket Torque Shear Strength (psf)			
U = Unsuccessful Split Spoon Sample Attempt				Suq = 15 lb Vane Undrained Shear Strength (psf)			
N = Non Well Take Sample				SC = Undrained Compressive Strength (psf)			
W = Unsuccessful Wire Line Sample Attempt				WC = Water Content, percent			
F = Field Vane Shear Test				PL = Plastic Limit			
R = Pocket Penetration				PS = Plasticity Index			
MR = Weight of 140lb. Hammer				R = Rig Specific Amplitude Correction Factor			
W = Field Vane Shear Test				Ag = 97.5% Surrogate Correction for Hammer Efficiency			
N = Unsuccessful Field Vane Shear Test Attempt				G = Grain Size Analysis			
				E = Consolidation Test			



Note: This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

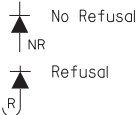
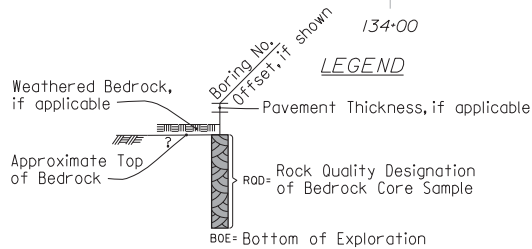
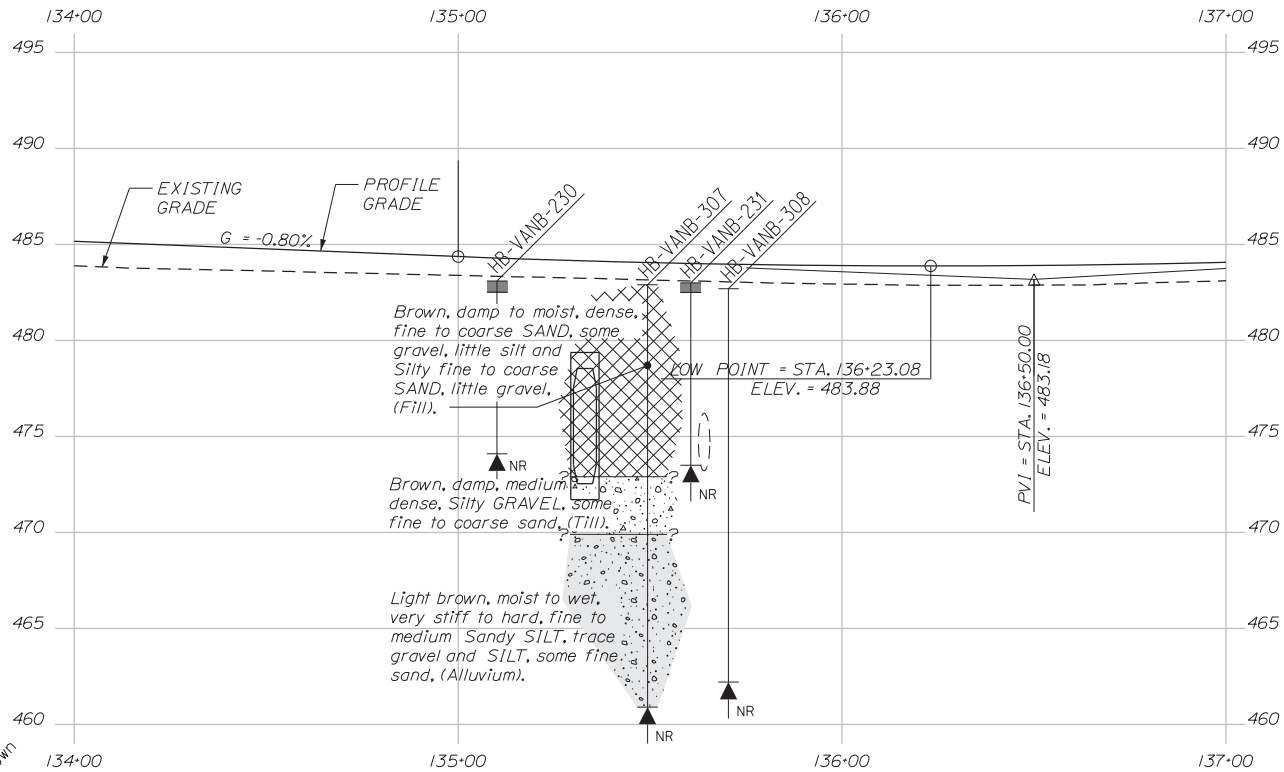
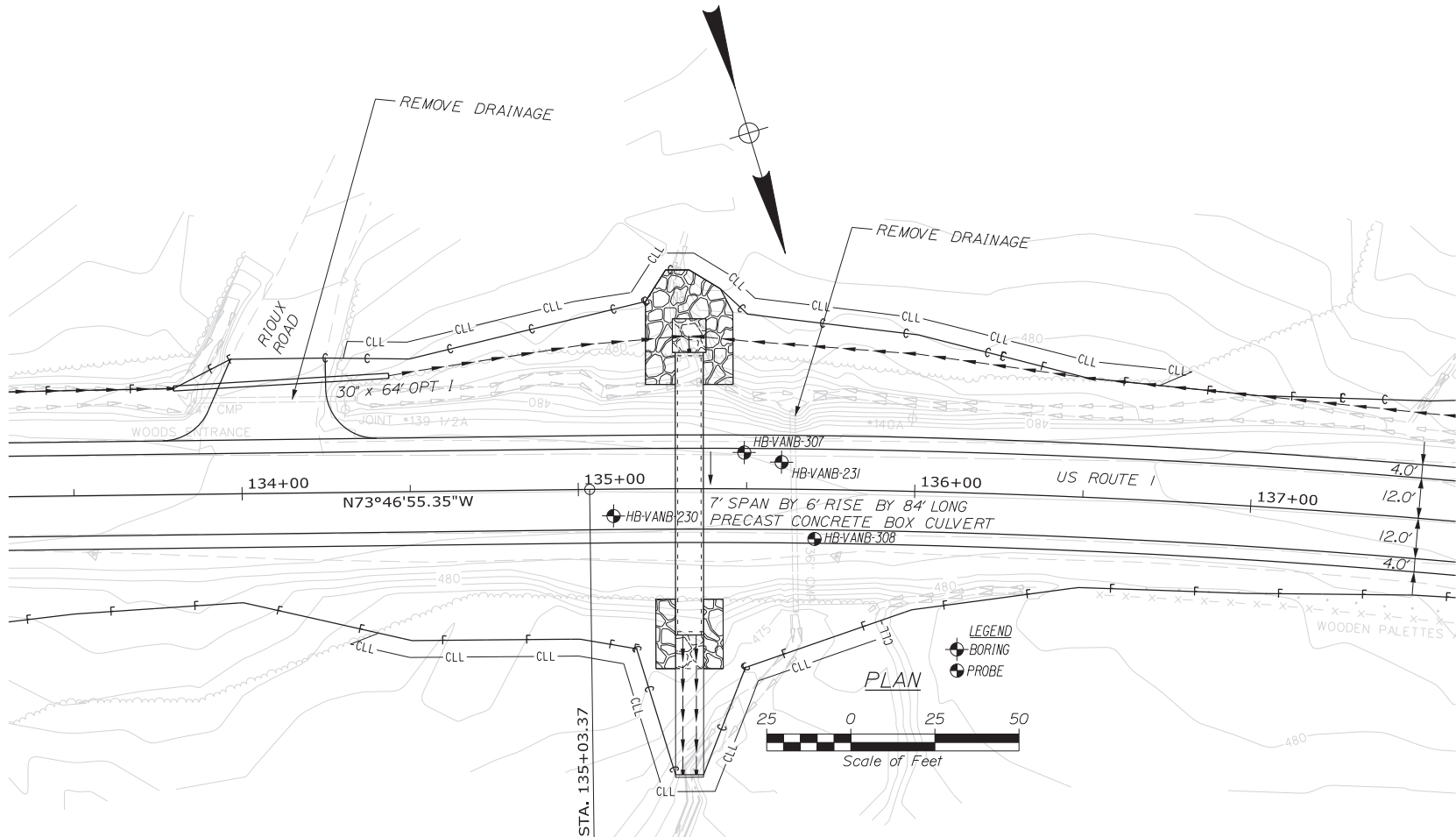
Maine Department of Transportation				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-303	
Soil/Book Exploration Log US CUSTOMARY UNITS				WIN: 20421.00			
Drillers: MalinDOT		Elevation (ft.): 472.1		Auger ID/OD: 5" Dia.			
Operator: Duggan/Miles		Datum: NAV088		Sampler: Standard Split Spoon			
Logged By: B. Willard		Rig Type: CME 45C		Hammer Wt./Fall: 140#/3'			
Date Start/Finish: 10/15/2018: 10:30-12:30		Drilling Method: Solid Stem Auger		Core Barrels: N/A			
Boring Location: 50+8.5, 11.7 ft R/L		Coring ID/OD: N/A		Water Level: 7.6 ft bgs.			
Hammer Efficiency Factor: 0.928		Hammer Type: Automatic 80		Hydraulic C		Rope A Cathead C	
DEFINITIONS:							
S = Soil Core Sample		S _u = Peak Retained Field Vane Undrained Shear Strength (psf)		S _u = Peak Retained Shear Strength (psf)		S _u = Peak Retained Shear Strength (psf)	
S _u = Soil Core Sample		S _u = Soil Core Sample		S _u = Soil Core Sample		S _u = Soil Core Sample	
S _u = Soil Core Sample		S _u = Soil Core Sample		S _u = Soil Core Sample		S _u = Soil Core Sample	
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Note: This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

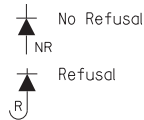
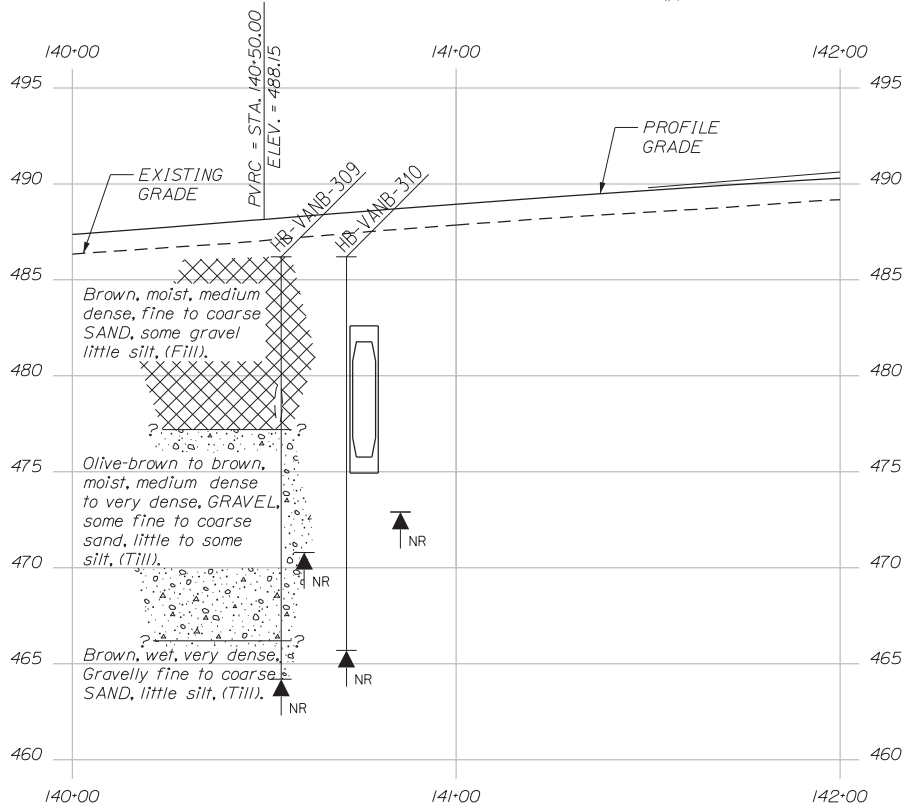
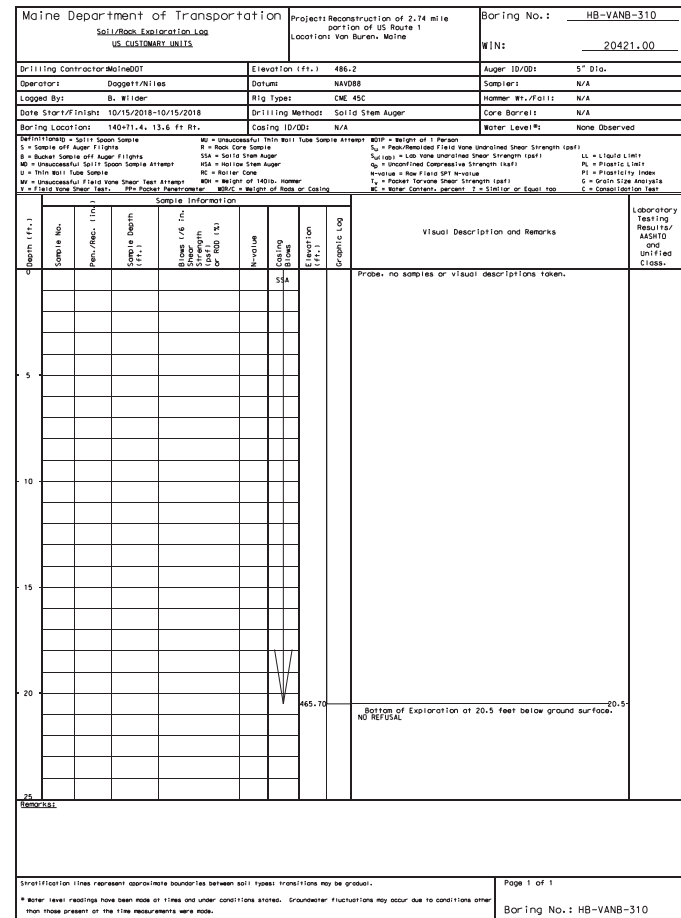
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project Reconstruction of 2.74 mile portion of US Route 1 Location: near Buren, Maine		Boring No.: <u>HB-VANB-306</u> WIN: <u>20421.00</u>	
Drilling Contractor/Well#001		Elevation (ft.)		487.5		Auger ID/OD: 5" ID/O.	
Operator: Duggett/NTES		Datum:		NAVD83		Sampler: 1" N/A	
Logged By: B. Wither		Rig Type:		CMC 45C		Hammer WT./Fall: N/A	
Date Started/Finished: 10/15/2018-10/15/2018		Drilling Method:		Solid Stem Auger		Core Barrel: N/A	
Boring Location: 118+42, 11.6 ft Rt.		Casing ID/OD:		N/A		Water Level: None Observed	
Drill/Bore ID = Split Spoon Sample S = Sample off Auger Flange BA = Bore Hole Sample SA = Solid Stem Auger SS = Solid Stem Auger MS = Mini Split Tube Sample W = Washed Sample F = Field Sample T = Test Sample W = Unconsolidated Split Spoon Sample MS = Mini Split Tube Sample W = Washed Sample F = Field Sample T = Test Sample							
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Note: This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

Maine Department of Transportation				Project: Reconstruction of 2.74 mile portion of US Route 1		Boring No.: HB-VANB-307	
Soil/Rock Exploration Log				Location: Van Buren, Maine		WIN: 20421.00	
US CUSTOMARY UNITS							
Drillers:	MaingDOT	Elevation (ft.):	482.9	Auger ID/OD:	5" Dia.		
Operator:	Doggett/Niles	Datum:	NAVD88	Sampler:	Standard Split Spoon		
Logged By:	B. Willner	Rig Type:	CME ASC	Hammer Wt./Fall:	140#/30"		
Date Start/Finish:	10/16/2018: 07:30-09:00	Drilling Method:	Solid Stem Auger	Core Barrel:	N/A		
Boring Location:	135+49.3, 10.8 ft Lt.	Casing ID/OD:	N/A	Water Level:	9.9 ft bgs.		
Hammer Efficiency Factor: 0.928		Hammer Type:	Automatic B	Hydraulic:			
Terminology:				Rock & Cathode			
S = Split Spoon Sample				S _u = Peak-Retained Field vane undrained shear strength (psf)			
W = Thin Wall Tube Sample				S _u = Lab vane undrained shear strength (psf)			
U = Thin Wall Tube Sample				S _u = Unconfined Compressive Strength (psf)			
M = Moisture Content (%)				P _r = Plasticity Index			
N = Field vane shear test				N ₆₀ = SPT blow count (blows/ft)			
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Appendix A

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM				MODIFIED BURMISTER SYSTEM	
MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	
		(little or no fines)	GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.	
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	
			GC	Clayey gravels, gravel-sand-clay mixtures.	
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS	SW	Well-graded sands, Gravelly sands, little or no fines	
		(little or no fines)	SP	Poorly-graded sands, Gravelly sand, little or no fines.	
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, Silty or Clayey fine sands, or Clayey silts with slight plasticity.	
			CL	Inorganic clays of low to medium plasticity, Gravelly clays, Sandy clays, Silty clays, lean clays.	
			OL	Organic silts and organic Silty clays of low plasticity.	
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine Sandy or Silty soils, elastic silts.	
			CH	Inorganic clays of high plasticity, fat clays.	
			OH	Organic clays of medium to high plasticity, organic silts.	
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.	
Desired Soil Observations (in this order, if applicable): Color (Munsell color chart) Moisture (dry, damp, moist, wet) Density/Consistency (from above right hand side) Texture (fine, medium, coarse, etc.) Name (Sand, Silty Sand, Clay, etc., including portions - trace, little, etc.) Gradation (well-graded, poorly-graded, uniform, etc.) Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic) Structure (layering, fractures, cracks, etc.) Bonding (well, moderately, loosely, etc.,) Cementation (weak, moderate, or strong) Geologic Origin (till, marine clay, alluvium, etc.) Groundwater level				Desired Rock Observations (in this order, if applicable): Color (Munsell color chart) Texture (aphanitic, fine-grained, etc.) Rock Type (granite, schist, sandstone, etc.) Hardness (very hard, hard, mod. hard, etc.) Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.) Geologic discontinuities/jointing: -dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.) -spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet) -tightness (tight, open, or healed) -infilling (grain size, color, etc.) Formation (Waterville, Ellsworth, Cape Elizabeth, etc.) RQD and correlation to rock quality (very poor, poor, etc.) ref: ASTM D6032 and FHWA NHI-16-072 GEC 5 - Geotechnical Site Characterization, Table 4-12 Recovery (inch/inch and percentage) Rock Core Rate (X.X ft - Y.Y ft (min:sec))	
Maine Department of Transportation Geotechnical Section Key to Soil and Rock Descriptions and Terms Field Identification Information				Sample Container Labeling Requirements: WIN Blow Counts Bridge Name / Town Sample Recovery Boring Number Date Sample Number Personnel Initials Sample Depth	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-101 WIN: 20421.00																																																																																																																																																																																																																																																																																																																													
Drilling Contractor: MaineDOT				Elevation (ft.): 454.0				Auger ID/OD: 5" Dia.																																																																																																																																																																																																																																																																																																																													
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																																																																																																																																																																																																																													
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																																																																																																																																																																																																																													
Date Start/Finish: 7/22/2014-7/22/2014				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																																																																																																																																																																																																																													
Boring Location: 18+50.3, 3.8 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																																																																																																																																																																																																													
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person Su = Peak/Remolded Field Vane Undrained Shear Strength (psf) Su(lab) = Lab Vane Undrained Shear Strength (psf) qp = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value Tv = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≈ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																																																																																																																																																																																																																																																					
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-102 WIN: 20421.00			
Drilling Contractor: MaineDOT			Elevation (ft.): 453.8		Auger ID/OD: 5" Dia.				
Operator: Giles/Daggett/Giles			Datum: NAVD88		Sampler: Off Flights				
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A				
Date Start/Finish: 7/22/2014-7/22/2014			Drilling Method: Solid Stem Auger		Core Barrel: N/A				
Boring Location: 18+50.4, 8.9 ft Rt.			Casing ID/OD: N/A		Water Level*: None Observed				
Definitions: D = Spillt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
Depth (ft.)	Sample Information							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)		
0	S3		0.54 - 2.20			SSA	453.3	6½" PAVEMENT.	G#264528 A-2-4, SM WC=4.5%
							451.6	Brown, dry, fine to coarse SAND, some silt, little gravel.	
								Olive-brown, wet, fine to coarse SAND, some silt, trace gravel.	
5									
							445.8		
								Bottom of Exploration at 8.0 feet below ground surface. NO REFUSAL	
10									
15									
20									
25									

Remarks:
 18+40, 14.0 ft Rt. Underground waterline.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

 * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1

Boring No.: HB-VANB-102

Maine Department of Transportation						Project: Reconstruction of 2.74 mile portion of US Route 1		Boring No.: HB-VANB-103																																																																																																																											
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Drilling Contractor: MaineDOT				Elevation (ft.): 453.4		Auger ID/OD: 5" Dia.																																																																																																																													
Operator: Giles/Daggett/Giles				Datum: NAVD88		Sampler: Off Flights																																																																																																																													
Logged By: B. Wilder				Rig Type: CME 45C		Hammer Wt./Fall: N/A																																																																																																																													
Date Start/Finish: 7/22/2014-7/22/2014				Drilling Method: Solid Stem Auger		Core Barrel: N/A																																																																																																																													
Boring Location: 18+50.4, 16.8 ft Rt.				Casing ID/OD: N/A		Water Level*: None Observed																																																																																																																													
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-104 WIN: 20421.00																																																																																																																						
Drilling Contractor: MaineDOT				Elevation (ft.): 456.4				Auger ID/OD: 5" Dia.																																																																																																																						
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Boring Location: 30+10.3, 6.1 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																						
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-105 WIN: 20421.00																																																																																																																																																									
Drilling Contractor: MaineDOT				Elevation (ft.): 455.8				Auger ID/OD: 5" Dia.																																																																																																																																																									
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																																																									
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																																																									
Date Start/Finish: 7/22/2014-7/22/2014				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																																																									
Boring Location: 30+10.4, 16.3 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																																									
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																																																																																	
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-106 WIN: 20421.00																																																																																																																																																								
Drilling Contractor: MaineDOT				Elevation (ft.): 465.3				Auger ID/OD: 5" Dia.																																																																																																																																																								
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Boring Location: 42+60.4, 4.2 ft Rt.				Casing ID/OD: N/A				Water Level*: 7.0 ft bgs.																																																																																																																																																								
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-107 WIN: 20421.00									
Drilling Contractor: MaineDOT						Elevation (ft.): 464.6				Auger ID/OD: 5" Dia.									
Operator: Giles/Daggett/Giles						Datum: NAVD88				Sampler: Off Flights									
Logged By: B. Wilder						Rig Type: CME 45C				Hammer Wt./Fall: N/A									
Date Start/Finish: 7/22/2014-7/22/2014						Drilling Method: Solid Stem Auger				Core Barrel: N/A									
Boring Location: 42+60.4, 14.2 ft Rt.						Casing ID/OD: N/A				Water Level*: 6.5 ft bgs.									
Definitions: D = Spilt Spoon Sample MU = Unsuccessful Thin Wall Tube Sample Attempt WO1P = Weight of 1 Person S = Sample off Auger Flights R = Rock Core Sample Su = Peak/Remolded Field Vane Undrained Shear Strength (psf) B = Bucket Sample off Auger Flights SSA = Solid Stem Auger Su(lab) = Lab Vane Undrained Shear Strength (psf) MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger qp = Unconfined Compressive Strength (ksf) U = Thin Wall Tube Sample RC = Roller Cone N-value = Raw Field SPT N-value LL = Liquid Limit MV = Unsuccessful Field Vane Shear Test Attempt WOH = Weight of 140lb. Hammer Ty = Pocket Torvane Shear Strength (psf) PL = Plastic Limit V = Field Vane Shear Test PP= Pocket Penetrometer WOR/C = Weight of Rods or Casing WC = Water Content, percent ≈ = Similar or Equal too G = Grain Size Analysis C = Consolidation Test																			
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-108 WIN: 20421.00																																																																																																																																																																																																																																																																																																																				
Drilling Contractor: MaineDOT				Elevation (ft.): 472.8				Auger ID/OD: 5" Dia.																																																																																																																																																																																																																																																																																																																				
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-109 WIN: 20421.00																																																																																															
Drilling Contractor: MaineDOT				Elevation (ft.): 472.9				Auger ID/OD: 5" Dia.																																																																																															
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																															
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																															
Date Start/Finish: 7/22/2014-7/22/2014				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																															
Boring Location: 50+10.4, 5.6 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																															
Definitions: D = Split Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person Su = Peak/Remolded Field Vane Undrained Shear Strength (psf) Su(lab) = Lab Vane Undrained Shear Strength (psf) qp = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value Tv = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≈ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																							
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Boring No.: HB-VANB-109																																																																																																							

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-111 WIN: 20421.00			
Drilling Contractor: MaineDOT			Elevation (ft.): 505.7		Auger ID/OD: 5" Dia.				
Operator: Giles/Daggett/Giles			Datum: NAVD88		Sampler: Off Flights				
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A				
Date Start/Finish: 7/22/2014-7/22/2014			Drilling Method: Solid Stem Auger		Core Barrel: N/A				
Boring Location: 70+10.3, 5.1 ft Rt.			Casing ID/OD: N/A		Water Level*: None Observed				
Definitions: D = Spillt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOC/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
Depth (ft.)	Sample Information							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)		
0	S18		0.58 - 6.30			SSA	505.1	7" PAVEMENT.	
								Brown, damp, fine to coarse SAND, some silt, little gravel.	G#264543 A-2-4, SM WC=6.7%
5									
	S19		6.30 - 8.00				499.4	Brown, wet, fine to coarse Sandy SILT, trace gravel.	G#264544 A-4, ML WC=20.6%
							497.7	Bottom of Exploration at 8.0 feet below ground surface. NO REFUSAL	
10									
15									
20									
25									
Remarks:									
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Page 1 of 1 Boring No.: HB-VANB-111	

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-114 WIN: 20421.00			
Drilling Contractor: MaineDOT				Elevation (ft.) 520.2				Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 7/22/2014-7/22/2014				Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 80+10.4, 15.0 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed			
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Sample Information											
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks		Laboratory Testing Results/ AASHTO and Unified Class.
0	S22		0.00 - 2.40			SSA			Brown, moist, fine to coarse SAND, some gravel, little silt.		G#264547 A-1-b, SM WC=4.7%
							517.8		Light brown, moist, fine to coarse Sandy SILT, little gravel.		
5											
							512.2				
									Bottom of Exploration at 8.0 feet below ground surface. NO REFUSAL		
10											
15											
20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 1	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-VANB-114	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-115 WIN: 20421.00			
Drilling Contractor: MaineDOT			Elevation (ft.): 522.8		Auger ID/OD: 5" Dia.				
Operator: Giles/Daggett/Giles			Datum: NAVD88		Sampler: Off Flights				
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A				
Date Start/Finish: 7/22/2014-7/22/2014			Drilling Method: Solid Stem Auger		Core Barrel: N/A				
Boring Location: 87+70.4, 5.1 ft Rt.			Casing ID/OD: N/A		Water Level*: None Observed				
Definitions: D = Spill Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
Depth (ft.)	Sample Information							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)		
0	S23		0.50 - 7.90			SSA	522.3	6" PAVEMENT. Brown, dry, fine to coarse SAND, some gravel, little silt.	G#264548 A-1-b, SM WC=2.6%
5							514.9	Bottom of Exploration at 7.9 feet below ground surface. REFUSAL	
10									
15									
20									
25									
Remarks:									
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Page 1 of 1 Boring No.: HB-VANB-115	

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-118 WIN: 20421.00			
Drilling Contractor: MaineDOT				Elevation (ft.) 519.8				Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 7/22/2014-7/22/2014				Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 94+10.4, 16.0 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed			
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks		Laboratory Testing Results/ AASHTO and Unified Class.
0	S27		0.00 - 1.60			SSA	518.2		Brown, damp, fine to coarse SAND, some gravel, little silt.		G#262323 A-1-b, SM WC=4.9%
									Brown, wet, fine to coarse Sandy SILT, trace gravel.		
5							511.8		Bottom of Exploration at 8.0 feet below ground surface. NO REFUSAL		
10											
15											
20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 1	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-VANB-118	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-119 WIN: 20421.00																																																																																																																																																									
Drilling Contractor: MaineDOT				Elevation (ft.): 522.7				Auger ID/OD: 5" Dia.																																																																																																																																																									
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																																																									
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-120 WIN: 20421.00																																																																																																																																																																							
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-201 WIN: 20421.00																																																																																																																		
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Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																		
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Date Start/Finish: 6/10/2015-6/10/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																		
Boring Location: 30+10.4, 9.2 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																		
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																																										
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Maine Department of Transportation						Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-205																																																																																																																																																																																																																																																																																																																																																																																																																			
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-206 WIN: 20421.00																																																																																																																		
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Boring Location: 94+10.4, 13.9 ft Lt. Shoulder				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																																							
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Page 1 of 1										Boring No.: HB-VANB-207																																																																																																																																																					

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-208 WIN: 20421.00																																																																																																																			
Drilling Contractor: MaineDOT				Elevation (ft.): 522.6				Auger ID/OD: 12" Dia.																																																																																																																			
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																			
Date Start/Finish: 6/10/2015-6/10/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																			
Boring Location: 100+10.4, 8.0 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																			
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-209 WIN: 20421.00																																																																																																																												
Drilling Contractor: MaineDOT				Elevation (ft.): 489.1				Auger ID/OD: 12" Dia.																																																																																																																												
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																												
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Date Start/Finish: 6/10/2015-6/10/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																												
Boring Location: 120+10.3, 8.1 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																												
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-210 WIN: 20421.00			
Drilling Contractor: MaineDOT			Elevation (ft.): 487.1		Auger ID/OD: 12" Dia.				
Operator: Giles/Daggett/Giles			Datum: NAVD88		Sampler: Off Flights				
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A				
Date Start/Finish: 6/10/2015-6/10/2015			Drilling Method: Solid Stem Auger		Core Barrel: N/A				
Boring Location: 130+10.4, 8.0 ft Rt.			Casing ID/OD: N/A		Water Level*: None Observed				
Definitions: D = Spill Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
Depth (ft.)	Sample Information							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)		
0	B10		0.42 - 2.30			SSA	486.7	 5" PAVEMENT. Brown, moist, fine to coarse SAND, some gravel, trace silt, occasional cobble.	G#271017 A-1-b, SW-SM WC=3.3% G#263860 A-2-4, SM WC=7.0%
	S10		2.30 - 4.00				484.8		
							483.1		
5								Bottom of Exploration at 4.0 feet below ground surface. NO REFUSAL	
10									
15									
20									
25									

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

 * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1

Boring No.: HB-VANB-210

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-211 WIN: 20421.00																																																																																								
Drilling Contractor: MaineDOT				Elevation (ft.): 486.9				Auger ID/OD: 12" Dia.																																																																																								
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																								
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																								
Date Start/Finish: 6/10/2015-6/10/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																								
Boring Location: 140+10, 7.0 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																								
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Page 1 of 1										Boring No.: HB-VANB-211																																																																																						

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Maine Department of Transportation						Project: Reconstruction of 2.74 mile portion of US Route 1		Boring No.: HB-VANB-213																																																																																					
Soil/Rock Exploration Log US CUSTOMARY UNITS						Location: Van Buren, Maine		WIN: 20421.00																																																																																					
Drilling Contractor: MaineDOT				Elevation (ft.): 493.1		Auger ID/OD: 12" Dia.																																																																																							
Operator: Giles/Daggett/Giles				Datum: NAVD88		Sampler: Off Flights																																																																																							
Logged By: B. Wilder				Rig Type: CME 45C		Hammer Wt./Fall: N/A																																																																																							
Date Start/Finish: 6/10/2015-6/10/2015				Drilling Method: Solid Stem Auger		Core Barrel: N/A																																																																																							
Boring Location: 150+10.3, 9.3 ft Rt.				Casing ID/OD: N/A		Water Level*: None Observed																																																																																							
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-215																																																																																																																																																																												
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Drilling Contractor: MaineDOT				Elevation (ft.): 456.4		Auger ID/OD:		5" Dia.																																																																																																																																																																												
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Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger		Core Barrel:		N/A																																																																																																																																																																												
Boring Location: 23+10.4, 6.7 ft Rt.				Casing ID/OD: N/A		Water Level*: None Observed																																																																																																																																																																														
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-216 WIN: 20421.00				
Drilling Contractor: MaineDOT			Elevation (ft.): 456.9		Auger ID/OD: 5" Dia.					
Operator: Giles/Daggett/Giles			Datum: NAVD88		Sampler: Off Flights					
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A					
Date Start/Finish: 6/15/2015-6/15/2015			Drilling Method: Solid Stem Auger		Core Barrel: N/A					
Boring Location: 24+85.4, 9.8 ft Lt.			Casing ID/OD: N/A		Water Level*: None Observed					
Definitions: D = Spillt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test										
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0	S13		0.67 - 2.00			SSA	456.2	[Pattern]	8" PAVEMENT. Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.	G#263863 A-2-4, SM WC=7.2%
	S14		2.00 - 6.00				454.9	[Pattern]	Grey, moist, fine to coarse SAND, some silt, trace gravel.	G#263864 A-2-4, SM WC=9.2%
5							450.9	[Pattern]	Dark brown, wet, fine to coarse Sandy SILT, trace gravel, trace organics.	G#263865 A-4, ML WC=26.9% Non-PLastic
	S15		6.40 - 9.50				450.5	[Pattern]	Grey, wet, Silty, fine to medium SAND.	
10							447.4	[Pattern]	Bottom of Exploration at 9.5 feet below ground surface. NO REFUSAL	
15										
20										
25										
Remarks:										
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.									Page 1 of 1 Boring No.: HB-VANB-216	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-217 WIN: 20421.00																																																																																																																																																																																																													
Drilling Contractor: MaineDOT				Elevation (ft.): 457.1				Auger ID/OD: 5" Dia.																																																																																																																																																																																																													
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																																																																																																													
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																																																																																																													
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Boring Location: 27+10.4, 6.7 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																																																																																													
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-218 WIN: 20421.00																																																																																																																																		
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-219 WIN: 20421.00			
Driller: MaineDOT				Elevation (ft.): 456.1				Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 31+10.4, 6.8 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed			
Hammer Efficiency Factor: 0.908				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
0							SSA	455.5		7" PAVEMENT.	
								453.9		Brown, moist, Gravelly fine to coarse SAND, some silt, occasional cobble.	
	1D	24/18	3.00 - 5.00	4/3/3/4	6	9				Grey, wet, medium dense, fine to coarse SAND, some gravel, some silt, trace organics.	G#263877 A-2-4, SM WC=18.9%
5	2D/A	24/19	5.00 - 7.00	3/5/5/4	10	15		451.0		2D (5.1-5.9 ft) Dark brown, moist, medium dense, fine to coarse SAND, some organic silt, some gravel, some peat.	G#263878 A-2-4, SM WC=50.5%
								450.2		2D/A (5.9-7.0 ft) Grey, moist,very stiff, SILT, little fine to coarse sand, trace gravel.	Loss=17.7% H2O=61.9% G#263879
	3D	24/20	7.00 - 9.00	6/5/7/5	12	18				Grey, moist, very stiff, SILT, trace fine to coarse sand, trace gravel.	A-4, ML WC=21.5% LL=26 PL=24 PI=2
								447.1			G#263880 A-4, ML WC=34.2% LL=31 PL=24 PI=7
10											
15											
20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Page 1 of 1 Boring No.: HB-VANB-219	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-220 WIN: 20421.00			
Drilling Contractor: MaineDOT			Elevation (ft.): 456.4		Auger ID/OD: 5" Dia.				
Operator: Giles/Daggett/Giles			Datum: NAVD88		Sampler: Off Flights				
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A				
Date Start/Finish: 6/15/2015-6/15/2015			Drilling Method: Solid Stem Auger		Core Barrel: N/A				
Boring Location: 33+10.4, 9.2 ft Lt.			Casing ID/OD: N/A		Water Level*: None Observed				
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
Depth (ft.)	Sample Information							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)		
0						SSA	455.8	7" PAVEMENT.	
								Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.	0.6
							454.0	Grey, moist, fine to coarse Sandy SILT, trace gravel.	2.4
5							451.3	Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble, some peat.	5.1
							450.3	Grey, wet, Silty, fine to medium SAND.	6.1
							447.4	Bottom of Exploration at 9.0 feet below ground surface. NO REFUSAL	9.0
10									
15									
20									
25									
Remarks:									
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Page 1 of 1 Boring No.: HB-VANB-220	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-221 WIN: 20421.00				
Driller: MaineDOT				Elevation (ft.): 457.6				Auger ID/OD: 5" Dia.				
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Standard Split Spoon				
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A				
Boring Location: 35+10.4, 9.1 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed				
Hammer Efficiency Factor: 0.908				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐								
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency $N_{60} = (\text{Hammer Efficiency Factor}/60\%)*N\text{-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0							SSA	457.1		6" PAVEMENT.	G#263874 A-2-4, SM WC=8.2% G#263875 A-1-b, SM WC=7.6% G#263876 A-2-4, SM WC=9.6%	
								455.4		Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.		
	1D	24/16	3.00 - 5.00	5/12/10/7	22	33				Brown, moist, dense, fine to coarse SAND, some silt, some gravel, occasional cobble, (Till).		
5	2D	24/19	5.00 - 7.00	4/7/11/12	18	27				Brown, moist, medium dense, fine to coarse SAND, some gravel, some silt, occasional cobble, (Till).		
	3D	24/15	7.00 - 9.00	8/11/12/17	23	35				Brown, moist, dense, fine to coarse SAND, some gravel, some silt, occasional cobble, (Till).		
								448.6				
10									Bottom of Exploration at 9.0 feet below ground surface. NO REFUSAL			
15												
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Remarks:												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Page 1 of 1 Boring No.: HB-VANB-221		

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-224 WIN: 20421.00																																																																																																																																																																																																																																																												
Driller: MaineDOT				Elevation (ft.): 463.3				Auger ID/OD: 5" Dia.																																																																																																																																																																																																																																																												
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Standard Split Spoon																																																																																																																																																																																																																																																												
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"																																																																																																																																																																																																																																																												
Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																																																																																																																																																												
Boring Location: 41+10.4, 7.1 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																																																																																																																																												
Hammer Efficiency Factor: 0.908				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐																																																																																																																																																																																																																																																																
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt				R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person				S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected				T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																																																																																																																																																																								
<table><tr><th colspan="10">Sample Information</th><th rowspan="2">Elevation (ft.)</th><th rowspan="2">Graphic Log</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/ AASHTO and Unified Class</th></tr><tr><th>Depth (ft.)</th><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N₆₀</th><th>Casing</th><th>Blows</th></tr><tr><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>SSA</td><td>462.7</td><td></td><td>7" PAVEMENT.</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>460.8</td><td></td><td>Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.</td><td></td><td></td></tr><tr><td></td><td>1D</td><td>24/14</td><td>3.00 - 5.00</td><td>3/4/6/6</td><td>10</td><td>15</td><td></td><td></td><td></td><td></td><td>Olive, wet, medium dense, Silty fine to medium SAND.</td><td>G#263871 A-4, SM WC=21.9%</td><td></td></tr><tr><td>5</td><td>2D</td><td>24/16</td><td>5.00 - 7.00</td><td>3/5/6/6</td><td>11</td><td>17</td><td></td><td></td><td></td><td></td><td>Olive, wet, very stiff, Sandy SILT, little gravel.</td><td>G#263872 A-4, SM WC=13.7%</td><td></td></tr><tr><td></td><td>3D</td><td>24/16</td><td>7.00 - 9.00</td><td>3/5/7/13</td><td>12</td><td>18</td><td></td><td></td><td></td><td></td><td>Olive, wet, very stiff, SILT, some fine to medium sand, trace gravel.</td><td>G#263873 A-4, ML WC=19.1%</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>454.3</td><td></td><td>Bottom of Exploration at 9.0 feet below ground surface. NO REFUSAL</td><td></td><td></td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>														Sample Information										Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class	Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing	Blows	0								SSA	462.7		7" PAVEMENT.												460.8		Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.				1D	24/14	3.00 - 5.00	3/4/6/6	10	15					Olive, wet, medium dense, Silty fine to medium SAND.	G#263871 A-4, SM WC=21.9%		5	2D	24/16	5.00 - 7.00	3/5/6/6	11	17					Olive, wet, very stiff, Sandy SILT, little gravel.	G#263872 A-4, SM WC=13.7%			3D	24/16	7.00 - 9.00	3/5/7/13	12	18					Olive, wet, very stiff, SILT, some fine to medium sand, trace gravel.	G#263873 A-4, ML WC=19.1%											454.3		Bottom of Exploration at 9.0 feet below ground surface. NO REFUSAL			10																																										15																																										20																																										25													
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Page 1 of 1												Boring No.: HB-VANB-224																																																																																																																																																																																																																																																								

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine			Boring No.: HB-VANB-225 WIN: 20421.00					
Drilling Contractor: MaineDOT						Elevation (ft.): 465.6			Auger ID/OD: 5" Dia.					
Operator: Giles/Daggett/Giles						Datum: NAVD88			Sampler: Off Flights					
Logged By: B. Wilder						Rig Type: CME 45C			Hammer Wt./Fall: N/A					
Date Start/Finish: 6/15/2015-6/15/2015						Drilling Method: Solid Stem Auger			Core Barrel: N/A					
Boring Location: 43+10.5, 8.2 ft Rt.						Casing ID/OD: N/A			Water Level*: None Observed					
Definitions: D = Split Spoon SampleMU = Unsuccessful Thin Wall Tube Sample AttemptWO1P = Weight of 1 PersonS = Sample off Auger FlightsR = Rock Core SampleSu _p = Peak/Remolded Field Vane Undrained Shear Strength (psf)B = Bucket Sample off Auger FlightsSSA = Solid Stem AugerSu(lab) = Lab Vane Undrained Shear Strength (psf)Liquid LimitMD = Unsuccessful Split Spoon Sample AttemptHSA = Hollow Stem Augerq _p = Unconfined Compressive Strength (ksf)PL = Plastic LimitU = Thin Wall Tube SampleRC = Roller ConeN-value = Raw Field SPT N-valueG = Grain Size AnalysisMV = Unsuccessful Field Vane Shear Test AttemptWOH = Weight of 140lb. HammerT _v = Pocket Torvane Shear Strength (psf)V = Field Vane Shear TestPP= Pocket PenetrometerWOR/C = Weight of Rods or CasingWC = Water Content, percent ≡ Similar or Equal tooC = Consolidation Test														
Sample Information										Visual Description and Remarks				Laboratory Testing Results/ AASHTO Unified Class.
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log						
0							SSA	465.1		6" PAVEMENT.				

Maine Department of Transportation						Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-226															
Soil/Rock Exploration Log US CUSTOMARY UNITS																									
Driller: MaineDOT						Elevation (ft.): 468.3				Auger ID/OD: 5" Dia.															
Operator: Giles/Daggett/Giles						Datum: NAVD88				Sampler: Standard Split Spoon															
Logged By: B. Wilder						Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"															
Date Start/Finish: 6/15/2015-6/15/2015						Drilling Method: Solid Stem Auger				Core Barrel: N/A															
Boring Location: 45+10.4, 8.7 ft Lt.						Casing ID/OD: N/A				Water Level*: None Observed															
Hammer Efficiency Factor: 0.908						Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐																			
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt						R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WOP = Weight of One Person						S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected						T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test							
Sample Information																									
Depth (ft.)		Sample No.		Pen./Rec. (in.)		Sample Depth (ft.)		Blows (/6 in.) Shear Strength (psf) or RQD (%)		N-uncorrected		N ₆₀		Casing Blows		Elevation (ft.)		Graphic Log		Visual Description and Remarks				Laboratory Testing Results/ AASHTO and Unified Class	
0														SSA		467.7				7" PAVEMENT. Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.				—0.6	
																465.6				Grey, moist, medium dense, Silty fine to coarse SAND, trace gravel.				G#263869 A-4, SM WC=16.3%	
5		1D		24/15		3.00 - 5.00		3/5/7/6		12		18													

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-227 WIN: 20421.00																																																																																																																																																																						
Drilling Contractor: MaineDOT				Elevation (ft.): 470.2				Auger ID/OD: 5" Dia.																																																																																																																																																																						
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																																																																						
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																																																																						
Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																																																																						
Boring Location: 47+10.4, 7.3 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																																																						
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-228 WIN: 20421.00			
Drilling Contractor: MaineDOT				Elevation (ft.): 471.9				Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 49+10.3, 7.3 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed			
Definitions: D = Spilt Spoon Sample MU = Unsuccessful Thin Wall Tube Sample Attempt WO1P = Weight of 1 Person S = Sample off Auger Flights R = Rock Core Sample S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) B = Bucket Sample off Auger Flights SSA = Solid Stem Auger S _{u(lab)} = Lab Vane Undrained Shear Strength (psf) MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q _p = Unconfined Compressive Strength (ksf) U = Thin Wall Tube Sample RC = Roller Cone N-value = Raw Field SPT N-value MV = Unsuccessful Field Vane Shear Test Attempt WOH = Weight of 140lb. Hammer T _v = Pocket Torvane Shear Strength (psf) V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
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0						SSA	471.3		7" PAVEMENT.		
							469.5		Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.	-0.6	
									Olive-brown, wet, fine to coarse Sandy SILT, trace gravel.	-2.4	
5							466.7		Brown, wet, Silty fine to coarse SAND, little gravel.	-5.2	
							462.9		Bottom of Exploration at 9.0 feet below ground surface. NO REFUSAL	-9.0	
10											
15											
20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 1	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-VANB-228	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-229 WIN: 20421.00																																																																																																																																																																						
Drilling Contractor: MaineDOT				Elevation (ft.): 473.9				Auger ID/OD: 5" Dia.																																																																																																																																																																						
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																																																																						
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																																																																						
Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																																																																						
Boring Location: 51+10.4, 7.4 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																																																						
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																																																																																														
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-230 WIN: 20421.00																																																																																																																																		
Drilling Contractor: MaineDOT				Elevation (ft.): 483.1				Auger ID/OD: 5" Dia.																																																																																																																																		
Operator: Giles/Daggett/Giles				Datum: NAVD88				Sampler: Off Flights																																																																																																																																		
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																																		
Date Start/Finish: 6/15/2015-6/15/2015				Drilling Method: Solid Stem Auger				Core Barrel: N/A																																																																																																																																		
Boring Location: 135+10.1, 8.2 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed																																																																																																																																		
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Boring No.: HB-VANB-230																																																																																																																																										

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine							Boring No.: HB-VANB-231 WIN: 20421.00													
Drilling Contractor: MaineDOT									Elevation (ft.): 483.0									Auger ID/OD: 5" Dia.								
Operator: Giles/Daggett/Giles									Datum: NAVD88									Sampler: Off Flights								
Logged By: B. Wilder									Rig Type: CME 45C									Hammer Wt./Fall: N/A								
Date Start/Finish: 6/15/2015-6/15/2015									Drilling Method: Solid Stem Auger									Core Barrel: N/A								
Boring Location: 135+60.6, 7.9 ft Lt.									Casing ID/OD: N/A									Water Level*: None Observed								
Definitions: D = Split Spoon Sample MU = Unsuccessful Thin Wall Tube Sample Attempt WO1P = Weight of 1 Person S = Sample off Auger Flights R = Rock Core Sample Su = Peak/Remolded Field Vane Undrained Shear Strength (psf) B = Bucket Sample off Auger Flights SSA = Solid Stem Auger Su(lab) = Lab Vane Undrained Shear Strength (psf) MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger qp = Unconfined Compressive Strength (ksf) U = Thin Wall Tube Sample RC = Roller Cone N-value = Raw Field SPT N-value MV = Unsuccessful Field Vane Shear Test Attempt WOH = Weight of 140lb. Hammer Ty = Pocket Torvane Shear Strength (psf) V = Field Vane Shear Test PP= Pocket Penetrometer WOR/C = Weight of Rods or Casing WC = Water Content, percent ≈ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																										
Sample Information																										
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks						Laboratory Testing Results/ AASHTO and Unified Class											
0						SSA	482.5	[Pattern]	6" PAVEMENT.						-0.5-											
							480.8	[Pattern]	Brown, damp, fine to coarse SAND, some silt, some gravel, occasional cobble.						-2.2-											
								[Pattern]	Brown, wet, Silty fine to coarse SAND, little gravel.																	
5								[Pattern]																		
								[Pattern]																		
								[Pattern]																		
								[Pattern]																		
								[Pattern]																		
10							473.5	[Pattern]	Bottom of Exploration at 9.5 feet below ground surface. NO REFUSAL						-9.5-											
								[Pattern]																		
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Stratification lines represent approximate boundaries between soil types; transitions may be gradual.																										
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.												Page 1 of 1 Boring No.: HB-VANB-231														

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-301 WIN: 20421.00					
Driller: MaineDOT				Elevation (ft.): 456.3				Auger ID/OD: 5" Dia.					
Operator: Daggett/Niles				Datum: NAVD88				Sampler: Standard Split Spoon					
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"					
Date Start/Finish: 10/15/2018; 08:00-10:00				Drilling Method: Solid Stem Auger				Core Barrel: N/A					
Boring Location: 33+51.6, 13.5 ft Lt.				Casing ID/OD: N/A				Water Level*: 10.0 ft bgs.					
Hammer Efficiency Factor: 0.928				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐									
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency $N_{60} = (\text{Hammer Efficiency Factor}/60\%)*N\text{-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test													
Depth (ft.)	Sample Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.		
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)					
0	1D	24/14	0.00 - 2.00	10/10/8/6	18	28	SSA	447.3		Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	G#342734 A-1-b, SM WC=5.4%		
5	2D	24/17	5.00 - 7.00	4/5/4/9	9	14						Grey, wet, stitff, fine to coarse Sandy SILT, trace gravel, (Fill).	G#342735 A-4, CL WC=20.6%
10	3D	24/15	10.00 - 12.00	2/3/5/5	8	12		447.3		Grey, wet, medium dense, fine to coarse SAND, some gravel, some silt, (Till).	G#342736 A-2-4, SM WC=9.5%		
15	4D	24/15	15.00 - 17.00	13/18/10/13	28	43		447.3		Grey, wet, dense, fine to coarse SAND, some gravel, some silt, (Till).	G#342737 A-2-4, SM WC=8.5%		
20	5D	24/14	20.00 - 22.00	7/17/16/19	33	51		447.3		Grey, wet, hard, SILT, some fine to coarse sand, some gravel, (Till).	G#342738 A-4, SM WC=9.8%		
25								434.3		Bottom of Exploration at 22.0 feet below ground surface. NO REFUSAL			

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

 * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1

Boring No.: HB-VANB-301

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-302 WIN: 20421.00				
Drilling Contractor: MaineDOT				Elevation (ft.): 456.4				Auger ID/OD: 5" Dia.				
Operator: Daggett/Niles				Datum: NAVD88				Sampler: N/A				
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A				
Date Start/Finish: 10/15/2018-10/15/2018				Drilling Method: Solid Stem Auger				Core Barrel: N/A				
Boring Location: 33+69.7, 12.2 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed				
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Sample Information												
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks			Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA			Probe, no samples or visual descriptions taken.			
5												
10												
15												
20							435.9		Bottom of Exploration at 20.5 feet below ground surface. NO REFUSAL			
25												
Remarks:												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 1		
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-VANB-302		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-303 WIN: 20421.00	
Driller: MaineDOT		Elevation (ft.): 472.1		Auger ID/OD: 5" Dia.			
Operator: Daggett/Niles		Datum: NAVD88		Sampler: Standard Split Spoon			
Logged By: B. Wilder		Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 10/15/2018; 10:30-12:30		Drilling Method: Solid Stem Auger		Core Barrel: N/A			
Boring Location: 50+18.5, 11.7 ft Rt.		Casing ID/OD: N/A		Water Level*: 7.6 ft bgs.			
Hammer Efficiency Factor: 0.928				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐			
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency $N_{60} = (\text{Hammer Efficiency Factor}/60\%) * N\text{-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test							

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0	1D	24/13	0.00 - 2.00	4/5/6/7	11	17	SSA			Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt.	G#342739 A-1-b, SM WC=7.1%	
5	2D	24/7	5.00 - 7.00	3/4/3/5	7	11				Brown, damp, medium dense, GRAVEL, some fine to coarse sand, little silt.	G#342740 A-1-b, GM WC=6.1%	
10	3D	24/18	10.00 - 12.00	4/5/8/16	13	20			462.1	Grey, wet, medium dense, fine to coarse SAND, some gravel, some silt, trace organics.	G#342741 A-2-4, SM WC=13.2%	
15	4D	24/19	15.00 - 17.00	5/10/13/14	23	36			457.6	Grey, wet, hard, SILT, little clay, trace fine to coarse sand, trace gravel.	G#342742 A-4, CL WC=15.7%	
20	5D	24/22	20.00 - 22.00	7/10/12/14	22	34			452.1	Light brown, moist, dense, fine to medium Sandy SILT, trace gravel, (Alluvium).	G#342743 A-4, CL WC=12.5%	
25									450.1	Bottom of Exploration at 22.0 feet below ground surface. NO REFUSAL		

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1

Boring No.: HB-VANB-303

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-304 WIN: 20421.00			
Drilling Contractor: MaineDOT				Elevation (ft.): 473.0				Auger ID/OD: 5" Dia.			
Operator: Daggett/Niles				Datum: NAVD88				Sampler: N/A			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 10/15/2018-10/15/2018				Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 50+42.6, 14.1 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed			
Definitions: D = Spilt Spoon Sample MU = Unsuccessful Thin Wall Tube Sample Attempt WO1P = Weight of 1 Person S = Sample off Auger Flights R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) B = Bucket Sample off Auger Flights SSA = Solid Stem Auger S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) U = Thin Wall Tube Sample RC = Roller Cone N-value = Raw Field SPT N-value MV = Unsuccessful Field Vane Shear Test Attempt WOH = Weight of 140lb. Hammer T_v = Pocket Torvane Shear Strength (psf) V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information								Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log			
0						SSA			Probe, no samples or visual descriptions taken.		
5											
10											
15											
20							452.5		Bottom of Exploration at 20.5 feet below ground surface. NO REFUSAL	20.5	
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.									Page 1 of 1		
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.									Boring No.: HB-VANB-304		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-305 WIN: 20421.00	
Driller: MaineDOT		Elevation (ft.): 488.2		Auger ID/OD: 5" Dia.			
Operator: Daggett/Niles		Datum: NAVD88		Sampler: Standard Split Spoon			
Logged By: B. Wilder		Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 10/15/2018; 13:00-14:30		Drilling Method: Solid Stem Auger		Core Barrel: N/A			
Boring Location: 118+27.2, 11.0 ft Lt.		Casing ID/OD: N/A		Water Level*: 10.0 ft bgs.			
Hammer Efficiency Factor: 0.928		Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐					
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency $N_{60} = (\text{Hammer Efficiency Factor}/60\%) * N\text{-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test							

Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
0							SSA	487.9		4" HMA.	
	1D	24/18	1.00 - 3.00	14/18/19/18	37	57				Brown, moist, very dense, fine to coarse SAND, some gravel, some silt.	G#342744 A-1-b, SM WC=5.9%
5											
	2D	24/16	5.00 - 7.00	3/5/7/7	12	19				Grey, wet, very stiff, Silty fine to coarse SAND, little gravel.	G#342745 A-4, SM WC=23.3%
10										Cobble from 9.3-9.7 ft bgs.	
	3D	24/17	10.00 - 12.00	4/5/8/9	13	20		478.2		Grey, wet, medium dense, fine to coarse SAND, some gravel, some silt, (Till).	G#342746 A-1-b, SM WC=11.4%
15											
	4D	24/17	15.00 - 17.00	10/21/20/20	41	63		473.2		Grey, wet, hard, fine to coarse Sandy SILT, little gravel, (Till).	G#342747 A-4, SM WC=12.1%
20											
	5D	24/17	20.00 - 22.00	12/19/20/24	39	60		468.2		Grey, wet, very dense, fine to coarse SAND, some silt, some gravel, (Till).	G#342748 A-2-4, SM WC=9.3%
								466.2		Bottom of Exploration at 22.0 feet below ground surface. NO REFUSAL	
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1

Boring No.: HB-VANB-305

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-306 WIN: 20421.00	
Drilling Contractor: MaineDOT				Elevation (ft.) 487.5				Auger ID/OD: 5" Dia.	
Operator: Daggett/Niles				Datum: NAVD88				Sampler: N/A	
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A	
Date Start/Finish: 10/15/2018-10/15/2018				Drilling Method: Solid Stem Auger				Core Barrel: N/A	
Boring Location: 118+42, 11.6 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed	
Definitions: D = Spilt Spoon Sample MU = Unsuccessful Thin Wall Tube Sample Attempt WO1P = Weight of 1 Person S = Sample off Auger Flights R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) B = Bucket Sample off Auger Flights SSA = Solid Stem Auger S_u(lab) = Lab Vane Undrained Shear Strength (psf) MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) U = Thin Wall Tube Sample RC = Roller Cone N-value = Raw Field SPT N-value MV = Unsuccessful Field Vane Shear Test Attempt WOH = Weight of 140lb. Hammer T_v = Pocket Torvane Shear Strength (psf) V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
Depth (ft.)	Sample Information							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)		
0						SSA		Probe, no samples or visual descriptions taken.	
5									
10									
15									
20							467.0	Bottom of Exploration at 20.5 feet below ground surface. NO REFUSAL	20.5
25									
Remarks:									
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.								Page 1 of 1	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Boring No.: HB-VANB-306	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine		Boring No.: HB-VANB-307 WIN: 20421.00	
Driller: MaineDOT		Elevation (ft.): 482.9		Auger ID/OD: 5" Dia.			
Operator: Daggett/Niles		Datum: NAVD88		Sampler: Standard Split Spoon			
Logged By: B. Wilder		Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 10/16/2018; 07:30-09:00		Drilling Method: Solid Stem Auger		Core Barrel: N/A			
Boring Location: 135+49.3, 10.8 ft Lt.		Casing ID/OD: N/A		Water Level*: 9.9 ft bgs.			
Hammer Efficiency Factor: 0.928		Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐					
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency $N_{60} = (\text{Hammer Efficiency Factor}/60\%) * N\text{-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test							

Depth (ft.)	Sample Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)				
0	1D	24/17	0.00 - 2.00	7/11/9/9	20	31	SSA	482.9		Brown, moist, dense, fine to coarse SAND, some gravel, little silt.	G#342749 A-1-b, SM WC=6.0%	
5	2D	24/16	5.00 - 7.00	13/10/8/8	18	28				Brown, damp, medium dense, Silty fine to coarse SAND, little gravel.	G#342750 A-4, SM WC=14.1%	
10	3D	24/9	10.00 - 12.00	3/6/10/15	16	25		472.9		Brown, damp, medium dense, Silty GRAVEL, some fine to coarse sand.	G#336876 A-4, GM WC=16.3%	
15	4D	24/15	15.00 - 17.00	7/7/9/9	16	25		469.9		Light brown, moist, very stiff, fine to medium Sandy SILT, trace gravel, (Alluvium).	G#336877 A-4, CL WC=10.7%	
20	5D	24/20	20.00 - 22.00	4/8/12/12	20	31		460.9		Light brown, wet, hard, SILT, some fine sand, (Alluvium).	G#336878 A-4, CL WC=22.4%	
25											Bottom of Exploration at 22.0 feet below ground surface. NO REFUSAL	

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

 * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1

Boring No.: HB-VANB-307

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-308 WIN: 20421.00			
Drilling Contractor: MaineDOT				Elevation (ft.): 482.7				Auger ID/OD: 5" Dia.			
Operator: Daggett/Niles				Datum: NAVD88				Sampler: N/A			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 10/16/2018-10/16/2018				Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 135+70.4, 14.7 Rt.				Casing ID/OD: N/A				Water Level*: None Observed			
Definitions: D = Spilt Spoon Sample S = Sample off Auger Flights B = Bucket Sample off Auger Flights MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MV = Unsuccessful Field Vane Shear Test Attempt V = Field Vane Shear Test, PP= Pocket Penetrometer MU = Unsuccessful Thin Wall Tube Sample Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of 1 Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information								Visual Description and Remarks		Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log			
0							SSA		Probe, no samples or visual descriptions taken.		
5											
10											
15											
20								462.2			
25									Bottom of Exploration at 20.5 feet below ground surface. NO REFUSAL	20.5	
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.											
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.											
Page 1 of 1											
Boring No.: HB-VANB-308											

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-309 WIN: 20421.00				
Driller: MaineDOT				Elevation (ft.): 487.5				Auger ID/OD: 5" Dia.				
Operator: Daggett/Niles				Datum: NAVD88				Sampler: Standard Split Spoon				
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 10/16/2018; 09:30-11:00				Drilling Method: Solid Stem Auger				Core Barrel: N/A				
Boring Location: 140+54.4, 12.0 ft Lt.				Casing ID/OD: N/A				Water Level*: None Observed				
Hammer Efficiency Factor: 0.928				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐								
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency $N_{60} = (\text{Hammer Efficiency Factor}/60\%)*N\text{-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0							SSA					
5	1D	24/16	5.00 - 7.00	4/6/8/11	14	22					Cobble from 1.2-2.0 ft bgs.	
10	2D	24/12	10.00 - 12.00	5/5/11/16	16	25					Brown, moist, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	G#336879 A-1-b, SM WC=5.8%
15	3D	24/14	15.00 - 17.00	11/17/20/18	37	57					Olive-brown, moist, medium dense, GRAVEL, some fine to coarse sand, some silt, (Till).	G#336880 A-2-4, GM WC=7.9%
20	4D	24/16	20.00 - 22.00	10/17/29/35	46	71					Brown, wet, very dense, GRAVEL, some fine to coarse sand, little silt, (Till).	G#336881 A-1-a, GM WC=6.9%
25											Brown, wet, very dense, Gravelly fine to coarse SAND, little silt, (Till).	G#336882 A-1-b, SM WC=8.2%
											Bottom of Exploration at 22.0 feet below ground surface. NO REFUSAL	
Remarks:												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.											Page 1 of 1 Boring No.: HB-VANB-309	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Reconstruction of 2.74 mile portion of US Route 1 Location: Van Buren, Maine				Boring No.: HB-VANB-310 WIN: 20421.00			
Drilling Contractor: MaineDOT				Elevation (ft.): 486.2				Auger ID/OD: 5" Dia.			
Operator: Daggett/Niles				Datum: NAVD88				Sampler: N/A			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 10/15/2018-10/15/2018				Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 140+71.4, 13.6 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed			
Definitions: D = Spilt Spoon Sample MU = Unsuccessful Thin Wall Tube Sample Attempt WO1P = Weight of 1 Person S = Sample off Auger Flights R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) B = Bucket Sample off Auger Flights SSA = Solid Stem Auger S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) U = Thin Wall Tube Sample RC = Roller Cone N-value = Raw Field SPT N-value MV = Unsuccessful Field Vane Shear Test Attempt WOH = Weight of 140lb. Hammer T_v = Pocket Torvane Shear Strength (psf) V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing WC = Water Content, percent ≡ = Similar or Equal too LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information								Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log			
0						SSA			Probe, no samples or visual descriptions taken.		
5											
10											
15											
20											
20.5							465.7		Bottom of Exploration at 20.5 feet below ground surface. NO REFUSAL	20.5	
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.											
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.											
Page 1 of 1											
Boring No.: HB-VANB-310											

Work Number: 20421.00

[illegible]

Appendix B

Laboratory Test Results

State of Maine - Department of Transportation
Laboratory Testing Summary Sheet

Town(s): Van Buren

Work Number: 20421.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C.	% Passing 200 Sieve	Classification		
								Unified	AASHTO	Frost
HB-VANB-101, S1	18+50.3	3.8 Rt.	0.5-3.2	264526	1	4.4	28.4	SM	A-2-4	II
HB-VANB-101, S2	18+50.3	3.8 Rt.	3.2-8.0	264527	1	8.1	34.8	SM	A-2-4	II
HB-VANB-102, S3	18+50.4	8.9 Rt.	0.54-2.2	264528	1	4.5	25.6	SM	A-2-4	II
HB-VANB-103, S4	18+50.4	16.8 Rt.	0.38-1.3	264529	1	11.7	50.7	ML	A-4	IV
HB-VANB-104, S5	30+10.3	6.1 Lt.	0.67-4.1	264530	2	4.9	29.0	SM	A-2-4	II
HB-VANB-104, S6	30+10.3	6.1 Lt.	4.1-7.0	264531	2	54.1	65.0	OL	A-4	IV
HB-VANB-104, S7	30+10.3	6.1 Lt.	7.0-10.0	264532	2	30.0	95.1	ML	A-4	IV
HB-VANB-105, S8	30+10.4	16.3 Lt.	0.0-2.2	264533	2	7.0	21.8	SM	A-1-b	II
HB-VANB-105, S9	30+10.4	16.3 Lt.	2.2-3.5	264534	2	10.7	36.4	SM	A-4	III
HB-VANB-106, S10	42+60.4	4.2 Rt.	0.63-3.5	264535	3	4.1	24.6	SM	A-1-b	II
HB-VANB-106, S11	42+60.4	4.2 Rt.	3.5-6.8	264536	3	16.5	63.5	ML	A-4	IV
HB-VANB-106, S12	42+60.4	4.2 Rt.	6.8-9.0	264537	3	12.1	35.0	SM	A-2-4	II
HB-VANB-107, S13	42+60.4	14.2 Rt.	0.0-2.5	264538	3	7.7	37.2	SM	A-4	III
HB-VANB-108, S14	50+10.4	10.7 Lt.	0.67-5.5	264539	4	4.8	26.6	SM	A-2-4	II
HB-VANB-108, S15	50+10.4	10.7 Lt.	6.5-7.2	264540	4	44.5	44.7	SM	A-4	III
HB-VANB-108, S16	50+10.4	10.7 Lt.	7.2-8.0	264541	4	23.3	58.4	ML	A-4	IV
HB-VANB-110, S17	50+10.3	15.6 Lt.	0.0-7.8	264542	4	5.8	19.9	SM	A-1-b	II
HB-VANB-111, S18	70+10.3	5.1 Rt.	0.58-6.3	264543	4	6.7	28.4	SM	A-2-4	II
HB-VANB-111, S19	70+10.3	5.1 Rt.	6.3-8.0	264544	4	20.6	51.9	ML	A-4	IV
HB-VANB-113, S20	80+10.4	4.9 Lt.	0.58-2.6	264545	5	6.3	29.9	SM	A-2-4	II
HB-VANB-113, S21	80+10.4	4.9 Lt.	2.6-8.0	264546	5	11.1	47.7	SM	A-4	III
HB-VANB-114, S22	80+10.4	15.0 Lt.	0.0-2.4	264547	5	4.7	17.6	SM	A-1-b	II
HB-VANB-115, S23	87+70.4	5.1 Rt.	0.5-7.9	264548	5	2.6	19.6	SM	A-1-b	II
HB-VANB-116, S24	87+70.4	15.1 Rt.	0.0-8.0	264549	5	11.3	30.5	SM	A-2-4	II
HB-VANB-117, S25	94+10.4	4.9 Lt.	0.5-2.3	264550	6	6.0	28.9	SM	A-2-4	II
HB-VANB-117, S26	94+10.4	4.9 Lt.	2.3-8.0	262322	6	12.3	58.7	ML	A-4	IV
HB-VANB-118, S27	94+10.4	16.0 Lt.	0.0-1.6	262323	6	4.9	17.8	SM	A-1-b	II
HB-VANB-119, S28	100+10.3	5.1 Rt.	0.58-3.8	262324	6	4.4	20.9	SM	A-1-b	II
HB-VANB-119, S29	100+10.3	5.1 Rt.	3.8-8.0	262325	6	13.7	66.1	ML	A-4	IV
HB-VANB-120, S30	100+10.4	15.1 Rt.	0.0-2.7	262299	7	4.9	20.7	SM	A-1-b	II
HB-VANB-121, S31	120+10.4	5.0 Lt.	0.58-2.1	262300	7	5.2	25.9	SM	A-2-4	II
HB-VANB-121, S32	120+10.4	5.0 Lt.	2.1-6.4	242976	7	8.5	37.8	SM	A-4	III
							LL/PI			
HB-VANB-101, S2	18+50.3	3.8 Rt.	3.2-8.0	264527	1	8.1	-NP-	SM	A-2-4	II
HB-VANB-104, S7	30+10.3	6.1 Lt.	7.0-10.0	264532	2	30.0	31/5	ML	A-4	IV
							(T 267)			
							Loss%	H2O%		
HB-VANB-104, S6	30+10.3	6.1 Lt.	4.1-7.0	264531	2	54.1	6.1	53.1	---	---
HB-VANB-108, S15	50+10.4	10.7 Lt.	6.5-7.2	264540	4	44.5	15.4	40.8	---	---

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible).
The "Frost Susceptibility Rating" is based upon the MDOT and Corps of Engineers Classification Systems.

GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

State of Maine - Department of Transportation
Laboratory Testing Summary Sheet

Town(s): Van Buren

Work Number: 20421.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C.	% Passing 200 Sieve	Classification		
								Unified	AASHTO	Frost
HB-VANB-201, B1	30+10.4	9.2 Lt.	0.67-1.7	271008	8	5.7	25.8	SM	A-2-4	II
HB-VANB-201, S1	30+10.4	9.2 Lt.	1.7-4.5	263851	8	9.7	36.5	SM	A-4	III
HB-VANB-202, B2	42+60.3	14.2 Rt.	0.0-1.7	271009	8	5.7	27.5	SM	A-2-4	II
HB-VANB-202, S2	42+60.3	14.2 Rt.	1.7-4.0	263852	8	9.7	35.1	SM	A-2-4	II
HB-VANB-203, B3	50+10.3	9.6 Lt.	0.67-2.5	271010	8	3.1	11.8	SW-SM	A-1-a	0
HB-VANB-203, S3	50+10.3	9.6 Lt.	2.5-4.0	263853	8	4.3	22.9	SM	A-1-b	II
HB-VANB-204, B4	70+10.4	8.5 Lt.	0.5-3.0	271011	9	4.3	14.4	SM	A-1-a	II
HB-VANB-204, S4	70+10.4	8.5 Lt.	3.0-4.5	263854	9	5.5	21.7	SM	A-1-b	II
HB-VANB-205, B5	80+10.4	7.6 Lt.	0.67-2.0	271012	9	3.5	13.0	SM	A-1-a	II
HB-VANB-205, S5	80+10.4	7.6 Lt.	2.0-4.5	263855	9	11.6	31.1	SM	A-2-4	II
HB-VANB-206, B6	87+70.4	8.0 Rt.	0.63-2.2	271013	9	3.8	12.4	SM	A-1-b	II
HB-VANB-206, S6	87+70.4	8.0 Rt.	2.2-4.5	263856	9	28.1	45.0	SM	A-4	III
HB-VANB-207, B7	94+10.4	13.9 Lt.	0.0-1.5	271014	10	3.8	14.6	SM	A-1-b	II
HB-VANB-207, S7	94+10.4	13.9 Lt.	1.5-4.0	263857	10	20.0	34.1	SM	A-2-4	II
HB-VANB-208, B8	100+10.4	8.0 Rt.	0.5-2.9	271015	10	3.3	10.5	SW-SM	A-1-a	0
HB-VANB-208, S8	100+10.4	8.0 Rt.	2.9-4.5	263858	10	9.9	37.6	SM	A-4	III
HB-VANB-209, B9	120+10.3	8.1 Lt.	0.5-2.0	271016	Not run by lab, bad odor in sample.					
HB-VANB-209, S9	120+10.3	8.1 Lt.	2.3-4.0	263859	10	17.8	19.7	GM	A-1-b	I
HB-VANB-210, B10	130+10.4	8.0 Rt.	0.42-2.3	271017	11	3.3	10.0	SW-SM	A-1-b	0
HB-VANB-210, S10	130+10.4	8.0 Rt.	2.3-4.0	263860	11	7.0	25.5	SM	A-2-4	II
HB-VANB-211, B11	140+10	7.0 Lt.	0.42-4.5	271018	11	3.9	11.1	SW-SM	A-1-a	0
HB-VANB-212, B12	140+10	14.0 Lt.	0.0-4.5	271019	11	4.5	8.4	GW-GM	A-1-a	0
HB-VANB-213, B13	150+10.3	9.3 Rt.	0.58-4.5	271020	11	4.0	14.9	SM	A-1-a	II
HB-VANB-214, B14	150+10.3	15.8 Rt.	0.0-3.3	271021	12	6.5	18.6	SM	A-2-4	II
HB-VANB-214, S11	150+10.3	15.8 Rt.	3.3-4.5	263861	12	19.4	27.5	SM	A-2-4	II
HB-VANB-215, S12	23+10.4	6.7 Rt.	7.5-8.6	263862	12	43.6	58.5	ML	A-4	IV
HB-VANB-216, S13	24+85.4	9.8 Lt.	0.67-2.0	263863	12	7.2	27.4	SM	A-2-4	II
HB-VANB-216, S14	24+85.4	9.8 Lt.	2.0-6.0	263864	12	9.2	34.8	SM	A-2-4	II
HB-VANB-216, S15	24+85.4	9.8 Lt.	6.4-9.5	263865	12	26.9	55.7	ML	A-4	IV
HB-VANB-217, S16	27+10.4	6.7 Rt.	4.5-6.1	263866	13	41.3	58.8	ML	A-4	IV
HB-VANB-219, 1D	31+10.4	6.8 Rt.	3.0-5.0	263877	13	18.9	23.2	SM	A-2-4	II
HB-VANB-219, 2D	31+10.4	6.8 Rt.	5.1-5.9	263878	13	50.5	29.3	SM	A-2-4	II
HB-VANB-219, 2D/A	31+10.4	6.8 Rt.	5.9-7.0	263879	13	21.5	78.9	ML	A-4	IV
HB-VANB-219, 3D	31+10.4	6.8 Rt.	7.0-9.0	263880	13	34.2	91.9	ML	A-4	IV
HB-VANB-221, 1D	35+10.4	9.1 Lt.	3.0-5.0	263874	14	8.2	27.3	SM	A-2-4	II
HB-VANB-221, 2D	35+10.4	9.1 Lt.	5.0-7.0	263875	14	7.6	22.6	SM	A-1-b	II
HB-VANB-221, 3D	35+10.4	9.1 Lt.	7.0-9.0	263876	14	9.6	25.7	SM	A-2-4	II
HB-VANB-222, S17	37+10.3	7.1 Rt.	1.4-4.5	263867	14	16.7	61.6	ML	A-4	IV
HB-VANB-222, S18	37+10.3	7.1 Rt.	4.5-9.0	263868	14	11.1	38.2	SM	A-4	III
HB-VANB-224, 1D	41+10.4	7.1 Rt.	3.0-5.0	263871	15	21.9	48.5	SM	A-4	III
HB-VANB-224, 2D	41+10.4	7.1 Rt.	5.0-7.0	263872	15	13.7	45.5	SM	A-4	III
HB-VANB-224, 3D	41+10.4	7.1 Rt.	7.0-9.0	263873	15	19.1	68.9	ML	A-4	IV
HB-VANB-226, 1D	45+10.4	8.7 Lt.	3.0-5.0	263869	15	16.3	39.8	SM	A-4	III
HB-VANB-226, 2D	45+10.4	8.7 Lt.	5.0-7.0	263870	15	19.6	35.5	SM	A-2-4	II

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MDOT and Corps of Engineers Classification Systems.

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WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

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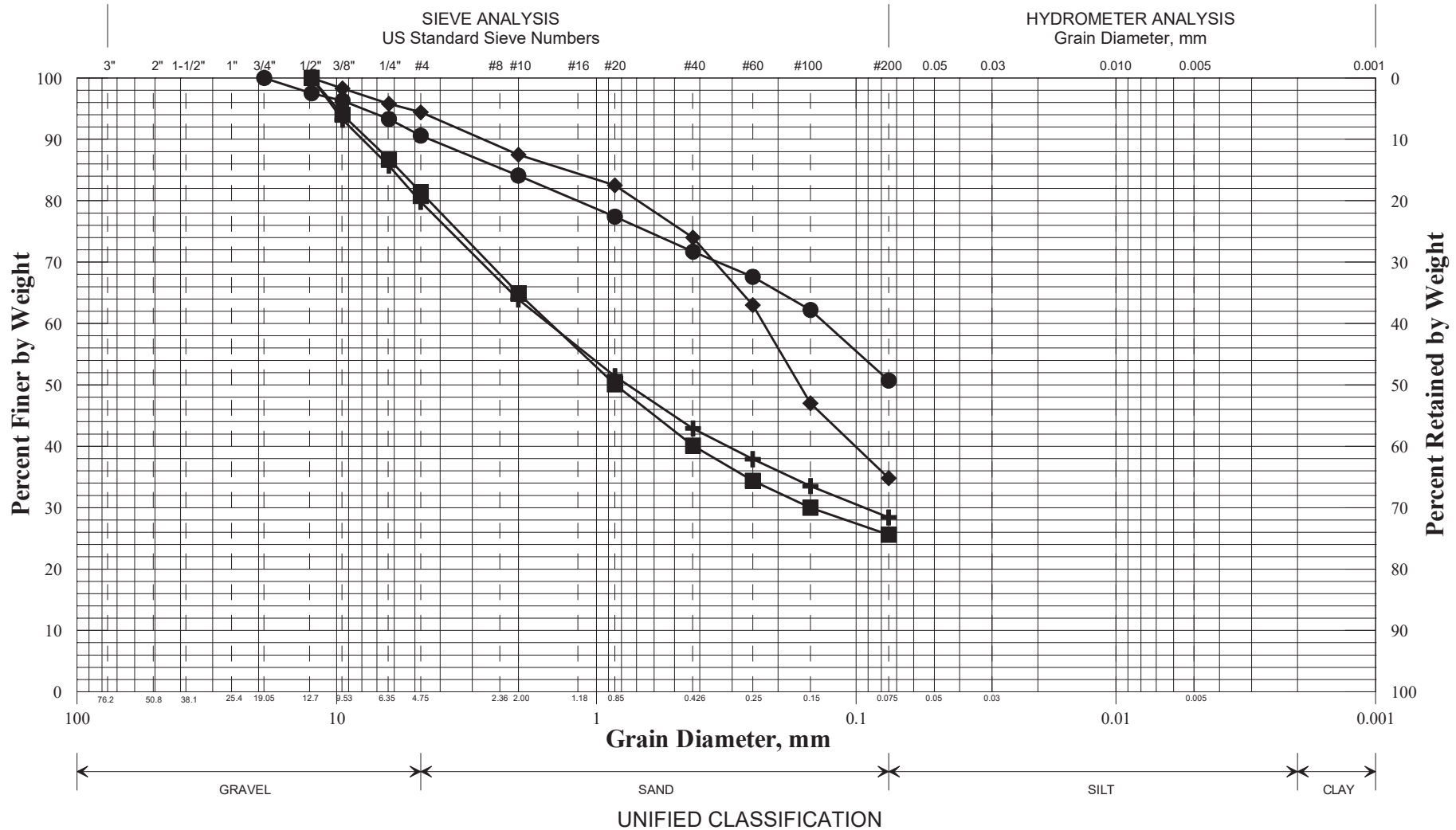
PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

Work Number: 20421.00

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MaineDOT and Corps of Engineers Classification Systems.

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

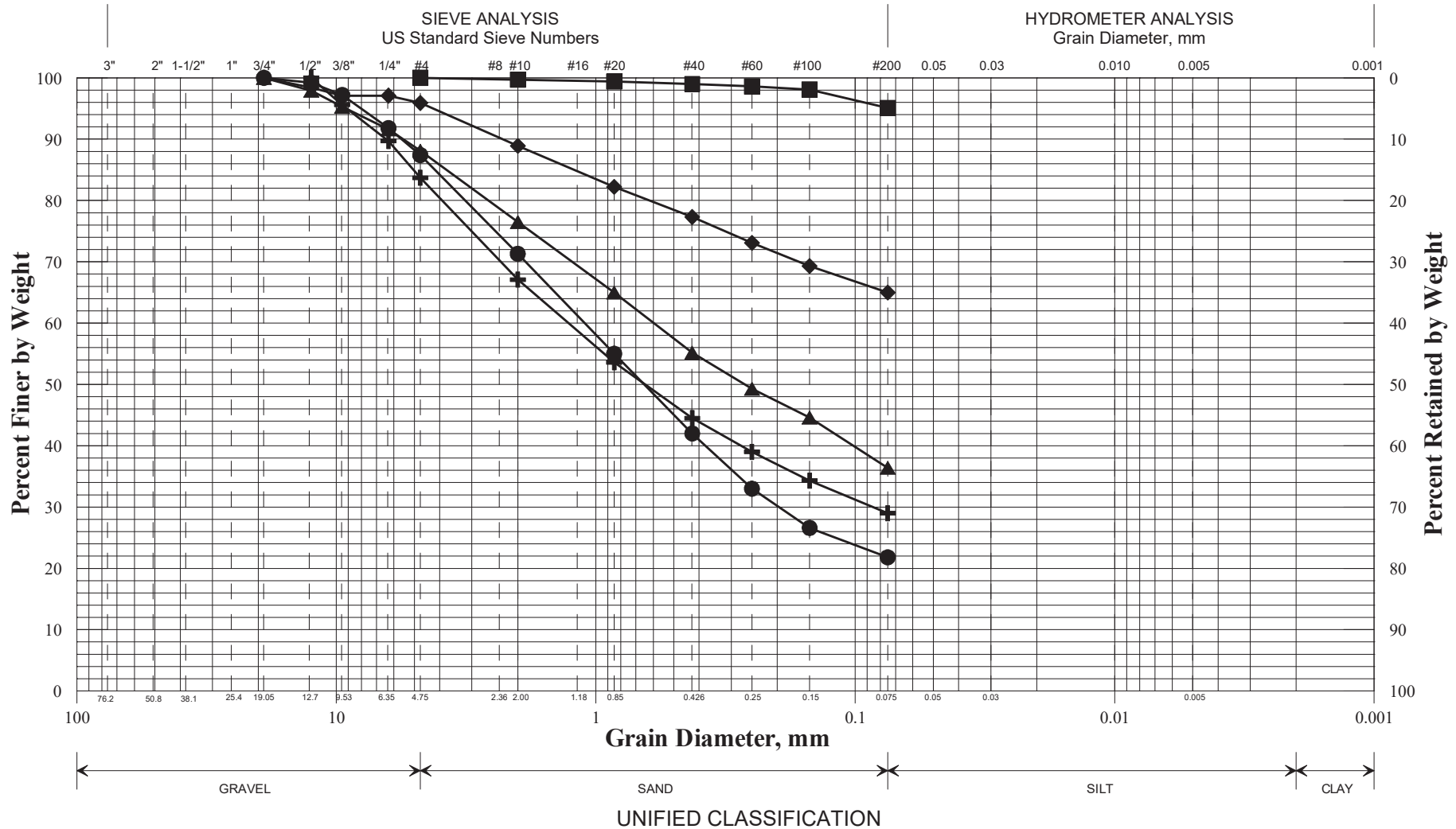
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-101/S1	18+50.3	3.8 Rt.	0.5-3.2	SAND, some silt, little gravel.	4.4			
◆	HB-VANB-101/S2	18+50.3	3.8 Rt.	3.2-8.0	SAND, some silt, trace gravel.	8.1			NP
■	HB-VANB-102/S3	18+50.4	8.9 Rt.	0.54-2.2	SAND, some silt, little gravel.	4.5			
●	HB-VANB-103/S4	18+50.4	16.8 Rt.	0.38-1.3	Sandy SILT, trace gravel.	11.7			
▲									
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WHITE, TERRY A	8/11/2014

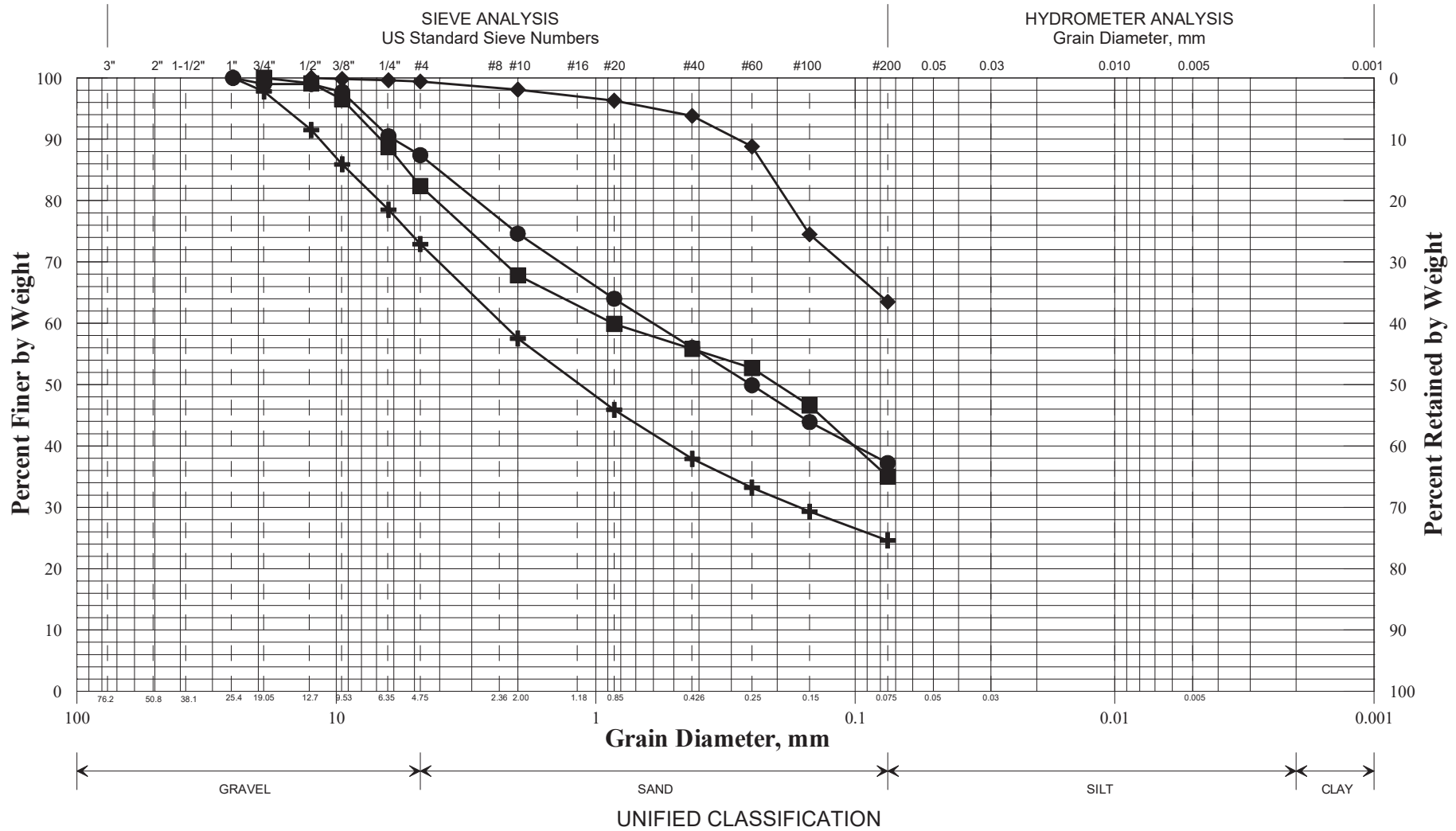
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-104/S5	30+10.3	6.1 Lt.	0.67-4.1	SAND, some silt, little gravel.	4.9			
◆	HB-VANB-104/S6	30+10.3	6.1 Lt.	4.1-7.0	SILT, some sand, trace gravel.	54.1			
■	HB-VANB-104/S7	30+10.3	6.1 Lt.	7.0-10.0	SILT, trace sand.	30.0	31	26	5
●	HB-VANB-105/S8	30+10.4	16.3 Lt.	0.0-2.2	SAND, some silt, little gravel.	7.0			
▲	HB-VANB-105/S9	30+10.4	16.3 Lt.	2.2-3.5	Silty SAND, little gravel.	10.7			
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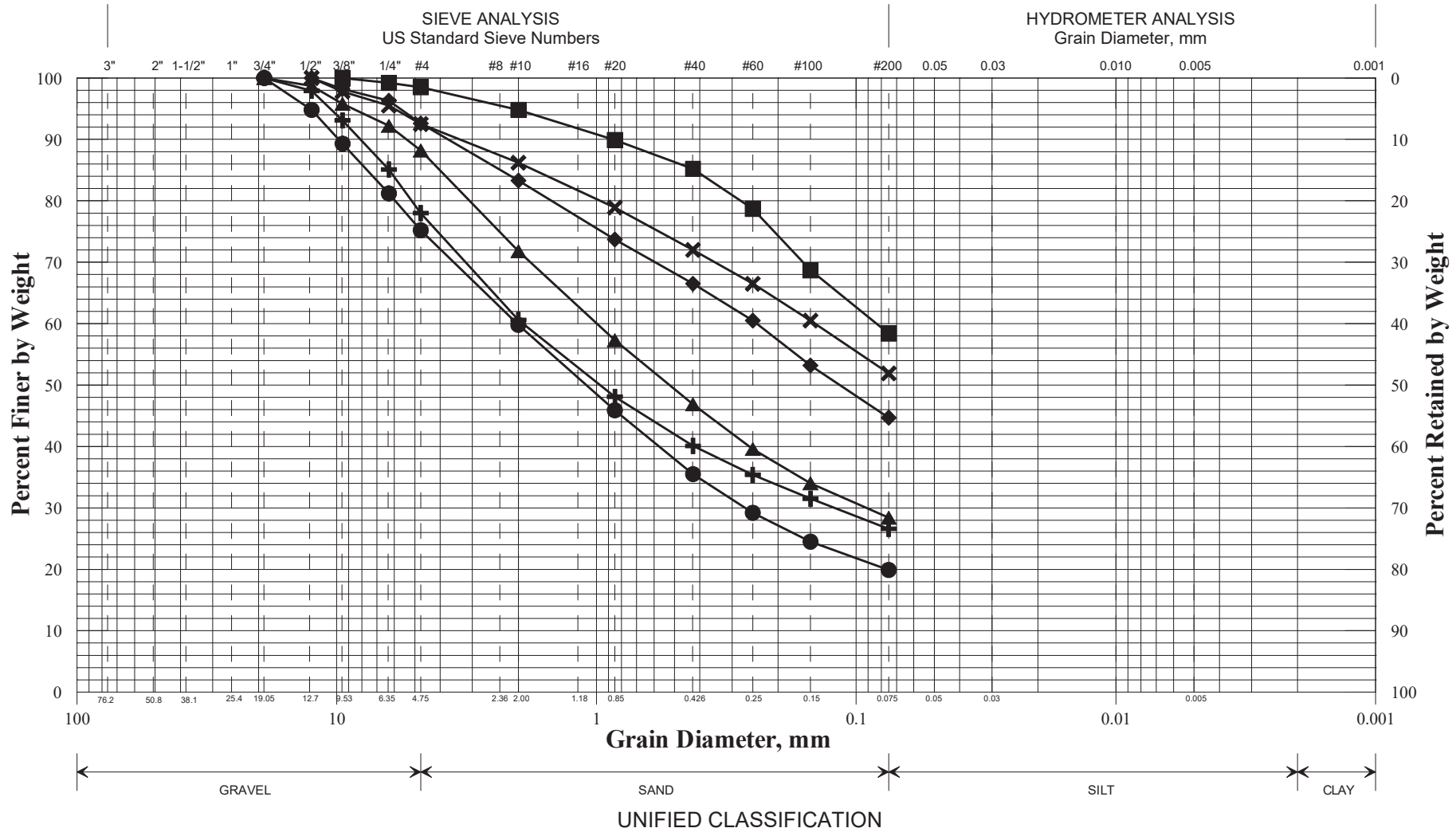
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-106/S10	42+60.4	4.2 Rt.	0.63-3.5	SAND, some gravel, some silt.	4.1			
◆	HB-VANB-106/S11	42+60.4	4.2 Rt.	3.5-6.8	Sandy SILT, trace gravel.	16.5			
■	HB-VANB-106/S12	42+60.4	4.2 Rt.	6.8-9.0	SAND, some silt, little gravel.	12.1			
●	HB-VANB-107/S13	42+60.4	14.2 Rt.	0.0-2.5	Silty SAND, little gravel.	7.7			
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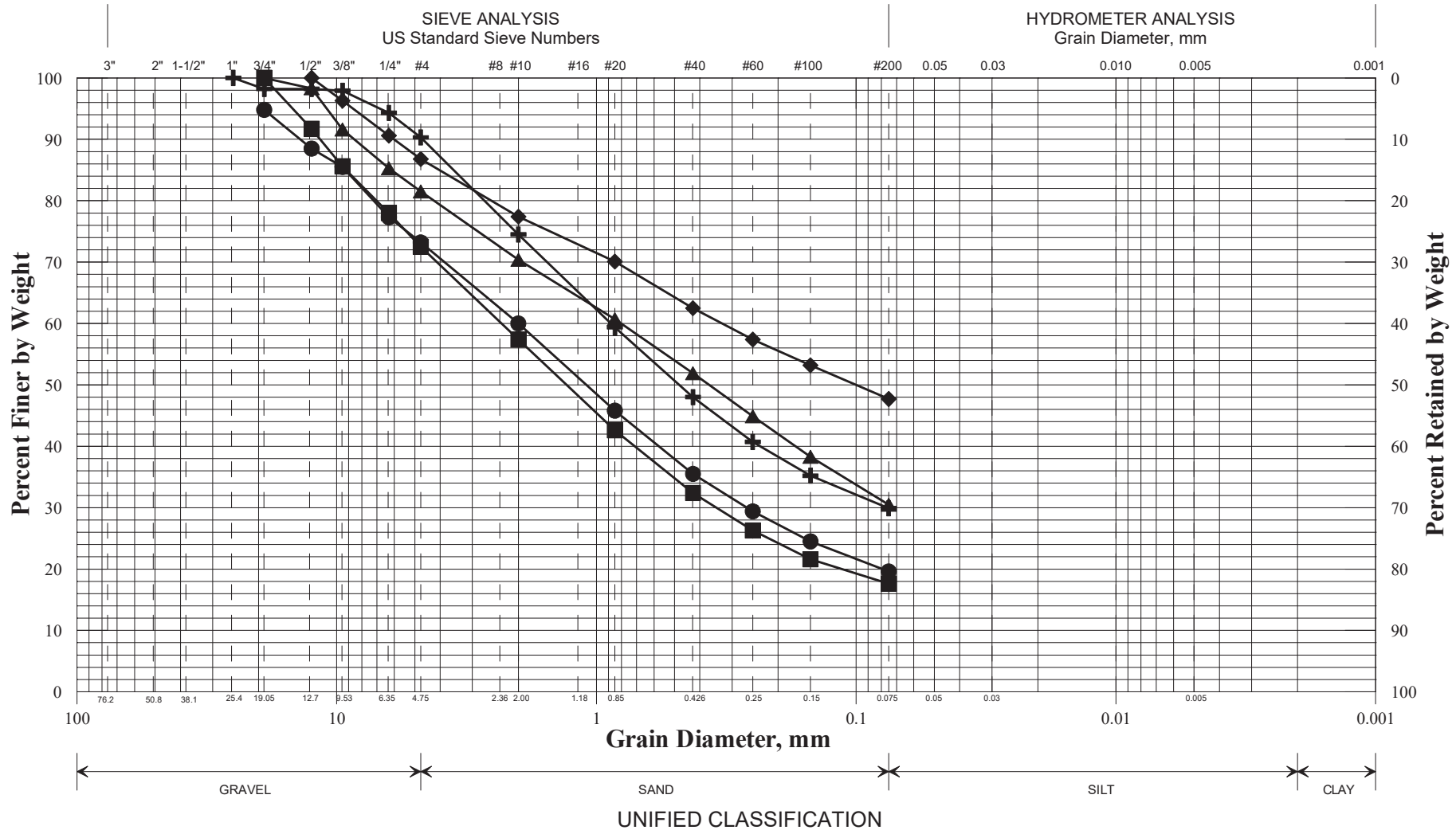
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GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-108/S14	50+10.4	10.7 Lt.	0.67-5.5	SAND, some silt, some gravel.	4.8			
♦	HB-VANB-108/S15	50+10.4	10.7 Lt.	6.5-7.2	Silty SAND, trace gravel.	44.5			
■	HB-VANB-108/S16	50+10.4	10.7 Lt.	7.2 - 8.0	Sandy SILT, trace gravel.	23.3			
●	HB-VANB-110/S17	50+10.3	15.6 Lt.	0.0-7.8	SAND, some gravel, little silt.	5.8			
▲	HB-VANB-111/S18	70+10.3	5.1 Rt.	0.58-6.3	SAND, some silt, little gravel.	6.7			
×	HB-VANB-111/S19	70+10.3	5.1 Rt.	6.3-8.0	Sandy SILT, trace gravel.	20.6			

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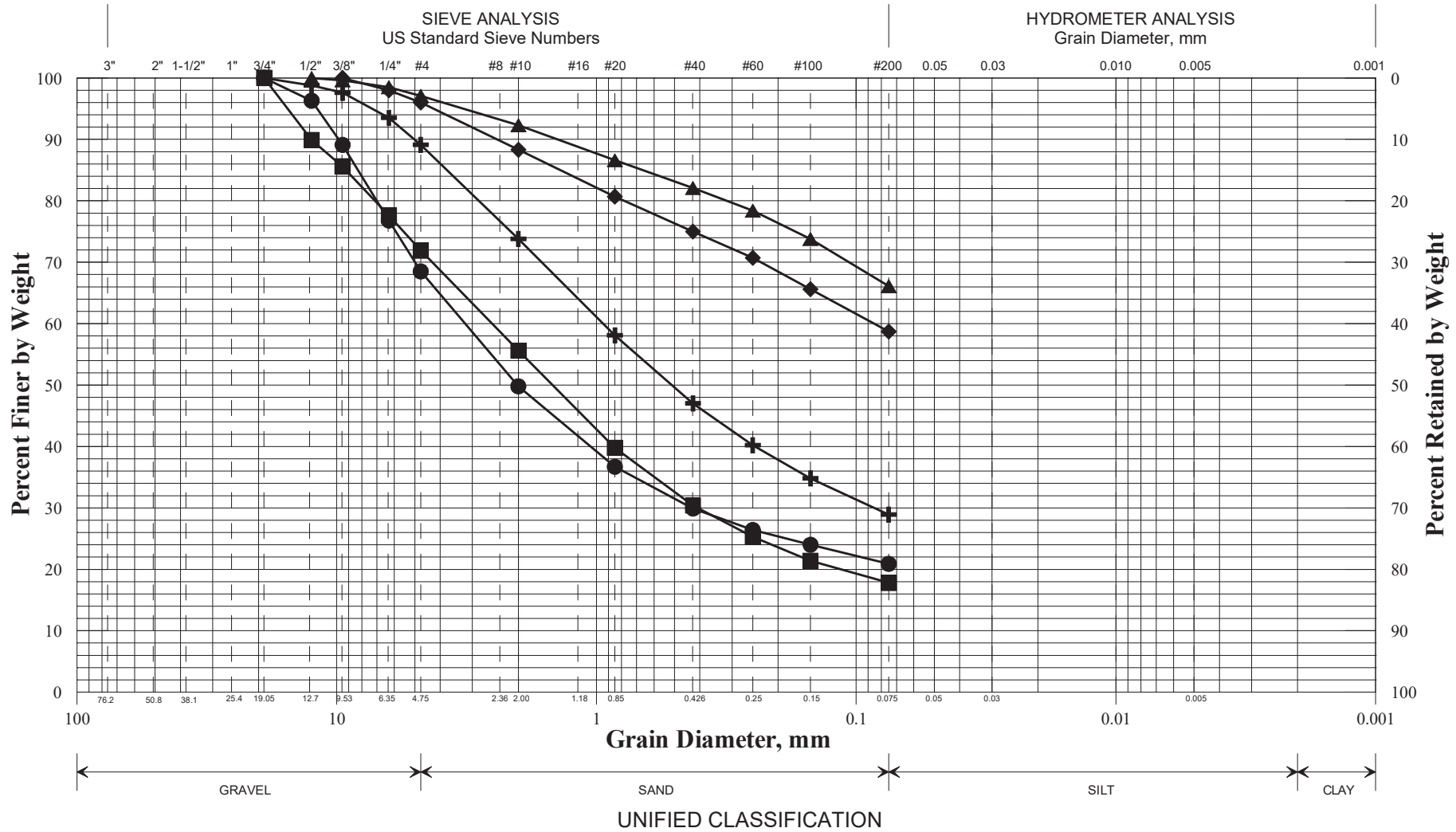
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-113/S20	80+10.4	4.9 Lt.	0.58-2.36	SAND, some silt, trace gravel.	6.3			
◆	HB-VANB-113/S21	80+10.4	4.9 Lt.	2.6-8.0	Sandy SILT, little gravel.	11.1			
■	HB-VANB-114/S22	80+10.4	15.0 Lt.	0.0-2.4	SAND, some gravel, little silt.	4.7			
●	HB-VANB-115/S23	87+70.4	5.1 Rt.	0.5-7.9	SAND, some gravel, little silt.	2.6			
▲	HB-VANB-116/S24	87+70.4	15.1 Rt.	0.0-8.0	SAND, some silt, little gravel.	11.3			
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WHITE, TERRY A 8/11/2014

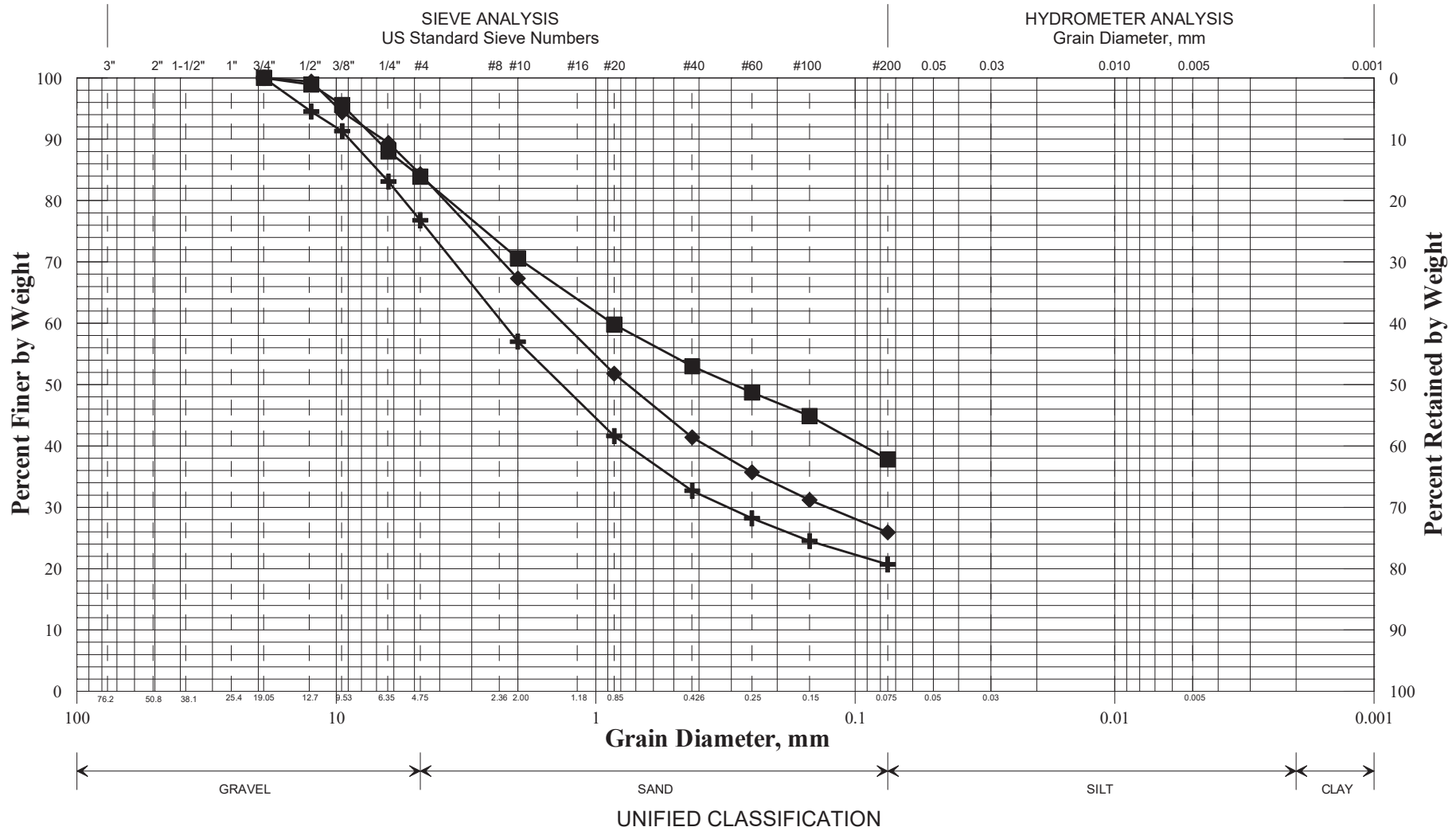
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GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-117/S25	94+10.4	4.9 Lt.	0.5-2.3	SAND, some silt, little gravel.	6.0			
◆	HB-VANB-117/S26	94+10.4	4.9 Lt.	2.3-8.0	Sandy SILT, trace gravel.	12.3			
■	HB-VANB-118/S27	94+10.4	16.0 Lt.	0.0-1.6	SAND, some gravel, little silt.	4.9			
●	HB-VANB-119/S28	100+10.3	5.1 Rt.	0.58-3.8	SAND, some gravel, little silt.	4.4			
▲	HB-VANB-119/S29	100+10.3	5.1 Rt.	3.8-8.0	SILT, some sand, trace gravel.	13.7			
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WHITE, TERRY A	8/11/2014

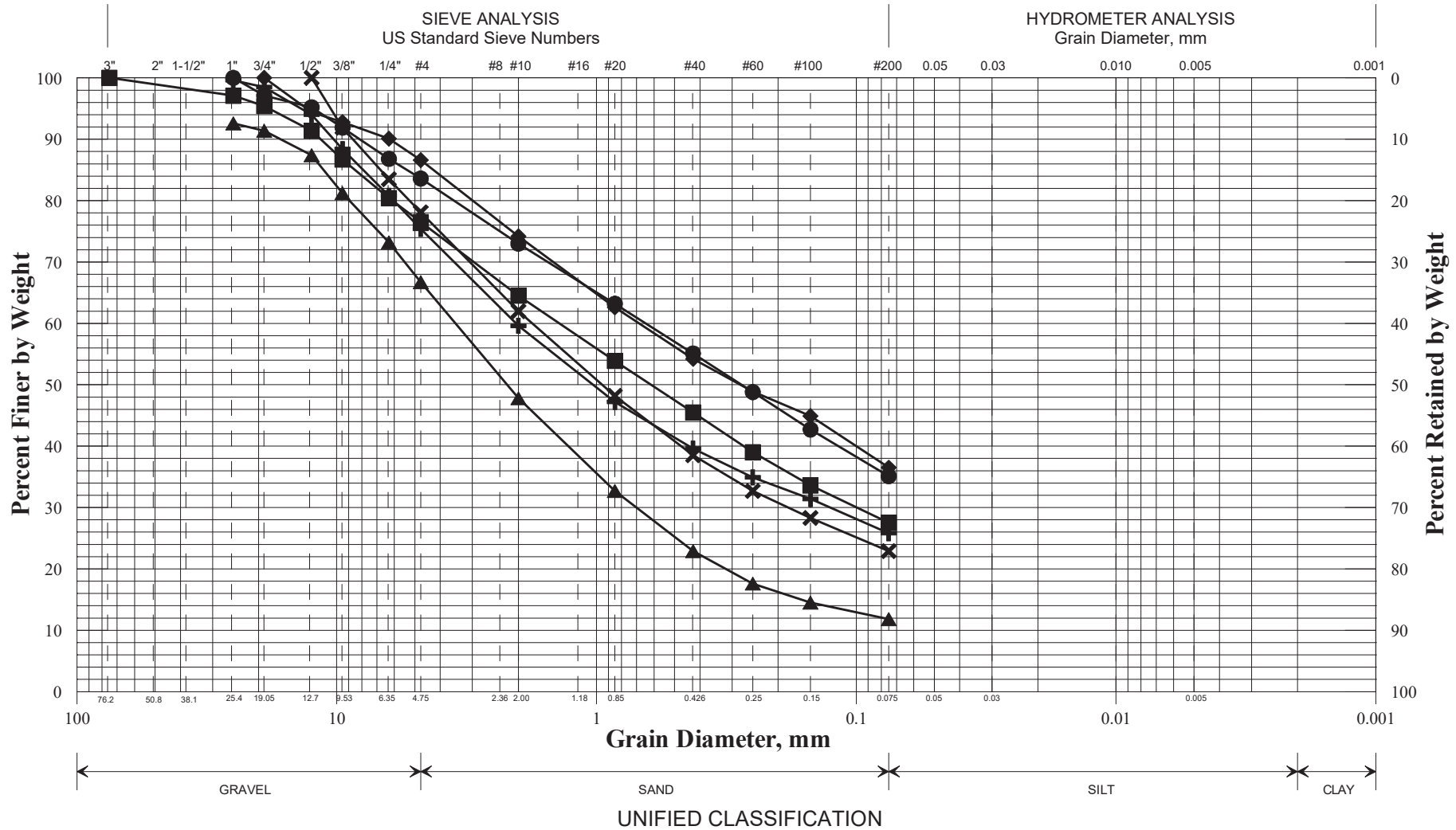
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-120/S30	100+10.4	15.1 Rt.	0.0-2.7	SAND, some gravel, some silt.	4.9			
◆	HB-VANB-121/S31	120+10.4	5.0 Lt.	0.58-2.1	SAND, some silt, little gravel.	5.2			
■	HB-VANB-121/S32	120+10.4	5.0 Lt.	2.1-6.4	Silty SAND, little gravel.	8.5			
●									
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WIN	
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WHITE, TERRY A	8/11/2014

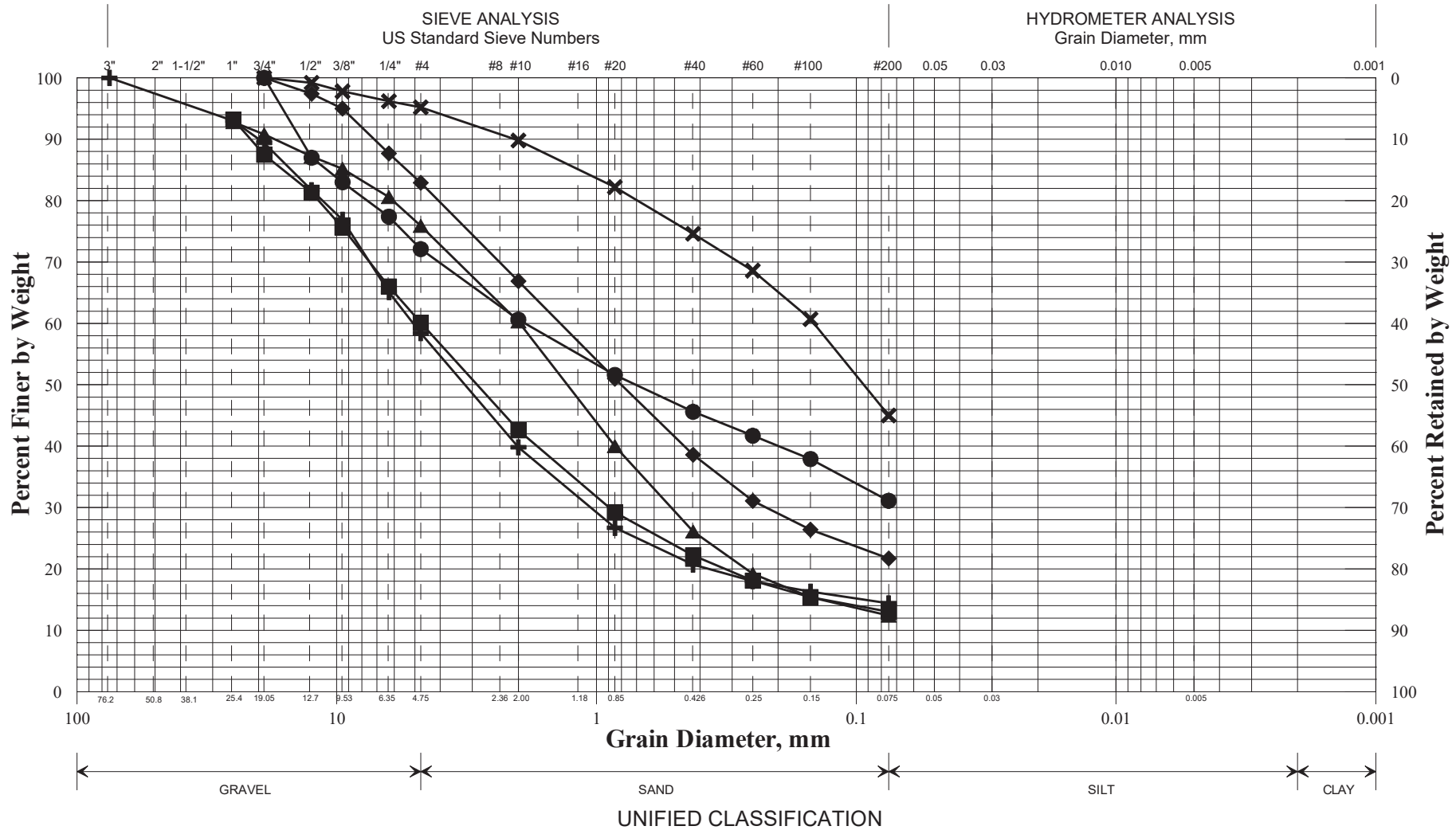
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-201/B1	30+10.4	9.2 Lt.	0.67-1.7	SAND, some silt, some gravel.	5.7			
◆	HB-VANB-201/S1	30+10.4	9.2 Lt.	1.7-4.5	Silty SAND, little gravel.	9.7			
■	HB-VANB-202/B2	42+60.3	14.2 Rt.	0.0-1.7	SAND, some silt, some gravel.	5.7			
●	HB-VANB-202/S2	42+60.3	14.2 Rt.	1.7-4.0	SAND, some silt, little gravel.	9.7			
▲	HB-VANB-203/B3	50+10.3	9.6 Lt.	0.67-2.5	SAND, some gravel, little silt.	3.1			
×	HB-VANB-203/S3	50+10.3	9.6 Lt.	2.5-4.0	SAND, some silt, some gravel.	4.3			

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Van Buren
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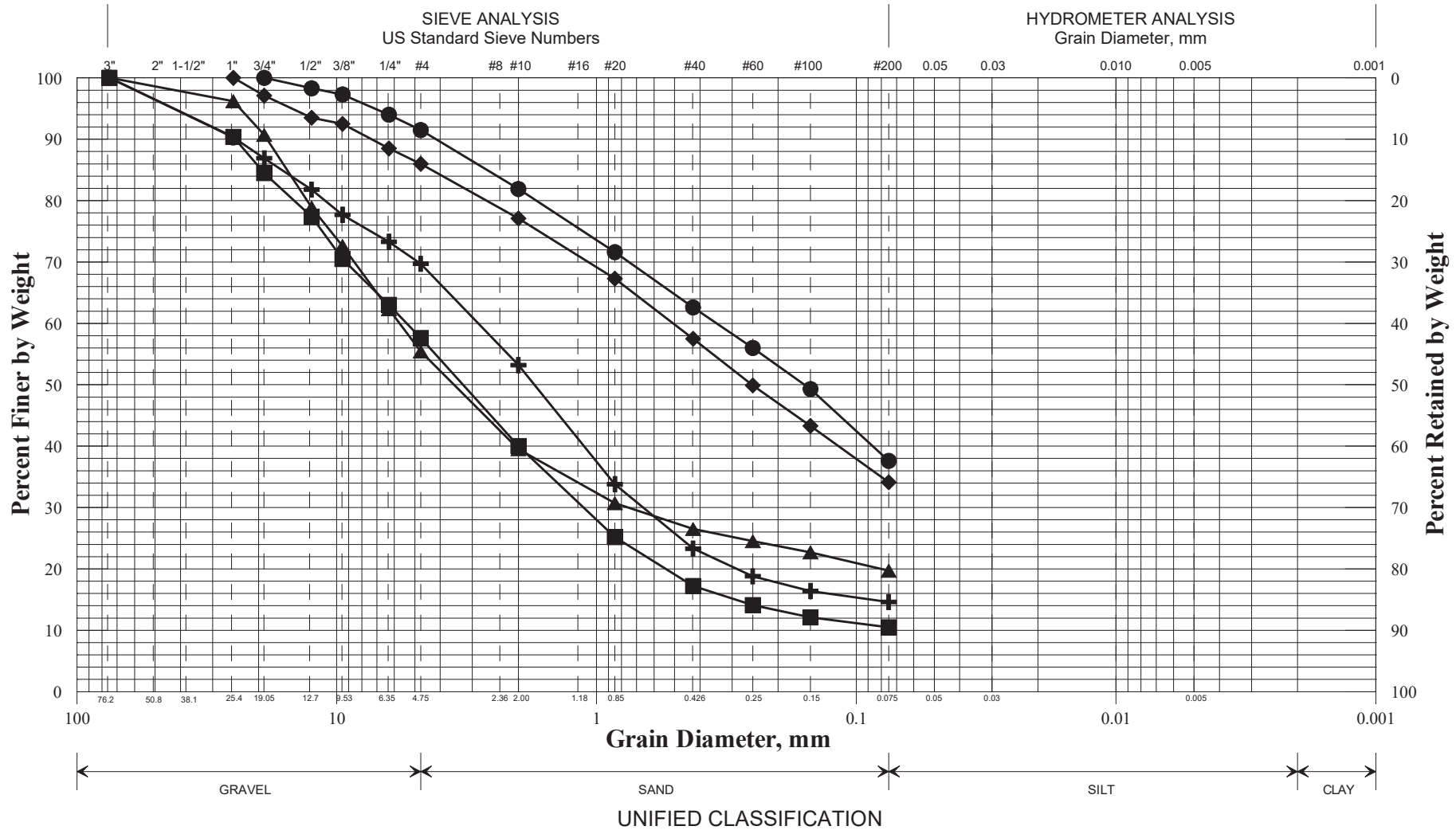
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-204/B4	70+10.4	8.5 Lt.	0.5-3.0	Gravelly SAND, little silt.	4.3			
◆	HB-VANB-204/S4	70+10.4	8.5 Lt.	3.0-4.5	SAND, some silt, little gravel..	5.5			
■	HB-VANB-205/B5	80+10.4	7.6 Lt.	0.67-2.0	Gravelly SAND, little silt.	3.5			
●	HB-VANB-205/S5	80+10.4	7.6 Lt.	2.0-4.5	SAND, some silt, some gravel.	11.6			
▲	HB-VANB-206/B6	87+70.4	8.0 Rt.	0.63-2.2	SAND, some gravel, little silt.	3.8			
×	HB-VANB-206/S6	87+70.4	8.0 Rt.	2.2-4.5	Silty SAND, trace gravel.	28.1			

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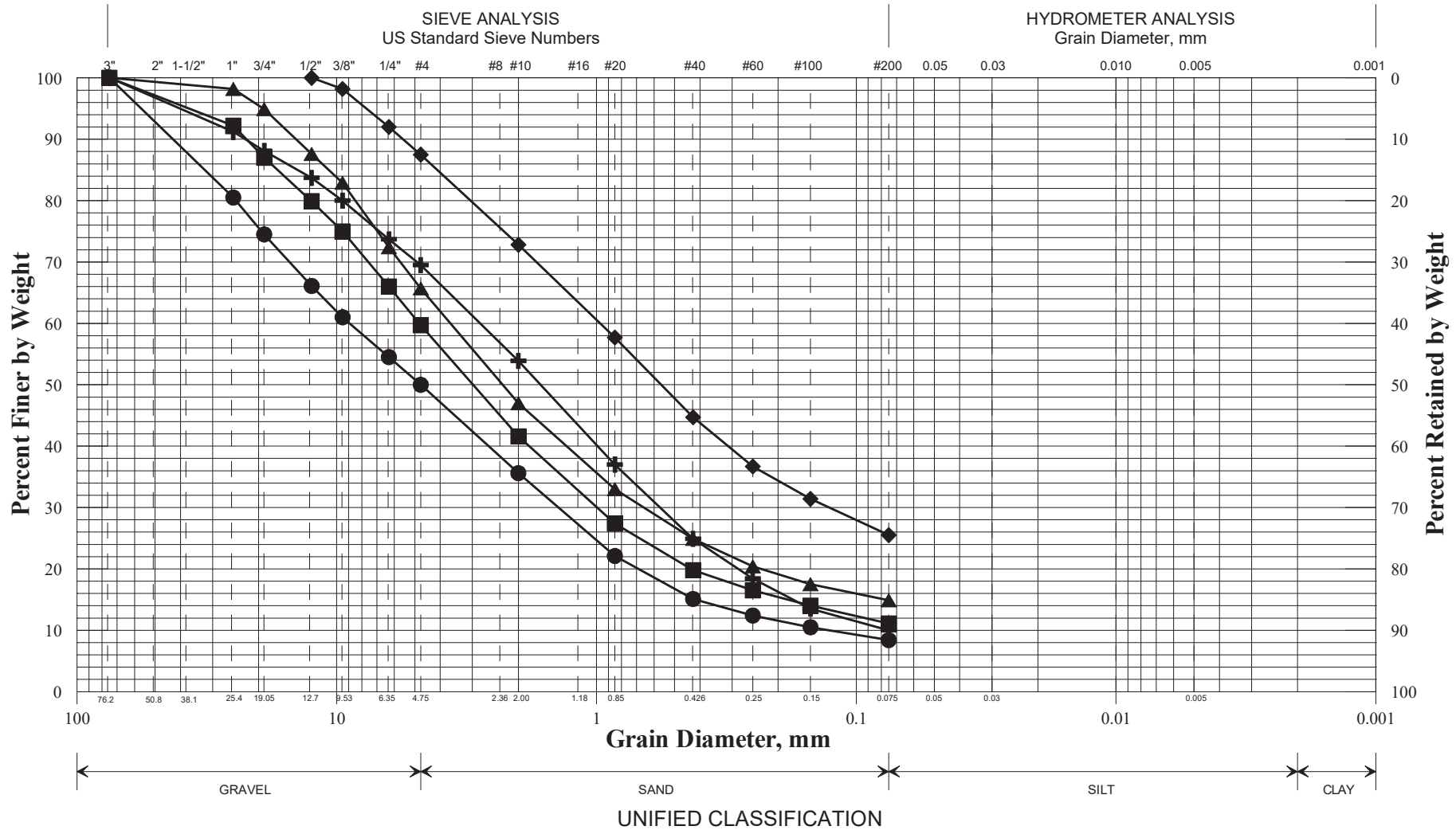
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GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-207/B7	94+10.4	13.9 Lt.	0.0-1.5	SAND, some gravel, little silt.	3.8			
◆	HB-VANB-207/S7	94+10.4	13.9 Lt.	1.5-4.0	SAND, some silt, little gravel.	20.0			
■	HB-VANB-208/B8	100+10.4	8.0 Rt.	0.5-2.9	Gravelly SAND, little silt.	3.3			
●	HB-VANB-208/S8	100+10.4	8.0 Rt.	2.9-4.5	Silty SAND, trace gravel.	9.9			
▲	HB-VANB-209/S9	120+10.3	8.1 Lt.	2.3-4.0	Sandy GRAVEL, little silt.	17.8			
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Town
Van Buren
Reported by/Date
WHITE, TERRY A 7/27/2015

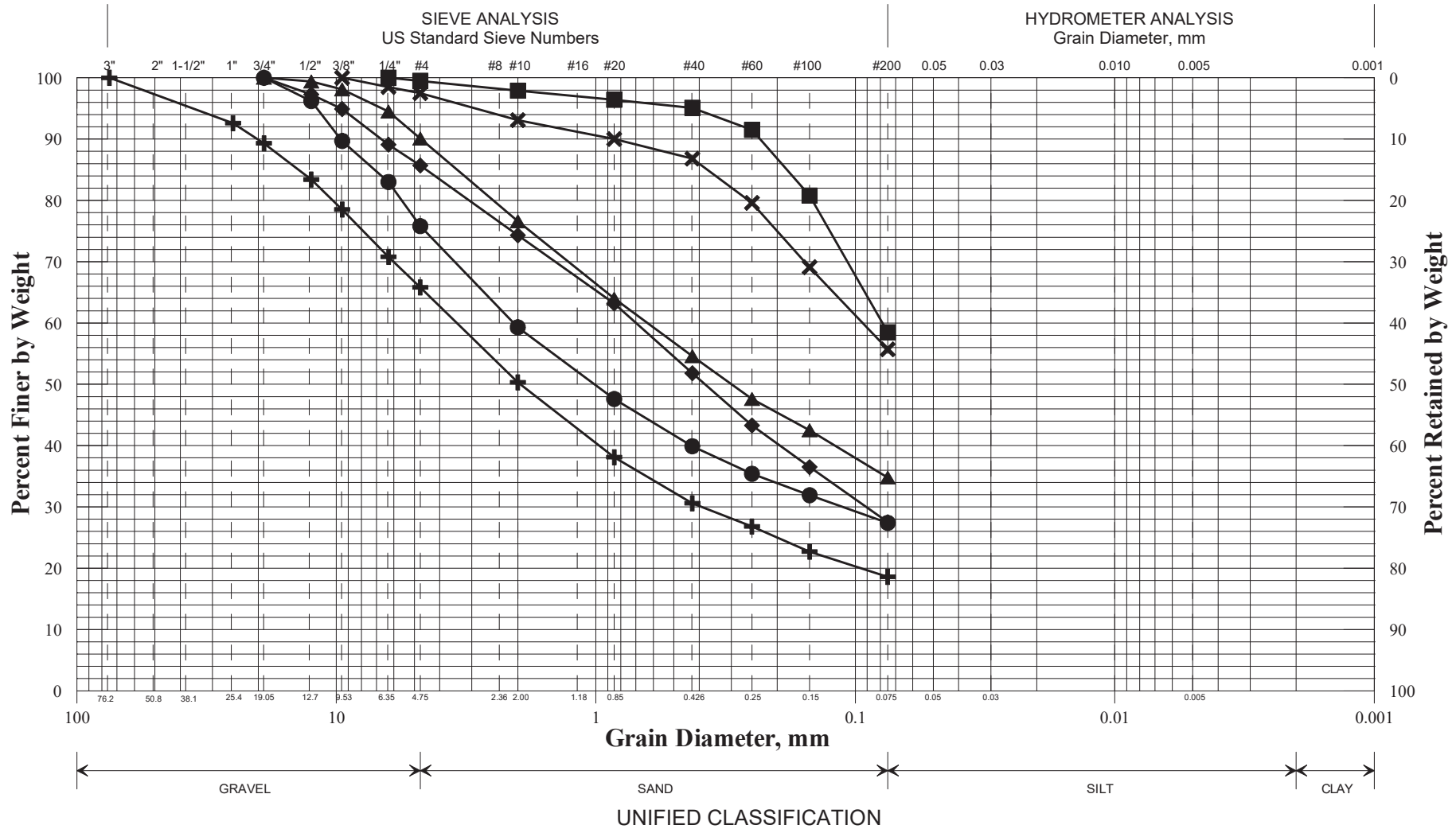
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GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-210/B10	130+10.4	8.0 Rt.	0.42-2.3	SAND, some gravel, trace silt.	3.3			
◆	HB-VANB-210/S10	130+10.4	8.0 Rt.	2.3-4.0	SAND, some silt, little gravel.	7.0			
■	HB-VANB-211/B11	140+10	7.0 Lt.	0.42-4.5	Gravelly SAND, little silt.	3.9			
●	HB-VANB-212/B12	140+10	14.0 Lt.	0.0-4.5	Sandy GRAVEL, trace silt.	4.5			
▲	HB-VANB-213/B13	150+10.3	9.3 Rt.	0.58-4.5	SAND, some gravel, little silt.	4.0			
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Town
Van Buren
Reported by/Date
WHITE, TERRY A 7/27/2015

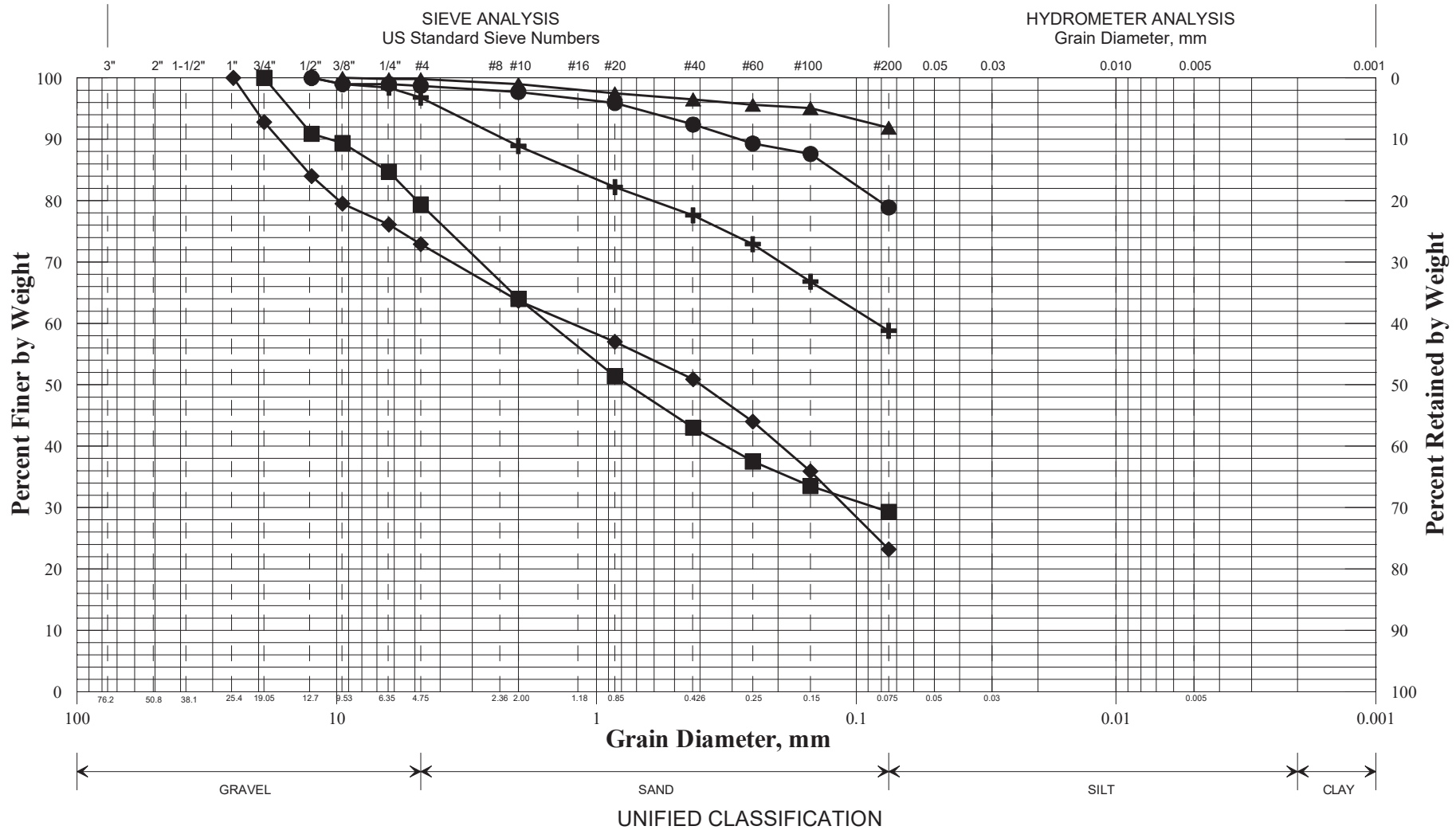
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GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-214/B14	150+10.3	15.8 Rt.	0.0-3.3	SAND, some gravel, little silt.	6.5			
◆	HB-VANB-214/S11	150+10.3	15.8 Rt.	3.3-4.5	SAND, some silt, little gravel.	19.4			
■	HB-VANB-215/S12	23+10.4	6.7 Rt.	7.5-8.6	Sandy SILT, trace gravel.	43.6			NP
●	HB-VANB-216/S13	24+85.4	9.8 Lt.	0.67-2.0	SAND, some silt, some gravel.	7.2			
▲	HB-VANB-216/S14	24+85.4	9.8 Lt.	2.0-6.0	SAND, some silt, trace gravel.	9.2			
×	HB-VANB-216/S15	24+85.4	9.8 Lt.	6.4-9.5	Sandy SILT, trace gravel.	26.9			NP

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Town
Van Buren
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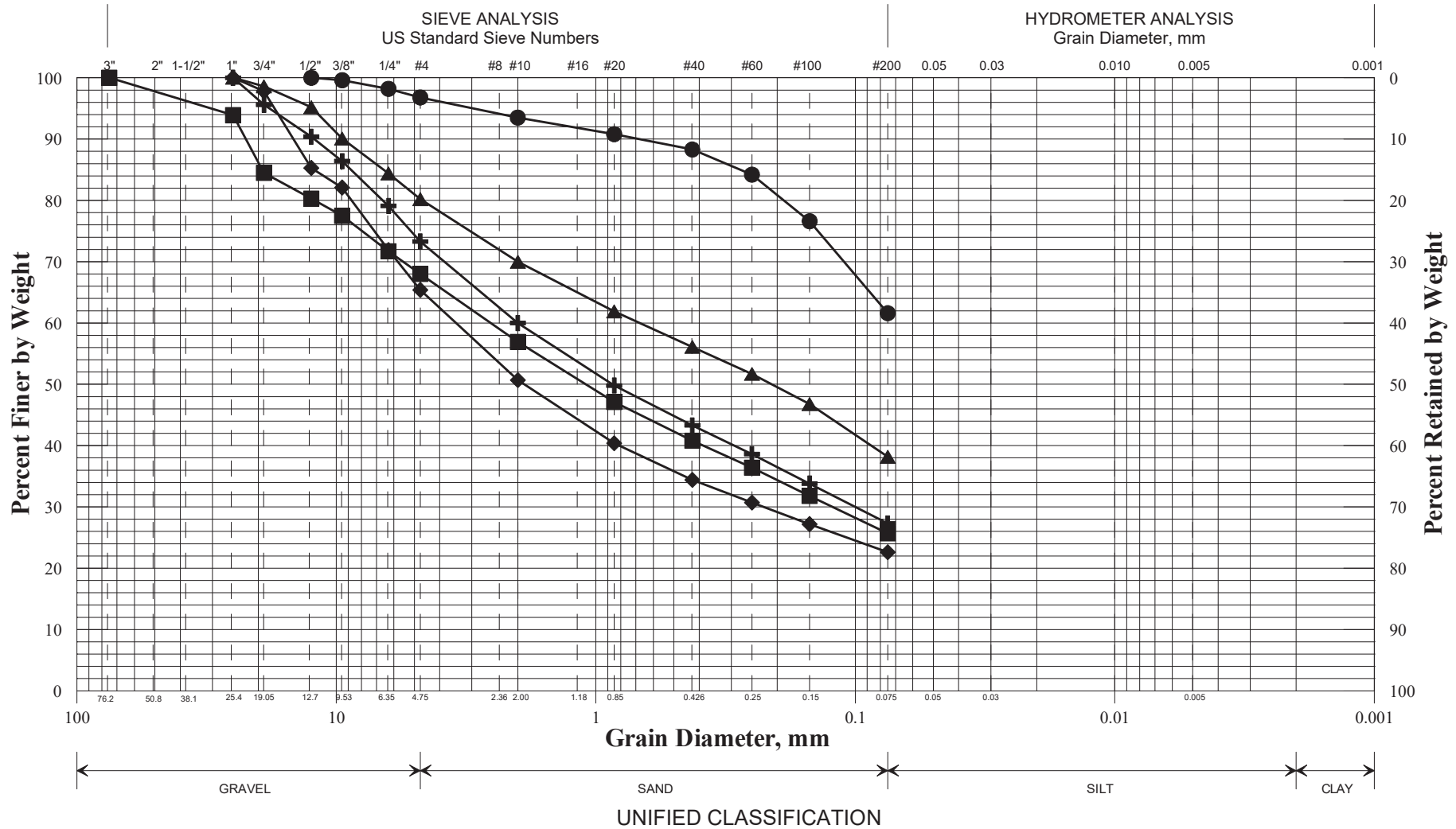
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	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-217/S16	27+10.4	6.7 Rt.	4.5-6.1	Sandy SILT, trace gravel.	41.3			NP
◆	HB-VANB-219/1D	31+10.4	6.8 Rt.	3.0-5.0	SAND, some gravel, some silt.	18.9			
■	HB-VANB-219/2D	31+10.4	6.8 Rt.	5.1-5.9	SAND, some silt, some gravel.	50.5			
●	HB-VANB-219/2DA	31+10.4	6.8 Rt.	5.9-7.0	SILT, little sand, trace gravel.	21.5	26	24	2
▲	HB-VANB-219/3D	31+10.4	6.8 Rt.	7.0-9.0	SILT, trace sand, trace gravel.	34.2	31	24	7
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Town
Van Buren
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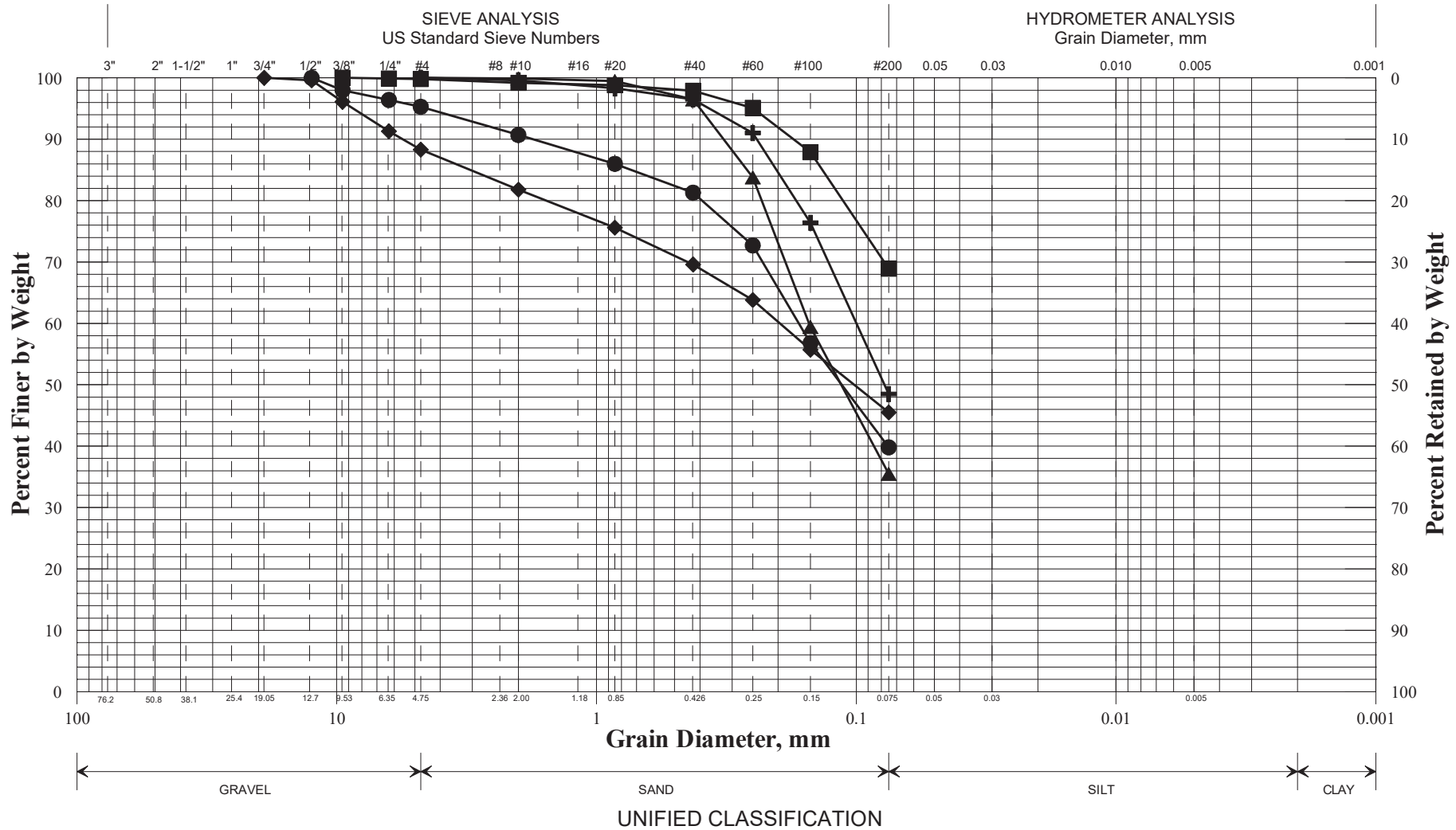
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	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-221/1D	35+10.4	9.1 Lt.	3.0-5.0	SAND, some silt, some gravel.	8.2			
◆	HB-VANB-221/2D	35+10.4	9.1 Lt.	5.0-7.0	SAND, some gravel, some silt.	7.6			
■	HB-VANB-221/3D	35+10.4	9.1 Lt.	7.0-9.0	SAND, some gravel, some silt.	9.6			
●	HB-VANB-222/S17	37+10.3	7.1 Rt.	1.4-4.5	Sandy SILT, trace gravel.	16.7			
▲	HB-VANB-222/S18	37+10.3	7.1 Rt.	4.5-9.0	Silty SAND, little gravel.	11.1			
×									

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020421.00
Town
Van Buren
Reported by/Date
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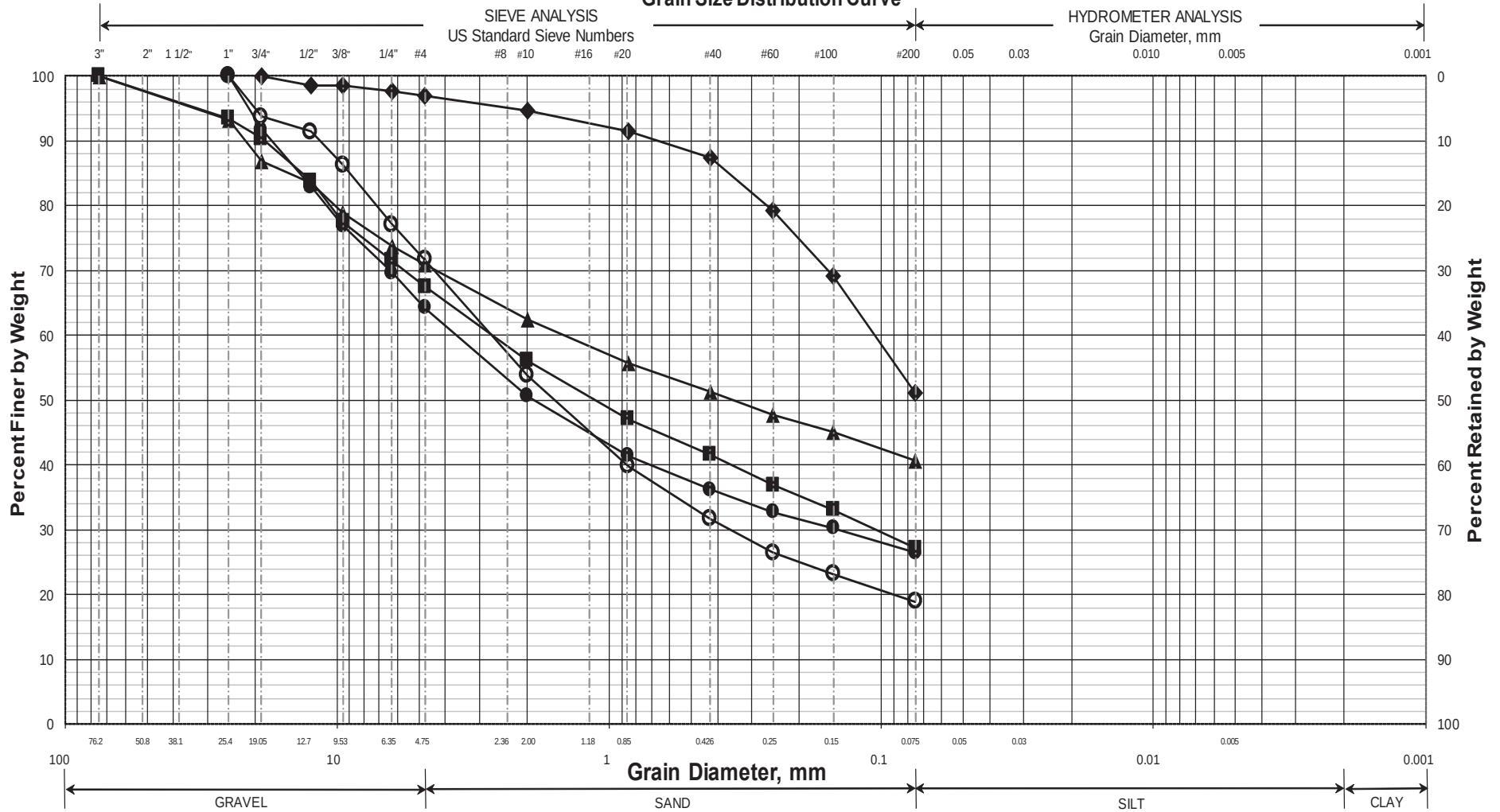
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-VANB-224/1D	41+10.4	7.1 Rt.	3.0-5.0	Silty SAND.	21.9			
◆	HB-VANB-224/2D	41+10.4	7.1 Rt.	5.0-7.0	Sandy SILT, little gravel.	13.7			
■	HB-VANB-224/3D	41+10.4	7.1 Rt.	7.0-9.0	SILT, some sand, trace gravel.	19.1			
●	HB-VANB-226/1D	45+10.4	8.7 Lt.	3.0-5.0	Silty SAND, trace gravel.	16.3			
▲	HB-VANB-226/2D	45+10.4	8.7 Lt.	5.0-7.0	SAND, some silt.	19.6			
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WIN
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Town
Van Buren
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WHITE, TERRY A 7/27/2015

Maine Department of Transportation Grain Size Distribution Curve

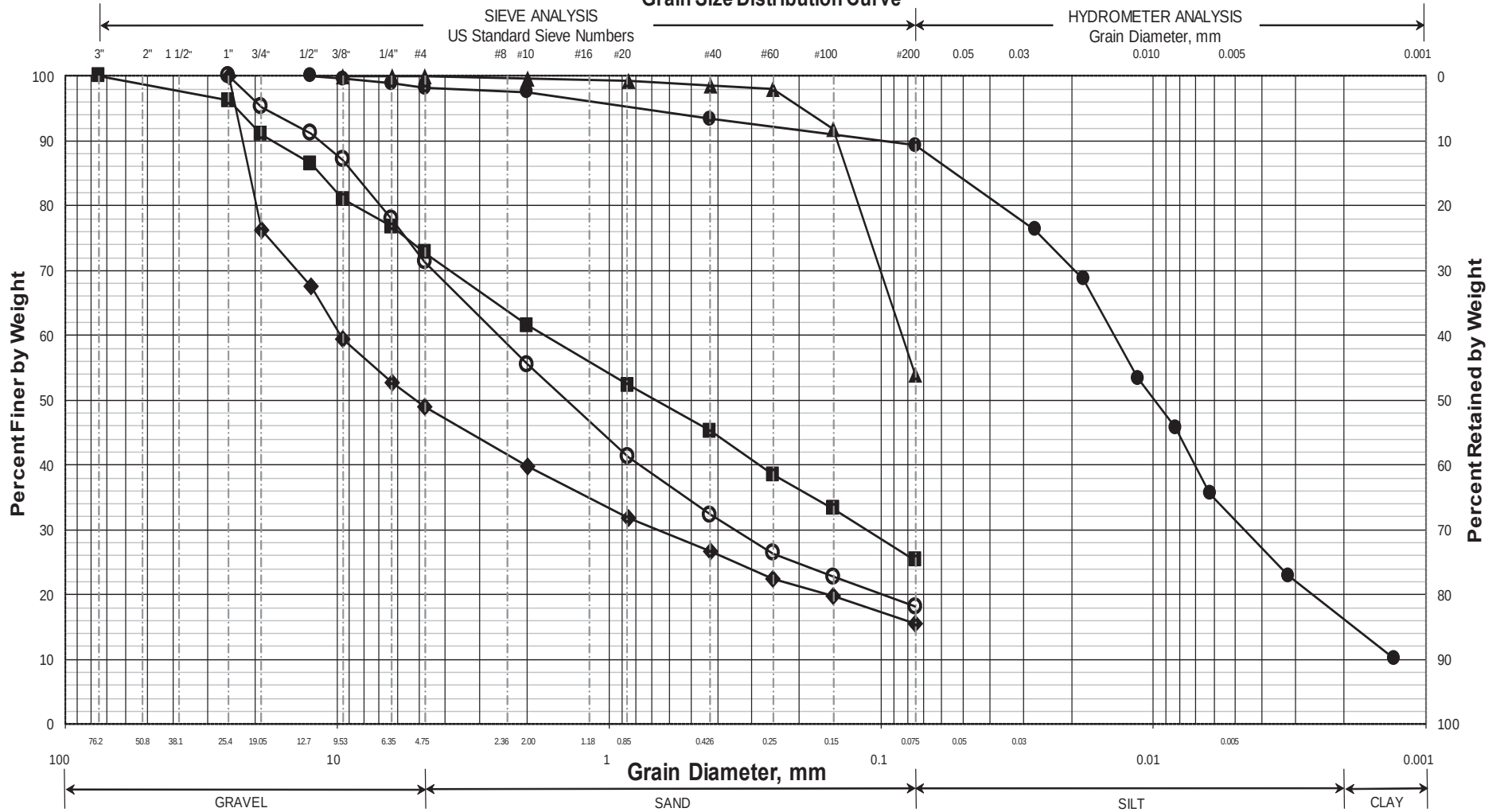


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-VANB-301/1D	33+51.6	13.5 LT	0.0-2.0	SAND, some gravel, little silt.	5.4			
◆	HB-VANB-301/2D	33+51.6	13.5 LT	5.5-7.0	Sandy SILT, trace gravel.	20.6			
■	HB-VANB-301/3D	33+51.6	13.5 LT	10.0-12.0	SAND, some gravel, some silt.	9.5			
●	HB-VANB-301/4D	33+51.6	13.5 LT	15.0-17.0	SAND, some gravel, some silt.	8.5			
▲	HB-VANB-301/5D	33+51.6	13.5 LT	20.0-22.0	SILT, some sand, some gravel.	9.8			
X									

WIN
020421.00
Town
Van Buren
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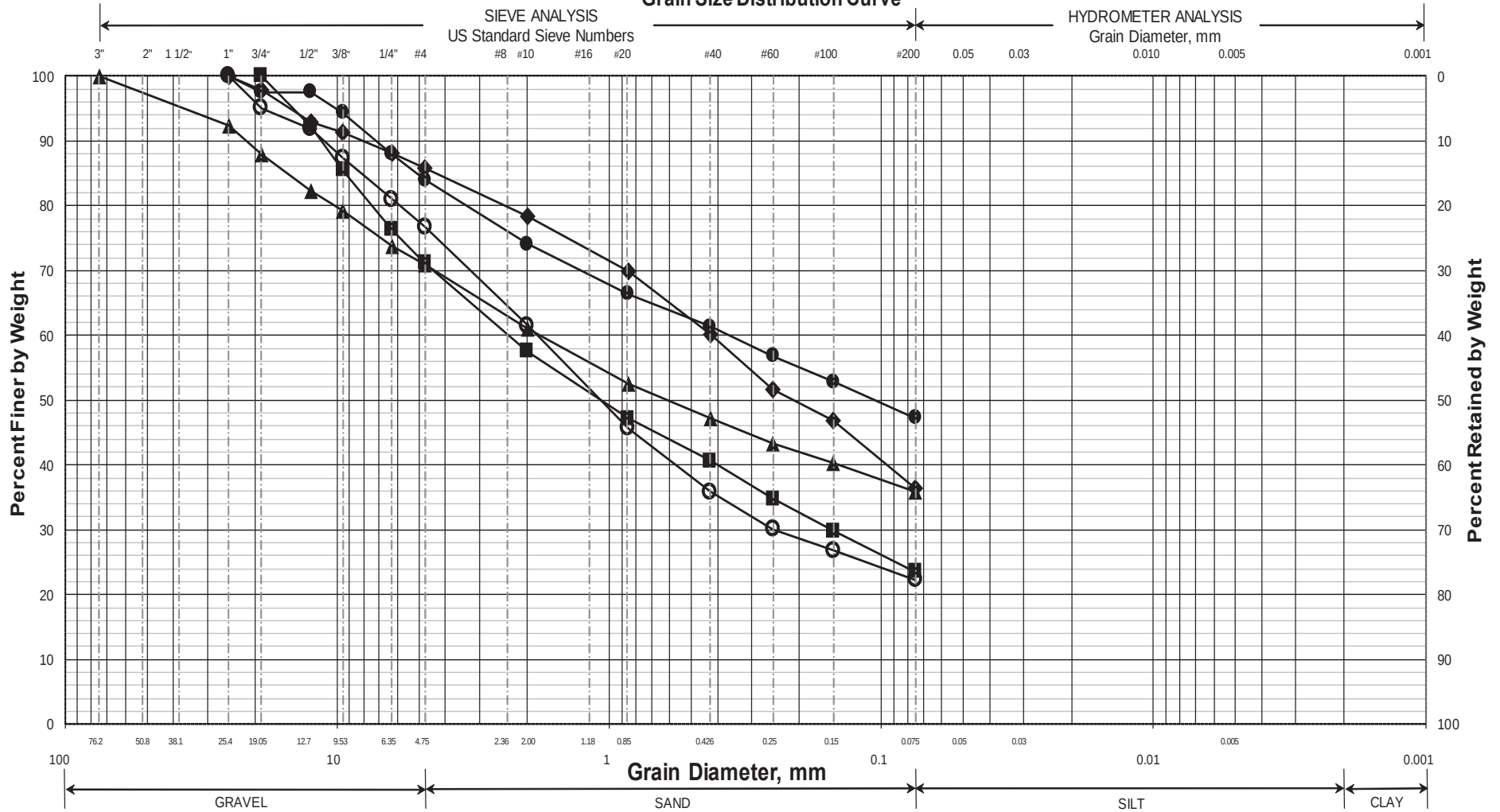


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
O	HB-VANB-303/1D	50+18.5	11.7 RT	0.0-2.0	SAND, some gravel, little silt.	7.1			
◆	HB-VANB-303/2D	50+18.5	11.7 RT	5.0-7.0	GRAVEL, some sand, little silt.	6.1			
■	HB-VANB-303/3D	50+18.5	11.7 RT	10.0-12.0	SAND, some gravel, some silt.	13.2			
●	HB-VANB-303/4D	50+18.5	11.7 RT	15.0-17.0	SILT, little clay, trace sand, trace gravel.	15.7			
▲	HB-VANB-303/5D	50+18.5	11.7 RT	20.0-22.0	Sandy SILT, trace gravel.	12.5			
X									

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020421.00
Town
Van Buren
Reported by/Date
WHITE, TERRY A 11/21/2018

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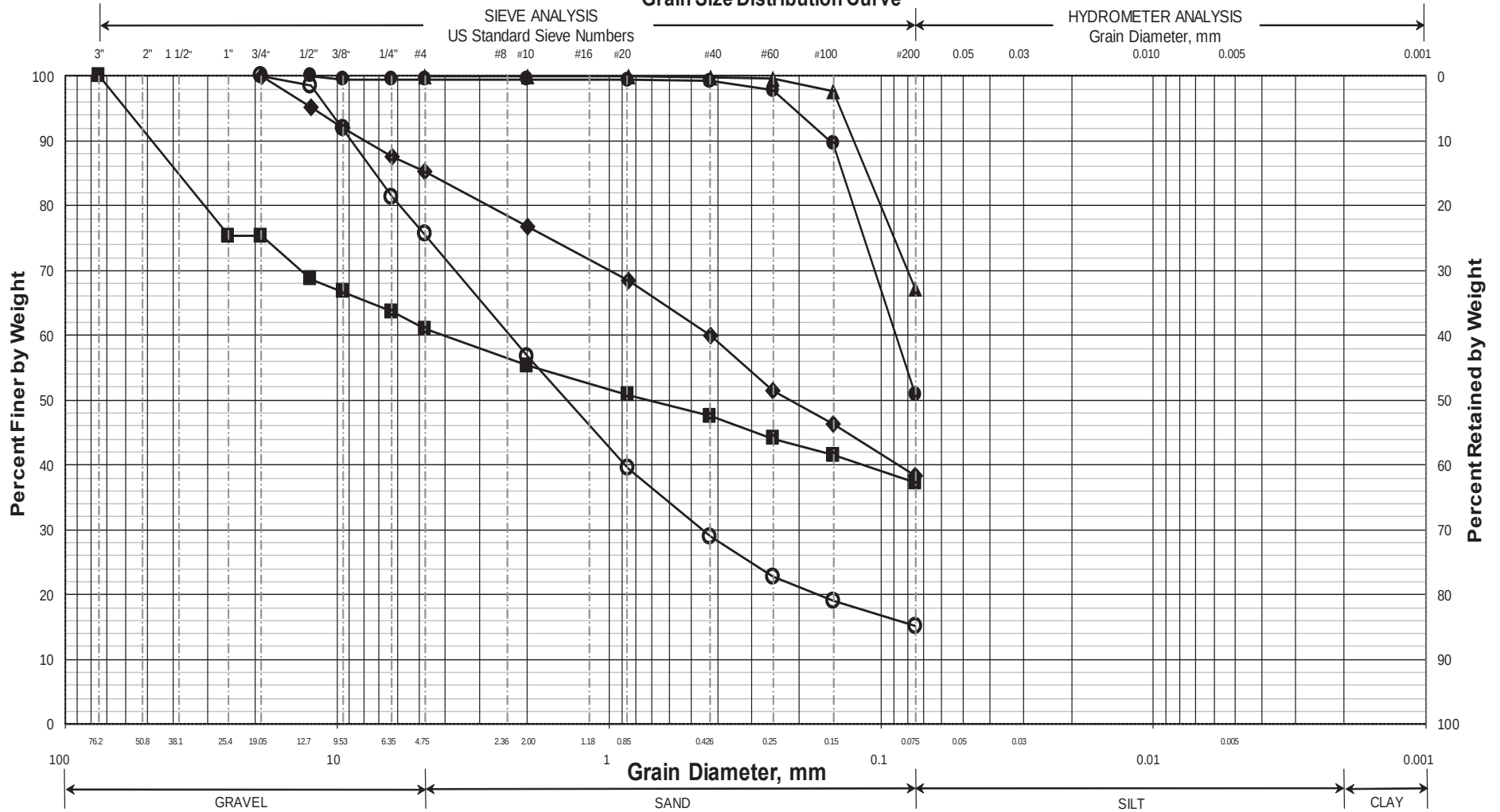


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-VANB-305/1D	118+27.2	11.0 LT	1.0-3.0	SAND, some gravel, some silt.	5.9			
◆	HB-VANB-305/2D	118+27.2	11.0 LT	5.5-7.0	Silty SAND, little gravel.	23.3			
■	HB-VANB-305/3D	118+27.2	11.0 LT	10.0-12.0	SAND, some gravel, some silt.	11.4			
●	HB-VANB-305/4D	118+27.2	11.0 LT	15.0-17.0	Sandy SILT, little gravel.	12.1			
▲	HB-VANB-305/5D	118+27.2	11.0 LT	20.0-22.0	SAND, some silt, some gravel.	9.3			
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WIN
020421.00
Town
Van Buren
Reported by/Date
WHITE, TERRY A 11/21/2018

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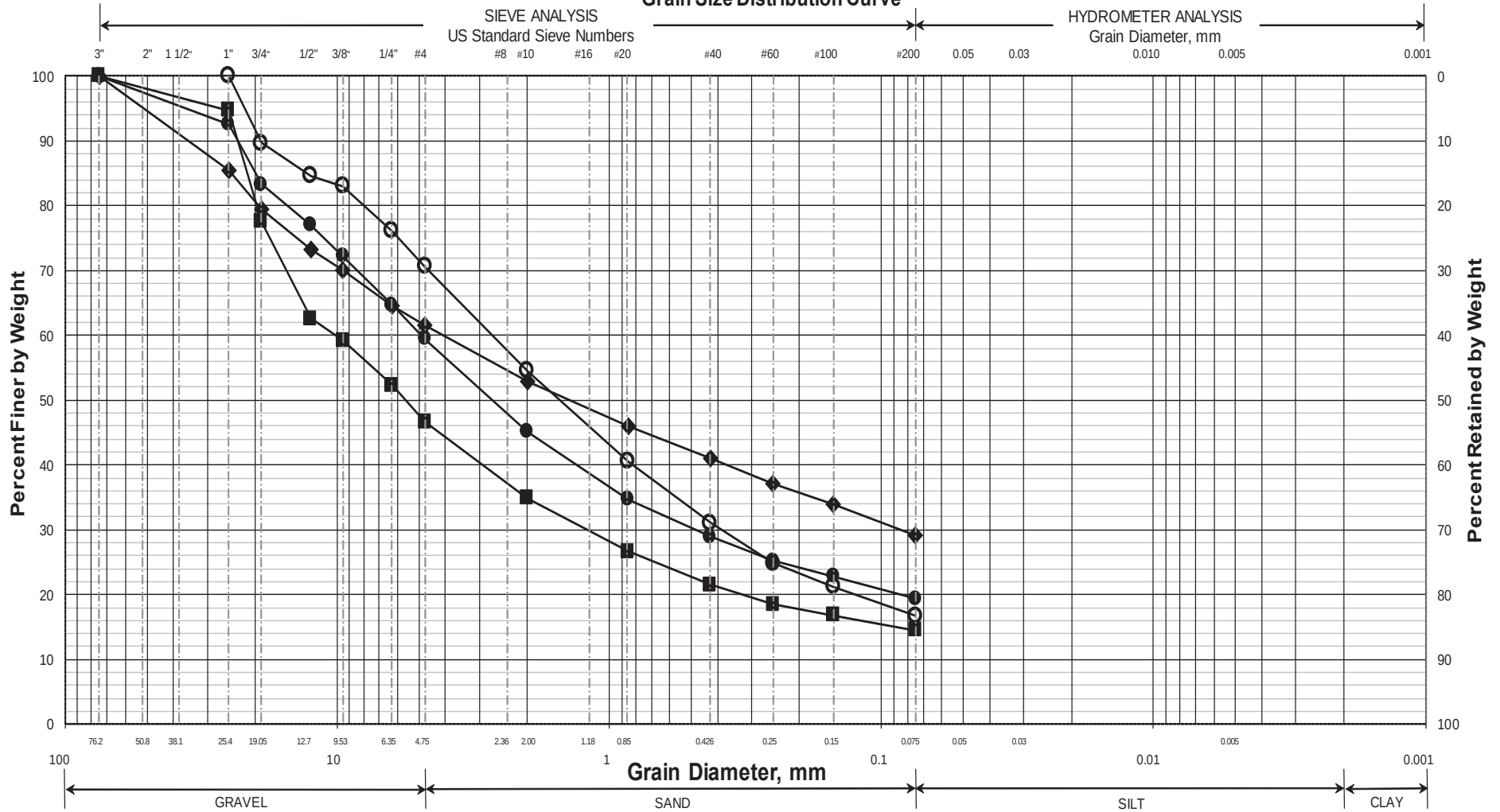


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-VANB-307/1D	135+49.3	10.8 LT	0.0-2.0	SAND, some gravel, little silt.	6			
◆	HB-VANB-307/2D	135+49.3	10.8 LT	5.0-7.0	Silty SAND, little gravel.	14.1			
■	HB-VANB-307/3D	135+49.3	10.8 LT	10.0-12.0	Silty GRAVEL, some sand.	16.3			
●	HB-VANB-307/4D	135+49.3	10.8 LT	15.0-17.0	Sandy SILT, trace gravel.	10.7			
▲	HB-VANB-307/5D	135+49.3	10.8 LT	20.0-22.0	SILT, some sand.	22.4			
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020421.00
Town
Van Buren
Reported by/Date
WHITE, TERRY A 11/21/2018

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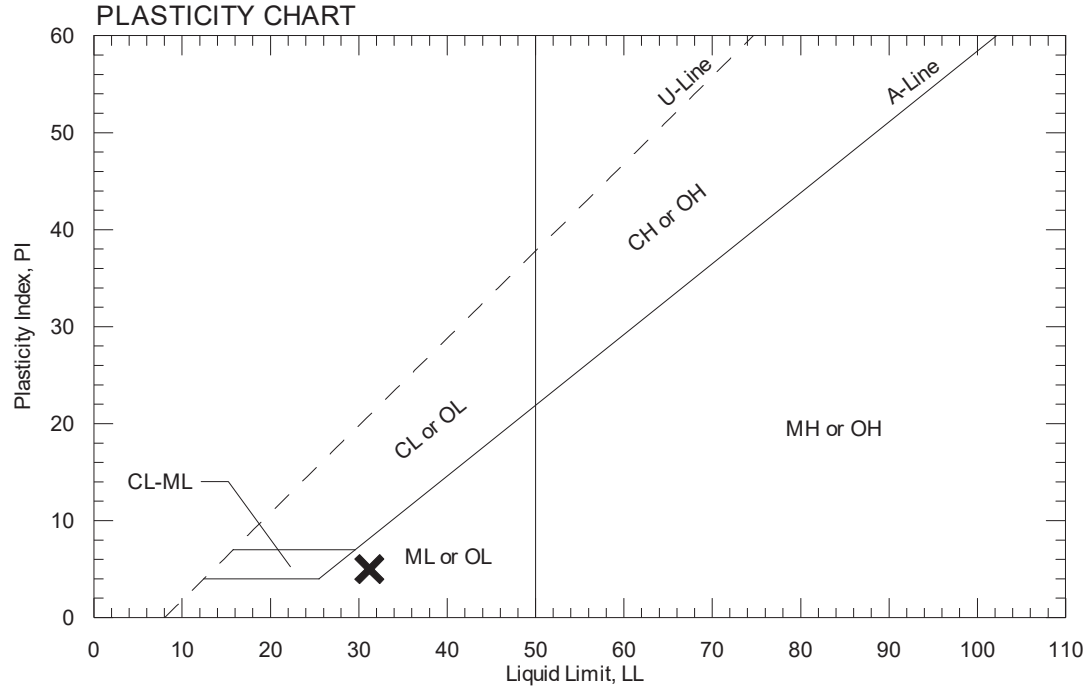
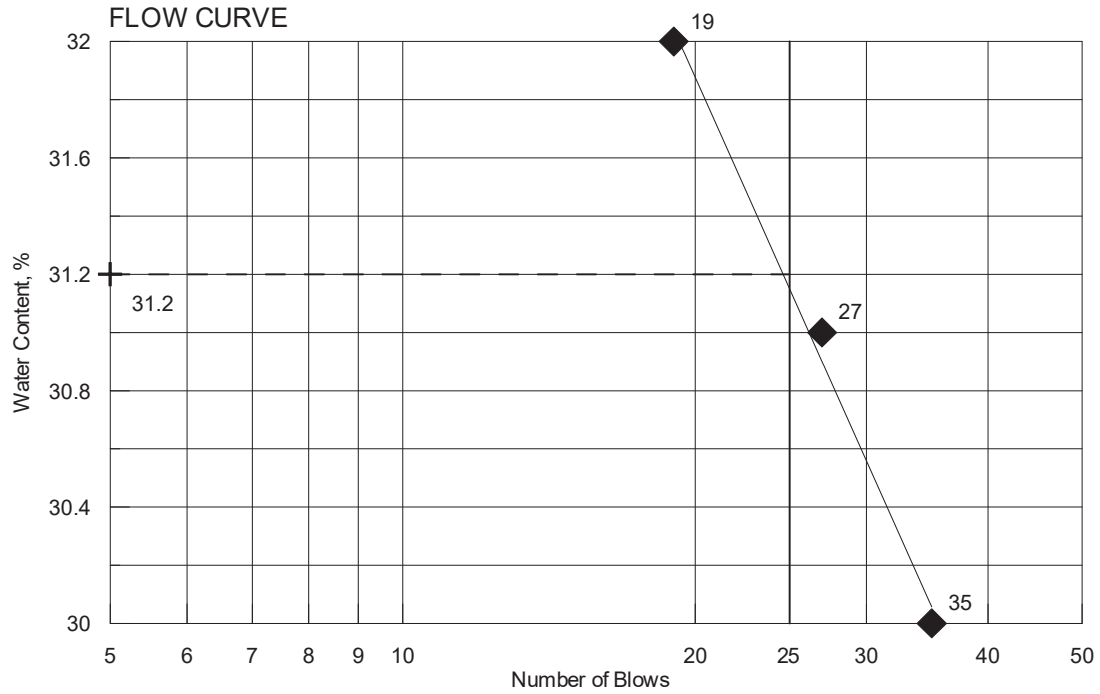


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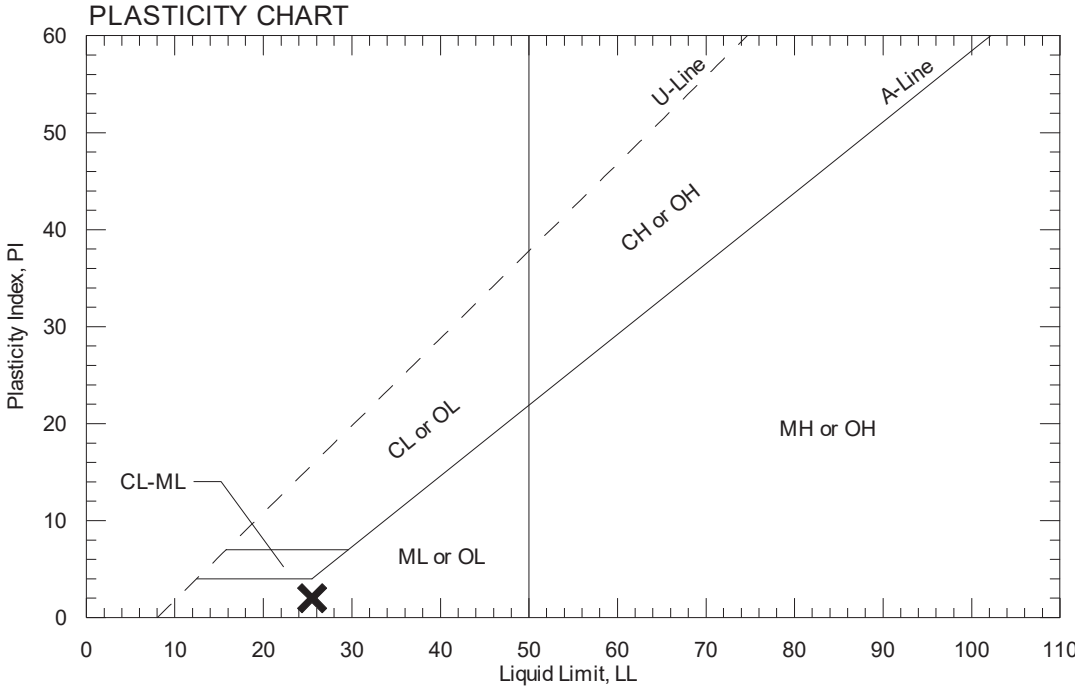
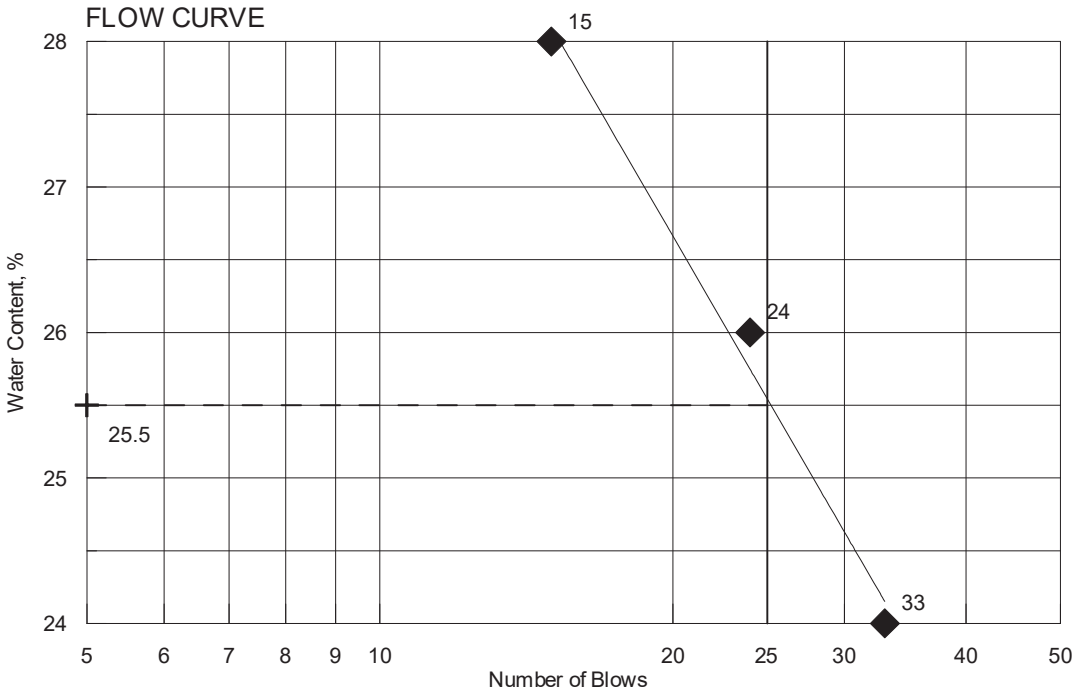
	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-VANB-309/1D	140+54.4	12.0 LT	5.0-7.0	SAND, some gravel, little silt.	5.8			
◆	HB-VANB-309/2D	140+54.4	12.0 LT	10.0-12.0	GRAVEL, some sand, some silt.	7.9			
■	HB-VANB-309/3D	140+54.4	12.0 LT	15.0-17.0	GRAVEL, some sand, little silt.	6.9			
●	HB-VANB-309/4D	140+54.4	12.0 LT	20.0-22.0	Gravelly SAND, little silt.	8.2			
▲									
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WIN
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Town
Van Buren
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WHITE, TERRY A 11/21/2018

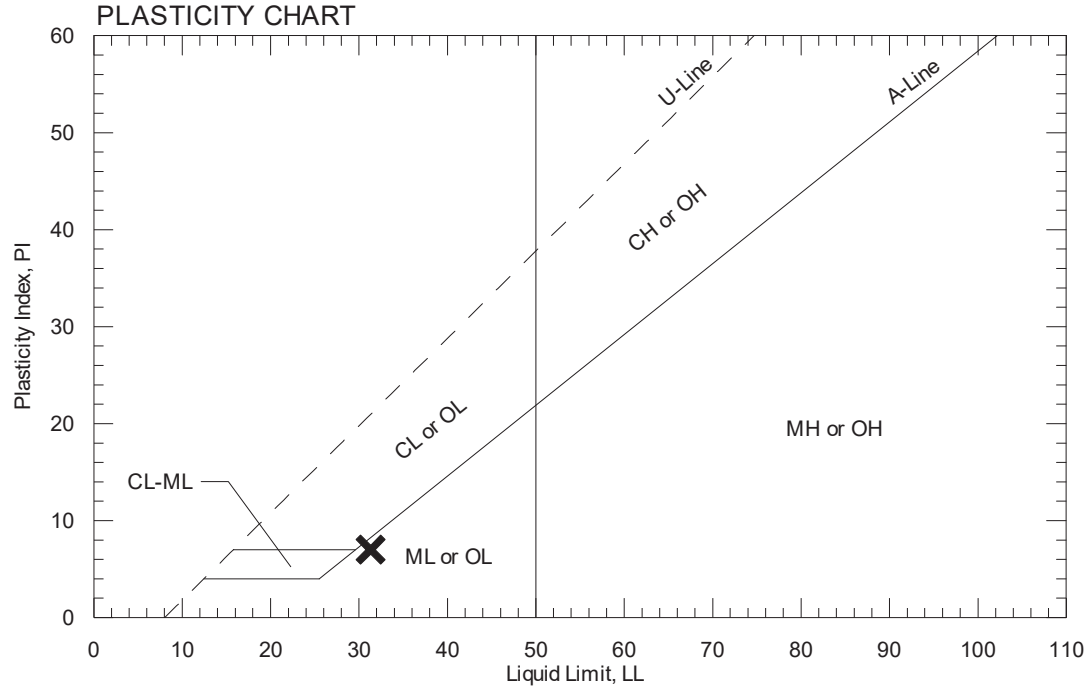
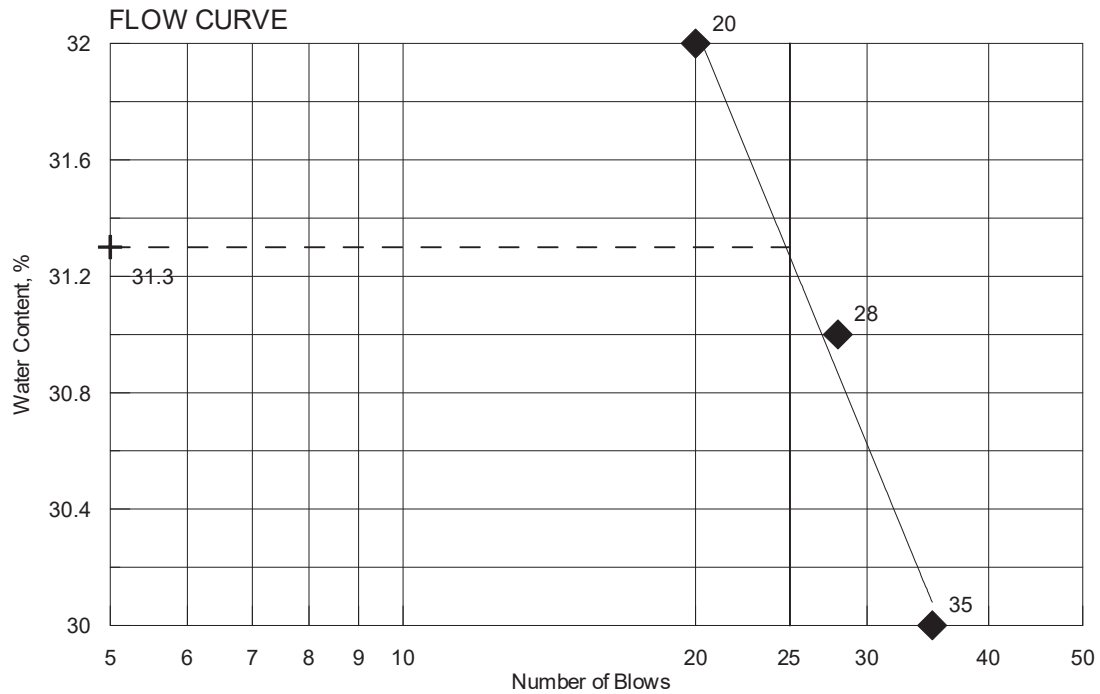
TOWN	Van Buren	Reference No.	264532
WIN	020421.00	Water Content, %	30
Sampled	7/22/2014	Liquid Limit @ 25 blows (T 89), %	31
Boring No./Sample No.	HB-VANB-104/S7	Plastic Limit (T 90), %	26
Station	30+10.3	Plasticity Index (T 90), %	5
Depth	7.0-10.0	Tested By	BBURR



TOWN	Van Buren	Reference No.	263879
WIN	020421.00	Water Content, %	21.5
Sampled	6/15/2015	Liquid Limit @ 25 blows (T 89), %	26
Boring No./Sample No.	HB-VANB-219/2DA	Plastic Limit (T 90), %	24
Station	31+10.4	Plasticity Index (T 90), %	2
Depth	5.9-7.0	Tested By	BBURR



TOWN	Van Buren	Reference No.	263880
WIN	020421.00	Water Content, %	34.2
Sampled	6/15/2015	Liquid Limit @ 25 blows (T 89), %	31
Boring No./Sample No.	HB-VANB-219/3D	Plastic Limit (T 90), %	24
Station	31+10.4	Plasticity Index (T 90), %	7
Depth	7.0-9.0	Tested By	BBURR



Appendix C

Calculations

Bearing Resistance - Existing Soils:

Part 1 - Service Limit State

Nominal and factored Bearing Resistance - Box Culvert on Sand

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the
Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: sand (SM)

Based on N-values, soils are medium dense at the bearing elevation

Density In Place: medium dense

Bearing Resistance: Ordinary Range (ksf) 4 to 8

Recommended Value of Use:

$$q_{nom} := 5 \cdot \text{ksf}$$

Resistance factor at the **service limit state** = 1.0 (LRFD Article 10.5.5.1)

$$\phi_{\text{service_bc}} := 1.0$$

$$q_{\text{factored_service_bc}} := q_{nom} \cdot \phi_{\text{service_bc}}$$

$$q_{\text{factored_service_bc}} = 5 \cdot \text{ksf}$$

Note: This bearing resistance is settlement limited (1 inch) and applies only at the service limit state.

Part 2 - Strength Limit State

Nominal and factored Bearing Resistance - Box Culvert on Sand

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017 - Article 10.6.3.1

Assumptions:

1. The box will be founded at ~ Elev 447.3 feet

Bottom of Construction will be 2 feet below box invert

$$D_{\text{footing}} := 2.0 \cdot \text{ft}$$

2. Assumed parameters for fill soils:

Saturated unit weight: $\gamma_s := 125 \cdot \text{pcf}$

Internal friction angle: $\phi_{ns} := 32 \cdot \text{deg}$

Undrained shear strength: $c_{ns} := 0 \cdot \text{psf}$

3. Box Culvert parameters

Width of box culvert, B $B_{\text{box}} := 7 \cdot \text{ft}$

Length of box culvert, L $L_{\text{box}} := 96 \cdot \text{ft}$

Nominal Bearing Resistance per LRFD Equation 10.6.3.1.2a-1

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5 \gamma B N_{\gamma m} C_{w\gamma}$$

Bearing Capacity Factors - LRFD Table 10.6.3.1.2a-1

For $\phi=32$ deg $N_c := 35.5$ $N_q := 23.2$ $N_\gamma := 30.2$

Shape Correction Factors LRFD Table 10.6.3.1.2a-3

for $\phi=32$ degrees

$$s_c := 1 + \left(\frac{B_{box}}{L_{box}} \right) \left(\frac{N_q}{N_c} \right) \quad s_c = 1.05$$

$$s_\gamma := 1 - 0.4 \left(\frac{B_{box}}{L_{box}} \right) \quad s_\gamma = 0.9708$$

$$s_q := 1 + \left(\frac{B_{box}}{L_{box}} \cdot \tan(\phi_{ns}) \right) \quad s_q = 1.05$$

Load Inclination Factors:

Assume all are 1.0 (LRFD Article C10.6.3.1.2a)

$i_c := 1.0$ $i_q := 1.0$ $i_\gamma := 1.0$

Depth Correction Factor LRFD Table 10.6.3.1.2a-4

$$\frac{D_{footing}}{B_{box}} = 0.2857 \quad \text{for } \phi=32 \text{ degrees} \quad d_q := 1.2$$

$$N_{cm} := N_c \cdot s_c \cdot i_c \quad N_{cm} = 37.1917 \quad \text{LRFD Eq. 10.6.3.1.2a-2}$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \cdot i_q \quad N_{qm} = 29.11 \quad \text{LRFD Eq. 10.6.3.1.2a-3}$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \cdot i_\gamma \quad N_{\gamma m} = 29.32 \quad \text{LRFD Eq. 10.6.3.1.2a-4}$$

Coefficients for Groundwater Depths LRFD Table 10.6.3.1.2a-2

Depth the water table: $D_w := 0 \cdot \text{ft}$ $C_{wq} := 0.5$ $C_{w\gamma} := 0.5$

$$q_{nominal} := c_{ns} \cdot N_{cm} + \gamma_s \cdot D_{footing} \cdot N_{qm} \cdot C_{wq} + 0.5(\gamma_s) B_{box} \cdot N_{\gamma m} \cdot C_{w\gamma}$$

$$q_{nominal} = 10.1 \cdot \text{ksf}$$

Factored Bearing Resistance for Strength Limit State

Resistance Factor: $\phi_b := 0.45$ LRFD Table 10.5.5.2.2-1

$$q_{factored} := q_{nominal} \cdot \phi_b$$

$$q_{factored} = 4.5 \cdot \text{ksf}$$

Recommend a limiting factored bearing resistance of 4.5 ksf for the Strength Limit State.

Modulus of Subgrade Reaction:

Reference: Foundation Analysis and Design 5th Edition JE Bowles Section 9-6

Width of box culvert, B $B_{\text{box}} = 7 \text{ ft}$
 Length of box culvert, L $L_{\text{box}} = 96 \text{ ft}$
 Thickness of box culvert, t $t_{\text{box}} := 12 \cdot \text{in}$ assumed
 Depth of box, D $D_{\text{box}} := 9.5 \cdot \text{ft}$
 Bearing Resistance: $q_{\text{factored_service_bc}} = 5 \cdot \text{ksf}$ Calculated above
 Modulus of Elasticity: Site soils at bearing elevation are Sand (medium dense)
 From Bowles Table 2-8 Modulus E_s for sand, dense ranges from 2100 - 4200 ksf

Use Modulus of Elasticity, E_s $E_s := 2500 \cdot \text{ksf}$
 Poisson's Ratio: Site soils are sand (medium dense)
 From Bowles Table 2-7 Poisson's Ratio μ for Sand/Gravelly Sand ranges from 0.3 - 0.4

Use Poisson's Ratio, μ $\mu := 0.35$

$$E_{\text{prime_s}} := \frac{1 - \mu^2}{E_s} \quad E_{\text{prime_s}} = 0.000351 \cdot \frac{\text{ft}^2}{\text{kip}}$$

Analyze corner:

Take H as 5*B as recommended in Bowles Chapter 5

$$H_{\text{inf}} := \frac{5 \cdot B_{\text{box}}}{B_{\text{box}}} \quad H_{\text{inf}} = 5 \quad \text{N in Table 5-2}$$

$$\frac{L_{\text{box}}}{B_{\text{box}}} = 13.7143 \quad \text{M in Table 5-2}$$

From Table 5-2 for N=5 and M=13.71

$$I_1 := 0.531$$

$$I_2 := 0.143 \quad \text{by interpolation}$$

Determine Steinbrenner influence factor - Bowles Section 5-6:

$$I_s := I_1 + \left[\frac{1 - (2 \cdot \mu)}{1 - \mu} \right] \cdot I_2 \quad I_s = 0.597$$

Determine Influence factor for footing depth - Bowles Figure 5-7

Depth ratio: $\frac{D_{\text{box}}}{B_{\text{box}}} = 1.3571 \quad \frac{L_{\text{box}}}{B_{\text{box}}} = 13.7143 \quad \mu = 0.35 \quad I_F := 0.78$

Calculate modulus of subgrade reaction - Bowles Eq. 9-7

$$k_s := \frac{1}{B_{\text{box}} \cdot E_{\text{prime_s}} \cdot I_s \cdot I_F} \quad \text{Bowles Eq. 9-7}$$

$$k_s = 506 \cdot \text{pci}$$

Recommend Modulus of Subgrade Reaction of 500 pci

Bearing Resistance - Existing Soils:

Part 1 - Service Limit State

Nominal and factored Bearing Resistance - Box Culvert on Sand

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the
Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: sand (SM)

Based on N-values, soils are medium dense at the bearing elevation

Density In Place: medium dense

Bearing Resistance: Ordinary Range (ksf) 4 to 8

Recommended Value of Use:

$$q_{nom} := 5 \cdot \text{ksf}$$

Resistance factor at the **service limit state** = 1.0 (LRFD Article 10.5.5.1)

$$\phi_{service_bc} := 1.0$$

$$q_{factored_service_bc} := q_{nom} \cdot \phi_{service_bc}$$

$$q_{factored_service_bc} = 5 \cdot \text{ksf}$$

Note: This bearing resistance is settlement limited (1 inch) and applies only at the service limit state.

Part 2 - Strength Limit State

Nominal and factored Bearing Resistance - Box Culvert on Sand

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017 - Article 10.6.3.1

Assumptions:

1. The box will be founded at ~ Elev 460.2 feet

Bottom of Construction will be 2 feet below box invert

$$D_{footing} := 2.0 \cdot \text{ft}$$

2. Assumed parameters for fill soils:

Saturated unit weight: $\gamma_s := 125 \cdot \text{pcf}$

Internal friction angle: $\phi_{ns} := 32 \cdot \text{deg}$

Undrained shear strength: $c_{ns} := 0 \cdot \text{psf}$

3. Box Culvert parameters

Width of box culvert, B $B_{box} := 8 \cdot \text{ft}$

Length of box culvert, L $L_{box} := 93 \cdot \text{ft}$

Nominal Bearing Resistance per LRFD Equation 10.6.3.1.2a-1

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5 \gamma B N_{\gamma m} C_{w\gamma}$$

Bearing Capacity Factors - LRFD Table 10.6.3.1.2a-1

For $\phi=32$ deg $N_c := 35.5$ $N_q := 23.2$ $N_\gamma := 30.2$

Shape Correction Factors LRFD Table 10.6.3.1.2a-3

for $\phi=32$ degrees

$$s_c := 1 + \left(\frac{B_{box}}{L_{box}} \right) \left(\frac{N_q}{N_c} \right) \quad s_c = 1.06$$

$$s_\gamma := 1 - 0.4 \left(\frac{B_{box}}{L_{box}} \right) \quad s_\gamma = 0.9656$$

$$s_q := 1 + \left(\frac{B_{box}}{L_{box}} \cdot \tan(\phi_{ns}) \right) \quad s_q = 1.05$$

Load Inclination Factors:

Assume all are 1.0 (LRFD Article C10.6.3.1.2a)

$i_c := 1.0$ $i_q := 1.0$ $i_\gamma := 1.0$

Depth Correction Factor LRFD Table 10.6.3.1.2a-4

$$\frac{D_{footing}}{B_{box}} = 0.25 \quad \text{for } \phi=32 \text{ degrees} \quad d_q := 1.2$$

$$N_{cm} := N_c \cdot s_c \cdot i_c \quad N_{cm} = 37.4957 \quad \text{LRFD Eq. 10.6.3.1.2a-2}$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \cdot i_q \quad N_{qm} = 29.34 \quad \text{LRFD Eq. 10.6.3.1.2a-3}$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \cdot i_\gamma \quad N_{\gamma m} = 29.16 \quad \text{LRFD Eq. 10.6.3.1.2a-4}$$

Coefficients for Groundwater Depths LRFD Table 10.6.3.1.2a-2

Depth the water table: $D_w := 0 \cdot \text{ft}$ $C_{wq} := 0.5$ $C_{w\gamma} := 0.5$

$$q_{nominal} := c_{ns} \cdot N_{cm} + \gamma_s \cdot D_{footing} \cdot N_{qm} \cdot C_{wq} + 0.5(\gamma_s) B_{box} \cdot N_{\gamma m} \cdot C_{w\gamma}$$

$$q_{nominal} = 11 \cdot \text{ksf}$$

Factored Bearing Resistance for Strength Limit State

Resistance Factor: $\phi_b := 0.45$ LRFD Table 10.5.5.2.2-1

$$q_{factored} := q_{nominal} \cdot \phi_b$$

$$q_{factored} = 4.9 \cdot \text{ksf}$$

Recommend a limiting factored bearing resistance of 5.0 ksf for the Strength Limit State.

Modulus of Subgrade Reaction:

Reference: Foundation Analysis and Design 5th Edition JE Bowles Section 9-6

Width of box culvert, B $B_{\text{box}} = 8 \text{ ft}$
 Length of box culvert, L $L_{\text{box}} = 93 \text{ ft}$
 Thickness of box culvert, t $t_{\text{box}} := 12 \cdot \text{in}$ assumed
 Depth of box, D $D_{\text{box}} := 14.1 \cdot \text{ft}$
 Bearing Resistance: $q_{\text{factored_service_bc}} = 5 \cdot \text{ksf}$ Calculated above
 Modulus of Elasticity: Site soils at bearing elevation are Sand (medium dense)
 From Bowles Table 2-8 Modulus E_s for sand, dense ranges from 2100 - 4200 ksf

Use Modulus of Elasticity, E_s $E_s := 2500 \cdot \text{ksf}$
 Poisson's Ratio: Site soils are sand (medium dense)
 From Bowles Table 2-7 Poisson's Ratio μ for Sand/Gravelly Sand ranges from 0.3 - 0.4

Use Poisson's Ratio, μ $\mu := 0.35$

$$E_{\text{prime_s}} := \frac{1 - \mu^2}{E_s} \quad E_{\text{prime_s}} = 0.000351 \cdot \frac{\text{ft}^2}{\text{kip}}$$

Analyze corner:

Take H as 5*B as recommended in Bowles Chapter 5

$$H_{\text{inf}} := \frac{5 \cdot B_{\text{box}}}{B_{\text{box}}} \quad H_{\text{inf}} = 5 \quad \text{N in Table 5-2}$$

$$\frac{L_{\text{box}}}{B_{\text{box}}} = 11.625 \quad \text{M in Table 5-2}$$

From Table 5-2 for N=5 and M=11.625

$$I_1 := 0.533$$

$$I_2 := 0.142 \quad \text{by interpolation}$$

Determine Steinbrenner influence factor - Bowles Section 5-6:

$$I_s := I_1 + \left[\frac{1 - (2 \cdot \mu)}{1 - \mu} \right] \cdot I_2 \quad I_s = 0.5985$$

Determine Influence factor for footing depth - Bowles Figure 5-7

$$\text{Depth ratio: } \frac{D_{\text{box}}}{B_{\text{box}}} = 1.7625 \quad \frac{L_{\text{box}}}{B_{\text{box}}} = 11.625 \quad \mu = 0.35 \quad I_F := 0.73$$

Calculate modulus of subgrade reaction - Bowles Eq. 9-7

$$k_s := \frac{1}{B_{\text{box}} \cdot E_{\text{prime_s}} \cdot I_s \cdot I_F} \quad \text{Bowles Eq. 9-7}$$

$$k_s = 472 \cdot \text{pci}$$

Recommend Modulus of Subgrade Reaction of 475 pci

Bearing Resistance - Existing Soils:

Part 1 - Service Limit State

Nominal and factored Bearing Resistance - Box Culvert on Sand

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the
Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: sand (SM)

Based on N-values, soils are medium dense at the bearing elevation

Density In Place: medium dense

Bearing Resistance: Ordinary Range (ksf) 4 to 8

Recommended Value of Use:

$$q_{nom} := 5 \cdot \text{ksf}$$

Resistance factor at the **service limit state** = 1.0 (LRFD Article 10.5.5.1)

$$\phi_{\text{service_bc}} := 1.0$$

$$q_{\text{factored_service_bc}} := q_{nom} \cdot \phi_{\text{service_bc}}$$

$$q_{\text{factored_service_bc}} = 5 \cdot \text{ksf}$$

Note: This bearing resistance is settlement limited (1 inch) and applies only at the service limit state.

Part 2 - Strength Limit State

Nominal and factored Bearing Resistance - Box Culvert on Sand

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017 - Article 10.6.3.1

Assumptions:

1. The box will be founded at ~ Elev 478.2 feet

Bottom of Construction will be 2 feet below box invert

$$D_{\text{footing}} := 2.0 \cdot \text{ft}$$

2. Assumed parameters for fill soils:

Saturated unit weight: $\gamma_s := 125 \cdot \text{pcf}$

Internal friction angle: $\phi_{ns} := 32 \cdot \text{deg}$

Undrained shear strength: $c_{ns} := 0 \cdot \text{psf}$

3. Box Culvert parameters

Width of box culvert, B $B_{\text{box}} := 8 \cdot \text{ft}$

Length of box culvert, L $L_{\text{box}} := 82 \cdot \text{ft}$

Nominal Bearing Resistance per LRFD Equation 10.6.3.1.2a-1

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5 \gamma B N_{\gamma m} C_{w\gamma}$$

Bearing Capacity Factors - LRFD Table 10.6.3.1.2a-1

For $\phi=32$ deg $N_c := 35.5$ $N_q := 23.2$ $N_\gamma := 30.2$

Shape Correction Factors LRFD Table 10.6.3.1.2a-3

for $\phi=32$ degrees

$$s_c := 1 + \left(\frac{B_{box}}{L_{box}} \right) \left(\frac{N_q}{N_c} \right) \quad s_c = 1.06$$

$$s_\gamma := 1 - 0.4 \left(\frac{B_{box}}{L_{box}} \right) \quad s_\gamma = 0.961$$

$$s_q := 1 + \left(\frac{B_{box}}{L_{box}} \cdot \tan(\phi_{ns}) \right) \quad s_q = 1.06$$

Load Inclination Factors:

Assume all are 1.0 (LRFD Article C10.6.3.1.2a)

$i_c := 1.0$ $i_q := 1.0$ $i_\gamma := 1.0$

Depth Correction Factor LRFD Table 10.6.3.1.2a-4

$$\frac{D_{footing}}{B_{box}} = 0.25 \quad \text{for } \phi=32 \text{ degrees} \quad d_q := 1.2$$

$$N_{cm} := N_c \cdot s_c \cdot i_c \quad N_{cm} = 37.7634 \quad \text{LRFD Eq. 10.6.3.1.2a-2}$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \cdot i_q \quad N_{qm} = 29.54 \quad \text{LRFD Eq. 10.6.3.1.2a-3}$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \cdot i_\gamma \quad N_{\gamma m} = 29.02 \quad \text{LRFD Eq. 10.6.3.1.2a-4}$$

Coefficients for Groundwater Depths LRFD Table 10.6.3.1.2a-2

Depth the water table: $D_w := 0 \cdot \text{ft}$ $C_{wq} := 0.5$ $C_{w\gamma} := 0.5$

$$q_{nominal} := c_{ns} \cdot N_{cm} + \gamma_s \cdot D_{footing} \cdot N_{qm} \cdot C_{wq} + 0.5(\gamma_s) B_{box} \cdot N_{\gamma m} \cdot C_{w\gamma}$$

$$q_{nominal} = 10.9 \cdot \text{ksf}$$

Factored Bearing Resistance for Strength Limit State

Resistance Factor: $\phi_b := 0.45$ LRFD Table 10.5.5.2.2-1

$$q_{factored} := q_{nominal} \cdot \phi_b$$

$$q_{factored} = 4.9 \cdot \text{ksf}$$

Recommend a limiting factored bearing resistance of 5.0 ksf for the Strength Limit State.

Modulus of Subgrade Reaction:

Reference: Foundation Analysis and Design 5th Edition JE Bowles Section 9-6

Width of box culvert, B $B_{\text{box}} = 8 \text{ ft}$
 Length of box culvert, L $L_{\text{box}} = 82 \text{ ft}$
 Thickness of box culvert, t $t_{\text{box}} := 12 \cdot \text{in}$ assumed
 Depth of box, D $D_{\text{box}} := 11.5 \cdot \text{ft}$
 Bearing Resistance: $q_{\text{factored_service_bc}} = 5 \cdot \text{ksf}$ Calculated above
 Modulus of Elasticity: Site soils at bearing elevation are Sand (medium dense)
 From Bowles Table 2-8 Modulus E_s for sand, dense ranges from 2100 - 4200 ksf

Use Modulus of Elasticity, E_s $E_s := 2500 \cdot \text{ksf}$
 Poisson's Ratio: Site soils are sand (medium dense)
 From Bowles Table 2-7 Poisson's Ratio μ for Sand/Gravelly Sand ranges from 0.3 - 0.4

Use Poisson's Ratio, μ $\mu := 0.35$

$$E_{\text{prime_s}} := \frac{1 - \mu^2}{E_s} \quad E_{\text{prime_s}} = 0.000351 \cdot \frac{\text{ft}^2}{\text{kip}}$$

Analyze corner:

Take H as 5*B as recommended in Bowles Chapter 5

$$H_{\text{inf}} := \frac{5 \cdot B_{\text{box}}}{B_{\text{box}}} \quad H_{\text{inf}} = 5 \quad \text{N in Table 5-2}$$

$$\frac{L_{\text{box}}}{B_{\text{box}}} = 10.25 \quad \text{M in Table 5-2}$$

From Table 5-2 for N=5 and M=10.25

$$I_1 := 0.533$$

$$I_2 := 0.142 \quad \text{by interpolation}$$

Determine Steinbrenner influence factor - Bowles Section 5-6:

$$I_s := I_1 + \left[\frac{1 - (2 \cdot \mu)}{1 - \mu} \right] \cdot I_2 \quad I_s = 0.5985$$

Determine Influence factor for footing depth - Bowles Figure 5-7

Depth ratio: $\frac{D_{\text{box}}}{B_{\text{box}}} = 1.4375 \quad \frac{L_{\text{box}}}{B_{\text{box}}} = 10.25 \quad \mu = 0.35 \quad I_F := 0.77$

Calculate modulus of subgrade reaction - Bowles Eq. 9-7

$$k_s := \frac{1}{B_{\text{box}} \cdot E_{\text{prime_s}} \cdot I_s \cdot I_F} \quad \text{Bowles Eq. 9-7}$$

$$k_s = 447 \cdot \text{pci}$$

Recommend Modulus of Subgrade Reaction of 450 pci

Bearing Resistance - Existing Soils:

Part 1 - Service Limit State

Nominal and factored Bearing Resistance - Box Culvert on Silty Gravel

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the
Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: silty gravel (GM)

Based on N-values, soils are medium dense at the bearing elevation

Density In Place: medium dense

Bearing Resistance: Ordinary Range (ksf) 8 to 14

no values given for GM soils.
used values for gravel-sand mixture.

Recommended Value of Use:

$$q_{nom} := 10 \cdot \text{ksf}$$

Resistance factor at the **service limit state** = 1.0 (LRFD Article 10.5.5.1)

$$\phi_{service_bc} := 1.0$$

$$q_{factored_service_bc} := q_{nom} \cdot \phi_{service_bc}$$

$$q_{factored_service_bc} = 10 \cdot \text{ksf}$$

Note: This bearing resistance is settlement limited (1 inch) and applies only at the service limit state.

Part 2 - Strength Limit State

Nominal and factored Bearing Resistance - Box Culvert on Silty Gravel

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017 - Article 10.6.3.1

Assumptions:

1. The box will be founded at ~ Elev 472.6 feet

Bottom of Construction will be 2 feet below box invert

$$D_{footing} := 2.0 \cdot \text{ft}$$

2. Assumed parameters for fill soils:

Saturated unit weight: $\gamma_s := 125 \cdot \text{pcf}$

Internal friction angle: $\phi_{ns} := 32 \cdot \text{deg}$

Undrained shear strength: $c_{ns} := 0 \cdot \text{psf}$

3. Box Culvert parameters

Width of box culvert, B $B_{box} := 7 \cdot \text{ft}$

Length of box culvert, L $L_{box} := 84 \cdot \text{ft}$

Nominal Bearing Resistance per LRFD Equation 10.6.3.1.2a-1

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5 \gamma B N_{\gamma m} C_{w\gamma}$$

Bearing Capacity Factors - LRFD Table 10.6.3.1.2a-1

For $\phi=32$ deg $N_c := 35.5$ $N_q := 23.2$ $N_\gamma := 30.2$

Shape Correction Factors LRFD Table 10.6.3.1.2a-3

for $\phi=32$ degrees

$$s_c := 1 + \left(\frac{B_{box}}{L_{box}} \right) \left(\frac{N_q}{N_c} \right) \quad s_c = 1.05$$

$$s_\gamma := 1 - 0.4 \left(\frac{B_{box}}{L_{box}} \right) \quad s_\gamma = 0.9667$$

$$s_q := 1 + \left(\frac{B_{box}}{L_{box}} \cdot \tan(\phi_{ns}) \right) \quad s_q = 1.05$$

Load Inclination Factors:

Assume all are 1.0 (LRFD Article C10.6.3.1.2a)

$i_c := 1.0$ $i_q := 1.0$ $i_\gamma := 1.0$

Depth Correction Factor LRFD Table 10.6.3.1.2a-4

$$\frac{D_{footing}}{B_{box}} = 0.2857 \quad \text{for } \phi=32 \text{ degrees} \quad d_q := 1.2$$

$$N_{cm} := N_c \cdot s_c \cdot i_c \quad N_{cm} = 37.4333 \quad \text{LRFD Eq. 10.6.3.1.2a-2}$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \cdot i_q \quad N_{qm} = 29.29 \quad \text{LRFD Eq. 10.6.3.1.2a-3}$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \cdot i_\gamma \quad N_{\gamma m} = 29.19 \quad \text{LRFD Eq. 10.6.3.1.2a-4}$$

Coefficients for Groundwater Depths LRFD Table 10.6.3.1.2a-2

Depth the water table: $D_w := 0 \cdot \text{ft}$ $C_{wq} := 0.5$ $C_{w\gamma} := 0.5$

$$q_{nominal} := c_{ns} \cdot N_{cm} + \gamma_s \cdot D_{footing} \cdot N_{qm} \cdot C_{wq} + 0.5(\gamma_s) B_{box} \cdot N_{\gamma m} \cdot C_{w\gamma}$$

$$q_{nominal} = 10 \cdot \text{ksf}$$

Factored Bearing Resistance for Strength Limit State

Resistance Factor: $\phi_b := 0.45$ LRFD Table 10.5.5.2.2-1

$$q_{factored} := q_{nominal} \cdot \phi_b$$

$$q_{factored} = 4.5 \cdot \text{ksf}$$

Recommend a limiting factored bearing resistance of 4.5 ksf for the Strength Limit State.

Modulus of Subgrade Reaction:

Reference: Foundation Analysis and Design 5th Edition JE Bowles Section 9-6

Width of box culvert, B $B_{\text{box}} = 7 \text{ ft}$
 Length of box culvert, L $L_{\text{box}} = 84 \text{ ft}$
 Thickness of box culvert, t $t_{\text{box}} := 12 \cdot \text{in}$ assumed
 Depth of box, D $D_{\text{box}} := 11.6 \cdot \text{ft}$
 Bearing Resistance: $q_{\text{factored_service_bc}} = 10 \cdot \text{ksf}$ Calculated above
 Modulus of Elasticity: Site soils at bearing elevation are Silty Gravel (medium dense)
 From Bowles Table 2-8 Modulus E_s for sand and gravel, dense ranges from 2100 - 4200 ksf

Use Modulus of Elasticity, E_s $E_s := 2700 \cdot \text{ksf}$
 Poisson's Ratio: Site soils are sand (medium dense)
 From Bowles Table 2-7 Poisson's Ratio μ for Sand/Gravelly Sand ranges from 0.3 - 0.4

Use Poisson's Ratio, μ $\mu := 0.35$

$$E_{\text{prime_s}} := \frac{1 - \mu^2}{E_s} \quad E_{\text{prime_s}} = 0.000325 \cdot \frac{\text{ft}^2}{\text{kip}}$$

Analyze corner:

Take H as 5*B as recommended in Bowles Chapter 5

$$H_{\text{inf}} := \frac{5 \cdot B_{\text{box}}}{B_{\text{box}}} \quad H_{\text{inf}} = 5 \quad \text{N in Table 5-2}$$

$$\frac{L_{\text{box}}}{B_{\text{box}}} = 12 \quad \text{M in Table 5-2}$$

From Table 5-2 for N=5 and M=12

$$I_1 := 0.532$$

$$I_2 := 0.142 \quad \text{by interpolation}$$

Determine Steinbrenner influence factor - Bowles Section 5-6:

$$I_s := I_1 + \left[\frac{1 - (2 \cdot \mu)}{1 - \mu} \right] \cdot I_2 \quad I_s = 0.5975$$

Determine Influence factor for footing depth - Bowles Figure 5-7

Depth ratio: $\frac{D_{\text{box}}}{B_{\text{box}}} = 1.6571 \quad \frac{L_{\text{box}}}{B_{\text{box}}} = 12 \quad \mu = 0.35 \quad I_F := 0.76$

Calculate modulus of subgrade reaction - Bowles Eq. 9-7

$$k_s := \frac{1}{B_{\text{box}} \cdot E_{\text{prime_s}} \cdot I_s \cdot I_F} \quad \text{Bowles Eq. 9-7}$$

$$k_s = 560 \cdot \text{pci}$$

Recommend Modulus of Subgrade Reaction of 560 pci

Bearing Resistance - Existing Soils:

Part 1 - Service Limit State

Nominal and factored Bearing Resistance - Box Culvert on Gravel

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the
Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: gravel (GM)

Based on N-values, soils are medium dense at the bearing elevation

Density In Place: medium dense

Bearing Resistance: Ordinary Range (ksf) 8 to 14

no values given for GM soils.
used values for gravel / gravel-sand mixture.

Recommended Value of Use:

$$q_{nom} := 10 \cdot \text{ksf}$$

Resistance factor at the **service limit state** = 1.0 (LRFD Article 10.5.5.1)

$$\phi_{service_bc} := 1.0$$

$$q_{factored_service_bc} := q_{nom} \cdot \phi_{service_bc}$$

$$q_{factored_service_bc} = 10 \cdot \text{ksf}$$

Note: This bearing resistance is settlement limited (1 inch) and applies only at the service limit state.

Part 2 - Strength Limit State

Nominal and factored Bearing Resistance - Box Culvert on Gravel

Reference: AASHTO LRFD Bridge Design Specifications 8th Edition 2017 - Article 10.6.3.1

Assumptions:

1. The box will be founded at ~ Elev 475.8 feet

Bottom of Construction will be 2 feet below box invert

$$D_{footing} := 2.0 \cdot \text{ft}$$

2. Assumed parameters for fill soils:

Saturated unit weight: $\gamma_s := 125 \cdot \text{pcf}$

Internal friction angle: $\phi_{ns} := 32 \cdot \text{deg}$

Undrained shear strength: $c_{ns} := 0 \cdot \text{psf}$

3. Box Culvert parameters

Width of box culvert, B $B_{box} := 6 \cdot \text{ft}$

Length of box culvert, L $L_{box} := 93 \cdot \text{ft}$

Nominal Bearing Resistance per LRFD Equation 10.6.3.1.2a-1

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5 \gamma B N_{\gamma m} C_{w\gamma}$$

Bearing Capacity Factors - LRFD Table 10.6.3.1.2a-1

For $\phi=32$ deg $N_c := 35.5$ $N_q := 23.2$ $N_\gamma := 30.2$

Shape Correction Factors LRFD Table 10.6.3.1.2a-3

for $\phi=32$ degrees

$$s_c := 1 + \left(\frac{B_{box}}{L_{box}} \right) \left(\frac{N_q}{N_c} \right) \quad s_c = 1.04$$

$$s_\gamma := 1 - 0.4 \left(\frac{B_{box}}{L_{box}} \right) \quad s_\gamma = 0.9742$$

$$s_q := 1 + \left(\frac{B_{box}}{L_{box}} \cdot \tan(\phi_{ns}) \right) \quad s_q = 1.04$$

Load Inclination Factors:

Assume all are 1.0 (LRFD Article C10.6.3.1.2a)

$i_c := 1.0$ $i_q := 1.0$ $i_\gamma := 1.0$

Depth Correction Factor LRFD Table 10.6.3.1.2a-4

$$\frac{D_{footing}}{B_{box}} = 0.3333 \quad \text{for } \phi=32 \text{ degrees} \quad d_q := 1.2$$

$$N_{cm} := N_c \cdot s_c \cdot i_c \quad N_{cm} = 36.9968 \quad \text{LRFD Eq. 10.6.3.1.2a-2}$$

$$N_{qm} := N_q \cdot s_q \cdot d_q \cdot i_q \quad N_{qm} = 28.96 \quad \text{LRFD Eq. 10.6.3.1.2a-3}$$

$$N_{\gamma m} := N_\gamma \cdot s_\gamma \cdot i_\gamma \quad N_{\gamma m} = 29.42 \quad \text{LRFD Eq. 10.6.3.1.2a-4}$$

Coefficients for Groundwater Depths LRFD Table 10.6.3.1.2a-2

Depth the water table: $D_w := 0 \cdot \text{ft}$ $C_{wq} := 0.5$ $C_{w\gamma} := 0.5$

$$q_{nominal} := c_{ns} \cdot N_{cm} + \gamma_s \cdot D_{footing} \cdot N_{qm} \cdot C_{wq} + 0.5(\gamma_s) B_{box} \cdot N_{\gamma m} \cdot C_{w\gamma}$$

$$q_{nominal} = 9.1 \cdot \text{ksf}$$

Factored Bearing Resistance for Strength Limit State

Resistance Factor: $\phi_b := 0.45$ LRFD Table 10.5.5.2.2-1

$$q_{factored} := q_{nominal} \cdot \phi_b$$

$$q_{factored} = 4.1 \cdot \text{ksf}$$

Recommend a limiting factored bearing resistance of 4.0 ksf for the Strength Limit State.

Modulus of Subgrade Reaction:

Reference: Foundation Analysis and Design 5th Edition JE Bowles Section 9-6

Width of box culvert, B $B_{\text{box}} = 6 \text{ ft}$
 Length of box culvert, L $L_{\text{box}} = 93 \text{ ft}$
 Thickness of box culvert, t $t_{\text{box}} := 12 \cdot \text{in}$ assumed
 Depth of box, D $D_{\text{box}} := 11.6 \cdot \text{ft}$
 Bearing Resistance: $q_{\text{factored_service_bc}} = 10 \cdot \text{ksf}$ Calculated above
 Modulus of Elasticity: Site soils at bearing elevation are Silty Gravel (medium dense)
 From Bowles Table 2-8 Modulus E_s for sand and gravel, dense ranges from 2100 - 4200 ksf

Use Modulus of Elasticity, E_s $E_s := 2700 \cdot \text{ksf}$
 Poisson's Ratio: Site soils are sand (medium dense)
 From Bowles Table 2-7 Poisson's Ratio μ for Sand/Gravelly Sand ranges from 0.3 - 0.4

Use Poisson's Ratio, μ $\mu := 0.35$

$$E_{\text{prime_s}} := \frac{1 - \mu^2}{E_s} \quad E_{\text{prime_s}} = 0.000325 \cdot \frac{\text{ft}^2}{\text{kip}}$$

Analyze corner:

Take H as 5*B as recommended in Bowles Chapter 5

$$H_{\text{inf}} := \frac{5 \cdot B_{\text{box}}}{B_{\text{box}}} \quad H_{\text{inf}} = 5 \quad \text{N in Table 5-2}$$

$$\frac{L_{\text{box}}}{B_{\text{box}}} = 15.5 \quad \text{M in Table 5-2}$$

From Table 5-2 for N=5 and M=15.5

$$I_1 := 0.530$$

$$I_2 := 0.145 \quad \text{by interpolation}$$

Determine Steinbrenner influence factor - Bowles Section 5-6:

$$I_s := I_1 + \left[\frac{1 - (2 \cdot \mu)}{1 - \mu} \right] \cdot I_2 \quad I_s = 0.5969$$

Determine Influence factor for footing depth - Bowles Figure 5-7

Depth ratio: $\frac{D_{\text{box}}}{B_{\text{box}}} = 1.9333 \quad \frac{L_{\text{box}}}{B_{\text{box}}} = 15.5 \quad \mu = 0.35 \quad I_F := 0.73$

Calculate modulus of subgrade reaction - Bowles Eq. 9-7

$$k_s := \frac{1}{B_{\text{box}} \cdot E_{\text{prime_s}} \cdot I_s \cdot I_F} \quad \text{Bowles Eq. 9-7}$$

$$k_s = 681 \cdot \text{pci}$$

Recommend Modulus of Subgrade Reaction of 680 pci