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FINAL GEOTECHNICAL DATA REPORT

BRIDGE NOS. M-05-001 = W-06-013 AND W-06-016 AND ASSOCIATED CAUSEWAY
WAREHAM STREET (US 6) OVER WEWEANTIC RIVER
MARION AND WAREHAM, MASSACHUSETTS

by
Haley & Aldrich, Inc.
Boston, Massachusetts

for
PARSONS
Boston, Massachusetts

File No. 40991-005
September 2024

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Attention: Steven Dylingowski, P.E.

Subject: Final Geotechnical Data Report
Bridge Nos. M-05-001 = W-06-013 and W-06-016 and Associated Causeway
Wareham Street (US 6) over Weweantic River
Marion and Wareham, Massachusetts

Ladies and Gentlemen:

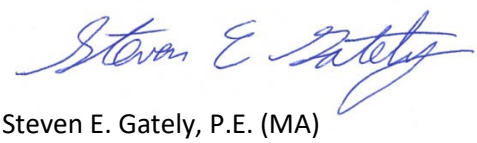
Haley & Aldrich, Inc. (Haley & Aldrich) is pleased to submit this Geotechnical Data Report in connection with the replacement of Bridge Nos. M-05-001 = W-06-013 and W-06-016 located along a causeway which carries US Route 6 over the Weweantic River between the towns of Marion and Wareham, Massachusetts (see Figure 1, Project Locus).

We understand that the bridges are to be replaced with wider structures that will include the addition of 4-ft wide shoulders and 10-ft wide Shared Use Paths (SUP). The replacement bridge decks will be approximately 2.5 ft higher than the existing bridge. The causeway approach to the bridge will also be widened, regraded, and raised to match the proposed higher and wider bridge.

This report presents subsurface geotechnical test borings and laboratory test results from three different geotechnical investigation phases for the project. The focus of the geotechnical investigations was on gathering information for the bridge replacement and associated causeway widening and grade raising.

Please contact us with any questions or comments concerning this report.

Sincerely yours,
HALEY & ALDRICH, INC.



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Enclosures

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Executive Summary

Bridge No. M-05-001 = W-06-013

The Commonwealth of Massachusetts Department of Transportation (MassDOT) is planning to construct the replacement of Bridge No. M-05-001 = W-06-013 over the Weweantic River in Marion and Wareham, Massachusetts. Built in 1929 and widened in 1957, the existing bridge is a two-span structure with both concrete and steel stringers and a concrete deck. Each span is 53-ft long and the bridge is 58.5-ft wide. The abutments of the existing bridge are timber pile supported and the center pier is supported on a spread footing.

The new bridge will also be a two-span structure with a 136 ft overall length and an 18.7 ft increased width. The replacement bridge will be constructed in two main stages with three traffic shifts along the same alignment as the existing bridge.

The observed subsurface conditions consist of a top layer of embankment soils overlying organic deposits. Underlying the organic deposits are glacial deposits overlying completely weathered bedrock (which can be split spoon sampled), overlying bedrock, which can be cored. The depth to cored bedrock from the existing roadway grade at the proposed abutments is between 44 and 48.5 ft. The overburden soils contain obstructions that will impact the design and construction of the replacement bridge. The obstructions encountered in the subsurface explorations for this report included cobbles, boulders, wood, steel slag, and unknown materials.

Bridge No. W-06-016

The Commonwealth of Massachusetts Department of Transportation (MassDOT) is planning to construct the replacement of Bridge No. W-06-016 over the Weweantic River in Wareham, Massachusetts. Built in 1929 and widened in 1957, the existing bridge is a 3-span structure with both concrete and steel stringers and a concrete deck. The 1929 width of the abutments and piers is 38.75 ft and the 1957 widened portion is 19.75 ft. The end spans are both 46.5 ft long and the center span is 51.5 ft long and the overall length from endpost to endpost is 178 ft. The abutments and piers of the existing bridge are timber pile supported.

The new bridge will be a 3-span structure with a 184 ft overall length between abutments, and 18.7 ft wider than the existing bridge. The end spans are both 56.0 ft long and the center span is 72 ft long. The replacement bridge will be constructed in two main stages with three traffic shifts along the same alignment as the existing bridge.

The observed subsurface conditions consist of a top layer of embankment soils overlying organic deposits. Underlying the organic deposits are glaciolacustrine and glaciofluvial deposits overlying bedrock. The depth to cored bedrock from the existing roadway grade at the proposed abutments is between 62 and 71 ft. The overburden soils contain obstructions that will impact the design and construction of the replacement bridge. Obstructions were also encountered in the subsurface explorations for this bridge.

Causeway Retaining Walls

As part of the project to replace Bridge Nos. M-05-001 = W-06-013 and W-06-016, the Commonwealth of Massachusetts Department of Transportation (MassDOT) is planning to widen and raise the Wareham Street Causeway (US 6) which crosses the Weweantic River between Marion and Wareham in Massachusetts (see Figure 1, Project Locus). The causeway is approximately one-third of one mile long.

The existing causeway will be regraded to a higher elevation and widened to allow for the addition of a 4-ft-wide shoulder and a 10-ft-wide Shared Use Path (SUP) on each side of the roadway. Along the centerline, the causeway grades are being raised as much as 3 ft. The grade increase in the SUP area is as high as 8 ft since the SUPs will be constructed over the existing causeway's side slopes. Retaining walls will be constructed to retain the raise in grade.

The observed subsurface conditions consist of a top layer of embankment soils overlying organic deposits. Underlying the organic deposits are glacial deposits overlying bedrock. The depth to coreable bedrock from the existing roadway grade at the causeway is between 32 and 68.5 ft.

The overburden soils contain obstructions that will impact the design and construction of the replacement bridge. The historic drawings suggest that there are likely buried stone walls and rubble fill in the existing embankments. Obstructions were also encountered in the subsurface explorations along the causeway. Most of the obstructions were encountered in the embankment fill; although occasional cobbles were noted in the glacial till deposits.

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1. Introduction

1.1 PURPOSE

The purpose of this study was to characterize subsurface conditions at the two bridges and the causeway carrying US Route 6 over the Weweantic River between the towns of Marion and Wareham, Massachusetts (see Figure 1, Project Locus). The data presented in this report is from 3 separate subsurface investigations performed by Haley & Aldrich, Inc. (Haley & Aldrich).

Built in 1929 and widened in 1957, Bridge M-05-001 = W-06-013 is a two-span structure with both concrete and steel stringers and a concrete deck. The spans are 49.75-ft long (clear) with the overall bridge length of 139 ft from endpost to endpost. The bridge is 58.5-ft wide.

Also built in 1929 and widened in 1957, Bridge W-06-016 is a 3-span structure with both concrete and steel stringers and a concrete deck. The end spans are both 46.5 ft long and the center span is 51.5 ft long for an overall length of 178 ft. The part of the existing bridge built in 1929 is 38.75 ft wide. In 1957 the bridge was widened by 19.75 ft for a total width of 58.5 ft. The abutments and piers of the existing bridge are timber pile supported.

In addition to the above stated scope, we obtained sediment samples from the river bottom for laboratory grain size analysis to be used by MassDOT in their scour analyses.

1.2 AVAILABLE DOCUMENTS - BRIDGE NO. M-05-001 = W-06-013

1.2.1 Bridge Plans Dated 27 April 1901

At least two bridges were built at the site of Bridge No. M-05-001 = W-06-013 prior to the existing bridge. Plans from 1901, 1904, 1929, and 1956 are available. It appears that, prior to 1901, the causeway was supported by stone retaining walls and riprap and was wider at the abutments. We are not aware of any drawings that show this earlier bridge but the outlines of the abutments and retaining walls are shown on the 1901 drawings. It also appears as though there were 3 rectangular piers (most likely of stone masonry construction) supporting this earlier bridge. Although the exact locations of the prior substructures are not clear, they appear to have been in about the same location as the current bridge. Therefore, it seems reasonable to assume that there are most likely remnants of the prior bridge structures and foundations buried beneath the existing causeway and in the river.

As part of the 1901 bridge replacement, the causeway elevation was increased by placing fill berms adjacent to the existing stone retaining walls on each side of the causeway, creating a buttressing slope protected by riprap. The 1901 drawings show the “West Bridge” (which is now Bridge No. M-05-001 = W-06-013) was to be supported on 10-in. dia. cast iron piles with 4 river piers spaced at about 16.5 ft on center. These drawings also show the abutments supported on timber piles and a 30-ft wide bridge deck with both a roadway and train or trolley tracks.

The 1904 drawing appears to be a survey of the top of the bridge’s wheel-guard and deck, perhaps done in response to some settlement of the bridge.

1.2.2 Bridge Plans Dated February 1929

Drawings dated 1929 show the replacement for the circa 1901 bridge. This 1929 bridge still exists as the northern roughly 2/3 of the current bridge, which was expanded to the south in the 1950's (as discussed below). These drawings indicate that the 1929 bridge has rubble concrete abutments bearing on timber piles and that the center pier was constructed on a rubble concrete spread footing, built within a cofferdam.

As part of the 1929 construction, the new abutments were constructed about 12 ft inboard of the existing abutments and the width of the causeway opening between abutments was increased. While the above water portions of the original abutments appear to have been removed, timber piles foundations (and possibly timber cribbing and masonry) are likely still in place.

The location of the abutments of the 1929 bridge relative to the 1901 bridge is shown on the 1929 drawings. The centerline alignment of the 1929 bridge is about 10 ft south of the 1901 bridge and the 1929 bridge was slightly wider. A 20-ft wide temporary bridge supported on timber piles is also referenced which was constructed at an unknown location to maintain traffic flow during the 1929 construction.

1.2.3 Bridge Plans Dated November 1956

The 1956 bridge drawings were for widening the bridge 20 ft to the south using similar foundations to the ones used for the 1929 bridge. Presumably the causeway was also widened in 1956. The 1959 drawings indicate that the timber piles driven to widen the bridge were designed for a 36-kip capacity.

1.2.4 MassDOT Timber Pile Driving Records dated 1957

The timber pile records suggest the piles are generally less than 50 ft long at Bridge No. M-05-001 = W-06-013.

1.3 AVAILABLE DOCUMENTS - BRIDGE NO. W-06-016

1.3.1 Bridge Plans Dated 27 April 1901

At least two bridges were built at the location of Bridge W-06-016 prior to the existing bridge. Plans from 1901, 1904, 1929, and 1956 are available. It appears that, prior to 1901, the causeway was supported by stone retaining walls and riprap and was wider at the abutments. We are not aware of any drawings that show this earlier bridge but the outlines of the abutments and retaining walls are shown on the 1901 drawings. It also appears as though there were 5 rectangular piers, most likely of stone masonry construction, supporting this earlier bridge. Although the exact locations of the prior substructures are not clear, they appear to have been in about the same location as the current bridge. Therefore, it seems reasonable to assume that there are most likely remnants of the prior bridge structures and foundations buried beneath the existing causeway and in the river.

As part of the 1901 bridge replacement, the causeway elevation was increased by placing fill berms adjacent to the existing stone retaining walls on each side of the causeway, creating a buttressing slope protected by riprap. The 1901 drawings show the "East Bridge" (which is now Bridge No. W-06-016) was

to be supported on 10-in. dia. cast iron piles with 5 river piers. These drawings also show the abutments supported on timber piles and a 30-ft wide bridge deck with both a roadway and train or trolley tracks.

The 1904 drawing appears to be a survey of the top of the bridge's wheel-guard and deck, perhaps done in response to some settlement of the bridge.

1.3.2 Bridge Plans Dated February 1929

Drawings dated 1929 show the replacement for the circa 1901 bridge. This 1929 bridge still exists as the northern roughly 2/3 of the current bridge, which was expanded to the south in the 1950's (as discussed below). These drawings indicate the 1929 bridge has rubble concrete abutments and piers bearing on timber piles. The piers were presumably built within cofferdams.

As part of the 1929 construction, the new west abutment was constructed about 12 ft west of the 1901 abutment and the new east abutment was constructed about 22 ft east of the 1901 abutment, resulting in a wider causeway opening between abutments. While the above water portions of the 1901 abutments and piers appear to have been removed, timber and iron pile foundations, and possibly timber cribbing and masonry, were likely left in place.

The location of the abutments of the 1929 bridge relative to the 1901 bridge is shown on the 1929 drawings. The centerline alignment of the 1929 bridge is about 8 ft south of the 1901 bridge and the 1929 bridge was slightly wider. A 20-ft wide temporary bridge supported on timber piles is also referenced which was constructed at an unknown location to maintain traffic flow during the 1929 construction.

1.3.3 Bridge Plans Dated November 1956

The 1956 bridge drawings were for widening the bridge 20 ft to the south using similar foundations to the ones used for the 1929 bridge. The 1956 drawings indicate that the timber piles driven to widen the bridge were designed for a 36-kip capacity. Presumably the causeway was also widened in 1956.

1.3.4 MassDOT Timber Pile Driving Records dated 1957

The timber pile records suggest the piles are generally less than 35 ft long at Bridge No. W-06-016.

1.4 EXISTING CONDITIONS

The Weweantic River is tidal and strong currents currently flow under the bridges during each tidal cycle. The Mean High Water is elevation (El. 1.8) and the Mean Low Water is El. –2.2. The water depth at high tide for Bridge M-05-001 = W-06-013 is about 15- to 18-ft at the river channel. The water depth at high tide for Bridge W-06-016 is about 16 to 24 ft in the river channel.

1.5 SITE RECONNAISSANCE

The causeway near the abutments is armored with riprap. The upstream side of the bridges (north side) have concrete girders and the 1957 bridge additions on the south side have steel girders. There is a duct bank between the northernmost two bridge girders. Between the southernmost concrete girders there

is a drainage pipe and a rectangular utility which likely houses communication ducts. There are manholes labeled sewer and Bell Telephone that line up with these utilities.

There is a space between the original 1929 pier stems and the 1957 pier stems. The existing granite block pier needs repointing and a new concrete pier cap, as a minimum, and may need to be replaced entirely (as currently proposed). The condition of the submerged rubble concrete footing is unknown.

1.6 ELEVATION DATUM

Elevations referenced in this report are in feet and are based on the North American Vertical Datum (NAVD) of 1988. All survey points have been determined with respect to the Massachusetts State Plane Coordinate System as referenced to the North American Datum of 1983 (NAD 83).

2. Subsurface Conditions

2.1 AVAILABLE SURFICIAL GEOLOGY MAPS AND HISTORIC SUBSURFACE INFORMATION

The site is shown on the United States Geological Survey (USGS) 2011 "Surficial Geology Map of the Onset Quadrangle, Massachusetts". The Marion Quadrangle is just west of the site. These maps show that the causeway is comprised of Artificial Fill and passes over Salt-marsh deposits with glacial till and coarse deposits (likely glacial fluvial deposits) in the area. There are no known bedrock outcrops in this area of Massachusetts.

The historic drawings suggest that there are likely buried stone walls and rubble fill in the existing embankments. There is also surficial riprap visible on the slopes of the causeway.

The 1929 explorations for Bridge M-05-001 = W-06-013 suggest the embankment fill consists of loose to hard sand and gravel with riprap and wood, with one boring stopped at an obstruction. The upper natural soils vary from soft mud and fine sand to fine dirty sand, to medium clay and fine sand. Denser soil with boulders (possible glacial till or glaciofluvial deposits) was encountered below the upper natural soils. The 1929 boring depth was about 40 ft below the top of the embankment. Three additional borings done in 1956 on the south side of the bridge extended to about 45 ft below the top of the embankment and indicated loose fine sand with trace silt to about 38 ft depth, overlying denser sand. These historic explorations are included in Appendix A on the bridge plans.

The 1929 explorations for Bridge W-06-013 suggest the embankment fill consists of loose sand and riprap fill and loose coarse dirty sand and boulders. The upper natural soils vary from soft mud and loose coarse sand, to fine dirty sand. Denser soil was encountered below the upper natural soils. The 1929 boring depth was about 55 ft below the top of the embankment. Four additional borings done in 1956 on the south side of the bridge extended to about 46 ft below the river bottom and indicated fine sand with trace silt overlying denser sand. These historic explorations are included on the bridge plans in Appendix B.

2.2 SUBSURFACE EXPLORATION PROGRAM

2.2.1 November 2017 to March 2018 Exploration Program

The bridge borings for this study were drilled by Northern Drill Service, Inc. of Northborough, MA using a truck-mounted Mobile Drill B57 drill rig. The borings for Bridge No. M-05-001 = W-06-013 and Bridge No. W-06-016 were done as part of the same exploration program. Two mobilizations were required to complete the borings due to a delay in getting Coast Guard approval for the borings through the bridge deck. The abutment borings were advanced between 28 November 2017 and 3 January 2018 and the borings through the bridge deck between 12 March 2018 and 30 March 2018.

In addition to the bridge borings, an upstream sediment sample was obtained. TG&B Marine Services of Monument Beach, MA obtained the required offshore sediment sample using vibrocore sampling equipment on 7 June 2018. Additional overbank sediment samples were taken along the shoreline from land.

All subsurface explorations were observed and logged by a Haley & Aldrich, Inc. (Haley & Aldrich) geologist on a full-time basis. Haley & Aldrich personnel were not on the boat during the offshore sediment sampling but supervised the work from shore and examined the samples after collection. We also collected the overbank sediment samples. Detailed soil descriptions are provided on the boring logs, which are included as Appendix C.

Boring locations were laid out in the field by Haley & Aldrich by taping from existing site features. "As-drilled" locations and ground surface elevations at the boring locations were surveyed by Survey and Mapping Consultants (SMC). The boring locations are provided on Figure 2, the Site and Subsurface Exploration Location Plan. The ground surface elevations, GPS coordinates at the exploration locations, and the as-drilled soil boring and rock core lengths are summarized on Figure 2.

The borings were all cased and advanced using the drill and wash method by either driving or spinning the casing. The borings were drilled to depths ranging from 29.5 to 59 ft below the roadway surface (abutment borings) or mudline (borings through the bridge deck). They were typically performed by first advancing a 5.0-in. (PW-size) inside diameter (ID) steel casing to a certain depth and then telescoping down to a deeper depth with 4.0-in. (HW-size) ID steel casing. Where necessary to get by obstructions, this was followed by telescoping down a 3.0-in. (NW-size) ID steel casing to the top of bedrock.

Split spoon soils samples were conducted in general accordance with ASTM D 1586 (2 in. outside dia. sampler driven 24 in. by blows from a 140-pound hammer falling freely for 30 in.). As the sampler was driven, the hammer blows required for each 6 in. interval was recorded on the boring log. The blow counts for the second and third 6-in. driving interval added together are the uncorrected Standard Penetration Test (SPT) N-value. The drill rig was equipped with a winch driven automatic hammer.

Split spoon soil samples were typically collected continuously in the upper 5 ft below the pavement and then typically at 5-ft intervals. Borings BB-3 and BB-4, which were advanced through the deck of Bridge M-05-001 = W-06-013, were sampled continuously from the mudline to refusal on bedrock. Borings BB-9 and BB-10, which were advanced through the deck of Bridge W-06-016, where sampled continuously from the mudline to a depth of about 12 to 15 ft.

2.2.2 December 2020 to February 2021 Exploration Program

This exploration program targeted getting subsurface information for design of the causeway and retaining walls and included a few borings along the roadway but mostly offshore borings in the vicinity of the toe of the causeway. All borings for this study were drilled by New England Boring Contractors. A truck-mounted Mobile Drill B48 drill rig was used for the three land-based borings, and a CME 45 drill rig was utilized for the borings performed from a barge. Land-based Borings BB-14, BB-15, and BB-16 were advanced between 26 January 2021 and 3 February 2021 and barge-based Borings BB-17 through BB-28A were advanced between 22 December 2020 and 20 January 2021.

All subsurface explorations were observed and logged by a Haley & Aldrich geologist on a full-time basis. Detailed soil descriptions are provided on the boring logs, which are included as Appendix C.

Borings BB-14 through BB-28A were located by Haley & Aldrich using a global positioning system (GPS) device with the following exceptions: The as-built locations of Borings BB-14 through BB-16 were determined using taped measurements to existing features. The mudline elevation at each boring

location in the river was determined by GPS measurement of the elevation of the barge deck and measurement of the water depth or by direct measurement, by placing the GPS rod on the river bottom.

The boring locations are provided on Figure 2, the Site and Subsurface Exploration Location Plan. The ground surface elevations, GPS coordinates at the exploration locations, and the as-drilled soil boring and rock core lengths are summarized on Figure 2.

The borings were all cased and advanced using the drill and wash method by either driving or spinning the casing. Land-based Borings BB-14 through BB-16 were drilled to depths ranging from 44.1 to 55.3 ft below the roadway surface. Barge-based Borings BB-17 through BB-28A were drilled to depths ranging from 15 to 47.7 ft below the river bottom. They were typically performed by first advancing a 4.0-in. (HW-size) inside diameter steel casing, and then telescoping down with a smaller diameter casing if needed to advance the explorations.

Split spoon soils samples were obtained in general accordance with ASTM D 1586 (2-in. outside dia. sampler driven 24 in. by blows from a 140-pound hammer falling freely for 30 inches). As the sampler was driven, the hammer blows required for each 6-in. interval were recorded on the boring log. The blow counts for the second and third 6-in. driving interval added together are the uncorrected Standard Penetration Test (SPT) N-value. The drill rigs were both equipped with a winch-driven automatic hammer.

For the barge-based borings, split spoon soil samples were typically collected continuously in the upper 8 to 13 ft below the river bottom and then typically at 5-ft intervals.

Undisturbed tube samples were also obtained in the organic stratum as noted on the boring logs.

The water borings were located as close to the toe of the existing causeway slope as possible given the barge logistics, water depth, and tides. It was not possible to drill borings or probes along the alignment of the retaining walls since that location is in the middle of an existing, steep riprap slope.

2.2.3 June 2024 to August 2024 Exploration Program

This third subsurface exploration program targeted getting subsurface information for design of the causeway retaining walls and some additional information at the locations of the proposed bridge piers. All of these borings were done along the roadway or from the bridge deck. In addition to borings, Hager-Richter Geoscience (HRGS) performed a seismic refraction and ground penetrating radar survey along the alignment of the proposed causeway retaining walls. The results of the geophysical testing are included in Appendix D.

All borings for this study were drilled by New England Boring Contractors. A truck-mounted Mobile Drill B48 drill rig was used between 06 June 2024 and 02 August 2024.

All subsurface explorations were observed and logged by a Haley & Aldrich, Inc. (Haley & Aldrich) geologist on a full-time basis. Detailed soil descriptions are provided on the boring logs, which are included as Appendix C.

BB-29 through BB-39 were located by Haley & Aldrich using a global positioning system (GPS) device with the following exceptions: the as-built locations of Borings BB-29A and BB-31 were determined

using taped measurements to existing features and elevations estimated from existing contours. The mudline elevation at each boring location in the river was determined by GPS measurement of the elevation of the barge deck and measurement of the water depth. Borings BB-30 and BB-33 were not performed.

The borings were all cased and advanced using the drill and wash method by either driving or spinning the casing. The borings were drilled to depths ranging from -41.8 to 77.5 ft below the roadway surface (causeway borings) or mudline (borings through the bridge deck). They were typically performed by first advancing a 5.0-in. (PW-size) inside diameter (ID) steel casing to a certain depth and then telescoping down to a deeper depth with 4.0-in. (HW-size) ID steel casing. Where necessary to get by obstructions, this was followed by telescoping down a 3.0-in. (NW-size) ID steel casing to the top of bedrock.

Split spoon soils samples were conducted in general accordance with ASTM D 1586 (2 in. outside dia. sampler driven 24 in. by blows from a 140-pound hammer falling freely for 30 in.). As the sampler was driven, the hammer blows required for each 6 in. interval was recorded on the boring log. The blow counts for the second and third 6-in. driving interval added together are the uncorrected Standard Penetration Test (SPT) N-value. The drill rig was equipped with a winch driven automatic hammer.

Split spoon soil samples were typically collected continuously in the upper 5 ft below the pavement and then typically at 5-ft intervals.

2.3 VERIFICATION OF SAMPLE DESCRIPTIONS ON BORING LOGS

Soil samples from the borings were classified by our field geologist in accordance with the Unified Soil Classification System using the Visual-Manual Procedure (ASTM D2488) as practiced by Haley & Aldrich. The soil samples were also examined in our office and the soil descriptions on the exploration logs edited where appropriate. The results of the geotechnical laboratory index testing were also incorporated onto the boring logs.

Bedrock core was classified in the field by our field geologist and the core examined and exploration logs reviewed in our office by a senior geologist.

All soil and bedrock samples were preserved in glass sample jars and wooden core boxes. Soil and bedrock samples will be transferred to a MassDOT storage facility.

2.4 GEOTECHNICAL LABORATORY TESTS – BRIDGE NO. M-05-001 = W-06-013

2.4.1 Soil Testing

Grain Size Distribution tests were conducted on three samples from Boring BB-3 and three samples from Boring BB-4 for use in the scour analyses (by MassDOT). Grain Size Distribution tests were also conducted on the vibrocore Sample SS-1 and the Marion overbank sample for use in scour analyses.

Sample S7 from Boring BB-6 was tested for organic content and gradation. The organic content was found to be 3.1%, the fines content 77.5% and the water content 52.0 and 53.3%.

Refer to Appendix E for the complete geotechnical laboratory test results.

2.4.2 Rock Testing

A sample of the rock core from Boring BB-3 was tested to determine its unconfined strength and modulus using ASTM D7012 Method D. The results of this laboratory testing are included in Appendix E.

2.5 GEOTECHNICAL LABORATORY TESTS – BRIDGE NO. W-06-016

2.5.1 Soil Testing

Grain Size Distribution tests were conducted on 4 samples from Boring BB-9 and 3 samples from Boring BB-10 for use in the scour analyses by MassDOT. Grain Size Distribution tests were also conducted on the vibrocore Sample SS-2 and the Marion overbank sample for use in scour analyses.

Sample S6 from Boring BB-9 was tested for plasticity and found to be non-plastic. Sample S5 from Boring BB-10 had 45.5% by weight passing the number 40 sieve indicating fine sand or finer and 31.2% passed the number 200 sieve indicating silt or clay. The sample was found to be non-plastic. Refer to Appendix E for the complete geotechnical laboratory test results.

2.5.2 Rock Testing

A sample of the rock core from Boring BB-10 was tested to determine its unconfined strength and modulus using ASTM D7012 Method D. The results of this laboratory testing are included in Appendix E.

2.6 GEOTECHNICAL LABORATORY TESTS – CAUSEWAY EXPLORATION PROGRAM

Soil index tests performed on disturbed samples as part of the causeway exploration program include the following:

- 3 Grain Size Distribution
- 4 Atterberg Limits
- 2 Moisture and Organic Matter

Soil tests performed on undisturbed samples as part of the recent exploration program include the following:

- 4 Tube X-Rays
- 4 Tube Handling and Logging (density; moisture content; torvane; description)
- 1 Grain Size Distribution
- 1 Atterberg Limits
- 1 Moisture, Ash, and Organic Matter
- 2 Laboratory Vane Shear
- 2 Incremental Consolidation (Method B)
- 3 Direct Simple Shear

A composite sample from Boring BB-29, BB-29A, BB-31, BB-32, and BB-37 was tested for pH and resistivity and a sample from Boring B-32 was tested for water-soluble sulfate and chloride.

Refer to Appendix E for the complete geotechnical laboratory test results.

2.7 SUBSURFACE SOIL AND ROCK CONDITIONS

2.7.1 Generalized Soil Conditions

The subsurface conditions encountered at the site consist of the following geologic units presented generally in order of increasing age and depth below ground surface in the embankment: man-placed fill, organic deposits, littoral, marine, or estuarine deposits, glaciolacustrine deposits, glaciofluvial deposits or glacial till deposits, and bedrock. The exception being that the water borings generally encountered organic deposits on the river bottom directly overlying glacial deposits. Figure 2 shows the boring locations. A description of each soil unit is provided below. Detailed soil descriptions are provided in the boring logs in Appendix C.

- **Causeway Fill** – The existing causeway fill was placed during the original causeway construction and subsequent widening. Based on the historic drawings and obstructions encountered, there are cobbles, boulders, wood, and other obstructions in the fill, including possibly buried stone walls and riprap. The fill was likely placed through the water and not compacted. The fill is generally very loose to very dense and is predominantly sand (SP, SP-SM, SM, SW, and/or SW-SM).
- **Organic Deposits** – Organic soils were encountered on the river bottom in almost all the water-based borings. Organic soils were also encountered in most of the land-based borings below the overlying fill. Where encountered, the organic deposits varied in thickness between 3.5 and 9 ft. The organic stratum is generally loose where classified as predominantly Sand (SM) and very soft to medium-stiff where classified as fine-grained (OL, OL/OH, or Peat).
- **Littoral, Marine, or Estuarine Deposits** – For simplicity and due to similar engineering soil properties, we have grouped these three types of deposits. Littoral deposits are a uniform sand deposit as one might find on a beach. Marine deposits are also generally sand but contain shells. Estuarine deposits are fine sandy deposits that are typical of an estuary depositional environment. Where encountered, these deposits are generally very loose to medium-dense sand (SP, SP-SM, SM, and/or SW).
- **Glaciolacustrine Deposits** – Glaciolacustrine or glaciofluvial deposits generally underlie the littoral, marine, or estuarine deposits or are directly below the organic deposits. The site may have been near a glacial lake delta that was alternately under water and above water. The glaciolacustrine deposits, where encountered, are silt (ML) or fine sand (SP) and are generally loose to very dense. Cobbles and boulders were also noted as occurring within the glaciolacustrine deposits. A 9-ft boulder was encountered in Boring BB-36 at a depth of 9.5 ft.
- **Glaciofluvial Deposits** –The glaciofluvial deposits, where encountered, are generally medium dense to very dense granular deposits (SP, SM, SW, and/or GP). Cobbles and boulders were also noted as occurring within the glaciofluvial deposits.

  Glacial Till Deposits – This deposit was encountered in Borings BB-1, BB-14, BB-15, BB-16, BB-19, BB-20, BB-22, BB-29, BB-29A, BB-31, BB-32, BB-36, BB-37 and BB-38. The glacial till is generally fine to coarse Sand (SP, SM, SW-SM, and/or GW) with 5 to 15 percent silt and 20 to 25 percent gravel and is medium-dense to very dense. The glacial till is moderately well-bonded in-situ. Cobbles and boulders are likely present in the glacial till deposits.

  Glacial till in the form of flow till was also encountered in Boring BB-8 embedded within the glaciolacustrine deposits. This glacial till was also very dense but was different than the glacial till encountered just above the bedrock in that it was about 30% fine sand and 70% silt.

- **Completely Weathered Bedrock** – Encountered in Borings BB-2, BB-5A, BB-10, BB-18, BB-31, BB-32, BB-34A, BB-35A and BB-39 just above the bedrock, this deposit was sampled with a split spoon but shows signs of relic rock fabric. The completely weathered bedrock generally classifies as Sand (SM, SW-SM) and is dense to very dense. Sampler refusals were also noted in this stratum.
- **Bedrock** - Bedrock encountered in the vicinity of Bridge W-6-016 consisted of Granitic Gneiss. Bedrock encountered in the vicinity of Bridge M-5-001 = W-6-013 is Granitic Gneiss and Quartz Breccia. There appears to be a fault zone in the area of Bridge M-5-001 = W-6-013 that has altered the bedrock particularly at the location of the pier.

2.7.2 Bedrock Conditions – Bridge M-05-001 = W-06-013

Bedrock was cored in all of the borings except BB-2. The overburden thickness above the top of fresh bedrock near the existing abutments varied from 43.5 to 48.5 ft. Near the existing pier the overburden thickness from the river bottom to the top of bedrock was 12.7 to 17 ft.

Rock quality designation (RQD) is a common parameter used to help assess the competency of sampled bedrock. RQD is defined as the sum of pieces of recovered bedrock greater than 4 in. in length divided by the total length of the core run. RQD for bedrock encountered is summarized below.

Substructure	Boring	Length of Rock Core Sampled (ft)	Range in RQD (%)	Average RQD (%)[1]
West Abutment	BB-1	15	70 to 78	74
West Abutment	BB-2	No Core	-	
Pier	BB-3	25.5	17 to 85	43
Pier	BB-4	14.5	60-87	74
Pier	BB-34A	25.2	0 to 70	23
East Abutment	BB-5A	5	67	67
East Abutment	BB-6	10	63-88	75

***Note**:*
[1] Average RQD is the mean of RQDs recorded for each boring.

2.7.3 Bedrock Conditions – Bridge W-06-016

Bedrock was cored in Borings BB-8 through BB-12, BB-35A and BB-36. The overburden thickness above the top of bedrock near the existing abutments varied from 60.3 to 71 ft. Near the existing piers the overburden thickness from the river bottom to the top of bedrock was 30.5 to 46.5 ft.

Rock quality designation (RQD) is a common parameter used to help assess the competency of sampled bedrock. RQD is defined as the sum of pieces of recovered bedrock greater than 4 in. in length divided by the total length of the core run. RQD for bedrock encountered is summarized below.

Substructure	Boring	Length of Rock Core Sampled (ft)	Range in RQD (%)	Average RQD (%)[1]
West Abutment	BB-7	No Core	-	-
	BB-8	10	0 to 96	57
West Pier	BB-10	15.3	63 to 92	80
	BB-35A	23.8	53 to 100	78
East Pier	BB-9	15	58 to 97	85
	BB-36	24.5	63 to 90	74
East Abutment	BB-11	10	54 to 96	75
	BB-12	5	10	10
160 ft West of West Abutment	BB-13	No Core	-	-

***Note**:*
[1] Average RQD is the mean of RQDs recorded for each boring.

2.7.4 Bedrock Conditions – Causeway

Bedrock was cored in Borings BB-29A, BB-31, BB-32 and BB-37 through BB-39. The overburden thickness above the top of bedrock at the causeway varied from 32.0 to 68.5 ft.

Rock quality designation (RQD) is a common parameter used to help assess the competency of sampled bedrock. RQD is defined as the sum of pieces of recovered bedrock greater than 4 in. in length divided by the total length of the core run. RQD for bedrock encountered is summarized below.

Substructure	Boring	Length of Rock Core Sampled (ft)	Range in RQD (%)	Average RQD (%)[1]
Causeway	BB-29A	10	72 to 97	85
	BB-31	10	67 to 82	75
	BB-32	9.8	48 to 52	50
	BB-37	9	17 to 63	40
	BB-38	10	72 to 83	78
	BB-39	10	47 to 80	64

***Note**:*
[1] Average RQD is the mean of RQDs recorded for each boring.

2.8 GROUNDWATER CONDITIONS

The groundwater level, which was generally encountered at a depth of 9 ft or deeper (approximately El. 1.8) in the land borings, will be heavily influenced by the tidal river level.

Groundwater levels are expected to fluctuate in response to seasonal, precipitation, tidal, and construction influences. Groundwater levels encountered during construction may vary from the levels noted on the boring logs and as reported herein.

2.9 OBSTRUCTIONS

Bridge M-05-001 = W-06-013

As noted on the boring logs, obstructions were encountered in the field explorations that could inhibit foundation construction. Most of the obstructions were encountered in the embankment fill; although, occasional cobbles were noted in the glaciolacustrine, glaciofluvial, and glacial till deposits and in the completely weathered bedrock.

The occurrence of potential obstructions specifically noted on the boring logs is summarized below:

Substructure	Boring	Number of Obstructions Encountered		
		Cobbles, Boulders, or Other Obstructions in the Fill and Organics Stratum	Cobbles, Boulders, or Other Obstructions in the Overburden below the Organics Stratum	Cobbles, Boulders, or Other Obstructions in Completely Weathered Bedrock Stratum
West Abutment	BB-1	1	1	NA
	BB-2	0	2	1
Pier	BB-3	NA	0	1
	BB-4	NA	0	0
	BB-34	1	(Note 3)	NA
	BB-34A	NA	1	0
East Abutment	BB-5	2 (Note 1)	NA	NA
	BB-5A	2 (Note 2)	0	NA
	BB-6	3	0	NA

Notes:

1. *Cored approximately 12-in. of steel infused slag from 12.0 to 13.0 ft in Boring BB-5. Drill casing broke and abandoned location after retrieving drill casing. Multiple cobbles and boulders in drill hole.*
2. *BB-5A is located 4.5 ft northeast of BB-5. Cobbles noted in upper 13 ft which were not sampled. Drilled through wood from 15.5 to 16.5 ft.*
3. *In boring BB-34, the bottom 5 ft section of the 6-in. diameter drill casing string broke off when driving through a possible wood obstruction at a depth of 4.5 ft below the mudline. When the 5 ft section of drill casing broke, the upper 27 ft length of drill casing dropped vertically below the bridge deck and fell perpendicular to the bridge through the water, ultimately laying flat on channel bottom. The 5 ft section of casing was not able to be retrieved and the top of the casing was pushed below the mudline. Retrieval of the 27 ft section was unsuccessful.*

Bridge W-06-016

As noted on the boring logs, obstructions that could inhibit foundation construction were encountered in the field explorations. Most of the obstructions were encountered in the embankment fill; although, occasional cobbles were noted in the glaciolacustrine, glaciofluvial, and glacial till deposits.

The occurrence of potential obstructions specifically noted on the boring logs is summarized below:

Substructure	Boring	Number of Obstructions (cobbles, boulders or other) Encountered		
		In the Fill and Organics Stratum	In the Overburden below the Organics Stratum	In Completely Weathered Bedrock Stratum
West Abutment	BB-7	0 (Note 1)	1	NA
	BB-8	4	3	NA
West Pier	BB-10	NA	0	0
	BB-35	NA	1 (Note 2)	NA
	BB-35A	NA	2	0
East Pier	BB-9	NA	2	NA
	BB-36	NA	1 (Note 3)	NA
East Abutment	BB-11	1	2	NA
	BB-12	4	0	NA

***Notes**:*

1. *5 ft of HW casing broke off at a depth of 39 to 44 ft below the roadway and was not retrievable in Boring BB-7. Current plans show this to be outside of the area of the proposed abutment.*
2. *Boring BB-35 casing refusal on possible steel and wood obstruction or construction debris at 2 ft.*
3. *Boring BB-36 cored a 9 ft thick boulder at a depth of 9.5 ft within the glaciolacustrine deposits.*

Causeway Retaining Wall Borings

As noted on the boring logs, obstructions that could inhibit foundation construction were encountered in the field explorations. Obstructions were encountered in the embankment fill and occasional cobbles and boulders were noted in the glaciolacustrine, glaciofluvial, and glacial till deposits.

In the past it is possible that riprap and/or stone retaining walls were buried when the downstream side of the causeway was widened, and because of this, there is the potential that obstructions could be encountered within the existing causeway and/or slopes.

The occurrence of potential obstructions specifically noted on the boring logs is summarized below:

Substructure	Boring	Number of Obstructions (cobbles, boulders or other) Encountered		
		In the Fill and Organics Stratum	In the Overburden below the Organics Stratum	In Completely Weathered Bedrock Stratum
Retaining Wall	BB-13	2	4	NA
	BB-14	1	0	NA
	BB-15	1	0	NA
	BB-16	1	0	NA
	BB-29	1	2	NA
	BB-29A	1	1	NA
	BB-31	2	3	NA

References

1. AASHTO 2020 LRFD Bridge Design Specifications, Customary U.S. Units.
2. ASTM, American Society for Testing and Materials Standards.
3. MassDOT LRFD Bridge Manual, January 2020 Revision 3

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FIGURES



MAP SOURCE: ESRI. SITE COORDINATES: 41°44'18"N. 70°44'48"W





HALEY ALDRICH

WAREHAM STREET CAUSEWAY (US 6) OVER WEWEANTIC RIVER
MASSDOT BRIDGES M-05-001=W-06-013 AND W-06-016
MARION AND WAREHAM, MASSACHUSETTS

PROJECT LOCUS

SCALE: AS SHOWN
SEPTEMBER 2024

FIGURE 1

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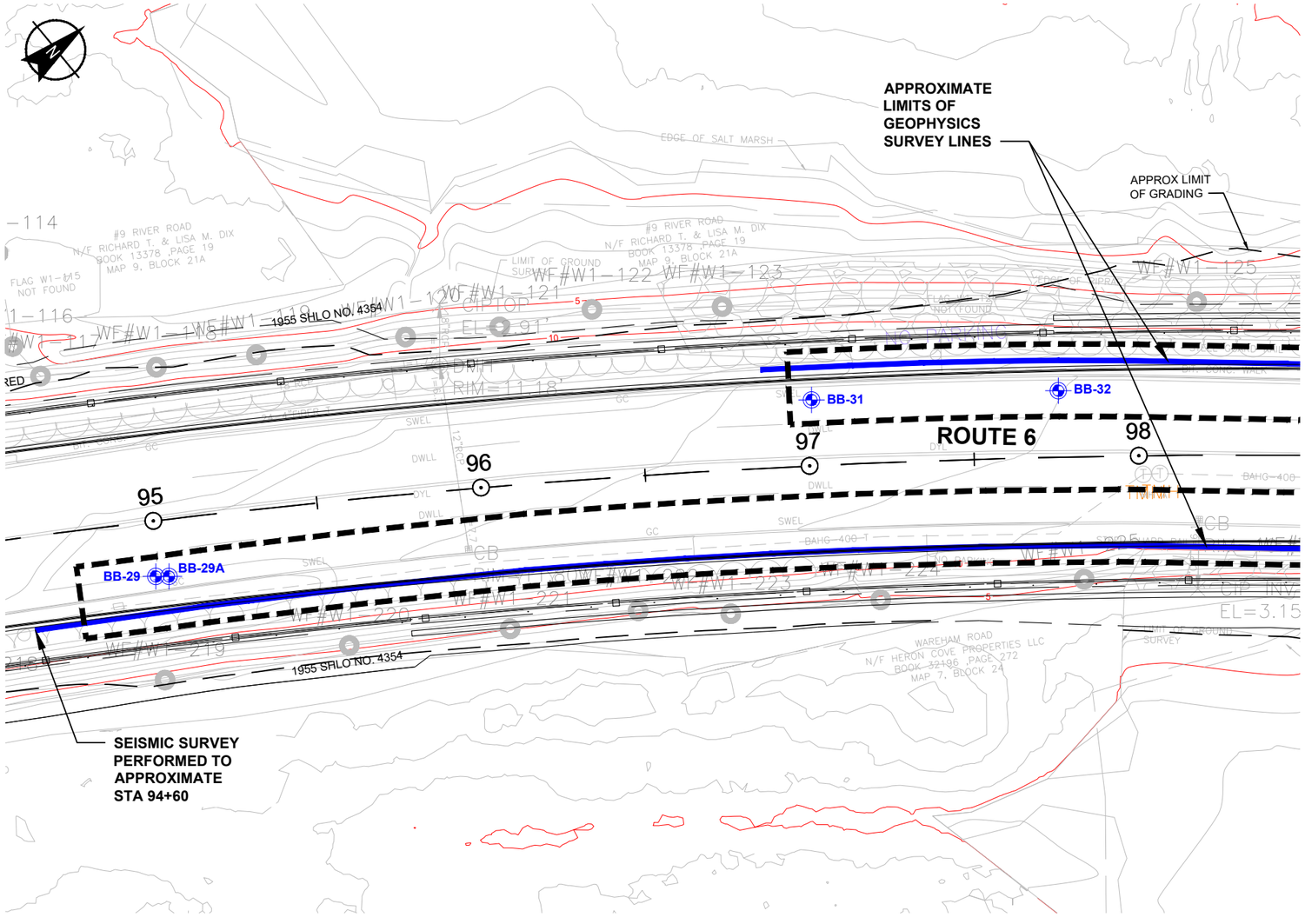

LEGEND

BB-29 — DESIGNATION AND LOCATION OF GEOTECHNICAL BORINGS ADVANCED BY NEW ENGLAND BORING CONTRACTORS BETWEEN 6 JUNE AND 2 AUGUST 2024

BB-16 — DESIGNATION AND APPROXIMATE LOCATION OF GEOTECHNICAL BORINGS ADVANCED BY NEW ENGLAND BORING CONTRACTORS BETWEEN 22 DECEMBER 2020 AND 3 FEBRUARY 2021.

BB-1 — DESIGNATION AND APPROXIMATE LOCATION OF GEOTECHNICAL BORING ADVANCED BY NORTHERN DRILLING SERVICE, INC. BETWEEN 11/28/2017 AND 1/3/2018 AND BETWEEN 3/12/2018 AND 3/30/2018.

SS-1 — DESIGNATION AND APPROXIMATE LOCATION OF VIBROCORE SEDIMENT SAMPLE TAKEN BY TG&B, INC. ON 6/7/2018.

APPROXIMATE SEISMIC SURVEY LINE

APPROXIMATE GROUND PENETRATING RADAR (GPR) SURVEY AREA

NOTES

1. BASE PLAN TAKEN FROM A DRAWING TITLED "MARION-WAREHAM, WAREHAM STREET (US 6) OVER WEWEANTIC RIVER, CONSTRUCTION PLANS, RECEIVED FROM PARSONS ON 12/30/2020 AND FROM CAD FILES "B605311_BR(M05001-W06013 Layout).dwg", "605311_BR(W06016 Layout).dwg", AND "605311_HD(Construct).dwg" RECEIVED FROM PARSONS ON 8/28/2024.
2. BASE PLAN AND BORING ELEVATIONS ARE BASED ON THE STATE PLANE COORDINATE SYSTEM AND THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988.

0 40 80
SCALE IN FEET

HALEY ALDRICH

WAREHAM STREET CAUSEWAY (US 6) OVER WEWEANTIC RIVER
MassDOT BRIDGES M-05-001=W-06-013 AND W-06-016
MARION AND WAREHAM, MASSACHUSETTS

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN BRIDGES M-05-001=W-06-013 AND W-06-016 AND CAUSEWAY

SCALE: AS SHOWN
SEPTEMBER 2024

FIGURE 2A

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ERVIN, DAYNA
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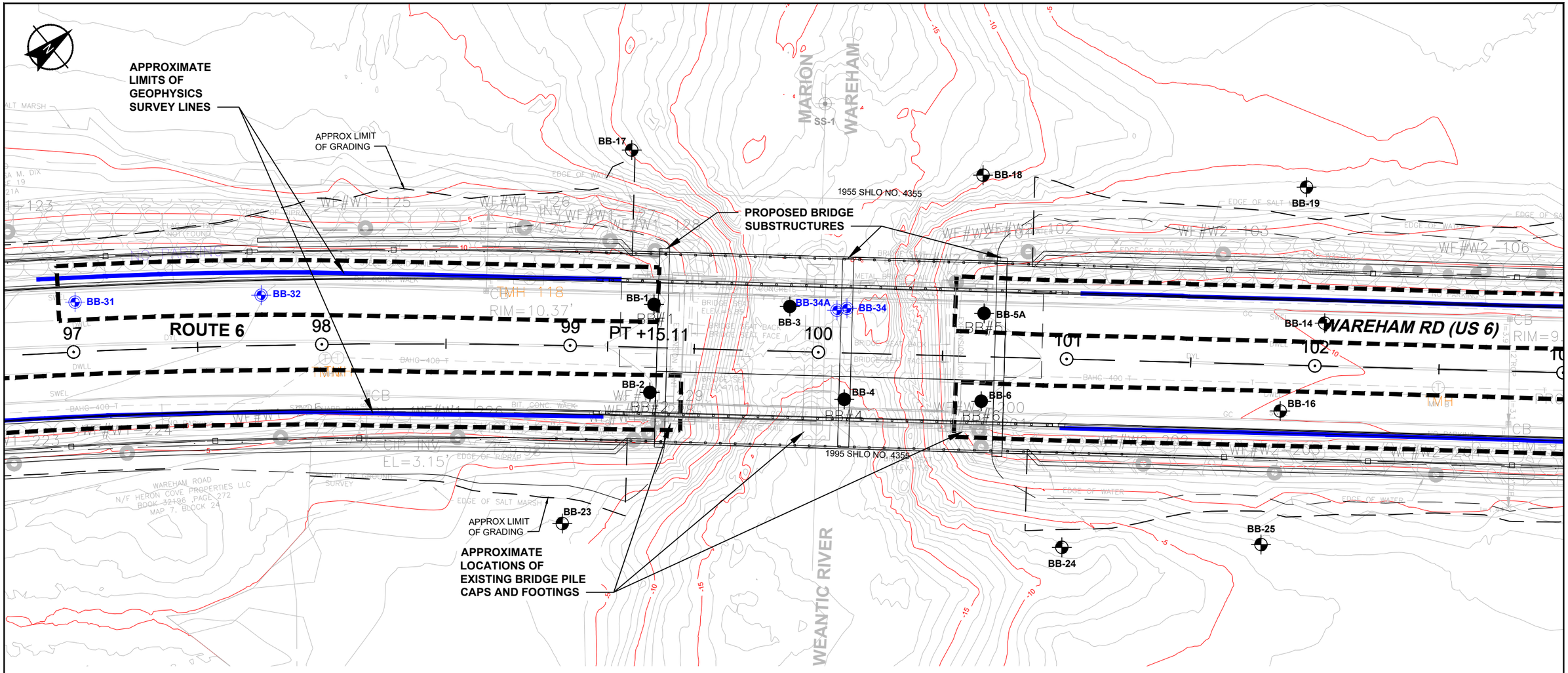

LEGEND

- **BB-31** — DESIGNATION AND LOCATION OF GEOTECHNICAL BORINGS ADVANCED BY NEW ENGLAND BORING CONTRACTORS BETWEEN 6 JUNE AND 2 AUGUST 2024
- **BB-16** — DESIGNATION AND APPROXIMATE LOCATION OF GEOTECHNICAL BORINGS ADVANCED BY NEW ENGLAND BORING CONTRACTORS BETWEEN 22 DECEMBER 2020 AND 3 FEBRUARY 2021.
- **BB-1** — DESIGNATION AND APPROXIMATE LOCATION OF GEOTECHNICAL BORING ADVANCED BY NORTHERN DRILLING SERVICE, INC. BETWEEN 11/28/2017 AND 1/3/2018 AND BETWEEN 3/12/2018 AND 3/30/2018.
- **SS-1** — DESIGNATION AND APPROXIMATE LOCATION OF VIBROCORE SEDIMENT SAMPLE TAKEN BY TG&B, INC. ON 6/7/2018.
- APPROXIMATE SEISMIC SURVEY LINE
- APPROXIMATE GROUND PENETRATING RADAR (GPR) SURVEY AREA

NOTES

1. BASE PLAN TAKEN FROM A DRAWING TITLED "MARION-WAREHAM, WAREHAM STREET (US 6) OVER WEWEANTIC RIVER, CONSTRUCTION PLANS, RECEIVED FROM PARSONS ON 12/30/2020 AND FROM CAD FILES "B605311_BR(M05001-W06013 Layout).dwg", "605311_BR(W06016 Layout).dwg", AND "605311_HD(Construct).dwg" RECEIVED FROM PARSONS ON 8/28/2024.
2. BASE PLAN AND BORING ELEVATIONS ARE BASED ON THE STATE PLANE COORDINATE SYSTEM AND THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988.

0 40 80
SCALE IN FEET

HALEY ALDRICH

WAREHAM STREET CAUSEWAY (US 6) OVER WEWEANTIC RIVER
MassDOT BRIDGES M-05-001=W-06-013 AND W-06-016
MARION AND WAREHAM, MASSACHUSETTS

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN BRIDGES M-05-001=W-06-013 AND W-06-016 AND CAUSEWAY

SCALE: AS SHOWN
SEPTEMBER 2024

FIGURE 2B

Layout: B114
Printed:
ERVIN, DAYNA
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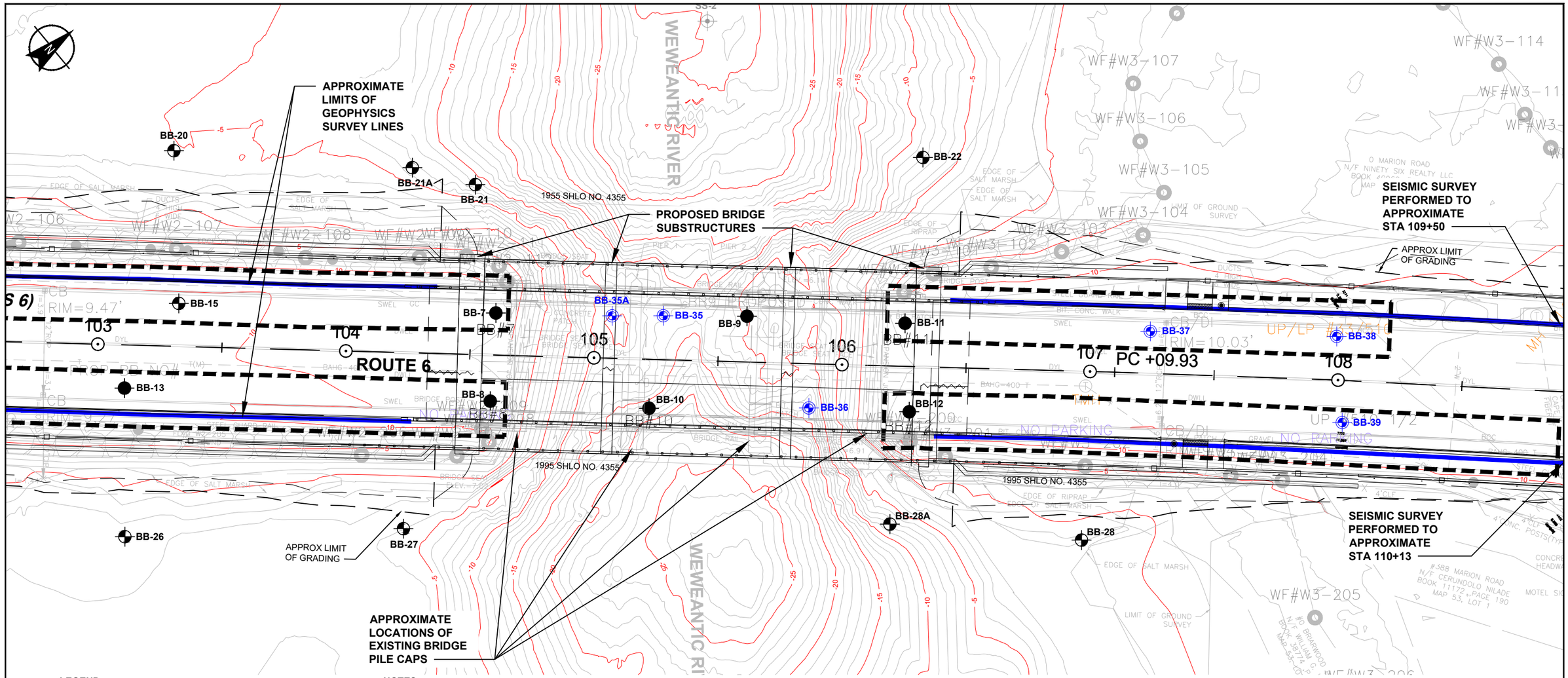

LEGEND

- **BB-35** — DESIGNATION AND LOCATION OF GEOTECHNICAL BORINGS ADVANCED BY NEW ENGLAND BORING CONTRACTORS BETWEEN 6 JUNE AND 2 AUGUST 2024
- **BB-15** — DESIGNATION AND APPROXIMATE LOCATION OF GEOTECHNICAL BORINGS ADVANCED BY NEW ENGLAND BORING CONTRACTORS BETWEEN 22 DECEMBER 2020 AND 3 FEBRUARY 2021.
- **BB-7** — DESIGNATION AND APPROXIMATE LOCATION OF GEOTECHNICAL BORING ADVANCED BY NORTHERN DRILLING SERVICE, INC. BETWEEN 11/28/2017 AND 1/3/2018 AND BETWEEN 3/12/2018 AND 3/30/2018.
- **SS-2** — DESIGNATION AND APPROXIMATE LOCATION OF VIBROCORE SEDIMENT SAMPLE TAKEN BY TG&B, INC. ON 6/7/2018.
- APPROXIMATE SEISMIC SURVEY LINE
- APPROXIMATE GROUND PENETRATING RADAR (GPR) SURVEY AREA

NOTES

1. BASE PLAN TAKEN FROM A DRAWING TITLED "MARION-WAREHAM, WAREHAM STREET (US 6) OVER WEWEANTIC RIVER, CONSTRUCTION PLANS, RECEIVED FROM PARSONS ON 12/30/2020 AND FROM CAD FILES "B605311_BR(M05001-W06013 Layout).dwg", "605311_BR(W06016 Layout).dwg", AND "605311_HD(Construct).dwg" RECEIVED FROM PARSONS ON 8/28/2024.
2. BASE PLAN AND BORING ELEVATIONS ARE BASED ON THE STATE PLANE COORDINATE SYSTEM AND THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988.

0 40 80
SCALE IN FEET

HALEY ALDRICH

WAREHAM STREET CAUSEWAY (US 6) OVER WEWEANTIC RIVER
MassDOT BRIDGES M-05-001=W-06-013 AND W-06-016
MARION AND WAREHAM, MASSACHUSETTS

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN BRIDGES M-05-001=W-06-013 AND W-06-016 AND CAUSEWAY

SCALE: AS SHOWN
SEPTEMBER 2024

FIGURE 2C

Layout: B115
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SUMMARY OF BORINGS								
BORING	NORTHING	EASTING	STATION	OFFSET (FT.)	AS DRILLED APPROX. SURFACE EL.	AS-DRILLED SOIL BORING DEPTH (FT)	AS-DRILLED ROCK CORE LENGTH (FT)	CLOSEST STRUCTURE
BB-1	2730242.0	861522.0	99+33	17.4 LT	10.8	44.0	15.0	SW ABUTMENT
BB-2	2730218.3	861548.2	99+33	18.0 RT	10.9	43.5	-	SW ABUTMENT
BB-3	2730283.8	861557.1	99+88	18.0 LT	-17.3	12.5	25.5	CENTER PIER
BB-4	2730277.1	861599.9	100+11	18.7 RT	-18.0	15.0	14.5	CENTER PIER
BB-5	2730342.7	861608.6	100+66	17.5 LT	11.0	48.5	5.0	NE ABUTMENT
BB-6	2730319.3	861635.4	100+66	17.9 RT	10.9	47.0	10.0	NE ABUTMENT
SS-1	2730346.4	861502.9	100+00	100.0 LT	-16.5	-	-	SEDIMENT SAMPLE

NOTE: BORING BB-5A IS A CONTINUATION OF BORING BB-5. BORING BB-5 IS LOCATED 4.5 FT SOUTHWEST OF BB-5A AT APPROXIMATELY THE SAME DISTANCE FROM THE CURB.

SUMMARY OF BORINGS								
BORING	NORTHING	EASTING	STATION	OFFSET (FT.)	AS DRILLED APPROX. SURFACE EL.	AS-DRILLED SOIL BORING DEPTH (FT)	AS-DRILLED ROCK CORE LENGTH (FT)	CLOSEST SUBSTRUCTURE
BB-7	2730640.2	861866.5	104+60	17.0 LT	10.8	60.3	-	SW ABUTMENT
BB-8	2730615.9	861891.4	104+59	18.6 RT	11.7	67.0	10	SW ABUTMENT
BB-9	2730717.7	861931.5	105+61	18.5 LT	-9.8	46.5	15.3	SW PIER
BB-10	2730664.2	861934.6	105+23	19.7 RT	-21.2	30.5	15	NE PIER
BB-11	2730765.5	861974.1	106+25	17.4 LT	10.8	71	10	NE ABUTMENT
BB-12	2730743.9	862002.5	106+28	18.3 RT	10.7	62	5	NE ABUTMENT
BB-13	2730505.1	861795.2	103+11	17.4 RT	9.5	58	-	RETAINING WALL
SS-2	2730780.6	861829.4	105+42	136.9 LT	-30.0	-	-	SEDIMENT SAMPLE

BORING LOCATIONS (FEET)								
BORING	NORTHING	EASTING	STATION	OFFSET	AS DRILLED APPROX. SURFACE EL.	AS-DRILLED SOIL BORING DEPTH (FT)	AS-DRILLED ROCK CORE LENGTH (FT)	CLOSEST SUBSTRUCTURE
BB-29	2729873.9	861289.1	95+00	16.8' S	12.5	44.0	-	RETAINING WALL
BB-29A	2729877.0	861291.7	95+03	17.3' S	12.5	40.5	10.0	RETAINING WALL
BB-31	2730062.0	861373.6	97+02	19.9' N	11.5	33.5	10.0	RETAINING WALL
BB-32	2730121.8	861418.8	97+76	20.2' N	11.1	32.0	9.8	RETAINING WALL
BB-34	2730301.1	861572.2	100+11	17.9' N	-14.9	5.0	-	PIER
BB-34A	2730297.5	861570.3	100+07	17.0' N	-14.9	17.0	25.2	PIER
BB-35	2730691.8	861910.0	105+28	17.7' N	-14.5	16.0	-	PIER
BB-35A	2730675.8	861897.0	105+07	17.1' N	-10.6	42.0	23.8	PIER
BB-36	2730713.7	861975.9	105+87	17.9' S	-13.0	46.5	9 (BOULDER), 24.5	PIER
BB-37	2730839.8	862039.1	107+24	16.8' N	10.2	68.5	9.0	RETAINING WALL
BB-38	2730896.6	862088.2	108+00	17.5' N	10.6	65.0	10.0	RETAINING WALL
BB-39	2730876.4	862116.5	108+03	17.0' S	10.4	63.5	10.0	RETAINING WALL

SUMMARY OF BORINGS*								
BORING	NORTHING	EASTING	STATION	OFFSET (FT.)	AS-DRILLED APPROX. SURFACE EL.	AS-DRILLED SOIL BORING DEPTH (FT)	AS-DRILLED ROCK CORE LENGTH (FT)	CLOSEST STRUCTURE
BB-14	2730446.3	861698.5	102+04	17.3' N	10	45.5	0	RETAINING WALL
BB-16	2730410.1	861714.6	101+87	18.6' S	10	44.1	0	RETAINING WALL
BB-17	2730274.3	861468.0	99+23	79.2' N	-10.2	15	0	TOE OF CAUSEWAY
BB-18	2730377.4	861565.4	100+64	73.0' N	-11.6	24.1	0	TOE OF CAUSEWAY
BB-19	2730475.3	861651.5	101+95	71.8' N	-5.0	31.7	0	TOE OF CAUSEWAY
BB-23	2730157.6	861566.7	98+98	71.7' S	-6.1	22	0	TOE OF CAUSEWAY
BB-24	2730307.3	861701.4	101+00	75.8' S	-7.6	22.5	5	TOE OF CAUSEWAY
BB-25	2730370.1	861751.3	101+80	72.5' S	-4.5	27.6	0	TOE OF CAUSEWAY

SUMMARY OF BORINGS*								
BORING	NORTHING	EASTING	STATION	OFFSET (FT.)	AS-DRILLED APPROX. SURFACE EL.	AS-DRILLED SOIL BORING DEPTH (FT)	AS-DRILLED ROCK CORE LENGTH (FT)	CLOSEST STRUCTURE
BB-15	2730543.7	861782.6	103+32	17.3' N	10	55.3	0	RETAINING WALL
BB-20	2730581.1	861733.7	103+29	78.8' N	-6.9	34.5	0	TOE OF CAUSEWAY
BB-21	2730666.6	861821.2	104+50	68.5' N	-8.5	25	0	TOE OF CAUSEWAY
BB-21A	2730651.2	861799.9	104+25	77.5' N	-6.5	4	0	TOE OF CAUSEWAY
BB-22	2730813.1	861926.9	106+30	84.3' N	-8.9	39	0	TOE OF CAUSEWAY
BB-26	2730467.4	861841.7	103+13	77.2' S	-3.0	33.5	4.5 (COBBLES)	TOE OF CAUSEWAY
BB-27	2730534.3	861889.8	104+25	70.9' S	-4	38	0	TOE OF CAUSEWAY
BB-28	2730765.0	862086.7	106+98	68.0' S	-0.6	12	0	TOE OF CAUSEWAY
BB-28A	2730709.3	862032.8	106+21	63.7' S	-8.9	47.7	0	TOE OF CAUSEWAY

NOTES

1. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 1988). ALL SURVEY POINTS HAVE BEEN DETERMINED WITH RESPECT TO THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM AS REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAVD 83).

2. SURVEY FOR BORINGS BB-14 THROUGH BB-39 WAS PROVIDED BY HALEY AND ALDRICH, INC. USING GPS WITH THE FOLLOWING EXCEPTIONS. THE AS-BUILT LOCATIONS OF BORINGS BB-14 THROUGH BB-16 AND BB-29A AND BB-31 WERE DETERMINED USING TAPED MEASUREMENTS TO EXISTING FEATURES. THE MUDLINE ELEVATION AT EACH BORING LOCATION IN THE RIVER WAS DETERMINED BY GPS MEASUREMENT OF THE ELEVATION OF THE BARGE DECK AND MEASUREMENT OF THE WATER DEPTH OR BY DIRECT MEASUREMENT OF PLACING THE GPS ROD ON THE RIVER BOTTOM. WHERE GPS WAS NOT USED, ELEVATIONS WERE ESTIMATED FROM CONTOURS OF GROUND SURFACE ELEVATION.

HALEY ALDRICH

WAREHAM STREET CAUSEWAY (US 6) OVER WEWEANTIC RIVER
MassDOT BRIDGES M-05-001=W-06-013 AND W-06-016
MARION AND WAREHAM, MASSACHUSETTS

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN BRIDGES M-05-001=W-06-013 AND W-06-016 AND CAUSEWAY

SCALE: AS SHOWN
SEPTEMBER 2024

FIGURE 2D

Layout: B116
Printed:
ERVIN, DAYNA
J:\GRAPHICS\40991\40991-005-B113.DWG

APPENDIX A
Historic Bridge Plans
Bridge M-05-001 = W-06-013

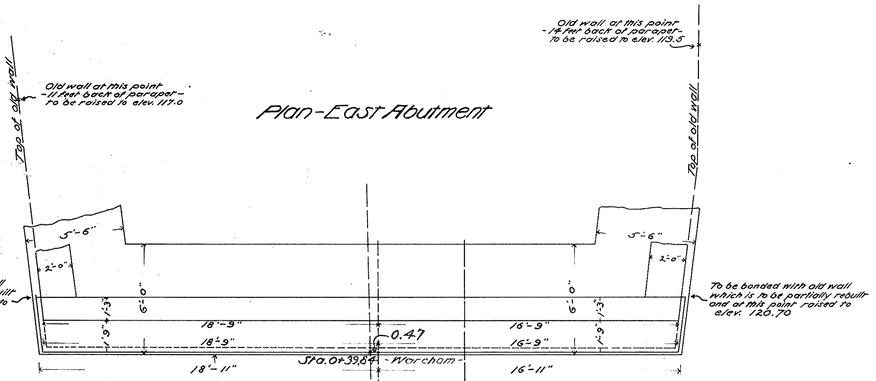
PLAN OF ABUTMENTS OF WEST BRIDGE STATION 0 -WAREHAM- MARION AND WAREHAM

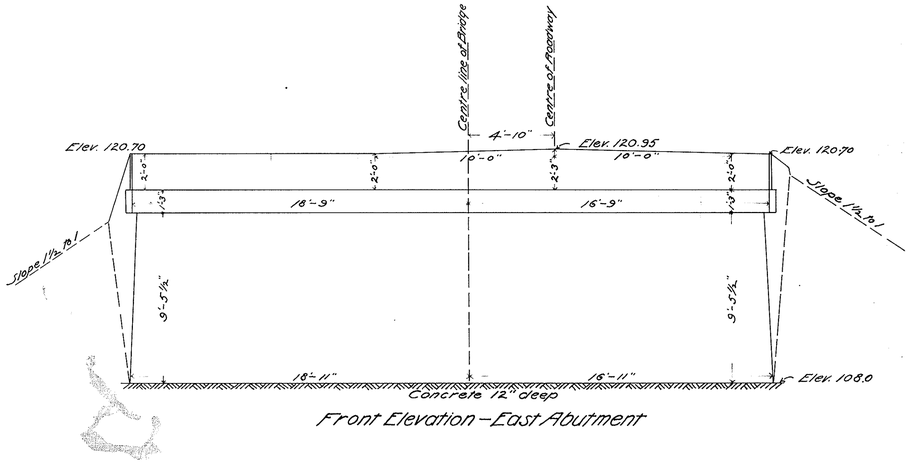
Scale: 1 inch = 4 feet

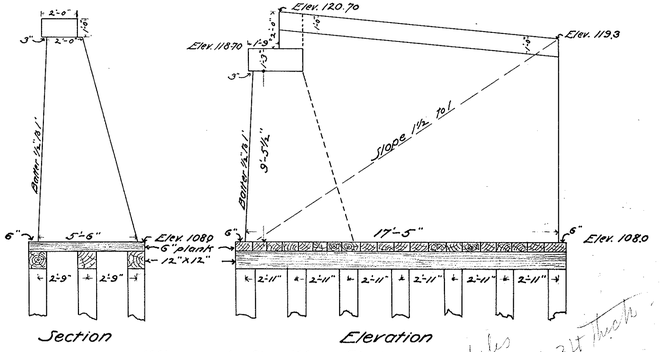
OFFICE OF
Massachusetts Highway Commission
20 Pemberton Sq. ~ Boston ~ Mass.
April 27 1901

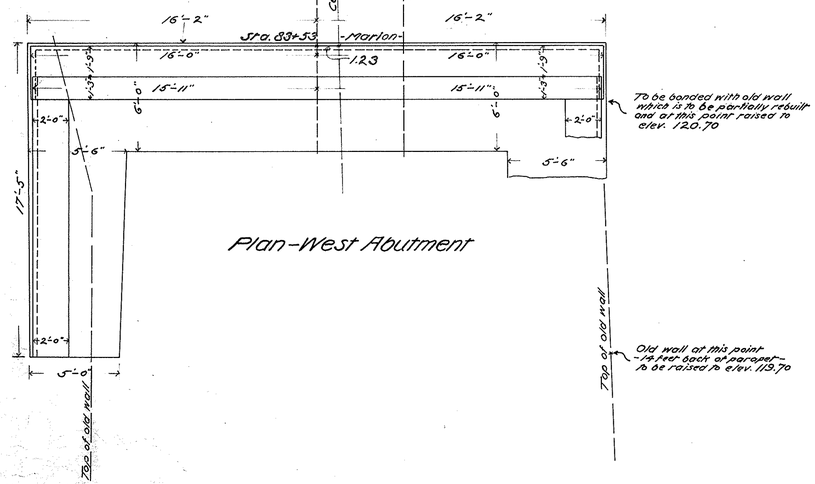
MASSACHUSETTS HIGHWAY COMMISSION
W. E. McClintock
CHAIRMAN

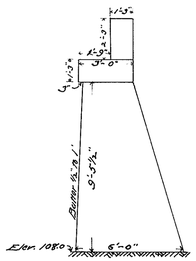
APPROVED
A. M. Lovis
ENGINEER

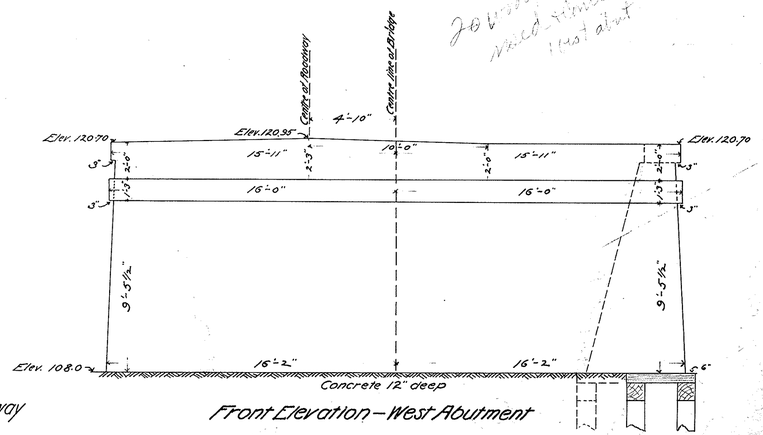






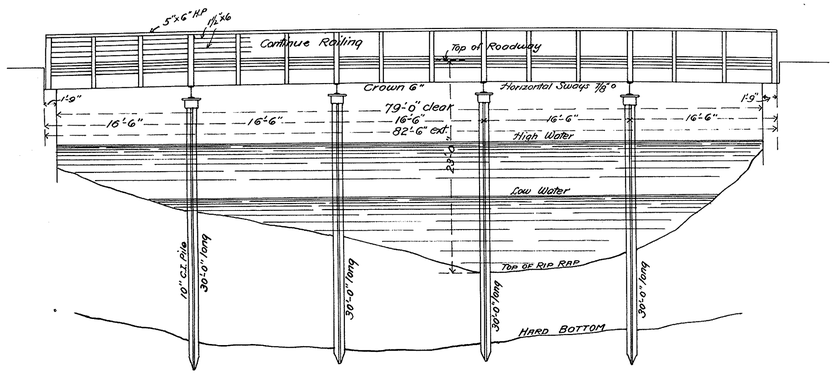




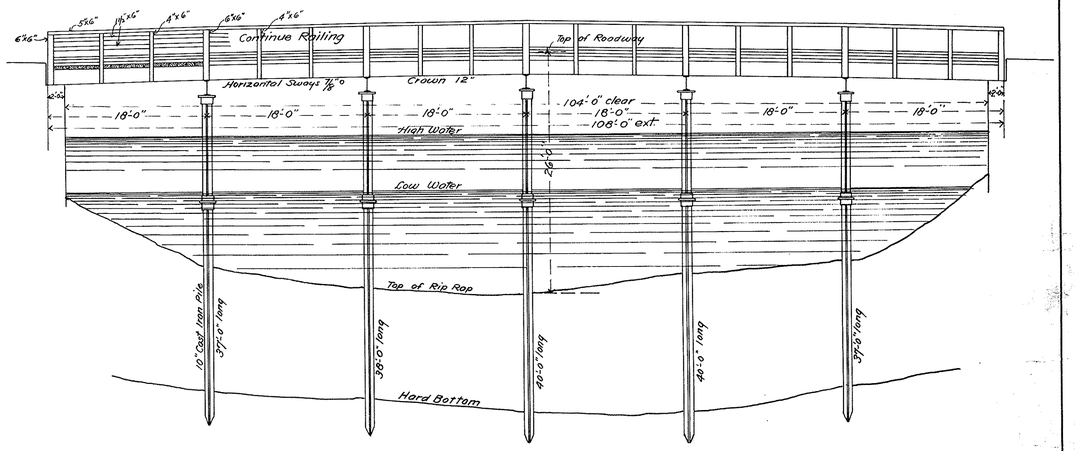


20 wooden piles driven 8 inch minimum cut 3ft thick at butt

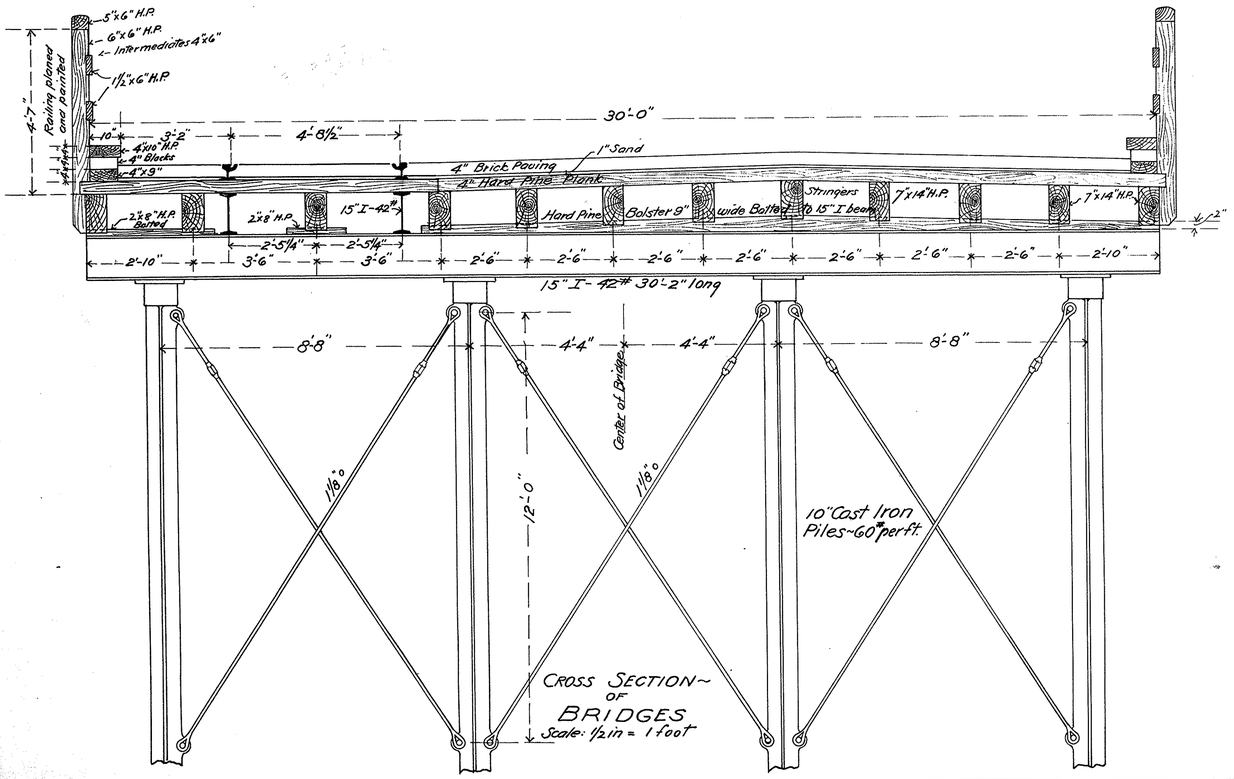
M-5-1



WEST BRIDGE
Scale: 1/8 in. = 1 foot.



EAST BRIDGE
Scale: 1/8 in = 1 foot

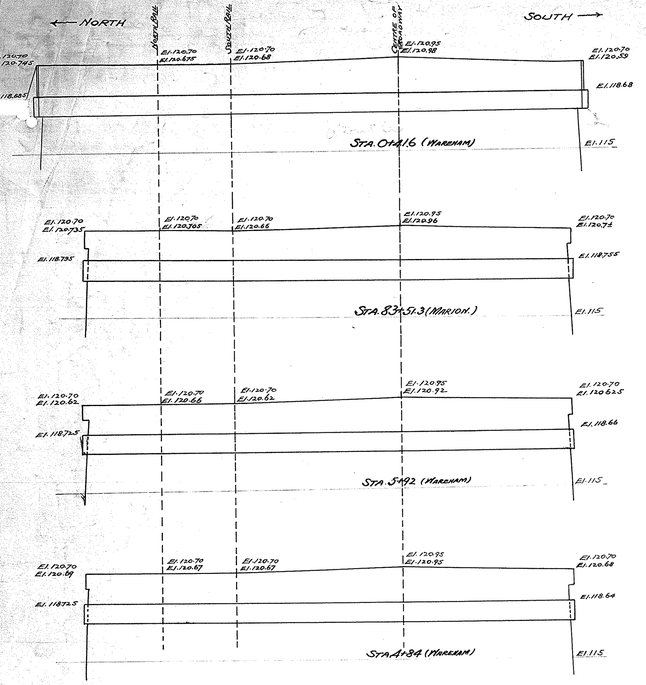


CROSS SECTION OF BRIDGES
Scale: ½ in = 1 foot

BRIDGES OVER WEWEANTIT RIVER
IN THE TOWNS OF
MARION AND WAREHAM

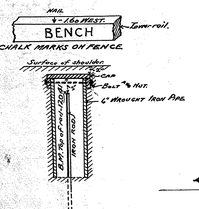
OFFICE OF
Massachusetts Highway Commission
#20 Pemberton Sq. ~ Boston~ Mass.

M-5-1

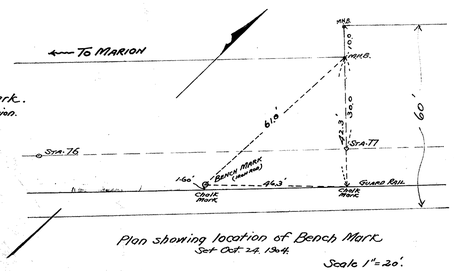


Elevations of Abutments
Scale 1"=4'

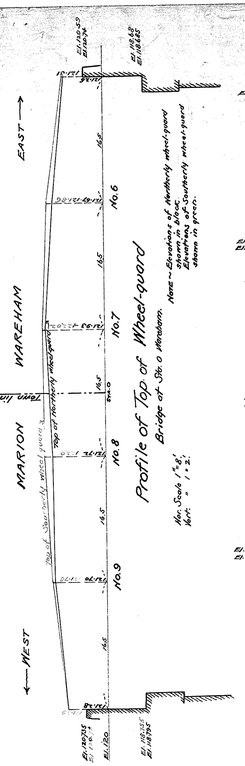
Note.~ Black shows elevations taken Oct. 24, 1904. Red shows proposed grades on profile.

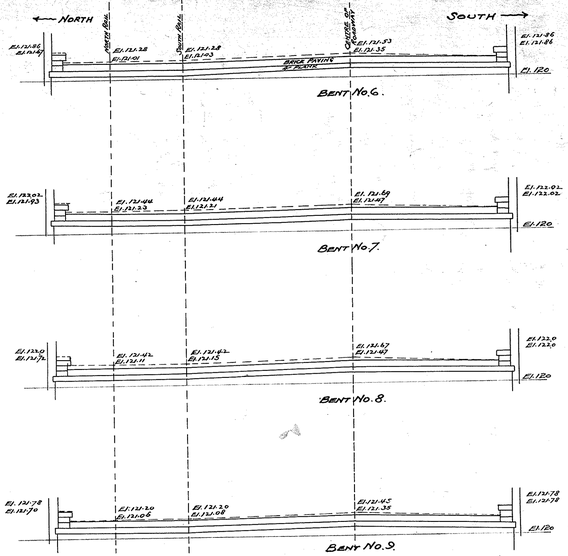


Detail of Bench-mark.
East of Sta. 76+58 - Marion.



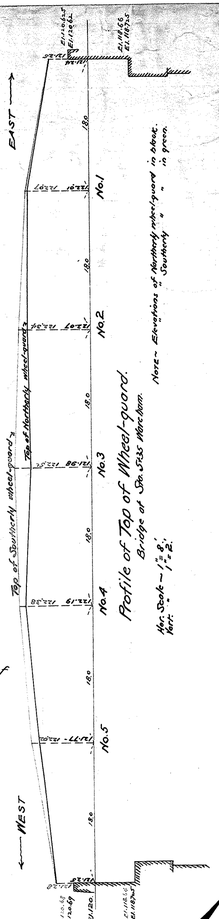
Plan showing location of Bench Mark.
Set Oct. 24, 1904.
Scale 1"=20'.

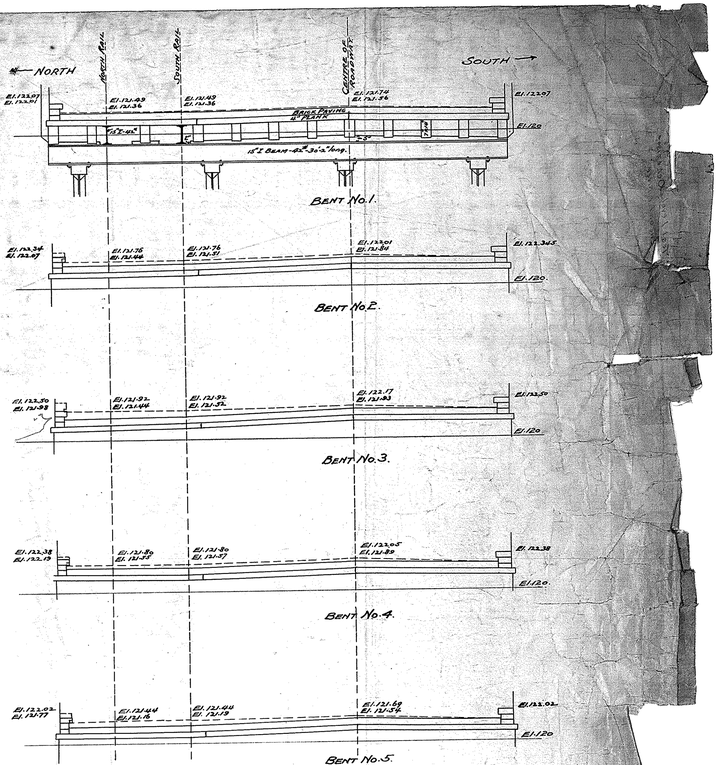




West Bridge.
Cross-sections of Floor.
Scale 1"=4'.

Note.~ Black shows elevations taken Oct. 24, 1904. Red shows standard section of bridge, as built with elevations based on present elevation of top of wheel-guard on southerly side.~



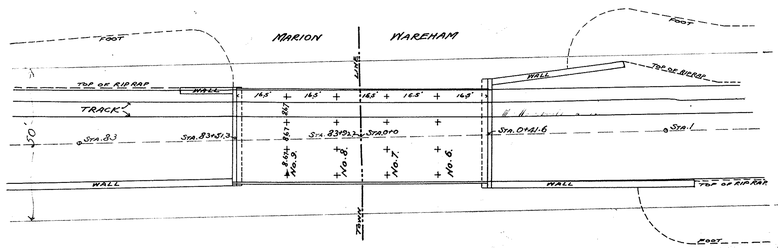


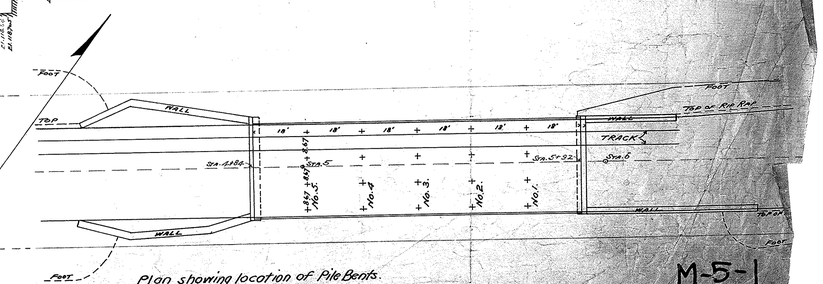
East Bridge.
Cross-sections of Floor.
Scale 1"=4'.

Note.~ Black shows elevations taken Oct. 24, 1904. Red shows standard section of bridge, as built with elevations based on present elevation of top of wheel-guard on southerly side.~

Profiles and Sections
Wareham ~ Marion
showing test levels on bridges over Weweantit River
taken October 24, 1904

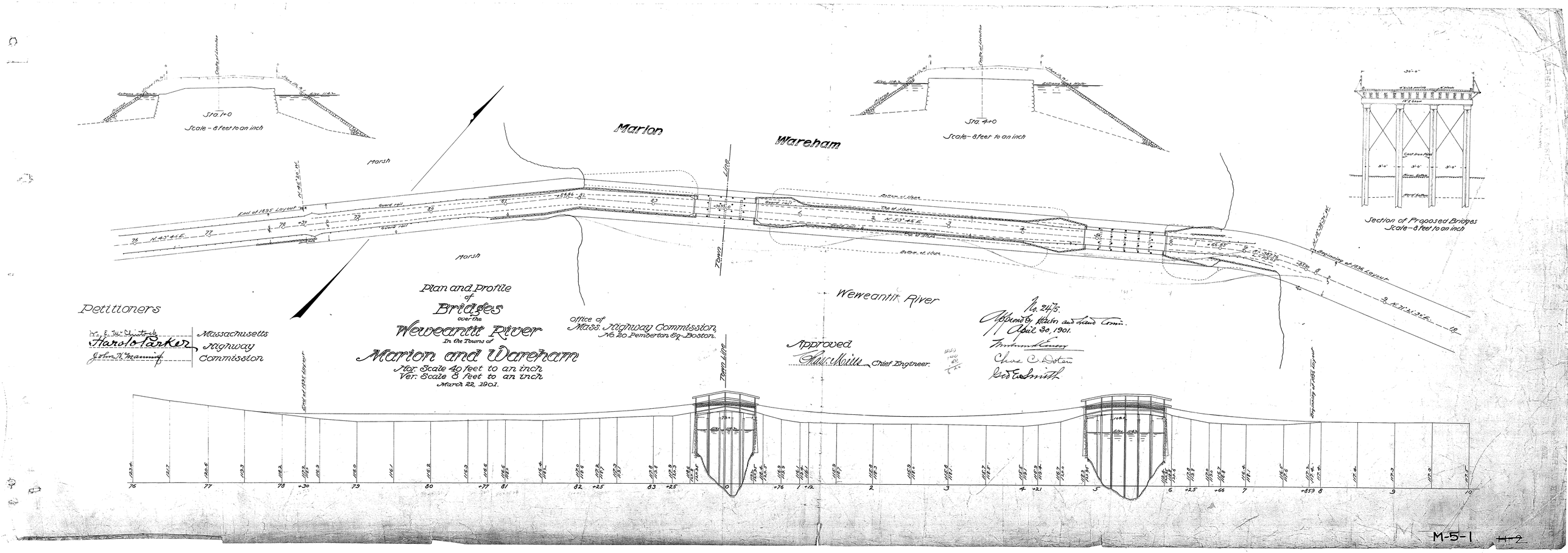
Office of
Massachusetts Highway Commission
20 Pemberton Sq. Boston.

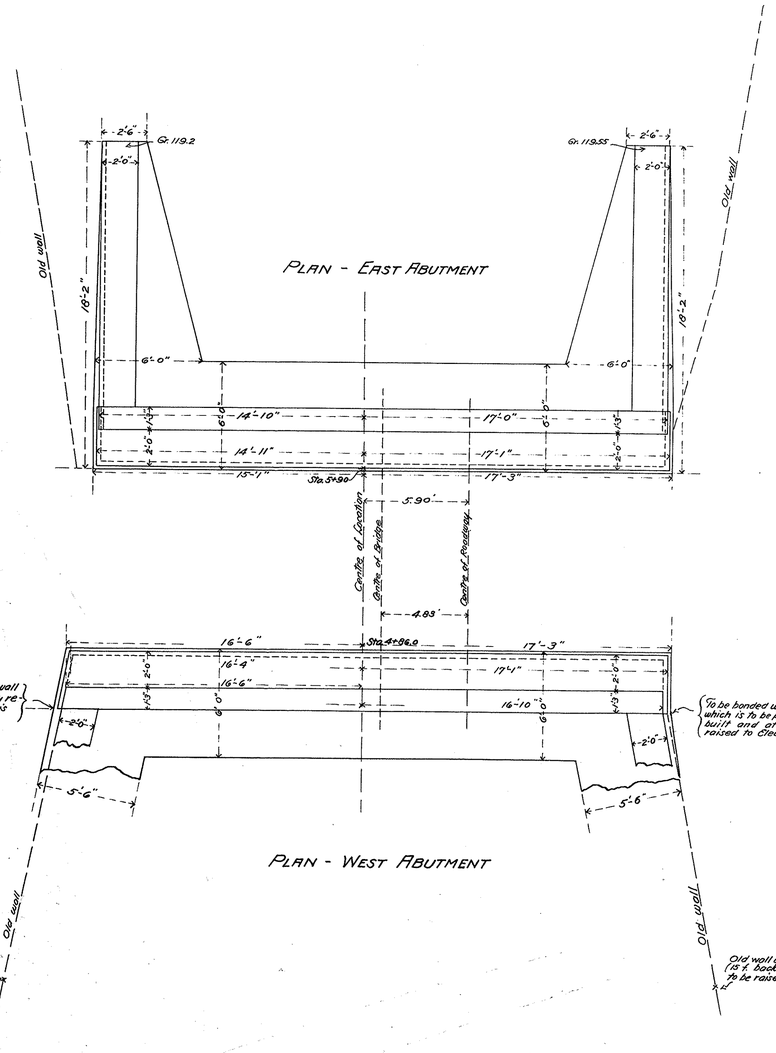




Plan showing location of Pile Bents.
Scale 1"=20.

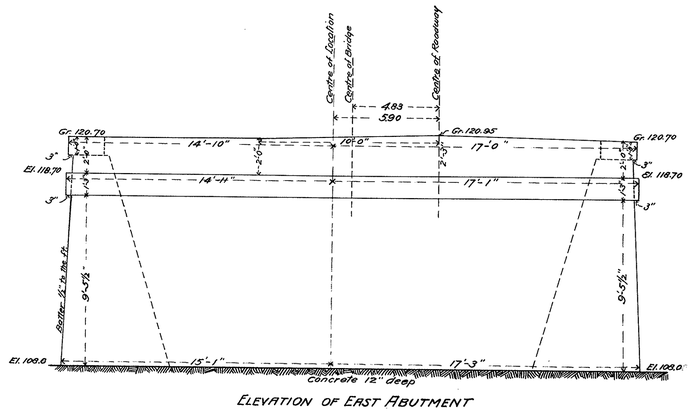
M-5-1


Sta. 1+0
Scale - 8 feet to an inch
Sta. 4+0
Scale - 8 feet to an inch
Marion
Wareham
Marsh
Marsh
Town Line
Weweantit River
Section of Proposed Bridges
Scale - 8 feet to an inch
Petitioners
W. E. McClintock
Harold Parker
John K. Mannix
Massachusetts Highway Commission
Plan and Profile of Bridges over the Weweantit River In the Towns of Marion and Wareham
Hor. Scale 40 feet to an inch
Ver. Scale 8 feet to an inch
March 22, 1901.
Office of Mass. Highway Commission, No. 20 Pemberton Sq. Boston.
Approved
Chas. Mills Chief Engineer.
No. 2475.
Approved by Harbor and Land Comm.
April 30, 1901.
Chas C. Doten
Geo E. Smith
M-5-1

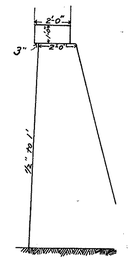


PLAN - EAST ABUTMENT

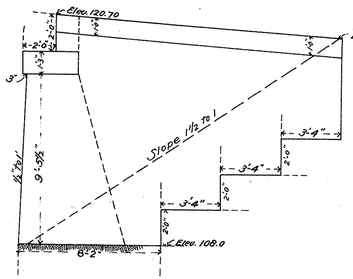
PLAN - WEST ABUTMENT



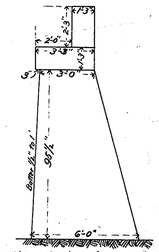
ELEVATION OF EAST ABUTMENT



Section ~ E. Abut.



ELEVATION OF RIGHT WING EAST ABUTMENT



Section ~ Centre of Roadway

Massachusetts Highway Commission

W. E. McClintock

CHAIRMAN

PLAN OF ABUTMENTS OF EAST BRIDGE STATION 5+50± WAREHAM, MASS.

Scale; 1 inch = 4 feet

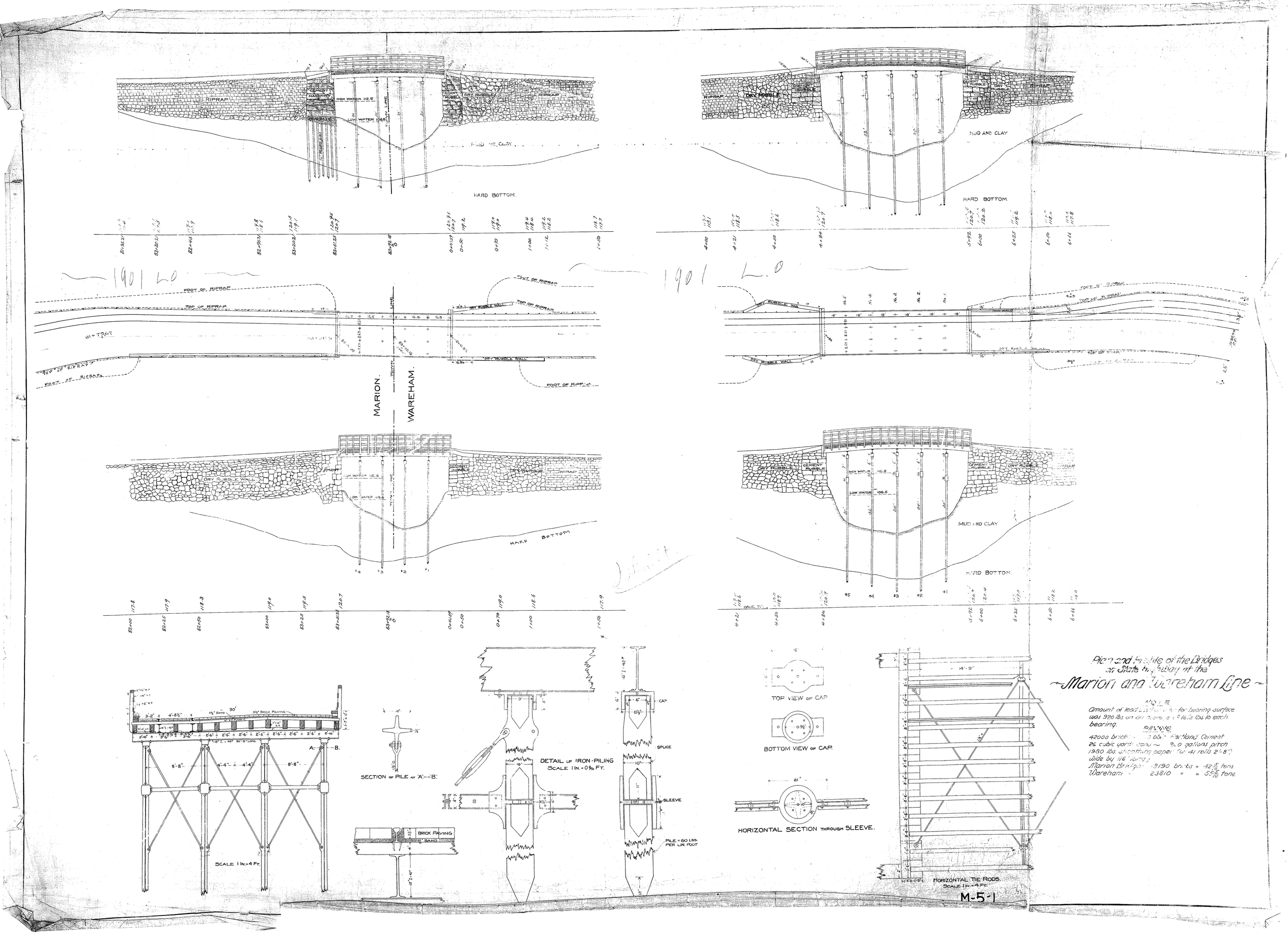
APPROVED

A. W. Lono

FIRST ASST. ENGINEER

OFFICE OF
Massachusetts Highway Commission
#20 Pemberton Sq. ~ Boston ~ Mass.
APRIL 27 1901

M-5-1



Plan and Profile of the Bridges on State Highway at the

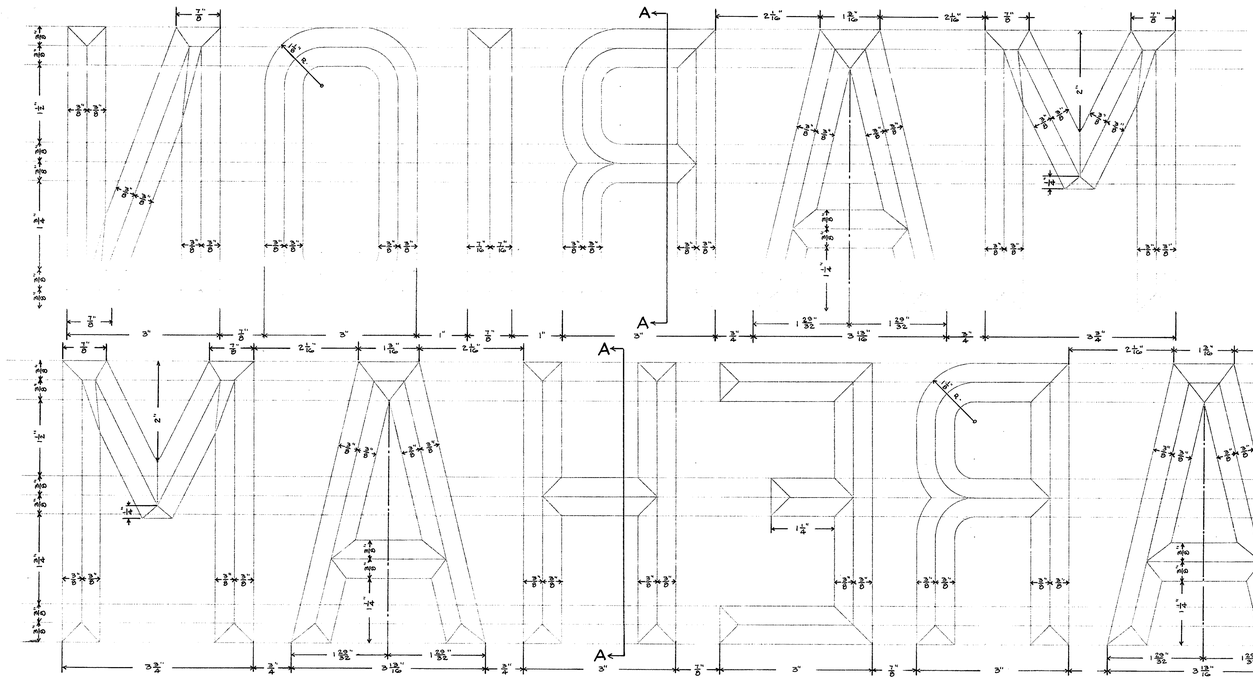
~Marion and Wareham Line~

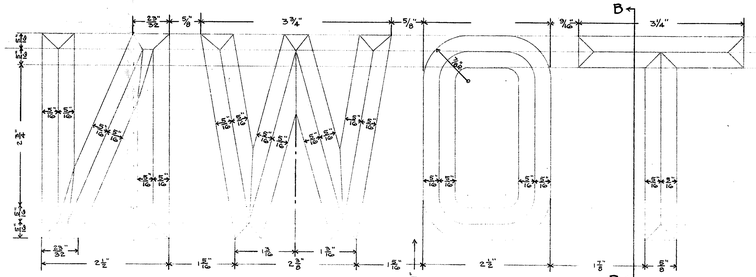
NOTE

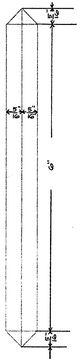
Amount of lead used on pile for bearing surface was 920 lbs on an average of 16½ lbs to each bearing.

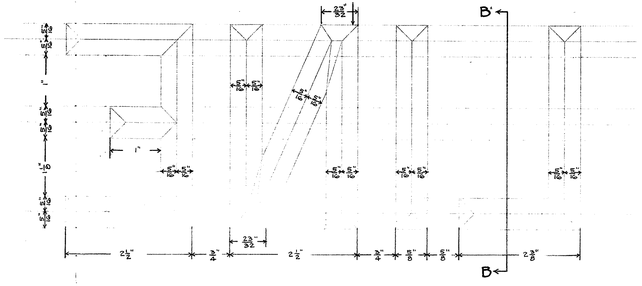
PAVING

42000 bricks — [illegible] Portland Cement
26 cubic yards sand — [illegible] gallons pitch
1980 lbs sheathing paper (or 41 rolls 2'-8") wide by 116' long)
Marion Bridge: 18190 bricks = 42 5/16 tons.
Wareham " 23810 " = 55 5/16 tons.









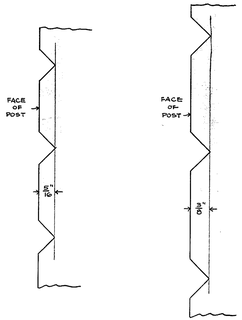
DETAILS OF WOODEN FORMS
FOR LETTERS
(NATURAL SCALE)

DETAILS FOR PLACING TOWN NAMES, SEAL, DATE, TOWN LINE
ON BRIDGE OVER WEWEANTIC RIVER BETWEEN TOWNS OF

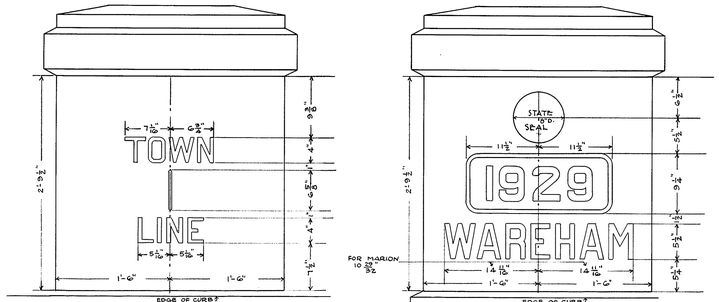
MARION AND WAREHAM

AT STA. 0+01.00 (WAREHAM)
SCALES AS NOTED

OFFICE OF
DEPARTMENT OF PUBLIC WORKS
STATE HOUSE ~ BOSTON, MASS.
FEB. 1929



SECTION B-B SECTION A-A
(SHOWING BEVEL OF LETTERS)
(NATURAL SCALE)



INSIDE ELEVATIONS OF POSTS
SHOWING LOCATIONS OF DATE, SEAL, & LETTERS
(SCALE: 1½"=1'-0")

BRIDGE Nº M-5-1=W-6-13

FED. ROAD DIST. No.	STATE	PROJ. No.	YEAR	No.	SHEETS
9	MASS	189-A	1929	37	65

NOTE: OLD STRUCTURE SHOWN IN SHORT DASH LINES

PLAN

SOUTHERLY ABUTMENT

NORTHERLY ABUTMENT

MARION

WAREHAM

(TOWN LINE)
STA. 0+01.00 (WAREHAM)
= STA. 83+92.81 (MARION)

STA. 83+41.31

STA. 0+52.50

N 41-20-50 E

℄ OF SURVEY

℄ OF CONSTRUCTION

90°

BEAM Nº1

BEAM Nº2

BEAM Nº3

BEAM Nº4

BEAM Nº5

BEAM Nº6

EDGE OF CURB

EDGE OF SIDEWALK

FACE OF OLD ABUTMENT

FACE OF ABUT. UNDER COPING

FACE OF NO. ABUTMENT

49'-9" SPAN UNDER COPINGS

CROSS BEAMS

BATTER 12"-0"

3½" FIBER DUCT

Nº 9 Nº 9A Nº 10 Nº 11 Nº 12 Nº 12A Nº 13 Nº 14

℄ OF PIER

- GENERAL NOTES -

FINISH:
ALL EXPOSED SURFACES TO BE RUBBED SMOOTH WITH CORUNDUM BRICK AND LEFT FREE FROM ALL FORM MARKS AND IMPERFECTIONS.

BENCH MARKS:

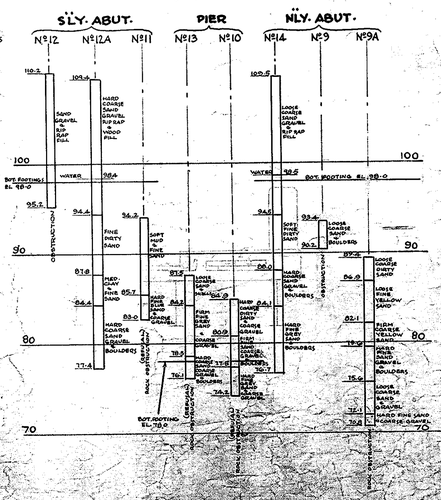
FOUNDATIONS:
FOUNDATIONS MAY BE ALTERED IF NECESSARY TO SUIT CONDITIONS OF CONSTRUCTION.

STEEL:
ALL REINFORCING STEEL TO BE DEFORMED BARS.

WEEP HOLES:
WEEP HOLES TO BE PLACED IN ABUTMENTS AND WINGS AS DIRECTED BY THE ENGINEER.

BORING NOTES: BORINGS TAKEN FOR PURPOSE OF DESIGN AND SHOW CONDITIONS AT BORING POINTS ONLY, BUT DO NOT NECESSARILY SHOW NATURE OF MATERIAL TO BE ENCOUNTERED IN CONNECTION WITH THE CONSTRUCTION OF THE BRIDGE.
LOCATION OF BORINGS SHOWN ON PLAN THUS ◉

BORING DATA
VERT. SCALE: 1"=8'-0"


S'LY. ABUT.
PIER
N'LY. ABUT.
Nº12
Nº12A
Nº11
Nº13
Nº10
Nº14
Nº9
Nº9A
SAND GRAVEL & RIP RAP FILL
HARD COARSE SAND GRAVEL & RIP RAP FILL
WOOD FILL
LOOSE COARSE SAND GRAVEL & RIP RAP FILL
WATER
BOT. FOOTINGS EL. 98.0
BOT. FOOTINGS EL. 78.0
CONSTRUCTION
FINE DIRTY SAND
SOFT MUCK
LOOSE COARSE SAND & BOULDERS
HARD COARSE SAND GRAVEL & BOULDERS
LOOSE FINE YELLOW SAND
HARD FINE SAND & BOULDERS
LOOSE COARSE SANDY GRAVEL
LOOSE FINE YELLOW SAND
FIRM COARSE YELLOW SAND
HARD FINE SAND & BOULDERS
LOOSE COARSE SAND & GRAVEL
HARD FINE SAND & GRAVEL
HARD COARSE SAND & GRAVEL
HARD FINE SAND & BOULDERS
LOOSE COARSE SAND & GRAVEL
HARD FINE SAND & GRAVEL
HARD COARSE SAND & GRAVEL
HARD FINE SAND & BOULDERS
LOOSE COARSE SAND & GRAVEL
HARD FINE SAND & GRAVEL
HARD COARSE SAND & GRAVEL
HARD FINE SAND & BOULDERS

FED. ROAD DIST. No.	STATE	FED. AID PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
9	MASS.	189-A	1929	38	65

ELEVATION

LONGITUDINAL SECTION AT ℄ BEAM No. 3

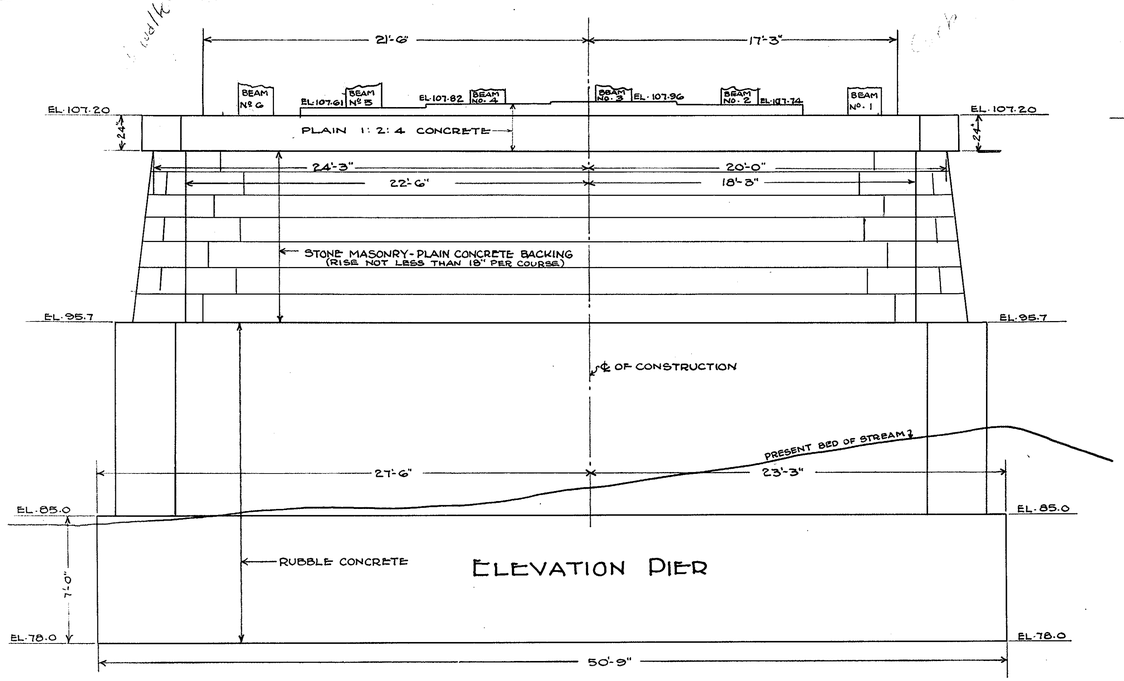
NOTE: REINFORCING STEEL LAYOUT SAME FOR ALL BEAMS.

NOTE: NO PILES UNDER PIER.

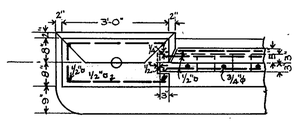
Sheet 2 of 3 Sheets

Bridge No. M-5-1-W-613

FED. ROAD DIST. No.	STATE	FED. AID PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
9	MASS.	189-A	1929	39	65

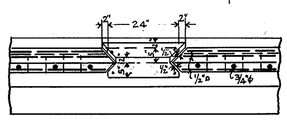


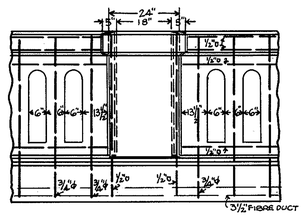
ELEVATION PIER

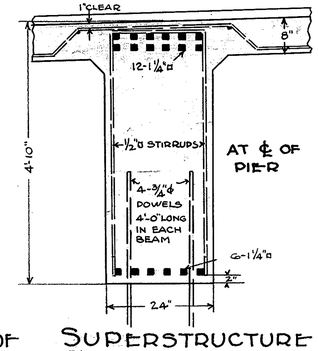


HALF PLAN AND ELEVATION OF FENCE & POSTS

SCALE: ½"=1'-0"



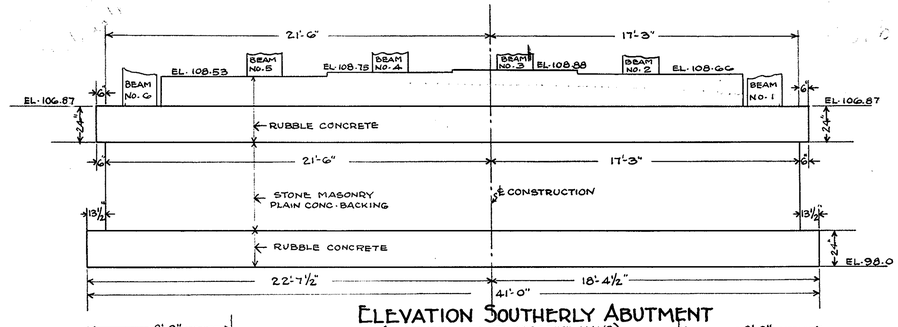




AT ℄ OF PIER

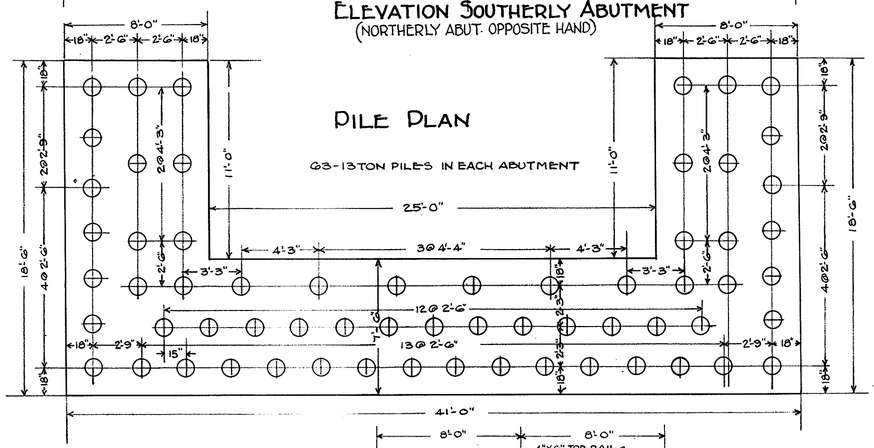
DETAILS OF SUPERSTRUCTURE

SCALE: ¾"=1'-0"



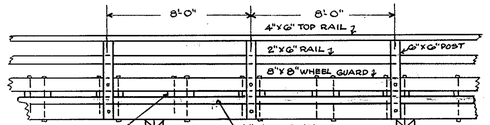
ELEVATION SOUTHERLY ABUTMENT

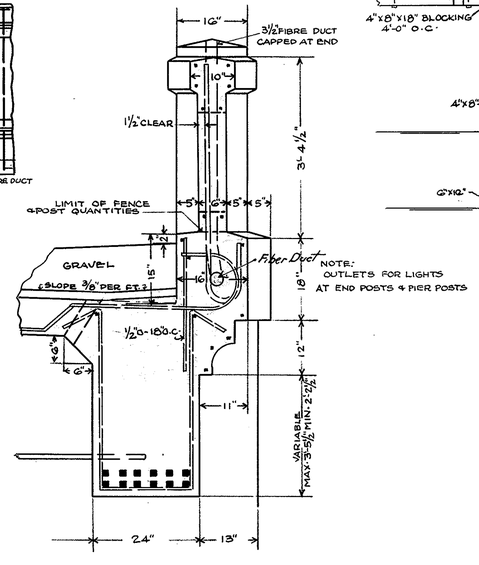
(NORTHERLY ABUT. OPPOSITE HAND)



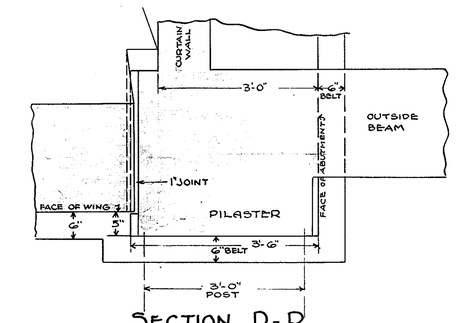
PILE PLAN

G3-13 TON PILES IN EACH ABUTMENT





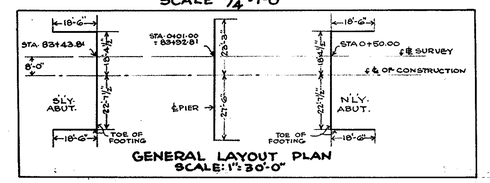
ELEVATION OF TEMPORARY BRIDGES



SECTION P₁-P₁

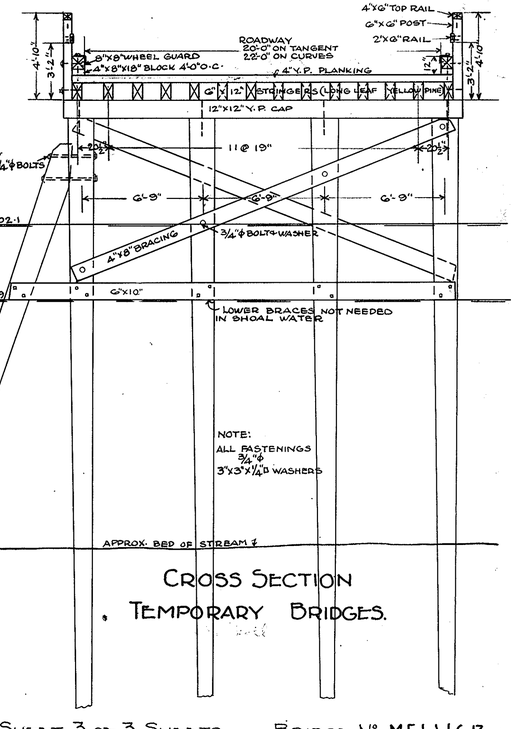
(DETAIL OF EXPANSION JOINT)

SCALE 3/4"=1'-0"



GENERAL LAYOUT PLAN

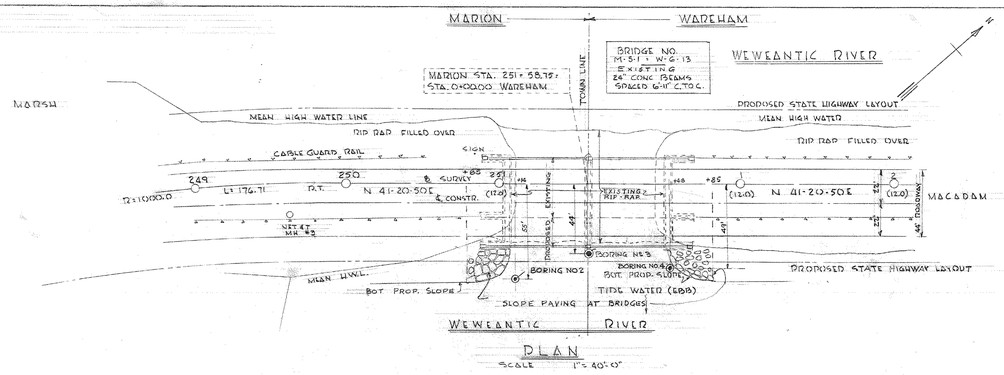
SCALE: 1"=30'-0"



CROSS SECTION TEMPORARY BRIDGES.

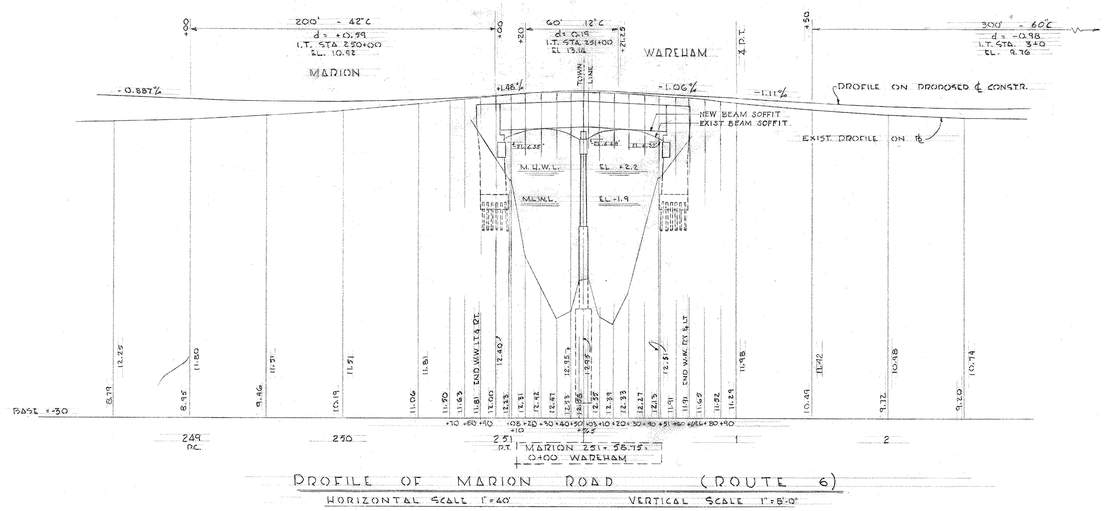
 BRIDGE No. M-51-W-6-13

PUB. RD DIV. NO.	STATE	FED AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
	MASS.			1	4



PLAN

SCALE 1" = 40'-0"



PROFILE OF MARION ROAD (ROUTE 6)

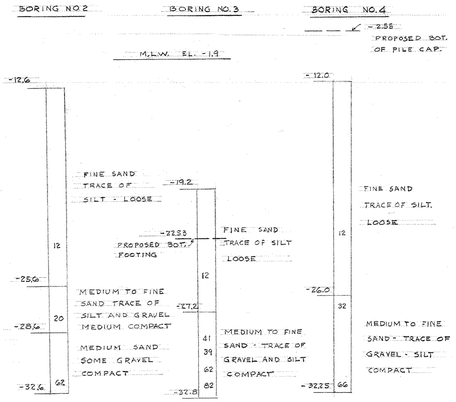
HORIZONTAL SCALE 1"=40' VERTICAL SCALE 1"=8'-0"

BORING NOTES

LOCATION OF BORING SHOWN THUS ◉ BORING NO 3.
BORING TAKEN FOR PURPOSE OF DESIGN AND SHOWS CONDITIONS AT BORING POINT ONLY, AND DOES NOT NECESSARILY SHOW NATURE OF MATERIAL TO BE ENCOUNTERED DURING CONSTRUCTION. FIGURES IN COLUMNS INDICATE BLOWS PER FOOT ON ONE INCH ϕ PIPE PRODUCED BY 30 INCH FALL OF 140 POUND HAMMER. BORING SAMPLES MAY BE SEEN AT THE OFFICE OF THE BRIDGE ENGINEER MR. J.C. RUNDLETT RM 609 100 NASSUA ST. BOSTON, MASS; ON ADVANCE NOTICE.

BORING DATA

SCALE ¼"=1'-0" BORINGS TAKEN DEC. 1954 BY THE AMERICAN DRILLING CO.



GENERAL NOTES

FOUNDATIONS	MAY BE ALTERED IF NECESSARY, TO SUIT CONDITIONS ENCOUNTERED IN CONSTRUCTION.
DATE AND SEAL	DATE TO BE CUT INTO ONE STONE OF SIZE DETAILED, LOCATED ON INSIDE FACES OF NORTHERLY & SOUTHERLY END DOATS AS SHOWN IN DETAIL ON SHEET No 4. A SHEET SHOWING SIZE AND CHARACTER OF NUMERALS WILL BE FURNISHED. SEAL WILL BE FURNISHED BY THE COMMONWEALTH.
DESIGN	ACCORDING TO THE 1953 SPECIFICATIONS OF THE AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS FOR H-20-44 LOADING.
BENCH MARK	B.M. #51 CHISELLED ON CONC. BRIDGE WALL STA. 250+93 MARION RD (ROUTE 6 ℄) 22.2 RT. ELEV. 12.32 - SEA LEVEL DATUM OF 1929
REINFORCEMENT	ALL REINFORCING STEEL BARS SHALL CONFORM TO A.S.T.M. SPECIFICATION A305-49. UNLESS OTHERWISE SHOWN ON PLANS, REINFORCING BARS SHALL BE LAPPED 20 DIAMETERS TO MAKE A SPLICE EXCEPT THAT MAIN REINFORCING BARS NEAR TOP OF SLABS & BEAMS HAVING MORE THAN 12" OF CONCRETE UNDER THE BARS, SHALL BE LAPPED 35 DIAMETERS TO MAKE A SPLICE.
PILES	TREATED TIMBER PILES SHALL BE DRIVEN TO A MINIMUN BEARING CAPACITY OF 18 TONS.
DIMENSIONS & DETAILS	SHOWN FOR EXISTING STRUCTURE MUST BE CHECKED IN THE FIELD BY THE CONTRACTOR.
PLANS OF THE EXISTING	BRIDGE ARE AVAILABLE AND MAY BE SEEN AT THE OFFICE OF THE BRIDGE ENGINEER, ROOM 609, 100 NASHUA ST., BOSTON, MASS.

ESTIMATED QUANTITIES

NOT GUARANTEED

CLASS A ROCK EXCAVATION	10 C.Y.
BRIDGE EXCAVATION	125 C.Y.
CLASS B ROCK EXCAVATION	5 C.Y.
CHANNEL EXCAVATION	20 C.Y.
GRAVEL BORROW	110 C.Y.
STEEL SHEETING	24,000 LBS.
TREATED TIMBER PILES	1380 L.F.
SLOPE PAVING AT BRIDGES	80 C.Y.
BRIDGE STRUCTURE (M-5-1 + W-6-13)	1 L.S.
CLASS I BIT. CONC. PAVEMENT TYPE I-1	110 TONS
BRIDGE EXCAVATION AT PIERS	125 C.Y.

NOV. 3, 1956	ISSUED FOR CONSTRUCTION

THE COMMONWEALTH OF MASSACHUSETTS

PROPOSED BRIDGE WIDENING

MARION - WAREHAM

ROUTE #6

OVER WEWEANTIC RIVER

SCALES AS NOTED

OFFICE OF

DEPARTMENT OF PUBLIC WORKS

100 NASHUA STREET BOSTON, MASS.

NOV. 1956

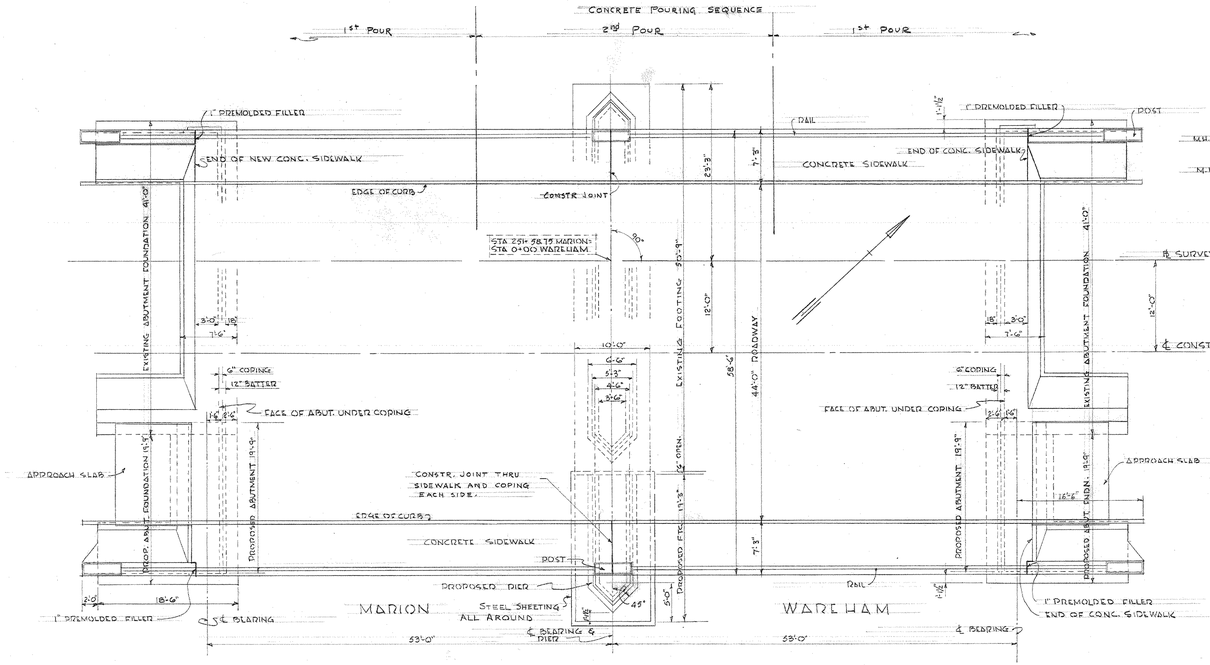
J.C. Rundlett
BRIDGE ENGINEER

H.E. Foley
CHIEF ENGINEER

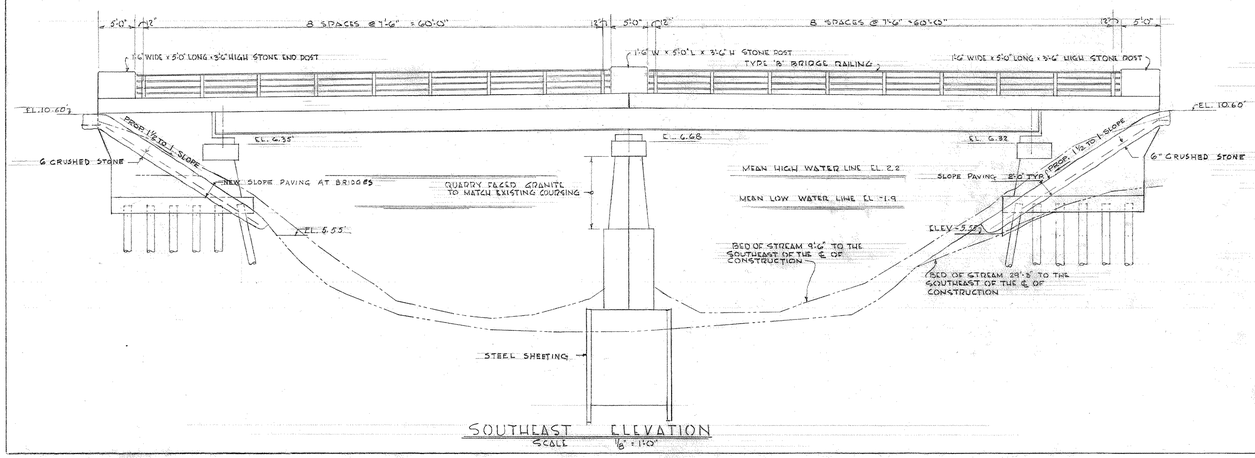
ABBOTT ASSOCIATES, INC.
ARCHITECTS & ENGINEERS
131 STATE STREET BOSTON, MASS.

SHEET 1 OF 4 SHEETS BRIDGE No. M-5-1 + W-6-13

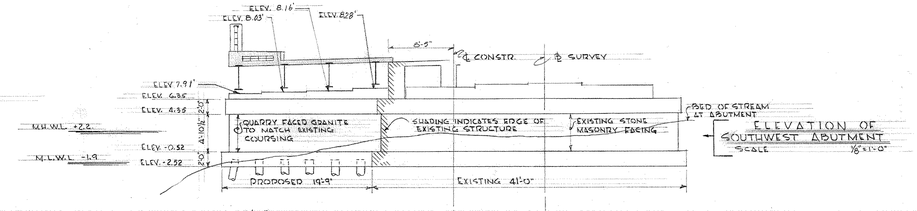
PUB. RD DIV. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
1	MASS.			2	4



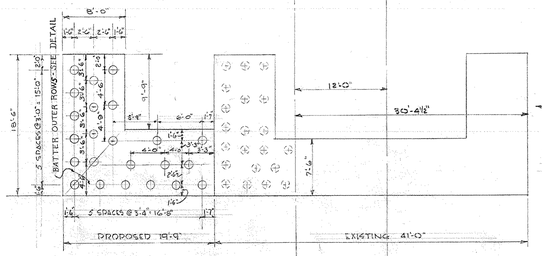
PLAN M-5-1 = W-6-13
SCALE 1/8"=1'-0"



SOUTHEAST ELEVATION
SCALE 1/8"=1'-0"



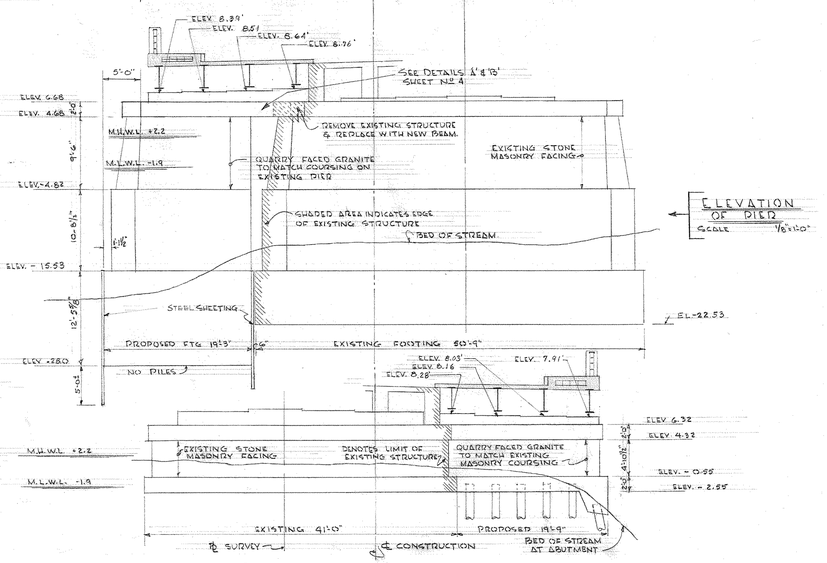
ELEVATION OF SOUTHWEST ABUTMENT
SCALE 1/8"=1'-0"



PILING PLAN OF SOUTHWEST ABUTMENT
SCALE 1/8"=1'-0"

PILING PLAN OF NORTHEAST ABUTMENT SIMILAR & OPPOSITE HAND.

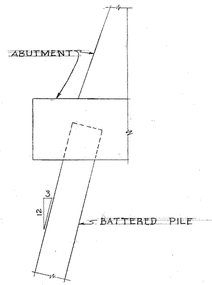
TOTAL NUMBER OF PILES = 23



ELEVATION OF PIER
SCALE 1/8"=1'-0"

ELEVATION OF NORTHEAST ABUTMENT
SCALE 1/8"=1'-0"

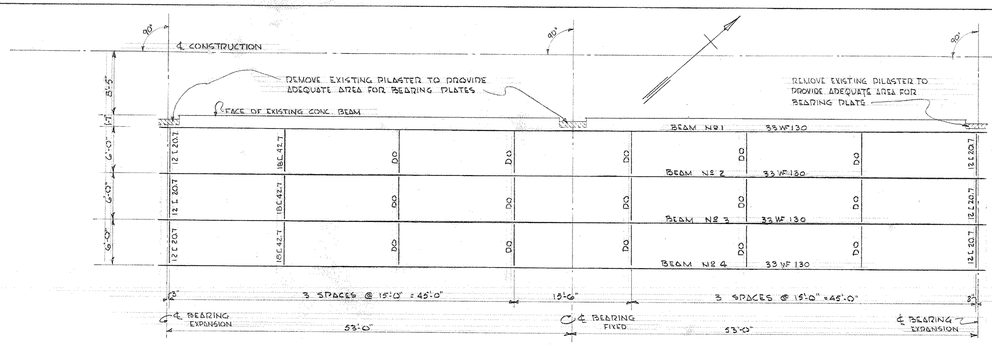
NOTE: PILES SHALL BE DRIVEN TO BEARINGS OF NOT LESS THAN 18 TONS.



TYPICAL PILE BATTER
NO SCALE

DATE	DESCRIPTION
NOV. 3, 1956	ISSUED FOR CONSTRUCTION
	USE ONLY PRINTS OF LATEST DATE

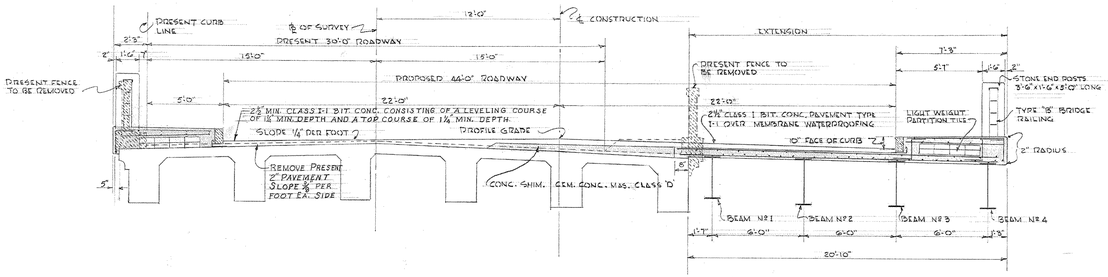
PUB.RD DIV. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
1	MASS.			3	4



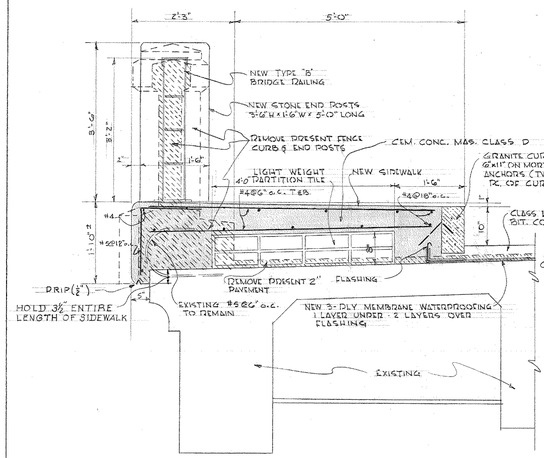
NOTE

1. ALL STRINGER ARE TO BE CAMBERED TO THE EXTENT THAT THE BRIDGE DECK UNDER FULL DEAD LOAD WILL FOLLOW AS NEARLY AS PRACTICABLE THE DESIGN PROFILE, AND IN NO CASE WITH LESS CAMBER THAN IS LIKELY TO REMAIN PERMANENT. THE PROPOSED CAMBER DESIGN SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

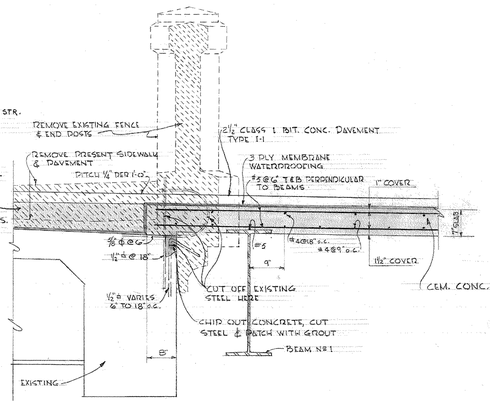
FRAMING PLAN M-5-1 - W-6-13
SCALE 1/16" = 1'-0"



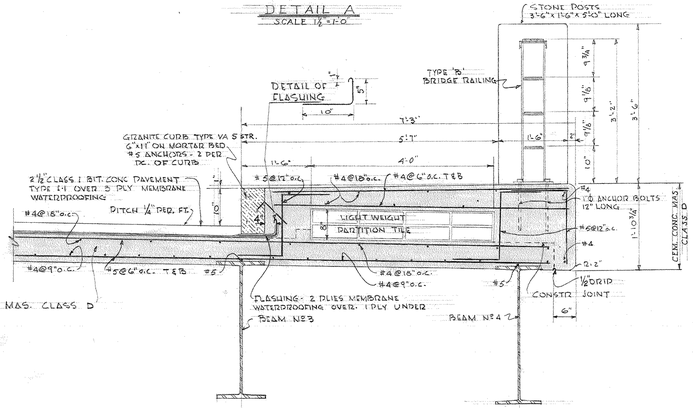
SECTION THRU BRIDGE
SCALE 1/4" = 1'-0"



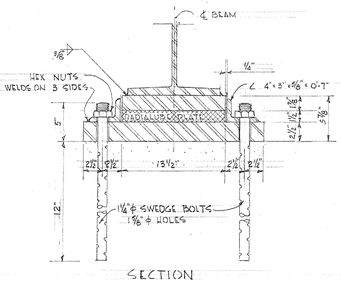
SECTION 3/4" = 1'-0"



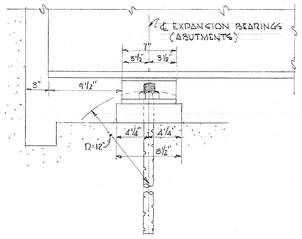
SECTION 3/4" = 1'-0"



SECTION 3/4" = 1'-0"

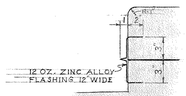


SECTION

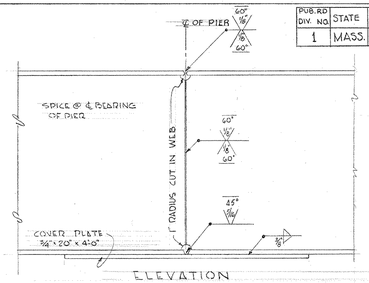


ELEVATION

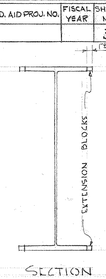
DETAILS OF EXPANSION BEARINGS
SCALE 1½" = 1'-0"



DETAIL A
SCALE 1½" = 1'-0"

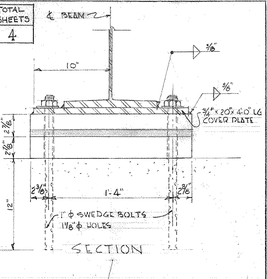


ELEVATION

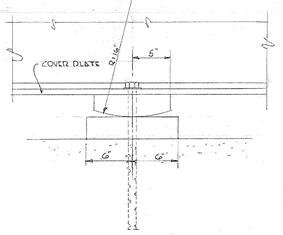


SECTION

BEAM SPLICE DETAIL
LOCATED OVER EACH PIER
SCALE 1" = 1'-0"

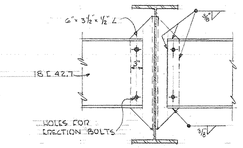


SECTION

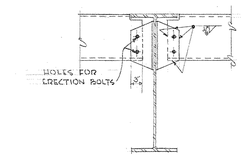


ELEVATION

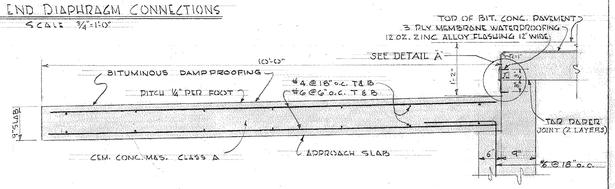
DETAIL - FIXED BEARING (PIER)
SCALE 1½" = 1'-0"



DETAILS - DIAPHRAGM CONNECTIONS
SCALE ¾" = 1'-0"



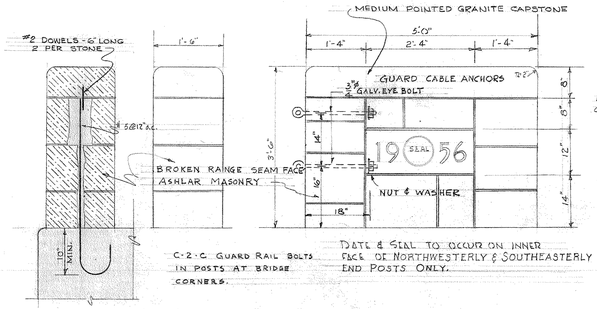
DETAILS END DIAPHRAGM CONNECTIONS
SCALE ¾" = 1'-0"



APPROACH SLAB DETAIL - TYPICAL FOR EACH ABUTMENT
SCALE ¾" = 1'-0"

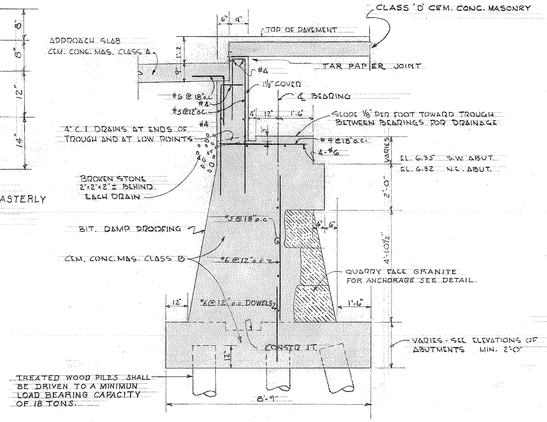
DATE	DESCRIPTION
NOV. 3, 1956	ISSUED FOR CONSTRUCTION
	USE ONLY PRINTS OF LATEST DATE

PUB RD DIV. NO.	STATE	FED AID PROJNO	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
1	MASS.			4	4



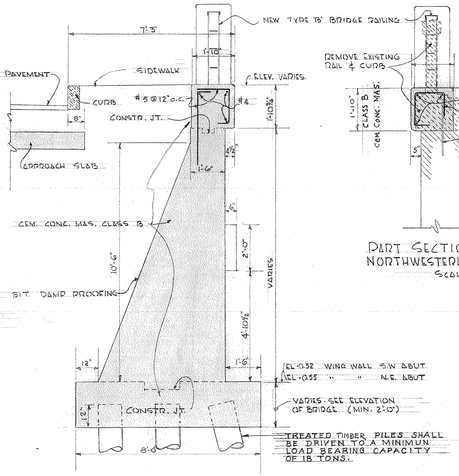
DETAILS OF STONE POSTS

SCALE 3/4" = 1'-0"



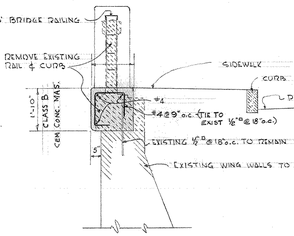
TYPICAL SECTION OF ABUTMENT EXTENSIONS

SCALE 3/8" = 1'-0"



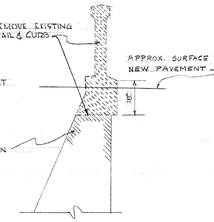
TYPICAL SECTION OF WING WALL

SCALE 3/8" = 1'-0"



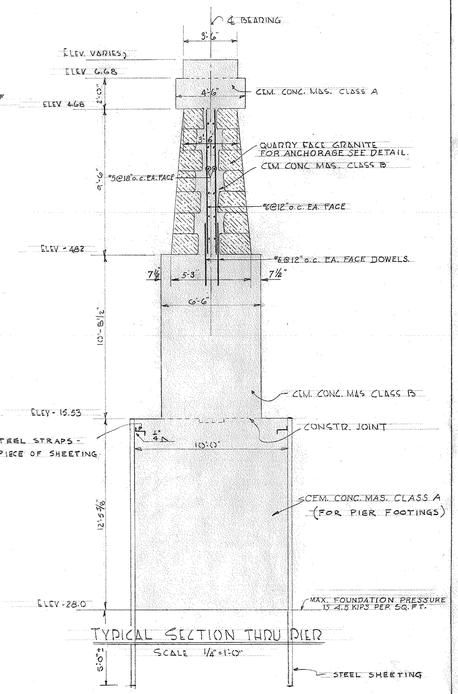
PART SECTION OF EXISTING NORTHWESTERLY WING WALLS

SCALE 3/8" = 1'-0"



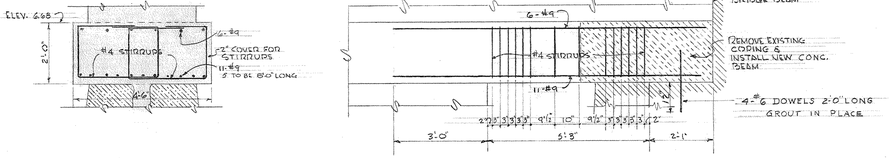
PART SECTION OF EXISTING SOUTHEASTERLY WING WALLS

SCALE 3/8" = 1'-0"



TYPICAL SECTION THRU PIER

SCALE 1/4" = 1'-0"

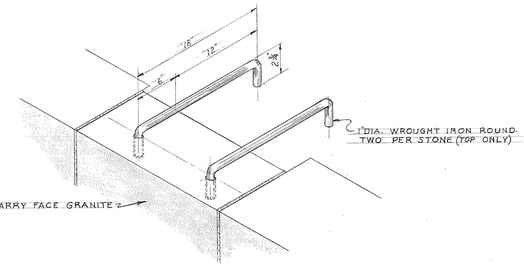


DETAIL 'A'

DETAIL 'B'

DETAILS OF CODING BETWEEN OLD AND NEW PIER

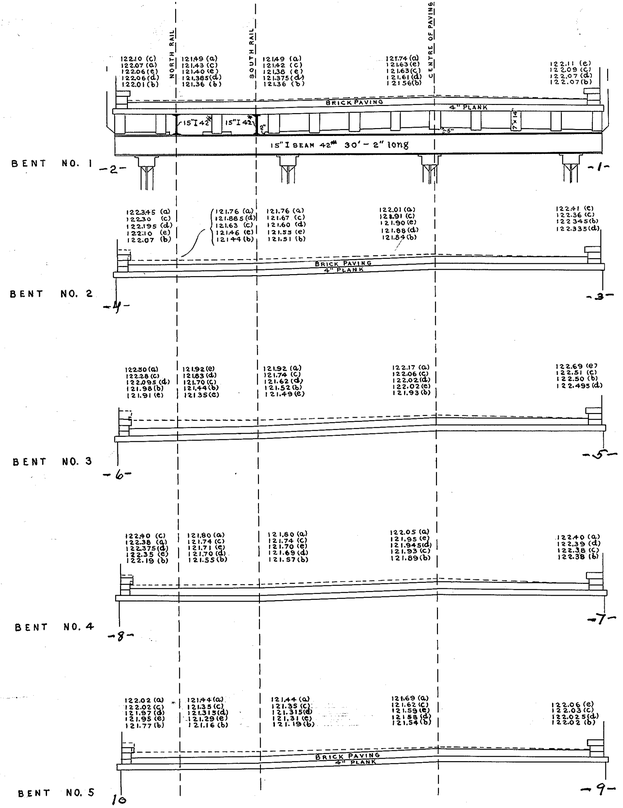
SCALE 1/2" = 1'-0"

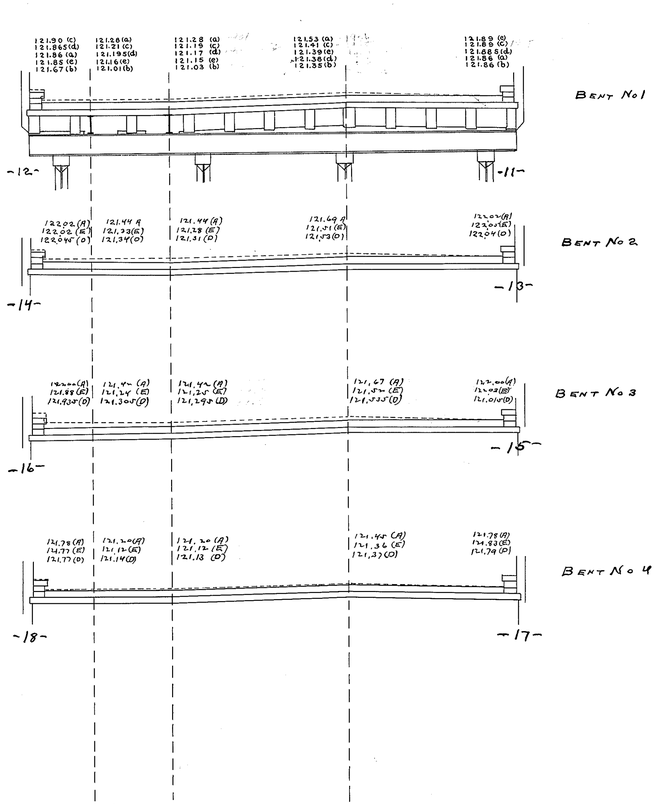


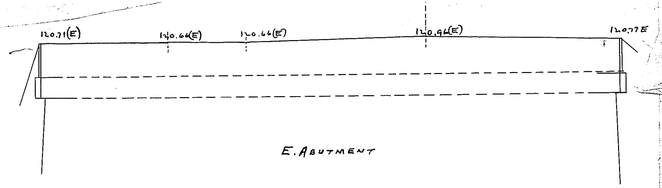
DETAIL OF STONE ANCHORAGE

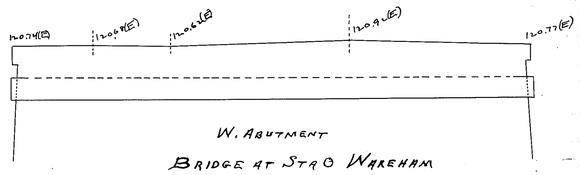
SCALE 1½" = 1'-0"

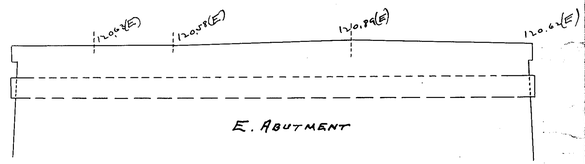
DATE	DESCRIPTION
NOV. 3, 1956	ISSUED FOR CONSTRUCTION
	USE ONLY PRINTS OF LATEST DATE.

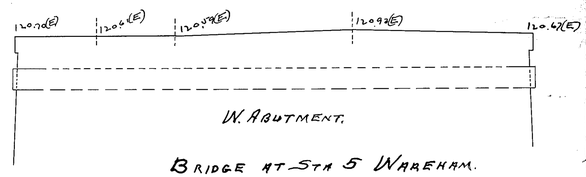












WAREHAM ~ MARION.

CROSS-SECTIONS SHOWING TEST LEVELS ON BRIDGES OVER THE WEWEANTIT RIVER.

~ SCALE 4 FT. TO 1 INCH ~

OCT. 27 1904.

BRIDGE AT STA. 5± WAREHAM.
~ SCALE 4 ~

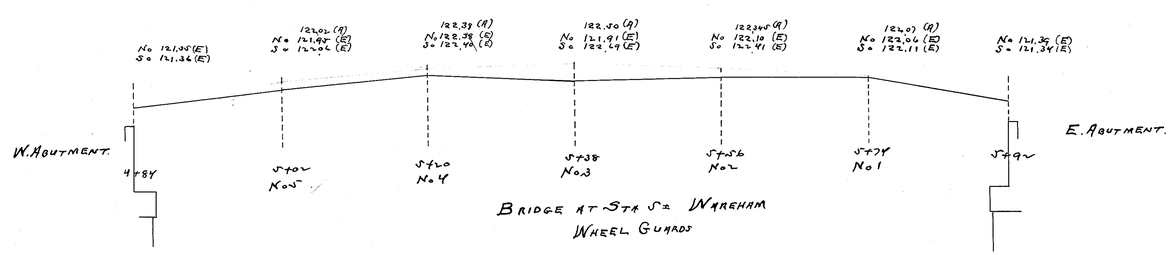
BRIDGE AT STA. 0 - WAREHAM.
~ SCALE 4 ~

NOTE~ SECTIONS OF BRIDGE TAKEN OCT. 24 1904 SHOWN IN BLACK. AND ELEVATIONS MARKED (b)
STANDARD SECTIONS FROM PLAN OF BRIDGE AS BUILT, AND BASED ON PRESENT ELEVATIONS OF TOP OF WHEEL GUARD ON SOUTHERLY SIDE OF BRIDGE, SHOWN BY BROKEN LINE. THE ELEVATIONS OF SAME ARE MARKED (a)

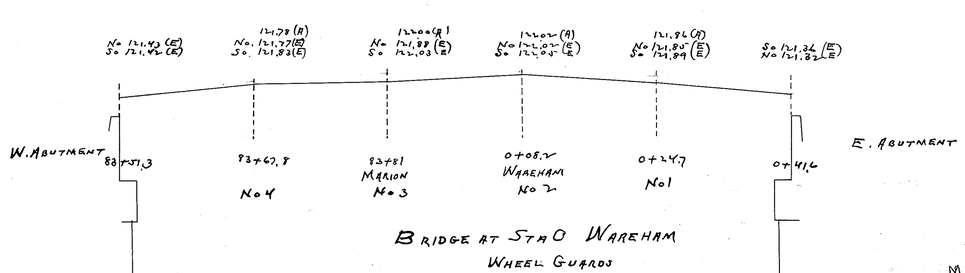
ALL ELEVATIONS REFERRED TO BENCH AT STA. 76+54 MARION.
SEE NOTE-BOOK 169 PAGE 69.

ELEVATIONS TAKEN DEC. 18, 1906, MARKED (d)
" " OCT. 26, 1905, " (c)
" " APR. 21, 1909, " (e)

NOTE- BLACK SHOWS PROFILE OF TOP OF NORTHERLY WHEEL GUARD.



BRIDGE AT STA 5± WAREHAM
WHEEL GUARDS



BRIDGE AT STA 0 WAREHAM
WHEEL GUARDS

M-5-1 = W-6-13

APPENDIX B
Historic Bridge Plans – W-06-016

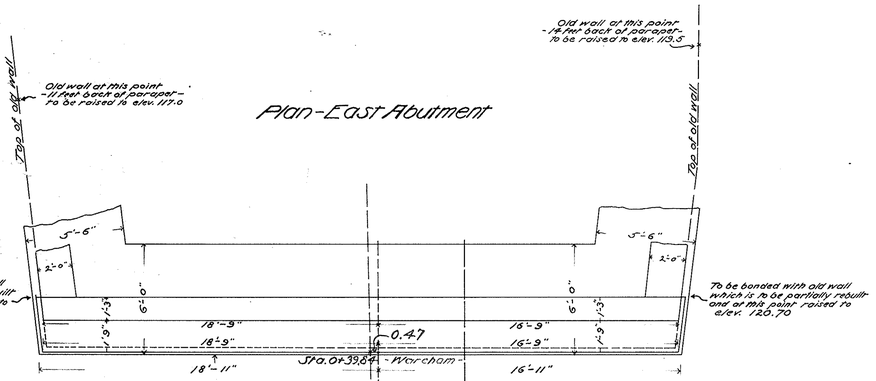
PLAN OF ABUTMENTS OF WEST BRIDGE STATION 0 -WAREHAM- MARION AND WAREHAM

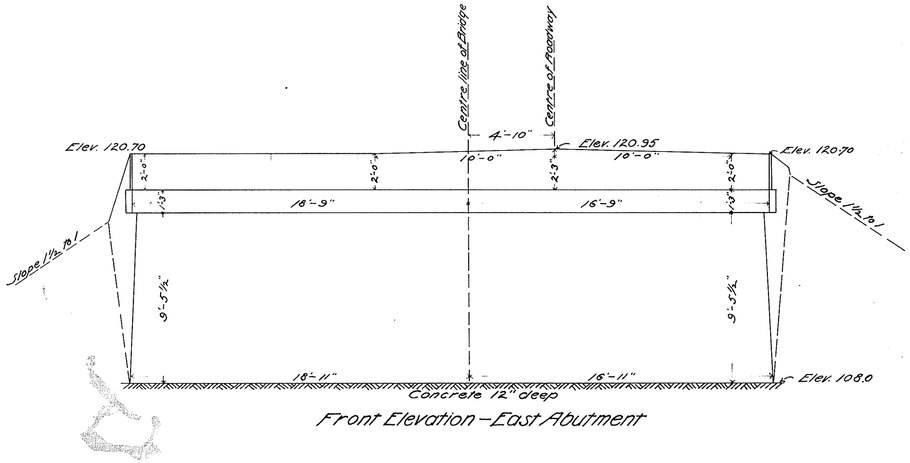
Scale: 1 inch = 4 feet

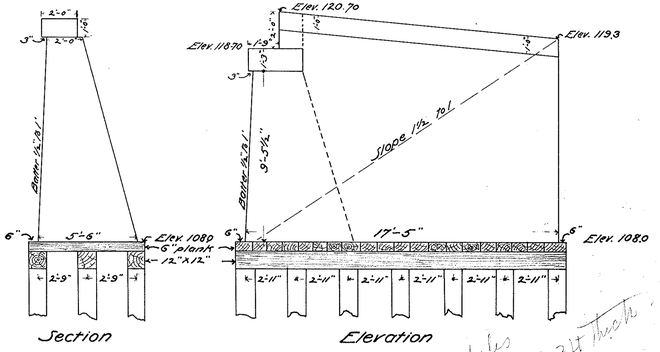
OFFICE OF
Massachusetts Highway Commission
20 Pemberton Sq. ~ Boston ~ Mass.
April 27 1901

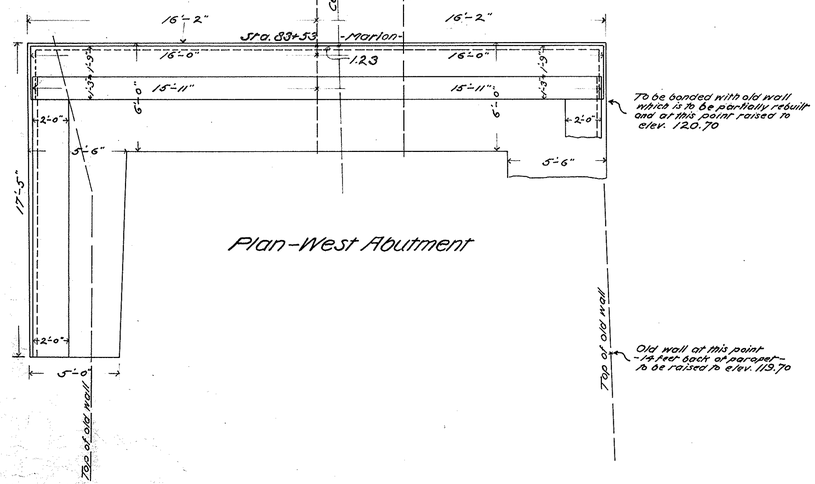
MASSACHUSETTS HIGHWAY COMMISSION
W. E. McClintock
CHAIRMAN

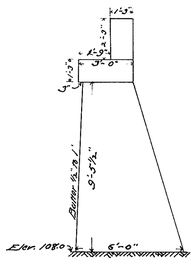
APPROVED
A. M. Lovis
ENGINEER

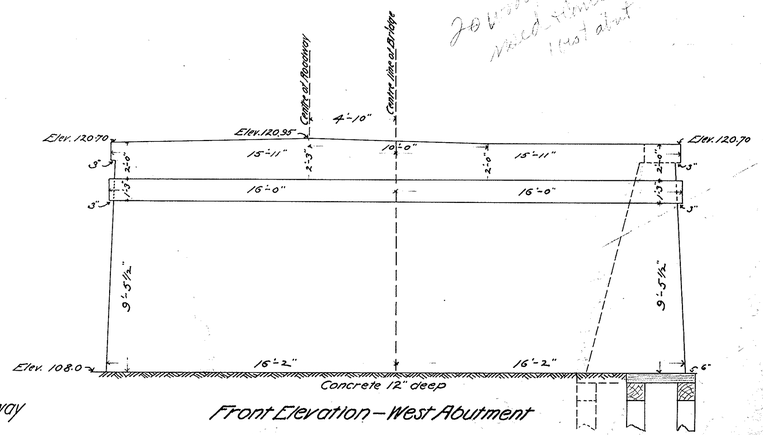






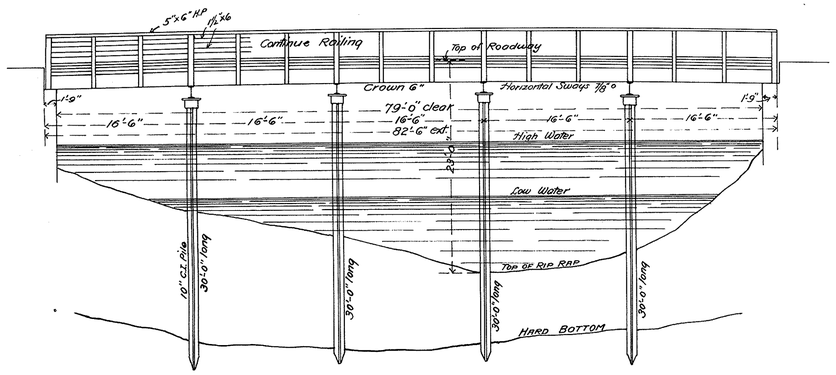




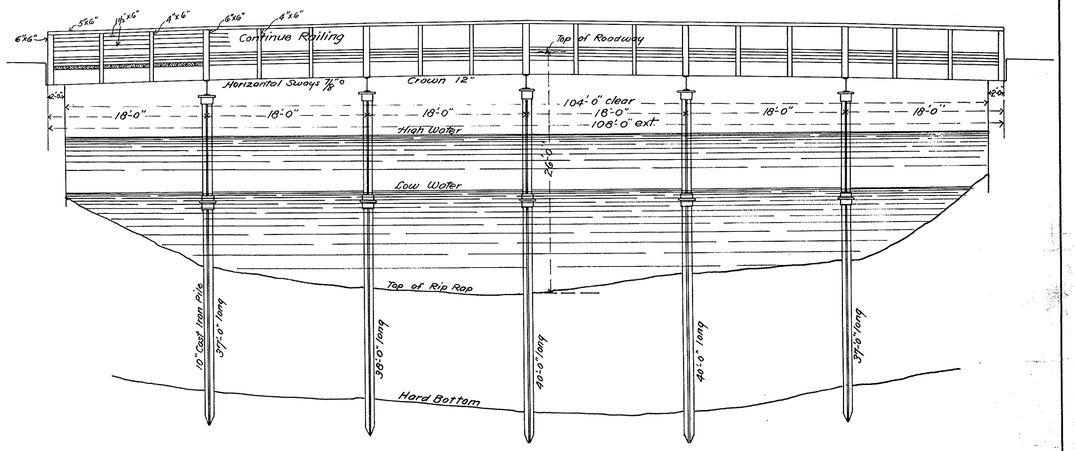


20 wooden piles driven 8 inch minimum cut 3ft thick at butt

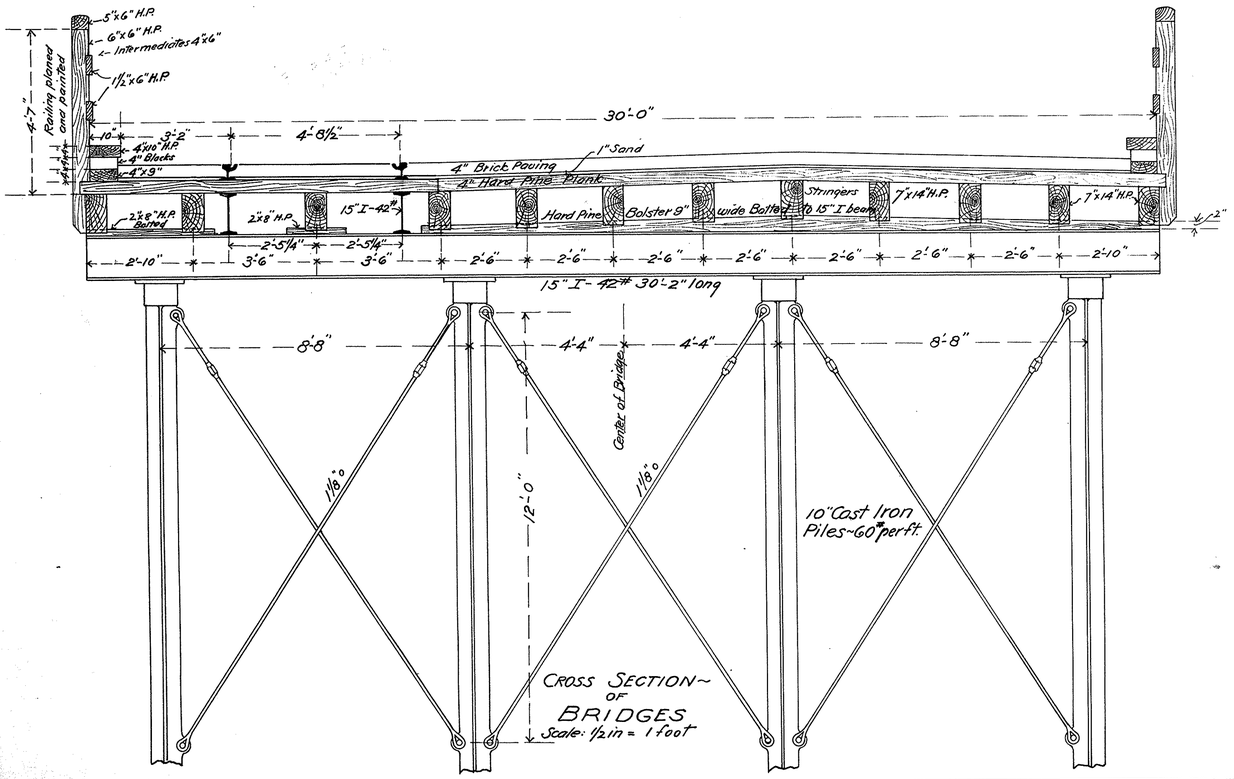
M-5-1



WEST BRIDGE
Scale: 1/8 in. = 1 foot.



EAST BRIDGE
Scale: 1/8 in = 1 foot

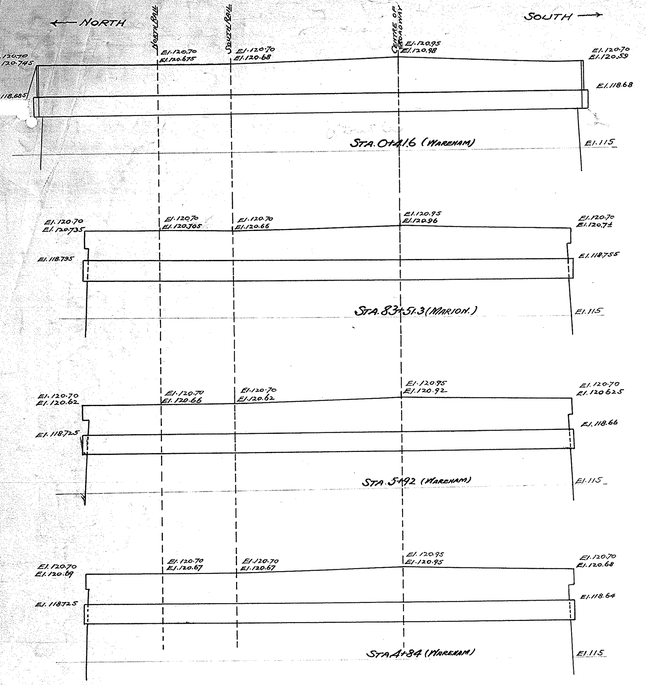


CROSS SECTION OF BRIDGES
Scale: ½ in = 1 foot

BRIDGES OVER WEWEANTIT RIVER
IN THE TOWNS OF
MARION AND WAREHAM

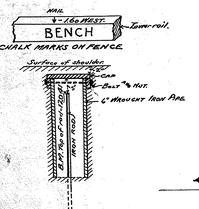
OFFICE OF
Massachusetts Highway Commission
#20 Pemberton Sq. ~ Boston~ Mass.

M-5-1

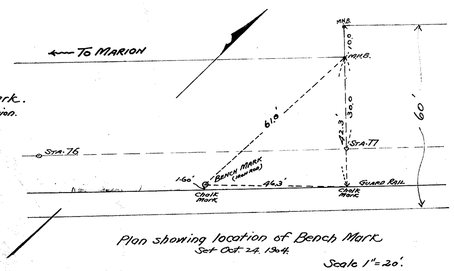


Elevations of Abutments
Scale 1"=4'

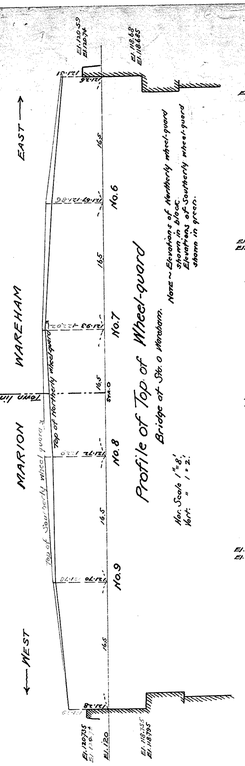
Note.~ Black shows elevations taken Oct. 24, 1904. Red shows proposed grades on profile.

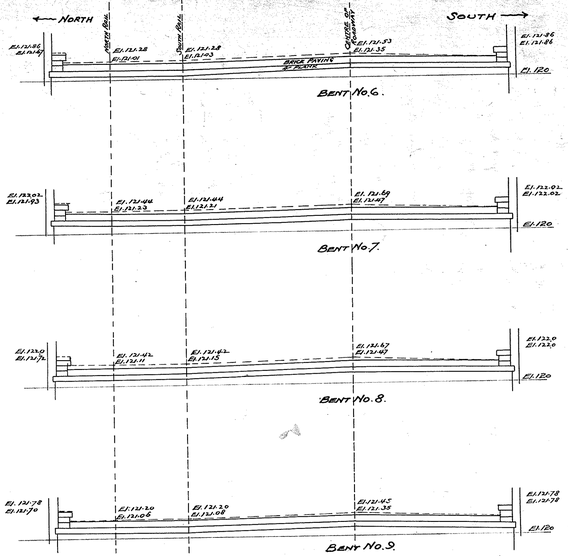


Detail of Bench-mark.
East of Sta. 76+58 - Marion.



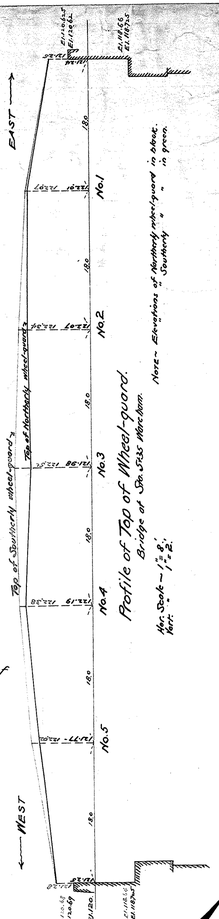
Plan showing location of Bench Mark.
Set Oct. 24, 1904.
Scale 1"=20'.

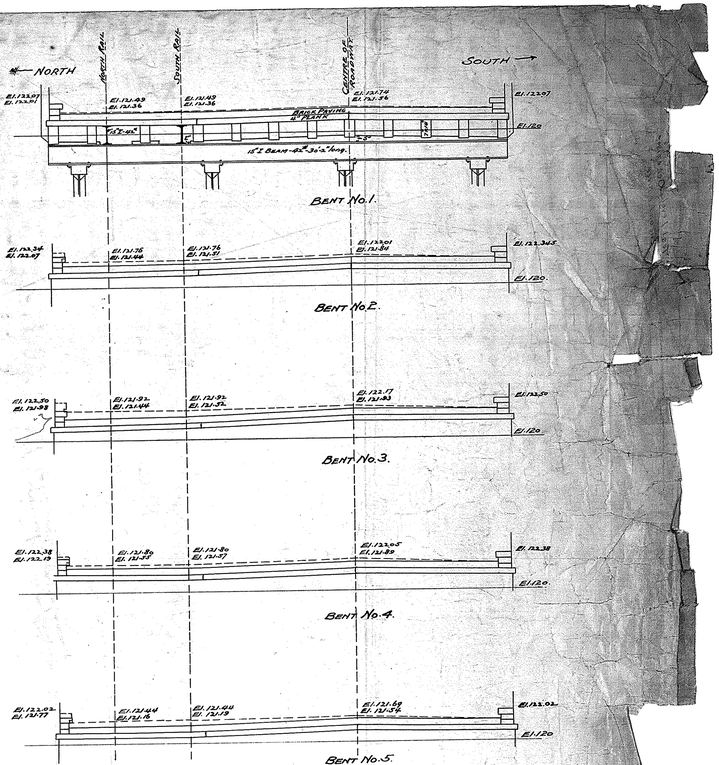




West Bridge.
Cross-sections of Floor.
Scale 1"=4'.

Note.~ Black shows elevations taken Oct. 24, 1904. Red shows standard section of bridge, as built with elevations based on present elevation of top of wheel-guard on southerly side.~



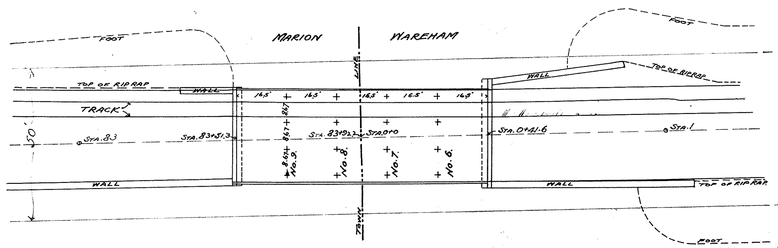


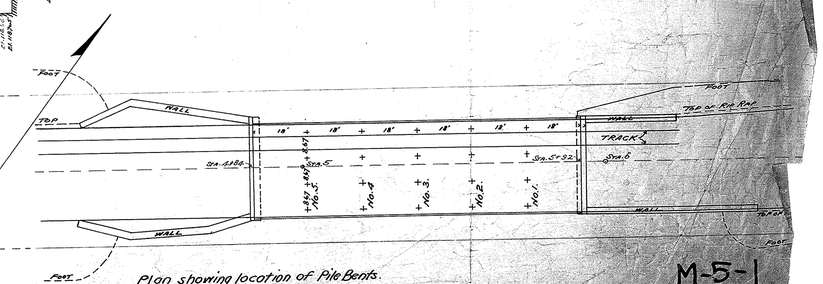
East Bridge.
Cross-sections of Floor.
Scale 1"=4'.

Note.~ Black shows elevations taken Oct. 24, 1904. Red shows standard section of bridge, as built with elevations based on present elevation of top of wheel-guard on southerly side.~

Profiles and Sections
Wareham ~ Marion
showing test levels on bridges over Weweantit River
taken October 24, 1904

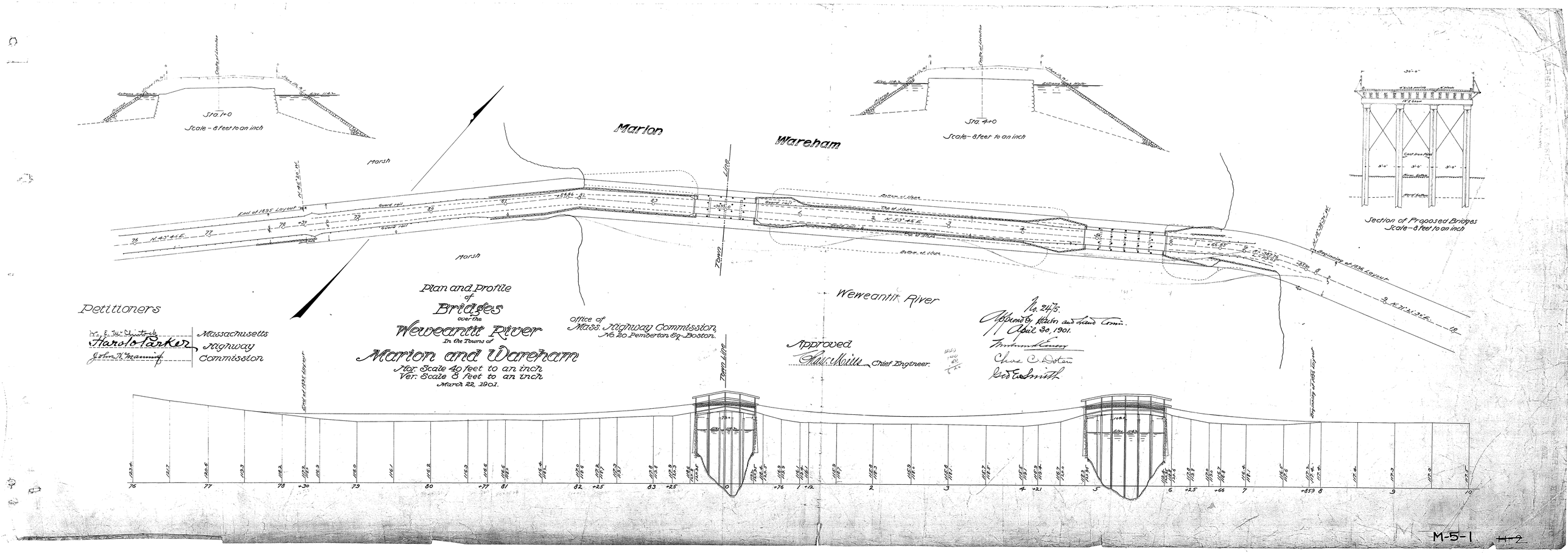
Office of
Massachusetts Highway Commission
20 Pemberton Sq. Boston.

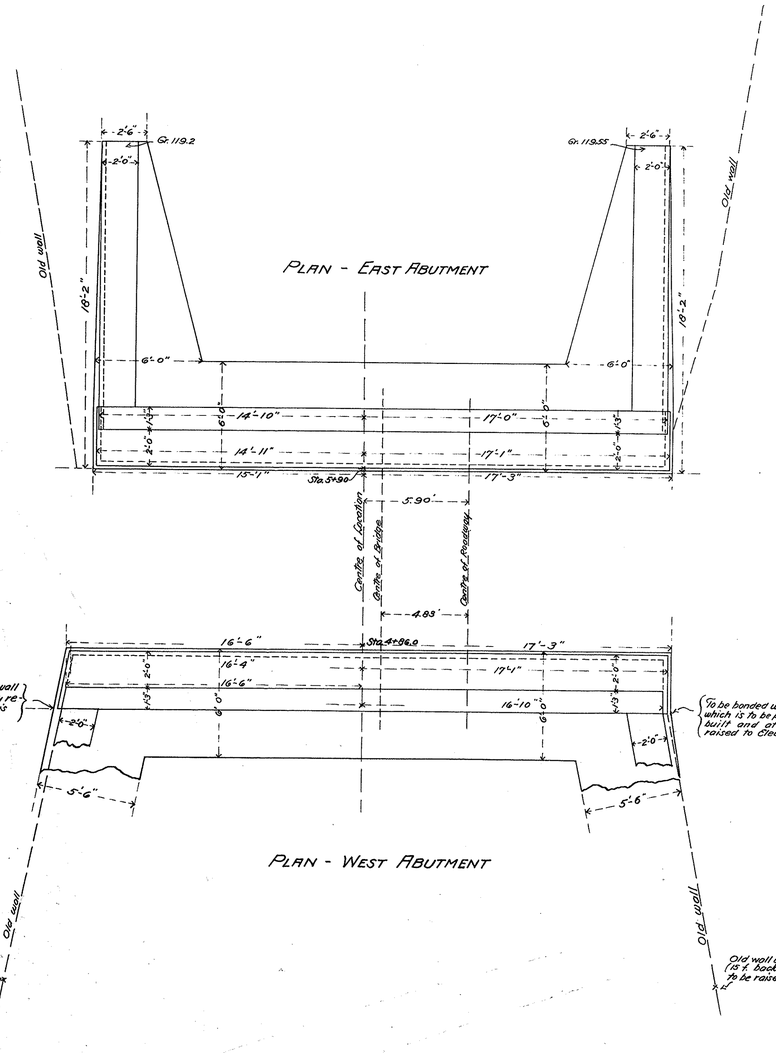




Plan showing location of Pile Bents.
Scale 1"=20.

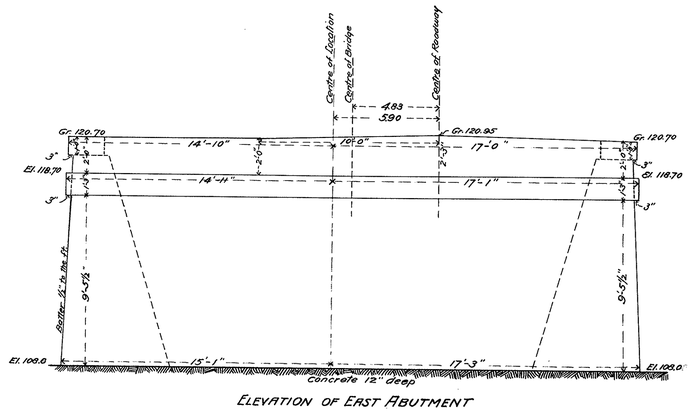
M-5-1


Sta. 1+0
Scale - 8 feet to an inch
Sta. 4+0
Scale - 8 feet to an inch
Marion
Wareham
Marsh
Marsh
Town Line
Weweantit River
Section of Proposed Bridges
Scale - 8 feet to an inch
Petitioners
W. E. McClintock
Harold Parker
John K. Mannix
Massachusetts Highway Commission
Plan and Profile of Bridges over the Weweantit River In the Towns of Marion and Wareham
Hor. Scale 40 feet to an inch
Ver. Scale 8 feet to an inch
March 22, 1901.
Office of Mass. Highway Commission, No. 20 Pemberton Sq. Boston.
Approved
Chas. Mills Chief Engineer.
No. 2475.
Approved by Harbor and Land Comm.
April 30, 1901.
Chas C. Doten
Geo E. Smith
M-5-1

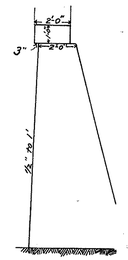


PLAN - EAST ABUTMENT

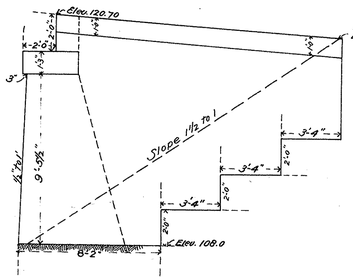
PLAN - WEST ABUTMENT



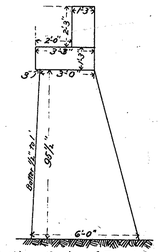
ELEVATION OF EAST ABUTMENT



Section ~ E. Abut.



ELEVATION OF RIGHT WING EAST ABUTMENT



Section ~ Centre of Roadway

Massachusetts Highway Commission

W. E. McClintock

CHAIRMAN

PLAN OF ABUTMENTS OF EAST BRIDGE STATION 5+50± WAREHAM, MASS.

Scale; 1 inch = 4 feet

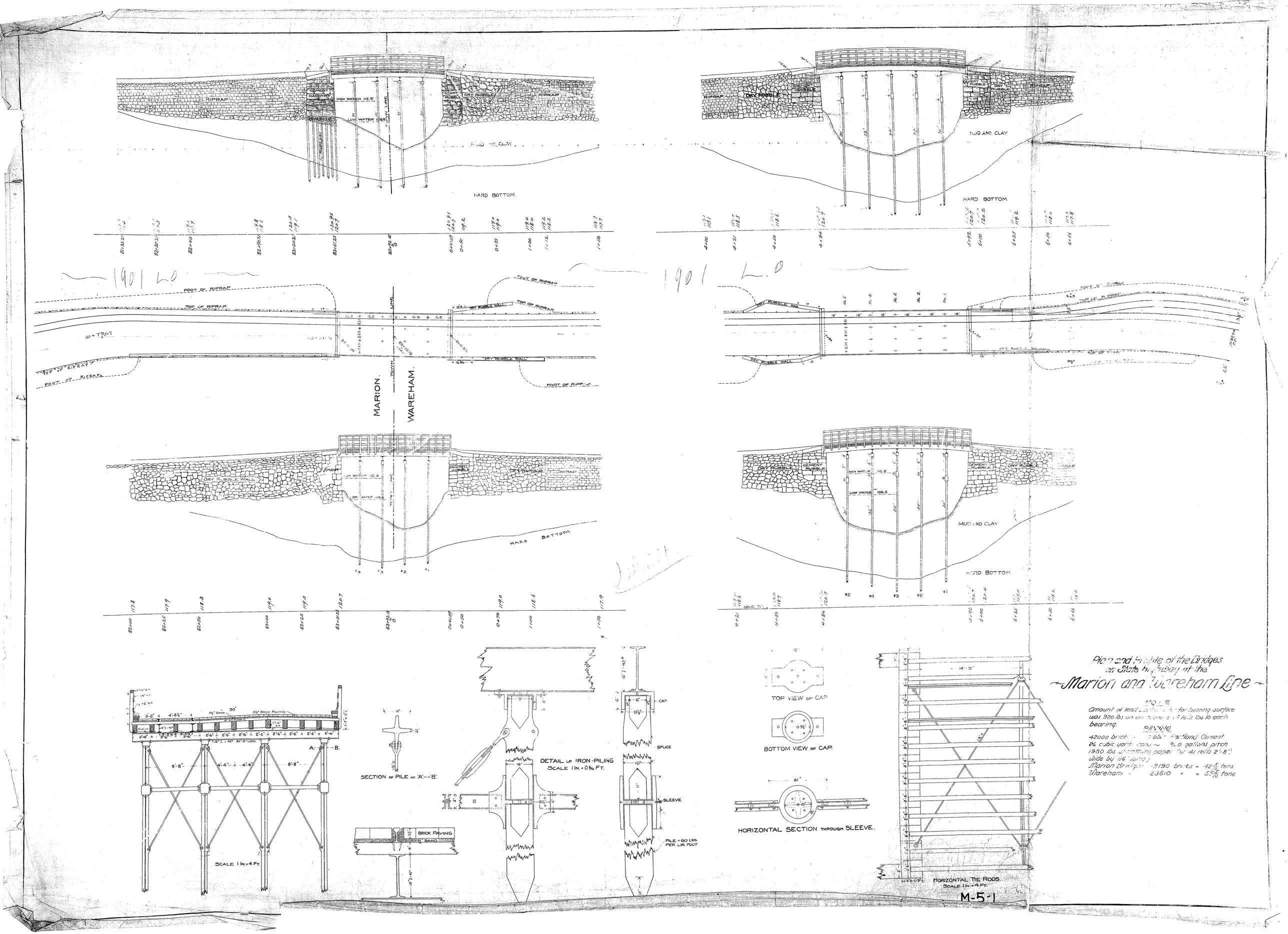
APPROVED

A. W. Lono

FIRST ASST. ENGINEER

OFFICE OF
Massachusetts Highway Commission
#20 Pemberton Sq. ~ Boston ~ Mass.
APRIL 27 1901

M-5-1



Plan and Profile of the Bridges on State Highway at the

~Marion and Wareham Line~

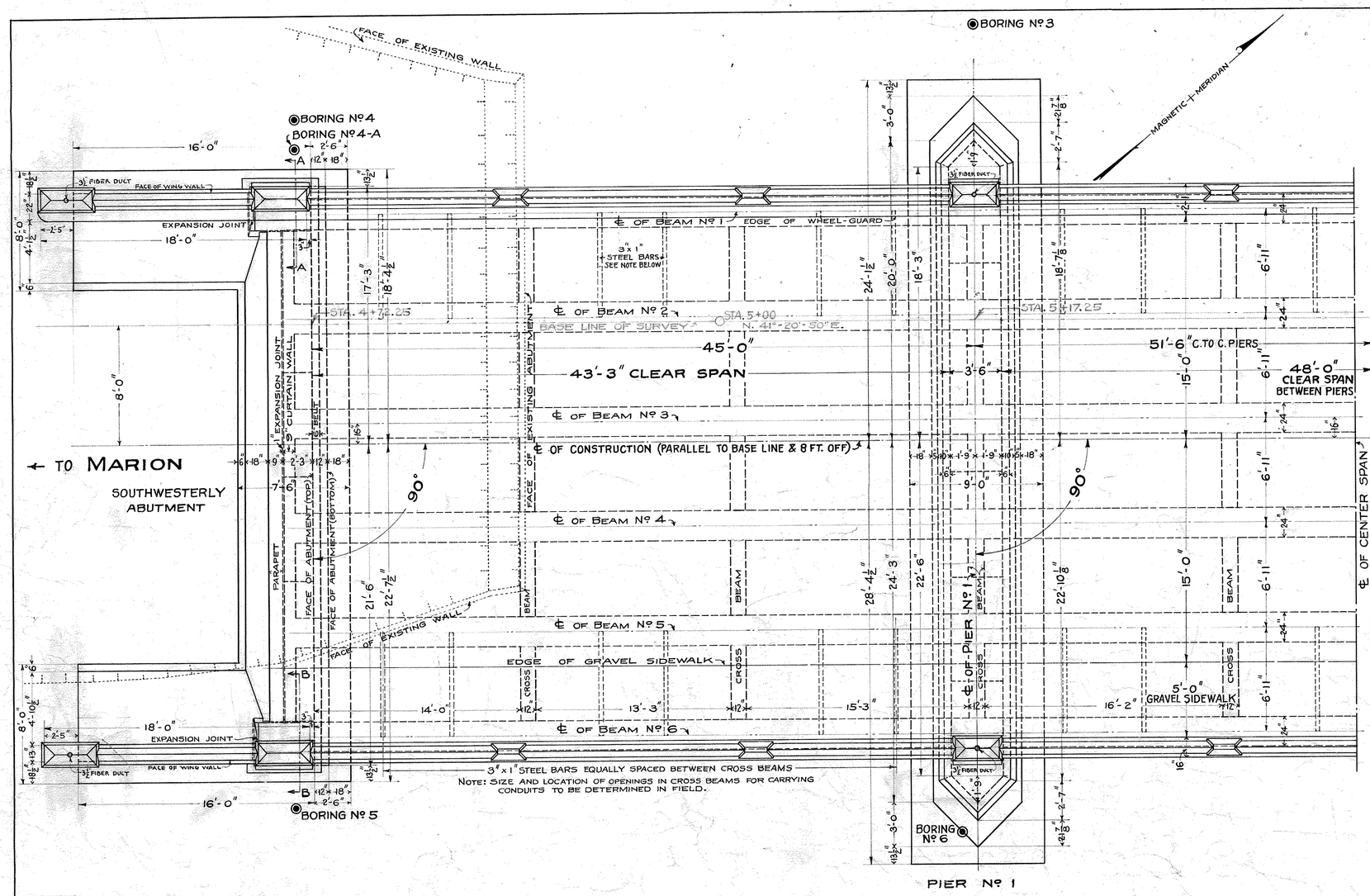
NOTE

Amount of lead used on pile for bearing surface was 920 lbs on an average of 16½ lbs to each bearing.

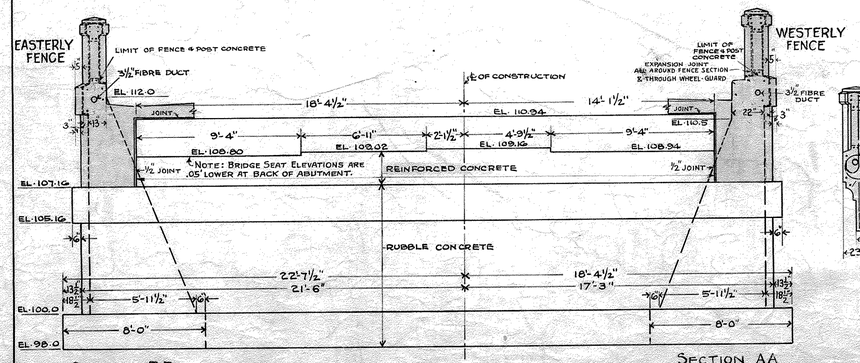
PAVING

42000 bricks — [illegible] Portland Cement
26 cubic yards sand — [illegible] gallons pitch
1980 lbs sheathing paper (or 41 rolls 2'-8") wide by 116' long)
Marion Bridge: 18190 bricks = 42 5/16 tons.
Wareham " 23810 " = 55 5/16 tons.

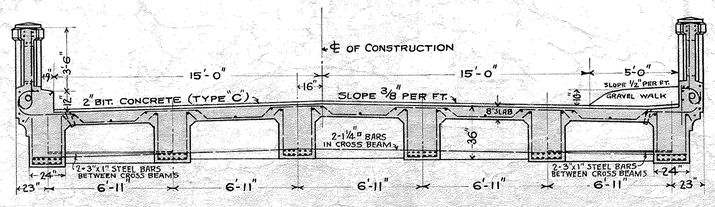
FED. ROAD DIST. No.	STATE	FED. AID PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
9	MASS.	189-A	1929	40	65



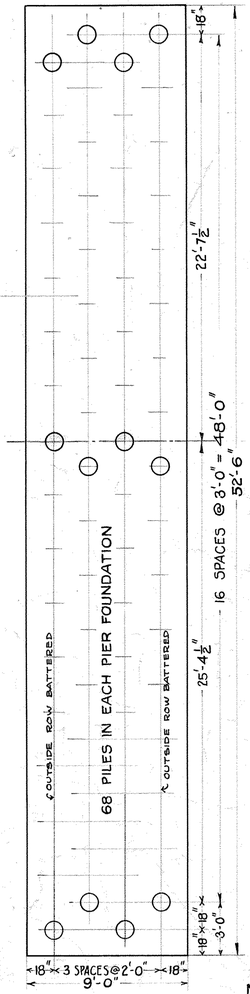
ONE HALF PLAN VIEW ~ OTHER HALF SIMILAR (SEE SHEET 2)



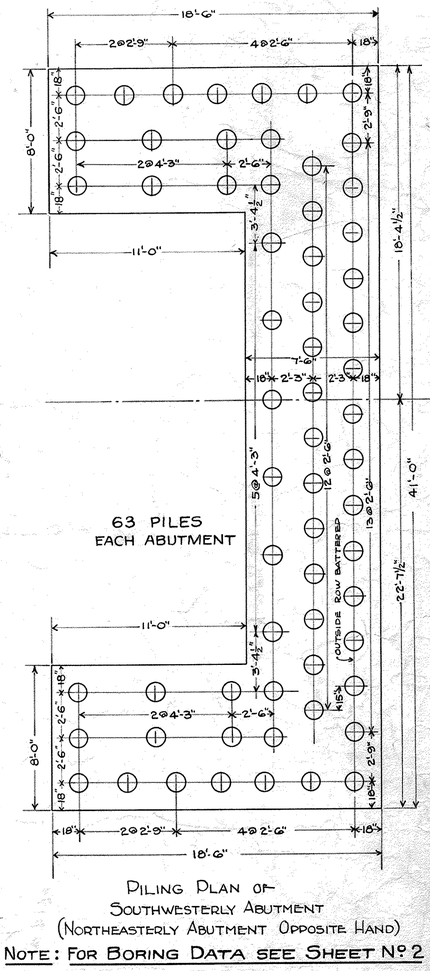
ELEVATION SOUTHWESTERLY ABUTMENT



TYPICAL CROSS SECTION AT MID SPAN



PILING PLAN
(BOTH PIERS)



PILING PLAN OF
SOUTHWESTERLY ABUTMENT
(NORTHEASTERLY ABUTMENT OPPOSITE HAND)

NOTE: FOR BORING DATA SEE SHEET Nº 2

ESTIMATED QUANTITIES (NOT GUARANTEED)

EXCAVATION (BRIDGE)	1090	CU. YDS.
EXCAVATION (LEDGE)	10	CU. YDS.
EXCAVATION (CHANNEL)	350	CU. YDS.
BORROW (GRAVEL)	500	CU. YDS.
CONCRETE 1:2:4 REINFORCED	373.5	CU. YDS.
CONCRETE (RUBBLE)	550	CU. YDS.
CONCRETE 1:2:4 REINFORCED (FENCES & POSTS)	24.2	CU. YDS.
CONCRETE 1:2:4 (PLAIN)	33	CU. YDS.
STONE MASONRY-(PLAIN CONCRETE BACKING)	140	CU. YDS.
RIP RAP	1140	TONS
PILES	6300	LIN. FT.
TEMPORARY BRIDGE	1	LUMP SUM
BITUMEN (SEAL COAT)	145	GALS.
REINFORCING STEEL	118,500	POUNDS
BITUMINOUS CONCRETE SURFACING (TYPE "C")	64	TONS
MOPPING BRIDGE FLOOR	290	GALS.
REMOVAL PRESENT BRIDGE	1	LUMP SUM
ZINC PLATES	2360	POUNDS
REMOVING & REBUILDING PRESENT WALLS	15	CU. YDS.
GALVANIZED IRON CURB BAR (INCL. IN REINF. STEEL)	179'-2"	

THE COMMONWEALTH OF MASSACHUSETTS
PROPOSED BRIDGE

WAREHAM

STATION 5+43.00
OVER WEWEANTIC RIVER

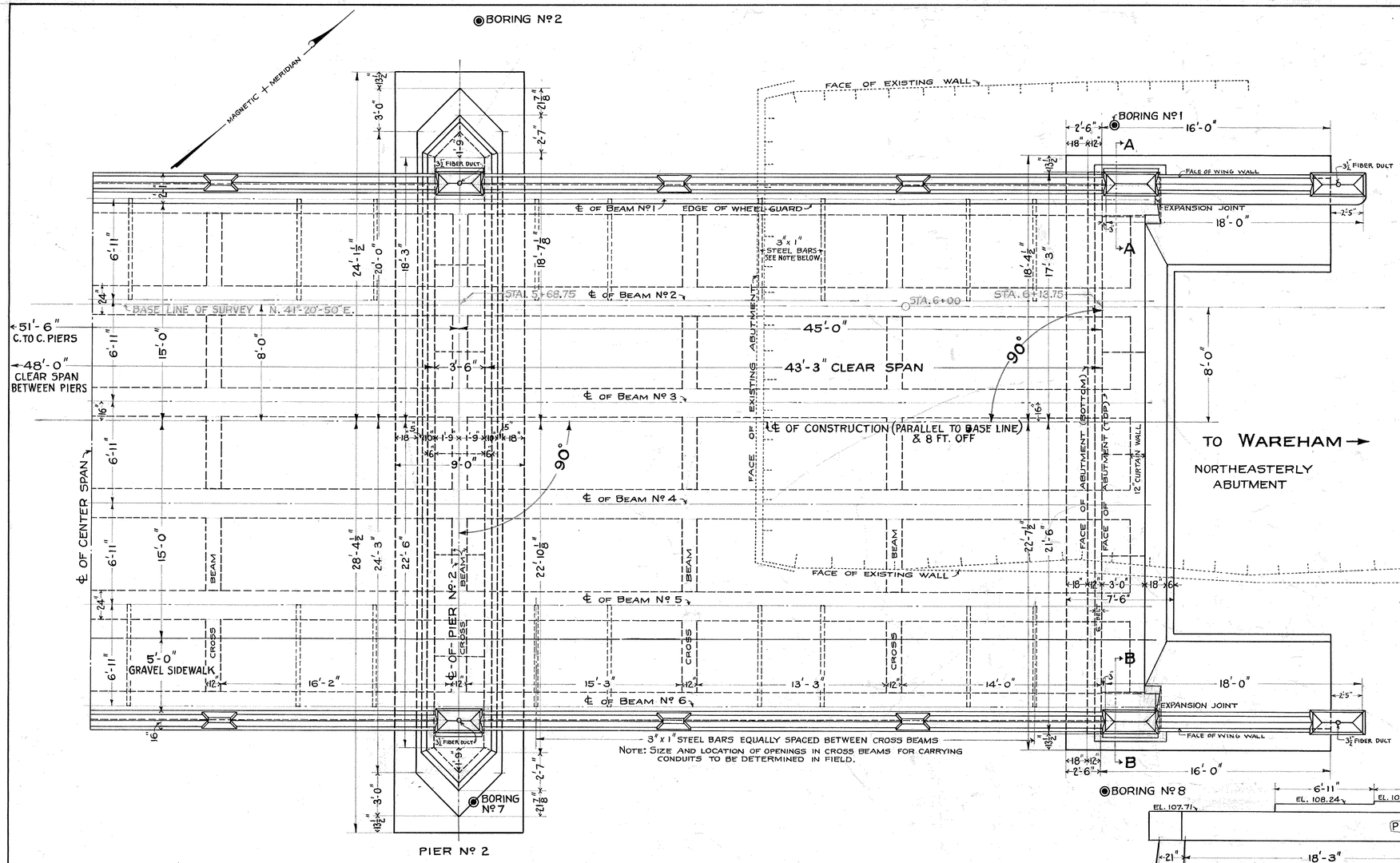
SCALE: FOUR FEET TO THE INCH UNLESS OTHERWISE NOTED

OFFICE OF
DEPARTMENT OF PUBLIC WORKS
STATE HOUSE ~ BOSTON, MASS.
FEBRUARY 1929

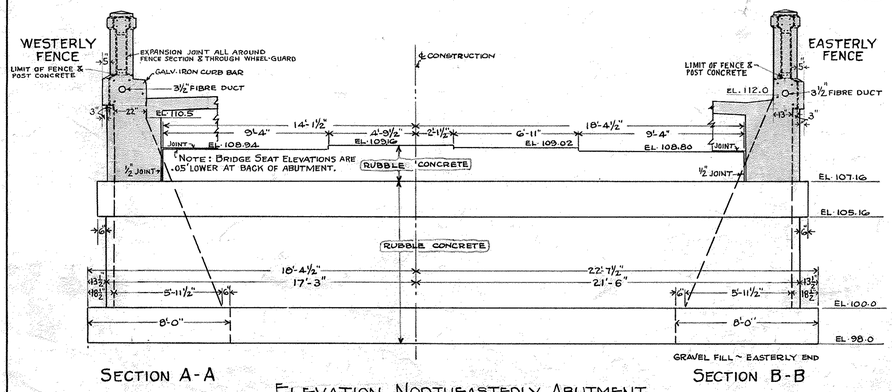
G. E. Hardesty — BRIDGE ENGINEER
A. W. Fuller — CHIEF ENGINEER

DESIGNED BY L.G.C. TRACED BY D.F.D. J.C.R. CHECKED BY

FED. ROAD DIST. No.	STATE	FED. AID PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
9	MASS.	189-A	1929	41	65



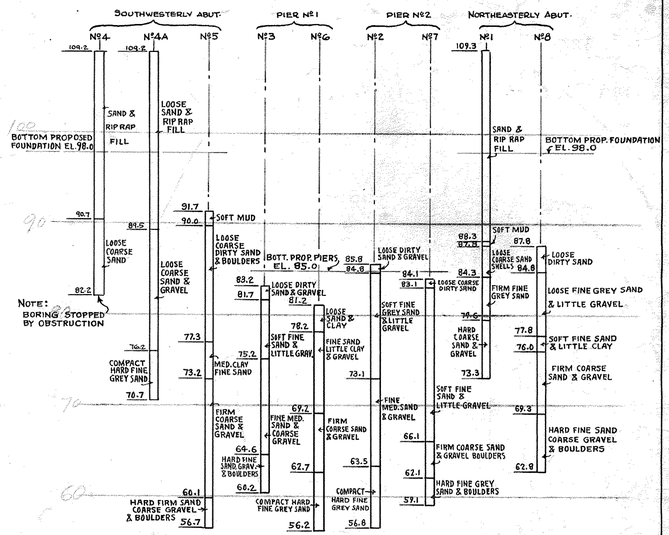
ONE HALF PLAN VIEW



SECTION A-A

ELEVATION NORTHEASTERLY ABUTMENT

SECTION B-B



BORING DATA

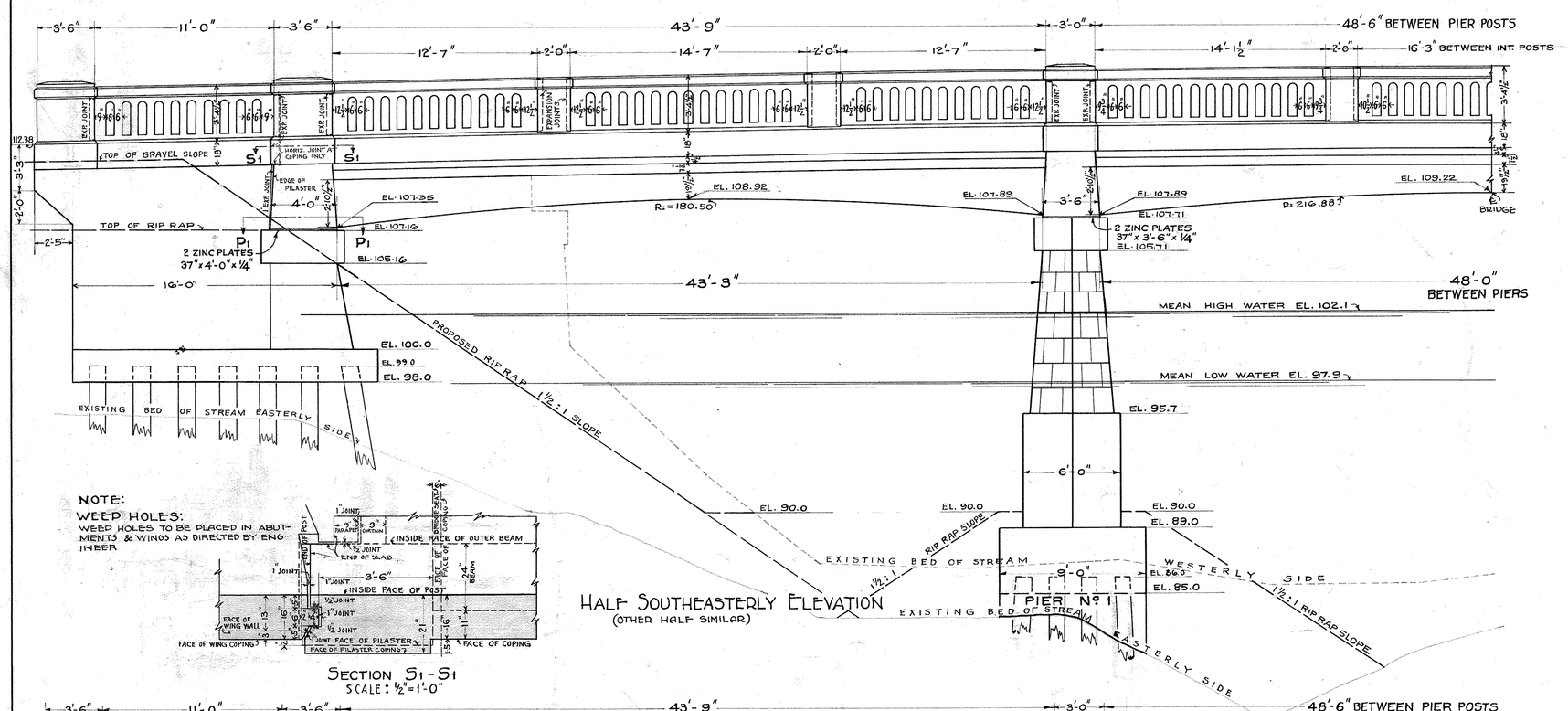
VERTICAL SCALE : 1" = 8'

BORING NOTES :

LOCATION OF BORINGS SHOWN ON PLAN VIEW THUS ◉
BORINGS TAKEN FOR PURPOSE OF DESIGN AND SHOW CONDITIONS AT BORING POINTS ONLY, AND DO NOT NECESSARILY SHOW NATURE OF MATERIAL TO BE ENCOUNTERED IN CONNECTION WITH THE CONSTRUCTION OF THE BRIDGE.

TYPICAL SOUTHERLY ELEVATION OF PIERS

FED. ROAD DIST. No.	STATE	FED. AID PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
9	MASS.	189-A	1929	42	65

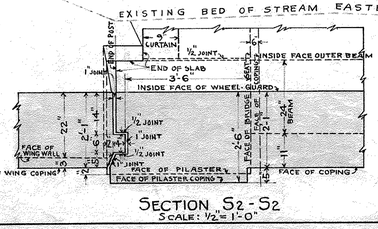


HALF SOUTHEASTERLY ELEVATION
(OTHER HALF SIMILAR)

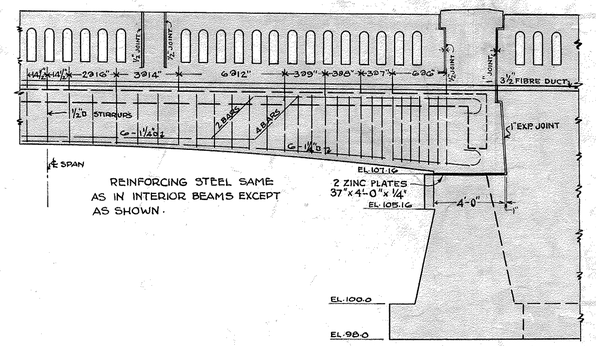
NOTE:
WEEP HOLES:
WEEP HOLES TO BE PLACED IN ABUTMENTS & WINGS AS DIRECTED BY ENGINEER

SECTION S1-S1
SCALE: ½"=1'-0"

HALF NORTHWESTERLY ELEVATION
(OTHER HALF SIMILAR)



SECTION S2-S2
SCALE: ½"=1'-0"



REINFORCING STEEL SAME AS IN INTERIOR BEAMS EXCEPT AS SHOWN.

LONGITUDINAL SECTION THRU OUTSIDE BEAM

GENERAL NOTES

FINISH :
ALL EXPOSED CONCRETE SURFACES TO BE RUBBED SMOOTH WITH CORUNDUM BRICK, AND LEFT FREE FROM ALL FORM MARKS AND IMPERFECTIONS.

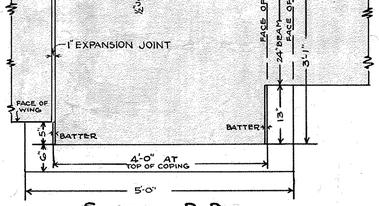
DATE & SEAL :
TO BE PLACED IN CENTER OF INSIDE FACE OF NORTHWESTERLY AND SOUTHEASTERLY END POSTS. FOR SIZE AND CHARACTER OF NUMERALS SEE DETAILS ON ANOTHER SHEET. SEAL TO BE PROTECTED AND KEPT CLEAN DURING CONSTRUCTION OF POSTS.

FOUNDATIONS :
MAY BE ALTERED IF NECESSARY TO SUIT CONDITIONS OF CONSTRUCTION.

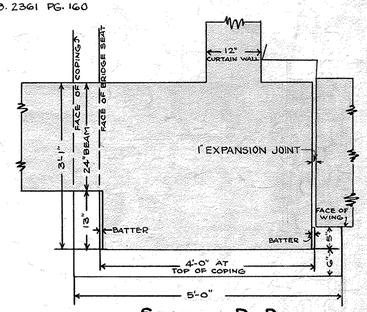
EXPANSION JOINTS :
TO BE BUILT SIMILAR TO THOSE SHOWN ON PLAN OF MARION-WAREHAM BRIDGE.

REINFORCING STEEL :
ALL REINFORCEMENT TO BE DEFORMED BARS.

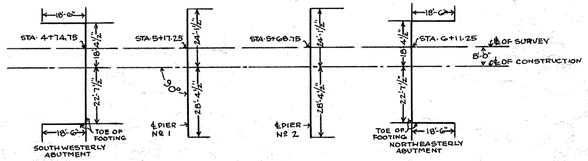
BENCH MARK
STA. 10+00 RT. CONC. STEP EL. 108.68 N.D. 2361 PG. 160



SECTION P1-P1
SHOWING EXPANSION JOINT IN PLAN - S'LY. ABUT.
SCALE: ¾"=1'-0"

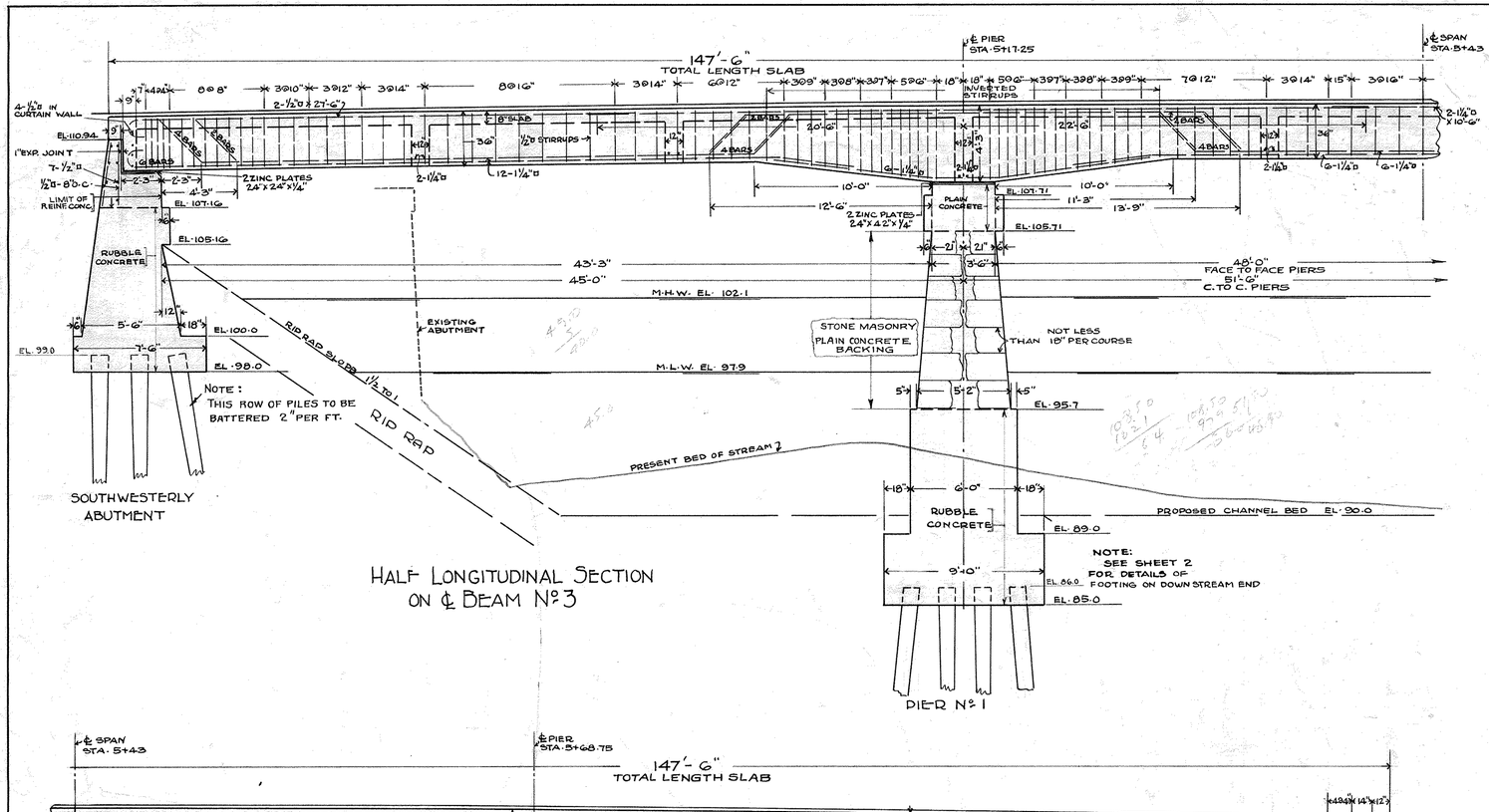


SECTION P2-P2
SHOWING EXPANSION JOINT IN PLAN - N'LY. ABUT.
SCALE: ¾"=1'-0"

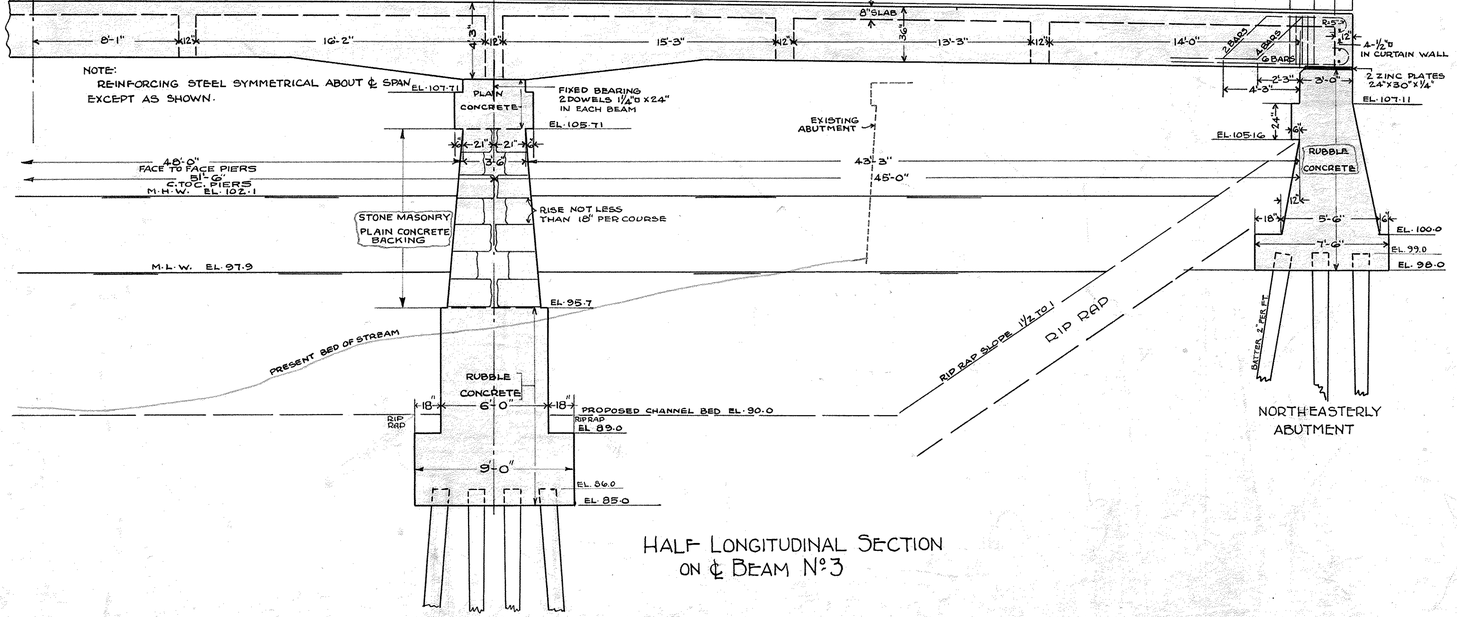


GENERAL LAYOUT PLAN
SCALE: 1"=30'-0"

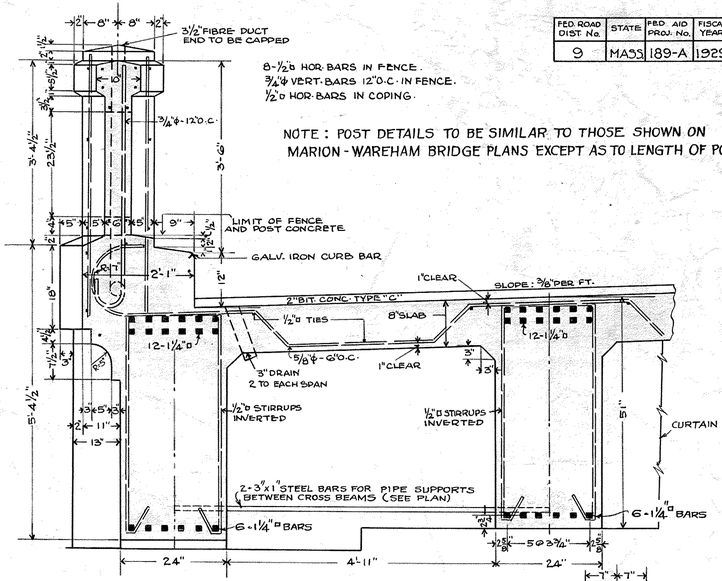
FED. ROAD DIST. No.	STATE	FED. AID PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
9	MASS	189-A	1929	43	65



HALF LONGITUDINAL SECTION ON ℄ BEAM Nº 3

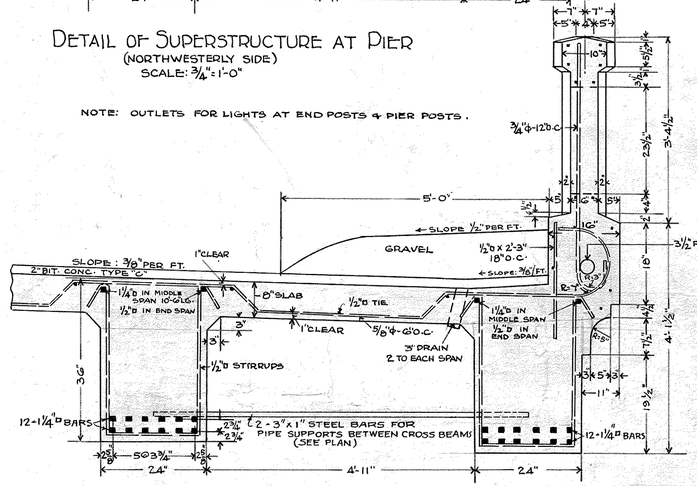


HALF LONGITUDINAL SECTION ON ℄ BEAM Nº 3

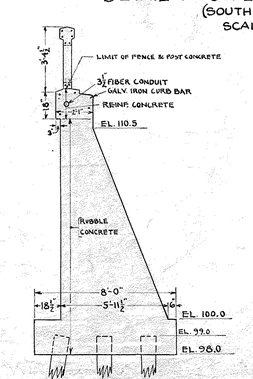


DETAIL OF SUPERSTRUCTURE AT PIER
(NORTHWESTERLY SIDE)
SCALE: ¾"=1'-0"

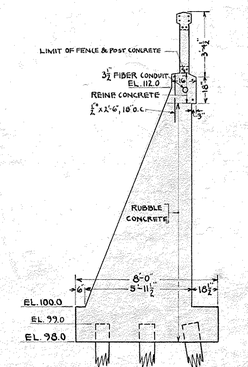
NOTE: OUTLETS FOR LIGHTS AT END POSTS & PIER POSTS.



DETAIL OF SUPERSTRUCTURE AT ℄ OF SPAN
(SOUTHEASTERLY SIDE)
SCALE: ¾"=1'-0"

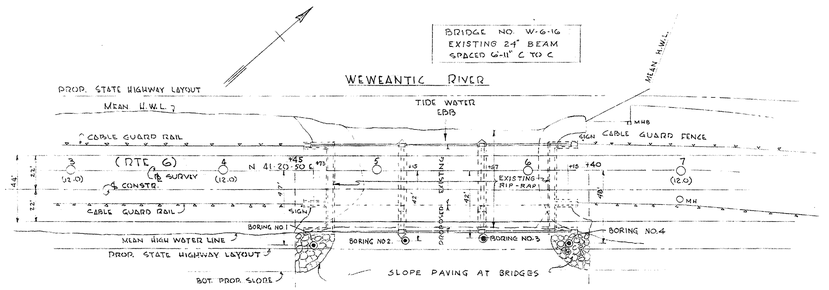


TYPICAL WING SECTION — N'W'LY SIDE



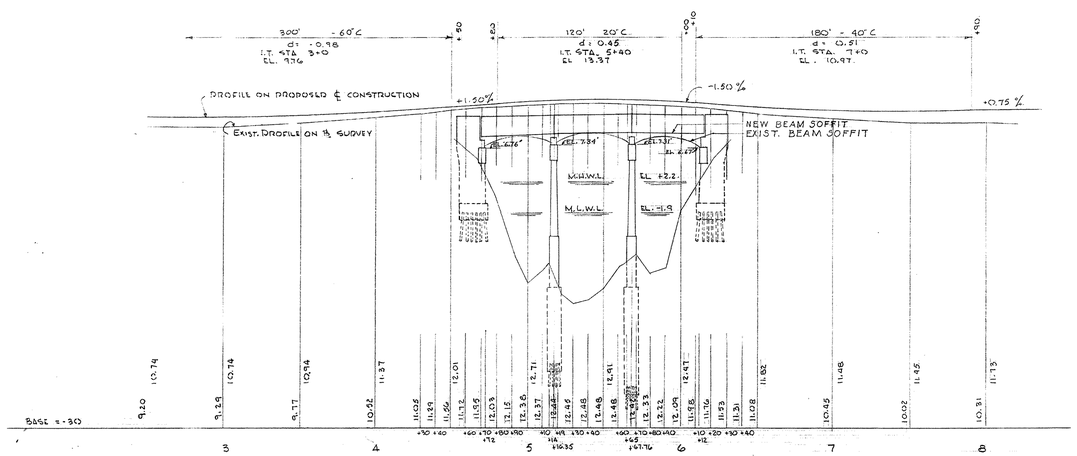
TYPICAL WING SECTION — S'E'LY SIDE

PUB RD DIV. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
1	MASS.			1	4



PLAN

SCALE 1" = 40'



PROFILE OF MARION ROAD (ROUTE 6)

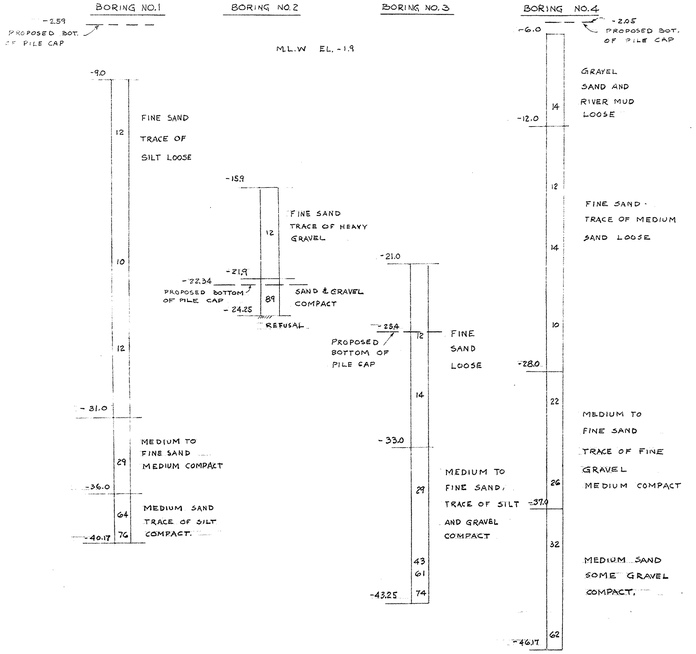
HORIZONTAL SCALE 1" = 40' VERTICAL SCALE 1" = 8'-0"

BORING NOTES

LOCATION OF BORING SHOWN THUS ◉ BORING NO.8. BORING TAKEN FOR PURPOSE OF DESIGN AND SHOW CONDITION AT BORING POINT ONLY, AND DO NOT NECESSARILY SHOW NATURE OF MATERIAL TO BE ENCOUNTERED DURING CONSTRUCTION. FIGURES IN COLUMNS INDICATE BLOWS PER FOOT ON ONE INCH ℄ PIPE PRODUCED BY 30 INCH FALL OF 140 POUND HAMMER. BORING SAMPLES MAY BE SEEN AT THE OFFICE OF THE BRIDGE ENGINEER MR. J.C. RUNDLETT ROOM 609 100 NASSUA ST. BOSTON, MASS, ON ADVANCE NOTICE.

BORING DATA

SCALE ¼" = 1'-0" BORINGS TAKEN DEC. 1954 BY THE AMERICAN DRILLING CO.



GENERAL NOTES

FOUNDATIONS	MAY BE ALTERED IF NECESSARY TO SUIT CONDITIONS ENCOUNTERED IN CONSTRUCTION.
DATE AND SEAL	DATE TO BE CUT INTO ONE STONE OF SIZE DETAILED, LOCATED ON INSIDE FACES OF NORTHWESTERLY & SOUTHEASTERLY POSTS AS SHOWN IN DETAIL ON SHEET № 3. A SHEET SHOWING SIZE AND CHARACTER OF NUMERALS WILL BE FURNISHED. SEAL WILL BE FURNISHED BY THE COMMONWEALTH.
DESIGN	ACCORDING TO THE 1953 SPECIFICATIONS OF THE AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS FOR H-20-44 LOADING.
BENCH MARK	B.M #51 CHISELED ⁰ ON CONC. BRIDGE WALL STA 250+93. MARION RD (ROUTE 6 & ℄) 22.7' FT. ELEV 12.32' SEA LEVEL DATUM OF 1929
REINFORCEMENT	ALL REINFORCING STEEL BARS SHALL CONFORM TO A.S.T.M. SPECIFICATION A 305-49, UNLESS OTHERWISE SHOWN ON PLANS, REINFORCING BARS SHALL BE LAPPED 20 DIAMETERS TO MAKE A SPLICE EXCEPT THAT MAIN REINFORCING BARS NEAR TOP OF SLABS & BEAMS HAVING MORE THAN 12" OF CONCRETE UNDER THE BARS, SHALL BE LAPPED 35 DIAMETERS TO MAKE A SPLICE.
PILES	TREATED TIMBER PILES SHALL BE DRIVEN TO A MINIMUM LOAD BEARING CAPACITY OF 18 TONS.

PLANS OF THE EXIST. BRIDGE ARE AVAILABLE AND MAY BE SEEN AT THE OFFICE OF THE BRIDGE ENGINEER, ROOM 609, 100 NASHUA ST, BOSTON, MASS. DIMENSIONS & DETAILS SHOWN FOR EXISTING STRUCTURE MUST BE CHECKED IN THE FIELD BY THE CONTRACTOR.

ESTIMATED QUANTITIES

NOT GUARANTEED

CLASS A ROCK EXCAVATION	10 C.Y.
BRIDGE EXCAVATION	190 C.Y.
CLASS B ROCK EXCAVATION	5 C.Y.
CHANNEL EXCAVATION	20 C.Y.
GRAVEL BORROW	110. C.Y.
STEEL SHEETING	46,200 LBS.
CLASS I BIT. CONC. PAVEMENT TYPE I-1	180 TONS
TREATED TIMBER PILES	2380 L.F.
SLOPE PAVING AT BRIDGES	180 C.Y.
BRIDGE STRUCTURE (W-6-16)	1 L.S.
BRIDGE EXCAVATION AT PIERS	110. C.Y.

NOV. 3, 1956	ISSUED FOR CONSTRUCTION

THE COMMONWEALTH OF MASSACHUSETTS

PROPOSED BRIDGE WIDENING

WAREHAM

ROUTE #6

OVER WEWEANTIC RIVER

SCALES AS NOTED

OFFICE OF

DEPARTMENT OF PUBLIC WORKS

100 NASHUA STREET BOSTON, MASS.

NOV. 1956

J.C. Rundlett — BRIDGE ENGINEER

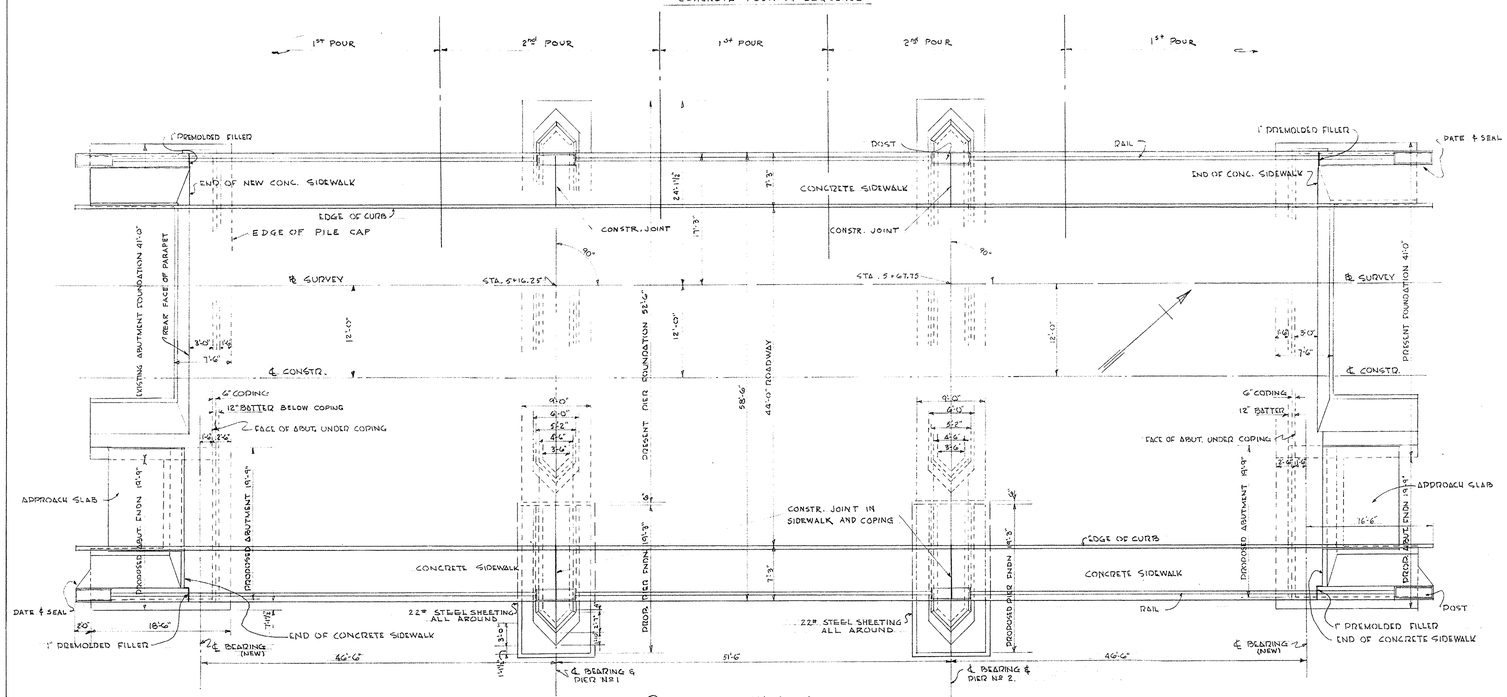
H. S. Gray — CHIEF ENGINEER

ABBOTT ASSOCIATES, INC.
ARCHITECTS & ENGINEERS
131 STATE STREET BOSTON, MASS.

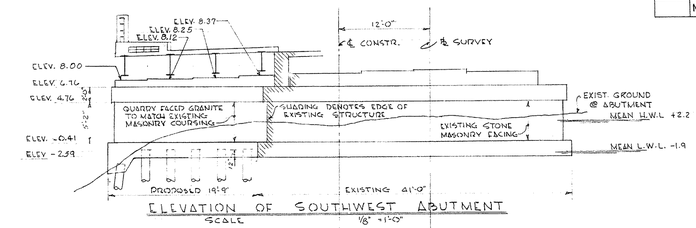
SHEET 1 OF 4 SHEETS BRIDGE № W-6-16

PUB. RD DW. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
	MASS.			2	4

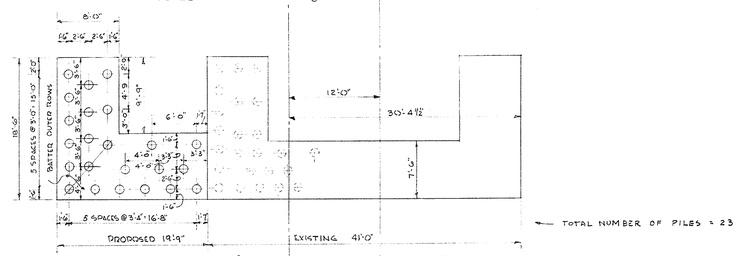
CONCRETE POURING SEQUENCE



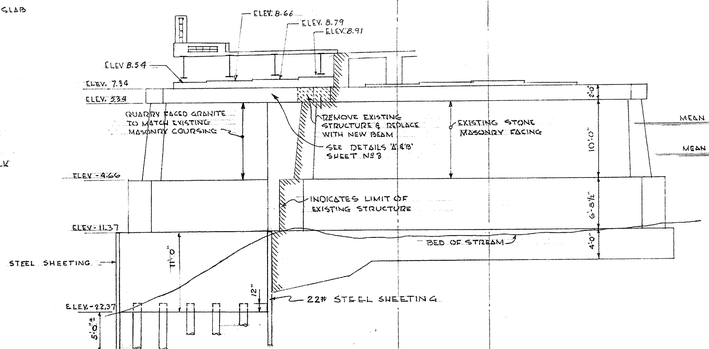
PLAN W-6-16
SCALE 1/8"=1'-0"



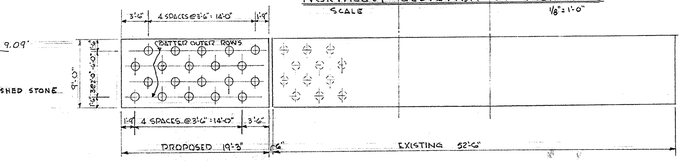
ELEVATION OF SOUTHWEST ABUTMENT
SCALE 1/8"=1'-0"



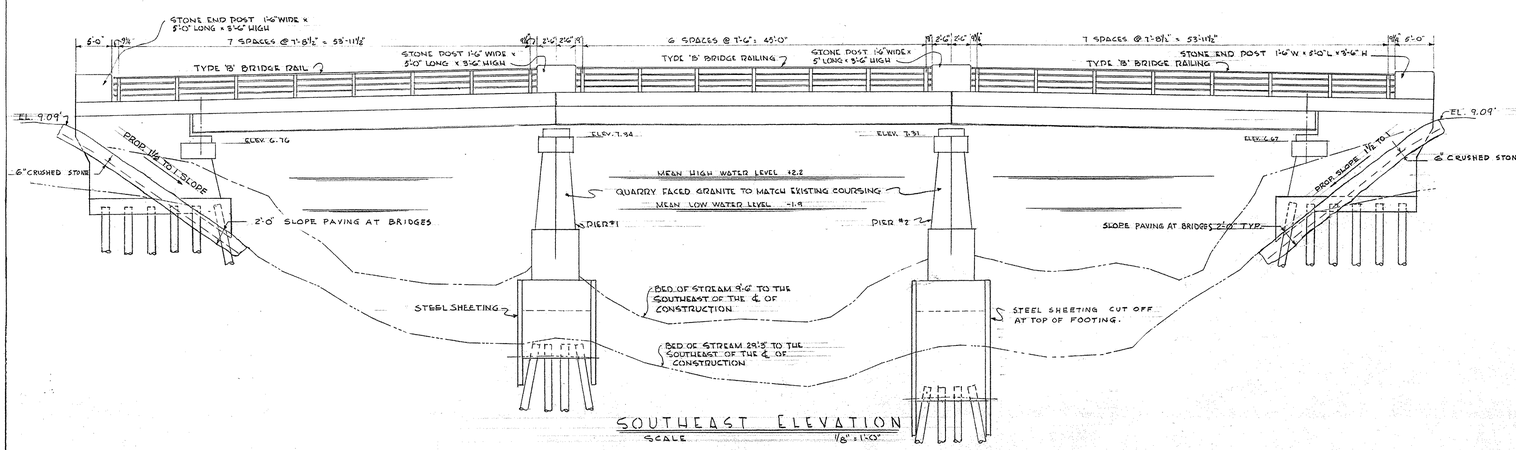
PILING PLAN OF SOUTHWEST ABUTMENT
SCALE 1/8"=1'-0"



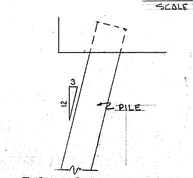
NORTHEAST ELEVATION OF PIER No. 1
SCALE 1/8"=1'-0"



PILE PLAN OF PIER No. 1
SCALE 1/8"=1'-0"



SOUTHEAST ELEVATION
SCALE 1/8"=1'-0"



TYPICAL PILE BATTER-PIERS
NO SCALE

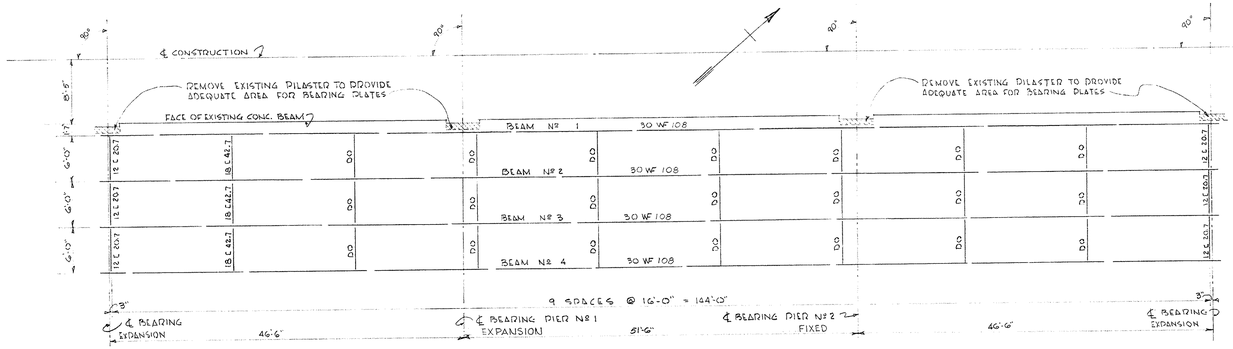
DATE	DESCRIPTION
NOV. 3, 1936	ISSUED FOR CONSTRUCTION
	USE ONLY PRINTS OF LATEST DATE

SHEET 2 OF 4 SHEETS BRIDGE No. W-6-16

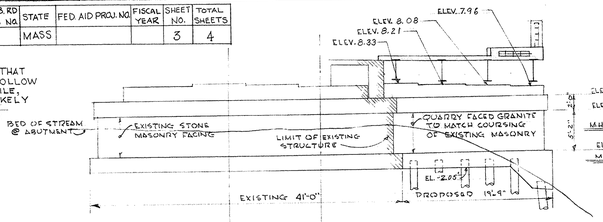
PUB. RD DIV. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
	MASS			3	4

NOTE

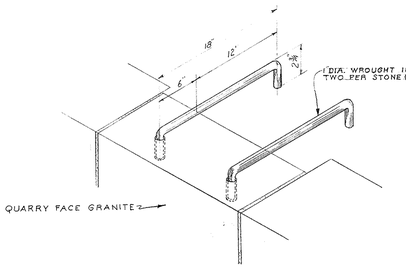
1. ALL STRINGERS ARE TO BE CAMBERED TO THE EXTENT THAT THE BRIDGE DECK UNDER FULL DEAD LOAD WILL FOLLOW AS NEARLY AS PRACTICABLE THE DESIGN PROFILE, AND IN NO CASE WITH LESS CAMBER THAN IS LIKELY TO REMAIN PERMANENT. THE PROPOSED CAMBER DESIGN SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.



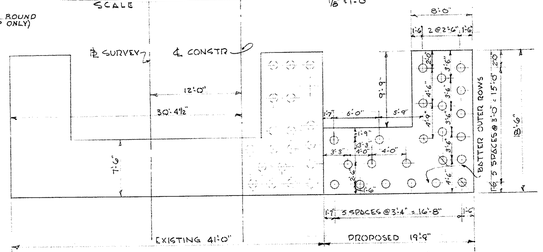
FRAMING PLAN W-6-16
SCALE 1/8" = 1'-0"



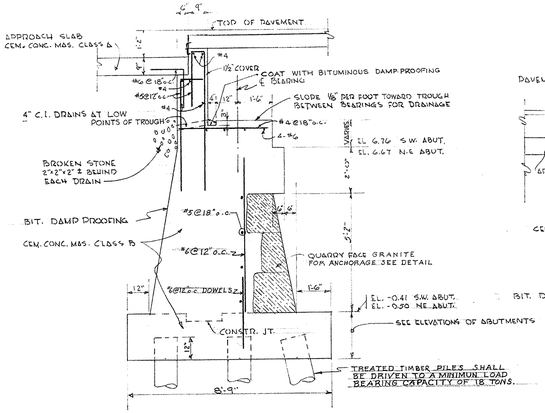
ELEVATION OF NORTHEAST ABUTMENT
SCALE 1/8" = 1'-0"



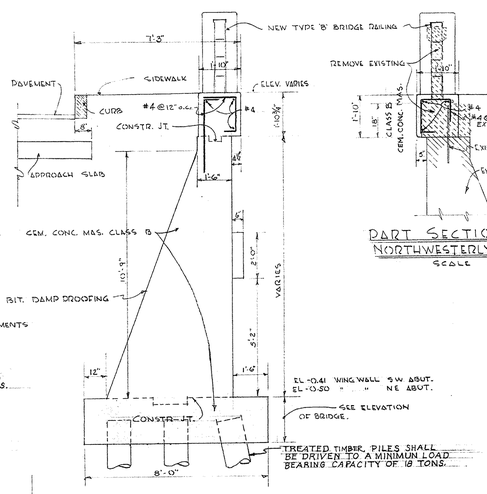
DETAIL OF STONE ANCHORAGE
SCALE 1½" = 1'-0"



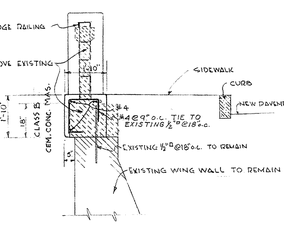
PILING PLAN OF NORTHEAST ABUTMENT
SCALE 1/8" = 1'-0"
TOTAL NUMBER OF PILES = 23



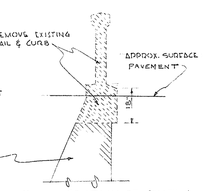
TYPICAL SECTION OF ABUTMENT EXTENSIONS
SCALE ⅜" = 1'-0"



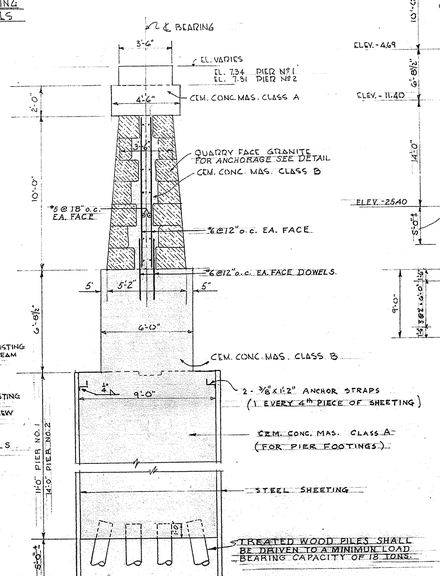
TYPICAL SECTION OF WING WALL
SCALE ⅜" = 1'-0"



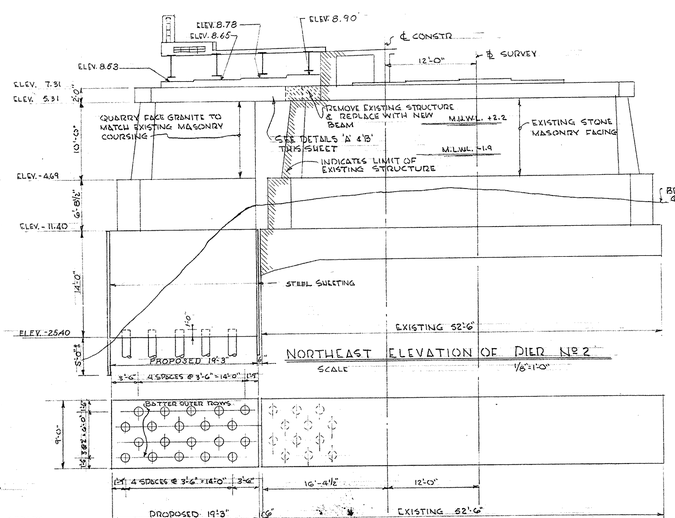
PART SECTION OF EXISTING NORTHWESTERLY WING WALLS
SCALE ⅜" = 1'-0"



PART SECTION OF EXISTING SOUTHEASTERLY WING WALLS
SCALE ⅜" = 1'-0"

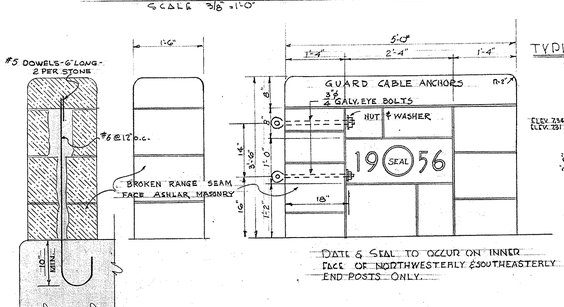


TYPICAL SECTION THRU PIERS
SCALE ⅜" = 1'-0"

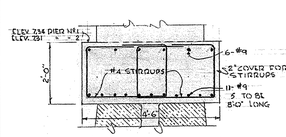


NORTHEAST ELEVATION OF PIER Nº 2
SCALE 1/8" = 1'-0"

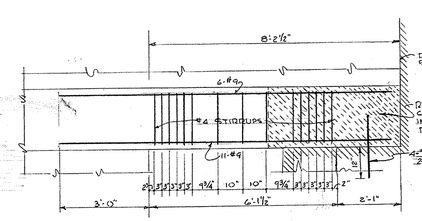
PILE PLAN OF PIER Nº 2
SCALE 1/8" = 1'-0"
TOTAL NUMBER OF PILES = 20



SECTION ELEVATIONS
DETAILS OF STONE POSTS
SCALE ¾" = 1'-0"



DETAIL 'A'

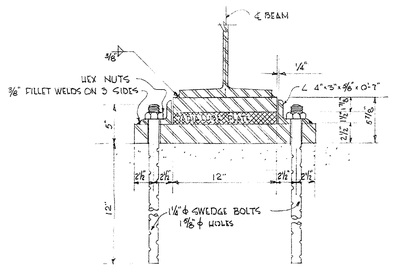


DETAIL 'B'

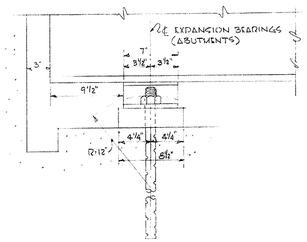
DETAILS OF COPING BETWEEN OLD AND NEW PIERS
SCALE ½" = 1'-0"

DATE	DESCRIPTION
Nov. 3, 1956	ISSUED FOR CONSTRUCTION
	USE ONLY PRINTS OF LATEST DATE

PUB. RD DIV. NO.	STATE	FED AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
	MASS.			4	4

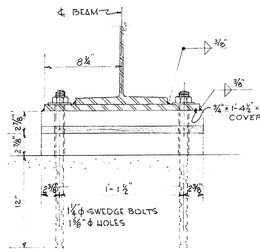


SECTION

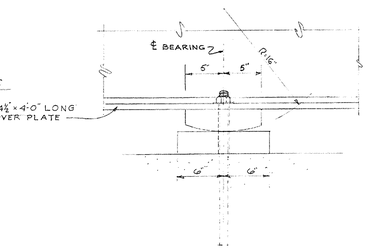


ELEVATION

DETAILS OF EXPANSION BEARINGS (ABUTMENTS)
SCALE 1½" = 1'-0"

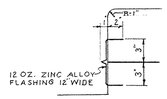


SECTION

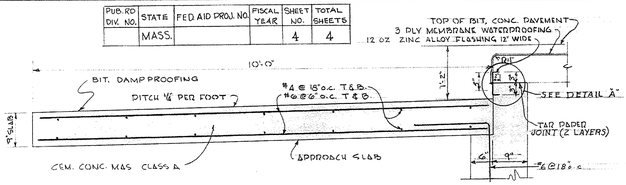


ELEVATION

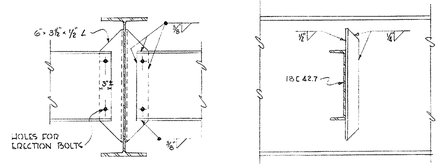
DETAILS · FIXED BEARINGS · PIER Nº 2
SCALE 1½" = 1'-0"



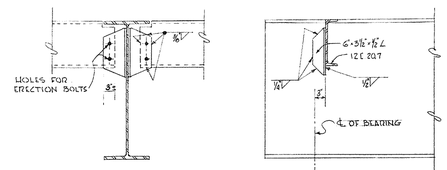
DETAIL A
SCALE 1½" = 1'-0"



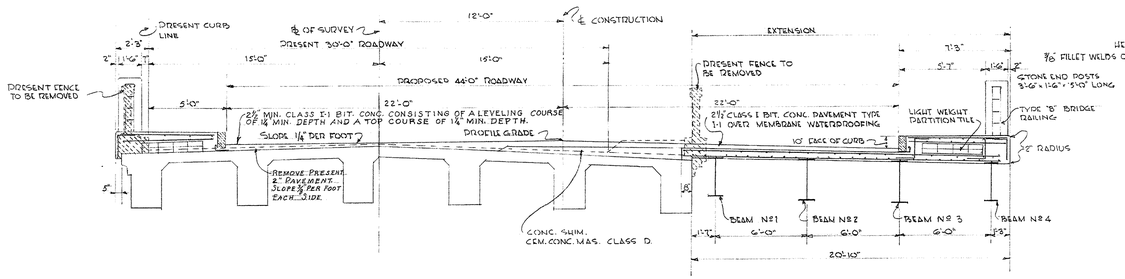
APPROACH SLAB DETAIL TYPICAL FOR EACH ABUTMENT
SCALE ¾" = 1'-0"



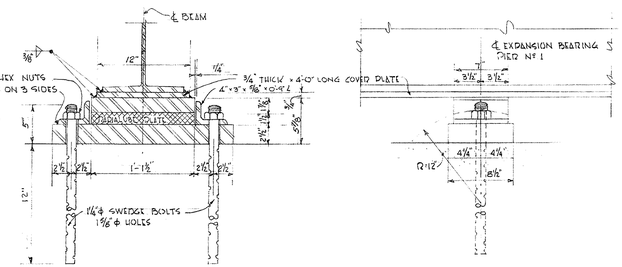
DETAILS · DIAPHRAGM CONNECTIONS
SCALE ¾" = 1'-0"



DETAILS · END DIAPHRAGM CONNECTIONS
SCALE ¾" = 1'-0"



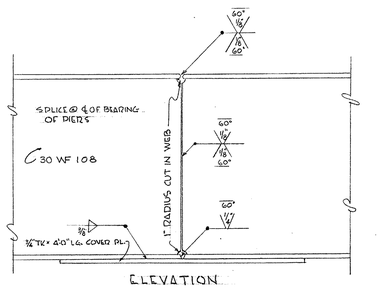
SECTION THRU BRIDGE
SCALE 1/4" = 1'-0"



SECTION

ELEVATION

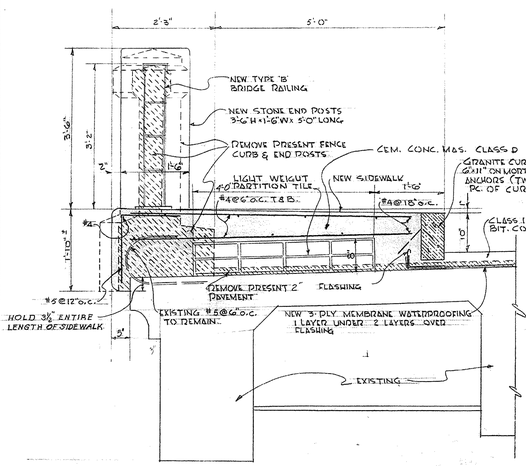
DETAILS OF EXPANSION BEARING · PIER Nº 1
SCALE 1½" = 1'-0"



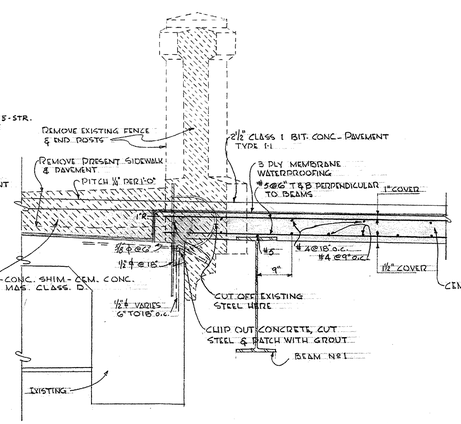
ELEVATION

BEAM SPLICE DETAIL
LOCATED OVER PIERS
SCALE: 1"=1'-0"

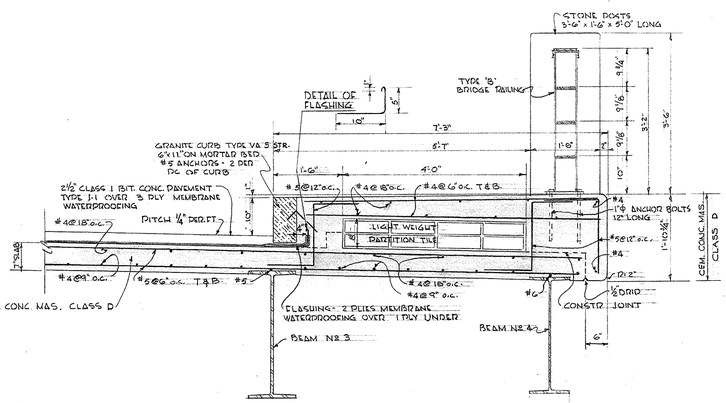
SECTION



SECTION ¾" = 1'-0"



SECTION ¾" = 1'-0"



SECTION ¾" = 1'-0"

DATE	DESCRIPTION
NOV. 3, 1956	ISSUED FOR CONSTRUCTION
	USE ONLY PRINTS OF LATEST DATE

SHEET 4 OF 4 SHEETS BRIDGE Nº W-6-16

APPENDIX C
Boring Logs

TEST BORING REPORT

Boring No. BB-1

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 3
Start December 29, 2017
Finish January 2, 2018
Driller C. Bierholm
H&A Rep. D. Palleiko/D. Warren
Elevation 10.8
Datum NAVD88
Location N 2730242 E 861522

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	Spin/140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: PW Spin 20', HW Drive 39', NW Spin 44'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					9.8	-ASPHALT/MACADAM ROADWAY-										
					1.0											
					9.3	-COARSE GRANULAR FILL-										
	6 17 15 16	S1 18	1.5 3.5	SP	1.5	Dense light brown poorly graded SAND (SP), trace gravel, mps 1.5 in., no structure, no odor, dry	5	5			90					
	17 20 18 10	S2 10	4.0 6.0	SW		Dense brown well graded SAND with gravel (SW), mps 1.5 in., no structure, no odor, moist	20	25	35	15	5					
5																
	8 9 4 2	S3 9	9.0 11.0	SP		Medium dense brown poorly graded SAND with gravel (SP), mps 1.5 in., no structure, no odor, wet	5	10	5	10	70					
10						-FILL-										
	11 6 4 11	S4 15	14.0 16.0	SM		Loose tan silty SAND (SM), trace gravel, mps 1.5 in., no structure, no odor, wet	5	5			75	15				
15						Note: Drill action indicates dense sand and gravel with cobbles from approximately 17.0-19.0 ft.										
					-8.2											
	9 5	S5 12	19.0 21.0	OL/ OH	19.0	Stiff brown sandy ORGANIC SILT (OL/OH), mps < 1mm, no structure, organic odor, moist					30	70				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
1/2/18	0920	80+	34.0	34.0	9.84

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	44.0
Rock Cored (ft)	15.0
Samples	9S, 3C

Boring No. BB-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-1
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	4 5					-ORGANIC DEPOSITS-										
					-11.7 22.5											
	6 9 10 18	S6 14	24.0 26.0	ML		Medium dense light gray-brown SILT (ML), mps < 1mm, no structure, no odor, wet						100				
25						-GLACIOLACUSTRINE DEPOSITS-										
					-15.2 26.0											
	24 21 32 20	S7 15	29.0 31.0	SM		Very dense gray-brown silty SAND with gravel (SM), mps 1.5 in., moderately well bonded in-situ, wet, with cobbles	10	10	10	10	45	15				
30						-GLACIAL TILL- (Ablation Till)										
	16 14 14 21	S8 16	34.0 36.0	SW- SM		Medium dense mottled orange brown to gray well graded SAND with silt and gravel (SW-SM), mps 1.5 in., no structure, no odor, wet, with cobbles	10	15	20	15	30	10				
35						Note: Cobbles from 38.0-38.6 ft.										
	82 100/0"	S9 6	39.0 39.5	SW	-28.7 39.5	Very dense orange brown well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	10	15	20	20	30	5				
40						TOP OF BEDROCK Note: Split spoon refusal at 39.5 ft. Advance roller bit to 44.0 ft through soft to moderately hard, highly to moderately weathered rock. Start rock core at 44.0 ft.										
45						SEE CORE BORING REPORT FOR ROCK DETAILS										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-1

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

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CORE BORING REPORT

Boring No. **BB-1**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
						High		Note: Set 3.0-in. casing to 42.5 ft. Clean out and advance bit to 44.0 ft to start C1. Drill action indicates moderately to highly weathered rock.
	5	C1	44.0 49.0	60 42	100 70	Fresh		C1: Very hard, fresh, gray and pink mottled, medium to very coarse-grained GRANITIC GNEISS. Massive. Primary joints low angle, moderately close to very close, rough, planar, discolored with manganese and/or iron staining, occasionally disintegrated, tight. Secondary joints moderately dipping to high angle, close to moderately close, smooth, planar, discolored with manganese and/or iron staining, occasionally disintegrated, tight.
45	4							
	4							
	4							
	5							-BEDROCK-
	4	C2	49.0 54.0	60 44	100 73			
50	3					Moderate		C2: Medium hard to soft, black/gray and pink mottled, moderately weathered, medium to coarse grained, altered GRANITIC GNEISS. Primary joints low angle, close to very closely spaced, rough, planar to undulating, disintegrated to decomposed, commonly iron stained, tight. Secondary joints moderate to high angle, close to moderately close, rough, planar, decomposed to disintegrated, commonly iron stained, tight, solid core pieces can be broken by hand.
	3							
	3							
	3							
	3	C3	54.0 59.0	60 47	100 78			
55	3					Fresh		C3: Very hard, fresh, gray and pink mottled, medium to very coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, close to moderately close, smooth to rough, planar, discolored with manganese staining, tight. Secondary joints moderate to high angle, close to moderately close, smooth, planar, discolored with manganese, tight.
	5							
	5							
	5						-48.2 59.0	BOTTOM OF EXPLORATION 59.0 FT
60								
65								
70								
75								

H+A_CORE+WELL-09 HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-2

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start January 3, 2018
Finish January 3, 2018
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation 10.9
Datum NAVD88
Location N 2730218.3, E 861548.2

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW	S	-	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4	1 3/8	-	Bit Type: Roller Bit
Hammer Weight (lb)	Spin/300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: PW Spin 29', HW Drive 39'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.1	-BITUMINOUS CONCRETE-										
				GP	0.8	-COARSE GRAVEL BASE-										
	6 51 22 18	S1 12	1.0 3.0	SP	9.9 1.0	Very dense gray brown to light brown poorly graded SAND (SP), mps 0.8 in., no structure, no odor, frozen		10		5	80	5				
	7 6 5 4	S2 7	4.0 6.0	SP		Medium dense light gray brown poorly graded SAND (SP), mps 0.8 in., no structure, no odor, moist		10		5	80	5				
5						-FILL-										
	7 6 3 3	S3 5	9.0 11.0	SP		Loose tan poorly graded SAND (SP), mps 0.8 in., no structure, no odor, wet		10	5	5	75	5				
10																
	9 25 20 18	S4 6	14.0 16.0	SP		Dense gray brown poorly graded SAND with gravel (SP), mps 1.0 in., no structure, no odor, wet	5	15	5	5	65	5				
15																
					-7.6	Note: Drill action and wash water change at 18.5 ft.										
					18.5											
	7 1	S5 5	19.0 21.0	OL/ OH		Soft dark brown to black ORGANIC SILT (OL/OH), mps 0.05 in., no structure, moderate hydrogen sulfide odor, wet					5	95	N	L	N	
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
1/2/18	1415	0.25	--	13.2	9.32*

*Water level not stabilized

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 43.5
Rock Cored (ft) --
Samples 9S

Boring No. BB-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED\40991-005-TB.GPJ Aug 27, 24

HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-2
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	2 2					-ORGANIC DEPOSITS-										
	2 10 12 10	S6 15	24.0 26.0	OL/ OH ML	-13.6 24.5	S6, 24.0-24.5 ft: Similar to above S6, 24.5-26.0 ft: Medium dense light gray SILT (ML), mps 0.05 in., no structure, no odor, wet						100	R	L	N	
25						-GLACIOLACUSTRINE DEPOSITS-										
					-17.1 28.0	Note: Drill action indicates occasional cobbles.										
	24 18 18 20	S7 11	29.0 31.0	SM		Dense gray silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet		15	5	10	55	15				
30						-GLACIOFLUVIAL DEPOSITS-										
						Note: Drill action indicates occasional cobbles.										
	26 62 120/2"	S8 10	34.0 35.1	SM	-23.6 34.5	Very dense gray and red brown mottled silty SAND with gravel (SM), mps 0.8 in., relic bedrock structure, no odor, wet		15	15	25	25	20				
35						-COMPLETELY WEATHERED BEDROCK-										
						Note: 1.2-ft cobble.										
	13 17 21 100/0"	S9 10	39.0 40.5	SM		Dense gray and red brown silty SAND with gravel (SM), mps 0.8 in., relic bedrock structure, no odor, wet		15	15	25	25	20				
40						Note: Advance roller bit to 43.5 ft with consistent drill action and cuttings.										
					-32.6 43.5	BOTTOM OF EXPLORATION 43.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-2

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-3

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start March 28, 2018
Finish March 30, 2018
Driller J. Bierholm
H&A Rep. D. Palleiko
Elevation -17.3
Datum NAVD88
Location
N 2730283.8
E 861557.1

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW/NW	S	--	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	4/3	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	Spin/300	140	-	Casing: HW Drive 8', NW Spin 12.5'
Hammer Fall (in.)	24	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	14 18 17 17	S1* 14	0.0 2.0	SM		Note: 29.0 ft bridge deck to river bottom. Dense black fading to tan poorly graded silty SAND with gravel (SM), mps 1.2 in., no structure, no odor, wet		15	12	22	28	23				
	19 89 19 17	S2 11	2.0 4.0	SP		Very dense tan to slight brown poorly graded SAND with gravel (SP), mps 1.2 in., no structure, no odor, wet -FLUVIAL DEPOSITS-	5	15		20	55	5				
5	34 18 13 13	S3* 16	4.0 6.0	SM		Dense tan to light brown poorly graded silty SAND with gravel (SM), mps 1.2 in., no structure, no odor, wet	11	16	11	16	21	25				
	22 100/1"	S4 7	6.0 8.0	SP	-23.9 6.6	Very dense light brown poorly graded SAND (SP) with gravel, mps 1.2 in., no structure, no odor, wet TOP OF WEATHERED BEDROCK	5	15		20	55	5				
					-25.3 8.0	Cobble from 6.6-8.0 ft.										
	17 18 65 92	S5* 16	8.0 10.0	SM		Very dense red brown to brown silty SAND with gravel (SM), mps 1.2 in., occasional pocket showing relic bedrock structure, no odor, wet -COMPLETELY WEATHERED BEDROCK-		24	13	19	23	21				
10	100/3"	S6 3	10.0 10.3			Completely weathered bedrock above 10.3 ft. Apparent moderately weathered bedrock below 10.3 ft. Note: Set 3-in. casing to 12.5 ft.	15	15	20	25	20	5				
					-29.8 12.5	SEE CORE BORING REPORT FOR ROCK DETAILS										
15																
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/29/18	0915	18	41.5	53.5	10.25
3/30/18	0915	18	52.0	57.0	8.94
3/30/18	1200	0.25	57.0	67.0	12.4

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 12.5
Rock Cored (ft) 25.5
Samples 6S, 6C

Boring No. BB-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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CORE BORING REPORT

Boring No. **BB-3**
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	7	C1	12.5 15.5	27 6	75 17	Slight	-29.8 12.5	C1 and C2: Very hard, slightly weathered gray and red brown, aphanitic to very coarse grained, rehealed QUARTZ BRECCIA. Massive. Primary joints low angle, close to very close, rough, planar to slightly undulating, discolored with iron staining, tight. Secondary joints high angle, close to very close, rough, planar to undulating, discolored with iron staining, tight. Breccia clasts prone to break free of quartz matrix causing frequent core jams, frequent vugs and pits up to 3/4" across, with iron staining, total water loss while coring.
	NR							
	NR							
15	4	C2	15.5 19.5	47 30	98 63	Slight		-BEDROCK- (FAULT ZONE BRECCIA)
	5							
	4							
	4							
	Jam	C3	19.5 24.5	41 17	68 28	Slight		C3: Very hard to hard, gray to red brown, slightly weathered, aphanitic to very coarse grained QUARTZ BRECCIA. Massive. Primary joints low angle, very close, rough, undulating, discolored with iron staining, tight. Secondary joints high angle, close to very close, rough, undulating, discolored with iron staining, tight.
20	2							
	2							
	2							
	3							
	3	C4	24.5 28.0	27 10	64 24	Slight to Moder-ate		C4: Very hard to hard, gray, slightly weathered, aphanitic to very coarse grained QUARTZ BRECCIA. Massive. Primary joints low angle, very close to closely spaced, rough, undulating, discolored with iron staining and limonite coating, open to tight. Secondary joints high angle, close to very closely spaced, rough, undulating, iron stained and limonite coated, open to closed. Interconnected vugs and pits create a void space of about 15% in rock core.
25	NR							
	NR							
	NR							Note: Hole collapsed between core runs. Advanced 3-in. casing to 28.0 ft to resume coring. Total water loss while advancing casing. Advanced roller bit to 28.0 ft to clear out debris from coring advancement.
	4	C5	28.0 33.0	53 26	88 43	Slight to Moder-ate		C5: Moderately hard, gray, slightly weathered, aphanitic to fine grained, hydrothermally altered GRANITIC GNEISS/BRECCIA. Primary joints low angle, extremely close to closely spaced, rough, planar to undulating, discolored with iron staining, commonly quartz healed. Secondary joints high angle, closely spaced, rough, undulating, discolored with iron staining and limonite coating, tight to open, highly weathered pockets, quartz veins reduced quantity of recovery.
	4							
30	Jam							
	3							
	4							
	4	C6	33.0 38.0	60 51	100 85	Slight		C6: Moderately hard to hard, mottled gray green and maroon, slightly weathered, aphanitic to very coarse grained, rehealed BRECCIA. Massive. Primary joints low angle, very close to moderately close, rough, planar, discolored to disintegrated, iron stained, tight. Secondary joints high angle, close, rough, undulating, discolored with iron staining, occassionally limonite coated, tight.
	4							
35	4							
	4							
	4						-55.3 38.0	BOTTOM OF EXPLORATION 38.0 FT
	4							
40								
45								

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TEST BORING REPORT

Boring No. BB-4

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start March 12, 2018
Finish March 15, 2018
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation -18.0
Datum NAVD88
Location N 2730277.1, E 861599.9

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	--	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: PW Spin 0.8', HW Drive 12.7', NW Spin 15'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	1/12 1 1	S1* 4	0.0 2.0	SW-SM		Note: 29.8 ft bridge deck to river bottom. Very loose black well graded SAND with silt and gravel (SW-SM), mps 1.2 in., no structure, no odor, wet	5	28	23	32	8	4				
	2 12 12 58	S2 12	2.0 4.0		-21.0	-FLUVIAL DEPOSITS-										
				SW	3.0	S2: Medium dense black fading to tan well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	10	15	15	30	20	10				
	26 28 34 25	S3* 14	4.0 6.0	SW		Very dense yellow brown well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	17	22	10	15	20	16				
5						-COMPLETELY WEATHERED BEDROCK-										
	22 20 24 23	S4 14	6.0 8.0	SW		Dense yellow brown well graded SAND with gravel (SW), mps 1.2 in., no odor, wet, granular structure resembles weathered bedrock (grus).	10	15	15	30	20	10				
	33 61 34 26	S5 8	8.0 10.0	SW		Very dense yellow brown well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	10	15	15	30	20	10				
10	28 25 18 100/2	S6* 15	10.0 11.7	SM		Dense yellow brown silty SAND with gravel (SM), mps 1.2 in., no structure, no odor, wet	5	26	11	18	19	21				
					-30.7 12.7	Note: Casing Refusal at 12.7 ft. Drill action indicates top of harder bedrock. Spin casing to 15.0 ft to begin core. -BEDROCK-										
15						SEE CORE BORING REPORT FOR ROCK DETAILS										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/18	0945	44	40.5	40.5	21.75*
3/15/18	1400	0.25	45.0	50.0	13.10

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 15.0
Rock Cored (ft) 14.5
Samples 6S, 3C

Boring No. BB-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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CORE BORING REPORT

Boring No. **BB-4**
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weathering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
15	4	C1	15.0	59	98	Slight		C1: Hard to moderately hard, slightly weathered, pink white and gray, medium to very coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, close to moderately spaced, rough, planar, discolored with iron staining and disintegrated, tight to open, frequent quartz veins intact along primary joints with vugs and "cocks comb" structure evident up to 3 in. thick, fine grained terminated quartz crystals common in vugs up to 1/2 in. deep. Quartz veins intrude zones of brecciated bedrock. Total water loss while coring.
	3		20.0	45	75			
	3							
	3							
	3							
20	2	C2	20.0	54	100	Slight		C2: Similar to above, except quartz veins up to 9 in. thick. Quartz veins intrude zones of brecciated bedrock.
	2		24.5	47	87			
	4							-BEDROCK-
	11							
	10							
25	4	C3	24.5	60	100	Slight		C3: Hard to soft, slightly to completely weathered, pink white and gray, moderate to very coarse grained GRANITIC GNEISS. Massive. Primary joint low angle, close to moderately spaced, rough, planar, discolored to decomposed, tight to open, frequent quartz veins intrude along primary joints up to 7 in. thick, fine grained terminated quartz crystals common in vugs up to 1/2 in. deep, "cocks comb" structure. Quartz veins intrude zones of brecciated bedrock. Total water loss while coring. From 26.7 to 27.5 ft: Zone of highly fractured "grus-like" decomposed GNEISS.
	4		29.5	36	60			
	2					Comp-lete		
	3					Slight		
	NR						-47.5	
30							29.5	BOTTOM OF EXPLORATION 29.5 FT
								Note: Hole collapsed to 20.0 ft upon removal of core barrel.
35								
40								
45								
50								

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TEST BORING REPORT

Boring No. BB-5

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start December 26, 2017
Finish December 26, 2018
Driller T. Tucker
H&A Rep. D. Warren
Elevation 11.0
Datum NAVD88
Location
N 2730342.7
E 861608.6

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW	S	-	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4	1 3/8	-	Bit Type: Roller Bit Drill Mud:
Hammer Weight (lb)	Spin	140	-	Casing: PW Drive 10', HW Drive 13'
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.5	-ASPHALT ROADWAY-										
					0.5	-TAR/GRAVEL MACADAM ROADBASE-										
				SM	10.2	Very dense dark brown silty SAND with gravel (SM), mps 1.5 in., no structure, no odor, dry	5	10	10	20	40	15				
	26 30 16 12	S1 20	1.0 3.0	SP-SM	0.8 9.8 1.2	Dense tan poorly graded SAND with silt (SP-SM), mps < 1mm, no structure, no odor, dry					90	10				
	12 16 17 10	S2 12	3.0 5.0	SP-SM		Similar to above. Spoon bent on edge of boulder. Drilled through boulder from approximately 3.5-5.0 ft.					90	10				
5						- FILL -										
						Note: Drilled through edge of boulder from 7.0-9.0 ft.										
	12 29 10 10	S3 5	8.0 10.0	SW		Dense gray well graded SAND with gravel (SW), mps 1.5 in., no structure, no odor, wet, with cobbles	15	25	30	20	10					
10						Note: Casing bent when advanced through numerous boulders in Fill from approximately 3.5-9.0 ft. Cored approximately 12.0 inches of steel infused slag from 12.0-13.0 ft. Casing broke. Abandoned location after retrieving broken pipe. Multiple boulders >/= 2.0 ft noted in open borehole after pulling casing.										
					-2.0 13.0	BOTTOM OF EXPLORATION 13.0 FT										
						Note: Moved rig 4.5 ft northeast and advanced boring of record. See log BB-5A.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 13.0
Rock Cored (ft) --
Samples 3S

Boring No. BB-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-5A

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 3
Start December 27, 2017
Finish December 28, 2017
Driller T. Tucker
H&A Rep. D. Warren
Elevation 11.0
Datum NAVD88
Location
N 2730342.7
E 861608.6

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	Spin/140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: PW Spin 20', HW Drive 44', NW Spin 48.5'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.2	-ROADWAY-										
					0.8	Boring located 4.5 ft northeast of trial refusal hole BB-5. See log BB-5 for overburden details. 0.0-13.0 ft: Drill action indicates coarse granular fill with cobbles. Note: Advanced borehole without sample to depth of exploration in companion hole BB-5.										
5																
10																
	7 5 3 2	S1 4	13.0 15.0	SW		Loose gray well graded SAND with gravel (SW), mps 1.5 in., no structure, no odor, wet	15	20	40	20	5					
15						-FILL- Note: Drilled through WOOD from approximately 15.5-16.5 ft. Coarse granular Fill noted below wood from approximately 16.5-17.5 ft.										
					-7.0											
	10 3 5 2	S2 9	18.0 20.0	SM	18.0	Loose brown (organic) silty SAND (SM), mps < 1mm, no structure, organic odor, wet -ORGANIC DEPOSITS-					85	15				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/28/17	0930	*Trapped	44.0	44.6	9.8*

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	48.5
Rock Cored (ft)	5.0
Samples	7S, 1C

Boring No. BB-5A

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-5A
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20						-ORGANIC DEPOSITS-										
					-11.0 22.0											
	4 8 10 11	S3	24.0 26.0	SP		Medium dense light gray to brown poorly graded SAND (SP), mps 0.25 in., no structure, no odor, wet			5	20	75					
25						-MARINE/GLACOFLUVIAL DEPOSITS-										
					-17.0 28.0											
	21 20 19 18	S4 8	29.0 31.0	SW		Dense brown well graded SAND (SW), trace gravel, mps 1.0 in., no structure, no odor, wet	5	5	20	40	30					
30																
	19 28 18 13	S5 9	34.0 36.0	SP		Dense brown poorly graded SAND with gravel (SP), mps 1.5 in., no structure, no odor, wet	5	10	5	5	75					
35						-GLACIOFLUVIAL DEPOSITS-										
	21 15 13 13	S6 8	39.0 41.0	GW		Dense brown well graded GRAVEL with sand (GW), mps 1.5 in., no structure, no odor, wet	25	30	20	10	15					
40																
					-32.5 43.5	TOP OF BEDROCK 43.5 FT										
	47 60/1"	S7 7	44.0 44.6	SW-SM		Very dense light gray well graded SAND with silt and gravel (SW-SM), mps 0.5 in., distinct granitic bedrock structure, wet. Sample consists of severely weathered, decomposed GRANITE										
45						-WEATHERED BEDROCK / GRUS-										
	50/0"	NR	48.0			Advanced borehole with button bit to 48.0 ft. Drill action and cuttings observed indicate weathered GRANITE to approximately 47.0 ft, harder bedrock at approximately 47.0 ft.										
			48.0		-37.5 48.5	Attempted spoon sample of weathered rock at 48.0 ft. Spoon refusal, no recovery. Spun NW casing to 48.5 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-5A

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CORE BORING REPORT

Boring No. **BB-5A**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
50	3 3 3 3 3	C1	48.5 53.5	58 40	97 67	Slight to Moder-ate	-37.5 48.5	C1: Hard, slightly to moderately weathered, pink-gray to brown, coarse to fine-grained GRANITE. Weak foliation dipping at high angles. Joints horizontal to dipping at high angles, occasionally vertical. Joints very close to moderately close, rough, planar, discolored and oxidized to decomposed, tight to open, with frequent silt infillings. -BEDROCK-
							-42.5 53.5	BOTTOM OF EXPLORATION 53.5 FT
55								
60								
65								
70								
75								
80								

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TEST BORING REPORT

Boring No. BB-6

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 3
Start December 18, 2017
Finish December 19, 2017
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation 10.9
Datum NAVD88
Location N 2730319.3, E 861635.4

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	Spin	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: PW Spin 39', HW Spin 44', NW Spin 47'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.1	-BITUMINOUS CONCRETE PAVING-										
	21 75/3"	S1 8	1.0 1.8	SP	0.8	Very dense light brown poorly graded SAND (SP), mps 0.8 in., no structure Note: Concrete encountered at 1.6 ft, moved 2 ft east. Rebar noted by drill action.		10		35	50	5				
5	3 4 3 3	S2 5	4.0 6.0	SW		Loose light brown well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	10	10	20	25	35					
						-FILL-										
10	5 7 6 4	S3 6	9.0 11.0	SW		Medium dense light brown well graded SAND (SW), mps 0.8 in., no structure, no odor, wet Note: Cobbles from 11.0 to 14.0 ft.	10	10	35	30	15					
15	17 29 23 23	S4 8	14.0 16.0	SW		Very dense light brown well graded SAND (SW), mps 1.0 in., no structure, no odor, wet	10	10	35	30	15					
20	13 17	S5 12	19.0 21.0	SP		Medium dense light brown poorly graded SAND with gravel (SP), mps 0.8 in., no structure, no odor, wet	10	20	45	15	10					

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/19/17	0900	18	40.5	40.0	9.71

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 47.0
Rock Cored (ft) 10.0
Samples 9S, 2C

Boring No. BB-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-6
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	13 7					-FILL-										
						Note: Cobble/Boulder encountered from 22.5 to 23.8 ft.										
					-12.9 23.8											
	9 11 8 6	S6 10	24.0 26.0	SP		Medium dense light gray with black bands poorly graded SAND (SP), mps 0.05 in., frequent interbeds of organic silty SAND up to 0.5 in. thick				5	90	5				
25						-ORGANIC / ESTUARINE DEPOSITS-										
					-15.1 26.0	Note: Wash water color change at 26.0 ft, very weak hydrogen sulfide odor.										
						-ORGANIC DEPOSITS-										
	1 1 1 1	S7* 12	29.0 31.0	OL/ OH		Very soft brown ORGANIC SILT with sand (OL/OH), mps 0.01 in., increasing fine sand with depth, no odor, wet, organic content = 3.1%			1	2	20	77	S	L	N	
30						Note: Drill action change at 33.5 ft.										
					-22.6 33.5											
	37 26 19 18	S8 1	34.0 36.0	SW		Dense light brown well graded SAND (SW), mps 0.5 in., no structure, no odor, wet		5	20	30	40	5				
35						-GLACIOFLUVIAL DEPOSITS-										
	25 18 17 11	S9 6	39.0 41.0	GP		Dense light brown poorly graded GRAVEL with sand (GP), mps 0.8 in., no structure, no odor, wet		70	15	10	5					
40						Note: Drill action change at 44.3 ft. TOP OF BEDROCK										
	130/4"	NR 0	44.0 44.3		-33.4 44.3	SEE CORE BORING REPORT FOR ROCK DETAILS										
45																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-6

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CORE BORING REPORT

Boring No. **BB-6**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
						Fresh	-33.4 44.3	TOP OF BEDROCK 44.3 FT
45								
	5	C1	47.0 52.0	60 53	100 88	Fresh		C1: Very hard, fresh, pink and gray, medium to very coarse grained GRANITIC GNEISS. Primary joints low angle, closely to moderately spaced, rough, planar to slightly undulating, iron stained to disintegrated/decomposed, tight. Secondary joints moderate angle, moderately spaced, smooth, planar, fresh, tight to quartz healed, occasionally epidote coated and vuggy.
	5							
	6							
50	6							-BEDROCK-
	5							
	6	C2	52.0 57.0	56 38	93 63	Fresh		C2: Very hard to moderately hard, fresh to slightly weathered, pink and gray, medium to very coarse grained GRANITIC GNEISS. Primary joints low angle, close to moderately spaced, rough, planar, discolored to disintegrated, tight, commonly quartz lined, occasionally healed, iron stained halos extending 1.0 to 2.0 in. into adjacent rock mass. Secondary joints high angle to vertical, moderately spaced, smooth, planar, discolored with iron staining to disintegrated, commonly quartz lined with micaceous appearing sheets of quartz.
	6							
	3					Slight		
55	3							
	6					Fresh		
							-46.1 57.0	BOTTOM OF EXPLORATION 57.0 FT
60								
65								
70								
75								

H+A_CORE+WELL-09 HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-7

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 3
Start December 12, 2017
Finish December 15, 2017
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation 10.8
Datum NAVD88
Location N 2730640.2 E 861866.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	-	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	-	Bit Type: Roller Bit
Hammer Weight (lb)	Spin	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: PW Spin 24', HW Spin 44', NW Spin 60.25'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.1	-BITUMINOUS CONCRETE-										
	8 30 20 12	S1 15	1.0 3.0	SW	0.8	Very dense gray fading to light brown then tan well graded SAND (SW), mps 0.8 in., pockets of poorly graded sand, no odor, moist		10	15	30	40	5				
	14 11 10 11	S2 14	4.0 6.0	SP		Medium dense tan poorly graded SAND (SP), mps 0.8 in., no structure, no odor, moist		10		10	75	5				
5						-FILL-										
	6 15 12 6	S3 5	9.0 11.0	SP		Medium dense tan to light brown with gray poorly graded SAND (SP), mps 0.5 in., no structure, no odor, wet		10		10	75	5				
10																
	10 6 10 12	S4 5	14.0 16.0	SW		Medium dense tan well graded SAND (SW), mps 1.0 in., no structure, no odor, wet		10	15	30	40	5				
15																
	5 1/12	S5 5	19.0 21.0		-8.7 19.5	-ORGANIC DEPOSITS-										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/15/17	1415	0.5	--	11.5	9.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 60.25
Rock Cored (ft) --
Samples 13S

Boring No. BB-7

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-7
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	- 1			OL/ OH		Very soft tan to dark brown ORGANIC SILT (OL/OH), mps 0.5 in., single layer of sandy SILT 6 in. thick, weak to moderate hydrogen sulfide odor, mussel shells		5			5	90	S	L	N	
						-ORGANIC DEPOSITS-										
					-12.2											
					23.0											
	5 6 5 8	S6 6	24.0 26.0	SP		Medium dense gray poorly graded SAND (SP), mps 0.05 in., no structure, no odor, wet				10	90					
25						-GLACIOLACUSTRINE DEPOSITS-										
					-17.2											
					28.0											
	7 4 4 7	S7 10	29.0 31.0	ML		Loose tan to light brown SILT with sand (ML), mps 0.05 in., no structure, no odor, wet					15	85	R	L	N	
30						-GLACIOLACUSTRINE DEPOSITS-										
	5 8 10 8	S8 11	34.0 36.0	ML		Medium dense tan to light brown SILT with sand (ML), mps 0.05 in., no structure, no odor, weak					20	80	R	L	N	
35					-27.2											
					38.0											
	9 10 12 12	S9 2	39.0 41.0	SM		Medium dense tan to light brown silty SAND with gravel (SM), mps 1.2 in., no structure, no odor, wet Note: Lost 5 ft of HW (4") casing at 40 to 45 ft.	10	15	15	25	20	15				
40						-GLACIOFLUVIAL DEPOSITS-										
	12 10 8 13	S10 3	44.0 46.0	SP		Medium dense tan poorly graded SAND with gravel (SP), mps 0.5 in., no structure, no odor, wet		15	5	25	50	5				
45																
	6	S11	49.0	SW		Loose light brown well graded SAND with gravel (SW), mps 1.0 in., no		15	20	25	35	5				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-7

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TEST BORING REPORT

Boring No. BB-7
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50	6 4 3	4	51.0			structure, no odor, wet										
						-GLACIOFLUVIAL DEPOSITS-										
55	6 14 19 43	S12 11	54.0 56.0	SW		Similar to above, except dense, mps 1.2 in.	10	10	20	25	30	5				
						Note: Encountered cobble from 56.5 to 57.0 ft.										
60	32 75 120/3"	S13 10	59.0 60.3	SW	-49.5 60.3	Very dense light brown well graded SAND with gravel (SW), mps 1.0 in., no structure, no odor, wet Note: Spoon refusal at 60.3 ft. Bedrock chips in tip consistent with bedrock observed at BB-8. POSSIBLE TOP OF BEDROCK AT 60.3 FT BOTTOM OF EXPLORATION 60.3 FT	10	10	20	25	30	5				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-7

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TEST BORING REPORT

Boring No. BB-8

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 4
Start November 28, 2017
Finish December 1, 2017
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation 11.7
Datum NAVD88
Location N 2730615.9 E 861891.4

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	Spin	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: PW Spin 30', HW Spin 51', NW Spin 63'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					11.0	-BITUMINOUS CONCRETE PAVEMENT-										
					0.8											
	15 23 50/0"	S1 9	1.0 2.0	SM		Very dense gray fading to light brown silty SAND (SM), mps 0.5 in., no structure, no odor, moist Note: Encountered granite block from 2.0-3.0 ft.		10	5	5	65	15				
	3 4 4 3	S2 6	4.0 6.0	SW		Loose brown well graded SAND (SW), mps 0.8 in., no structure, no odor, moist	5	5	15	30	40	5				
5						-FILL-										
	11 7 6 9	S3 3	9.0 20.0	GW		Medium dense light brown well graded GRAVEL with sand (GW), mps 1.2 in., no structure, no odor, wet Note: Encountered granite obstruction from 11.5-13.2 ft.	45	25	5	10	15					
10																
15	3 3 4 8	S4 1	14.0 16.0	SW		Loose light brown well graded SAND (SM), mps 0.3 in., no structure, no odor, wet Note: Encountered cobbles from 16.5-17.3 ft. Note: Encountered cobbles from 17.5-18.5 ft.										
	8 12	S5 9	19.0 21.0	SW		Medium dense light gray to light brown well graded SAND (SM), mps 0.5 in., no structure, no odor, wet	5	5	20	30	35	5				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
11/30/17	0920	18	51.0	51.0	5.11
12/1/17	0925	18	63.0	68.0	10.5
12/1/17	1210	0.2	63.0	77.0	12.12

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 67.0
Rock Cored (ft) 10.0
Samples 13S, 3C

Boring No. BB-8

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-8
File No. 40991-005
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	12 14					-FILL-										
					-10.3 22.0	Note: Wash water change at 22.0 ft.										
	5 5 6 3	S6 11	24.0 26.0	SP		Medium dense gray poorly graded SAND (SP), mps 0.10 in., no structure, no odor, wet				5	95					
25						-GLACIOLACUSTRINE DEPOSITS-										
					-16.3 28.0											
	2 5 6 12	S7 12	29.0 31.0	ML		Medium dense gray to olive gray SILT (ML), mps 0.05 in., no structure, no odor, wet						100	R	L	N	
30						-GLACIOLACUSTRINE DEPOSITS-										
	17 9 17 22	S8 1	34.0 36.0	ML		Medium dense olive gray sandy SILT (ML), mps 0.3 in., no structure, no odor, wet		15	5	10	15	55				
35																
	22 17 15 18	S9 10	39.0 41.0	SW		Dense light brown well graded SAND with gravel (SW), mps 1.2 in., frequent fining upward beds with gravel pieces, no odor, wet	10	15	15	25	30	5				
40						Note: Occasional gravel/cobbles.										
					-32.3 44.0											
	14 16 126	S10 9	44.0 45.5	ML		Very dense light brown sandy SILT (ML), mps 1.2 in., weakly bonded, no odor, moist					30	70				
45						-GLACIAL TILL- (FLOW TILL)										
					-36.3 48.0											
						Note: Occasional cobbles and boulders up to 2.0 ft thick										
						-GLACIOLACUSTRINE DEPOSITS-										
	11	S11	49.0	ML		Medium dense tan sandy SILT (ML), mps 0.05 in., no structure, no odor,					30	70	M	L	N	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-8

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TEST BORING REPORT

Boring No. BB-8
File No. 40991-005
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50	16 14 22	13	51.0			wet -GLACIOLACUSTRINE DEPOSITS-										
					-39.3 51.0	Note: Occasional cobbles/boulders.										
55	31 121 42 47	S12 15	54.0 56.0	SM		Very dense gray brown to gray silty SAND (SM), mps 1.2 in., weakly bonded, no odor, wet	10			5	70	15				
						-GLACIAL TILL- Note: Occasional cobbles and boulders up to 18.0+ in.										
60	29 41 49 80	S13 14	59.0 61.0	SM		Very dense tan silty SAND (SM), mps 1.0 in., weakly bonded, no odor, moist	10			5	70	15				
						Note: Drill action change. Bit advances hard and smooth.										
					-49.8 61.5	TOP OF BEDROCK AT 61.5 FT Note: Advanced roller bit to 67.0 ft, consistent drill action, set NW casing to 63.0 ft.										
65																
						SEE CORE BORING REPORT FOR ROCK DETAILS										
70																
75																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-8

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CORE BORING REPORT

Boring No. **BB-8**
File No. 40991-005
Sheet No. 4 of 4

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	5	C1	67.0 68.0	3 0	25 0	Fresh		C1: Core jam at 68.0 ft. Advanced roller bit to 68.0 ft to clear borehole.
	4	C2	68.0 72.0	48 46	100 96	Fresh		C1-C2, 67.0-72.0 ft: Very hard, fresh, very coarse to fine grained GRANITIC GNEISS. Massive. Primary joints low angle, moderately close, rough, planar, discolored with iron staining, tight. Secondary joints moderately dipping, moderately spaced, rough, planar, fresh, tight.
	4							
70	5							
	4							-BEDROCK- (GRANITIC GNEISS)
	5	C3	72.0 77.0	44 34	73 57	Fresh		
	6							C3: Very hard, fresh, very coarse to fine grained GRANITIC GNEISS. Massive. Primary joints low angle, moderately close to widely spaced, rough, planar, fresh, tight. Secondary joints vertical, widely spaced, rough, planar, fresh, tight.
	8							
75	21							
	10						-65.3 77.0	BOTTOM OF EXPLORATION 77.0 FT
80								
85								
90								
95								
100								

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TEST BORING REPORT

Boring No. BB-9

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 3
Start March 20, 2018
Finish March 27, 2018
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation -9.8
Datum NAVD88
Location N 2730717.7 E 861931.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: PW Spin 8', HW Drive 42.5', NW Spin 46.5'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	12 7 8 14	S1* 10	0.0 2.0	GP-GM		Bridge deck is 0.35 ft Bituminous Pavement and 0.65 ft Concrete. 21.5 ft bridge deck to river bottom. Medium dense black poorly graded GRAVEL with silt and sand (GP-GM), mps 1.2 in., no structure, no odor, wet	31	19	7	14	19	10				
	22 11 9 5	S2 6	2.5 4.5	SM		Medium dense black silty SAND with gravel (SM), mps 1.2 in., no structure, no odor, wet	10	15	15	20	20	20				
						-FLUVIAL DEPOSITS-										
5	1 3 2 5	S3* 8	4.5 6.5	SP-SM		Loose black poorly graded SAND with silt and gravel (SP-SM), mps 1.2 in., no structure, no odor, wet, trace shell fragments		24	14	27	25	10				
	5 3 4 2	S4* 10	6.5 8.5	ML	-16.3 6.5	Loose olive brown SILT (ML), mps 0.1 in., no structure, no odor, wet					5	95	R	L	N	
						-GLACIOLACUSTRINE DEPOSITS-										
	1 2 2 2	S5 7	8.5 10.5	ML		Very loose olive brown SILT (ML), mps 0.05 in., occasional layers of lean clay up to 1/2 in. thick, no odor, wet					10	90	R	L	N	
10	4 2 3 3	S6 8	10.5 12.5	ML		Loose olive brown SILT (ML), mps 0.05 in., no structure, no odor, wet					5	95	R	L	N	
	2 3 4 6	S7* 20	12.5 14.5	ML		Similar to above Note: * indicates sample gradation based on geotechnical laboratory index testing.					3	97	R	L	N	
15					-25.3 15.5	Note: Drill action indicates change at 15.5 ft. Note: Casing advancement slows.										
	24 20 14 10	S8 7	17.5 19.5	SM		Dense light brown to tan silty SAND (SM), mps 1.2 in., no structure, no odor, wet	10		15	20	40	15				
20						-GLACIOFLUVIAL DEPOSITS-										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/26/18	0930	66	58.25*	58.15*	11.76*
3/27/18	1300	0.25	58.25*	58.25*	12.93*

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 46.5
Rock Cored (ft) 15.25
Samples 13S, 4C

Boring No. BB-9

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-9
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20						-GLACIOFLUVIAL DEPOSITS-										
						Note: Occasional cobble.										
	9 8 5 9	S9 6	22.5 24.5	SW-SM		Medium dense light brown well graded SAND with silt and gravel (SW-SM), mps 1.0 in., no structure, no odor, wet		15	15	20	40	10				
25																
	15 17 20 22	S10 19	27.5 29.5	ML	-37.3 27.5	Dense tan SILT (ML), mps 0.01 in., no structure, no odor, wet					5	95	R	L	N	
30						-GLACIOLACUSTRINE DEPOSITS-										
	16 20 25 24	S11 15	32.5 34.5			Dense tan SILT (ML), mps 0.01 in., no structure, no odor, wet					5	95	R	L	N	
35						Note: Casing advancement slows.										
					-45.8 36.0	Note: Casing advancement slows.										
	100/5"	S12 4	37.5 37.9	SW		Very dense gray well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	5	15	20	25	30	5				
40						-GLACIOFLUVIAL DEPOSITS-										
						Note: Occasional cobble.										
	42 65 100/1"	S13 11	42.5 43.6	SW		Very dense gray well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	5	15	20	25	20	15				
						Note: Drill action change. Rollerbit advances with difficulty for 1.5 ft then completely weathered rock from 45.1-45.6 ft. Rolls hard 45.6-46.5 ft. Set 3-in. casing to 46.5 ft.										
45						TOP OF BEDROCK AT 45.5 FT										
					-55.3 45.5	SEE CORE BORING REPORT FOR ROCK DETAILS										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-9

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CORE BORING REPORT

Boring No. **BB-9**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	4	C1	46.5	60	100	Fresh		C1: Very hard, fresh, gray, pink and grey green speckled, medium to coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, moderately close to widely spaced, rough, planar to undulating, tight, iron stained. Secondary joints high angle, moderately close, rough, planar, discolored with iron staining, tight, poorly developed shear/flow structure in rock mass.
	6		51.5	51	85			
	6							
50	6							Note: Frequent core jams from 51.5-54.8 ft.
	7							-BEDROCK- (GRANITIC GNEISS)
	Jam	C2	51.5	39	98	Fresh		C2: Very hard fresh, gray, pink and gray green speckled, medium to coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, moderately to widely spaced, rough, planar to undulating, iron stained, tight. Secondary joints high angle, moderately close, rough, planar to undulating, fresh, tight.
	4		54.8	35	88			
	NR							
55	11	C3	54.8	60	100	Fresh		C3 and C4: Very hard, fresh, gray, pink and gray green, medium to coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, moderately spaced, rough to occassionally smooth, undulating to planar, discolored with iron staining, tight. Secondary joints high angle, moderately close to very close, rough, undulating, fresh, tight, common calcite or epidote infilled/healed.
	12		59.8	58	97			
	11							
	8							
	8							
60	7	C4	59.8	18	75	Fresh		
	7		61.8	14	58			
							-71.6	
							61.8	BOTTOM OF EXPLORATION 61.8 FT
65								
70								
75								
80								

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TEST BORING REPORT

Boring No. BB-10

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 3
Start March 16, 2018
Finish March 20, 2018
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation -21.2
Datum NAVD88
Location
N 2730664.2
E 861934.6

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: PW Spin 0.8', HW Drive 26', NW Spin
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	1 8 6 5	S1* 8	0.0 2.0	GW-GM		0.8 ft Concrete/Asphalt Bridge Deck. 33.0 ft bridge deck to river bottom. Medium dense gray well graded GRAVEL with silt and sand (GW-GM), mps 1.2 in., no structure, no odor, wet	6	45	17	16	10	6				
					-23.2	-FLUVIAL DEPOSITS-										
	6 9 13 15	S2 10	2.0 4.0	SP-SM	2.0	Medium dense gray to brown poorly graded sand (SP), mps 1.2 in., no structure, no odor, wet	10			25	55	10				
						-GLACIOLACUSTRINE DEPOSITS-										
5	5 7 7 10	S3* 12	4.0 6.0	SM		Medium dense light brown to brown silty SAND with gravel (SM), mps 0.3 in., no structure, no odor, wet	7	10	9	25	33	16				
	8 14 5 6	S4 12	6.0 8.0	SP		Medium dense gray brown to black poorly graded SAND (SP), mps 0.8 in. no structure, no odor, wet										
					-29.2											
	25 46 41 53	S5* 16	8.0 10.0	GM	8.0	Very dense gray silty GRAVEL with sand (GM), no structure, no odor, moist	21	14	8	12	14	31	R	L	N	
10	29 29 21 26	S6 20	10.0 12.0	SP		Very dense tan poorly graded SAND (SP), mps 0.1 in., no structure, no odor, wet		5	5	5	80	5				
						-GLACIOFLUVIAL DEPOSITS-										
						Note: * indicates sample gradation based on geotechnical laboratory index testing.										
15																
	19 16 9 9	S7 11	16.0 18.0	SW		Medium dense gray brown well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	10	15	20	20	30	5				
						-GLACIOFLUVIAL DEPOSITS-										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/19/18	0930	70	26.5	26.5	+22.28
3/20/18	0920	18.5	30.5	45.5	+21.25

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	30.5
Rock Cored (ft)	15.0
Samples	9S, 3C

Boring No. BB-10

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-10
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20					-41.7 20.5	-GLACIOFLUVIAL DEPOSITS-										
	12 23 19 17	S8 19	21.0 23.0	ML		Dense light brown SILT with sand (ML), mps 0.05 in., no structure, no odor, wet				5	15	80	R	L	N	
25						-GLACIOLACUSTRINE DEPOSITS-											
	100/5"	S9 5	26.0 26.5	ML	-47.7 26.5	Very dense gray SILT with gravel (ML), mps 1.2 in., no structure, no odor, wet	30				5	65	R	L	N	
						TOP OF BEDROCK AT 26.5 FT										
						Note: Spoon refusal at 26.5 ft. Spin 3-in. casing through completely WEATHERED BEDROCK from 26.5-28.5 ft as indicated by wash. Set 3-in. casing at 30.5 ft to start C1.										
					-49.7 28.5	TOP OF HARDER BEDROCK AT 28.5 FT										
30					-51.7 30.5	SEE CORE BORING REPORT FOR ROCK DETAILS										
35																
40																
45																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-10

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CORE BORING REPORT

Boring No. **BB-10**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	3	C1	30.5	58	97	Fresh	-51.7	C1: Very hard, fresh, gray black and pink speckled, coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, moderately close to widely spaced, rough, planar to undulating, tight to open, discolored with iron staining. Iron stain halos extend into rock mass. Rock mass shows some shearing of crystal matrix/flow structure poorly developed.
	3		35.5	55	92		30.5	Note: To obtain extra sample for environmental testing and scour analysis, a 3-in sampler was driven over hte same interval following SPT sampling with the 2-in simpler. This was done for the continuous samples in the upper 10-15.0 ft.
	4							-BEDROCK-
	3							(GRANITIC GNEISS)
35	4							
	4	C2	35.5	57	95	Fresh		C2: Very hard, fresh, gray black and pink speckled, coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, closely spaced, rough, planar, discolored with iron staining. Iron stain halos extend into rock mass. Rock mass shows shearing and translocation of crystal matrix as poorly developed flow bands.
	3		40.5	38	63			
	4							
	4							
	4							
40	4	C3	40.5	57	95	Fresh		C3: Very hard, fresh, gray black pink and green speckled, coarse grained GRANITIC GNEISS. Massive. Primary joints low angle, closely spaced, rough, planar, discolored with iron staining, tight. Iron stain halos extend into rock mass. Occasional pods and pockets of epidote. Indistinct flow bands, poorly developed.
	NR		45.5	48	80			
	NR							
	NR							
	NR							
45							-66.7	
							45.5	BOTTOM OF EXPLORATION 45.5 FT
50								
55								
60								
65								

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TEST BORING REPORT

Boring No. BB-11

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 4
Start December 6, 2017
Finish December 12, 2017
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation 10.8
Datum NAVD88
Location N 2730765.5 E 861974.1

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	Spin	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: PW Spin 30', HW Spin 69', NW Spin 71'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.1	-BITUMINOUS CONCRETE PAVEMENT-										
					0.8											
	10 28 14 10	S1 14	1.0 3.0	SW		Dense light brown well graded SAND (SW), mps 1.0 in., no structure, no odor, moist		10	15	30	40	5				
	4 8 8 70	S2 6	4.0 6.0	SP		Medium dense light brown poorly graded SAND with gravel (SP), mps 1.2 in., no structure, no odor, moist	10	15	5	15	50	5				
5						Note: Granite obstruction in Fill from 6.5-8.5 ft.										
	4 16 4 5	S3 3	9.0 11.0	SW		Medium dense light brown well graded SAND with gravel (SW), mps 1.2 in, no structure, no odor, wet	40		15	20	25					
10						-FILL-										
	4 3 1 1	S4 5	14.0 16.0	SW		Very loose light brown well graded SAND (SW), mps 0.3 in., no structure, no odor, wet		5	20	30	45					
15						Note: Wash water color change.										
					-8.2											
	1 1	S5 13	19.0 21.0	PT	19.0	Very soft dark brown fibrous PEAT (PT), mps 0.10 in., fibrous organic mat, moderate hydrogen sulfide odor, wet						100	N	L	N	
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/11/17	0930	64.0	49.0	49.0	7.8

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	71.0
Rock Cored (ft)	10.0
Samples	14S, 3C

Boring No. BB-11

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-11
File No. 40991-005
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	1 1					-ORGANIC DEPOSITS-										
					-12.2 23.0	Note: Drill action and wash water color change at 23.0 ft.										
25	7 12 12 17	S6 11	24.0 26.0	SP		Medium dense tan to light brown poorly graded SAND (SP), mps 0.5 in., slight fining-up sequence, no odor, wet			5	15	75	5				
						-GLACIOFLUVIAL DEPOSITS-										
30	29 14 8 12	S7 5	29.0 31.0	SM		Medium dense light gray silty SAND with gravel (SM), mps 1.2 in., no structure, no odor, wet	5	15	10	25	30	15				
						Note: Occasional cobbles.										
35	7 14 13 14	S8 6	34.0 36.0	SW		Medium dense gray well graded SAND with gravel (SW), mps 0.8 in., no structure, no odor, wet	10	15	25	30	20					
					-27.2 38.0											
40	9 22 24 32	S9 15	39.0 41.0	SP-SM		Dense light brown to tan poorly graded SAND with SILT (SP-SM), mps 0.05 in., increasing silt with depth, no odor, wet					90	10	R	L	N	
						-GLACIOLACUSTRINE DEPOSITS-										
					-32.2 43.0											
45	13 24 24 30	S10 17	44.0 46.0	ML		Dense tan SILT (ML), mps 0.05 in., no structure, no odor, wet					5	95	R	L	N	
						-GLACIOLACUSTRINE DEPOSITS-										
	17	S11	49.0	ML		Dense tan SILT with sand (ML), mps 0.05 in., no structure, no odor, wet					20	80	R	L	N	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-11

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-11
File No. 40991-005
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50	23 24 18	15	51.0													
						-GLACIOLACUSTRINE DEPOSITS-										
55	16 23 36 43	S12 11	54.0 56.0	ML		Very dense tan SILT with sand (ML), mps 0.05 in., no structure, no odor, wet					15	85	R	L	N	
					-47.2	Note: Gravel layer.										
					58.0											
60	20 35 42 25	S13 13	59.0 61.0	SM		Very dense tan silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet		15	10	15	45	15				
						Note: Drill action indicates cobbles from 61.5-62.2 ft.										
						-GLACIOFLUVIAL DEPOSITS-										
65	28 39 40 48	S14 17	64.0 66.0	SM		Very dense tan silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet	5	5	20	15	40	15				
						Note: Drill action indicates top of rock at 69.5 ft.										
						TOP OF BEDROCK AT 69.5 FT										
70					-58.7 69.5	Note: Advance roller bit to 71.0 ft and start C1.										
						SEE CORE BORING REPORT FOR ROCK DETAILS										
75																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-11

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-11**
File No. 40991-005
Sheet No. 4 of 4

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weathering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	6	C1	71.0	48	100	Fresh		C1: Very hard, fresh, pink and gray speckled, medium to very coarse grained GRANITIC GNEISS, occasionally foliated. Primary joints low angle, moderately to widely spaced, rough, planar, iron staining, tight. Secondary joints moderate angle, moderately to closely spaced, rough, planar, iron stained to occasionally disintegrated, tight.
	4		75.0	36	75			
	5							-BEDROCK- (GRANITIC GNEISS)
	4							
75	7	C2	75.0	24	100	Fresh		C2: Very hard, fresh, pink and gray speckled, medium to very coarse grained GRANITIC GNEISS. Massive. Primary joints moderate angle, moderately spaced, smooth, planar to slightly undulating, disintegrated to occasionally iron stained, tight.
	9		77.0	23	96			
	8	C3	77.0	42	88	Fresh to Moderate		C3: Very hard, fresh, moderately weathered, pink and gray speckled, medium to coarse grained GRANITIC GNEISS. Primary joints low angle, moderately spaced, smooth to rough, planar to slightly undulating, decomposed to disintegrated, iron stained, tight. Secondary joints moderate angle, moderately spaced, smooth, planar, disintegrated, limonite and epidote coated, tight.
	6		81.0	26	54			
	6							
80	7							
							-70.2	
							81.0	BOTTOM OF EXPLORATION 81.0 FT
85								
90								
95								
100								
105								

H+A_CORE+WELL-09 HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-12

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 4
Start December 4, 2017
Finish December 5, 2017
Driller C. Bierholm
H&A Rep. D. Palleiko/S. Gately
Elevation 10.7
Datum NAVD88
Location N 2730743.9 E 862002.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4/3	1 3/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	Spin	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: PW Spin 25', HW Spin 62', NW Spin 64'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.0	-BITUMINOUS CONCRETE PAVEMENT-										
	23 120/2"	S1 8	1.0 1.8	SM	0.8	Very dense black fading to brown silty SAND with gravel (SM), mps 1.2 in., no structure, no odor, moist	15	15	10	20	25	15				
						-FILL-										
						Note: Encountered metal obstruction. Moved 2 ft NE.										
5	5 4 2 4	S2 6	4.0 6.0	SW		Loose light brown well graded SAND (SW), mps 0.8 in., no structure, no odor, wet		10	15	30	40	5				
10	6 5 4 3	S3 5	9.0 11.0	SW		Loose light brown to gray well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	10	10	15	25	35	5				
						Note: Drill action change indicates boulders in FILL from 12.0-16.0 ft.										
15	6 13 22 100/1"	S4 9	16.0 17.6	SW		Dense light brown well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, wet	10	15	15	25	35					
						Note: Encountered boulder from 17.6-19.0 ft.										
20	12 6	S5 10	19.0 21.0	SP		Medium dense gray to brown poorly graded SAND (SP), mps 0.10 in., no structure, no odor, wet			5	5	85	5				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/4/17	1300	--	26.0	30.0	8.15

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 62.0
Rock Cored (ft) 5.0
Samples 13S, 1C

Boring No. BB-12

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-12
File No. 40991-005
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	10 10					-FILL-										
						Note: Wash water color change to dark brown.										
					-12.3 23.0											
	3 4 100/2"	S6 7	24.0 25.2	SM		Soft dark brown and light gray organic silty SAND (SM), mps 0.5 in., intermixed with gray SILT (ML), moderate hydrogen sulfide odor, wet			5	25	35	35				
25					-14.5 25.2	-ORGANIC DEPOSITS-										
						Note: Encountered boulder 25.2-29.5 ft.										
						-FILL-										
					-18.8 29.5											
30	12 9 12 13	S7 4	30.0 32.0	SM		Medium dense gray silty SAND (SM), mps 0.2 in., no structure, no odor, wet			5	20	40	35				
						Note: Wash water changes color to red brown.										
	5 11 12 14	S8 9	34.0 36.0	SW		Medium dense red brown well graded SAND with gravel (SW), mps 1.0 in., no structure, no odor, wet	5	15	15	30	30	5				
35						-GLACIOFLUVIAL DEPOSITS-										
					-28.3 39.0											
	11 28 14 10	S9 5	39.0 41.0	SP		Dense tan poorly graded SAND (SP), mps 0.8 in., no structure, no odor, wet		5	5		85	5				
40						-GLACIOLACUSTRINE DEPOSITS-										
	20 33 35 41	S10 20	45.0 47.0	SP		Very dense tan poorly graded SAND (SP), mps 0.05 in., no structure, no odor, wet				5	90	5				
45					-37.3 48.0											
	18	S11	49.0	ML		Dense tan SILT with sand (ML), mps 0.05 in., no structure, no odor, wet					15	85	R	L	N	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-12

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TEST BORING REPORT

Boring No. BB-12
File No. 40991-005
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50	18 22 16	18	51.0			-GLACIOLACUSTRINE DEPOSITS-										
55	13 25 31 35	S12 19	54.0 56.0	ML		Very dense tan SILT with sand (ML), mps 0.05 in., occasional interbeds of silty fine sand up to 6-in. thick, no odor, wet					25	75	R	L	N	
60	14 35 28 35	S13 20	59.0 61.0	ML		Very dense tan SILT with sand (ML), mps 0.3 in., occasional layer of silty SAND up to 1/2-in. thick, no odor, wet Note: Occasional gravel to 62.0 ft. Note: Drill action change.					15	85	R	L	N	
					-51.3 62.0	TOP OF BEDROCK AT 62.0 FT Note: Advanced roller bit to 64.0 ft. Consistent drill action, start C1 at 64.0 ft.										
65						SEE CORE BORING REPORT FOR ROCK DETAILS										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-12

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CORE BORING REPORT

Boring No. **BB-12**
File No. 40991-005
Sheet No. 4 of 4

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
65	3.5	C1	64.0	6	10			C1: Very hard, fresh, very coarse to fine grained GRANITE. Massive, primary joints moderately dipping, rough.
	3.8		69.0	6	10			Note: Poor recovery
	2							-BEDROCK-
	3.3							
	4						-58.3	
							69.0	BOTTOM OF EXPLORATION 69.0 FT
70								
75								
80								
85								
90								
95								

H+A_CORE+WELL-09 HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-13

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 3
Start December 20, 2017
Finish December 21, 2017
Driller C. Bierholm
H&A Rep. D. Palleiko
Elevation 9.5
Datum NAVD88
Location N 2730505.1, E 861795.2

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW	S	-	Rig Make & Model: Mobile Drill B57
Inside Diameter (in.)	5/4	1 3/8	-	Bit Type: Roller Bit
Hammer Weight (lb)	Spin/300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: PW Spin 36', HW Drive 52.5'
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: NA

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					8.8	-BITUMINOUS CONCRETE PAVING-										
	6 18 20 19	S1 14	1.0 3.0	SW	0.8	Dense light brown well graded SAND with gravel (SW), mps 1.2 in., no structure, no odor, moist	5	15	20	25	30	5				
						-FILL-										
5	6 5 4 8	S2 7	4.0 6.0	SP		Loose light brown poorly graded SAND (SP), mps 1.0 in., no structure, no odor, wet		5		15	75	5				
					3.2 6.3											
						Note: Granite obstructions in Fill.										
					0.7 8.8											
10	12 3 5 8	S3 4	9.0 11.0	SW		Loose brown well graded SAND (SW), mps 1.2 in., no structure, no odor, wet		10	20	25	40	5				
						-FILL-										
					-4.5 14.0	Note: Drill action indicates occasional cobbles.										
15	4 1 1 2	S4 5	14.0 16.0	OL/ OH		Very soft black to dark brown ORGANIC SILT with sand (OL/OH), mps 1.0 in., no structure, no odor, 10% wood fragments					15	85	S	L	N	
						ORGANIC DEPOSITS-										
20	3 1	S5 11	19.0 21.0	OL/ OH		Medium stiff dark brown sandy ORGANIC SILT (OL/OH), mps 0.05 in., increasing sand with depth to silty SAND at 20.5 ft, no odor, wet					40	60	R	L	N	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/21/17	0930	18.5	40.5	40.0	4.28

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 58.0
Rock Cored (ft) --
Samples 12S

Boring No. BB-13

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-13
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	4 9			SM	-11.0 20.5						60	40				
	5 3 3 11	S6 8	24.0 26.0	SP		Loose tan to gray poorly graded SAND (SP), mps 0.10 in., no structure, no odor, wet			5	5	90					
25						-GLACIOLACUSTRINE DEPOSITS-										
	3 5 9 14	S7 5	29.0 31.0	ML	-19.5 29.0	Medium dense gray to olive gray SILT (ML), mps 0.05 in., occasional laminae of clay up to 0.05 in. thick, no odor, wet					5	95	R	L	N	
30						-GLACIOLACUSTRINE DEPOSITS-										
	5 7 10 10	S8 10	34.0 36.0	ML		Medium dense gray to olive gray SILT (ML), frequent laminae of lean clay up to 1/8 in. thick, (varves), no odor, wet					5	95	R	L	N	
35					-28.0 37.5	Note: Casing advancement slows at 37.5 ft.										
	19 26 21 21	S9 7	39.0 41.0	SW		Dense olive brown well graded SAND with gravel (SW), mps 0.9 in., no structure, no odor, wet		15	20	30	35					
40						-GLACIOFLUVIAL DEPOSITS-										
						Note: Cobble at 42.0 ft.										
						Note: Cobble from 43.5 to 44.0 ft.										
	9 12 7 5	S10 8	44.0 46.0	SP		Medium dense tan poorly graded SAND with gravel (SP), mps 1.2 in., no structure, no odor, wet	5	15		10	65	5				
45					-37.0 46.5	Note: Casing refusal at 46.5 ft. Note: Cobble encountered from 46.5 to 47.0 ft.										
					-37.5 47.0											
	8	S11	49.0	SW		Dense brown well graded SAND with gravel (SW), mps 1.0 in., pockets of	5	15	10	20	50					

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-13

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TEST BORING REPORT

Boring No. BB-13
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50	16 22 35	11	51.0			increased gravel, no odor, wet										
						Note: Occasional gravel/cobbles to 54.0 ft.										
55	12 38 75 120/3"	S12 12	54.0 56.0	SP	-46.3	Very dense tan poorly graded SAND (SP), mps 0.3 in., no structure, no odor, wet				10	90					
					55.8	POSSIBLE TOP OF BEDROCK AT 55.8 FT										
						Note: Split spoon refusal at 55.8 ft. Advance roller bit to 58.0 ft. Consistent hard, smooth drill action. Cuttings consistent with rock lithology encountered in cores of other borings. -POSSIBLE BEDROCK-										
					-48.5 58.0	BOTTOM OF EXPLORATION 58.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-13

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TEST BORING REPORT

Boring No. BB-14

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start February 1, 2021
Finish February 3, 2021
Driller P. Schofield
H&A Rep. D. Warren
Elevation 10.0
Datum NAVD88
Location N 2730446.3, E 861698.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: B48 Mobile Drill
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to Hoist/Hammer: Winch / Automatic hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					9.5	-ASPHALT ROADWAY-										
	20 50/1"	S1 6	1.0 1.6	SP-SM	0.5 8.5 1.5	Very dense light brown poorly graded SAND with silt and gravel (SP-SM), mps 0.75 in., no odor		15	5	5	65	10				
				SP-SM	8.2 1.8	- FILL -	5	5			80	10				
5	15 17 13 11	S2 15	4.0 6.0			- MACADAM ROADWAY - Medium dense light brown to orange poorly graded SAND with silt (SP-SM), mps 1.0 in., no odor, moist										
				SM	2.5 7.5	- FILL -	5	10	15	10	45	15				
10	4 2 1 1	S3 6	9.0 11.0			Very loose brown silty SAND with gravel (SM), mps 1.0 in., no odor, wet - FILL -										
				SW-SM	-2.5 12.5	Medium dense brown well graded SAND with silt and gravel (SW-SM), mps 1.0 in., no odor, wet	10	15	15	15	35	10				
15	14 10 6 12	S4 5	14.0 16.0			- FILL -										
				OL	-6.5 16.5	Soft dark brown ORGANIC SILT (OL), mps 0.01 in., organic odor, wet Atterberg Limits test results: Sample is non-plastic.		5			30	65				
	2 2 1 2	S5** 6	17.0 19.0			- ORGANIC ESTUARINE DEPOSITS -										
				SM	-9.0 19.0	NOTE: Tube refusal at 19 ft.					80	20				
20	5 4 2 3	S6 10	19.0 21.0			Loose brown silty SAND (SM), mps 0.1 in., organic odor, wet, (Organic) silty SAND - ESTUARINE DEPOSITS -										
					-12.5 22.5											
	7 8 9 10	S7 16	24.0 26.0	SP		Medium dense gray poorly graded SAND (SP), mps 0.25 in., wet - MARINE DEPOSITS -			5	50	40	5				
25					-17.0 27.0											
30	4	S8	29.0	ML		Very stiff gray to brown SILT (ML), mps 0.01 in., laminae, no odor, wet,						100				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
02/03/21	13:53	0.5	44.0	46.0	8.5
	at completion, not stabilized				

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 46
Rock Cored (ft)
Samples S11

Boring No. BB-14

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED\40991-005-TB.GPJ Aug 27, 24

HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-14
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	9 12 10	17	31.0			laminated - GLACIOLACUSTRINE DEPOSITS -										
					-22.5 32.5	NOTE: Drill action suggests coarse grained deposits at 32.5 ft.										
35	16 11 10 12	S9 15	34.0 36.0	SM		Medium dense light brown silty SAND (SM), mps 0.5 in., no odor, wet, ablation till - GLACIAL TILL -		5	5	10	65	15				
40	14 5 5 6	S10 12	39.0 41.0	SM		Loose light brown silty SAND (SM), mps 0.5 in., no odor, wet, ablation till		5	5	10	65	15				
45	14 13 11 100/1"	S11 8	44.0 45.6	SM	-35.5 45.5	Medium dense brown silty SAND with gravel (SM), mps 1.0 in., no odor TOP OF PROBABLE BEDROCK	5	10	5	10	55	15				
					-36.0 46.0	Roller bit refusal at 46.0 ft Drill action suggests hard fresh ROCK - PROBABLE BEDROCK - BOTTOM OF EXPLORATION 46.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-14

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TEST BORING REPORT

Boring No. BB-15

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start January 28, 2021
Finish January 29, 2021
Driller P. Schofield
H&A Rep. D. Warren
Elevation 10.0
Datum NAVD88
Location N 2730543.7 E 861782.6

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: B48 Mobile Drill
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to 49.0 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					9.5	-ASPHALT ROADWAY-										
					0.5											
	33	S1	1.0	SP-SM	9.0	-GRAVEL SUB BASE-					90	10				
	97/5"	10	1.9		1.0											
					8.5	- FILL -										
					1.5											
					8.1	Very dense orange poorly graded SAND with silt (SP-SM), mps 0.1 in., no										
					1.9	odor, moist										
				SP-SM	6.5						90	10				
5	14	S2	4.0		3.5											
	14	12	6.0			- FILL -										
	12															
	17															
					3.0											
				SM	7.0	- MACADAM ROADWAY -										
						Medium dense orange poorly graded SAND with silt (SP-SM), mps 0.1 in., no odor, moist										
	11	S3	9.0							10	70	20				
10	4	10	11.0			Loose gray brown to orange silty SAND (SM), mottled, organic odor, wet										
	1															
	1															
	14	S4	14.0	SW		Medium dense brown well graded SAND with gravel (SW), mps 1.5 in., no	10	20	35	20	10	5				
15	12	3	16.0			odor, wet, poor recovery, pushing cobble										
	9															
	4					- FILL -										
						Very soft, woodland stem fragment noted in wash at 18 ft. depth										
	3	S	17.0		-8.0											
	1	0	19.0		18.0											
	1															
	1															
		S5**	19.0	OL		Soft brown ORGANIC SILT (OL) mps 0.1 in., organic odor, wet					30	70				
20	3	10	21.0			Atterberg Limits test results: Sample is non-plastic.										
	2															
	2				-11.0											
	3	S6	21.0	SM	21.0	- ORGANIC ESTUARINE DEPOSITS -					75	25				
	4	14	23.0			Medium dense gray brown silty SAND (SM), mps 0.1 in., organic odor, wet,										
	3					(Organic) silty sand										
	8															
	10				-14.0											
	6	S7	24.0	SP	24.0	- ESTUARINE DEPOSITS -			5	5	85	5				
25	9	15	26.0			Medium dense gray poorly graded SAND (SP), mps 0.25 in., no odor, wet										
	11															
	11					- MARINE DEPOSITS -										
					-18.5											
					28.5											
30	5	S8	29.0	ML		Stiff gray brown SILT (ML) mps 0.01 in., laminae, no odor, wet					5	95				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
01/29/21	12:42	0.0	49.0	55.0	14.5
	at completion	, not stabilized			

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 55.3
Rock Cored (ft)
Samples S13

Boring No. BB-15

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-15
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	6 6 8	12	31.0													
	4 6 7 8	S9 16	34.0 36.0	ML		Stiff gray brown SILT (ML) mps 0.01 in., laminae, no odor, wet						100				
35						- GLACIOLACUSTRINE DEPOSITS -											
	3 5 8 13	S10	39.0 41.0	ML		Stiff gray brown SILT (ML) mps 0.01 in., laminae, no odor, wet						100				
40					-31.5 41.5											
	14 13 13 12	S11 11	44.0 46.0	SM		Medium dense gray silty SAND with gravel (SM), mps 1.5 in., no odor, wet	5	10	5	5	55	20				
45						- GLACIAL TILL -										
					-37.0 47.0											
	24 34 19 16	S12 8	49.0 51.0	GW		Very dense gray well graded GRAVEL with sand (GW), mps 1.5 in., no odor, wet, ablation till	25	35	25	10	5					
50						- GLACIAL TILL -										
					-42.5 52.5											
	56 55 100/3"	S13 12	54.0 55.3	SM		Very dense gray brown silty SAND with gravel (SM), mps 1.5 in., no odor, wet	10	10	10	5	45	20				
55					-45.3 55.3	- GLACIAL TILL -										
						BOTTOM OF EXPLORATION 55.3 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-15

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TEST BORING REPORT

Boring No. BB-16

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: B48 Mobile Drill
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to 44.0 ft.
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model:

File No. 40991-005
Sheet No. 1 of 2
Start January 26, 2021
Finish January 27, 2021
Driller P. Schofield
H&A Rep. D. Warren
Elevation 10.0
Datum NAVD88
Location
N 2730410.1
E 861714.6

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					9.5	-ASPHALT-										
					0.5	2 in. gravel below asphalt										
	14 17 17 20	S1 13	1.0 3.0	SW		Dense well-graded brown SAND with gravel (SW)		15	20	40	20	5				
5	12 8 9 80/3"	S2 5	4.0 6.0	SM		Medium dense brown silty SAND (SM)		10	30	30	15	15				
						Note: Obstruction at 5.8 ft depth.										
10	16 12 4 4	S3 3	9.0 11.0	SW-SM		Medium dense brown well graded SAND with silt (SW-SM)	5	5	30	30	20	10				
						-FILL-										
15	120/5"	S4 4	14.0 14.4	SW		Very dense brown well graded SAND with gravel (SW)	20	10	30	20	15	5				
	2 2 2 2	S5** 24	16.0 18.0	SM	-6.3 16.3	Top 3 in. S5: Same as above				2	71	27				
	PUSH	U1** 24	18.0 20.0	SM		Bottom 21 in. S5: Very loose dark gray silty SAND, strong organic odor, occasional fibers, non-plastic, 3.2% organics, gradation test run				2	73	25				
						**See lab test data on undisturbed tube samples										
20	PUSH	U2** 21.8	20.0 22.0	OL/OH	-10.0 20.0	Top U1: Silty SAND (SM)										
						Bottom U1: Organic SOIL (OL/OH)										
					-11.5 21.5	TOP U2: Organic SOIL (OL/OH), ** See lab test data on undisturbed tube samples										
						Bottom U2: Brown SAND (SP)										
						-ORGANIC ESTUARINE DEPOSITS-										
25	2 7 6 4	S6 14	24.0 26.0	SP PT		Bottom 6 in. of push had more resistance										
						Top 5 in. (Jar S6A): Medium dense dark gray SAND (SP) interbedded with organic SILT and pockets of PEAT (PT) and wood fragments		2	5	5	73	15				
						Bottom 9 in. (Jar S6B): Medium dense gray SAND (SP)										
					-17.0 27.0	-ESTUARINE DEPOSITS-										
30	11	S7	29.0	SM		Medium dense gray silty SAND (SM), mps 0.1 in., no odor, wet					75	25				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
01/27/21	14:10	0.25	0.0	14.0	12.0
	not stabilized, hole collapsed				

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 44.1
Rock Cored (ft)
Samples S10

Boring No. BB-16

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-16
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	12 9 14	16	31.0	ML	-20.0 30.0	- MARINE DEPOSITS - Very stiff brown SILT with sand (ML), mps 0.1 in., laminae, no odor, wet, laminated					15	85				
35	5 7 15 14	S8 18	34.0 36.0	ML		Very stiff light brown to tan SILT (ML), mps 0.01 in., laminae, no odor, wet, laminated -GLACIOLACUSTRINE DEPOSITS-						100				
					-27.0 37.0											
40	11 14 7 7	S9 6	39.0 41.0	SW		Medium dense brown well graded SAND with gravel (SW), mps 1.5 in., no odor, wet	10	20	35	20	15					
					-31.5 41.5	- GLACIOFLUVIAL DEPOSITS -										
	22 17 100/1"	S10 9	43.0 44.1	SM	-34.1 44.1	Dense light brown silty SAND with gravel (SM), mps 1.5 in., no odor, wet, - GLACIAL TILL - TOP OF PROBABLE BEDROCK BOTTOM OF EXPLORATION 44.1 FT	5	10	5	5	55	20				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-16

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TEST BORING REPORT

Boring No. BB-17

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start January 4, 2021
Finish January 4, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -10.2
Datum NAVD88
Location N 2730274.3 E 861468

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to 14.0 ft.
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel %	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test: Dilatancy	Toughness	Plasticity	Strength
0	2 4 7 9	S1 18	0.0 2.0	OL/OH ML		S1, top 6 in.: Soft ORGANIC SOIL with sand (OL/OH) S1, bottom 12 in.: Medium dense light gray SILT with sand (ML) mps 1mm, frequent partings, slight organic odor, wet, trace fibers	10	5	5	5 10	15 10	60 80				
	100	S2 6	2.0 2.5	ML	-12.7 2.5	Very dense yellow brown SILT with sand (ML) mps 1mm, frequent partings, no odor, wet				5	10	85				
	27 13 11 19	S3 13	4.0 6.0	SM		-GLACIOLACUSTRINE DEPOSITS- Note: Probable large cobble at 2.5 ft. Medium dense olive gray silty SAND with gravel (SM) mps 2.5 cm, no structure, no odor, wet	5	10	15	20	35	15				
5						-GLACIOFLUVIAL DEPOSITS-										
	34 22 20 36	S4 13	9.0 11.0	SM		Dense olive gray silty SAND with gravel (SM) mps 2.2cm, no structure, no odor, wet	5	10	15	20	35	15				
10						Note: Difficult casing advancement at 14.0 ft. and unable to drive deeper. Advanced borehole with button bit to 15.0 ft. with angular sand-sized material observed in screened drill wash.										
15	100	S 0	15.0 15.0		-25.2 15.0	No recovery Split spoon refusal at 15.0 ft.										
						BOTTOM OF EXPLORATION 15.0 FT.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 15
Rock Cored (ft)
Samples S4

Boring No. BB-17

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-18

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start December 29, 2020
Finish December 29, 2020
Driller S. Cooley
H&A Rep. S. Shay
Elevation -11.6
Datum NAVD88
Location N 2730377.4, E 861565.4

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive to 23.0 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/24in	S1 12	0.0 2.0	OL/OH		Very soft black ORGANIC SOIL (OL/OH) mps 2 mm, no structure, organic odor wet, trace shell fragments -ORGANIC ESTUARINE DEPOSITS-	5			5	5	85				
	1 3 8 7	S2 15	2.0 4.0	OL/OH	-14.6	S2, top 6 in.: Similar to above except sandy ORGANIC SOIL					30	70				
				SW	3.0 -15.6	S2, bottom 9 in.: Medium dense light gray well-graded SAND (SP) mps 1 cm as trace gravel, no structure, slight organic odor, wet			30	30	35	5				
5	1/12in	S3 9	4.0 6.0	SP-SM	4.0	-LITTORAL DEPOSITS-			10	10	70	10				
	1/12in				-17.1	Very loose olive brown poorly-graded SAND with silt (SP-SM) mps 3mm, no structure, organic odor, wet, trace shell fragments -ESTUARINE DEPOSITS-					5	95	R	L	L	L
	1 2 5 8	S4 15	6.0 8.0	ML	5.5	Loose orange brown SILT (ML) mps 0.1mm, no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-										
					-20.1 8.5											
10	18 13 15 20	S5 14	10.0 12.0	SM		Medium dense olive brown silty SAND with gravel (SM) mps 2cm, no structure, no odor, wet	5	10	15	20	30	20				
15	24 14 12 12	S6 13	15.0 17.0	SM		Medium dense olive brown silty SAND with gravel (SM) mps 2.5 cm, no structure, no odor, wet -GLACIOFLUVIAL DEPOSITS-	5	10	15	20	30	20				
20	120/4in	S7 4	20.0 20.3	SM	-31.6 20.0	Very dense light beige silty SAND with gravel (SM) mps 3 cm, no structure, no odor, wet, possible highly weathered rock Note: Inconsistent drilling effort 20.0 to 23.0 ft. indicates possible cobbles or weathered rock	10	10	15	15	35	15				
					-35.6	POSSIBLE TOP OF BEDROCK										
	100/1in	S 0	24.0 24.1		24.0 -35.7 24.1	No recovery Split spoon refusal at 24.1 ft. -BOTTOM OF EXPLORATION 24.1 FT.- Note: BSC Group/Paul Mancuso received two composite zip-lock bags of soil (S1-S4 and S5-S6) for environmental purposes										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 24.1
Rock Cored (ft)
Samples S7

Boring No. BB-18

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-19

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start December 28, 2020
Finish December 28, 2020
Driller S. Cooley
H&A Rep. S. Shay
Elevation -5.0
Datum NAVD88
Location
N 2730475.3
E 861651.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive to 31.0 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/24 in.	S1 8	0.0 2.0	OL/OH		Very soft black ORGANIC SOIL with gravel (OL/OH) mps 1cm, no structure, organic odor, wet, trace shell fragments		25	10	5		60				
	WOH/24 in.	S2 12	2.0 4.0	OL/OH		Very soft dark olive brown sandy ORGANIC SOIL (OL/OH) mps 1mm, occasional gray fine sand seams, strong organic odor, wet				5	40	55				
					-9.0	-ORGANIC ESTUARINE DEPOSITS-										
5	1 1 2 4	S3 10	4.0 6.0	SP	4.0	Very loose gray poorly-graded SAND (SP) mps 1mm, frequent brown sandy organic soil interbedding, organic odor, wet				20	75	5				
	2 3 3 3	S4 18	6.0 8.0	SP		Loose gray poorly-graded SAND (SP) mps 1mm, well stratified, organic odor, wet, trace organic fibers throughout, trace decayed wood				20	75	5				
						-ESTUARINE DEPOSITS-										
					-14.0 9.0											
10	4 4 5 6	S5 13	10.0 12.0	SW		Loose light gray well-graded SAND (SW) mps 4mm, weakly stratified, no odor, wet			30	35	35					
						-LITTORAL DEPOSITS-										
					-18.5 13.5											
15	4 5 5 7	S6 16	15.0 17.0	ML		Stiff olive gray SILT (ML) mps 0.1mm, frequent partings, no odor, wet					10	90	R	L	L	L
						-GLACIOLACUSTRINE DEPOSITS-										
					-24.5 19.5	Note: Change in drilling effort at 19.5 ft.										
20	100/2 in.	S7 2	20.7 20.9	GP	-26.0 21.0	Very dense olive brown poorly-graded GRAVEL (GP) mps 1.5cm, no structure, no odor, wet		100								
	11 10 11 12	S8 12	22.5 24.5	SP-SM		Note: Advanced borehole with button bit to 21.5 ft. Advanced borehole with core barrel from 21.5 ft. to indicate probable boulder (approximately 1.6-foot dia.) from 20.9 to 22.5 ft. Medium dense olive brown poorly-graded SAND with silt and gravel (SP-SM) mps 1.2cm, no structure, no odor, wet		30	15	15	30	10				
25						-GLACIOFLUVIAL DEPOSITS-										
	14 9 6	S9 4	28.0 30.0	SP-SM		Medium dense olive brown poorly-graded SAND with silt and gravel (SP-SM) mps 1.5cm, no structure, no odor, wet		40	10	15	25	10				
30																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 31.7
Rock Cored (ft)
Samples S10

Boring No. BB-19

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-19

File No. 40991-005

Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	11				-36.0											
	120/5 in.	S10 5	31.0 31.4	SM	31.0 -36.7 31.7	Very dense olive brown silty SAND with gravel (SM) mps 2.2 cm, moderately bonded, no odor, wet -GLACIAL TILL DEPOSITS- BOTTOM OF EXPLORATION 31.7 FT.	5	10	20	20	30	15				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-19

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TEST BORING REPORT

Boring No. BB-20

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start December 23, 2020
Finish December 23, 2020
Driller S. Cooley
H&A Rep. S. Shay
Elevation -6.9
Datum NAVD88
Location N 2730581.1 E 861733.7

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to 32.0 ft.
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/ 24in.	S1 16	0.0 2.0	OL/ OH		Very soft dark brown sandy ORGANIC SOIL (OL/OH) mps 0.1mm, no structure, organic odor, wet					45	55				
	WOH/ 24in.	S2 18	2.0 4.0	OL/ OH		Very soft dark brown sandy ORGANIC SOIL (OL/OH) mps 0.1mm, no structure, organic odor, wet					45	55				
						- ORGANIC ESTUARINE DEPOSITS-										
5	WOH/ 24in.	S3 14	4.0 6.0	OL/ OH		Very soft dark brown, sandy ORGANIC SOIL (OL/OH) mps 0.1mm, no structure, organic odor, wet, trace shell fragments					45	55				
					-12.9											
	WOH/ 24in.	S4** 19	6.0 8.0	SM	6.0	** Very loose dark brown organic silty SAND (SM), mps 0.1mm, no structure, organic odor, wet, 3.9% organic content, PI = 1.7, LL = 41, PL = 39.3, gradation test run				13	52	35				
	1/12in.	S5 18	8.0 10.0			S5, top 9 in.: Very soft decayed red brown wood										
					-15.9											
	3 2			SP	9.0	S5, bottom 9 in.: Very loose gray poorly-graded SAND (SP) mps 0.2mm, no structure, no odor, wet					95	5				
10	2 5 5 7	S6 20	10.0 12.0	SP		Loose gray poorly-graded SAND (SP) mps 8mm, no structure, no odor, wet		5	10	10	75					
						-LITTORAL DEPOSITS-										
					-19.9											
					13.0	Note: Change in drilling effort at 13.0 ft.										
	5 4 5 7	S7 8	14.0 16.0	ML		Stiff gray SILT with sand (ML) mps 4mm, no structure, no odor, wet, sand confined to top 2 in. of sample			5	5	5	85				
15																
	3 5 3 4	S8 17	19.0 21.0	ML		Medium stiff olive brown SILT (ML) mps <0.1mm, no structure, no odor, wet						100	R	L	L	L
20						-GLACIOLACUSTRINE DEPOSITS-										
	5 7 8 10	S9 18	24.0 26.0	ML		Stiff olive gray SILT (ML) mps <0.1mm, no structure, no odor, wet						100	R	L	L	L
25																
					-33.9											
					27.0	Note: Change in drilling effort at 27.0 ft.										
						-GLACIAL TILL DEPOSITS-										
	112	S10	29.0	SM		Very dense olive gray to light gray silty SAND (SM) with gravel, mps 3cm,	5	10	30	20	20	15				
30																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 34.5
Rock Cored (ft)
Samples S11

Boring No. BB-20

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-20
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	30 50 64	13	31.0			no structure, no odor, wet -GLACIAL TILL DEPOSITS- Note: Unable to drive casing beyond 32.0 ft. Advanced borehole with button bit to 32.5 ft. for S11										
	108 47 20 14	S11 6	32.5 34.5	SP	-41.4 34.5	Very dense, pink brown poorly-graded SAND with gravel (SP) possibly as weathered bedrock although unable to discern rock fabric, mps 3cm, no structure, no odor, wet		10	60	15	10	5				
						BOTTOM OF EXPLORATION 34.5 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-20

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-21A

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to 2.0 ft
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model:

File No. 40991-005
Sheet No. 1 of 1
Start December 23, 2020
Finish December 23, 2020
Driller S. Cooley
H&A Rep. S. Shay

Elevation -6.5
Datum NAVD88

Location
N 2730651.2
E 861799.9

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel %	Sand %			Fines %	Field Test			
							Coarse	Fine	Coarse	Medium	Fine		Dilatancy	Toughness	Plasticity	Strength
0																
	Push/24 in.	U1** 21	2.0 4.0	SP PT		** Gray SAND (SP) with PEAT (PT) and clay (visual description of content of tube) GUS sampler used										
					-10.5 4.0	-ESTUARINE DEPOSITS- BOTTOM OF EXPLORATION AT 4.0 FT.										

Water Level Data						Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample	Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft) 4 Rock Cored (ft) Samples U1 **Boring No. BB-21A**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-21

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start December 22, 2020
Finish December 22, 2020
Driller S. Cooley
H&A Rep. S. Shay
Elevation -8.5
Datum NAVD88
Location N 2730666.6 E 861821.2

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to 23.2 ft.
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH 1/18in.	S1 6	0.0 2.0	SM		Very loose black silty SAND (SM) with up to 20% organic content, mps 6mm, no structure, slight organic odor, wet, trace shell fragments			10	15	50	25				
					-10.5	- ORGANIC ESTUARINE DEPOSITS-										
	3 3 3 4	S2 8	2.0 4.0	SM	2.0	Loose black silty SAND (SM) with up to 20% organic content, mps 6mm, no structure, slight organic odor, wet, trace shell fragments			10	15	50	25				
					-12.5	-ESTUARINE DEPOSITS-										
5	1 3 3 4	S3 5	4.0 6.0	SW	4.0	Loose light gray well-graded SAND (SW) mps 3cm, single-grain structure, no odor, wet	5	5	30	30	30					
						-LITTORAL DEPOSITS-										
	4	S4 10	6.0 8.0	ML	-15.0 6.5	Note: Top 2 in., S4 similar to above Medium stiff olive gray SILT (ML) mps <0.1mm, no structure, no odor, wet						100	R	L	L	L
	4 3 7	S5 14	8.0 10.0	ML		Soft olive brown SILT (ML) mps <0.1mm, no structure, no odor, wet						100	R	L	L	L
10	1 2 2 5	S6 16	10.0 12.0	ML		Medium stiff olive brown SILT (ML) mps <0.1mm, no structure, no odor, wet						100	R	L	L	L
	3 3 5 6					-GLACIOLACUSTRINE DEPOSITS-										
15	4 5 5 6	S7 18	15.0 17.0	ML		Stiff olive brown SILT (ML) mps <0.1mm, occasional varves, no odor, wet						100	R	L	L	L
					-27.5 19.0	Note: Change in drilling effort at 19.0 ft.										
20	14 10 7 6	S8 9	20.0 22.0	SW-SM		Medium dense olive brown well-graded SAND with silt (SW-SM) mps 3cm, no structure, no odor, wet	5	5	30	25	25	10				
						-GLACIOFLUVIAL DEPOSITS-										
					-31.7 23.2	Note: Abrupt change in effort to advance casing at 23.2 ft. Advanced borehole with button bit to 25.0 ft. Pink and white angular sand-sized rock chips observed in wash water										
25					-33.5 25.0	Possible boulder or bedrock from 23.2 ft.										
						BOTTOM OF EXPLORATION 25.0 FT.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 25
Rock Cored (ft)
Samples S8

Boring No. BB-21

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-22

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start December 30, 2020
Finish December 30, 2020
Driller S. Cooley
H&A Rep. S.Shay
Elevation -8.9
Datum NAVD88
Location
N 2730813.1
E 861926.9

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive to 37.0 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/24 in.	S1 18	0.0 2.0	PT		Very soft black PEAT (PT) mps 1mm, 30% organic fibers, strong organic odor, wet -SALT MARSH DEPOSITS-										
	WOH/24 in.	S2 16	2.0 4.0	PT	-11.9	Very soft black PEAT (PT) mps 1mm, 30% organic fibers, strong organic odor, wet										
				OL/OH	3.0	S3, top 6 in.: Very soft dark brown ORGANIC SOIL(OL/OH) mps 0.1mm, no structure, strong organic odor, wet, trace fibers					5	95				
	WOH 6 8 7	S3 22	4.0 6.0	SM	-13.4 4.5	- ORGANIC ESTUARINE DEPOSITS-					70	30				
5	1 2 3 4	S4** 18	6.0 8.0	SP-SM	-14.9 6.0	S3, bottom 16 in.: Medium dense olive gray silty SAND (SM) mps 0.5mm, no structure, no odor wet Loose olive gray poorly-graded SAND (SP-SM) mps 0.5mm, no structure, no odor, wet, **Gradation test run -LITTORAL DEPOSITS-				1	92	7				
	2 3 4 4	S5 13	10.0 12.0	ML	-17.9 9.0	Medium stiff gray top 3 in. to yellow brown SILT (ML) mps <0.1mm, no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100	R	L	L	L
10																
	11 6 5 4	S6 15	15.0 17.0	SP-SM	-22.4 13.5	Medium dense beige poorly-graded SAND with silt (SP-SM) mps 3cm, minor sorting, coarse sand and gravel confined to occasional pockets, no odor, wet -GLACIOFLUVIAL DEPOSITS-	5	5	15	15	50	10				
15																
	7 6 5 6	S7 12	20.0 22.0	SP-SM		Medium dense beige poorly-graded SAND with silt (SP-SM) mps 3 cm, minor, no structure, no odor, wet	5	5	15	20	45	10				
20																
	2 7 8 13	S8 19	25.0 27.0	ML	-32.4 23.5	Medium dense olive brown SILT with sand (ML) mps 4mm, interbedded sand seams up to 1" wide, no odor, wet -GLACIOLACUSTRINE DEPOSITS-			5	5	10	80				
25																
30																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 39
Rock Cored (ft)
Samples S10

Boring No. BB-22

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-22
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	21 33 40 47	S9 14	30.0 32.0	ML	-39.9 31.0	S9, top 7 in.: Very dense olive brown SILT with sand (ML) mps 2mm, no structure, no odor, wet					20	80				
				SM		S9, bottom 7 in.: Very dense olive brown silty SAND with gravel (SM) mps 3cm, no structure, no odor, wet	5	15	15	15	35	15				
						Note: Change in effort to advance casing at 35.0 ft. Advanced borehole with button bit to 35.5 ft. prior to S10										
35	19 21 30 120/4 in.	S10 18	35.5 37.2	SM		Very dense olive brown silty SAND with gravel (SM) mps 3cm, no structure although moderately well-bonded, no odor, wet	5	15	15	15	35	15				
						-GLACIAL TILL-										
					-47.9	No recovery										
	100/0 in.	S 0	39.0 39.0		39.0	Split spoon refusal at 39.0 ft.										
						BOTTOM OF EXPLORATION 39.0 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-22

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-23

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start January 19, 2021
Finish January 19, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -6.1
Datum NAVD88
Location
N 2730157.6
E 861566.7

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive to 21.0 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	Free fall		0.0 2.0			No recovery										
	WOH/24 in.	S1 16	2.0 4.0	OL/OH	-10.1 4.0	Very soft dark brown sandy ORGANIC SOIL (OL/OH) mps 6mm, no structure, organic odor, wet, trace fibers -ORGANIC ESTUARINE DEPOSITS-		5	5	5	20	65				
5	33 15 16 20	S2 10	4.0 6.0	SP-SM ML	-11.1 5.0 -13.6 7.5	S2, top 4 in.: Dense gray poorly-graded SAND (SP-SM) mps 2.8cm, no structure, slight organic odor (from above), wet, trace shell fragments -LITTORAL DEPOSITS- S2, bottom 6 in.: Dense light gray with faint yellow brown mottling SILT with sand (ML) mps 3mm, no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-	5	5	15 5	15 5	50 5	10 85				
10	18 22 23 23	S3 2	9.0 11.0	GP	-18.6 12.5	Dense red orange poorly-graded GRAVEL with sand (GP) difficult to fully characterize with low recovery, possible cobble fragments	10	65	10	10	5					
15	20 14 14 14	S4 9	14.0 16.0	SM		Medium dense olive brown silty SAND with gravel (SM) mps 3cm, no structure, no odor, wet -GLACIOFLUVIAL DEPOSITS-	5	10	10	15	45	15				
20	35 21 18 25	S5 13	19.0 21.0	SM	-27.1 21.0	Medium dense olive brown silty SAND as residual soil (SM) mps 3cm, no structure, no odor, wet POSSIBLE TOP OF BEDROCK 21.0 FT.	5	5	10	15	40	25				
	100/0 in.	S 0	22.0 22.0		-28.1 22.0	Note: Abrupt change in effort to drive casing at 21.0 ft. Advanced borehole with button bit to 22.0 ft. No recovery Split spoon refusal at 22 ft. BOTTOM OF EXPLORATION 22.0 FT.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 22
Rock Cored (ft)
Samples S5

Boring No. BB-23

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-24

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start January 13, 2021
Finish January 13, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -7.6
Datum NAVD88
Location N 2730307.3, E 861701.4

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive to 21.0 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/24 in.	S1 10	0.0 2.0	OL/OH		Very soft black sandy ORGANIC SOIL (OL/OH) mps 0.5mm, no structure, organic odor, wet, trace shell fragments					45	55				
	WOH/24 in.	S2 17	2.0 4.0	OL/OH		Very soft dark brown sandy ORGANIC SOIL (OL/OH) mps 0.5mm, no structure, organic odor, wet					50	50				
					-11.6	-ORGANIC ESTUARINE DEPOSITS-										
5	1 2 2 3	S3 8	4.0 6.0	SW	4.0	Very loose light gray well-graded SAND (SW) mps 2.2cm, single-grain structure, no odor, wet	5		35	30	30					
	3 2 1 2	S4 6	6.0 8.0	SP		Very loose light gray poorly-graded SAND (SP) mps 2cm, single-grain structure, no odor, wet	5		15	30	50					
						-LITTORAL DEPOSITS-										
10	1 2 1 2	S5 12	9.0 11.0	SP		Very loose light gray poorly-graded SAND (SP) mps 4mm, weakly stratified, no odor, wet			10	20	70					
					-20.1 12.5	Note: Abrupt change in drilling effort at 12.5 ft.										
15	10 14 13 18	S6 8	14.0 16.0	SM		Medium dense olive brown silty SAND with gravel (SM) mps 2.5cm, moderately bonded, no odor, wet	5	10	15	20	35	15				
						-GLACIOFLUVIAL DEPOSITS-										
					-25.1 17.5											
20	18 10 12 12	S7 6	19.0 21.0	GP		Medium dense olive brown poorly-graded GRAVEL with sand (GP) mps 3cm, no structure, no odor, wet	10	45	10	10	20	5				
					-28.6 21.0	TOP OF BEDROCK 21.0 FT.										
						Note: Abrupt change in effort to advance casing at 21.0 ft. Advanced borehole with button bit to 22.5 ft. as drilling effort indicated possible weathered rock.										
25						SEE CORE BORING REPORT FOR ROCK DETAILS										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 22.5
Rock Cored (ft) 5.0
Samples S7,C1

Boring No. BB-24

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-24**
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
25	4	C1	22.5 27.5	58 97	97 162	Fresh		Very hard, fresh, pink orange, medium-grained GRANITE. Single vertical to near vertical joint top 2 ft. of core, undulating, rough, slight coating of secondary mineralization, tight. -BEDROCK-
	4							
	4							
	4							
	4						-35.1 27.5	
								BOTTOM OF EXPLORATION 27.5 FT.
30								
35								
40								
45								
50								
55								

H+A_CORE+WELL-09 HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

TEST BORING REPORT

Boring No. BB-25

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start January 12, 2021
Finish January 13, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -4.5
Datum NAVD88
Location
N 2730370.1
E 861751.3

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive to 27.0 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/24in.	S1 6	0.0 2.0	OL/OH		Very soft black ORGANIC SOIL (OL/OH) mps 2mm , no structure, strong organic odor, wet, trace shell fragments				5	5	90				
	WOH/24in.	S2 8	2.0 4.0	OL/OH		Very soft black ORGANIC SOIL (OL/OH) mps 1mm, no structure, strong organic odor, wet, trace fibers					5	95				
						Undisturbed tube attempt 4.0-6.0 ft., no recovery										
5						-ORGANIC ESTUARINE DEPOSITS-										
	1/12in.	S3 10	8.0 10.0	OL/OH	-13.5	Very soft brown sandy ORGANIC SOIL (OL/OH) mps 1mm, interbedded gray fine sand seams mostly at bottom of sample, slight organic odor, wet, trace shell fragments					40	60				
	1 3	S4 6	10.0 12.0	SM	9.0	Loose brown silty SAND (SM) mps 1mm, weakly stratified, slight organic odor, wet, up to 20% organic content				5	55	40				
10	1 3 4 5				-17.5	-ESTUARINE DEPOSITS-										
	1 2 4 4	S5 7	14.0 16.0	SW	13.0	Loose light gray well-graded SAND (SW) mps 4mm, single-grain structure except for silt seam bottom 1" of sample, no odor, wet			30	35	30	5				
15					-21.5	-LITTORAL DEPOSITS-										
	4 7 12 47	S6 13	19.0 21.0	ML	17.0	Very stiff yellow brown SILT (ML) mps 2.8cm as single coarse gravel piece in spoon tip, frequent varves, no odor, wet		5			5	90				
20					-25.5	-GLACIOLACUSTRINE DEPOSITS-										
					21.0	Note: Change in drilling effort at 21.0 ft. Drilling effort indicated probable cobble 6-8 inches diameter plus few others to 24.0 ft.										
	34 22 33 21	S7 12	24.0 26.0	SP		Very dense olive brown poorly-graded SAND (SP) with silt and gravel, mps 2.5cm, no structure, no odor, wet	10	15	15	20	30	10				
25						-GLACIOFLUVIAL DEPOSITS-										
					-32.1											
	100/1in.	S 0	27.5 27.6		27.6	No recovery Split spoon refusal at 27.6 ft.										
						BOTTOM OF EXPLORATION 27.6 FT.										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 27.6
Rock Cored (ft)
Samples S7

Boring No. BB-25

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-26

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 2
Start January 11, 2021
Finish January 11, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -3.0
Datum NAVD88
Location N 2730467.4 E 861841.7

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Drive to 33.0 ft.
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/24 in.	S1 9	0.0 2.0	OL/OH		Very soft dark brown to black ORGANIC SOIL (OL/OH) mps 1mm, no structure, strong organic odor, wet, trace shell fragments, possible amorphous peat				5	5	90				
	WOH/24 in.	S2 10	2.0 4.0	OL/OH		Very soft dark brown to black ORGANIC SOIL (OL/OH) mps 1mm, no structure, strong organic odor, wet, trace shell fragments, possible amorphous peat					5	95				
5			4.0 6.0			Undisturbed tube attempt 4.0-6.0 ft., no recovery										
						-ORGANIC ESTUARINE DEPOSITS-										
	WOH/24 in.	S3 21	6.0 8.0	OL/OH		Very soft dark olive brown ORGANIC SOIL (OL/OH) with sand, mps 1mm, no structure, organic odor, wet, trace fibers					20	80				
	WOH/12 in.	S4 14	8.0 10.0	OL/OH		Very soft dark olive brown sandy ORGANIC SOIL (OL/OH) mps 1mm, frequent interbedded gray sand seams, organic odor, wet, trace fibers					30	70				
10	1 2	S5 12	10.0 12.0	SP-SM	-13.0 10.0	Very loose gray poorly-graded SAND with silt (SP-SM) mps 3mm, frequent interbedded brown organic silt, slight organic odor, wet, most coarse to medium sand confined to bottom 4" of sample			15	20	55	10				
	1 1 1 2				-16.0 13.0	-LITTORAL DEPOSITS-										
15	3 4 5 6	S6 12	14.0 16.0	ML		Loose light olive brown SILT (ML) mps 0.1mm, frequent partings, no odor, wet						100	R	L	L	M
						-GLACIOLACUSTRINE DEPOSITS-										
20	3 3 6 6	S7 18	19.0 21.0	ML		Loose olive brown SILT (ML) mps 0.1mm, frequent partings, no odor, wet						100	R	L	L	M
					-25.5 22.5	Note: Change in effort to advance casing at 22.5 ft.										
25	11 9 13 28	S8 14	24.0 26.0	SM		Medium dense olive brown silty SAND (SM) mps 2.2cm, no structure, no odor, wet	5	5	15	15	40	20				
						-GLACIOFLUVIAL DEPOSITS-										
30	11	S9	29.0	SM		Medium dense olive brown silty SAND (SM) mps 2.2cm, no structure, no	5	5	15	15	40	20				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 33.5
Rock Cored (ft) 4.5 (Not Bedrock)
Samples S9

Boring No. BB-26

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-26
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	7 5 5	8	31.0			odor, wet										
					-36.0 33.0	Note: Abrupt change in effort to advance casing at 33.0 ft. Advanced borehole with button bit to 33.5 ft. prior to core attempt. Advanced borehole with core barrel 33.5 to 38.0 ft. to recover 21" of various lithologies with variable drill rates to indicate presence of common cobbles.										
35		C1 21	33.5 38.0													
					-41.0 38.0	BOTTOM OF EXPLORATION 38.0 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-26

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TEST BORING REPORT

Boring No. BB-27

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start January 15, 2021
Finish January 15, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -4.0
Datum NAVD88
Location N 2730534.3, E 861889.8

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive 25.0 ft., NW spin
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	Free fall	S1 2	0.0 2.0	OL/OH		Very soft black ORGANIC SOIL with sand (OL/OH) mps 6mm, no structure, no odor, wet, trace shell fragments		5	5	5	5	80				
	Free fall	S2 4	2.0 4.0	OL/OH		Very soft black ORGANIC SOIL with sand (OL/OH) mps 2mm, no structure, no odor, wet, trace shell fragments			5	5	10	80				
						-ORGANIC ESTUARINE DEPOSITS-										
5	Free fall	S3 4	4.0 6.0	OL/OH		Very soft black ORGANIC SOIL with sand (OL/OH) mps 2mm , no structure, no odor, wet, trace shell fragments			5	5	10	80				
	WOH/24 in.	S4 4	6.0 8.0	OL/OH		Very soft dark olive brown sandy ORGANIC SOIL(OL/OH) mps 1mm, no structure, no odor, wet				5	25	70				
	WOH/12 in.	S5 18	8.0 10.0	OL/OH	-13.0	S5, top 9 in.: Similar to above with trace fibers										
10	5 4			SP-SM	9.0	S5, bottom 9 in.: Loose gray poorly-graded SAND with silt (SP-SM) mps 0.2mm, no structure, no odor, wet					90	10				
						-LITTORAL DEPOSITS-										
					-16.0 12.0											
15	3 2 3 6	S6 13	14.0 16.0	ML		Medium stiff olive brown SILT (ML) mps <0.1mm, weakly stratified, no odor, wet						100	R	L	L	L
20	4 6 8 9	S7 13	19.0 21.0	ML		Stiff olive brown SILT (ML) mps 0.1mm, frequent well-defined partings, no odor, wet					5	95	R	L	L	L
						-GLACIOLACUSTRINE DEPOSITS-										
					-28.0											
25	11 120/4 in.	S8 6	24.0 24.8	SM	24.0	Very dense light olive brown silty SAND with gravel (SM) mps 3cm, no structure, no odor, wet Note: Advanced borehole with button bit and core barrel from 24.8 to 27.5 ft. Recovered 19" granitic boulder material	10	10	15	15	35	15				
						-GLACIAL TILL DEPOSITS-										
	7 8 10 11	S9 8	27.5 29.5	SM		Medium dense light olive brown silty SAND (SM) mps 1.8cm, no structure, no odor, wet Note: Driller installed NW casing after S9		10	15	15	45	15				
30																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 38
Rock Cored (ft)
Samples S10

Boring No. BB-27

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED\40991-005-TB.GPJ Aug 27, 24

HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-27
File No. 40991-005
Sheet No. 2 of 1

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30						Note: Few cobbles indicated by drilling effort 30.0 to 34.5 ft.										
35	27 9 120/5 in.	S10 10	34.5 35.9	SM		Very dense light olive brown silty SAND (SM) mps 2.5cm, no structure, no odor, wet	5	5	15	15	45	15				
						-GLACIAL TILL DEPOSITS-										
						Note: Advanced borehole with NW spin casing to 38.0 ft. through cobbles/boulder with sand infilling.										
					-42.0 38.0	BOTTOM OF EXPLORATION AT 38.0 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-27

H&A-TEST BORING-09 REV HA-LIB09-BOS - COPY2.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\COMBINED40991-005-TB.GPJ Aug 27, 24

HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-28

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 40991-005
Sheet No. 1 of 1
Start January 14, 2021
Finish January 14, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -0.6
Datum NAVD88
Location
N 2730765
E 862086.7

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: HW Driver to 10 ft.
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 1 1/12 in.	S1 8	0.0 2.0	SP	-1.6	S1, Top 4 in. : Loose gray fine sand layer (SP)					100					
				OL/OH	1.0	-ESTUARINE DEPOSITS-			5	10	10	75				
	1 1/12 in.	S2 10	2.0 4.0	OL/OH		S1, bottom 4 in. : Very soft black sandy ORGANIC SOIL (OL/OH) mps 0.1mm, no structure, organic odor, wet Very soft dark brown to black sandy ORGANIC SOIL (OL/OH) mps 0.1mm, no structure, organic odor, wet					25	75				
5	1	S3 10	4.0 6.0	OL/OH		Very soft black to dark olive brown sandy ORGANIC SOIL (OL/OH) mps 0.1mm, no structure, organic odor, wet				5	20	75				
	1 1 1 1	U1 10	6.0 8.0			-ORGANIC ESTUARINE DEPOSITS-										
	Push/24 in.	S4* 20	8.0 10.0	OL/OH	-9.1 8.5	Note: Top 6 in. of sample similar to above * Blow counts in soil interval of unsuccessful tube attempt (no recovery, 8.0-10.0). Fine gray sand bottom 14 in. of sample				5	20	75				
10	3* 5* 7* 6*	S5 18	10.0 12.0	SP		Medium dense light gray poorly-graded SAND (SP) mps 1mm, single-grain structure, no odor, wet				5	90	5				
	4 6 11 8				-12.6 12.0	-ESTUARINE DEPOSITS- BOTTOM OF EXPLORATION AT 12.0 FT.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 12
Rock Cored (ft)
Samples S5, U1

Boring No. BB-28

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-28A

Project	MARION-WAREHAM CAUSEWAY (ROUTE 6) BRIDGE, MARION/WAREHAM, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING CONTRACTORS

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: CME 45 on barge
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	140	140	-	Casing: HW Drive 42.0, NW Drive 47.0 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Winch / Automatic Hammer PID Make & Model:

File No. 40991-005
Sheet No. 1 of 2
Start January 20, 2021
Finish January 20, 2021
Driller S. Cooley
H&A Rep. S. Shay
Elevation -8.9
Datum NAVD88
Location
N 2730709.3
E 862032.8

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOH/24 in.	S1 12	0.0 2.0	OL/OH		Very soft black sandy ORGANIC SOIL (OL/OH) mps 5mm, no structure, organic odor, wet, trace shell fragments					50	50				
					-10.9	-ORGANIC ESTUARINE DEPOSITS-										
	3 3 7 6	S2 9	2.0 4.0	SP	2.0	Loose dark brown to gray poorly-graded SAND (SP) mps 2.5cm, no structure, slight organic odor, wet		5	30	26	30	9				
5	14 5 3 2	S3 2	4.0 6.0	SP		Loose gray poorly-graded SAND (SP) mps 1cm, no structure, no odor, wet, difficult to fully characterize (low recovery)		5	30	40	20	5				
						-LITTORAL DEPOSITS-										
					-15.9											
	3 2 4 5	S4 13	9.0 11.0	ML	7.0	Medium stiff olive gray SILT (ML) mps 0.1mm, weakly stratified, no odor, wet					5	95	R	L	L	L
10																
15	3 4 4 5	S5 16	14.0 16.0	ML		Medium stiff olive gray to olive brown SILT (ML) mps 0.1mm, weakly stratified, no odor, wet						100	R	L	L	L
20	2 2 1 2	S6 18	19.0 21.0	ML		Soft olive brown SILT (ML) mps 0.1mm, weakly stratified, no odor, wet						100	R	L	L	L
25	4 3 5 2	S7 14	24.0 26.0	ML		Medium stiff olive brown SILT with sand (ML) mps 2mm, frequent interbedded sand seams, no odor, wet					15	85	R	L	L	L
						-GLACIOLACUSTRINE DEPOSITS-										
					-36.4											
30	7	S8	29.0	SM	27.5	Loose olive brown silty SAND (SM) mps 8mm, no structure although minor		5	10	15	50	20				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 47.7
Rock Cored (ft)
Samples S12

Boring No. BB-28A

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-28A
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30	5 3 4	14	31.0			sorting, no odor, wet -GLACIOFLUVIAL DEPOSITS-										
35	1 7 18 29	S9 17	34.0 36.0	SP/SM	-44.9 36.0	Medium dense light olive brown to brown poorly-graded SAND (SP) and silty SAND (SM) mps 6mm, well-defined interbedded stratification and sorting in seams and pockets, no odor, wet Note: Possible cobble at 37.2 ft. indicated by drilling effort -GLACIOLACUSTRINE DEPOSITS-		5	10	10	55	20				
40	13 17 23 21	S10 18	39.0 41.0	ML	-49.9 41.0	Dense beige sandy SILT (ML) mps 2mm, gradational structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-					40	60				
45	24 30 27 19	S11 12	42.0 44.0	SM		Very dense beige silty SAND (SM) mps 5mm, weakly stratified, no odor, wet Note: HW casing driving hard at 42.0 ft. Driller installed NW casing after S11 -GLACIOFLUVIAL DEPOSITS-			10	10	65	15				
	25 120/2 in.	S12 8	47.0 47.7	SM	-56.6 47.7	Very dense beige silty SAND (SM) mps 1cm, weakly stratified, no odor, wet BOTTOM OF EXPLORATION 47.7 FT. Split spoon refusal at 47.7 ft.		5	10	10	55	20				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-28A

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TEST BORING REPORT

Boring No. BB-29

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW/NW	S	NX	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	5/4	3 7/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: PW driven 20 ft, HW driven 26 ft, NW spun 40 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 2
Start	June 13, 2024
Finish	June 17, 2024
Driller	M. Pham
H&A Rep.	D. Warren
Elevation	12.5
Datum	NAVD88
Location	N 2729873.9 E 861289.1

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					12.0	-ASPHALT ROADWAY-										
	31 51 33 23	S-1 14	0.5 2.5	SM	0.5	Very dense light gray silty SAND with gravel (SM), no structure, no odor, dry - FILL -	10	10	5	5	55	15				
	12 26 19 14	S-2 12	4.0 6.0	SM		Dense light brown silty SAND with gravel (SM), no structure, no odor, moist	5	10	5	5	55	20				
5																
	7 8 22 39	S-3 10	9.0 11.0	SM	2.5	Medium dense gray-brown black silty SAND (SM), no structure, slight organic odor, wet, trace organic soil	5	5	5	5	50	30				
10	11 9 6 6	S-4 4	11.0 13.0	SW-SM	10.0	Medium dense brown well-graded SAND with silt and gravel (SW-SM), no structure, no odor, wet Note: Casing deflecting off probable boulder at approximately 10 ft. -FILL-	5	15	30	25	15	10				
	1/12 - 1 1	S-5 12	14.0 16.0	PT	-1.5 14.0	Very soft brown PEAT (PT), no structure, organic odor, wet -ORGANIC DEPOSITS-						100				
15	2 3 2 1	S-6 12	16.0 18.0	PT		Medium stiff brown PEAT (PT), no structure, organic odor, wet						100				
	4 7 7 14	S-7 8	19.0 21.0	SP	-6.5 19.0	Medium dense brown poorly-graded SAND (SP), no structure, no odor, wet -MARINE DEPOSITS-				20	75	5				
20																

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
06/17/24	12:48	tidal			

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	44.0
Rock Cored (ft)	0.0
Samples	S12

Boring No. BB-29

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-29
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						-MARINE DEPOSITS-										
					-11.5											
25	7 10 10 11	S-8 12	24.0 26.0	SM	24.0	Medium dense gray silty SAND (SM), stratified, no odor, wet					80	20				
						-GLACIOLACUSTRINE DEPOSITS-										
					-13.5 26.0	Note: Casing refusal at 26 ft. Advanced borehole with button bit to 27.3 ft. and cored from approximately 27.3-29 ft. Recovered 13 inches 0f granitic boulder.										
						-BOULDER-										
					-16.5											
	27	S-9 6	29.0 29.5	SM	29.0	Dense gray silty SAND with gravel (SM), no structure, no odor, wet, well-graded SAND with one 3-in. silt seam Note: Cored 29.5-32.5 ft. Recovered 26 inches of granitic cobbles/boulders with coarse gravel.		15	45	10	5	25				
30						-GLACIOFLUVIAL DEPOSITS-										
					-20.0											
	12 23 23 20	S-10 12	32.5 34.5	SW	32.5	Dense gray well-graded SAND with gravel (SW), with tightly nested cobbles and boulders	10	15	25	36	6	8				
						-GLACIOFLUVIAL DEPOSITS-										
35	12 18 20 19	S-11 14	34.5 36.5	SW		Dense gray well-graded SAND with gravel (SW), with tightly nested cobbles and boulders	10	15	25	21	21	8				
					-26.0											
	12 20 23 50/0"	S12 12	38.5 40.0	SM	38.5	Dense orange-brown silty SAND with gravel (SM), bonded, no odor, wet	5	10	5	5	60	15				
						-GLACIAL TILL-										
					-27.5	TOP OF PROBABLE BEDROCK AT 40.0 FT										
40					40.0	-PROBABLE BEDROCK- Note: Spun NW casing to 40 ft and attempted to core rock at 41 ft. Casing bent in boulders, unable to advance core barrel. Advanced borehole with button bit to 44 ft. Drill action suggests very hard, sound bedrock.										
					-31.5											
					44.0	BOTTOM OF EXPLORATION 44.0 FT Note: Equipment refusal at 44.0 ft. Borehole backfilled with cuttings upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-29

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-29A

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW	S	NX	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	5/4	1 3/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Polymer/VariFlo
Hammer Fall (in.)	24	30	-	Casing: PW driven, HW driven
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 3
Start	July 31, 2024
Finish	August 2, 2024
Driller	C. Knight
H&A Rep.	D. Warren
Elevation	12.5
Datum	NAVD88
Location	N 2729877.0 E 861291.7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					12.0	-ASPHALT ROADWAY-										
	27 61 53 37	S-1 15	1.0 3.0	SM	0.5	Note: Boring located approximately 4 ft east of BB-29. Very dense light gray brown silty SAND with gravel (SM), no structure, no odor, moist	5	10	5	5	55	20				
						-FILL-										
	24 32 24 17	S-2 10	3.5 5.5	SM		Very dense light brown silty SAND (SM), no structure, no odor, moist		10	5	5	65	15				
5					4.0											
	15 12 9 5	S-3 6	8.5 10.5	GW	8.5	Medium dense gray-brown well-graded GRAVEL with sand (GW), no structure, no odor, wet, with cobbles	30	35	20	10	5					
10					0.5											
					12.0	Note: Wood fragments noted in wash from approximately 12 -14 ft, recovered 4-in. wood timber fragment. Note: Spoon pushing wood at 13.5 ft. Probable wood mat at bottom of fill above organics.										
	18 9 4 10	S-4 4	13.5 15.5	OL/ OH	-1.5 14.0	Medium stiff dark brown ORGANIC SOIL with sand (OL/OH), no structure, organic odor, wet, 50% fibrous PEAT					15	85				
15						-ORGANIC DEPOSITS-										
	3 4 4 4	S-5 14	15.5 17.5													
					-6.0											
	9 10 7	S-6 14	18.5 20.5	SP- SM	18.5	Medium dense brown poorly-graded SAND with silt (SP-SM), no structure, slight organic odor, wet -MARINE DEPOSITS-				10	80	10				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
08/02/24	07:36	16.0	34.0	50.5	12.1

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	40.5
Rock Cored (ft)	10.0
Samples	S10, C2

Boring No. BB-29A

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. BB-29A
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	8					-MARINE DEPOSITS-										
	4 6 7 6	S-7 12	23.5 25.5	SM	-11.0 23.5	Medium dense light gray silty SAND (SM), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS-					75	25				
25																
	12 17 14 41	S-8 10	28.5 30.5	SM		Dense light gray silty SAND with gravel (SM), stratified, no odor, wet; silty SAND with gravel with seams of SILT with gravel	10	10	10	5	35	30				
30						Note: PW casing refusal at 30 ft. Drilled through BOULDER from approximately 30-32.5 ft and telescoped HW casing to next sampling interval.											
	28 27 16 14	S-9 8	33.5 35.5	SM		Dense dark gray silty SAND with gravel (SM), no odor, wet, with tightly nested cobbles and boulders	10	10	10	10	45	15				
35					-26.0											
	17 15 16 75/3"	S-10 9	38.5 40.5	ML	38.5	Dense orange-brown sandy SILT with gravel (ML), bonded, no odor, wet, -GLACIAL TILL- Note: Spoon Bouncing 40.3 ft. HW casing refusal at 40.3 ft. TOP OF BEDROCK AT 40.3 FT	5	10	5	5	10	65				
40					-27.8 40.3	SEE CORE BORING REPORT FOR ROCK DETAILS										
45																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-29A

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-29A**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	7.88	C1	40.5	58.0	97	Fresh		C1: Very hard, fresh weathered, pink, gray, coarse grained to aphanitic, GRANITE. Primary joint set low angle, close to wide, smooth to rough, silt infilling, discolored, joints dipping at low angles to horizontal, tight to open.
	6.53		45.5	58.0	97			
	7.12							-BEDROCK-
	7.2							
45	7.27							
	3.85	C2	45.5	48.0	80	Slight		C2: Very hard, fresh to slightly weathered, pink, gray, coarse grained to aphanitic, GRANITE. Primary joint set low angle, close to wide, smooth to rough, silt infilling, discolored, joints dipping at low angles to horizontal, tight to open.
	3.98		50.5	43.0	72			
	3.95							Note: Wash color change indicates highly weathered seam at approximately 48.5 ft.
	5.3							
50	6.53						-38.0	
							50.5	BOTTOM OF EXPLORATION 50.5 FT
								Note: Borehole backfilled with cuttings upon completion.
55								
60								
65								
70								
75								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-31

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SW/PW/HW	S	NX	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	6/5/4	1 3/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: SW driven 15.5 ft, PW driven 30.5 ft, HW driven 33.5 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 3
Start	July 26, 2024
Finish	July 30, 2024
Driller	C. Knight
H&A Rep.	D. Warren
Elevation	11.5 (est.)
Datum	NAVD88
Location	N 2730062.0 E 861373.6

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	16 28 37 29	S-1 14	0.5 2.5	SM		Dense light brown to tan silty SAND with gravel (SM), no structure, no odor, dry -FILL- Note: Casing refusal at 3 ft. Drill action and cuttings observed indicate possible gravel and tar road bed from approximately 3-3.5 ft.	5	10	5	5	60	15				
					8.5 3.0											
	56 115	S-2 9	3.5 4.5	SW		Very dense black to brown well-graded SAND with gravel (SW), no structure, trace black tar - possible roadbed remnants.	20	20	30	20	10					
5					5.5											
					6.0	Note: Drill action indicates tightly nested cobbles and coarse gravel with tar-like odor noted at 6-9 ft.										
	6 8 4 5	S-3 4	9.0 11.0	SM		Medium dense gray silty SAND with gravel (SM), no structure, no odor Note: Poor recovery, spoon pushing coarse gravel. Overdrove 3-in. spoon to collect sample.	15	25	10	5	30	15				
10					0.0											
	1 1 1 2	S-4 10	11.5 13.5	OL/OH	11.5	Very soft brown sandy ORGANIC SOIL (OL/OH), no structure, organic odor, wet, trace peat fibers, roots -ORGANIC DEPOSITS-					35	65				
					-2.5 14.0											
	6 16 20 24	S-5 9	14.0 16.0	ML		Dense light gray SILT with sand (ML), bonded, no odor, wet, with cobbles -GLACIAL TILL- Note: Drilled through boulders from approximately 16-18 ft.			5	5	10	80				
15																
	92 50/2"	S-6 7	19.0 19.7	ML		Very dense brown sandy SILT with gravel (ML), bonded, no odor, wet Note: Drilled through boulders from approximately 19.5-21.5 ft.	5	10	5	5	25	50				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/30/24	13:27	1.0	27.0	43.5	11.5

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	33.5
Rock Cored (ft)	10.0
Samples	S8, C2

Boring No. BB-31

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-31
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	17 27 35 29	S-7 17	24.0 26.0	ML		Very dense brown sandy SILT with gravel (ML), bonded, no odor, wet, with cobbles -GLACIAL TILL-	5	10	5	5	25	50				
25																
	29 52 38 100/3"	S-8 14	29.0 30.8	ML		Very dense brown sandy SILT with gravel (ML), bonded, no odor, wet Note: Drilled through boulder from approximately 30.5-32 ft.	5	10	5	5	25	50				
30					-21.0 32.5	TOP OF BEDROCK AT 32.5 FT Moderately to slightly weathered GRANITE Note: Advanced borehole with button bit to 33.5 ft. Drill action indicates hard, moderately weathered GRANITE.										
					-22.0 33.5	SEE CORE BORING REPORT FOR ROCK DETAILS										
35																
40																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-31

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-31**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
35	6.78	C1	33.5	54.0	90	Slight	-22.0	C1: Very hard, moderately to slightly weathered, red-brown, gray, green, coarse grained to aphanitic, GRANITE. Secondary joint set high angle, close to wide, smooth to rough, silt infilling, discolored to decomposed, tight to open.
	5.05		38.5	49.0	82		33.5	
	4.65							-BEDROCK-
	4.52							
	5.17							
40	8.65	C2	38.5	58.0	97	Slight		C2: Very hard, moderately to slightly weathered, red-brown, gray, green, coarse grained to aphanitic, GRANITE. Frequent oxidized open joints. Primary joint set high angle, close to moderate, smooth to rough, silt with occasional chlorite coatings infilling, discolored to decomposed, joints dipping at high angles to vertical.
	3.15		43.5	40.0	67			
	3.5							
	3.82							
	3.62							
45	0						-32.0 43.5	BOTTOM OF EXPLORATION 43.5 FT
								Note: Borehole backfilled with cuttings upon completion.
50								
55								
60								
65								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-32

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SW/PW	S	NX	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	6/5	1 3/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: SW driven 10.5 ft, PW driven 31 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 3
Start	July 15, 2024
Finish	July 15, 2024
Driller	M. Pham
H&A Rep.	D. Warren
Elevation	11.1
Datum	NAVD88
Location	N 2730121.8 E 861418.8

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.6	-ASPHALT ROADWAY-										
	23 42 45 65	S-1 18	0.5 2.5	SP-SM	0.5 10.4 0.8	Dense Grade GRAVEL roadbase Very dense brown to gray poorly-graded SAND with silt and gravel (SP-SM), no structure, no odor, dry -FILL-	5	10	5	10	60	10				
	31 71 90	S-2 14	3.5 5.0	SP-SM		Very dense brown to poorly-graded SAND with silt and gravel (SP-SM), no structure, no odor, moist, trace tar fragments	5	10	5	10	60	10				
5					2.6											
	17 27	S-3 8	8.5 9.5	SM	8.5 1.6	Dense gray-brown silty SAND (SM), no structure, mothball-like odor, moist, slight creosote-like odor	5	5	5	5	60	20				
	18 14	S-3A 6	9.5 10.5	OL/OH	9.5	Hard brown sandy ORGANIC SOIL (OL/OH), no structure, organic odor, wet					20	80				
10	4 9 16 23	S-4 12	10.5 12.5	OL/OH		Stiff brown ORGANIC SOIL (OL/OH), no structure, organic odor, wet, 20% peat -ORGANIC DEPOSITS-						100				
					-2.4											
	6 2 3 5	S-5 10	13.5 15.5	SM	13.5	Loose brown silty SAND (SM), no structure, no odor, wet -ESTUARINE DEPOSITS-					80	20				
15					-7.4											
	20 24 27	S-6 12	18.5 20.5	SM	18.5	Very dense brown silty SAND with gravel (SM), bonded, no odor, moist, ablation till -GLACIAL TILL-	5	10	5	5	60	15				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/15/24	14:07	0.25 not stabilized	10.5	41.8	11.8

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	32.0
Rock Cored (ft)	9.8
Samples	S10, C2

Boring No. BB-32

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-32
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	48															
	16 23 28 46	S-7 14	23.5 25.5	SM		Very dense brown silty SAND with gravel (SM), bonded, no odor, moist, ablation till -GLACIAL TILL-	5	10	5	5	60	15				
25					-17.4											
	15 13 23	S-8 9	28.5 30.0	SP-SM	28.5	Dense orange-brown poorly-graded SAND with silt and gravel (SP-SM), no structure, no odor, wet -GLACIAL TILL-	5	10	10	10	55	10				
30	100/5"	S-8A 2	30.0 30.4	SW	-18.9 30.0	TOP OF BEDROCK AT 30 FT Very dense orange-brown to light gray well-graded SAND with gravel (SW), exhibits relict rock structure, no odor, wet, slightly weathered GRANITE Note: Advanced borehole with button bit to 32 ft and drove casing 31 ft. Drill action indicates hard, sound bedrock.	10	35	40	10	5					
					-20.9 32.0	-WEATHERED BEDROCK- SEE CORE BORING REPORT FOR ROCK DETAILS										
35																
40																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-32

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-32**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
35	8.23 7.47 5.65 6.6 6.58	C1	32.0 36.8	48.0 30.0	83 52	Slight	-20.9 32.0	C1: Hard, slightly weathered, gray-brown, coarse grained to fine grained, GRANITE. Primary joint set low angle, very close to close, planar to undulating, silt infilling, discolored to decomposed, joints tight to open, dipping at low to moderate angles. Secondary joint set moderately dipping, very close to close, planar to undulating, silt infilling, discolored to decomposed, joints tight to open, dipping at moderate to high angles. -BEDROCK-
40	5.68 4.1 5.28 2.18 2.13	C2	36.8 41.8	41.0 29.0	68 48	Slight		C2: Hard, slightly weathered, gray-brown, coarse grained to fine grained, GRANITE. Primary joint set low angle, very close to moderate, planar to undulating, silt infilling, discolored to decomposed, joints tight to open, dipping at low to moderate angles. Secondary joint set low angle, close to moderate, planar to undulating, silt infilling, discolored to decomposed, joints tight to open, dipping at moderate to high angles. Note: Core barrel jammed 36.8 ft. Note: Core barrel penetration rate and wash color change indicate highly weathered rock not recovered from approximately 40-41.8 ft.
							-30.7 41.8	BOTTOM OF EXPLORATION 41.8 FT Note: Borehole backfilled with cuttings upon completion.
45								
50								
55								
60								
65								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-34

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SW/PW/HW	S	-	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	6/5/4	1 3/8	-	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	30	30	-	Casing: SW driven 5 ft
				Hoist/Hammer: Winch / Automatic Hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 1
Start	July 8, 2024
Finish	July 8, 2024
Driller	M. Pham
H&A Rep.	D. Warren
Elevation	-14.9
Datum	NAVD88
Location	N 2730301.1 E 861572.2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel %	Sand %	Fines %	Field Test
0						Note: 26.5 ft bridge deck to mudline. Bridge deck 0.3 ft asphalt, 0.75 ft concrete. ALL DEPTHS REFERENCED FROM MUD LINE.				
						Note: Bottom 5 ft of 6-in. diameter casing broke off when driving through possible wood obstruction at 4.5 ft. 5 ft of casing lost in hole below mudline. 27 ft length of pipe dropped below bridge deck, laying flat on channel bottom. Retrieval was unsuccessful.				
5					-19.9 5.0	BOTTOM OF EXPLORATION 5.0 FT				

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	5.0
Rock Cored (ft)	0.0
Samples	-

Boring No. BB-34

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None; **Toughness**: L - Low M - Medium H - High; **Plasticity**: N - Nonplastic L - Low M - Medium H - High; **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-34A

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SW/PW/HW	S	NX	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	6/5/4	1 3/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	30	30	-	Casing: SW driven 6.5 ft, PW driven 8.5 ft, HW driven 23.5 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No. 40991-005
Sheet No. 1 of 2
Start July 9, 2024
Finish July 12, 2024
Driller M. Pham
H&A Rep. D. Warren
Elevation -14.9
Datum NAVD88
Location
N 2730297.5
E 861570.3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOR /12" - 2 12	S-1 6	0.0 2.0	SM	-15.9	Note: Drill action indicates very loose Silty SAND with organic silt from 0-0.5 ft.										
				SW	1.0	-FLUVIAL DEPOSITS- Medium dense gray to black well-graded SAND with gravel (SW), no structure, no odor, wet	10	20	35	20	10	5				
						-MARINE SAND/GRAVEL- Note: Boring offset approximately 3 ft west of BB-34. Note: 26.5 ft bridge deck to mudline. Bridge deck 0.3 ft asphalt, 0.75 ft concrete. ALL DEPTHS REFERENCED FROM MUD LINE.										
5					-20.9											
	30 46 51 45	S-2 14	6.0 8.0	SP	6.0	Very dense tan poorly-graded SAND with gravel (SP), no structure, no odor, wet	5	10	5	5	75					
						-GLACIOFLUVIAL DEPOSITS- TOP OF BEDROCK AT APPROXIMATELY 8.5 FT										
					-23.4											
10					8.5	Note: PW casing refusal 8.5 ft. Advanced borehole with button bit to 10 ft and telescoped HW casing to 10 ft. Water loss and drill action indicate highly fractured weathered bedrock to approximately 16 ft.										
	43 60 91 51	S-3 15	11.5 13.5	GP		Very dense yellow-brown poorly-graded GRAVEL with sand (GP), exhibits relict rock structure, no odor, wet, completely weathered, decomposed GRANITE	5	50	35	5	5					
						-WEATHERED BEDROCK/GRUS-										
15						Note: Drove HW casing to 17 ft and began coring. Core barrel jamming in fractured rock, hole collapsing.										
					-31.9 17.0	SEE CORE BORING REPORT FOR ROCK DETAILS										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
07/12/24	08:38	tidal			

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	17.0
Rock Cored (ft)	25.2
Samples	S3, C6

Boring No. BB-34A

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-34A**
File No. 40991-005
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weathering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	3.78	C1	17.0 18.0	4.0 0.0	33 0	High	-31.9 17.0	C1: Recovered 4 inches of loose Quartz Breccia corestones. Joints indiscernible due to poor recovery. Note: Advanced borehole with button bit to 19 ft and re-drove casing to 19 ft. Drill action indicates hard weathered rock with open fractures.
	7.07	C2	19.0 22.5	12.0 0.0	29 0	High		C2: Recovered 12 inches of loose Quartz Breccia corestones. Joints indiscernible due to poor recovery. Poor recovery and water loss indicate highly weathered/decomposed rock with frequent very hard Quartz seams.
20	3.68							
	5.32							-BEDROCK-
	4.48							
	5.53	C3	23.5 27.7	32.0 0.0	64 0	Moder-ate		C3: Very hard to hard, moderately weathered, red-brown, light gray, coarse grained to aphanitic, BRECCIA AND GRANITE. Altered GRANITE with irregular rehealed brecciated quartz seams. Frequent iron stained pits and vugs. Primary joint set high angle, very close to close, rough, silt infilling, discolored to disintegrated, frequent iron oxide staining. Secondary joint set moderately dipping, very close to close, rough, silt infilling, discolored to disintegrated, frequent iron oxide staining. Note: Core barrel jammed at 22.5 ft. Total water loss noted coring C2. Advanced borehole with button bit and drove HW casing to 23.5 ft. Note: Core barrel jammed at 25.7 ft. Pulled rods and emptied core barrel.
	7.48							
25	5.98							
	6.65							
	8.43							
	5.6	C4	27.7 32.2	50.0 11.0	93 20	Moder-ate		C4: Very hard to hard, moderately to slightly weathered, red-brown, light gray, green, coarse grained to aphanitic, BRECCIA AND GRANITE. Altered GRANITE with irregular rehealed brecciated quartz seams. Frequent iron stained pits and vugs. Primary joint set very close to close, planar to undulating, silt infilling, discolored to decomposed, frequently oxidized. Secondary joint set moderately dipping, very close to close, planar to undulating, silt infilling, discolored to decomposed, frequently oxidized joints dipping at moderate to high angles. Note: #=RQD Qualifier for moderately weathered rock.
	5.47							
30	4.62							
	4.38							-BEDROCK (FAULT ZONE BRECCIA/MYLONITE)-
	6.62							
	4.7	C5	32.2 37.2	58.0 42.0	97 70	Slight		C5: Very hard to hard, slightly weathered, green, gray, coarse grained to aphanitic, GRANITE. Altered GRANITE with irregular rehealed brecciated quartz seams. Frequent iron stained pits and vugs. Primary joint set low angle, very close to close, planar to undulating, silt infilling, discolored to decomposed, frequently oxidized, joints dipping at low to moderate to high angles.
	4.85							
	4.68							
35	5.25							
	5.98							
	5.05	C6	37.2 42.2	60.0 30.0	100 50	Slight		C5: Very hard to hard, slightly weathered, red-brown, gray, coarse grained to aphanitic, GRANITE. Altered GRANITE with irregular rehealed brecciated quartz seams. Frequent iron stained pits and vugs. Primary joint set low angle, very close to close, planar to undulating, silt infilling, discolored to decomposed, frequently oxidized, joints dipping at low to moderate to high angles. Secondary joint set moderately dipping, very close to close, planar to undulating, silt infilling, discolored to decomposed, frequently oxidized, joints dipping at moderate to high angles.
	4.58							
	6.43							
40	5.32							
	6.73						-57.1 42.2	BOTTOM OF EXPLORATION 42.2 FT Note: Borehole backfilled with cuttings upon completion.
45								
50								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-35

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SW/PW	S	-	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	6/5	1 3/8	-	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: SW spun 2 ft, PW driven 14 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No. 40991-005
Sheet No. 1 of 1
Start June 24, 2024
Finish June 26, 2024
Driller M. Pham
H&A Rep. D. Warren
Elevation -14.5
Datum NAVD88
Location
N 2730691.8
E 861910.0

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	1 8 4 5	S-1 8	0.0 2.0	GW-GM		Medium dense black well-graded GRAVEL with silt and sand (GW-GM), no structure, no odor, wet	30	40	10	5	5	10				
						-FLUVIAL DEPOSITS-										
						Note: 26 ft from bridge deck to mudline. Bridge deck is 0.35 ft asphalt, 0.65 ft concrete. ALL DEPTHS REFERENCED FROM MUD LINE.										
						Note: Casing refusal in obstructions at approximately 2 ft. Possible bridge construction debris.										
					-17.5											
	6 4 5 4	S-2 12	3.0 5.0	MH	3.0	Stiff light gray elastic SILT with sand (MH), no odor, wet					15	85				
						-GLACIOLACUSTRINE DEPOSITS-										
5																
	3 4 4 6	S-3 12	8.0 10.0	MH		Medium stiff gray-brown elastic SILT (MH), no structure, no odor, wet						100				
10																
	7 6 8 16	S-4 12	13.0 15.0	ML		Stiff gray-brown SILT (ML), stratified, no odor, moist, SILT interbedded with fine SAND partings and very thin lean CLAY laminae					10	90				
15																
					-30.5											
					16.0	BOTTOM OF EXPLORATION 16.0 FT										
						Note: Casing deflecting off obstructions at 2 ft , driving off vertical. Pulled 5-in. casing and restarted hole with 6-in. pipe after sampling to 16 ft. 6-in. button bit refusal on steel with wood also noted in wash. Relocated to BB-35A.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
06/26/24	08:25	0.0 tidal			

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	16.0
Rock Cored (ft)	0.0
Samples	S4

Boring No. BB-35

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-35A

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SW/PW/ HW	S	-	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	6/5/4	1 3/8	-	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: SW spun 6.5 ft, PW driven, HW driven
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No. 40991-005
Sheet No. 1 of 4
Start June 26, 2024
Finish July 2, 2024
Driller M. Pham
H&A Rep. D. Warren/M. Dodson
Elevation -10.6
Datum NAVD88
Location
N 2730675.8
E 861897.0

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					-11.6	Drill action indicates coarse SAND and GRAVEL -FLUVIAL DEPOSITS-										
					1.0	Note: 22 ft from bridge deck to mudline. Bridge deck is 0.35 ft asphalt, 0.65 ft concrete. ALL DEPTHS REFERENCED FROM MUD LINE.										
	1/24"	S-1 8	2.5 3.0	OL/ OH		Very soft dark brown ORGANIC SOIL (OL/OH), no structure, no odor, wet -ORGANIC DEPOSITS-						100				
5					-17.1											
	3 4 4 5	S-2 18	6.5 8.5	SP-SM	6.5	Loose light gray poorly-graded SAND with silt (SP-SM), no structure, no odor, wet, 10% organics, trace shell fragments -ESTUARINE DEPOSITS-			15	25	50	10				
					-19.6 9.0											
10	2 2 3 5	S-3 12	11.5 13.5	ML		Loose light gray SILT (ML), no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100				
15	4 4 8 10	S-4 14	16.5 18.5	ML		Medium dense gray to brown SILT with sand (ML), laminated, no odor, wet, laminated SILT with thin seams of well graded SAND.		5	5	5	5	80				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	42.0
Rock Cored (ft)	23.8
Samples	S8, C6

Boring No. BB-35A

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-35A
File No. 40991-005
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20					-30.6 20.0											
	7 6 7 14	S-5 10	21.5 23.5	SM		Medium dense brown silty SAND (SM), no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-		5	5	5	50	35				
25																
	31 24 21 37	S-6 15	26.5 28.5	SM		Dense light brown tan silty SAND (SM), layered, no odor, wet, well-graded SAND interlayered with poorly-graded SAND and sandy SILT -GLACIOFLUVIAL DEPOSITS-			10	15	35	40				
30					-42.1											
	15 21 23 32	S-7 14	31.5 33.5	ML	31.5	Hard light brown tan sandy SILT (ML), layered, no odor, wet, SILT and sandy silt interlayered with 10% dark brown oxidized well-graded sand -GLACIOLACUSTRINE DEPOSITS- Note: Two 6-in. cobbles from 34-35 ft.			5	5	25	65				
35					-47.1											
	34 52 40 45	S-8 16	36.5 38.5	SM	36.5	Very dense tan silty SAND with gravel (SM), no structure, no odor, wet -GLACIOFLUVIAL DEPOSITS-	10	15	15	15	30	15				
40					-50.6 40.0	Probable weathered Granite based on advance rate and cuttings -PROBABLE WEATHERED BEDROCK- Note: Casing refusal at 40 ft, began losing water while drilling ahead 40-40.5 ft.										
					-52.6 42.0	Note: Rolled ahead after driving 4-in. casing to 40.5 ft, water return drilling open in probable weathered Granite Bedrock. SEE CORE BORING REPORT FOR ROCK DETAILS										
45																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-35A

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-35A**
File No. 40991-005
Sheet No. 3 of 4

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	6	C1	42.0 47.0	51.0 32.0	85 53	Slight	-52.6 42.0	C1: Very hard, fresh to slightly weathered, tan, gray, pink, white, black, fine grained to coarse grained, GRANITE AND GNEISS. Weakly foliated gneissic GRANITE. Primary joint set moderately dipping, very close to moderately spaced, rough, occasional iron staining and precipitate infilling, fresh to discolored, open. Secondary joint set low angle, very close to moderately spaced, smooth to rough, fresh to decomposed, tight to open.
	6							
	8							Note: Open joints from 42.2-42.4 ft and from 45-46 ft depth may be the source of missing recovery.
45	7.5							
	8							-BEDROCK-
	7.5	C2	47.0 50.0	36.0 36.0	100 100	Fresh		C2: Very hard, fresh weathered, tan, gray, pink, white, black, fine grained to coarse grained, GRANITE AND GNEISS. Weakly foliated gneissic GRANITE. Primary joint set moderately dipping, moderate to wide spacing, rough, occasional iron staining and precipitate infilling, fresh to discolored. One high angle joint at 50.8 ft, rough, planar, discolored, tight.
	8.5							
	12							
50	6.5	C3	50.0 54.0	48.0 48.0	100 100	Fresh		C3: Very hard, fresh weathered, tan, gray, pink, white, black, fine grained to coarse grained, GRANITE AND GNEISS. Weakly foliated gneissic GRANITE. One high angle joint at 50.7 ft, rough, planar, iron stained, discolored, tight.
	7.5							
	7.5							
	8							
	5.5	C4	54.0 59.0	60.0 60.0	100 100	Fresh		C4: Very hard, fresh to slightly weathered, tan, gray, pink, white, black, fine grained to coarse grained, GRANITE AND GNEISS. Weakly foliated gneissic GRANITE. Very slightly weathered/discolored brown below approximately 57.0 ft. Note: Installed new core shoe at 54 ft, core times decreased.
55	5.5							
	4							
	4							
	5							
	8	C5	59.0 62.3	38.0 22.0	95 55	Slight		C5: Very hard, slightly weathered, tan, gray, pink, white, black, fine grained to coarse grained, GRANITE AND GNEISS. Weakly foliated gneissic GRANITE. Slightly weathered/discolored brown. Primary joint set low angle, very close to moderate spacing, rough, iron staining and precipitate, limonite coatings infilling, discolored to decomposed, frequent 1/2-in. discolored halos at joints. Secondary joint set vertical, very close, rough, iron precipitate and limonite infilling, discolored, 2 close joints at 62.3 ft, one joint continuous through core to 65.6 ft. (not counted against RQD due to unknown spacing).
60	5							
	5							
	2							
	4.5	C6	62.3 65.8	42.0 24.0	100 57	Slight		C6: Very hard to hard, slightly weathered, tan, gray, pink, white, black, coarse grained, GRANITE AND GNEISS. Weakly foliated gneissic GRANITE. Slightly weathered/discolored brown. Primary joint set low angle, very close to moderately spaced, rough, iron staining and precipitate infilling, discolored to decomposed, occasional 1/2-in. discolored halos at joints.
	5							
	7.5							
65	5						-76.4 65.8	BOTTOM OF EXPLORATION 65.8 FT
								Note: Borehole backfilled with cuttings upon completion.
70								
75								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-36

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	SW/PW/ HW	S	NX	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	6/5/4	1 3/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: SW driven 6 ft, PW driven 9.5 ft, HW driven 45.5 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 3
Start	July 16, 2024
Finish	July 25, 2024
Driller	M. Pham
H&A Rep.	D. Warren
Elevation	-13.0
Datum	NAVD88
Location	N 2730713.7 E 861975.9

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	WOR/24"	NR	0.0 2.0			No recovery Note: 24.5 ft bridge deck to mudline. Bridge deck is 0.25 ft asphalt, 0.6 ft concrete. ALL DEPTHS REFERENCED FROM MUD LINE.										
	3 5 3 4	S-1 6	2.0 4.0	SW		Loose black well-graded SAND with gravel (SW), no structure, organic odor, wet, trace shell fragments -FLUVIAL DEPOSITS-		25	40	25	10					
5																
	34 8 3 4	S-2 4	6.0 8.0	ML	-19.5 6.5	Note: Spoon pushing coarse gravel at 6 ft. Medium dense tan SILT (ML), no structure, no odor, wet Note: No initial recovery. Redrove 3-in. spoon to collect sample. -GLACIOLACUSTRINE DEPOSITS-						100				
					-22.0											
	11 102	S-3 6	9.0 10.0	MH	9.0 -22.5 9.5	Very stiff light brown to tan elastic SILT (MH), stratified, no odor, wet, decomposed rock fragments in spoon tip						100				
10						Note: Advanced borehole with button bit from 9.5 to 14.5 ft. Drill action indicates sound bedrock. Set casing to 11 ft and cored from 14.5-19.5 ft. Core barrel broke thru bottom of apparent 9-ft BOULDER at approximately 18.5 ft. Drove SW casing to 10 ft and overcored 9 ft boulder with PQ (5-in.OD) core barrel. Recovered 75 inches of previously drilled boulder. HW casing telescoped thru boulder to continue with boring. -GNEISSIC BOULDER- (GLACIAL ERRATIC)										
15																
					-32.5											
20	16 21 13 15	S-4 14	19.5 21.5	SM	19.5	Dense tan silty SAND (SM), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS-			5	5	55	35				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	46.5
Rock Cored (ft)	24.5
Samples	S10, C5

Boring No. BB-36

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-36
File No. 40991-005
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	11 16 17 21	S-5 15	23.5 25.5	SM		Dense tan silty SAND (SM), stratified, no odor, wet, silty FINE SAND interbedded with seams of fine sandy SILT -GLACIOLACUSTRINE DEPOSITS-					55	45				
30	25 46 57 71	S-6 16	28.5 30.5	SM	-47.5	Very dense tan silty SAND (SM), stratified, no odor, wet					80	20				
35	18 23 27 30	S-7 18	34.5 36.5	ML	34.5	Dense tan SILT with sand (ML), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS- Note: Losing all water from approximately 38.5-43 ft. Drill action indicates coarse SAND and GRAVEL.					15	85				
40	120/5"	S- 8 4	39.5 39.9	SW	-52.5 39.5	Very dense gray-brown to red-brown well-graded SAND with gravel (SW), no structure, no odor, wet, with cobbles -GLACIOFLUVIAL DEPOSITS-	20	35	30	10	5					
45	59 100/4"	S-9 9	44.5 45.3	SM	-57.5 44.5 -58.3 45.3	Very dense gray-brown silty SAND (SM), bonded, no odor, wet -GLACIAL TILL- -TOP OF BEDROCK AT 45.3 FT -BEDROCK- Note: Drove HW casing to refusal at 45.5 ft and advanced borehole with button bit to 46.5 ft. Drill action indicates hard, sound bedrock. SEE CORE BORING REPORT FOR ROCK DETAILS	5	5	10	5	55	20				
50																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-36

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-36**
File No. 40991-005
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	5.02	C1	46.5 51.5	60.0 38.0	100 63	Slight		C1: Very hard, slightly weathered, red-brown, pink, gray, coarse grained to aphanitic, GRANITE. Primary joint set low angle, very close to close, smooth to rough, silt infilling, discolored to decomposed, joints dipping at low to moderate angles, tight to open and occasionally healed. Secondary joint set high angle, very close to close, smooth to rough, silt infilling, discolored to decomposed, joints dipping at high angles, tight to open and occasionally healed.
	7.57							
	6.05							
	7.98							
50	6.88							
	3.92	C2	51.5 56.0	54.0 36.0	100 67	Slight		C2: Very hard, slightly weathered, red-brown, pink, gray, coarse grained to aphanitic, GRANITE. Rock breaks readily along foliation planes. Primary joint set low angle, very close to moderate, smooth to rough, silt infilling, discolored to decomposed, joints dipping at low to moderate angles, frequently horizontal, tight to open.
	4.5							
	5.32							Note: Core barrel frequently jamming from approximately 54-56 ft.
	7.83							
55	8.5							-BEDROCK-
	6.6	C3	56.0 61.0	60.0 54.0	100 90	Slight		C3: Very hard, slightly weathered, red-brown, pink, gray, coarse grained to aphanitic, GRANITE. Rock breaks along readily along foliation planes. Primary joint set low angle, very close to moderate, smooth to rough, silt infilling, discolored to decomposed, joints dipping at low to moderate angles, frequently horizontal, tight to open.
	8.07							
	6.78							
	4.95							
60	6.28							
	4.28	C4	61.0 66.0	53.0 38.0	88 63	Slight		C4: Very hard, slightly weathered, red-brown, pink, gray, coarse grained to aphanitic, GRANITE. Primary joint set low angle, very close to moderate, smooth to rough, silt infilling, discolored to decomposed, joints dipping at low to moderate angles, frequently horizontal, occasional high angles, tight to open.
	6.48							
	7.83							
	7.4							
65	11.7							
	9.47	C5	66.0 71.0	60.0 51.0	100 85	Slight		C5: Very hard, slightly weathered, red-brown, pink, gray, coarse grained to aphanitic, GRANITE. Primary joint set low angle, very close to moderate, smooth to rough, silt infilling, discolored to decomposed, joints dipping at low to moderate angles, frequently horizontal, occasional high angles, tight to open.
	4.2							
	6.38							
	6.22							
70	5.63							
							-84.0 71.0	BOTTOM OF EXPLORATION 71.0 FT
								Note: Borehole backfilled with cuttings upon completion.
75								
80								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-37

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW	S	NQ	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	5/4	3 7/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: PW driven 24 ft. HW driven 68 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 4
Start	June 10, 2024
Finish	June 18, 2024
Driller	M. Pham
H&A Rep.	D. Warren
Elevation	10.2
Datum	NAVD88
Location	N 2730839.8 E 862039.1

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					9.9	-ASPHALT ROADWAY-										
	65 125	S-1 6	0.5 1.5	GW	0.3 9.2 1.0	Very dense gray well-graded GRAVEL with sand (GW), no structure, no odor, dry, refusal in Asphalt sub base -FILL- Note: Drill action indicates very dense Granular Fill with cobbles from approximately 2-4 ft.	60	20	10	5	5					
5	17 15 12 16	S-2 10	4.0 6.0	SM		Dense light brown to tan silty SAND with gravel (SM), no structure, no odor, moist -FILL-	5	5	5	5	60	20				
					1.2											
10	2 2 3 4	S-3 14	9.0 11.0	SM	9.0	Loose brown silty SAND (SM), no structure, slight organic odor, wet, 15% organic soil -ESTUARINE DEPOSITS-				5	80	15				
	5 7 9 9	S-4 16	11.0 13.0	SM		Medium dense brown silty SAND (SM), no structure, slight organic odor, wet, 15% organic soil, trace roots			5	5	75	15				
					-3.8											
15	5 5 6 8	S-5 14	14.0 16.0	ML	14.0	Medium dense light brown SILT (ML), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100				
					-8.8											
20	7 10 12 12	S-6 14	19.0 21.0	SM	19.0	Medium dense light gray silty SAND (SM), no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-		5	5	5	60	25				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	68.5
Rock Cored (ft)	9.0
Samples	S15, C2

Boring No. BB-37

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-37
File No. 40991-005
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						-GLACIOLACUSTRINE DEPOSITS-										
					-13.8											
25	7 7 7 8	S-7 3	24.0 26.0	SW	24.0	Medium dense well-graded SAND with gravel (SW), no structure, no odor, wet Note: Poor recovery, spoon pushing coarse gravel.	5	20	50	20	5					
						-GLACIOFLUVIAL DEPOSITS-										
30	25 12 6 6	S-8 12	29.0 31.0	SW		Medium dense brown well-graded SAND with gravel (SW), no structure, no odor, wet.	5	10	10	25	45	5				
					-23.8											
35	3 4 5 8	S-9 12	34.0 36.0	SM	34.0	Loose tan silty fine SAND (SM), stratified with thin seams of coarse to fine sand, no odor, wet		5	5	5	65	20				
						-GLACIOLACUSTRINE DEPOSITS-										
					-28.8											
40	7 13 22 32	S-10 15	39.0 41.0	ML	39.0	Dense tan SILT (ML), stratified, no odor, wet						100				
						-GLACIOLACUSTRINE DEPOSITS-										
45	19 29 31 36	S-11 18	44.0 46.0	ML		Very dense tan SILT (ML), stratified, no odor, wet						100				
					-38.8											
50	73 27 19 22	S-12 15	49.0 51.0	SM	49.0	Dense light gray silty SAND with gravel (SM), bonded, no odor, wet	5	15	10	5	50	15				
						-GLACIAL TILL-										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-37

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-37
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Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
55	12 19 14 21	S-13 5	54.0 56.0	SW-SM		Dense light gray well-graded SAND with silt and gravel (SW-SM), no structure, no odor, wet, with cobbles	5	10	10	10	55	10				
						-GLACIAL TILL-										
						Note: Casing refusal at 57 ft. Cored through 1-ft boulder and tightly nested cobbles from approximately 57 -59.5 ft.										
60	5 19 27 24	S-14 9	59.5 61.5	SM		Dense light gray silty SAND with gravel (SM), no structure, no odor, wet	5	10	5	5	60	15				
65	27 55 85	S-15 16	64.0 65.5	SM		Very dense light gray silty SAND (SM), bonded, no odor, wet, with cobbles	5	5	5	5	60	20				
					-56.8 67.0	TOP OF BEDROCK AT 67.0 FT										
						-BEDROCK-										
						Note: Casing refusal at 68 ft. Advanced borehole with button bit to 69 ft. Drill action indicates very hard, sound bedrock from 67-69 ft.										
70					-58.3 68.5	SEE CORE BORING REPORT FOR ROCK DETAILS										
75																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-37

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

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CORE BORING REPORT

Boring No. **BB-37**
File No. 40991-005
Sheet No. 4 of 4

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
70	5.25 6.28 7.7 8.18	C1	68.5 72.5	42.0 8.0	88 17	High	-58.3 68.5	C1: Moderately hard to very hard, highly to moderately weathered, gray-brown, green, pink, coarse grained to fine grained, GRANITE with discolored and oxidized to decomposed open joints. Primary joint set low angle, very close to close, smooth to rough, silt infilling, discolored to decomposed, joints dipping at low angles to horizontal. Secondary joint set high angle, very close to close, smooth to rough, silt infilling, discolored to disintegrated. Note: 8-in. # RQD qualifier for moderately weathered rock.
75	6.95 4.4 7.25 7.37 7.97	C2	72.5 77.5	60.0 38.0	100 63	Moder-ate		C2: Moderately hard to very hard, moderately weathered, gray-brown, green, pink, coarse grained to fine grained, GRANITE, with discolored and oxidized to decomposed open joints. Primary joint set low angle, very close to close, rough and planar, silt infilling, decomposed. Secondary joint set high angle, very close to close, rough and planar, silt infilling, discolored to decomposed. Note: 38-in. # RQD qualifier for moderately weathered rock. Note: Core barrel jammed at 72.5 ft. -BEDROCK-
							-67.3 77.5	BOTTOM OF EXPLORATION 77.5 FT
80								Note: Elevated water level in tub observed after coring indicates minor artesian flow from bedrock. Bedrock core hole backfilled with bentonite to seal. Borehole backfilled with bentonite chips and borehole cuttings upon completion.
85								
90								
95								
100								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-38

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW	S	NQ	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	5/4	3 7/8	2.0	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: Water
Hammer Fall (in.)	30	30	-	Casing: PW driven 20 ft, HW driven 65 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 4
Start	June 6, 2024
Finish	June 10, 2024
Driller	M. Pham
H&A Rep.	D. Warren
Elevation	10.6
Datum	NAVD88
Location	N 2730896.6 E 862088.2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.0	-ASPHALT ROADWAY-										
	21 36 37 28	S-1 18	0.8 2.8	SW-SM	0.6	Very dense light brown well-graded SAND with silt and gravel (SW-SM), no structure, no odor, dry Note: Approximately 2 in. thick Macadam road base at 1.5 ft. -FILL-	5	10	10	10	55	10				
	8 12 12 12	S-2 10	4.0 6.0	SP-SM	6.6 4.0	Medium dense light brown poorly-graded SAND with silt (SP-SM), no structure, no odor, moist -FILL-	5	5	5		75	10				
5					1.6											
	8 4 3 10	S-3 8	9.0 11.0	SW-SM	9.0	Loose gray-brown well-graded SAND with silt and gravel (SW-SM), no structure, no odor, wet, trace silty fine SAND in spoon tip -FILL-	10	20	20	10	30	10				
10				SM	0.1 10.5	Very dense gray-brown silty SAND (SM) Note: traces of organic soil noted in wash from approximately 11-13.5 ft. -ESTUARINE DEPOSITS-										
	6 8 14 24	S-4 12	14.0 16.0	ML	-3.4 14.0	Medium dense tan SILT (ML), no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100				
15																
	5 5 5 5	S-5 14	19.0 21.0	ML		Medium dense tan SILT (ML), stratified, no odor, wet						100				
20																

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
06/07/24	14:07	tidal			

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram: Riser Pipe, Screen, Filter Sand, Cuttings, Grout, Concrete, Bentonite Seal

Summary	
Overburden (ft)	65.0
Rock Cored (ft)	10.0
Samples	S14, C2
Boring No.	**BB-38**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

TEST BORING REPORT

Boring No. BB-38
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Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	2 2 3 4	S-6 15	24.0 26.0	ML		Loose tan SILT (ML), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100				
30	2 2 4 5	S-7 16	29.0 31.0	ML		Loose tan SILT (ML), stratified, no odor, wet						100				
35	5 7 8 8	S-8 16	34.0 36.0	SM	-23.4 34.0	Medium dense tan silty SAND (SM), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS-					80	20				
40	7 8 7 10	S-9 12	39.0 41.0	SM		Medium dense light brown to gray-brown silty SAND (SM), mottled, no odor, wet, silty fine SAND with seams of coarse to fine sand		5	10	5	65	15				
45	8 10 8 13	S-10 17	44.0 46.0	ML	-33.4 44.0	Medium dense tan SILT (ML), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100				
50	3 6 6 6	S-11 12	49.0 51.0	ML		Medium dense tan SILT (ML), stratified, no odor, wet						100				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-38

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

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Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
					-43.4											
	3 3 5 6	S-12 14	54.0 56.0	SM	54.0	Loose tan silty SAND (SM), stratified, no odor, wet -GLACIOLACUSTRINE DEPOSITS-			5	5	75	15				
					-48.4											
60	18 17 30 28	S-13 16	59.0 61.0	SM	59.0	Dense light gray silty SAND with gravel (SM), bonded, no odor, moist -GLACIAL TILL-	5	10	5	5	60	15				
	45 100/5"	S-14 7	64.0 64.9	SM	-53.9 64.5	Very dense light gray silty SAND with gravel (SM), bonded, no odor, moist, with frequent cobbles TOP OF BEDROCK AT APPROXIMATELY 64.5 ft SEE CORE BORING REPORT FOR ROCK DETAILS	5	10	5	5	60	15				
65																
70																
75																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-38

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

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CORE BORING REPORT

Boring No. **BB-38**
File No. 40991-005
Sheet No. 4 of 4

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
65	5.13	C1	65.0	49.0	82	Slight		C1: Very hard, slightly weathered, pink, gray, coarse grained to fine grained, GRANITE. Primary joint set low angle, very close to moderate, smooth to rough, frequent silt infilling, discolored, joints dipping at low angles to horizontal. Secondary joint set high angle, close to moderate, occasional silt infilling, discolored.
	11.73		70.0	43.0	72			
	6.72							-BEDROCK-
	6.9							
	5.32							
70	6.85	C2	70.0	50.0	83	Slight		C2: Very hard, slightly weathered, pink, gray, coarse grained to fine grained, GRANITE. Primary joint set horizontal, close to wide, smooth to rough, discolored.
	6.72		75.0	50.0	83			
	11.62							
	9.58							
	10.62							
75							-64.4	BOTTOM OF EXPLORATION 75.0 FT
							75.0	
								Note: Borehole backfilled with bentonite chips and borehole cuttings upon completion.
80								
85								
90								
95								
100								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-39

Project	BRIDGE NOS M-05-001= W-06-013 & W06-016, RTE 6, WAREHAM/MARION, MA
Client	PARSONS
Contractor	NEW ENGLAND BORING, INC.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	PW/HW	S	NX	Rig Make & Model: B53 MOBILE DRILL
Inside Diameter (in.)	5/4	3 7/8	2.0	Bit Type: Button Bit
Hammer Weight (lb)	300	140	-	Drill Mud: Water
Hammer Fall (in.)	24	30	-	Casing: PW driven 25 ft, HW driven 68 ft
				Hoist/Hammer: Winch / Automatic hammer
				PID Make & Model: Not used

File No.	40991-005
Sheet No.	1 of 4
Start	June 18, 2024
Finish	June 21, 2024
Driller	M. Pham
H&A Rep.	D. Warren/M. Dodson
Elevation	10.4
Datum	NAVD88
Location	N 2730876.4 E 862116.5

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					10.1	-ASPHALT ROADWAY-										
	11 17 12 14	S-1 15	0.5 2.5	GW-GM SP-SM	0.3 9.9 0.5	Note: Boring offset approximately 7 ft east to clear telecom line. Well-graded GRAVEL with silt and sand (GW-GM), dense grade roadbase Medium dense light brown poorly-graded SAND with silt (SP-SM), no structure, no odor, dry -FILL-					90	10				
	13 11 8 4	S-2 6	4.0 6.0	SM	6.4 4.0	Medium dense gray-brown silty SAND with gravel (SM), no structure, no odor, moist -FILL-	5	10	10	10	50	15				
5																
	30 36 31 26	S-3 8	9.0 11.0	SW	1.4 9.0	Very dense brown well-graded SAND with gravel (SW), no structure, no odor, wet -FILL-	5	15	35	30	15					
10				SP	-1.1 11.5	Dense gray-brown poorly-graded SAND (SP), no structure, no odor, wet -ESTUARINE DEPOSITS-					100					
	10 12 20 53	S-4 4	14.0 16.0	ML	-5.1 15.5	Dense olive-gray SILT (ML), no structure, no odor, wet -GLACIOLACUSTRINE DEPOSITS-						100				
15																
	9 10 12 18	S-5 12	19.0 21.0	ML		Very stiff light brown to tan SILT with sand (ML), stratified, no odor, wet					15	85	R		N	
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	63.5
Rock Cored (ft)	10.0
Samples	S13, C2

Boring No. BB-39

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-39
File No. 40991-005
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						-GLACIOLACUSTRINE DEPOSITS-										
					-13.6											
25	3 4 6 8	S-6 10	24.0 26.0	CL	24.0	Stiff tan to light brown lean CLAY (CL), laminated, no odor, wet, 5% frequent fine sand partings					5	95	N-S	L	M	
						-GLACIOLACUSTRINE DEPOSITS-										
					-18.6											
30	4 7 9 10	S-7 13	29.0 31.0	MH	29.0	Very stiff gray and orange-brown elastic SILT with sand (MH), bedded, no odor, wet, becoming oxidized orange to black with depth, black coloration in a medium sand bed near bottom of recovery				5	10	85	S	L	L	
						-GLACIOLACUSTRINE DEPOSITS-										
						Note: Drill action and cuttings indicate frequent layers of probable well graded sand with occasional gravel. Placed 4-in. casing to 34 ft prior to S8 collection.										
					-23.6											
35	10 13 14 12	S-8 9	34.0 36.0	SP	34.0	Medium dense tan poorly-graded SAND (SP), bedded, no odor, wet		5	10	35	45	5				
						-GLACIOFLUVIAL DEPOSITS-										
					-28.6											
40	7 7 9 10	S-9 12	39.0 41.0	SW	39.0	Medium dense light brown well-graded SAND (SW), no structure, no odor, wet		5	20	40	35					
						-GLACIOFLUVIAL DEPOSITS-										
					-33.6											
45	14 16 29 42	S-10 8	44.0 46.0	ML	44.0	Hard SILT with sand (ML), stratified, no odor, wet				5	20	75				
						-GLACIOLACUSTRINE DEPOSITS-										
50	17 23 31 31	S-11	49.0 51.0	ML		Hard tan SILT (ML), stratified, no odor, wet					5	95	R		N	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-39

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

TEST BORING REPORT

Boring No. BB-39
File No. 40991-005
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
55	20 33 40 32	S-12 15	54.0 56.0	ML		Hard tan sandy SILT (ML), stratified, no odor, wet, becoming more coarse and sandy with depth, granite gravel bottom few inches of sample -GLACIOLACUSTRINE DEPOSITS-	5	5	5	5	15	65	R		N	
					-45.6 56.0	-GLACIOFLUVIAL DEPOSITS- Based on drill action and cuttings 56-57 ft										
					-46.6 57.0	TOP OF WEATHERED BEDROCK AT APPROXIMATELY 57.0 FT Highly weathered, fractured GRANITE. Based on very resistive drill action and tan to light brown to pink coarse to medium sand-sized granite chips in wash, more resistive 58-59.9 ft, may indicate better quality rock. -PROBABLE WEATHERED BEDROCK-										
60					-49.5 59.9											
	60 70 62 65	S-13 6	60.5 62.5	SW		Light brown to orange brown well-graded SAND with gravel (SW) distinct rock fabric, no odor, wet Note: Sample composed entirely of angular granite fragments and particles, likely broken by driving of spoon, small portion of white decomposed silt-sized specks intermixed in matrix. -DECOMPOSED BEDROCK-	10	20	30	20	15	5				
					-53.1 63.5	Note: Casing refusal at 63 ft. Advanced borehole with button bit to 63.5 ft . Drill action indicates hard, weathered rock. SEE CORE BORING REPORT FOR ROCK DETAILS										
65																
70																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. BB-39

H&A-TEST BORING-09 REV PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB GREAT PYRAMID H&A.GPJ \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

HALEY ALDRICH

CORE BORING REPORT

Boring No. **BB-39**
File No. 40991-005
Sheet No. 4 of 4

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
65	6.07 7.05 7.18 6.07 4.77	C1	63.5 68.5	40.0 28.0	67 47	Slight	-53.1 63.5	C1: Hard to very hard, slightly to moderately weathered, pink, gray, coarse grained to fine grained, GRANITE. Frequent healed joints. Primary joint set low angle, very close to close, rough, silt infilling, discolored to decomposed, joints dipping at low angles to horizontal, tight to open. Secondary joint set vertical, close to moderate, rough and undulating, discolored to decomposed. Note: Drill action indicates highly weathered, open fractures at 66 ft. Note: 50-75% water loss noted at 67.5 ft.
70	4.13 5.87 4.73 6.2 5.12	C2	68.5 73.5	60.0 48.0	100 80	Moder-ate		C2: Moderately hard to very hard, slightly to moderately weathered, pink, gray, red-brown, coarse grained to fine grained, GRANITE. Occasional healed joints. Primary joint set very close to moderate, rough and undulating, silt infilling, discolored to disintegrated. Note: Total water loss while coring C2. -BEDROCK-
75							-63.1 73.5	BOTTOM OF EXPLORATION 73.5 FT Note: Borehole backfilled with cuttings upon completion.
80								
85								
90								
95								

H+A_CORE+WELL-09 PLOG-HA-LIB09-BOS STANDARD ONLY-MARCH 2024.GLB HA-TB+CORE+WELL-09 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\BOS_COMMON\40991\GINT\2024 EXPLORATIONS\40991-005-TB.GPJ Aug 28, 24

APPENDIX D
HRGS Geophysics Investigation Report

HRGS

GEOPHYSICAL SURVEY – *REV 1.0*
CAUSEWAY EXPLORATION
BRIDGES M-05-001=W-06-013 & W-06-016
MARION/WAREHAM, MASSACHUSETTS

Prepared for:

Haley & Aldrich, Inc.
465 Medford Street, Suite 2200
Boston, Massachusetts 02129

Prepared by:

Hager-Richter Geoscience, Inc.
2 Industrial Way – S/2
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File 24PG12
September 2024

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HRGS
HAGER-RICHTER GEOSCIENCE

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September 6, 2024
File 24PG12

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RE: Geophysical Survey – *Rev 1.0*
Causeway Exploration
Bridges M-05-001=W-06-013 & W-06-016
Marion/Wareham, Massachusetts

Dear Mr. Gately:

In this report, we summarize the results of a surface geophysical survey conducted in June and August 2024 by Hager-Richter Geoscience, Inc., (HRGS) at the above referenced site located in Marion and Wareham, Massachusetts for Haley & Aldrich, Inc. (H&A). The scope of the survey and area of interest were specified by H&A.

INTRODUCTION

The site is located along the U.S. Route 6 causeway connecting Marion to Wareham, Massachusetts across the Weweantic River. The general location of the site is shown in Figure 1. H&A is conducting a geotechnical investigation in support of plans to widen the roadway and install retaining walls along the causeway. As part of the project, H&A required a geophysical survey to determine the depth and configuration of bedrock under the causeway and to detect subsurface obstacles that might impact plans to install the retaining walls.

The U.S. Route 6 causeway includes four vehicle lanes and flanking sidewalks. Two bridges, one approximately 180 feet long and the other approximately 120 feet long, are imbedded within the causeway. According to boring logs BB-1 to BB-39, provided by H&A, the existing causeway subsurface from the top down in general consists of 15 to 20 feet of fill, 3 to 10 feet of organic deposits, 3 to 10 feet of littoral, marine, or estuarine deposits, 20 to 30 feet of glaciolacustrine, glaciofluvial, or glacial till deposits overlying bedrock, which was encountered at depths of 40 to 70 feet. Boulders and rip-rap are expected to be present within the fill materials.

H&A specified six seismic transects, identified as Seismic Lines 1 through 6. Lines 1 and 2 were located in Wareham on the northeast side of the bridges, Lines 3 and 4 were located in Wareham in the center causeway section between the bridges, and Lines 5 and 6 were located in Marion on the southwest side of the bridges. The locations of the seismic transects and GPR coverage are shown in the upper panels of Plates 1, 2, and 3.

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HRGS

OBJECTIVES

The objectives of the surface geophysical survey were to determine the depth and configuration of the bedrock surface along the causeway and detect subsurface obstacles in the fill.

THE SURVEY

Steven Grant, P.G., Amanda Fabian, P.G., Peter Giger, and Alex Brown of HRGS conducted the surface geophysical survey on June 5, 6, and 13, and August 20, 2024. The project was coordinated with Mr. Steven Gately, P.E., of H&A. Mr. Dwight Warren, also of H&A, was present during the fieldwork and assisted with coordination. Original data and field notes reside in the HRGS files and will be retained for a minimum of three years. Photograph 1 shows typical conditions while acquiring GPR Data.



Photograph 1.Typical conditions at the site. Photo taken during closure of the east-bound lane of Route 6 for the GPR survey. View to the southwest from Wareham toward the bridges.

The locations of the seismic lines were georeferenced using a Trimble Geo7X CM GPS system utilizing a Zephyr-2 external antenna, as well as using tie-ins to local features. The locations of the seismic lines are shown in Plates 1, 2, and 3.

EQUIPMENT AND PROCEDURES

Seismic Refraction Profiling. The seismic refraction survey was acquired along six seismic lines ranging from 220 to 376 feet, for a total length of 2,032 linear feet of seismic refraction profiling. Seismic profiling along each spread was conducted using two 24-channel seismographs (Geometrics Geodes)

coupled to 45 to 48 14-Hz geophones spaced 5 to 8 feet apart. An 8-pound sledgehammer striking an aluminum plate placed on the ground was used as the energy source. Between five (5) and six (6) shot points were acquired for each seismic spread – two (2) located internal to the spread, one (1) at each end of the spread, and offset shots located in-line but outside of each end of the geophone spread, where possible. This configuration provides reversed profiles. The seismograph is connected to and controlled by a laptop computer. The software provides for the acquisition, display, plotting, filtering, and storage of seismic data in the field.

The seismic refraction data were interpreted with the Generalized Reciprocal Method (GRM). For the GRM interpretation, we used IXRefraX, commercially licensed software from Interpex Limited. GRM allows the depth to bedrock to be determined for *each* geophone location, rather than only at the shot points as for most other methods, and it is less sensitive to the presence of dipping interfaces and hidden layers. The GRM method requires at least one (1) shot at each end of the cable.

Ground Penetration Radar (GPR). GPR was acquired along the sidewalk and adjacent travel lane in both the east and west bound lanes of Route 6 with the goal of detecting and locating subsurface obstacles within the fill. GPR data were acquired along traverses oriented parallel to the roadway and spaced from 2.5 apart and along traverses oriented perpendicular to the roadway and spaced 20 feet apart across the accessible portions of the areas of interest. The GPR method can detect both metal and nonmetal objects.

We used our GSSI SIR 4000 subsurface imaging radar system with the 350 MHz Hyperstacking antenna. Data is recorded digitally, and the GPR data can be reviewed in the field. The system includes a survey wheel that triggers the recording of the data at fixed intervals, thereby ensuring the accuracy of the locations of features detected along each survey line.

The GPR data was processed and interpreted using RADAN 7.5, commercially licensed software developed by the equipment manufacturer.

The locations of the transects were surveyed in the field and georeferenced by Hager-Richter using our Trimble Geo7X CM GPS system utilizing a Zephyr-2 external antenna.

LIMITATIONS OF THE METHOD

> IN GENERAL, THE ACCURACY (STANDARD DEVIATION) OF THE APPARENT DEPTHS OF RELATIVELY COMPETENT BEDROCK DETERMINED BY THE SEISMIC REFRACTION METHOD IS ABOUT ± 10% OF THE APPARENT DEPTH OF BEDROCK, OR ± 2 FEET, WHICHEVER IS GREATER. THE BEDROCK MODEL SHOWN AS A PROFILE OR LISTED AS TABULAR DATA SHOULD NOT BE USED SOLELY FOR CONTRACT BEDROCK REMOVAL QUANTITIES.

Seismic Refraction Profiling. As with all geophysical methods, the seismic refraction method assumes that the local geology is relatively uncomplicated. In particular, the seismic refraction method assumes that interfaces between geologic materials correlate with sharp increases in seismic velocity and that the interfaces between geologic units are relatively flat lying. The method is not very sensitive to lateral

variations within layers, and relatively subtle features such as fracture zones within bedrock generally cannot be detected unless there is a topographic expression of the feature and/or a significant drop in bedrock velocity. The accuracy of the method is degraded in areas with strong topographic relief and/or where the interfaces have apparent dips greater than about 20°. ***In general, the accuracy of depths determined is estimated to be about 10% or 2 feet, whichever is greater. The results of this survey should not be relied upon for contract bedrock removal quantities.***

Where two (2) materials do not exhibit contrasting velocities, or where velocities gradually increase with depth, a clear refracted signal is not generated, and the seismic refraction method cannot be used to distinguish the two materials. In some cases, the "geophysical contact" between materials with contrasting velocities does not correlate exactly with the "geologic contact." For example, where a highly weathered bedrock is overlain by a dense material such as till, the velocity range of the weathered bedrock might overlap or approach the velocity range of the till, and the two materials cannot be distinguished seismically. In such cases, the depth determined by seismic refraction is the depth of *competent* bedrock, which might be located at some depth below the geologic contact.

The depth relations of the water table and bedrock may constitute a significant problem for the seismic refraction technique. This problem is that of a "blind layer." A blind layer occurs where the thickness of the saturated overburden is less than about half the depth of bedrock. In such cases, the water-saturated material immediately above bedrock is "blind" in the sense that no refracted seismic energy from it will be received as a first arrival of seismic energy, and all methods used to reduce the seismic data to determine the depth of bedrock, the objective of this survey, use *only* first arrivals. Thus, the saturated layer will not be detected where it is close to bedrock, and most methods of seismic data reduction will indicate that bedrock is considerably shallower than it is. Although GRM, the method used by HRGS to reduce the seismic refraction data, does not use first arrivals through the water saturated zone (because there is none to use) in such cases, GRM determines the depth of bedrock correctly by using the *average* velocity of the saturated and unsaturated zones.

A "hidden layer" occurs where a lower velocity material underlies a higher velocity material, a common situation in stratified sediments. An example is where sand is present under layers of clay or till. As in the case of a "blind layer," most methods of seismic refraction data reduction will indicate that bedrock is deeper than it is if a hidden layer is present but not detected. Internal tests in the seismic refraction data reduction software that we use (IXRefraX by Interpex) indicate that such layers might be present, and an average velocity of the two layers is used to determine the depth of bedrock.

Wetland soils (organics) usually have decaying organic materials within it. Gas bubbles produced during the decay of organic materials can absorb seismic signals, thereby reducing the amount of seismic signal transmitting through to the bedrock.

GPR. There are limitations of the GPR technique as used to detect and/or locate targets such as those of the objectives of this survey: (1) surface conditions, (2) electrical conductivity of the ground, (3) contrast of the electrical properties of the target and the surrounding soil, and (4) spacing of the traverses. Of these restrictions, only the last is controllable by us.

HRGS

The condition of the ground surface can affect the quality of the GPR data and the depth of penetration of the GPR signal. Sites covered with debris, obstacles, etc. limit the survey access and the coupling of the GPR antenna with the ground. In many cases, the GPR signal will not penetrate below concrete pavement, especially inside buildings, and a target may not be detectable. The GPR method also commonly does not provide useful data under canopies found at some facilities.

The electrical conductivity of the ground determines the attenuation of the GPR signals, and thereby limits the maximum depth of exploration. For example, the GPR signal does not penetrate clay-rich soils, and targets buried in clay might not be detected.

A definite contrast in the electrical conductivities of the surrounding ground and the target material is required to obtain a reflection of the GPR signal. If the electrical conductivity contrast between the soil and boulders are too small, then the boulder reflections may be too weak to recognize.

Spacing of the traverses is limited by access at many sites, but where flexibility of traverse spacing is possible, the spacing is adjusted to the size of the target.

RESULTS

General.

The geophysical survey consisted of seismic refraction profiling along six transects totaling 2,032 linear feet of seismic refraction profiling. In addition, GPR surveying was conducted in the sidewalk and adjacent travel lane on each side of the roadway in the causeway sections. Plates 1, 2, and 3 show the geophysical results for the southwest (Seismic Lines 5 and 6 and adjacent GPR Lines), central (Seismic Line 3 and 4 and adjacent GPR Lines) and northeast (Seismic Lines 1 and 2 and adjacent GPR Lines) sections of the causeway. Each Plate includes a site plan that shows the locations of the seismic and GPR lines as well as an interpretation of the GPR data (top panel) and the results of the seismic refraction survey as profiles (bottom panel). The results of the seismic refraction survey are also listed in tabular form in Table 1.

Seismic Refraction Survey.

Data Quality. The quality of the seismic refraction data ranges from poor to very good. Ground vibrations from vehicles and coupling of the seismic signal onto the adjacent guardrail generated noise that interfered with the seismic data. Despite the noise, picking the first arrivals of the compressional wave was possible for the majority of the seismic data.

A measure of the accuracy of the data can be obtained by comparing the seismically determined depths with depths of refusal or rock recorded in nearby borings and at seismic line intersections. An examination of Table 2 shows that there was generally good agreement between the seismic data and available depths of refusal or rock from borehole data. In general, based on this and similar seismic refraction projects, the accuracy of depths determined from seismic refraction is estimated to be in general about 10% or 2 feet, whichever is greater.

Interpretation of Velocities. Based on the interpretation obtained with the GRM method, materials with two distinct velocity ranges were detected. The uppermost material exhibits a compressional wave velocity of approximately 2,600 to 3,450 feet per second (fps), inferred to represent a mixture of unsaturated and saturated soil. The lowermost material exhibits compressional wave velocities ranging from about 11,800 fps to about 18,100 fps and is inferred to represent competent bedrock.

Where the top of bedrock is highly fractured and/or deeply weathered, it might exhibit lower velocities that cannot be detected as a distinct layer on the basis of the seismic refraction data. Thus, the top of rock determined on the basis of seismic refraction data generally is the top of competent bedrock, which might be located somewhat below the geologic contact between the overburden and bedrock.

Bedrock Depths and Configuration. The results of the seismic refraction survey are shown in profile form in Plates 1, 2, and 3 and are listed in tabular form in Table 1. For Lines 5 and 6, located on the southwest side of the causeway in Marion, the depth of competent bedrock determined seismically varies between about 35 and 43 feet below ground surface, and bedrock elevation varies between -22 and -32 feet, an apparent relief of about 10 feet. For Lines 3 and 4, located in the central section of the causeway in Wareham, the depth of competent bedrock determined seismically varies between about 41 and 61 feet below ground surface, and bedrock elevation varies between -30 and -51 feet, an apparent relief of about 21 feet. For Lines 1 and 2, located on the northeast side of the causeway in Wareham, the depth of competent bedrock determined seismically varies between about 53 and 73 feet below ground surface, and bedrock elevation varies between -41 and -62 feet, an apparent relief of about 21 feet. In general, bedrock is highest on the Marion side of the causeway.

Ground Penetrating Radar Survey

General. The locations of the GPR traverses and the integrated interpretation of the geophysical data are shown in the upper panels of Plates 1 – 3. In most of the areas, apparent GPR signal penetration was good, with two-way travel time reflections received from 50-90 ns. Based upon site specific velocity matching calibrations, the GPR signal penetration for most areas surveyed is estimated to have been 8-16 feet. In general, GPR penetration was highest along the unpaved shoulders and lessened with increased distance into the roadway. Several areas with limited GPR signal penetration (less than about 6 feet) were present along the portions of the survey areas closest to the road center.

GPR Survey and Integrated Interpretation. The GPR records exhibited reflections consistent with possible boulders in most of the areas surveyed. Possible boulders or other obstructions were detected at depths ranging from 1 or 2 feet to almost 16 feet. The upper panels of Plates 1, 2, and 3 show the locations of possible boulders, with approximate depth ranges indicated. Note that GPR reflections from a boulder are non-unique – it is possible that some of the reflections attributed to boulders in this project represent other types of objects (e.g. other materials in the fill, old structures, etc.).

Several possible drain lines associated with catch basins were detected in the areas of interest, and their locations are shown on the upper panels of Plates 1-3. In addition, several unidentified possible utilities were detected and their locations are shown on the upper panels of Plates 1-3.

GPR reflections consistent with buried concrete surfaces were detected in the areas of interest and their locations are shown in the upper panels of Plates 1-3. Most such surfaces were detected at depths of about 1 to 2 feet. We note that most such concrete surfaces were detected near the bridge ends and might represent structures related to the abutments.

CONCLUSIONS

Based on the seismic surveys conducted by HRGS along the U.S. Route 6 causeway containing Bridges M-05-001=W-06-013 & W-06-016 in Marion and Wareham, Massachusetts for H&A, we conclude the following:

- For Lines 1 and 2, located on the northeast side of the causeway in Wareham, the depth of competent bedrock determined seismically varies between 53 and 73 feet below ground surface, and bedrock elevation varies between -41 and -61 feet, an apparent relief of about 20 feet.

- For Lines 3 and 4, located in the central section of the causeway in Wareham, the depth of competent bedrock determined seismically varies between 41 and 61 feet below ground surface, and bedrock elevation varies between -30 and -51 feet, an apparent relief of about 21 feet.

- For Lines 5 and 6, located on the southwest side of the causeway in Marion, the depth of competent bedrock determined seismically varies between 35 and 43 feet below ground surface, and bedrock elevation varies between -22 and -32 feet, an apparent relief of about 10 feet.

- In general, bedrock is highest on the Marion side of the causeway.

- Possible boulders or other subsurface objects are present in the survey areas and are plotted according to depth ranges.

- Drains and possible unidentified utilities are present in the survey areas.

- Possible buried concrete surfaces are present in the survey areas.

LIMITATIONS ON USE OF THIS REPORT

This letter report was prepared for the exclusive use of Haley & Aldrich, Inc. (Client). No other party shall be entitled to rely on this Report, or any information, documents, records, data, interpretations, advice, or opinions given to Client by Hager-Richter Geoscience, Inc. (HRGS) in the performance of its work. The Report relates solely to the specific project for which HRGS has been retained and shall not be used or

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HRGS has used reasonable care, skill, competence, and judgment in the performance of' its services for this project consistent with professional standards for those providing similar services at the same time, in the same locale, and under like circumstances. Unless otherwise stated, the work performed by HRGS should be understood to be exploratory and interpretational in character and any results, findings or recommendations contained in this Report or resulting from the work proposed may include decisions which are judgmental in nature and not necessarily based solely on pure science or engineering. It should be noted that our conclusions might be modified if subsurface conditions were better delineated with additional subsurface exploration including, but not limited to, test pits, soil borings with collection of soil and water samples, and laboratory testing.

Except as expressly provided in this limitations section, HRGS makes no other representation or warranty of any kind whatsoever, oral or written, expressed or implied; and all implied warranties of merchantability and fitness for a particular purpose, are hereby disclaimed. If you have any questions or comments on this letter report, please contact us at your convenience. It has been a pleasure to work with Haley & Aldrich, Inc., on this project. We look forward to working with you again in the future.

Sincerely,
Hager-Richter Geoscience, Inc.



Steven Grant, P.G.
Senior Geophysicist

Attachments: Table 1
Figure 1
Plates 1 - 3

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TABLE 1
SEISMIC REFRACTION RESULTS
CAUSEWAY EXPLORATION
BRIDGES M-05-001=W-06-013 & W-06-016
MARION/WAREHAM, MASSACHUSETTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
1	0+00	106+38.4	30.3' RT	862018.9	2730744.2	11	70	-59
1	0+08	106+46.4	30.2' RT	862024.1	2730750.2	11	70	-59
1	0+16	106+54.4	30.1' RT	862029.4	2730756.2	11	70	-59
1	0+24	106+62.4	29.9' RT	862034.7	2730762.2	11	70	-59
1	0+32	106+70.3	29.8' RT	862039.9	2730768.2	11	70	-59
1	0+40	106+78.3	29.7' RT	862045.2	2730774.2	11	69	-58
1	0+48	106+86.3	29.6' RT	862050.5	2730780.2	11	69	-58
1	0+56	106+94.3	29.4' RT	862055.8	2730786.2	11	69	-58
1	0+64	107+02.3	29.3' RT	862061.1	2730792.5	11	69	-58
1	0+72	107+10.3	29.2' RT	862066.3	2730798.5	11	69	-58
1	0+80	107+18.3	29.1' RT	862071.6	2730804.5	11	68	-57
1	0+88	107+26.3	28.9' RT	862076.9	2730810.5	11	68	-57
1	0+96	107+34.2	28.8' RT	862082.1	2730816.5	11	68	-57
1	1+04	107+42.2	28.7' RT	862087.4	2730822.5	11	68	-57
1	1+12	107+50.2	28.6' RT	862092.7	2730828.5	11	68	-57
1	1+20	107+58.2	28.4' RT	862097.9	2730834.5	11	67	-56
1	1+28	107+66.2	28.3' RT	862103.2	2730840.5	11	67	-56
1	1+36	107+74.2	28.2' RT	862108.5	2730846.5	11	65	-54
1	1+44	107+82.2	28.1' RT	862113.8	2730852.5	11	64	-52
1	1+52	107+90.2	28.0' RT	862119.1	2730858.5	11	62	-51
1	1+60	107+98.1	27.8' RT	862124.3	2730864.5	11	60	-49
1	1+68	108+06.1	27.7' RT	862129.6	2730870.5	11	59	-48
1	1+76	108+14.1	27.6' RT	862134.9	2730876.5	11	60	-48
1	1+84	108+22.1	27.5' RT	862140.1	2730882.8	11	60	-49
1	1+92	108+30.1	27.3' RT	862145.4	2730888.8	11	60	-49
1	2+00	108+38.1	27.2' RT	862150.7	2730894.8	11	61	-49
1	2+08	108+46.1	27.1' RT	862155.9	2730900.8	11	57	-46

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

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TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
1	2+16	108+54.1	27.0' RT	862161.2	2730906.8	11	56	-45
1	2+24	108+62.0	26.8' RT	862166.5	2730912.8	12	55	-43
1	2+32	108+70.0	26.7' RT	862171.8	2730918.8	12	55	-44
1	2+40	108+78.0	26.6' RT	862177.1	2730924.8	12	57	-45
1	2+48	108+86.0	26.5' RT	862182.3	2730930.8	12	58	-46
1	2+56	108+94.0	26.4' RT	862187.6	2730936.8	12	58	-46
1	2+64	109+02.0	26.2' RT	862192.9	2730942.8	12	57	-46
1	2+72	109+10.0	26.1' RT	862198.1	2730948.8	12	58	-46
1	2+80	109+18.0	26.0' RT	862203.4	2730954.8	12	57	-45
1	2+88	109+25.9	25.9' RT	862208.7	2730960.8	12	54	-42
1	2+96	109+33.9	25.7' RT	862213.9	2730967.0	12	55	-43
1	3+04	109+41.9	25.6' RT	862219.2	2730973.0	12	56	-44
1	3+12	109+49.9	25.5' RT	862224.5	2730979.0	12	54	-42
1	3+20	109+57.9	25.4' RT	862229.8	2730985.0	12	53	-41
1	3+28	109+65.9	25.2' RT	862235.1	2730991.0	12	55	-43
1	3+36	109+73.9	25.1' RT	862240.3	2730997.0	12	55	-43
1	3+44	109+81.9	25.0' RT	862245.6	2731003.0	12	55	-43
1	3+52	109+89.8	24.9' RT	862250.9	2731009.0	12	56	-44
1	3+60	109+97.8	24.7' RT	862256.1	2731015.0	12	56	-44
1	3+68	110+05.8	24.6' RT	862261.4	2731021.0	12	56	-44
1	3+76	110+13.8	24.5' RT	862266.7	2731027.0	12	56	-44
2	0+00	106+43.8	26.6' LT	861979.3	2730785.5	11	70	-59
2	0+07	106+50.8	26.7' LT	861983.9	2730790.8	11	70	-59
2	0+14	106+57.7	26.8' LT	861988.5	2730796.0	11	70	-59
2	0+21	106+64.7	26.9' LT	861993.1	2730801.2	11	70	-59
2	0+28	106+71.7	27.0' LT	861997.7	2730806.8	11	70	-59
2	0+35	106+78.7	27.1' LT	862002.2	2730812.0	11	70	-59
2	0+42	106+85.6	27.2' LT	862006.9	2730817.2	11	70	-59
2	0+49	106+92.6	27.3' LT	862011.4	2730822.5	11	70	-59
2	0+56	106+99.6	27.4' LT	862016.1	2730827.8	11	70	-59
2	0+63	107+06.5	27.5' LT	862020.6	2730833.0	11	70	-59
2	0+70	107+13.5	27.6' LT	862025.2	2730838.2	11	70	-59
2	0+77	107+20.5	27.7' LT	862029.8	2730843.5	11	70	-59

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

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TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
2	0+84	107+27.4	27.7' LT	862034.4	2730849.0	11	70	-59
2	0+91	107+34.4	27.8' LT	862039.0	2730854.2	11	70	-59
2	0+98	107+41.4	27.9' LT	862043.6	2730859.5	11	70	-59
2	1+05	107+48.4	28.0' LT	862048.2	2730864.8	11	70	-59
2	1+12	107+55.3	28.1' LT	862052.8	2730870.0	11	69	-58
2	1+19	107+62.3	28.2' LT	862057.4	2730875.2	11	70	-59
2	1+26	107+69.3	28.3' LT	862062.0	2730880.5	11	70	-59
2	1+33	107+76.2	28.4' LT	862066.6	2730885.8	11	71	-60
2	1+40	107+83.2	28.5' LT	862071.2	2730891.2	11	71	-60
2	1+47	107+90.2	28.6' LT	862075.8	2730896.5	11	71	-60
2	1+54	107+97.2	28.7' LT	862080.4	2730901.8	11	71	-60
2	1+61	108+04.1	28.8' LT	862084.9	2730907.0	11	72	-61
2	1+68	108+11.1	28.9' LT	862089.6	2730912.2	11	73	-62
2	1+75	108+18.1	29.0' LT	862094.1	2730917.5	11	71	-60
2	1+82	108+25.0	29.1' LT	862098.8	2730922.8	11	69	-58
2	1+89	108+32.0	29.2' LT	862103.3	2730928.0	11	69	-58
2	1+96	108+39.0	29.3' LT	862107.9	2730933.5	11	68	-57
2	2+03	108+45.9	29.4' LT	862112.5	2730938.8	11	68	-57
2	2+10	108+52.9	29.5' LT	862117.1	2730944.0	11	68	-57
2	2+17	108+59.9	29.6' LT	862121.7	2730949.2	11	68	-57
2	2+24	108+66.9	29.7' LT	862126.3	2730954.5	11	68	-57
2	2+31	108+73.8	29.8' LT	862130.9	2730959.8	11	68	-57
2	2+38	108+80.8	29.8' LT	862135.5	2730965.0	11	68	-57
2	2+45	108+87.8	29.9' LT	862140.1	2730970.2	11	68	-57
2	2+52	108+94.7	30.0' LT	862144.7	2730975.8	11	68	-57
2	2+59	109+01.7	30.1' LT	862149.2	2730981.0	11	68	-57
2	2+66	109+08.7	30.2' LT	862153.9	2730986.2	11	68	-57
2	2+73	109+15.6	30.3' LT	862158.4	2730991.5	11	68	-57
2	2+80	109+22.6	30.4' LT	862163.1	2730996.8	11	68	-57
2	2+87	109+29.6	30.5' LT	862167.6	2731002.0	11	68	-57
2	2+94	109+36.6	30.6' LT	862172.2	2731007.2	11	68	-57
2	3+01	109+43.5	30.7' LT	862176.8	2731012.8	11	68	-57
2	3+08	109+50.5	30.8' LT	862181.4	2731018.0	11	68	-57

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

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TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
3	0+00	101+05.9	26.8' LT	861627.5	2730378.8	11	48	-37
3	0+07	101+12.9	26.8' LT	861632.1	2730384.0	11	47	-36
3	0+14	101+20.0	26.8' LT	861636.7	2730389.2	11	47	-36
3	0+21	101+27.0	26.8' LT	861641.2	2730394.8	11	48	-37
3	0+28	101+34.0	26.8' LT	861645.8	2730400.0	11	46	-35
3	0+35	101+41.1	26.8' LT	861650.4	2730405.2	11	46	-35
3	0+42	101+48.1	26.8' LT	861655.0	2730410.5	11	46	-35
3	0+49	101+55.1	26.8' LT	861659.6	2730415.8	11	46	-35
3	0+56	101+62.2	26.8' LT	861664.1	2730421.0	11	46	-35
3	0+63	101+69.2	26.8' LT	861668.7	2730426.5	11	46	-35
3	0+70	101+76.2	26.8' LT	861673.3	2730431.8	11	46	-35
3	0+77	101+83.3	26.8' LT	861677.9	2730437.0	10	47	-36
3	0+84	101+90.3	26.8' LT	861682.4	2730442.2	10	49	-39
3	0+91	101+97.3	26.8' LT	861687.0	2730447.5	10	49	-39
3	0+98	102+04.4	26.8' LT	861691.6	2730453.0	10	51	-41
3	1+05	102+11.4	26.8' LT	861696.2	2730458.2	10	54	-43
3	1+12	102+18.4	26.8' LT	861700.8	2730463.5	10	54	-43
3	1+19	102+25.5	26.8' LT	861705.3	2730468.8	10	54	-44
3	1+26	102+32.5	26.8' LT	861709.9	2730474.0	10	53	-43
3	1+33	102+39.5	26.8' LT	861714.5	2730479.2	10	51	-41
3	1+40	102+46.6	26.8' LT	861719.1	2730484.8	10	50	-40
3	1+47	102+53.6	26.8' LT	861723.6	2730490.0	10	49	-39
3	1+54	102+60.6	26.8' LT	861728.2	2730495.2	10	48	-38
3	1+61	102+67.7	26.8' LT	861732.8	2730500.5	10	48	-38
3	1+68	102+74.7	26.9' LT	861737.4	2730505.8	10	47	-37
3	1+75	102+81.8	26.9' LT	861741.9	2730511.0	10	48	-38
3	1+82	102+88.8	26.9' LT	861746.6	2730516.5	10	50	-40
3	1+89	102+95.8	26.9' LT	861751.1	2730521.8	10	51	-41
3	1+96	103+02.9	26.9' LT	861755.7	2730527.0	10	52	-42
3	2+03	103+09.9	26.9' LT	861760.3	2730532.2	10	52	-42
3	2+10	103+16.9	26.9' LT	861764.9	2730537.5	10	53	-43
3	2+17	103+24.0	26.9' LT	861769.4	2730543.0	10	56	-46
3	2+24	103+31.0	26.9' LT	861774.0	2730548.2	10	58	-48

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
3	2+31	103+38.0	26.9' LT	861778.6	2730553.5	10	61	-51
3	2+38	103+45.1	26.9' LT	861783.2	2730558.8	10	61	-51
3	2+45	103+52.1	26.9' LT	861787.8	2730564.0	10	61	-51
3	2+52	103+59.1	26.9' LT	861792.3	2730569.2	10	61	-51
3	2+59	103+66.2	26.9' LT	861796.9	2730574.8	10	61	-51
3	2+66	103+73.2	26.9' LT	861801.5	2730580.0	10	61	-51
3	2+73	103+80.2	26.9' LT	861806.1	2730585.2	10	61	-51
3	2+80	103+87.3	26.9' LT	861810.6	2730590.5	10	61	-51
3	2+87	103+94.3	26.9' LT	861815.2	2730595.8	10	61	-51
3	2+94	104+01.3	26.9' LT	861819.8	2730601.2	11	61	-51
3	3+01	104+08.4	26.9' LT	861824.4	2730606.5	11	61	-51
3	3+08	104+15.4	26.9' LT	861828.9	2730611.8	11	61	-51
3	3+15	104+22.4	26.9' LT	861833.6	2730617.0	11	61	-51
3	3+22	104+29.5	26.9' LT	861838.1	2730622.2	11	61	-50
3	3+29	104+36.5	26.9' LT	861842.7	2730627.5	11	61	-50
4	0+00	100+98.8	27.7' RT	861664.1	2730337.8	11	43	-32
4	0+07	101+05.8	27.7' RT	861668.7	2730343.0	11	43	-32
4	0+14	101+12.8	27.7' RT	861673.3	2730348.2	11	43	-33
4	0+21	101+19.8	27.7' RT	861677.9	2730353.5	11	43	-33
4	0+28	101+26.8	27.7' RT	861682.4	2730359.0	11	43	-32
4	0+35	101+33.8	27.7' RT	861687.1	2730364.2	11	42	-31
4	0+42	101+40.8	27.8' RT	861691.6	2730369.5	11	42	-32
4	0+49	101+47.8	27.8' RT	861696.2	2730374.8	11	42	-31
4	0+56	101+54.8	27.8' RT	861700.8	2730380.0	11	41	-30
4	0+63	101+61.8	27.8' RT	861705.4	2730385.2	11	41	-31
4	0+70	101+68.8	27.8' RT	861709.9	2730390.8	11	42	-31
4	0+77	101+75.8	27.8' RT	861714.6	2730396.0	10	43	-33
4	0+84	101+82.8	27.8' RT	861719.1	2730401.2	10	45	-34
4	0+91	101+89.8	27.8' RT	861723.7	2730406.5	10	46	-36
4	0+98	101+96.8	27.8' RT	861728.3	2730411.8	10	49	-39
4	1+05	102+03.8	27.8' RT	861732.9	2730417.0	10	52	-42
4	1+12	102+10.8	27.8' RT	861737.4	2730422.5	10	53	-43
4	1+19	102+17.8	27.8' RT	861742.1	2730427.8	10	53	-43

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
4	1+26	102+24.8	27.9' RT	861746.6	2730433.0	10	54	-44
4	1+33	102+31.8	27.9' RT	861751.2	2730438.2	10	56	-46
4	1+40	102+38.8	27.9' RT	861755.8	2730443.5	10	57	-47
4	1+47	102+45.8	27.9' RT	861760.4	2730448.8	10	57	-47
4	1+54	102+52.8	27.9' RT	861764.9	2730454.2	10	57	-47
4	1+61	102+59.8	27.9' RT	861769.6	2730459.5	10	57	-47
4	1+68	102+66.8	27.9' RT	861774.1	2730464.8	10	56	-46
4	1+75	102+73.8	27.9' RT	861778.7	2730470.0	10	56	-46
4	1+82	102+80.8	27.9' RT	861783.3	2730475.2	10	57	-47
4	1+89	102+87.8	27.9' RT	861787.9	2730480.5	10	57	-47
4	1+96	102+94.8	27.9' RT	861792.4	2730486.0	10	57	-47
4	2+03	103+01.8	27.9' RT	861797.1	2730491.2	10	57	-47
4	2+10	103+08.8	28.0' RT	861801.6	2730496.5	10	58	-48
4	2+17	103+15.8	28.0' RT	861806.2	2730501.8	10	58	-48
4	2+24	103+22.8	28.0' RT	861810.8	2730507.0	10	58	-48
4	2+31	103+29.8	28.0' RT	861815.4	2730512.2	10	58	-48
4	2+38	103+36.8	28.0' RT	861819.9	2730517.8	10	58	-48
4	2+45	103+43.8	28.0' RT	861824.6	2730523.0	10	58	-48
4	2+52	103+50.8	28.0' RT	861829.1	2730528.2	10	58	-48
4	2+59	103+57.8	28.0' RT	861833.7	2730533.5	10	58	-48
4	2+66	103+64.8	28.0' RT	861838.3	2730538.8	10	58	-48
4	2+73	103+71.8	28.0' RT	861842.9	2730544.0	10	58	-48
4	2+80	103+78.8	28.0' RT	861847.4	2730549.5	10	58	-48
4	2+87	103+85.8	28.0' RT	861852.1	2730554.8	10	58	-48
4	2+94	103+92.8	28.1' RT	861856.6	2730560.0	11	58	-47
4	3+01	103+99.8	28.1' RT	861861.2	2730565.2	11	58	-48
4	3+08	104+06.8	28.1' RT	861865.8	2730570.5	11	59	-48
4	3+15	104+13.8	28.1' RT	861870.4	2730575.8	11	59	-48
4	3+22	104+20.8	28.1' RT	861874.9	2730581.0	11	60	-49
4	3+29	104+27.8	28.1' RT	861879.6	2730586.5	11	61	-50
5	-2+20	094+57.3	23.7' RT	861272.7	2729834.8	13	40	-28
5	-2+15	094+62.3	23.7' RT	861275.5	2729838.9	13	42	-29
5	-2+10	094+67.2	23.6' RT	861278.2	2729843.0	13	42	-29

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
5	-2+05	094+72.2	23.6' RT	861281.0	2729847.2	13	42	-29
5	-2+00	094+77.2	23.5' RT	861283.7	2729851.3	13	42	-29
5	-1+95	094+82.2	23.5' RT	861286.4	2729855.5	12	42	-30
5	-1+90	094+87.1	23.4' RT	861289.2	2729859.6	12	42	-30
5	-1+85	094+92.1	23.4' RT	861291.9	2729863.8	12	42	-30
5	-1+80	094+97.1	23.4' RT	861294.6	2729867.9	12	42	-30
5	-1+75	095+02.0	23.3' RT	861297.4	2729872.1	12	42	-30
5	-1+70	095+07.0	23.3' RT	861300.1	2729876.2	12	41	-29
5	-1+65	095+12.0	23.2' RT	861302.9	2729880.4	12	41	-28
5	-1+60	095+16.9	23.2' RT	861305.6	2729884.5	12	41	-28
5	-1+55	095+21.9	23.1' RT	861308.3	2729888.6	12	39	-27
5	-1+50	095+26.9	23.1' RT	861311.1	2729892.8	12	39	-27
5	-1+45	095+31.9	23.1' RT	861313.8	2729896.9	12	38	-26
5	-1+40	095+36.8	23.0' RT	861316.6	2729901.1	12	38	-26
5	-1+35	095+41.8	23.0' RT	861319.3	2729905.2	12	37	-25
5	-1+30	095+46.8	22.9' RT	861322.0	2729909.4	12	37	-24
5	-1+25	095+51.7	22.9' RT	861324.8	2729913.5	12	37	-24
5	-1+20	095+56.7	22.8' RT	861327.5	2729917.7	12	38	-26
5	-1+15	095+61.7	22.8' RT	861330.3	2729921.8	12	39	-26
5	-1+10	095+66.6	22.8' RT	861333.0	2729926.0	12	39	-27
5	-1+05	095+71.6	22.7' RT	861335.7	2729930.1	12	40	-28
5	-1+00	095+76.6	22.7' RT	861338.5	2729934.3	12	39	-27
5	-0+95	095+81.6	22.6' RT	861341.2	2729938.4	12	39	-26
5	-0+90	095+86.5	22.6' RT	861343.9	2729942.5	12	39	-26
5	-0+85	095+91.5	22.6' RT	861346.7	2729946.7	12	38	-26
5	-0+80	095+96.5	22.5' RT	861349.4	2729950.8	12	38	-25
5	-0+75	096+01.4	22.5' RT	861352.2	2729955.0	12	37	-25
5	-0+70	096+06.4	22.4' RT	861354.9	2729959.1	12	37	-25
5	-0+65	096+11.4	22.4' RT	861357.6	2729963.3	12	36	-24
5	-0+60	096+16.3	22.3' RT	861360.4	2729967.4	12	37	-25
5	-0+55	096+21.3	22.3' RT	861363.1	2729971.6	12	36	-24
5	-0+50	096+26.3	22.3' RT	861365.9	2729975.7	12	36	-24
5	-0+45	096+31.3	22.2' RT	861368.6	2729979.9	12	36	-24

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
5	-0+40	096+36.2	22.2' RT	861371.3	2729984.0	12	37	-25
5	-0+35	096+41.2	22.1' RT	861374.1	2729988.1	12	36	-24
5	-0+30	096+46.2	22.1' RT	861376.8	2729992.3	12	36	-24
5	-0+25	096+51.1	22.0' RT	861379.6	2729996.4	12	37	-25
5	-0+20	096+56.1	22.0' RT	861382.3	2730000.6	12	38	-25
5	-0+15	096+61.1	22.0' RT	861385.0	2730004.7	12	37	-25
5	-0+10	096+66.0	21.9' RT	861387.8	2730008.9	12	37	-25
5	-0+05	096+71.0	21.9' RT	861390.5	2730013.0	12	37	-25
5	0+00	096+77.3	20.9' RT	861392.2	2730018.2	12	37	-25
5	0+05	096+82.3	21' RT	861395.4	2730022.0	12	37	-24
5	0+10	096+87.4	21.2' RT	861398.6	2730026.0	12	38	-24
5	0+15	096+92.4	21.3' RT	861401.8	2730029.8	12	38	-24
5	0+20	096+97.5	21.4' RT	861405.0	2730033.5	12	38	-27
5	0+25	097+02.5	21.6' RT	861408.2	2730037.5	12	38	-27
5	0+30	097+07.6	21.7' RT	861411.4	2730041.2	12	38	-27
5	0+35	097+12.6	21.8' RT	861414.7	2730045.0	12	38	-27
5	0+40	097+17.6	22.0' RT	861417.9	2730049.0	12	38	-27
5	0+45	097+22.7	22.1' RT	861421.1	2730052.8	12	38	-27
5	0+50	097+27.7	22.2' RT	861424.3	2730056.5	12	38	-27
5	0+55	097+32.8	22.4' RT	861427.5	2730060.5	11	38	-27
5	0+60	097+37.8	22.5' RT	861430.7	2730064.2	11	38	-27
5	0+65	097+42.9	22.6' RT	861433.9	2730068.0	11	38	-27
5	0+70	097+47.9	22.8' RT	861437.1	2730072.0	11	38	-27
5	0+75	097+52.9	22.9' RT	861440.4	2730075.8	11	39	-27
5	0+80	097+58.0	23.0' RT	861443.6	2730079.5	11	39	-27
5	0+85	097+63.0	23.2' RT	861446.8	2730083.5	11	39	-28
5	0+90	097+68.1	23.3' RT	861450.0	2730087.2	11	41	-30
5	0+95	097+73.1	23.4' RT	861453.2	2730091.0	11	42	-31
5	1+00	097+78.2	23.6' RT	861456.4	2730095.0	11	42	-31
5	1+05	097+83.2	23.7' RT	861459.6	2730098.8	11	42	-31
5	1+10	097+88.2	23.8' RT	861462.8	2730102.5	11	42	-31
5	1+15	097+93.3	24.0' RT	861466.1	2730106.5	11	40	-29
5	1+20	097+98.3	24.1' RT	861469.2	2730110.2	11	39	-28

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
5	1+25	098+03.4	24.3' RT	861472.4	2730114.0	11	40	-29
5	1+30	098+08.4	24.4' RT	861475.7	2730118.0	11	41	-30
5	1+35	098+13.4	24.5' RT	861478.9	2730121.8	11	42	-31
5	1+40	098+18.5	24.7' RT	861482.1	2730125.5	11	42	-31
5	1+45	098+23.5	24.8' RT	861485.3	2730129.5	11	42	-31
5	1+50	098+28.6	24.9' RT	861488.5	2730133.2	11	42	-31
5	1+55	098+33.6	25.1' RT	861491.8	2730137.0	11	42	-31
5	1+60	098+38.7	25.2' RT	861494.9	2730141.0	11	42	-31
5	1+65	098+43.7	25.3' RT	861498.1	2730144.8	11	42	-31
5	1+70	098+48.7	25.5' RT	861501.4	2730148.5	11	42	-31
5	1+75	098+53.8	25.6' RT	861504.6	2730152.5	11	42	-31
5	1+80	098+58.8	25.7' RT	861507.8	2730156.2	11	42	-31
5	1+85	098+63.9	25.9' RT	861511.0	2730160.0	11	43	-32
5	1+90	098+68.9	26.0' RT	861514.2	2730164.0	11	43	-32
5	1+95	098+74.0	26.1' RT	861517.4	2730167.8	11	43	-32
5	2+00	098+79.0	26.3' RT	861520.6	2730171.5	11	43	-32
5	2+05	098+84.0	26.4' RT	861523.8	2730175.5	11	43	-32
5	2+10	098+89.1	26.5' RT	861527.1	2730179.2	11	43	-32
5	2+15	098+94.1	26.7' RT	861530.2	2730183.0	11	43	-32
5	2+20	098+99.2	26.8' RT	861533.4	2730187.0	11	43	-32
5	2+25	099+04.2	26.9' RT	861536.7	2730190.8	11	43	-32
5	2+30	099+09.3	27.1' RT	861539.9	2730194.5	11	43	-32
5	2+35	099+14.3	27.2' RT	861543.1	2730198.5	11	43	-32
6	0+00	096+87.6	29.9' LT	861357.3	2730056.5	13	35	-22
6	0+05	096+92.6	29.8' LT	861360.5	2730060.2	13	35	-22
6	0+10	096+97.5	29.8' LT	861363.6	2730064.2	13	35	-22
6	0+15	097+02.5	29.7' LT	861366.8	2730068.0	13	36	-24
6	0+20	097+07.4	29.6' LT	861370.0	2730072.0	13	38	-25
6	0+25	097+12.4	29.6' LT	861373.2	2730075.8	13	38	-25
6	0+30	097+17.3	29.5' LT	861376.3	2730079.8	13	38	-26
6	0+35	097+22.3	29.4' LT	861379.5	2730083.5	13	39	-26
6	0+40	097+27.2	29.4' LT	861382.7	2730087.5	12	39	-26
6	0+45	097+32.2	29.3' LT	861385.8	2730091.2	12	39	-27

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
6	0+50	097+37.1	29.2' LT	861389.0	2730095.2	12	38	-26
6	0+55	097+42.1	29.2' LT	861392.2	2730099.0	12	38	-26
6	0+60	097+47.0	29.1' LT	861395.4	2730103.0	12	39	-27
6	0+65	097+52.0	29.0' LT	861398.5	2730106.8	12	39	-26
6	0+70	097+56.9	28.9' LT	861401.7	2730110.8	12	38	-26
6	0+75	097+61.9	28.9' LT	861404.9	2730114.5	12	37	-26
6	0+80	097+66.9	28.8' LT	861408.1	2730118.2	12	38	-26
6	0+85	097+71.8	28.7' LT	861411.2	2730122.2	12	36	-24
6	0+90	097+76.8	28.7' LT	861414.4	2730126.0	11	36	-24
6	0+95	097+81.7	28.6' LT	861417.6	2730130.0	11	36	-25
6	1+00	097+86.7	28.5' LT	861420.7	2730133.8	11	36	-25
6	1+05	097+91.6	28.5' LT	861423.9	2730137.8	11	38	-27
6	1+10	097+96.6	28.4' LT	861427.1	2730141.5	11	37	-26
6	1+15	098+01.5	28.3' LT	861430.2	2730145.5	11	36	-25
6	1+20	098+06.5	28.3' LT	861433.4	2730149.2	11	35	-24
6	1+25	098+11.4	28.2' LT	861436.6	2730153.2	11	35	-24
6	1+30	098+16.4	28.1' LT	861439.8	2730157.0	11	36	-25
6	1+35	098+21.3	28.1' LT	861442.9	2730161.0	11	38	-27
6	1+40	098+26.3	28.0' LT	861446.1	2730164.8	11	39	-28
6	1+45	098+31.2	27.9' LT	861449.2	2730168.8	11	40	-29
6	1+50	098+36.2	27.9' LT	861452.4	2730172.5	11	40	-29
6	1+55	098+41.1	27.8' LT	861455.6	2730176.2	11	40	-29
6	1+60	098+46.1	27.7' LT	861458.8	2730180.2	11	40	-29
6	1+65	098+51.1	27.7' LT	861461.9	2730184.0	11	40	-29
6	1+70	098+56.0	27.6' LT	861465.1	2730188.0	11	40	-29
6	1+75	098+61.0	27.5' LT	861468.2	2730191.8	11	39	-28
6	1+80	098+65.9	27.4' LT	861471.4	2730195.8	11	40	-29
6	1+85	098+70.9	27.4' LT	861474.6	2730199.5	11	40	-29
6	1+90	098+75.8	27.3' LT	861477.8	2730203.5	11	41	-30
6	1+95	098+80.8	27.2' LT	861480.9	2730207.2	11	41	-30
6	2+00	098+85.7	27.2' LT	861484.1	2730211.2	11	42	-31
6	2+05	098+90.7	27.1' LT	861487.2	2730215.0	11	42	-31
6	2+10	098+95.6	27.0' LT	861490.4	2730219.0	11	42	-31

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Seismic Line	HRGS Station (ft)	Approx. MassDOT Station (ft)	Approx MassDOT Offset (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Bedrock Depth (ft)	Bedrock Elevation (ft)
6	2+15	099+00.6	27.0' LT	861493.6	2730222.8	11	42	-31
6	2+20	099+05.5	26.9' LT	861496.8	2730226.8	11	42	-31
6	2+25	099+10.5	26.8' LT	861499.9	2730230.5	11	42	-31
6	2+30	099+15.4	26.8' LT	861503.1	2730234.2	11	42	-31
6	2+35	099+20.4	26.7' LT	861506.3	2730238.2	11	42	-31

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to Massachusetts State Plane NAD83 in US survey feet. Elevations and MassDOT stationing /offsets along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

HRGS

TABLE 2
COMPARISON OF ELEVATIONS BETWEEN
SEISMIC DATA AND BORINGS
CAUSEWAY EXPLORATION
BRIDGES M-05-001=W-06-013 & W-06-016
MARION/WAREHAM, MASSACHUSETTS

Location of Boring Relative to Seismic Line				Bedrock Elevations (feet)		Bedrock Depth from Boring (feet)	Difference	
Seismic Line and Station		Boring	Distance from Seismic Line To Boring	Seismic Line	Boring		Feet	Percent
Line 1	0+00	BB-12	16' WNW	-59	-51	62	8	13
Line 1	1+61	BB-39	8' NW	-49	-53	64	-4	7
Line 2	0+00	BB-11	21' N	-59	-59	70	0	0
Line 2	0+81	BB-37	6' SE	-59	-57	67	2	3
Line 2	1+56	BB-38	2' SE	-60	-54	65	6	10
Line 3	0+98	BB-14	9' SE	-41	-36	46	5	11
Line 3	2+27	BB-15	9' SE	-48	-45	55	3	5
Line 3	3+29	BB-7	26' NE	-50	-50	60	1	1
Line 4	0+88	BB-16	10' NW	-36	-34	44	2	4
Line 4	2+12	BB-13	11' NW	-48	-46	56	1	2
Line 5	-1+76	BB-29	0'	-30	-28	40	3	6
Line 5	2+35	BB-2	22' N	-32	-31	41	1	2
Line 6	0+13	BB-31	3' SE	-24	-21	33	3	9
Line 6	0+89	BB-32	1' SE	-24	-19	30	5	17
Line 6	2+35	BB-1	16' ENE	-31	-29	40	2	6
				Average			2	6
				Standard Deviation			3	5

Each listed difference in feet reflects the absolute difference between bedrock elevation determined seismically and at a nearby boring. Each percentage difference was calculated by dividing the absolute difference in feet by the depth of bedrock reported for the nearby boring. Only borings located less than about 25 feet from a seismic line were used in this comparison. Elevations along the seismic lines were determined from plans provided by H&A and are relative to the NAVD 1988 datum.

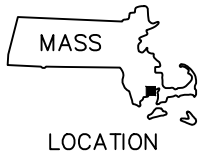


N

H-R

APPROXIMATE SCALE (feet)

0 1000 2000



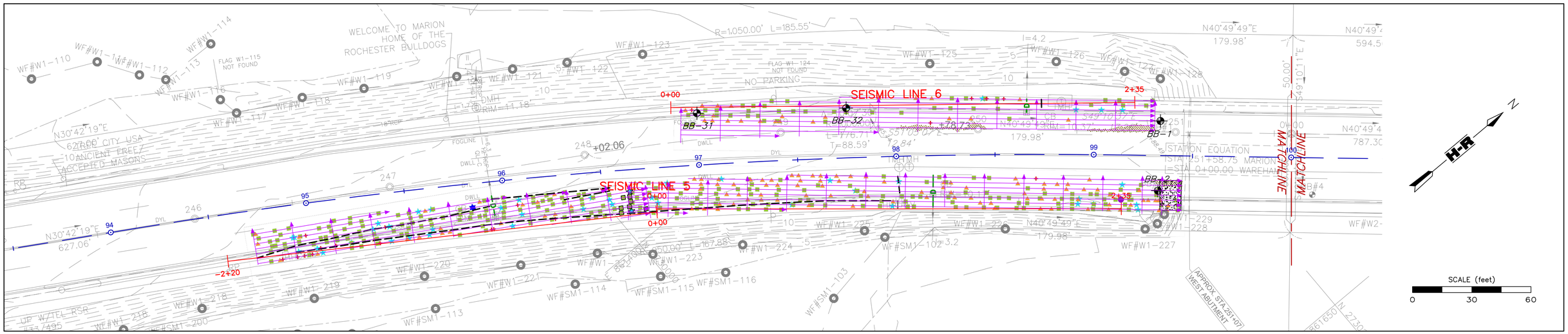
LOCATION

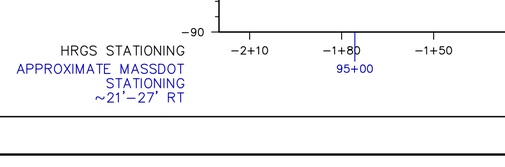
NOTE:

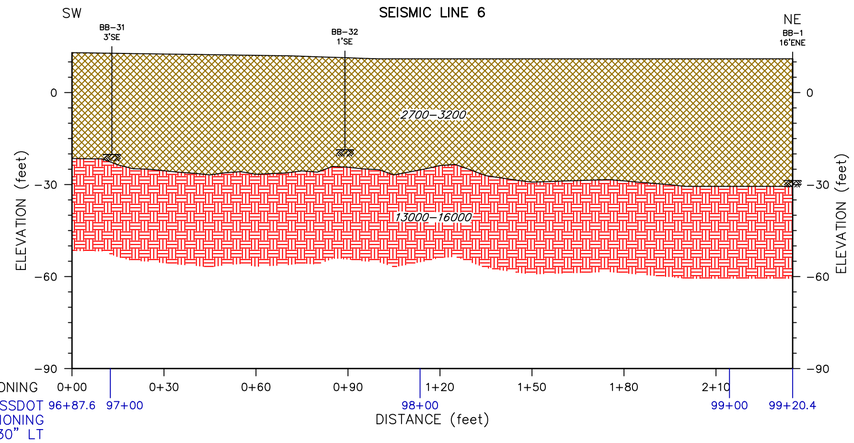
Modified from Google Earth Pro aerial photograph.

Figure 1
General Site Location
Causeway Exploration
Bridges M-05-001=W-06-013 & W-06-016
Marion/Wareham, Massachusetts

File 24PG12	September, 2024
HRGS	**Atkinson, NH** **Fords, NJ**







SEISMIC LEGEND

- Seismic line
- Unsaturated/ saturated soils
- Bedrock
- 13200–16300 — Velocity (fps)
- Interface determined from seismic refraction data
- BB–1 16'ENE — Boring with identification, distance from traverse, and depth of bedrock based on logs provided by Haley & Aldrich, Inc.
- Boring

GPR LEGEND

- GPR traverse
- Drain line
- Possible utility
- Area of limited GPR signal penetration (SEE TEXT)
- Concrete structure
- Possible boulders depth range indicated
  - 0 to 3
  - 3 to 6
  - 6 to 9
  - 9 to 12
  - 12 to 15
  - 15 to 18

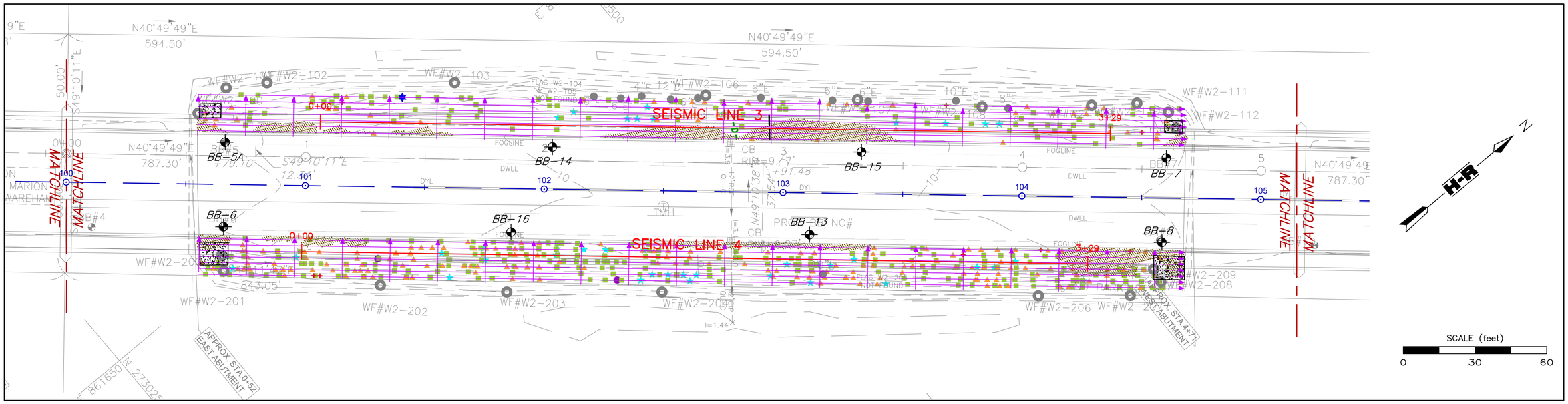
NOTES:

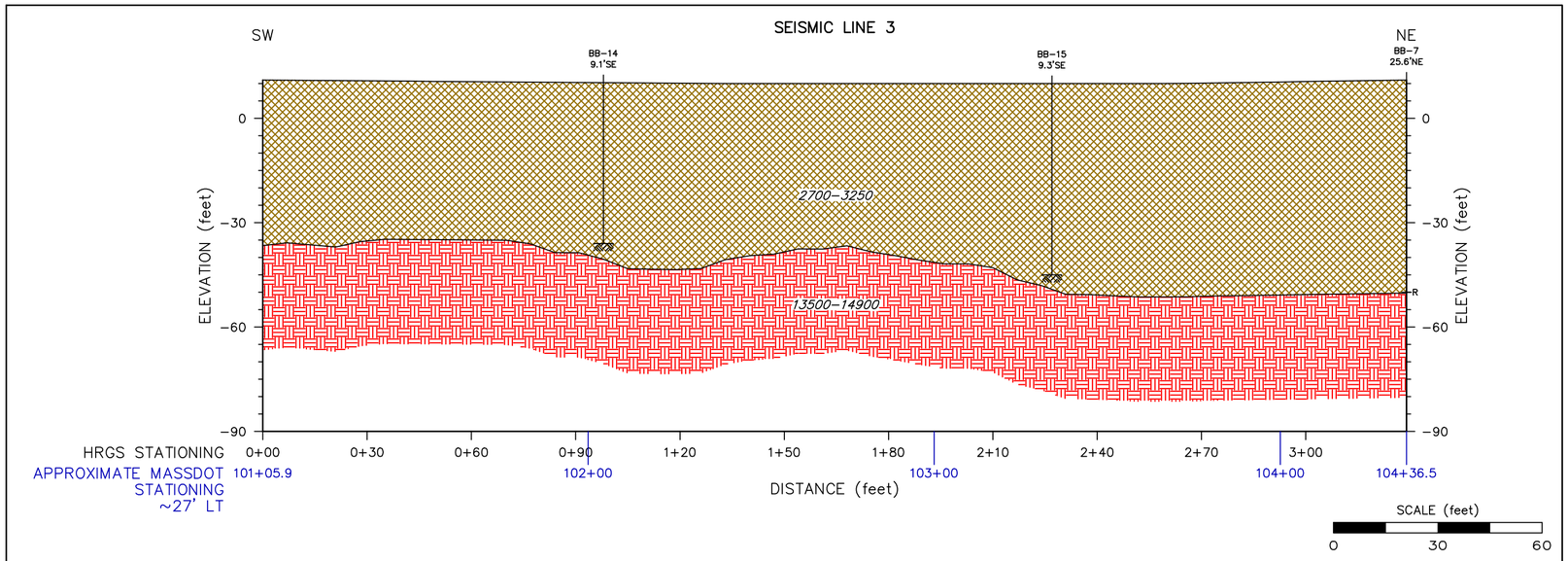
1. Modified from site plan provided by Haley & Aldrich, Inc., identified as 201717700ws_R11.dwg
2. Estimated accuracy (standard deviation) of depth of bedrock is ±10% or 2 feet, whichever is greater.
3. The depths determined for bedrock are depths of competent rock; weathered and/or fractured bedrock might occur at shallower depths.
4. Surface elevations estimated from plans provided by Haley & Aldrich, Inc.
5. Data were analyzed using the Generalized Reciprocal Method.

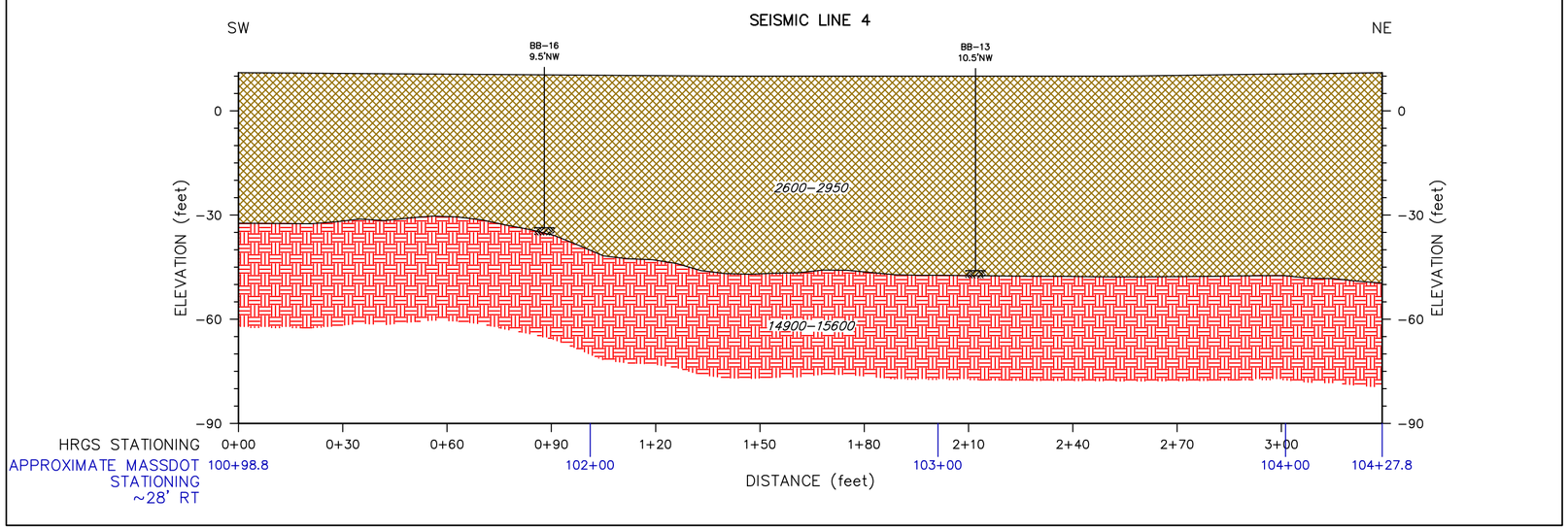
PLATE 1
GEOPHYSICAL SURVEY & INTEGRATED INTERPRETATION CAUSEWAY EXPLORATION
BRIDGES M–05–001=W–06–013 & W–06–016
MARION/WAREHAM, MASSACHUSETTS

FILE 24PG12 | SEPTEMBER, 2024

HRGS | Atkinson, NH Fords, NJ







SEISMIC LEGEND

- Seismic line
- Unsaturated/ saturated soils
- Bedrock
- 13200-16300 — Velocity (fps)
- Interface determined from seismic refraction data
- BB-1 16'ENE — Boring with identification, distance from traverse, and depth of bedrock based on logs provided by Haley & Aldrich, Inc.
- Boring

GPR LEGEND

- GPR traverse
- D — Drain line
- Possible utility
- Area of limited GPR signal penetration (SEE TEXT)
- Concrete structure
- Possible boulders depth range indicated
  - 0 to 3
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NOTES:

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3. The depths determined for bedrock are depths of competent rock; weathered and/or fractured bedrock might occur at shallower depths.
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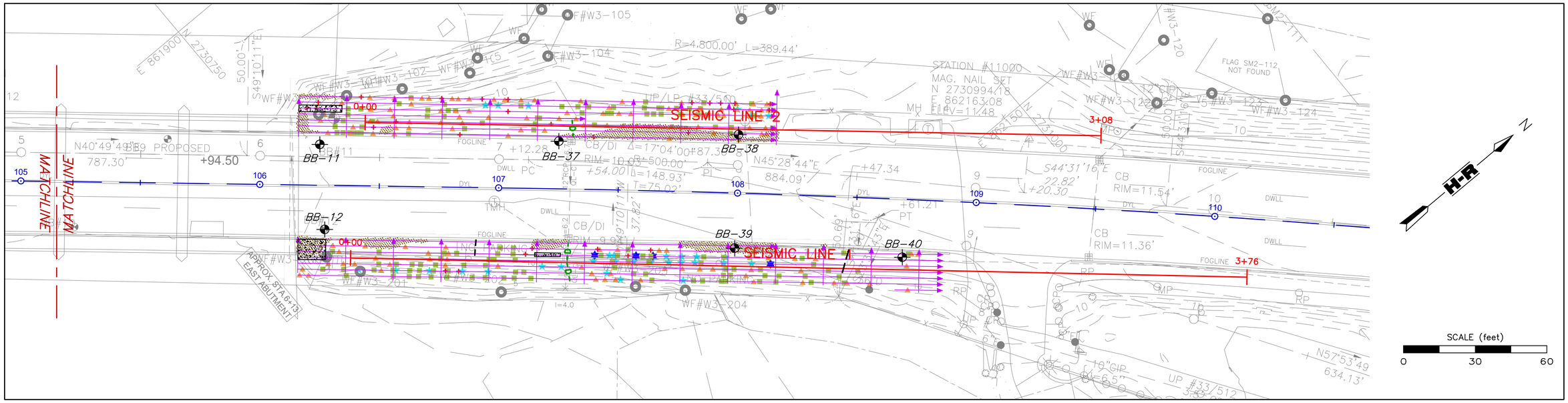
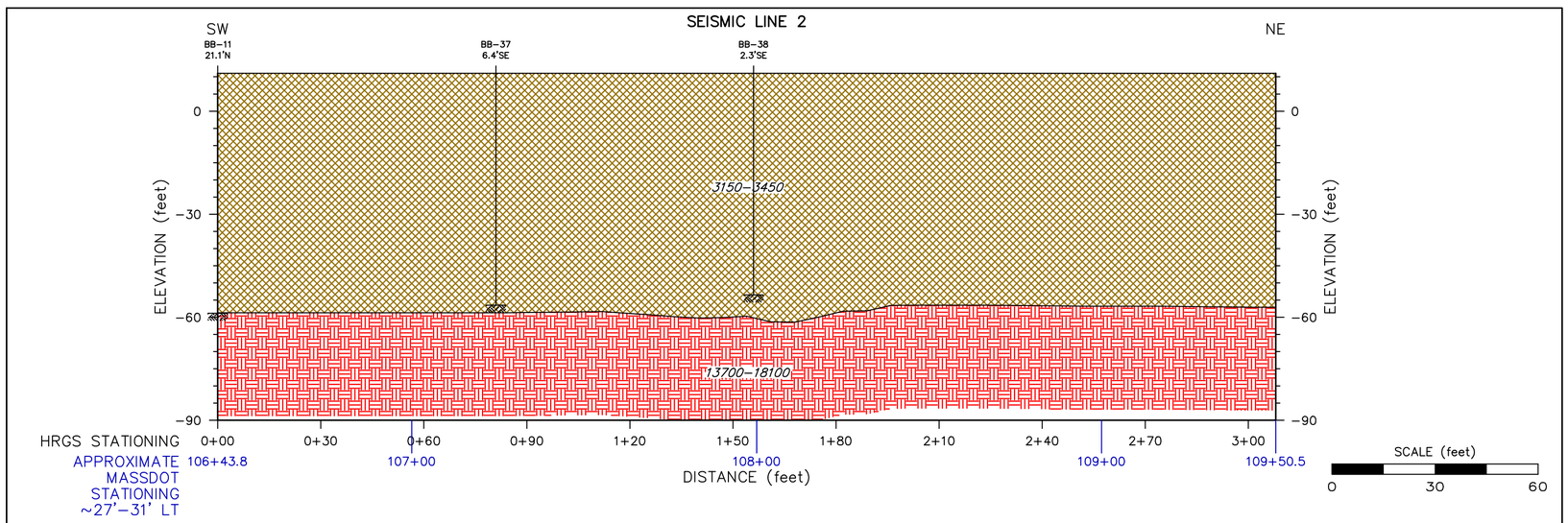
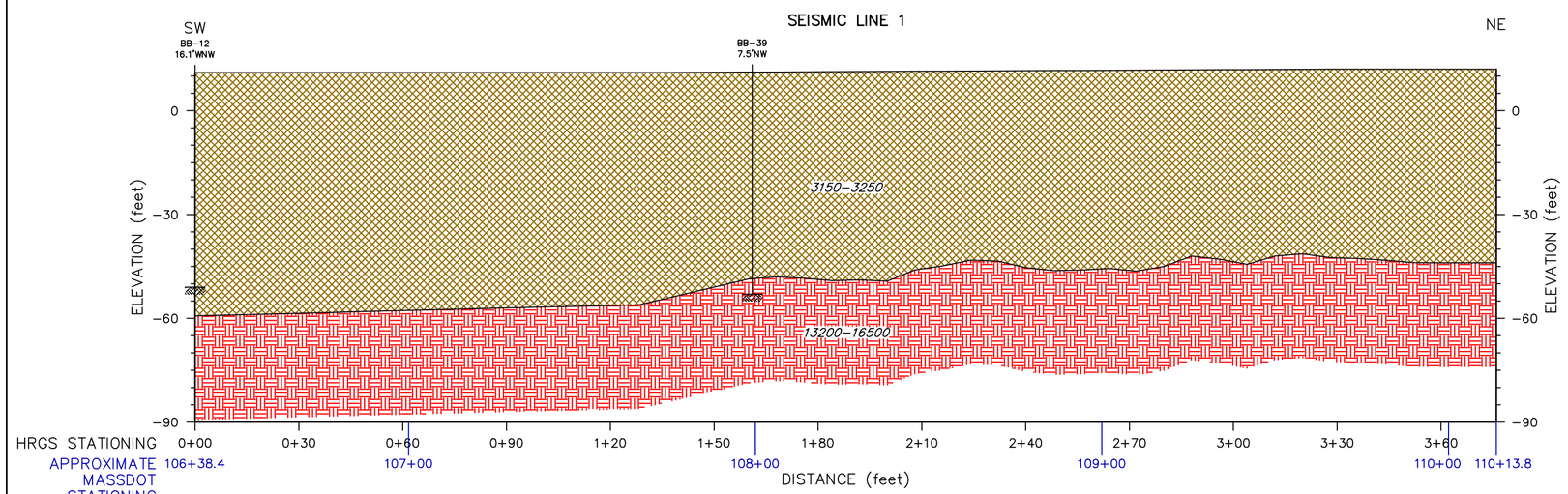
PLATE 2
GEOPHYSICAL SURVEY & INTEGRATED INTERPRETATION
CAUSEWAY EXPLORATION
BRIDGES M-05-001=W-06-013 & W-06-016
MARION/WAREHAM, MASSACHUSETTS

FILE 24PG12 | SEPTEMBER, 2024

HRGS | Atkinson, NH / Fords, NJ







SEISMIC LEGEND

- Seismic line
- Unsaturated/ saturated soils
- Bedrock
- 13200-16300 — Velocity (fps)
- Interface determined from seismic refraction data
- BB-1 16'ENE — Boring with identification, distance from traverse, and depth of bedrock based on logs provided by Haley & Aldrich, Inc.
- Boring

GPR LEGEND

- GPR traverse
- D — Drain line
- Possible utility
- Area of limited GPR signal penetration (SEE TEXT)
- Concrete structure
- 0 to 3
- 3 to 6
- 6 to 9
- 9 to 12
- 12 to 15
- 15 to 18

Possible boulders depth range indicated

NOTES:

1. Modified from site plan provided by Haley & Aldrich, Inc., identified as 201717700ws_R11.dwg
2. Estimated accuracy (standard deviation) of depth of bedrock is ±10% or 2 feet, whichever is greater.
3. The depths determined for bedrock are depths of competent rock; weathered and/or fractured bedrock might occur at shallower depths.
4. Surface elevations estimated from plans provided by Haley & Aldrich, Inc.
5. Data were analyzed using the Generalized Reciprocal Method.

PLATE 3
GEOPHYSICAL SURVEY & INTEGRATED INTERPRETATION CAUSEWAY EXPLORATION
BRIDGES M-05-001=W-06-013 & W-06-016
MARION/WAREHAM, MASSACHUSETTS

FILE 24PG12 | SEPTEMBER, 2024

HRGS | Atkinson, NH Fords, NJ

APPENDIX E
Geotechnical Laboratory Testing Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	14.6	11.9	22.3	28.2	21.7	1.3
□	0.0	11.4	16.0	10.4	15.9	21.1	23.0	2.2
△	0.0	0.0	24.3	13.3	19.1	22.7	18.5	2.1

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	BB-3	S01	0.0-2.0 ft.				13.1	33.47	0.87	SM
□	BB-3	S03	4.0-6.0 ft.				12.0	91.83	0.45	SM
△	BB-3	S05	8.0-10.0 ft.				7.0	69.57	0.70	SM

	Sample Description
○	Gray brown silty sand
□	Red yellow silty sand with gravel
△	Red yellow silty sand with gravel

Remarks:

HALEY ALDRICH

Bridge No. M-05-001 = W-06-013
Marion and Wareham, Massachusetts

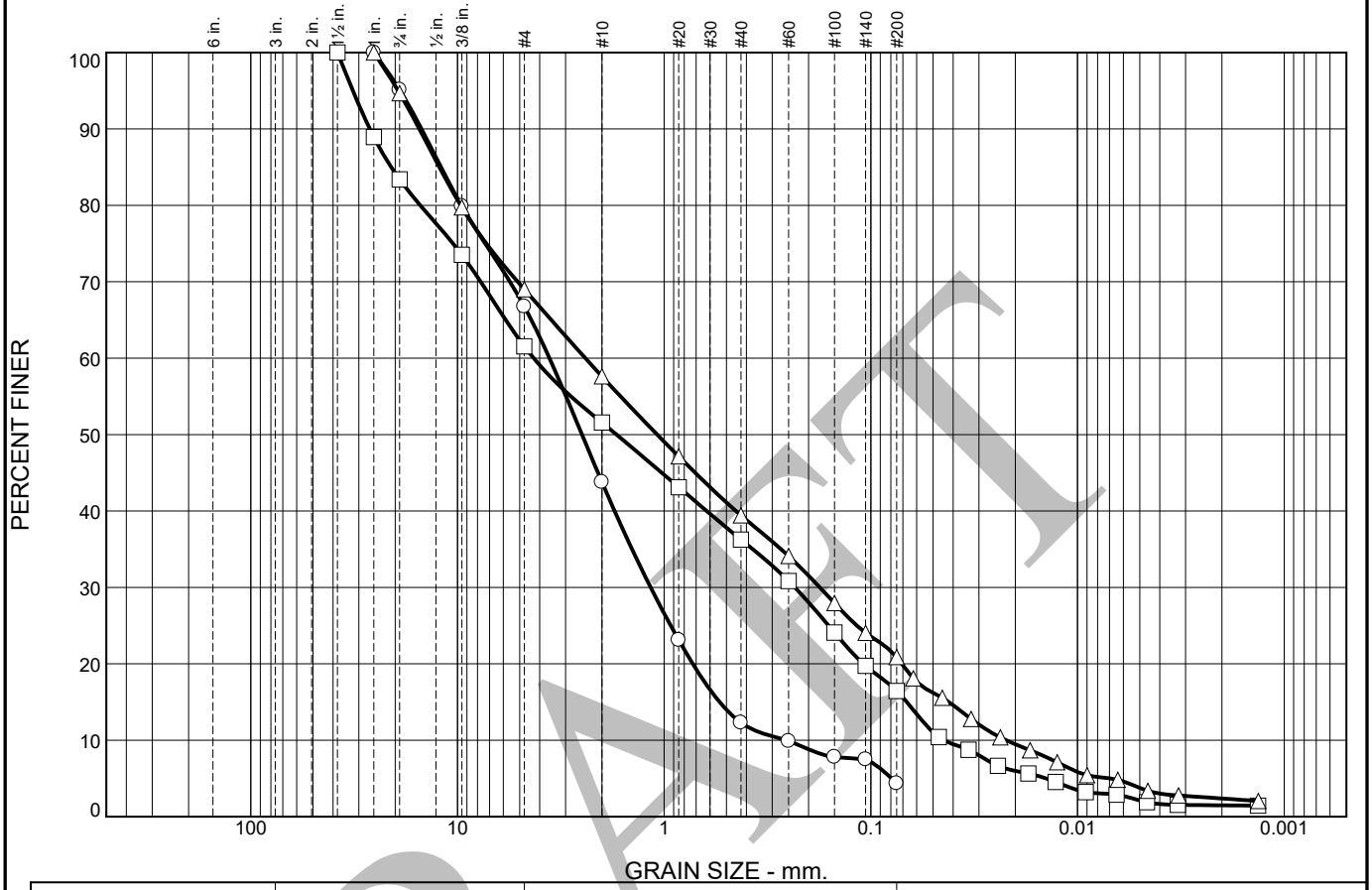
GRAIN SIZE DISTRIBUTION

DATE: 5/9/2018

FILE NO: 40991-005

DRAFT

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	4.9	28.3	23.0	31.5	8.0	4.3	
□	0.0	16.6	21.9	9.9	15.3	19.8	15.0	1.5
△	0.0	5.3	25.7	11.4	18.2	18.5	18.5	2.4

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	BB-4	S01	0.0-2.0 ft.				18.5	13.96	1.46	SW
□	BB-4	S03	4.0-6.0 ft.				9.7	96.55	0.29	SM
△	BB-4	S06	10.0-11.7 ft.				12.4	108.62	0.59	SM

	Sample Description
○	Dark gray well-graded sand with gravel
□	Yellow silty sand with gravel
△	Tan silty sand with gravel

Remarks:

HALEY ALDRICH

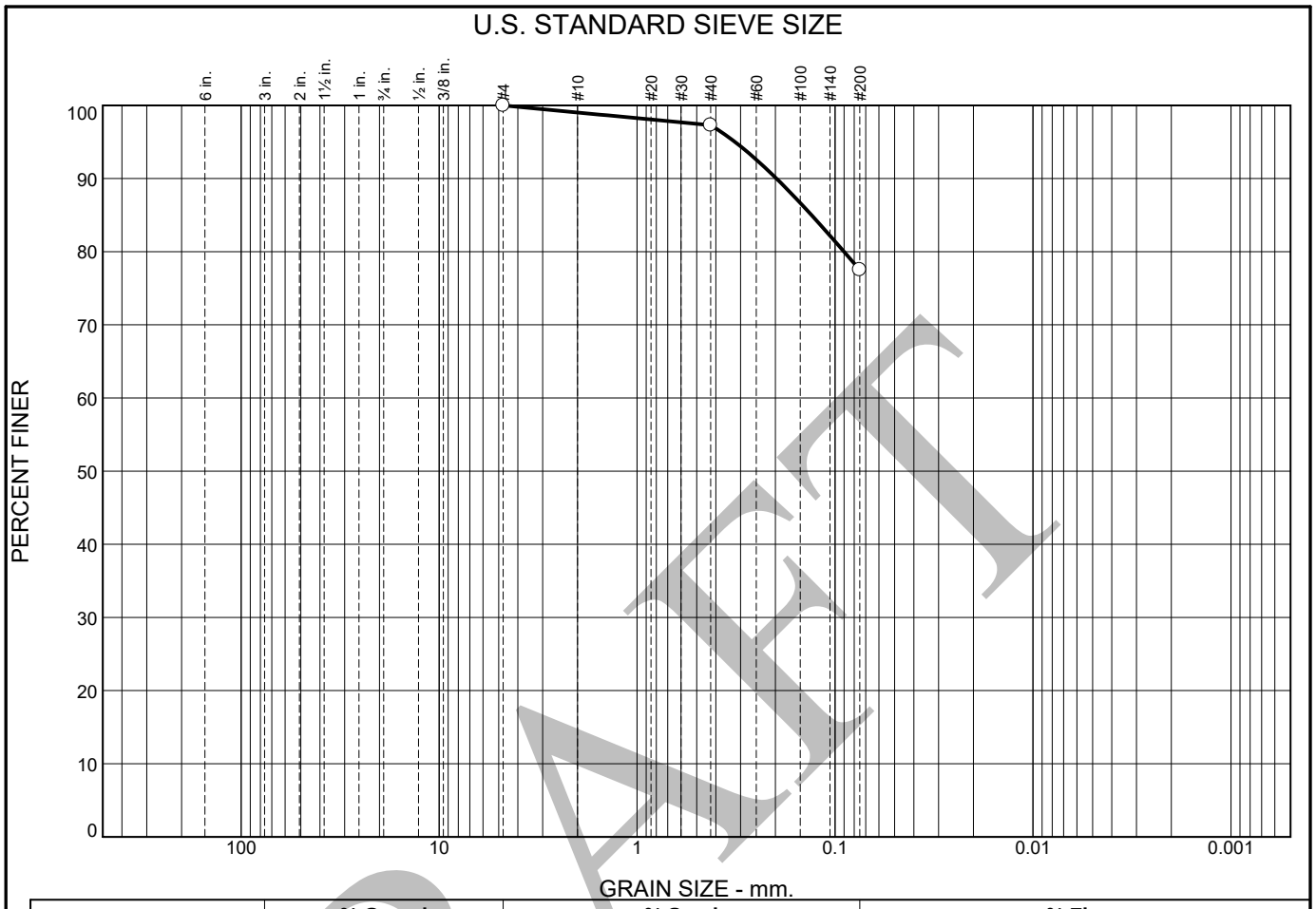
Bridge No. M-05-001 = W-06-013
Marion and Wareham, Massachusetts

GRAIN SIZE DISTRIBUTION

DATE: 5/9/2018

FILE NO: 40991-005

DRAFT



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	1.0	1.7	19.8	77.5	

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				W_L	W_P	I_P				
○	BB-6	S07	29.0-31.0 ft.				53.3			

	Sample Description
○	Dark brown organic silt with sand

Remarks:

○Organic Content = 3.1%

HALEY ALDRICH

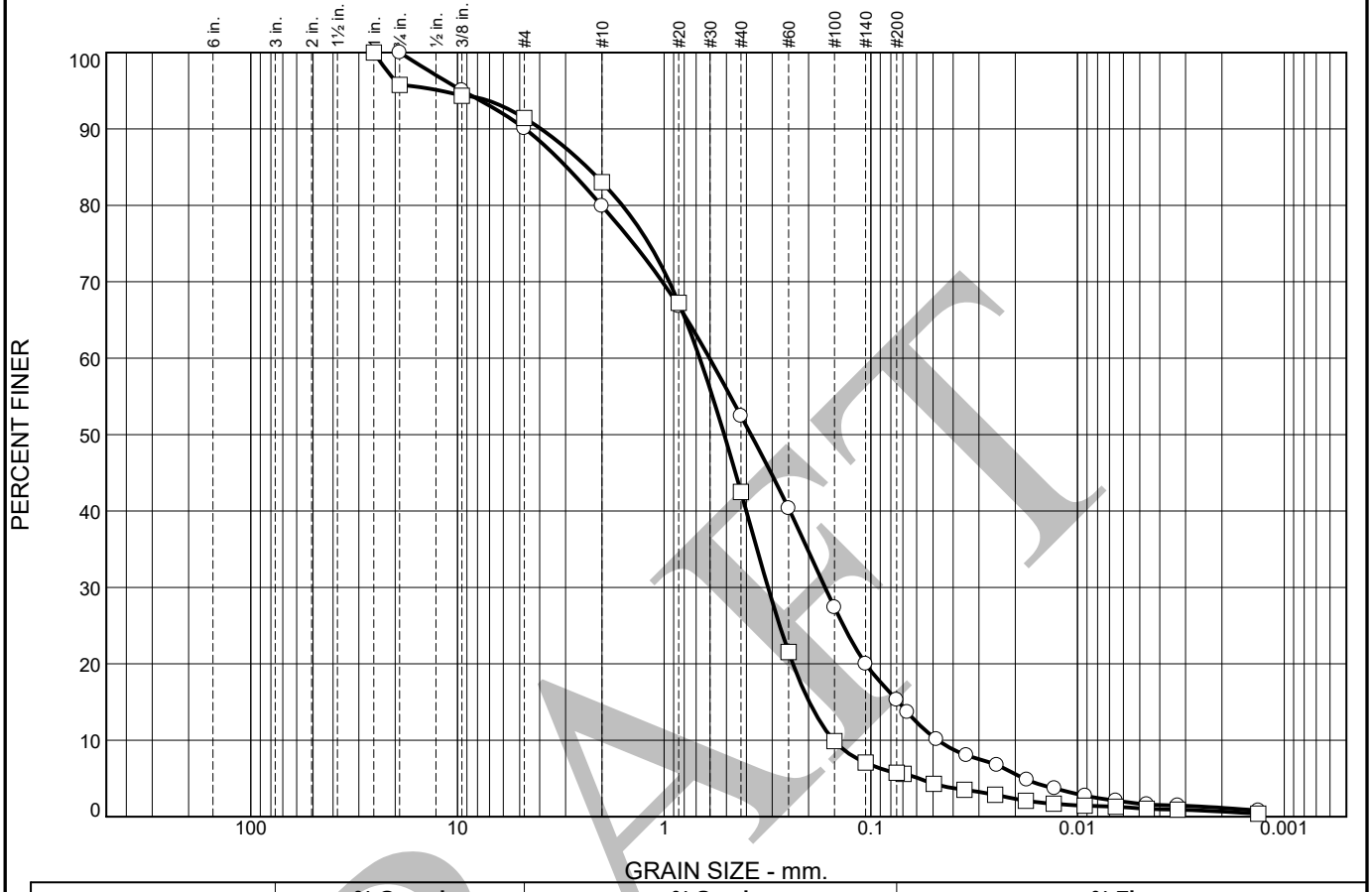
Bridge No. M-05-001 = W-06-013
Marion and Wareham, Massachusetts

GRAIN SIZE DISTRIBUTION

DATE: 5/9/2018 FILE NO: 40991-005

DRAFT

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	9.9	10.2	27.5	37.1	14.1	1.2
□	0.0	4.2	4.4	8.4	40.5	36.7	5.1	0.7

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	SS1		3.0-9.0 Inches				13.1	12.73	0.97	SM
□	SS2		3.0-9.0 inches				20.6	4.45	0.97	SP-SM

	Sample Description
○	Brown silty sand
□	Dark brown poorly graded sand with silt

Remarks:

Bridge Nos. M-05-013 = W-06-013 and W-06-016
Marion and Wareham, Massachusetts

HALEY ALDRICH

GRAIN SIZE DISTRIBUTION

DATE: 6/19/2018

FILE NO: 40991-005

DRAFT

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.4	10.0	34.2	42.3	5.6	0.5
□	0.0	3.6	6.1	9.3	18.3	57.7	4.3	0.7

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	Marion	Overbank	0.0-12.0 inches				23.8	5.13	0.86	SP-SM
□	Wareham	Overbank	0.0-12.0 inches				21.0	3.35	0.72	SP-SM

	Sample Description
○	Dark brown poorly graded sand with silt
□	Brown poorly graded sand with silt

Remarks:

Bridge Nos. M-05-013 = W-06-013 and W-06-016
Marion and Wareham, Massachusetts

HALEY ALDRICH

GRAIN SIZE DISTRIBUTION

DATE: 6/19/2018

FILE NO: 40991-005

DRAFT

HALEY ALDRICH

TEST DATE: 4/23/2018

ORGANIC CONTENT RESULTS

FILE No.:	**40991-005**
PROJECT:	**Bridge No. M-05-001 = W-06-013** **Marion and Wareham, Massachusetts**

EXPL. No.:	BB-6
SAMPLE No.:	S07
DEPTH (ft.):	29.0-31.0
SAMPLE DESCRIPTION:	Dark brown organic silt with sand

"AS RECEIVED" WATER CONTENT

WT CONT. + WET SAMPLE (g)	124.74
WT CONT. + DRY SAMPLE (g)	87.51
WT CONTAINER (g)	15.87
MOISTURE CONTENT (%)	**52.0**

LOSS ON IGNITION

WT CONTAINERS + OVEN DRY SAMPLE BEFORE COMBUSTION (g)	44.2752
WT CONTAINERS + OVEN DRY SAMPLE AFTER COMBUSTION (g)	43.8745
WT CONTAINER (CRUCIBLE + B CAN)	31.4815
ORGANIC CONTENT (%)	**3.1**

J:\Lab\GEOSYSW\40991-005.GEO\[BB-6 S07 Org Content.xls]Data Report

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

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Chicago
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Transmittal

TO:

Steven Gately

Haley & Aldrich, Inc.

465 Medford Street, Suite 2200

Charlestown, MA 02129

DATE: 5/11/2018	GTX NO: 308001
RE: Rt 6 Bridges W-06-013/W-06-016	

COPIES	DATE	DESCRIPTION
	5/11/2018	**May 2018 Laboratory Test Report**

REMARKS:

SIGNED:

Jonathan Campbell, Assistant Laboratory Manager

CC:

APPROVED BY:

Mark Dobday, P.G., Laboratory Manager

GeoTesting EXPRESS

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May 11, 2018

Steven Gately
Haley & Aldrich, Inc.
465 Medford Street, Suite 2200
Charlestown, MA 02129

RE: Rt 6 Bridges W-06-013/W-06-016, Wareham, MA (GTX-308001)

Dear Steven:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received two samples from you on 4/20/2018. These samples were labeled as follows:

Boring Number	Sample Number	Depth
BB-3	C2	16.3-16.8
BB-10	C1	30.5-31.2

GTX performed the following tests on these samples:

2 ASTM D7012 Method D- Elastic Moduli of Rock in Uniaxial Compression

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Jonathan Campbell
Assistant Laboratory Manager

GeoTesting EXPRESS

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Geotechnical Test Report **5/11/2018**

GTX-308001

Rt 6 Bridges W-06-013/W-06-016

Wareham, MA

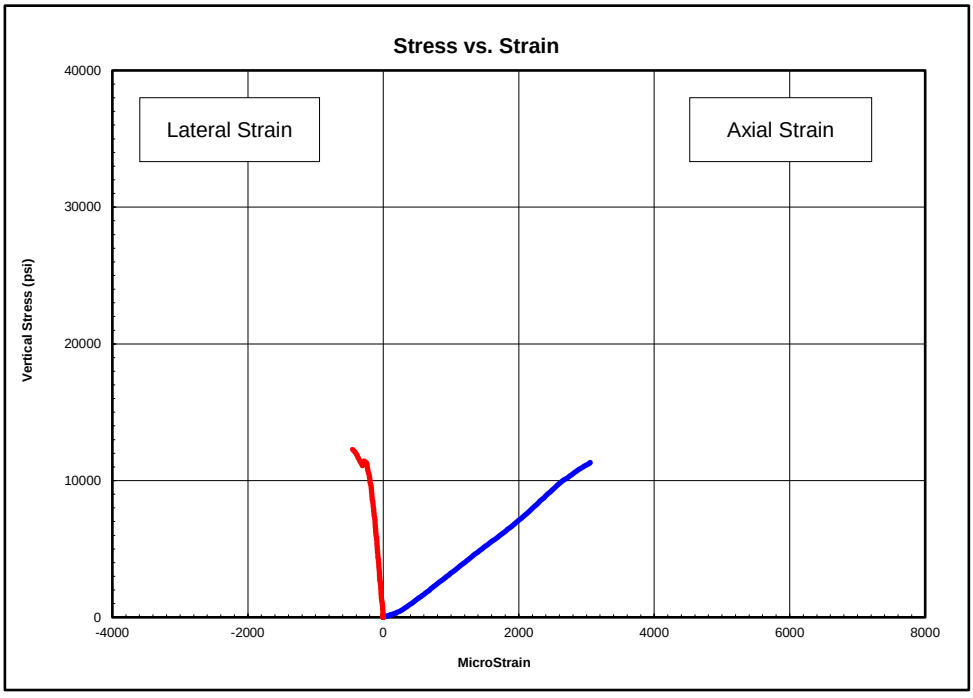
Client Project No.: 40991-005

Prepared for:

Haley & Aldrich, Inc.

Client:	Haley & Aldrich Inc.
Project Name:	Rt 6 Bridges W-06-013/W-06-016
Project Location:	Wareham, MA
GTX #:	308001
Test Date:	5/8/2018
Tested By:	pas
Checked By:	jsc
Boring ID:	BB-3
Sample ID:	C2
Depth, ft:	16.3-16.8
Sample Type:	rock core
Sample Description:	See photographs Discontinuity failure L/D < 2.0

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 11,421 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
1300-4900	3,870,000	0.07
4900-8400	3,990,000	0.08
8400-11900	1,110,000	0.08

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Haley & Aldrich Inc.	Test Date:	5/3/2018
Project Name:	Rt 6 Bridges W-06-013/W-06-016	Tested By:	pas
Project Location:	Wareham, MA	Checked By:	jsc
GTX #:	308001		
Boring ID:	BB-3		
Sample ID:	C2		
Depth:	16.3-16.8 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	3.85	3.85	3.85
Specimen Diameter, in:	1.98	1.98	1.98
Specimen Mass, g:	483.49		
Bulk Density, lb/ft^3	155	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	1.9	**Length to Diameter Ratio Tolerance Met?**	NO

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

END FLATNESS AND PARALLELISM (Procedure FP1)

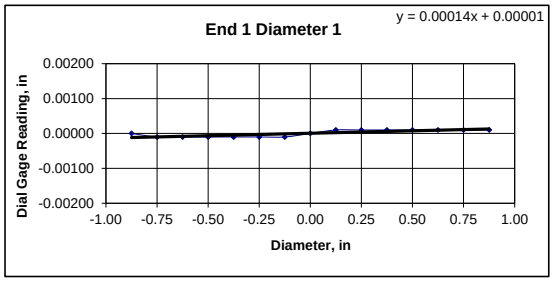
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010

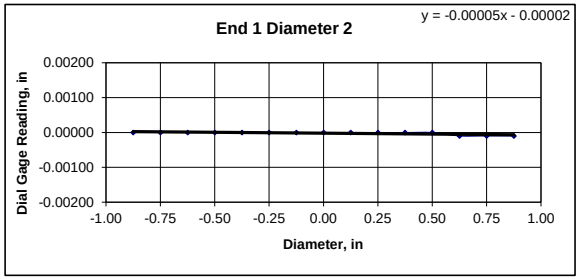
Difference between max and min readings, in:
0° = 0.00020 90° = 0.00010

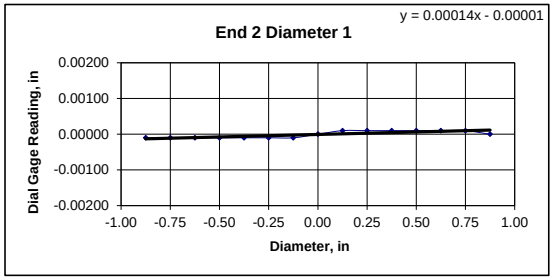
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010

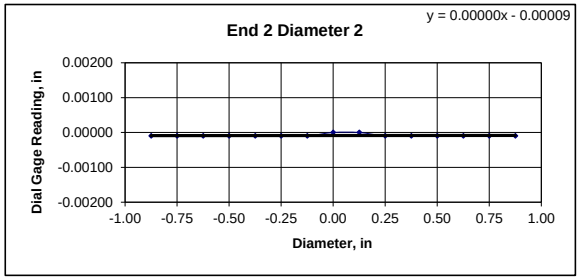
Difference between max and min readings, in:
0° = 0.0002 90° = 0.0001

Maximum difference must be < 0.0020 in. Difference = ± 0.00010
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00014
Angle of Best Fit Line: 0.00802

End 2:
Slope of Best Fit Line 0.00014
Angle of Best Fit Line: 0.00802

Maximum Angular Difference: 0.00000

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00005
Angle of Best Fit Line: 0.00295

End 2:
Slope of Best Fit Line 0.00000
Angle of Best Fit Line: 0.00016

Maximum Angular Difference: 0.00278

Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	1.980	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES
END 2					
Diameter 1, in	0.00020	1.980	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	Haley & Aldrich Inc.
Project Name:	Rt 6 Bridges W-06-013/W-06-016
Project Location:	Wareham, MA
GTX #:	308001
Test Date:	5/8/2018
Tested By:	pas
Checked By:	jsc
Boring ID:	BB-3
Sample ID:	C2
Depth, ft:	16.3-16.8

Direct Tensile Strength of Rock ASTM D2936
Performed On Concrete Cores



Before Testing



After Testing

308001

GeoTesting EXPRESS

ROCK CHAIN OF CUSTODY & TEST REQUEST

GeoTesting Express, Inc.
125 Nagog Park
Acton, MA 01720
800 434 1062 Toll Free
978 635 0266 Fax

2358 Perimeter Park Drive, Suite 320
Atlanta, GA 30341
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

CLIENT		INVOICE (complete if different from Client)	
Company: Haley & Aldrich, Inc.		Company:	
Address:		Address:	
City, State, Zip:		City, State, Zip:	
Contact:	Phone:	Contact:	Phone:
E-mail:	Cell:	E-mail:	Cell:

PROJECT		
Project Name: Route 6 Bridges W-06-013 and W-06-016	Client Project #: 40991-005	Purchase Order#:
Project Location: Marion and Wareham, MA	GTX Sales Order #:	Requested Turnaround:
On-site Contact: Steven Gately	E-mail: SGately@HaleyAldrich.com	Phone: 617-886-7314

ROCK			CERCHAR Abrasivity (ASTM D 7625) * 55HRC/40HRC	Direct Shear (ASTM D5607)*	Direct Tensile Strength (ASTM D 2936)	Elastic Moduli in Triaxial Compression (ASTM D 7012B)	Elastic Moduli in Uniaxial Compression (ASTM D 7012D)	Unit Weight (ISRM)	Petrographic Analysis (ISRM)	Point Load Index (ASTM D 5731)* Diametral, Axial, Lump/Block	Punch Penetration (Handewith)	Slake Durability (ASTM D 4644)	Splitting (Brazilian) Tensile Strength (ASTM D 3967)	Schmidt Hammer (ASTM D 5873)	Total Hardness (Schmidt Hammer and Taber Abrasion)	Triaxial Compression (ASTM D 7012A)	Unconfined Compression (ASTM D 7012C)	Other:	Other:
Core Run #	Sample ID	Depth																		
BB-3 C2		16.3-16.8					x													
~~BB-4 C1~~		~~18.3 to 18.6~~																x		
BB-10 C1		30.5-31.2					x													

*Specify Test Conditions (Undisturbed or Remolded, Density and Moisture, Test Normal Loads, Test Confining Stresses, etc.):

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: _____ **PRINT NAME:** _____ **DATE:** _____

For GTX Use Only
Incoming Sample Inspection Performed ☐
Adverse conditions: _____

Relinquished By:	**DATE:** 4/20/18	**Received By:** GTX	**DATE:** 4/20/18
	TIME: 10:52		**TIME:** 10:52 AM
Relinquished By:	**DATE:** 4/20/18	**Received By:**	**DATE:** 4/20/18
	TIME: 1:20 pm		**TIME:** 1:20 pm

GeoTesting EXPRESS

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

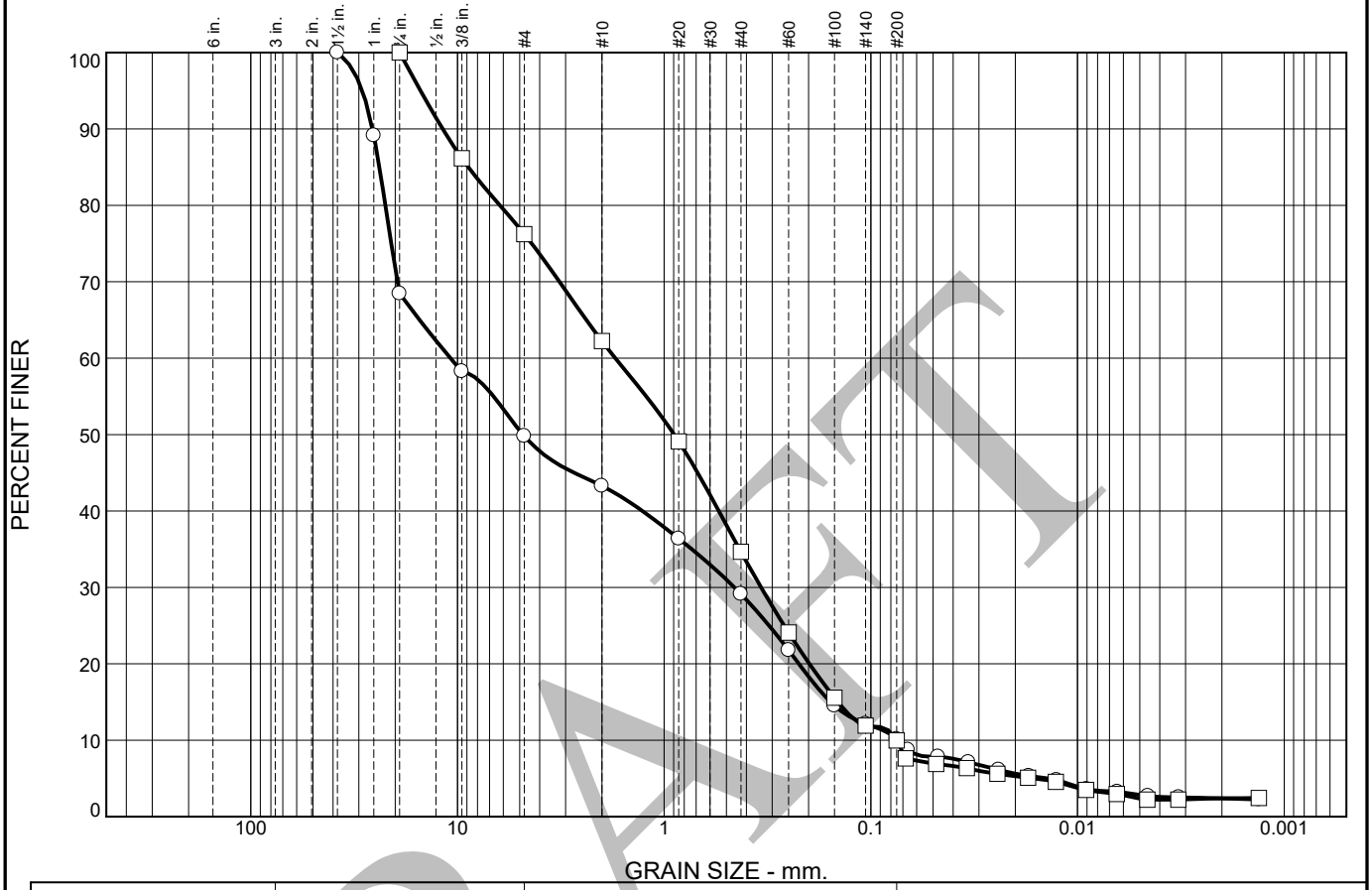
GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	31.5	18.7	6.5	14.2	18.9	7.8	2.4
□	0.0	0.0	23.8	14.0	27.5	24.7	7.6	2.4

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	BB-9	S01	0.0-2.0 ft.				65.5	146.20	0.26	GP-GM
□	BB-9	S03	4.5-6.5 ft.				31.2	22.95	0.89	SP-SM

	Sample Description
○	Light brown poorly graded gravel with silt and sand
□	Dark gray poorly graded sand with silt and gravel

Remarks:

Bridge No. W-06-016
Wareham, Massachusetts

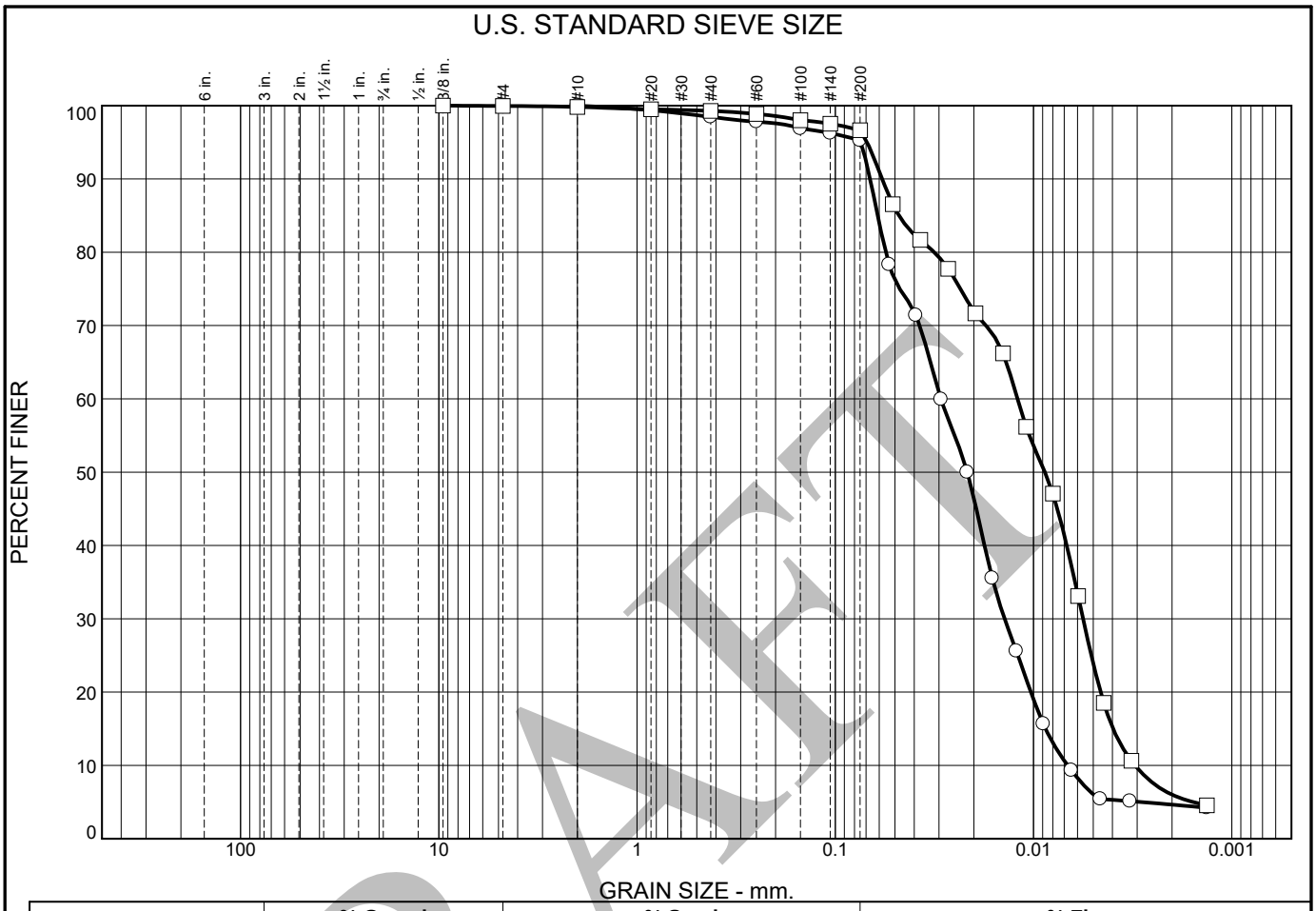
HALEY ALDRICH

GRAIN SIZE DISTRIBUTION

DATE: 5/9/2018

FILE NO: 40991-005

DRAFT



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	1.5	3.2	90.7	4.6
□	0.0	0.0	0.0	0.2	0.5	2.7	90.6	6.0

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				W_L	W_P	I_P				
○	BB-9	S04	6.5-8.5 ft.				32.3	4.36	0.99	ML
□	BB-9	S07	12.5-14.5 ft.				29.7	3.91	0.85	ML

	Sample Description
○	Olive gray silt
□	Light brown silt

Remarks:

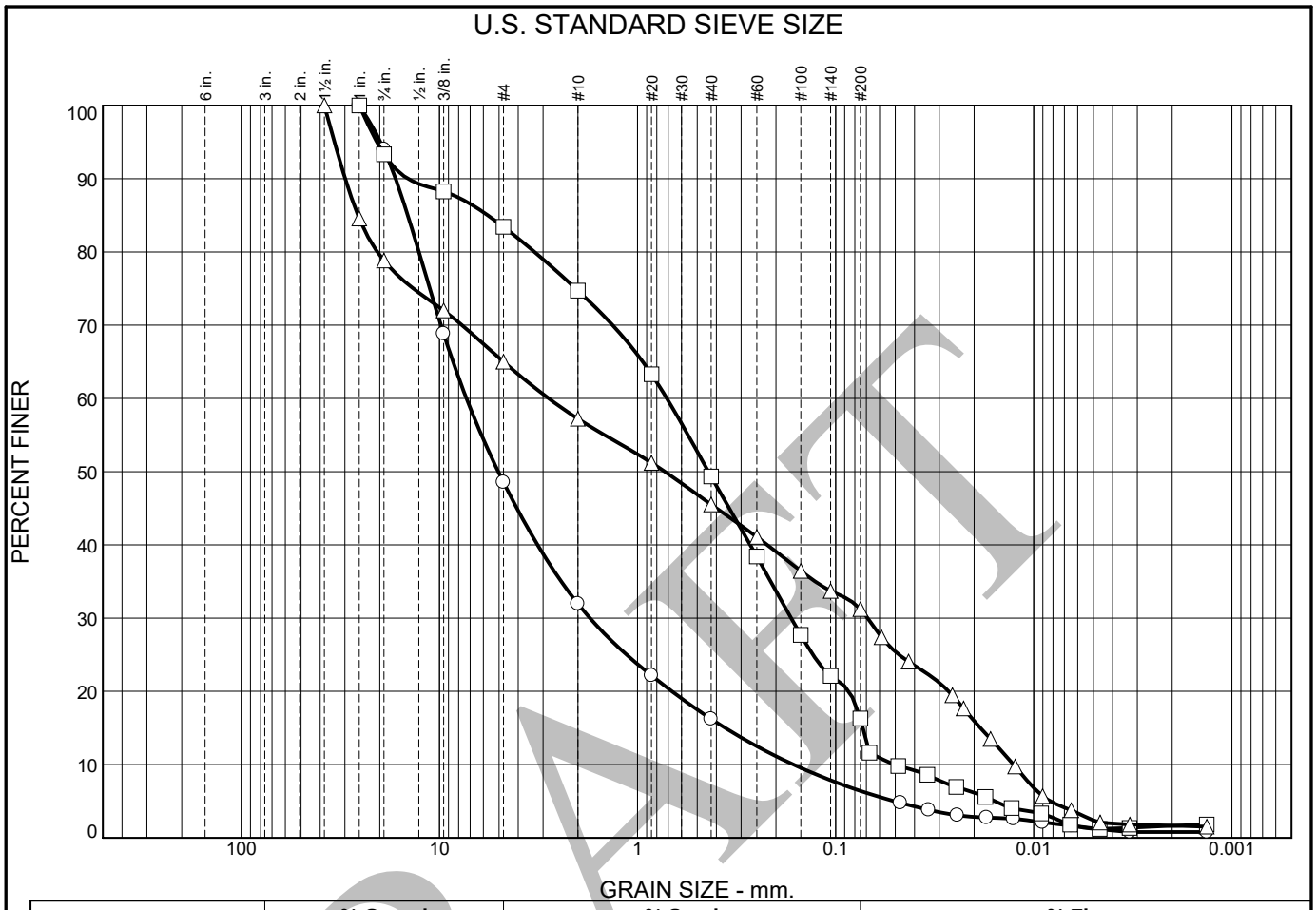
HALEY ALDRICH

Bridge No. W-06-016
Wareham, Massachusetts

GRAIN SIZE DISTRIBUTION

DATE: 5/9/2018 FILE NO: 40991-005

DRAFT



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	6.0	45.4	16.6	15.8	9.8	5.6	0.8
□	0.0	6.7	9.9	8.7	25.4	33.0	14.7	1.6
△	0.0	21.2	13.8	7.8	11.7	14.3	29.5	1.7

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	BB-10	S01	0.0-2.0 ft.				41.4	44.75	2.53	GW-GM
□	BB-10	S03	4.0-6.0 ft.				13.9	14.12	0.79	SM
△	BB-10	S05	8.0-10.0 ft.		NP		12.2	222.08	0.13	GM

	Sample Description
○	Dark gray well-graded gravel with silt and sand
□	Brown silty sand with gravel
△	Olive silty gravel with sand

Remarks:

HALEY ALDRICH

Bridge No. W-06-016
Wareham, Massachusetts

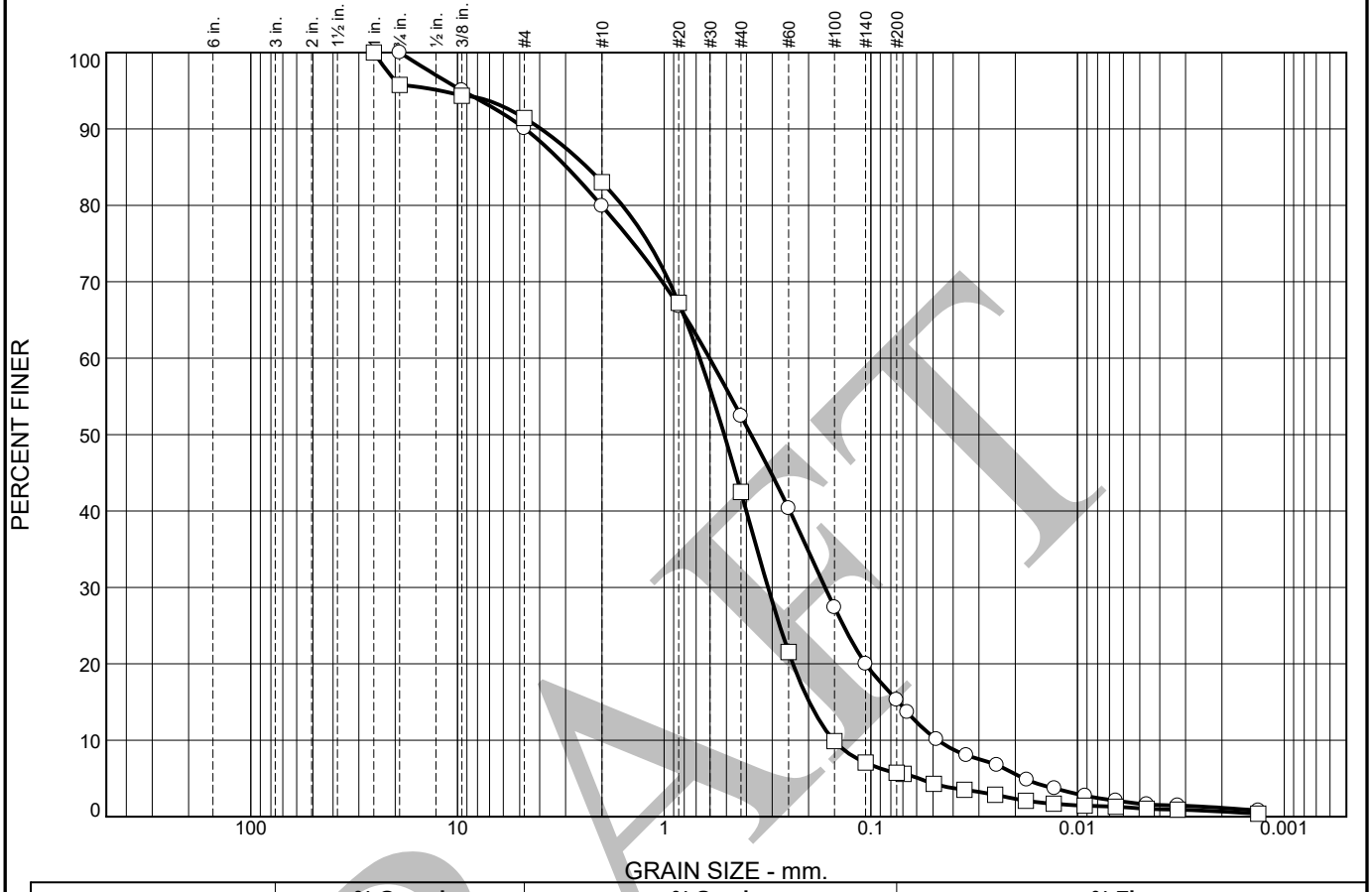
GRAIN SIZE DISTRIBUTION

DATE: 5/9/2018

FILE NO: 40991-005

DRAFT

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	9.9	10.2	27.5	37.1	14.1	1.2
□	0.0	4.2	4.4	8.4	40.5	36.7	5.1	0.7

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	SS1		3.0-9.0 Inches				13.1	12.73	0.97	SM
□	SS2		3.0-9.0 inches				20.6	4.45	0.97	SP-SM

	Sample Description
○	Brown silty sand
□	Dark brown poorly graded sand with silt

Remarks:

Bridge Nos. M-05-013 = W-06-013 and W-06-016
Marion and Wareham, Massachusetts

HALEY ALDRICH

GRAIN SIZE DISTRIBUTION

DATE: 6/19/2018

FILE NO: 40991-005

DRAFT

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.4	10.0	34.2	42.3	5.6	0.5
□	0.0	3.6	6.1	9.3	18.3	57.7	4.3	0.7

	Expl. No.	Sample No.	Depth (m.)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	Marion	Overbank	0.0-12.0 inches				23.8	5.13	0.86	SP-SM
□	Wareham	Overbank	0.0-12.0 inches				21.0	3.35	0.72	SP-SM

	Sample Description
○	Dark brown poorly graded sand with silt
□	Brown poorly graded sand with silt

Remarks:

Bridge Nos. M-05-013 = W-06-013 and W-06-016
Marion and Wareham, Massachusetts

HALEY ALDRICH

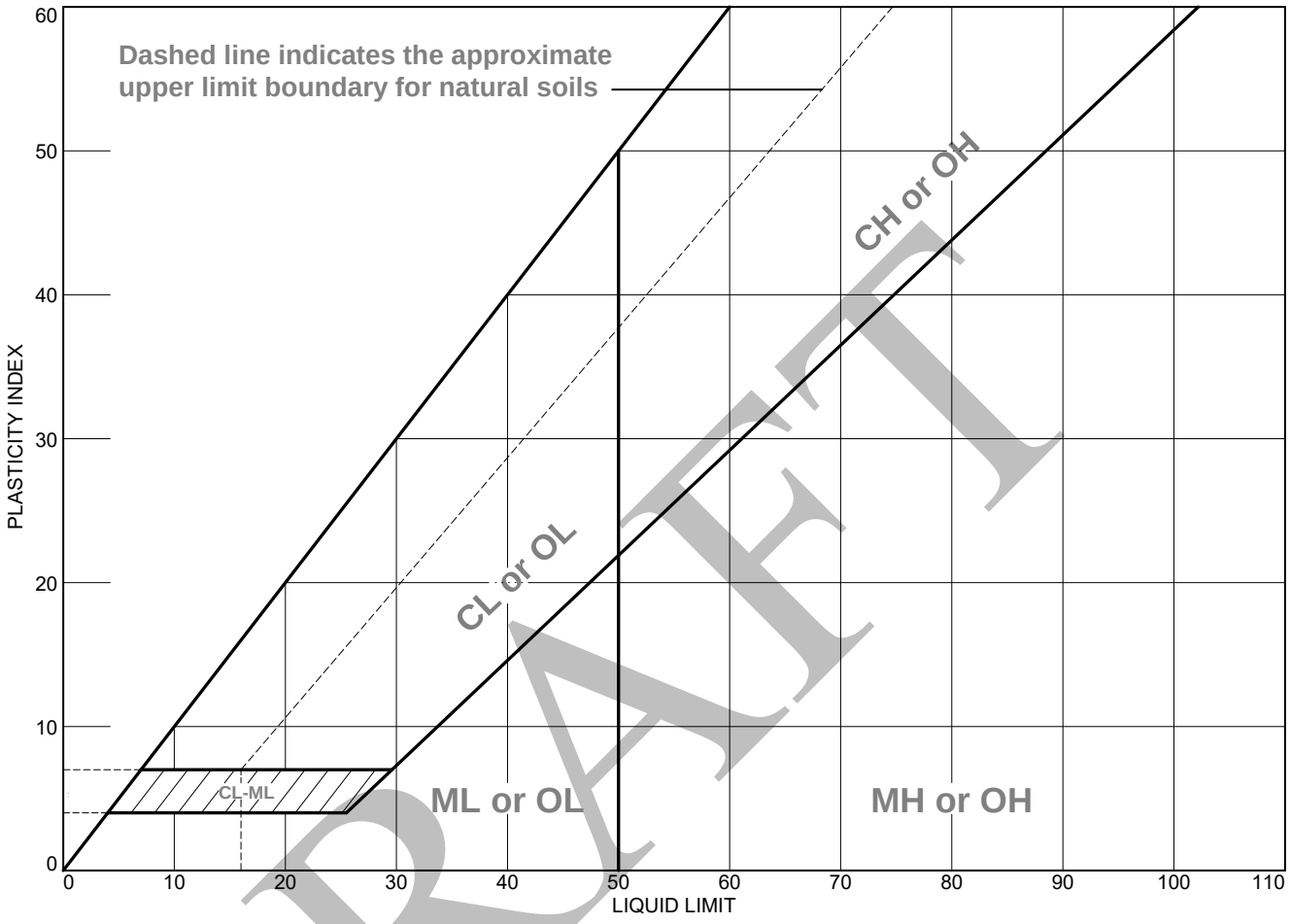
GRAIN SIZE DISTRIBUTION

DATE: 6/19/2018

FILE NO: 40991-005

DRAFT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light brown silt		NP				ML
■	Olive silty gravel with sand		NP		45.5	31.2	GM

Project No. 40991-005 **Client:**

Project: Bridge No. W-06-016
Wareham, Massachusetts

●**Source of Sample:** BB-9 **Depth:** 10.5-12.5 ft. **Sample Number:** S06

■**Source of Sample:** BB-10 **Depth:** 8.0-10.0 ft. **Sample Number:** S05

Remarks:

HALEY ALDRICH

Figure 40991-005

DRAFT

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York

www.geotesting.com

Transmittal

TO:

Steven Gately

Haley & Aldrich, Inc.

465 Medford Street, Suite 2200

Charlestown, MA 02129

DATE: 5/11/2018	GTX NO: 308001
RE: Rt 6 Bridges W-06-013/W-06-016	

COPIES	DATE	DESCRIPTION
	5/11/2018	**May 2018 Laboratory Test Report**

REMARKS:

SIGNED:

Jonathan Campbell, Assistant Laboratory Manager

CC:

APPROVED BY:

Mark Dobday, P.G., Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York
www.geotesting.com

May 11, 2018

Steven Gately
Haley & Aldrich, Inc.
465 Medford Street, Suite 2200
Charlestown, MA 02129

RE: Rt 6 Bridges W-06-013/W-06-016, Wareham, MA (GTX-308001)

Dear Steven:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received two samples from you on 4/20/2018. These samples were labeled as follows:

Boring Number	Sample Number	Depth
BB-3	C2	16.3-16.8
BB-10	C1	30.5-31.2

GTX performed the following tests on these samples:

2 ASTM D7012 Method D- Elastic Moduli of Rock in Uniaxial Compression

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Jonathan Campbell
Assistant Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
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Chicago
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New York

www.geotesting.com

Geotechnical Test Report **5/11/2018**

GTX-308001

Rt 6 Bridges W-06-013/W-06-016

Wareham, MA

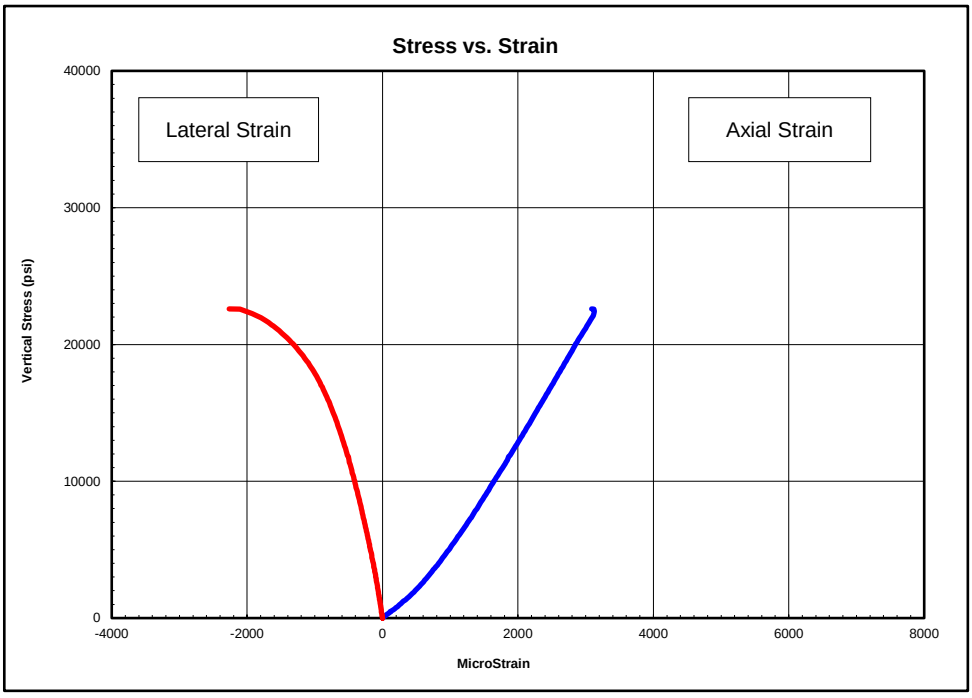
Client Project No.: 40991-005

Prepared for:

Haley & Aldrich, Inc.

Client:	Haley & Aldrich Inc.
Project Name:	Rt 6 Bridges W-06-013/W-06-016
Project Location:	Wareham, MA
GTX #:	308001
Test Date:	5/8/2018
Tested By:	pas
Checked By:	jsc
Boring ID:	BB-10
Sample ID:	C1
Depth, ft:	30.53-30.9
Sample Type:	rock core
Sample Description:	See photographs Intact material failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 23,293 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
2300-8500	6,790,000	0.29
8500-14800	8,060,000	0.48
14800-21000	8,450,000	---

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Haley & Aldrich Inc.	Test Date:	5/3/2018
Project Name:	Rt 6 Bridges W-06-013/W-06-016	Tested By:	pas
Project Location:	Wareham, MA	Checked By:	jsc
GTX #:	308001		
Boring ID:	BB-10		
Sample ID:	C1		
Depth:	30.53-30.9 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.21	4.21	4.21
Specimen Diameter, in:	1.98	1.98	1.98
Specimen Mass, g:	549.29		
Bulk Density, lb/ft^3	161	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.1	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? NO

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? NO

END FLATNESS AND PARALLELISM (Procedure FP1)

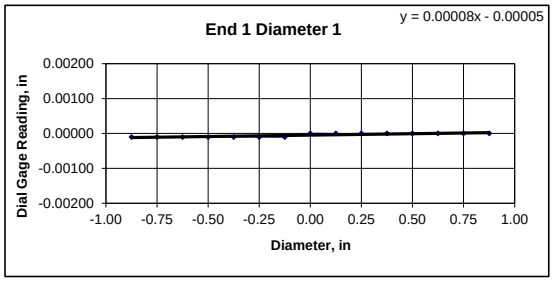
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

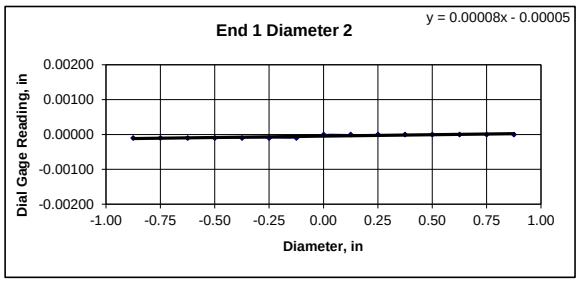
Difference between max and min readings, in:
0° = 0.00010 90° = 0.00010

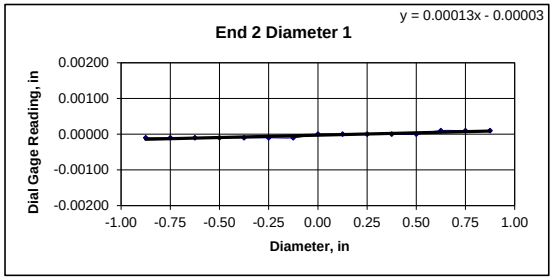
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010

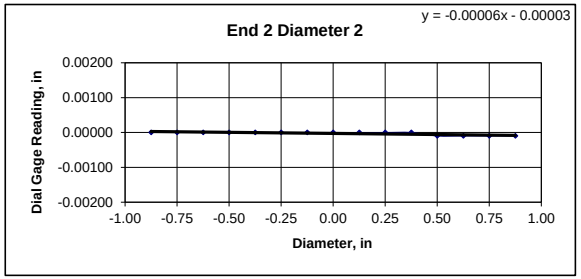
Difference between max and min readings, in:
0° = 0.0002 90° = 0.0001

Maximum difference must be < 0.0020 in. Difference = ± 0.00010
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00008
Angle of Best Fit Line: 0.00458

End 2:
Slope of Best Fit Line 0.00013
Angle of Best Fit Line: 0.00753

Maximum Angular Difference: 0.00295

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00008
Angle of Best Fit Line: 0.00458

End 2:
Slope of Best Fit Line 0.00006
Angle of Best Fit Line: 0.00360

Maximum Angular Difference: 0.00098

Parallelism Tolerance Met? YES
Spherically Seated

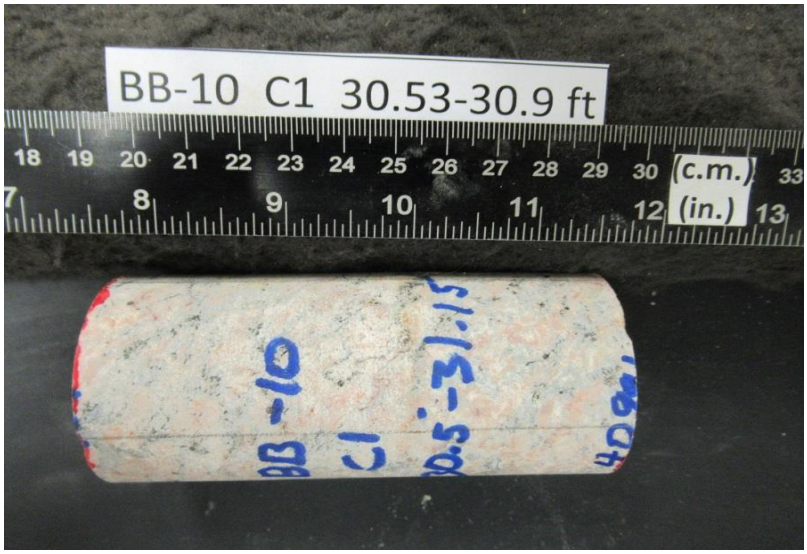
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00010	1.980	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES
END 2					
Diameter 1, in	0.00020	1.980	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	Haley & Aldrich Inc.
Project Name:	Rt 6 Bridges W-06-013/W-06-016
Project Location:	Wareham, MA
GTX #:	308001
Test Date:	5/8/2018
Tested By:	pas
Checked By:	jsc
Boring ID:	BB-10
Sample ID:	C1
Depth, ft:	30.5-31.2

Direct Tensile Strength of Rock ASTM D2936
Performed On Concrete Cores



Before Testing



After Testing

308001

GeoTesting EXPRESS

ROCK CHAIN OF CUSTODY & TEST REQUEST

GeoTesting Express, Inc.
125 Nagog Park
Acton, MA 01720
800 434 1062 Toll Free
978 635 0266 Fax

2358 Perimeter Park Drive, Suite 320
Atlanta, GA 30341
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

CLIENT		INVOICE (complete if different from Client)	
Company: Haley & Aldrich, Inc.		Company:	
Address:		Address:	
City, State, Zip:		City, State, Zip:	
Contact:	Phone:	Contact:	Phone:
E-mail:	Cell:	E-mail:	Cell:

PROJECT		
Project Name: Route 6 Bridges W-06-013 and W-06-016	Client Project #: 40991-005	Purchase Order#:
Project Location: Marion and Wareham, MA	GTX Sales Order #:	Requested Turnaround:
On-site Contact: Steven Gately	E-mail: SGately@HaleyAldrich.com	Phone: 617-886-7314

ROCK			CERCHAR Abrasivity (ASTM D 7625) * 55HRC/40HRC	Direct Shear (ASTM D5607)*	Direct Tensile Strength (ASTM D 2936)	Elastic Moduli in Triaxial Compression (ASTM D 7012B)	Elastic Moduli in Uniaxial Compression (ASTM D 7012D)	Unit Weight (ISRM)	Petrographic Analysis (ISRM)	Point Load Index (ASTM D 5731)* Diametral, Axial, Lump/Block	Punch Penetration (Handewith)	Slake Durability (ASTM D 4644)	Splitting (Brazilian) Tensile Strength (ASTM D 3967)	Schmidt Hammer (ASTM D 5873)	Total Hardness (Schmidt Hammer and Taber Abrasion)	Triaxial Compression (ASTM D 7012A)	Unconfined Compression (ASTM D 7012C)	Other:	Other:
Core Run #	Sample ID	Depth																		
BB-3 C2		16.3-16.8					x													
~~BB-4 C1~~		~~18.3 to 18.6~~																x		
BB-10 C1		30.5-31.2					x													

*Specify Test Conditions (Undisturbed or Remolded, Density and Moisture, Test Normal Loads, Test Confining Stresses, etc.):

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: _____ **PRINT NAME:** _____ **DATE:** _____

For GTX Use Only
Incoming Sample Inspection Performed ☐
Adverse conditions: _____

Relinquished By:	**DATE:** 4/20/18	**Received By:** GTX	**DATE:** 4/20/18
	TIME: 10:52		**TIME:** 10:52 AM
Relinquished By:	**DATE:** 4/20/18	**Received By:**	**DATE:** 4/20/18
	TIME: 1:20 pm		**TIME:** 1:20 pm

GeoTesting EXPRESS

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

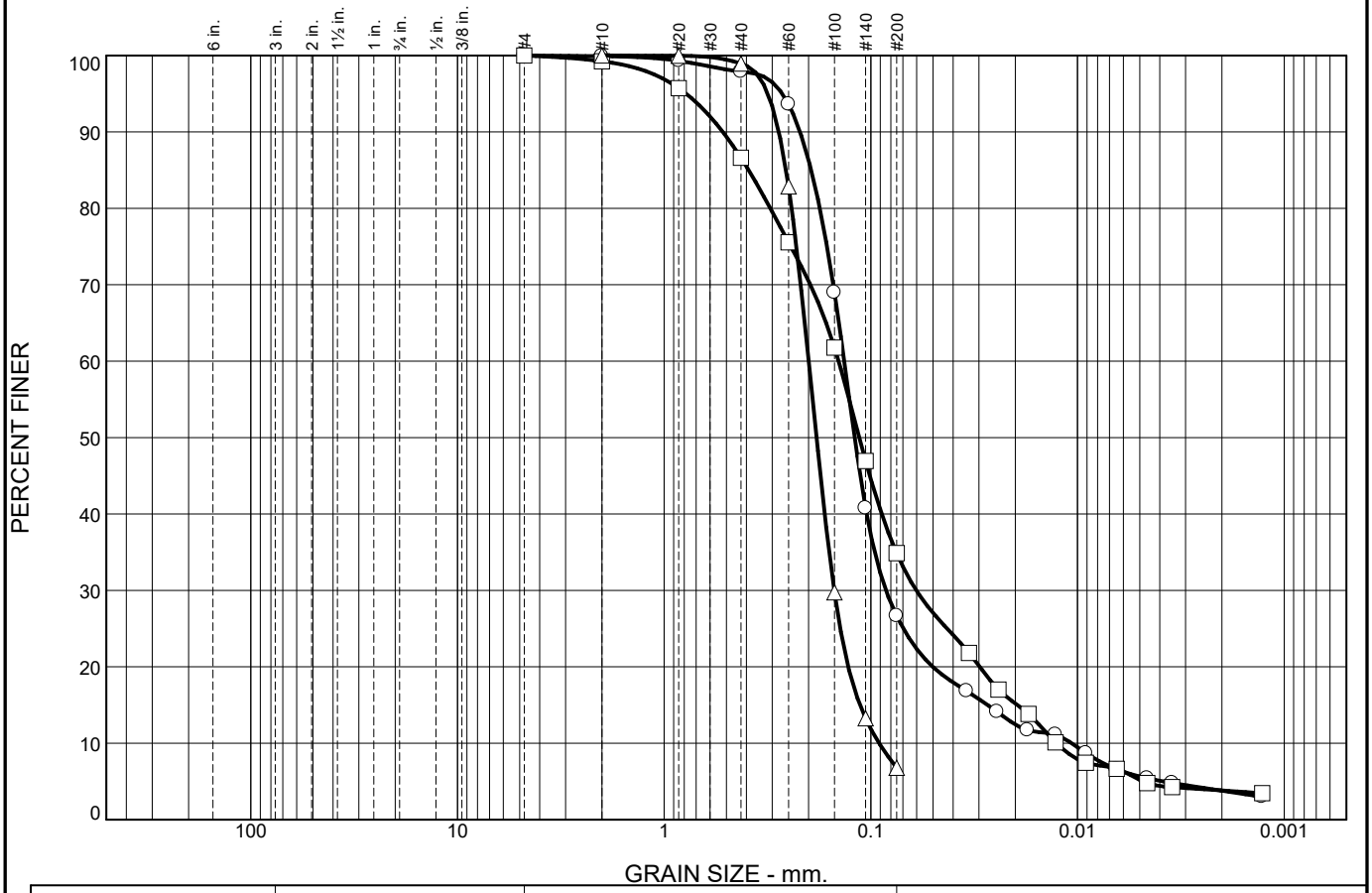
GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

U.S. STANDARD SIEVE SIZE



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	2.0	71.2	22.9	3.8
□	0.0	0.0	0.0	0.8	12.6	51.7	31.1	3.8
△	0.0	0.0	0.0	0.0	1.1	92.1	6.8	

	Expl. No.	Sample No.	Depth (ft)	Atterberg Limits %			Water Content (%)	C_u	C_c	USCS
				w_L	w_P	I_P				
○	BB-16	S05	16.0-18.0	NV	NP	NP	35.8	12.61	4.97	SM
□	BB-20	S04	6.0-8.0	41.0	39.3	1.7	43.8	11.32	2.00	SM
△	BB-22	S04	6.0-8.0				23.3	2.19	1.24	SP-SM

	Sample Description
○	Dark gray brown organic silty sand
□	Dark brown organic silty sand
△	Tan poorly graded sand with silt

Remarks:

○Organic Content = 3.2%

□Organic Content = 3.9%

HALEY ALDRICH

Marion and Wareham Causeway
Marion and Wareham, Massachusetts

GRAIN SIZE DISTRIBUTION

DATE: 3/31/2021

FILE NO: 40991-005

HALEY ALDRICH

TEST DATE: 3/11/2021

ORGANIC CONTENT RESULTS

FILE No.:	**40991-005**
PROJECT:	**Marion and Wareham Causeway**
	Marion and Wareham, Massachusetts
EXPL. No.:	BB-16
SAMPLE No.:	S05
DEPTH (ft.):	16.0-18.0
SAMPLE DESCRIPTION:	Dark gray brown organic silty sand

"AS RECEIVED" WATER CONTENT

WT CONT. + WET SAMPLE (g)	19.9258
WT CONT. + DRY SAMPLE (g)	17.9023
WT CONTAINER (g)	12.2464
MOISTURE CONTENT (%)	**35.8**

LOSS ON IGNITION

WT CONTAINERS + OVEN DRY SAMPLE BEFORE COMBUSTION (g)	29.9672
WT CONTAINERS + OVEN DRY SAMPLE AFTER COMBUSTION (g)	29.6040
WT CONTAINER (CRUCIBLE + B CAN)	18.5941
ORGANIC CONTENT (%)	**3.2**

J:\Lab\EXCEL\CLASSIF\Organic Content\40991-005 Marion-Wareham\[BB-16 S05.xls]Data Report

HALEY ALDRICH

TEST DATE: 3/11/2021

ORGANIC CONTENT RESULTS

FILE No.:	**40991-005**
PROJECT:	**Marion and Wareham Causeway**
	Marion and Wareham, Massachusetts
EXPL. No.:	BB-20
SAMPLE No.:	S04
DEPTH (ft.):	6.0-8.0
SAMPLE DESCRIPTION:	Dark gray brown organic silty sand

"AS RECEIVED" WATER CONTENT

WT CONT. + WET SAMPLE (g)	11.9953
WT CONT. + DRY SAMPLE (g)	10.1876
WT CONTAINER (g)	6.0574
MOISTURE CONTENT (%)	**43.8**

LOSS ON IGNITION

WT CONTAINERS + OVEN DRY SAMPLE BEFORE COMBUSTION (g)	28.3181
WT CONTAINERS + OVEN DRY SAMPLE AFTER COMBUSTION (g)	27.8723
WT CONTAINER (CRUCIBLE + B CAN)	16.8436
ORGANIC CONTENT (%)	**3.9**

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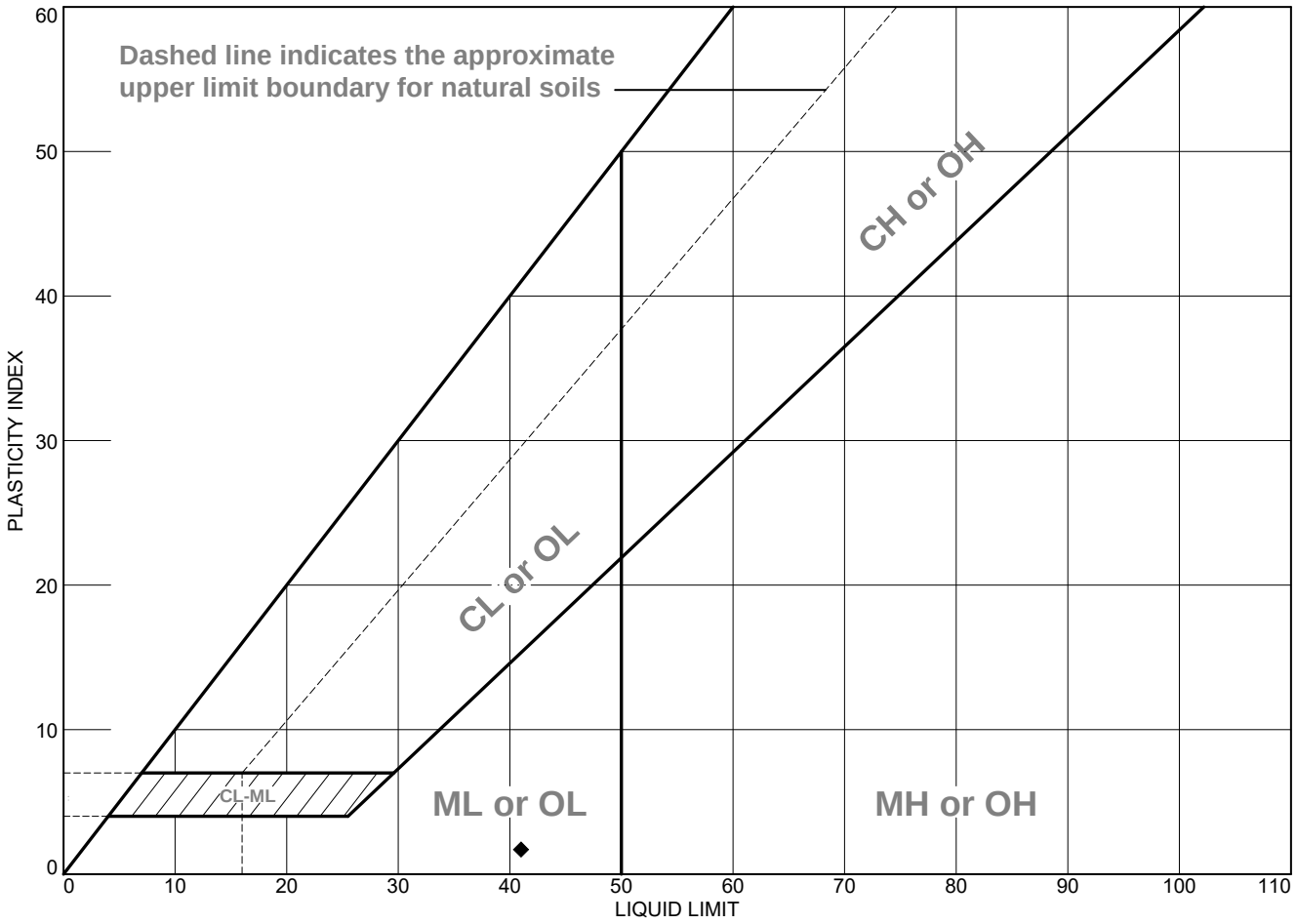
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark brown organic silt	NV	NP	NP			OL
■	Dark gray organic silt	NV	NP	NP			OL
▲	Dark gray brown organic silty sand	NV	NP	NP	97.9	26.7	SM
◆	Dark brown organic silty sand	41.0	39.3	1.7	86.6	34.9	SM

Project No. 40991-005 **Client:**

Project: Marion and Wareham Causeway
Marion and Wareham, Massachusetts

●**Source of Sample:** BB-14 **Depth:** 17.0-19.0 **Sample Number:** S05
■**Source of Sample:** BB-15 **Depth:** 19.0-21.0 **Sample Number:** S05
▲**Source of Sample:** BB-16 **Depth:** 16.0-18.0 **Sample Number:** S05
◆**Source of Sample:** BB-20 **Depth:** 6.0-8.0 **Sample Number:** S04

Remarks:

HALEY ALDRICH

Figure 40991-005

Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-16
Sample ID:	U-1
Depth:	18-20

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
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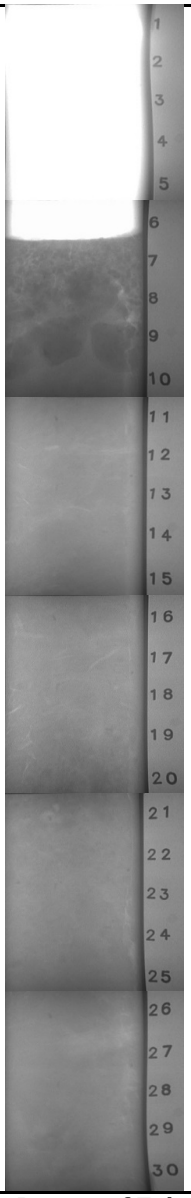
	Bottom of Tube



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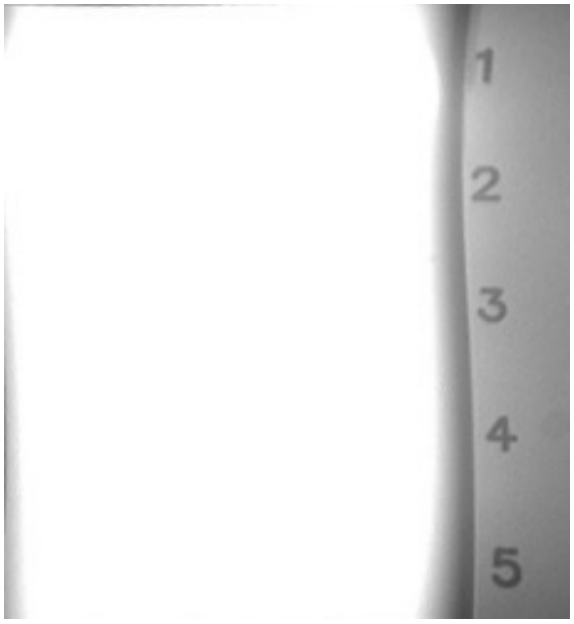

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Project Location:	Marion & Wareham, MA
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Tested By:	trm
Checked By:	bfs
Boring ID:	BB-16
Sample ID:	U-1
Depth:	18-20

X-Ray of Soil Sample by ASTM D4452

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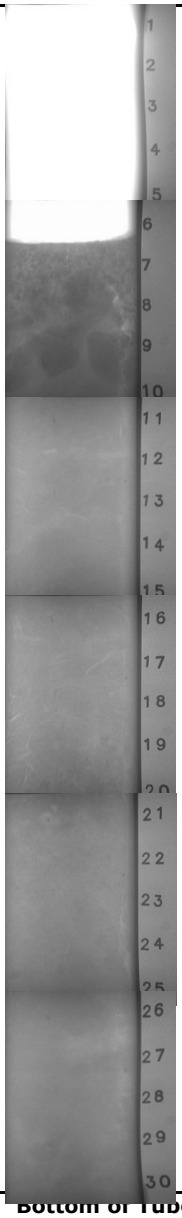

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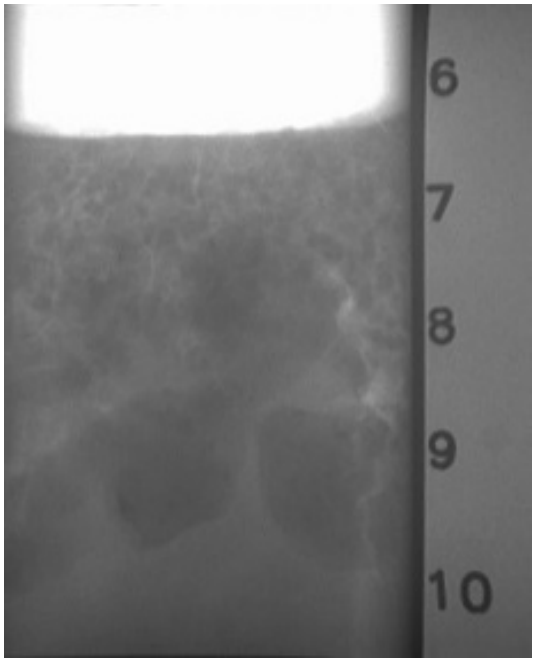

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X-Ray of Soil Sample by ASTM D4452

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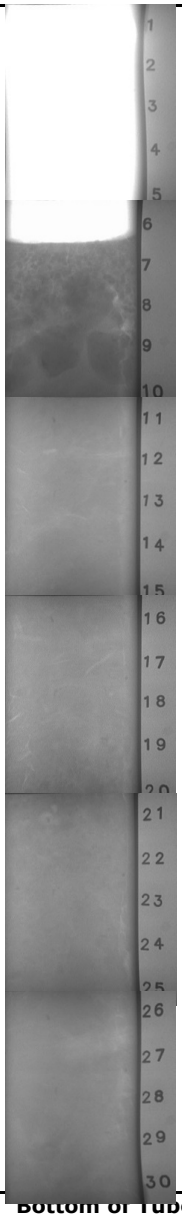

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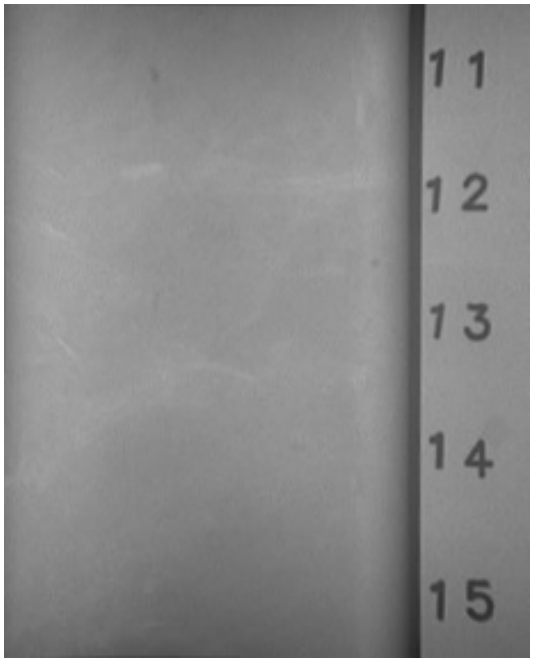

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X-Ray of Soil Sample by ASTM D4452

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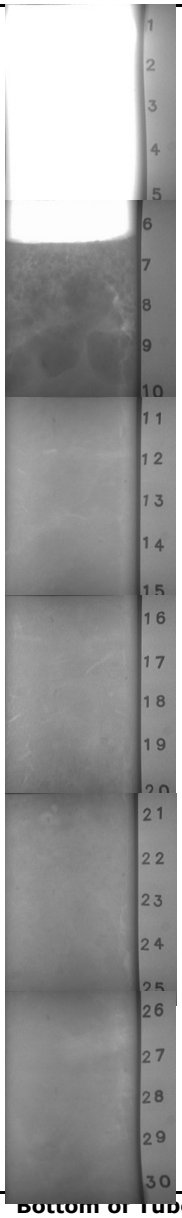

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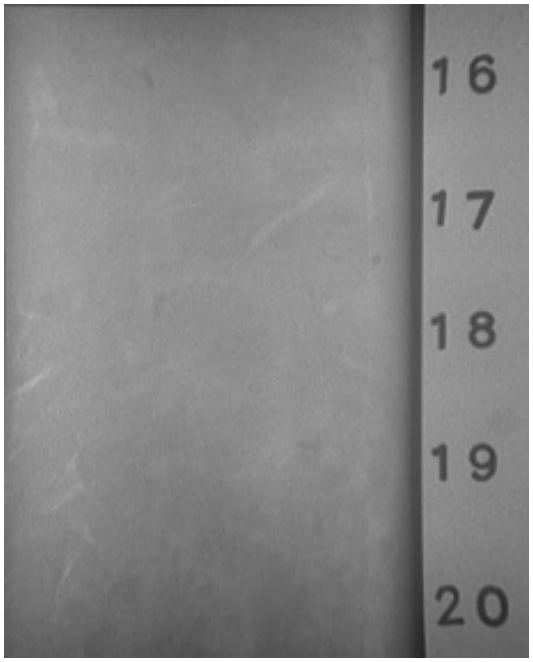

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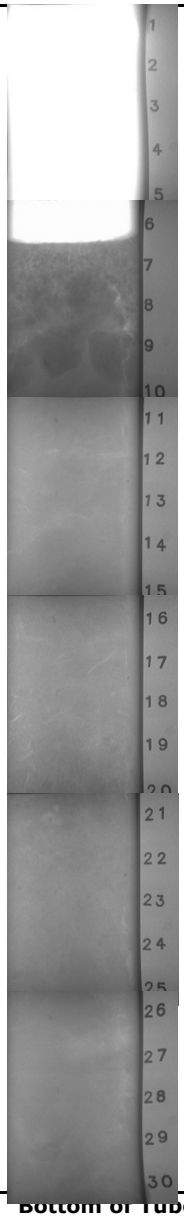

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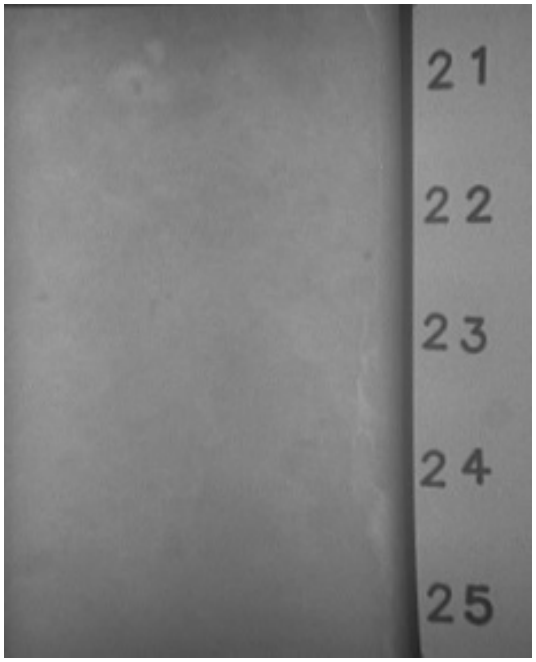

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X-Ray of Soil Sample by ASTM D4452

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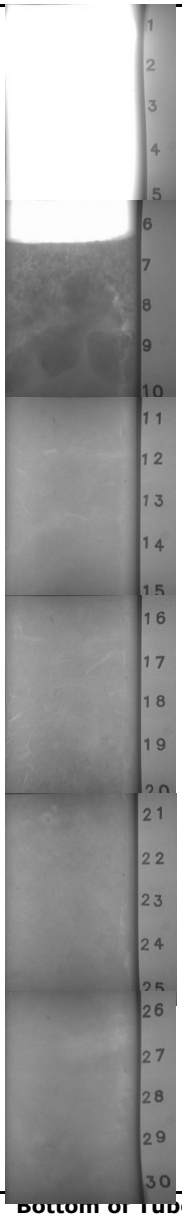

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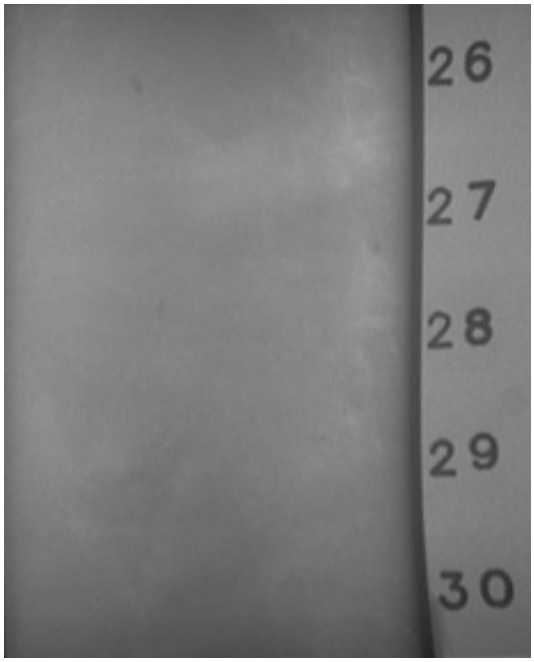

Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-16
Sample ID:	U-2
Depth:	20-22

X-Ray of Soil Sample by ASTM D4452

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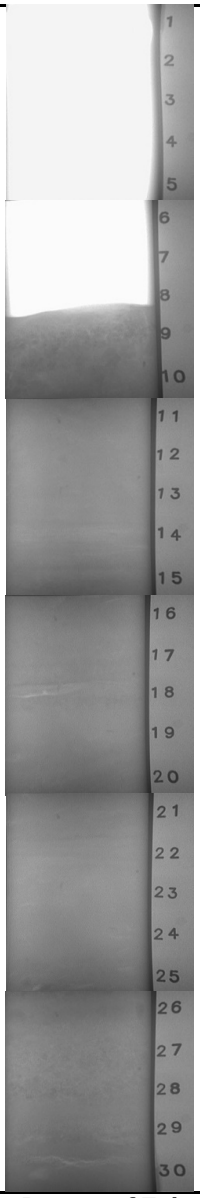

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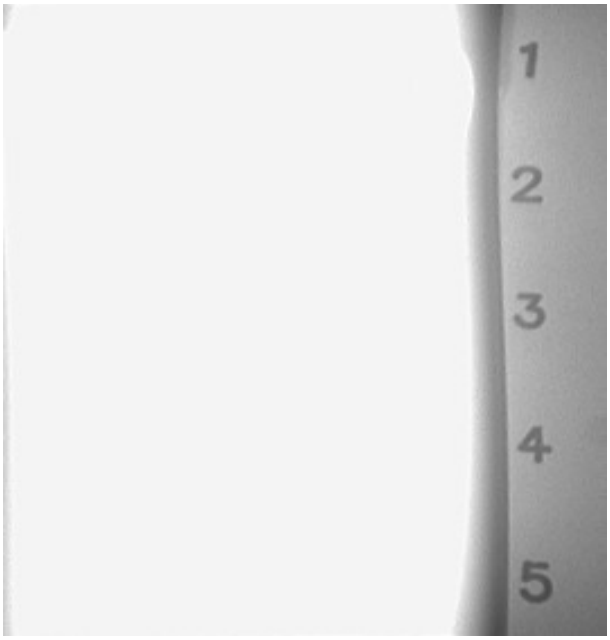

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X-Ray of Soil Sample by ASTM D4452

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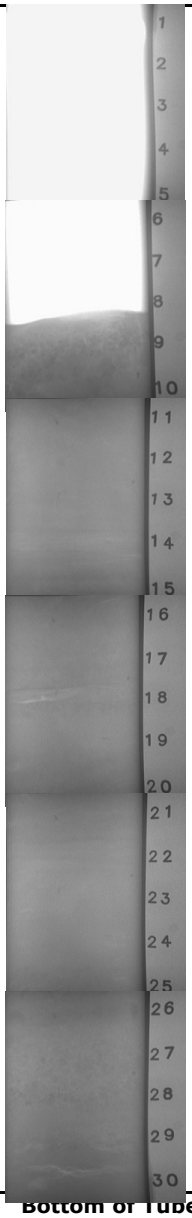

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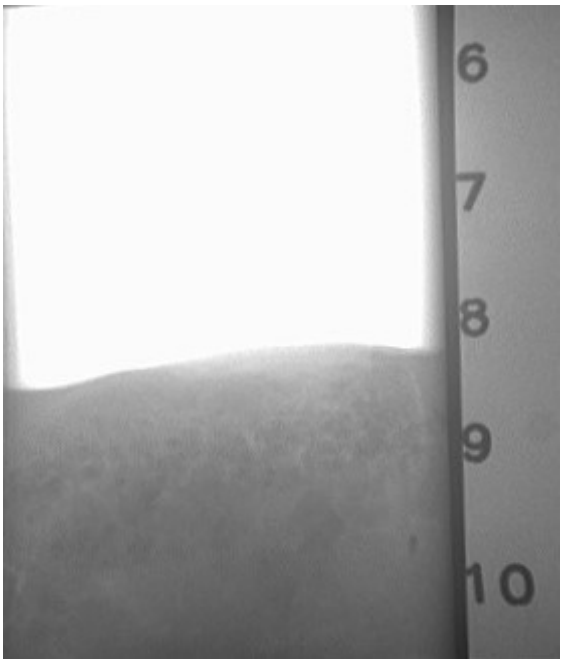

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GTX #:	313173
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Boring ID:	BB-16
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Depth:	20-22

X-Ray of Soil Sample by ASTM D4452

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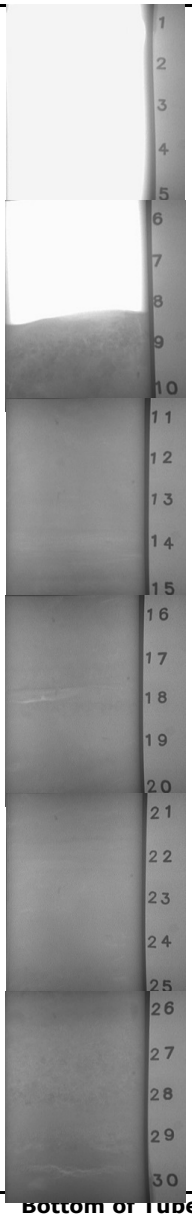

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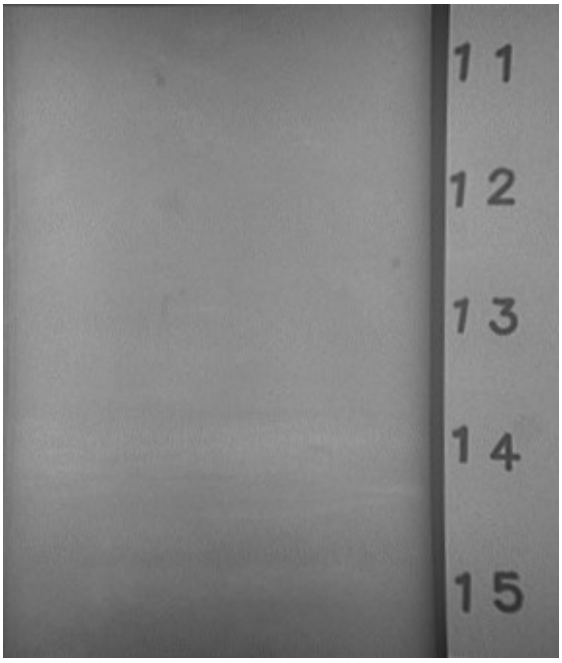

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X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
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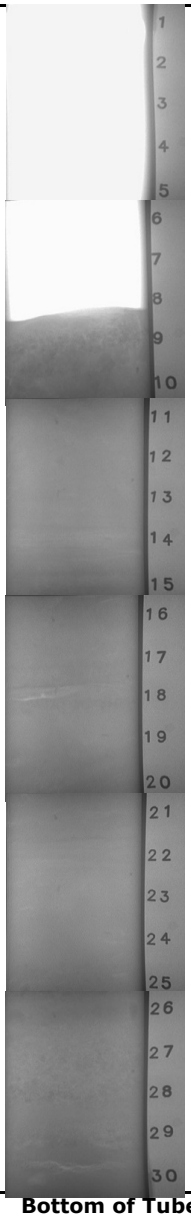
	Bottom of Tube



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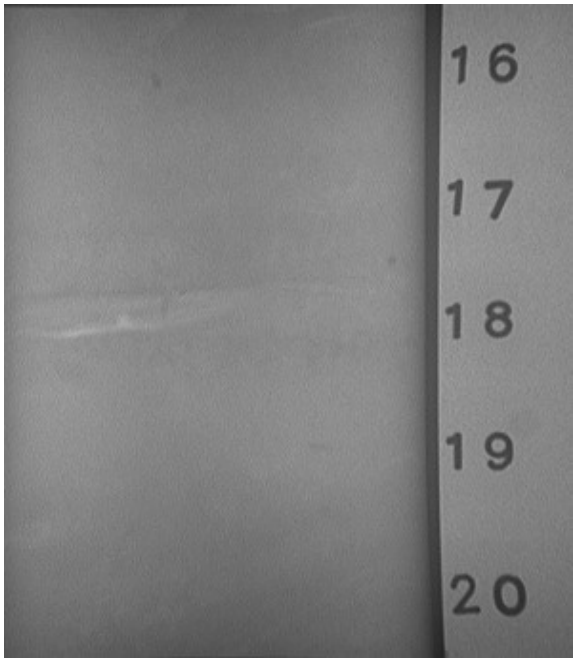

Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-16
Sample ID:	U-2
Depth:	20-22

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
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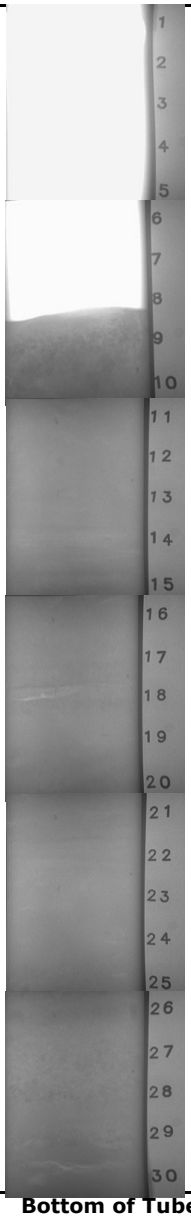
	Bottom of Tube



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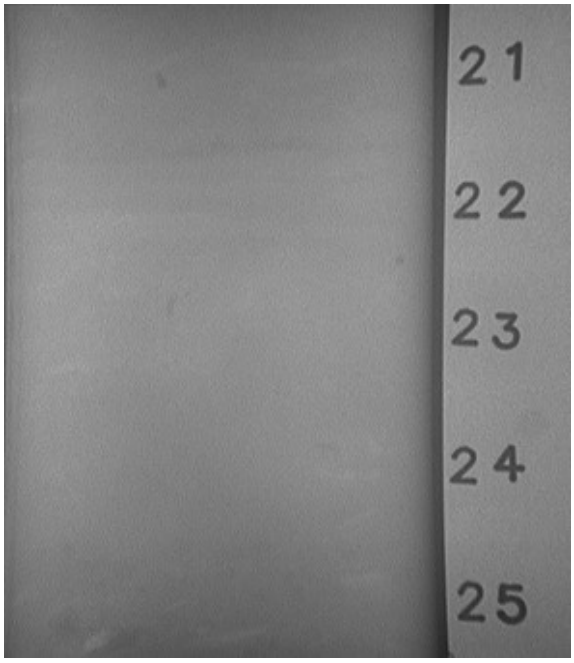

Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-16
Sample ID:	U-2
Depth:	20-22

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
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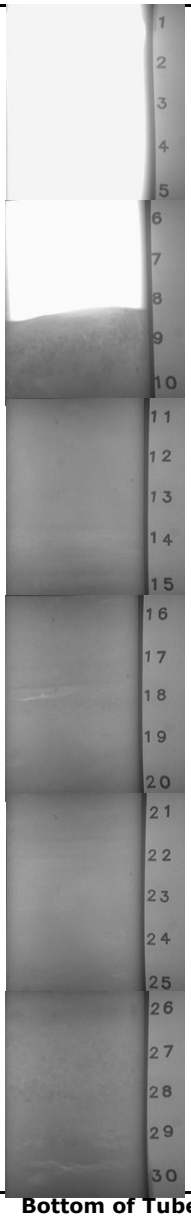

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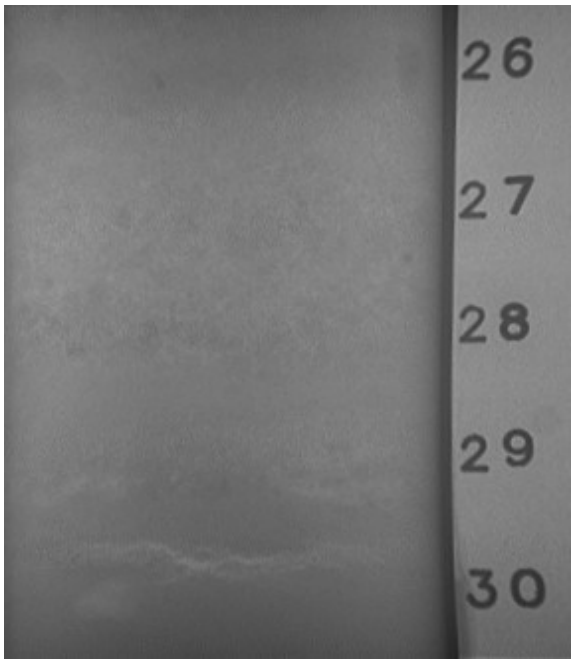

Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-21A
Sample ID:	U-1
Depth:	2-4

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
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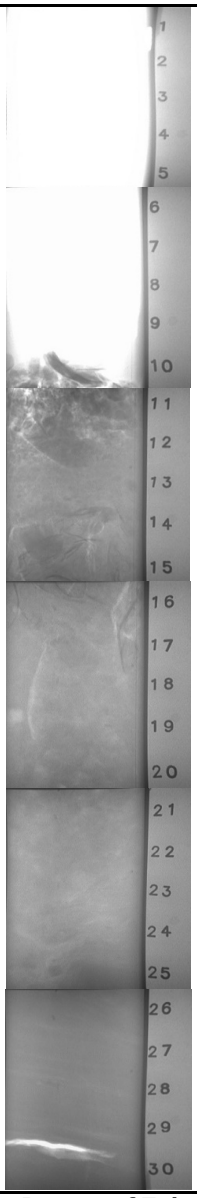
	Bottom of Tube



SECTION 1



Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-21A
Sample ID:	U-1
Depth:	2-4

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
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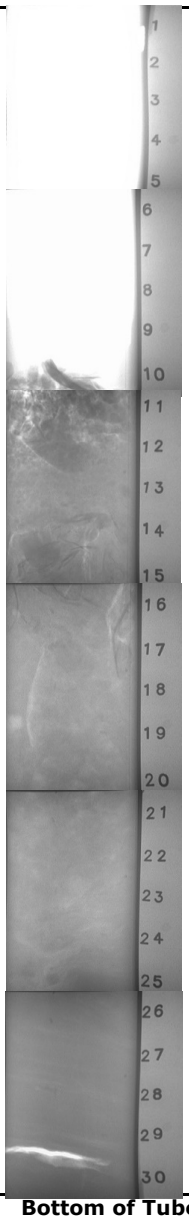
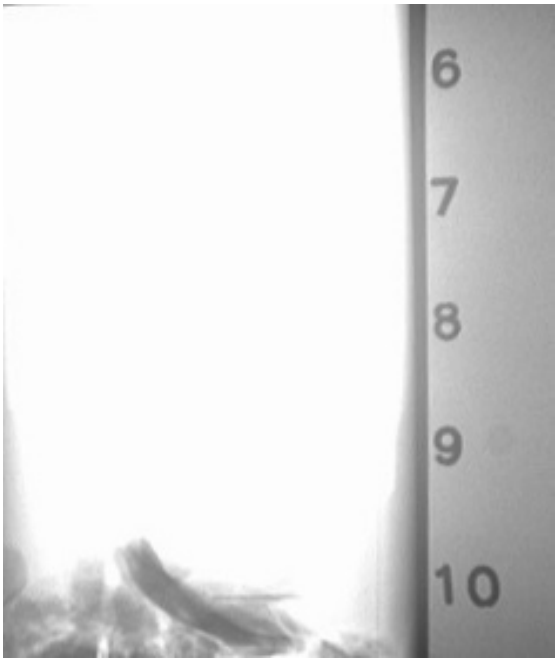
	Bottom of Tube



SECTION 2



Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-21A
Sample ID:	U-1
Depth:	2-4

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
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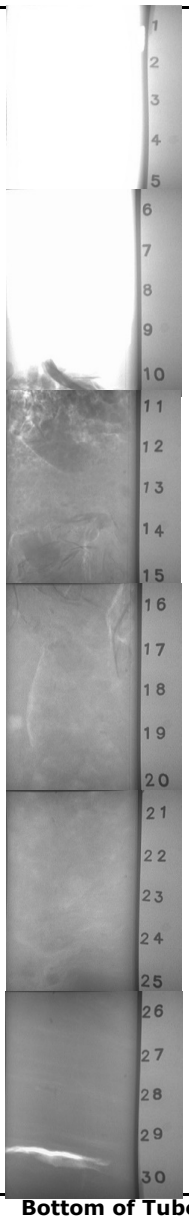
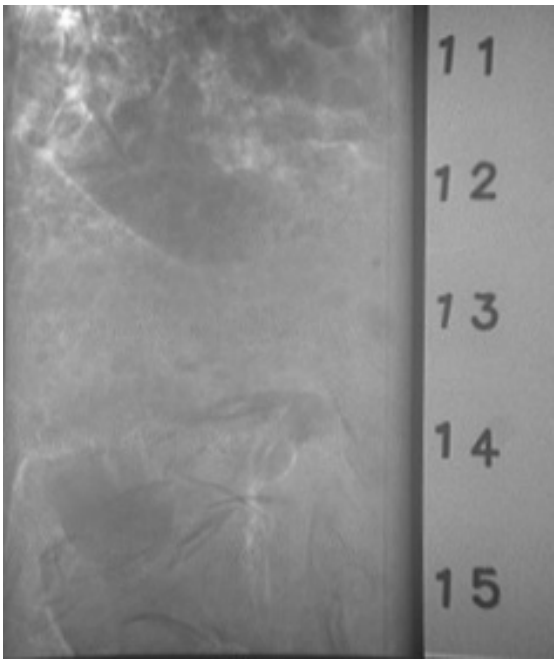
	Bottom of Tube



SECTION 3



Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-21A
Sample ID:	U-1
Depth:	2-4

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
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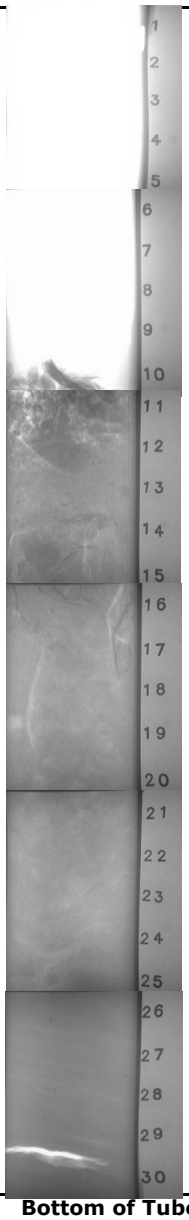
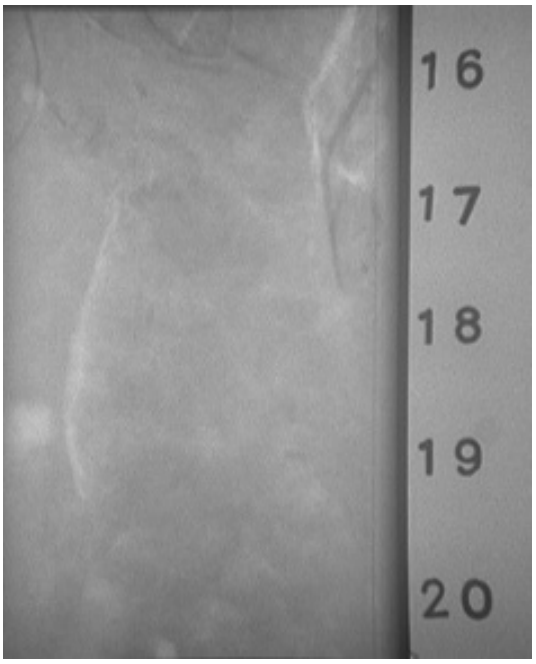
	Bottom of Tube



SECTION 4



Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-21A
Sample ID:	U-1
Depth:	2-4

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
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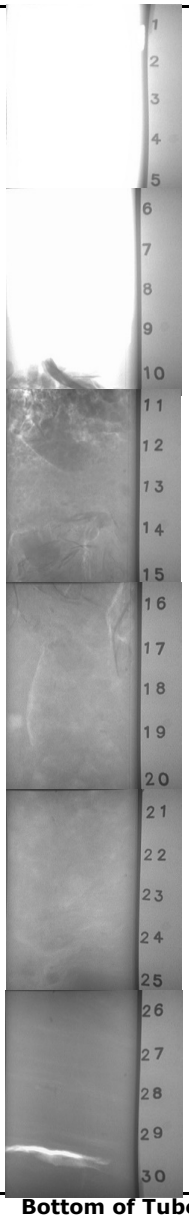
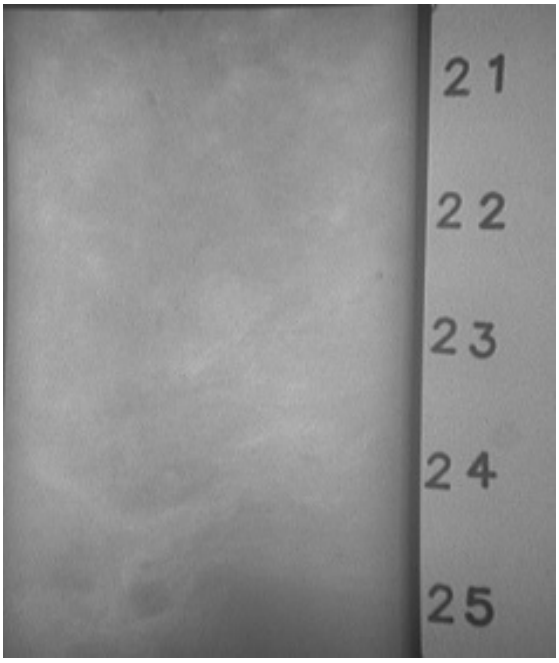
4	
5	
6	
	Bottom of Tube



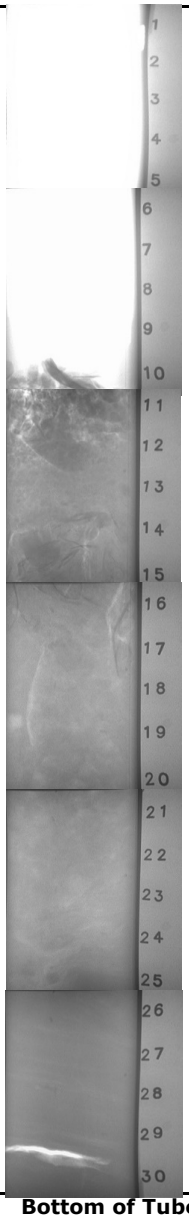
SECTION 5



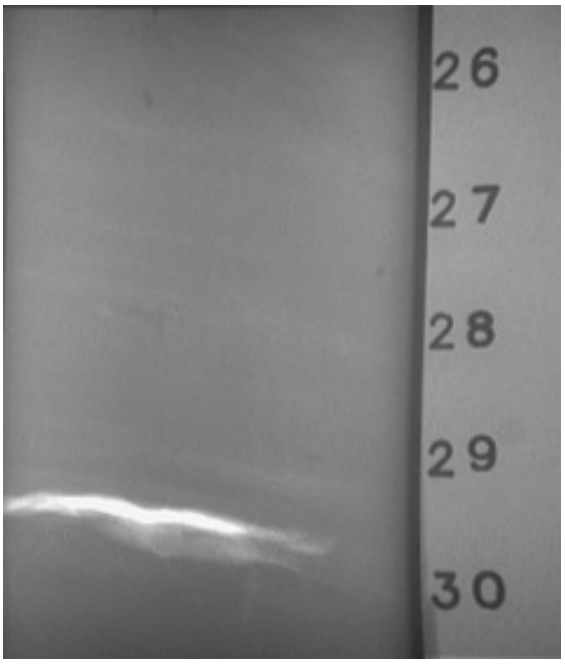
Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-21A
Sample ID:	U-1
Depth:	2-4

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



SECTION 6



Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-28
Sample ID:	U-1
Depth:	6-8

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



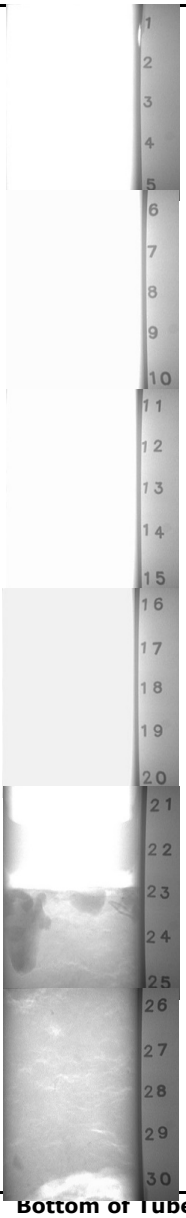
SECTION 1



Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-28
Sample ID:	U-1
Depth:	6-8

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



SECTION 2



Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-28
Sample ID:	U-1
Depth:	6-8

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



SECTION 3



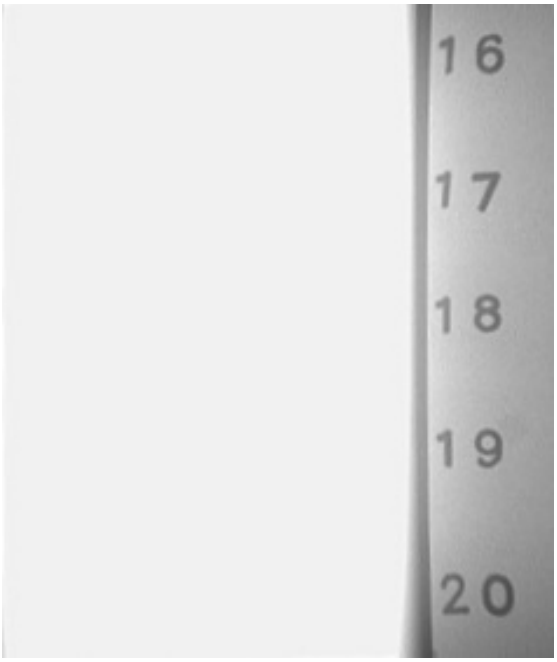
Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-28
Sample ID:	U-1
Depth:	6-8

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



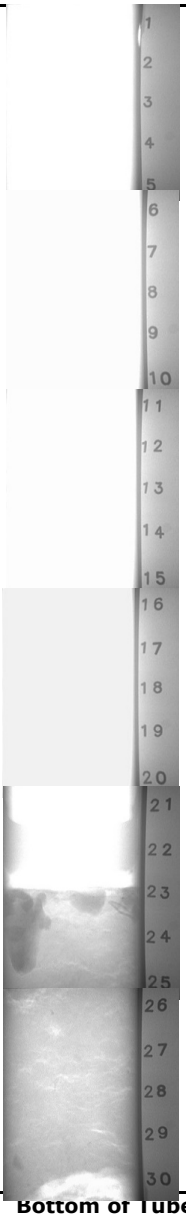
SECTION 4



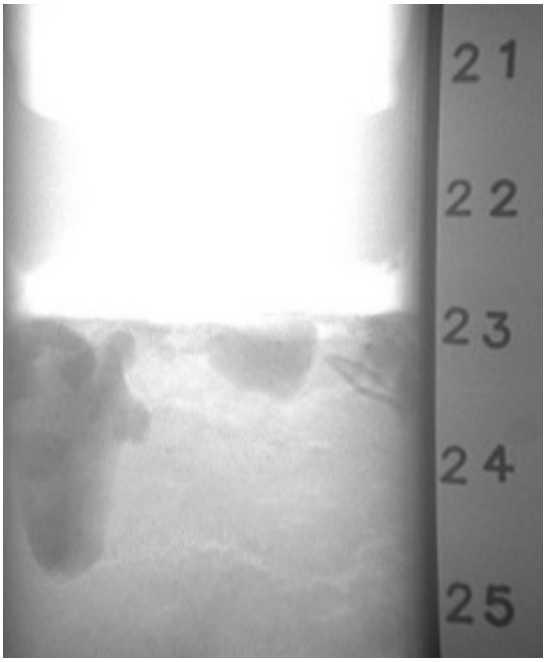
Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-28
Sample ID:	U-1
Depth:	6-8

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



SECTION 5



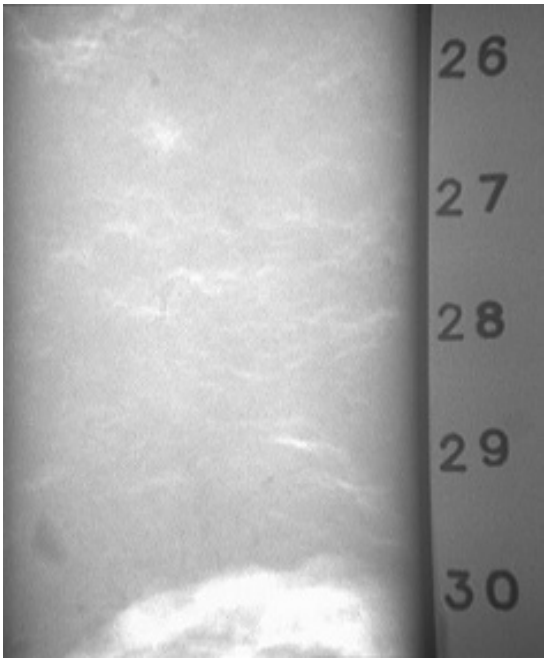
Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Test Date:	02/12/21
Tested By:	trm
Checked By:	bfs
Boring ID:	BB-28
Sample ID:	U-1
Depth:	6-8

X-Ray of Soil Sample by ASTM D4452

Section	Top of Tube
1	
2	
3	
4	
5	
6	
	Bottom of Tube



SECTION 6



GeoTesting EXPRESS

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New York

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Transmittal

TO:

Steven Gately

Haley & Aldrich, Inc.

465 Medford Street, Suite 2200

Boston, MA 02129

DATE: 4/30/2021	GTX NO: 313173
RE: Marion/Wareham Causeway	

COPIES	DATE	DESCRIPTION
	4/30/2021	**March and April 2021 Laboratory Test Report**

REMARKS:

SIGNED: Sarah Delaney

Sarah Delaney, Assistant Laboratory Manager

APPROVED BY: Jon Campbell

Jonathan Campbell, Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York
www.geotesting.com

April 30, 2021

Steven Gately
Haley & Aldrich, Inc.
465 Medford Street, Suite 2200
Boston, MA 02129

RE: Marion/Wareham Causeway, Marion & Wareham, MA (GTX-313173)

Dear Steven Gately:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received four samples from you on 2/5/2021. These samples were labeled as follows:

Boring Number	Sample Number	Depth
BB-16	U-1	18-20
BB-16	U-2	20-22
BB-21A	U-1	2-4
BB-28	U-1	6-8

GTX performed the following tests on these samples:

2 ASTM D2435 - Incremental Consolidation (method B, <=2.87 inch diameter)
1 ASTM D2974 - Moisture, Ash and Organic Matter
1 ASTM D4318 - Atterberg Limits
2 ASTM D4648 - Laboratory Vane Shear
3 ASTM D6528 - Direct Simple Shear (1 normal stress, <=2.5 inch diameter)
1 ASTM D6913/D7928 - Grain Size Analysis - Sieve and Hydrometer
4 GTX-S1003 - Tube Handling and Log (density; moisture content; torvane; description)

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Sarah Delaney
Assistant Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

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Atlanta
Chicago
Los Angeles
New York

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Geotechnical Test Report **4/30/2021**

GTX-313173

Marion/Wareham Causeway

Marion & Wareham, MA

Client Project No.: 0040991-005

Prepared for:

Haley & Aldrich, Inc.

Client:	Haley & Aldrich, Inc.				
Project:	Marion/Wareham Causeway				
Location:	Marion & Wareham, MA			Project No:	GTX-313173
Boring ID:	BB-16	Sample Type:	tube	Tested By:	cam
Sample ID:	U-1	Test Date:	03/22/21	Checked By:	emm
Depth :	18-20	Test Id:	612384		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand				
Sample Comment:	---				

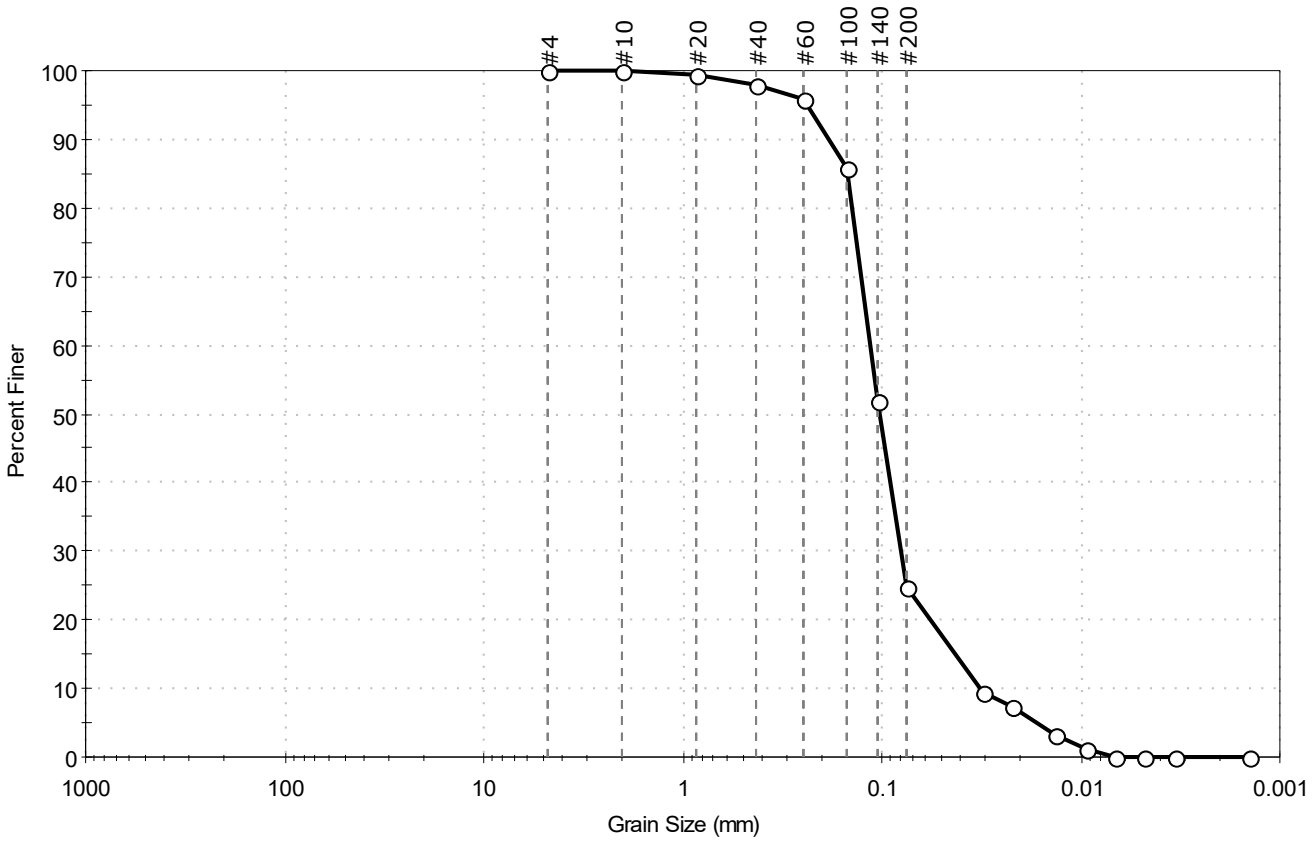
Moisture, Ash, and Organic Matter - ASTM D2974

Boring ID	Sample ID	Depth	Description	Moisture Content,%	Ash Content,%	Organic Matter,%
BB-16	U-1	18-20	Moist, dark brown silty sand	33	98.5	1.5

Notes: Moisture content determined by Method A and reported as a percentage of oven-dried mass; dried to a constant mass at temperature of 105º C
Ash content and organic matter determined by Method C; dried to constant mass at temperature 440º C

Client:	Haley & Aldrich, Inc.				
Project:	Marion/Wareham Causeway				
Location:	Marion & Wareham, MA			Project No:	GTX-313173
Boring ID:	BB-16	Sample Type:	tube	Tested By:	ckg
Sample ID:	U-1	Test Date:	03/24/21	Checked By:	emm
Depth :	18-20	Test Id:	612383		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	75.3	24.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	98		
#60	0.25	96		
#100	0.15	86		
#140	0.11	52		
#200	0.075	25		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0308	9		
---	0.0221	7		
---	0.0136	3		
---	0.0095	1		
---	0.0068	0		
---	0.0048	0		
---	0.0034	0		
---	0.0014	0		

Coefficients

D_{85} = 0.1488 mm	D_{30} = 0.0802 mm
D_{60} = 0.1152 mm	D_{15} = 0.0426 mm
D_{50} = 0.1035 mm	D_{10} = 0.0319 mm
C_u = 3.611	C_c = 1.750

Classification

ASTM Silty SAND (SM)

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	Haley & Aldrich, Inc.				
Project:	Marion/Wareham Causeway				
Location:	Marion & Wareham, MA			Project No:	GTX-313173
Boring ID:	BB-16	Sample Type:	tube	Tested By:	cam
Sample ID:	U-1	Test Date:	03/23/21	Checked By:	emm
Depth :	18-20	Test Id:	612382		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	U-1	BB-16	18-20	31	n/a	n/a	n/a	n/a	Silty SAND (SM)

2% Retained on #40 Sieve
Dry Strength: LOW
Dilatancy: RAPID
Toughness: n/a
The sample was determined to be Non-Plastic

Client:	Haley & Aldrich, Inc.
Project Name:	Marion/Wareham Causeway
Project Location:	Marion & Wareham, MA
GTX #:	313173
Date:	03/29/21
Tested by:	md
Checked by:	emm

Laboratory Vane Shear by ASTM D4648

Boring ID	Sample ID	Depth, ft	Visual Description	Vane Shear Strength, kN/m^2	Vane Shear Strength, tsf
BB-16	U-1	18-20	Moist, dark brown silty sand	5.5	0.06
				6.2	0.06
				5.1	0.05
			Average	5.6	0.06
BB-16	U-2	20-22	Moist, brown peat with sand	4.3	0.04
				4.6	0.05
				5.1	0.05
			Average	4.7	0.05

Comments:

Client:	Haley & Aldrich, Inc.		
Project Name:	Marion/Wareham Causeway		
Project Location:	Marion & Wareham, MA		
GTX #:	313173	Tested By:	md
Test Date:	03/29/30	Checked By:	emm

Tube Handling with Moisture Content (ASTM D2216), Density of Soil (ASTM D7263), Hand-Held Torvane, and Visual Description

Boring ID	Sample ID	Depth, ft	Section	Visual Description	Bulk Density, lb/ft^3	Moisture Content, %	Dry Density, lb/ft^3	Hand Held Torvane Readings, tsf			
								1	2	3	Average
BB-16	U-1	18-20	Top	Moist, dark brown silty sand	111.6	32.8	84.0	0.10	0.10	0.10	0.10
			Middle	Moist, dark brown silty sand	114.9	32.6	86.6	0.10	0.10	0.10	0.10
			Bottom	Moist, dark brown silty sand	113.9	35.6	84.0	0.05	0.05	0.05	0.05
BB-16	U-2	20-22	Top	Moist, brown peat with sand	119.6	30.5	91.6	0.05	0.05	0.05	0.05
			Middle	Moist, brown peat with sand	114.7	29.5	88.5	0.05	0.05	0.05	0.05
			Bottom	Moist, brown peat with sand	116.8	30.5	89.5	0.05	0.05	0.05	0.05
BB-21A	U-1	2-4	Top	Mosit, gray sand with peat and clay	106.7	39.3	76.6	---	---	---	---
			Middle	Mosit, gray sand with peat and clay	106.3	42.1	74.8	0.10	0.10	0.10	0.10
			Bottom	Mosit, gray sand with peat and clay	114.7	45.2	79.0	---	---	---	---
BB-28	U-1	6-8	Bottom	Moist, brown organic material	71.1	325.4	16.7	0.05	0.05	0.05	0.05

Notes: Density determined on undisturbed tube samples provided to GeoTesting Express in Shelby tubes
Moisture content determined by ASTM D2216 at 110° C

Consolidated Undrained Direct Simple Shear Testing of Cohesive Soils by ASTM D6528

Client:	Haley & Aldrich, Inc.	GTX#:	313173
Project Name:	Marion/Wareham Causeway	Test Date:	3/30/21
Project Location:	Marion & Wareham, MA		

Boring ID: BB-16
Sample ID: U-1
Depth, ft: 18-20
Visual Description: Moist, dark brown silty sand

Test Equipment: Top and bottom box (circular) = 2.50 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch. Stacked rings used. Set up included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: density: Extruded from tube, cut, trimmed and placed into apparatus at as-received and moisture content.

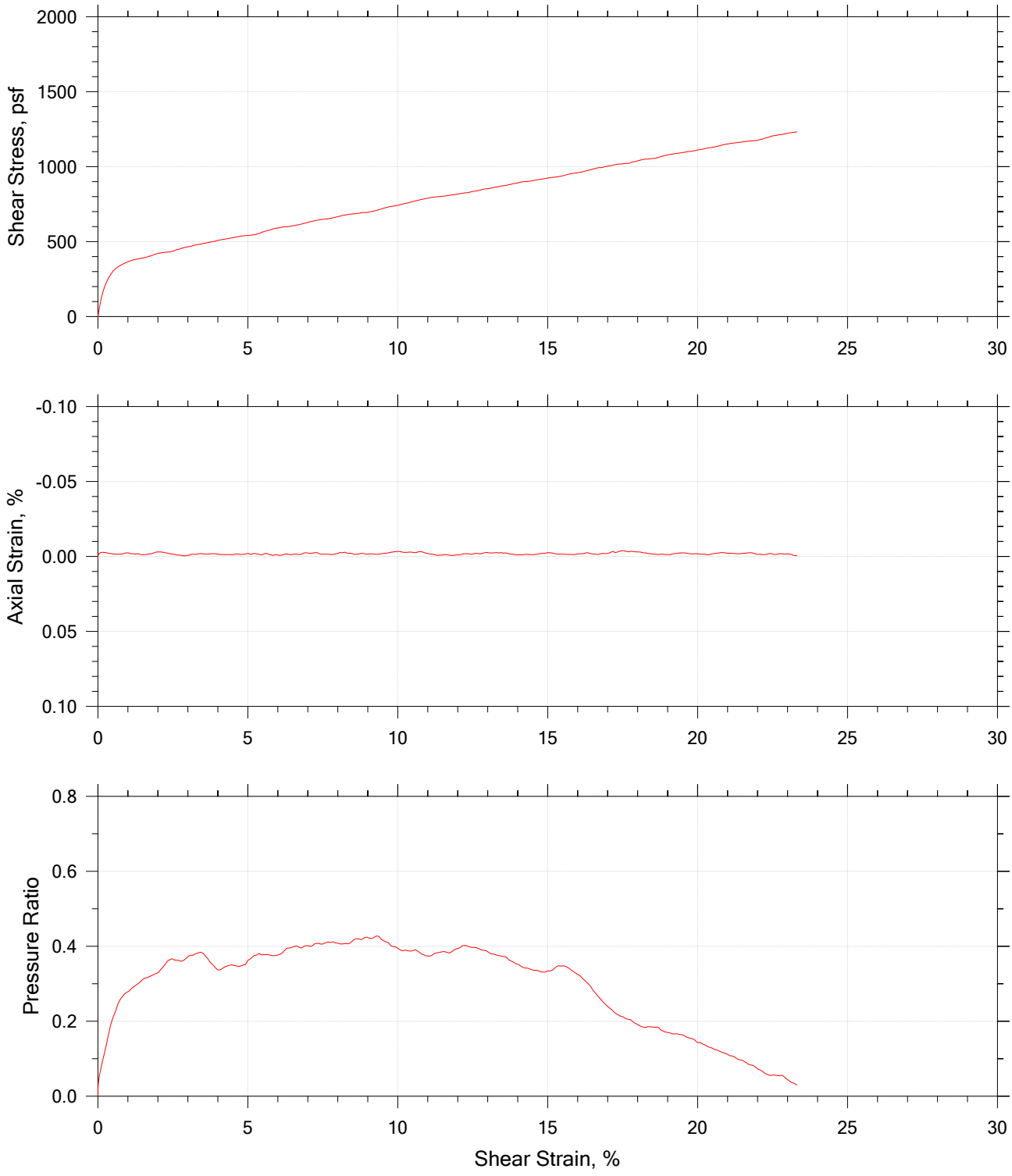
Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	DSS-3				
Initial Moisture Content, %	35.6				
Initial Dry Density, pcf	80.7				
Nominal Rate of Shear Strain, %/hr	5.0				
Maximum Vertical Consolidation Stress, psf	1,900				
Final Moisture Content, %	31.0				
Measured Peak Shear Stress, psf	1,111.4				
Shear Strain at Peak Shear Stress, %	20.0				
Membrane Correction, psf	49				
Corrected Peak Shear Stress, psf	1,062.4				
S_u / σ'_{vc}	0.56				

Comments: Failure taken at peak prior to or at 20% strain, per ASTM D6528.

Tested By: md Checked By: njh

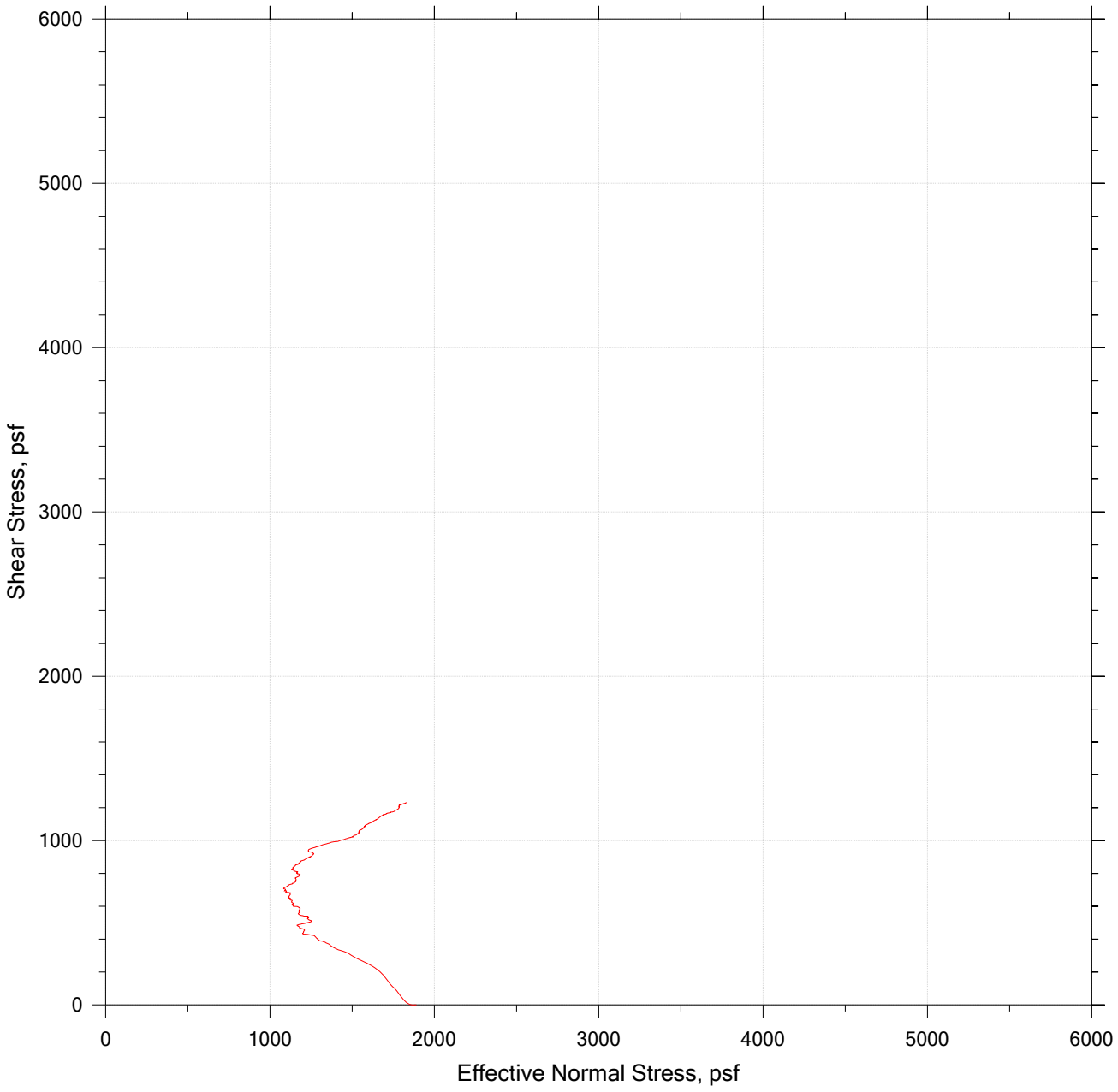
Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

Direct Simple Shear Test



GeoTesting EXPRESS	Project Name: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project Number: GTX-313173
	Boring Number: BB-16	Tester: md	Checker: njh
	Sample Number: U-1	Test Date: 03/30/21	Depth: 18-20 ft
	Test Number: DSS-3	Preparation: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System GG		

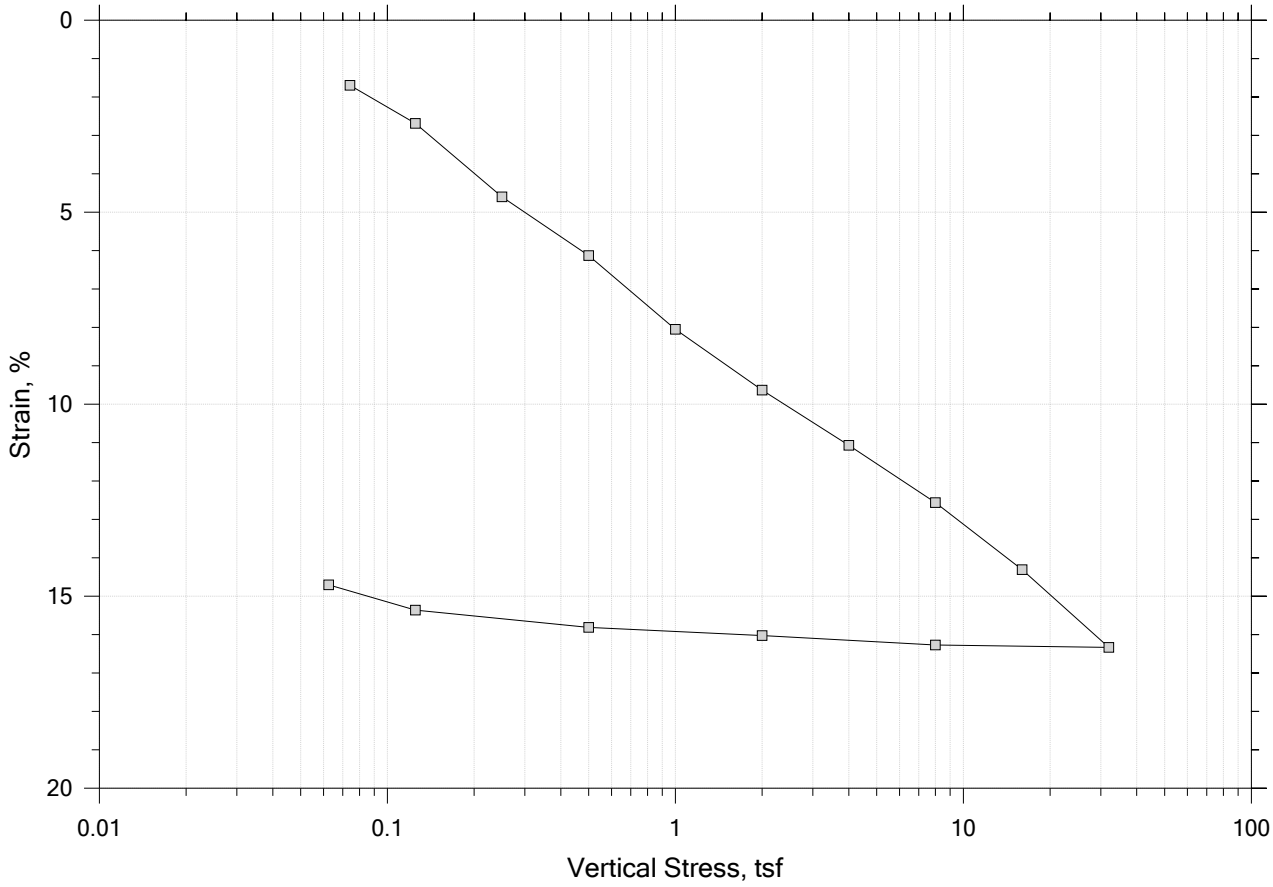
Direct Simple Shear Test

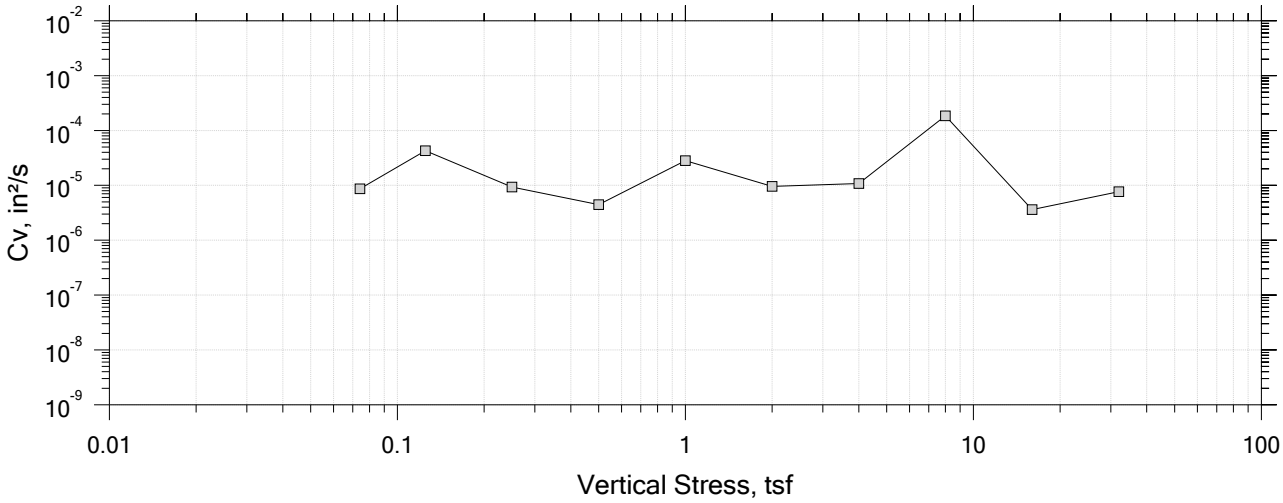


GeoTesting EXPRESS	Project Name: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project Number: GTX-313173
	Boring Number: BB-16	Tester: md	Checker: njh
	Sample Number: U-1	Test Date: 03/30/21	Depth: 18-20 ft
	Test Number: DSS-3	Preparation: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System GG		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

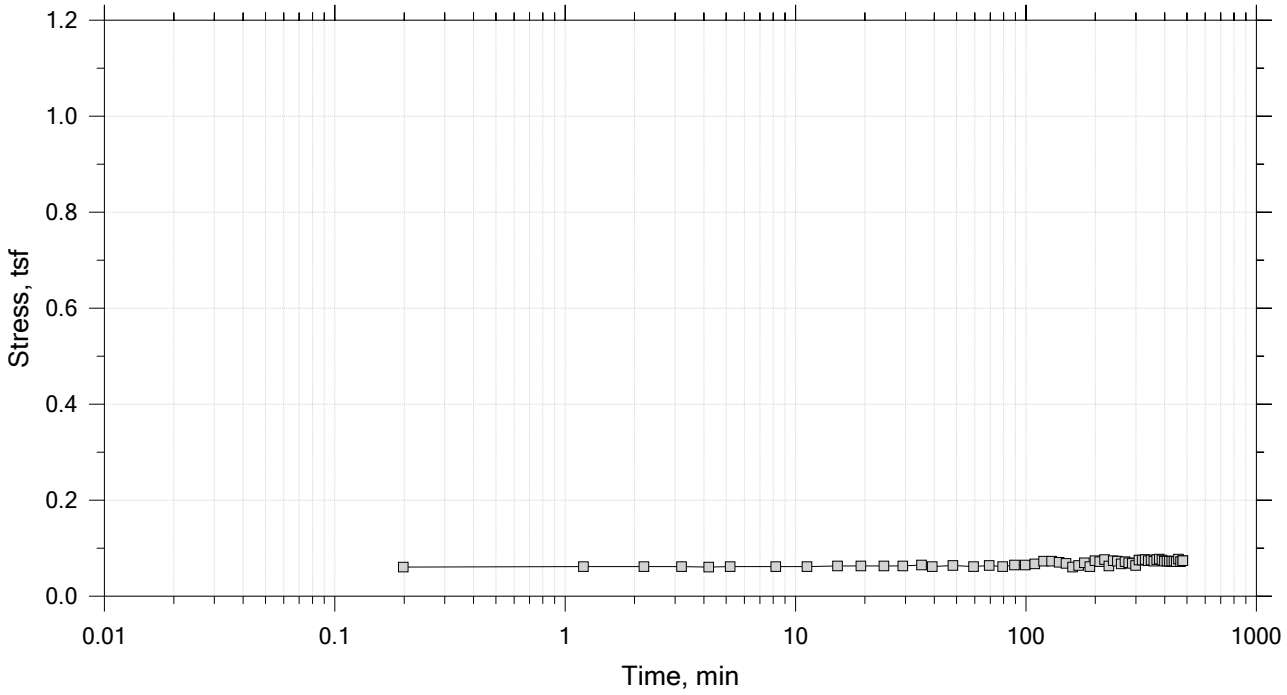


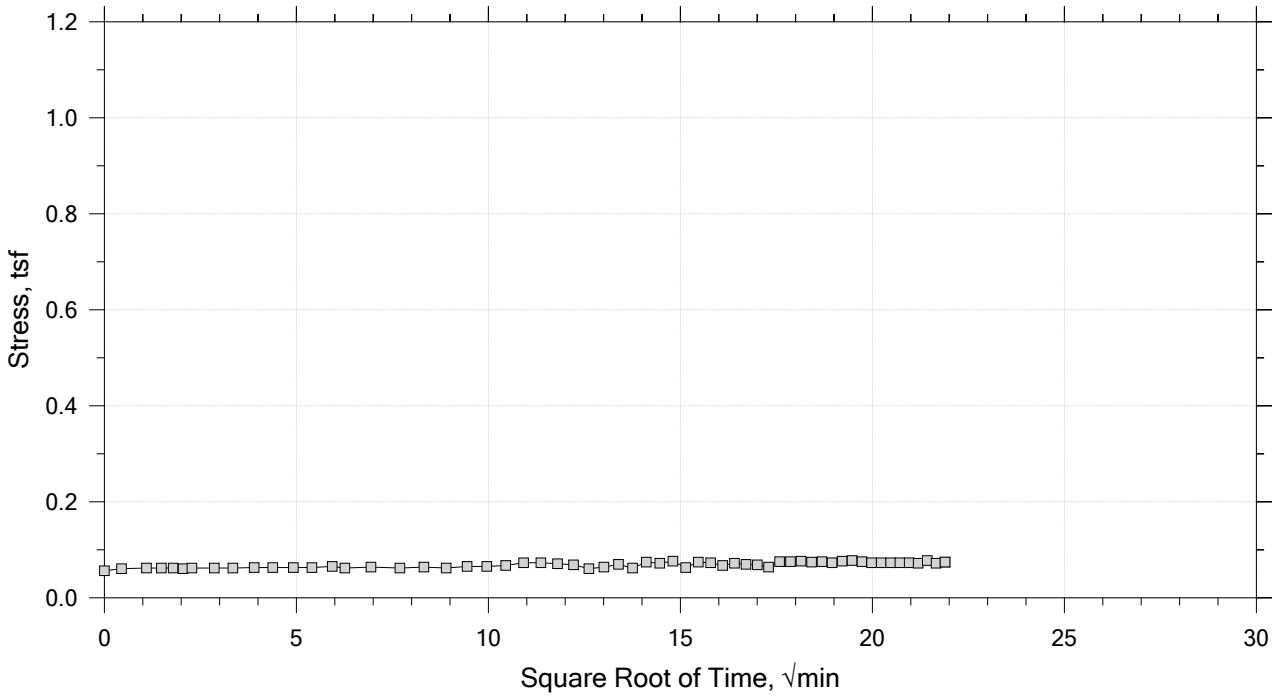


GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 15
Constant Volume Step
Stress: 0.0741 tsf





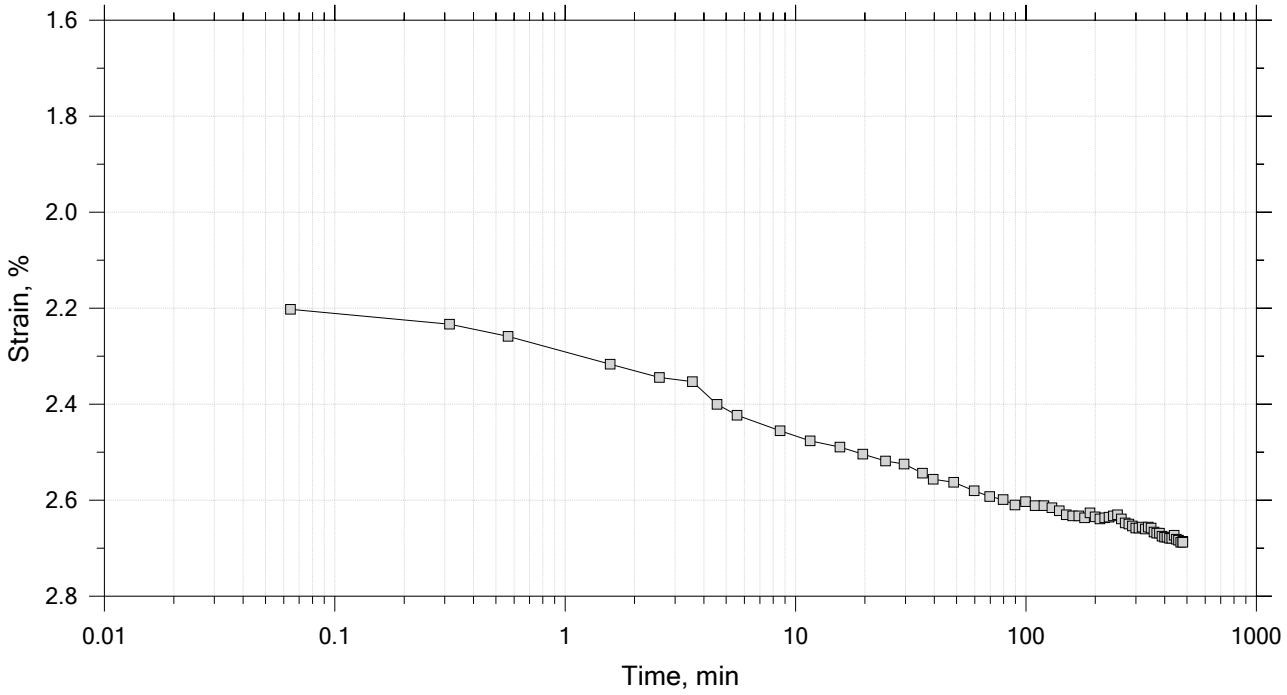
Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

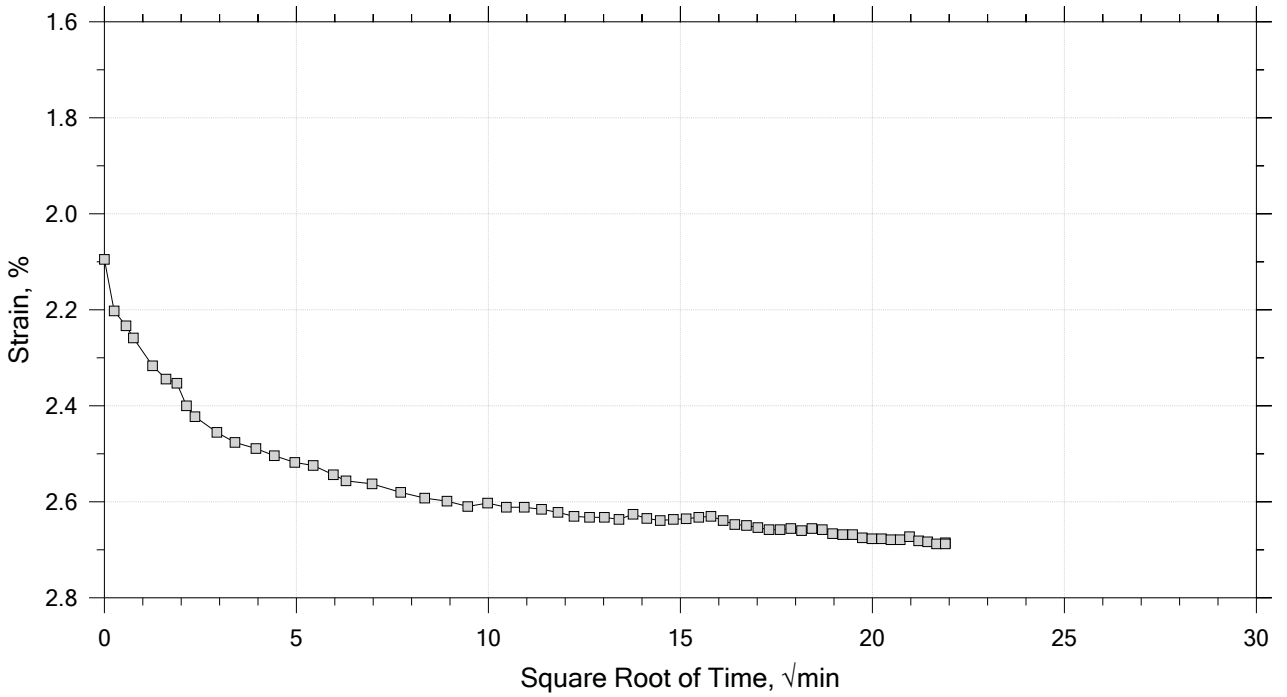
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 15

Constant Load Step

Stress: 0.125 tsf





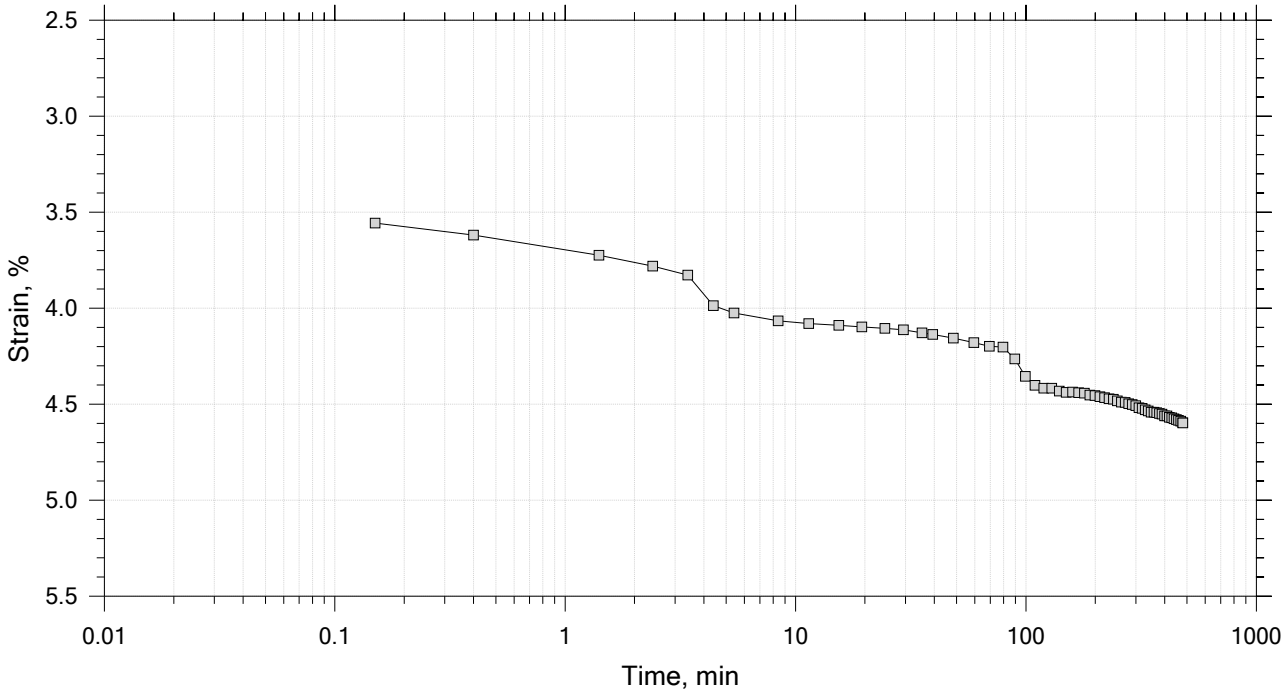
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

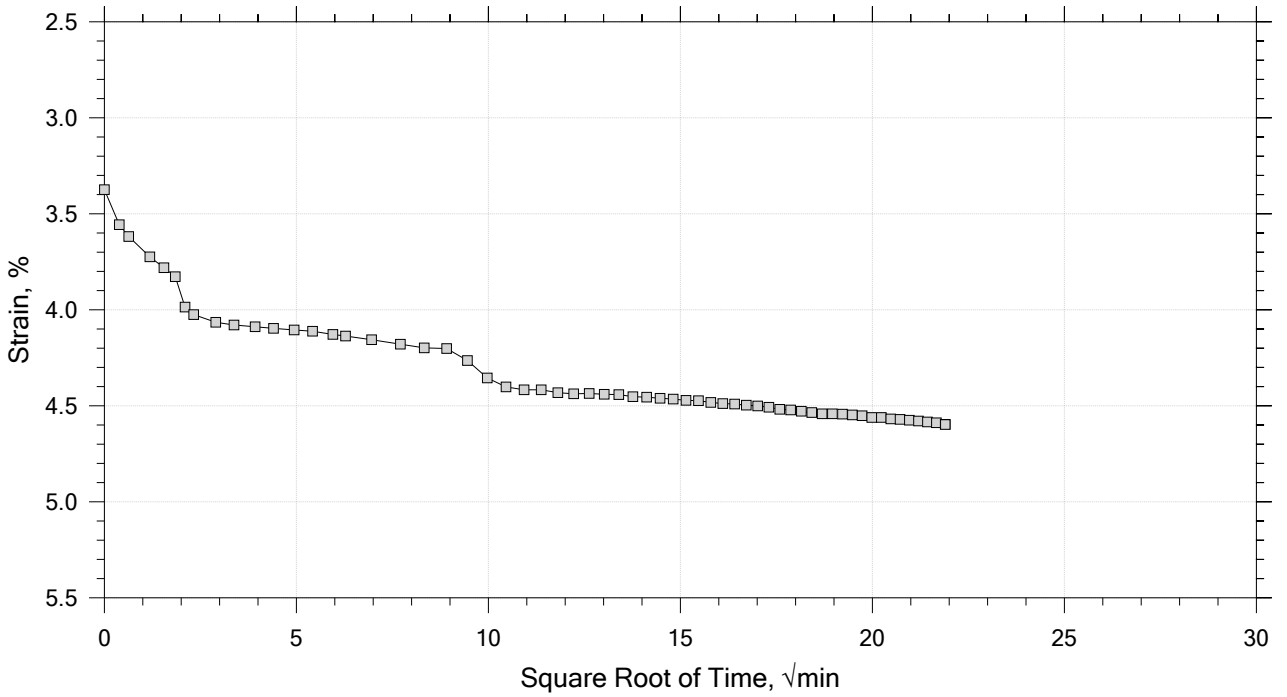
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 15

Constant Load Step

Stress: 0.25 tsf





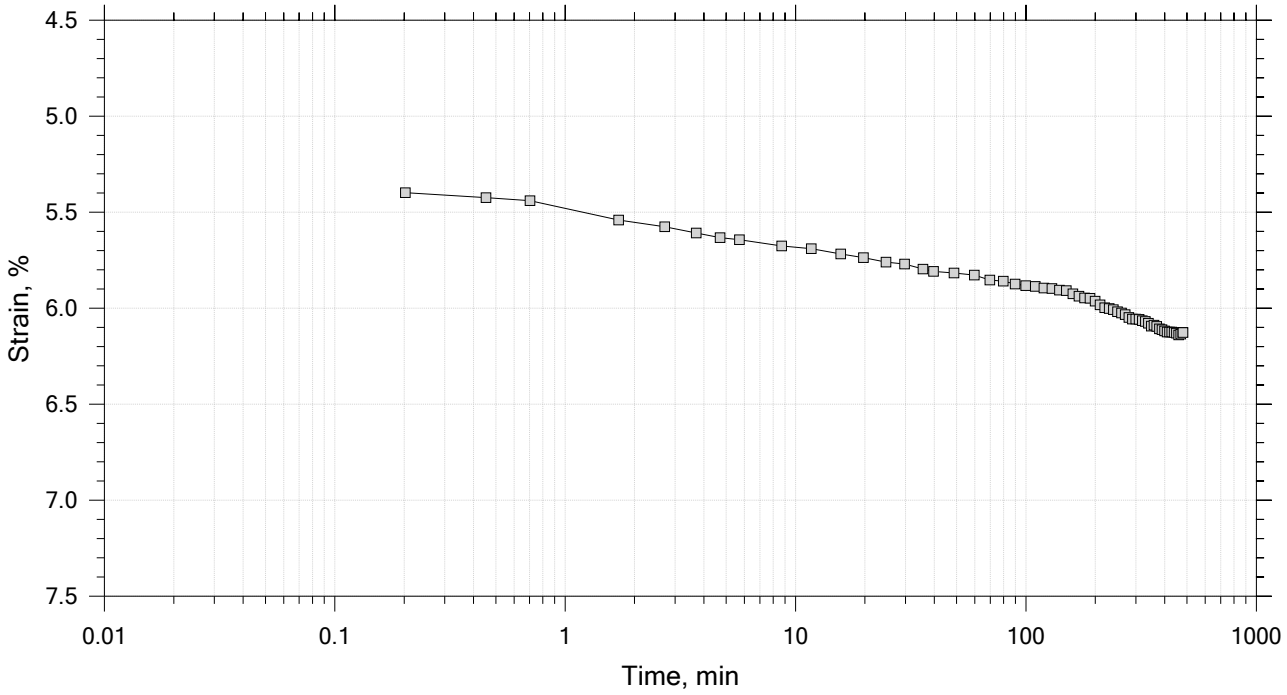
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

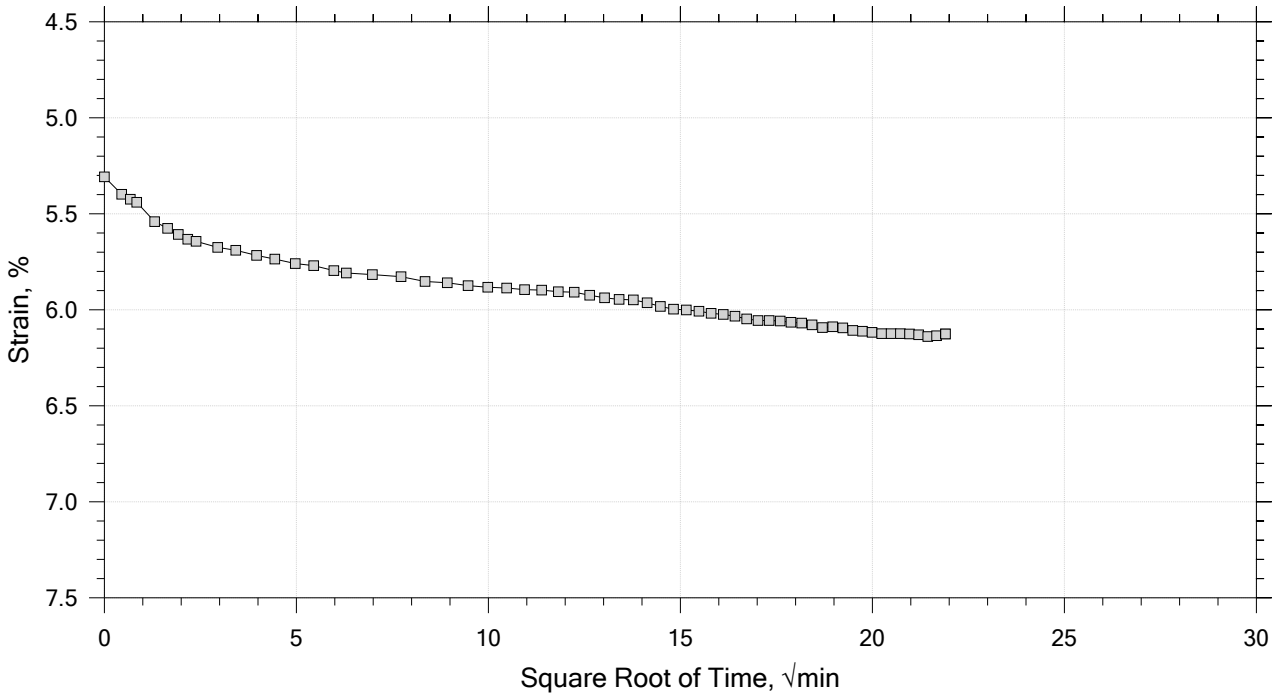
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15

Constant Load Step

Stress: 0.5 tsf





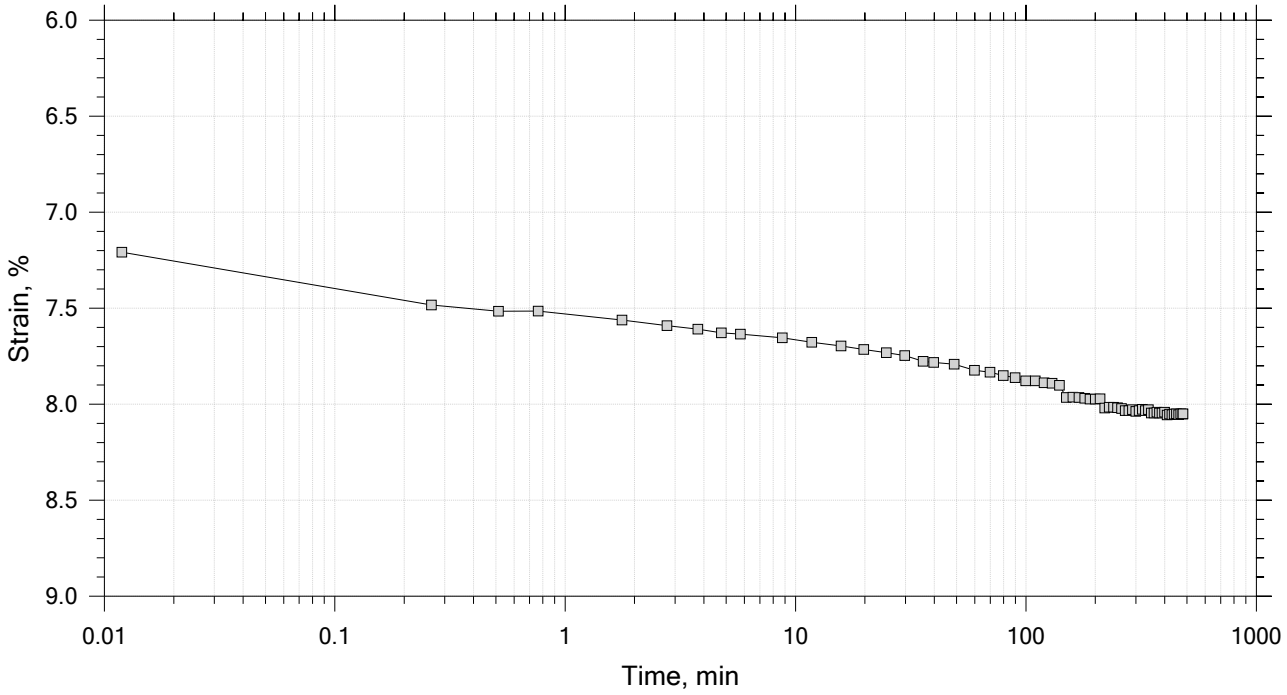
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

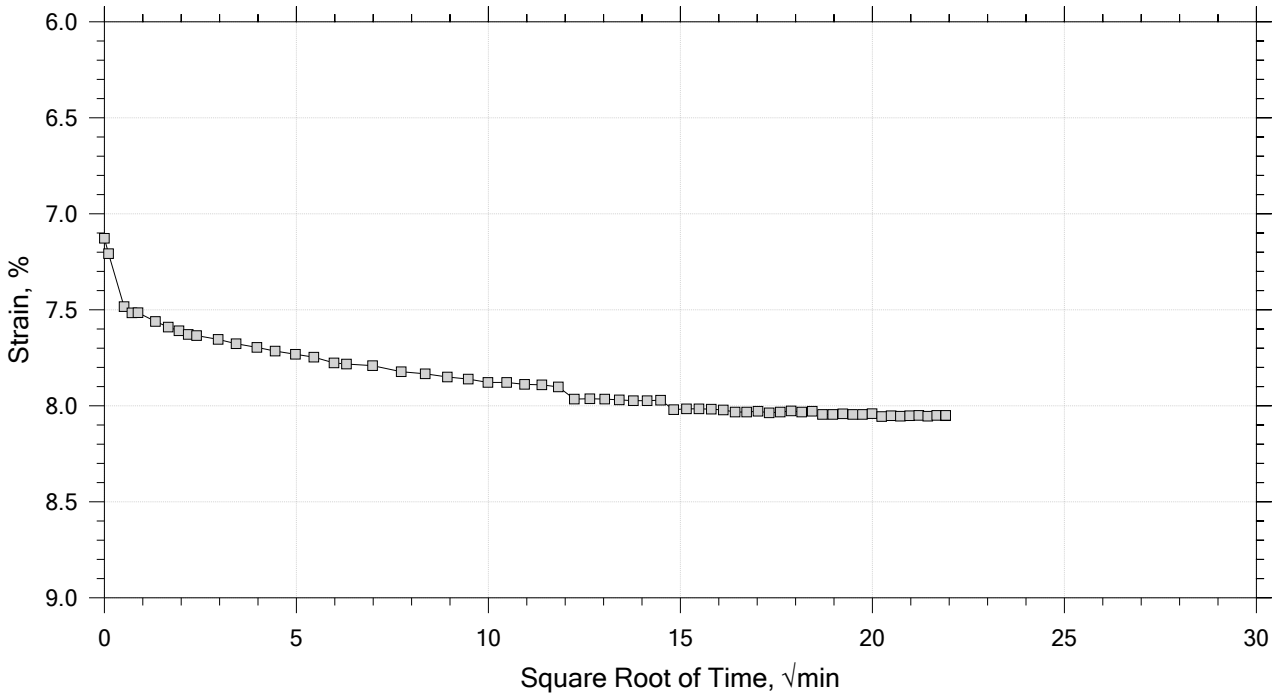
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15

Constant Load Step

Stress: 1 tsf





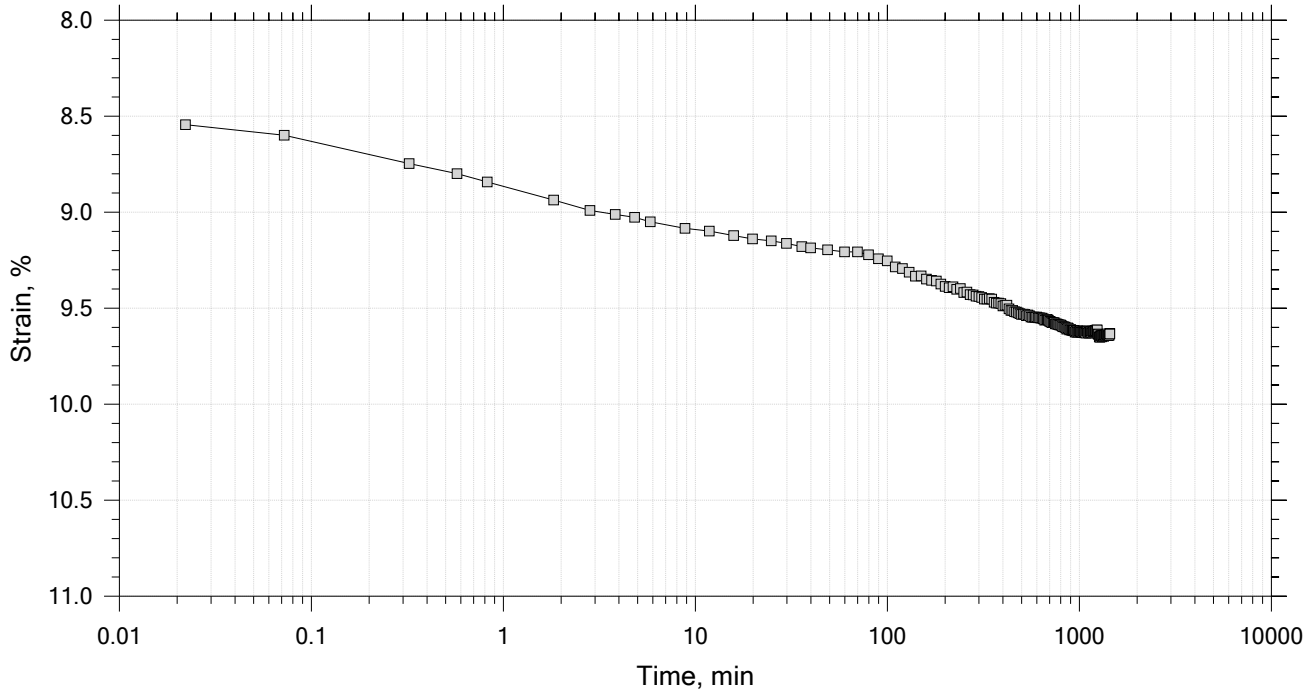
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

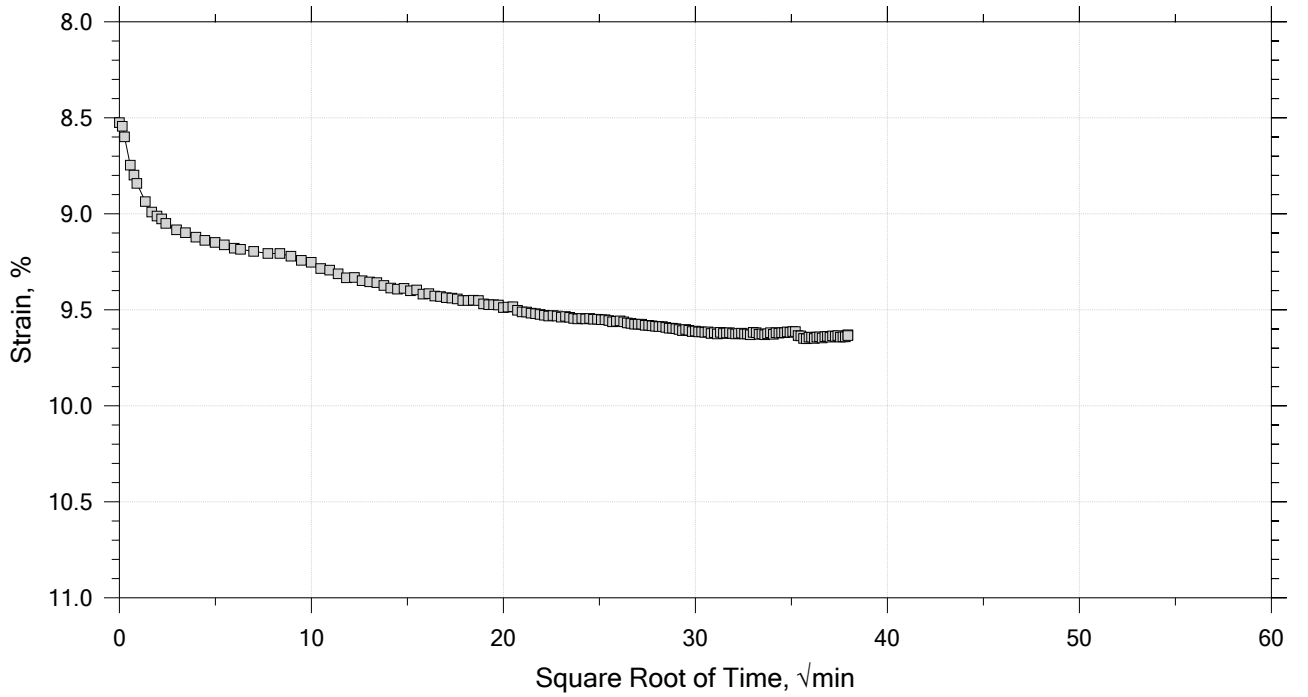
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15

Constant Load Step

Stress: 2 tsf





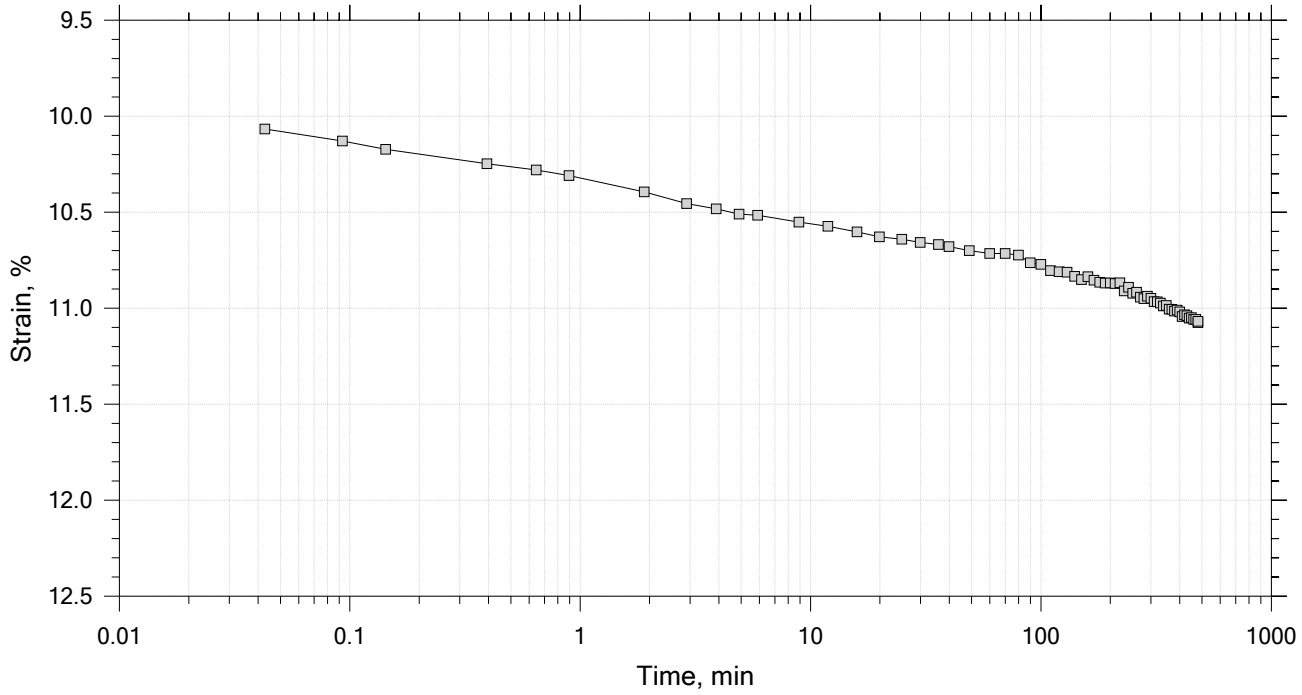
Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

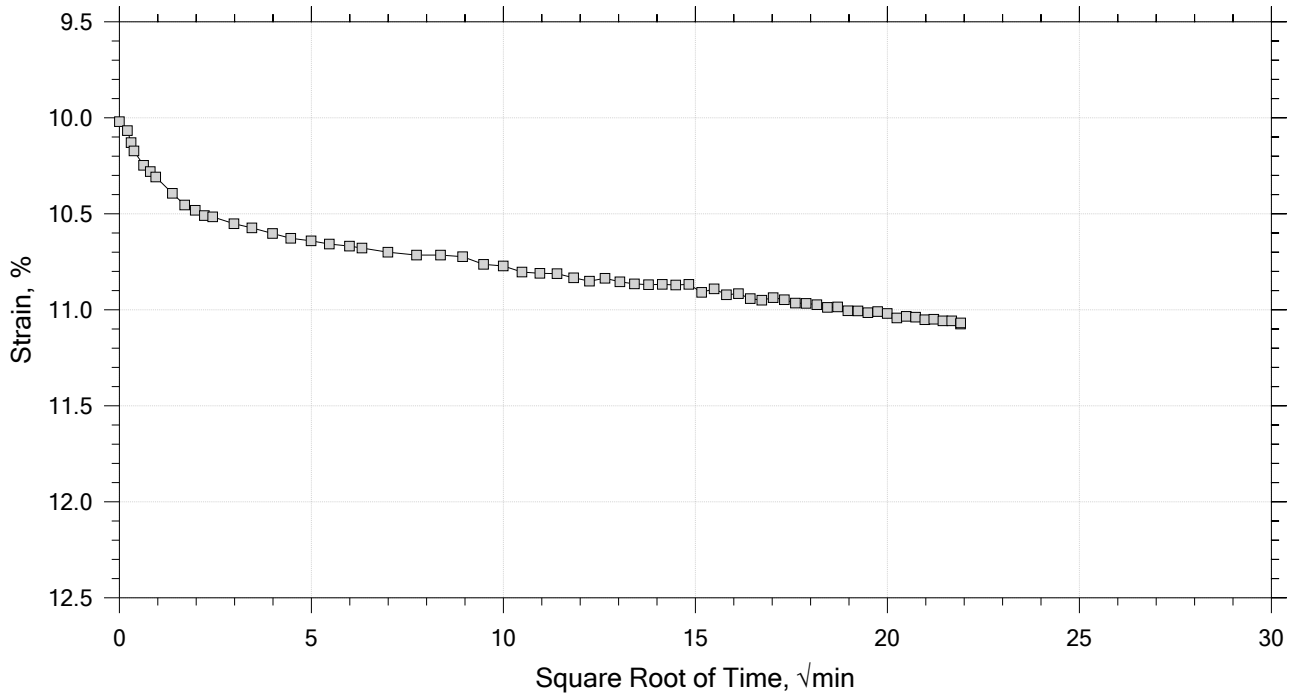
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 4 tsf





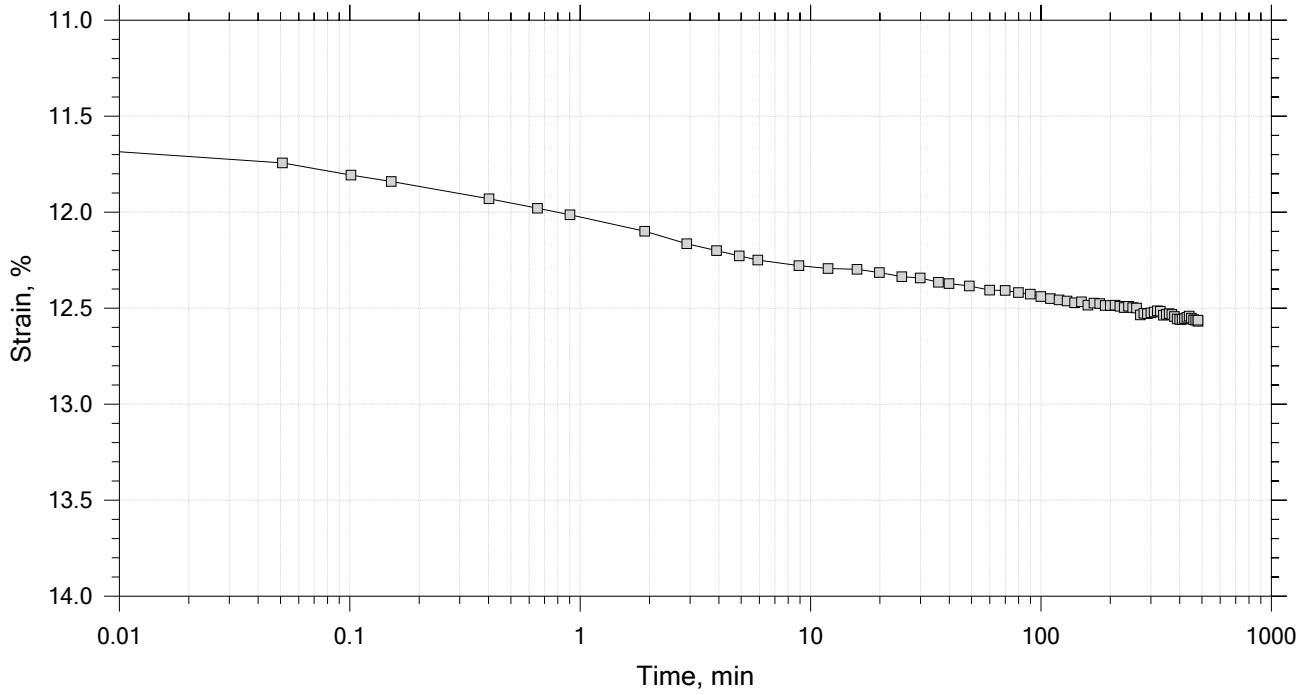
Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

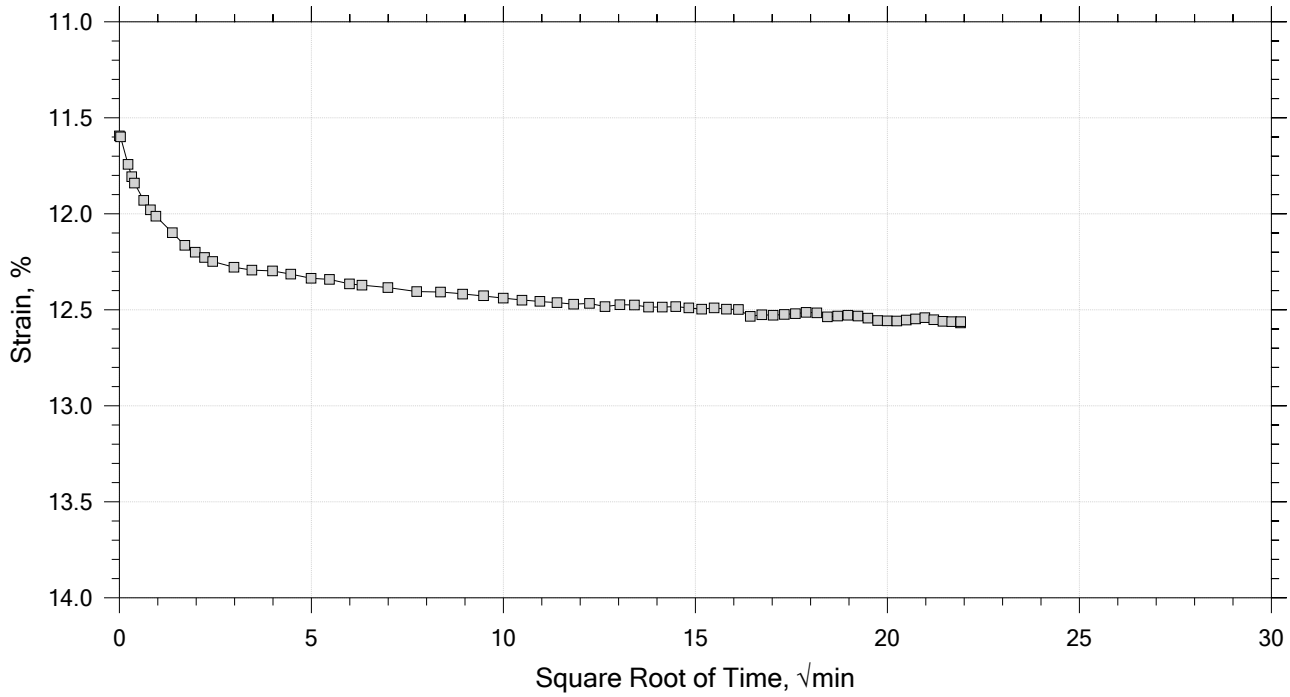
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 8 tsf





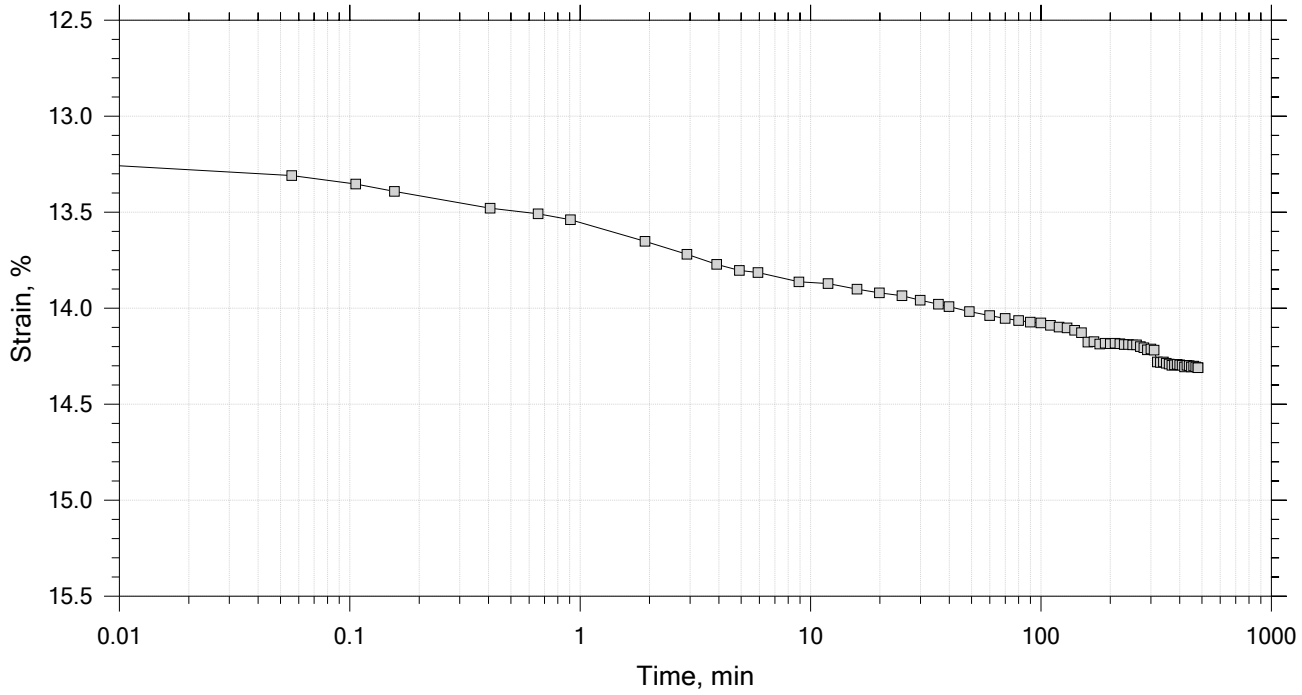
Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

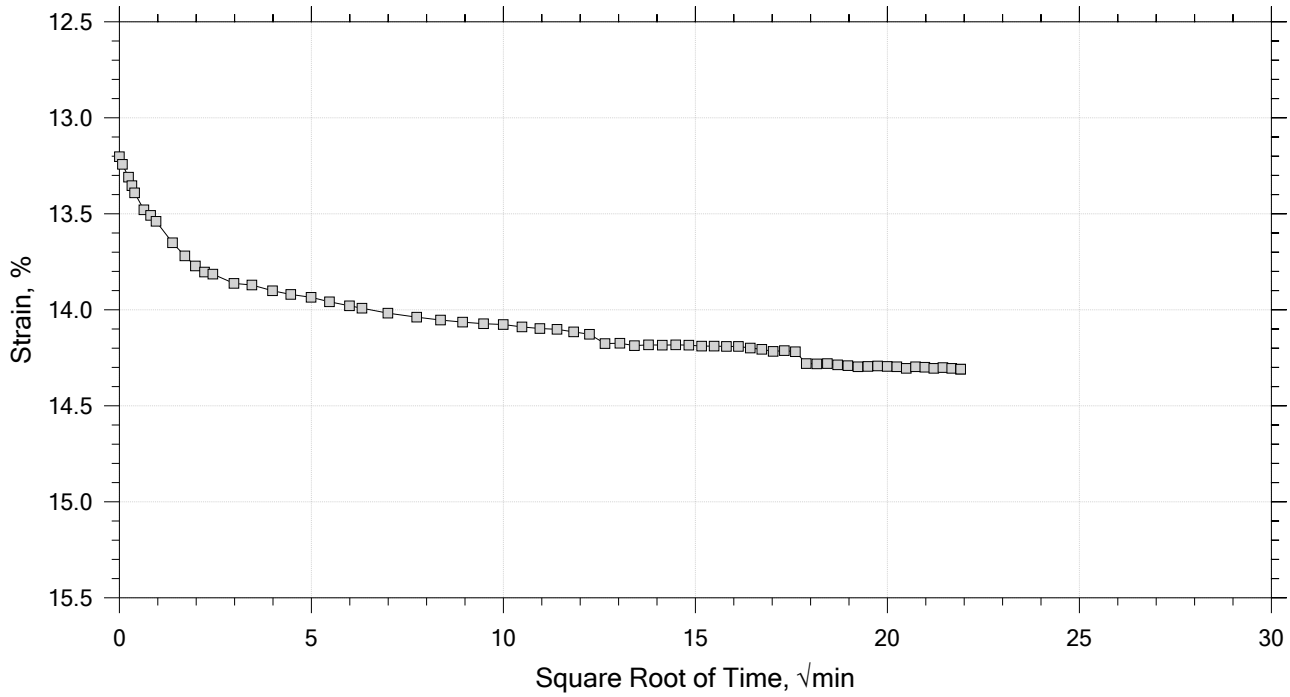
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 16 tsf





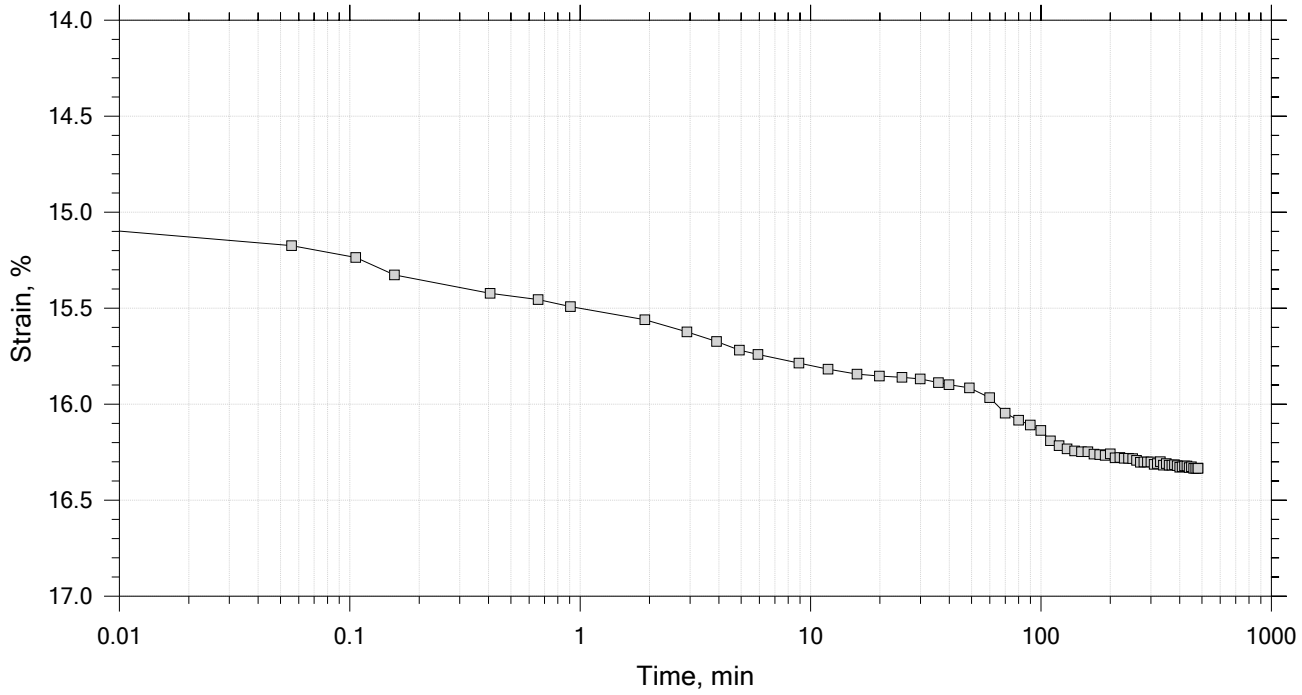
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

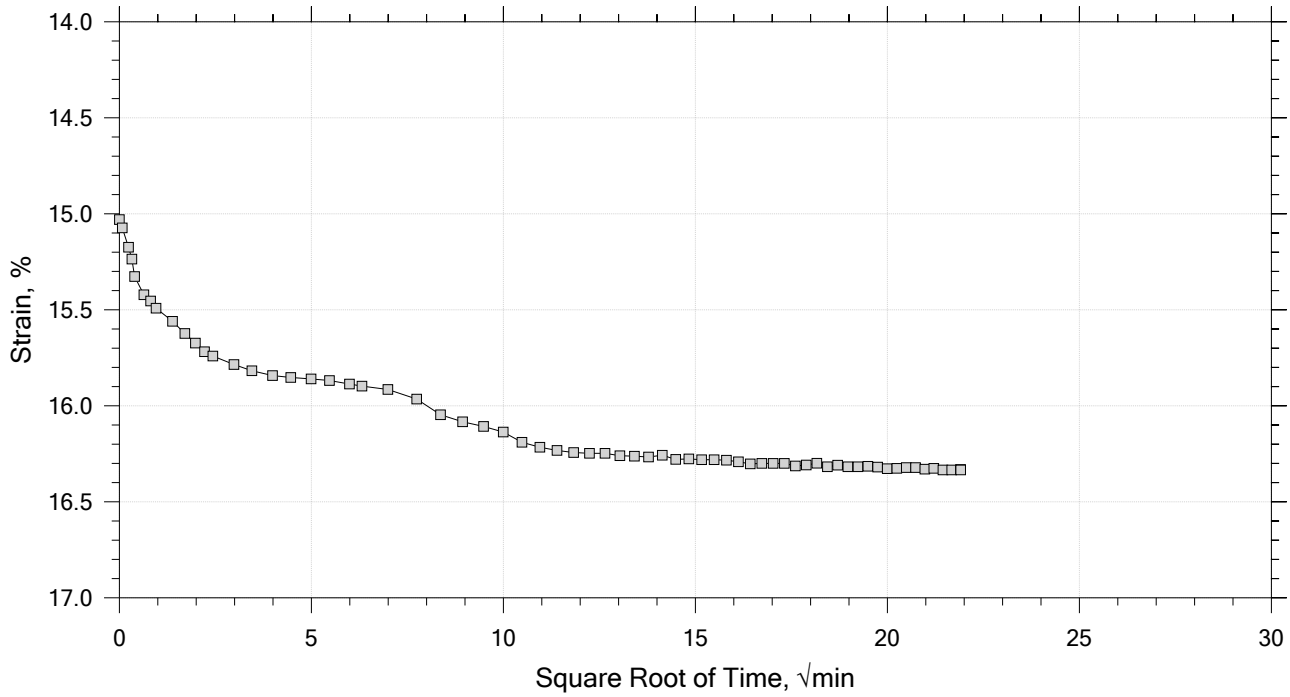
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15

Constant Load Step

Stress: 32 tsf

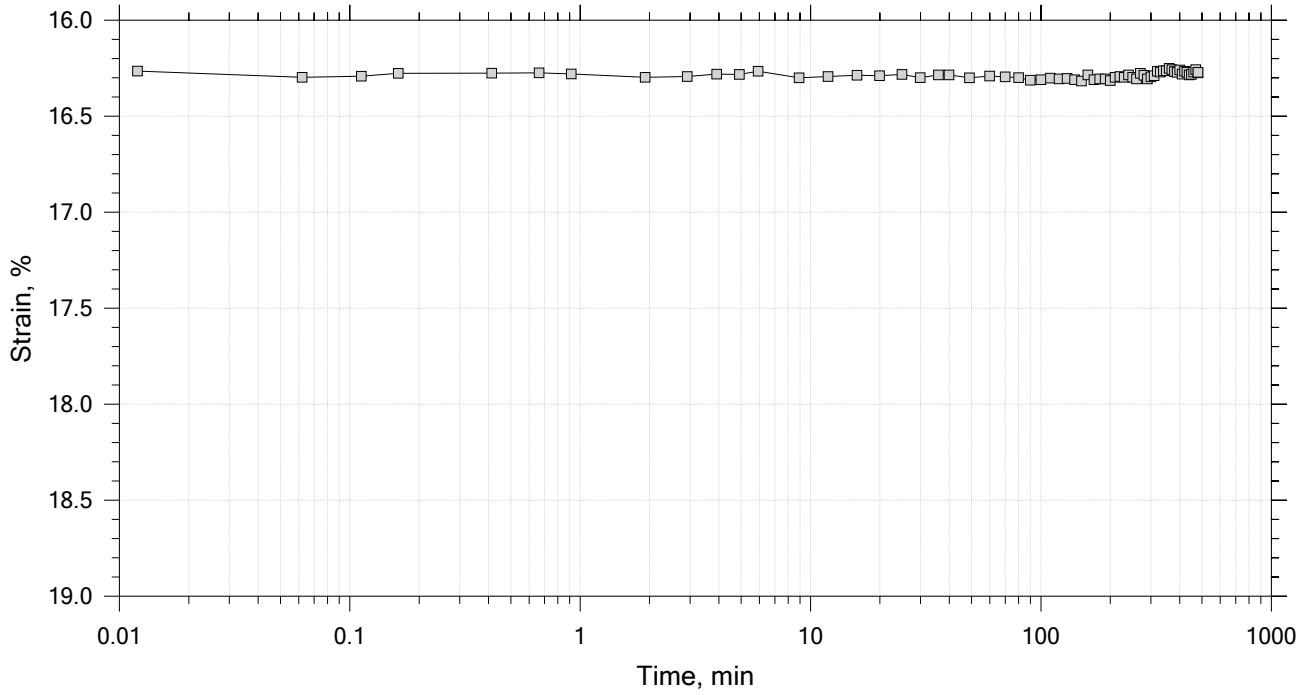


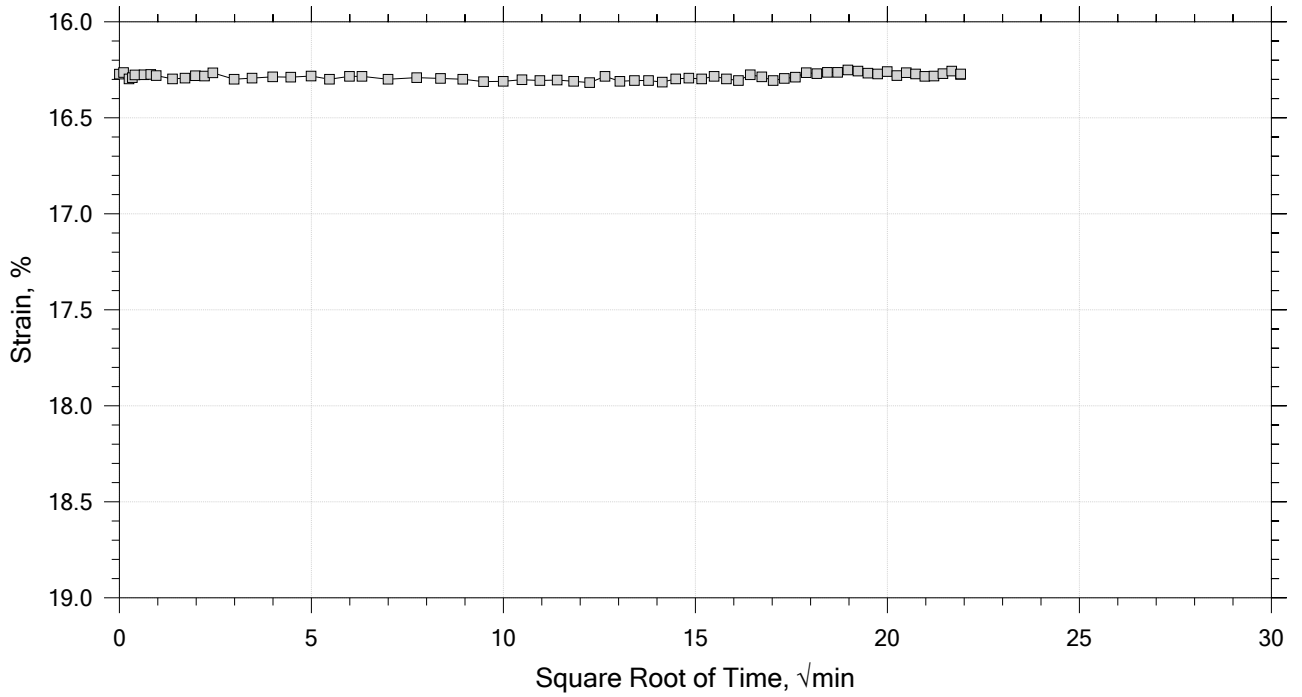


GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15
Constant Load Step
Stress: 8 tsf





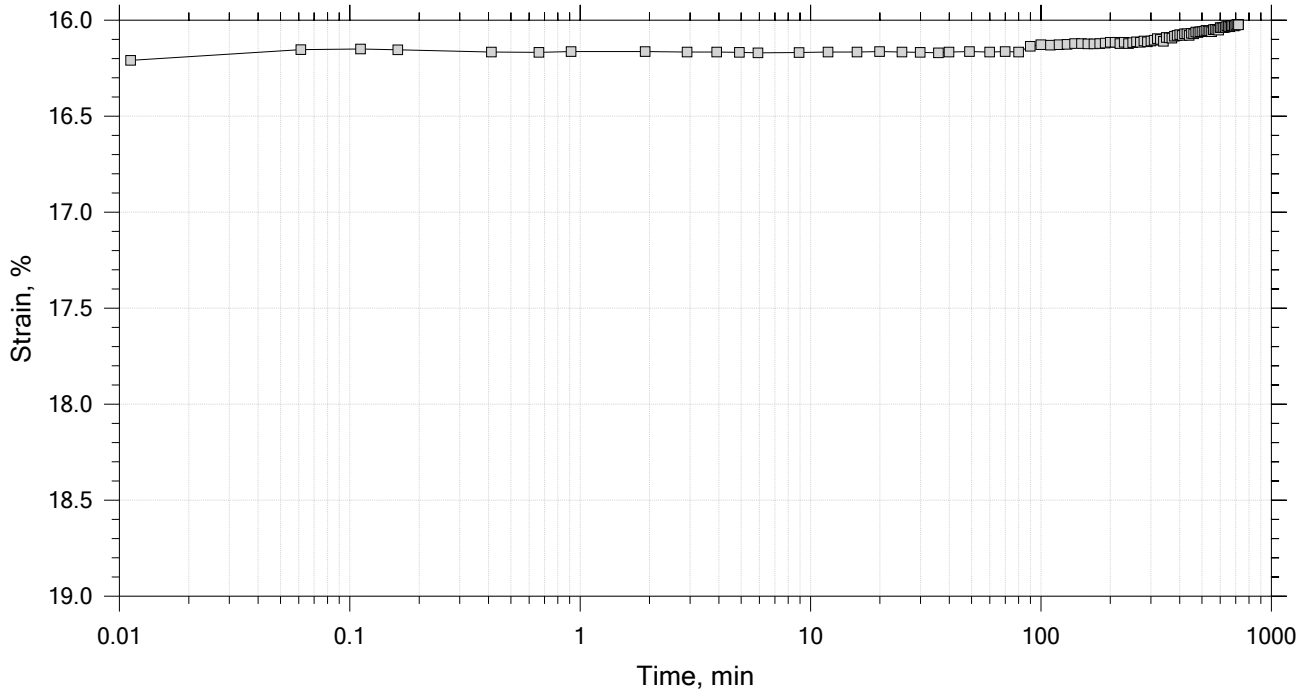
Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

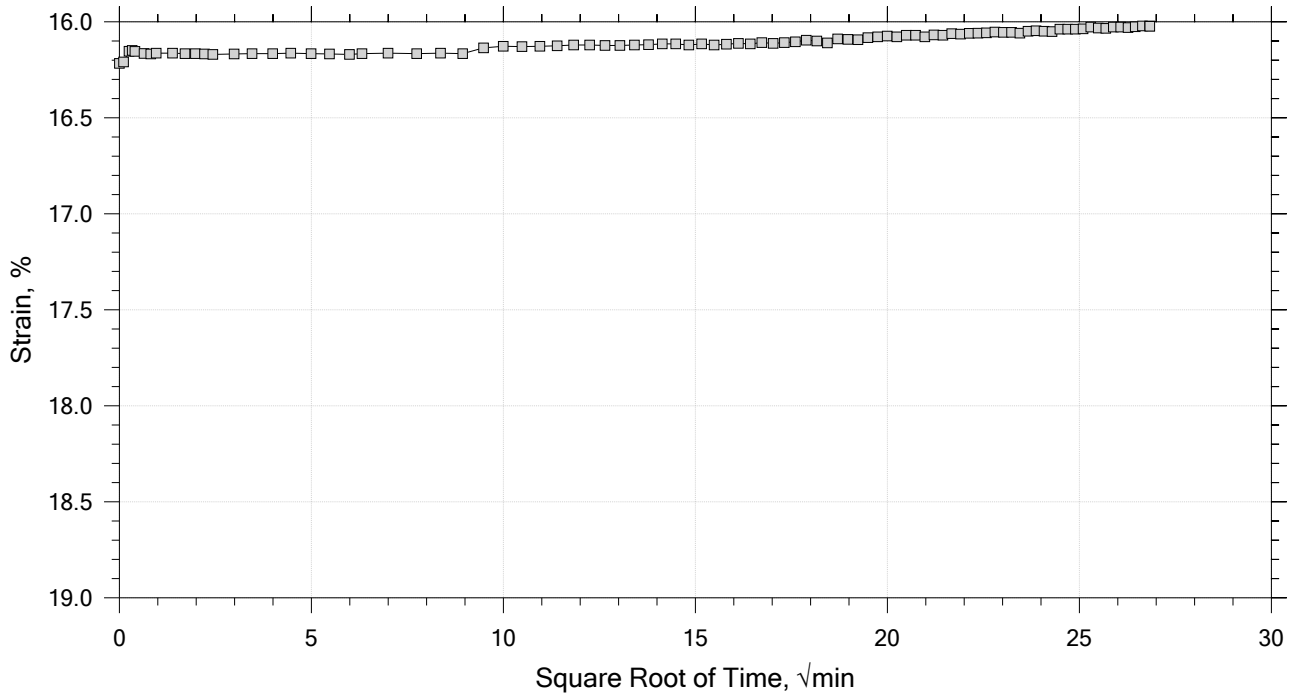
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15

Constant Load Step

Stress: 2 tsf

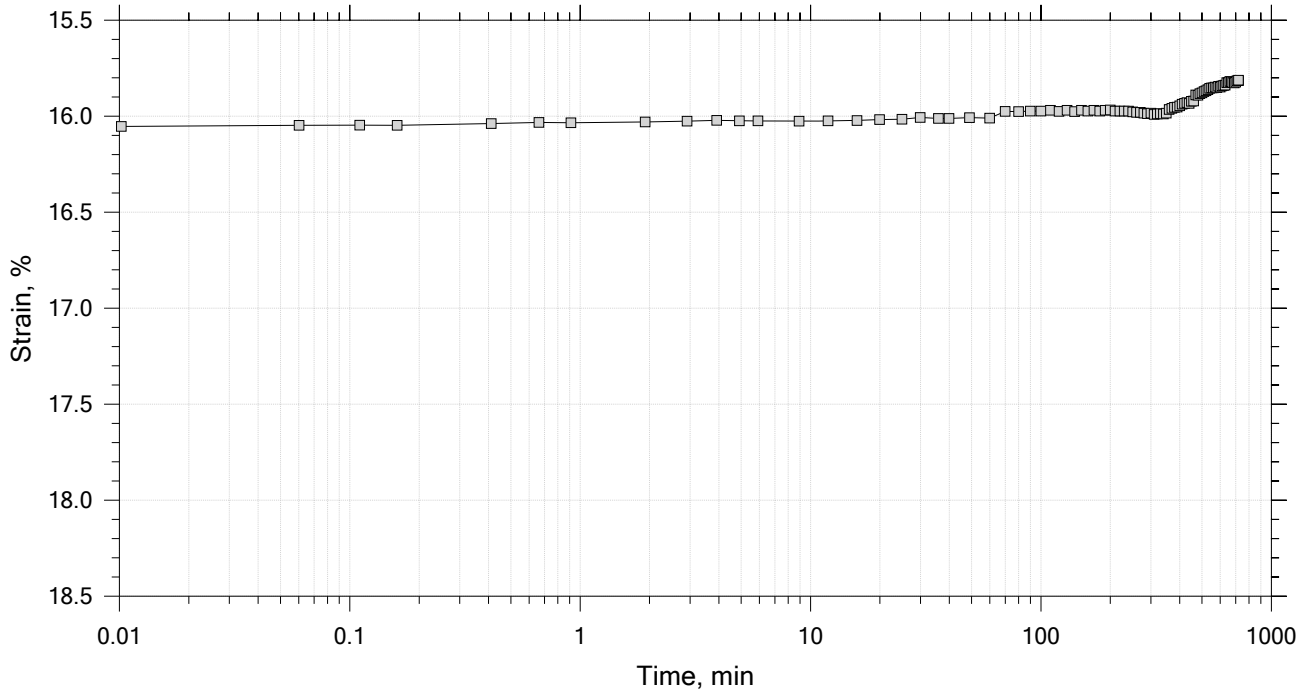


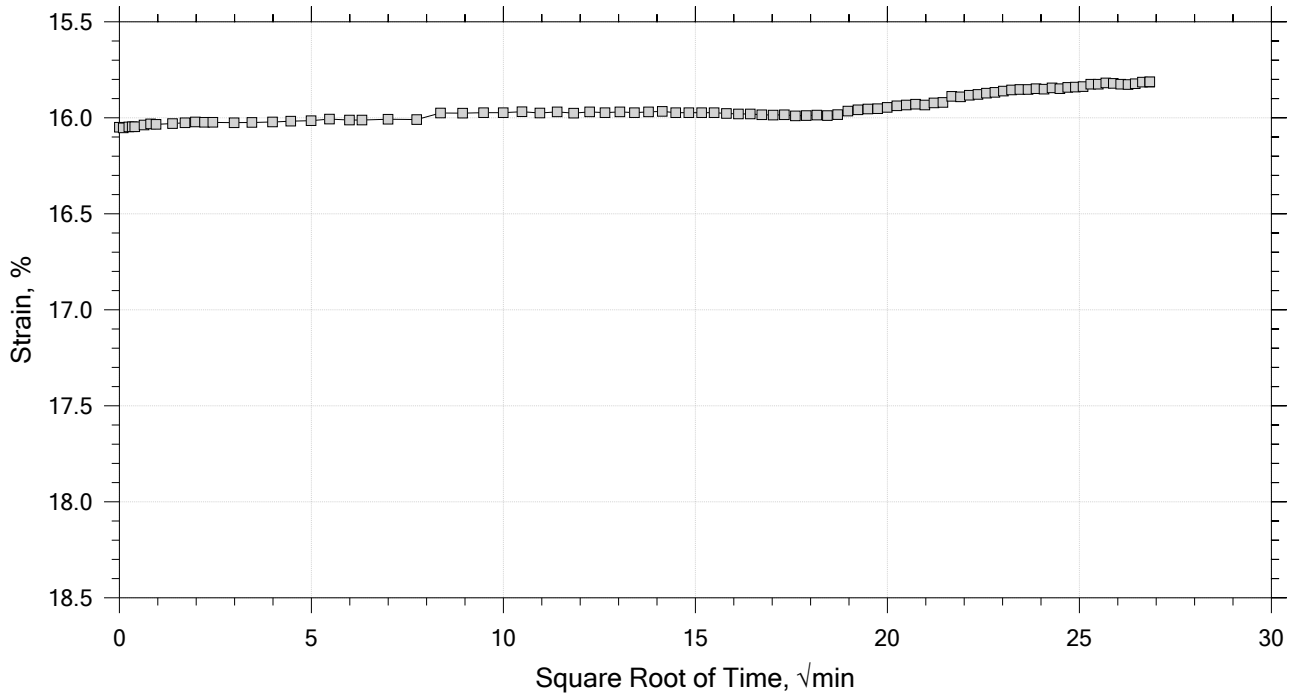


GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15
Constant Load Step
Stress: 0.5 tsf

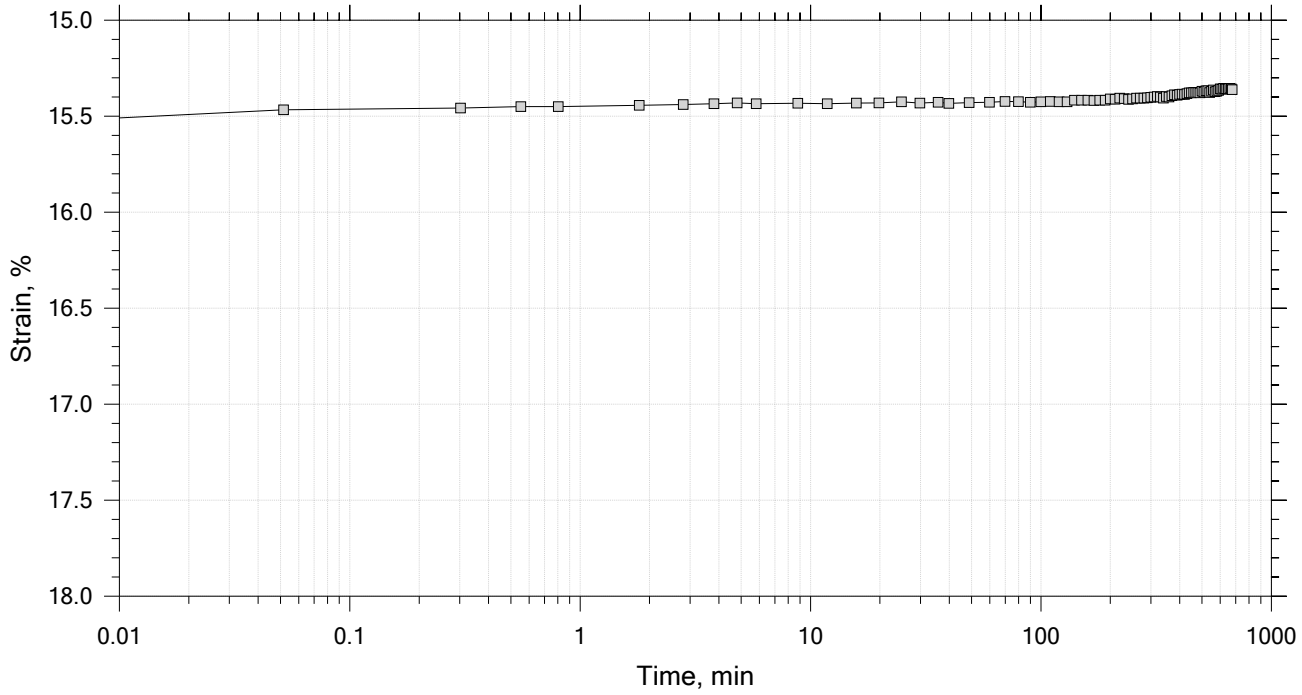


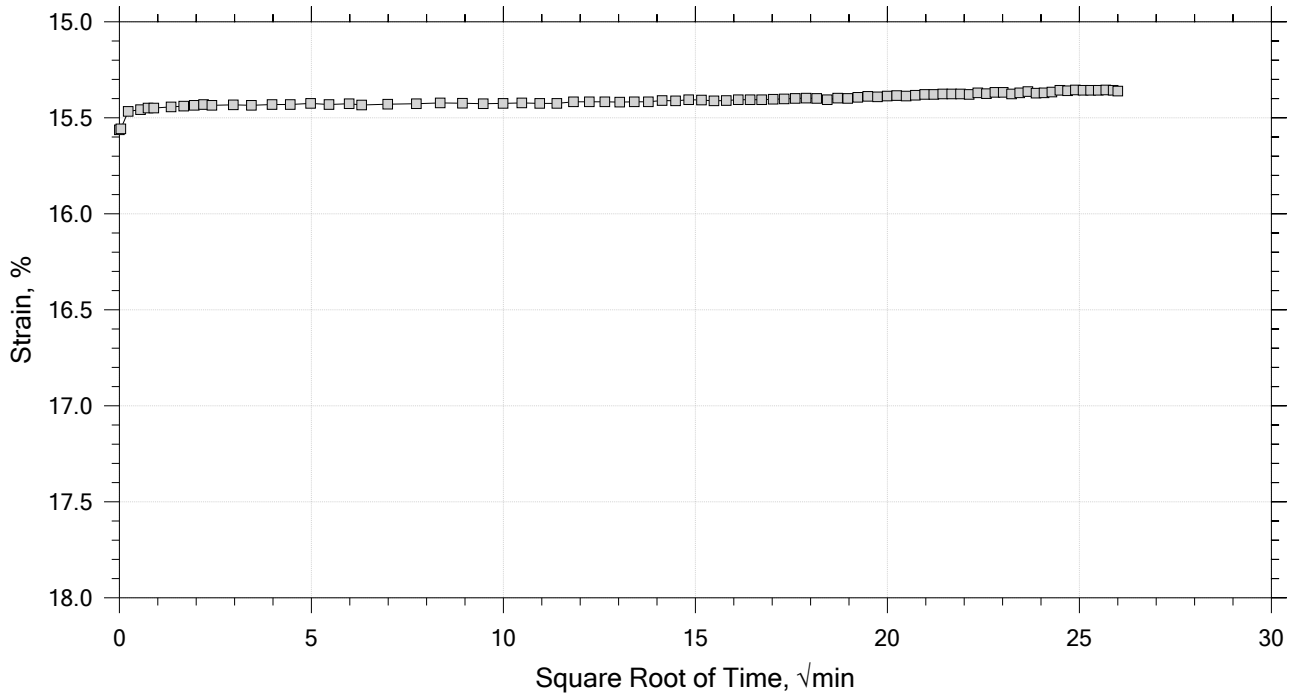


Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15
Constant Load Step
Stress: 0.125 tsf

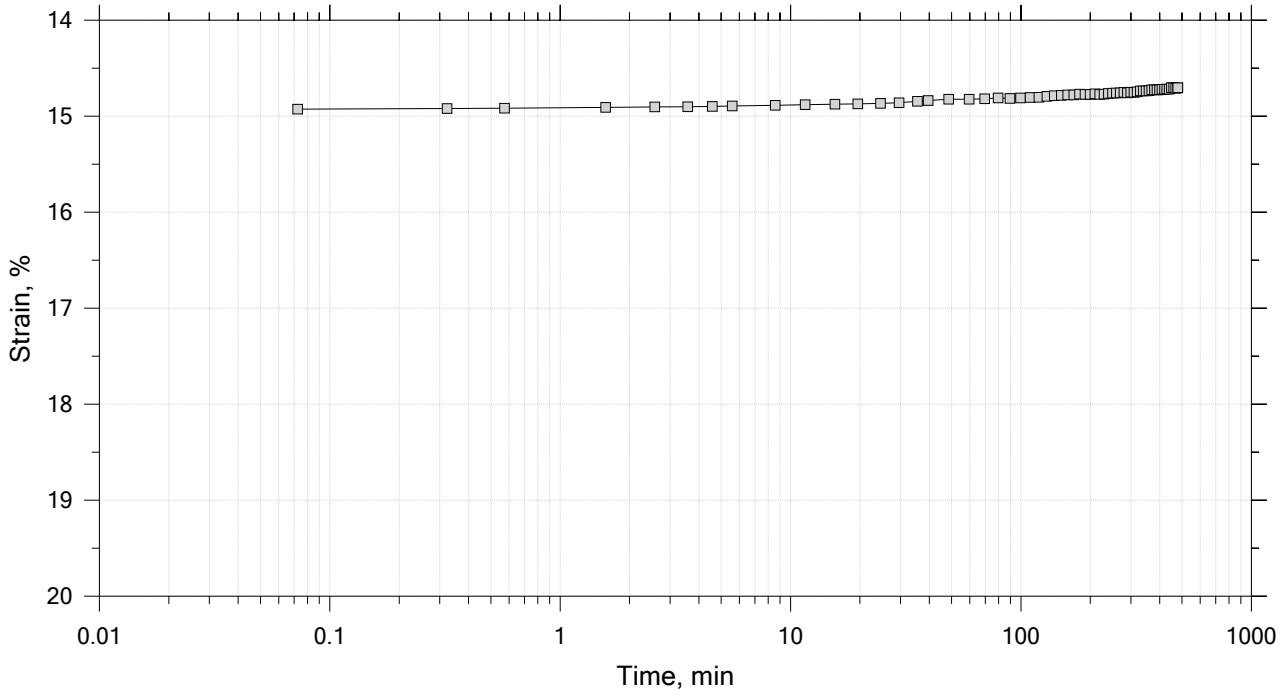


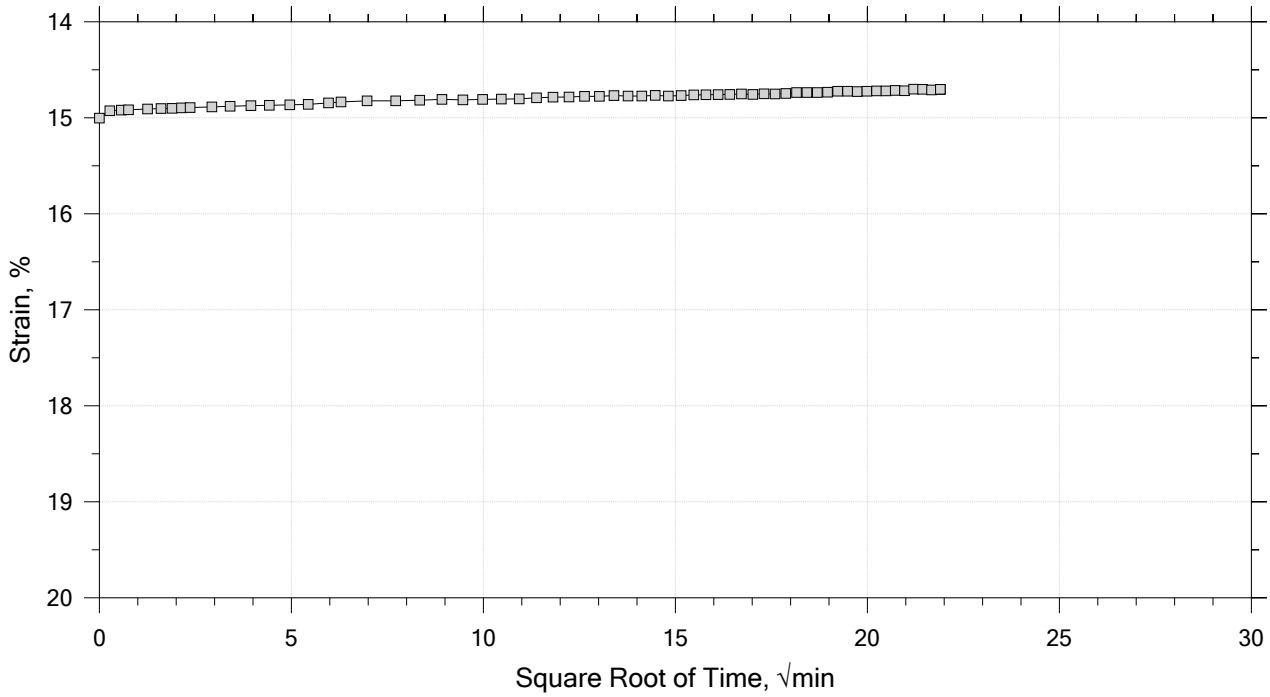


Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15
Constant Load Step
Stress: 0.0625 tsf





GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.71	Liquid Limit: NP
Initial Height: 0.75 in	Initial Void Ratio: 0.877	Plastic Limit: NP
Final Height: 0.65 in	Final Void Ratio: 0.626	Plasticity Index: NP

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E-1613	RING		E1916
Mass Container, gm	8.15	109.79	109.79	8.28
Mass Container + Wet Soil, gm	89.02	224.41	216.98	111.96
Mass Container + Dry Soil, gm	68.27	196.84	196.84	92.48
Mass Dry Soil, gm	60.12	87.051	87.051	84.2
Water Content, %	34.51	31.67	23.14	23.14
Void Ratio	---	0.88	0.63	---
Degree of Saturation, %	---	97.82	100.00	---
Dry Unit Weight, pcf	---	90.078	103.94	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-16	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, dark brown silty sand		
	Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv in²/s	Mv 1/tsf	k ft/day
1	0.0741	0.01271	0.845	1.69	226.585	8.62e-06	2.29e-01	3.69e-05
2	0.125	0.02016	0.826	2.69	44.556	4.27e-05	1.95e-01	1.56e-04
3	0.250	0.03448	0.790	4.60	197.626	9.34e-06	1.53e-01	2.67e-05
4	0.500	0.04595	0.762	6.13	400.053	4.45e-06	6.12e-02	5.10e-06
5	1.00	0.06037	0.726	8.05	60.997	2.81e-05	3.85e-02	2.03e-05
6	2.00	0.07226	0.696	9.63	172.938	9.55e-06	1.58e-02	2.83e-06
7	4.00	0.08301	0.669	11.1	147.715	1.08e-05	7.17e-03	1.45e-06
8	8.00	0.09422	0.641	12.6	8.345	1.85e-04	3.73e-03	1.30e-05
9	16.0	0.1073	0.608	14.3	411.572	3.62e-06	2.18e-03	1.48e-07
10	32.0	0.1225	0.570	16.3	185.608	7.68e-06	1.27e-03	1.82e-07
11	8.00	0.1220	0.571	16.3	---	---	2.60e-05	---
12	2.00	0.1202	0.576	16.0	---	---	4.14e-04	---
13	0.500	0.1186	0.580	15.8	---	---	1.41e-03	---
14	0.125	0.1152	0.588	15.4	519.243	2.73e-06	1.20e-02	6.15e-07
15	0.0625	0.1103	0.601	14.7	361.884	3.97e-06	1.05e-01	7.82e-06

GeoTesting EXPRESS

Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-16	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 18-20
Test No.: IP-2	Sample Type: intact	Elevation: ---
Description: Moist, dark brown silty sand		
Remarks: System LTIII-16-0834, Swell Pressure = 0.0741 tsf		
Displacement at End of Increment		

Consolidated Undrained Direct Simple Shear Testing of Cohesive Soils by ASTM D6528

Client:	Haley & Aldrich, Inc.	GTX#:	313173
Project Name:	Marion/Wareham Causeway	Test Date:	3/19/21
Project Location:	Marion & Wareham, MA		

Boring ID: BB-16
Sample ID: U-2
Depth, ft: 20-22

Visual Description: Moist, brown peat with sand

Test Equipment: Top and bottom box (circular) = 2.50 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch. Stacked rings used. Set up included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: density: Extruded from tube, cut, trimmed and placed into apparatus at as-received and moisture content.

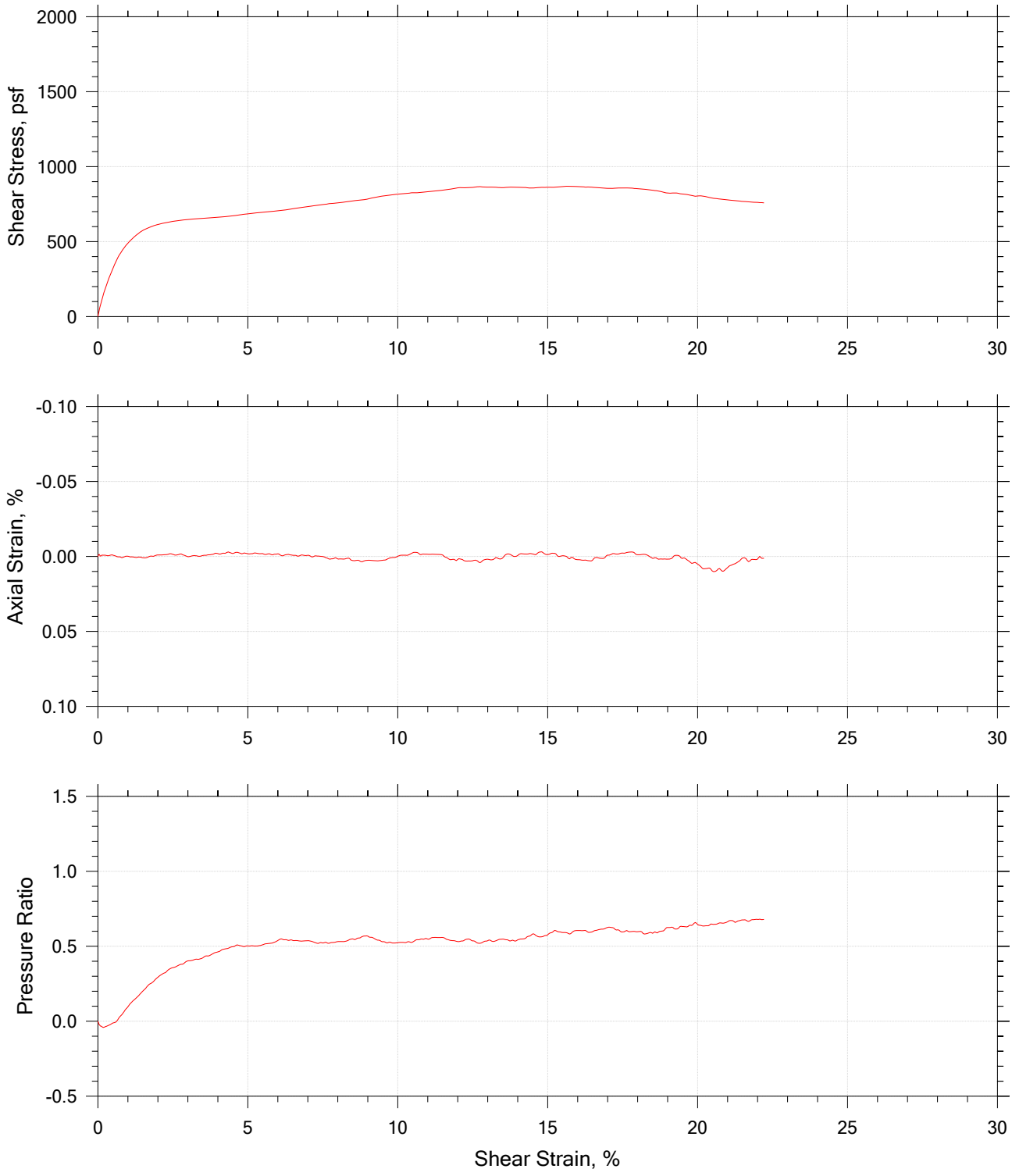
Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	DSS-1	DSS-2			
Initial Moisture Content, %	30.5	30.5			
Initial Dry Density, pcf	84.5	84.8			
Nominal Rate of Shear Strain, %/hr	5.0	5.0			
Maximum Vertical Consolidation Stress, psf	2,850	3,800			
Final Moisture Content, %	29.8	29.2			
Measured Peak Shear Stress, psf	870.6	2351.4			
Shear Strain at Peak Shear Stress, %	15.7	20.0			
Membrane Correction, psf	56	49			
Corrected Peak Shear Stress, psf	814.6	2302.4			
S_u / σ'_{vc}	0.29	0.61			

Comments: Failure taken at peak prior to or at 20% strain, per ASTM D6528.

Tested By: md Checked By: njh

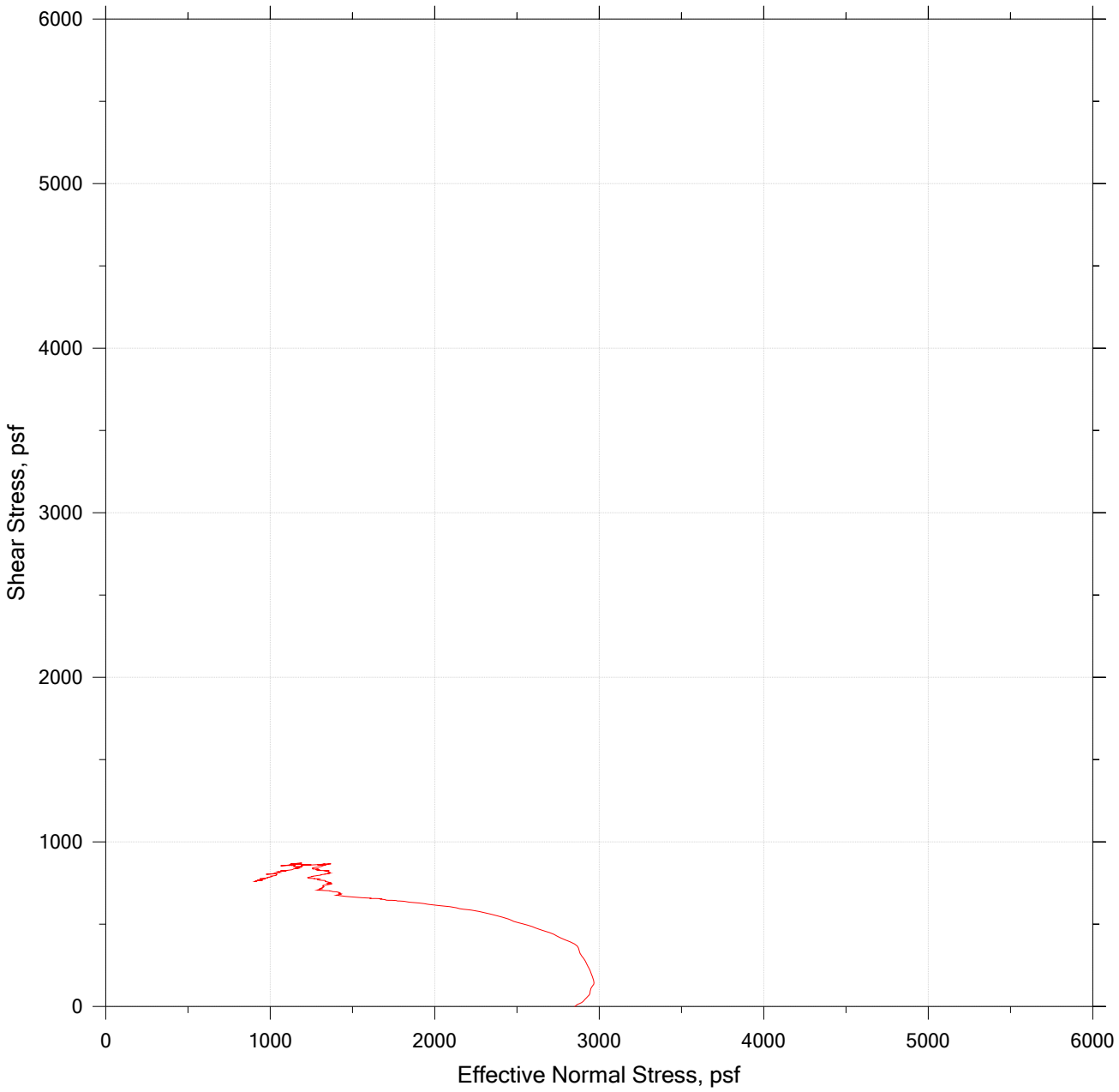
Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

Direct Simple Shear Test



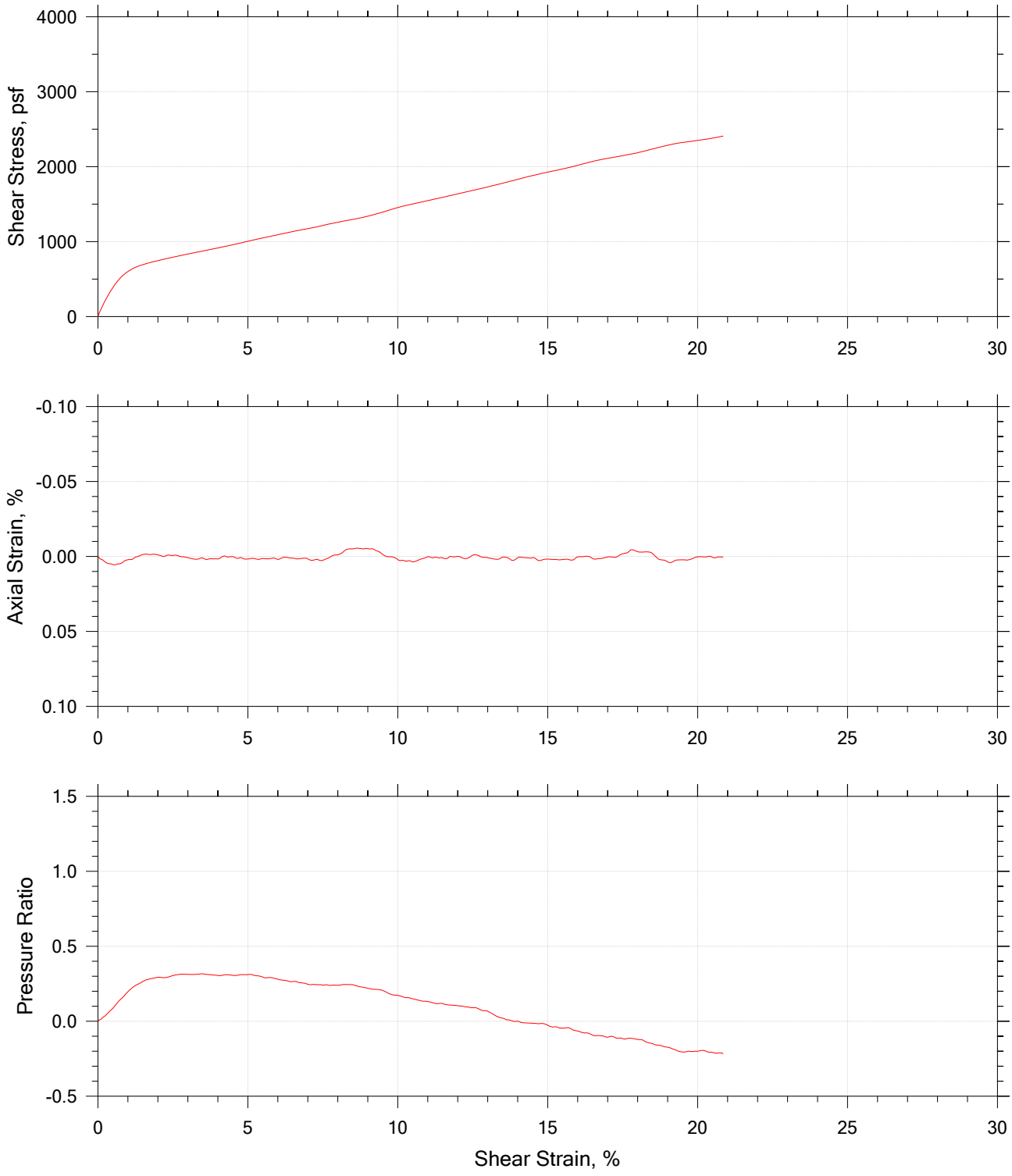
GeoTesting EXPRESS	Project Name: Marion/Wareham Couseway	Location: Marion & Wareham, MA	Project Number: GTX-313173
	Boring Number: BB-16	Tester: md	Checker: njh
	Sample Number: U-2	Test Date: 03/19/21	Depth: 20-22 ft
	Test Number: DSS-1	Preparation: intact	Elevation: ---
	Description: Moist, brown peat with sand		
	Remarks: System HH		

Direct Simple Shear Test



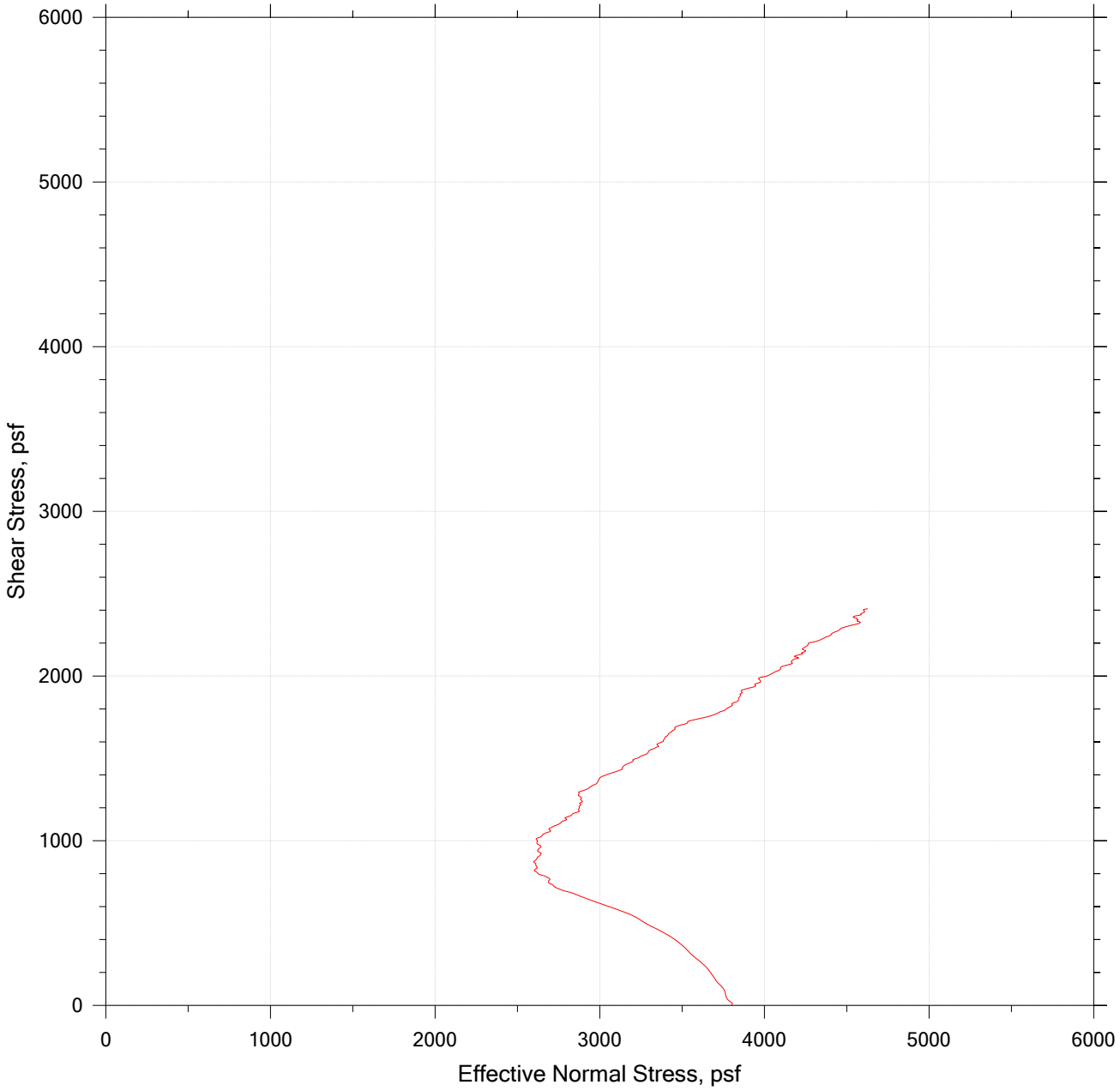
GeoTesting EXPRESS	Project Name: Marion/Wareham Couseway	Location: Marion & Wareham, MA	Project Number: GTX-313173
	Boring Number: BB-16	Tester: md	Checker: njh
	Sample Number: U-2	Test Date: 03/19/21	Depth: 20-22 ft
	Test Number: DSS-1	Preparation: intact	Elevation: ---
	Description: Moist, brown peat with sand		
	Remarks: System HH		

Direct Simple Shear Test



GeoTesting EXPRESS	Project Name: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project Number: GTX-313173
	Boring Number: BB-16	Tester: md	Checker: njh
	Sample Number: U-2	Test Date: 03/19/21	Depth: 20-22 ft
	Test Number: DSS-2	Preparation: intact	Elevation: ---
	Description: Moist, brown peat with sand		
	Remarks:		

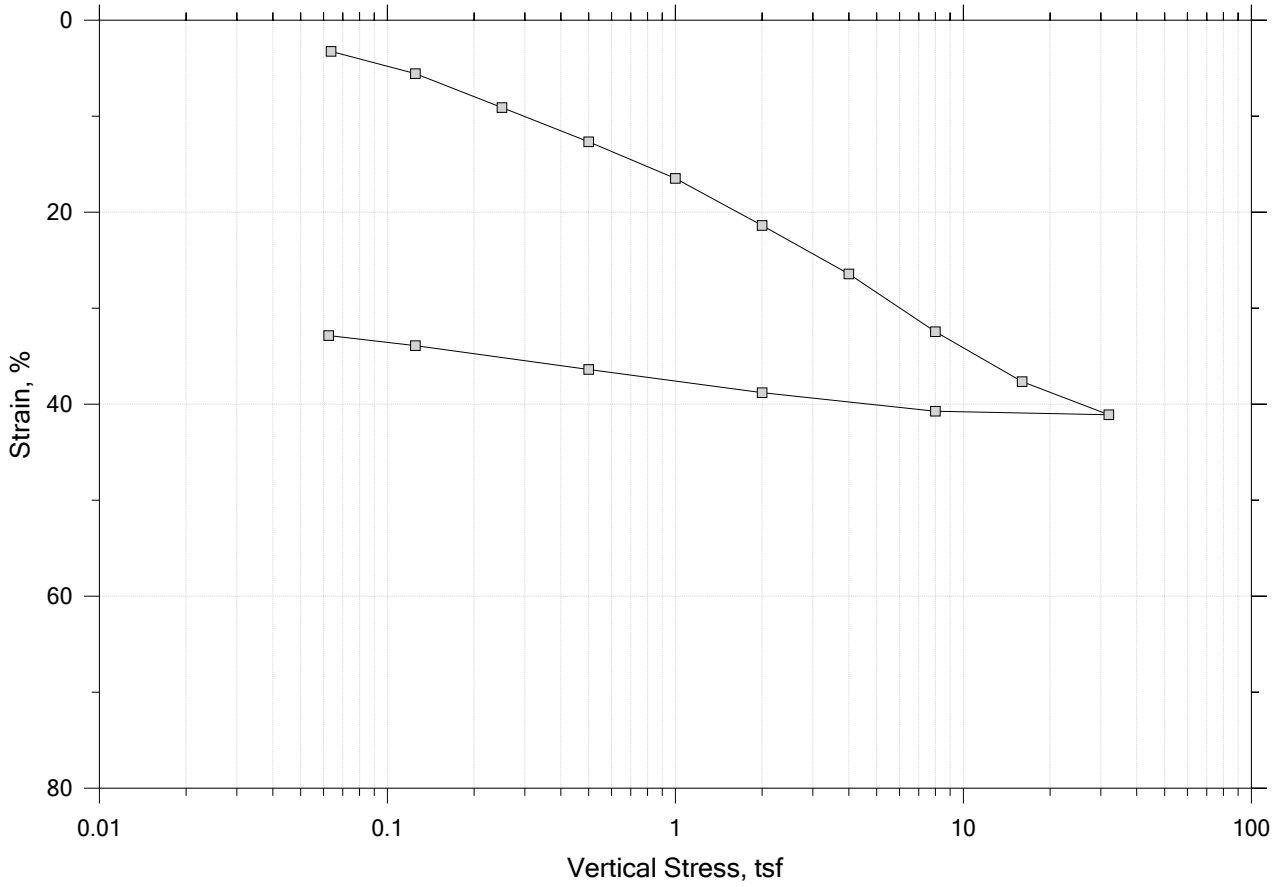
Direct Simple Shear Test

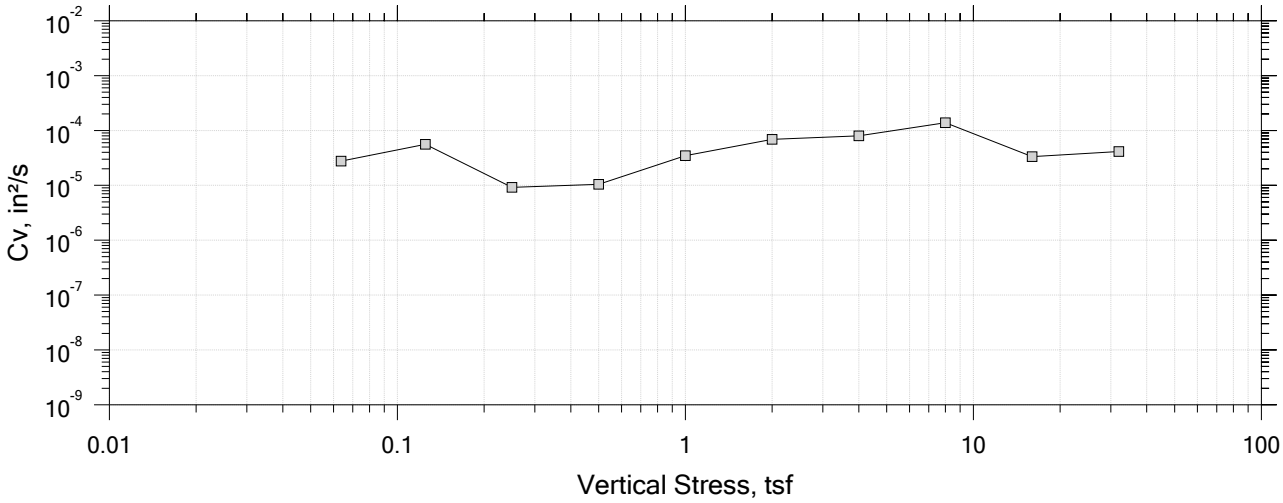


GeoTesting EXPRESS	Project Name: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project Number: GTX-313173
	Boring Number: BB-16	Tester: md	Checker: njh
	Sample Number: U-2	Test Date: 03/19/21	Depth: 20-22 ft
	Test Number: DSS-2	Preparation: intact	Elevation: ---
	Description: Moist, brown peat with sand		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





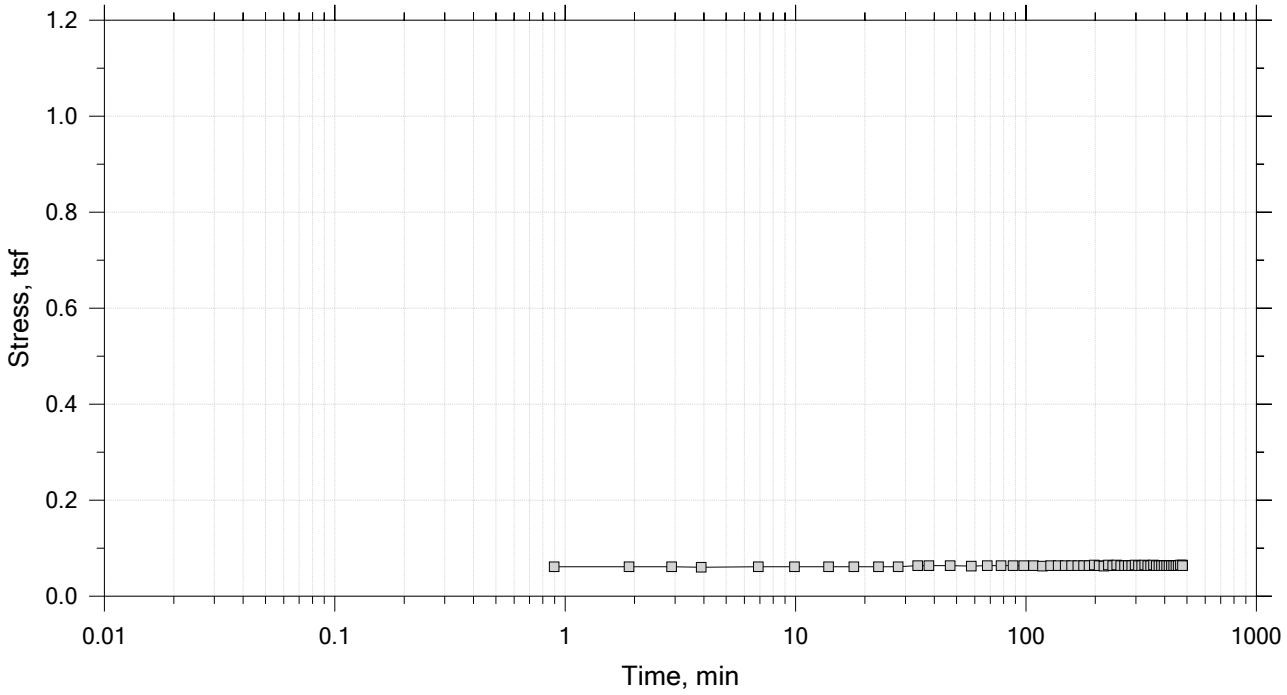
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		
	Displacement at End of Increment		

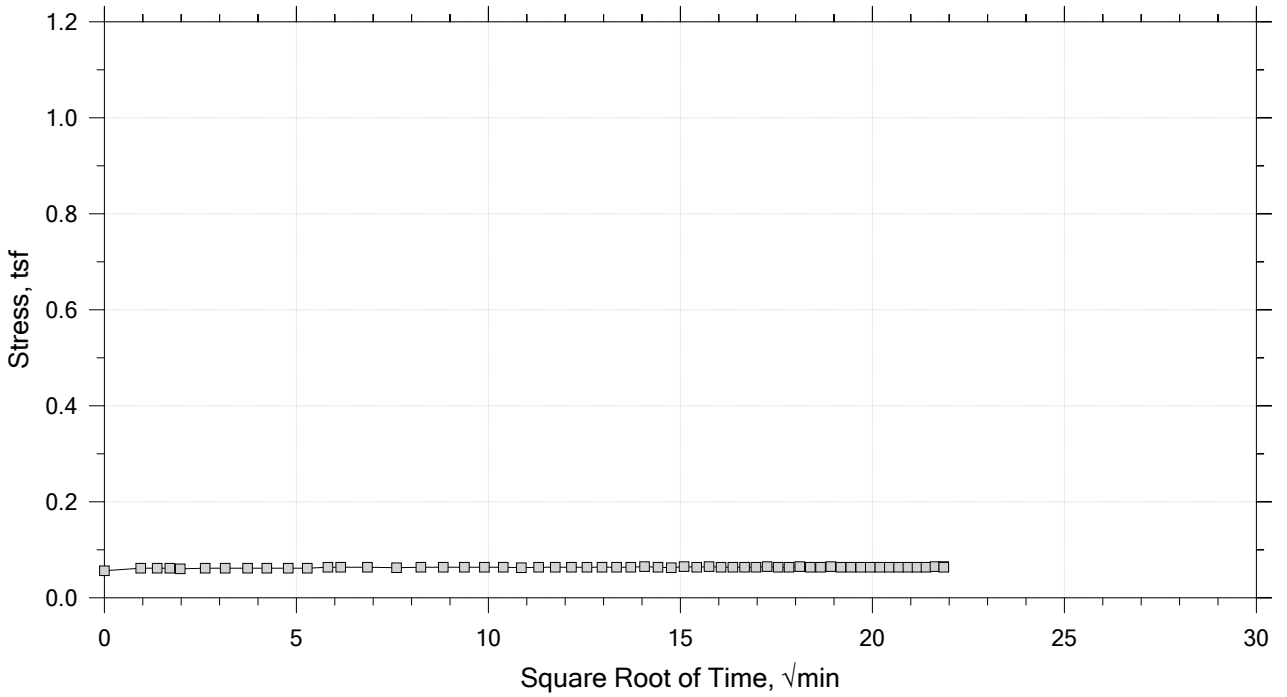
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 15

Constant Volume Step

Stress: 0.0637 tsf





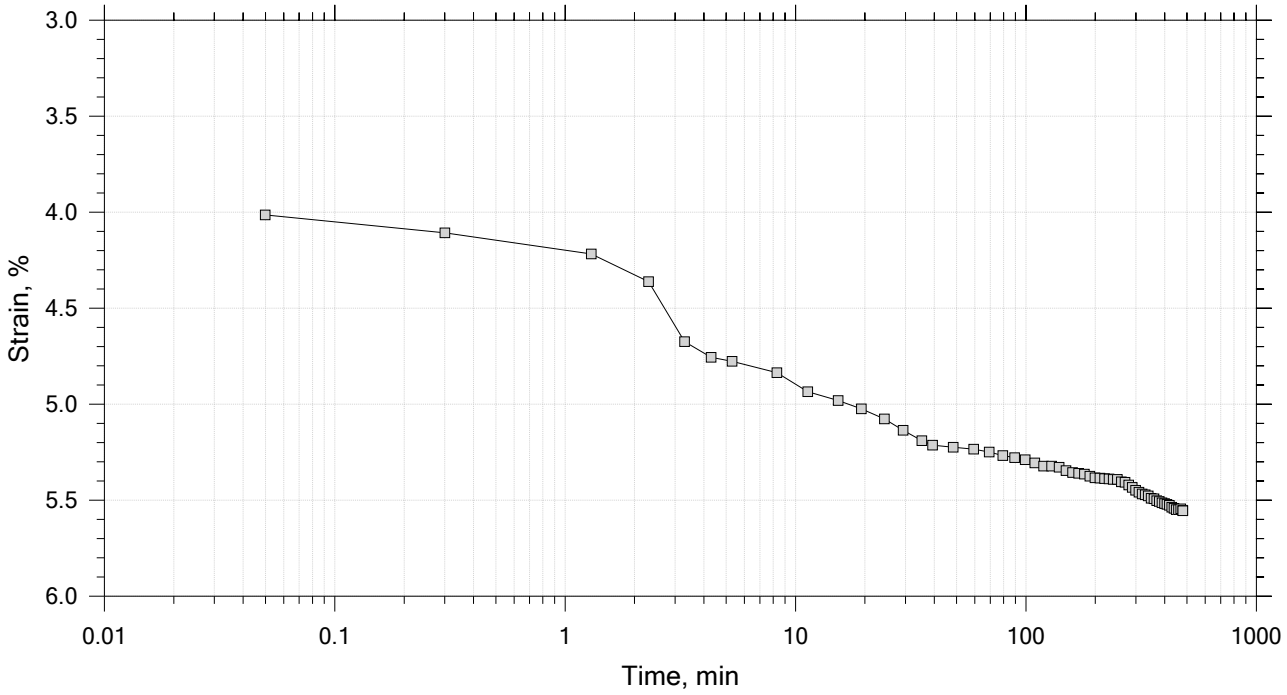
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

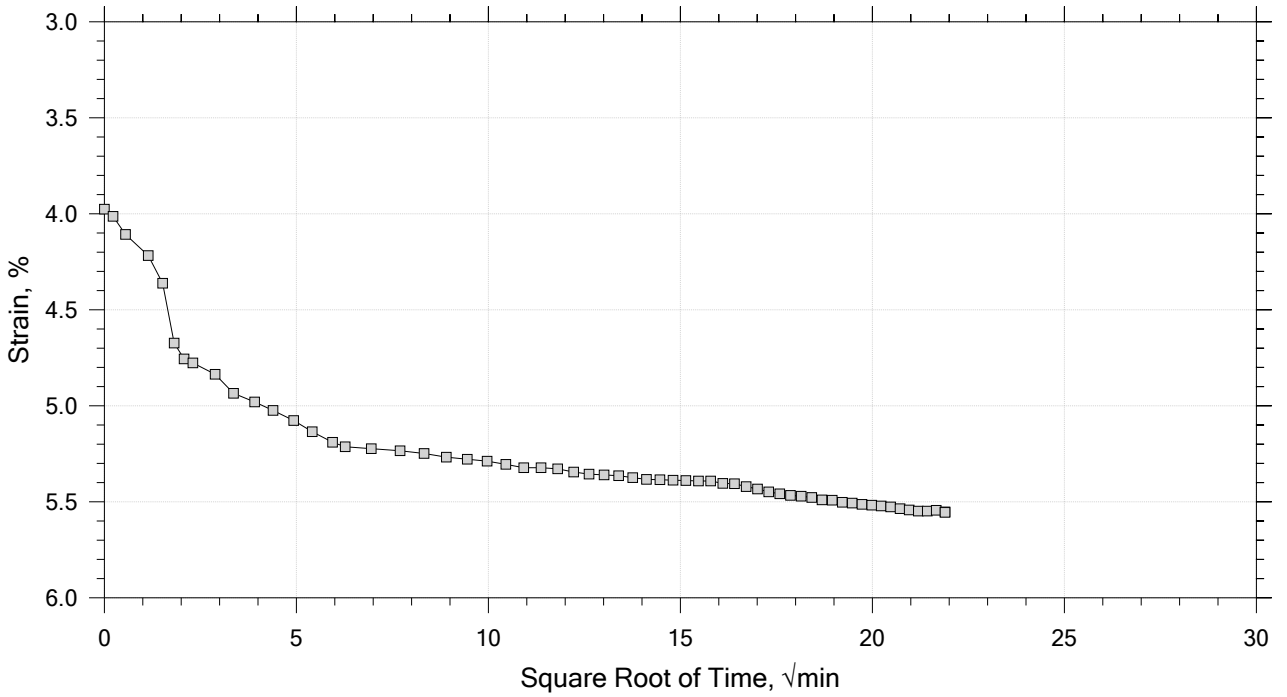
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 15

Constant Load Step

Stress: 0.125 tsf

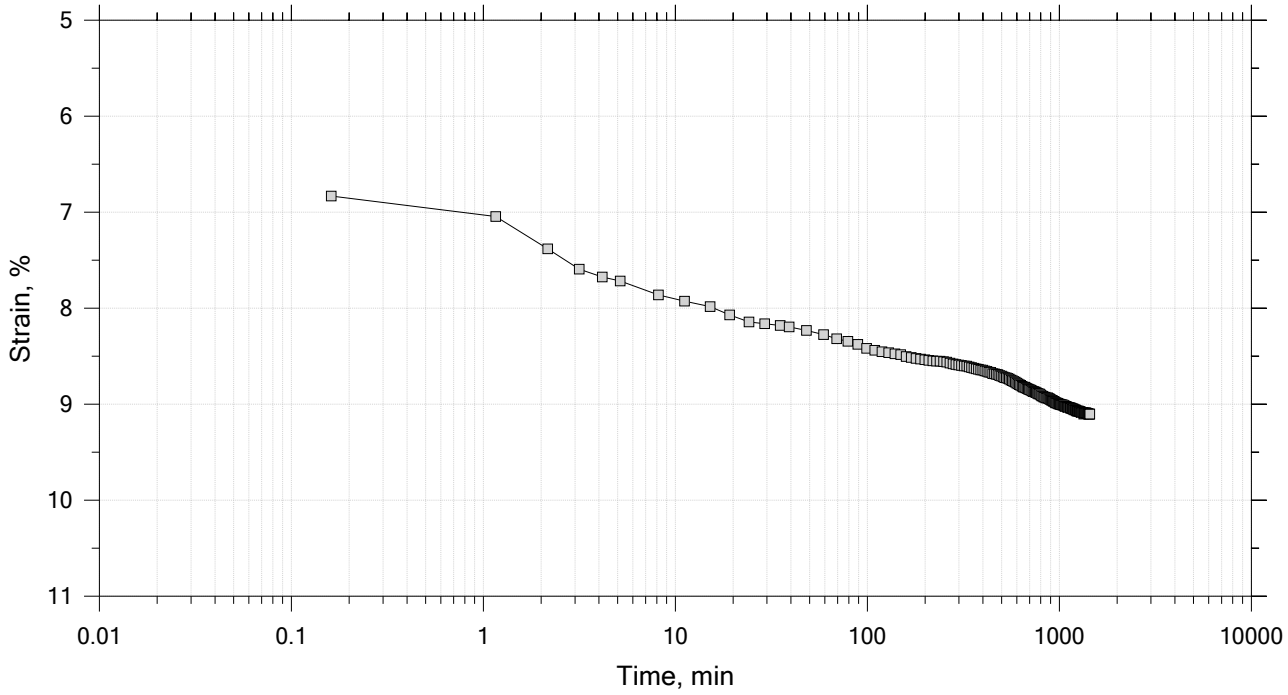


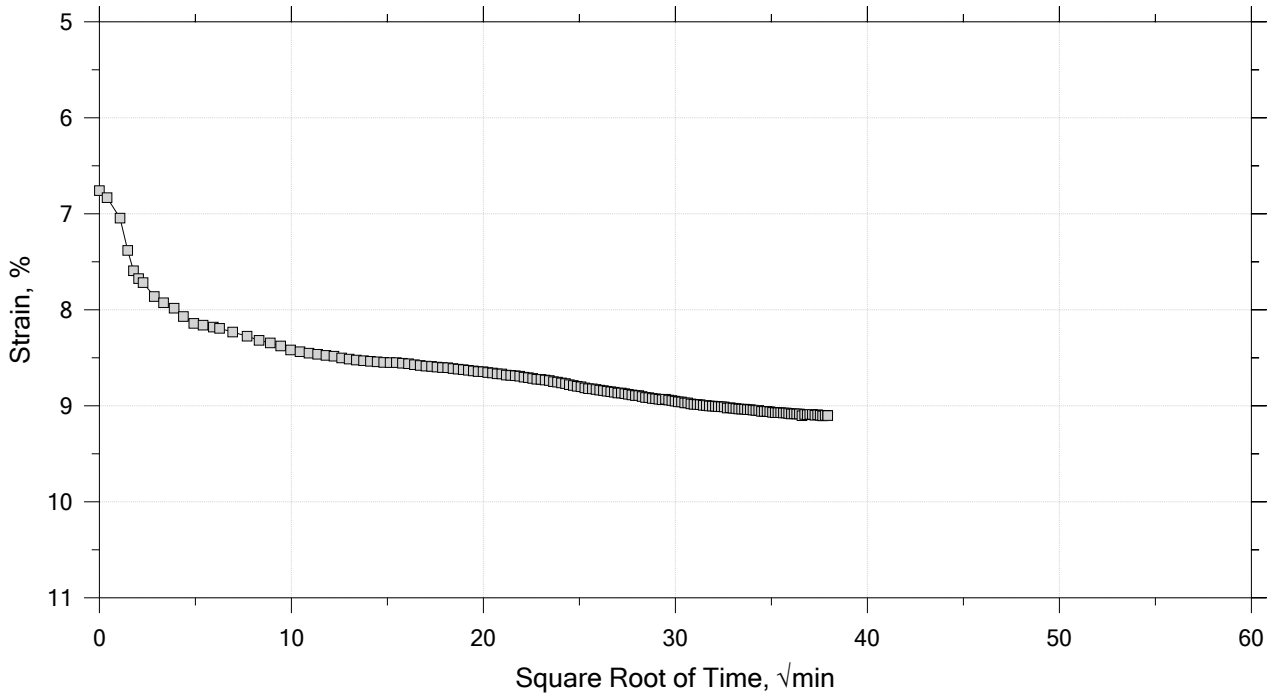


Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-21A	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray sand with peat and clay		
Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 15
Constant Load Step
Stress: 0.25 tsf





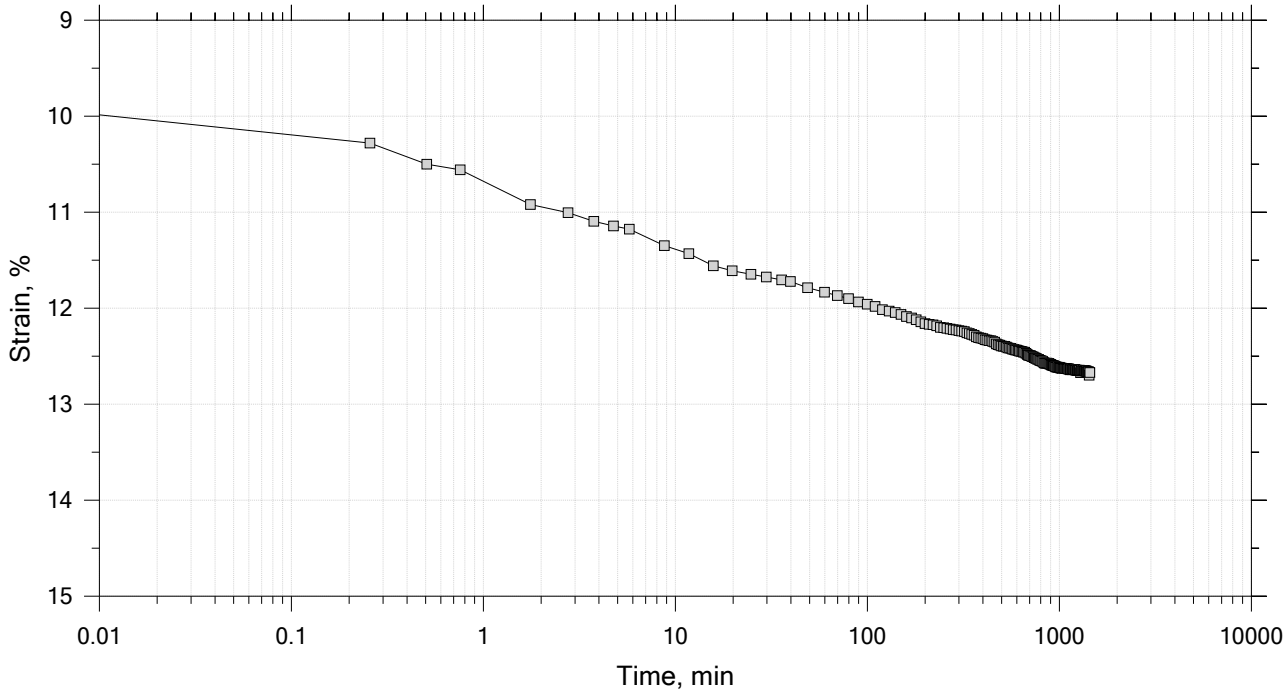
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

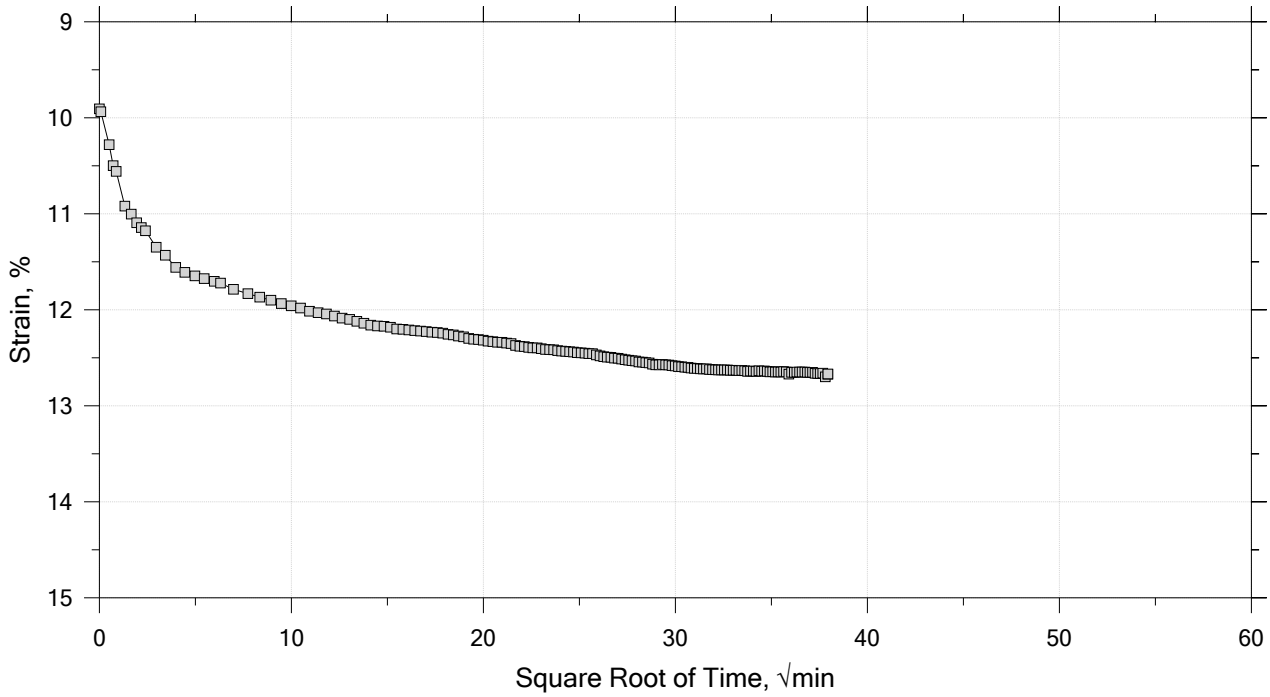
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15

Constant Load Step

Stress: 0.5 tsf





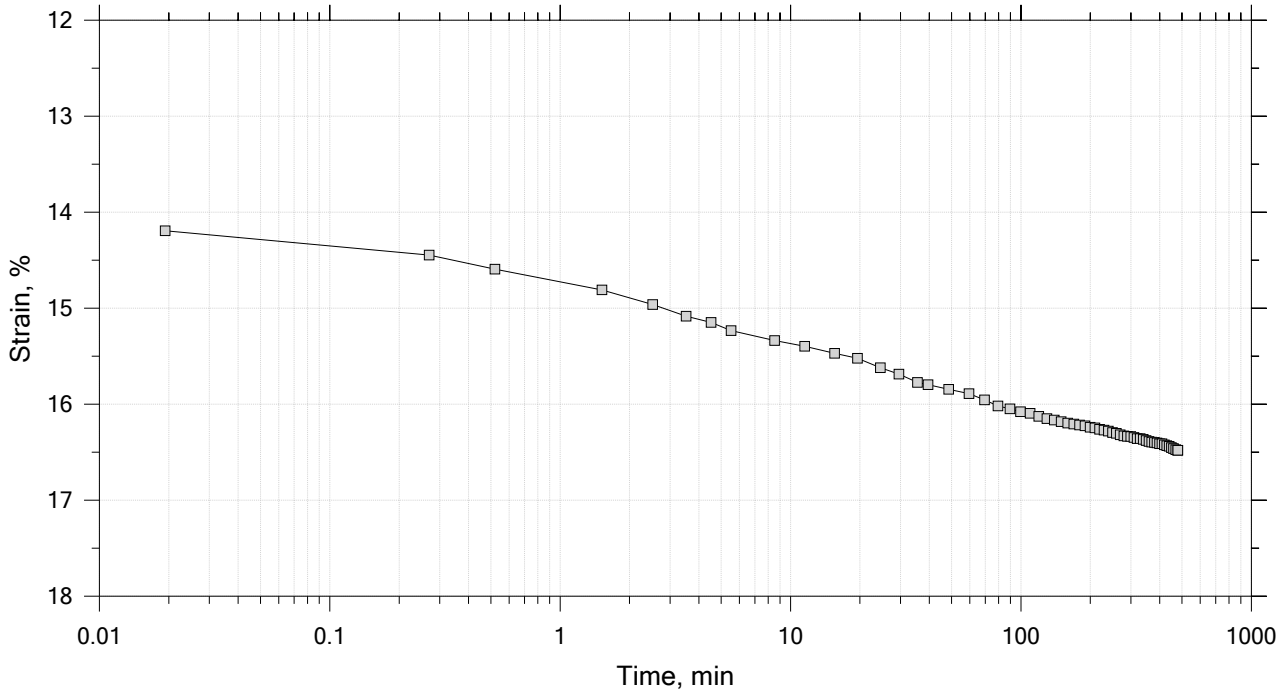
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

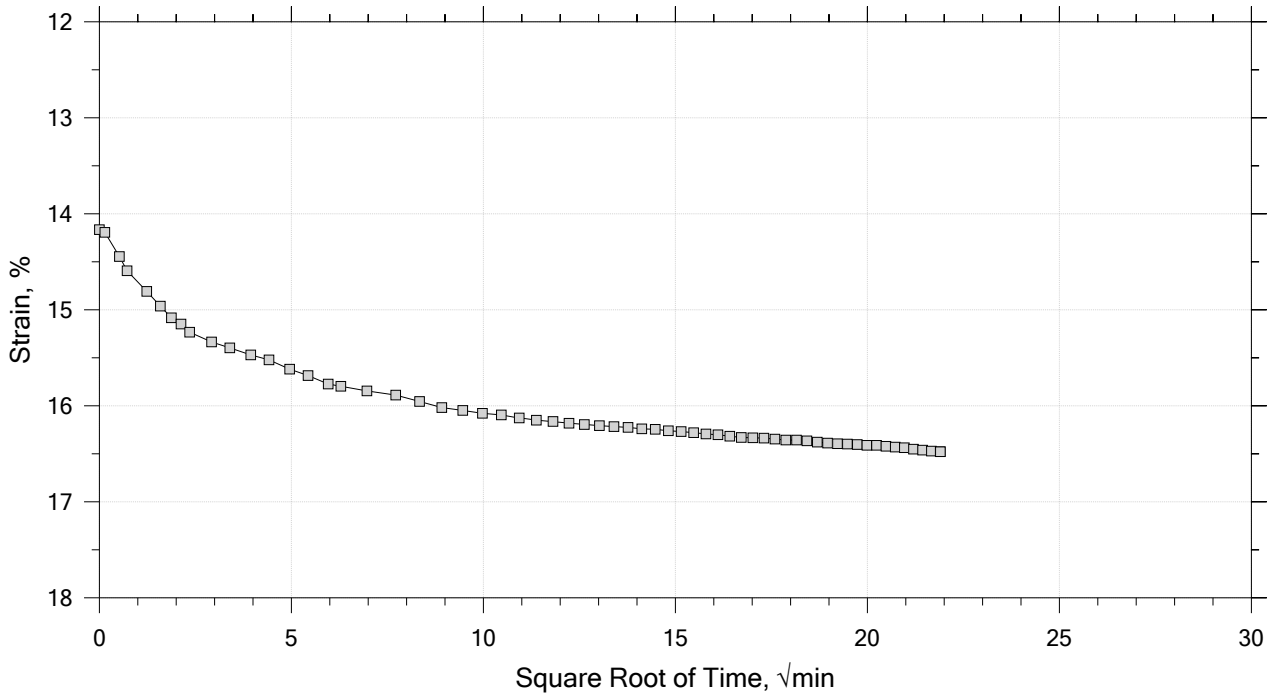
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15

Constant Load Step

Stress: 1 tsf





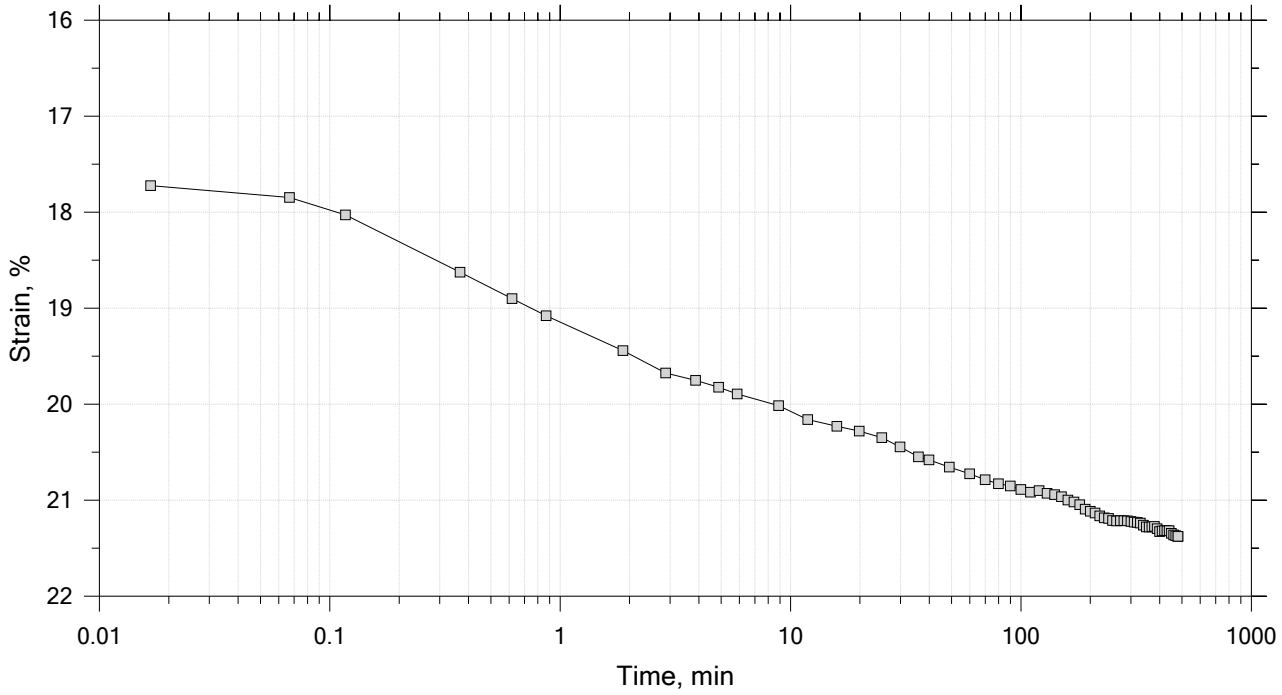
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

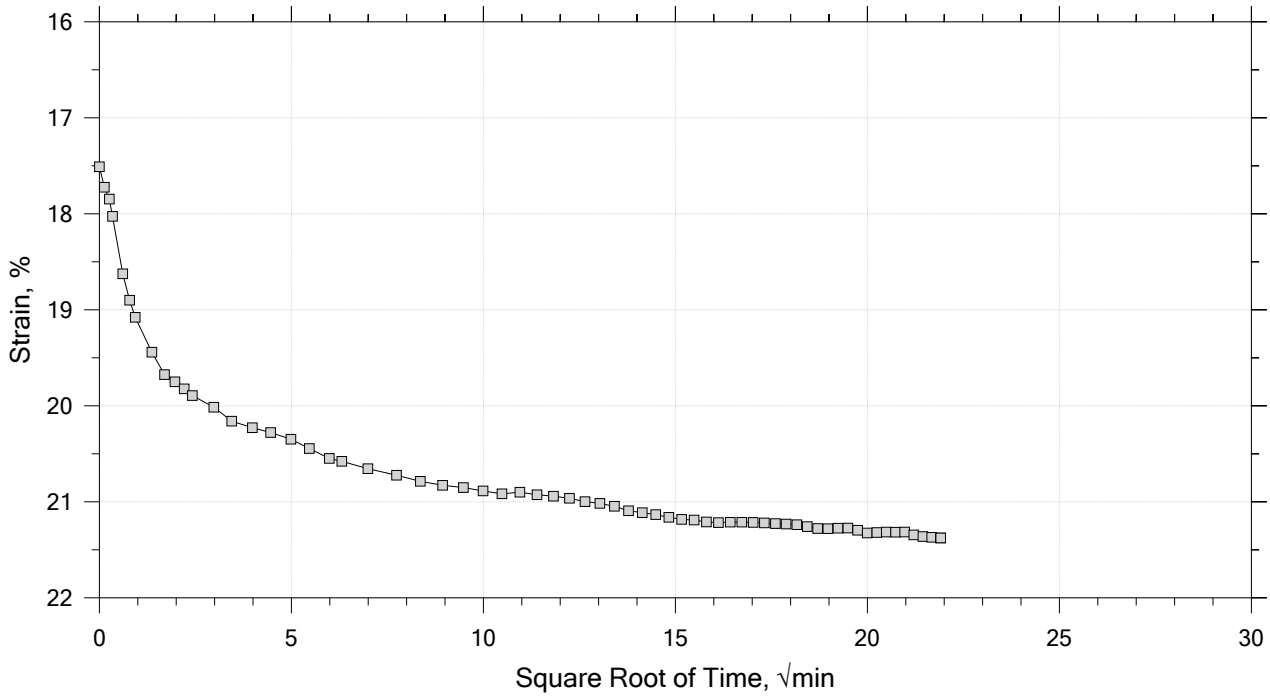
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15

Constant Load Step

Stress: 2 tsf





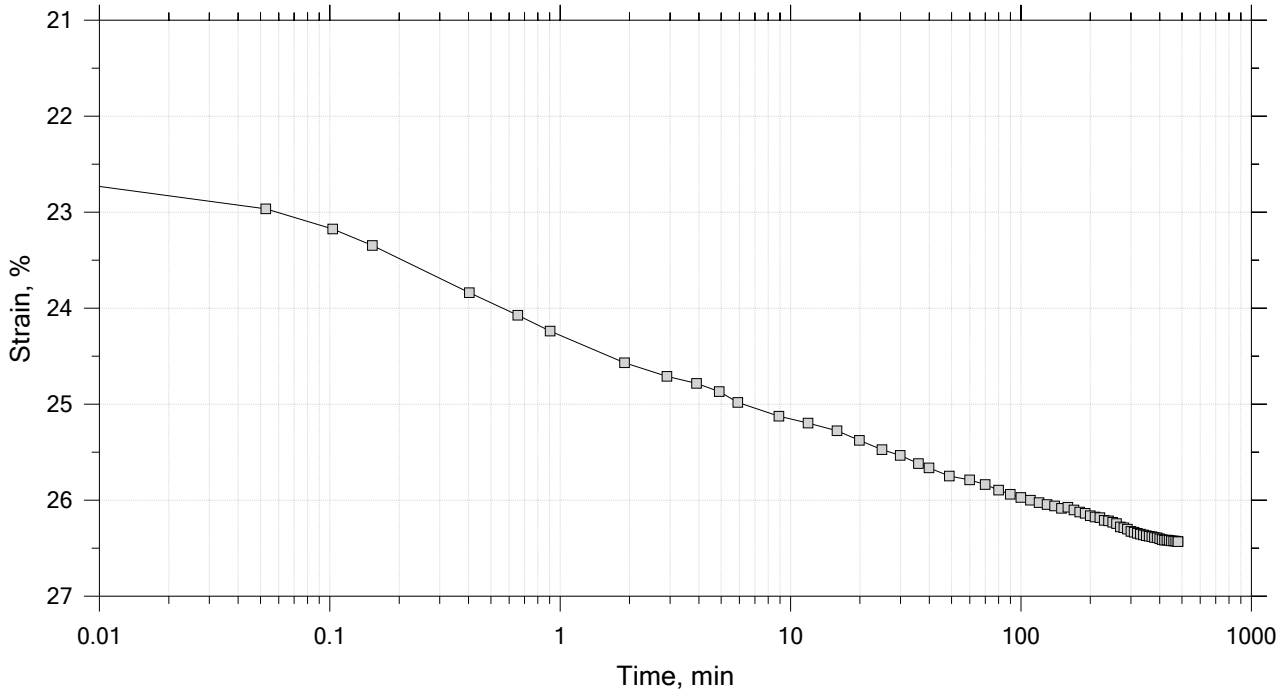
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

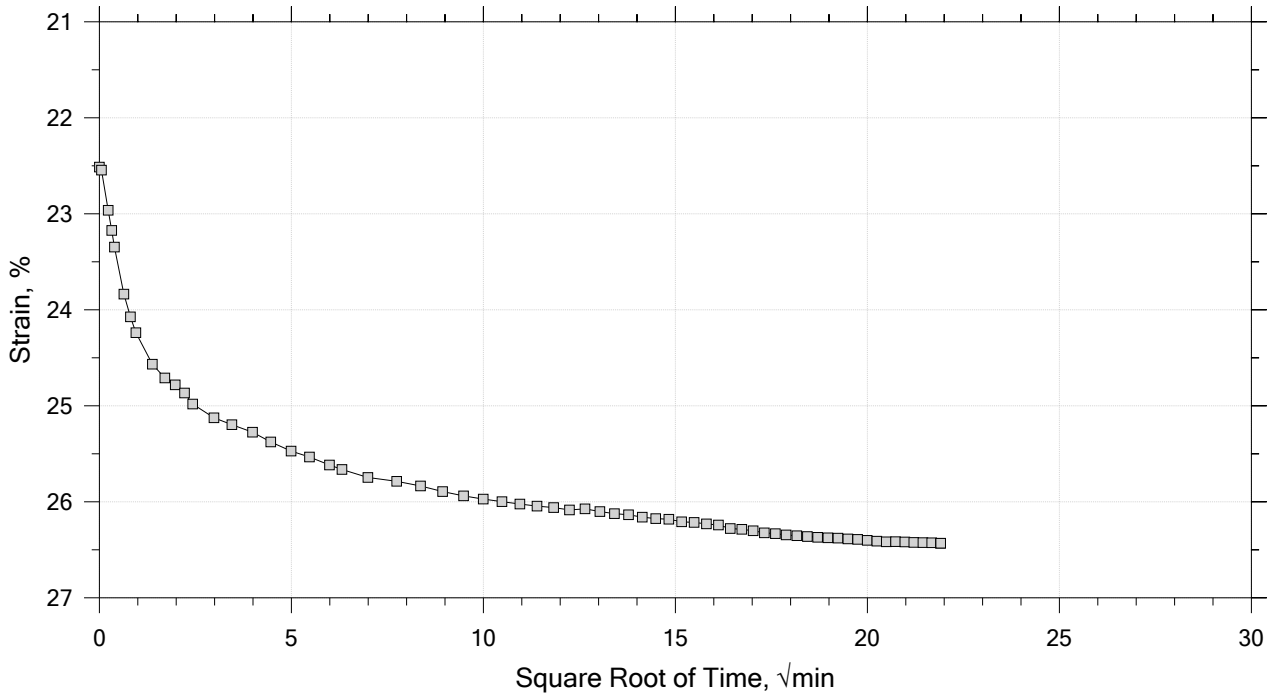
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 4 tsf





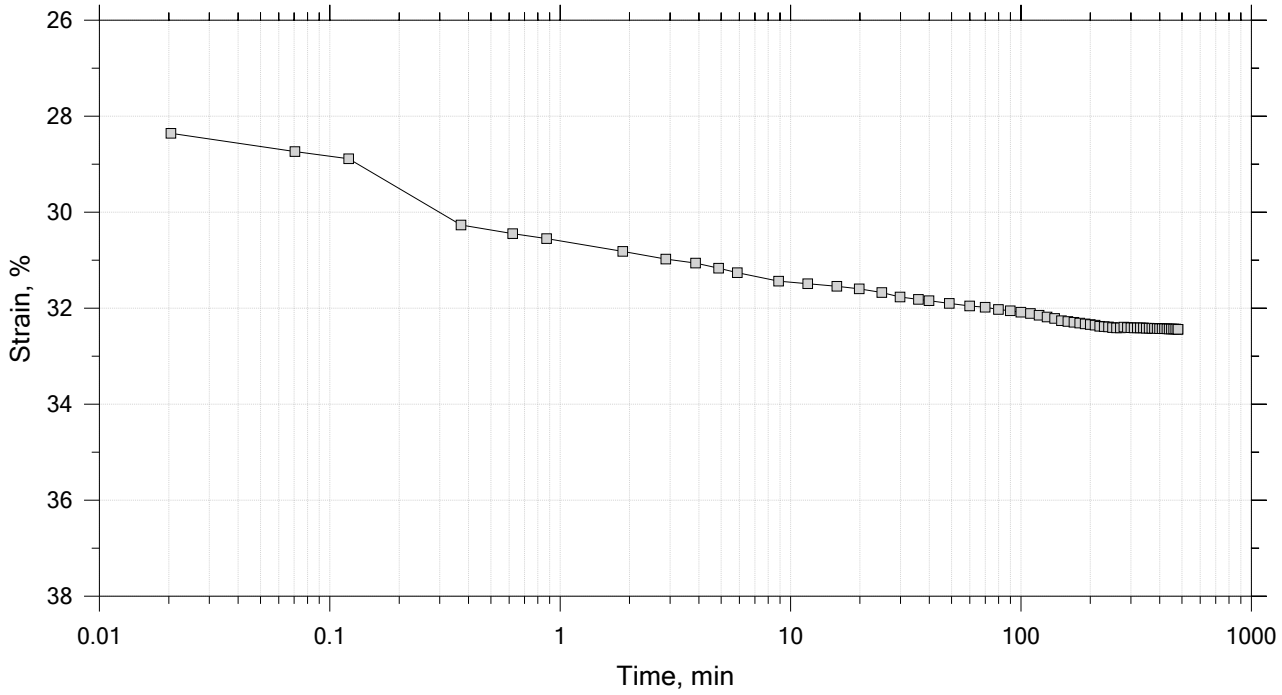
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

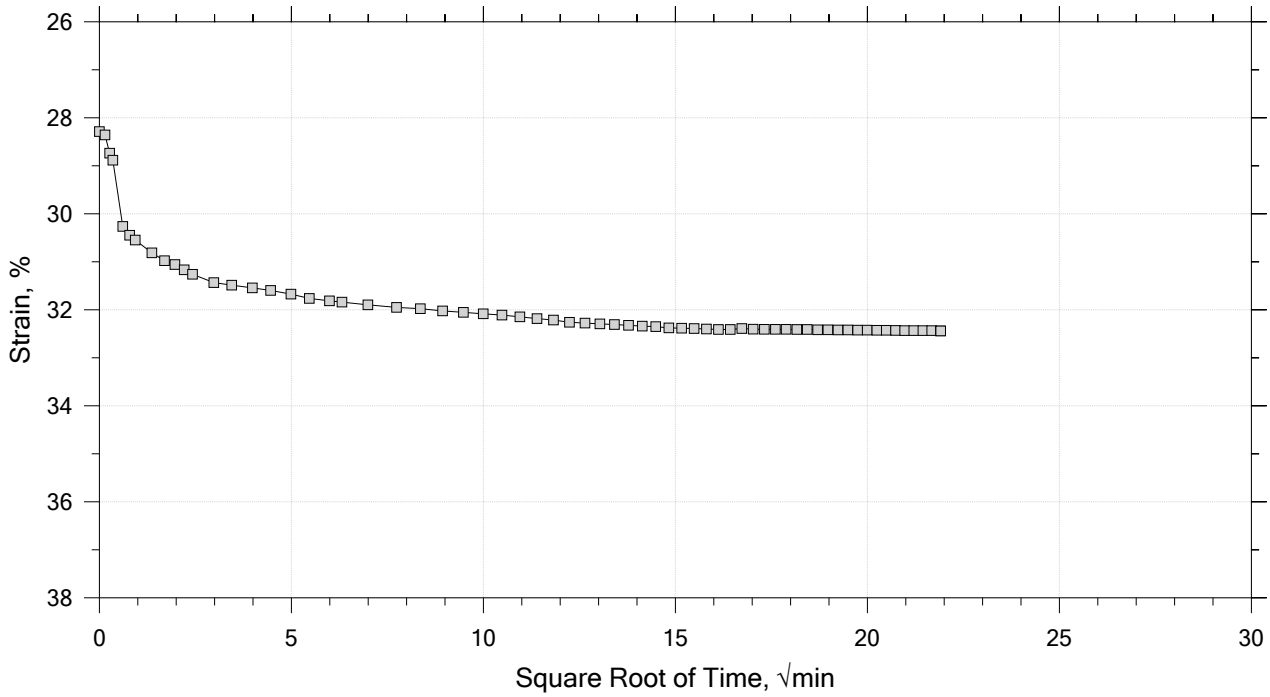
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 8 tsf





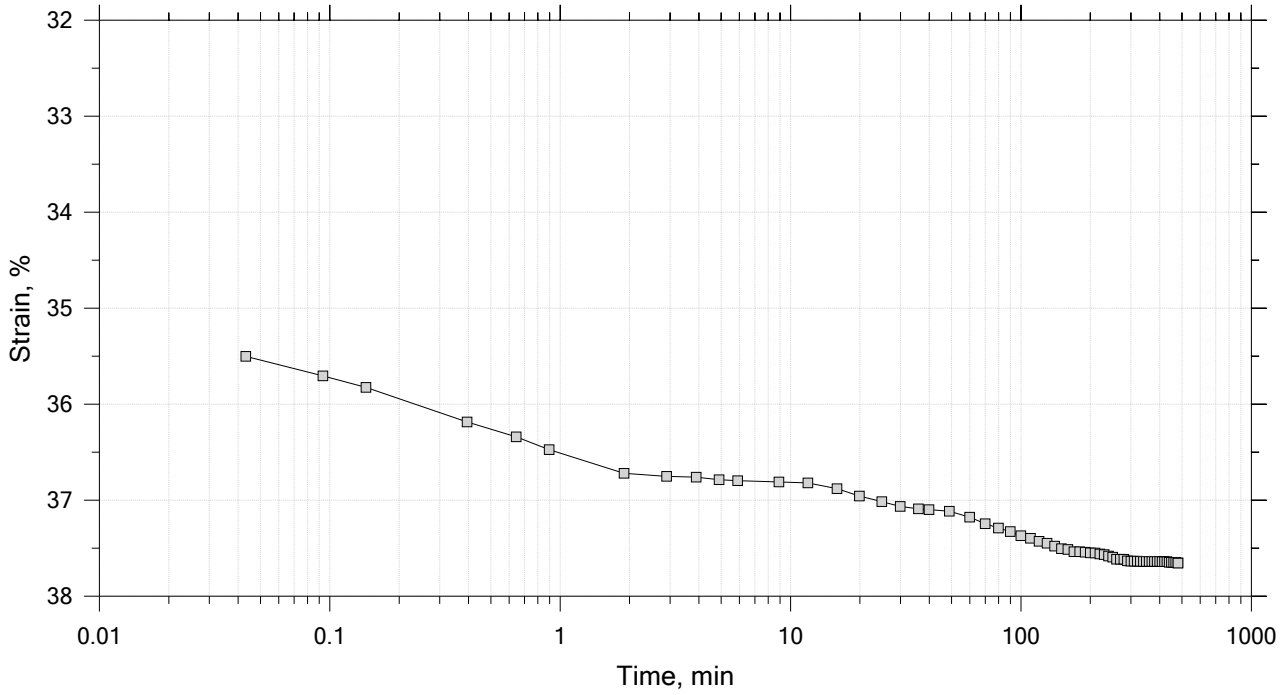
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

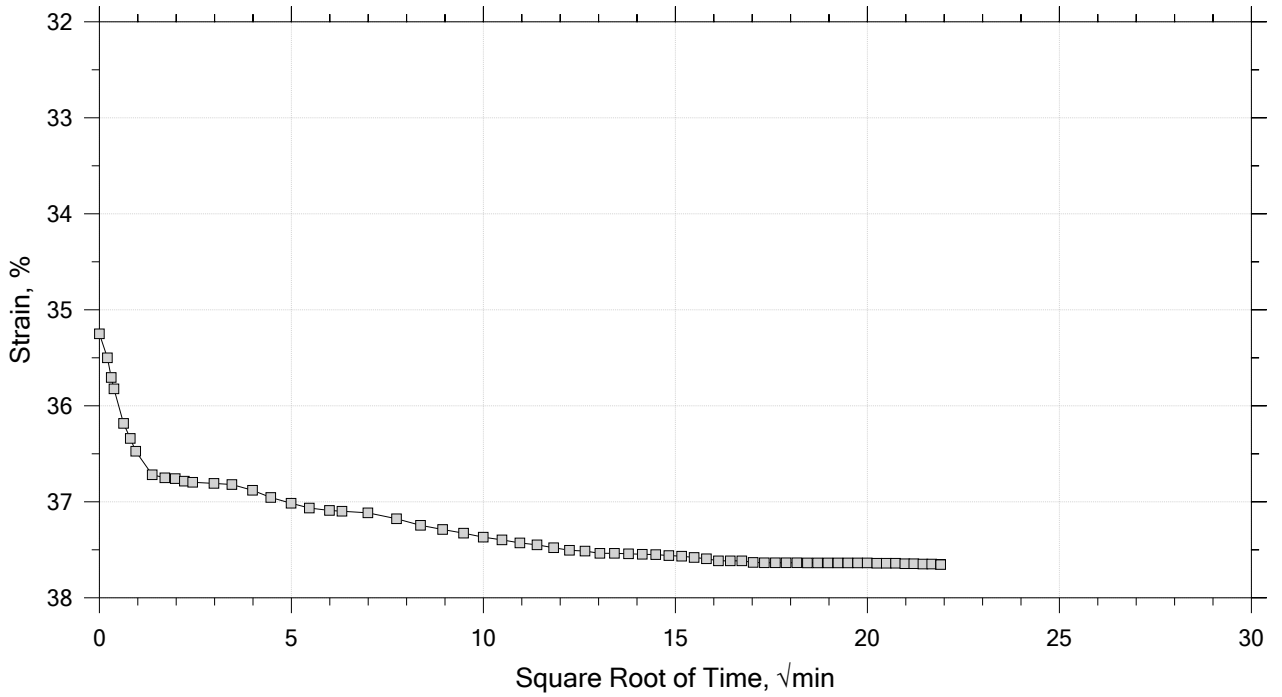
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 16 tsf

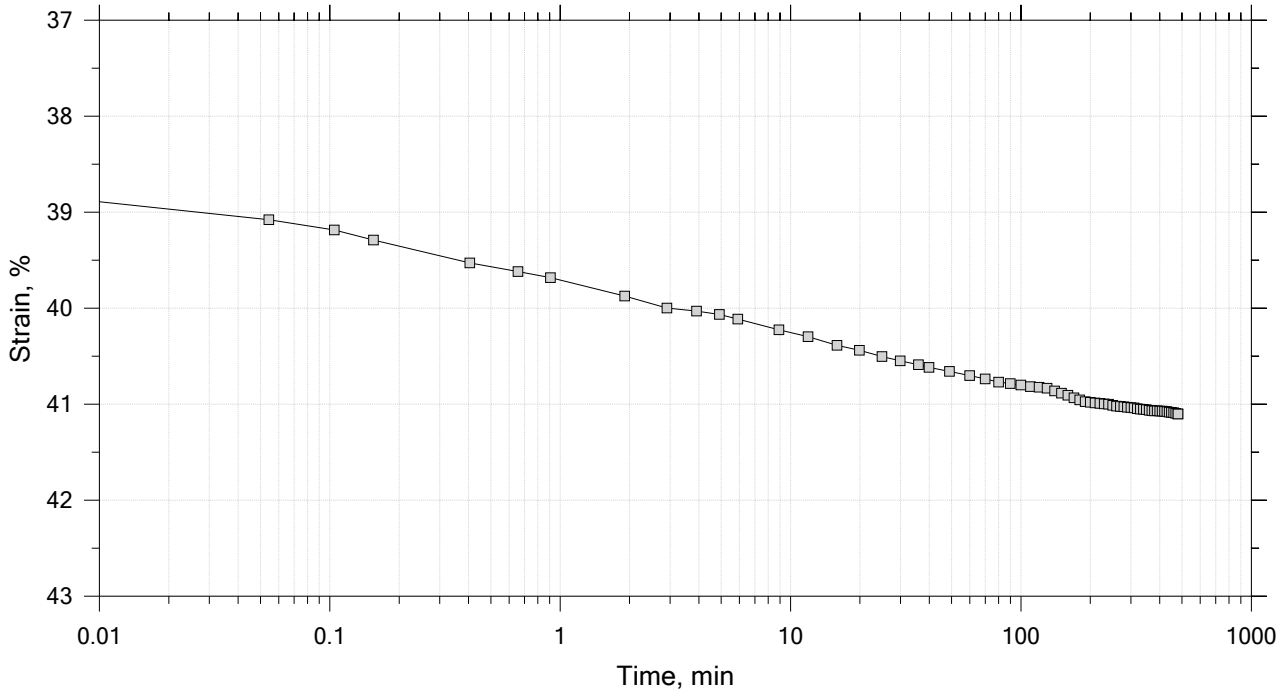


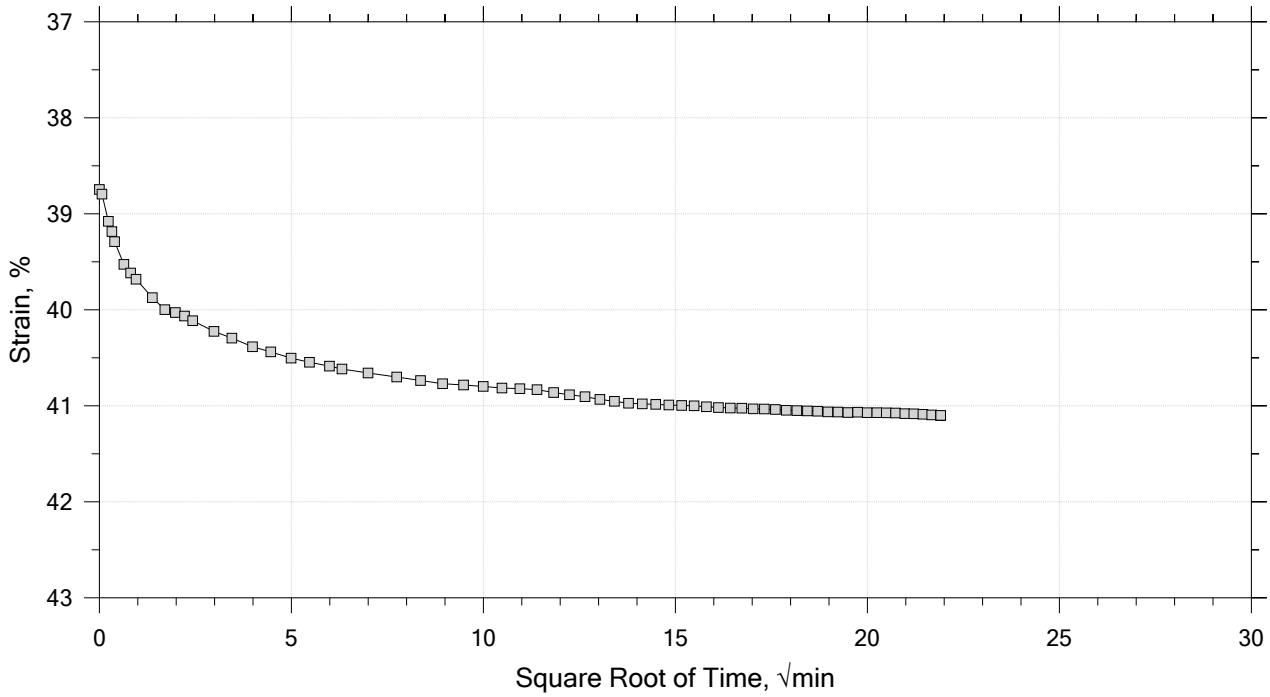


GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15
Constant Load Step
Stress: 32 tsf

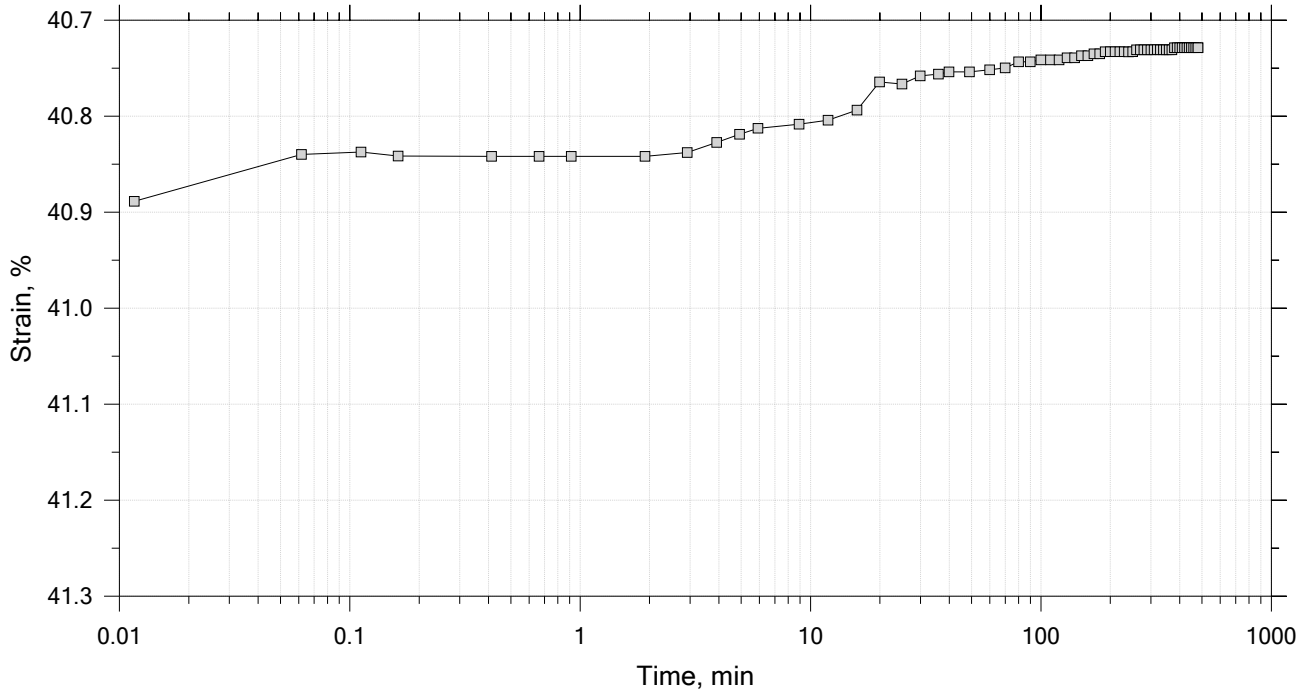


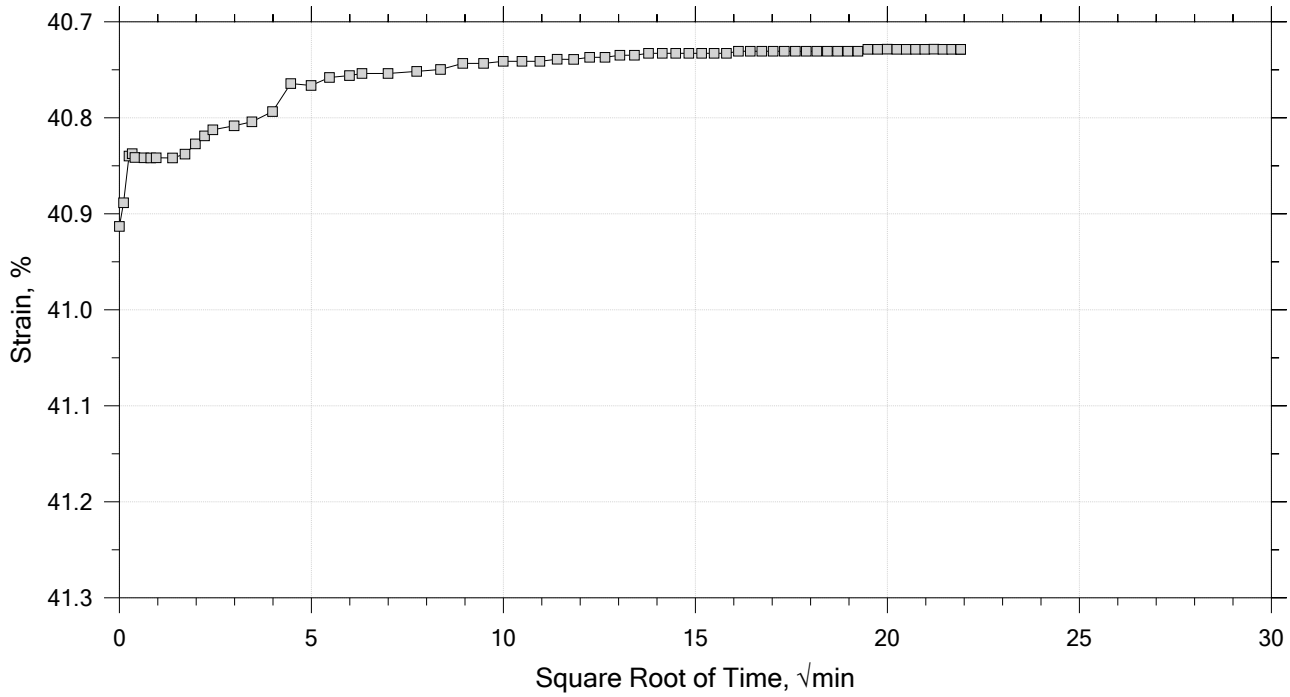


GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15
Constant Load Step
Stress: 8 tsf

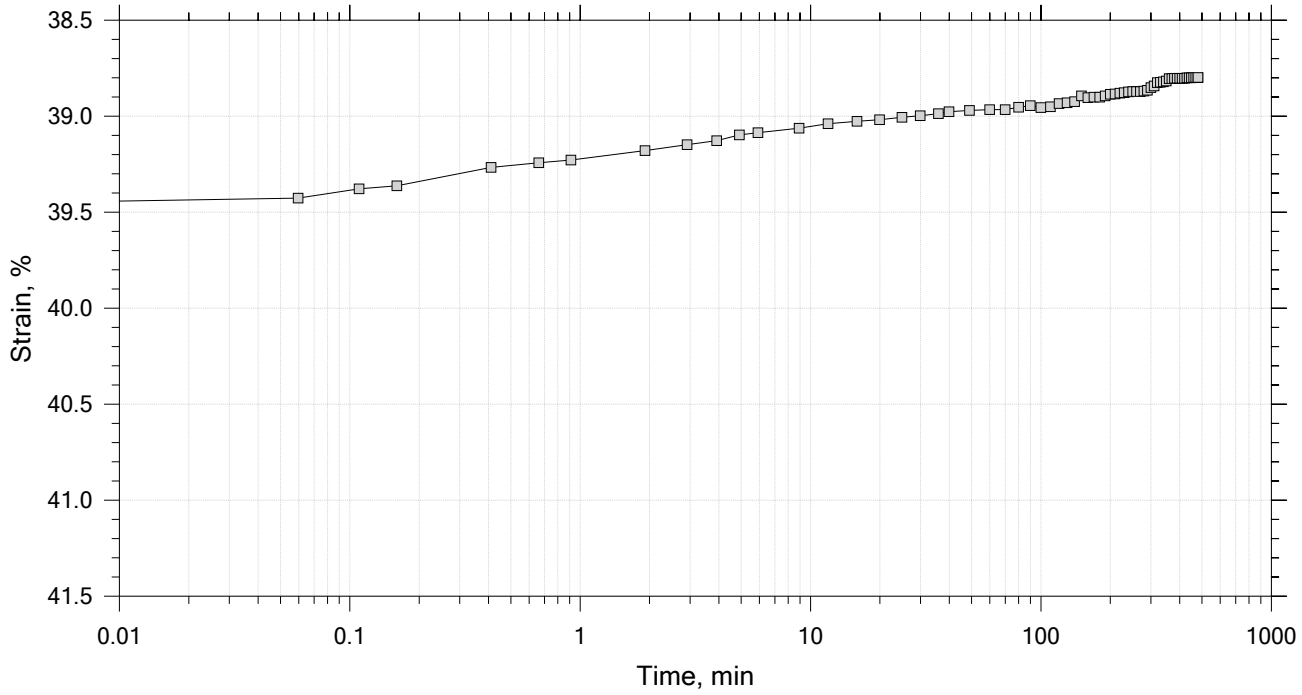


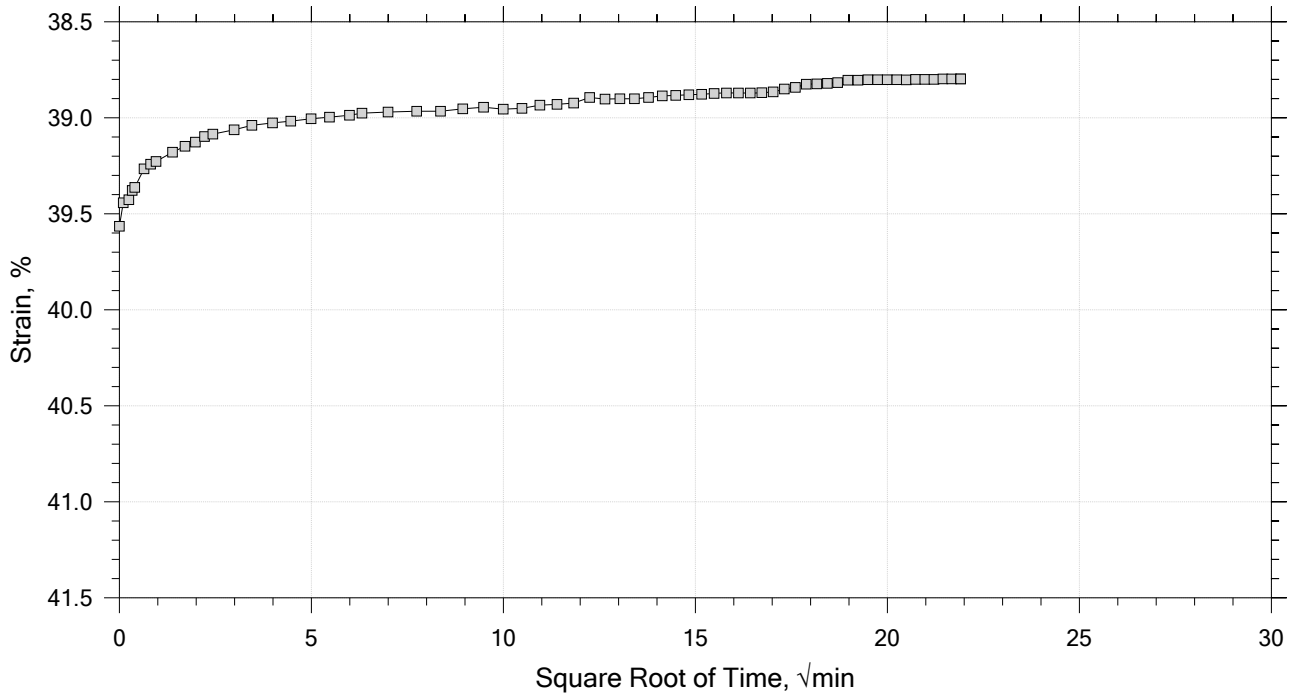


Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-21A	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray sand with peat and clay		
Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15
Constant Load Step
Stress: 2 tsf





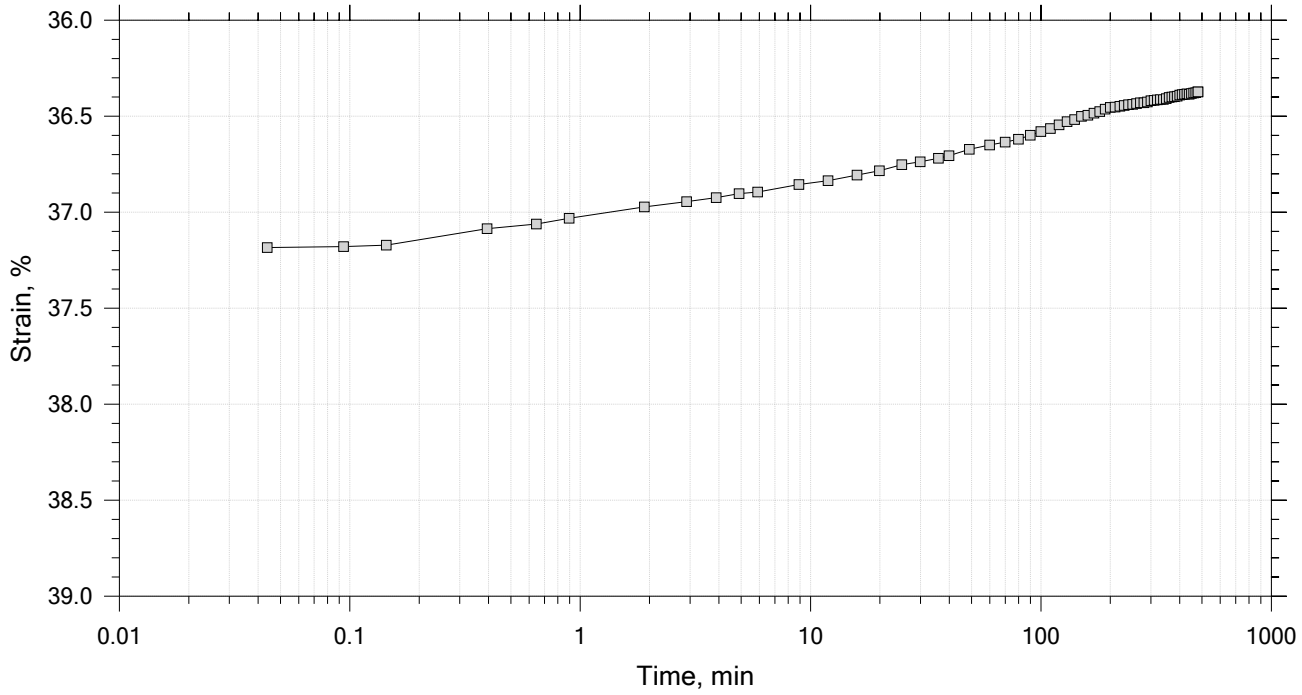
GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

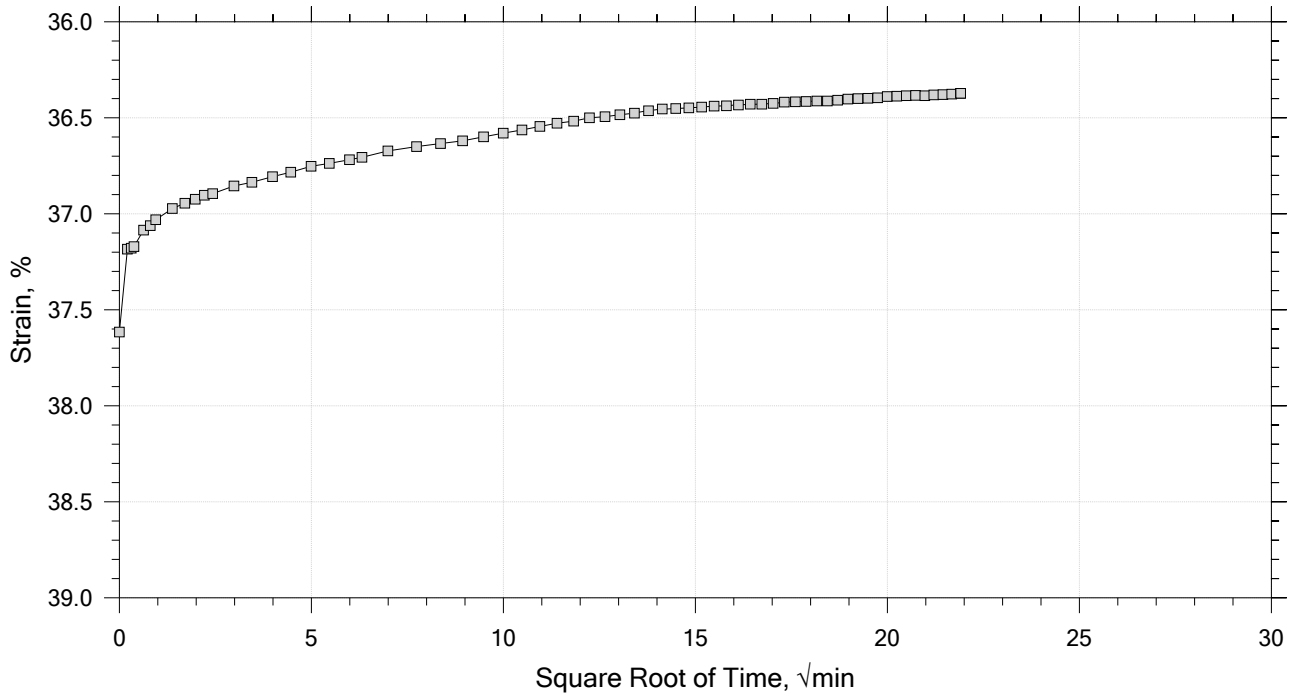
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15

Constant Load Step

Stress: 0.5 tsf





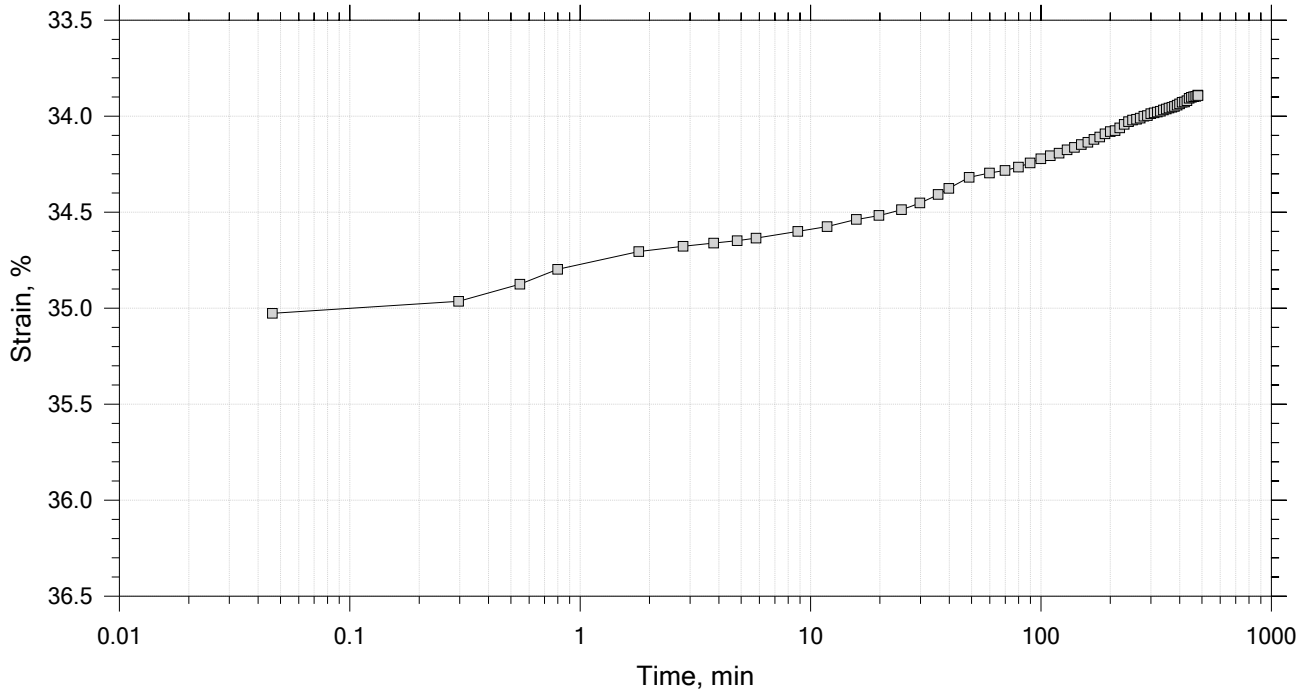
Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
Boring No.: BB-21A	Tested By: md	Checked By: anm
Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray sand with peat and clay		
Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

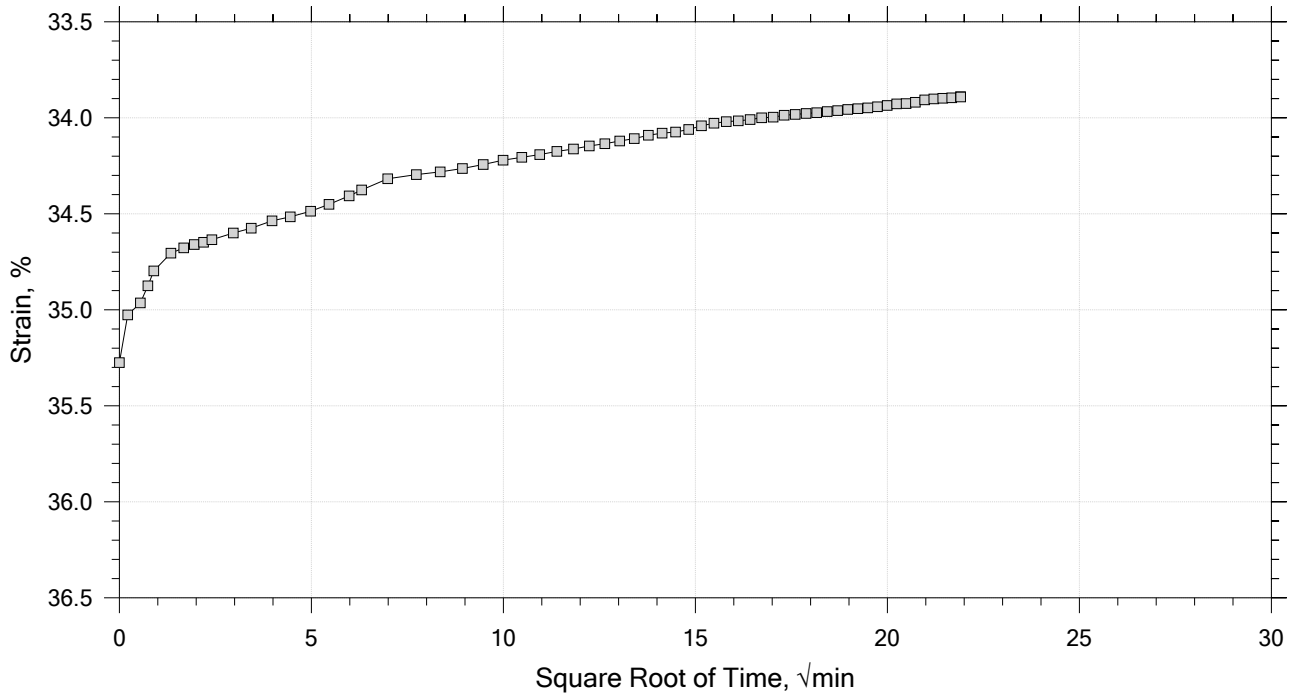
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15

Constant Load Step

Stress: 0.125 tsf

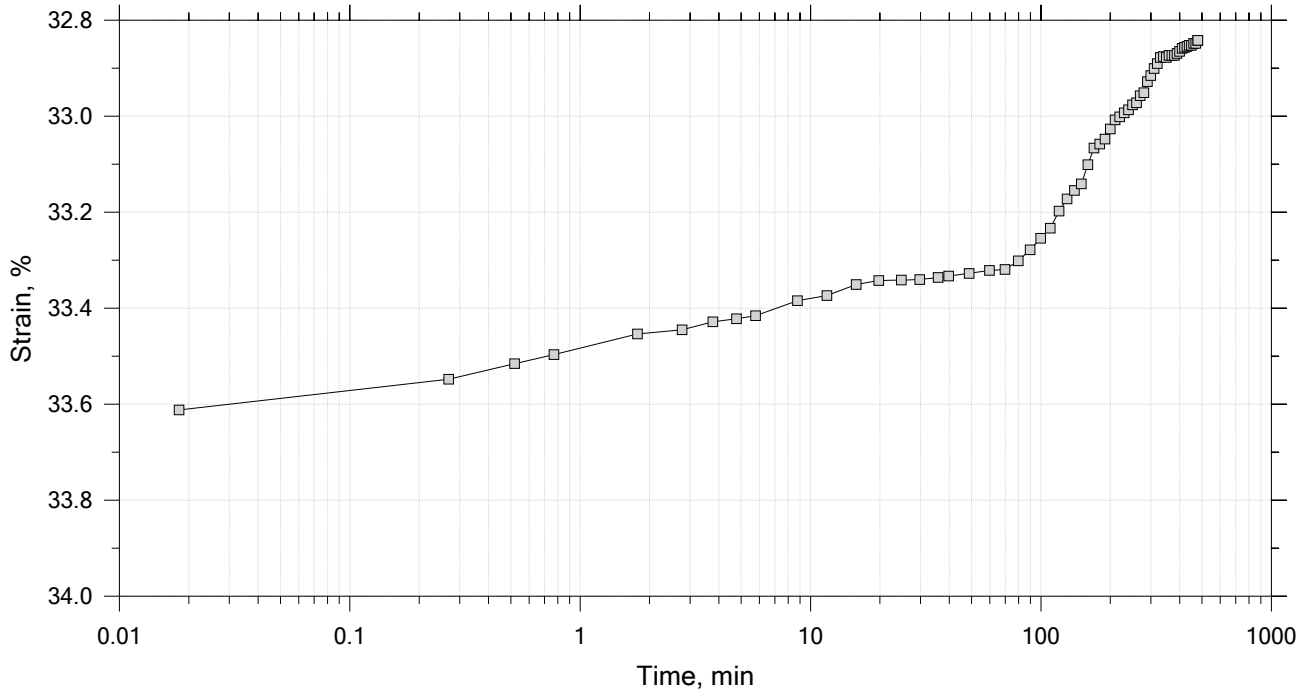


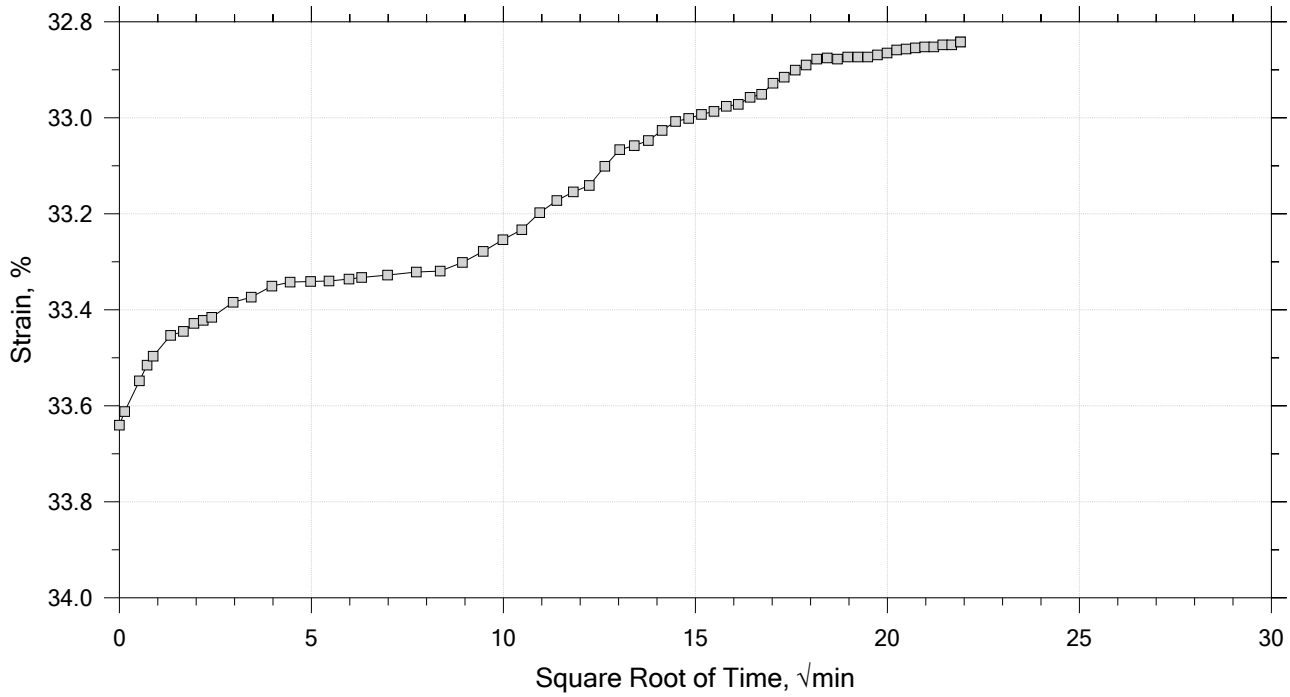


GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15
Constant Load Step
Stress: 0.0625 tsf





GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.71	Liquid Limit: ---
Initial Height: 0.75 in	Initial Void Ratio: 1.33	Plastic Limit: ---
Final Height: 0.55 in	Final Void Ratio: 0.71	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E-1481	RING		E1812
Mass Container, gm	8.32	110.06	110.06	8.12
Mass Container + Wet Soil, gm	140.21	212.73	198.61	96.58
Mass Container + Dry Soil, gm	99.16	180.24	180.24	78.23
Mass Dry Soil, gm	90.84	70.181	70.181	70.11
Water Content, %	45.19	46.29	26.17	26.17
Void Ratio	---	1.33	0.71	---
Degree of Saturation, %	---	94.29	100.00	---
Dry Unit Weight, pcf	---	72.622	99.03	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv in²/s	Mv 1/tsf	k ft/day
1	0.0637	0.02433	1.26	3.24	69.704	2.76e-05	5.09e-01	2.63e-04
2	0.125	0.04166	1.20	5.56	32.404	5.61e-05	3.77e-01	3.96e-04
3	0.250	0.06827	1.12	9.10	185.312	9.21e-06	2.84e-01	4.90e-05
4	0.500	0.09502	1.04	12.7	151.549	1.04e-05	1.43e-01	2.78e-05
5	1.00	0.1236	0.948	16.5	41.620	3.48e-05	7.62e-02	4.97e-05
6	2.00	0.1603	0.833	21.4	18.901	6.91e-05	4.90e-02	6.34e-05
7	4.00	0.1982	0.715	26.4	14.384	8.00e-05	2.53e-02	3.79e-05
8	8.00	0.2433	0.575	32.4	7.153	1.38e-04	1.50e-02	3.89e-05
9	16.0	0.2824	0.454	37.7	25.167	3.33e-05	6.52e-03	4.07e-06
10	32.0	0.3083	0.373	41.1	17.656	4.14e-05	2.15e-03	1.67e-06
11	8.00	0.3055	0.382	40.7	39.913	1.74e-05	1.55e-04	5.05e-08
12	2.00	0.2910	0.427	38.8	358.236	2.01e-06	3.22e-03	1.21e-07
13	0.500	0.2728	0.484	36.4	79.305	9.76e-06	1.62e-02	2.96e-06
14	0.125	0.2542	0.541	33.9	107.954	7.75e-06	6.62e-02	9.60e-06
15	0.0625	0.2463	0.566	32.8	459.770	1.92e-06	1.68e-01	6.04e-06

GeoTesting EXPRESS	Project: Marion/Wareham Causeway	Location: Marion & Wareham, MA	Project No.: GTX-313173
	Boring No.: BB-21A	Tested By: md	Checked By: anm
	Sample No.: U-1	Test Date: 03/18/21	Depth: 2-4
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray sand with peat and clay		
	Remarks: System LTIII-E, Swell Pressure = 0.0637 tsf		
	Displacement at End of Increment		

GeoTesting EXPRESS

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

Client:	Haley & Aldrich, Inc.
Project Name:	M-05-001, W-06-13 & W06-016, RTE6
Project Location:	Marion-Wareham, MA
GTX #:	319665
Test Date:	08/29/24
Tested By:	NMK
Checked By:	jsc

pH by AASHTO T 289

Boring ID	Sample ID	Depth, ft	Description	pH
BB-32	S-4	10.5-12.5	Moist, very dark gray silty clay with organics	6.16

Note by Haley & Aldrich, Inc. 9/10/24: sample tested was a composite of samples from the following borings and sample numbers:
BB-32, S-4, 10.5 to 12.5 ft depth;
BB-29, S-4, 11.0 to 13.0 ft depth;
BB-29, S-5, 14.0 to 16.0 ft depth;
BB-29, S-6, 16.0 to 18.0 ft depth;
BB-29A, S-3, 8.5 to 10.5 ft depth;
BB-29A, S-4, 13.5 to 15.5 ft depth;
BB-29A, S-5, 15.5 to 17.5 ft depth;
BB-31, S-4, 11.5 to 13.5 ft depth;
BB-32, S-3, 8.5 to 9.5 ft depth;
BB-32, S-3A, 9.5 to 10.5 ft depth.

Client:	Haley & Aldrich, Inc.
Project:	M-05-001, W-06-13 & W06-016, RTE6
Location:	Marion-Wareham, MA
GTX#:	319665
Test Date:	9/3/2024
Due Date:	9/5/2024
Tested By:	NMK
Checked By:	jsc

Minimum Laboratory Soil Resistivity by AASHTO T 288

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(ohm\text{-}cm)^{-1}$
BB-32	S-4	10.5-12.5	Moist, very dark gray silty clay with organics	489	2.05E-03

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
Water added to sample to create a thick slurry prior to testing (saturated condition).
Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
Test conducted in standard laboratory atmosphere: 68-73 F

Note by Haley & Aldrich, Inc. 9/10/24: sample tested was a composite of samples from the following borings and sample numbers:
BB-32, S-4, 10.5 to 12.5 ft depth;
BB-29, S-4, 11.0 to 13.0 ft depth;
BB-29, S-5, 14.0 to 16.0 ft depth;
BB-29, S-6, 16.0 to 18.0 ft depth;
BB-29A, S-3, 8.5 to 10.5 ft depth;
BB-29A, S-4, 13.5 to 15.5 ft depth;
BB-29A, S-5, 15.5 to 17.5 ft depth;
BB-31, S-4, 11.5 to 13.5 ft depth;
BB-32, S-3, 8.5 to 9.5 ft depth;
BB-32, S-3A, 9.5 to 10.5 ft depth.



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GEOTESTING EXPRESS INCORPORATED
125 NAGOG PARK
ACTON MA 01720-3451
USA

Analysis No.	TS-A2412100
Report Date	31 August 2024
Date Sampled	27 August 2024
Date Received	29 August 2024
Where Sampled	Acton, MA USA
Sampled By	Client

This is to attest that we have examined: Soil for Project Name: M-05-001, W-06-13, W06-16, RTE6; Site Location: - — -; Job Number: GTX-319665

When examined to the applicable requirements of:

AASHTO T 291-18	"Standard Method of Test for Determining Water-Soluble Chloride Ion Content in Soil" Method B
AASHTO T 290-20	"Standard Method of Test for Determining Water-Soluble Sulfate Ion Content in Soil"

Results:

AASHTO T 291 - Chloride Method B

Sample		Results		Minimum Detection Limit
		ppm (mg/kg)	%[1]	
BB-32		700.	0.0700	10.
S-4	10.5 – 12.5'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

AASHTO T 290 – Sulfate (Soluble)

Sample		Results		Minimum Detection Limit
		ppm (mg/kg)	%[1]	
BB-32		10.	0.0010	10.
S-4	10.5 – 12.5'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

END OF ANALYSIS

USEPA Laboratory ID UT00930

Merrill Gee P.E. – Engineer in Charge

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