HARRIMAN

Architects + Engineers

BAYCO, LLC.
Bayside Development
Portland, Maine

Project No. 08576

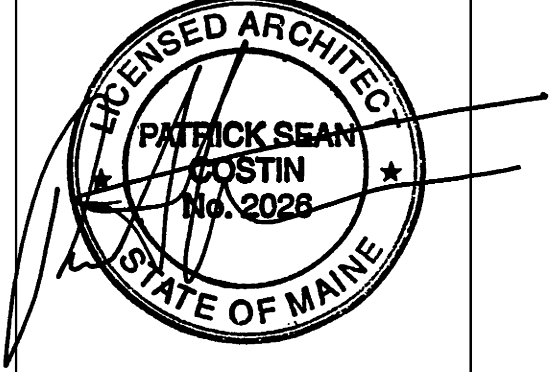
January 7, 2009

100% Site Enabling Pkg

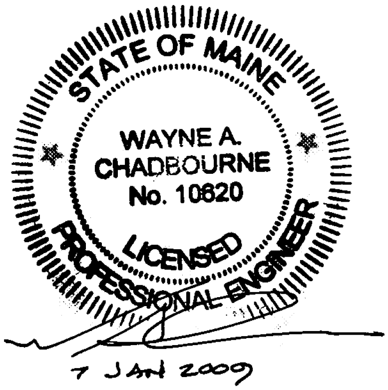
PROFESSIONAL SEAL PAGE

SITE ENABLING PACKAGE
PROJECT NO. 08576

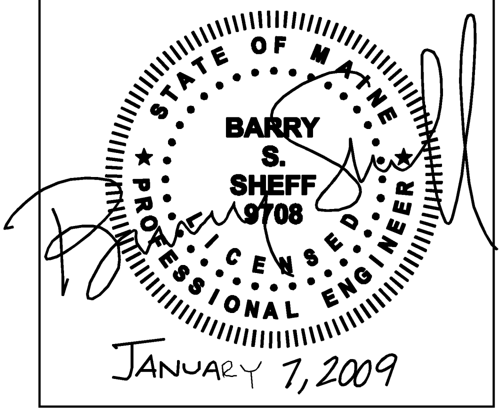
Architect
H A R R I M A N



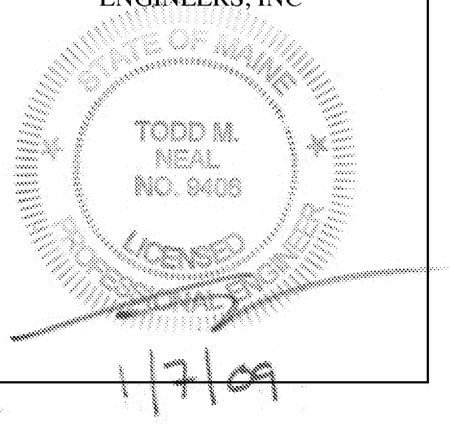

Geotechnical Engineer
HALEY & ALDRICH




Civil Engineer
WOODARD & CURRAN




Structural Engineer
BECKER STRUCTURAL
ENGINEERS, INC



## SECTION 02010 – EXISTING SUBSURFACE CONDITIONS

## PART 1 – GENERAL

### 1.01 REQUIREMENTS INCLUDED

A. Examination of the Site

1. Before submitting bids, the CONTRACTOR shall visit the site and inform themselves as to the location, nature of the work, equipment and facilities needed, general and local conditions prevailing at the site and all matters which may affect the work under this contract.

2. Before submitting bids, the CONTRACTOR shall examine all sources of information concerning subsurface soil and groundwater conditions. Each bidder shall draw their own conclusions concerning how these affect their work. Conditions which would not permit the CONTRACTOR to fulfill the intent of the contract shall be brought to the attention of the OWNER consistent with Notice to Contractors.

3. Subsurface Information: A geotechnical data report summarizing subsurface conditions and a memorandum summarizing the results of a test pit exploration program have been prepared for the project by Haley & Aldrich, Inc., dated September 10 and 4 December, 2008, are included as Attachments A and B, respectively.

B. Test Boring Results

1. The OWNER assumes no responsibility for the accuracy of the test results as shown in the appended reports. They are included only as a general indication of the materials likely to be found adjacent to the holes bored at the site of the proposed work. The CONTRACTOR shall examine this data and make their own investigation and other preliminary data, and shall base their bid on his/her opinion of the conditions likely to be encountered.

2. The bidder’s submission of their proposal shall be considered “prima facie” evidence that they have made their examination as described in this Section.

### 1.02 RELATED REQUIREMENTS

A. Instructions to Bidders

## PART 2 – PRODUCTS (not applicable)

## PART 3 – EXECUTION (not applicable)

**End of Section**

Attachments:

Attachment A: Report entitled, “Geotechnical Data Report, MaineHealth / United Way Development, Somerset and Chestnut Streets, Portland, Maine,” prepared by Haley & Aldrich, Inc., dated10 September 2008

Attachment B: Memorandum entitled, “Results of Test Pit Exploration Program, MaineHealth / United Way Development, Somerset and Chestnut Streets, Portland, Maine,” prepared by Haley & Aldrich, Inc., dated 4 December 2008.

**Attachment A**

**GEOTECHNICAL DATA REPORT**
**MAINEHEALTH / UNITED WAY DEVELOPMENT**
**SOMERSET AND CHESTNUT STREETS**
**PORTLAND, MAINE**

**by**

**Haley & Aldrich, Inc.**
**Portland, Maine**

**for**

**Maine Medical Center**
**Portland, Maine**

**File No. 35611-000**
**10 September 2008**

HALEY&
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HALEY& ALDRICH

10 September 2008
File No. 35611-000

Maine Medical Center
22 Bramhall Street
Portland, Maine 04102-3175

Attention: Daniel F. Doughty, AIA
Director

Subject: Geotechnical Data Report
Maine Health/United Way Development
Somerset and Chestnut Streets
Portland, Maine

Dear Dan:

This data report presents the results of the geotechnical field investigation and laboratory test program conducted in support of the subject project. This work was undertaken at your request and in accordance with our proposal dated 2 July 2008 and your subsequent authorization.

We have coordinated our work with the following project team members:

| | | |
|---|---|---|
| ■ | Maine Medical Center (MMC) | Owner |
| ■ | Consigli Construction Co., Inc. (Consigli) | General Contractor |
| ■ | Scott Simons Architects (SSA) | Architect (Garage) |
| ■ | Harriman Associates, Inc. (Harriman) | Architect/Structural/MEP (Offices) |
| ■ | Becker Structural Engineers, Inc. (BSE) | Structural Engineer (Garage) |
| ■ | Woodard & Curran (W&C) | Civil Engineer (Garage and Offices) |
| ■ | John Tewhey Associates (JTA) | Environmental Compliance |

This report has been prepared for use by the design team during the design development (DD) and contract document (CD) phases of the project. A final geotechnical engineering report will be issued separately outlining foundation support and other geotechnical recommendations for the east office building and parking garage.

It is our intent that this report be included in the CD set or as a reference document in the CDs for use by prospective bidding contractors.

## ELEVATION DATUM

Elevations referenced herein are in feet and reference Portland City Datum (PCD). Portland City Datum relates to the National Geodetic Vertical Datum of 1929 (NGVD 29) as follows:

Elevation in ft (PCD) = Elevation in ft (NGVD 29) + 0.02 ft

## SITE LOCATION, EXISTING CONDITIONS & PREVIOUS USE

The proposed development area is located in the Bayside area of Portland. This portion of the Back Cove region, including this site, once consisted of tidal mudflats (see 1886 Sanborn Maps for area in Appendix D) and was filled with demolition debris (brick, concrete, rock fragments and wood), refuse, ash and soil during the 18$^{th}$, 19$^{th}$ and 20$^{th}$ centuries, a great portion of which was generated by the Great Portland Fire of 1866.

The approximate 3-acre site is bound by Elm Street to the south, Somerset Street to the east, commercial parcels to the west and Chestnut Street to the north. This parcel is currently undeveloped. Existing site grades range from El. 9 around the perimeter to El. 12 at the center of the site. A portion of the parcel was formerly occupied by the Union Branch rail yard. The general site location is shown on Figure 1, Project Locus. Historical Sanborn Maps of the site are provided in Appendix F.

## PROPOSED SITE DEVELOPMENT

It is our understanding that the principal components of the site development include the following:

- East Office Building – eight-story, approximately 84,000 square foot (sf) office building located at the east end of site, adjacent to Somerset and Chestnut Streets.
- West Office Building – future ten-story, approximately 100,000 sf office building located at the west end of site, adjacent to Somerset and Elm Streets.
- Parking Garage – seven-story, approximately 700-car parking structure located between the east and west office buildings, along Somerset Street.

It is our understanding that the feasibility of constructing one level of below-grade parking within the above-grade footprint of the parking garage will be considered by the design team during the DD phase. It has not yet been determined if the east and west office buildings will be structurally connected or separate from the parking garage. The Trust for Public Land will be designing/constructing a public trail that will be integral to the proposed site development and will run along the north side of the site behind the office buildings and garage.

Based on discussions with Harriman and W&C, it is our understanding that proposed site grades will be within 1 ft of existing site grades.

## SUBSURFACE EXPLORATION PROGRAM

### Previous Explorations

Previous explorations were conducted at the site in association with three separate projects: 1) Portland Brownfield's Project completed by Tewhey Associates in 1998, 2) Phase II Environmental Site Assessment (ESA) completed by Haley & Aldrich in 2000 on the former Union Branch Rail Line for the Maine Department of Transportation, and 3) Master Planning Geotechnical Investigation completed by Haley & Aldrich in 2006 for SSA on behalf of the City of Portland.

Explorations consisted of both test borings and test pits. The locations of the explorations are shown on Figure 2, Site and Subsurface Exploration Location Plan. Logs detailing subsurface soil, rock and groundwater conditions for previous explorations are provided in Appendix A.

Portland Brownfield's Project Explorations (1998)

A total of ten test pits, designated TP-1 through TP-10, were excavated as part of the Portland Brownfield's project completed by Tewhey Associates in October 1998. Test pits were excavated by Commercial Paving & Recycling of Scarborough, Maine. Of these explorations, only TP-3 through TP-6 were excavated within the vicinity of the proposed office buildings and parking garage. Only these explorations are discussed herein. Test pits were excavated to depths ranging from approximately 10 to 12 ft below ground surface (BGS) and were monitored in the field by Tewhey Associates.

Phase II ESA Explorations (2000)

A total of fifteen test borings, designated B101 through B115, and twenty-six test pits, designated TP101 through TP125, were drilled/excavated for the Phase II ESA completed by Haley & Aldrich in November 2000. Of these explorations, only test boring B110(OW) and test pits TP103 through TP105 and TP117 through TP122 were conducted at the subject site. Only these explorations are discussed herein.

The test boring was drilled by Maine Test Borings, Inc. of Brewer, Maine and was advanced to a depth of 12 ft BGS using a Mobile Drill B-47 track mounted drill rig with 4.25-in. inside diameter (ID) hollow stem augers (HSA). Soil samples were collected continuously through fill soils and into naturally deposited soils by driving a 1-3/8-in. ID split-spoon sampler with a 140-lb hammer dropped from a height of 30 in., as indicated on the test boring logs. The number of hammer blows required to advance the sampler through each 6 in. interval was recorded and is provided on the test boring logs. The Standard Penetration Test (SPT) N-value is defined as the total number of blows required to advance the sampler through the middle 12 in. of the 24-in. sampling interval. An observation well was installed in completed borehole B110.

The test pits were excavated by Environmental Projects, Inc. of Gray, Maine and were advanced to depths ranging from 3.5 to 12.5 ft BGS using a Komatsu tracked excavator.

Master Planning Explorations (2006)

Eleven test borings, designated HA06-1 through HA06-11, were drilled in association with the Bayside Parking Garage, proposed for an adjacent property and a Master Planning study partially conducted on the subject parcel. Only test borings HA06-7 through HA06-8 were drilled in the vicinity of the proposed east office building and parking garage and are discussed herein.

Test boring locations were laid out in the field by Haley & Aldrich by taping/pacing distances from existing site features. "As-drilled" test boring locations were recorded in the field by Haley & Aldrich using GPS survey equipment.

Subsurface explorations were drilled using trailer-mounted Mobile Drill B-47 drill rig. Test borings were drilled to depths of 54 and 67 ft BGS, respectively, using 3.0-in. (NW-size) ID steel casing. Soil samples were collected at standard, 5-ft intervals using the same methodology described in the previous section.

In-situ vane shear tests were conducted within the glaciomarine clay deposit in test boring HA06-7. Vane shear tests were performed to provide information on the undrained shear strength and compressibility characteristics of the glaciomarine clay present at the site. Results of the vane shear testing are summarized in Table II and are provided on the test boring logs in Appendix A.

**Recent Explorations**

A total of thirteen test borings, designated HA08-1 through HA08-13, were drilled within the limits of the proposed office buildings and parking garage.

Test boring locations were laid out in the field by Haley & Aldrich by taping/pacing distances from existing site features. "As-drilled" test boring locations were recorded in the field by Haley & Aldrich using GPS survey equipment.

Subsurface explorations were drilled using track-mounted Mobile Drill B-50 drill rig. Test borings were drilled to depths ranging from 14 to 102 ft BGS using 3.0-in. (NW-size) or 4.0-in. (HW-size) ID steel casing. Soil samples were collected continuously through the fill and harbor bottom deposits and at standard, 5-ft intervals, or 10-ft intervals thereafter using the methodology described in the previous sections. Soil samples were preserved in glass jars. These samples are currently stored at our office and are available for viewing upon request.

Test borings HA08-5, HA08-7 and HA08-13 were advanced into bedrock using a 2.0-in. (NQ-size) ID diamond-tipped core barrel. Rock core samples are also being stored at our office and are available for review upon request.

In-situ vane shear tests were conducted within the glaciomarine clay deposit in several of the test borings. Vane shear tests were performed to provide information on the undrained shear strength and compressibility characteristics of the glaciomarine clay at the site.

Results of the vane shear testing are summarized in Table II and are provided on the test boring logs in Appendix B.

A total of five, relatively undisturbed samples of glaciomarine clay were obtained in test borings HA08-4, HA08-8 and HA08-10. The samples were collected in order accurately determine the compressibility characteristics and the stress history of the clay. The samples were obtained by advancing a thin-wall Shelby Tube sampler into the clay using a piston sampler. Drilling mud was used while advancing the test borings in order to minimize soil disturbance. The drilling mud consists of a relatively thick and smooth mixture of water and bentonite-based powder.

Three observation wells were installed in completed boreholes HA08-5, HA08-7 and HA08-12 to provide information on the static groundwater level within the footprint of the proposed buildings and to determine whether the groundwater levels at the site are affected by tidal fluctuations in nearby Back Cove. The observation wells consisted of 2-in. ID, machine-slotted PVC pipe and solid PVC riser pipe extending approximately 3 ft above existing ground surface. The observation wells were outfitted with a steel guardpipe and steel lock/cap assembly. Observation well installation and groundwater monitoring reports are provided in Appendix C.

## SUBSURFACE CONDITIONS

### Soil/Bedrock Conditions

Generally, subsurface explorations encountered the following geologic units, presented in order of increasing depth below existing ground surface:

- Bituminous Concrete/Fill
- Harbor Bottom Deposit
- Glaciomarine Clay
- Glaciomarine Sand
- Glacial Till
- Bedrock

Refer to Table I for a summary of subsurface explorations, Appendix A for historic subsurface exploration logs and Appendix B for recent test boring logs for more detailed information regarding the conditions encountered at the site. A brief description of each geologic unit is provided below.

<u>Bituminous Concrete/Fill</u>

The Bayside region of the Back Cove area was once a tidal mudflat area and it has a long history of filling. Approximately 10 to 15 ft of fill overlies the entire site. Several different types of material were encountered within this layer and consisted of the following:

- poorly graded to well graded GRAVEL (SP to SW) with varying percentages of silt,
- silty GRAVEL (GM)
- silty SAND (SM) with varying percentages of gravel,
- poorly graded to well graded SAND (SP to SM) with varying percentages of silt,
- Rock fill was encountered in test boring HA08-2 between 10 and 14 ft BGS.

The fill soils generally contained ash, cinders, and brick and concrete fragments.

In addition, bituminous concrete was encountered at the ground surface in test borings HA08-1, HA08-3 and HA08-4, generally within the limits of the existing parking lot located on the south end of the site. The thickness of the material ranged from 0.1 to 1.0 ft.

<u>Harbor Bottom Deposit</u>

This deposit was encountered in all the test borings with the exception of HA06-7, HA06-8, HA08-2 and HA08-13. This deposit was likely exposed at the historic ground surface in the tidal/mudflat area of the Back Cove prior to site filling (see Sanborn maps in Appendix F). Where encountered, the thickness of the layer ranged from approximately 1 to 5.5 ft. The material typically consisted of gray, sandy ORGANIC SILT (OL/OH) with varying percentages of organic matter (rootlets, wood fragments etc.) and shells. In some locations the material consisted of gray SILT (ML) with varying amounts of sand or gray silty SAND (SM). The deposit was generally very soft to very stiff with SPT N-values ranging from 1 to 24 bpf.

<u>Glaciomarine Clay</u>

Glaciomarine clay was encountered in each test boring. The deposit ranged in thickness from approximately 20 to 55 ft and generally increases in thickness to the south and west. The upper 5 to 8 ft of the deposit consisted of olive gray lean CLAY (CL) and was typically medium stiff to stiff with undrained shear strengths ranging from 1,000 to 1,700 pounds per square foot (psf) (referred to herein as the clay "crust" ). The lower portion of the deposit consisted of soft to medium stiff, gray lean CLAY (CL) with undrained shear strengths typically ranging from 400 to 800 psf.

<u>Glaciomarine Sand</u>

Glaciomarine sand was encountered directly beneath the glaciomarine clay in test borings drilled in the northeastern portion of the site (HA08-8, HA08-10, HA08-11 and HA08-13). The thickness of the deposit ranged from approximately 5.5 to 12 ft and generally increased in thickness to the north and east. The material typically consisted of gray, poorly graded SAND (SP), well graded SAND (SW), or silty SAND (SP). The soil was generally loose to medium dense with SPT N-values ranging from 4 to 21 bpf.

Glacial Till

Glacial till was encountered either directly beneath the glaciomarine clay or the Glaciomarine Sand in all test borings with exception of HA08-8, HA08-12 and HA08-13. Where encountered, the thicknesses of the layer ranged from approximately 1.5 to 30 ft (HA08-1) and generally increased in thickness to the south and west. The glacial till generally consisted of gray silty SAND (SM) with varying amounts of gravel. The soil was typically medium dense to very dense with SPT N-values ranging from 14 to in excess of 150 bpf. Cobbles and boulders were not encountered in the till during drilling of the test borings.

Bedrock

Bedrock was sampled in test borings HA08-5(OW), HA08-7(OW) and HA08-13. Bedrock encountered at the site consists of moderately hard, fresh to highly weathered, dark gray CHLORITE SCHIST or moderately hard, moderately to highly weathered, dark gray SILTSTONE. Primary joints were dipping at near vertical angles. Both types of bedrock encountered at the site are considered part of the Cape Elizabeth Formation. At most test boring locations several feet of highly weathered bedrock was encountered.

Rock quality designation (RQD) is a common parameter that is 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 recovered bedrock. RQD values for bedrock encountered at the site ranged from 0 to 70 percent and were typically less than 20 percent.

**Groundwater Conditions**

Haley & Aldrich measured groundwater levels in the observation wells installed in completed boreholes HA08-5, HA08-7 and HA08-12. Initially, the groundwater level data was collected periodically using a manually operated water level indicator. Beginning on 7 August 2008 downhole transducers were installed in the observation wells and were programmed to record the groundwater level in the wells every 15 minutes. This was done to determine whether the static groundwater level within the proposed building/garage footprints is influenced by tidal fluctuations in nearby Back Cove. All groundwater depths were measured relative to the existing ground surface. The transducers were removed from the observation wells on 22 August 2008.

Based on the data collected between 7 and 22 August 2008, groundwater levels were measured between 6 and 8 ft below existing ground surface and do not appear to be influenced by tidal fluctuations in Back Cove.

Groundwater levels may fluctuate with season, precipitation, temperature and construction activities. Therefore, groundwater levels during and following construction may vary from that indicated in the observation wells. Observation well installation and groundwater monitoring reports are provided in Appendix C.

**SOIL SCREENING**

During the test boring program, samples were collected continuously through the man-placed fill soils. The soil samples were collected and were preserved by placing aluminum foil over the top of each jar and storing them on ice until they were returned to the Haley & Aldrich laboratory in Portland, Maine.

Upon receipt of the samples in our laboratory each sample was screened using a Thermo 580B Photoionization Detector (PID) to check for the presence of hydrocarbons in the soil samples. The results of the sample screening are recorded on the Headspace Screening Report provided in Appendix E.

**GEOTECHNICAL LABORATORY SOIL TESTING**

A laboratory testing program was conducted to assist in soil classification, evaluate reuse potential of the in-situ fill soils, and for determination of engineering properties (strength and compressibility) of the naturally deposited glaciomarine clay soils. This information will be needed to develop final geotechnical recommendations for the project. The testing program included four grain size analyses, four natural water content tests, six Atterberg Limits tests, and two constant rate of strain consolidation (CRSC) tests (used to determine the compressibility and stress history characteristics). Prior to CRSC testing, radiography tests were conducted on tube samples collected during the subsurface exploration program. Radiography tests were run on five thin-walled tube samples of soil selected for laboratory testing to aid in assessing the sample quality, general material type and presence of areas of disturbance and variations in soils retrieved.

All laboratory testing was completed in accordance with applicable ASTM test procedures. Grain size analyses were conducted by Haley & Aldrich at our laboratory in Boston, Massachusetts. Natural water content, Atterberg Limits, and CRSC tests were completed by GeoTesting Express of Boxborough, Massachusetts. Laboratory test results are provided in Appendix D.

**CLOSURE**

Based on the "soft" condition of the soils present at the site, impacts of site grading, pavement evaluations and building and utility support should be considered carefully during the design-phase of the project. We will provide foundation support and other geotechnical design recommendations under separate cover during the DD phase of the project.

We appreciate the opportunity to provide geotechnical and environmental engineering services on this project. Please do not hesitate to call if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.

Bryan C. Steinert
Engineer

STATE OF MAINE
WAYNE A.
CHADBOURNE
No. 10620
LICENSED
PROFESSIONAL ENGINEER

Wayne A. Chadbourne, P.E.
Vice President

Attachments:

- Table I - Summary of Subsurface Explorations
- Table II - Summary of In-Situ Vane Shear Test Results
- Figure 1 - Project Locus
- Figure 2 - Site and Subsurface Exploration Location Plan
- Appendix A - Historic Subsurface Explorations
- Appendix B - Recent Subsurface Explorations
- Appendix C - Observation Well Installation and Groundwater Monitoring Reports
- Appendix D - Laboratory Test Results
- Appendix E - Soil Screening Headspace Reports
- Appendix F - Historic Sanborn Maps

c: Scott Simons Architects; Attn: Scott Simon (.pdf only)
Harriman Associates, Inc.; Attn: Patrick Costin, Keith Brenner (.pdf only)
Woodard & Curran; Attn: Barry Sheff (.pdf only)
Becker Structural Engineers; Attn: Todd Neal (.pdf only)
Tewhey Associates; Attn; John Tewhey (.pdf only)
Consigli Construction Co.; Attn: David Thomas (.pdf only)

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## REFERENCES

1. Haley & Aldrich, Inc. "Report No. 1: Engineering Properties of Foundation Soils, Long Creek-Fore River and Back Cove Area, Portland, Maine," prepared for Maine State Highway Commission, October 1969.

2. Haley & Aldrich, Inc. "Report on Phase II Environmental Site Assessment, Union Branch Rail Line Property, Portland, Maine," prepared for Maine Department of Transportation, December 2000.

3. Haley & Aldrich, Inc. "Report on Subsurface Explorations & Foundation Design Recommendations, Proposed Bayside Parking Garage, 25 Somerset Street, Portland, Maine" prepared for Scott Simons Architects, 22 September 2006.

4. Haley & Aldrich, Inc. "Master Planning Geotechnical Investigation, Proposed Bayside Development, Parcels A and B, Somerset Street, Portland, Maine" prepared for Scott Simons Architects, 25 October 2006

**TABLE I**
Summary of Subsurface Explorations
MaineHealth / United Way Development
Somerset and Chestnut Streets
Portland, Maine

| Test Boring No.[1] | Estimated Ground Surface Elevation[2,3] | Thickness of Strata (ft) | | | | | | Approx. Elevation of Top of Weathered Bedrock[3] | Approx. Elevation of Top of Competent Bedrock[3,5] | Elevation of Bottom of Exploration[3] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Bituminous Concrete | Fill | Harbor Bottom Deposit | Glaciomarine Deposit (clay) | Glaciomarine Deposit (sand) | Glacial Till | | | |
| HA08-1 | 11.5 | 0.1 | 8.9 | 5.5 | 54.5 | NE | 29.5 | -87.0 | -90.5 | -90.5 |
| HA08-2 | 9.0 | NE | 14.0 | NE | 47.0 | NE | 5.6 | -57.6 | -59.7 | -59.7 |
| HA08-3 | 11.0 | 1.0 | 11.0 | 4.1 | >1.9 | NE | NE | NE | NE | -7.0 |
| HA08-4 | 12.0 | 0.5 | 12.5 | 3.9 | 41.9 | NE | 5.6 | -52.4 | -54.0 | -54.0 |
| HA08-5(OW) | 9.0 | NE | 10.5 | 2.5 | 40.0 | NE | 9.5 | -53.5 | -54.8 | -59.8 |
| HA08-6 | 10.0 | NE | 12.3 | >1.7 | NE | NE | NE | NE | NE | -4.0 |
| HA08-7(OW) | 12.0 | NE | 12.5 | 1.5 | 24.0 | NE | 22.1 | -48.1 | -50.0 | -60.0 |
| HA08-8 | 9.0 | NE | 9.5 | 4.3 | 29.2 | 5.6 | NE | -39.6 | -41.5 | -41.5 |
| HA08-9 | 11.0 | NE | 12.0 | 2.0 | >2.0 | NE | NE | NE | NE | -5.0 |
| HA08-10 | 9.0 | NE | 10.0 | 1.3 | 23.9 | 10.3 | 2 | -38.5 | -40.5 | -40.5 |
| HA08-11 | 11.0 | NE | 12.5 | 1.7 | 19.8 | 12.0 | 6.5 | -41.5 | -44.0 | -44.0 |
| HA08-12(OW) | 11.0 | NE | 11.6 | 2.4 | >2.0 | NE | NE | NE | NE | -5.0 |
| HA08-13 | 9.0 | NE | 12.5 | NE | 27.1 | 7.0 | NE | -37.6 | -37.6 | -47.0 |
| HA06-7 | 10.5 | NE | 13.0 | NE | 51.0 | NE | >3.0 | NE | NE | -56.5 |
| HA06-8 | 12.0 | NE | 14.0 | NE | 33.2 | NE | 1.6 | -39.0 | NE | -39.0 |
| B112 (OW) | 10.0 | NE | 9.9 | >2.1 | NE | NE | NE | NE | NE | -2.0 |
| TP-3 | 11.0 | NE | 9.0 | >1.5 | NE | NE | NE | NE | NE | 0.5 |
| TP-4 | 11.0 | NE | 12.0 | NE | NE | NE | NE | NE | NE | -1.0 |
| TP-5 | 11.5 | NE | 10.5 | NE | NE | NE | NE | NE | NE | -0.5 |
| TP-6 | 12.0 | NE | 10.0 | NE | NE | >1.0 | NE | NE | NE | 1.0 |
| TP103 | 10.0 | NE | 9.5 | 1.5 | NE | >1.0 | NE | NE | NE | -2.0 |
| TP104 | 10.0 | NE | 9.5 | NE | NE | >0.5 | NE | NE | NE | 0.0 |
| TP105 | 12.0 | NE | >3.5 | NE | NE | NE | NE | NE | NE | 8.5 |
| TP117 | 11.0 | NE | >9.5 | NE | NE | NE | NE | NE | NE | 1.5 |
| TP118 | 11.0 | NE | >9.0 | NE | NE | NE | NE | NE | NE | 2.0 |
| TP119 | 11.0 | NE | >9.5 | NE | NE | NE | NE | NE | NE | 1.5 |
| TP120 | 11.0 | NE | >8.5 | NE | NE | NE | NE | NE | NE | 2.5 |
| TP121 | 12.0 | NE | >8.0 | NE | NE | NE | NE | NE | NE | 4.0 |
| TP122 | 12.0 | NE | 10.0 | >1.5 | NE | NE | NE | NE | NE | 0.5 |
| TP123 | 10.0 | NE | 11.0 | >1.5 | NE | NE | NE | NE | NE | -2.5 |

Notes:
1 Test boring locations are shown on Figure 2, Site and Subsurface Exploration Location Plan.
2 Ground surface elevations at test boring locations are approximate and were estimated by interpolating between elevation contour data provided by Woodard & Curran
3 Elevations are in feet and reference Portland City Datum.
4 "NE" indicates stratum was not encountered in test boring.
5 The top of competent bedrock is considered to be the elevation at which the advancement of the roller cone resulted in no additional penetration.

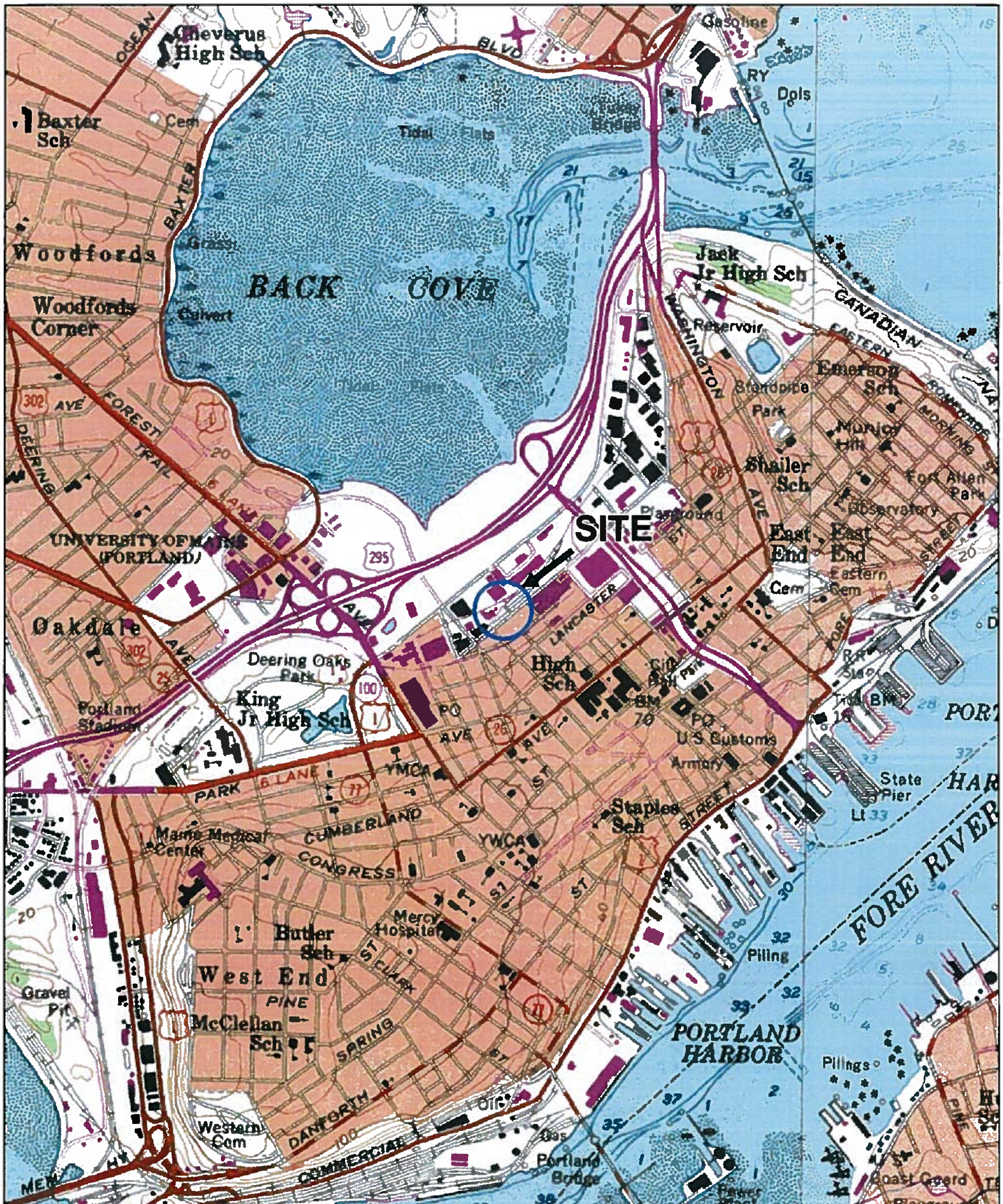


HALEY& ALDRICH

**TABLE II**
Summary of In-Situ Vane Shear Test Results
MaineHealth / United Way Development
Somerset and Chestnut Streets
Portland, Maine

| Test Boring No.[2] | Approximate Ground Surface Elevation (ft)[1,3] | Vane Size (in. x in.) | Test No.[4] | Depth below ground surface (ft) | Approximate Elevation (ft)[1,3] | $V_{max}$ [5,7] (in-lbs) | $V_{remolded}$ [5,7] (in-lbs) | $S_u$ [6,7] (psf) | $S_{u(remolded)}$ [6,7] (psf) |
|---|---|---|---|---|---|---|---|---|---|
| HA06-7 | 10.5 | 2 x 8.5 | FV1 | 20.3 - 21.0 | -9.8 - -10.5 | - | - | 1,680 | - |
| | | 2 x 8.5 | FV2 | 25.3 - 26.0 | -14.8 - -15.5 | - | - | 840 | 270 |
| | | 2 x 8.5 | FV3 | 35.3 - 36.0 | -24.8 - -25.5 | - | - | 590 | 110 |
| | | 2 x 8.5 | FV4 | 40.3 - 41.0 | -29.8 - -30.5 | - | - | 580 | 170 |
| | | 2 x 8.5 | FV5 | 56.0 - 56.7 | -45.5 - -46.2 | - | - | 860 | - |
| HA08-1 | 11.5 | 2 x 8.5 | FV1 | 25.3 - 26.0 | -13.8 - -14.5 | 264 | 72 | 900 | 250 |
| | | 2 x 8.5 | FV2 | 35.3 - 36.0 | -23.8 - -24.5 | 192 | 96 | 650 | 330 |
| | | 2 x 8.5 | FV3 | 45.3 - 46.0 | -33.8 - -34.5 | 204 | 120 | 690 | 410 |
| | | 2 x 8.5 | FV4 | 56.3 - 57.0 | -44.8 - -45.5 | 360 | 156 | 1,220 | 530 |
| HA08-2 | 9.0 | 2 x 8.5 | FV1 | 25.3 - 26.0 | -16.3 - -17.0 | 180 | 60 | 610 | 200 |
| | | 2 x 8.5 | FV2 | 35.3 - 36.0 | -26.3 - -27.0 | 120 | 36 | 410 | 120 |
| | | 2 x 8.5 | FV3 | 45.3 - 46.0 | -36.3 - -37.0 | 168 | 48 | 570 | 160 |
| | | 2 x 8.5 | FV4 | 55.3 - 56.0 | -46.3 - -47.0 | 144 | 36 | 490 | 120 |
| HA08-4 | 12.0 | 3.5 x 8 | FV1 | 22.3 - 23.0 | -10.3 - -11.0 | 950 | - | 1,050 | - |
| | | 3.5 x 8 | FV2 | 27.3 - 28.0 | -15.3 - -16.0 | 540 | 142 | 590 | 160 |
| | | 3.5 x 8 | FV3 | 30.3 - 31.0 | -18.3 - -19.0 | 450 | 80 | 500 | 90 |
| | | 3.5 x 8 | FV4 | 35.3 - 36.0 | -23.3 - -24.0 | 305 | 45 | 340 | 50 |
| | | 3.5 x 8 | FV5 | 40.3 - 41.0 | -28.3 - -29.0 | 360 | 108 | 400 | 120 |
| | | 3.5 x 8 | FV6 | 45.3 - 46.0 | -33.3 - -34.0 | 384 | 96 | 420 | 110 |
| | | 3.5 x 8 | FV7 | 50.3 - 51.0 | -38.3 - -39.0 | 552 | 72 | 610 | 80 |
| HA08-5(OW) | 9.0 | 2 x 8.5 | FV1 | 20.3 - 21.0 | -11.3 - -12.0 | 212 | 75 | 720 | 260 |
| | | 2 x 8.5 | FV2 | 25.3 - 26.0 | -16.3 - -17.0 | 213 | 59 | 720 | 200 |
| | | 2 x 8.5 | FV3 | 30.3 - 31.0 | -21.3 - -22.0 | 215 | 51 | 730 | 170 |
| | | 2 x 8.5 | FV4 | 35.3 - 36.0 | -26.3 - -27.0 | 175 | 85 | 600 | 290 |
| | | 2 x 8.5 | FV5 | 40.3 - 41.0 | -31.3 - -32.0 | 175 | 55 | 600 | 190 |
| | | 2 x 8.5 | FV6 | 50.3 - 51.0 | -41.3 - -42.0 | 205 | 109 | 700 | 370 |
| HA08-7(OW) | 12.0 | 2 x 8.5 | FV1 | 20.3 - 21.0 | -8.3 - -9.0 | 245 | 95 | 830 | 320 |
| | | 2 x 8.5 | FV2 | 25.3 - 26.0 | -13.3 - -14.0 | 215 | 51 | 730 | 170 |
| | | 2 x 8.5 | FV3 | 30.3 - 31.0 | -18.3 - -19.0 | 201 | 82 | 680 | 280 |
| | | 2 x 8.5 | FV4 | 35.3 - 36.0 | -23.3 - -24.0 | 255 | 62 | 870 | 210 |
| HA08-8 | 9.0 | 3.5 x 8 | FV1 | 18.3 - 19.0 | -9.3 - -10.0 | 420 | 60 | 460 | 70 |
| | | 3.5 x 8 | FV2 | 22.3 - 23.0 | -13.3 - -14.0 | 552 | 48 | 610 | 50 |
| | | 3.5 x 8 | FV3 | 30.3 - 31.0 | -21.3 - -22.0 | 346 | 108 | 380 | 120 |
| | | 3.5 x 8 | FV4 | 35.3 - 36.0 | -26.3 - -27.0 | 708 | 132 | 780 | 150 |
| | | 3.5 x 8 | FV5 | 39.3 - 40.0 | -30.3 - -31.0 | 936 | 72 | 1,030 | 80 |
| HA08-10 | 9.0 | 3.5 x 8 | FV1 | 19.3 - 20.0 | -10.3 - -11.0 | 468 | 96 | 520 | 110 |
| | | 3.5 x 8 | FV2 | 23.3 - 24.0 | -14.3 - -15.0 | 660 | 120 | 730 | 130 |
| | | 3.5 x 8 | FV3 | 27.3 - 28.0 | -18.3 - -19.0 | 360 | 84 | 400 | 90 |
| | | 3.5 x 8 | FV4 | 30.3 - 31.0 | -21.3 - -22.0 | 204 | 62 | 220 | 70 |
| HA08-11 | 11.0 | 2 x 8.5 | FV1 | 25.3 - 26.0 | -14.3 - -15.0 | 215 | 50 | 720 | 170 |
| HA08-13 | 9.0 | 2 x 8.5 | FV1 | 20.3 - 21.0 | -11.3 - -12.0 | 199 | 50 | 670 | 170 |
| | | 2 x 8.5 | FV2 | 25.3 - 26.0 | -16.3 - -17.0 | 174 | 71 | 590 | 240 |
| | | 2 x 8.5 | FV3 | 30.3 - 31.0 | -21.3 - -22.0 | 82 | 75 | 280 | 250 |
| | | 2 x 8.5 | FV4 | 35.3 - 36.0 | -26.3 - -27.0 | 215 | 64 | 720 | 220 |

Notes:
1. Estimated ground surface elevations are based on interpretation of the site plans prepared by Woodard & Curran (measured to the nearest 0.5 ft).
2. Test boring locations were determined using GPS equipment and/or by taping and pacing from existing site features.
3. Elevations are measured in feet reference Portland City Datum.
4. Vane test numbers are shown on the test boring logs presented in Appendix A and B.
5. $V_{max}$ and $V_{remolded}$ represent direct peak and remolded vane shear values, respectively, measured in the field.
6. $S_u$ and $S_{u(remolded)}$ represent corrected undrained peak and residual shear strengths, respectively, based on the vane paddle size (rounded to the nearest 10 psf).
7. in-lbs = inch-pounds of torque, psf = pounds per square foot




SITE COORDINATES:43°39'42"N 70°15'46"W

N
W E
S

U.S.G.S. QUADRANGLE: PORTLAND WEST, ME

HALEY & ALDRICH

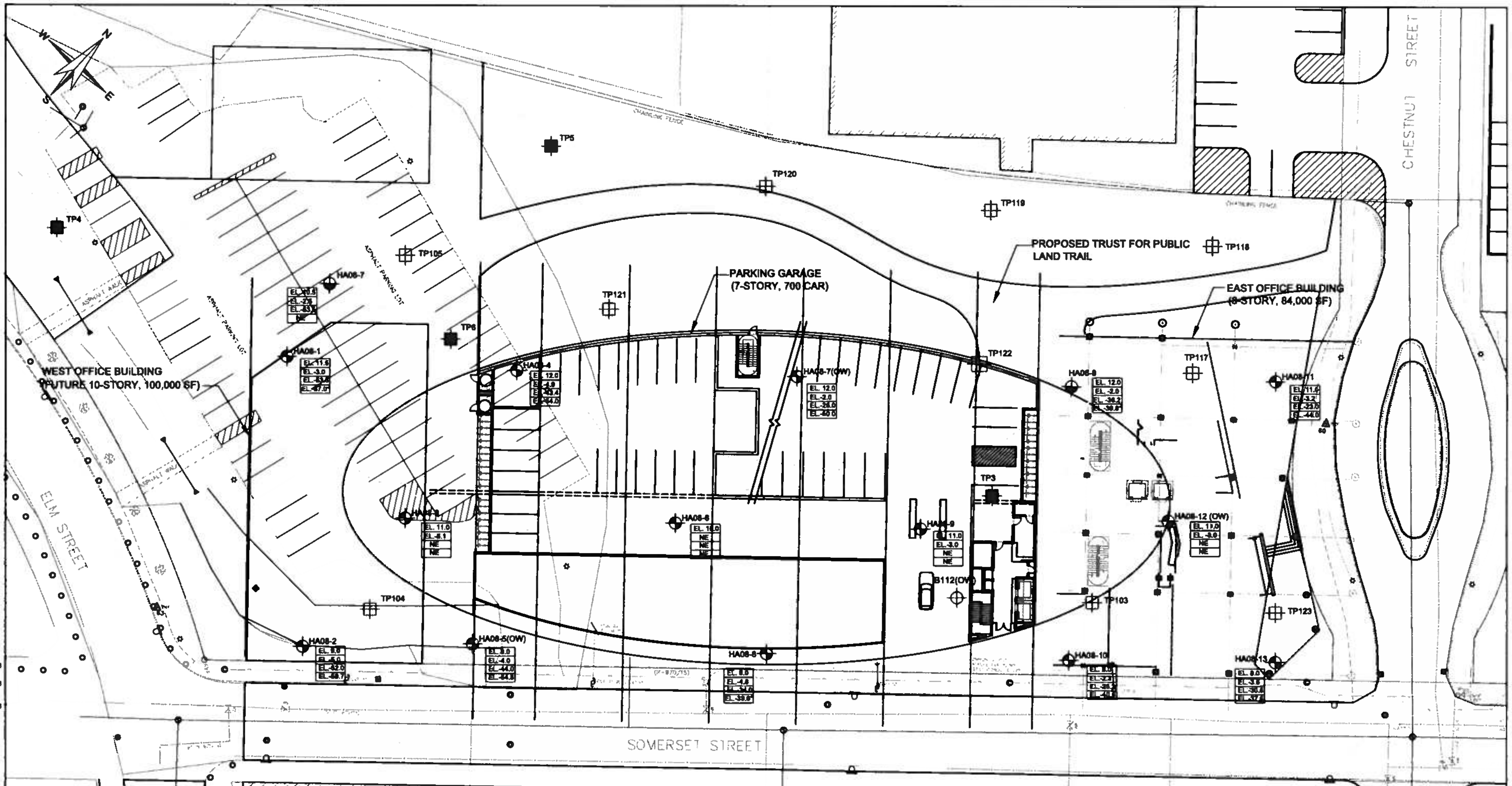
MAINEHEALTH / UNITED WAY DEVELOPMENT
SOMERSET STREET
PORTLAND, MAINE

PROJECT LOCUS

SCALE: 1:24,000
SEPTEMBER 2008

FIGURE 1

35611-000 1.PDF




**NOTES:**

1. EXISTING SITE CONDITIONS, CONTOURS OF EXISTING GROUND SURFACE ELEVATIONS AND LOCATION AND ORIENTATION OF EXISTING SITE FEATURES ARE TAKEN FROM THE ELECTRONIC AUTOCAD FILE "219897 XOOC.dwg" PROVIDED BY WOODARD & CURRAN ON 21 JULY 2008.
2. THE LOCATION AND ORIENTATION OF PROPOSED SITE FEATURES ARE TAKEN FROM THE ELECTRONIC AUTOCAD FILE " FP01.dwg " PROVIDED BY SCOTT SIMONS ARCHITECTS ON 22 AUGUST 2008.
3. LOCATIONS OF HISTORIC SUBSURFACE EXPLORATIONS WERE DETERMINED IN THE FIELD BY TAPING/PACING DISTANCES FROM EXISTING SITE FEATURES. LOCATIONS OF "HA08" AND "HA08" SERIES OF TEST BORINGS WERE DETERMINED IN THE FIELD USING GPS SURVEY EQUIPMENT.
4. ELEVATIONS ARE IN FEET AND REFERENCE PORTLAND CITY DATUM.
5. SUBSURFACE EXPLORATIONS WERE MONITORED IN THE FIELD BY HALEY & ALDRICH PERSONNEL (EXCEPT FOR THE "TP1" SERIES OF TEST PITS, WHICH WERE MONITORED BY TEWHEY ASSOCIATES.
6. REFER TO APPENDIX A FOR LOGS OF HISTORIC SUBSURFACE EXPLORATIONS, APPENDIX B FOR LOGS OF RECENT SUBSURFACE EXPLORATIONS, AND APPENDIX C FOR OBSERVATION WELL INSTALLATION AND GROUNDWATER MONITORING REPORTS.
7. GROUND SURFACE ELEVATIONS AT SPECIFIC TEST BORING LOCATIONS ARE APPROXIMATE AND WERE ESTIMATED USING SITE TOPOGRAPHIC INFORMATION PROVIDED BY WOODARD & CURRAN.

**LEGEND:**

| | |
|---|---|
| HA08-1 | DESIGNATION AND LOCATION OF TEST BORING DRILLED BY MAINE TEST BORINGS, INC. OF BREWER, MAINE IN JULY AND AUGUST 2008 |
| HA08-7 | DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING DRILLED BY MAINE TEST BORINGS, INC. OF BREWER, MAINE IN AUGUST 2008 |
| EL. 11.5 | APPROXIMATE GROUND SURFACE ELEVATION |
| EL. -3.0 | APPROXIMATE TOP OF CLAY ELEVATION |
| EL. -57.5 | APPROXIMATE BOTTOM OF CLAY ELEVATION |
| EL. -80.5 | APPROXIMATE ELEVATION OF ROLLER CONE REFUSAL IN BEDROCK |
| B112 | DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING DRILLED BY MAINE TEST BORINGS, INC. OF BREWER, MAINE IN NOVEMBER 2000 |
| TP103 | DESIGNATION AND APPROXIMATE LOCATION OF TEST PIT EXCAVATED BY ENVIRONMENTAL PROJECTS, INC. OF AUBURN, MAINE IN NOVEMBER 2000 |
| TP3 | DESIGNATION AND APPROXIMATE LOCATION OF TEST PIT EXCAVATED BY COMMERCIAL PAVING & RECYCLING OF SCARBOROUGH, MAINE IN OCTOBER 1998 |
| 11 | ELEVATION CONTOUR OF EXISTING GROUND SURFACE |
| (OW) | DENOTES OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE |
| NE | DENOTES SOIL STRATA, ROCK WAS NOT ENCOUNTERED IN EXPLORATION |
| • | DENOTES ROLLERCONE REFUSAL IN BEDROCK NOT ENCOUNTERED. SEE TEST BORING LOG FOR DETAILS |

0 20 40 60 80

SCALE IN FEET

HALEY & ALDRICH

MAINEHEALTH / UNITED WAY DEVELOPMENT
SOMERSET AND CHESTNUT STREETS
PORTLAND, MAINE

## SITE AND SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
SEPTEMBER 2008

FIGURE 2

G:\PROJECTS\35811\PRELIMINARY SKETCHES\NEW FIGURE 2\2008_0807_HAI_BASE PLAN.DWG

# APPENDIX A

## Historic Subsurface Explorations

HALEY&
ALDRICH

**1998 Portland Brownfield's Project**
**Test Pit Logs**

HALEY & ALDRICH

| TEWHEY ASSOCIATES | | TEST PIT LOG | |
|---|---|---|---|
| PROJECT: | Portland Brownfields- Portland Terminal | BACKHOE: | Commercial Paving |
| PROJECT NO: | 97-005 | | |
| DATE: | 10-29-98 | NO: | TP-3 |
| INVESTIGATOR | J. Tewhey | LOCATION: | Middle of Site |

| PID (ppm) | Ref. Soil Samples (Recovery) | Description | Depth (Feet) |
|---|---|---|---|
| 1.5 | **S-1** | Coarse black sand and gravel with coal and ash (FILL). | 1.0 |
| | | Light brown coarse sand to gray medium sand and silty sand (FILL). | 2.0 |
| | | | 3.0 |
| | | | 4.0 |
| | | | 5.0 |
| | | | 6.0 |
| 1.5 | S-2 | | 7.0 |
| | | | 8.0 |
| | | Black bay mud with glass and pottery chards. | 9.0 |
| <1.0 | **S-3** | | 10.0 |
| | | Bottom of Excavation = 10.5 ft. | 11.0 |
| | | | 12.0 |
| | | | 13.0 |
| | | | 14.0 |
| | | | 15.0 |
| | | | 16.0 |
| | | | 17.0 |
| | | | 18.0 |
| | | | 19.0 |
| | | | 20.0 |

| | |
|---|---|
| Comments: | Sample ID in bold indicates soil sample was submitted to laboratory for analysis. |
| Water Table Present: | Wetness observed at 4 ft below ground surface. |

| TEWHEY ASSOCIATES | | TEST PIT LOG | |
|---|---|---|---|
| PROJECT: | Portland Brownfields- Portland Terminal | BACKHOE: | Commercial Paving |
| PROJECT NO: | 97-005 | | |
| DATE: | 10-29-98 | NO: | TP-4 |
| INVESTIGATOR | J. Tewhey | LOCATION: | West Side of Site-- |

| PID (ppm) | Ref. Soil Samples (Recovery) | Description | Depth (Feet) |
|---|---|---|---|
| | | 4-inches loam over brown gravel with lenses of black granular soils and bricks (FILL). | 1.0 – 3.0 |
| 2.0 | **S-1** | Dense black medium sand with silt (FILL). | 4.0 – 6.0 |
| 1.5 | S-2 | Gray ash (FILL). | 7.0 |
| <1.0 | **S-3** | Demolition debris... bricks and wood fragments (FILL). | 8.0 – 12.0 |
| | | Black bay mud with glass and pottery chards. | 12.0 – 13.0 |
| | | Bottom of Excavation = 12 ft. | 13.0 – 20.0 |

| | |
|---|---|
| **Comments:** | Sample ID in **bold** indicates soil sample was submitted to laboratory for analysis. |
| **Water Table Present:** | Wetness observed at 7 ft below ground surface. |

| TEWHEY ASSOCIATES | | TEST PIT LOG | |
|---|---|---|---|
| ROJECT: | Portland Brownfields- Portland Terminal | BACKHOE: | Commercial Paving |
| PROJECT NO: | 97-005 | | |
| ATE: | 10-29-98 | NO: | TP-5 |
| NVESTIGATOR | J. Tewhey | LOCATION: | West Side of Site |

| PID (ppm) | Ref. Soil Samples (Recovery) | Description | Depth (Feet) |
|---|---|---|---|
| | | Brown gravel with lenses of black granular soils and bricks (FILL). | 1.0 |
| 2.0 | S-1 | | 2.0 |
| | | | 3.0 |
| | | Gray ash (FILL). | 4.0 |
| | | | 5.0 |
| | | | 6.0 |
| 2.0 | **S-2** | | 7.0 |
| | | | 8.0 |
| | | | 9.0 |
| | | | 10.0 |
| | | Black bay mud with glass and pottery shards. | 11.0 |
| | | Bottom of Excavation = 11 ft. | 12.0 |
| | | | 13.0 |
| | | | 14.0 |
| | | | 15.0 |
| | | | 16.0 |
| | | | 17.0 |
| | | | 18.0 |
| | | | 19.0 |
| | | | 20.0 |

| Comments: | Sample ID in **bold** indicates soil sample was submitted to laboratory for analysis. |
|---|---|
| Vater Table Present: | Wetness observed at 4 ft below ground surface. |

## TEWHEY ASSOCIATES — TEST PIT LOG

| | | | |
|---|---|---|---|
| PROJECT: | Portland Brownfields- Portland Terminal | BACKHOE: | Commercial Paving |
| PROJECT NO: | 97-005 | | |
| DATE: | 10-29-98 | NO: | TP-6 |
| INVESTIGATOR | J. Tewhey | LOCATION: | West Side of Site |

| PID (ppm) | Ref. Soil Samples (Recovery) | Description | Depth (Feet) |
|---|---|---|---|
| | | Coarse black sand and gravel with coal and ash (FILL). | 0.0–3.0 |
| 1.0 | **S-1** | | |
| | | Dark brown, black, silty fine sand (FILL). | 3.0–5.0 |
| 2.0 | S-2 | Gray ash (FILL). | 5.0–7.0 |
| 2.0 | **S-3** | Black dump refuse... glass, wood, pottery, metal, leather, sewerage odor (FILL). | 7.0–10.0 |
| | | Dark gray silty clay with clam shells (native). | 10.0–11.0 |
| | | Bottom of Excavation = 11 ft. | 11.0 |

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0

| | |
|---|---|
| Comments: | Sample ID in bold indicates soil sample was submitted to laboratory for analysis. |
| Water Table Present: | Wetness observed at 5 ft below ground surface. |

**2000 Phase II Environmental Site Assessment**
**Test Pit and Test Boring Logs**

HALEY & ALDRICH

HALEY & ALDRICH

# TEST PIT LOG

**Test Pit No.** TP103

| | |
|---|---|
| **Project** | Union Branch Acquisition |
| **Location** | Portland, Maine |
| **Client** | Maine Department of Transportation |
| **Contractor** | Environmental Projects, Inc. |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket |

| | |
|---|---|
| **File No.** | 80509-014 |
| **Date** | 20 November 2000 |
| **Weather** | Cloudy |
| **H&A Rep** | J. Tewhey |

**Ground El.:** ft
**El. Datum:**

**Location:** See Plan

**Groundwater depths/entry rates (in./min.):** Water inflow is rapid from -HARBOR BOTTOM DEPOSIT- Water slow at 3.0 ft.(perched), rapid at 10.0 ft.

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | 103-1 0' | | | -RAILYARD FILL- (See 101-1) | | | | | | | | | | |
| | 103-2 1' | 0.5 | SW | Light brown well-graded SAND, few lenses of dark granular rail bed material as in 103-1<br>-SAND FILL- | | | 10 | 80 | 5 | 5 | | | | |
| 2 | 103-3 3' | 2.0 | ML | Olive-gray clayey SILT with sand and gravel, medium stiff<br>-CLAYEY SILT FILL- | | | | | | | | | | |
| 4 | 103-4 5.5' | 4.0 | ML | Gray clayey SILT with sand, very soft<br>-CLAYEY SILT FILL- | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | |
| 10 | 103-5 9.5' | 9.5 | | Black-brown organic material with some clay<br>-HARBOR BOTTOM DEPOSIT-(FILL) | | | | | | | | | | |
| | 103-6 11' | 11.0 | CL | Olive-gray lean CLAY with silt, trace medium sand, medium stiff, presence of clam shell fossils is diagnostic of -NATIVE SOILS-<br><<C>-MARINE DEPOSIT- | | | | | | | | | | |
| 12 | | 12.0 | | Bottom of Exploration at 12.0 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:**

**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 |

**Standing Water in Completed Pit**
at depth ft
measured after hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**
Pit Depth 12.0
Pit Length x Width 4.0 x 14.0

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

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HALEY & ALDRICH

# TEST PIT LOG

**Test Pit No.** TP104

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 20 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Cloudy |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

**Ground El.:** ft
**El. Datum:**
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):** Water emerges from ash at 6.0 ft., has slight sheen

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | 104-1 0.5' | | | Gray coarse coal ash mixed with 20% silty LOAM -ASH FILL- | | | | | | | | | | |
| | 104-2 1.5' | 1.5 | ML | Olive-gray clayey SILT with sand, stiff -CLAYEY SILT FILL- | | | | | | | | | | |
| 2 | | 2.5 | | Gray, coarse coal ash -ASH FILL- | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | |
| 6 | 104-3 7' | 6.0 | | Dark brown to black heterogeneous mix of ash, organic marine deposit, trash and clayey SILT -ASH AND REFUSE FILL- | | | | | | | | | | |
| 8 | 104-4 9' | | | Black stained coarse COAL ASH with trash, glass, ceramic, leather, metal, shell, wood | | | | | | | | | | |
| | | 9.5 | CL | Olive-gray lean CLAY with silt -MARINE DEPOSIT- | | | | | | | | | | |
| 10 | | 10.0 | | Bottom of Excavation at 10.0 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:**

**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 |

**Standing Water in Completed Pit**

at depth 7.5 ft
measured after 0.25 hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**

Pit Depth 10.0
Pit Length x Width 4.0 x 14.0

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

# TEST PIT LOG

HALEY & ALDRICH

**Test Pit No.** TP105

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 20 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Cloudy |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

**Ground El.:** ft
**El. Datum:**
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):**

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | | | | Heterogeneous mix of used brick, sheets of metal, concrete blocks in matrix of brown sandy LOAM | | | | | | | | | | |
| | | | | -MIXED FILL- | | | | | | | | | | |
| 2 | | | | Solid mass of wood in matrix of black rubber/plastic prevented digging | | | | | | | | | | |
| | | 3.5 | | Bottom of Excavation at 3.5 ft. | | | | | | | | | | |

**Obstructions:** Wood and rubber/plastic massive block

**Remarks:**

**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 |

**Standing Water in Completed Pit**
at depth ft
measured after hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**
Pit Depth 3.5
Pit Length x Width 4.0 x 10.0

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

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HALEY & ALDRICH

# TEST PIT LOG

**Test Pit No.** TP117

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 21 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Clear |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

| | | |
|---|---|---|
| **Ground El.:** ft<br>**El. Datum:** | **Location:** See Plan | **Groundwater depths/entry rates (in./min.):** Water entering pit slowly at 5.0 ft. |

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | 117-1<br>0.5' | 1.0 | | -RAILYARD FILL- (See 101-1) | | | | | | | | | | |
| 2<br>4 | 117-2<br>3' | 5.0 | | Light brown to brown poorly-graded sand, mps= 0.25 in. with wavy lenses of dark brown sand<br>-SAND FILL- | | 5 | 10 | 80 | 5 | | | | | |
| 6<br>8 | 117-3<br>7.5' | 9.5 | | Olive-gray clayey SILT with sand<br>-CLAYEY SILT FILL- | | | 5 | 5 | 30 | 60 | | | | |
| | | | | Bottom of Excavation at 9.5 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:** Hole collapsed due to failure of clayey silt fill.

**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 |

**Standing Water In Completed Pit**

at depth ft

measured after hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**

Pit Depth 9.5

Pit Length x Width 4.0 x 11.0

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

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# TEST PIT LOG

**Test Pit No.** TP118

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 21 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Clear |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

**Ground El.:** ft
**El. Datum:**
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):** Water slowly seeping at 6.5 ft.

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | Brown sandy loam with organics and roots | | | | | | | | | | |
| | | 0.5 | | -SILT FILL- | | | | | | | | | | |
| 2 | 118-1 2.5' | | | Olive-brown to olive-gray clayey SILT FILL, stiff, becomimg medium stiff to soft with depth<br>-CLAYEY SILT FILL- | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | |
| 6 | | 6.5 | | Olive-brown silty SAND, mps= 1.0 inch<br>-SAND FILL- | | | | | | | | | | |
| 8 | 118-2 7.5' | | | | | | | | | | | | | |
| | | 8.5 | SM | Black silty SAND | 10 | 5 | 5 | 15 | 40 | 25 | | | | |
| | | 9.0 | | Bottom of Excavation at 9.0 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:** Clayey silt fill collapsed upon setting for a few minutes.

**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 |

**Standing Water in Completed Pit**
at depth ft
measured after hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**
Pit Depth 9.0
Pit Length x Width 4.0 x 12.0

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

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# TEST PIT LOG

**Test Pit No.** TP119

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 21 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Clear |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

| | | |
|---|---|---|
| **Ground El.:** ft<br>**El. Datum:** | **Location:** See Plan | **Groundwater depths/entry rates (in./min.):** Water emerges from ash at 6.0 ft. |

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | | 0.3 | | | | | | | | | | | | |
| | 119-1 1' | 1.5 | | Light brown to brown well-graded SAND, mps= 1.0 in. -SAND FILL- | | | | | | | | | | |
| 2 | 119-2 2' | 3.0 | | Gray coarse coal ash with lenses of black railroad yard soils and light brown sand (as in 119-1) -ASH FILL- | | | | | | | | | | |
| 4 | 119-3 4.5' | | | | | | | | | | | | | |
| 6 | 119-4 7' | 9.5 | | Gray coarse coal ash with mixed trash, all stained jet black, glass, brick, ceramics, leather, metal, wood -ASH AND REFUSE FILL- | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | |
| | | | | Bottom of Excavation at 9.5 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:** Standing water in pit has prominent petroleum sheen; no petroleum odor (cold weather may inhibit odor)

| 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 |

**Standing Water in Completed Pit**

at depth 6.0 ft
measured after 0.25 hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**

Pit Depth 9.5
Pit Length x Width 4.0 x 14.0

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

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# TEST PIT LOG

**Test Pit No.** TP120

| | |
|---|---|
| **Project** | Union Branch Acquisition |
| **Location** | Portland, Maine |
| **Client** | Maine Department of Transportation |
| **Contractor** | Environmental Projects, Inc. |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket |

| | |
|---|---|
| **File No.** | 80509-014 |
| **Date** | 21 November 2000 |
| **Weather** | Clear |
| **H&A Rep** | J. Tewhey |

**Ground El.:** ft
**El. Datum:**

**Location:** See Plan

**Groundwater depths/entry rates (in./min.):** Water entering pit rapidly from 6-7 ft.

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | 120-1 0' | 0.5 | | Light brown poorly-graded SAND, mps= 0.25 in., grass, roots | | | 10 | 80 | 5 | 5 | | | | |
| | 120-2 1' | | | -RAILYARD FILL- (See 101-1) | | | | | | | | | | |
| 2 | | 2.5 | | | | | | | | | | | | |
| 4 | 120-3 5' | | | Gray coarse coal ash | | | | | | | | | | |
| 6 | | | | -ASH FILL- | | | | | | | | | | |
| 8 | | 8.5 | | Bottom of Excavation at 8.5 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:** Slight petroleum sheen on standing water, no petroleum odor

| 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 |

**Standing Water in Completed Pit**

| | | |
|---|---|---|
| at depth | 6.5 | ft |
| measured after | 0.25 | hours elapsed |

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**

| | |
|---|---|
| Pit Depth | 8.5 |
| Pit Length x Width | 4.0 x 13.0 |

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

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# TEST PIT LOG

**Test Pit No.** TP121

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 21 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Clear |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

| | | |
|---|---|---|
| **Ground El.:** ft<br>**El. Datum:** | **Location:** See Plan | **Groundwater depths/entry rates (in./min.):** |

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | 121-1<br>1' | | | Brown silty GRAVEL with sand, grass, roots<br>GRAVEL FILL- | 40 | 15 | 10 | 10 | 10 | 15 | | | | |
| 2 | 121-2<br>2' | 2.0 | | -RAILYARD FILL- (See 101-1) | | | | | | | | | | |
| | | 2.8 | | | | 5 | 10 | 80 | 5 | | | | | |
| 4 | 121-3<br>4.5' | | | Light brown to brown well-graded SAND, mps= 0.25 in., wavy lenses of dark brown sand<br>-SAND FILL- | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | |
| | 121-4<br>7' | 7.0 | | Olive-gray calyey SILT with sand and gravel<br>-CLAYEY SILT FILL-<br>Note: Log platform at 8.0 ft. | 5 | 5 | 5 | 5 | 20 | 60 | | | | |
| 8 | | 8.0 | | Bottom of Excavation at 8.0 ft. | | | | | | | | | | |

| | | |
|---|---|---|
| **Obstructions:** Wooden (log) platform or road at 8.0 ft. prevented more digging. | **Remarks:** | **Field Tests**<br>Dilatancy R - Rapid S - Slow N - None<br>Toughness L - Low M - Medium H - High<br>Plasticity N - Nonplastic L - Low M - Medium H - High<br>Dry Strength N - None L - Low M - Medium H - High V - Very High |

| **Standing Water in Completed Pit** | **Boulders** | **Test Pit Dimensions (ft)** |
|---|---|---|
| at depth ft<br>measured after hours elapsed | Diameter (in.) / Number / Approx. Vol. (cu.ft)<br>12" to 24" =<br>over 24" = | Pit Depth 8.0<br>Pit Length x Width 4.0 x 11.0 |

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

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# TEST PIT LOG

**Test Pit No.** TP122

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 21 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Clear |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

**Ground El.:** ft
**El. Datum:**
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):** Water seeping slowly at 3.5 ft.

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | 122-1 0.5' | | | -RAILYARD FILL- (See 101-1) | | | | | | | | | | |
| | | 1.0 | | Olive-brown clayey SILT with sand and gravel<br>-CLAYEY SILT FILL- | | | | | | | | | | |
| 2 | 122-2 2' | | | | | | | | | | | | | |
| | | 3.0 | | Olive-gray clayey SILT with sand and gravel (sand lenses shed water into pit)<br>-CLAYEY SILT FILL- | | | | | | | | | | |
| 4 | 122-3 4' | | | | | | | | | | | | | |
| 6 | | 6.0 | | Olive-gray to gray coarse SAND with silt, some ash and marine organics from former back cove bottom<br>-SANDY MIXED FILL- | | | | | | | | | | |
| 8 | 122-4 8' | | | | | | | | | | | | | |
| 10 | 122-5 10.5' | 10.0 | CL | Native clay deposits (See 107-4)<br>-MARINE DEPOSIT- | | | | | | | | | | |
| | | 11.5 | | Bottom of Excavation at 11.5 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:** Water draining from sand lense between clay layers at 3.5 ft.

**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 |

**Standing Water in Completed Pit**
at depth ft
measured after hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**
Pit Depth 11.5
Pit Length x Width 4.0 x 12.0

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

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# TEST PIT LOG

**Test Pit No.** TP123

| | | | |
|---|---|---|---|
| **Project** | Union Branch Acquisition | **File No.** | 80509-014 |
| **Location** | Portland, Maine | **Date** | 21 November 2000 |
| **Client** | Maine Department of Transportation | **Weather** | Clear |
| **Contractor** | Environmental Projects, Inc. | **H&A Rep** | J. Tewhey |
| **Equipment Used** | Komatsu Excavator 0.75 Cubic Yard Bucket | | |

**Ground El.:** ft
**El. Datum:**
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):**

| Depth (ft) | Sample ID | Stratum Change Depth (ft) | USCS Symbol | 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 | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 123-1 0' | | | -RAILYARD FILL- (See 101-1) | | | | | | | | | | |
| | 123-2 1' | 1.0 | | Light brown well-graded SAND | | | 5 | 80 | 10 | 5 | | | | |
| | 123-3 1.5' | 1.5 | | Olive-brwon clayey SILT with sand and gravel, dry, stiff<br>-CLAYEY SILT FILL- | | | | | | | | | | |
| 2 | | 2.5 | | Olive-gray clayey SILT with sand and gravel, wet, soft<br>-CLAYEY SILT FILL- | | | | | | | | | | |
| 4 | 123-4 4' | | | | | | | | | | | | | |
| 6 | | 6.0 | | Gray coarse coal ash<br>-ASH FILL- | | | | | | | | | | |
| | 123-5 7' | | | | | | | | | | | | | |
| 8 | | 8.5 | | Gray coarse coal ash with trash; wood, ceramics, glass, leather, metal, brick<br>-ASH AND REFUSE FILL- | | | | | | | | | | |
| | 123-6 9' | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | |
| | 123-7 11' | 11.0 | CL | Native clay deposits (See 107-4)<br>-MARINE DEPOSIT- | | | | | | | | | | |
| 12 | | 12.5 | | Bottom of Excavation at 12.5 ft. | | | | | | | | | | |

**Obstructions:**

**Remarks:**

**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 |

**Standing Water in Completed Pit**
at depth ft
measured after hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12" to 24" | | = |
| over 24" | | = |

**Test Pit Dimensions (ft)**
Pit Depth 12.5
Pit Length x Width 4.0 x 14.0

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

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# TEST BORING REPORT

**Boring No.** B112

Project: Union Branch Rail Line Property Portland, Maine
Client: Maine Department of Transportation
Contractor: Maine Test Borings, Inc.

File No. 80509-014
Sheet No. 1 of 1
Start 17 November 2000
Finish 17 November 2000
Driller D. McKeen
H&A Rep. K. Stephenson
Elevation
Datum
Location See Plan

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | HSA | S | - |
| Inside Diameter (in.) | 4.25 | 1 3/8 | - |
| Hammer Weight (lb.) | | 140 | - |
| Hammer Fall (in.) | | 30 | - |

Drilling Equipment and Procedures
Rig Make & Model: Mobile B47 Bombardier
Bit Type:
Drill Mud:
Casing:
Hoist/Hammer: Winch/ Doughnut Hammer

| Depth (ft.) | SPT* | Sample No. & Rec. (in.) | Sample Depth (ft.) | Well Diagram | Elev./Depth (ft.) | USCS Symbol | 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 | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 7 10 23 | S1 16" | 0.0 2.0 | | | | Loose, black silty SAND, glass, roots, debris -DEBRIS FILL- | | | | 10 | 70 | 20 | | | | |
| | | | | | 0.6 | | Medium dense, brown to light brown SAND, little silt -GRANULAR FILL- | | | 20 | 50 | 20 | 10 | | | | |
| | 20 13 11 6 | S2 12" | 2.0 4.0 | | 1.8 | | Medium dense, gray-brown silty coarse to fine SAND, glass, trace clay (till fill) | | 5 | | 10 | 65 | 20 | | | | |
| | | | | | | | Medium dense, gray silty coarse to fine SAND (damp) | | 5 | | 15 | 60 | 20 | | | | |
| 5 | WOR WOH 1 2 | S3 18" | 4.0 6.0 | | 4.0 | | Very soft, fine sandy SILT with clay, trace gravel and coarse to medium sand | | 5 | 10 | 10 | 25 | 50 | | | | |
| | WOH WOH 1 1 | S4 12" | 6.0 8.0 | | | | Similar to S3 | | | | | | | | | | |
| | WOR WOH 2 1 | S5 22" | 8.0 10.0 | | | | Very loose, gray silty SAND, little gravel and clay | | 10 | 10 | | 50 | 30 | | | | |
| | | | | | 9.4 | | Very soft, black fine sandy SILT with coal fragments | | | | | | | | | | |
| 10 | 1 1 2 2 | S6 24" | 10.0 12.0 | | | OL/ OH | Very soft, dark gray organic SILT -HARBOR BOTTOM DEPOSIT- | | | | | 10 | 90 | | | | |
| | | | | | 9.9 | CL | Soft, gray SILT to CLAY with sand, shells | | | | | | | | | | |
| | | | | | 12.0 | | Bottom of Exploration at 12.0 ft. No refusal<br><br>No elevated PID readings detected during drilling and sampling procedures. | | | | | | | | | | |

Water Level Data

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

Sample Identification
O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon
G Geoprobe

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

Summary
Overburden (lin. ft.) 12.0
Rock Cored (lin. ft.) --
Samples 6S

**Boring No.** B112

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

*SPT = Sampler blows per 6 in. **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.**

**2006 Master Planning**
**Test Boring Logs**

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# TEST BORING REPORT

**Boring No.** HA06-7

| | |
|---|---|
| Project | Proposed Bayside Parking Garage & Master Planning Portland, Maine |
| Client | Scott Simons Architects |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 33538-000 |
| Sheet No. | 1 of 3 |
| Start | 7 August 2006 |
| Finish | 8 August 2006 |
| Driller | T. Schaefer |
| H&A Rep. | K. Stone |
| Elevation | 10.5 +/- |
| Datum | Portland City |
| Location | See Plan |

| | Casing | Sampler | Barrel | Drilling Equipment and Procedures |
|---|---|---|---|---|
| Type | NW | SS | - | Rig Make & Model: Mobile Drill / Truck |
| Inside Diameter (in.) | 3.0 | 1.375 | - | Bit Type: Roller Bit; Drill Mud: None |
| Hammer Weight (lb.) | 300 | 140 | - | Casing: NW Drive 65.0 ft |
| Hammer Fall (in.) | 30 | 30 | - | Hoist/Hammer: Winch / Doughnut Hammer |

| Depth (ft.) | SPT[1] | Sample No. & Rec. (in.) | Sample Depth (ft.) | Well Diagram | Elev./Depth (ft.) | USCS Symbol | Visual-Manual Identification and Description (Density/consistency, color, GROUP NAME, max. particle size[2], structure, odor, moisture, optional descriptions, geologic interpretation) | Gravel % Coarse | Gravel % Fine | Sand % Coarse | Sand % Medium | Sand % Fine | % Fines | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 11 10 18 | S1 12 | 0.0 2.0 | NO WELL INSTALLED | | SM | Medium dense, dark brown, silty SAND with gravel (SM), mps 1.1 in., no odor, dry -FILL- | | 15 | 10 | 25 | 35 | 15 | | | | |
| 5 | 6 8 7 3 | S2 8 | 5.0 7.0 | | | SW | Medium dense, brown, well-graded SAND with gravel (SW), mps 1.0 in., no odor, moist -FILL- | | 15 | 25 | 35 | 30 | | | | | |
| 10 | 9 4 5 8 | S3 0 | 10.0 12.0 | | | | NOTE: No recovery, small piece of wood in tip of spoon. Sheen observed in wash water from 10.0 to 13.0 ft -FILL- | | | | | | | | | | |
| | | | | | 13.0 | | | | | | | | | | | | |
| 15 | 7 10 13 21 | S4 22 | 15.0 17.0 | | | CL | Hard, olive-brown to gray, lean CLAY (CL), mps 0.42 mm, mottled, occasional fine sand and silt partings, no odor, wet -MARINE CLAY- | | | | | | 100 | | | | |
| 20 | 3 4 6 5 | S5 22 | 20.0 22.0 | | | CL | Stiff, gray, lean CLAY (CL), mps 0.075 mm, no odor, wet, frequent black streaks -MARINE CLAY- FV1 (20.3 - 21.0 ft), Su = 1680 psf | | | | | | 100 | | | | |
| 25 | | | | | | | | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft.) to: Bottom of Casing | Bottom of Hole | Water |
|---|---|---|---|---|---|
| 8/8/06 | 06:30 | 12.5 | 60.0 | 62.0 | 14.1 |

**Sample Identification**

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

**Well Diagram**

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

**Summary**

Overburden (lin. ft.) 67.0
Rock Cored (lin. ft.) -
Samples S10

**Boring No.** HA06-7

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

[1]SPT = Sampler blows per 6 in. [2]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.**

| Depth (ft.) | SPT[1] | Sample No. & Rec. (in.) | Sample Depth (ft.) | Well Diagram | Elev./Depth (ft.) | USCS Symbol | Visual-Manual Identification and Description (Density/consistency, color, GROUP NAME, max. particle size[2], 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 | | | | | | | FV2 (25.3 - 26.0 ft), Su = 840 psf / 270 psf | | | | | | | | | | |
| 30 | WOR WOR WOH WOH | S6 24 | 30.0 32.0 | | | CL | Medium stiff, lean CLAY (CL), mps 0.075 mm, wet, frequent black streaks -MARINE CLAY- | | | | | | 100 | | | | |
| 35 | | | | | | | FV3 (35.3 - 36.0 ft), Su = 590 psf / 110 psf | | | | | | | | | | |
| 40 | WOR WOR WOR WOR | S7 24 | 40.0 42.0 | | | CL | Medium stiff, lean CLAY (CL), mps 0.075 mm, wet, with frequent black streaks -MARINE CLAY- | | | | | | 100 | | | | |
| 45 | | | | | | | FV4 (40.3 - 41.0 ft), Su = 580 psf / 170 psf | | | | | | | | | | |
| 50 | WOR WOR WOR WOR | S8 24 | 50.0 52.0 | | | CL | Medium stiff, lean CLAY (CL), mps 0.075 mm, wet, with frequent black streaks -MARINE CLAY- | | | | | | 100 | | | | |
| 55 | | | | | | | FV5 (56.0 - 56.7 ft), Su = 860 psf | | | | | | | | | | |
| 60 | WOR WOR WOR WOR | S9 24 | 60.0 62.0 | | | CL | Medium stiff, lean CLAY (CL), mps 2.0 mm, wet, trace sand -MARINE CLAY- | | | | | | 100 | | | | |

[1]SPT = Sampler blows per 6 in. [2]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.

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA06-7
File No. 33538-000
Sheet No. 3 of 3

| Depth (ft.) | SPT[1] | Sample No. & Rec. (in.) | Sample Depth (ft.) | Well Diagram | Elev./Depth (ft.) | USCS Symbol | Visual-Manual Identification and Description (Density/consistency, color, GROUP NAME, max. particle size[2], 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 64.0 | | | | | | | | | | | | |
| 65 | 11<br>32<br>20<br>20 | S10<br>15 | 65.0<br>67.0 | | | SM | Very dense, gray, silty SAND (SM), mps 0.75 in., bonded, no odor, wet<br>-GLACIAL TILL- | | 20 | 10 | 10 | 45 | 15 | | | | |
| | | | | | 67.0 | | -BOTTOM OF EXPLORATION-<br><br>NOTE:<br>1. FV1 (20.4 - 21.0 ft) indicates in-situ field vane performed at depth interval listed, corrected peak / residual shear strengths are provided. See Table II for details.<br>2. WOR = Weight of drill Rods; WOH = Weight of Hammer. | | | | | | | | | | |

[1]SPT = Sampler blows per 6 in. [2]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.**

**Boring No.** HA06-7

USCS_TB4 USCSLIB4.GLB USCSTB+CORE4.GDT G:\PROJECTS\33538\FIELD FORMS\33538-000.GPJ 17 Oct 08

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No. HA06-8**

Project: Proposed Bayside Parking Garage & Master Planning Portland, Maine
Client: Scott Simons Architects
Contractor: Maine Test Borings, Inc.

File No. 33538-000
Sheet No. 1 of 2
Start: 10 August 2006
Finish: 10 August 2006
Driller: T. Schaefer
H&A Rep.: B. Steinert
Elevation: 12.0 +/-
Datum: Portland City
Location: See Plan

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | SS | - |
| Inside Diameter (in.) | 3.0 | 1.375 | - |
| Hammer Weight (lb.) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill / Truck
Bit Type: Roller Bit
Drill Mud: None
Casing: NW Drive 25.0 ft
Hoist/Hammer: Winch / Doughnut Hammer

| Depth (ft.) | SPT[1] | Sample No. & Rec. (in.) | Sample Depth (ft.) | Well Diagram | Elev./Depth (ft.) | USCS Symbol | Visual-Manual Identification and Description (Density/consistency, color, GROUP NAME, max. particle size[2], structure, odor, moisture, optional descriptions, geologic interpretation) | Gravel % Coarse | Gravel % Fine | Sand % Coarse | Sand % Medium | Sand % Fine | % Fines | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 15 28 32 23 | S1 12 | 0.0 2.0 | NO WELL INSTALLED | | SP-SM | Very dense, dark brown to black, poorly graded SAND with gravel (SP-SM), mps 1 in., hydrocarbon odor, moist, coal and wood fragments present -FILL- | 20 | 10 | 10 | 40 | 10 | 10 | | | | |
| | | | | | | | NOTE: Similar material to above observed in auger cuttings from 0.0 to 5.0 ft | | | | | | | | | | |
| 5 | 52 52 42 28 | S2 8 | 5.0 7.0 | | 5.3 | SW-SM | Very dense, dark brown to black, well graded SAND with silt (SW-SM), mps 4.75 mm, slight hydrocarbon odor, moist, trace coal and brick fragments -FILL- | 0 | 0 | 10 | 50 | 30 | 10 | | | | |
| | | | | | | SP | Medium dense to dense, yellow-brown, poorly graded SAND (SP), mps 2.0 mm, no odor, moist, wood stuck in tip of spoon -FILL- | 0 | 0 | 0 | 15 | 80 | 5 | | | | |
| 10 | 2 6 6 8 | S3 12 | 10.0 12.0 | | 10.5 | SM | Very loose, yellow-brown to brown, silty SAND (SM), mps 4.75 mm, no odor, wet, trace wood fragments -FILL- | 0 | 0 | 15 | 50 | 20 | 15 | | | | |
| | | | | | | SM | Medium dense, dark brown to gray, silty SAND (SM), mps 4.75 mm, no odor, wet, some reworked natural material -FILL- | 0 | 0 | 20 | 45 | 20 | 15 | | | | |
| | | | | | 14.0 | | | | | | | | | | | | |
| 15 | 4 7 8 11 | S4 20 | 15.0 17.0 | | | CL | Stiff, olive-gray, lean CLAY (CL), mps 0.075 mm, bonded, mottled, no odor, moist to wet -MARINE CLAY- | | | | | | 100 | | | | |
| | | | | | 17.0 | | | | | | | | | | | | |
| 20 | WOH WOH 1 3 | S5 24 | 20.0 22.0 | | | CL | Very soft, gray, lean CLAY (CL), mps 1 in., bonded, no odor, wet, frequent black streaks -MARINE CLAY- | | | | | | 100 | | | | |
| 25 | | | | | | | | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft.) to: Bottom of Casing | Bottom of Hole | Water |
|---|---|---|---|---|---|
| 8/10/06 | 11:00 | 0 | - | 9.1 | 6.8 |

**Sample Identification**

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

**Well Diagram**

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

**Summary**

Overburden (lin. ft.) 54.0
Rock Cored (lin. ft.) 0.0
Samples S10

**Boring No. HA06-8**

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

[1]SPT = Sampler blows per 6 in. [2]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.**

HALEY & ALDRICH

# TEST BORING REPORT

Boring No. HA06-8
File No. 33538-000
Sheet No. 2 of 2

| Depth (ft.) | SPT[1] | Sample No. & Rec. (in.) | Sample Depth (ft.) | Well Diagram | Elev./Depth (ft.) | USCS Symbol | Visual-Manual Identification and Description (Density/consistency, color, GROUP NAME, max. particle size[2], 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 | WOR WOR WOR WOR | S6 24 | 25.0 27.0 | | | CL | Very soft, gray, lean CLAY (CL), mps 0.42 mm, bonded, no odor, wet, frequent black streaks and fine sand partings, trace shells -MARINE CLAY- | | | | | 10 | 90 | | | | |
| 30 | WOR WOR WOR WOR | S7 24 | 30.0 32.0 | | 30.3 | CL | Very soft, gray, lean CLAY (CL), mps 0.075 mm, bonded, no odor, wet, trace shells, black streaks/specs become less frequent with depth -MARINE CLAY- | | | | | | 100 | | | | |
| 35 | | | | | | | | | | | | | | | | | |
| 40 | WOR WOR WOR WOH | S8 24 | 40.0 42.0 | | | CL | Very soft, gray, lean CLAY (CL), mps 0.075 mm, bonded, no odor, wet, trace fine sand -MARINE CLAY- | | | | | | 100 | | | | |
| 45 | | | | | | | | | | | | | | | | | |
| 50 | 3 18 26 22 | S9 12 | 50.0 52.0 | | 50.2 | SW-SM | Dense, gray, well graded SAND with silt (SW-SM), mps 4.75 mm, bonded, no odor, wet -GLACIAL TILL- | 0 | 0 | 30 | 40 | 20 | 10 | | | | |
| | 38 40 52 55 | S10 12 | 52.0 54.0 | | 51.8 | BR | -WEATHERED BEDROCK- | | | | | | | | | | |
| | | | | | 54.0 | | -BOTTOM OF EXPLORATION- | | | | | | | | | | |

[1]SPT = Sampler blows per 6 in. [2]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.

Boring No. HA06-8

# APPENDIX B

## Recent Subsurface Explorations

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-1

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 4 |
| Start | 8 August 2008 |
| Finish | 12 August 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 11.5 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | -- |
| Inside Diameter (in.) | 3.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: None
Casing: NW drive to 102.0 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | 0.1 | | -Bituminous Concrete- | | | | | | | | | | |
| | 20<br>50<br>23<br>26 | S1<br>16 | 1.0<br>3.0 | | GW | Very dense, gray, well-graded GRAVEL (GW), mps 1-3/8 in., no structure, no odor, wet, intermixed with 15% concrete<br>-FILL- | 35 | 35 | 10 | 10 | 10 | | | | | |
| | 5<br>8<br>100 | S2<br>19 | 3.0<br>4.5 | 3.0 | SM | Very dense, dark gray, silty SAND (SM), mps 1-3/8 in., no structure, no odor, moist, intermixed with 10% concrete and ash<br>-FILL- | 5 | 5 | 30 | 30 | 15 | 15 | | | | |
| 5 | 18<br>13<br>8<br>6 | S3<br>22 | 5.0<br>7.0 | | SM | Medium dense, dark gray, silty SAND (SM), mps 1-3/8 in., no structure, no odor, moist<br>-FILL- | 5 | 5 | 30 | 30 | 15 | 15 | | | | |
| | 7<br>4<br>2<br>2 | S4<br>11 | 7.0<br>9.0 | | SM | Loose, dark gray, silty SAND (SM), mps 1-3/8 in., no structure, no odor, wet<br>-FILL- | 5 | 5 | 30 | 30 | 15 | 15 | | | | |
| | | | | 9.0 | | | | | | | | | | | | |
| 10 | 2<br>1<br>3<br>3 | S5<br>7 | 10.0<br>12.0 | | OL/<br>OH | Loose, gray, sandy ORGANIC SILT (OL/OH), trace shells, mps 2.0 mm, no structure, organic odor, wet<br>-HARBOR BOTTOM DEPOSIT- | | | | | 15 | 85 | | | | |
| | 28<br>12<br>11<br>10 | S6<br>9 | 12.0<br>14.0 | | OL/<br>OH | Medium dense, gray, sandy ORGANIC SILT (OL/OH), trace shells, mps 2.0 mm, no structure, petroleum-like odor, wet, frequent sand partings | | | | | 15 | 85 | | | | |
| | | | | 14.5 | | | | | | | | | | | | |
| 15 | 7<br>11<br>18<br>21 | S7<br>24 | 15.0<br>17.0 | | CL | Very stiff, olive-gray, silty lean CLAY (CL), mps 2.0 mm, brown mottling, no structure, no odor, moist<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 20 | | | | | | | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft) to: Bottom of Casing | Bottom of Hole | Water |
|---|---|---|---|---|---|
| 8/12/08 | 1148 | | 99.0 | 101.7 | 19.1 |
| 8/12/08 | 1230 | | - | 76.0 | 7.1 |

**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) | 98.5 |
| Rock Cored (ft) | 0 |
| Samples | 18S |

**Boring No.** HA08-1

**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.

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | | | | | | | | | | | |
| 25 | WOH<br>WOH<br>WOH<br>WOH | S8<br>24 | 25.0<br>27.0 | | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist<br>FV1 (25.3-26.0 ft), Su = 900/250 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 30 | | | | | | | | | | | | | | | | |
| 35 | WOR<br>WOR<br>WOH<br>WOH | S9<br>21 | 35.0<br>37.0 | | CL | Medium stiff, dark gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet<br>FV2 (35.3-36.0 ft), Su = 650/330 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 40 | | | | | | | | | | | | | | | | |
| 45 | WOR<br>WOR<br>WOR<br>WOR | S10<br>24 | 45.0<br>47.0 | | CL | Very soft, dark gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet<br>FV3 (45.3-46.0 ft), Su = 204/120 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | Note: Trace of sand and gravel observed in wash water. | | | | | | | | | | |
| 55 | | | | | | | | | | | | | | | | |
| | WOR<br>WOR<br>WOR<br>WOR | NR | 56.0<br>58.0 | | | Note: No recovery, probable gravel or cobble pushed by spoon tip.<br>FV4 (56.3-57.0 ft), Su = 1220/530 psf | | | | | | | | | | |
| 60 | WOR<br>WOR<br>WOR<br>WOR | S11<br>24 | 60.0<br>62.0 | | CL | Very soft, dark gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet, frequent fine sand seams<br>-GLACIOMARINE DEPOSIT- | | | | | 5 | 95 | N | L | L | |
| 65 | 5<br>1<br>3<br>10 | S12<br>14 | 65.0<br>67.0 | 65.0 | SC/SM | Very loose, gray, clayey SAND to silty SAND (SC/SM), mps 0.25 in., no structure, no odor, wet<br>-GLACIOMARINE DEPOSIT- | | 5 | 15 | 20 | 45 | 15 | | | | |
| | | | | 69.0 | | | | | | | | | | | | |
| 70 | 23<br>24<br>31<br>43 | S13<br>24 | 70.0<br>72.0 | | SM | Very dense, gray, silty SAND with gravel (SM), mps 0.25 in., bonded, no odor, moist<br>-GLACIAL TILL- | | 10 | 20 | 25 | 30 | 15 | | | | |
| 75 | 44<br>76<br>81<br>100/4" | S14<br>15 | 75.0<br>77.0 | | SM | Very dense, gray, silty SAND with gravel (SM), mps 0.25 in., bonded, no odor, moist<br>-GLACIAL TILL- | 5 | 5 | 20 | 25 | 30 | 15 | | | | |

# HALEY & ALDRICH

# TEST BORING REPORT

Boring No. HA08-1
File No. 35611-000
Sheet No. 4 of 4

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 80 | 50 44 56 65 | S15 19 | 80.0 82.0 | | SM | Very dense, gray, silty SAND (SM), mps 0.25 in., bonded, no odor, moist -GLACIAL TILL- | 5 | 5 | 20 | 25 | 30 | 15 | | | | |
| 85 | 57 87 102 90 | S16 18 | 85.0 87.0 | | SM | Very dense, gray, silty SAND (SM), mps 0.25 in., bonded, no odor, moist -GLACIAL TILL- | 5 | 5 | 20 | 25 | 30 | 15 | | | | |
| 90 | 8 21 62 87 | S17 18 | 90.0 92.0 | | SM | Very dense, gray, silty SAND (SM), mps 0.25 in., bonded, no odor, moist, occasional pockets of sandy SILT -GLACIAL TILL- | 5 | 5 | 20 | 25 | 30 | 15 | | | | |
| 95 | | | | | | | | | | | | | | | | |
| | | | | 98.5 | | | | | | | | | | | | |
| 100 | 34 48 71 146 | S18 14 | 100.0 102.0 | | BR | Highly weathered SCHIST -WEATHERED BEDROCK- Note: Unable to advance core barrel through casing at 90.0 ft, casing deflected from 90.0 to 100.0 ft. | | | | | | | | | | |
| | | | | 102.0 | | BOTTOM OF EXPLORATION | | | | | | | | | | |

Notes:
1. FV1 (25.3-26.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.
2. WOR = Weight of Drill Rods; WOH = Weight of Hammer.

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

# HALEY & ALDRICH — TEST BORING REPORT

**Boring No.** HA08-2

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |
| File No. | 35611-000 |
| Sheet No. | 1 of 3 |
| Start | 12 August 2008 |
| Finish | 13 August 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 9 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | -- |
| Inside Diameter (in.) | 3.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: None
Casing: NW drive to 68.7 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 5 8 12 | S1 24 | 0.0 2.0 | | SM | Medium dense, brown, silty SAND (SM), mps 0.25 in., trace wood and ash, no structure, no odor, moist -FILL- | | | 30 | 30 | 25 | 15 | | | | |
| | 12 14 12 9 | NR | 2.0 4.0 | | | | | | | | | | | | | |
| | 2 3 4 6 | S2 19 | 4.0 6.0 | 4.0 | SP | Loose, red-brown, poorly graded SAND (SP), mps 4.0 mm, no structure, no odor, moist -FILL- | | | 30 | 30 | 40 | | | | | |
| 5 | 5 6 2 1 | S3 14 | 6.0 8.0 | | SP | Loose, red-brown, poorly graded SAND (SP), mps 4.0 mm, no structure, no odor, moist -FILL- | | | 30 | 30 | 40 | | | | | |
| | 1 1 1 1 | S4 7 | 8.0 10.0 | 7.9 | GM | Very loose, black, silty GRAVEL (GM), mps 0.5 in., trace shells and wood -FILL- | 40 | 30 | 5 | 5 | | 20 | | | | |
| | | | | 9.8 | OL/OH | Very soft, black, ORGANIC SILT (OL/OH), mps 2.0 mm, no structure, organic odor, wet -FILL- | | | | | | 100 | | | | |
| 10 | 3 11 51 54 | S5 4 | 10.0 12.0 | 10.0 | GP | Very dense, gray, poorly graded GRAVEL (GP), mps 1-3/8 in., no structure, no odor, wet -FILL- NOTE: Advanced roller bit through rock fill from 10.0 to 13.8 ft, advance casing to 15.0 ft and resume sampling. | 20 | 45 | 5 | 5 | 5 | | | | | |
| | | | | 14.0 | | | | | | | | | | | | |
| 15 | WOH 2 4 4 | NR | 15.0 17.0 | | | Note: No recovery, probable cobble pushed by spoon tip. | | | | | | | | | | |
| | 4 6 4 4 | S6 24 | 17.0 19.0 | | CL | Stiff, gray, silty lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist -GLACIOMARINE DEPOSIT- | | | | | | | | | | |
| 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) 68.7
Rock Cored (ft) 0
Samples 10S

**Boring No.** HA08-2

**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.

| | | |
|---|---|---|
| **HALEY & ALDRICH** | **TEST BORING REPORT** | **Boring No.** HA08-2<br>File No. 35611-000<br>Sheet No. 2 of 3 |

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | Note: Advanced NW casing to 25.0 ft and wash out with roller bit. Bottom 10.0 ft of casing spun off and could not be retrieved. Relocated boring approximately 5 ft west and resumed sampling at 25.0 ft. | | | | | | | | | | |
| 25 | WOH<br>WOH<br>WOH<br>WOH | S7<br>24 | 25.0<br>27.0 | | CL | Very soft, dark gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet<br>FV1 (25.3-26.0 ft), Su = 610/200 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 30 | | | | | | | | | | | | | | | | |
| 35 | WOR<br>WOH<br>WOH<br>WOH | S8<br>4 | 35.0<br>37.0 | | CL | Medium stiff, gray, lean CLAY (CL), trace gravel, mps 1.0 in., no structure, no odor, wet<br>FV2 (35.3-36.0 ft), Su = 410/120 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 40 | | | | | | | | | | | | | | | | |
| 45 | WOR<br>WOH<br>WOH<br>WOH | S9<br>24 | 45.0<br>47.0 | | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet<br>FV3 (45.3-46.0 ft), Su = 570/160 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |

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

**Boring No.** HA08-2

# HALEY & ALDRICH

# TEST BORING REPORT

Boring No. HA08-2
File No. 35611-000
Sheet No. 3 of 3

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | | | | | | | | | | | |
| 55 | WOR<br>WOR<br>WOR<br>WOR | NR | 55.0<br>57.0 | | | Note: No recovery, gravel in spoon tip.<br>FV4 (55.3-56.0 ft), Su = 490/120 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | | | | | |
| 60 | | | | | | | | | | | | | | | | |
| | | | | 61.0 | | Note: Drill action indicates stratum change at 61.0 ft. Gravel in drill wash water. | | | | | | | | | | |
| 65 | 11<br>16<br>16<br>48/3" | S10<br>17 | 65.0<br>67.0 | | SM | Dense, olive-gray, silty SAND (SM), mps 4.0 mm, bonded, no odor, moist<br>-GLACIAL TILL- | | | 30 | 30 | 25 | 15 | | | | |
| | | | | 66.6 | BR | Note: Recovery from 66.6 to 67.0 ft consists of SCHIST.<br>-WEATHERED BEDROCK- | | | | | | | | | | |
| | | | | 68.7 | | Note: Roller cone refusal. | | | | | | | | | | |

BOTTOM OF EXPLORATION

Notes:
1. FV1 (25.3-26.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.
2. WOR = Weight of Drill Rods; WOH = Weight of Hammer.

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-3

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 2 |
| Start | 24 July 2008 |
| Finish | 24 July 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 11 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | -- |
| Inside Diameter (in.) | 3.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: None
Casing: NW drive to 18.0 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | -Bituminous Concrete- | | | | | | | | | | |
| | 32 17 10 7 | S1 19 | 1.0 3.0 | 1.0 | GW | Medium dense, gray, well-graded gravel with sand (GW), intermixed with 30% concrete fragments, no structure, no odor, moist | 40 | 30 | 15 | 10 | 5 | | | | | |
| | | | | 2.0 | SM | Medium dense, gray, silty SAND (SM), mps 0.25 mm, no structure, no odor, moist | | | 30 | 30 | 25 | 15 | | | | |
| | 5 12 11 8 | S2 20 | 3.0 5.0 | | SM | Medium dense, gray, silty SAND (SM), intermixed with 15% ash and cinders, mps 0.25 in, no structure, no odor, moist -FILL- | | | 30 | 20 | 25 | 15 | | | | |
| 5 | 2 2 1 2 | S3 9 | 5.0 7.0 | 4.5 | SW | Medium dense, red-brown, well-graded SAND (SW), mps 0.5 in., no structure, no odor, moist, sample composed entirely of cinder and ash, trace brick and coal -FILL- | | | 30 | 40 | 30 | | | | | |
| | 9 8 6 3 | S4 4 | 7.0 9.0 | | GP | Medium dense, dark brown, poorly-graded GRAVEL (GP), mps 1-3/8 in., trace cinder, glass and wood fragments -FILL- | 40 | 35 | 10 | 5 | 5 | 5 | | | | |
| 10 | 1 1 2 2 | S5 20 | 10.0 12.0 | 10.0 | SM | Very loose, gray, silty SAND (SM), intermixed with 15% cinders and ash, mps 0.5 in., no structure, no odor, wet, organic silt in tip of spoon -FILL- | | | 30 | 30 | 25 | 15 | | | | |
| | 1 3 3 2 | S6 18 | 12.0 14.0 | 12.0 | ML | Medium stiff, gray, SILT with sand (ML), mps 2.0 mm, some shell fragments, trace organic matter, no structure, hydrogen sulfide odor, moist -HARBOR BOTTOM DEPOSIT- | | | | | 10 | 90 | | | | |
| 15 | WOH WOH 1 2 | S7 16 | 14.0 16.0 | | ML | Very soft, gray, SILT with sand (ML), mps 2.0 mm, some shell fragments, trace organic matter, no structure, hydrogen sulfide odor, moist | | | | | 10 | 90 | | | | |
| | WOH 2 5 7 | S8 21 | 16.0 18.0 | 16.1 | ML | Very soft, gray, SILT with sand (ML), mps 2.0 mm, some shell fragments, trace organic matter, no structure, hydrogen sulfide odor, moist | | | | | 10 | 90 | | | | |
| | | | | | CL | Medium stiff, gray with occasional mottled brown, lean CLAY (CL), mps 2.0 mm, occasional fine sand pockets, trace root fibers, no odor, moist -GLACIOMARINE DEPOSIT- | | | | | 5 | 95 | | | | |
| | | | | 18.0 | | BOTTOM OF EXPLORATION<br>Notes:<br>1. WOH = Weight of Hammer. | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft) to: Bottom of Casing | Bottom of Hole | Water |
|---|---|---|---|---|---|
| 7/24/08 | | 0.25 | 16.0 | 18.0 | 4.0 |
| 7/24/08 | | 0.5 | - | 18.0 | 7.5 |

**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) | 18.0 |
| Rock Cored (ft) | 0 |
| Samples | 8S |

**Boring No.** HA08-3

**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.**

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-4

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 3 |
| Start | 4 August 2008 |
| Finish | 4 August 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 12 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | HW | S | -- |
| Inside Diameter (in.) | 4.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: Bentonite
Casing: HW Drive to 64.4 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | -Bituminous Concrete- | | | | | | | | | | |
| | 15 17 14 11 | S1 23 | 0.5 2.5 | 0.5 | SP-SM | Dense, dark brown, poorly-graded SAND with silt (SP-SM), trace gravel, mps 1-3/8 in., intermixed with 5% cinder, ash, no structure, no odor, moist -FILL- | 5 | | 30 | 40 | 15 | 10 | | | | |
| | 14 12 12 25 | S2 7 | 2.5 4.5 | | SP-SM | Medium dense, dark brown, poorly-graded SAND with silt (SP-SM), trace gravel, mps 1-3/8 in., intermixed with 5% cinder, ash, no structure, no odor, moist | 5 | | 30 | 40 | 15 | 10 | | | | |
| 5 | 8 10 7 8 | S3 24 | 5.0 7.0 | | SM | Medium dense, brown, silty SAND (SM), mps 0.5 in., intermixed with 20% cinder and ash, no structure, no odor, moist -FILL- | | | 30 | 30 | 20 | 20 | | | | |
| | 8 5 3 3 | S4 4 | 7.0 9.0 | | SP-SM | Loose, dark brown, poorly-graded SAND with silt (SP-SM), mps 0.25 in., trace wood, no structure, no odor, moist | | | 35 | 40 | 15 | 10 | | | | |
| 10 | 2 4 4 6 | S5 6 | 9.0 11.0 | | SP-SM | Loose, dark brown, poorly-graded SAND with silt (SP-SM), mps 0.25 in., trace wood, trace shells and glass, no structure, no odor, wet | | | 35 | 40 | 15 | 10 | | | | |
| | 2 3 4 3 | S6 12 | 11.0 13.0 | 11.0 | SM | Loose, gray, silty SAND (SM), trace gravel and roots, mps 0.25 in., no structure, no odor, wet | | 5 | 15 | 30 | 30 | 20 | | | | |
| | WOH 1 3 3 | S7 21 | 13.0 15.0 | 13.0 | ML | Soft, gray, sandy SILT (ML), trace fine gravel, mps 0.25 mm, trace shells, no structure, no odor, wet -HARBOR BOTTOM DEPOSIT- | | 5 | | 15 | 30 | 50 | | | | |
| 15 | 4 12 12 15 | S8 5 | 15.0 17.0 | | ML | Very stiff, gray, sandy SILT (ML), trace fine gravel, mps 0.25 mm, trace shells, no structure, no odor, wet, clay in tip of spoon | | 5 | 10 | 15 | 20 | 50 | | | | |
| | 4 6 10 14 | S9 24 | 17.0 19.0 | 16.9 | CL | Very stiff, gray, silty lean CLAY (CL), mps 2.0 mm., occasional brown mottling, no structure, no odor, moist -GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 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) 66.0
Rock Cored (ft) 0
Samples 17S, 2U

**Boring No.** HA08-4

**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.

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 3 4 4 | S10 24 | 20.0 22.0 | | CL | Medium stiff, gray, silty lean CLAY (CL), mps 2.0 mm, occasional brown mottling, no structure, no odor, moist | | | | | | 100 | N | L | L | |
| | 1 3 3 3 | S11 12 | 22.0 24.0 | | CL | Stiff, gray, silty lean CLAY (CL), mps 2.0 mm, occasional brown mottling, no structure, no odor, moist<br>FV1 (22.3-23.0 ft), Su = 1,045 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 25 | P U S H | U1 23 | 25.0 27.0 | | | | | | | | | | | | | |
| | | | | | | FV2 (27.3-28.0 ft), Su = 590/160 psf | | | | | | | | | | |
| 30 | WOR WOR WOR WOR | S12 22 | 30.0 32.0 | | CL | Medium stiff, dark gray, lean CLAY (CL), trace fine sand and gravel from 31.7 to 32.0 ft., no structure, no odor, wet<br>FV3 (30.3-31.0 ft), Su = 500/90 psf | | | | | 5 | 95 | N | L | L | |
| | P U S H | U2 23 | 33.0 35.0 | | | | | | | | | | | | | |
| 35 | | | | | | FV4 (35.3-36.0 ft), Su = 340/65 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | | | | | |
| 40 | WOR WOR WOR WOR | S13 22 | 40.0 42.0 | | CL | Soft, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet<br>Su = 400/120 psf<br>FV5 (40.3-41.0 ft), Su = 400/120 psf | | | | | | 100 | N | L | L | |
| 45 | WOR WOR WOR WOR | S14 24 | 45.0 47.0 | | CL | Soft, gray, lean CLAY (CL), trace gravel, mps 2.0 mm, no structure, no odor, wet<br>FV6 (45.3-46.0 ft), Su = 420/110 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |

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

HALEY & ALDRICH

# TEST BORING REPORT

Boring No. HA08-4
File No. 35611-000
Sheet No. 3 of 3

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | WOR<br>WOR<br>WOR<br>WOR | S15<br>24 | 50.0<br>52.0 | | CL | Medium stiff, gray, lean CLAY (CL), trace gravel, mps 2.0 mm, no structure, no odor, wet<br>FV7 (50.3-51.0 ft), Su = 610/80 psf | | | | | | 100 | N | L | L | |
| 55 | WOR<br>3<br>3<br>6 | S16<br>24 | 55.0<br>57.0 | 55.4 | SC | Loose, gray, clayey SAND (SC), mps 4.0 mm, no structure, no odor, wet<br>-GLACIOMARINE DEPOSIT- | | | | | 75 | 25 | | | | |
| | | | | 58.8 | | | | | | | | | | | | |
| 60 | 13<br>17<br>24<br>34 | S17<br>24 | 60.0<br>62.0 | | SM | Dense, gray, silty SAND (SM), trace gravel, mps 1-3/8 in., bonded, no odor, moist<br>-GLACIAL TILL-<br><br>Note: Drill action indicates probable bedrock at 64.4 ft. | | 5 | 20 | 30 | 30 | 15 | | | | |
| 65 | | | | 64.4 | | -WEATHERED BEDROCK- | | | | | | | | | | |
| | | | | 66.0 | | Note: Roller bit refusal at 66.0 ft.<br>BOTTOM OF EXPLORATION | | | | | | | | | | |

Notes:
1. FV1 (22.3-23.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.
2. WOR = Weight of Drill Rods; WOH = Weight of Hammer.

# HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-5(OW)

| | | | |
|---|---|---|---|
| Project | Maine Health/United Way Development, Portland, Maine | File No. | 35611-000 |
| Client | Maine Medical Center | Sheet No. | 1 of 4 |
| Contractor | Maine Test Borings, Inc. | Start | 31 July 2008 |
| | | Finish | 1 August 2008 |
| | | Driller | M. Porter |
| | | H&A Rep. | O. Lawlor |
| | | Elevation | 9 +/- |
| | | Datum | Portland City Datum |
| | | Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | NQ |
| Inside Diameter (in.) | 3.0 | 1 3/8 | 2.0 |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: None
Casing: NW drive to 63.8 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Well Diagram | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | 4 9 11 22 | S1 11 | 0.0 2.0 | | | SP | Medium dense, brown, poorly-graded SAND (SP), occasional silt pockets, trace cinder and ash, mps 1.0 in., no structure, no odor, moist -FILL- | | | 30 | 40 | 25 | 5 | | | | |
| | 22 19 13 11 | S2 14 | 2.0 4.0 | | | SW-SM | Dense, brown, well-graded SAND with silt (SW-SM), mps 1-3/8 in., trace cinders and ash | | | 30 | 40 | 20 | 10 | | | | |
| 5 | 6 5 2 3 | S3 8 | 4.0 6.0 | | | SW-SM | Loose, brown, well-graded SAND with silt (SW-SM), mps 1-3/8 in., trace cinders and ash -FILL- | | | 30 | 40 | 20 | 10 | | | | |
| | 2 1 1 6 | S4 5 | 6.0 8.0 | | | SW-SM | Very loose, brown, well-graded SAND with silt (SW-SM), mps 1-3/8 in., trace cinders and ash, wet | | | 30 | 40 | 20 | 10 | | | | |
| | 6 5 2 1 | S5 7 | 8.0 10.0 | | 8.0 | SM | Loose, gray, silty SAND (SM), mps 0.5 in., trace shell and brick fragments, no structure, no odor, moist -FILL- | | | 20 | 30 | 35 | 15 | | | | |
| 10 | 2 2 3 3 | S6 20 | 10.5 12.5 | | 10.5 | OL/OH | Medium stiff, dark gray, ORGANIC SILT (OL/OH), mps 0.25 in., trace shell fragments, no structure, organic odor, moist -HARBOR BOTTOM DEPOSIT- | | | | | | 100 | | | | |
| | 10 11 14 15 | S7 6 | 13.0 15.0 | | 13.0 | CL | Medium stiff, olive-gray, silty lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist, probable rock pushed by spoon | | | | | | 100 | N | L | L | |
| 15 | 3 4 4 5 | S8 20 | 15.0 17.0 | | | CL | Medium stiff, gray with brown mottles, silty lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist -GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 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) 63.8
Rock Cored (ft) 5.0
Samples 13S, 1C

**Boring No.** HA08-5(OW)

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: 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.** HA08-5(OW)
File No. 35611-000
Sheet No. 2 of 4

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Well Diagram | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | | FV1 (20.3-21.0 ft), Su = 720/260 psf | | | | | | | | | | |
| 25 | WOR<br>WOR<br>WOH<br>WOH | S9<br>24 | 25.0<br>27.0 | | | CL | Medium stiff, gray to black, lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist<br>FV2 (25.3-26.0 ft), Su = 720/200 psf | | | | | | 100 | N | M | M | |
| 30 | | | | | | | FV3 (30.3-31.0 ft), Su = 730/170 psf<br><br>-GLACIOMARINE DEPOSIT- | | | | | | | | | | |
| 35 | WOR<br>WOR<br>WOR<br>WOR | S10<br>21 | 35.0<br>37.0 | | | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet<br>FV4 (35.3-36.0 ft), Su = 600/290 psf | | | | | | 100 | N | L | L | |
| 40 | WOR<br>WOR<br>WOR<br>WOR | S11<br>24 | 40.0<br>42.0 | | | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet<br>FV5 (40.3-41.0 ft), Su = 600/190 psf<br><br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 45 | | | | | | | | | | | | | | | | | |

**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. HA08-5(OW)
File No. 35611-000
Sheet No. 3 of 4

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Well Diagram | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | WOR<br>WOR<br>WOR<br>WOR | S12<br>24 | 50.0<br>52.0 | | | CL | Medium stiff, gray, lean CLAY (CL), fine sand in spoon tip, mps 2.0 mm, no structure, no odor, wet<br>FV6 (50.3-51.0 ft), Su = 700/370 psf<br>-GLACIOMARINE DEPOSIT-<br>Note: Sand and fine gravel observed in wash water. | | | | | 5 | 95 | N | L | L | |
| | | | | | 53.0 | | -PROBABLE GLACIAL TILL- | | | | | | | | | | |
| 55 | | | | | | | | | | | | | | | | | |
| 60 | 16<br>9<br>7<br>10 | NR | 60.0<br>62.0 | | | | | | | | | | | | | | |
| | | | | | 62.5 | | Note: Casing refusal at 62.5 ft. Advanced roller bit to 63.8 ft. Begin NQ Rock Core at 63.8 ft. See Core Boring Report for Details. | | | | | | | | | | |
| | 36<br>50/1" | S13<br>5 | 63.2<br>63.7 | | | | Notes:<br>1. FV1 (20.3-21.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.<br>2. WOR = Weight of Drill Rods; WOH = Weight of Hammer. | | | | | | | | | | |
| 65 | | | | | | | | | | | | | | | | | |

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

Boring No. HA08-5(OW)

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# CORE BORING REPORT



| 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* |
| 65 | 6<br>7<br>6 | C1 | 63.8<br>65.4 | 19<br>0 | 99<br>0 | | | Moderately hard, moderate to highly weathered, dark green aphanitic CHLORITE SCHIST. Foliation is extremely thin, vertical. Primary joint set is parallel to foliation, vertical, extremely close, smooth, stepped, fresh to discolored with pyrite, open.<br>Note: RQD affected by extremely close fractures and drill action. |
| | 6<br>7 | C2 | 65.4<br>68.8 | 36<br>12 | 88<br>29 | | 65.4 | Moderately hard, moderate to highly weathered, dark green aphanitic CHLORITE SCHIST. Occasional, very thin, high angle to vertical quartz veins. Primary joint set is parallel to foliation, vertical, extremely close, smooth, stepped, fresh to discolored with pyrite, open. |
| 70 | | | | | | | 68.8 | BOTTOM OF EXPLORATION<br>Note: Observation Well installed in completed borehole. See installation report for details. |
| 75 | | | | | | | | |
| 80 | | | | | | | | |
| 85 | | | | | | | | |
| 90 | | | | | | | | |

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-6

| | | | |
|---|---|---|---|
| Project | Maine Health/United Way Development, Portland, Maine | File No. | 35611-000 |
| Client | Maine Medical Center | Sheet No. | 1 of 1 |
| Contractor | Maine Test Borings, Inc. | Start | 23 July 2008 |
| | | Finish | 24 July 2008 |
| | | Driller | M. Porter |
| | | H&A Rep. | O. Lawlor |
| | | Elevation | 10 +/- |
| | | Datum | Portland City Datum |
| | | Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | -- |
| Inside Diameter (in.) | 3.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

- Rig Make & Model: Mobile Drill B-50 Bombardier
- Bit Type: Roller Bit
- Drill Mud: None
- Casing: NW drive to 12.0 ft.
- Hoist/Hammer: Winch Doughnut Hammer
- PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 5 13 6 | S1 22 | 0.0 2.0 | | SM | Medium dense, brown, silty SAND (SM), mps 1.0 in., no structure, no odor, moist -FILL- | | 5 | 30 | 30 | 20 | 15 | | | | |
| | 13 17 17 18 | S2 21 | 2.0 4.0 | | SM | Dense, gray to brown, silty SAND (SM), mps 1.0 in. trace brick fragments, cinders, wood, no structure, cinder odor, moist | | 5 | 30 | 30 | 20 | 15 | | | | |
| | 5 6 9 10 | S3 20 | 4.0 6.0 | | SM | Medium dense, gray to brown, silty SAND (SM), mps 1.0 in. trace brick fragments, cinders, wood, no structure, cinder odor, moist | | 5 | 30 | 30 | 20 | 15 | | | | |
| 5 | | | | 5.0 | SW | Medium dense, light brown, well-graded SAND (SW), occasional silt pockets, mps 0.5 in., no structure, no odor, moist | | 5 | 30 | 35 | 30 | | | | | |
| | 6 2 2 2 | S4 16 | 6.0 8.0 | | SW | Very loose, brown, well-graded SAND (SW), occasional pockets of dark gray sandy silt, mps 0.25 in., no structure, no odor, moist | | 5 | 30 | 35 | 30 | | | | | |
| | 3 4 3 4 | S5 8 | 8.0 10.0 | | SM | Loose, dark brown, silty SAND with gravel (SM), mps 1.0 in., no structure, no odor, wet -FILL- | 5 | 5 | 20 | 25 | 25 | 20 | | | | |
| 10 | 5 4 7 5 | S6 2 | 10.0 12.0 | | SM | Medium dense, dark brown, silty SAND with gravel (SM), mps 1.0 in., no structure, no odor, wet, trace brick and shell fragments | 5 | 5 | 20 | 25 | 25 | 20 | | | | |
| | 4 2 2 5 | S7 14 | 12.0 14.0 | 12.3 | SM | Loose, dark brown, silty SAND with gravel (SM), mps 1.0 in., no structure, no odor, wet, trace brick and shell fragments | 5 | 5 | 20 | 25 | 25 | 20 | | | | |
| | | | | | ML | Soft, gray, sandy SILT (ML), little shell fragments, trace clay, frequent partings along fine sand seams, no odor, moist -HARBOR BOTTOM DEPOSIT- | | | | | 5 | 95 | | | | |
| | | | | 14.0 | | BOTTOM OF EXPLORATION | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft) to: Bottom of Casing | Depth (ft) to: Bottom of Hole | Depth (ft) to: Water |
|---|---|---|---|---|---|
| N/A | | | | | |

**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) 14.0
- Rock Cored (ft) 0
- Samples 7S

**Boring No.** HA08-6

**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.

**HALEY & ALDRICH**

# TEST BORING REPORT

**Boring No. HA08-7(OW)**

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 4 |
| Start | 30 July 2008 |
| Finish | 31 July 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 12 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel | Drilling Equipment and Procedures |
|---|---|---|---|---|
| Type | NW | S | NQ | Rig Make & Model: Mobile Drill B-50 Bombardier |
| Inside Diameter (in.) | 3.0 | 1 3/8 | 2.0 | Bit Type: Roller Bit<br>Drill Mud: None |
| Hammer Weight (lb) | 300 | 140 | - | Casing: NW drive to 62.0 ft. |
| Hammer Fall (in.) | 30 | 30 | - | Hoist/Hammer: Winch Doughnut Hammer<br>PID Make & Model: |

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Well Diagram | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | 6<br>12<br>13<br>12 | S1<br>15 | 0.0<br>2.0 | | | SW-SM | Medium dense, dark brown, well-graded SAND with silt (SW-SM), mps 0.25 in., intermixed with 10% ash and brick, trace wood, no structure, no odor, moist<br>-FILL- | | | 30 | 40 | 20 | 10 | | | | |
| | 6<br>12<br>21<br>25 | S2<br>16 | 2.0<br>4.0 | | | SW-SM | Dense, dark brown, well-graded SAND with silt (SW-SM), mps 0.25 in., intermixed with 10% ash and brick, trace wood, occasional sandy silt pockets, no structure, no odor, moist | | | 30 | 40 | 20 | 10 | | | | |
| 5 | 5<br>7<br>12<br>9 | S3<br>24 | 4.0<br>6.0 | | | SM | Medium dense, brown, silty SAND (SM), mps 0.25 in., intermixed with 15% cinder and ash fragments, no structure, no odor, moist<br>-FILL- | | | 20 | 30 | 30 | 20 | | | | |
| | 3<br>4<br>5<br>2 | S4<br>24 | 6.0<br>8.0 | | 6.2 | SM | Loose, brown, silty SAND (SM), mps 0.25 in., intermixed with 15% cinder and ash fragments, no structure, no odor, moist | | | 20 | 30 | 30 | 20 | | | | |
| | | | | | | SM | Loose, gray, silty SAND (SM), mps 4.0 mm, no structure, no odor, wet | | | 20 | 30 | 25 | 25 | | | | |
| | 7<br>15<br>14<br>10 | S5<br>20 | 8.0<br>10.0 | | 8.0 | SW | Medium dense, light brown, well-graded SAND (SW), mps 1-3/8 in., no structure, no odor, wet<br>-FILL- | | | 35 | 30 | 30 | | | | | |
| 10 | 3<br>2<br>2<br>2 | S6<br>10 | 10.0<br>12.0 | | 10.0 | SM | Very loose, gray, silty SAND (SM), trace clay, mps 4.0 mm, no structure, no odor, wet<br>-FILL- | | | 20 | 30 | 30 | 20 | | | | |
| | 1<br>1<br>2<br>1 | S7<br>17 | 12.0<br>14.0 | | | SM | Very loose, gray, silty SAND (SM), trace clay, mps 4.0 mm, no structure, no odor, wet | | | 20 | 30 | 30 | 20 | | | | |
| | | | | | 12.5 | OL/OH | Soft, dark brown, ORGANIC SILT (OL/OH), trace sand and shells, mps 2.0 mm, no structure, organic odor, wet<br>-HARBOR BOTTOM DEPOSIT- | | | | | 5 | 95 | | | | |
| 15 | 4<br>4<br>4<br>7 | NR | 14.0<br>16.0 | | 14.0 | | Note: No recovery, probable gravel pushed by spoon through clay. | | | | | | | | | | |
| | 2<br>3<br>4<br>7 | S8<br>24 | 16.0<br>18.0 | | | CL | Medium stiff, mottled olive-gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | | | | |
| 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) | 62.0 |
| Rock Cored (ft) | 10.0 |
| Samples | 14S, 2C |

**Boring No. HA08-7(OW)**

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



| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Well Diagram | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | WOR<br>WOH<br>WOH<br>WOH | S9<br>24 | 20.0<br>22.0 | | | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist<br>FV1 (20.3-21.0 ft), Su = 830/320 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 25 | | | | | | | FV2 (25.3-26.0 ft), Su = 730/170 psf | | | | | | | | | | |
| 30 | WOH<br>WOH<br>WOH<br>WOR | S10<br>24 | 30.0<br>32.0 | | | CL | Medium stiff, gray, lean CLAY (CL), occasional partings along fine sand seams, no odor, moist<br>FV3 (30.3-31.0 ft), Su = 680/280 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 35 | | | | | | | FV4 (35.3-36.0 ft), Su = 870/210 psf | | | | | | | | | | |
| | | | | | 38.0 | | | | | | | | | | | | |
| 40 | 5<br>5<br>9<br>19 | S11<br>2 | 40.0<br>42.0 | | | SM | Medium dense, gray, silty SAND with gravel (SM), mps 1-3/8 in., well bonded, no odor, wet<br>-GLACIAL TILL- | 5 | | 15 | 30 | 30 | 20 | | | | |
| 45 | 12<br>8<br>9<br>10 | S12<br>21 | 45.0<br>47.0 | | | SM | Medium dense, gray, silty SAND with gravel (SM), mps 1-3/8 in., well bonded, no odor, wet<br>-GLACIAL TILL- | 5 | 5 | 15 | 25 | 30 | 20 | | | | |



H&A-TEST BORING-07-1 HA-LIB07-1R-POR-06-03-08.GLB HA-TB+CORE+WELL-07-1.GDT G:\PROJECTS\35611\FIELD PROGRAM\35611-000 TB.GPJ 10 Sep 08

# HALEY & ALDRICH

# TEST BORING REPORT

Boring No. HA08-7(OW)
File No. 35611-000
Sheet No. 3 of 4

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Well Diagram | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | | Note: Drilled through cobble from 50.1 to 50.5 ft. | | | | | | | | | | |
| | 8<br>6<br>9<br>16 | S13<br>22 | 50.5<br>52.5 | | | | Medium dense, silty SAND with gravel (SM), mps 1-3/8 in., well bonded, no odor, wet<br>-GLACIAL TILL- | 5 | 5 | 30 | 25 | 20 | 15 | | | | |
| 55 | | | | | | | | | | | | | | | | | |
| 60 | 40<br>75<br>125<br>50/1" | S14<br>12 | 60.0<br>61.6 | | 60.1 | | Very dense, silty SAND with gravel (SM), mps 1-3/8 in., well bonded, no odor, wet, 1/2 to 1-3/8 in. fragments of weathered CHLORITE SCHIST<br>-WEATHERED BEDROCK- | 5 | 5 | 15 | 25 | 35 | 15 | | | | |
| | | | | | 61.6 | | Note: Bedrock encountered at 61.6 ft. Advanced roller bit to 62.0 ft. Begin NQ rock core at 62.0 ft. See Core Boring Report for details.<br><br>Notes:<br>1. FV1 (20.3-21.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.<br>2. WOR = Weight of Drill Rods; WOH = Weight of Hammer. | | | | | | | | | | |
| 65 | | | | | | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | | | | | | |

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



H&A-TEST BORING-07-1 HA-LIB07-1R-POR-06-03-08.GLB HA-TB+CORE+WELL-07-1.GDT G:\PROJECTS\35611\FIELD PROGRAM\35611-000 TB.GPJ 10 Sep 08

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# CORE BORING REPORT

**Boring No. HA08-7(OW)**
File No. 35611-000
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* |
| | 2 | C1 | 62.0<br>67.0 | 36<br>6 | 60<br>10 | | | Moderately hard, moderate to highly weathered, dark gray, aphanitic SILTSTONE. Foliation is extremely thin, high angle to vertical. Primary joint set is parallel to foliation, high angle to vertical, close to extremely close, rough, stepped to undulating, fresh to discolored with pyrite, tight. |
| | 2 | | | | | | | |
| | 2 | | | | | | | |
| 65 | 2 | | | | | | | |
| | 2 | | | | | | | |
| | 2 | C2 | 67.0<br>72.0 | 24<br>0 | 40<br>0 | | 67.0 | Note: Recovery consists of 1.0 to 3.0 in. pieces and fragments of hard, dark gray, slightly weathered, aphanitic SILTSTONE, due to extremely close fracture spacings and drill action. |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| 70 | 3 | | | | | | | |
| | 3 | | | | | | | Note: Advanced roller bit to 70.6 ft. to flush unrecovered rock fragments. Borehole caved to 65.0 ft after removal of drill rods. |
| | 2 | | | | | | 72.0 | BOTTOM OF EXPLORATION<br><br>Note: Observation well installed in completed borehole. See installation report for details. |
| 75 | | | | | | | | |
| 80 | | | | | | | | |
| 85 | | | | | | | | |
| 90 | | | | | | | | |

| HALEY & ALDRICH | TEST BORING REPORT | Boring No. HA08-8 |
|---|---|---|

Project: Maine Health/United Way Development, Portland, Maine
Client: Maine Medical Center
Contractor: Maine Test Borings, Inc.

File No. 35611-000
Sheet No. 1 of 3
Start: 6 August 2008
Finish: 7 August 2008
Driller: M. Porter
H&A Rep. O. Lawlor
Elevation: 9 +/-
Datum: Portland City Datum
Location: See Plan

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | HW | S | -- |
| Inside Diameter (in.) | 4.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**
Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: Bentonite
Casing: HW Drive to 50.5 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 10 13 14 | S1 5 | 0.0 2.0 | 0.2 | SW | -TOPSOIL- Medium dense, light brown, well-graded SAND with gravel (SW), mps 0.25 in., no structure, no odor, moist | 5 | 5 | 30 | 40 | 20 | | | | | |
| | 11 14 26 29 | S2 16 | 2.0 4.0 | 2.0 | SM | Dense, gray-green, silty SAND with gravel (SM), mps 1 3/8 in., no structure, no odor, moist, reworked till -FILL- NOTE: Augered through cobble from 4.0 - 4.7 ft. | 5 | 5 | 25 | 25 | 25 | 15 | | | | |
| 5 | 1 1 1 3 | S3 20 | 5.0 7.0 | | SM | Very loose, gray-green, silty SAND with gravel (SM), mps 1 3/8 in., no structure, no odor, moist, reworked till -FILL- | 5 | 5 | 25 | 25 | 25 | 15 | | | | |
| | 2 2 4 3 | S4 19 | 7.0 9.0 | | SM | Loose, gray-green, silty SAND with gravel (SM), mps 1 3/8 in., no structure, no odor, moist, reworked till -FILL- | 5 | 5 | 25 | 25 | 25 | 15 | | | | |
| 10 | 3 1 1 1 | S5 13 | 9.0 11.0 | 9.5 | OL/OH | Very soft, dark gray, ORGANIC SILT (OL/OH), trace sand, glass and shell fragments, mps 4.0 mm, no structure, no odor, wet -HARBOR BOTTOM DEPOSIT- | | | | | 5 | 95 | | | | |
| | 6 13 4 6 | S6 19 | 12.0 14.0 | | OL/OH | Medium dense, dark gray, ORGANIC SILT (OL/OH), trace sand, glass and shell fragments, mps 4.0 mm, no structure, no odor, wet | | | | | 5 | 95 | | | | |
| 15 | 2 3 4 7 | S7 24 | 14.0 16.0 | 13.8 | CL | Medium stiff, olive-gray, silty lean CLAY (CL), trace gravel, occasional brown mottles, mps 0.25 in., no structure, no odor, moist -GLACIOMARINE DEPOSIT- | | 5 | | | | 95 | N | L | L | |
| | WOR WOH WOH WOH | S8 24 | 16.0 18.0 | | CL | Soft, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet FV1 (18.3-19.0 ft), Su = 460/70 psf -GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 20 | | | | | | | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft) to: Bottom of Casing | Bottom of Hole | Water |
|---|---|---|---|---|---|
| 8/7/08 | | | - | 50.5 | 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) 50.5
Rock Cored (ft) 0
Samples 13S, 2U
**Boring No.** HA08-8

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: 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-07-1 HA-LIB07-1R-POR-06-03-08.GLB HA-TB+CORE+WELL-07-1.GDT G:\PROJECTS\35611\FIELD PROGRAM\35611-000 TB.GPJ 10 Sep 08

HALEY & ALDRICH

# TEST BORING REPORT



| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | PUSH | U1 18 | 20.0 22.0 | | | | | | | | | | | | | |
| | | | | | | FV2 (22.3-23.0 ft), Su = 610/50 psf | | | | | | | | | | |
| 25 | WOR WOH WOH WOH | S9 24 | 25.0 27.0 | | CL | Very soft, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet -GLACIOMARINE DEPOSIT- | | | | | | 100 | | | | |
| 30 | WOR WOR 1 WOH | S10 24 | 30.0 32.0 | | CL | Soft, gray, lean CLAY (CL), mps 2.0 mm FV3 (30.3-31.0 ft), Su = 380/120 psf -GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 35 | WOR WOR WOR WOR | S11 24 | 35.0 37.0 | | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm FV4 (35.3-36.0 ft), Su = 780/150 psf -GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| | | | | | | FV5 (39.3-40.0 ft), Su = 1,030/80 psf | | | | | | | | | | |
| 40 | PUSH | U2 24 | 41.0 43.0 | | | | | | | | | | | | | |
| | 2 6 6 7 | S12 18 | 43.0 45.0 | 43.0 | SP | Medium dense, gray, poorly-graded SAND (SP), trace gravel, mps 0.5 in., no structure, no odor, wet -GLACIOMARINE DEPOSIT- | 5 | | 20 | 30 | 45 | | | | | |
| 45 | | | | | | | | | | | | | | | | |
| | | | | | | Note: Casing refusal on probable bedrock at 48.6 ft. | | | | | | | | | | |
| | | | | 48.6 | | -WEATHERED BEDROCK- | | | | | | | | | | |

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

# HALEY & ALDRICH

# TEST BORING REPORT

Boring No. HA08-8
File No. 35611-000
Sheet No. 3 of 3

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | | | | | | | | | | | |
| | 100/1" | S13<br>4 | 50.2<br>50.5 | 50.5 | | Weathered Rock fragments<br>-WEATHERED BEDROCK-<br>Note: Split spoon refusal | | | | | | | | | | |

BOTTOM OF EXPLORATION

Notes:
1. FV1 (22.3-23.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.
2. WOR = Weight of Drill Rods; WOH = Weight of Hammer.

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

Boring No. HA08-8

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-9

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 1 |
| Start | 24 July 2008 |
| Finish | 24 July 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 11 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | -- |
| Inside Diameter (in.) | 3.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: None
Casing: NW drive to 16.0 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 3 5 6 | S1 3 | 0.0 2.0 | | GM | Loose, gray-brown, silty GRAVEL with sand (GM), mps 0.5 in., no structure, organic odor, wet -FILL- | 15 | 45 | 10 | 10 | 5 | 15 | | | | |
| | 4 6 9 11 | S2 22 | 2.0 4.0 | 2.0 | | Note: Sample composed of cinder and ash from 2.0 to 3.0 ft. | | | | | | | | | | |
| | | | | 3.0 | SM | Medium dense, gray, silty SAND (SM), trace gravel, mps 0.25 in., no structure, no odor | | 5 | 30 | 30 | 20 | 15 | | | | |
| 5 | 1 3 3 3 | S3 22 | 4.0 6.0 | | SM | Loose, gray, silty SAND (SM), mps 0.25 in., no structure, no odor, moist -FILL- | | | 10 | 30 | 30 | 30 | | | | |
| | 1 2 3 3 | S4 16 | 6.0 8.0 | | SM | Loose, gray, silty SAND (SM) with gravel, mps 0.25 in., no structure, no odor, moist<br>Note: Groundwater encountered at 7.1 ft. | 5 | 5 | 15 | 30 | 15 | 30 | | | | |
| | WOH 3 6 11 | S5 10 | 8.0 10.0 | | SM | Loose, gray, silty SAND (SM) with gravel, mps 0.25 in., no structure, no odor, moist -FILL- | 5 | 5 | 15 | 30 | 15 | 30 | | | | |
| 10 | 4 5 3 2 | S6 8 | 10.0 12.0 | | SM | Loose, gray, silty SAND (SM) with gravel, mps 0.25 in., no structure, no odor, moist, trace wood and glass fragments | 5 | 5 | 20 | 30 | 25 | 15 | | | | |
| | 2 3 4 5 | S7 2 | 12.0 14.0 | 12.0 | ML | Medium stiff, dark gray, SILT (ML), trace wood, mps 2.0 mm, no structure, organic odor, wet -HARBOR BOTTOM DEPOSIT- | | | | | 5 | 95 | | | | |
| 15 | 5 4 6 5 | S8 20 | 14.0 16.0 | 14.0 | CL | Stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist -GLACIOMARINE DEPOSIT- | | | | | | 100 | | | | |
| | | | | 16.0 | | BOTTOM OF EXPLORATION<br>Note:<br>1. WOH = Weight of Hammer. | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft) to: Bottom of Casing | Bottom of Hole | Water |
|---|---|---|---|---|---|
| 7/24/08 | 1315 | 0.25 | 14.0 | 16.0 | 3.7 |

**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 |
| Samples | 8S |

**Boring No.** HA08-9

**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.

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-10

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 3 |
| Start | 7 August 2008 |
| Finish | 7 August 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 9 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | HW | S | -- |
| Inside Diameter (in.) | 4.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: Bentonite
Casing: HW drive to 49.5 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 8 17 21 | S1 20 | 0.0 2.0 | | ML | Medium dense, olive-gray, sandy SILT (ML), trace gravel and brick, mps 0.25 in., bonded, no odor, moist - till fill -FILL- | | 5 | 10 | 15 | 20 | 50 | | | | |
| | 17 15 14 12 | S2 23 | 2.0 4.0 | 2.0 | SM | Medium dense, olive-gray, silty SAND (SM), trace gravel, mps 0.25 in., no structure, no odor, moist -FILL- | | 5 | 15 | 30 | 30 | 20 | | | | |
| 5 | 2 2 3 3 | S3 19 | 4.0 6.0 | | SM | Loose, olive-gray, silty SAND (SM), trace gravel, mps 0.25 in., no structure, no odor, wet -FILL- | | 5 | 15 | 30 | 30 | 20 | | | | |
| | 3 5 8 15 | S4 12 | 6.0 8.0 | | SM | Medium dense, olive-gray, silty SAND (SM), trace gravel, mps 0.25 in., no structure, no odor, wet -FILL- NOTE: Wood in spoon tip with creosote-like odor. | | 5 | 15 | 30 | 30 | 20 | | | | |
| | 8 6 6 3 | S5 7 | 8.0 10.0 | 8.0 | OL/OH | Medium dense, dark gray to black, sandy ORGANIC SILT (OL/OH), trace brick and metal -HARBOR BOTTOM DEPOSIT- | | | 10 | 10 | 10 | 70 | | | | |
| 10 | 1 2 2 2 | S6 24 | 10.0 12.0 | | OL/OH | Soft, dark gray to black, sandy ORGANIC SILT (OL/OH), trace shells -HARBOR BOTTOM DEPOSIT- | | | | | | 100 | N | L | L | |
| | 2 3 3 4 | S7 15 | 12.0 14.0 | 11.3 | CL | Medium stiff, gray, silty lean CLAY (CL), trace sand, mps 4.0 mm, no structure, no odor, moist -GLACIOMARINE DEPOSIT- | | | | | 5 | 95 | N | L | L | |
| 15 | | | | | | | | | | | | | | | | |
| | WOR WOR | S8 24 | 19.0 21.0 | | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, wet | | | | | | 100 | N | L | L | |
| 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) 49.5
Rock Cored (ft) 0
Samples 12S, 1U

**Boring No.** HA08-10

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: 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-07-1 HA-LIB07-1R-POR-06-03-08.GLB HA-TB+CORE+WELL-07-1.GDT G:\PROJECTS\35611\FIELD PROGRAM\35611-000 TB.GPJ 10 Sep 08

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-10
File No. 35611-000


| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | WOH WOH | | | | | FV1 (19.3-20.0 ft), Su = 520/110 psf<br>-GLACIOMARINE DEPOSIT- | | | | | | | | | | |
| | | | | | | FV2 (23.3-24.0 ft), Su = 730/130 psf | | | | | | | | | | |
| | | | | | | Note: Wood fibers observed in wash water from 24.5 to 25.0 ft. | | | | | | | | | | |
| 25 | P U S H | U1 22 | 25.0 27.0 | | | | | | | | | | | | | |
| | | | | | | FV3 (27.3-28.0 ft), Su = 400/90 psf | | | | | | | | | | |
| 30 | WOR WOR WOR WOR | S9 24 | 30.0 32.0 | | CL | Very soft, gray, lean CLAY (CL), mps 2.0 mm, occasional fine sand partings, no odor, wet<br>FV4 (30.0-31.0 ft), Su = 220/70 psf<br>-GLACIOMARINE DEPOSIT- | | | | | 5 | 95 | N | L | L | |
| 35 | WOR WOR 3 2 | S10 24 | 35.0 37.0 | 35.2 | CL | Very soft, gray, lean CLAY (CL), mps 2.0 mm, occasional fine sand partings, no odor, wet | | | | | 5 | 95 | N | L | L | |
| | | | | | SM | Loose, gray, silty SAND (SM), mps 4.0 mm, no structure, no odor, wet<br>-GLACIOMARINE DEPOSIT- | | | 5 | 10 | 70 | 15 | | | | |
| 40 | 5 2 7 7 | S11 6 | 40.5 42.5 | | SW-SM | Loose, gray, well graded SAND with silt (SW-SM), mps 0.25 in., no structure, no odor, wet<br>-GLACIOMARINE DEPOSIT- | 5 | 5 | 25 | 25 | 30 | 10 | | | | |
| 45 | 9 9 5 6 | S12 6 | 45.5 47.5 | 45.5 | SP-SM | Medium dense, gray, poorly graded SAND with silt (SP-SM), mps 0.25 in., no structure, no odor, wet, schist fragment in tip of spoon<br>-GLACIAL TILL- | 5 | 5 | 5 | 25 | 50 | 10 | | | | |
| | | | | 47.5 | BR | -WEATHERED BEDROCK- | | | | | | | | | | |
| | | | | 49.5 | | | | | | | | | | | | |

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

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Note: Roller cone refusal. | | | | | | | | | | |
| | | | | | | BOTTOM OF EXPLORATION | | | | | | | | | | |

Notes:
1. FV1 (19.3-20.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.
2. WOR = Weight of Drill Rods; WOH = Weight of Hammer.

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

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-11

| | | | |
|---|---|---|---|
| Project | Maine Health/United Way Development, Portland, Maine | File No. | 35611-000 |
| Client | Maine Medical Center | Sheet No. | 1 of 3 |
| Contractor | Maine Test Borings, Inc. | Start | 28 July 2008 |
| | | Finish | 29 July 2008 |
| | | Driller | M. Porter |
| | | H&A Rep. | O. Lawlor |
| | | Elevation | 11 +/- |
| | | Datum | Portland City Datum |
| | | Location | See Plan |

| | Casing | Sampler | Barrel | Drilling Equipment and Procedures |
|---|---|---|---|---|
| Type | NW | S | -- | Rig Make & Model: Mobile Drill B-50 Bombardier |
| Inside Diameter (in.) | 3.0 | 1 3/8 | -- | Bit Type: Roller Bit<br>Drill Mud: None |
| Hammer Weight (lb) | 300 | 140 | - | Casing: NW drive to 55.0 ft. |
| Hammer Fall (in.) | 30 | 30 | - | Hoist/Hammer: Winch Doughnut Hammer<br>PID Make & Model: |

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | 3<br>10<br>13<br>10 | S1<br>22 | 0.0<br>2.0 | | SM | Medium dense, brown, silty SAND with gravel (SM), mps 0.75 in., intermixed with 10% brick, cinders, and plastics fragments, no structure, no odor, moist<br>-FILL- | 5 | 5 | 25 | 30 | 20 | 15 | | | | |
| | 16<br>34<br>29<br>29 | S2<br>24 | 2.0<br>4.0 | | SM | Very dense, creosote colored, silty SAND with gravel (SM), mps 0.75 in., intermixed with 30% wood, brick, and cinders, no structure, no odor, moist | 5 | 5 | 25 | 30 | 20 | 15 | | | | |
| | 12<br>20<br>18<br>13 | S3<br>24 | 4.0<br>6.0 | 4.1 | SM | Very dense, creosote colored, silty SAND with gravel (SM), mps 0.75 in., intermixed with 30% wood, brick, and cinders, no structure, no odor, moist | 5 | 5 | 25 | 30 | 20 | 15 | | | | |
| 5 | | | | | SW | Dense, light brown, well-graded, SAND (SW), mps 4.0 mm, no structure, no odor, moist | | | 25 | 30 | 45 | | | | | |
| | 7<br>7<br>6<br>7 | S4<br>16 | 6.0<br>8.0 | | SW | Medium dense, gray-brown, well-graded SAND (SW), mps 0.25 in., no structure, no odor, wet | | | 30 | 35 | 35 | | | | | |
| | 7<br>11<br>18<br>11 | S5<br>18 | 8.0<br>10.0 | | SW | Medium dense, gray, well-graded SAND (SW), mps 0.25 in., no structure, no odor, wet<br>-FILL- | | | 35 | 30 | 30 | | | | | |
| 10 | 2<br>4<br>6<br>2 | S6<br>13 | 10.0<br>12.0 | | SW | Loose, gray, well-graded SAND (SW), mps 0.25 in., occasional silt pockets, material appears reworked, no structure, no odor, wet<br>Note: Organics observed in wash water from 12.0 to 12.5 ft. | | | 30 | 30 | 30 | 10 | | | | |
| | 2<br>3<br>3<br>4 | S7<br>24 | 12.5<br>14.5 | 12.5 | SM | Loose, gray, silty SAND (SM), mps 0.25 in., some shell fragments, no structure, no odor, wet<br>-HARBOR BOTTOM DEPOSIT- | | | 10 | 10 | 55 | 25 | | | | |
| | | | | 14.2 | CL | Medium stiff, gray, silty lean CLAY (CL), mps 4.0 mm, no structure, no odor, wet with occasional brown mottles | | | | | | 100 | | | | |
| 15 | 1<br>2<br>2<br>2 | S8<br>24 | 15.0<br>17.0 | | CL | Soft, gray, lean CLAY (CL), mps 4.0 mm, frequent partings along fine sand seams, no odor, moist<br>-GLACIOMARINE DEPOSIT- | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | |

| 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<br>T - Thin Wall Tube<br>U - Undisturbed Sample<br>S - Split Spoon Sample | Riser Pipe<br>Screen<br>Filter Sand<br>Cuttings<br>Grout<br>Concrete<br>Bentonite Seal | Overburden (ft) 55.0<br>Rock Cored (ft) 0<br>Samples 12S |

**Boring No.** HA08-11

**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.

# HALEY & ALDRICH

# TEST BORING REPORT

Boring No. HA08-11
File No. 35611-000
Sheet No. 2 of 3

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | | | | | | | | | | | | | | | | |
| 25 | WOR<br>WOH<br>WOH<br>WOH | S9<br>24 | 25.0<br>27.0 | | CL | Medium stiff, gray, silty lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist<br>FV1 (25.3-26.0 ft), Su = 720/170 psf<br><br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | N | |
| 30 | | | | | | | | | | | | | | | | |
| | | | | 34.0 | | Note: Drill action indicates probable gravel from 34.0 to 35.0 ft. Fine gravel observed in wash water. | | | | | | | | | | |
| 35 | 2<br>3<br>2<br>2 | S10<br>19 | 35.0<br>37.0 | | SP-SM | Loose, gray, poorly-graded SAND with silt (SP-SM), trace gravel, mps 0.25 in., no structure, no odor, wet<br><br>-GLACIOMARINE DEPOSIT- | | 5 | | 5 | 80 | 10 | | | | |
| 40 | 8<br>11<br>10<br>19 | S11<br>4 | 40.0<br>42.0 | | SP-SM | Medium dense, gray, poorly-graded SAND with silt (SP-SM), trace gravel, mps 1-3/8 in., no structure, no odor, wet<br><br>-GLACIOMARINE DEPOSIT- | 5 | | | 5 | 80 | 10 | | | | |
| 45 | | | | | | | | | | | | | | | | |

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

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 10 12 19 13 | S12 9 | 50.0 52.0 | | SM | Dense, gray, silty SAND (SM), trace gravel, mps 0.5 in., bonded, no odor, wet<br>GLACIAL TILL-<br>Note: Drill action indicates probable bedrock at 52.5 ft. | | 5 | 10 | 10 | 60 | 15 | | | | |
| | | | | 52.5 | | -WEATHERED BEDROCK- | | | | | | | | | | |
| 55 | | | | 55.0 | | Note: Casing refusal at 53.4 ft. Roller bit refusal at 55 ft. | | | | | | | | | | |

BOTTOM OF EXPLORATION

Notes:
1. FV1 (25.3-26.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.
2. WOR = Weight of Drill Rods; WOH = Weight of Hammer.

HALEY & ALDRICH

# TEST BORING REPORT

**Boring No.** HA08-12(OW)

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 1 |
| Start | 24 July 2008 |
| Finish | 24 July 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 11 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | -- |
| Inside Diameter (in.) | 3.0 | 1 3/8 | -- |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: None
Casing: NW drive to 16.0 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Well Diagram | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | 4 10 7 7 | S1 17 | 0.0 2.0 | | | SM | Medium dense, gray, silty SAND with gravel (SM), trace cinders, mps 0.5 in., no structure, no odor, moist -FILL- | 5 | 5 | 10 | 25 | 35 | 20 | | | | |
| | 5 11 15 9 | S2 21 | 2.0 4.0 | | | SM | Medium dense, gray, silty SAND with gravel (SM), intermixed with 15% cinders, mps 0.5 in., no structure, no odor, moist | 5 | 5 | 5 | 25 | 40 | 20 | | | | |
| 5 | 3 6 10 12 | S3 18 | 4.0 6.0 | | 5.0 | SM | Medium dense, gray, silty SAND with gravel (SM), intermixed with 15% cinders, mps 0.5 in., no structure, no odor, moist | 5 | 5 | 20 | 20 | 20 | 30 | | | | |
| | | | | | | SW | Note: Groundwater encountered at 5.4 ft. Medium dense, light brown, well-graded SAND (SW), mps 0.25 in., no structure, no odor, moist | | | 30 | 40 | 30 | | | | | |
| | 7 11 12 11 | S4 20 | 6.0 8.0 | | | SW | Medium dense, light brown, well-graded SAND (SW), with occasional pockets of fine sand, mps 0.25 in., no structure, no odor, moist | | | 30 | 40 | 30 | | | | | |
| | 7 7 15 15 | S5 22 | 8.0 10.0 | | | SW | Medium dense, gray, well-graded SAND (SW), mps 0.25 in., no structure, no odor, wet -FILL- | | | 35 | 35 | 30 | | | | | |
| 10 | 4 4 3 2 | S6 17 | 10.0 12.0 | | | SW | Loose, gray, well-graded SAND (SW), mps 0.25 in., no structure, no odor, wet | | | 35 | 35 | 30 | | | | | |
| | 3 4 4 3 | NR | 12.0 14.0 | | 11.6 | ML | Medium stiff, dark gray, SILT with sand (ML), mps 4.0 mm, no structure, no odor, moist Note: No Recovery. Probable shells in spoon tip, shells observed in wash water. -HARBOR BOTTOM DEPOSIT- | | | | 5 | 5 | 90 | | | | |
| 15 | 1 3 3 3 | S7 21 | 14.0 16.0 | | 14.0 | CL | Medium stiff, gray with occasional brown mottling, lean CLAY (CL), trace root fibers, mps 2.0 mm, no structure, no odor, moist -GLACIOMARINE DEPOSIT- | | | | | | 100 | | | | |
| | | | | | 16.0 | | BOTTOM OF EXPLORATION Note: Observation well installed in completed borehole. See Well Installation Report for details. | | | | | | | | | | |

**Water Level Data**

| Date | Time | Elapsed Time (hr.) | Depth (ft) to: Bottom of Casing | Bottom of Hole | Water |
|---|---|---|---|---|---|
| 7/24/08 | | 0.25 | 14.0 | 16.0 | 7.62 |

**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 |
| Samples | 7S |

**Boring No.** HA08-12(OW)

**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.** HA08-13

| | |
|---|---|
| Project | Maine Health/United Way Development, Portland, Maine |
| Client | Maine Medical Center |
| Contractor | Maine Test Borings, Inc. |

| | |
|---|---|
| File No. | 35611-000 |
| Sheet No. | 1 of 3 |
| Start | 29 July 2008 |
| Finish | 29 July 2008 |
| Driller | M. Porter |
| H&A Rep. | O. Lawlor |
| Elevation | 9 +/- |
| Datum | Portland City Datum |
| Location | See Plan |

| | Casing | Sampler | Barrel |
|---|---|---|---|
| Type | NW | S | NQ |
| Inside Diameter (in.) | 3.0 | 1 3/8 | 2.0 |
| Hammer Weight (lb) | 300 | 140 | - |
| Hammer Fall (in.) | 30 | 30 | - |

**Drilling Equipment and Procedures**

Rig Make & Model: Mobile Drill B-50 Bombardier
Bit Type: Roller Bit
Drill Mud: None
Casing: NW drive to 46.6 ft.
Hoist/Hammer: Winch Doughnut Hammer
PID Make & Model:

| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3 7 11 11 | S1 20 | 0.0 2.0 | | SP-SM | Medium dense, dark brown, poorly-graded SAND with silt (SP-SM), mps 1.0 in., intermixed with 10% cinders -FILL- | | | 30 | 40 | 20 | 10 | | | | |
| | 14 11 10 8 | S2 6 | 2.0 4.0 | | SP | Medium dense, brown, poorly-graded SAND (SP), occasional silt pockets, mps 1-3/8 in., intermixed with 30% cinder and ash fragments | | | 30 | 40 | 20 | 10 | | | | |
| 5 | 2 2 2 1 | S3 8 | 4.0 6.0 | | SP | Very loose, brown, poorly-graded SAND (SP), mps 1-3/8 in., intermixed with 30% cinder and ash fragments -FILL- | | 5 | 30 | 40 | 25 | | | | | |
| | 1 4 3 3 | S4 6 | 6.0 8.0 | 6.0 | GW | Loose, brown to red-brown, well-graded GRAVEL (GW), mps 1-3/8 in., intermixed with 10% wood and glass fragments, no structure, no odor, wet | 30 | 35 | 10 | 10 | 10 | | | | | |
| | 5 3 1 1 | S5 12 | 8.0 10.0 | | GP | Very loose, gray, brown, poorly-graded GRAVEL (GP), mps 1.0 in., trace glass and wood, no structure, no odor, wet -FILL- | 30 | 40 | 10 | 10 | 5 | 5 | | | | |
| 10 | 1 1 2 107 | S6 15 | 10.0 12.0 | 10.0 | ML | Very loose, gray, sandy SILT (ML), mps 0.25 in., trace wood and glass, shells, no structure, no odor, wet -FILL- | | | 5 | 10 | 15 | 70 | | | | |
| | | | | | | Note: Drilled through cobble from 12.0 to 12.4 ft. | | | | | | | | | | |
| | 2 3 3 4 | S7 24 | 12.5 14.5 | 12.5 | CL | Medium stiff, gray, lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist, occasional brown mottles -GLACIOMARINE DEPOSIT- | | | | | | 100 | N | M | M | |
| 15 | | | | | | | | | | | | | | | | |
| 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) 46.6
Rock Cored (ft) 9.4
Samples 10S, 2C

**Boring No.** HA08-13

**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



| Depth (ft) | Sampler Blows per 6 in. | Sample No. & Rec. (in.) | Sample Depth (ft) | Stratum Change Elev/Depth (ft) | USCS Symbol | 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 | WOR<br>WOR<br>WOH<br>WOH | S8<br>24 | 20.0<br>22.0 | | CL | Medium stiff, silty lean CLAY (CL), mps 2.0 mm, no structure, no odor, moist<br>FV1 (20.3-21.0 ft), Su = ~670/170 psf<br><br>-GLACIOMARINE DEPOSIT- | | | | | | 100 | N | L | L | |
| 25 | | | | | | Note: Trace fine gravel observed in wash water.<br>FV2 (25.3-26.0 ft), Su = 590/240 psf | | | | | | | | | | |
| 30 | WOR<br>WOR<br>WOR<br>WOH | S9<br>24 | 30.0<br>32.0 | | CL | Soft, gray, silty lean CLAY (CL), mps 2.0 mm, occasional partings along sand seams, no odor, moist<br>FV3 (30.3-31.0 ft), Su = 280/250 psf<br><br>-GLACIOMARINE DEPOSIT- | | | | | 5 | 95 | N | L | L | |
| 35 | | | | | | FV4 (35.3-36.0 ft), Su = 720/220 psf<br><br>Note: Sand observed in wash water and on drill rods. | | | | | | | | | | |
| | | | | 39.6 | | | | | | | | | | | | |
| 40 | 4<br>2<br>2<br>4 | S10<br>4 | 40.0<br>42.0 | | SP | Very loose, gray, poorly-graded SAND (SP), mps 4.0 mm, no structure, no odor, wet<br><br>-GLACIOMARINE DEPOSIT- | | | | 45 | 50 | 5 | | | | |
| 45 | | | | | | | | | | | | | | | | |
| | | | | 46.6 | | Note: Casing refusal at 46.6 ft. Advanced roller bit to 46.6 ft. Begin NQ rock core at 46.6 ft. See Core Boring Report for details.<br>Notes:<br>1. FV1 (20.3-21.0 ft) indicates in-situ field vane performed at depth interval shown, corrected peak/residual shear strengths are provided. See Table II for details.<br>2. WOR = Weight of Drill Rods; WOH = Weight of Hammer. | | | | | | | | | | |

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

HALEY & ALDRICH

# CORE BORING REPORT



| 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* |
| | 2<br>2<br>4<br>7<br>3 | C1 | 46.6<br>51.0 | 40<br>0 | 76<br>0 | | | Moderately hard, moderate to highly weathered, dark green, aphanitic CHLORITE SCHIST. Foliation is extremely thin, high angle. Primary joint set is parallel to foliation, high angle, very close to undulating, fresh to discolored with pyrite, very tight to tight |
| 50 | | | | | | | | |
| | 2<br>2<br>2<br>2<br>2 | C2 | 51.0<br>56.0 | 60<br>42 | 100<br>70 | | 51.0 | Moderately hard, slightly weathered to fresh, dark green, aphanitic CHLORITE SCHIST. Foliation is extremely thin, high angle to vertical. Primary joint set is parallel to foliation, high angle to vertical, close to very close, smooth to polished, stepped to undulating, fresh to discolored with pyrite, very tight to tight. Occasional extremely thin to thin, high angle to vertical quartz veins |
| 55 | | | | | | | | |
| | | | | | | | 56.0 | BOTTOM OF EXPLORATION |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |

# APPENDIX C

## Observation Well Installation and Groundwater Monitoring Reports

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ALDRICH

HALEY & ALDRICH

# OBSERVATION WELL INSTALLATION REPORT

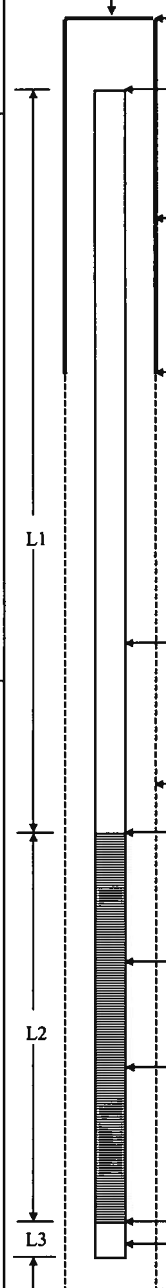
| Well No. |
|---|
| HA08-5(OW) |
| Boring No. |
| HA08-5(OW) |

| | | | |
|---|---|---|---|
| **PROJECT** | Maine Health/United Way Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP.** | O. Lawlor |
| **CONTRACTOR** | Maine Test Borings, Inc. | **DATE INSTALLED** | 8/1/2008 |
| **DRILLER** | M. Porter | **WATER LEVEL** | - |

| | | | | |
|---|---|---|---|---|
| **Ground El.** | 9.0 +/- ft | **Location** | See Plan | ☑ **Guard Pipe** |
| **El. Datum** | Portland City | | | ☐ **Roadway Box** |

| SOIL/ROCK CONDITIONS | BOREHOLE BACKFILL |
|---|---|
| FILL | BENTONITE |
| | 3.0 |
| | FILTER SAND |
| 10.5 | |
| HARBOR BOTTOM DEPOSIT | |
| 13.0 | |
| | 15.0 |
| GLACIOMARINE DEPOSITS | DRILL CUTTINGS |
| 53.0 | |
| GLACIAL TILL | |
| 63.8 | |
| BEDROCK | |
| 65.5 | 65.5 |

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)




| | | |
|---|---|---|
| **Type of protective cover/lock** | Locked Cover | |
| **Height of top of guard pipe above ground surface** | 3.0 | ft |
| **Height of top of riser pipe above ground surface** | 2.8 | ft |
| **Type of protective casing:** | Steel Guard Pipe | |
| **Length** | 5.0 | ft |
| **Inside Diameter** | 3.0 | in |
| **Depth of bottom of guard pipe/roadway box** | | ft |

| Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---|---|---|
| Concrete | - | - |
| Bentonite Seal | 0.0 | 3.0 |
| | | |
| | | |

| | | |
|---|---|---|
| **Type of riser pipe:** | Schedule 40 PVC | |
| **Inside diameter of riser pipe** | 2.0 | in |
| **Type of backfill around riser** | Filter Sand/Bentonite | |
| **Diameter of borehole** | 3.0 | in |
| **Depth to top of well screen** | 5.0 | ft |
| **Type of screen** | Mach. Slotted Sch. 40 PVC | |
| **Screen gauge or size of openings** | 0.010 | in |
| **Diameter of screen** | 2.0 | in |
| **Type of backfill around screen** | Filter Sand | |
| **Depth of bottom of well screen** | 15.0 | ft |
| **Bottom of Silt trap** | - | ft |
| **Depth of bottom of borehole** | 65.5 | ft |

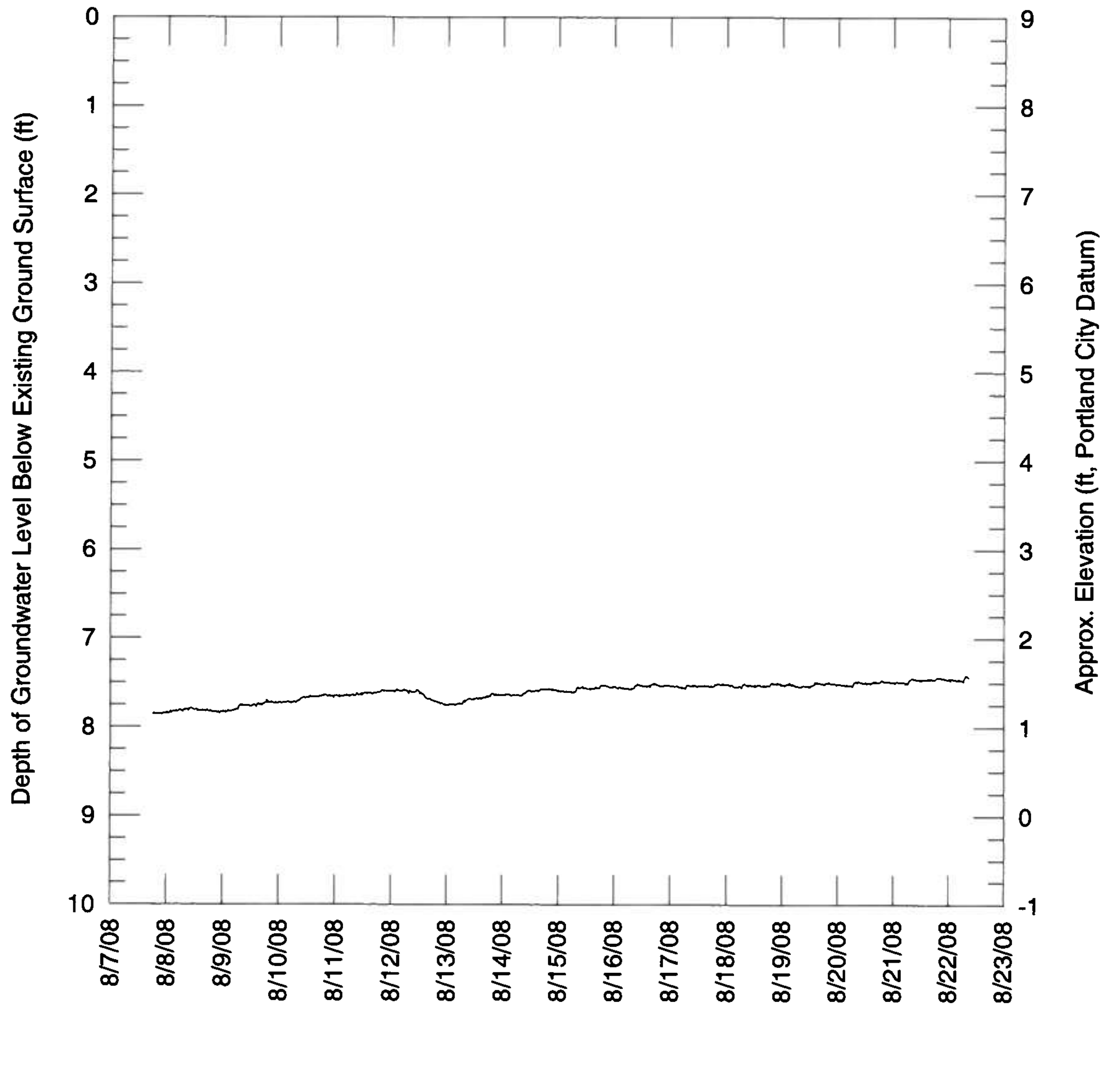
(Not to Scale)

| Riser Pay Length (L1) | | Length of screen (L2) | | Length of silt trap (L3) | | Pay length |
|---|---|---|---|---|---|---|
| 7.8 ft | + | 10 ft | + | 0 ft | = | 17.8 ft |

**COMMENTS:**

**Results of Groundwater Monitoring**
**Observation Well HA08-5(OW)**

MaineHealth/UnitedWay Development
Somerset and Chestnut Streets
Portland, Maine
Haley & Aldrich File No. 35611-000



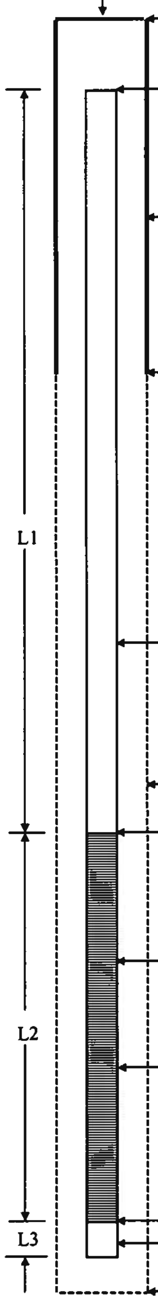
| HALEY& ALDRICH | OBSERVATION WELL INSTALLATION REPORT | Well No. HA08-7(OW) |
|---|---|---|
| | | Boring No. HA08-7(OW) |

| | | | |
|---|---|---|---|
| **PROJECT** | Maine Health/United Way Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP.** | O. Lawlor |
| **CONTRACTOR** | Maine Test Borings, Inc. | **DATE INSTALLED** | 7/31/2008 |
| **DRILLER** | M. Porter | **WATER LEVEL** | - |

**Ground El.** 12.0 +/- ft **Location** See Plan ☑ **Guard Pipe**
**El. Datum** Portland City ☐ **Roadway Box**

| **SOIL/ROCK CONDITIONS** | Depth | **BOREHOLE BACKFILL** | Depth |
|---|---|---|---|
| FILL | | BENTONITE | 3.0 |
| | 12.5 | | |
| GLACIOMARINE DEPOSIT | | FILTER SAND | 15.0 |
| | 38.0 | | |
| GLACIAL TILL | | DRILL CUTTINGS | |
| | 60.1 | | |
| BEDROCK | 72.0 | | 72.0 |

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)




| | | |
|---|---|---|
| **Type of protective cover/lock** | Locked Cover | |
| **Height of top of guard pipe box above ground surface** | 3.0 | ft |
| **Height of top of riser pipe above ground surface** | 2.8 | ft |
| **Type of protective casing:** | Steel Guard Pipe | |
| **Length** | 5.0 | ft |
| **Inside Diameter** | 3.0 | in |
| **Depth of bottom of guard pipe/roadway box** | 2.0 | ft |

| **Type of Seals** | **Top of Seal (ft)** | **Thickness (ft)** |
|---|---|---|
| Concrete | - | - |
| Bentonite Seal | 0.0 | 3.0 |
| | | |
| | | |

| | | |
|---|---|---|
| **Type of riser pipe:** | Schedule 40 PVC | |
| **Inside diameter of riser pipe** | 2.0 | in |
| **Type of backfill around riser** | Filter Sand/Bentonite | |
| **Diameter of borehole** | 3.0 | in |
| **Depth to top of well screen** | 5.0 | ft |
| **Type of screen** | Mach. Slotted Sch. 40 PVC | |
| **Screen gauge or size of openings** | 0.010 | in |
| **Diameter of screen** | 2.0 | in |
| **Type of backfill around screen** | Filter Sand | |
| **Depth of bottom of well screen** | 15.0 | ft |
| **Bottom of Silt trap** | 15.0 | ft |
| **Depth of bottom of borehole** | 72.0 | ft |

(Not to Scale)

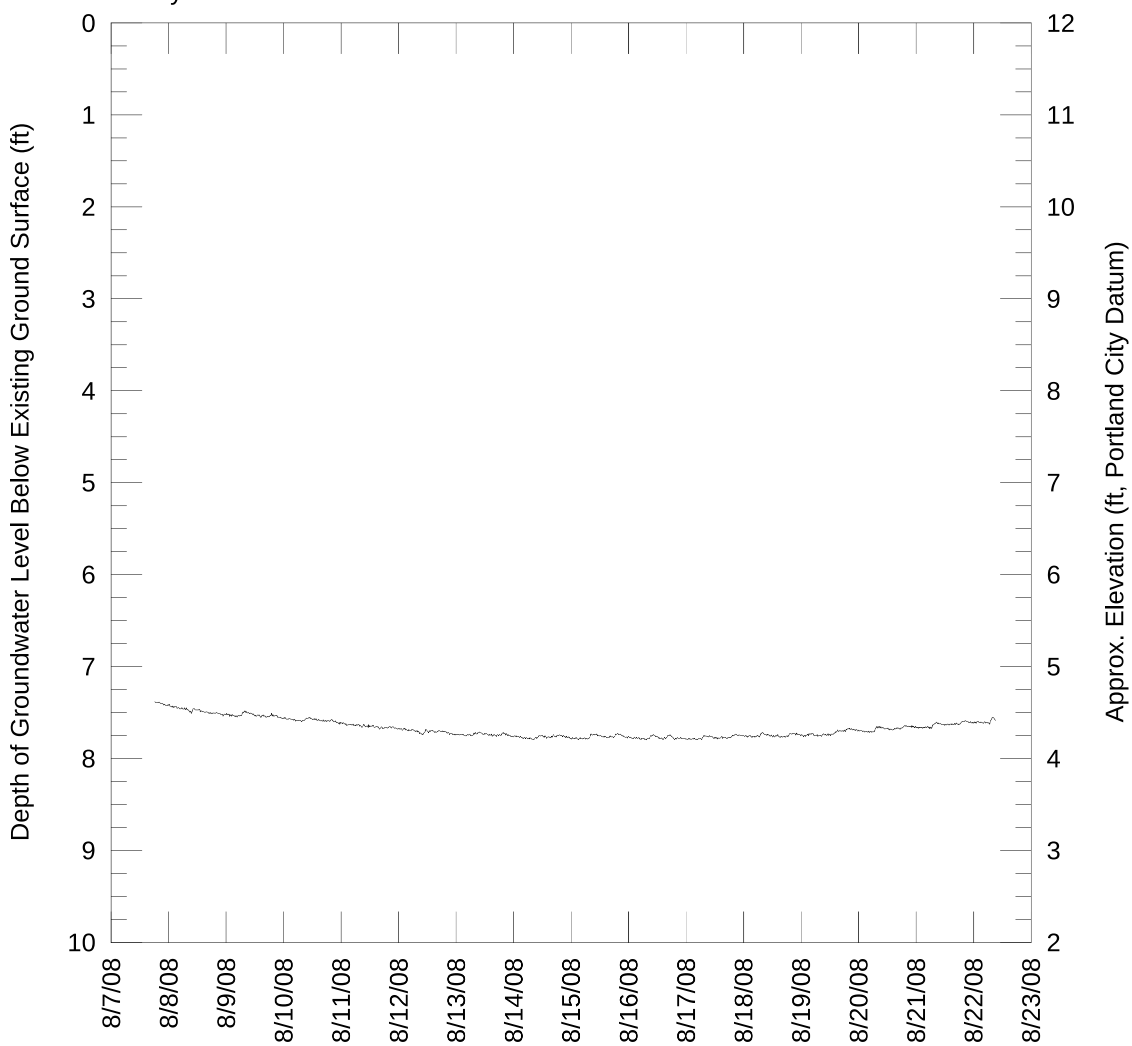
| Riser Pay Length (L1) | | Length of screen (L2) | | Length of silt trap (L3) | | Pay length |
|---|---|---|---|---|---|---|
| 7.8 ft | + | 10 ft | + | 0 ft | = | 17.8 ft |

**COMMENTS:**

Form 2007

**Results of Groundwater Monitoring**
**Observation Well HA08-7(OW)**

MaineHealth/UnitedWay Development
Somerset and Chestnut Streets
Portland, Maine
Haley & Aldrich File No. 35611-000



HALEY & ALDRICH

# OBSERVATION WELL INSTALLATION REPORT

| | |
|---|---|
| Well No. | HA08-12(OW) |
| Boring No. | HA08-12(OW) |

| | | | |
|---|---|---|---|
| **PROJECT** | Maine Health/United Way Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP.** | O. Lawlor |
| **CONTRACTOR** | Maine Test Borings, Inc. | **DATE INSTALLED** | 7/24/2008 |
| **DRILLER** | M. Porter | **WATER LEVEL** | - |

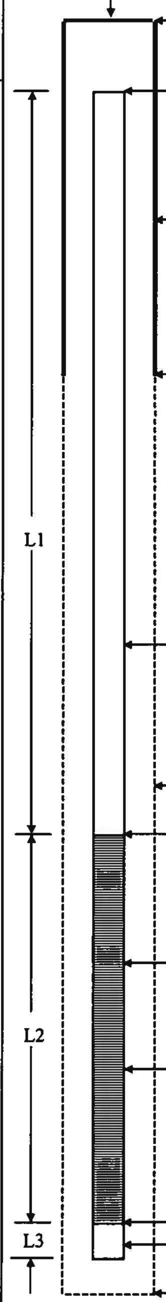
**Ground El.** 11.0 +/- ft  **Location** See Plan  ☑ **Guard Pipe**

**El. Datum** Portland City  ☐ **Roadway Box**

| **SOIL/ROCK CONDITIONS** | **BOREHOLE BACKFILL** |
|---|---|
| FILL | BENTONITE |
| 11.6 | 3.0 |
| HARBOR BOTTOM DEPOSIT | FILTER SAND |
| 14.0 | |
| GLACIOMARINE DEPOSIT | |
| 16.0 | 16.0 |

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)




| | | |
|---|---|---|
| **Type of protective cover/lock** | Locked Cover | |
| **Height of top of guard pipe above ground surface** | 3.0 | ft |
| **Height of top of riser pipe above ground surface** | 2.75 | ft |
| **Type of protective casing:** | Steel Guard Pipe | |
| **Length** | 5.0 | ft |
| **Inside Diameter** | 3.0 | in |
| **Depth of bottom of guard pipe/roadway box** | 2.0 | ft |

| **Type of Seals** | **Top of Seal (ft)** | **Thickness (ft)** |
|---|---|---|
| Concrete | - | - |
| Bentonite Seal | 0.0 | 3.0 |
| | | |
| | | |

| | | |
|---|---|---|
| **Type of riser pipe:** | Schedule 40 PVC | |
| **Inside diameter of riser pipe** | 2.0 | in |
| **Type of backfill around riser** | Filter Sand/Bentonite | |
| **Diameter of borehole** | 3.0 | in |
| **Depth to top of well screen** | 4.0 | ft |
| **Type of screen** | Mach. Slotted Sch. 40 PVC | |
| **Screen gauge or size of openings** | 0.010 | in |
| **Diameter of screen** | 2.0 | in |
| **Type of backfill around screen** | Filter Sand | |
| **Depth of bottom of well screen** | 14.0 | ft |
| **Bottom of Silt trap** | 14.0 | ft |
| **Depth of bottom of borehole** | 16.0 | ft |

(Not to Scale)

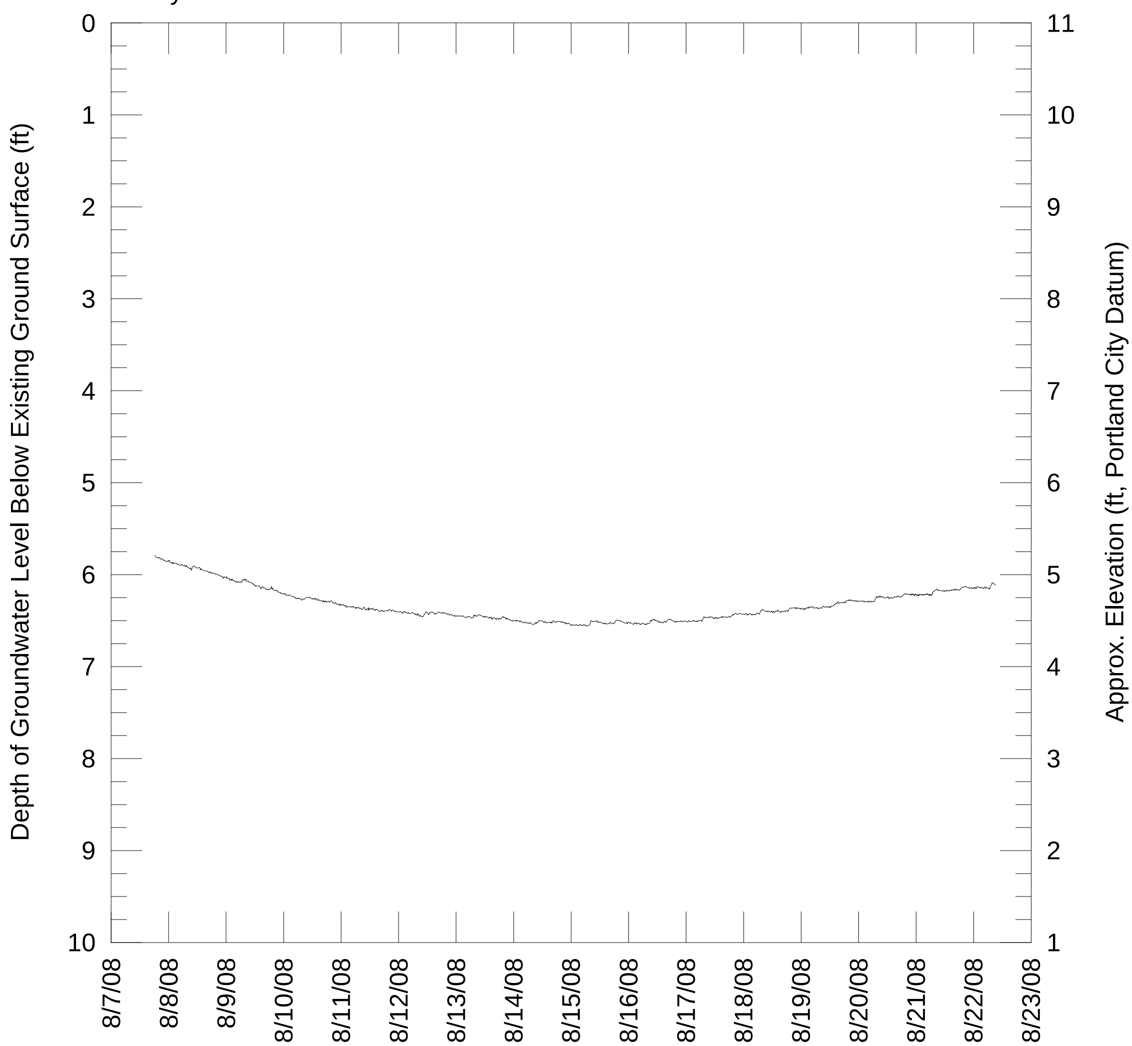
| Riser Pay Length (L1) | | Length of screen (L2) | | Length of silt trap (L3) | | Pay length |
|---|---|---|---|---|---|---|
| 6.75 ft | + | 10 ft | + | 0 ft | = | 16.75 ft |

**COMMENTS:**

Form 2007

**Results of Groundwater Monitoring**
**Observation Well HA08-12(OW)**

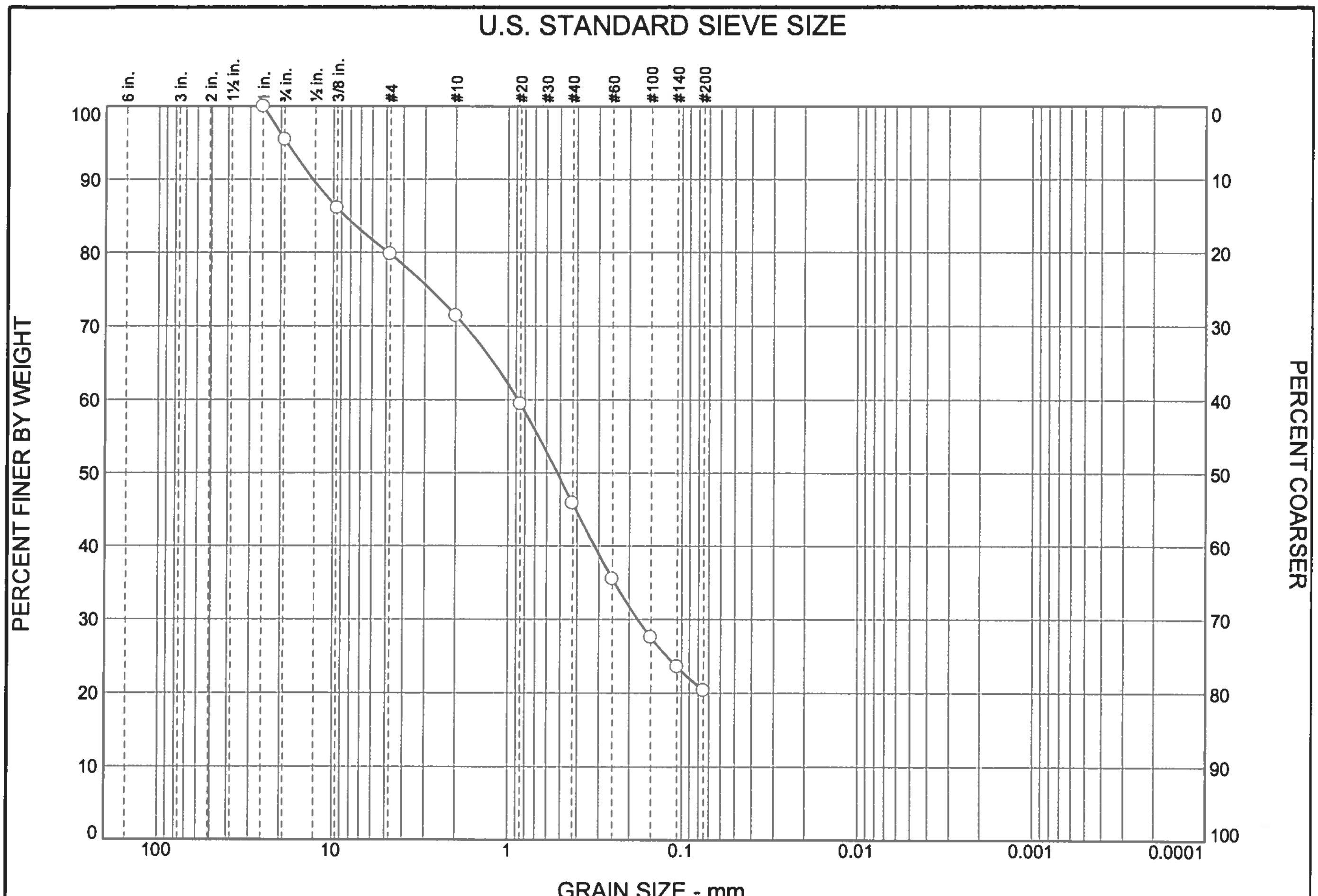
MaineHealth/UnitedWay Development
Somerset and Chestnut Streets
Portland, Maine
Haley & Aldrich File No. 35611-000



# APPENDIX D

## Laboratory Test Results

# Grain Size Distribution Reports




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 4.5 | 15.8 | 8.3 | 25.6 | 25.5 | 20.3 | |

| Expl. No. | Sample No. | Depth (ft) | Atterberg Limits % | | | Water Content (%) | $C_u$ | $C_c$ | USCS |
|---|---|---|---|---|---|---|---|---|---|
| | | | $W_L$ | $W_P$ | $I_P$ | | | | |
| HA08-4 | C01 | 0.5-4.5 | | | | 9.9 | | | SM |

**Sample Description**

Dark brown silty sand with gravel

**Remarks:**

Composite Sample: S01 & S02

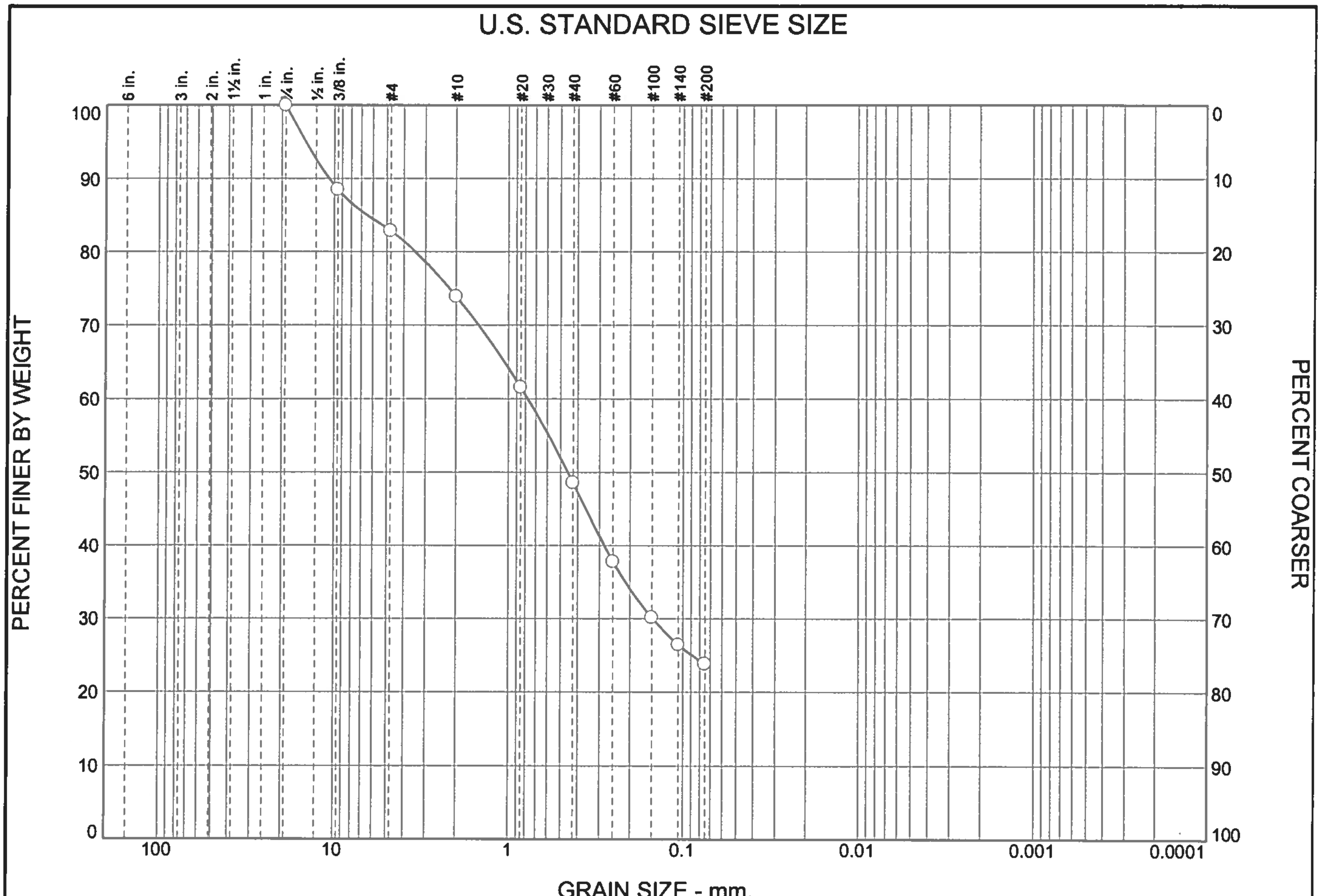
HALEY& ALDRICH

Maine Health/United Way Development
Portland, Maine

GRAIN SIZE DISTRIBUTION

DATE: 8/29/2008

FILE NO: 35611-000




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 17.2 | 8.9 | 25.3 | 24.8 | 23.8 | |
| | | | | | | | |
| | | | | | | | |

| Expl. No. | Sample No. | Depth (ft) | Atterberg Limits % | | | Water Content (%) | $C_u$ | $C_c$ | USCS |
|---|---|---|---|---|---|---|---|---|---|
| | | | $W_L$ | $W_P$ | $I_P$ | | | | |
| HA08-6 | S02 | 2.0-4.0 | | | | 16.8 | | | SM |
| | | | | | | | | | |
| | | | | | | | | | |

| Sample Description |
|---|
| Dark brown silty sand with gravel |
| |
| |

**Remarks:**

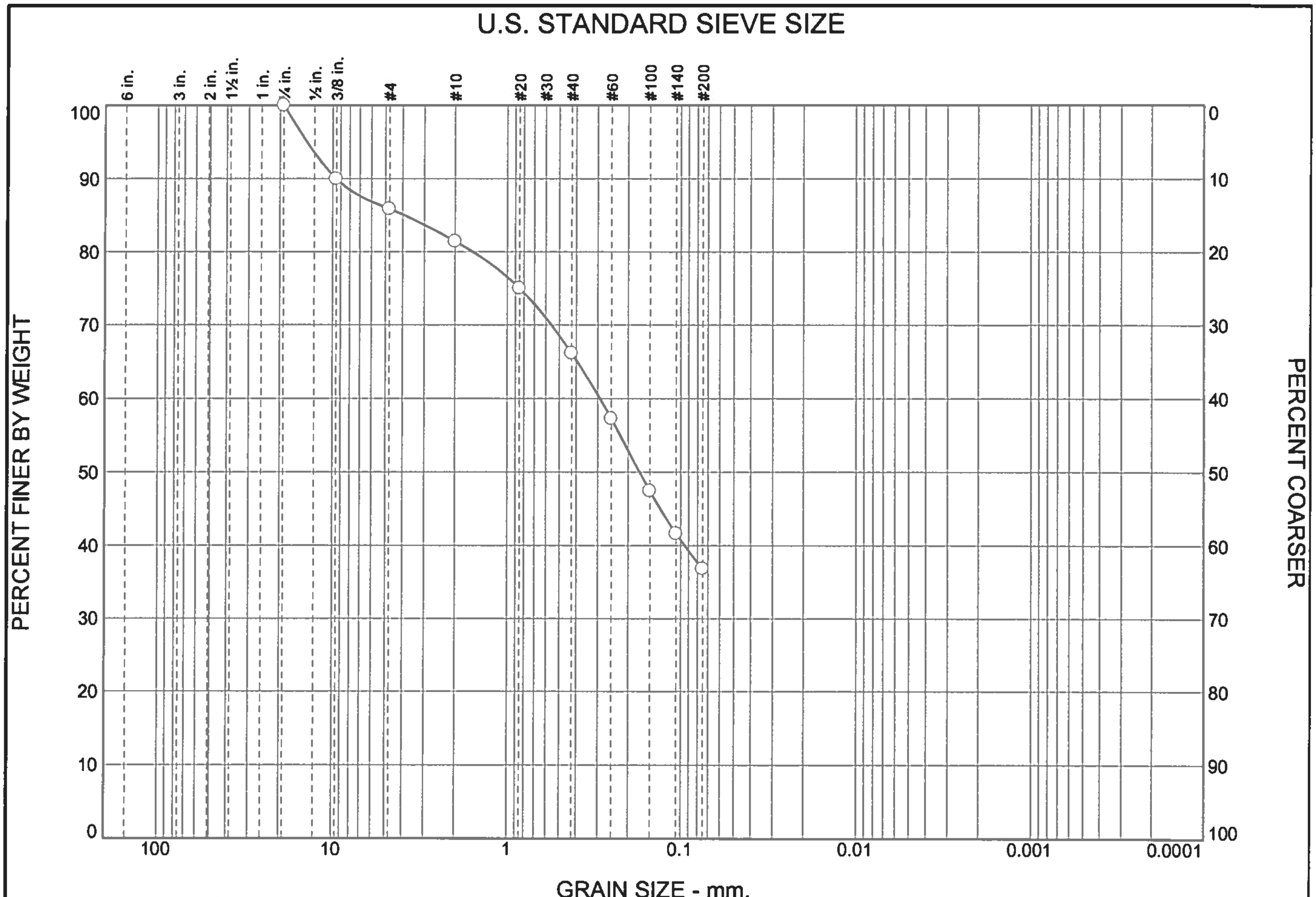
HALEY& ALDRICH

Maine Health/United Way Development
Portland, Maine

GRAIN SIZE DISTRIBUTION

DATE: 8/29/2008

FILE NO: 35611-000




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 14.1 | 4.5 | 15.3 | 29.3 | 36.8 | |

| Expl. No. | Sample No. | Depth (ft) | Atterberg Limits % | | | Water Content (%) | $C_u$ | $C_c$ | USCS |
|---|---|---|---|---|---|---|---|---|---|
| | | | $W_L$ | $W_P$ | $I_P$ | | | | |
| HA08-10 | C01 | 0.0-4.0 | | | | 9.1 | | | SM |

| Sample Description |
|---|
| Brown silty sand |

**Remarks:**

Composite Sample: S01 & S02

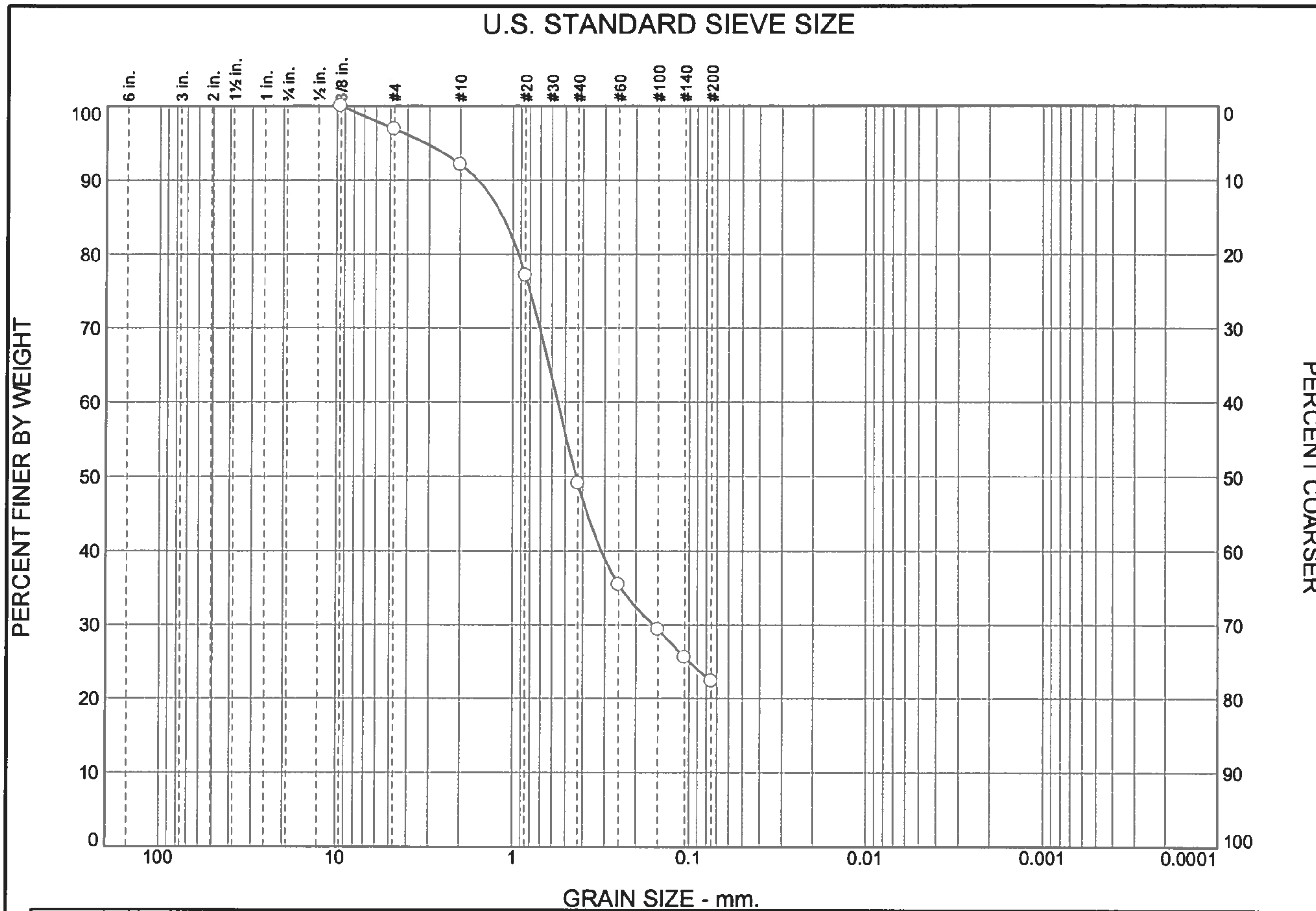
HALEY& ALDRICH

Maine Health/United Way Development
Portland, Maine

GRAIN SIZE DISTRIBUTION

DATE: 8/29/2008

FILE NO: 35611-000




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 3.1 | 4.8 | 43.0 | 26.8 | 22.3 | |
| | | | | | | | |
| | | | | | | | |

| Expl. No. | Sample No. | Depth (ft) | Atterberg Limits % | | | Water Content (%) | $C_u$ | $C_c$ | USCS |
|---|---|---|---|---|---|---|---|---|---|
| | | | $W_L$ | $W_P$ | $I_P$ | | | | |
| HA08-12 | S03 | 4.0-6.0 | | | | 9.7 | | | SM |
| | | | | | | | | | |
| | | | | | | | | | |

| Sample Description |
|---|
| Brown silty sand |
| |
| |

**Remarks:**

HALEY& ALDRICH

Maine Health/United Way Development
Portland, Maine

GRAIN SIZE DISTRIBUTION

DATE: 8/29/2008

FILE NO: 35611-000

**Atterberg Limits and Natural Water Content Reports**

HALEY & ALDRICH

GeoTesting express
a subsidiary of Geocomp Corporation

| | | | |
|---|---|---|---|
| Client: Haley & Aldrich, Inc. | | | |
| Project: Maine Health / United Way Development | | | |
| Location: Portland, ME | | Project No: | GTX-8427 |
| Boring ID: --- | Sample Type: --- | Tested By: | ap |
| Sample ID:--- | Test Date: 08/15/08 | Checked By: | jdt |
| Depth : --- | Sample Id: --- | | |

# Moisture Content of Soil - ASTM D 2216-05

| Boring ID | Sample ID | Depth | Description | Moisture Content,% |
|---|---|---|---|---|
| HA08-4 | S-12 | 30-32 ft | Moist, olive gray clay | 38.3 |
| HA08-4 | S-13 | 40-42 ft | Moist, olive gray clay | 41.8 |
| HA08-8 | S-10 | 30-32 ft | Moist, olive gray clay | 42.7 |
| HA08-8 | S-11 | 35-37 ft | Moist, olive gray clay | 30.8 |

Notes: Temperature of Drying : 110° Celsius

GeoTesting express
a subsidiary of Geocomp Corporation

| | | | |
|---|---|---|---|
| Client: | Haley & Aldrich, Inc. | | |
| Project: | Maine Health / United Way Development | | |
| Location: | Portland, ME | Project No: | GTX-8427 |
| Boring ID: --- | Sample Type: --- | Tested By: | ap |
| Sample ID:--- | Test Date: 09/03/08 | Checked By: | jdt |
| Depth : --- | Sample Id: --- | | |

# Moisture Content of Soil - ASTM D 2216-05

| Boring ID | Sample ID | Depth | Description | Moisture Content,% |
|---|---|---|---|---|
| HA08-4 | U-2 | 33-35 ft | Moist, dark greenish gray clay | 31.4 |
| HA08-10 | U-1 | 25-27 ft | Moist, gray clay | 37.9 |

Notes: Temperature of Drying : 110° Celsius

printed 9/3/2008 12:03:56 PM

GeoTesting express
a subsidiary of Geocomp Corporation

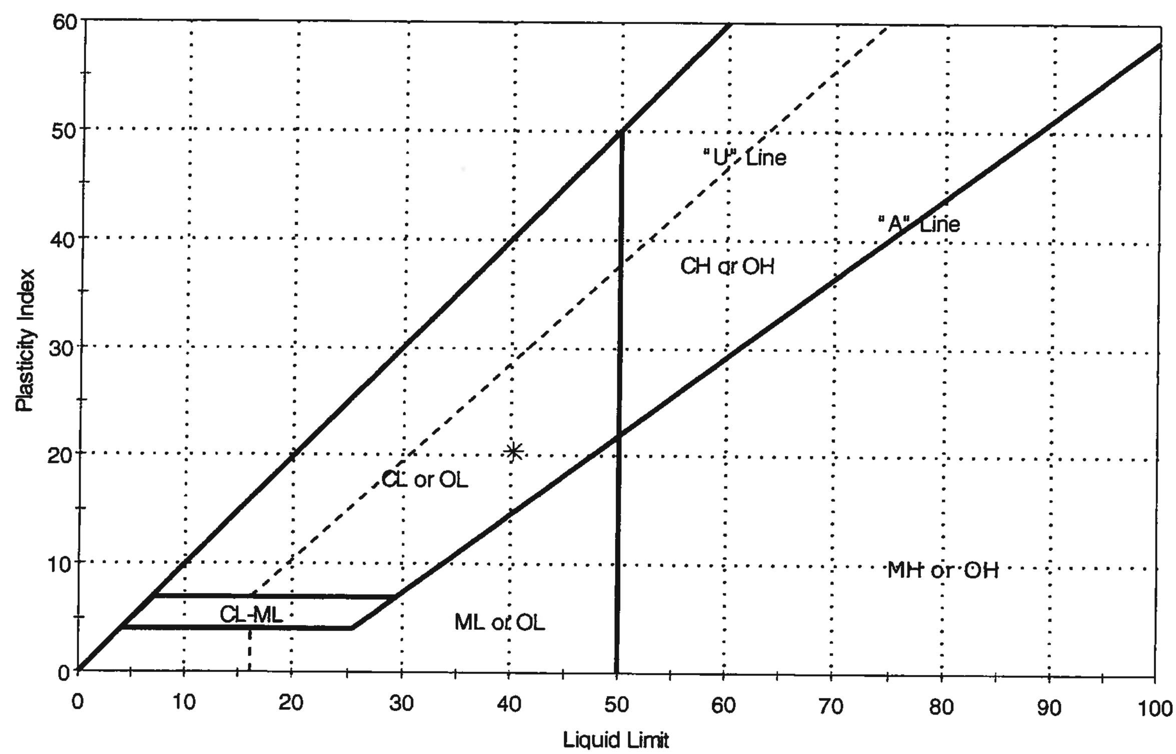
| | |
|---|---|
| Client: | Haley & Aldrich, Inc. |
| Project: | Maine Health / United Way Development |
| Location: | Portland, ME |

Project No: GTX-8427

| | | | | | |
|---|---|---|---|---|---|
| Boring ID: | HA08-4 | Sample Type: | jar | Tested By: | ap |
| Sample ID: | S-12 | Test Date: | 08/12/08 | Checked By: | jdt |
| Depth : | 30-32 ft | Test Id: | 136560 | | |

| | |
|---|---|
| Test Comment: | --- |
| Sample Description: | Moist, olive gray clay |
| Sample Comment: | --- |

# Atterberg Limits - ASTM D 4318-05




| Symbol | Sample ID | Boring | Depth | Natural Moisture Content,% | Liquid Limit | Plastic Limit | Plasticity Index | Liquidity Index | Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| * | S-12 | HA08-4 | 30-32 ft | 38 | 40 | 20 | 20 | 1 | |

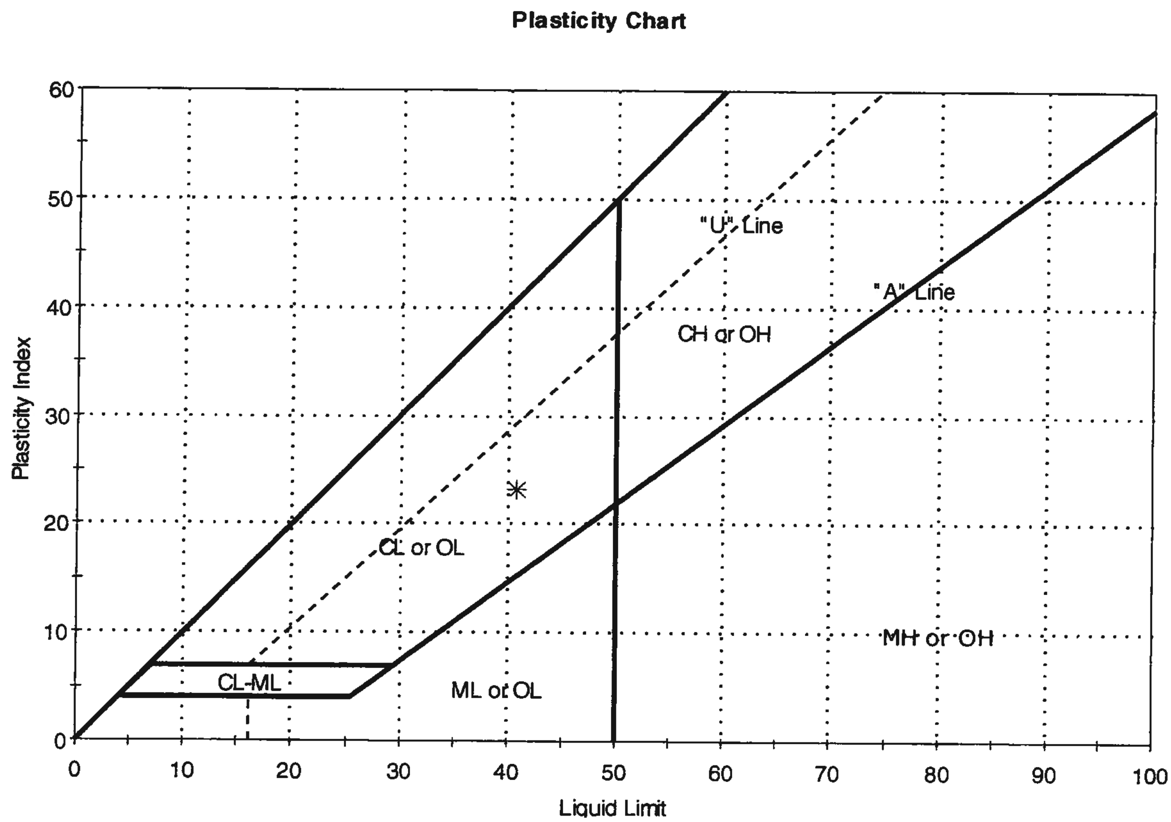
Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

GeoTesting express
a subsidiary of Geocomp Corporation

| | | | |
|---|---|---|---|
| Client: Haley & Aldrich, Inc. | | | |
| Project: Maine Health / United Way Development | | | |
| Location: Portland, ME | | Project No: | GTX-8427 |
| Boring ID: HA08-4 | Sample Type: tube | Tested By: | ap |
| Sample ID: U-2 | Test Date: 08/26/08 | Checked By: | jdt |
| Depth : 33-35 ft | Test Id: 136851 | | |
| Test Comment: --- | | | |
| Sample Description: Moist, dark greenish gray clay | | | |
| Sample Comment: --- | | | |

# Atterberg Limits - ASTM D 4318-05




| Symbol | Sample ID | Boring | Depth | Natural Moisture Content,% | Liquid Limit | Plastic Limit | Plasticity Index | Liquidity Index | Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| * | U-2 | HA08-4 | 33-35 ft | 31 | 41 | 17 | 24 | 1 | |

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilentancy: SLOW

Toughness: LOW

printed 9/3/2008 12:04:16 PM

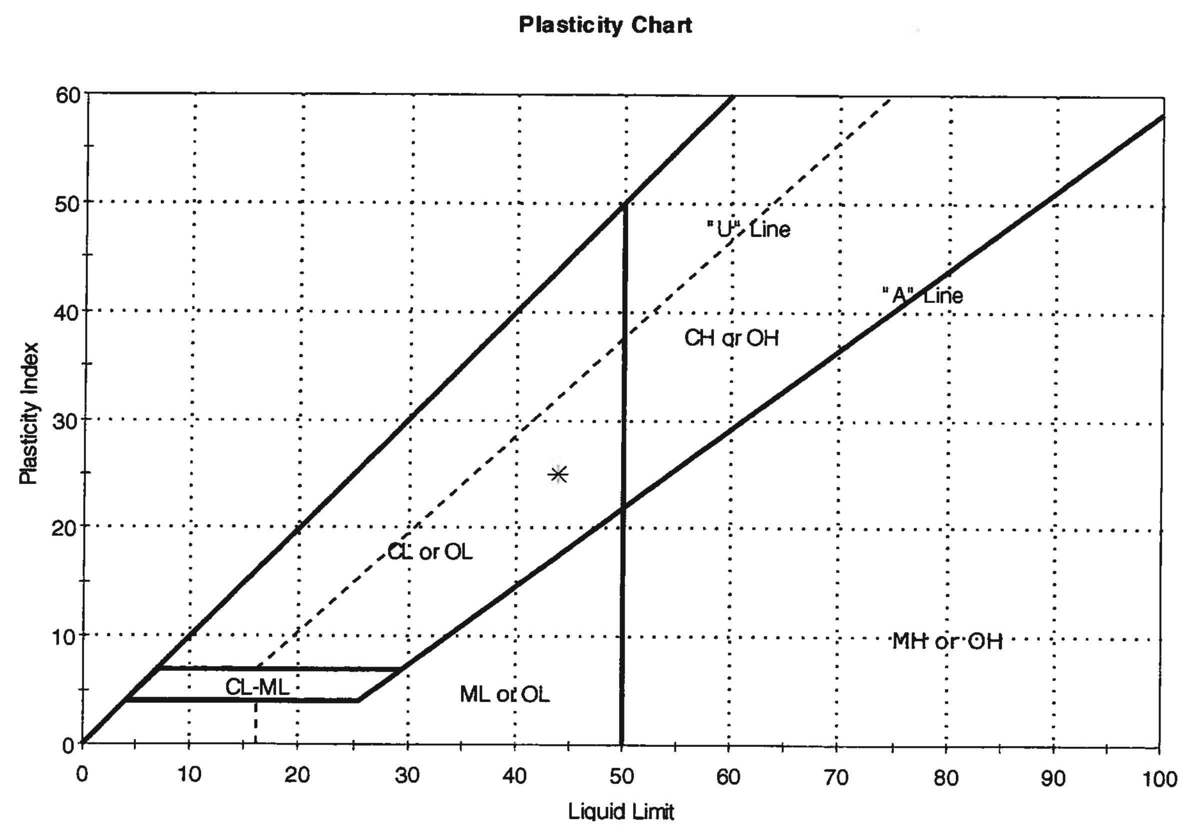
GeoTesting express
a subsidiary of Geocomp Corporation

| | |
|---|---|
| Client: Haley & Aldrich, Inc. | |
| Project: Maine Health / United Way Development | |
| Location: Portland, ME | Project No: GTX-8427 |

| | | |
|---|---|---|
| Boring ID: HA08-4 | Sample Type: jar | Tested By: ap |
| Sample ID:S-13 | Test Date: 08/13/08 | Checked By: jdt |
| Depth : 40-42 ft | Test Id: 136561 | |

Test Comment: ---
Sample Description: Moist, olive gray clay
Sample Comment: ---

# Atterberg Limits - ASTM D 4318-05




| Symbol | Sample ID | Boring | Depth | Natural Moisture Content,% | Liquid Limit | Plastic Limit | Plasticity Index | Liquidity Index | Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| * | S-13 | HA08-4 | 40-42 ft | 42 | 44 | 19 | 25 | 1 | |

Sample Prepared using the WET method

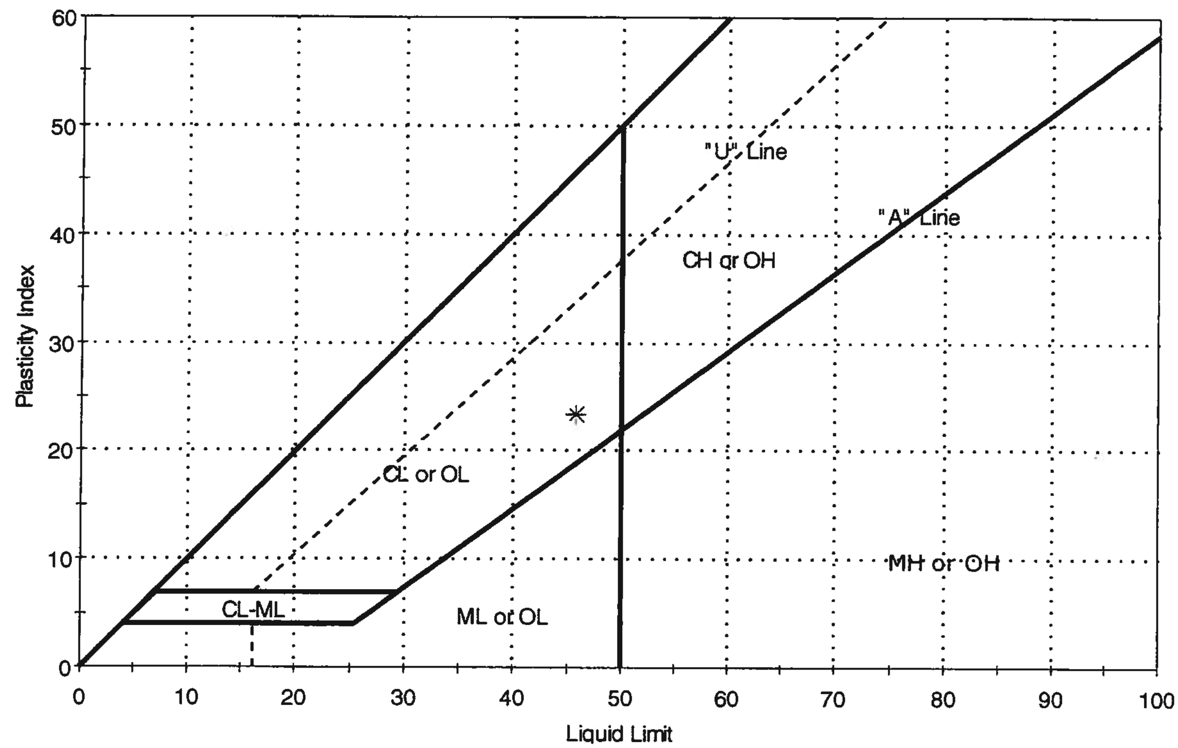
Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

printed 8/15/2008 11:54:46 AM

GeoTesting express
a subsidiary of Geocomp Corporation

| | | | |
|---|---|---|---|
| Client: Haley & Aldrich, Inc. | | | |
| Project: Maine Health / United Way Development | | | |
| Location: Portland, ME | | Project No: | GTX-8427 |
| Boring ID: HA08-8 | Sample Type: jar | Tested By: | ap |
| Sample ID:S-10 | Test Date: 08/12/08 | Checked By: | jdt |
| Depth : 30-32 ft | Test Id: 136562 | | |
| Test Comment: --- | | | |
| Sample Description: Moist, olive gray clay | | | |
| Sample Comment: --- | | | |

# Atterberg Limits - ASTM D 4318-05




| Symbol | Sample ID | Boring | Depth | Natural Moisture Content,% | Liquid Limit | Plastic Limit | Plasticity Index | Liquidity Index | Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| * | S-10 | HA08-8 | 30-32 ft | 43 | 46 | 23 | 23 | 1 | |

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilentancy: SLOW

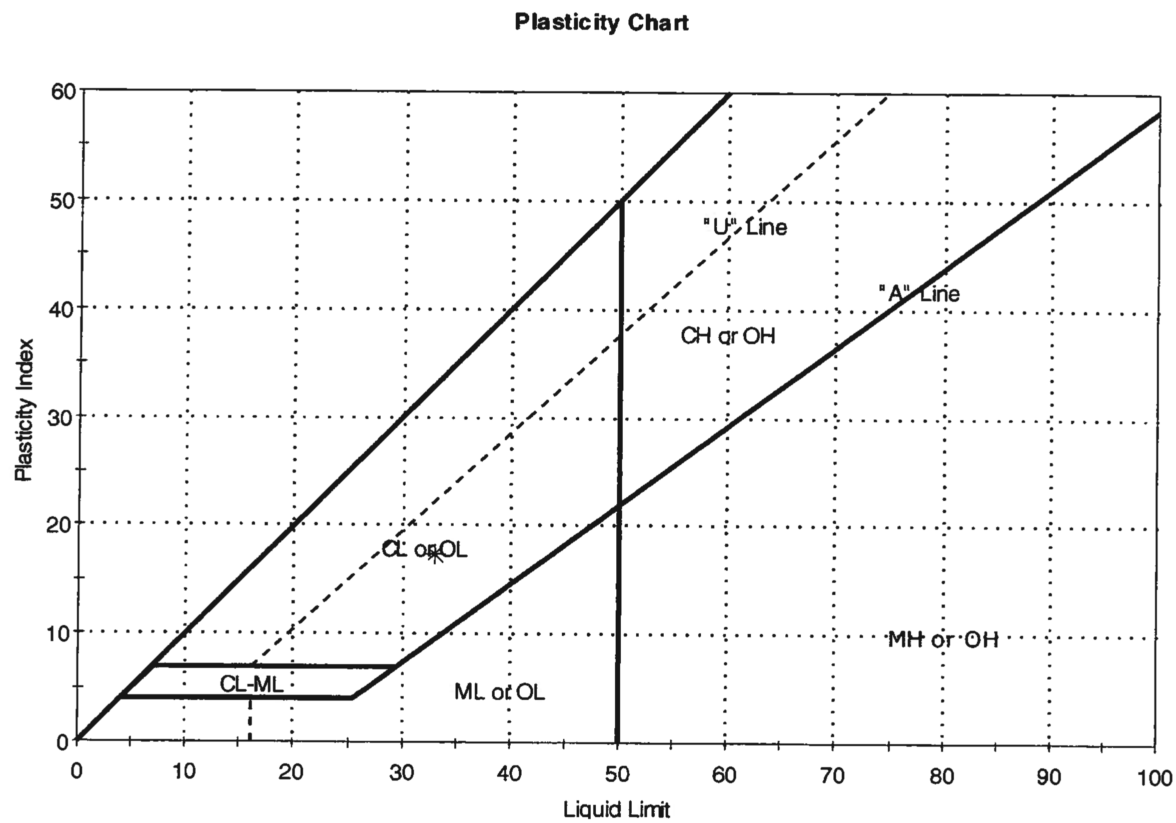
Toughness: LOW

printed 8/15/2008 11:54:51 AM

GeoTesting express
a subsidiary of Geocomp Corporation

| | | | |
|---|---|---|---|
| Client: Haley & Aldrich, Inc. | | | |
| Project: Maine Health / United Way Development | | | |
| Location: Portland, ME | | Project No: | GTX-8427 |
| Boring ID: HA08-8 | Sample Type: jar | Tested By: | ap |
| Sample ID: S-11 | Test Date: 08/13/08 | Checked By: | jdt |
| Depth : 35-37 ft | Test Id: 136563 | | |
| Test Comment: --- | | | |
| Sample Description: Moist, olive gray clay | | | |
| Sample Comment: --- | | | |

# Atterberg Limits - ASTM D 4318-05




| Symbol | Sample ID | Boring | Depth | Natural Moisture Content,% | Liquid Limit | Plastic Limit | Plasticity Index | Liquidity Index | Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| * | S-11 | HA08-8 | 35-37 ft | 31 | 33 | 16 | 17 | 1 | |

Sample Prepared using the WET method

Dry Strength: VERY HIGH

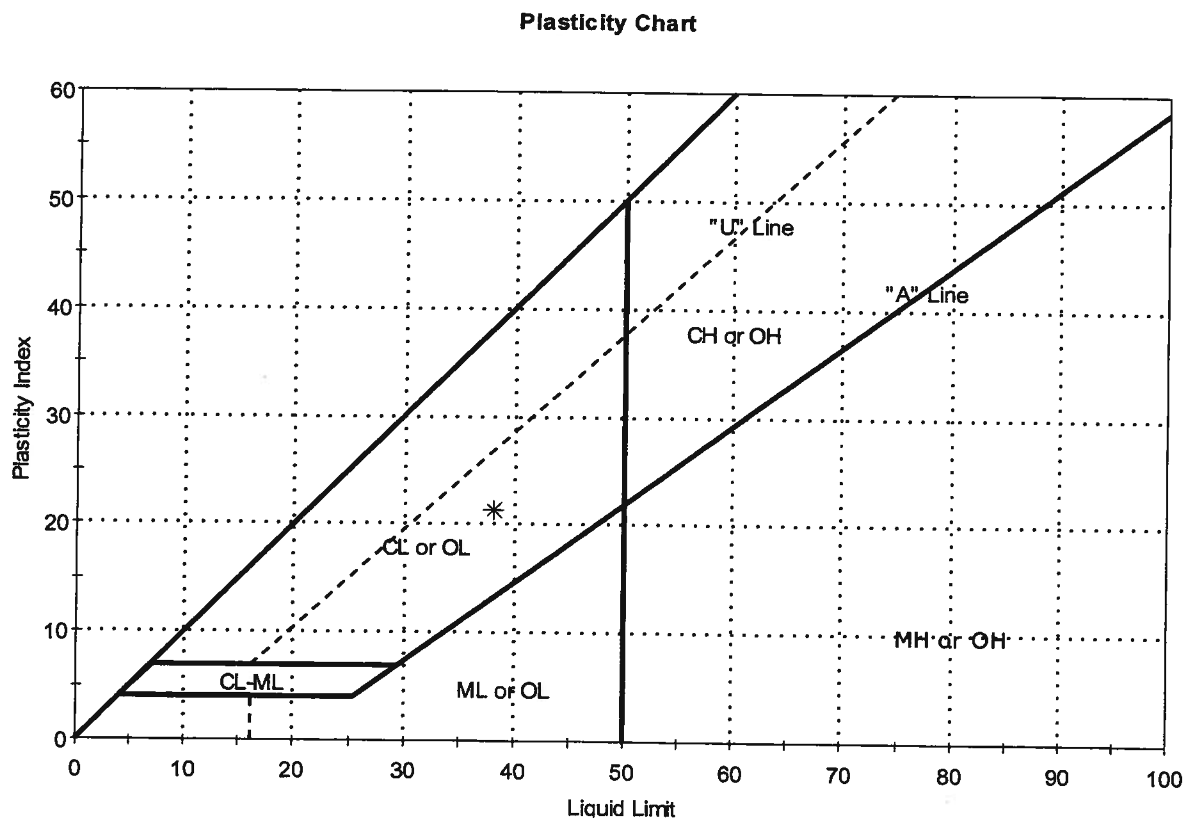
Dilentancy: SLOW

Toughness: LOW

**GeoTesting express**
a subsidiary of Geocomp Corporation

| | | | |
|---|---|---|---|
| Client: Haley & Aldrich, Inc. | | | |
| Project: Maine Health / United Way Development | | | |
| Location: Portland, ME | | Project No: | GTX-8427 |
| Boring ID: HA08-10 | Sample Type: tube | Tested By: | ap |
| Sample ID: U-1 | Test Date: 08/26/08 | Checked By: | jdt |
| Depth : 25-27 ft | Test Id: 136852 | | |
| Test Comment: --- | | | |
| Sample Description: Moist, gray clay | | | |
| Sample Comment: --- | | | |

# Atterberg Limits - ASTM D 4318-05




| Symbol | Sample ID | Boring | Depth | Natural Moisture Content,% | Liquid Limit | Plastic Limit | Plasticity Index | Liquidity Index | Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| * | U-1 | HA08-10 | 25-27 ft | 38 | 38 | 17 | 21 | 1 | |

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

printed 8/27/2008 8:34:43 AM

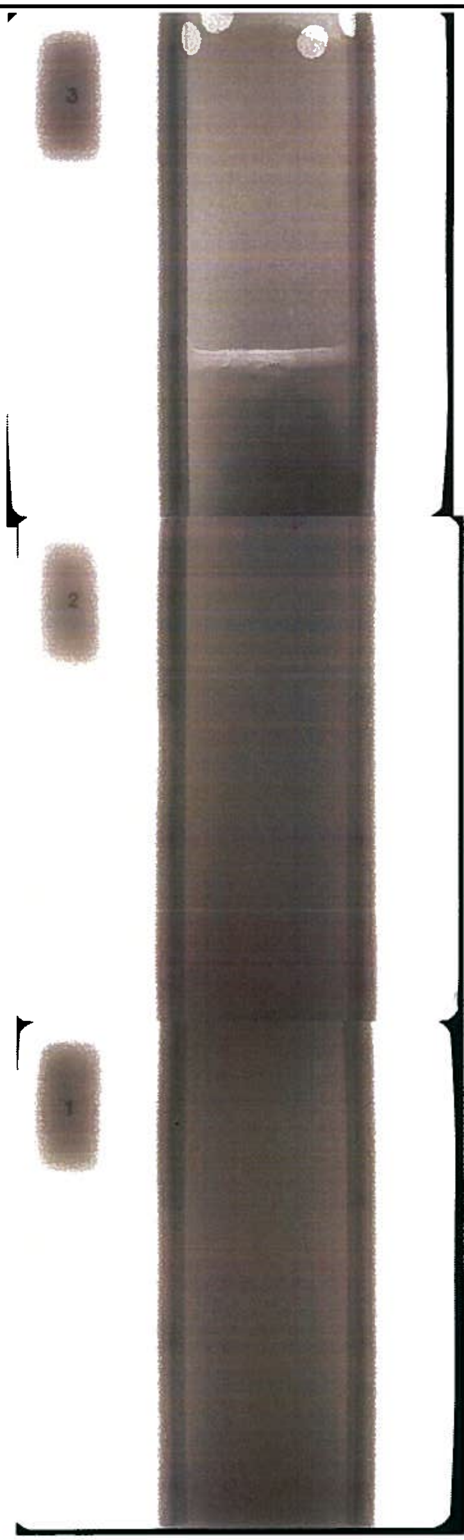
**Radiography Test Reports**

HALEY & ALDRICH

GeoTesting express

a subsidiary of Geocomp Corporation

| | |
|---|---|
| Client: | Haley & Aldrich, Inc. |
| Project Name: | Maine Health/United Way Development |
| Project Location: | Portland, ME |
| GTX #: | 8427 |
| Test Date: | 08/11/08 |
| Tested By: | edd/md |
| Checked By: | jdt |
| Boring ID: | HA08-4 |
| Sample ID: | U-1 |
| Depth, ft: | 25-27 |



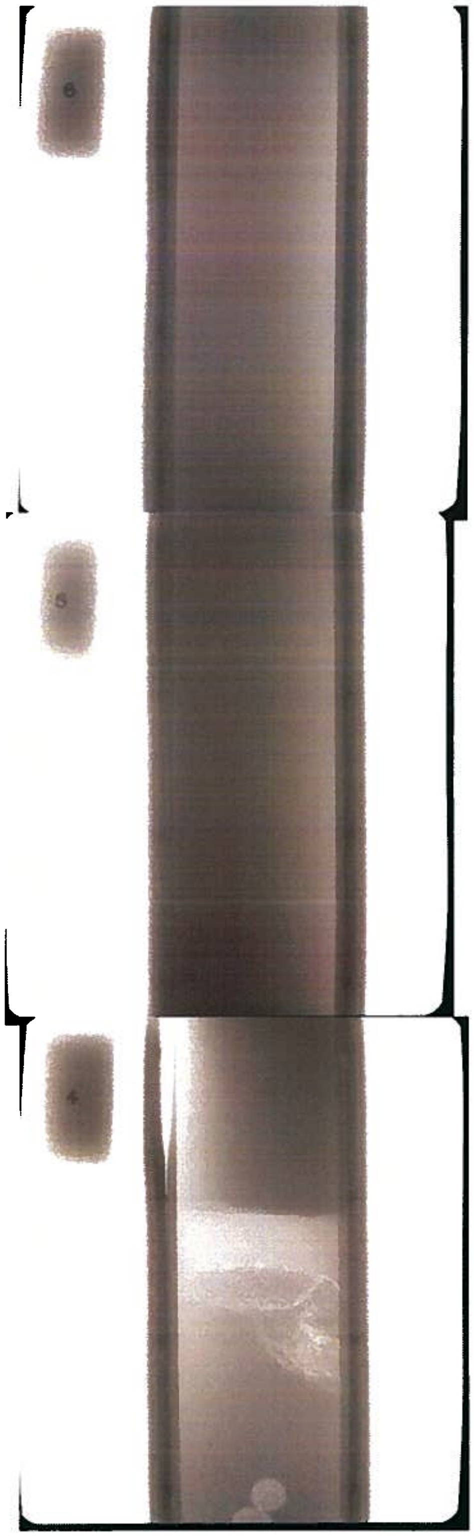
Top of Tube

Middle of Tube

Bottom of Tube

GeoTesting express
a subsidiary of Geocomp Corporation

| | |
|---|---|
| Client: | Haley & Aldrich, Inc. |
| Project Name: | Maine Health/United Way Development |
| Project Location: | Portland, ME |
| GTX #: | 8427 |
| Test Date: | 08/11/08 |
| Tested By: | edd/md |
| Checked By: | jdt |
| Boring ID: | HA08-4 |
| Sample ID: | U-2 |
| Depth, ft: | 33-35 |



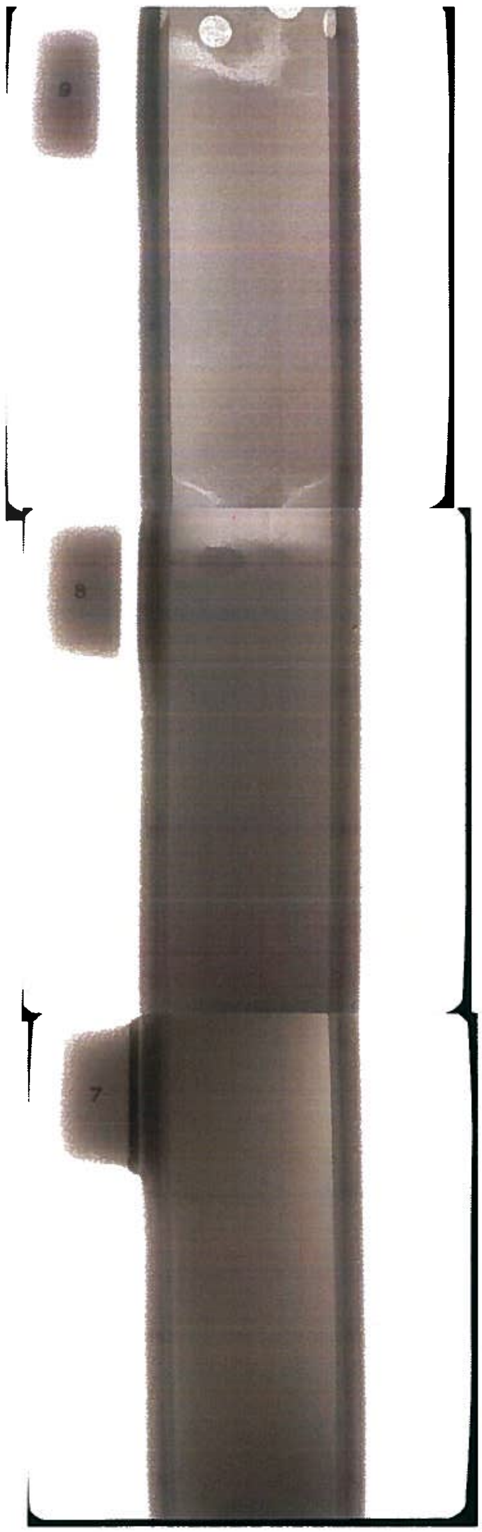
Top of Tube

Middle of Tube

Bottom of Tube

GeoTesting
express
a subsidiary of Geocomp Corporation

| | |
|---|---|
| Client: | Haley & Aldrich, Inc. |
| Project Name: | Maine Health/United Way Development |
| Project Location: | Portland, ME |
| GTX #: | 8427 |
| Test Date: | 08/11/08 |
| Tested By: | edd/md |
| Checked By: | jdt |
| Boring ID: | HA08-8 |
| Sample ID: | U-1 |
| Depth, ft: | 20-22 |



Top of Tube

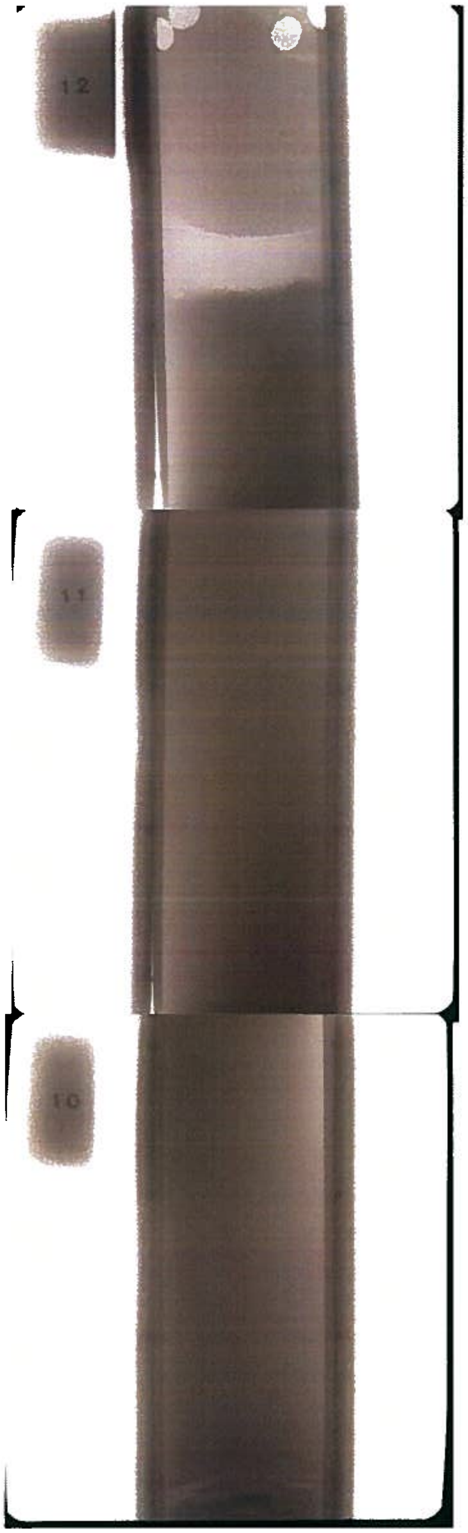
Middle of Tube

Bottom of Tube

GeoTesting express

a subsidiary of Geocomp Corporation

| | |
|---|---|
| Client: | Haley & Aldrich, Inc. |
| Project Name: | Maine Health/United Way Development |
| Project Location: | Portland, ME |
| GTX #: | 8427 |
| Test Date: | 08/11/08 |
| Tested By: | edd/md |
| Checked By: | jdt |
| Boring ID: | HA08-8 |
| Sample ID: | U-2 |
| Depth, ft: | 41-43 |



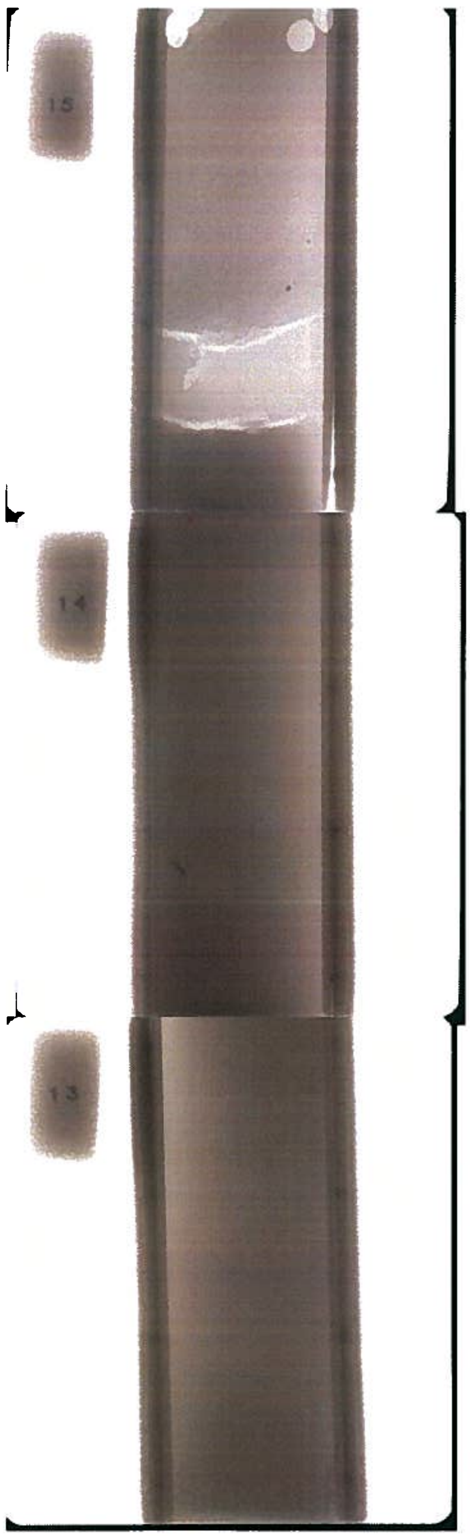
Top of Tube

Middle of Tube

Bottom of Tube

GeoTesting express
a subsidiary of Geocomp Corporation

| | |
|---|---|
| Client: | Haley & Aldrich, Inc. |
| Project Name: | Maine Health/United Way Development |
| Project Location: | Portland, ME |
| GTX #: | 8427 |
| Test Date: | 08/11/08 |
| Tested By: | edd/md |
| Checked By: | jdt |
| Boring ID: | HA08-10 |
| Sample ID: | U-1 |
| Depth, ft: | 25-27 |



Top of Tube

Middle of Tube

Bottom of Tube

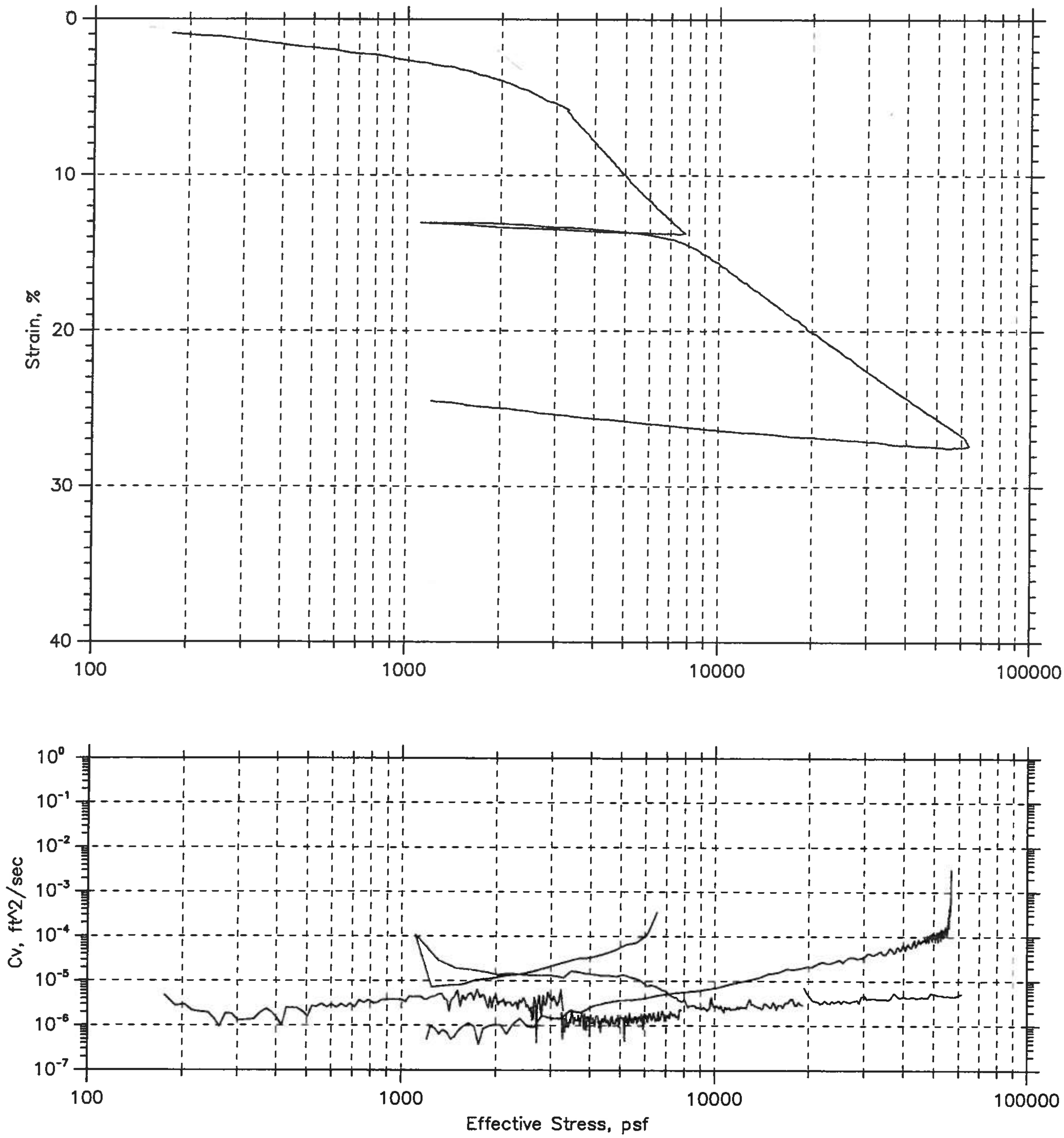
**Consolidation Test Reports**

HALEY & ALDRICH

## Constant Rate of Consolidation

Constant Strain Rate by ASTM D4186

Summary Report



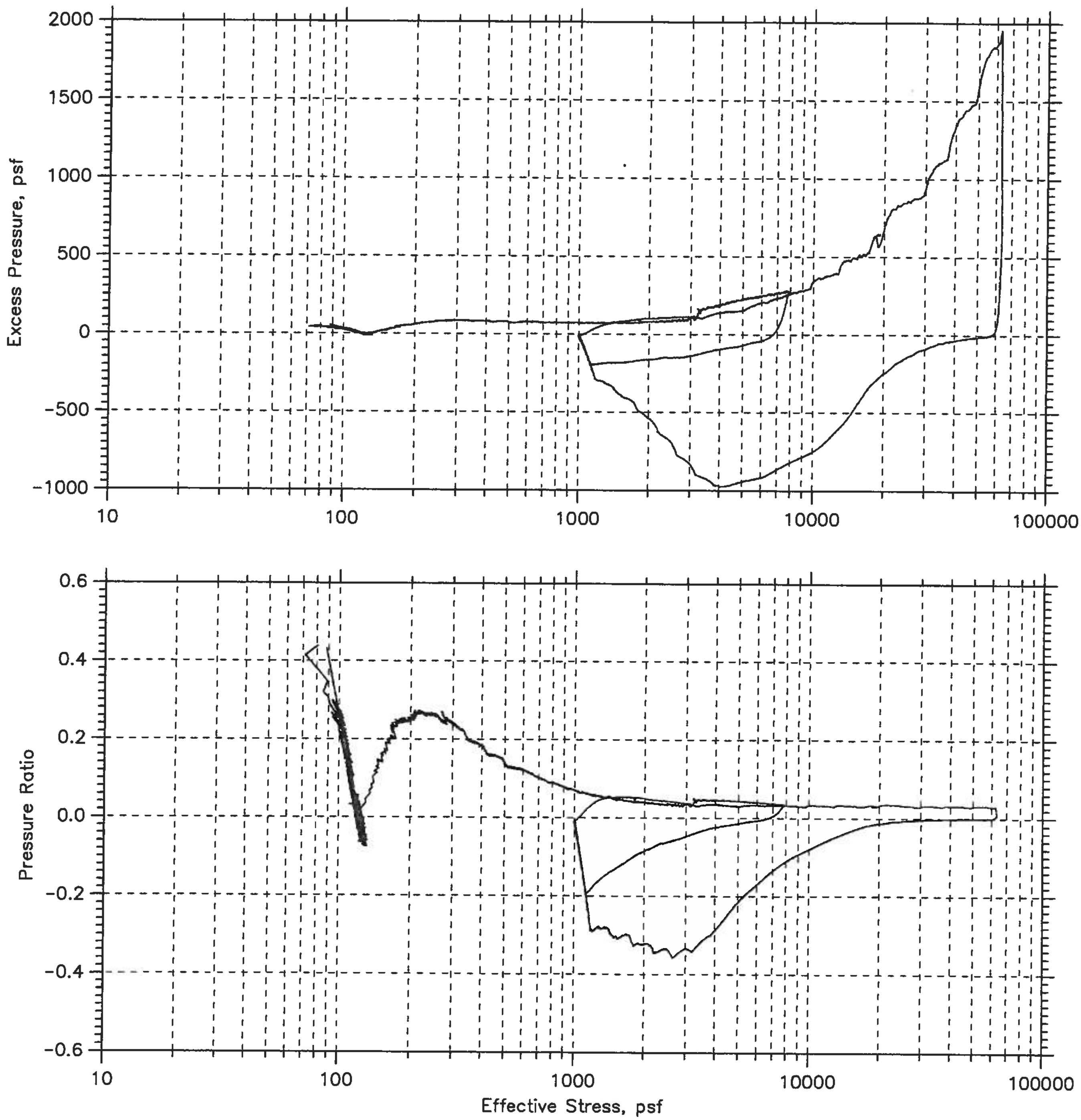

| | | |
|---|---|---|
| Project: Maine Health | Location: Portland, ME | Project No.: GTX-8427 |
| Boring No.: HA-08-4 | Tested By: md | Checked By: jdt |
| Sample No.: U-2 | Test Date: 08/27/08 | Depth: 33-35 |
| Test No.: CRC-1A | Sample Type: tube | Elevation: --- |
| Description: Moist, dark greenish gray clay | | |
| Remarks: System S | | |
| | | |

Wed, 03-SEP-2008 11:15:15

## Constant Rate of Consolidation

Constant Strain Rate by ASTM D4186

Pressure Curves




| | | |
|---|---|---|
| Project: Maine Health | Location: Portland, ME | Project No.: GTX-8427 |
| Boring No.: HA-08-4 | Tested By: md | Checked By: jdt |
| Sample No.: U-2 | Test Date: 08/27/08 | Depth: 33-35 |
| Test No.: CRC-1A | Sample Type: tube | Elevation: --- |
| Description: Moist, dark greenish gray clay | | |
| Remarks: System S | | |
| | | |

Wed, 03-SEP-2008 11:15:16

# CRC TEST DATA

Project: Maine Health
Boring No.: HA-08-4
Sample No.: U-2
Test No.: CRC-1A

Location: Portland, ME
Tested By: md
Test Date: 08/27/08
Sample Type: tube

Project No.: GTX-8427
Checked By: jdt
Depth: 33-35
Elevation: ---

Soil Description: Moist, dark greenish gray clay
Remarks: System S

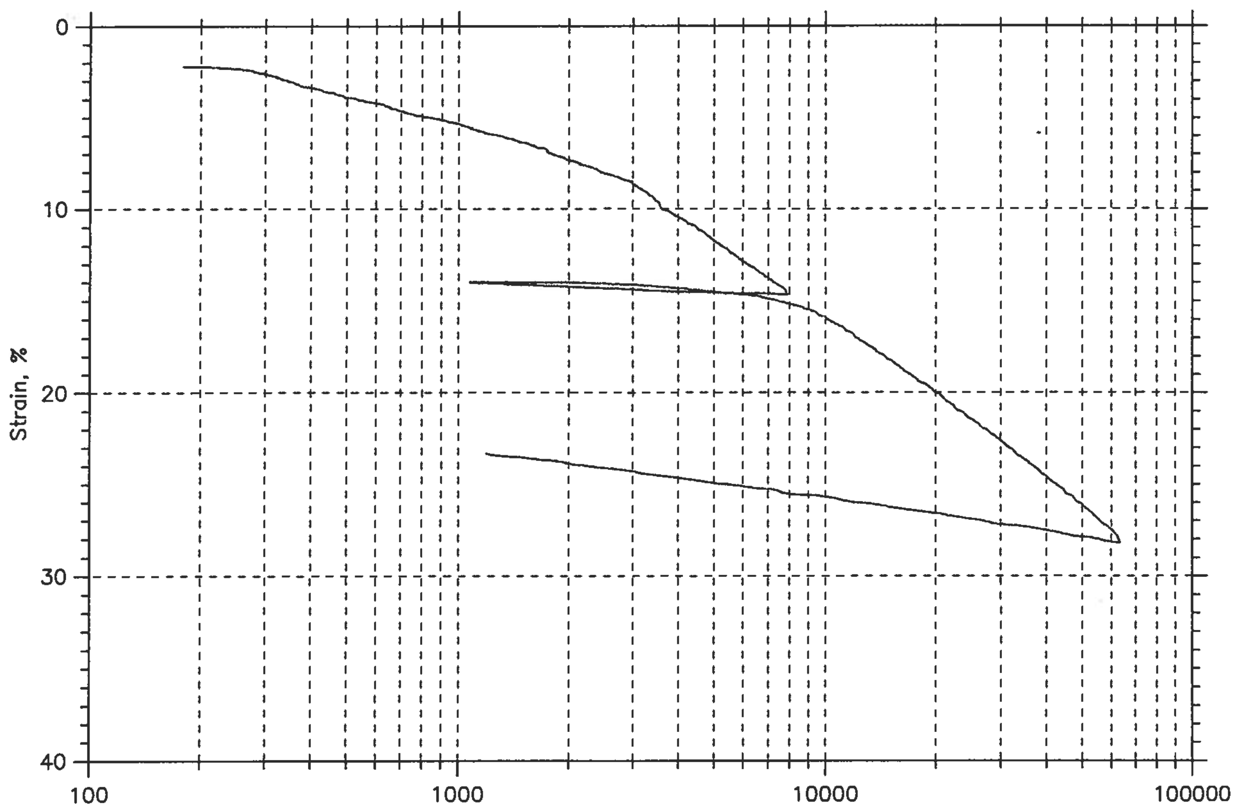
Estimated Specific Gravity: 2.80
Initial Void Ratio: 0.98
Final Void Ratio: 0.50

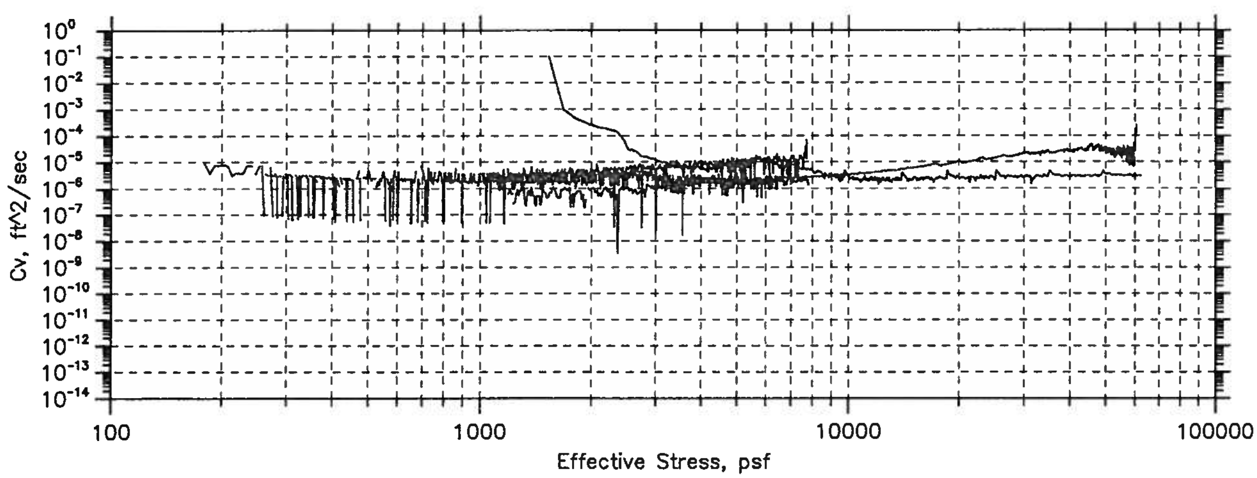
Liquid Limit: 41
Plastic Limit: 17
Plasticity Index: 24

Initial Height: 1.00 in
Specimen Diameter: 2.50 in

| | Before Consolidation | | After Consolidation | |
|---|---|---|---|---|
| | Trimmings | Specimen+Ring | Specimen+Ring | Trimmings |
| Container ID | 3217 | RING | | vrayum |
| Wt. Container + Wet Soil, gm | 211.83 | 353.9 | 336.26 | 140.32 |
| Wt. Container + Dry Soil, gm | 163.17 | 318.01 | 318.01 | 122.08 |
| Wt. Container, gm | 8.29 | 204.15 | 204.15 | 8.27 |
| Wt. Dry Soil, gm | 154.88 | 113.86 | 113.86 | 113.81 |
| Water Content, % | 31.42 | 31.52 | 16.03 | 16.03 |
| Void Ratio | --- | 0.98 | 0.50 | --- |
| Degree of Saturation, % | --- | 90.23 | 90.62 | --- |
| Dry Unit Weight, pcf | --- | 88.366 | 116.9 | --- |

## Constant Rate of Consolidation
Constant Strain Rate by ASTM D4186
Summary Report

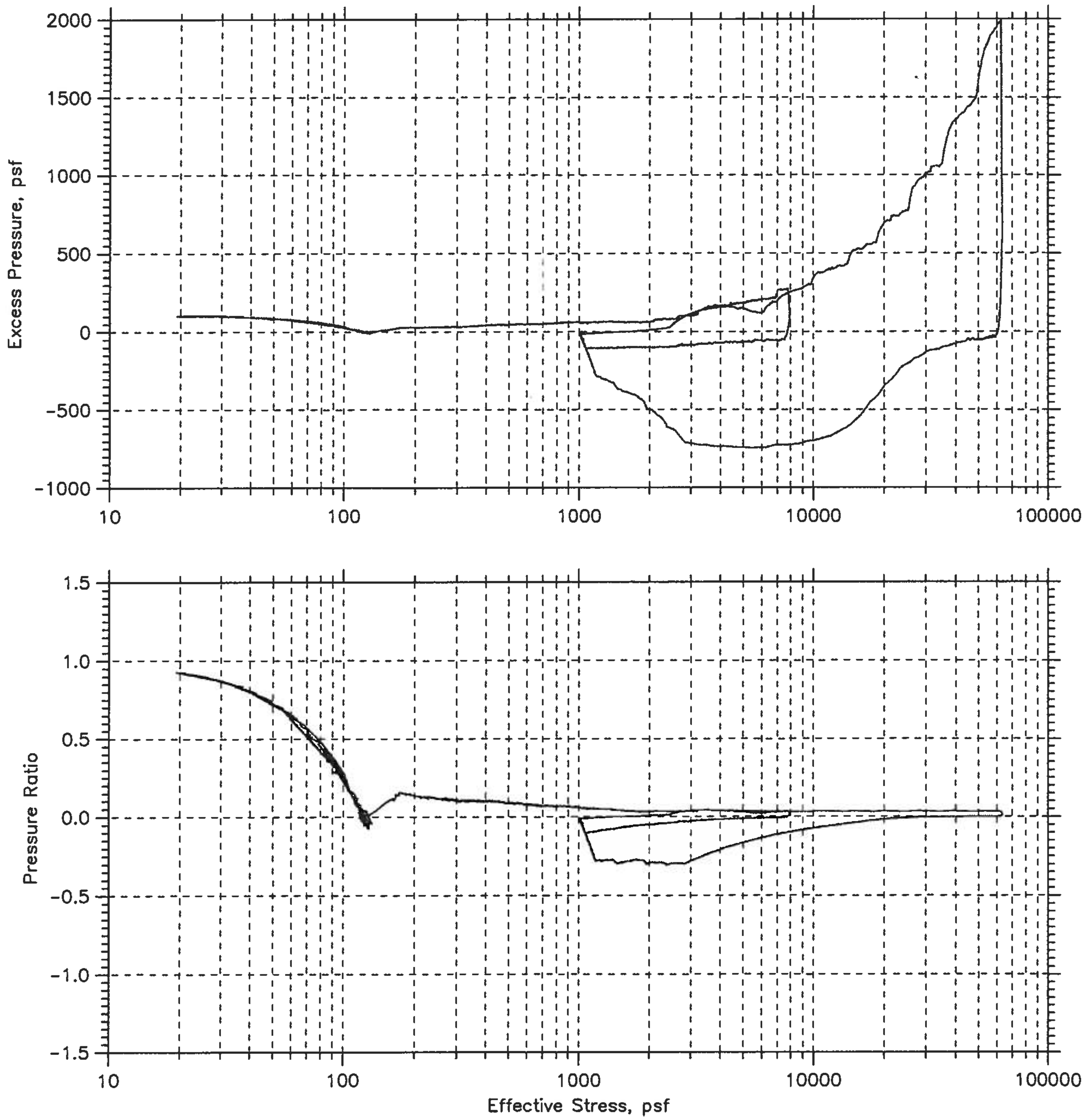



| | | |
|---|---|---|
| Project: Maine Health | Location: Portland, ME | Project No.: GTX-8427 |
| Boring No.: HA-08-10 | Tested By: md | Checked By: jdt |
| Sample No.: U-1 | Test Date: 08/25/08 | Depth: 25-27 |
| Test No.: CRC-2 | Sample Type: tube | Elevation: --- |
| Description: Moist, gray clay | | |
| Remarks: System 0 | | |
| | | |

Fri, 05-SEP-2008 11:12:28

## Constant Rate of Consolidation
Constant Strain Rate by ASTM D4186
Pressure Curves




| | | |
|---|---|---|
| Project: Maine Health | Location: Portland, ME | Project No.: GTX-8427 |
| Boring No.: HA-08-10 | Tested By: md | Checked By: jdt |
| Sample No.: U-1 | Test Date: 08/25/08 | Depth: 25-27 |
| Test No.: CRC-2 | Sample Type: tube | Elevation: --- |
| Description: Moist, gray clay | | |
| Remarks: System 0 | | |

Fri, 05-SEP-2008 11:12:37

CRC TEST DATA

Project: Maine Health
Boring No.: HA-08-10
Sample No.: U-1
Test No.: CRC-2

Location: Portland, ME
Tested By: md
Test Date: 08/25/08
Sample Type: tube

Project No.: GTX-8427
Checked By: jdt
Depth: 25-27
Elevation: ---

Soil Description: Moist, gray clay
Remarks: System O

Estimated Specific Gravity: 2.90
Initial Void Ratio: 1.13
Final Void Ratio: 0.64

Liquid Limit: 38
Plastic Limit: 17
Plasticity Index: 21

Initial Height: 1.00 in
Specimen Diameter: 2.50 in

| | Before Consolidation | | After Consolidation | |
|---|---|---|---|---|
| | Trimmings | Specimen+Ring | Specimen+Ring | Trimmings |
| Container ID | organic | RING | | 3171 |
| Wt. Container + Wet Soil, gm | 118.23 | 368.58 | 349.88 | 26.19 |
| Wt. Container + Dry Soil, gm | 88.77 | 325.88 | 325.88 | 22.93 |
| Wt. Container, gm | 8.07 | 216.55 | 216.55 | 8.08 |
| Wt. Dry Soil, gm | 80.7 | 109.33 | 109.33 | 14.85 |
| Water Content, % | 36.51 | 39.06 | 21.95 | 21.95 |
| Void Ratio | --- | 1.13 | 0.64 | --- |
| Degree of Saturation, % | --- | 99.91 | 99.29 | --- |
| Dry Unit Weight, pcf | --- | 84.848 | 110.31 | --- |

**APPENDIX E**

**Soil Screening Headspace Reports**

HALEY & ALDRICH

# HEADSPACE SCREENING REPORT



| | | | |
|---|---|---|---|
| **PROJECT** | MaineHealth / UnitedWay Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP** | O. Lawlor |
| **INSTRUMENT** | Thermo 580B | **DATE SAMPLED** | 7/23/2008 - 7/24/2008 |
| **DATE CALIBRATED** (1) | 7/28/2008 **LAMP (eV)** 10.6 | **DATE SCREENED** | 7/28/2008 |
| **AMBIENT TEMPERATURE** | RT **CALIBRATED BY** DAD | **SCREENING LOC.** | H&A Portland Lab |

| Exploration | Sample Number | Depth (ft) | Sample Description | Sample Reading (ppm)(2) | Back-Ground Reading (ppm)(2) | Remarks | GC(3) | Containers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Drill Jar | | | |
| HA08-3 | S1 | 1.0-3.0 | well graded gravel with sand | 0.9 | 0.0 | | | X | | | |
| HA08-3 | S2 | 3.0-5.0 | silty sand with ash & cinders | 1.2 | 0.0 | | | X | | | |
| HA08-3 | S3 | 5.0-7.0 | cinders, ash, brick, and coal | 2.8 | 0.0 | | | X | | | |
| HA08-3 | S4 | 7.0-9.0 | poorly-graded gravel, cinders | 1.5 | 0.0 | | | X | | | |
| HA08-3 | S5 | 10.0-12.0 | silty sand, cinders and ash | 14.9 | 0.0 | | | X | | | |
| HA08-3 | S6 | 12.0-14.0 | silt with sand, shells, organics | 0.0 | 0.0 | | | X | | | |
| HA08-3 | S7 | 14.0-16.0 | silt with sand, shells, H2S odor | 0.0 | 0.0 | | | X | | | |
| HA08-6 | S1 | 0.0-2.0 | silty sand | 0.0 | 0.0 | | | X | | | |
| HA08-6 | S2 | 2.0-4.0 | silty sand, brick, cinders, wood | 0.0 | 0.0 | Tinfoil cover torn | | X | | | |
| HA08-6 | S3 | 4.0-6.0 | silty to well graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-6 | S4 | 6.0-8.0 | poorly graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-6 | S5 | 8.0-10.0 | silty sand with gravel | 0.0 | 0.0 | | | X | | | |
| HA08-6 | S6 | 10.0-12.0 | silty sand w/ gravel, brick, shell | 0.0 | 0.0 | | | X | | | |
| HA08-6 | S7 | 12.0-14.0 | sandy silt, shell fragments | 0.0 | 0.0 | | | X | | | |
| HA08-9 | S1 | 0.0-2.0 | silty gravel with sand, org odor | 0.0 | 0.0 | | | X | | | |
| HA08-9 | S2 | 2.0-4.0 | cinders and ash to silty sand | 0.0 | 0.0 | | | X | | | |
| HA08-9 | S3 | 4.0-6.0 | silty sand | 0.0 | 0.0 | | | X | | | |
| HA08-9 | S4 | 6.0-8.0 | silty sand with gravel | 0.0 | 0.0 | | | X | | | |
| HA08-9 | S5 | 8.0-10.0 | silty sand with gravel | 0.0 | 0.0 | | | X | | | |
| HA08-9 | S6 | 10.0-12.0 | silty sand, wood and glass | 0.0 | 0.0 | | | X | | | |
| HA08-9 | S7 | 12.0-14.0 | silt, wood fragments, org odor | 0.0 | 0.0 | Poor sample recovery | | X | | | |
| HA08-9 | S8 | 14.0-16.0 | lean clay | 0.0 | 0.0 | | | X | | | |
| HA08-12 | S1 | 0.0-2.0 | silty sand with gravel, cinders | 0.0 | 0.0 | | | X | | | |
| HA08-12 | S2 | 2.0-4.0 | silty sand with gravel, cinders | 0.0 | 0.0 | | | X | | | |
| HA08-12 | S3 | 4.0-6.0 | silty sand - poorly graded sand | 0.0 | 0.0 | | | X | | | |

1. Instrument calibrated to the manufacturer standard.
2. ppm represents concentration of detectable volatile gaseous compounds in parts per million of air.
3. Sample assigned for gas chromatograph screening.

| Sampled and relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|
| Sign: NA | Sign: NA | Sign: NA | Sign: NA |
| Print: NA | Print: NA | Print: NA | Print: NA |
| Firm: NA | Firm: NA | Firm: NA | Firm: NA |
| Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA |

HALEY & ALDRICH

# HEADSPACE SCREENING REPORT



| | | | |
|---|---|---|---|
| **PROJECT** | MaineHealth / UnitedWay Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP** | O. Lawlor |
| **INSTRUMENT** | Thermo 580B | **DATE SAMPLED** | 7/23/2008 - 7/24/2008 |
| **DATE CALIBRATED** (1) | 7/28/2008 **LAMP (eV)** 10.6 | **DATE SCREENED** | 7/28/2008 |
| **AMBIENT TEMPERATURE** | RT **CALIBRATED BY** DAD | **SCREENING LOC.** | H&A Portland Lab |

| Exploration | Sample Number | Depth (ft) | Sample Description | Sample Reading (ppm)(2) | Back-Ground Reading (ppm)(2) | Remarks | GC(3) | Containers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Drill Jar | | | |
| HA08-12 | S4 | 6.0-8.0 | poorly graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-12 | S5 | 8.0-10.0 | well graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-12 | S6 | 10.0-12.0 | well graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-12 | S7 | 12.0-14.0 | no recovery, shells in wash | 0.0 | 0.0 | | | X | | | |

1. Instrument calibrated to the manufacturer standard.
2. ppm represents concentration of detectable volatile gaseous compounds in parts per million of air.
3. Sample assigned for gas chromatograph screening.

| Sampled and relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|
| Sign: NA | Sign: NA | Sign: NA | Sign: NA |
| Print: NA | Print: NA | Print: NA | Print: NA |
| Firm: NA | Firm: NA | Firm: NA | Firm: NA |
| Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA |

HALEY & ALDRICH

# HEADSPACE SCREENING REPORT



| | | | |
|---|---|---|---|
| **PROJECT** | MaineHealth / UnitedWay Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP** | O. Lawlor |
| **INSTRUMENT** | Thermo 580B | **DATE SAMPLED** | 7/28/2008 - 7/29/2008 |
| **DATE CALIBRATED** (1) | 7/30/2008 **LAMP (eV)** 10.6 | **DATE SCREENED** | 7/30/2008 |
| **AMBIENT TEMPERATURE** | RT **CALIBRATED BY** DAD | **SCREENING LOC.** | H&A Portland Lab |

| Exploration | Sample Number | Depth (ft) | Sample Description | Sample Reading (ppm)(2) | Back-Ground Reading (ppm)(2) | Remarks | GC(3) | Containers: Drill Jar | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HA08-11 | S1 | 0.0-2.0 | sand w/ brick, cinders & plastic | 0.0 | 0.0 | | | X | | | |
| HA08-11 | S2 | 2.0-4.0 | sand w/ brick, cinders & plastic | 5.0 | 0.0 | | | X | | | |
| HA08-11 | S3 | 4.0-6.0 | poorly graded sand | 12.3 | 0.0 | | | X | | | |
| HA08-11 | S4 | 6.0-8.0 | well graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-11 | S5 | 8.0-10.0 | well graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-11 | S6 | 10.0-12.0 | well graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-13 | S1 | 0.0-2.0 | poorly graded sand, cinders | 0.0 | 0.0 | | | X | | | |
| HA08-13 | S2 | 2.0-4.0 | poorly graded sand,cinder&ash | 0.0 | 0.0 | | | X | | | |
| HA08-13 | S3 | 4.0-6.0 | poorly graded sand,cinder&ash | 0.0 | 0.0 | | | X | | | |
| HA08-13 | S4 | 6.0-8.0 | well graded gravel, wood&glass | 0.0 | 0.0 | | | X | | | |
| HA08-13 | S5 | 8.0-10.0 | gravel, wood and glass | 0.0 | 0.0 | | | X | | | |
| HA08-13 | S6 | 10.0-12.0 | sandy silt, wood, glass & shells | 0.0 | 0.0 | | | X | | | |

1. Instrument calibrated to the manufacturer standard.
2. ppm represents concentration of detectable volatile gaseous compounds in parts per million of air.
3. Sample assigned for gas chromatograph screening.

| Sampled and relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|
| Sign: NA | Sign: NA | Sign: NA | Sign: NA |
| Print: NA | Print: NA | Print: NA | Print: NA |
| Firm: NA | Firm: NA | Firm: NA | Firm: NA |
| Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA |

HALEY & ALDRICH

# HEADSPACE SCREENING REPORT



| | | | |
|---|---|---|---|
| **PROJECT** | MaineHealth / UnitedWay Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP** | O. Lawlor |
| **INSTRUMENT** | Thermo 580B | **DATE SAMPLED** | 7/30/2008 - 8/4/2008 |
| **DATE CALIBRATED** (1) | 7/30/2008 **LAMP (eV)** 10.6 | **DATE SCREENED** | 8/6/2008 |
| **AMBIENT TEMPERATURE** | RT **CALIBRATED BY** DAD | **SCREENING LOC.** | H&A Portland Lab |

| Exploration | Sample Number | Depth (ft) | Sample Description | Sample Reading (ppm)(2) | Back-Ground Reading (ppm)(2) | Remarks | GC(3) | Containers: Drill Jar | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HA08-4 | S1 | 0.5-2.5 | sand with silt, cinder and ash | 69.0 | 0.0 | | | X | | | |
| HA08-4 | S2 | 2.5-4.5 | sand with silt, cinder and ash | 55.0 | 0.0 | | | X | | | |
| HA08-4 | S3 | 5.0-7.0 | silty sand, cinder and ash | 0.0 | 0.0 | | | X | | | |
| HA08-4 | S4 | 7.0-9.0 | poorly graded sand with wood | 40.0 | 0.0 | | | X | | | |
| HA08-4 | S5 | 9.0-11.0 | sand w/ silt, wood, glass, shells | 0.0 | 0.0 | | | X | | | |
| HA08-5 | S1 | 0.0-2.0 | poorly graded sand, cinder, ash | 123.0 | 0.0 | | | X | | | |
| HA08-5 | S2 | 2.0-4.0 | poorly graded sand, cinder, ash | 114.0 | 0.0 | | | X | | | |
| HA08-5 | S3 | 4.0-6.0 | poorly graded sand, cinder, ash | 6.0 | 0.0 | | | X | | | |
| HA08-5 | S4 | 6.0-8.0 | poorly graded sand, cinder, ash | 4.2 | 0.0 | | | X | | | |
| HA08-5 | S5 | 8.0-10.0 | silty sand, shell and brick | 2.5 | 0.0 | | | X | | | |
| HA08-7 | S1 | 0.0-2.0 | sand with silt, ash, brick, wood | 9.4 | 0.0 | | | X | | | |
| HA08-7 | S2 | 2.0-4.0 | sand with silt, ash, brick | 4.2 | 0.0 | | | X | | | |
| HA08-7 | S3 | 4.0-6.0 | silty sand, cinder and ash | 0.8 | 0.0 | | | X | | | |
| HA08-7 | S4 | 6.0-8.0 | silty sand, cinder and ash | 0.8 | 0.0 | | | X | | | |
| HA08-7 | S5 | 8.0-10.0 | well graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-7 | S6 | 10.0-12.0 | silty sand, trace clay | 0.0 | 0.0 | | | X | | | |

1. Instrument calibrated to the manufacturer standard.
2. ppm represents concentration of detectable volatile gaseous compounds in parts per million of air.
3. Sample assigned for gas chromatograph screening.

| Sampled and relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|
| Sign: NA | Sign: NA | Sign: NA | Sign: NA |
| Print: NA | Print: NA | Print: NA | Print: NA |
| Firm: NA | Firm: NA | Firm: NA | Firm: NA |
| Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA |

HALEY & ALDRICH

# HEADSPACE SCREENING REPORT



| | | | |
|---|---|---|---|
| **PROJECT** | MaineHealth / UnitedWay Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP** | O. Lawlor |
| **INSTRUMENT** | Thermo 580B | **DATE SAMPLED** | 8/6/2008 - 8/13/2008 |
| **DATE CALIBRATED** (1) | | **DATE SCREENED** | 8/13/2008 |
| **LAMP (eV)** | 10.6 | **SCREENING LOC.** | H&A Portland Lab |
| **AMBIENT TEMPERATURE** | RT | **CALIBRATED BY** | DAD |

| Exploration | Sample Number | Depth (ft) | Sample Description | Sample Reading (ppm)(2) | Back-Ground Reading (ppm)(2) | Remarks | GC(3) | Containers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Drill Jar | | | |
| HA08-8 | S1 | 0.0-2.0 | poorly graded sand with gravel | 0.0 | 0.0 | | | X | | | |
| HA08-8 | S2 | 2.0-4.0 | silty sand with gravel | 0.0 | 0.0 | | | X | | | |
| HA08-8 | S3 | 5.0-7.0 | silty sand with gravel | 5.9 | 0.0 | | | X | | | |
| HA08-8 | S4 | 7.0-9.0 | silty sand with gravel | 14.5 | 0.0 | | | X | | | |
| HA08-1 | S1 | 1.0-3.0 | well graded gravel, concrete | 0.0 | 0.0 | | | X | | | |
| HA08-1 | S2 | 3.0-5.0 | silty sand, concrete, ash | 0.0 | 0.0 | | | X | | | |
| HA08-1 | S3 | 5.0-7.0 | silty sand | 0.0 | 0.0 | Tinfoil cover torn | | X | | | |
| HA08-1 | S4 | 7.0-9.0 | silty sand | 0.0 | 0.0 | | | X | | | |
| HA08-1 | S5 | 10.0-12.0 | sandy organic soil, with shells | 0.0 | 0.0 | | | X | | | |
| HA08-1 | S6 | 12.0-14.0 | sandy organic soil, with shells | 0.0 | 0.0 | Tinfoil cover torn | | X | | | |
| HA08-10 | S1 | 0.0-2.0 | sandy silt, brick | 0.0 | 0.0 | | | X | | | |
| HA08-10 | S2 | 2.0-4.0 | silty sand | 0.0 | 0.0 | | | X | | | |
| HA08-10 | S3 | 4.0-6.0 | silty sand | 0.0 | 0.0 | | | X | | | |
| HA08-10 | S4 | 6.0-8.0 | silty sand, wood w/ creosote | 0.0 | 0.0 | | | X | | | |
| HA08-10 | S5 | 8.0-10.0 | sandy organic silt, brick, metal | 0.0 | 0.0 | | | X | | | |
| HA08-2 | S1 | 0.0-2.0 | silty sand, wood and ash | 0.0 | 0.0 | | | X | | | |
| HA08-2 | S2 | 4.0-6.0 | poorly graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-2 | S3 | 6.0-8.0 | poorly graded sand | 0.0 | 0.0 | | | X | | | |
| HA08-2 | S4 | 8.0-10.0 | silty gravel, shells and wood | 0.0 | 0.0 | | | X | | | |
| HA08-2 | S5 | 10.0-12.0 | poorly graded gravel | 0.0 | 0.0 | | | X | | | |

1. Instrument calibrated to the manufacturer standard.
2. ppm represents concentration of detectable volatile gaseous compounds in parts per million of air.
3. Sample assigned for gas chromatograph screening.

| Sampled and relinquished by: | Received by: | Relinquished by: | Received by: |
|---|---|---|---|
| Sign: NA | Sign: NA | Sign: NA | Sign: NA |
| Print: NA | Print: NA | Print: NA | Print: NA |
| Firm: NA | Firm: NA | Firm: NA | Firm: NA |
| Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA | Date: NA Time: NA |

# APPENDIX F

## Historic Sanborn Maps

# PORTLAND

## MAINE

PUBLISHED BY THE

## Sanborn Map and Publishing Co.

LIMITED

117 BROADWAY NEW YORK

SCALE 50 FT. TO AN INCH

## OCT, 1886



## INDEX.

### STREETS.

A

| | | |
|---|---|---|
| Adams, | | 3 |
| " Court, | | 6 |
| Alder, | 1-33 | 22 |
| " | 35-79 | 13 |
| Anderson, | 1-64 | 30 |
| Arsenal, | 1-35 | 25 |
| Ashland Ave., | | 3 |
| Atlantic, | 67-184 | 23 |

B

| | | |
|---|---|---|
| Beach, | | 31 |
| Beckett, | 81-103 | 23 |
| Bond, | 1-13 | 30 |
| Boyd, | 1-45 | 30 |
| Brackett, | 1-45 | 30 |
| " | 81-127 | *27 |
| " | [illegible] | [illegible] |
| Bradford, | 1-33 | *3 |
| Brattle, | | 13 |
| Briggs, | | 22 |
| Brown, | 1-71 | *18 |
| " | 2-72 | *13 |
| Burnham's Lane, | | 6 |

C

| | | |
|---|---|---|
| Canton, | | 13 |
| Cary Lane, | | 3 |
| Cedar, | | 16 |
| Center, | 1-40 | 8 |
| " | 41-101 | 25 |
| " | 100-130 | 19 |
| Central, | | 9 |
| Chapel, | | 16 |
| [illegible] | | |

### SPECIALS.

[illegible]

* Indicates only one side of Street shown.

SITE (APPROX.)
Back Bay.
PORTLAND ME.
15
SOMERSET
KENNEBEC
LINCOLN
OXFORD
CUMBERLAND
PREBLE
ELM
CEDAR
CHESTNUT
STONE ST.
FOREST AVE.
ELMWOOD PL.
HALL
LANE
MERRILL CT.
J.F. MERRILL REFRIGERATOR M'F'Y.
W. H. STONE SAWG. PLANING & MOULDING MILL.
E.D. PETTENGILL & CO. PICKLE M'F'Y.
PORTLAND & ROCHESTER R.R. FREIGHT HO.
PORTLAND STOVE FOUNDRY CO. WORKS.
C.E. WHITNEY CARRIAGE M'F'Y.
CASCO CARBONIZED & CEMENT PIPE CO.
C.H. BUCKNAM. FURN'E M'F'Y.
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
Scale of Feet.
SEE SHEET No. 10.
SEE SHEET No. 16.
No. 13.
No. 22.
No. 33.


1886

INSURANCE MAPS

# Portland

## MAINE

### VOLUME ONE

PUBLISHED BY THE

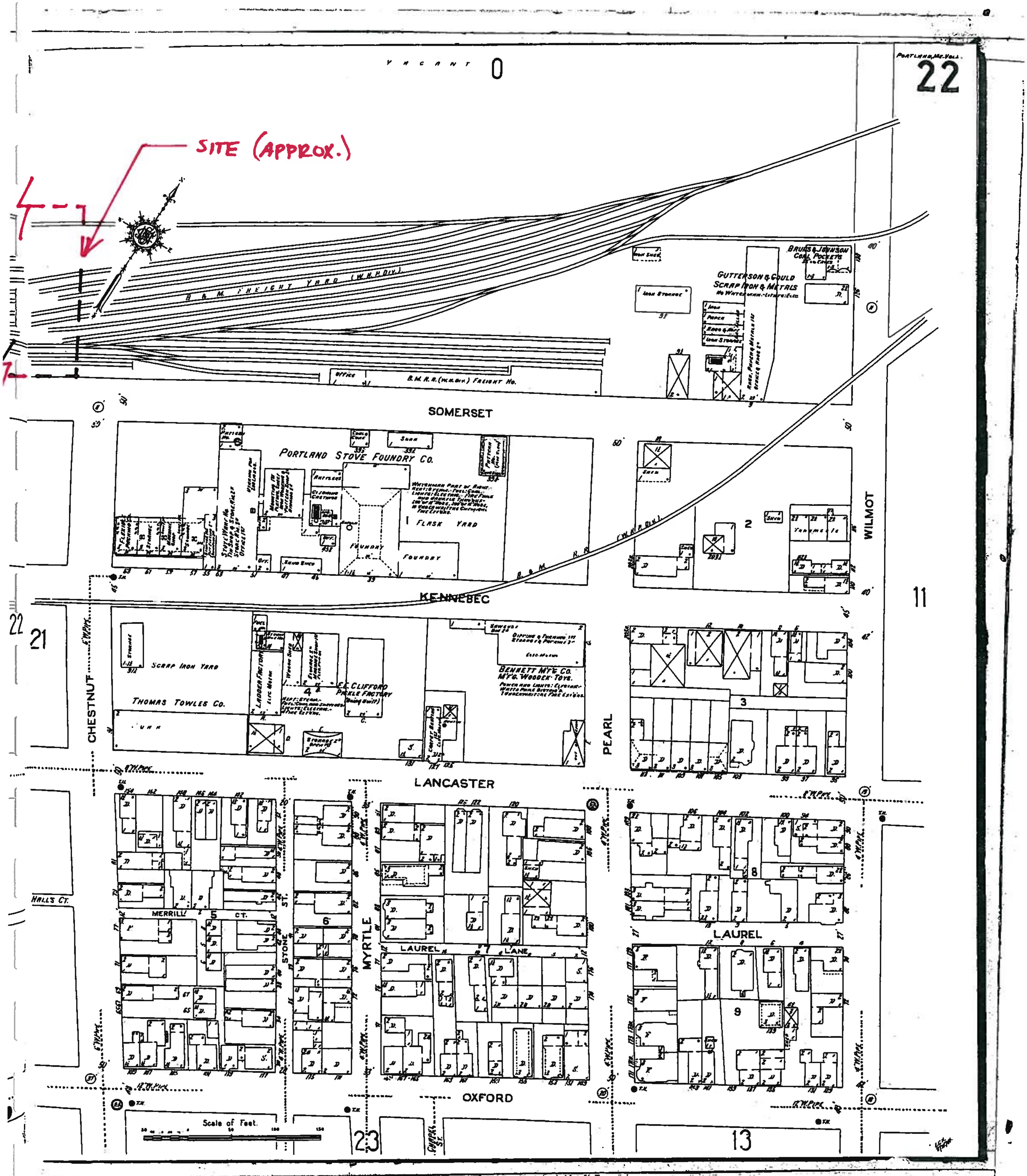
SANBORN MAP COMPANY

11 BROADWAY, NEW YORK

1909


21
35
0
SITE (APPROX.)
35
W.R. ALLEN CO.
MF'G INTERIOR FINISH
SOMERSET
W BURROWES BUILDER
JEROME RUMERY & CO
PLANING & MOULDING MILL
BERRY-CLARK CO.
STORE FIXTURES.
LUMBER
SHED
ALDER
B. & M. R.R.
B.&M. R.R. PASSENGER DEPOT
KENNEBEC
PREBLE
7
22
36
HOTEL
COBB & WEBSTER CARP'N SHOP
CEDAR
CHESTNUT
LANCASTER
ELM
LOCKE & YORKS CARRIAGE CO.
HALL'S CT.
OXFORD
36
23
Scale of Feet

1909



PORTLAND, ME. VOL. 1
22
VACANT
SITE (APPROX.)
B. & M. FREIGHT YARD (W.N.P. DIV.)
B. M. R.R. (W.N.DIV.) FREIGHT HO.
GUTTERSON & GOULD SCRAP IRON & METALS
BRUNS & JOHNSON COAL POCKETS
SOMERSET
PORTLAND STOVE FOUNDRY CO.
FLASK YARD
FOUNDRY
B. & M. R.R. (W.N.P. DIV.)
KENNEBEC
WILMOT
11
22
21
CHESTNUT
SCRAP IRON YARD
THOMAS TOWLES CO.
F.E. CLIFFORD PICKLE FACTORY (Being Built)
BENNETT MF'G. CO. MF'G. WOODEN TOYS.
PEARL
LANCASTER
HALL'S CT.
MERRILL CT.
STONE ST.
MYRTLE
LAUREL LANE
LAUREL
OXFORD
Scale of Feet.
23
CHAPEL ST.
13


1909

INSURANCE MAPS

# Portland

## MAINE

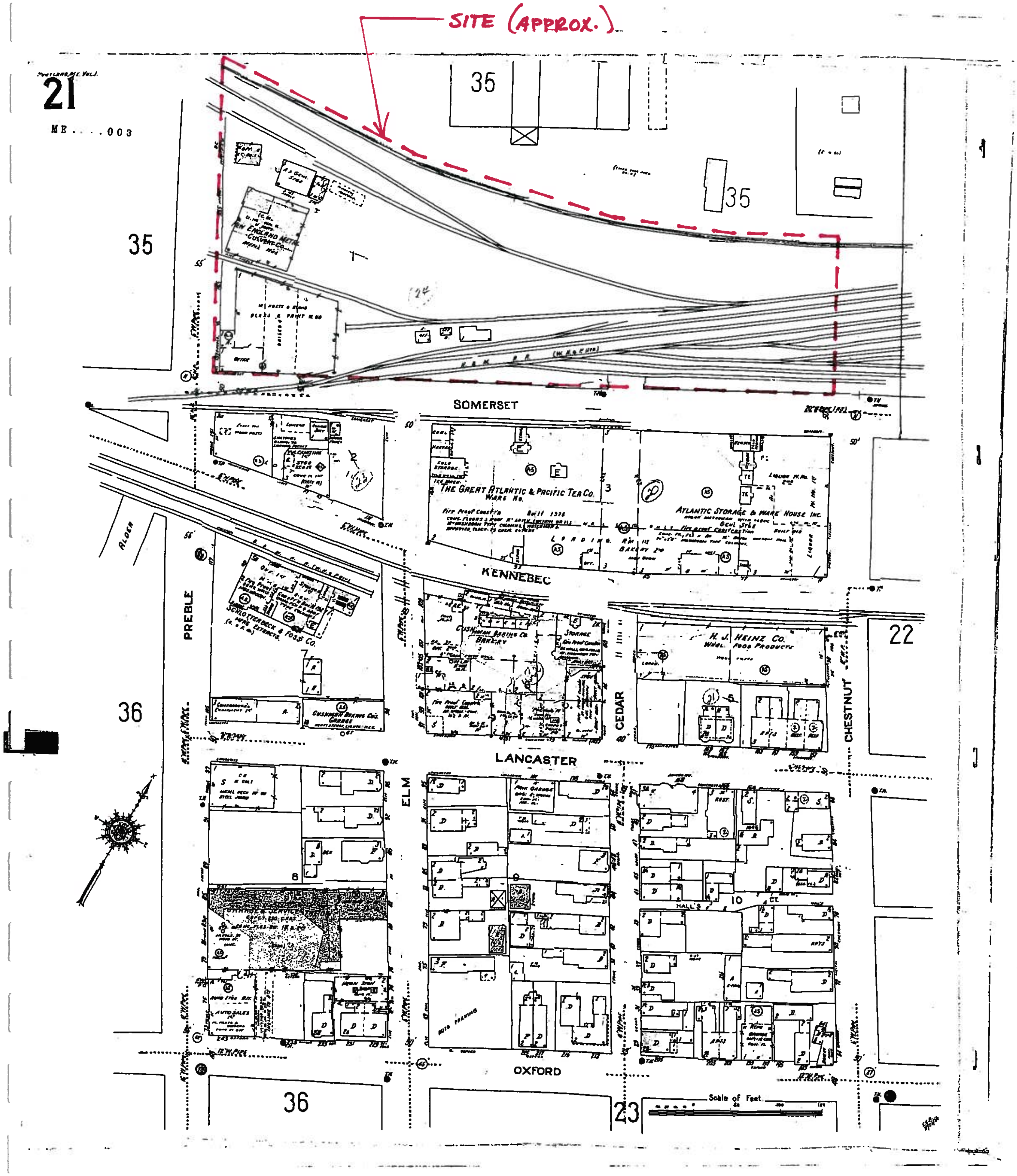
## VOLUME ONE

PUBLISHED BY THE

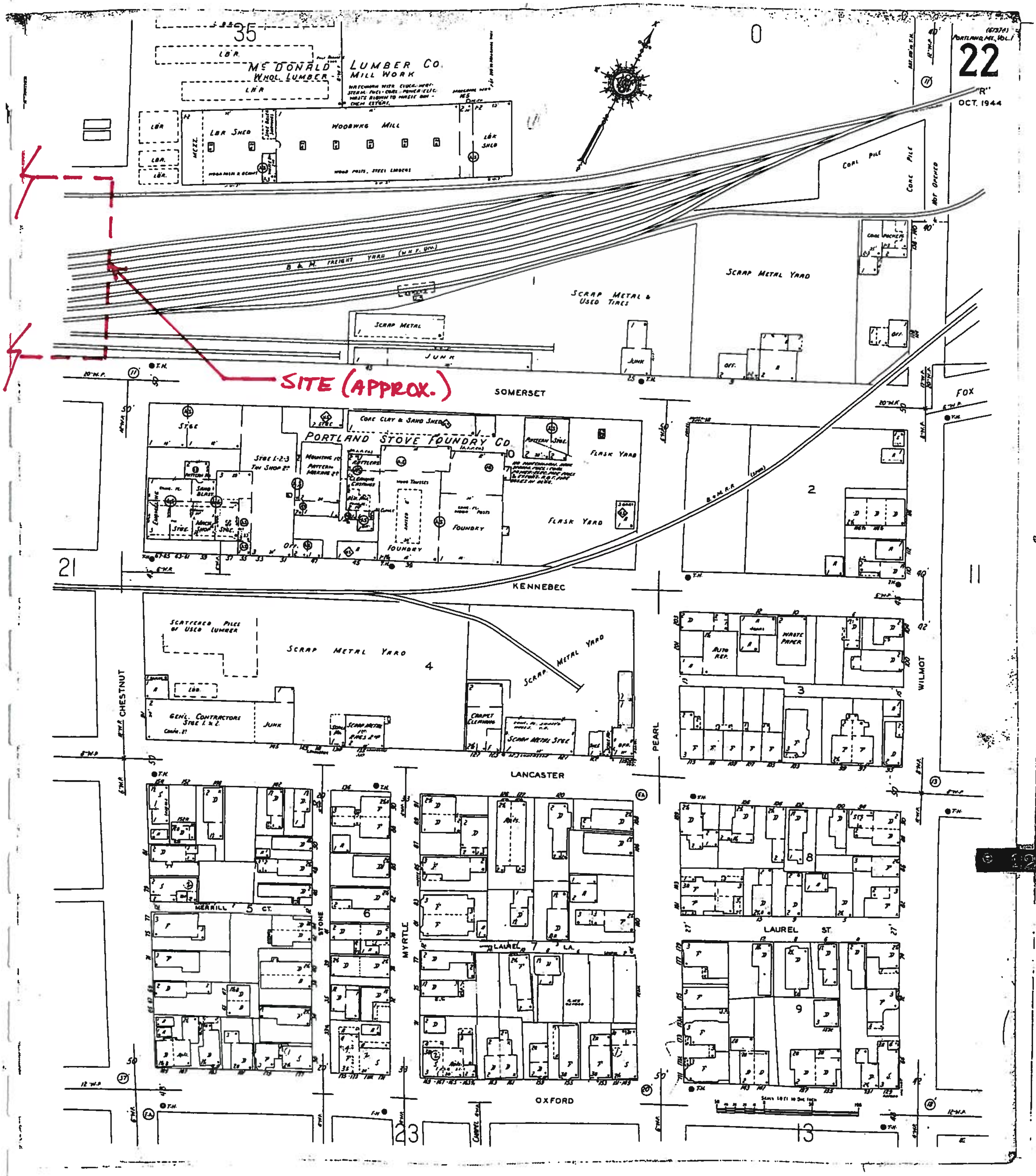
SANBORN MAP COMPANY

11 BROADWAY, NEW YORK

1909


SITE (APPROX.)
21
ME.....003
35
35
35
35
SOMERSET
THE GREAT ATLANTIC & PACIFIC TEA CO.
WARE HO.
ATLANTIC STORAGE & WARE HOUSE INC.
NEW ENGLAND METAL CULVERT CO.
KENNEBEC
CUSHMAN BAKING CO.
BAKERY
SCHLOTTERBECK & FOSS CO.
H. J. HEINZ CO.
WHOL. FOOD PRODUCTS
ALDER
PREBLE
36
ELM
CEDAR
CHESTNUT
22
LANCASTER
HALL'S CT.
OXFORD
36
23
Scale of Feet

1909 - 1950


22
PORTLAND, ME. VOL. I
OCT. 1944
Mc DONALD LUMBER Co.
WHOL. LUMBER
MILL WORK
WOODWKG MILL
LBR SHED
B. & M. FREIGHT YARD
SCRAP METAL & USED TIRES
SCRAP METAL YARD
COAL PILE
SCRAP METAL
JUNK
SITE (APPROX.)
SOMERSET
FOX
PORTLAND STOVE FOUNDRY CO.
FLASK YARD
FOUNDRY
KENNEBEC
SCRAP METAL YARD
GENL. CONTRACTORS
LANCASTER
CHESTNUT
PEARL
WILMOT
STONE
MYRTLE
MERRILL CT.
LAUREL LA.
LAUREL ST.
OXFORD

1909-1950

**Attachment B**

Haley & Aldrich
75 Washington Avenue
Suite 203
Portland, ME 04101-2617

Tel: 207.482.4600
Fax: 207.775.7666
HaleyAldrich.com

HALEY& ALDRICH

**MEMORANDUM**

4 December 2008
File No. 35611-000, -010

| | |
|---|---|
| TO: | Maine Medical Center<br>Mr. Daniel F. Doughty, AIA,<br>Ms. Nancy Innes |
| C: | Harriman Associates, Inc.; Patrick Costin, AIA, Keith Brenner, P.E.<br>Becker Structural Engineers; Todd Neal, P.E.<br>Scott Simons Architects; Scott Simons, AIA<br>Woodard & Curran; Barry Sheff, P.E.<br>Consigli Construction Co.; David Thomas |
| FROM: | Haley & Aldrich, Inc.<br>Bryan C. Steinert, Wayne A. Chadbourne, P.E.<br>BCS |
| SUBJECT: | Results of Test Pit Exploration Program<br>Maine Health/United Way Development<br>Somerset and Chestnut Streets<br>Portland, Maine |

This memorandum presents a summary of the exploratory test pit excavations performed for the subject project. This work was performed in accordance with our proposal dated 2 July 2008 and your subsequent authorization. The information summarized herein will be used by Haley & Aldrich and the rest of the design team to assess dewatering requirements for construction of the below-grade elements (i.e., grade beams, pile caps, elevator pits, utilities) of the proposed parking garage and office building.

## ELEVATION DATUM

Elevations referenced herein are in feet and reference Portland City Datum (PCD). Portland City Datum relates to the National Geodetic Vertical Datum of 1929 (NGVD 29) as follows:

Elevation in feet (PCD) = Elevation in ft (NGVD 29) + 0.02 ft

## TEST PIT EXPLORATIONS

Three exploratory test pits, designated TP-201 through TP-203, were excavated by Environmental Projects, Inc. (EPI) of Auburn, Maine on 20 October 2008. The test pits were excavated in the vicinity of previously installed groundwater observation wells using a Komatsu PC 35MR excavator. The test pits were excavated to depths ranging from approximately 8 to 11 ft below existing ground surface (BGS). A Haley & Aldrich engineer was on-site to monitor the excavations and to prepare logs detailing the soil and groundwater conditions encountered in each test pit. Upon completion, each excavation was backfilled up to ground surface. Approximate 16-in. thick lifts of excavated soils were used to backfill each test pit excavation. Each lift was moderately compacted using down-pressure from the excavator bucket. The approximate test pit locations are shown on the attached site plan. Test pit logs documenting encountered subsurface conditions and photographs taken during the test pit program are also attached.

## SOIL AND GROUNDWATER CONDITIONS

### Soil Conditions

Based on our review of historic Sanborn maps, this area of Bayside was once a tidal mudflat. At various times over the past century the site has been filled as the area has undergone development. Based on our test borings and test pits, 10 to 15 ft of man-placed fill soils are present within the footprints of the proposed office building and garage. As is typical of this material, the fill encountered in the test pit excavations was not uniform and primarily consisted of the following soil types:

- silty SAND (SM) with varying percentages of gravel
- poorly graded to well graded SAND (SP to SW) with varying percentages of silt and gravel

Please note that we encountered an undetermined thickness of reworked clay fill in the western portion of TP-203 below El. 5.5. Clay fill was not encountered in the other test pits or previous test borings (including boring HA08-5(OW) located approximately 10 ft northeast of TP-203). The fill soils generally contained ash, cinders, brick, concrete and porcelain fragments (see photographs). In addition, timber railroad ties and steel rails were encountered between 1 and 2 ft BGS in TP-201 (see photographs).

### Groundwater Conditions

Groundwater levels have been measured in the observation wells installed in completed boreholes HA08-5, HA08-7 and HA08-12 over the past several months. Back in August, downhole transducers were installed in these wells and groundwater levels were measured every 15 minutes (from 7 August to 22 August 2008). This was done to estimate the depth to the static groundwater levels at the site and to determine whether the groundwater levels are influenced by tidal fluctuations in nearby Back Cove. Based on the data collected in August 2008, groundwater levels were measured between 6 and 8 ft below existing ground surface, and the levels in the wells were determined not to be influenced by tidal fluctuations in Back Cove.

During the test pit program in October 2008, groundwater was encountered in each test pit excavation and ranged in depth from 6.5 to 10.5 ft BGS (stabilized levels). Water levels in the nearby observation wells were also measured during execution of the test pit program.

Groundwater levels have been measured in the observations wells twice since October 2008. The most recent measurements (1 December 2008) were conducted after a period of significant precipitation had occurred (2.0 in. of rain on 25 November and 0.75 in. of rain on 30 November).

A tabular summary of the water levels measured in the observation wells and test pits is provided below. Please note that the elevations are approximate and were based on ground topographic data provided by Woodard & Curran.

| Exploration | Ave. Groundwater Level Measured in Observation Well August 2008 | Groundwater Level Measured in Observation Well on 10/20/08 | Groundwater Level Measured in Test Pit Excavated on 10/20/08 | Groundwater Level Measured in Observation Well on 12/1/08 |
|---|---|---|---|---|
| TP-201/ HA08-12(OW) | El. 4.8 | El. 5.1 | El. 4.5 | El. 5.8 |
| TP-202/ HA08-7(OW) | El. 4.3 | El. 4.6 | El. 4.0 | El. 5.0 |
| TP-203/ HA08-5(OW) | El. 1.3 | El. 0.9 | El. -1.5 | El. 1.1 |

It is our opinion that the relatively low groundwater levels measured in TP-203 and HA08-5(OW) are a result of the presence of the clay fill material that is present in this area. The plan extent of the clay fill is not known. We have attached the groundwater monitoring reports for the three observation wells at the site with updated data through 1 December 2008.

Please note that the water levels in the observation wells rose as much as 1 ft from the October reading to the early December reading.

The test pits were excavated to depths coincident with the depth that groundwater infiltration into the test pits was observed. Based on measurements of recharge/recovery of the water levels in the test pits, we estimated groundwater infiltration rates of 5 to 10 gallons per minute (gpm). Each test pit was left open for approximately 1.5 hours. Water levels in the open test pits were measured and appeared to stabilize after approximately 30 minutes.

## CONSTRUCTION DEWATERING

Based on a proposed lowest-level floor slab at El. 11 and an average pile cap thickness of 4 ft, we estimate that the bottom of the excavations for the pile caps and grade beams will be at approximately El. 6 (approximate). Also, it is our understanding that the bottom of the elevator pit excavations will be approximately 1 to 2 ft below the bottom of the pile caps/grade beams, or approximately El. 4.

Based on the anticipated depth of excavations and the measured groundwater data summarized above, we anticipate that groundwater will be encountered in excavations required for construction of both the grade beams and pile caps and elevator pits. Based on our understanding of the current construction schedule, excavation work for grade beams, pile caps and elevator pits will be conducted in the winter of 2009. Because of this, we anticipate that groundwater levels encountered at the site will be within the levels summarized in the table above. Please note however, that we do not have any groundwater data during the springtime snowmelt period, a time of the year when groundwater levels are typically the highest. As a result, if the foundation excavation and utility installation work is delayed and slips into the spring of 2009, the groundwater levels encountered at that time could be several feet higher than El. 6.

Based on the anticipated bottom of excavation levels, we expect that dewatering could be performed using a series of open sumps and temporary ditches within the excavations. Sumps should be capable of pumping at least 10 gpm and be provided with filters suitable to prevent pumping of fine-grained soil particles. Rainwater or snowmelt should be directed away from exposed soil bearing surfaces.

Dewatering and discharge of dewatering effluent should be performed in accordance with all applicable local, state and federal regulations. Due to physical site constraints, we anticipate that on-site recharge will not be feasible and that dewatering discharge will likely need to be directed to the local storm drain system. Sedimentation tanks and other treatment equipment may be required for legal disposal of the effluent. If dewatering effluent is discharged into a storm drain system that empties into the Back Cove, a NPDES permit will be required for legal disposal of the effluent.

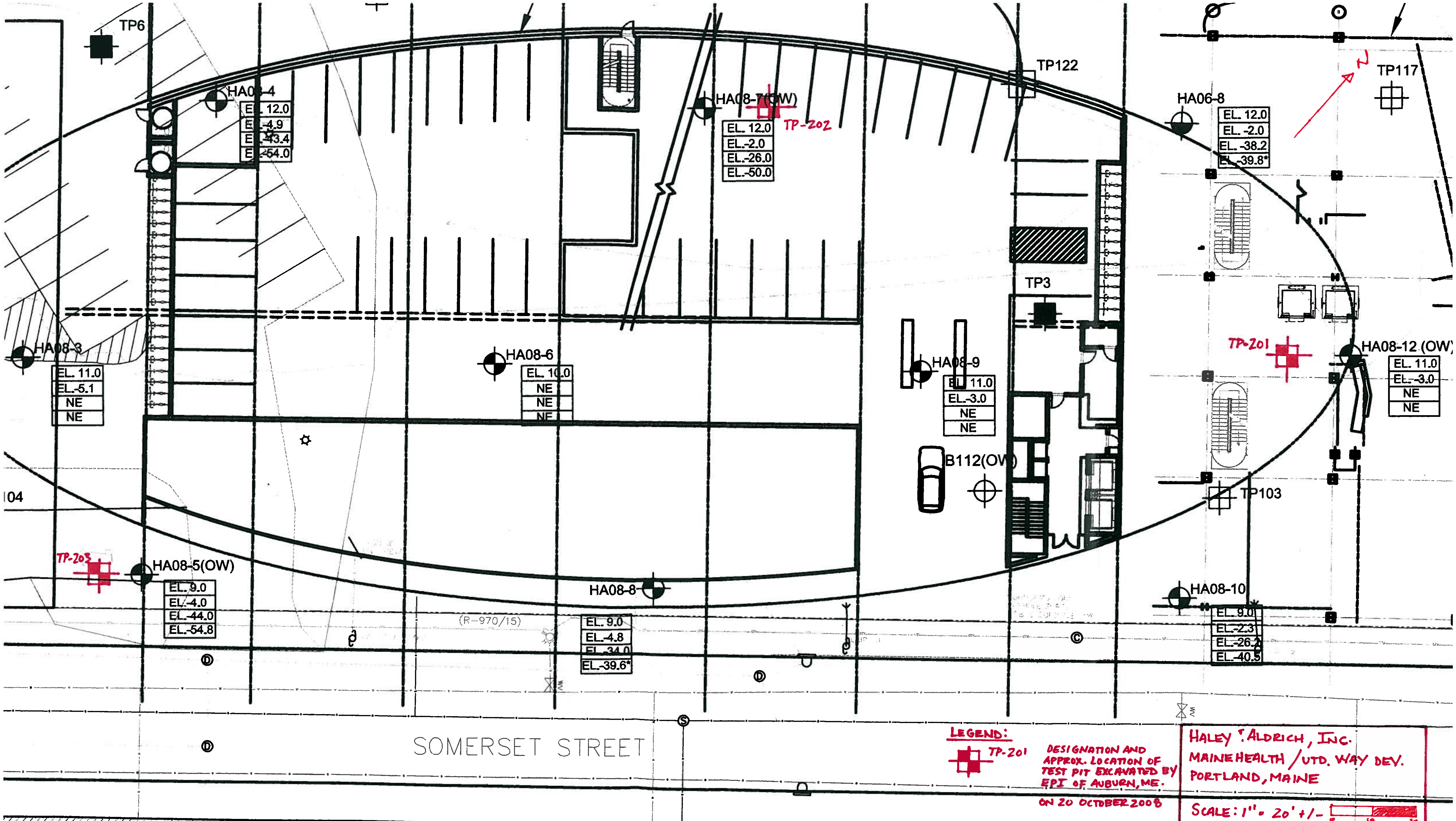
## CLOSURE

We trust this provides sufficient information to proceed with design development and estimation of project costs for construction dewatering. Please do not hesitate to contact us if you require additional information.

Attachments:
Test Pit Location Plan (1 sheet)
Test Pit Logs (3 sheets)
Photographs (3 sheets)
Groundwater Monitoring Data (3 sheets)

STATE OF MAINE
WAYNE A.
CHADBOURNE
No. 10620
LICENSED
PROFESSIONAL ENGINEER

G:\PROJECTS\35611\Groundwater Infiltration Memo\2008-1204-bcs&wac-testpitmemo-f.doc




RIENTATION OF EXISTING
ARD & CURRAN ON 21 JULY

CAD FILE " FP01.dwg "

LEGEND:

| | |
|---|---|
| HA08-1 | DESIGNATION AND LOCATION OF TEST BORING DRILLED BY MAINE TEST BORINGS, INC. OF BREWER, MAINE IN JULY AND AUGUST 2008 |
| HA06-7 | DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING DRILLED BY MAINE TEST BORINGS, INC. OF BREWER, MAINE IN AUGUST 2006 |
| ----11------ | ELEVATION CONTOUR OF EXISTING GROUND SURFACE |
| (OW) | DENOTES OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE |
| NE | DENOTES SOIL STRATA, ROCK WAS NOT ENCOUNTERED |

HALEY&

HALEY & ALDRICH

# TEST PIT LOG

**Test Pit No.** TP-201

**Project** Maine Health / United Way Development
**Location** Somerset & Chestnut Streets, Portland, Maine
**Client** Maine Medical Center
**Contractor** Environmental Projects, Inc.
**Equipment Used** Komatsu PC 35 MR

**File No.** 35611-000
**H&A Rep** B. Steinert
**Date** 20 October 2008
**Weather** Sunny, 50°

**Ground El.:** 11 +/-
**El. Datum:** Portland City Datum
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):** 4.6 gal/min

| Depth (ft) | Sample ID | Stratum Change Elev./ Depth (ft) | USCS Symbol | VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION) | Gravel % Coarse | Gravel % Fine | Sand % Coarse | Sand % Medium | Sand % Fine | % Fines | Field Tests Dilatancy | Field Tests Toughness | Field Tests Plasticity | Field Tests Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | SW- SM | Gray-brown, well-graded SAND with silt and gravel (SW-SM), mps 8 in., no structure, no odor, dry, bricks, concrete, wood throughout, railroad ties and steel tracks in north side of test pit at ~1.5 ft<br>-FILL- | 10 | 15 | 15 | 35 | 15 | 10 | | | | |
| 2 | | 2.0 | SP | Black, poorly graded SAND with silt (SP), mps 4.75 mm, no structure, no odor, dry, some coal/ash fragments, trace organics<br>-FILL- | | | 5 | 50 | 30 | 15 | | | | |
| 4 | | 3.5 | SP | Tan to yellow-brown, poorly graded SAND (SP), mps 4.75 mm, no structure, no odor, moist to wet with depth<br>-FILL- | | | 10 | 60 | 20 | 10 | | | | |
| 6 | | | | | | | | | | | | | | |
| 8 | | 8.0 | | -BOTTOM OF EXCAVATION- | | | | | | | | | | |

**Obstructions:** None. Miscellaneous debris (bricks, wood, granite pavers), rail timbers, tracks present throughout.

**Remarks:** Water observed seeping into test pit excavation at approximately 8 ft below existing ground surface.

**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 |

**Standing Water in Completed Pit**
at depth 6.5 ft
measured after 31 min. hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12 to 24 | NA | = NA |
| over 24 | NA | = NA |

**Test Pit Dimensions (ft)**
Pit Length x Width (ft) 6 x 3
Pit Depth (ft) 8.0

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

HA TESTPIT-07-1 HA-LIB07-1R-POR-06-03-08.GLB HA-TP07-1.GDT G:\PROJECTS\35611\FIELD PROGRAM\35611 TP201-203.GPJ 4 Dec 08

HALEY& ALDRICH

# TEST PIT LOG

**Test Pit No.** TP-202

**Project** Maine Health / United Way Development
**Location** Somerset & Chestnut Streets, Portland, Maine
**Client** Maine Medical Center
**Contractor** Environmental Projects, Inc.
**Equipment Used** Komatsu PC 35 MR

**File No.** 35611-000
**H&A Rep** B. Steinert
**Date** 20 October 2008
**Weather** Sunny, 50°

**Ground El.:** 12 +/-
**El. Datum:** Portland City Datum
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):** 3.7 gal/min

| Depth (ft) | Sample ID | Stratum Change Elev./ Depth (ft) | USCS Symbol | VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION) | Gravel % Coarse | Gravel % Fine | Sand % Coarse | Sand % Medium | Sand % Fine | % Fines | Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | SC | Dark brown, clayey SAND (SC), mps 2 in., no structure, slight creosote-like odor, moist, brick and porcelain fragments present, trace organics (rootlets) -FILL- | | 5 | 10 | 30 | 40 | 15 | | | | |
| 2 | | | | | | | | | | | | | | |
| | | 3.5 | SP- SM | Black, poorly graded SAND with silt (SP-SM), mps 2 mm, no structure, organic odor, moist, rootlets throughout, probable former topsoil | | | | 10 | 70 | 20 | | | | |
| 4 | | 4.0 | SW | Light brown, well-graded SAND with gravel (SW), mps 3 in., no structure, no odor, moist | 5 | 15 | 30 | 25 | 15 | 10 | | | | |
| | | 4.5 | SM | Black, silty SAND with gravel (SM), mps 2 in., no structure, no odor, moist to wet, trace organics, brick bragments, clinker-like material -FILL- | | 15 | 15 | 35 | 15 | 20 | | | | |
| 6 | | 6.5 | SP | Tan to yellow-brown, poorly graded SAND (SP), mps 4.75 mm, no structure, no odor, moist to wet -FILL- | | | 10 | 60 | 15 | 5 | | | | |
| 8 | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | |
| | | 11.0 | | -BOTTOM OF EXCAVATION- | | | | | | | | | | |

**Obstructions:** NA

**Remarks:** Water observed seeping into test pit excavation at approximately 11 ft below existing ground surface.

**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

**Standing Water in Completed Pit**
at depth 8.0 ft
measured after 18 min. hours elapsed

**Boulders**

| Diameter (in.) | Number | Approx. Vol. (cu.ft) |
|---|---|---|
| 12 to 24 | NA | = NA |
| over 24 | NA | = NA |

**Test Pit Dimensions (ft)**
Pit Length x Width (ft) 6 x 3
Pit Depth (ft) 11.0

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

HALEY & ALDRICH

# TEST PIT LOG

**Test Pit No.** TP-203

| | | | |
|---|---|---|---|
| **Project** | Maine Health / United Way Development | **File No.** | 35611-000 |
| **Location** | Somerset & Chestnut Streets, Portland, Maine | **H&A Rep** | B. Steinert |
| **Client** | Maine Medical Center | **Date** | 20 October 2008 |
| **Contractor** | Environmental Projects, Inc. | | |
| **Equipment Used** | Komatsu PC 35 MR | **Weather** | Sunny, 50° |

**Ground El.:** 9 +/-
**El. Datum:** Portland City Datum
**Location:** See Plan
**Groundwater depths/entry rates (in./min.):** 4.6 gal/min

| Depth (ft) | Sample ID | Stratum Change Elev./ Depth (ft) | USCS Symbol | VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION) | Gravel % Coarse | Gravel % Fine | Sand % Coarse | Sand % Medium | Sand % Fine | % Fines | Field Tests Dilatancy | Toughness | Plasticity | Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | SW- SM | Gray-brown, well-graded SAND with silt (SW-SM), mps 0.75 in., no structure, no odor, moist, trace brick fragments<br>-FILL- | | 5 | 25 | 45 | 15 | 10 | | | | |
| 2 | | 2.0 | SP | Tan to yellow-brown, poorly graded SAND (SP), mps 4.75 mm, no structure, no odor, moist | | | 10 | 60 | 20 | 10 | | | | |
| | | 2.7 | SW | Dark brown to black, well-graded SAND with gravel (SW), mps 3 in., no structure, no odor, moist to wet | 15 | 10 | 25 | 35 | 10 | 5 | | | | |
| 4 | | 3.5 | SW- SM | Brown, well-graded SAND with silt (SW-SM), mps 4 in., no structure, no odor, moist, cinders, ash, bricks, concrete fragments present<br>-FILL-<br>Note: Gray, lean CLAY with bricks and little fine to medium sand observed in western third of test pit. | | | 35 | 20 | 30 | 15 | | | | |
| 6 | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | |
| | | 11.0 | | -BOTTOM OF EXCAVATION- | | | | | | | | | | |

**Obstructions:** NA

**Remarks:** Water observed seeping into test pit excavation at approximately 11 ft below existing ground surface.

**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

**Standing Water in Completed Pit**
at depth 10.5 ft
measured after 17 min. hours elapsed

**Boulders**

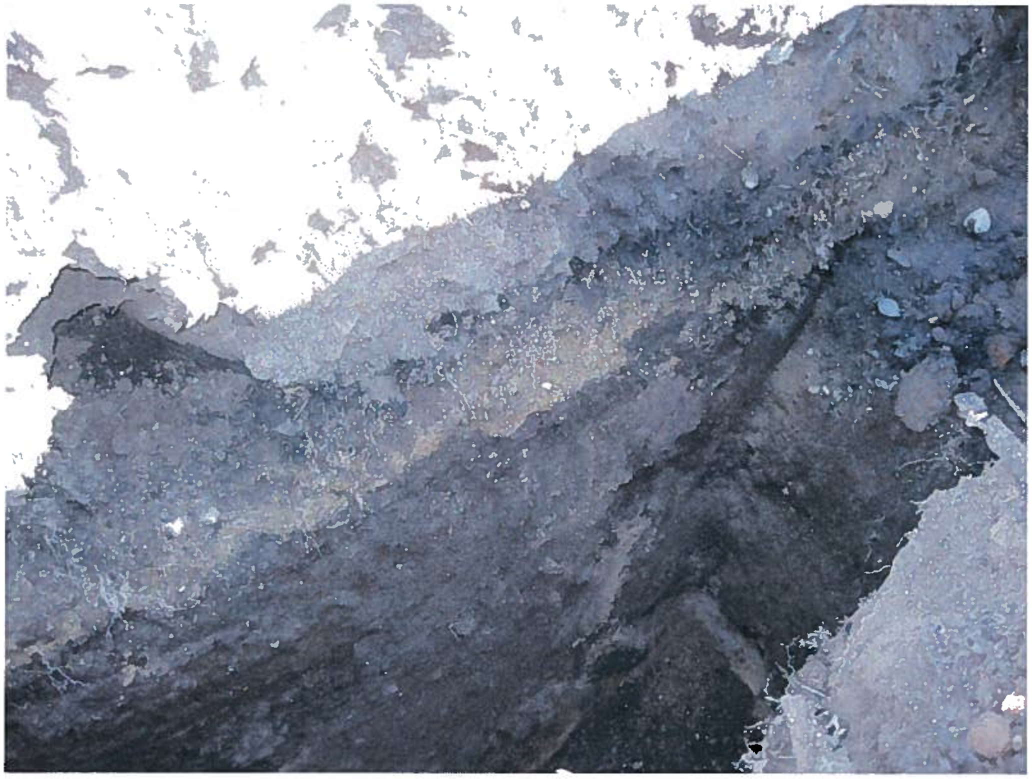
| Diameter (in.) | Number | | Approx. Vol. (cu.ft) |
|---|---|---|---|
| 12 to 24 | NA | = | NA |
| over 24 | NA | = | NA |

**Test Pit Dimensions (ft)**
Pit Length x Width (ft) 7 x 3
Pit Depth (ft) 11.0

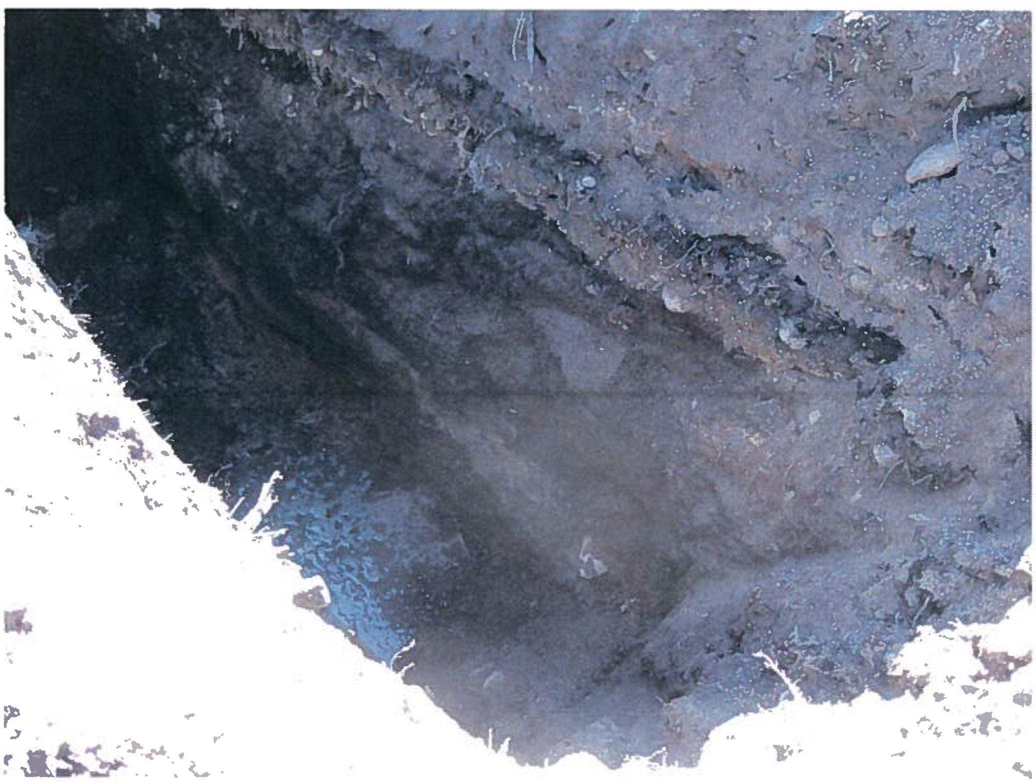
**NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.**


*Photograph 1. In-situ fill soils encountered in TP-201, looking northwest (10/20/08).*

*Photograph 2. In-situ fill soils and groundwater encountered in TP-201, looking northwest (10/20/08).*



*Photograph 3. In-situ fill soils encountered in TP-202, looking north (10/20/08).*



*Photograph 4. In-situ fill soils and groundwater encountered in TP-202, looking southeast (10/20/08).*

HALEY& ALDRICH

# GROUNDWATER MONITORING REPORT

OW/PZ NUMBER **HA08-5(OW)**



| | | | |
|---|---|---|---|
| **PROJECT** | Maine Health/United Way Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP.** | O. Lawlor |
| **CONTRACTOR** | Maine Test Borings, Inc. | **DATE** | 8/4/2008 |
| **ELEVATION SUBTRAHEND** | 9.0 (Approximate) | | |

| Date | Time | Elapsed Time (days) | Depth of Water from Top of Riser Pipe | Elevation of Water | Remarks | Read By |
|---|---|---|---|---|---|---|
| 8/4/2008 | 1200 | 0 | 7.3 | 4.5 | GW level prior to well development | OEL |
| 8/4/2008 | 1240 | 0 | 9.5 | 2.3 | GW level after well development | OEL |
| 8/7/2008 | 1805 | 3 | 7.9 | 3.9 | GW level prior to level logger install. | CLH |
| 8/22/2008 | 1000 | 18 | 8.3 | 3.5 | GW level after level logger removal | CLH |
| 10/20/2008 | 1200 | 77 | 10.9 | 0.9 | GW level during TP-203 excavation | BCS |
| 11/17/2008 | 1131 | 105 | 10.8 | 1.0 | | ECB |
| 12/1/2008 | 1353 | 119 | 10.7 | 1.1 | | BCS |

HALEY& ALDRICH

# GROUNDWATER MONITORING REPORT

OW/PZ NUMBER
**HA08-7(OW)**

Page 1 of 1

| | | | |
|---|---|---|---|
| **PROJECT** | Maine Health/United Way Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP.** | O. Lawlor |
| **CONTRACTOR** | Maine Test Borings, Inc. | **DATE** | 8/4/2008 |
| **ELEVATION SUBTRAHEND** | 12.0 (Approximate) | | |

| Date | Time | Elapsed Time (days) | Depth of Water from Top of Riser Pipe | Elevation of Water | Remarks | Read By |
|---|---|---|---|---|---|---|
| 8/4/2008 | 1115 | 0 | 10.3 | 4.5 | GW level prior to well development | OEL |
| 8/4/2008 | 1140 | 0 | 12.3 | 2.5 | GW level after well development | OEL |
| 8/7/2008 | 1800 | 3 | 10.2 | 4.6 | GW level prior to level logger install. | CLH |
| 8/22/2008 | 950 | 18 | 10.1 | 4.7 | GW level after level logger removal | CLH |
| 10/20/2008 | 1200 | 77 | 10.2 | 4.6 | GW level during TP-202 excavation | BCS |
| 11/17/2008 | 1134 | 105 | 10.2 | 4.6 | | ECB |
| 12/1/2008 | 1354 | 119 | 9.8 | 5.0 | | BCS |

| HALEY & ALDRICH | # GROUNDWATER MONITORING REPORT | OW/PZ NUMBER HA08-12(OW) Page 1 of 1 |
|---|---|---|

| | | | |
|---|---|---|---|
| **PROJECT** | Maine Health/United Way Development | **H&A FILE NO.** | 35611-000 |
| **LOCATION** | Portland, Maine | **PROJECT MGR.** | W. Chadbourne |
| **CLIENT** | Maine Medical Center | **FIELD REP.** | O. Lawlor |
| **CONTRACTOR** | Maine Test Borings, Inc. | **DATE** | 8/4/2008 |
| **ELEVATION SUBTRAHEND** | 11.0 (Approximate) | | |

| Date | Time | Elapsed Time (days) | Depth of Water from Top of Riser Pipe | Elevation of Water | Remarks | Read By |
|---|---|---|---|---|---|---|
| 8/4/2008 | 1030 | 0 | 8.9 | 4.9 | GW level prior to well development | OEL |
| 8/4/2008 | 1100 | 0 | 9.0 | 4.8 | GW level after well development | OEL |
| 8/7/2008 | 1745 | 3 | 8.6 | 5.2 | GW level prior to level logger install. | CLH |
| 8/22/2008 | 945 | 18 | 8.4 | 5.4 | GW level after level logger removal | CLH |
| 10/20/2008 | 1200 | 77 | 8.7 | 5.1 | GW level during TP-201 excavation | BCS |
| 11/17/2008 | 1137 | 105 | 8.5 | 5.3 | | ECB |
| 12/1/2008 | 1358 | 119 | 8.0 | 5.8 | | BCS |

# SECTION 02110 – HANDLING OF CONTAMINATED SOILS

## PART 1 – GENERAL

1.01 DESCRIPTION OF WORK: Removal and disposal or remediation of contaminated site soils in accordance with the Voluntary Remedial Action Plan Application submitted by the City of Portland to the Maine Department of Environmental Protection on November 13, 2008 and the December 18, 2008 letter from Tewhey Associates to Woodard & Curran RE: Soil and Groundwater Handling Information for Construction Documents Bayside Railyard Subdivision, Somerset Street, Portland, Maine. All work associated with contaminated soils, including but not limited to excavation, stockpiling, handling, transportation and disposal shall be completed in accordance with local, state and federal regulations.

1.02 RELATED WORK:

A. Existing Subsurface Conditions: Section 02010
B. Demolition: Section 02220
C. Earthwork: Section 02300
D. Dewatering: Section 02240

1.03 REQUIREMENTS INCLUDED:

A. Examination of the Site:

1. Before submitting bids, the CONTRACTOR shall visit the site and inform themselves as to the location, nature of the work, equipment and facilities needed, general and local conditions prevailing at the site and all matters which may affect the work under this contract.

2. Before submitting bids, the CONTRACTOR shall examine all sources of information concerning subsurface soil and groundwater. Each bidder shall draw their own conclusions concerning how these affect their work. Conditions which would not permit the Contractor to fulfill the intent of the contract shall be brought to the attention of the OWNER consistent with Notice to Contractors.

3. Subsurface information and laboratory testing: Recommendations by the City of Portland Brownfields Project Manager, Tewhey Associates have been prepared for the project by John Tewhey dated December 18, 2008 and is included as Attachment A for reference. Each bidding CONTRACTOR shall be in receipt of these reports as a prerequisite of the bid.

4. A Voluntary Remedial Action Plan application was submitted by the City of Portland to the Maine Department of Environmental Protection on November 13, 2008. In response to this application, a No Action Assurance letter was sent to the City of Portland from the Maine Department of Environmental Protection on November 21, 2008. Copies of the application and the response letter are included as Attachment B for reference. Each bidding CONTRACTOR shall be in receipt of these reports as a prerequisite of the bid.

B. Test Boring Results

1. The OWNER assumes no responsibility for the accuracy of the test results as shown in the Specifications. They are included only as a general indication of the materials likely to be found adjacent to the holes bored at the site of the proposed work. The CONTRACTOR shall examine this data and make his own investigation and other preliminary data, and they shall base their bid on their opinion of the conditions likely to be encountered.

3. The bidder's submission of their proposal shall be considered "prima facie" evidence that they have made their examination as described in this Section.

PART 2 – PRODUCTS (not applicable)

PART 3 – EXECUTION

3.01 REMOVAL AND DISPOSAL OF CONTAMINATED SOILS:

A. General: All work shall be performed in accordance with related Specification Sections; Contract Documents; aforementioned reports and letters dated November 13, 2008, November 21, 2008 and December 19, 2008; and in accordance with all Local, State and Federal Regulations.

3.02 ON-SITE REUSE OF CONTAMINATED SOILS

A. General: On-site reuse of contaminated soils as site fills shall be conducted in accordance with Section 02300, the aforementioned reports and letters.

Attachments:

Attachment A: Recommendation Letter from Tewhey Associates, dated December 18, 2008

Attachment B: Voluntary Remediation Action Plan, dated November 13, 2008 and No Action response letter from Maine DEP, dated November 21, 2008.

**End of Section**

**TEWHEY ASSOCIATES**
**P.O. Box 238**
**Gorham, Maine 04038**
**(207) 839-4261 • FAX (207) 839-3834 • E-mail: info@tewhey.com**

**Hydrogeologic and Environmental Consultants**

December 18, 2008 m975MH-W&C

Barry Sheff
Woodard & Curran
41 Hutchins Drive
Portland, ME 04102

**RE: Soil and Groundwater Handling Information for Construction Documents Bayside Railyard Subdivision, Somerset Street, Portland, Maine.**

Dear Barry:

In the process of developing soil and groundwater handling information for future construction activities on the Bayside Railyard Subdivision (BRS) site on Somerset Street in Portland, Tewhey Associates has reviewed the previous environmental studies of the area:

- ✓ **Site Assessment and Environmental Analysis: Phase I of the Portland Brownfields Project, Portland, Maine,** Tewhey Associates, April 1999.
- ✓ **Environmental Remediation Plan, Phase III of the Portland Brownfields Project, Portland, Maine**, Tewhey Associates, March 1999.
- ✓ **Phase II Environmental Site Assessment, Union Branch Rail Line Property, Portland, Maine**, Haley & Aldrich, Inc., December 2000.
- ✓ Maine DOT letter from D. Doughty et al to N. Hodgkins of the Maine DEP, RE: Voluntary Remedial Action Plan, Union Branch Rail Line Property, Portland, Maine, June 15, 2001; rev.1 July 23, 2001.
- ✓ Maine DEP letter from N. Hodgkins to D. Doughty et al of the Maine DOT, RE: Union Branch Rail Line Property, Portland, Maine, Voluntary Response Action Program No Action Assurance Letter, July 26, 2001.
- ✓ Tewhey Associates letter from J. Tewhey to R. Knowland of the City of Portland, RE: Soil Remediation Considerations Related to the Developemnt of the Union Branch Rail Line Parcel in Bayside, January 31, 2002.

- ✓ Tewhey Associates memorandum from J. Tewhey to R. Knowland of the City of Portland, RE: Results of Recent Testing of Soils at the Former Rail Yard Site in Bayside, April 8, 2003.

- ✓ Tewhey Associates Memorandum from J. Tewhey to M. Adelson of the City of Portland, RE: Results of Testing of Excavated Soil at the Former Rail Yard Site in Bayside, December13, 2003.

- ✓ **Geotechnical Data Report, MaineHealth / United Way Development, Somerset and Chestnut Streets, Portland, Maine,** Haley & Aldrich, Inc., September 2008.

- ✓ City of Portland letter from P. Littell to N. Hodgkins of the Maine DEP, RE: Voluntary Remedial Action Plan, Bayside Railyard Subdivision – Lots 1, 2, 3, 4, and 9, Portland, Maine, November 13, 2008.

- ✓ Maine DEP letter from N. Hodgkins to P. Littell et al of the City of Portland, RE: Bayside Railyard Subdivision, Somerset Street, Portland, Maine – Voluntary Response Action Program (VRAP) No Action Assurance Letter, November 21, 2008.

**Soil Conditions**. The requirements for soil categorization and handling during construction at the BRS site have been developed on the basis of the documents listed above, in particular, (1) the VRAP approval document of July 2001 for the rail yard area in Bayside, (2) the revised and updated VRAP approval for the BRS site of November 2008, and (3) the soil analytical results of the previous site investigations of the BRS site completed by Tewhey Associates during the period 1997 to present. The VRAP documents describe three soil groups on the rail yard property for the purpose of testing, handling, and remediation.

The three soil groups described in the Maine DEP VRAP approvals for the BRS site are described below:

- **Group One Soils**. Group 1 soils are clean, uncontaminated soils. They have no visible or olfactory evidence of contamination and exhibit field photoionization detections (PID) of less than 20 ppm. It has been the experience of Tewhey Associates and other Bayside investigators that Group 1 soils comprise the majority of subsurface fill soils on the BRS site. Surficial soils to a depth of 1 to 3 feet are often stained black and contain coal and cinders as a result of long-term exposure to railroad operations in the Bayside area and the BRS site, in particular. The surficial soils on the BRS site and vicinity are likely to fall into the Group 2 category (see below).

- **Group Two Soils**. Group 2 soils have visible evidence of contamination. Visual evidence of contamination includes coal, ash, cinders, and dark brown or black color. Group 2 soils occasionally have a petroleum or tar odor. Group 2 soils are considered to be contaminated unless field and laboratory testing confirms that contaminant concentrations are present at levels less than one-half of the Maine DEP Remedial Action Guidelines for soil. Group 2 soils can be used in construction projects if they are capped by at least one-foot of clean gravel or are covered by foundations or paving.

- **Group Three Soils**. If Group 2 soils are found to fall into the category of hazardous waste on the basis of Toxic Characteristic Leaching Procedure (TCLP) or other laboratory testing, those soils are characterized as Group 3 soils. Group 3 soils must be removed from the BRS site and be properly disposed of as hazardous waste. Extensive testing of soils at the BRS site has shown that no Group 3 soils are present on the BRS site.

**Soil Handling Recommendations**. Group 1 soils at the BRS site typically consist of gray-olive-blue marine clay fill and light brown to yellow sand fill. Group 1 soils are typically subsurface soils and are rarely found at the ground surface. Group 2 soils are typically surficial fill materials that have been stained and contaminated by past railroad and industrial operations. In past construction projects in the rail yard area, soils that have Group 2 characteristics have typically been stockpiled adjacent to the construction project and either (1) utilized judiciously on the construction site as fill material in low areas and subsequently covered as required by VRAP requirements or (2) spread under controlled conditions on other portions of the rail yard site that require filling. No Group 2 soils have been removed from the rail yard site in former construction projects.

At the BRS site, it is expected that most surficial soils will fall into the Group 2 category. Upon encountering these soils during construction, they will typically be removed, stockpiled, and reused in the manner described above. On previous rail yard construction projects in Bayside, a Tewhey Associates representative was present on the site during initial soil excavation and was available to assist in the identification and handling of Group 2 soils. Stockpiled Group 2 soils should be covered and protected from erosion by means of standard construction site practices. A Tewhey Associates representative or other City of Portland representative will be available during construction to (1) brief construction crews on soil handling and safety issues and (2) assist in soil classifications and handling decisions.

**Volatile Organic Compounds in Shallow Soi**l. During the Haley & Aldrich site exploration work on the BRS site in the summer of 2008, there were two boring locations on Lot 3 in which moderate levels of volatile organic compounds (VOCs) were detected in shallow soils. The boring locations were designated as HA08-5 and HA08-4. The potential presence of VOCs in shallow soil in the western portion of Lot 3 will be addressed in the field by a Tewhey Associates representative prior to the start of site excavation. Any VOC-contaminated soils will be identified and mitigated prior to the start of site development.

**Groundwater Conditions**. There are three groundwater monitoring wells on the BRS site. The three wells were installed by the firm of Haley & Aldrich on Lot 3 of the BRS site in August 2008. The three monitoring wells are designated HA08-5, HA08-7, and HA08-12. Transducers were installed in the three wells and groundwater elevation data were collected during the period August 7-22, 2008. Groundwater levels were measured between 6 and 8 feet below existing ground surface and did not appear to be influenced by tidal fluctuations in Back Cove. The field and laboratory data indicate that (1) the average depth to perched groundwater at the three locations is 7 feet, (2) there were no PID indications of volatile organic contaminants in the groundwater regime on the BRS site, (3) there is no significant organic or inorganic contaminants in groundwater as determined by previous testing in monitoring wells that are adjacent to the BRS site, and (4) there has been no free-product petroleum floating on groundwater in monitoring wells within or adjacent to the BRS site. The analytical results of previous soils investigations at the BRS site by Tewhey Associates supports the premise that that is little or no volatile organic contaminants (VOCs) in groundwater on and near the BRS site. The quality of groundwater beneath the BRS site is likely to be acceptable by the Portland Water District for release to the municipal sewer subsequent to settling of sediments in a holding tank. A Tewhey Associates representative will be available to conduct groundwater testing, should groundwater management and handling be necessary on the BRS site.

**Groundwater Handling Recommendations**. It is unlikely that dewatering will be required at the BRS site. Perched groundwater is common in areas of clay fill material. A perched water table consists of the presence of a shallow groundwater perched on layers of clay fill. Breaching the clay layer allows the perched water to drain to the static water table. The static water table is at a depth of about 7 feet. On the basis of monitoring wells installed within and immediately adjacent to the BRS site, the water quality of the static water table is such that it is likely that, if dewatering were to be necessary, it could be released to the municipal sewer after solids are settled out. A settling or holding tank will be required for settling of solids if dewatering should be required. Steve Harris of the City of Portland Engineering Department can provide information on the VOC and metals limits for discharge to the Portland POTW. A Tewhey Associates representative or City of Portland representative will be available during construction to (1) provide field and lab testing of groundwater encountered on the site and (2) assist in safety and handling issues associated with groundwater.

Very truly yours,

**Tewhey Associates**

*signed*

John D. Tewhey, Ph.D
Principal

**Planning & Urban Development Department**
Penny St. Louis Littell, Director

November 13, 2008

VIA EMAIL & US MAIL

Nicholas J. Hodgkins, VRAP
Maine Department of Environmental Protection
Bureau of Remediation and Waste Management
Division of Remediation
17 State House Station
Augusta, Maine 04333-0017

Subject: Voluntary Remedial Action Plan
Bayside Railyard Subdivision -- Lots 1, 2, 3, 4 and 9
Portland, Maine

Dear Nick:

Enclosed is an Application for Assistance under the Voluntary Response Action Program (VRAP) for the Bayside Railyard Subdivision property (the "Subdivision") in Portland, and a check for the application fee of $500.00. This Application relates to the management of Group 2 soils in particular on Lots 1, 2, 3, 4 and 9 of the Subdivision. A reduced copy of the proposed Subdivision Plat is attached hereto.

This application has been prepared on behalf of the City of Portland (the "City"), as the Applicant and the Downtown Portland Corporation, BAYCO LLC (BAYCO"), and MaineHealth as Co-Applicants. Downtown Portland Corporation is the current property owner. BAYCO is currently under contract by Purchase and Sale Agreement to buy Lot 3 and construct a parking garage and office building thereon. MaineHealth will be buying Lots 1 and 2. Lots 4 and 9 will be transferred to the City and are to become the Bayside Trail. Construction on Lot 3 will begin in February 2009.

This letter describes the project and the proposed remedial actions associated with Lots 1-4 and Lot 9 in the Subdivision. The proposed remedial actions are based on and consistent with the Voluntary Remedial Action Plan for the Union Branch Rail Line Property approved by DEP in 2001 (the "2001 VRAP Plan"), a copy of which is attached to this letter.

**Introduction**

The Subdivision is a portion of the former Union Branch Rail Line that once ran through the Bayside section of Portland. The Maine Department of Transportation (MDOT) purchased the Union Branch Rail Line property from the Portland Terminal Company

(PT) in 2001. At that time MDOT and PT applied for assistance under VRAP and the attached 2001 VRAP Plan was submitted with the VRAP application. On July 26, 2001, the Maine Department of Environmental Protection (DEP) issued a VRAP No Action Assurance letter to MDOT and PT. The No Action Assurance letter provides liability protection from actions by DEP provided the proposed voluntary remedial actions and certain conditions are met by future developers.

**Existing Voluntary Remedial Action Plan**

The attached July 23, 2001 voluntary remedial action plan describes the previous environmental investigations of the entire Union Branch Rail Line property including property which is the subject of this application (hereinafter the "Property" or "railyard"). A copy of a Phase II Environmental Site Assessment (ESA) report prepared by Haley & Aldrich and Tewhey Associates was provided to DEP at that time. The Phase II ESA and other nearby investigations found similar conditions on and beneath the ground surface in the Bayside area and in the railyard. The 2001 VRAP Plan submitted with the 2001 VRAP Application proposed to classify soils excavated during future development of the Union Branch Rail Line property as Group 1, Group 2 or Group 3 soils. In brief, Group 1 soils are not considered contaminated, Group 2 soils are considered contaminated but can be reused on-site, and Group 3 soils are contaminated and must be disposed off-site.

The 2001 VRAP Plan indicated that future developers must agree to utilize this classification system and apply the related remediation concepts, <u>or</u> develop <u>alternate</u> plans that must be approved by MDOT, PT and VRAP. After consideration of site conditions in the property and current development plans, BAYCO as the future owner and developer of Lot 3 , the City of Portland as the former owner of the property and future owner and developer of the trail (to be placed on Lots 4 and 9), Maine Health as the future owner of Lots 1 and 2, and Downtown Portland Corporation as the current owner of the property have decided to conduct future development (including related excavations) applying the remediation concepts and classification system set forth in the existing 2001 VRAP Plan and the July 26, 2001 No Action Assurance letter.

**Property Description**

The Subdivision is about 6.5 acres and consists of most of the former railyard between Franklin Arterial and Elm Street, and adjacent to and north of Somerset Street. The Subdivision will consist of nine lots (Lots 1 through 9) although Lots 5, 6, 7 and 8 are not part of this Application and plan. The City previously constructed a roadway through the property to complete the connection of Chestnut Street between Marginal Way and Somerset Street.

As part of the roadway construction and other development in the area, the City of Portland has previously spread Group 2 soils on a portion of the railyard property west of Chestnut Street.

**Current Development Plans**

BAYCO intends to construct a parking garage and office building on Lot 3 of the Subdivision. These buildings will occupy about 1 acre of the 1.2 acre Lot 3. Basements are not planned but excavations will be required throughout the lot for foundation systems and utility corridors. In addition, a significant portion of the Group 2 soils on

Lots 1 and 2 are to be spread on the trail area (Lots 4 and 9) as part of the trail construction and to facilitate anticipated future development of Lots 1 and 2. A site plan that shows the BAYCO development on Lot 3 is attached to this letter.

In addition, in connection with trail construction by the City, it should be anticipated that minor excavation and soil redistribution will take place in order to accommodate water fountains, lighting, landscaping elements, etc.

**Proposed Remedial Actions**

All excavated soils will be observed, screened and if necessary tested according to the requirements of the 2001 VRAP Plan. Lots 1, 2 and 4 may be used for construction staging, equipment and storage areas.

In substance, Group 2 soils will be excavated from Lots 1, 2 and 3 and within Somerset Street (during utility trench excavation work). Group 2 soils will subsequently be re-deposited either as fill around the foundations of the new buildings or spreadon Lots 4 and 9. We anticipate construction sequencing will require Group 2 soils to be temporarily stockpiled on Lots 1, 4 or 9 and re-deposited either on Lot 4, and/or 9 in connection with the trail construction.

The City and the BAYCO contractor, Consigli Construction Co. will be responsible for erosion control of the excavated and any temporarily stockpiled Group 2 soils on Lots 4 and 9 and Lots 1, 2, 3, respectively. Controls will mitigate windblown or water borne migration of these Group 2 soils. Bayco will prepare and implement a plan that describes the anticipated construction sequence and placement of soils to coordinate City and contractor responsibilities during the excavation phases of the project.

In accordance with the July 26, 2001 No Action Assurance letter, after the remedial actions are completed for its property (Lot 3), BAYCO will submit a report to DEP which will summarize the successful implementation of the requirements. It is understood that VRAP will then issue a Certificate of Completion for this portion of the Subdivision.

In accordance with the July 26, 2001 No Action Assurance Letter, after the remedial actions are completed for its property (Lots 1 and 2), MaineHealth will submit a report to DEP which will summarize the successful implementation of the requirements. It is understood that the DEP will then issue a Certificate of Completion for this portion of the Subdivision.

In accordance with the July 26, 2001 No Action Assurance Letter, after the remedial actions are completed for its property (Lots 4 and 9), the City will submit a report to DEP which will summarize the successful implementation of the requirements. It is understood that the DEP will then issue a Certificate of Completion for this portion of the Subdivision.

Ground surface conditions at Lots 5, 6, 7 and 8 of the Bayside Subdivision will generally not be affected or disturbed by the City or Consigli during construction of the BAYCO development on Lot 3 or the trail construction. It is anticipated that future development on these lots will be handled under the 2001 VRAP Plan as well but that could change depending on future owner or developer plans.

**Application for Assistance**

The application for VRAP assistance is attached to this Voluntary Remedial Action Plan. As discussed in our meetings in Portland on November 5th and 10th, 2008, DEP has agreed that the general information requirements concerning water supplies in the area and evaluation of vapor intrusion into buildings will be waived by DEP based on its extensive knowledge of the project site and subsurface conditions from prior studies and reports. It is understood that project will be classified as a Tier I for Public Communications and that DEP does not need a CD of the previously submitted Phase II ESA report prepared by Haley & Aldrich and Tewhey Associates.

**Closure**

We trust that this plan and the attached information will be sufficient for VRAP to provide a No Action Assurance letter to City of Portland, Downtown Portland Corporation, BAYCO LLC, and MaineHealth. As you know, the parties have requested this letter prior to November 26, 2008 since No Action Assurance is a condition of the Purchase and Sale Agreement among the applicant and co-applicants and is required to obtain the project financing.

We appreciate your assistance on this project. Please contact me if you have any questions or need additional information.

CITY OF PORTLAND

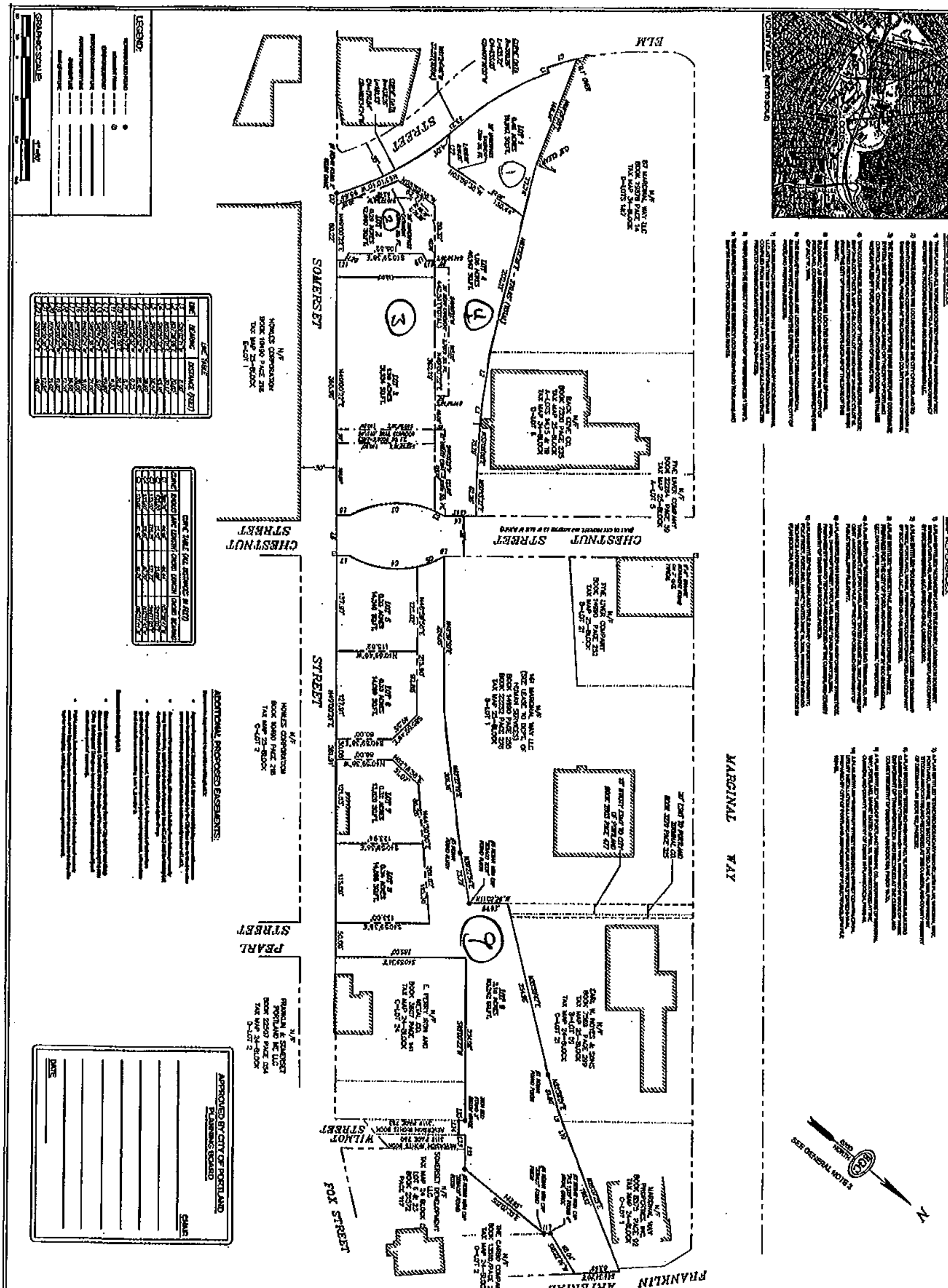
Penny Littell

By: Penny St. Louis Littell, Its
Director of Planning & Urban
Development

Attachments:

Application for Assistance under the Voluntary Response Action Program
Application Fee
Bayside Railyard Subdivision Recording Plat – October 3, 2008 (Draft)
Voluntary Remedial Action Plan – July 23, 2001
No Action Assurance letter – July 26, 2001
Site Plan – BAYCO LLC Bayside Development – October 24, 2008

cc:
Donald L. Quigley – MaineHealth
Nathan H. Smith – Bernstein, Shur
Stephen J. Kelley – Haley & Aldrich, Inc.
John D. Tewhey – Tewhey Associates
Dave Thomas - Consigli




RECORDING PLAT
OF PROPERTY LOCATED ON
**SOMERSET STREET**
**PORTLAND, MAINE**

PREPARED FOR:
**DOWNTOWN PORTLAND CORPORATION**
389 CONGRESS STREET, PORTLAND, MAINE 04101

SGC

SGC ENGINEERING, LLC
- Civil Design & Survey Engineering
- Environmental & Regulatory Permitting
- Electrical Power Systems Engineering

SERVING OUR CLIENTS IN THE U.S.A. & CANADA

SHEET 1 OF 1

STATE OF MAINE

REVISIONS:

| NO. | DATE | |
|---|---|---|
| 1 | | APPROVED FOR SUBMITTAL |

CUMBERLAND, ss REGISTRY OF DEEDS
Received
at ___ h ___ m ___ M, and
Filed in Plan Book ___ Page ___
ATTEST:

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0016

ANGUS S. KING, JR.
GOVERNOR

JOHN G. MELROSE
COMMISSIONER

15 June 2001
23 July 2001 (revised per DEP comment)

Mr. Nicholas J. Hodgkins
Maine Department of Environmental Protection
Bureau of Hazardous Materials and Solid Waste Control
Division of Site Investigation and Remediation
State House Station #17
Augusta, Maine 04333-0017

Subject: Voluntary Remedial Action Plan
Union Branch Rail Line Property
Portland, Maine

Dear Nick:

Enclosed is an Application for Assistance under the Voluntary Remedial Action Plan Program (VRAP) for the former Union Branch Rail Line property in Portland. Haley & Aldrich, Portland Terminal Company (PT) and the Maine Department of Transportation (MDOT) have prepared this letter and the attached documents. MDOT and PT, owners of the property, will be co-applicants for assistance under VRAP. MDOT is planning to acquire the property from PT.

## PROPERTY DESCRIPTION

The Union Branch rail line is approximately 2 miles long, extending through the heart of the Portland Bayside area. The rail line has been abandoned for some time. The Portland Terminal Company, a member of Guilford Rail System, owns the rail line. The former Union Branch Rail Line begins at the railroad bridge over St. John Street and ends at the AAA office building near Tukey's Bridge.

Portions of the Union Branch line rails have been removed at street crossings and several short sections have been purchased by abutters. These out-sales have resulted in the line being broken into five separate sections. One section includes an eight-acre former railyard.

The five sections are as follows:

| | |
|---|---|
| Sta. 4+32 to Sta. 45+90 | St. John St. railroad bridge to Forest Avenue |
| Sta. 45+90 to Sta. 55+30 | Forest Avenue to Hanover Street |

| | | |
|---|---|---|
| Sta. 58+55 to Sta. 78+22 | Preble Street to Franklin Arterial | former railyard |
| Sta. 78+22 to Sta. 82+60 | Franklin Arterial to Boyd Street | |
| Sta. 87+57 to Sta. 105+60 | Diamond Street to Anderson Street | |

## ENVIRONMENTAL INVESTIGATIONS

Tewhey Associates of South Portland, Maine has completed several investigations of the former railyard for the City of Portland Brownfields project. MDOT has completed a Phase I environmental site assessment of other portions of the rail line. Haley & Aldrich and Tewhey Associates completed a Phase II environmental site assessment (ESA) of the former Union Branch rail line property in Portland, Maine for MDOT in December 2000. The purpose of the Phase II ESA was to explore and test areas of concern identified during the previous investigations, as well as general conditions along portions of the rail line. A copy of the Phase II report was provided to the DEP Voluntary Remedial Action Program (VRAP) during a meeting in Augusta on 4 May 2001.

Previous studies have revealed the presence of subsurface contaminants that are associated with the fill materials that underlie the entire project site. These contaminants include polycyclic aromatic hydrocarbons (PAHs), coal, cinders, and coal ash that has been used as fill in the Bayside area, demolition debris fill, and volatile organic compounds (VOCs) associated with the unsorted fill materials and many underground petroleum storage tanks that have been present in the general area. Former railroad and industrial operations, two active metal recycling operations, and the uncontrolled disposal of trash and other waste materials on vacant sites have had the potential to contribute contaminants to surficial soils along the rail line.

Based on the lack of evidence for the presence of oil and hazardous materials, explorations and testing were not conducted along the rail line from St. John Street to Forest Avenue. Explorations were done from Franklin Street Arterial to North Boyd Street but, based on field observations, testing were not completed. Between Forest Avenue and Hanover Street subsurface explorations, testing and observations uncovered no significant contaminant concerns.

However, several contaminants were detected along the other two sections of the Union Branch project site (the former railyard and from Diamond Street to Anderson Street). In general, low to moderate concentrations of metals, particularly arsenic and lead were detected in all of the submitted soil samples. Semi-volatile organic compounds (particularly PAHs) were detected in most of the soil samples. VOCs were detected in two soil samples. Diesel Range Organics were detected in soil at the location where odors were noted in groundwater. Low concentrations of PCBs and pesticides were detected at one location. Contaminants in some samples exceed Maine's residential, adult worker, and trespasser Remedial Action Guidelines (RAGS). Also, the soils generally did not meet the generic beneficial use standards in Appendix A of Chapter 418 of Maine's Solid Waste Management Rules.

Fill, up to 14 ft. thick, was encountered in all explorations. The fill included ash, coal, cinders, metals pieces, pottery and other manmade items. Water levels in observation wells along the rail line ranged from 1 to 8 ft. below ground surface. A weathered fuel oil odor was noted in the water in one observation well. However, no evidence of non-aqueous phase liquid hydrocarbons (free product) was noted in any of the observation wells.

Based on a review of MDEP files, discussions with several MDEP staff members and other environmental professionals familiar with this section of Portland the contaminants, the soil materials, ash, cinders, and contaminants found along the Union Branch Railroad line are similar to those found at other sites in the area.

## SUMMARY OF ENVIRONMENTAL CONDITIONS

Based on: 1) the concentrations of compounds detected in the soil, 2) the presence of visual indications of contaminants in the observed soil, and 3) the industrial setting of the project site, subsurface conditions beneath the former rail line Union Branch property have been impacted by oil or hazardous materials. The findings show that in all areas along the Union Branch rail line, where present, the dark surficial soils have been impacted by previous land use.

Groundwater in the area is not used for potable water supplies. The entire Bayside area of Portland has previously been deemed a Maine Department of Environmental Protection (MDEP) groundwater non-attainment zone where groundwater is assumed to be contaminated and only free petroleum products require remediation.

The results of this Phase II ESA are compatible with and confirm the findings of the previously conducted Portland Brownfields studies. Observations in borings and test pits along the Union Branch rail line show surficial impacts along the railbeds, and in locations where the scrap metal yards have encroached upon the project site. The stratigraphy of fill containing soil materials, ash, cinders, and demolition debris over mudflat deposits is consistent with other sites in the Bayside area. Contaminants including PAHs, lead and arsenic are also consistent with the contaminants in other fill materials in the Bayside area.

## POTENTIAL DEVELOPMENT OF RAIL LINE

Specific developments along the former rail line have not been proposed, other than to limit development to industrial/commercial purposes by a restriction in the deed conveying the property. However, the railyard portion of the rail line is part of the City of Portland identified Brownfields project. Industrial and commercial businesses may locate in this area in the future. In addition, MDOT is investigating the possibility of operating a rail line along a portion of the former Union Branch line. The City is also considering constructing paved recreational trails along portions of the former rail line, consistent with the use restriction.

PT and MDOT agree that certain land use restrictions are appropriate based on the findings of the Phase II ESA. Residential development will be prohibited by deed agreement between PT and MDOT. Also, extraction of groundwater for drinking water will not be allowed.

PT and MDOT request liability assurances and protection from state enforcement from VRAP for the following potential future development within the Union Branch rail line property:

Paved Recreational Trails – walking and bicycle

Industrial Buildings – including below grade construction

Commercial and Municipal Buildings– including below grade construction

Rail Lines

Roadways

Paved Parking and Access Areas

PT and MDOT understand that without completion of development along the Union Branch that is consistent with the deeded use restrictions, liability protections from state enforcement cannot be provided by VRAP. However, MDOT and PT are requesting a letter of assurance from the VRAP program that if certain remedial actions and land-use restrictions are included during development that the liability protection will be granted at the end of the development process. MDOT and PT will submit documentation of the completion of development to VRAP once the soil with contaminant concentrations above DEP's Remedial Action Guidelines have been capped by development or 12 inches of clean, stabilized soil material. Soils will be stabilized in accordance with MDOT's Best Management Practices for Erosion and Sediment Control. Until a Certificate of Completion is provided by VRAP, PT and MDOT will prepare and submit or require potential developers to prepare and submit a site-specific soil and water sampling and handling plan to MDEP prior to each stage of development, and will not permit work to be done unless the work will be in conformance with the VRAP conditions.

## POTENTIAL RISKS

The contaminants and concentrations of contaminants encountered along the Union Branch rail line property are similar to those found in other areas at other sites in the Bayside and Marginal Way areas of Portland. Therefore, there is no significant difference in potential risks along the Union Branch rail line than are present at other sites in the area, including the recently constructed Department of Human Services building, U-Haul VRAP Site, and the health food store currently under construction on Marginal Way.

Site soils that have metals (lead and arsenic) and PAHs that exceed Maine Remedial Action Guidelines (RAGs) are considered a human health risk through direct contact. Although VOCs and petroleum products are present in the soil and groundwater along some areas of the rail line property, at the low concentrations detected, these contaminants will not pose a vapor hazard in the air spaces of future buildings and basements. The land use restrictions and remedial activities designed to isolate contaminated media from direct contact with humans will significantly reduce future risks to human health and the environment.

The water table in some areas is approximately 1 ft. below ground surface and dewatering could be required in order to excavate in these areas. Although groundwater could be contaminated in some areas, groundwater in the area is not used for potable water and is unlikely to be extracted for other uses. Therefore, there is little future risk to human health and the environment.

## PROPOSED REMEDIAL ACTIONS

To the extent possible, a goal for all future developments along the rail line will be to minimize excavations and promote re-use of excavated soils on the development site. Excavated soils exceeding Maine RAGs that are removed from the site shall be disposed of or treated at licensed facilities. Soils that exceed the Maine RAGs but will not be excavated, or will be excavated and reused on the site shall be covered during the process of site development with uncontaminated onsite or imported materials as part of the development of the Union Branch rail line property.

PT and MDOT propose to develop cleanup standards of ½ the Maine RAGs for the Union Branch rail line property. Excavated soils shall be classified as Group 1, Group 2, and Group 3. Future developers must agree to classify the soils and use the following remediation concepts or develop alternative, site-specific remediation plans approved by PT, MDOT and VRAP.

### Group 1 Soils

Group 1 soils shall have no visible or olfactory evidence of contamination and field screening readings using a photoionization detector (PID) shall be less than or equal to 20 parts per million (ppm). Visual evidence of contamination shall include coal, ash, cinders, black discoloration, solvent or petroleum odors, oil stains, and metal pieces. Generally the fill materials that underlie the Union Branch rail line will not be classified as Group 1 soils. The Phase II testing indicates that elevated concentrations of metals, specifically lead and arsenic, and other contaminants are detected in soils and fill where visual evidence of contamination, as defined above, was observed.

Group 1 soils are not considered contaminated. Special handling and disposal are not required. Developers and contractors can dispose or waste Group 1 soils on or off site at their discretion.

**Group 2 Soils**

Group 2 soils shall have visible or olfactory evidence of contamination and/or field screening readings using a photoionization detector (PID) shall be more than 20 ppm. Visual evidence of contamination shall include coal, ash, cinders, black discoloration, solvent or petroleum odors, oil stains, and metal pieces. Generally the fill materials that underlie the Union Branch rail line will be classified as Group 2 soils.

Group 2 soils are considered contaminated unless testing confirms that contaminants are present at concentrations less than or equal to ½ the Maine RAGs for adult workers or trespassers, whichever is less. Field testing by techniques approved by MDOT and MDEP, such as x-ray fluorescence (XRF) and immunoassay, may be used. ***If these field-testing methods are employed during excavation then one in every twenty samples shall be split and the subsample will be submitted to a fixed laboratory for confirmatory analysis.*** If the testing confirms that concentrations are less than or equal to ½ the Maine RAGs for adult workers or trespassers, special handling and disposal are not required and developers and contractors can dispose or waste these soils on or off-site at their discretion (See Group 1).

If the testing confirms that concentrations are greater than ½ the Maine RAGs for adult workers or trespassers, special handling and disposal are required. ***Group 2 soils shall not include hazardous waste, petroleum saturated soil, or free petroleum product.*** Group 2 soils shall be used on site when possible or disposed of as special waste. If used on-site, these soils shall be capped by Group 1 soils, clean soil materials, buildings, or pavement to prevent direct human contact. Soil caps shall be covered by loam, seeded and documented by the engineer of record. The capped areas will require periodic maintenance to assure that the Group 2 soils do not become exposed or otherwise become a contact risk. As part of any development plan, those areas to be capped will be identified, and the manner of capping specified. It is envisioned that any areas that are not developed would be capped with 12 inches of clean, stabilized soil. Soils will be stabilized in accordance with MDOT's Best Management Practices for Erosion and Sediment Control

**Group 3 Soils**

Group 3 soils shall be hazardous by characteristic according to State of Maine Hazardous Waste Management Rules, dated 23 January 2001. This testing shall be required if soil concentrations exceed Maine RAGs and the soil must be disposed off-site with the record owner documented as generator. Group 3 soils must be disposed as hazardous waste. It should be noted that evidence of Group 3 soils was not observed in the previous testing.

***Group 3 soils shall also include any petroleum saturated soil or free petroleum product on the groundwater table that is encountered during construction activities. Petroleum saturated soil or free floating product will be collected and removed from the site and disposed of as special waste or recycled at a licensed facility.***

***Developers will include provisions in their plans to remediate petroleum-contaminated soils to DEP's "intermediate" standards around proposed basements and along subterranean utility corridors so that petroleum vapors and contaminants do not migrate into structures or along these corridors (see Procedural Guidelines for Establishing Action Levels for Remediation of Oil Contaminated Soil and Groundwater). If petroleum contaminants cannot efficiently be removed than the developer may submit a proposal for alternative engineering controls to DEP-VRAP for review and approval.***

Groundwater

Groundwater from beneath the Union Branch rail line property shall not be used for drinking water supplies or extraction for other purposes such as irrigation. Dewatering may be required for construction below grade especially in areas where the water table is just below the ground surface.

If possible, groundwater from construction dewatering will be re-injected into ground by sumps excavated on-site and engineer of record shall document the location. If groundwater must be discharged into the municipal sewer system or into storage tanks, the water must be tested and pre-treated prior to disposal to meet discharge requirements of the sewer district.

The goal will be to create or construct barriers to prevent water seepage into below grade structures rather than use active dewatering systems after construction. This will minimize the need to handle, test and pre-treat groundwater perpetually and reduce the chance of settlement of existing structures due to lowering of the water table.

**CLOSURE**

PT and the Maine Department of Transportation desire that liability assurances and protection from state enforcement actions for related issues along the Union Branch Rail Line can be obtained during the VRAP process. PT and MDOT understand that some limitations to site use will be required and have proposed conceptual remedial actions that will minimize the potential risks as the area is developed in the future. We look forward to the opportunity to work with you on this project.

We trust that this information will be sufficient for VRAP to provide an assurance letter to PT and MDOT prior to transfer of property ownership and initiation of site development activities. We understand that we will be notified in two weeks about the site's eligibility under the Voluntary Remedial Action Plan Program. If you have any questions or comments please do not hesitate to call Dale F. Doughty at (207) 287-8312 or Cynthia S. Scarano at (978) 663-6957. MDOT will contact you directly to arrange for the review fee to be paid through the State's internal billing system.

Sincerely,

Dale F. Doughty, C. G.
Supervisor of Hazardous Waste &
Groundwater
Maine Department of Transportation

Sincerely,

Cynthia S. Scarano
Environmental Director and Project Manager and
Guilford Rail System

CC: MDOT, Legal Office
MDOT, Office of Passenger Transportation

Attachments: VRAP application

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

ANGUS S. KING, JR.
GOVERNOR

MARTHA KIRKPATRICK
COMMISSIONER

July 26, 2001

FILE COPY

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APR - 8 2008
FACILITIES DEVELOPMENT

Mr. Dale Doughty
Office of Environmental Services
Maine Department of Transportation
16 State House Station
Augusta, Maine 04333-0016

Ms. Cynthia Scarano
Guilford Rail Line
Iron Horse Park
North Billerica, Massachusetts 01862-1688

Re: Union Branch Rail Line Property, Portland, Maine-Voluntary Response Action Program No Action Assurance Letter

Mr. Doughty and Ms. Scarano:

The Maine Department of Environmental Protection ("Department") has received and reviewed the revised "Voluntary Remedial Action Plan, Union Branch Rail Line Property, Portland, Maine", dated July 23, 2001, submitted by the Maine Department of Transportation ("MDOT") and the Portland Terminal Company (a member of the Guilford Rail System). [illegible] action plan outlines the remedial approach for the approximately 2 mile long Union Branch Line. Actual remedial actions will occur as the portions of the property are redeveloped. It is the Department's understanding that each portion of the property will participate in the Department's Voluntary Response Action Program ("VRAP") as it is redeveloped.

Based on the Department's review of the revised remedial action plan, we concur that the proposed approach, which [illegible] soils into three groups by specific contaminant characteristics, will be sufficient to meet the Department's remedial objectives for the property. The Department's decision is based on the understanding that although future development plans for the property have not been finalized at this time [illegible] use will be limited to commercial/industrial or passive recreational uses (unless approved by the Department); that groundwater at the property will not be used for drinking water or other uses without prior permission from the Department, and; that future developers of portions of the property must agree to classify, handle, and dispose of soils in accordance with the remedial action plan [illegible]ernative, site-specific remediation plan is approved by the Portland Terminal Company, MDOT and the Department.

Provided that the remedial action plan (or an alternative acceptable to Portland Terminal Company, MDOT, and the Department) is successfully implemented as each portion of the property is developed, the Portland Terminal Company, MDOT and their successors and/or assigns, will be granted, the liability protection provided by 38 M.R.S.A. § 343-E(1) for the property known as the Union Branch Rail Line, which extends from the railroad bridge over St. John Street to the AAA office building near Tukey's Bridge, Portland, Maine. The Department will take no action against the Portland Terminal Company, MDOT and those persons identified in 38 M.R.S.A. § 343-E(6).

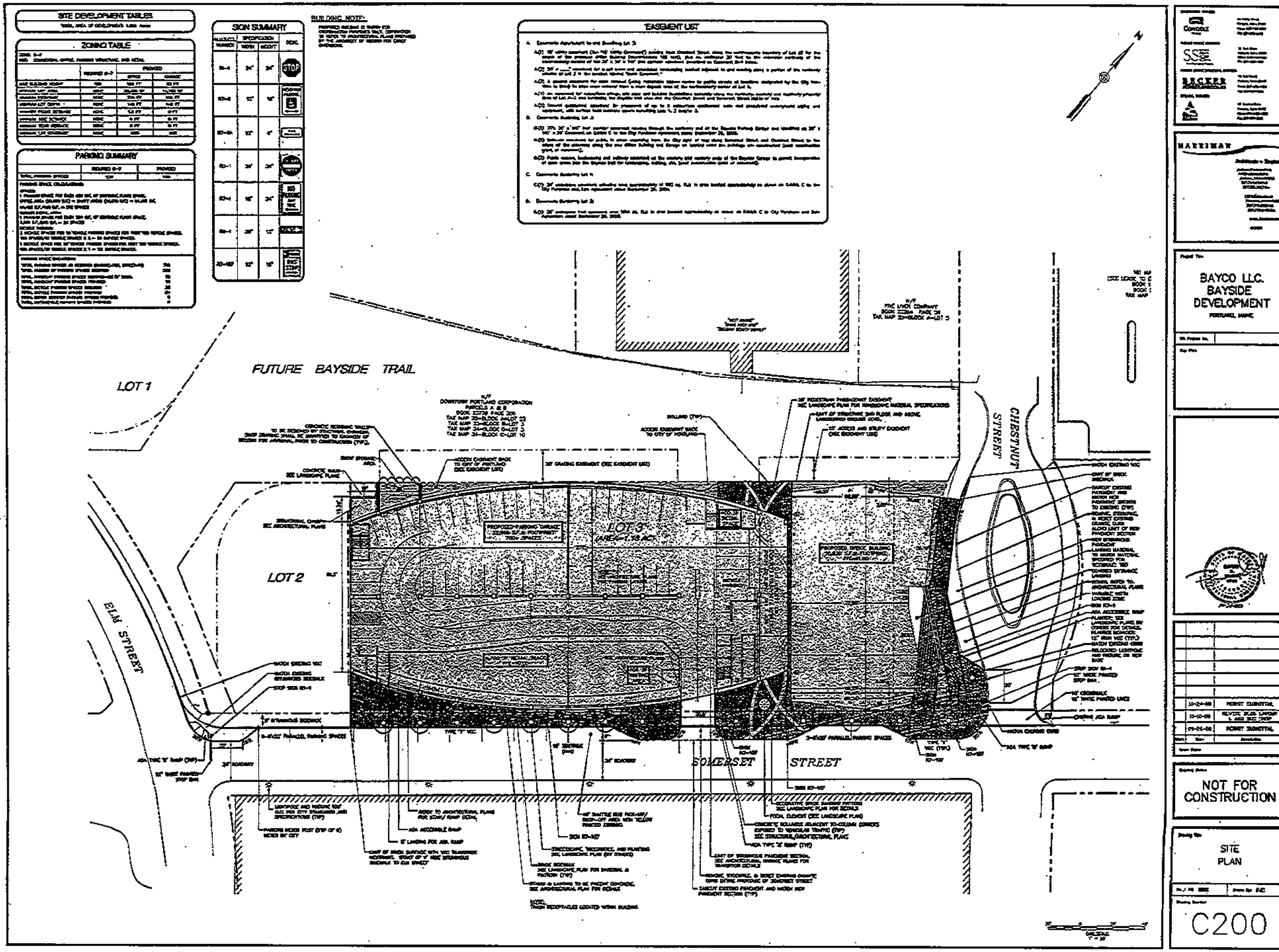
Once the recommended tasks are completed for a portion of the property, a report summarizing the successful implementation of the tasks should be sent to the VRAP. The applicant redeveloping that portion of the property will then receive a VRAP Certificate of Completion for that portion of the property. Once all the portions of the property and successfully remediated and redeveloped, a summary report should be sent to the VRAP. Upon review and concurrence with the summary report, the Department will issue to the Portland Terminal Company and the MDOT a Commissioner's Certificate of Completion.

If you have any questions regarding this letter, please feel free to call me at 207-287-4854.

Sincerely,

Nicholas J. Hodgkins
Voluntary Response Action Program
Division of Remediation

Cc: Stephen J. Kelley, Haley & Aldrich


SITE DEVELOPMENT TABLES
ZONING TABLE
PARKING SUMMARY
SIGN SUMMARY
BUILDING NOTE:
EASEMENT LIST
FUTURE BAYSIDE TRAIL
LOT 1
LOT 2
LOT 3
ELM STREET
CHESTNUT STREET
SOMERSET STREET
BAYCO LLC.
BAYSIDE
DEVELOPMENT
NOT FOR
CONSTRUCTION
SITE
PLAN
C200

# Maine Department of Environmental Protection

## Maine Voluntary Response Action Program

## Application for Assistance

Please complete this application to request technical assistance from the Voluntary Remedial Action Plan Program (VRAP) pursuant to Title 38 MRSA, Section 342, Subsection 15.

### General Site Information

Property name: Bayside Subdivision

Street Address: Somerset Street

City (or Township): Portland

Tax map #: Map 34-Block D-Lot 3; Map 25-Block A-Lot 22; and Map 24-Block C-Lot 10.

Lot #: 1, 2, 3, 4 & 9

UTM Coordinates (Map Datum: NAD83): Zone 19 398242E 4835101N

Total Acreage of Property (all parcels): 6.5

### Property Description Recorded at Registry of Deeds

County: Cumberland Book: 23759 Page: 305

### Applicant Information

Applicant/Organization*: City of Portland

Contact Person: Penny St. Louis Littell Title: Director of Planning & Urban Development

Address: 389 Congress Street

City: Portland State: ME Zip: 04101

Phone: 207-874-8719 Fax:

E-mail: PL@portlandmaine.gov

*The applicant/co-applicant are the individual(s) or organization(s) that will be the recipient of any applicable administrative or liability assurances provided by VRAP. The applicant is also responsible for payment of fees for Department review and oversight costs.

## Co-Applicant Information (if applicable)

Co-Applicant/Organization*: BAYCO LLC

Contact Person: Nathan H. Smith Title: Attorney for BAYCO LLC

Address: 100 Middle Street

City: Portland State: ME Zip: 04101

Phone: 207-228-7235 Fax: 207-774-1127

E-mail: nsmith@bernsteinshur.com

Co-Applicant/Organization*: MaineHealth

Contact Person: Donald L. Quigley Title: Vice President, Legal Affairs

Address: 465 Congress Street, Suite 600

City: Portland State: ME Zip: 04101

Phone: 207-775-7010 Fax: 207-775-7029

E-mail: quigld@mmc.org

## Current property owner (if different than applicant)

Name: Penny St. Louis Littell Title: Director of Planning & Urban Development

Organization: Downtown Portland Corporation

Address: 389 Congress Street

City: Portland State: ME Zip: 04101

Phone: 207-874-8719 Fax:

E-mail: PL@portlandmaine.gov

## Involvement with other regulatory programs

☐ Yes

☒ None known

If yes, list the program/contact person from the Department:

## Contact person(s)

Please list the name(s) of your current environmental consultant and legal counsel.

**Consultant:** John D. Tewhey of Tewhey Associates

| | | | |
|---|---|---|---|
| Address: | P.O. Box 238 | | |
| City: | Gorham | State: ME | Zip: 04038-0238 |
| Phone: | 207-839-4261 | Fax: 207-839-3834 | |
| E-Mail: | info@tewhey.com | | |

**Attorney:** of

| | | |
|---|---|---|
| Address: | | |
| City: | State: | Zip: |
| Phone: | Fax: | |
| E-mail: | | |

**As applicant/co-applicant, agents that may act on my behalf (list, if any):**

For BAYCO/MaineHealth , Stephen J. Kelley, C.G. of Haley & Aldrich, Inc skelley@haleyaldrich.com.

For , of .

For , of .

For , of .

For , of .

## Certification

I hereby make a request of VRAP to assist me and the company/organization I represent in determining whether the above-described property has been the site of a release or threatened release of a hazardous substance, hazardous waste, hazardous matter, special waste, pollutant or contaminant, including petroleum products or by-products. I understand this assistance may include the review of agency records and files, and review and approval of my investigation plans and reports as well as remedial action plans and implementation.

I am aware that the property listed in this application will be placed on the Division of Remediation's Sites List Database that is located on the Department's website, and that any documents I submit to the Department are publicly available through their file room. I am also aware that VRAP, at its discretion, may contact municipal officials regarding investigation/ remedial actions at sites participating in the program.

I am further aware that I must reimburse VRAP for the costs of providing this assistance. I understand that reimbursement requests may be made on a periodic basis and that failure to reimburse VRAP for costs in a timely manner may result in disqualification from VRAP and/or liens being placed on the property.

Typed/printed name: City of Portland by Penny St. Louis Littell Title: Director of Planning & Urban Development

Signature: Penny Littell Date: 10-14-08

*******Note: For Properties with Petroleum Discharges from USTs or ASTs*******

If your property has petroleum discharges (or potential discharges) related to an underground storage tank ("UST") or aboveground storage tank ("AST") facility, **please also sign the following:**

I hereby agree to comply with Title 38 MRSA, Section 568 A.4, which includes the submittal of work plans, budgets, and schedules to the Department for review and approval. I also agree to keep a detailed record of all costs associated with the investigation and cleanup of petroleum discharges at the property, and will submit estimates of past costs to investigate and cleanup petroleum discharges at the property that have been incurred prior to making this application.

Typed/printed name: Title: N/A

Signature:________________________________________ Date:_______________

Revised : 4/17/08

November 21, 2008

City of Portland
Attn: Penny St.Louis Littell
Director of Planning & Urban Development
389 Congress Street
Portland, Maine 04101

BAYCO LLC
Attn: Nathan H. Smith
Bernstein Shur
100 Middle Street
Portland, Maine 04101

MaineHealth
Attn: Donald L. Quigley
Vice President, Legal
465 Congress Street, Suite 600
Portland, Maine 04101

Re: Bayside Railyard Subdivision, Somerset Street, Portland, Maine—
Voluntary Response Action Program (VRAP) No Action Assurance Letter

Ms. Littell, Mr. Smith and Mr. Quigley:

The Maine Department of Environmental Protection (the "Department") has received and reviewed the November 13, 2008 letter outlining the remedial action plan for remediation of the Bayside Railyard Subdivision project, located on Somerset Street in Portland and encompassing lots 1, 2, 3, 4 and 9 of the former railyard property. The remedial plan was prepared by Haley & Aldrich, Inc. ("H&A") and submitted by the City of Portland with the request that the city, Downtown Portland Corporation, BAYCO LLC, and MaineHealth, as co-applicants to the program, receive the protections from environmental liability as provided by VRAP Law.

Based on the Department's review of the abovementioned remedial plan, and a review of documents concerning environmental conditions at the railyard that had previously been submitted to the Department, we concur that the proposed remedial actions, which include the excavation and appropriate capping of Group 2 soils (as defined in the July 23, 2001 Voluntary Remedial Action Plan for the Union Branch Rail Line Property submitted to the Department), will meet the Department's remedial objectives for the property. The Department's concurrence is based on the understanding that no potable wells will be installed on the property in the future, that the property will not be used for residential purposes, and that any soils that do not qualify as Group 2 soils will be treated in accordance with the July 23, 2001 plan.

Provided that remedial actions are completed to the satisfaction of the Department, the City of Portland, Downtown Portland Corporation, BAYCO LLC, and MaineHealth, as co-applicants, and their successors and/or assigns and lenders will be granted the liability protection provided by 38 M.R.S.A. §343-E(1) and (5) for the site which is located on Somerset Street and designated as Lots 1, 2, 3, 4 and 9 of the Subdivision and are further described in Book 23759, Page 305 of the Cumberland County Registry of Deeds. The Department will take no action against the City of Portland, Downtown Portland Corporation, BAYCO LLC and MaineHealth, and those persons identified in 38 M.R.S.A. §343-E(6) including any lenders and any successors or assigns of the applicant and the co-applicants..

Once the recommended tasks are completed, a report summarizing the successful implementation of the tasks should be sent to the VRAP. Upon review and approval of the summary report, the VRAP will issue to the City of Portland, Downtown Portland Corporation, BAYCO LLC and MaineHealth, a Certificate of Completion for the property.

If you have any questions regarding this letter, please feel free to call me at 207-287-4854.

Sincerely,

Nicholas J. Hodgkins
Voluntary Response Action Program
Division of Remediation

Pc: Stephen Kelley, Haley & Aldrich
John Tewhey, Tewhey Associates
Dave Thomas, Consigli

SECTION 02200 – SITE PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Work covered by this Section includes site clearing and grubbing as required to perform the Work as shown on Drawings.

B. The CONTRACTOR shall limit the area of clearing and grubbing to the minimum area possible to allow for the proper installation of the Work.

1.02 RELATED WORK: Includes, but not limited to, the following:

A. Handling of Contaminated Soils: Section 02110

B. Erosion and Sedimentation Control: Section 02370

C. Demolition: Section 02220

1.03 QUALITY ASSURANCE:

A. Confine clearing and grubbing operations to within the following limits:

1. All areas where Work is required to be done, but, to the minimum extent possible to properly install the Work.
2. Within the Grading Limits as shown on the Drawings.

B. No trees, plants, shrubs, flowers or vegetables shall be removed or trimmed without the prior permission of the ENGINEER, except where otherwise specified.

C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1.04 STORAGE AND HANDLING:

A. Store trees, plants and shrubs in protected areas and give ample water to keep them in a thriving condition for subsequent replanting.

B. Obstruction of roads, driveways, sidewalks, gutters and drainage ditches, swales and channels with stored materials is not permitted.

1.05 JOB CONDITIONS:

A. The locations of trees, plantings, vegetation, sidewalks, curbs and other living and nonliving items, as shown on the Drawings, have been determined by actual surveys at the time surveys were made. Since that time, the condition of things may have changed. Remove and replace all obstacles and obstructions, as required to complete the Work, whether shown on the Drawings or not, at no extra cost to OWNER.

B. Explosives are not permitted for clearing and grubbing operations.

C. Use all means necessary to protect existing objects not indicated to be removed. In the event of damage, make all necessary repairs and replacements and restore to its original condition, as acceptable to ENGINEER.

1.06 SCHEDULING:

A. Avoid interference with the use of, and passage to and from, adjacent buildings, facilities, driveways, walks, drainage systems and road.

B. Pavements which are required to be removed, including roads, driveways and walks, shall be saw-cut in advance, but do not remove until the Work is ready to be installed.

C. Do not remove highway signs, guardrails and other control, safety and warning devices until just prior to the installation of the Work.

D. All items affecting traffic, safety, lives and the containment of humans and animals and all items essential to the protection of property or the operation of a business be left in place as long as possible and replaced as soon as possible when such items must be removed.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verify that all limiting boundaries such as permanent and temporary easements, property lines, rights-of-way and grading limits have been accurately located and clearly marked.

B. Verify that pipeline routings and other items of work have been accurately located and clearly marked.

3.02 PREPARATION:

A. Mark all trees, plantings and other objects which are deemed necessary to be removed, trimmed, cut, or removed and preserved.

B. Notify and accompany ENGINEER through the site to inspect the items which are to be trimmed, removed, and replanted prior to start of the Work.

C. Protect existing trees and other vegetation indicated or directed by ENGINEER to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavating materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.

D. Water trees and other vegetation which are to remain within the limits of work as required to maintain their health during the course of construction.

E. Adjacent property and other works to remain: protect throughout the work by fences, barricades, and the exercise of special care to avoid unnecessary damage.

F. Existing Trees, Brush, Shrubs, and Other Vegetation:

a. Protect existing trees to remain by the erection of 4-FT high snow fence anchored by 8-FT high steel fence stakes at the drip line, or as directed by ENGINEER. Maintain fencing during the full time of construction work on site. Trim any branches interfering with the work and only as directed by ENGINEER.

b. Protect shrubs and bushes by tying off, staking, tarpaulins, fences, or barricades.

c. Protect shallow-rooted plants at ground surface under and in some cases outside the spread of branches by covering, or by fences, or by bridging with timber mats to avoid overly compacting the root mass.

d. Prepare trees to be transplanted by pruning branches back and by pruning roots and watering seven (7) days prior to digging.

3.03 PERFORMANCE:

A. Clearing and Grubbing:

1. Clearing consists of cutting and disposing of all trees, down timber, stubs, brush, bushes, snags, rubbish, debris, and other objectionable matter and materials and the removal and storage of fences, signs, walks, guard rails, curbs and other items to be restored.

2. Grubbing consists of the removal and disposal of all stumps, roots, duff, foundations and other objectionable matter and materials to a minimum of 12 inches below original ground surface.

3. All operations shall be done in a manner so that present growth will blend with the limits of construction and a natural appearance will be attained.

4. Employ necessary measures to avoid erosion in accordance with Section 02370 Erosion and Sedimentation Control.

B. Topsoil:

1. Topsoil is defined as friable loam surface soil found in a depth of not less than 4 inches from the original ground surface. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2-inches in diameter, and without weeds, roots, and other objectionable material.

2. Strip topsoil within limits as designated on Drawings or required to whatever depths encountered in a manner to prevent mixing with underlying subsoil or objectionable material.

3. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to main root system.

4. Stockpile soil in storage piles in areas acceptable to the OWNER. Construct storage piles to freely drain surface water. Cover storage piles as necessary to prevent windblown dust and erosion.

5. Surplus loam and topsoil not required for completion of the Work shall remain the property of the OWNER. Stockpile this material on-site and maintain and protect until Work is complete.

6. No soil shall be removed from the site without authorization from the OWNER.

C. Pavements, Walks, Curbs, & Rails:

1. Remove existing pavements, walks, and curbs to the limits shown on the Drawings, or if not shown, to the minimum extent possible.

2. Saw-cut asphalt and concrete paved surfaces before removal. Use a saw which will cut a neat, straight joint line.

3. Carefully remove granite and stone curbs and guard rails to the minimum extent possible. Terminate removals at a joint or guard rail post. Store and protect for reuse.

4. Unless otherwise specified, all materials removed and not reused shall become the property of the CONTRACTOR.

D. Walls, Fences, and Other Obstructions:

1. All guard rails, fences, signs, and other obstructions encountered shall be carefully removed and stored for subsequent reuse as depicted on the Plans or required by ENGINEER.

2. Do not disturb property markers unless absolutely necessary and approved by ENGINEER for removal. If it becomes necessary to disturb or remove a property marker, employ a Land Surveyor Registered in the State of Maine at no additional cost to the OWNER to establish the property marker location by providing a minimum of four (4) ties to the marker. The Registered Land Surveyor shall replace the property marker as soon as possible.

3. Unless otherwise specified, all materials removed and not reused shall become the property of the CONTRACTOR.

E. Disposal:

1. Burning at the site is not permitted unless otherwise approved by ENGINEER. If burning is allowed, the CONTRACTOR shall be responsible for obtaining all necessary permits.

2. Materials not specified to be stored or re-used shall be promptly removed and disposed of off-site in a lawful manner.

F. Protection: Carefully protect and guard all trees, shrubs and vegetation and take every precaution to avoid damage to utilities, buildings and other property.

G. Replanting and Restoration of Surfaces: The requirements for replanting and restoration of surfaces are as noted in the General Notes on Sheet G001 of the plans.

H. Replacement of pavements, walks, curbs, rails, walls, fences and other obstructions: Replace materials that have been removed in order to perform the Work to the original or better condition as directed by the ENGINEER.

**End of Section**

# SECTION 02220 – DEMOLITION

## PART 1 - GENERAL

### 1.01 DESCRIPTION OF WORK:

A. Demolition includes modification, removal, relocation, and/or disposal of items as shown on Drawings or as specified. This includes, but is not limited to, the following:

1. Demolition of above-grade and below-grade portions of buildings as indicated on the drawings, including but not limited to the building superstructure, fixtures, utilities, base slab, footings, foundation walls, pile caps, grade beams, and any additional items associated with the building or contained within the building.
2. Removal and replacement of utility mains, structures, and services, including storm sewers, sanitary sewers, water piping, and gas piping as required to accommodate new construction.
3. Relocation of utility poles and overhead wires as identified in the drawings.
4. Removal of existing exterior lighting as required.
5. Removal and replacement of hot bituminous pavement as required to accommodate new construction.
6. Removal of granite curbing within project area.
7. Coring of holes of diameter required and at locations required to accommodate utilities and piping as necessary for new construction.
8. All procedures required for the decommissioning of monitoring wells.
9. All other demolition work required to allow complete installation of the Project.

B. Street Opening, Street Occupancy, and Moratorium:

1. See letter from City of Portland to Bayco LLC dated September 23, 2008, Attachment A

C. Related Work Specified Elsewhere Includes:

1. Site Preparation: Section 02200
2. Earthwork: Section 02300
3. Sewers and Drains 02600
4. Drainage Structures 02630

### 1.02 SUBMITTALS:

A. Submit proposed methods and disposal plans for demolition to OWNER and ENGINEER for review prior to start of work as specified.

B. Submit schedule indicating proposed sequence of demolition to OWNER and ENGINEER and for review prior to start of work. Include coordination for shutoff, capping and continuation of utility services as required, together with details for dust and noise control protection.

C. CONTRACTOR shall contact DigSafe as required.

D. Submit letter to the ENGINEER and OWNER stating that all observation wells have been decommissioned in accordance with the requirements outlined herein. Letter shall include a site plan showing the locations of the decommissioned wells.

1.03 JOB CONDITIONS:

A. Permits: CONTRACTOR shall obtain all required permits for demolition.

B. Condition of Structures: The OWNER assumes no responsibility for actual condition of structures to be demolished.

1. Conditions existing at time of inspection for bidding purposes will be maintained by OWNER in so far as practicable.

C. Explosives: Use of explosives will not be permitted.

D. Traffic: Conduct demolition operations and removal of debris to ensure no interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways.

E. Protections: Provide temporary barricades and other forms of protection to ensure safe passage of personnel around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

1. Provide protective measures as required to provide free and safe passage of people.

2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to the demolished and adjacent facilities or work to remain.

3. Remove protections at completion of Work.

F. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to OWNER.

G Environmental Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations, permits, laws, ordinances, etc. pertaining to environmental protection.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.01 PREPARATION:

A. General: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to the demolished and adjacent facilities or work to remain.

B. Locate, identify, stub-off and disconnect utility services in accordance with City and private utility standards that are not indicated to remain in accordance with plans.

3.02 DEMOLITION:

A. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings or as specified in accordance with demolition schedule and applicable regulations.

B. Provide services for effective air and water pollution controls (water sprinkling, temporary enclosures, and other suitable methods) to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations, permits, laws, and ordinances pertaining to environmental protection.

C. Completely fill below grade areas and voids resulting from demolition work. Provide fill materials as shown on the Drawing or as specified in section 02300, Earthwork.

D. Saw-cut asphalt and concrete paved surfaces before removal. Joint cut should be neat and straight.

3.03 SALVAGED MATERIALS:

A. General: Where shown on the Drawings or specified as Salvage, Property of OWNER, or Deliver to OWNER, carefully remove indicated items, clean, store, and turn over to OWNER in area designated by ENGINEER or OWNER.

B. Any unanticipated items of significant historic or commercial value discovered in the demolition work shall remain the property of OWNER. CONTRACTOR will have the option to take possession of all other demolition materials or to dispose of them suitably. No materials assigned to CONTRACTOR may remain on site without written authorization from ENGINEER or OWNER.

C. All demolition work within the City right-of-way is to be completed in accordance with City standards. Curbing, street-signs and other items not proposed for reuse shall be transported to the City of Portland Outer Congress Street Stockyard at no cost to the OWNER.

3.04 PIPE CORING:

A. General: Core holes for all pipe protrusions through existing structures to allow watertight installation of pipe and link seal or pipe sleeve as required. Double link seals shall be installed at all pipe protrusions through concrete walls containing liquid or saturated conditions on either side.

3.05 DECOMMISSIONING OF MONITORING WELLS:

A. Flush monitoring wells with potable water to clear out and evacuate accumulated sediment, which will be verified by comparing the cleared well depth to the installed well depth record.

B. Tremie grout the entire well screen and riser column. The monitoring well screen and riser shall be tremie-grouted starting at the well bottom to approximately one (1) ft below ground surface, or level of foundation excavation, whichever is deeper, using a thick, Portland cement and bentonite grout mix. The grout may not be placed by pouring. The volume of grout must be sufficient to compensate for settling. The grout will also be “topped-off” if settling of the grout occurs. The grout mixing is to be performed using a Moyno-type cavity pump or a portable “grout plant” equipped with an accessory pump.

C. Remove the existing roadway boxes, surface seals, steel casing and PVC piping from the ground surface to approximately two (2) ft depth below surface grade, or level of foundation excavation if applicable, and the resulting void space backfilled and tamped with a manufactured sand/gravel concrete aggregate (such as Sakrete® gravel mix) to surface grade.

D. Restore the ground surface and clear the work area of debris. As part of their site restoration services, the contractor will be responsible for disposal of debris generated by the well decommissioning process (roadway boxes, casings, broken surface seals, etc.).

3.06 DISPOSAL OF DEMOLISHED MATERIALS:

A. General: Remove from Project site debris, rubbish, and other materials resulting from demolition operations. Do not remove from Project site without prior permission by OWNER or ENGINEER. Store all demolished materials that OWNER wishes to retain at location designated by OWNER or ENGINEER.

B. Burning of removed materials from demolished structures will not be permitted on site.

C. Dispose of demolition debris in a lawful manner.

D. Management of hazardous materials not specifically identified in this specification shall be extra work. This provision does not relieve CONTRACTOR of his responsibility to respond promptly and appropriately to indications of hazardous material.

E. In the event that unanticipated hazardous materials are discovered or suspected, contractor shall carry out suitable measures to minimize hazards and immediately report conditions to ENGINEER.

3.07 CLEAN-UP:

A. General: CONTRACTOR shall remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the Work, all materials, equipment, waste, and debris of every sort shall be removed and premises shall be left, clean, neat and orderly.

3.08 PORTLAND WATER DISTRICT:

A. General: CONTRACTOR shall complete all work in accordance with the Portland Water District's Standard Specifications.

3.09 CITY OF PORTLAND SANITARY AND STORM SEWER:

A. General: CONTRACTOR shall complete all work in accordance with the City of Portland Maine Technical and Design Standards and Guidelines, latest edition, and all other Ordinances and Requirements of the City of Portland.

3.10 NORTHERN UTILITIES GAS:

A. General: CONTRACTOR shall complete all work in accordance with the requirements of Northern Utilities Gas Company.

<u>Attachments:</u>

Attachment A: Letter from City of Portland to BAYCO LLC, dated September 23, 2008

**End of Section**

**Executive Department**
Joseph E. Gray, Jr., City Manager

September 23, 2008

William Caron, Manager
BAYCO LLC
Suite 600
465 Congress Street
Portland, ME 04101-3537

Re: BAYCO LLC Office Building and Garage Located at Somerset and Chestnut Streets in Portland, Maine (the "Project")

Dear Bill:

In connection with the Project, this letter will confirm my agreement on behalf of the City with regard to the following:

1. In order to keep spur development in this area of Bayside, the City hereby agrees to waive street opening fees for the installation of subsurface utility lines crossing Somerset Street, Elm Street and Chestnut Street in connection with the Project.

2. The City also agrees to waive fees for street occupancy on Somerset Street (one lane – Chestnut to Elm) for placement of temporary power lines, utilities installation, staging and other construction related activities, if the same is determined to be needed. This waiver also will include a waiver of any charges for lost parking meter revenues during the construction phase of the project for that portion of Somerset Street..

3. Because the placement of utility lines in Chestnut Street may precede by several months the expiration of the five-year opening moratorium for new streets, the City agrees to waive the moratorium and the permanent pavement restoration fee to permit the necessary installations in a cost effective and timely manner, so long as BAYCO completes the Chestnut Street surface restoration in a manner satisfactory to the City.

Finally, this letter will confirm that the City anticipates installing final pavement surface in Somerset Street following the completion of the Project at a time when the City deems it appropriate.

Sincerely,

Joseph E. Gray
City Manager

# SECTION 02240 – DEWATERING

## PART 1 - GENERAL

### 1.01 Description of Work

A. Provide, install, and maintain all necessary material and equipment used to keep excavation free of standing or flowing water and to transport water to a suitable discharge point.

B. Provide measures to dispose of water in accordance with all local, state and federal regulations. Notify Steve Harris at the City of Portland Environmental Engineering Department prior to conduction dewatering operations.

C. Related Work elsewhere includes:

1. Existing Subsurface Conditions Section 02010
2. Handling Contaminated Soils: Section 02110
3. Lateral Earth Support: Section 02250
4. Earthwork: Section 02300
5. Erosion and Sedimentation Control: Section 02370
6. Water System Distribution: Section 02510
7. Sewers and Drains: Section 02600
8. Drainage Structures: Section 02630
9. Stormwater Treatment System: Section 02631

### 1.02 Submittals

A. At least 2 weeks prior to the start of construction in any areas of anticipated dewatering, submit to the ENGINEER and City of Portland Environmental Engineering Department, a written plan for removal, storage, treatment, and disposal of groundwater from excavations. Do not proceed with construction in any of these areas until the plan has been reviewed and approved by the ENGINEER and City of Portland Environmental Engineering Department.

## PART 2 – PRODUCTS (not applicable)

## PART 3 - EXECUTION

### 3.01 General:

A. Only trained personnel are authorized to conduct dewatering, storage, and discharge operations.

### 3.02 Dewatering Excavations:

A. Perform all work in the dry. Prevent surface water or groundwater from flowing into excavations and from flooding project site and surrounding area. Do not allow water to accumulate in excavations.

B. Provide and maintain pumps, well points, gravel-pack walls, sumps, hoses, filters, and all other dewatering system components necessary to convey water away from excavations. The CONTRACTOR should note that several excavations for foundation elements, elevator pits and utilities adjacent to and within the Office and Garage footprints will extend several feet (up to 5 to 6 ft in some areas) below the observed/measured groundwater levels at the site (please refer to the groundwater level information summarized in Attachment B, Section 02010). The work of this Section shall include the design and installation of support of excavation systems (in accordance with Section 02250) if the CONTRACTOR determines that such systems will be required to provide sufficient lateral groundwater cut-off, so that all earthwork activities can be conducted in-the-dry as outlined herein and in Section 02300.

C. Minimize the suspended solids content in the water by lining the excavation collection area with crushed stone and placing the pump intake in a perforated bucket.

D. Convey water removed from excavations to a frac tank. Do not use trench excavations as temporary drainage ditches. Do not allow silt laden water to discharge to gutters or storm drainage system. Do not discharge water directly to the storm, sanitary or combined sewer.

E. Any damages to existing facilities or new work resulting from the failure of the CONTRACTOR to maintain the work areas in a dry condition shall be repaired by the CONTRACTOR, as directed by the ENGINEER, at no additional expense to the OWNER. Pumping shall be continuous where specified or directed or as necessary to protect the work and to maintain satisfactory progress.

3.03 Storage/Treatment/Discharge Process:

A. Water removed from excavations shall be stored in a frac tank to allow settling of solids and testing prior to discharge. The dewatering pump line shall be placed at the opposite end from the tank outlet.

B. Limit circulating tank contents to prevent freezing. Do not discharge from the tank while the circulation pump is operating to allow adequate settling time before discharge.

C. If needed for additional storage and treatment volume, provide a second tank to be placed in series for secondary settlement. Transfer the water from the first tank to the second tank by suspending the intake line immediately below the water level to minimize disturbance of sediment at the bottom of the tank.

D. Prior to discharge of the initial tank load, the CONTRACTOR must collect a water sample for laboratory analysis of the parameters identified with an “X” in the lists appended within this specification using the methods identified within the list. The CONTRACTOR must provide the test results to the ENGINEER and City of Portland Environmental Engineering Department. The City will use these test results to develop a baseline for testing of future frac tank loads. All future frac tank loads shall be required to be tested in accordance to the baseline developed by these initial analyses.

The City must provide approval to CONTRACTOR prior to additional effluent discharge.

The CONTRACTOR must provide access to the tanks for the City of Portland Environmental Engineering Department to take independent water samples. Do not add water or other materials to the frac tank after collecting the water sample.

E. Managing and treating water determined to have contaminant levels exceeding the City’s Industrial Pretreatment Program limits shall be in accordance with local, state, and federal regulations.

The CONTRACTOR shall work with the City of Portland and the ENGINEER to identify any other contaminants exceeding the Industrial Pretreatment Program discharge limits. The City of Portland and the ENGINEER shall provide recommended treatment methods for water found to exceed the City of Portland’s Industrial Pretreatment Program discharge limitations.

Recent environmental analysis conducted at the site indicates that Total Petroleum Hydrocarbons (TPH) will likely be encountered in certain areas of the site. Free product and water with a visible sheen cannot be discharged to the sanitary and/or combined sewer. This situation shall be controlled by spill pads typical of hydrophobic pads by SPC Sorbent Products Company or approved equal which soak visible sheens off the surface of the water. The CONTRACTOR may submit an alternative method for free product and sheen removal for review and approval by both the City and the ENGINEER.

F. Follow direction provided by the City of Portland Environmental Engineering Department on further testing and disposal requirements.

G. Obtain all local, state, and federal approvals necessary for the discharge of the water. If water is discharged to the combined or sanitary sewer, bag filters must be installed on the discharge piping and water must meet the City of Portland's Industrial Pretreatment Program discharge limitations.

H. The City of Portland and/or the Portland Water District reserve the right to stop the CONTRACTOR from discharging flow to the combined sewer system during periods of time when the Combined Sewer Overflow (CSO) is or has the potential to be active.

3.04 Diversion of Water

A. The CONTRACTOR shall be responsible for providing and maintaining all ditching, grading, sheeting, and bracing, pumping and appurtenant work for the protection from flooding as necessary to permit the construction of work in the dry.

B. Upon completion of the contract work, the CONTRACTOR shall remove all temporary construction and shall do all necessary earthwork and grading to restore the areas disturbed to their original condition or to such other conditions as indicated or directed by the OWNER.

C. Water shall not be permitted to flow into or through excavations in which work is under way or has been partially completed. The CONTRACTOR shall not restrict or close off the natural flow of water in such a way that ponding or flooding will occur, and shall at all times prevent flooding of public and private property. All damages resulting from flooding or restriction of flows shall be the sole responsibility of the CONTRACTOR, at no additional expense to the OWNER.

## City of Portland and Portland Water District Industrial Waste Report

| Location: | Maine Health/United Way Bayside Development, Portland | Sample Date | |
|---|---|---|---|

| Sample Type | | | | | | Sample Condition |
|---|---|---|---|---|---|---|
| Composite | X | Grab | | Discrete | | Refrigerated |

• Methods 40 CFR Part 136 •

| | ID No | Parameter | Preservative | Method | Report Value | Duplicate % Recovery | Analysis Date | Analyst |
|---|---|---|---|---|---|---|---|---|
| X | 23 | *pH* (Composite | Analysis (ASAP) | 150.1 | | | | |
| X | 1 | *Caustic Alk.* | Refrigerate | 310.1 | | | | |
| X | 30 | *TSS* | Refrigerate | 160.2 | | | | |
| X | 14 | *Cadmium* | HNO3 to pH <2 | 200.7 | | | | |
| X | 14 | *Copper* | HNO3 to pH <2 | 200.7 | | | | |
| X | 14 | *Chromium* | HNO3 to pH <2 | 200.7 | | | | |
| X | 14 | *Lead* | HNO3 to pH <2 | 200.7 | | | | |
| X | 14 | *Nickel* | HNO3 to pH <2 | 200.7 | | | | |
| X | 14 | *Zinc* | HNO3 to pH <2 | 200.7 | | | | |
| X | 32 | *Silver* | HNO3 to pH <2 | 200.7 | | | | |
| X | 54 | *Mercury* | HNO3 to pH <2 | 245.1 | | | | |
| X | 62 | *Arsenic* | HNO3 to pH <2 | 206.2/200.7 | | | | |

| Person(s) Sampling | | Community | | Location | |
|---|---|---|---|---|---|

| Type Of System: | Industrial | Combined | Sanitary | Storm | Surface |
|---|---|---|---|---|---|

**Automatic Sampler Information:**

| | | | | | |
|---|---|---|---|---|---|
| Date/Time Set: | | Start Time: | | Time Period: | |
| Time Interval: | | Samples per Bottle | | No. of Bottles | |
| Date/Time Pulled: | | Comments: | | | |

**Grab Sample Information (including bottle size & type)**

| | | | | | |
|---|---|---|---|---|---|
| Date/Time Pulled: | | | | No. of Samples | |
| 1000 ml HDPE Ambe | | 1000 ml Glass | | 950 ml Plastic | |
| Other Bottle Type: | | | | | |

| Relinquished by: | Received by: | Date / Time: |
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| | | |

| Reviewed for release by | | Date: | |
|---|---|---|---|

**Notes: Copy Thomas Wiley, PWD and Return Original to Stephen Harris or Charles Moore at Portland Public Works**

## City of Portland and Portland Water District Industrial Waste Report

| Location: | Maine Health/United Way Bayside Development, Portland | Sample Date: | |
|---|---|---|---|

| Sample Type | | | | | | Sample Condition |
|---|---|---|---|---|---|---|
| Composite | | Grab | | Discrete | | |

*• Methods 40 CFR Part 136 •*

| | ID No | Parameter | Preservative | Method | Report Value | Duplicate % Recovery | Analysis Date | Analyst |
|---|---|---|---|---|---|---|---|---|
| X | 56 | ***Tot. Cyanide*** **(Grab)** | NaOH to pH >12, Refrigerate | 335.2 | | | | |
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| Person(s) Sampling: | | Community: | | Location: | |
|---|---|---|---|---|---|

| Type Of System: | Industrial | Combined | Sanitary | Storm | Surface |
|---|---|---|---|---|---|

**Automatic Sampler Information:**

| Date/Time Set: | | Start Time: | | Time Period: | |
|---|---|---|---|---|---|
| Time Interval: | | Samples per Bottle | | No. of Bottles | |
| Date/Time Pulled: | | Comments: | | | |

**Grab Sample Information (including bottle size & type)**

| Date/Time Pulled: | | | | No. of Samples | |
|---|---|---|---|---|---|
| 1000 ml HDPE Ambe | | 1000 ml Glass | | 950 ml Plastic | |
| Other Bottle Type: | | | | | |

| Relinquished by: | Received by: | Date / Time: |
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| Reviewed for release by | | Date: | |
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**Notes: Copy Thomas Wiley, PWD and Return Original to Stephen Harris or Charles Moore at Portland Public Works**

## City of Portland and Portland Water District Industrial Waste Report

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Location:** | Maine Health/United Way Bayside Development, Portland | | | | | **Sample Date:** | | |
| **Sample Type** | | | | | **Sample Condition** | | | |
| **Composite** | | **Grab** | | **Discrete** | | | | |
| ***• Methods 40 CFR Part 136 •*** | | | | | | | | |

| | ID No | Parameter | Preservative | Method | Report Value | Duplicate % Recovery | Analysis Date | Analyst |
|---|---|---|---|---|---|---|---|---|
| X | 1 | *pH* | Analyze (ASAP) | 150.1 | | | | |
| | | *Caustic Alk.* | Refrigerate | 310.1 | | | | |
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| **Person(s) Sampling:** | | **Community:** | | **Location** | |
| **Type Of System:** | **Industrial** | **Combined** | **Sanitary** | **Storm** | **Surface** |

| | | | | | |
|---|---|---|---|---|---|
| **Automatic Sampler Information:** | | | | | |
| Date/Time Set: | | Start Time: | | Time Period | |
| Time Interval: | | Samples per Bottle | | No. of Bottles | |
| Date/Time Pulled: | | Comments: | | | |
| **Grab Sample Information (including bottle size & type)** | | | | | |
| Date/Time Pulled: | | | | No. of Samples | |
| 1000 ml HDPE Amber | | 1000 ml Glass | | 950 ml Plastic | |
| Other Bottle Type: | | | | | |

| **Relinquished by:** | **Received by:** | **Date / Time:** |
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| **Reviewed for release by** | | **Date** | |

**Notes: Copy Thomas Wiley, PWD and Return Original to Stephen Harris or Charles Moore at Portland Public Works**

## City of Portland and Portland Water District Industrial Waste Report

| | | | |
|---|---|---|---|
| **Location:** | **Maine Health/United Way Bayside Development, Portland** | **Sample Date:** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Type** | | | | | | **Sample Condition** |
| **Composite** | | **Grab** | **X** | **Discrete** | | |

***• Methods 40 CFR Part 136 •***

| | ID No | Parameter | Preservative | Method | Report Value | Duplicate % Recovery | Analysis Date | Analyst |
|---|---|---|---|---|---|---|---|---|
| **X** | | ***FLASHPOINT*** **(Closed Cup)** | **None** | | | | | |
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| **Person(s) Sampling:** | | **Community:** | **Portland** | **Location:** | |

| | | | | | |
|---|---|---|---|---|---|
| **Type Of System:** | **X** | | | | |
| | Industrial | Combined | Sanitary | Storm | Surface |

**Automatic Sampler Information:**

| | | | | | |
|---|---|---|---|---|---|
| Date/Time Set: | | Start Time: | | Time Period: | |
| Time Interval: | | Samples per Bottle | | No. of Bottle | |
| Date/Time Pulled: | | Comments: | | | |

**Grab Sample Information (including bottle size & type)**

| | | | | | |
|---|---|---|---|---|---|
| Date/Time Pulled: | | | | No. of Samples | |
| 1000 ml HDPE Ambe | | 1000 ml Glass | | 950 ml Plastic | |
| Other Bottle Type: | | | | | |

| Relinquished by: | Received by: | Date / Time: |
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| **Reviewed for release by** | | **Date:** | |

**Notes: Copy Thomas Wiley, PWD and Return Original to Stephen Harris or Charles Moore at Portland Public Works**

## City of Portland and Portland Water District Industrial Waste Report

| **Location:** | Maine Health/United Way Bayside Development, Portland | | | | **Sample Date:** | | | |
|---|---|---|---|---|---|---|---|---|
| **Sample Type** | | | | | **Sample Condition** | | | |
| **Composite** | | **Grab** | | **Discrete** | | | | |
| • *Methods 40 CFR Part 136* • | | | | | | | | |
| | **ID No** | **Parameter** | **Preservative** | **Method** | **Report Value** | **Duplicate % Recovery** | **Analysis Date** | **Analyst** |
| | | ***PCB's and Pesticides*** | | EPA 608 | | | | |
| | | ***(GRO) Gasoline RangeOrganics*** | | Me HETL 4.2.17 | | | | |
| | | ***(DRO) Diesel RangeOrganics*** | | Me HETL 4.1.25 | | | | |
| X | | ***Hydrocarbon (PAH Range)*** | | EPA 8015 | | | | |
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| **Person(s) Sampling:** | | **Community** | | **Location** | |
|---|---|---|---|---|---|
| **Type Of System:** | **Industrial** | **Combined** | **Sanitary** | **Storm** | **Surface** |

| **Automatic Sampler Information:** | | | | | |
|---|---|---|---|---|---|
| Date/Time Set: | | Start Time: | | Time Period | |
| Time Interval: | | Samples per Bottle | | No. of Bottles | |
| Date/Time Pulled: | | Comments: | | | |

| **Grab Sample Information (including bottle size & type)** | | | | | |
|---|---|---|---|---|---|
| Date/Time Pulled: | | | | No. of Samples | |
| 1000 ml HDPE Amber | | 1000 ml Glass | | 950 ml Plastic | |
| Other Bottle Type: | | | | | |

| **Relinquished by:** | **Received by:** | **Date / Time:** |
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| **Reviewed for release by** | | **Date** | |
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**Notes: Copy Thomas Wiley, PWD and Return Original to Stephen Harris or Charles Moore at Portland Public Works**

**End of Section**

# SECTION 02250 – LATERAL EARTH SUPPORT

## PART 1 - GENERAL

### 1.01 GENERAL

A. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

### 1.02 DESCRIPTION

A. The Work specified in this Section includes design, furnishing, and installation of temporary excavation support systems as necessary to conduct the work and protect adjacent structures.

1. Unless otherwise indicated on the drawings, the excavation support systems may be comprised of soldier piles and lagging, steel or timber sheet piling or other systems designed by the CONTRACTOR and reviewed by the ENGINEER. Timber sheet piling support of excavation systems shall not be used for excavations greater than 20 ft in depth.

B. Following construction, support of excavation system elements shall be removed in accordance with the requirements stated herein.

C. The system shall be designed to limit the total movement of the system, including lateral deflection, specifically adjacent to the office building and parking garage elevator pits, pile caps and grade beams located in the southeast corner of the parking garage, and adjacent to the storm drain and 36-in. diameter sewer in Somerset Street. The CONTRACTOR is solely responsible for the health and safety of the work specified in this Section.

D. Geotechnical Instrumentation shall be installed by the CONTRACTOR on the excavation support system to monitor lateral and vertical movements of the system. The CONTRACTOR is responsible for installing and surveying the reference points on the top of the support of excavation system as well as summarizing and providing data to the ENGINEER.

E. Take all measures necessary to protect the occupants and operations of the existing facilities from dust, excess noise, vibrations or other impacts of the construction.

### 1.03 RELATED WORK

A. Section 02010: Existing Subsurface Data

B. Section 02110: Handling Contaminated Soils

C. Section 02200: Site Preparation

D. Section 02220: Demolition

E. Section 02240: Dewatering

F. Section 02300: Earthwork

G. Section 02380: Foundation Piles

1.04 DEFINITIONS AND REFERENCES

A. American Society of Testing and Materials (ASTM):

l. A36: Standard Specification for Structural Steel.

2. A416: Specification for Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete.

3. A722: Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete.

4. A615: Standard Specifications for Deformed and Plain Billet- Steel Bars for Concrete Reinforcement.

B. American Wood-Preservers Association (AWPA) Standards.

C. American Welding Society (AWS) Code: D1.1.

D. Federal Standard, FS TT-W-S71: Wood Preservation and Treating Practices.

E. Occupational Safety and Health Administration (OSHA) Standards and Interpretations: Subpart P - Excavations, Trenching, and Shoring, current edition.

G. American Concrete Institute (ACI)

1. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete

H. OWNER: BAYCO, LLC.

I. ENGINEER: Authorized representatives of the OWNER. For the work covered under this Section, this term will include Haley & Aldrich, Inc.

1.05 JOB CONDITIONS

A. Refer to Section 02010 for available information on existing subsurface conditions.

B. Prior to submitting their bid, the CONTRACTOR shall review and understand the information provided herein and the information outlined in Section 02010. The subsurface information is made available to the CONTRACTOR for informational purposes only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs or other data.

C. Below-Grade Utilities and Obstructions

1. The CONTRACTOR is advised that the near surface, in-situ fill soils may contain cobbles, boulders and man-made structures, which may include, but are not limited to, granite blocks, cobbles, former utilities and foundations, rail lines, previous earth support systems and other structures which may interfere with support of excavation installation, excavation, pile installation and new construction, and may require removal. These items will not be considered obstructions and shall be removed as needed at no additional cost to the OWNER. Historic Sanborn Maps of the site showing locations of previous structures

on the site have been provided for CONTRACTOR consideration (see Attachment A, Section 02010).

2. Cobbles and boulders within the naturally deposited soils will not be considered obstructions.

3. Refer to the site civil plans for locations of utilities to remain, to be relocated, or to be removed.

1.06 QUALITY ASSURANCE

A. Prepare design, including calculations and drawings, under the direction of a Professional Engineer licensed in the State of Maine.

B. Qualifications of Support of Excavation System Designer:

1. Shall be a Professional Engineer licensed in the State of Maine specializing in geotechnical construction.

2. Support of Excavation system designer shall stamp and sign all support of excavation system calculations, details, and drawings.

C. Install all support of excavation systems under the supervision of a specialist having the following qualifications:

1. Not less than five (5) years experience in the design and installation of systems of similar type and equal complexity as the proposed systems.

2. Completed five (5) successful support of excavation systems of similar type and equal complexity as the proposed system in the last five (5) years.

E. Design support of excavation systems to withstand an additional 2 feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.

F. Design support of excavation systems for stability of excavations through overburden soils and for safety during construction.

G. Design support of excavation systems, taking into account dewatering procedures to address groundwater flows and surcharge loading to address construction equipment loading as necessary.

H. Obtain and comply with all permits, laws, regulations and codes.

I. All welding shall be performed in accordance with AWS D1.1.

J. The CONTRACTOR shall install the reference points on the support of excavation (and obtain baseline readings) prior to the start of excavation within 50 ft of the support system. The CONTRACTOR shall immediately replace, at no additional cost to the OWNER, unsatisfactory instrumentation or instrumentation that is damaged during the project. This latter requirement applies to all instrumentation installed by the CONTRACTOR regardless of location, and all instrumentation damaged as a result of the Work.

1.07 DESIGN CRITERIA

A. The excavation support system shall be designed to support earth, water, and surcharge loads (from adjacent buildings, construction equipment and stockpiles, cranes, traffic using HS20-44 loading, and other sources) imposed on the system during the construction period. The CONTRACTOR'S design shall also consider the means and methods and construction process proposed by the CONTRACTOR to install foundation piles and construct below grade structures.

B. Minimum criteria for design of the excavation support systems are outlined below. Design calculations and drawings shall be prepared and stamped by a Professional Engineer licensed in the State of Maine, employed by the CONTRACTOR and will be reviewed by the ENGINEER.

1. Design each component of the excavation support system to support the maximum combination of loading (including but not limited to loading from soil, groundwater and construction surcharges) than can occur during construction.

2. Design support of excavation systems using the following soil properties:

| Soil | Total Unit Weight (pcf) | Phi (degrees) | $s_u$ (psf) |
|---|---|---|---|
| Fill | 125 | 30 | not applicable |
| Marine Clay | 115 | not applicable | 600 |

Rankine active and passive earth pressure coefficients and a static groundwater level at El. 7.0 (Portland City Datum) shall be used to design all excavation support systems.

3. A minimum lateral surcharge pressure of 100 psf for surcharge loads due to construction equipment shall be used for design, and distributed as a uniform pressure over the height of excavation. The CONTRACTOR shall increase the surcharge loads based on construction equipment and staging requirements.

1.08 SUBMITTALS

A. Submit the following:

1. All qualifications as listed below. Include with all job/project references the name of the project and the names, current addresses and telephone numbers of persons in charge of representing such projects' owner or the owner at the time of excavation.

a. Support of Excavation System Designer's qualifications.

b. Support of Excavation System Supervisor's qualifications.

2. List of all applicable laws, regulations, rules, and codes to which support of excavation system design conforms.

3. Shop Drawings:

Submit a plan showing location and details of the proposed temporary excavation support system stamped and signed by a Professional Engineer licensed in the State of Maine. The CONTRACTOR shall be solely responsible for the adequacy and safety of the means, methods and sequencing of construction. This submittal shall include the following items as a minimum:

a. Show plan limits of proposed earth excavation support system(s), depth of proposed system(s), location and extent of differing types of support relative to existing features (including existing utilities) and the permanent structures to be constructed.

b. Elevations, sections and profiles showing bearing elevations, and maximum excavation levels.

c. Construction details including materials, sizes, dimensions, connections and methods and sequence of excavation support installation, pile installation, permanent structure installation, and excavation backfilling, and excavation support system removal.

d. Plan showing the location and designation of reference points to be installed at the tops of the support systems, and the location of any additional settlement points and other instrumentation proposed by the CONTRACTOR.

e. Provide weekly lateral and vertical survey data from the reference points installed on the top of the support systems. The data shall be provided to the ENGINEER within 48 hours of completion of each survey and shall be tabularized showing at a minimum the following information for each survey: reference point designation, date surveyed, and vertical and horizontal survey data.

4. Tolerable support of excavation system movements for each proposed support of excavation system.

5. Complete set of stamped design calculations for all support of excavation systems including assumptions and all parameters used in design.

6. Verification that heavy structural timber used on the job has been treated with wood preservatives.

7. Estimates of lateral and vertical movements of existing utilities, or other structures.

1.09 DELIVERY, STORAGE AND HANDLING

A. Store soldier piles and bracing materials to prevent sagging which would produce permanent deformation. Keep concentrated loads which occur during stacking or lifting below the level which would produce permanent deformation of the material.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural steel shall conform to the current edition of “AISC Specifications for the Design and Erection of Structural Steel for Buildings”. All welding shall conform to the latest addition of AWS D1.1.

B. If used, provide timber sheeting and lagging conforming to the following requirements:

1. Moisture content shall not exceed 19 percent.

2. Provide sound, well-seasoned timber such as Douglas Fir, Southern Pine, Cedar or equal.

3. Preservation wood treatment in accordance with FS TT-W-571.

4. Allowable working stress of not less than 1200 psi.

5. Nominal thickness of not less than 3 inches.

C. Survey Reference Points on Support of Excavation System: Chisel mark or welded survey hub on the top of the excavation support wall. Survey marks shall be clearly identified using fluorescent spray paint and the individual reference point designations shall be clearly displayed in permanent ink or paint.

PART 3 - EXECUTION

3.01 EXECUTION

A. Perform the support of excavation program in such a manner as to prevent undermining or disturbing foundations of existing structures or of Work ongoing or previously completed.

B. Do not begin excavation within 50 ft of any support of excavation system until all support of excavation submittals have been reviewed by the OWNER and the ENGINEER.

C. Control surface water and groundwater.

D. Review of the CONTRACTOR’S design by the OWNER and ENGINEER will in no way relieve the CONTRACTOR of responsibility for the successful performance of construction or any method of protection for adjoining property. The CONTRACTOR shall correct any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance, or design at no additional cost to the OWNER. The CONTRACTOR shall resolve all claims, costs and damages that arise as a result of the Work performed at no additional cost to the OWNER. Protect all existing utilities affected by construction from damage.

E. Expose active utilities by hand, where they lie within Work area.

F. Notify utility owners if existing utilities interfere with the support of excavation system. Modify the existing utility with the utility owner's permission or have the utility owner make the modifications at no additional cost to the OWNER.

G. Do not splice elements of the support of excavation system.

H. Excavations shall not proceed more than 2 feet below any bracing level prior to the installation and loading of the brace.

I. Install survey reference points along top of the excavation support wall to monitor vertical and lateral movements of the wall. The maximum spacing between points shall not exceed 25 ft along the length of the excavation support wall.

3.02 SOLDIER PILES AND LAGGING

A. Install pile tips to embedment elevations shown on accepted shop drawings.

B. Install lagging with openings (gaps) between boards to retain the material type encountered in the excavation while allowing free draining of water. As the installation progresses, backpack the voids between the excavation face and the lagging with sandpack or existing fill to establish a tight contact. Pack openings between lagging with hay or other porous material to allow free draining for water without loss of retained soil or sandpack. A maximum height of unlagged face shall not exceed 3 ft. Coordinate the excavation with lagging placement. Reduce the maximum height of unlagged face if water is flowing from the face of the excavation, or if soil to be retained moves toward the excavation.

C. If running sand and silt is encountered, secure the lagging to the soldier piles to avoid shifting or movement of the lagging and pack opening between lagging with additional porous material to contain the leaking material.

D. If very fine sand and/or silt are encountered, take measures to retain the material in place and prevent loss of ground and/or movements which may cause damage to adjacent buildings, structures or utilities.

3.03 STEEL AND TIMBER SHEET PILES

A. Limit sheetpile-driving induced ground vibrations (maximum peak particle velocity) to less than the values provided below at all nearby fresh concrete, as measured by the ENGINEER.

| Concrete Age (days) | Maximum Peak Particle Velocity (in./sec) |
|---|---|
| 0 to 1 day old | 0.5 |
| 1 to 7 days old | 2.0 |
| Greater than 7 days old | 3.0 |

B. Drive sheetpiling in plumb position such that each pile installed is continuously interlocked with adjacent piles along the entire length. Use templates or other temporary alignment facilities to maintain sheeting on line.

C. Drive sheeting to the depths shown on shop drawings. Do not overdrive sheeting or otherwise cause damage to sheetpile (tops, tips, or interlocks).

D. After driving, sheeting shall be in direct contact with material to be retained.

3.04 MAINTENANCE OF SOIL SUPPORTS

A. Maintain steel members for bracing and replacement lagging on hand throughout lagging and bracing Work and other support of excavation operations to protect the Work and for use in case of accident or emergency.

B. Seal leaks uncovered in the walls as excavation progress.

3.05 REMOVAL OF SUPPORT OF EXCAVATION SYSTEM

A. Remove the support of excavation system without endangering the construction, under this or other Contracts, other structures, utilities, or property. The CONTRACTOR shall remove all excavation support system elements unless approved by the OWNER.

B. Immediately backfill all voids left or caused by withdrawal of support of excavation systems with crushed stone, granular fill, or flowable fill as specified in Section 02300 by tamping with tools specifically adapted for that purpose.

C. If approved by the OWNER, support of excavation system elements that are to remain in place shall be cutoff to a minimum depth of 5 ft below finished site grades.

D. Conduct survey of the locations and final cut-off elevations of the top of all support of excavation systems left in place and submit to the OWNER.

3.06 MOVEMENT CONTROL

A. Maintain the lateral movement of the excavation support system below the tolerable movements as provided in the support system submittal.

B. Adjacent above and below-grade site improvements are sensitive to ground movement and settlement. Adjacent structures will be influenced by the performance of the CONTRACTOR'S excavation support system

C. The CONTRACTOR shall notify the ENGINEER if measured movements exceed anticipated tolerable movements. The CONTRACTOR shall take immediate steps to control further movement by revising their procedures, providing supplemental bracing or other measures (working 24 hours per day and temporarily terminating work in the area of movement if necessary).

D. If movement of the excavation support system reaches or exceeds the anticipated tolerable value, the ENGINEER, based on their judgment and review of the movement monitoring data, may require that the CONTRACTOR temporarily terminate the work in the area where such movement is occurring and implement all necessary mitigation measures which are satisfactory to the ENGINEER to arrest the movements at no additional cost to the OWNER, including backfilling of the excavation.

E. These criteria are intended to establish a minimum basis for the CONTRACTOR'S design and procedures and in no way relieve the CONTRACTOR of their sole responsibility for preventing detrimental movements and damage to adjacent existing and new site improvements.

**End of Section**

SECTION 02300 - EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Work included under this Section includes, but is not limited to, providing all labor, materials, equipment, and incidentals to conduct and complete the Work related to the planned building, utilities and site improvements as specified herein and shown on the Drawings.

1. Excavate all materials, including soil, boulders, abandoned utilities, existing and previous building foundations, railroad tracks, pavements, curbs, granite blocks, and all other materials as necessary to construct the building improvements shown on the Drawings.
2. The CONTRACTOR shall be solely responsible for impacts and damage to structures due to their work, and for corrective action or repairs needed to restore the structure(s) to its original condition at no additional cost to the OWNER. Where structures are adversely affected by construction operations, they shall be repaired, restored and replaced in accordance with the requirements outlined herein.
3. The CONTRACTOR shall note that some over-excavation and replacement of in-situ fill soils may be required to reach the bearing soils for parking garage and office building footings.
4. Handle, process, re-handle, segregate, and stockpile materials during the course of the Work. Existing on-site materials may require processing prior to reuse. Processing may include separating, crushing, blending, screening, and other measures to meet the requirements herein and as directed by the ENGINEER. Only those soils and other materials approved by the ENGINEER shall be reused on-site.
5. Prepare, grade, shape, compact and protect all subgrades, backfills, and ground surfaces shown on the Drawings.
6. Dewater as necessary to enable construction of site improvements, including backfilling, in-the-dry in accordance with section 02240. The CONTRACTOR shall be responsible for control, pumping, and legal disposal of groundwater, precipitation, or other water which enters or accumulates in excavations to maintain stable subgrades and allow all below-grade construction to be conducted in-the-dry.
7. Provide, place, moisture condition, compact, and grade fill, backfill and other materials to the horizontal and vertical limits to construct the proposed site improvements and achieve the lines and grades as shown on the Drawings.
8. Place plastic separators, vapor barriers, mudmats, and geotextiles as necessary and required.
9. Install underslab drainage system elements at the locations and elevations shown on the Drawings.
10. Preserve and protect existing structures and utilities and new site improvements during the course of the Work.
11. Manage and legally dispose off-site all excess excavated materials, including, but not limited to soil, rock, boulders, water, demolition waste, and debris that cannot be reused on-site.
12. Obtain, maintain and pay for all required permits, licenses, and approvals prior to commencing the Work of this and other related Sections.
13. Off-site disposal of contaminated material, if required, shall not be conducted without prior approval of the OWNER and ENGINEER. Disposal of contaminated material shall be done in accordance with Section 02110.
14. Provide and install erosion control during the Work as indicated on the Drawings, as required in the Specifications, and in accordance with applicable regulations and permits.
15. The CONTRACTOR shall be solely responsible for impacts and damage to any existing structures due to their Work, and for corrective action or repairs needed to restore the structure(s) to original condition at no additional cost to the OWNER.

B. Related Work Specified Elsewhere:

1. Existing Subsurface Conditions: Section 02010
2. Handling of Contaminated Soils: Section 02110
3. Site Preparation: Section 02200
4. Demolition: Section 02220
5. Dewatering: Section 02240
6. Lateral Earth Support: Section 02250
7. Erosion and Sedimentation Control: Section 02370

1.02 PROTECTION:

A. Paved Surfaces: Do not operate equipment that will cause damage on paved surfaces. Any damage to existing roads or other paved surfaces caused by construction equipment shall be repaired at no additional cost to OWNER.

B. Maintain excavations with approved barricades, lights, and signs to protect life and property until excavation is filled and graded to a condition acceptable to the ENGINEER.

C. Protect structures, utilities, groundwater monitoring wells, property monuments, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. The CONTRACTOR shall be responsible for actual cost of repair or replacement of any items damaged as a result of construction activities, including any professional services required for inspection of repairs and replacement.

1.03 QUALITY ASSURANCE:

A. Testing and Inspection: OWNER shall be responsible for all testing, unless otherwise noted. The cost for retesting due to failed tests shall be the responsibility of the CONTRACTOR.

The CONTRACTOR shall be responsible for coordinating with the ENGINEER to allow for testing to be performed at the frequencies specified. A minimum of 48 hours notice for in-place testing shall be given to allow proper scheduling by the ENGINEER.

Materials Testing Firm: Company specializing in in-situ testing of compacted fills with a minimum of five years documented experience. Company to be acceptable by the ENGINEER and OWNER. Materials testing firm to be independent of CONTRACTOR.

B. The ENGINEER will observe the CONTRACTOR'S earthwork activities, including excavation, dewatering, subgrade preparation, backfilling and on-site reuse of excavated materials. The CONTRACTOR shall provide sufficient notice to the ENGINEER to allow the ENGINEER to be present to observe the Work.

C. The ENGINEER will conduct field and laboratory density testing of placed and compacted soils to confirm compliance with the requirements of this Section. Field and laboratory density testing will be conducted in general conformance with ASTM or other applicable reference standards. The CONTRACTOR shall cooperate with the ENGINEER in all respects to facilitate any testing or observations.

D. The CONTRACTOR shall not place or compact any fill, backfill, prepare subgrades or place concrete on bearing surfaces unless the ENGINEER is present to observe the Work. Materials placed and/or compacted which do not conform to project specifications for the area, shall be removed and replaced with appropriate, suitable material when directed by the OWNER or the ENGINEER at no additional cost to the OWNER. Costs related to testing or replacement of nonconforming Work or materials, and/or delays caused by nonconforming Work or materials, shall be paid for by the CONTRACTOR at no additional cost to the OWNER.

E. The presence of the ENGINEER shall not relieve the CONTRACTOR of their responsibility to perform the Work in accordance with the Contract Documents, nor shall it be construed to relieve the CONTRACTOR from full responsibility for the means and methods of construction, protection of site improvements against damage, and for safety on the construction site. The CONTRACTOR shall comply with all applicable laws, rules, ordinances and regulations of the Federal Government, the State of Maine, and the City of Portland, governing the transportation, storage, handling and use of explosives. All labor, materials, equipment and services necessary to make the blasting operations comply with such requirements shall be provided without additional cost to the OWNER.

F. The CONTRACTOR shall adhere to the applicable requirements of the specifications, OSHA Standards and to all other applicable ordinances, codes, statutory rules, and regulations of federal, state, and local authorities having jurisdiction over the Work of this Section.

G. The CONTRACTOR may conduct additional field and laboratory testing or screening tests for their own information at no additional cost to the OWNER.

H. In case of conflict between regulations or between regulations and Specifications, the CONTRACTOR shall comply with the strictest applicable codes, regulations, or Specifications.

1.04 JOB AND SUBSURFACE CONDITIONS:

A. Site Information: The CONTRACTOR may make their own borings, hand probes, explorations, and observations to determine soil, groundwater levels, and other subsurface conditions at no additional cost to OWNER. Coordinate with OWNER prior to start of additional investigative work.

B. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations. Coordinate with utility companies for actual locations and shut-off services. If utilities are encountered that are not shown or that are shown incorrectly on the Drawings, notify ENGINEER immediately. Repair damaged utilities to satisfaction of the ENGINEER and utility.

1.05 REFERENCES:

A. Manual of Accident Prevention in Construction - Associated General Contractors of America, Inc.

B. 29 CFR 1926/1910 - OSHA Safety and Health Standards for Construction Industry

C. Standard Specifications for Highways and Bridges - Maine Department of Transportation, current edition

1.06 SUBMITTALS:

A. General

1. Unless otherwise noted, the CONTRACTOR shall forward submittals to the ENGINEER a minimum of two weeks prior to any planned work related to the CONTRACTOR'S submittals.
2. The time period(s) for submittals are the minimum required by the ENGINEER to review, comment, and respond to the CONTRACTOR. The ENGINEER may require resubmission(s) for various reasons. The CONTRACTOR is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the Work.
3. The CONTRACTOR'S submittals shall be reviewed and accepted by the ENGINEER prior to conducting any Work.
4. The CONTRACTOR'S submittals shall be prepared and stamped by a Professional Engineer registered in the State of Maine, retained by the CONTRACTOR as requested by the ENGINEER.
5. Acceptance of the CONTRACTOR'S submittals by the ENGINEER does not relieve the CONTRACTOR their responsibility for the adequacy, safety and performance of the Work.

B. Excavation and Backfilling

1. A narrative and drawings (plans and elevations at 1 in.= 40 ft scale) describing the schedule, construction sequence and procedures for excavation, subgrade preparation, foundation construction, cold weather subgrade protection, backfilling, dewatering, soil handling, stockpiling and other related activities. This includes soil management to eliminate cross-contamination of soils.

2. Details of proposed backfill materials and equipment.

3. Proposed types and sources of all off-site fill materials, including topsoil. For each type of soil to be utilized as fill or backfill, the CONTRACTOR shall submit results of all aggregate gradation, moisture density, and field compaction testing for all materials to the ENGINEER. Submit minimum 50-lb. bag samples of each on-site or off-site material proposed for use, from each borrow source or supplier to the ENGINEER'S laboratory for review and laboratory testing at least 2 weeks prior to use on site. Do not import any material to the site unless accepted by the ENGINEER. With each sample provide the following documentation:

   a. Location of the borrow source site.
   b. Present and past usage of the source site material.
   c. All previously existing report(s) associated with an assessment of the source site as related to the presence of oil or hazardous materials.

   If materials are suspected of containing oil and/or hazardous materials based on the ENGINEER'S review of the submitted data described above, the CONTRACTOR shall submit chemical test data on the material. The cost of any required testing shall be borne entirely by the CONTRACTOR. The ENGINEER will review the data and determine its acceptability for use on site.

4. For use of filter fabrics, underslab drain piping, prefabricated vertical drainage board, and underslab drain cleanouts submit manufacturer's literature for approval by the ENGINEER.

5. Submit details regarding proposed dewatering procedures including general approach to dewatering; equipment; pumping locations; discharge locations; means for preventing the pumping of fines from subgrade soils; means for controlling suspended solids in effluent.

1.07 LINES, GRADES AND TOLERANCES:

A. The CONTRACTOR shall be responsible for establishing all lines, grades and other survey control to complete the Work as shown on the Drawings.

B. Maintain the moisture content of backfill materials as necessary to allow for the material to be readily placed to the degree of compaction specified herein.

C. Construct finished soil and backfill surfaces to the elevations indicated on the Drawings.

D. Compact backfill materials to the specified degree of compaction.

PART 2 - MATERIALS

2.01 MATERIALS:

A. General: All materials utilized for this Project shall be obtained from a source that has been licensed or permitted for such use by local and state authorities. The CONTRACTOR shall be required to submit evidence of such if so requested.

1. Suitable materials: Suitable soil materials are defined as those complying with ASTM D2487 soil classification groups GW, SM, SW, and SP.

2. Unsuitable materials: Materials containing excessive amounts of water, clay, vegetation, organic matter, debris, pavement, stones or boulders over 6-inches in greatest dimension, frozen material, and material which, in the opinion of the ENGINEER, will not provide a suitable foundation or subgrade.

3. On-Site Material: Any suitable material from on-site excavation.

4. Material for embankments and general site fills may contain pieces of excavated ledge having a greatest dimension of up to 6-inches, unless otherwise approved by the ENGINEER.

5. Inspection: The ENGINEER may inspect off-site sources of materials and order tests of these materials to verify compliance with these Specifications.

6. Sieve Analysis: Submit sieve analysis in accordance with ASTM D422 for all materials prior to start of construction.

B. Gravel/Aggregate Base: Hard, durable gravel contained only particles passing the 2-inch sieve. Equal to MaineDOT 703.06, Type A material. Sieve analysis by weight:

| Sieve Size | % Passing by Weight |
|---|---|
| 2" | 100 |
| 1/2" | 45 - 70 |
| 1/4" | 30 – 55 |
| No. 40 | 0 – 20 |
| No. 200 | 0 – 5 |

C. Aggregate Subbase: Sand or gravel of hard, durable particles; equal to MaineDOT 703.06 Type D material. Aggregate subbase shall not contain particles that will not pass the 6-inch sieve. The part that passes the 3-inch sieve shall meet the following gradation requirements:

| Sieve Size | % Passing by Weight |
|---|---|
| 1/4" | 25 – 70 |
| No. 40 | 0 – 30 |
| No. 200 | 0 – 7 |

D. Subbase Fill: Sand or gravel of hard, durable particles; equal to MaineDOT 703.06 Type F material. Subbase fill shall not contain particles that will not pass the 6-inch sieve. The part that passes the 3-inch sieve shall meet the following gradation requirements:

| Sieve Size | % Passing by Weight |
|---|---|
| 1/4" | 60 – 100 |
| No. 40 | 0 – 50 |
| No. 200 | 0 – 7 |

E. 3/4" Crushed Stone: Durable, clean angular rock fragments obtained by breaking and crushing rock material.

| Sieve Size | % Passing by Weight |
|---|---|
| 1" | 100 |
| 3/4" | 90 – 100 |
| 3/8" | 20 – 55 |
| No. 4 | 0 – 10 |
| No. 200 | 0 – 1.5 |

F.Sand: Sand shall be well-graded coarse sand without excessive fines and free from loam, clay, and organic matter. Beach sand shall not be used. The grading requirements are as follows:

| Sieve Size | % Passing by Weight |
|---|---|
| 3/8" | 100 |
| No. 4 | 95 – 100 |
| No. 16 | 50 – 85 |
| No. 50 | 10 – 30 |
| No. 100 | 2 – 10 |

G. Granular Fill: Granular Fill shall consist of clean, aggregate sand and gravel mineral soil free of organic material, loam, trash, snow, ice, frozen soil or other compressible material well graded within the following limits:

| Sieve Size | % Passing by Weight |
|---|---|
| 3” | 100 |
| No. 4 | 30 – 90 |
| No. 40 | 10 – 50 |
| No. 200 | 0 – 5 |

Granular Fill shall be used below slabs within 5 feet in plan of pile caps and grade beams, sidewalks, exterior slabs, and at other locations shown on the Drawings. Processed concrete/building debris is not acceptable for use as Granular Fill.

H. Riprap: In accordance with MaineDOT 703.26 – Plain and Hand Laid Riprap, or as otherwise noted.

I. Refill Material: Use 3/4" crushed stone for refilling excavation below normal grade, rock excavation or refilling excavations of unsuitable material, unless otherwise directed by ENGINEER.

J. Fabric Protection Layer: As specified on the Contract Plans.

K. Select Backfill: Use gravel/aggregate base material as directed by the ENGINEER.

L. Common Borrow: Earth suitable for embankment and general site fills construction free from frozen material, perishable rubble, peat and other unsuitable material. Moisture content shall be sufficient to provide required compaction and stable embankment, but shall not exceed 4% above optimum.

M. Underslab Drain Piping: 4-in. diameter perforated and solid PVC or HDPE pipe, or approved equivalent, shall be used for the underslab drainage system at the location shown on the Drawings. Perforations shall be compatible with the crushed stone.

N. Drainage Board: Drainage Board shall consist of a High Density Polyethylene (HDPE) drainage net with a non-woven, synthetic, chemically resistant non-biodegradable fabric attached to both sides of the drainage net. The drainage board shall have a minimum transmissivity of 0.0024-gal/min/ft, and shall be installed against the outside face of the finished foundation wall as shown on the Drawings.

O. Geotextile: Geotextile shall consist of a non-woven, synthetic, chemically resistant non-biodegradable fabric. Geotextile shall be used to prevent fine-grained soils from migrating into coarse grain materials as judged necessary by the ENGINEER, and at the locations shown on the Drawings. Mirafi 160N, or approved equivalent shall be used as Geotextile.

PART 3 - EXECUTION

3.01 EXCAVATION:

A. General: Excavation shall include the removal of all encountered materials, including but not limited to, soil, boulders, asphalt pavement, concrete (reinforced and unreinforced), miscellaneous debris, buried and abandoned foundations and utilities, railroad tracks, site improvements, incidental structures and all other materials encountered to the limits shown on the Drawings, or designated in the Specifications. Where excavations are required to be made into the Zone of Influence (ZOI) below an existing or new foundation, utility or other structure, the CONTRACTOR shall design excavation and bracing system, underpinning, or other system approved by the ENGINEER to: 1) provide support to protect the soil within the ZOI from loosening and becoming disturbed, and 2) protect the structure from movement. The ZOI beneath a structure or utility is defined by imaginary lines extending outward 2 ft laterally beyond the bottom edge of a footing or from the springline of a utility and down on a one horizontal to one vertical (1H:1V) slope to the top of the natural inorganic bearing soils. Soils located within the zone of influence provide foundation support. Excavation and backfilling shall be performed in the same day.

B. Classifications: The following classifications of excavation will be made which will be paid for on a unit cost basis:

Rock Excavation
Excavation below Normal Grade

C. Rock Excavation includes removal and disposal of materials and obstructions encountered that cannot be excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping; includes boulders larger than 2 cubic yards each.

Do not perform rock excavation or excavation of unsuitable materials until material to be excavated has been cross-sectioned and classified by the ENGINEER. Pre-drilling and blasting of bedrock through overburden may be allowed. However, if this method is used, the rock excavation quantities will be adjusted downward in proportion to the ground swell from this blasting method.

D. Earth Excavation: Remove and dispose of obstructions visible on ground surface, underground structures, utilities, railroad tracks, and items indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation.

E. Excavation in Paved Areas: Cut pavement prior to excavation to provide a clean, uniform edge. Minimize disturbance of remaining pavement. Cut and remove the minimum amount of pavement required to do the Work. Use shoring and bracing where sides of excavation will not stand without undermining pavement.

F. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate the final 1.0 feet to foundation subgrade level using methods and equipment designed to prevent disturbance to the bearing soils (by hand or by smooth bucket excavator).Trim bottoms to required lines and grades to leave solid base to receive other Work. When excavating in clay material, use a smooth-edged bucket to avoid disturbance of the bottom of the excavation. Use shoring and bracing as required by OSHA standards.

G. Excavation for Utility Trenches: Excavate to widths shown on the Drawings and depths indicated or required to establish indicated slope and invert elevations.

Produce an evenly graded, flat trench bottom at the subgrade elevation required for installation of pipe and bedding material. Place backfill material directly into trench or excavation. Do not stockpile material to be used as backfill along edges of trenches. Load excavated material directly into trucks, unless otherwise permitted by the ENGINEER.

H. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the ENGINEER. Unauthorized excavation, as well as remedial work directed by the ENGINEER, including refilling, shall be at the CONTRACTOR's expense.

I. Refilling Unauthorized Excavation: For trenches, use 3/4-inch crushed stone. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the ENGINEER.

J. Excavation of Unsuitable Materials: When excavation has reached required subgrade elevations, notify the ENGINEER who will make an inspection of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper as directed by the ENGINEER and replace excavated material as specified. Removal of unsuitable material and its replacement as directed by the ENGINEER will be paid for as Excavation Below Normal Grade unless material has been made unsuitable by the CONTRACTOR's operations. In this instance, removal and replacement will be performed at the CONTRACTOR's expense.

K. Material Storage: Stockpile and maintain suitable surplus excavated materials for re-use as backfill within the Project limits, as directed by the ENGINEER. Place, grade, and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations.

3.02 BLASTING

A. General: Obtain approval of the OWNER and ENGINEER before blasting. All blasting for utilities shall be paid as Utility Trench Blasting. All blasting related to footings, foundations and other site elements NOT related to utilities shall be paid as Open Blasting.

B. Pre-blast Survey shall be the responsibility of the CONTRACTOR. Provide pre-blast survey prior to any blasting or blasting related operations. A written report of the preblast survey will be provided to the OWNER by the CONTRACTOR and will be available for review by the City of Portland. A copy of the blasting plan will be submitted to the City of Portland and the OWNER for review and approval prior to the initiation of the site preparation work.

All owners of dwellings or residences located within 500-feet of the blasting location shall be notified, in writing, by the CONTRACTOR a minimum of 30 days prior to the scheduled blasting date about the proposed blasting and how to request a pre-blast survey. Upon request, the CONTRACTOR shall determine the pre-blasting condition of any structure located within this area and prepare a written report. The pre-blast survey shall be limited to the surface conditions of the structures but shall comply in all respects with 30 CFR, Chapter VII, Section 816.62.

1. Pre-blast Survey shall include, but not be limited to:
    a. Video tape of each structure within 500-feet of the blasting location to show pre-blast conditions. Highlight existing defects in structures and pavements. Provide some means of establishing scale of existing defects (i.e., include tape measure or folding ruler at defect during video taping).
    b. Video taping shall be done with commercial grade equipment to allow equipment still viewing without distortion of the viewed area.
    c. Still photos and videotapes shall be retained by the pre-blast surveyor and shall be available for viewing by the OWNER and ENGINEER within 24 hours upon request.
2. A blasting plan shall be prepared which addresses:
    a. Airblast Limits
    b. Ground Vibrations
    c. Maximum Peak Particle Velocity

3. The blasting plan shall meet criteria established in Chapter 3 (Control of Adverse Effects) in the Blasting Guidance Manual of the United States Department of the Interior Office of Surface Mining Reclamation and Enforcement.

4. Provisions and measures to monitor and assure compliance with the blasting plan.

5. The blasting plan and preblast survey shall conform to all recommendations of the project geotechnical report and supplemental geotechnical evaluations included in these Specifications.

C. Particle Velocities: Maximum allowable peak particle velocity shall be limited to 1.25 inches per second within 300 feet of the blast site. Monitor at location designated by the ENGINEER.

D. Documentation: Submit an accurate record of the blasting operation to the ENGINEER. A copy should be retained by the blasting firm for at least 3 years. This record shall consist of the following information as listed in 30 CFR, Chapter VII, Section 816.68.

1. Name of the firm conducting the blast.
2. Location, date, and time of the blast.
3. Name, signature, and certification number of the blaster conducting the blast.
4. Identification, direction, and distance, in feet, from the nearest blast hole to the nearest dwelling, public building, school, church, community or institutional building outside the project area.
5. Weather conditions, including those that may cause possible adverse blasting effects.
6. Type of material blasted.
7. Sketches of the blast pattern including number of holes, burden, spacing, decks, and delay pattern.
8. Diameter and depth of holes.
9. Types and total weight of explosives used.
10. Mats or other protections used.
11. Seismographic and airblast records, which shall include: type of instrument, sensitivity, and calibration signal or certification of annual calibration; exact location of instrument and the date, time, and distance from the blast; and the vibration and/or airblast level recorded.

E. All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction", issued by the Associated General Contractors of America, Inc., of the "Construction Safety Rules and Regulations", as adopted by the State Board of Construction Safety, Augusta, Maine, and the Maine Department of Transportation "Standard Specifications" Section 105.2.6, Use of Explosives. Blasting through the overburden will not be allowed.

F. Drilling equipment will be equipped with suitable dust control apparatus that must be kept in repair and used during all drilling operations.

G. Open blasting shall pertain to all blasting required for the placement of foundations, footings, and other project elements not specifically identified in paragraph H, utility trench blasting. Vertical pay limits for all open blasting shall be one (1) foot below the base of structural elements to be placed. Horizontal pay limits for all open blasting shall be two (2) feet beyond each outside edge of structural elements to be placed. Blasting for placement of underdrain piping and associated appurtenances depicted along building footings will be considered open blasting.

H. Utility trench blasting shall pertain to all blasting required for the placement of any pipe, utility structure, or associated appurtenances. Utilities associated with the site shall include water distribution and service, sanitary sewer collection and service, storm sewer collection, underground electrical service, telecommunications, data, and geothermal related elements, as indicated on the drawings. All blasting required for the placement of utilities outside the horizontal and vertical pay limits defined by open blasting described in paragraph G, shall be paid as utility trench blasting. Pay limits for piping and utility structures shall be as depicted on the contract drawings.

3.03 STABILITY OF EXCAVATIONS:

A. General: Slope sides of excavations to comply with OSHA Regulations and Local Codes. Shore and brace where sloping is not possible due to space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

B. Refer to Section 02250 for shoring requirements.

3.04 DEWATERING:

A. General: Refer to Section 02240 for dewatering requirements

3.05 SUBGRADE PREPARATION:

A. General

1. Care shall be taken to avoid disturbance to subgrades. Prepare subgrades no steeper than one vertical to ten horizontal unless otherwise approved by the ENGINEER.
2. Provide a firm, smooth, stable, undisturbed subgrade as judged by the ENGINEER. Loose, disturbed soil shall be removed by hand shovel.
3. Subgrades consisting of cohesive soils shall not be “backbladed” or compacted to prepare a smooth surface.
4. Subgrades consisting of granular soils shall be recompacted until firm.
5. Movement of construction equipment directly over exposed final subgrades, except for compaction equipment, shall not be permitted.
6. The exposed subgrade will be examined in the field by the ENGINEER to observe the strength and bearing capacity of the soils. Disturbed or soft or unstable soils, as judged by the ENGINEER, shall be excavated and replaced with lean concrete, granular fill, or other acceptable materials at no additional cost to the OWNER. Concrete shall not be placed prior to inspection of soil subgrade by ENGINEER
7. Prevent soil subgrades from freezing and frost. Soil subgrades that freeze prior to concrete or backfill placement shall be thawed and recompacted, or removed and replaced with non-frozen backfill, lean concrete or other acceptable material as directed by the ENGINEER.
8. Group 2 soils suitable for reuse beneath the Garage ramp and within the footprint of the Office and Garage shall be granular in nature and must be able to be placed in lifts and compacted in accordance with the requirements outlined herein. Suitable Group 2 soils

shall not contain appreciable amounts of topsoil, organic matter or miscellaneous debris. Group 2 soils shall not be placed in these areas without the prior approval of the ENGINEER.

9. Group 1 soils suitable for reuse beneath the Garage ramp and within the footprint of the Office and Garage shall be granular in nature and must be able to be placed in lifts and compacted in accordance with the requirements outlined herein. Suitable Group 1 soils shall not contain appreciable amounts of topsoil, organic matter or miscellaneous debris. Group 1 soils shall not be placed in these areas without the prior approval of the ENGINEER.

B. Office Building Footings

1. For all footings remove all in-situ fill soil, organic material, debris, disturbed soil and other compressible materials from within the Zone of Influence (ZOI) of footings to a minimum depth of 1 foot below the footing bearing level.
2. Proof-compact the acceptable subgrade (if bearing soils are granular in nature) to achieve a firm subgrade. Do not proof compact cohesive soil subgrades.
3. Place and compact Granular Fill, 1-1/2 inch crushed stone material, or other approved material in engineered lifts from the prepared subgrade elevation to the design footing bearing elevation to the limits shown on the Drawings.
4. Footing subgrade shall be approved by ENGINEER and footings shall bear on:
   a. 12 inch minimum thickness of 1-1/2 inch crushed stone placed following over-excavation of fill soil as described above.
   b. 12 inch minimum thickness of granular fill placed following over-excavation of fill soils as described above.

C. Building Slabs-on-Grade

1. Over-excavate all fill, topsoil, disturbed soil and any materials to a depth of at least 12 in. below the slab-on-grade bearing elevation, unless otherwise noted on the Drawings. Any utility abandoned in-place below the slab-on-grade shall be entirely backfilled with lean concrete or other grout material approved by the ENGINEER.
2. Proof-compact granular subgrade soils if required to achieve a firm subgrade. Do not proof compact cohesive soil subgrades.
3. Place and compact granular fill within 12 in. of the slab, unless otherwise noted on the Drawings.

3.06 BACKFILL AND FILL:

A. General: Place suitable soil material in layers to required elevations as shown on the Drawings. Fill, backfill, and compact to produce minimum subsequent settlement of the material and provide adequate support for the surface treatment or structure to be placed on the material. Place material in approximately horizontal layers of beginning at lowest area to be filled. Do not impair drainage.

B. Ground Surface Preparation: Remove vegetation, debris, unsuitable soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Remove material to the full extent of root penetration. Scarify surfaces so that fill material will bond with existing surface.

C. Placement: Place backfill and fill materials in layers not more than 12-inches in loose depth for material compacted by heavy compaction equipment, and not more than 9-inches in loose depth for material compacted by hand-operated tampers. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

D. Backfill excavations as promptly as work permits, but not until completion of the following:

Acceptance of construction below finish grade including dampproofing, and/or waterproofing.

Inspection, approval and recording locations of underground utilities.

Removal of concrete formwork.

Removal of shoring and bracing, and backfilling of voids with suitable materials.

Removal of trash and debris from excavation.

Permanent or temporary horizontal bracing is in place on horizontally supported walls.

Backfill cast-in-place concrete structures when the concrete has developed adequate strength.

Use care in backfilling to avoid damage or displacement of underground structures and pipe.

E. Backfilling Trenches: See Trench Detail on the Drawings.

Bed pipe in 3/4-inch crushed stone, unless otherwise indicated. Limits of bedding and requirements for remaining trench backfill shown on Drawings.

F. Replacement of Unsuitable Materials:

Below normal grade: See paragraph 3.01J.

Above normal grade: Replace unsuitable material with suitable material from on-site. All excess suitable material must be used before additional material from off-site is used.

3.07 COMPACTION:

A. Methods: Use methods which produce the required degree of compaction throughout the entire depth of material placed without damage to new or existing facilities and which are approved by the ENGINEER. Adjust moisture content of soil as required. Remove and replace material that is too wet to compact to required density. Compact each horizontal layer of fill and slope as Work progresses.

B. Degree of Compaction: Compact to the following minimum densities:

| FILL AND BACKFILL LOCATION | DENSITY |
|---|---|
| Under structure foundations and slab on grade | 95% of max. |
| Top 3 feet under pavement | 95% |
| Within 5 feet laterally from edges of pile caps/ grade beams | 95% |
| Below top 3 feet under pavement | 92% |
| Structural fills | 95% |
| Pipe Bedding | 95% |
| Adjacent to structure foundation walls, retaining walls, and tank walls | 95% |
| Trenches through Gravel areas | 95% |
| Trenches through other non-paved areas | 90% |
| Embankments | 90% |

Maximum density: ASTM D1557.
Field density tests: ASTM D1556 (sand cone) or ASTM D2167 (rubber balloon), or ASTM D2922 (nuclear methods).

C. Testing: In-situ density testing of placed/compacted lifts of soil will be performed by a material testing firm hired by the OWNER. The ENGINEER will provide part-time oversight of these activities. Perform additional work to obtain proper compaction if in-place densities do not meet specified densities at no additional cast to the OWNER.

D. Protection of Fill

1. The CONTRACTOR shall take the necessary steps to avoid disturbance of subgrade and underlying soils during excavation and backfilling operations. Procedures for excavating and backfilling shall be revised as necessary to avoid disturbance of subgrade and underlying soils, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials, dewatering, and other acceptable control measures. Disturbance shall include the deterioration of backfill (after placement and satisfactory compaction) due to the Contractor's operations, such as moving equipment, hauling trucks, etc. All excavated or backfilled areas or subgrades that become disturbed during construction shall be removed and replaced with acceptable materials.

2. During earthwork operations, protect geofoam fill from damage. Damaged geofoam will be replaced per direction of the ENGINEER at no additional cost to the OWNER.

3. Prevent materials below constructed foundations from freezing. Materials that become frozen shall be removed and replaced, including foundations, at no additional cost to the OWNER.

4. At the completion of Work, all ground surfaces shall be left in a firm, stable, unyielding, reasonably uniform condition, free of ruts and surface irregularities, in accordance with grading requirements shown on the Drawings.

3.08 Reuse of In-Situ Soils

A. Group 2 Fill Soils

1. The CONTRACTOR shall, to the extent possible, reuse all Group 2 soils on site in areas acceptable to the ENGINEER and OWNER. Acceptable areas include the landscape berm along the north side of the Garage, beneath the Garage ramp, and within the office and garage footprints (except within 12 inches of slabs-on-grade, as base/subbase or roadway and within 5 feet in plan of grade beams, pile caps and footings).

2. The CONTRACTOR shall not remove any Group 2 soils from the site without notifying the ENGINEER and obtaining written approval from the OWNER.

A. Group 1 Fill Soils

1. The CONTRACTOR shall, to the extent possible, reuse all Group 1 soils on site in the "acceptable" areas outlined above. Group 2 soils shall be reused prior to reuse of Group 1 soils.

2. The CONTRACTOR shall not remove any Group 1 soils from the site without notifying the ENGINEER and obtaining written approval from the OWNER.

3.09 GRADING:

A. Grading: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finish surface within specified tolerances and compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Structure Lines: Grade areas adjacent to structure to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes and as follows:

Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.

Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2 inch above or below required subgrade elevation.

Fill Under Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10-foot straightedge.

D. Compaction: After grading, compact subgrade surfaces as required.

3.10 FOUNDATION DRAINAGE

A. Install perimeter and underslab drainage system at locations shown on the Drawings. Pipe shall be laid flat with the invert positioned above the bottom of footing bearing level and at least 12 in. below the adjacent lowest level floor slab surface.

B. Perimeter drainage pipe shall be completely wrapped in a minimum of 6-inches of 3/4-in. crushed stone and geotextile. Pipe shall be placed with joints tightly closed in accordance with manufacturer's recommendations so that flow lines conform to required grades. For perforated collector pipe, lay pipe with perforations down.

C. Underslab drainage pipe shall be installed at the locations and elevations shown on the plans.

D. Provide wall through penetrations at locations shown on the Drawings to allow connection of the perimeter and underslab drain piping. Perimeter and underslab drain pipes shall be installed at the same invert elevation.

E. At locations where perimeter drainage is installed, a prefabricated geocomposite drainage board shall be installed along the backfilled side of foundation walls. The drainage board shall be applied from the top of the footing up to within 1 ft below proposed finished grade.

F. Any sections of piping that are not true to lines and grades, or that show any undue settlement after being laid, or are damaged shall be removed and re-laid or replaced at no additional cost to the Owner.

G. Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components, and retest system until satisfactory.

H. Provide cleanouts for drainage piping at changes of direction, bend of lines, and wherever indicated on the Drawings, and necessary to enable system to be cleaned out. Extend cleanouts to finished grade or top of slab and provide surface protection. Coordinate cleanout locations with structural and architectural improvements.

3.11 EROSION CONTROL: Provide erosion control measures as specified in Section 02370 and as shown on Drawings.

3.12 MAINTENANCE:

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during warranty period; remove surface, add backfill material, compact, and replace surface. Restore appearance, quality, and condition of surface to match adjacent work, and eliminate evidence of restoration work to greatest extent possible.

3.12 DISPOSAL OF EXCESS MATERIALS: Remove excess excavated material and dispose of it off-site in a lawful manner, unless otherwise directed by ENGINEER.

**End of Section**

SECTION 02370 – EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Provide and maintain devices to control erosion, siltation, sedimentation and dust that occur during construction operations. Undertake every reasonable precaution and do whatever is necessary to avoid erosion of soil and to prevent silting of wetland areas, drainage ditches, streams, and lakes.

B. Provide measures to control dust caused whether on or off the Project site.

C. Deficiencies in erosion control measures indicated by failures or erosion shall be immediately corrected by providing additional measures or different techniques to correct the situation and prevent subsequent erosion.

D. Exposure of soils on embankments, excavations, and graded areas shall be kept as short as possible. Initiate seeding and other erosion control practices as soon as reasonably possible.

E. Provide erosion control measures in any ditch, swale or channel before water is allowed to flow in the waterway.

F. Mechanized Equipment will not be permitted in water courses unless specifically required in the Contract Documents.

1.02 QUALITY ASSURANCE:

A. Conform to all requirements of applicable federal, state and local permits, and Contract Documents, and conform to the recommendations of the Standards (see Part D below) whether the measures are specifically noted herein, or not.

B. Meet with the ENGINEER to discuss erosion control requirements prior to the start of construction.

D. Standards: "Maine Erosion and Sedimentation Control BMPs" prepared by the Maine Department of Environmental Protection, current revision.

1.03 SUBMITTALS:

A. Erosion Control Program: Prepare and submit to ENGINEER for approval prior to construction startup.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. General: Use the following materials in construction of sediment traps, erosion control devices, and slope protection as specified on the DRAWINGS. Other materials require approval of the ENGINEER.

B. Heavy Rip-Rap: Sound, durable rock which will not disintegrate due to exposure to water or weather; angular in shape such as rough, unhewn quarry stone or fragments obtained by blasting, breaking or crushing natural rock.

Round boulders or cobbles will not be permitted.

Stone Weight: Minimum weight of 500 pounds each and at least 50 percent of the stones, by volume, shall exceed 1,000 pounds each.

C. Rip-Rap Stone: Sound, durable rock which will not disintegrate due to exposure to water or weather; angular in shape such as rough, unhewn quarry stone or fragments obtained by blasting, breaking or crushing natural rock.

Rounded boulders or cobbles will not be permitted.

Stone Weight: 10 pounds to 200 pounds, with approximately 50% of the stones weighing at least 50 pounds. Stones weighing more than 200 pounds may be used where practicable.

D. Stone Ditch Protection: Sound, durable rock, which will not disintegrate due to exposure to water or weather; angular in shape such as rough, unhewn quarry stone or fragments obtained by blasting, breaking or crushing natural rock.

Rounded boulders or cobbles will not be permitted.

Stone size shall conform to a grain diameter of $D_{50}$ = 6-inch, with a maximum stone size of 9-inch.

E. Gravel Blanket: 6 inches of 1-1/2-inch crushed gravel blanket placed under and over filter fabric as shown on DRAWINGS. Sieve analysis by weight:

| Sieve Size* | Max % Passing by Weight |
|---|---|
| 2" | 100 |
| No. 4 | 30-55 |
| No. 200 | 0-10 |

F. Revegetation Mat: Provide Mirafi Miramat, or equal.

G. Mats and Nettings:

1. Wood Excelsior Blanket: Machine produced blanket of curled wood excelsior with 80% of the fibers being 6 inches or longer. The wood fibers shall be evenly distributed throughout the blanket and a covered with a photodegradable plastic mesh. Typical weight of 0.9 pounds per square yard. Curlex by American Excelsior, or approved equal.

2. Straw Blanket: A machine produced blanket consisting of 100% straw, with a polypropylene net on the top and bottom surfaces and sewn together with biodegradable thread. Typical weight of 0.5 pounds per square yard. S150 by North American Green, or approved equal.

3. Erosion Control Blanket Anchors: Wooden pegs or metal staples as recommended by the manufacturer for the installation of the erosion control blanket. The fasteners shall not be longer than 9 inches.

H. Mulches:

1. Long fibered hay or straw in dry condition and which are relatively free of weeds and foreign matter detrimental to plant life.

2. Mulch binder: An asphalt emulsion mulch binder of type acceptable to the ENGINEER.

3. Mulch netting: Plastic or nylon mesh netting with approximate openings of 1/4- to 1-inch; or other netting approved by the ENGINEER.

I. Temporary Seed: Seed variety and applied rate are selected based upon the date of application, and as determined by the following table. Equivalent seed mixture based on its suitability for use in controlling erosion of the various soil types and slopes may be used as approved by the ENGINEER.

| Dates | Seed | Applied Rate |
|---|---|---|
| 4-1 to 7-1<br>8-15 to 9-15 | Annual Ryegrass | 0.9 lb/1000 $ft^2$ |
| 5-15 to 8-15 | Sudangrass | 0.9 lb/1000 $ft^2$ |
| 9-15 to 10-15 | Winter Rye | 3.0 lb/1000 $ft^2$ |

J. Sod:

1. Grown from certified seed of adapted varieties to produce high quality sod free of any serious thatch, weeds, insects, diseases and other pest problems.

2. At least one year old and not older than three years. Cut with a 1/2- to 1-inch layer of soil.

K. Drains:

1. Flexible drains consisting of collapsible neoprene pipe, minimum 8-inch diameter.

2. Corrugated metal pipe and inlet of a gauge consistent with the loading conditions, minimum 12-inch diameter.

L. Polyethylene Liner: U.V. Resistant, minimum thickness 6 mils.

M. Woven Filter Fabric: Provide Mirafi 600X woven textile or equal.

N. Non-Woven Fabric: Equal to Mirafi 160N, or approved equal.

O. Siltation Fence: MIRAFI Environfence, Amoco 1380 Silt Stop, or approved equal.

P. Hay Bale Barrier: Rectangular shaped bales of hay or straw weighting at least 40 pounds per bale; free from noxious weed seeds and rough or woody materials.

Q. Catch Basin Inlet Sediment Barrier: ACF Environmental, Inc. High Flow Siltsack® or approved equal.

## PART 3 - EXECUTION

### 3.01 TEMPORARY EROSION DEVICES:

A. General: Provide the following devices to control erosion. Other devices require approval of the ENGINEER.

B. Hay Bale Barrier: Provide temporary hay bale fence as shown on DRAWINGS, and in ditches at 100-foot minimum intervals or where designated by the ENGINEER for erosion checks.

1. Bales shall be placed in a row with ends tightly abutting the adjacent bales.
2. Each bale shall be embedded in the soil a minimum of 4 inches.
3. Bales shall be securely anchored in place by stakes or re-bars driven through the bales. The first stake in each bale shall be angled toward previously laid bale to force bales together.
4. Inspection shall be frequent and repair or replacement shall be made promptly as needed.
5. Bales shall be removed when they have served their usefulness so as not to block or impede storm flow or drainage.

C. Silt Fence:

1. Install silt fence prior to any earthwork including grubbing.
2. Place where shown on Drawings or as directed by the ENGINEER. Install parallel to contours where possible, prior to site clearing and grading activities.
3. Bury lower edge of fabric at least 8 inches below ground surface to prevent underflow.
4. Curve ends of fence uphill to prevent flow around ends.
5. Inspect frequently; repair or replace any damaged sections.
6. Remove fence only when adequate grass catch has been established as determined by the ENGINEER.

D. Mulch:

1. Undertake immediately after each area has been properly prepared.
2. When seed for erosion control is sown prior to placing the mulch, place mulch on the seeded areas within 48 hours after seeding.
3. Apply mulch at 1.5 to 2.0 tons per acre. Mulch applied between the dates of December 1 through March 31 for winter stabilization shall be applied at 3.0 to 4.0 tons per acre.
4. Blowing chopped mulch will be permitted.

5. Hay mulch should cover the ground enough to shade it, but the mulch should not be so thick that a person standing cannot see ground through the mulch.

6. Remove matted mulch or bunches.

E. Temporary Erosion Control Matting:

1. Surface Preparation:

a. Conform to grades and cross sections for slopes and ditches shown on the Drawings.
b. Finish to a smooth and even condition with all debris, roots, stones, and lumps raked out and removed.
c. Loosen soil surface to permit bedding of the matting.
d. Unless otherwise directed, apply seed prior to placement.

2. Installation:

a. Place strips lengthwise in the direction of the flow of water.
b. Where strips are laid parallel or meet as in a tee, overlap at least 4 inches.
c. Overlap ends at least 6 inches in a shingle fashion.
d. The up-slope end of each strip of the matting shall be turned down and buried to a depth of not less than 6 inches with the soil firmly tamped against it.
e. The ENGINEER may require that any other edge exposed to more than normal flow of water be buried in a similar manner.
f. Build check slots at right angles to the direction of the flow of water. Space so that one check slot or one end occurs within each 50 feet of slope length. Construct by placing a tight fold of the matting at least 6 inches vertically into the ground, and tamp the same as up-slope ends.
g. Bury edges of matting around the edges of catch basins and other structures.
h. When ordered, additional seed shall be spread over matting, particularly at those locations disturbed by building the slots. Matting shall then be pressed onto the ground with a light lawn roller or by other satisfactory means.
i. Drive staples vertically into the ground flush with the surface.
j. On slopes flatter than 4:1, space staples not more than 3 feet and one row, alternately spaced, down the center.
k. On grades 4:1 or steeper, place staples in the same three rows, but spaced 2 feet apart.
l. On all overlapping or butting edges, double the number of staples, with the spacing halved; all ends of the matting and all required check slots shall likewise have staples spaced every foot.

F. Temporary Seeding:

1. Seed with appropriate seeds and application rates from the table in paragraph 2.01I of this Section. Seed shall be sown at the rate indicated, on the pure live seed basis.

2. Mulch areas where temporary seeding has been applied. Do not mulch seeded areas where matting will be immediately installed.

3. If temporary seeding does not achieve adequate growth by December 1, an additional layer of mulch shall be applied at that time.

G. Topsoil Storage:

1. Topsoil which is stockpiled on the site for use in loam applications shall be placed out of natural drainages, in piles not more than 8 feet in height, which have side slopes of 2:1 to 1.5:1.

2. A trench, depth as required, shall be constructed around the base of the pile to prevent eroding soil from washing into drainages.

3. Any topsoil piles shall be covered with temporary seed and mulch immediately following stockpiling.

H. Temporary berms: Construct temporary barriers along the toe of embankments using side drains as required.

I. Temporary slope drains: Collapsible pipe with corrugated metal pipe inlet.

J. Sedimentation basins: Construct sedimentation basins adequate to avoid siltation of streams and rivers.

K. Sediment Traps: Construct sediment traps in runoff ditches, using hay bale fence, at a minimum of 100-foot intervals or as required.

L. Catch Basin Inlet Sediment Barrier: Install, check, and clean or replace per manufacturer’s recommendations.

3.02 REMOVAL OF TEMPORARY EROSION CONTROL:

A. Remove temporary materials and devices when permanent soil stabilization has been achieved. Re-use materials in good condition if approved by the ENGINEER.

B. Remove unsuitable materials from site and dispose of in a legal manner.

3.03 SUBGRADE PREPARATION:

A. Grade and compact, where possible, areas to receive protection to a uniform slope. Allow for depth of protection stone layer.

B. Footing trench: Excavate trench across toe of slope as shown on the DRAWINGS for rip-rap.

3.04 FILTER FABRIC PLACEMENT:

A. General: Place filter fabric under the rip-rap, or stone ditch protection as shown on the DRAWINGS. Filter fabric is to be placed in one continuous piece. Sew all seams as per manufacturer's recommendation.

3.05 RIP-RAP PLACEMENT:

A. General: Place required rip-rap to full depth shown on DRAWINGS in one operation without special handwork, measured perpendicular to the face of the slope to obtain a uniform appearance true to line and grade. Place larger stones at bottom of slope. Place stones in close contact, with interlocking of face stones and backing stones. Fill openings between stones with smaller rocks or coarse gravel.

3.06 MAINTENANCE:

A. Inspect erosion control practices immediately after each rainfall and at least daily during prolonged rainfall or snowmelt for damage. Provide maintenance and make appropriate repairs or replacement at no additional cost to the OWNER, until Project acceptance or as required to comply with maintenance requirements if longer.

B. Remove silt from silt fence when it has reached one foot above grade or prior to expected heavy runoff or siltation.

C. Repair matting if any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, make satisfactory repairs immediately.

D. Following temporary and/or final seeding, the contractor shall inspect the work area semimonthly until the seedlings have vegetated 85% - 90% of the area. Reseeding shall be carried our by the CONTRACTOR with follow-up inspections in the event of any failures until vegetation is adequately established.

**End of Section**

SECTION 02380 – FOUNDATION PILES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, furnishing all labor, materials, equipment, and incidentals necessary to complete the following work:

1. Furnishing and installing the following:

   a. Parking Garage: 160 ton allowable design compression capacity, 16-in. square precast, prestressed concrete foundation piles at the locations shown on the Drawings, driven to end bearing with a minimum 360 ton ultimate capacity.
   b. Office Building: 125 ton allowable design compression capacity, 14-in. square precast, prestressed concrete foundation piles at the locations shown on the Drawings, driven to end bearing with a minimum 280 ton ultimate capacity.

2. Furnishing and installing steel bottom plates as outlined in this Section.
3. Conducting computer wave equation analyses by WEAP (Wave Equation Analyses for Piles) prior to mobilization and import of pile materials to the site in order (1) to determine the end bearing driving criteria for the pile to achieve the design compression capacity stated above and (2) to demonstrate that the stress levels in the piles do not exceed the allowable tensile and compressive strengths of the piles during driving to ultimate capacity with the proposed hammer-pile-soil system. WEAP analyses shall be conducted for all hammer-pile systems proposed to complete the Work.
4. Installing indicator piles at designated production pile locations and performing Dynamic Pile (PDA) testing on all of the indicator piles at locations shown on the Drawings. PDA testing shall be conducted prior to the start of production pile driving to confirm pile design capacities, evaluate the driving energy transferred to the pile during installation, determine stresses induced in the piles during driving, determine range of installed pile lengths, and evaluate performance of the pile driving equipment. Indicator piles are to be driven at a minimum of nine designated production pile locations for the Parking Garage and a minimum of four designated production pile locations for the Office Building. If more than one hammer type is used by the CONTRACTOR, a minimum of seven additional indicator piles will be installed and tested by the CONTRACTOR as determined by the ENGINEER.
5. Restrike up to five indicator piles (with the PDA measurements) between 24 and 48 hours after completion of initial driving.
6. Perform CAPWAP analyses on a minimum of four of the indicator piles at locations determined by the GEOTECHNICAL ENGINEER.
7. Installing production piles based on the WEAP analyses and the results of the dynamic testing.
8. Splicing piles as required.
9. Provide survey control, layout of design pile locations, pile heave measurements, pile cut-off elevations, preparation of as-built sketches and related survey control work.
10. Cutting off piles at design cut-off elevations and disposing pile cut-offs at approved off-site locations. Preparing the exposed end of the pile to receive the structural connection to the floor slab and/or pile cap.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02010: Existing Subsurface Conditions

B. Section 02110: Handling Contaminated Soils

C. Section 02220: Site Demolition

D. Section 02240: Dewatering

E. Section 02250: Lateral Support of Excavation

F. Section 02300: Earthwork

1.03 DEFINITIONS AND REFERENCE STANDARDS

A. ARCHITECT (Parking Garage): Scott Simons Architects, Portland, Maine

B. ARCHITECT (Office Building): Harriman Associates, Inc., Auburn, Maine

C. STRUCTURAL ENGINEER (Parking Garage): Becker Structural Engineers, Inc., Portland, Maine

D. STRUCTURAL ENGINEER (Office Building): Harriman Associates, Inc., Auburn, Maine

E. GEOTECHNICAL ENGINEER: Haley & Aldrich, Inc., Portland, Maine

F. ENGINEER: Authorized representatives of the OWNER. For the work covered under this Section, this term will include Haley & Aldrich, Inc., Becker Structural Engineers, Inc., and/or Harriman Associates, Inc.

G. CONTRACTOR: Person or organization identified in the Agreement as being responsible for the Work under this Section. The term CONTRACTOR shall also refer to an authorized representative(s) of the CONTRACTOR.

H. ASTM: Specifications of the American Society for Testing and Materials, latest edition.

I. AWS: AWS D1.1 Structural Welding Code – Steel, latest edition.

J. AISC: Specification of the American Institute of Steel Construction, latest edition.

K. AASHTO: Specification of the American Association of State Highway and Transportation Officials, latest edition.

L. ACI: Specification of the American Concrete Institute, latest edition.

M. PCI: Specification of the Prestressed Concrete Institute, latest edition.

N. OSHA: Occupational Health and Safety Administration.

O. IBC Code: International Building Code (2003 edition).

1.04 PROJECT CONDITIONS

A. Site, Subsurface Soil, and Groundwater Conditions:

1. A geotechnical data report summarizing subsurface conditions and a memorandum summarizing the results of a test pit exploration program have been prepared for the project by Haley & Aldrich, Inc. Refer to Section 02010 for this information.

B. In-Situ Fill/Obstructions

1. The CONTRACTOR is advised that the in-situ fill soils may contain former and existing utilities, concrete and other foundations and floor slabs from previous structures, rail lines and other materials which may interfere with new foundation locations and require removal. These items will not be considered obstructions and shall be removed as needed at no additional cost to the OWNER.
2. Pre-drilling of foundation piles may be required at pile locations prior to pile installation as described herein. The CONTRACTOR shall pre-drill where necessary to clear underground structures and other debris prior to pile installation. Pre-excavations shall be backfilled and compacted in a controlled manner prior to pile installation in accordance with Section 02300 using on-site fill materials with objects larger than 4 in. removed.

C. Review of Existing Information:

1. Prior to submitting a bid, the CONTRACTOR shall review and understand the information referenced in Sections 02010 and 02110 and other applicable resources. The referenced reports are made available to the CONTRACTOR for information only. The subsurface information and environmental conditions presented in these documents are for information only and shall not be interpreted as a warranty of subsurface or environmental conditions whether interpreted from written text, boring logs, chemical test results, or other data.
2. The CONTRACTOR shall draw their own conclusions regarding site conditions based upon site visit(s) and from available sources, for which the OWNER and its consultants assume no responsibility. The CONTRACTOR shall assume that subsurface conditions between subsurface explorations could differ from conditions shown in the records of the explorations.

D. Protection of Adjacent Property and Utilities:

1. The CONTRACTOR shall protect adjacent structures (above ground and buried) from damage associated with pile driving and other related operations. Damage due to pile driving or other construction activities shall be repaired immediately by the CONTRACTOR at their own expense.

1.05 QUALITY ASSURANCE

A. Comply with all rules, regulations, laws and ordinances of the State of Maine, City of Portland, OSHA and of all other authorities having jurisdiction. All labor, materials, equipment, permits and services necessary to make the work comply with such requirements shall be provided by the CONTRACTOR.

B. Field Monitoring and Testing:

1. In accordance with the requirements of the IBC Code, the GEOTECHNICAL ENGINEER will provide full-time monitoring of the CONTRACTOR'S pile driving operations. No piles shall be advanced except in the presence of the GEOTECHNICAL ENGINEER.
2. The GEOTECHNICAL ENGINEER will prepare and maintain pile driving records which include the following information:

a. Project name and number.
b. Name of CONTRACTOR.
c. Pile location and number.
d. Design pile capacity.
e. Type and size of hammer used.
f. Material type, dimensions, and thickness of any pile driving cushion between the hammer and pile.
g. Rate of operation of pile driving equipment.
h. Pile dimensions.
i. Elevation of tip.
j. Elevation of butt before and after cut-off.
k. Ground elevation.
l. Number of blows for each foot of penetration and final penetration resistance.
m. Pile location deviation.
n. Pile uplift and redrive information.
o. Unusual occurrences during pile driving.

C. The CONTRACTOR shall fully cooperate with the GEOTECHNICAL ENGINEER and the OWNER'S other representatives to facilitate all work of this Section.

D. The CONTRACTOR or the pile supplier shall provide daily quality control of concrete and other materials for pile manufacture at the plant. From time to time the ENGINEER may visit the plant to observe pile manufacturing.

E. Certification of quality and source of pile materials to be used in the work shall be furnished, in a form acceptable to the GEOTECHNICAL ENGINEER, at the time of delivery of materials to the site. Pile materials shall also be subject to on-site inspection by the GEOTECHNICAL and/or STRUCTURAL ENGINEER for conformance with specifications.

F. Approvals given by the GEOTECHNICAL ENGINEER or OWNER shall not relieve the CONTRACTOR of their responsibility for performing the work in accordance with the Contract Documents, nor shall they be construed to relieve the CONTRACTOR from their full responsibility for the means and methods of construction and for safety on the construction site.

G. The CONTRACTOR shall employ a Professional Engineer licensed in the State of Maine who specializes in geotechnical engineering to perform WEAP Analyses for all hammer-pile systems and types of piles, to conduct PDA testing, and to perform related CAPWAP analyses. The licensed Professional Engineer shall have not less than 5 years experience within the last 10 years in making consulting engineering recommendations, design, or supervising installation of pile foundations, and shall have completed WEAP analyses, PDA testing and CAPWAP analyses on not less than five unrelated, independent projects, in which piles were successfully installed using the pile driving criteria developed from the wave equation analyses and the load test results.

H. Qualifications of Contractor:

1. Shall have at least 3 years experience within the last 10 years in pile driving of similar type and complexity as the indicated pile foundations.
2. Shall have completed not less than 3 successful pile foundations of similar type and complexity as the indicated pile foundations within the last year.

I. All welding shall be performed by operators who have been previously qualified by tests as prescribed in the "AWS Standard Code for Welding in Building Construction". Evidence that welders meet qualification requirements shall be submitted to the GEOTECHNICAL ENGINEER before welding has begun. Monitoring of welding and welds may be performed by an independent testing agency employed by the OWNER. The CONTRACTOR shall fully cooperate with the agency to facilitate inspection, notifying it at least one working day in advance when welding operations are to be performed. Welds that do not conform to applicable specifications shall be repaired as directed by the OWNER or their authorized representative.

1.06 SUBMITTALS

A. General:

1. The CONTRACTOR shall submit the information specified herein to the GEOTECHNICAL ENGINEER for review. All submittals and data shall be legible, provided in English, and stamped by a Professional Engineer licensed in the State of Maine and retained by the CONTRACTOR.
2. The CONTRACTOR shall adhere to the approved submittal schedule, making every effort for timely submissions and allowing adequate time for the GEOTECHNICAL ENGINEER to review, evaluate and respond to the CONTRACTOR. The CONTRACTOR is responsible for scheduling specified submittals and re-submittals so as to prevent delays in the work.
3. Unless otherwise specified, submittals shall be made not less than three weeks before the start of the work. No work shall be started until the necessary review and approvals have been given.

B. Shop Drawings:

1. Shop Drawings showing pile size, pile reinforcing, pile tip and splice details, pick up points and other items pertinent and as applicable to particular pile design and handling, including steel bottom plates.
2. Shop Drawings and design calculations for all items pertinent to pile manufacturing and handling/installation.
3. A tabular summary of anticipated pile lengths at each column location.
4. Shop Drawing showing pile layout and pile numbering.

C. Pile Driving and Dynamic Load Test Equipment:

1. Manufacturer's literature, including technical and performance literature for pile driving hammer(s), cushions, hoses, and other equipment for piles.
2. Details of equipment and procedures for pre-excavation or pre-drilling, as required.
3. Qualifications and experience of CONTRACTOR'S Professional Engineer performing the PDA testing and CAPWAP analyses.
4. Description of dynamic testing equipment and procedures.
5. Complete reports of PDA measurements/analyses and CAPWAP analyses performed during the indication pile program at least three working days prior to the commencement of the scheduled production pile driving.

D. Pile Design/Manufacture:

1. Name and address of pile manufacturer/supplier.
2. Effective prestress in piles.
3. With each delivery of piles, results of concrete strength tests conducted by a certified laboratory on samples cured in the same environment as the piles. No piles will be accepted unless accompanied by concrete strength data upon delivery.
4. Name and address of pile splice manufacturer/supplier.

E. Wave Equation (WEAP) Analyses:

1. Qualifications and experience of CONTRACTOR'S Professional Engineer performing the WEAP analyses.
2. The CONTRACTOR shall propose final driving criteria (blow count) as the minimum number of hammer blows for each inch of the final 6 in. of pile penetration in the bearing stratum for all hammer-pile systems. The proposed criteria shall be submitted to the GEOTECHNICAL ENGINEER for review. Piles shall not be installed prior to review of the criteria by the GEOTECHNICAL ENGINEER.
3. Results of WEAP analyses performed and stamped by a Professional Engineer licensed in the State of Maine, which demonstrate that all hammer-pile systems are capable of obtaining the required pile load capacity in accordance with the IBC Code without damage to the pile due to driving stresses. The WEAP analyses shall model bearing conditions in soil and bedrock, and anticipated pile lengths across the site. The submittal shall also include any additional applicable assumptions used in the analyses.

   a. Analyses over a range of final pile penetration resistance, from to 2 to 14 blows per inch.
   b. The minimum allowable toe quake used in the analyses shall be 0.04 in.
   c. The minimum allowable toe damping used in the analyses shall be 0.15 sec/ft.
   d. The maximum allowable compressive stress in the pile during driving shall not exceed the maximum allowable compressive strength of the concrete in accordance with the IBC Code (1808.2.3.3). Provide documentation showing the calculated maximum allowable compressive strength of the piles.
   e. The maximum allowable tensile stress in the pile shall not be exceeded during driving. Provide documentation showing the calculated maximum allowable tensile strength of the piles in accordance with Section 1809 of the IBC Code.
   f. The minimum resistance from the pile tip shall be 90 percent.
   g. The hammer efficiency shall be selected based on the wave equation program default for the selected hammer.

F. Pile Dynamic (PDA) Testing:

1. Report summarizing the results of the PDA testing and CAPWAP analyses conducted by the CONTRACTOR'S Professional Engineer.

G. As Driven Pile Location Data:

1. Submit sketch and tabular documentation of actual pile location in relation to the design location within one working day after each individual pile is completed.
2. Within seven (7) days after the completion of all pile driving and re-driving, submit to the Owner a final as-driven pile location drawing (1 in. = 20 ft), certified by a Land Surveyor licensed in the State of Maine.
3. All drawings and sketches shall include the following

   a. Column lines, north arrow and graphical scale.
   b. Each pile identified by a separate number, designated by the CONTRACTOR and submitted prior to pile driving.
   c. Elevation of each top of pile prior to and after cutting, to the nearest 0.01 foot.
   d. Deviation in feet, to the nearest 0.01 foot, from plan design location at cutoff elevation.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The CONTRACTOR shall deliver piles at approved times and in sequence to assure continuity of pile driving.

B. Piles shall be handled, transported, stacked, and protected to prevent damage.

C. Lifting points shall be clearly marked on the piles by the manufacturer. Piles shall be lifted up into the leads at the designated lifting points.

D. Piles shall be clearly marked with the length of the pile prior to delivery.

1.08 LINES AND GRADES

A. The CONTRACTOR shall stake the pile locations and establish all elevations required. A baseline and benchmark located on or close to the site will be provided by the OWNER. The CONTRACTOR shall be responsible for the maintenance and protection of the baseline and benchmark, and all pile location stakes.

B. The CONTRACTOR shall employ a Land Surveyor licensed in the State of Maine, familiar with pile installation, who shall establish lines and levels. The CONTRACTOR shall be responsible for determining the location of piles, as well as keeping up to date records of the amount of uplift of individual piles, and establishing actual pile locations.

PART 2 - PRODUCTS

2.01 GENERAL

A. Pile materials shall be new and of uniform quality. Manufactured or assembled pile materials shall be of sufficient strength and rigidity to withstand all driving stresses.

B. Length of piles to be ordered shall be determined by the CONTRACTOR. Ordering, delivery and use of piles shall be planned and performed in such a manner that minimizes delays or interruption of driving and precludes the need for splices. Ordering and delivery of piles shall be planned in such a manner that changes in length for piles not yet manufactured may be made if driving experience, as work progresses, indicates need for such changes.

2.02 PRECAST-PRESTRESSED CONCRETE PILES

A. Piles shall be square precast-prestressed concrete piles with 16-inch (Parking Garage) and 14-inch (Office Building) minimum side dimensions. All precast concrete piles shall be designed, reinforced and manufactured in accordance with current standards of the Joint Committee of AASHTO and PCI. Hollow core piles will not be accepted.

B. Concrete for precast piles shall be Type V and shall have minimum compressive strength of 5,000 psi at 28 days. The maximum water/cement ratio shall not exceed 0.40. No precast concrete piles shall be delivered to the site before concrete has attained a compressive strength of 4,000 psi, based on tests of cylinders cast from same batches and cured under same conditions as pile concrete. Provide the GEOTECHNICAL ENGINEER with each delivery, documentation in acceptable form indicating that concrete used in piles had attained minimum compressive strength of 4,000 psi, prior to delivery of piles to site, and that the piles conform to PCI and AASHTO requirements. Pile materials shall also be subject to on-site inspection for conformance with specifications. Regardless of concrete strength data, no piles shall be delivered to site until they are at least 48 hours old.

C. If, for any reason, a pile is damaged or reinforcing steel is exposed, its use shall not be allowed.

D. Lateral reinforcing at both ends of piles shall be spaced sufficiently close to resist impact stresses due to driving and in no case more than three (3) inches on center. Lateral reinforcing for piles shall also conform to the requirements of the IBC Code. Top of pile must be perpendicular to longitudinal axis of pile, and ends of any prestressing or reinforcing steel shall be cut flush with top of pile to prevent direct impact on steel during driving.

E. Precast piles shall be cast with a steel bottom plate. The plate shall have a minimum thickness of 1-1/2 inches, have the same lateral dimensions as the pile, and shall be attached to the pile with dowels as indicated in the AASHTO-PCI standards. Dowels shall extend into the pile a minimum distance of 30 inches.

F. Concrete for precast piles shall contain a maximum tricalcium aluminate (C3A) content of six (6) percent. Upon delivery of the piles to the site, provide the GEOTECHNICAL ENGINEER with certificates indicating that the tricalcium aluminate content conforms to this requirement.

H. Requirements for Pile Cap Seismic Connection: The CONTRACTOR shall consider the requirements outlined in the IBC Code when estimating anticipated pile lengths at each column location or other point of structure support to ensure that the minimum required length of reinforcement requirements in the upper portion of the pile is achieved in accordance with the seismic requirements of the IBC Code.

I. Reinforcing Steel

1. Reinforcing bars: ASTM A615, grade 60, deformed.
2. Spiral reinforcing for piles: ASTM A615, grade 60 plain bars, or ASTM A82 smooth wire, except that for wire with Fy over 60,000 psi, the Fy shall be the stress corresponding to strain of 0.35 percent.

2.03 SPLICES

A. Full length piles shall be used wherever practicable.

B. If full length piles cannot be used, only one splice per pile shall be allowed.

C. Splices, when required, shall develop one hundred percent of the pile strength in tension, compression, and in bending. Details of the splice shall be shown on the Shop Drawings. Splices may be made by the cement-dowel method. Mechanical splices may be accepted by the ENGINEER if the splice can transfer full pile strength in compression, tension, and bending.

D. The strength of all splices, in compression, tension, and bending, shall be equal to or greater than the ultimate capacities of the pile section.

E. Piles may be spliced in the leads. The sections of piles to be spliced shall be secured in alignment such that there is no eccentricity between the axes of the two spliced lengths, or angle between them, after the splice has been completed.

F. Precast-prestressed piles shall be spliced with Sure-Lock type splice, or approved equivalent developing 100 percent of the pile section strength.

G. Mechanical drive-fit splices shall not be used.

2.04 PILE TIP/DRIVING SHOE

A. Precast piles shall be cast with a steel bottom plate. The plate shall have a minimum thickness of 1-1/2 inches, have the same lateral dimensions as the pile, and shall be attached to the pile with dowels as indicated in the AASHTO-PCI standards. Dowels shall extend into the pile a minimum distance of 30 inches.

2.05 PILE LENGTH MARKINGS

A. Permanently mark the entire length of each pile with horizontal lines (perpendicular to long axis of pile) measured from the pile tip at 12-in. intervals. In addition, footage shall be marked and designated at 5-ft intervals, starting from the tip of the pile.

PART 3 - EXECUTION

3.01 SEQUENCE OF OPERATIONS AND EQUIPMENT REQUIREMENTS

A. The CONTRACTOR shall provide the necessary pile driving equipment for full-time operation at the site during the work to complete the work on schedule. The work shall require the mobilization of crane mounted equipment for installation of the indicator and production piles.

B. Prior to production pile installation, the CONTRACTOR shall drive indicator piles at production pile locations, at the locations shown on the Drawings. The CONTRACTOR’S Professional Engineer shall perform dynamic (PDA) testing during installation of each indicator pile to aid in estimating the required pile lengths and to evaluate hammer performance, acceptable driving stresses, and to confirm the final driving criteria based on the measured hammer energy transferred to the pile.

C. Production piles shall not be installed before the indicator piles are driven and results reviewed by the GEOTECHNICAL ENGINEER. Production piles installed prior to completion of the indicator pile program will be at the sole risk of the CONTRACTOR. The CONTRACTOR may elect to drive more than the required minimum number of indicator piles at the CONTRACTOR'S election if approved by the GEOTECHNICAL ENGINEER.

D. The CONTRACTOR shall coordinate their pile installation operations with other work on the site.

3.02 PILE DRIVING CRITERIA

A. The CONTRACTOR shall furnish and install precast, prestressed concrete piles to bedrock and to the approved final penetration resistance that will develop the required design compression capacity as specified herein.

B. The CONTRACTOR shall drive piles to not less than an approved final penetration resistance over the final 6 in. of driving as determined by the WEAP analyses and confirmed by the PDA testing unless directed by the GEOTECHNICAL ENGINEER.

C. To limit the potential for overstressing of the pile during driving, if less than 1/2 in. of penetration is achieved in 10 successive hammer blows, driving should be stopped and the pile shall be evaluated by the GEOTECHNICAL ENGINEER.

3.03 INDICATOR PILE INSTALLATION

A. Indicator piles shall be driven by the CONTRACTOR using the proposed production pile driving equipment to the final driving criteria identified herein and as supported by the CONTRACTOR'S approved WEAP analyses.

B. Indicator piles shall be driven at the locations shown on the plans.

C. Per the requirements of the IBC Code, no piles shall be driven or tested except in the presence of the GEOTECHNICAL ENGINEER.

D. The use of followers will not be permitted unless authorized in writing by the GEOTECHNICAL ENGINEER.

3.04 DYNAMIC PILE (PDA) TESTING

A. During driving of the indicator piles, the CONTRACTOR'S Professional Engineer shall conduct PDA testing on all indicator piles to evaluate the performance of the hammer-pile system(s), calculate stresses in the pile during driving, assess the structural integrity of the pile, and evaluate pile capacity/pile driving criteria. The CONTRACTOR'S Professional Engineer shall perform CAPWAP analyses on four of the piles as selected by the GEOTECHNICAL ENGINEER. Up to five indicator piles will be restruck between 24 and 48 hours after completion of driving as determined by the GEOTECHNICAL ENGINEER to assess "false driving resistance" and "setup" of the piles

B. The CONTRACTOR shall plan adequate time for PDA testing and CAPWAP analyses to be performed during driving of the indicator piles.

C. If based on the results of the PDA testing, the GEOTECHNICAL ENGINEER determines the hammer(s) is not working adequately; the hammer(s) will be repaired or replaced by the CONTRACTOR at no additional cost to the OWNER. In this instance, the CONTRACTOR shall redrive all previously driven piles and possibly additional indicator piles and repeat the dynamic testing, as required by the GEOTECHNICAL ENGINEER, at no additional cost to the OWNER.

D. If, at any time during production pile driving, the CONTRACTOR proposes to change the pile installation equipment (including the individual hammer or hammer type) from that used to install the indicator piles, PDA testing shall be performed by the CONTRACTOR'S Professional Engineer at the CONTRACTOR'S expense to confirm that the new hammer can transfer the minimum required energy to the pile and that pile stresses are within acceptable limits. Dynamic testing of a minimum of an additional 4 piles will be required in this case.

E. Depending on the results of the PDA testing the GEOTECHNICAL ENGINEER may adjust indicator pile locations and final driving criteria.

3.05 PRODUCTION PILE INSTALLATION

A. Piles shall be installed with approved modern equipment in good working order. The proposed pile installation equipment and methods shall be subject to approval of the GEOTECHNICAL ENGINEER and approval shall be secured before the start of installation.

B. The leads of the pile driving rig shall be fixed at two points; the points shall be at least half the length of the leads apart in order to maintain the pile and hammer in axial alignment at the correct plan location during the entire driving operation. The leads shall extend down to the lowest point at which the hammer must operate.

C. At the CONTRACTOR'S option, an approved vibratory hammer may be used to install piles through overburden soils (i.e., fill, marine clay). If piles are initially installed using a vibratory hammer, impact driving to final bearing shall be completed within four hours of the completion of vibratory advance. Impact pile driving shall be continuous and without interruption for the final 10 ft of penetration.

D. Piles shall be driven with a single-acting, double-acting, or differential-acting steam, hydraulic, air, or diesel hammer(s) as approved based on the WEAP analyses, PDA testing and CAPWAP analyses. When the determination of the final driving resistance is being made, the steam, hydraulic, air or diesel hammer shall be operated at a speed not less than 95 percent of the maximum blows per minute for which the hammer is rated by the manufacturer. The CONTRACTOR shall maintain the boiler or air pressure recommended by the manufacturer and shall employ the proper size hose and connections. When the determination of final driving resistance is being made with a diesel hammer, the energy being delivered to the pile shall be determined as the product of the weight of the ram times the observed or equivalent stroke for open diesel hammers; for closed diesel hammers, the energy shall be that indicated by an output gauge calibrated to measure total hammer energy. The GEOTECHNICAL ENGINEER will monitor hammer performance of an open-ended diesel using a saximeter which measures the rate of hammer operation.

E. Special Requirement for Diesel Hammers: In the case of a diesel hammer, the CONTRACTOR shall provide an apparatus approved by the GEOTECHNICAL ENGINEER to measure gas pressures inside the hammer and total hammer energy for closed hammers, or ram bounce height in the case of open hammers.

F. An aluminum micarta cushion block or other cushion material consistent with WEAP analyses and PDA testing and if approved by the GEOTECHNICAL ENGINEER, shall be used in the hammer for driving piles. Cushions shall be replaced when burned or otherwise worn.

G. Hammers used to install production piles shall be the same physical equipment that was used to install the indicator piles.

H. The use of followers will not be permitted unless authorized in writing by the GEOTECHNICAL ENGINEER.

I. Piles that are unsatisfactory as installed shall be removed, or repaired at no additional cost to the Owner.

J. Pre-drilling:

   1. If the CONTRACTOR elects to pre-drill it will be considered incidental to its work, at no additional cost to the OWNER.

K. Driving:

   1. As part of preparation for driving, each pile shall be marked as specified herein.
   2. Pile tips shall be protected as specified herein.
   3. All piles shall be driven plumb/vertical at the locations and orientations shown on the plans. The CONTRACTOR shall utilize a pile alignment system such as templates or other measures to position the piles at the correct location. Pile location and orientation shall be

checked during driving and appropriate measures taken, as necessary, to maintain the correct pile position.

4. Each pile shall be driven to end-bearing into the bedrock (below the marine clay) to a minimum ultimate capacity (compression) of 360 tons (Parking Garage) and 280 tons (Office Building) using the accepted final pile driving criteria.
5. Pile driving shall be continuous and without interruption for the final 10 ft of penetration. If pile driving is interrupted during the final 10 ft of driving, the GEOTECHNICAL ENGINEER shall be the sole judge of whether the pile driving resistance is impacted by frictional resistance above the bearing stratum. Pile driving shall be terminated when the accepted final pile driving criteria is achieved or when pile penetration is less than 1/2 inch in 10 successive blows in the bearing stratum.
6. Pile driving resistance shall be constant or increasing during achievement of the final driving criteria.
7. During pile driving, the maximum compressive and tensile stress in the piles shall not exceed the maximum allowable compressive and tensile strength of the concrete in accordance with the IBC Code (Section 1808).
8. When driving piles through soft soils or in pre-drilled holes, the hammer ram velocity at impact shall be reduced to avoid damage of the pile due to tensile stresses in the piles.
9. Immediately after a pile in a pile group is driven, and prior to driving another pile within the piles' radius of uplift, the CONTRACTOR will establish a reference point and its elevation on the pile for the purpose of checking uplift (heave) of the pile as additional piles are driven.
10. After all piles within the radius of uplift have been driven, the CONTRACTOR shall determine the elevation of the reference points on each of the piles in the group. If uplift of 0.04 feet or more has occurred, the pile shall be redriven to its original elevation, and deeper if necessary, to the accepted final pile driving criteria. After redriving each pile, the CONTRACTOR will re-establish the elevation of the reference point. Redriving shall be repeated as often as necessary until the measured uplift on any pile is less than 0.04 ft.
11. The radius of uplift shall be initially assumed to be 30 ft. This radius may be expanded or contracted by the GEOTECHNICAL ENGINEER based on actual field measurements and is defined as the maximum distance between piles such that pile driving causes uplift of 0.04 feet or more in the affected pile.
12. Piles in a group shall be driven commencing in the center of the group and working toward the edge. All piles in any one group shall be driven before moving to other locations, unless otherwise acceptable to the GEOTECHNICAL ENGINEER.

L. Vibration Control:

1. Limit pile-driving induced ground vibrations (maximum peak particle velocity) to less than the values provided below at all nearby fresh concrete, as measured by the GEOTECHNICAL ENGINEER.

| Concrete Age (days) | Maximum Peak Particle Velocity (in./sec) |
|---|---|
| 0 to 1 day old | 0.5 |
| 1 to 7 days old | 2.0 |
| Greater than 7 days old | 3.0 |

2. If pile-driving induced vibrations exceed the level specified above, the CONTRACTOR shall adapt and modify pile driving procedures and equipment to limit vibrations below the specified level, at no additional cost to the OWNER.
3. Vibration monitoring will be performed by the GEOTECHNICAL ENGINEER as necessary to determine compliance with this criterion.

M. Cutting Off Piles:

1. Pile tops shall be cut off square and within 1 in. of the elevations shown on the Drawings. The pile cut-offs shall be stockpiled in a designated area of the site and shall be removed from the site by the CONTRACTOR at no additional cost to the OWNER.
2. If piles are driven below the design elevation and can not be satisfactorily built-up in the opinion of the STRUCTURAL and GEOTECHNICAL ENGINEERS, these piles shall be cutoff a minimum of 1 ft below the design bottom of the pile cap and abandoned at no cost to the OWNER. Additional piles required to compensate for an abandoned pile shall be driven as directed by the GEOTECHNICAL and STRUCTURAL ENGINEERS, at no additional cost to the OWNER.
3. Prepare all pile types to receive connection to pile cap and/or floor slab.

3.06 SPLICING

A. A maximum of one splice per pile will be permitted using the splicing system approved by the ENGINEER and the methods recommended by the Manufacturer. Splices shall develop one hundred percent of the pile strength in tension, compression and bending.

B. Pile splices shall be located so as to permit continuous driving through the bearing stratum and to final end bearing.

C. The strength of all splices, in compression, tension, and bending, shall be equal to or greater than the ultimate capacities of the pile section.

D. Piles may be spliced in the leads. The sections of piles to be spliced shall be secured in alignment such that there is no eccentricity between the axes of the two spliced lengths, or angle between them, after the splice has been completed.

E. Unless waived by the ENGINEER, the CONTRACTOR shall proof test the proposed splice. Splicing and testing shall be done in the presence of the ENGINEER. Testing shall be completed, to the satisfaction of the ENGINEER, during production pile driving. A minimum of six tests shall be conducted, consisting of a minimum of two tests each in compression, tension and bending. Tests shall be conducted on full scale splices, which are constructed in a manner identical to that proposed for use on the project. Tests shall be conducted using calibrated equipment to monitor load and deflection. The CONTRACTOR shall take all measurements and submit results of the tests to the ENGINEER. Tests results shall include calculations based on the test data, of the capacity of the splice in compression, tension and bending made by a Professional Engineer licensed in the State of Maine. The splice will be approved provided that at least two tests each in compression, tension and bending demonstrate that the capacity of the proposed splice is equal to or greater than the ultimate capacity of the pile. Prior to the start of testing, the CONTRACTOR shall submit the proposed proof testing methods to the ENGINEER for review and approval.

3.07 TOLERANCES AND CRITERIA FOR ACCEPTANCE

A. Location: Piles shall be driven as close as practicable to the plan location. A maximum permissible lateral deviation from the design location measured in any direction at cut-off elevation will be 1.5 inches for single piles and groups of two piles, and 3 inches for each pile within groups of three (3) or more piles. A maximum deviation from design cut-off elevation equal to 1 in. will be permitted.

B. Plumbness: The pile plumbness, as measured on the projection of the pile above ground, shall not deviate by greater than ten percent from the vertical alignment. Pulling piles into alignment or position will not be permitted.

C. Piles that are damaged below cut-off elevation during driving will be rejected. If, upon comparing pile performance during driving with that of other driven piles, and based on the GEOTECHNICAL ENGINEER'S knowledge of subsurface conditions, the GEOTECHNICAL ENGINEER determines that a pile has been unacceptably damaged; the GEOTECHNICAL ENGINEER may reject the pile.

D. Piles indicating sudden or peculiar decrease in penetration resistance during driving will be assumed to be broken or damaged, and will be rejected unless the GEOTECHNICAL ENGINEER'S review of available data indicates that sudden decrease in driving resistance is due to natural subsurface conditions and continued acceptable driving behavior is observed.

E. Piles that are rejected because of damage, mislocation or misalignment, or failure to meet the driving criteria due to causes other than obstructions as defined herein, shall be cut off a minimum of 1 ft below the design bottom of the pile cap and abandoned, and additional piles shall be driven as directed by the GEOTECHNICAL ENGINEER at no additional cost to the OWNER.

F. When otherwise acceptable installed piles exceed the specified location and/or plumbness tolerances, the STRUCTURAL ENGINEERS will analytically determine the total loads on individual piles, based on a survey by the CONTRACTOR'S Land Surveyor. If the load on any pile exceeds 110 percent of the specified load capacity, corrections shall be made by adding piles, or other procedures, in accordance with a design provided by the STRUCTURAL ENGINEER.

G. The installation of replacement piles and other corrective measures shall in all cases be in accordance with designs provided by the STRUCTURAL ENGINEER.

H. Any increased costs for redesign and for construction caused by rejected piles or piles exceeding tolerances not caused by obstructions shall be the responsibility of the CONTRACTOR.

I. Vibration levels will be monitored as necessary by the GEOTECHNICAL ENGINEER during pile driving.

**End of Section**

SECTION 02510 – WATER SYSTEM DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK: Water distribution piping includes:

A. Supply and installation of all distribution piping as noted on the Drawings and in accordance with Portland Water District specifications.

B. Verifying location of existing utilities prior to construction.

C. Supply and installation of all valving, and accessories.

D. Supply and installation of new hydrants, as noted on the Drawings.

E. Flushing, testing and disinfection.

F. Repair of water piping damaged during construction.

1.02 RELATED WORK:

A. Lateral Earth Support: Section 02250

B. Earthwork: Section 02300

C. Erosion and Sedimentation Control: Section 02370

1.03 QUALITY ASSURANCE:

A. Code Compliance: Comply with State Plumbing Code and local plumbing codes where more stringent. Comply with Maine Department of Human Services, Division of Health Engineering rules.

B. AWWA Standards: Comply with requirements of Section 4 of AWWA C601, "Preventive Measures During Construction" for cleanliness.

C. Other Standards: Comply with requirements of the Portland Water District specifications.

D. Testing: CONTRACTOR shall pay for all flushing, pressure and leakage testing, disinfection, and fire flow testing.

1.04 SUBMITTALS: Submit manufacturer's product data and installation instructions for each product specified for water service piping.

PART 2 - PRODUCTS

2.01 PRESSURE PIPE:

A. General: Provide fittings and other required piping accessories of same type and class of material as conduit, or of material having equal or superior physical and chemical properties.

B. Copper Tube: Type K conforming to ASTM B88, with compression fittings.

C. Ductile Iron Pipe: Push-on joints unless indicated otherwise, centrifugally cast bituminous-coated, cement-lined (AWWA C104), seal-coated and manufactured in accordance with the latest revision of AWWA Standards C150 and C151. Interior shall be seal-coated twice with asphalt to a minimum of 2 mils dry film thickness. Pipe shall be Class 52 unless indicated otherwise. Weight, class, manufacturer’s mark, year of production, and “DI” or “Ductile” shall be cast or stamped on the pipe.

2.02 VALVES, FITTING, CLAMPS, ETC.:

A. General: All products used in the construction that come in contact with drinking water shall meet the National Sanitation Foundation Standard 61 for Drinking Water System Components - Health Effects. The products and/or materials covered include, but are not limited to, protective materials (coatings, linings, liners, etc.), joining and sealing materials (solvent cements, welding materials, gaskets, etc.), and mechanical devices used in transmission/distribution systems, (valves, etc.).

B. Gate Valves:

1. Gate valves shall be of the resilient wedge gate valve design, meeting or exceeding all requirements of the latest revision of AWWA C509.
2. The wedge shall consist of a ductile iron casting encased in a bonded-in-place nitrile elastomer covering which forms the resilient sealing surfaces.
3. The valves shall be of the nonrising stem design constructed of Grade D or E manganese bronze with sealing accomplished by double "0" rings situated that the “O” ring above the thrust collar can be replaced with the valve under pressure and in the open position, shall open right (clockwise), the stem nut shall be of Grade D or E manganese bronze, designed with a thrust collar integrally cast to the stem, and designed with two (2) synthetic polymer thrust washers that are positioned with one above and one below the thrust collar.
4. All gate valves shall be rated for zero leakage at 200 psi differential working pressure and have a 400 psi hydrostatic test for structural integrity.
5. Valves shall have mechanical joints and shall be furnished with Cor-ten or approved equal bolts and nuts.
6. The internal and external valve body, including the stuffing box, bonnet, and interior of the wedge shall be epoxy coated with 8 mils D.F.T., the preferred method of application being fusion-bonding or electrostatic bonding process.
7. The operating nut shall be two (2) inch-square ductile iron with a countersunk hold down nut made of 316 stainless steel or silicone bronze for tapered stems. Stems of full diameter shall have a stainless steel pin inserted thru the stem.
8. The seal plate and bonnet bolts shall be 316 stainless steel.
9. Valves shall be U.S.P. Metroseal or Waterous Series 500. No substitutes permitted.

C. Corporation Stops: Sizes 3/4- to 1-inch, shall be an inverted key or a ball valve design with a brass ball that is Teflon coated. Sizes 1-1/2 to 2-inch shall be ball valve design with a brass ball that is Teflon coated. All sizes to have ON-OFF identification mark on the operating nut. Valves shall have full-port opening and shall be supported by 2 seats for water tight shut off in either direction. Body shall be of heavy duty design.

D. Curb Stops: For sizes 3/4- to 2-inch, the valves shall be a brass ball that is Teflon (or equal) coated and supported by water-tight seats in either direction. Valves shall have full-port opening, shall open with 1/4 turn (90°) with a check or stop, and shall not have a drain. Valve stem shall have two “O” rings and a bronze ring lock which holds the stem solidly in the valve body. Valve body shall be of heavy duty design.

E. Repair Clamps: Sleeve shall be of full circle design, either one piece or two piece, for pipe sizes 2- to 12-inch. Body shall be 18-8 stainless steel shell. Gasket shall be full length and diameter of the body size, shall form a multiple O-ring sealing barrier for the entire length and circumference, and shall be virgin rubber (ASTM D2000 AA 415). Lugs, sidebar, and lifting bar shall be heavy gauge 18-8 stainless steel. Bolts and nuts shall be Teflon coated 18-8 heavy gauge stainless steel. Armor or bridging plate between sidebars shall be heavy gauge 18-8 stainless steel bonded to the gasket to bridge lug area.

F. Split Repair Sleeves: Split repair sleeves shall be mechanical joint, shall be AB-CD pattern to permit use of plain rubber and duck-tipped gaskets for various O.D. piping sizes, and shall be provided with a 2-inch F.I.P.T. test port with brass plug. Interior and exterior shall be bituminous coated with a minimum of 4 mils dry film thickness. Side rubber gaskets shall be rectangular to cross-section and fit into grooved channels in the casting. Gaskets shall extend entire length of the sleeve and shall not require cutting or trimming to match MJ end gaskets. All side bolts shall be 316 stainless steel. Mechanical joint with accessories furnished: DI glands, gaskets, Cor-Ten T-bolts and nuts.

G. Service Saddles: Service saddle shall have “larger sized” body, which shall have minimum diameter of 6 inches and multiple “O” ring type sealing. Saddle body shall be ductile iron with epoxy coating. Sealing gaskets shall be either Buna-N rubber or SBR rubber (ASTM D2000). There shall be two holding bands, U-bolt type, made of 304 stainless steel.

H. Valve Boxes: Shall be cast iron or ductile free from defects. Interior and exterior of all components shall be bituminous coated with a minimum of 4 mils dry film thickness. Bottom section shall be slide-type with bell-type base. Top section shall be slide-type with top flange. Extensions shall be slide-type with minimum 3-inch belled bottom. Cover shall be 2-inch drop-type cover to fit 7-1/4 inch opening of top section and shall have the word “WATER” clearly cast into the cover.

I. Service Boxes: Shall be 1-inch Schedule 40 steel pipe with top having 1-inch NPT pipe thread for screw-on cover or coupling, Erie style with 5-6’ slide-type riser. Cover shall be heavy duty Quincy type that screws on and shall be tapped with a 1-inch rope thread with solid brass plug with pentagon operating head. Foot shall be heavy duty cast iron design, Ford or equal. Large, heavy duty foot piece shall have an arch that will fit over 2-inch ball-valve curb stops. Rod shall be 24- to 36-inch, self-aligning design, 1/2 inch minimum, 304 stainless steel with integral yoke and brass cotter pin. Rod “wrench-flat” shall have minimum thickness of 1/4-inch tapered to 1/16-inch and width of 5/8-inch or 1/2-inch.

J. Ductile Iron Fittings: Material shall be ASTM A536-72 mini grade 70-50-05, in accordance with AWWA C110 (latest revision) for fittings larger than 16-inches and C153 (latest revision) for fittings 16-inches and less. Fittings shall be cement lined AWWA C104 (or latest revision). Interior seal coated AWWA C104 with minimum 4 mils dry film thickness. Exterior bituminous coated, 4 mils minimum dry film thickness. Sleeves shall not be cement lined, but shall be bituminous coated inside and outside, 4 mils minimum dry film thickness. Mechanical joint with accessories furnished: DI glands, gaskets, Cor-Ten T-bolts and nuts. Class 350 pressure rating in accordance with AWWA C110 for 3- to 24-inch sizes. Class 250 pressure rating in accordance with AWWA C110 for 30- to 48-inch sizes. The compact fittings must provide adequate space for the MJ joint and accessories to be installed without special tools.

K. Hydrants: All material used in the production of fire hydrants for ordinary service shall conform to the specifications designated for each material listed in AWWA Standard C502. All hydrants shall be Clow Eddy, American Darling B62-B or U.S. Pipe USMET250, no substitution permitted, and shall incorporate the following:

1. Traffic type at ground line with breakaway feature and shall have segmented flanges but not frangible bolts, break type rod coupling set equal to or below the line of the top flange of the lower barrel, and an approved rubber gasket between the barrels.
2. 6-foot bury with 5-1/2 foot minimum cover or as necessary
3. 6-inch mechanical joint inlet
4. 5-1/4 inch valve opening - valve to open right (clockwise)
5. Two 2-1/2 inch NST hose nozzles, port cover the same as operating nut & w/o chain
6. One 4-1/2 inch NST steamer nozzle, port cover the same as operating nut & w/o chain
7. Operating nut - pentagon shape, ductile iron or bronze, pentagon in shape with dimensions of top 1-13/16 inches tapering to 1-7/8 inches on the bottom
8. 6-inch minimum inside barrel diameter
9. Valve seat and sub-seat shall be bronze to bronze
10. Blocking area on bottom shall be a minimum of 30 sq. in. and a minimum of 20 sq. in. on the back.
11. Drain ring to be plugged prior to installation
12. Hydrant stem shall be 1-inch diameter
13. All buried mechanical joint bolts and nuts shall be Cot-ten or equal
14. All buried flange joint bolts shall be 316 stainless steel or silicone bronze
15. All protective coatings shall be a minimum of 6 mil D.F.T.
16. All surfaces normally exposed to water shall be epoxy coated, all internal and external cast or ductile iron surfaces shall be coated with bituminous coating
17. Coatings for upper exterior barrel shall have surface preparation blast clean SSPC-SP-6; primer of Glidden #5207-White, 2-3 mil D.F.T.; second coat of Glidden #4560-Yellow, 2-3 mil D.F.T.; finish coat of Glidden #4560-Yellow, 2-3 mil D.F.T.; total D.F.T. of all coats a minimum of 6 mil D.F.T.
18. Coatings for bonnet, operating nut, and port cap shall be blast clean surface preparation, SSPC-SP-6; primer of Glidden #5207-White, 2-3 mil D.F.T.; second coat of Glidden #4392-Aluminum, 2-3 mil D.F.T.; finish coat of Glidden #4392-Aluminum, 2-3 mil D.F.T.; total D.F.T. of all coats a minimum of 6 mil D.F.T.

2.03 ACCESSORIES:

A. General: Provide anchorages for tees, plugs, caps, and bends. After installation, apply a full coat of asphalt or other acceptable corrosion-retarding material to surfaces of rods and clamps.

B. Clamps, Straps and Washers: Steel, meeting or exceeding all requirements of the latest revision of ANSI/ASTM A506.

C. Threaded Rod: Steel, meeting or exceeding all requirements of the latest revision of ANSI/ASTM A575.

D. Rod Couplings: Malleable iron, meeting or exceeding all requirements of the latest revision of ANSI/ASTM A197.

E. Bolts: Cor-Ten steel as specified, or 316 stainless steel, in accordance with Portland Water District specifications.

F. Cast Iron Washers: Meeting or exceeding all requirements of the latest revision of ANSI/ASTM A126, Class A.

G. Thrust Blocks: Shall be 3000 psi concrete, size as shown on Drawings.

H. Pipe Lubricant: Suitable for use in potable water supply.

I. Marking Tape: Lineguard III by Tri-Sales, Inc., 2-inch wide, green; detectable with magnetic locators, or approved equal.

J. Rigid Insulation: Extruded closed-cell rigid foamed polystyrene, 2-inch thickness, width of trench, Styrofoam HI-60, by Dow Chemical, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Install products in compliance with manufacturer's instructions. Prevent introduction of any groundwater or foreign materials into pipe during construction. Provide watertight plug in ends of pipe at all times when construction is not in progress. Coordinate all work with the Portland Water District.

B. Excavation: Where location of distribution pipe is known, excavate within 2 feet of pipe by hand.

C. Hydrants: Install as indicated on Drawings. Refer to details on Drawings. Joints to be as specified. Tees for hydrants to be “MJ Hydrant Tees” or approved equal.

D. Bedding of Pipe: Bed in sand or crushed stone. Refer to trench detail on Drawings.

E. Cleaning: Clear interior of pipe of dirt and other superfluous material as work progresses. Place plugs in end of uncompleted pipe whenever work stops.

F. Coordinate connections to existing water mains with the Portland Water District. Provide 48 hours notice prior to such work. The CONTRACTOR is responsible for the cost and all work associated with water service taps and connection to existing mains.

G. Water Service Piping: Extend water service piping of size indicated to existing water service. Provide new shutoffs as indicated and shown. Bed pipe in sand or crushed stone. See trench detail on Drawings.

3.02 INSULATION:

A. Install as shown on Drawings.

B. Provide 2-inch minimum thickness compacted sand layers for sanitary and storm sewer, directly above and below insulation.

3.03 FLUSHING AND TESTING:

A. General: The CONTRACTOR shall not operate any existing Portland Water District valves for filling, flushing or testing the new main. The District will provide the necessary personnel upon request.

B. Flushing: The CONTRACTOR shall flush the new main at a minimum velocity of 2.5 feet per second to remove any particulate matter. Provide the following minimum flow in gallons per minute: 4" dia. - 100 GPM; 6" dia. - 220 GPM; 8" dia. - 390 GPM; 12" dia. - 880 GPM. The CONTRACTOR shall be responsible for disposal of all flushing water and providing any necessary hoses or equipment for flushing.

C. Perform pressure and leakage testing of completed lines. CONTRACTOR shall coordinate all testing with the Portland Water District. Pressurize test pipe to 150 psi and allow to stabilize (+/- 2.5 psi) for a minimum of 15 minutes. Pressure and leakage test shall be conducted at pressure of 150 psi for minimum of two hours. Maximum allowable leakage per 1000 feet of pipeline shall be 0.37 gph for 4-inch diameter pipe and 0.55 gph for 6-inch diameter pipe.

D. Perform operational testing of valves by opening and closing under water pressure to insure proper operation.

3.04 DISINFECTION:

A. General: Upon satisfactory completion of the pressure and leak test, all new water mains shall be disinfected before they are placed into service in accordance with AWWA Standard C651, latest revision, and procedures specified herein. Fittings required for final connection to existing water main shall be disinfected by swabbing with a sodium hypochlorite solution immediately prior to final connection.

B. Disinfection:

1. The CONTRACTOR shall chlorinate the new water main in accordance with the continuous feed method specified in Section 5.2 of AWWA Standard C651, latest revision, using 5 percent to 15 percent sodium hypochlorite solution.

2. The CONTRACTOR may use calcium hypochlorite granules or tablets placed in the new water mains during installation in accordance with Section 5.1 of AWWA Standard C651, latest revision, in addition to the continuous feed method, not as a substitute.

C. Chlorine Requirement: The new water main shall be chlorinated so that a chlorine residual of not less than 25 parts per million remains in the water after standing 24 hours in the pipe. Chlorine residual at start of the test shall be a minimum of 50 parts per million.

D. Point of Application: Chlorinating solution point of application shall be within 10 feet of the connection to the existing main through a corporation stop inserted in the water main. Alternate points of application may be used when accepted or directed by the Portland Water District.

E. Rate of Application: Water from the distribution system, or other source of supply as accepted by the Portland Water District, shall be controlled to flow very slowly into the new water main during application of the chlorine. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the new water main that the dosage applied to the water will be sufficient for a minimum of 50 parts per million unless directed by the Portland Water District.

F. Retention Period: Treated water shall be retained in the new water main for a minimum of 24 hours. CONTRACTOR shall provide sampling taps at 500 ft. intervals, at all deadends, and at end of all new water mains. Take one sample at each location. Treated water shall contain no less than 25 parts per million of available chlorine.

G. Flushing and Draining:

1. At the end of the retention period, the chlorination water shall be flushed from the main until all heavily chlorinated water has been removed. CONTRACTOR shall arrange for all testing of water. CONTRACTOR shall provide testing at no cost to CONTRACTOR.

2. CONTRACTOR shall coordinate with the Portland Water District to obtain all water required for flushing and draining. CONTRACTOR to provide temporary blow-offs as necessary for flushing and draining.

3. Chlorine residual of water being disposed shall be neutralized by treating with one of the chemicals listed in the table below:

Amount Of Chemicals Required To Neutralize Various
Residual Chlorine Concentrations In 100,000 Gallons Of Water*

| Residual Chlorine Concentration (mg/l) | Sulfur Dioxide | Sodium Bisulfate | Sodium Sulfite | Sodium Thiosulfate |
|---|---|---|---|---|
| 1 | 0.8 | 1.2 | 1.4 | 1.2 |
| 2 | 1.7 | 2.5 | 2.9 | 2.4 |
| 10 | 8.3 | 12.5 | 14.6 | 12.0 |
| 50 | 41.7 | 62.6 | 73.0 | 60.0 |

*Except for residual chlorine concentration, all amounts are in pounds

H. Bacteriological Testing: Following disinfection and final flushing, bacteriological testing shall be done as specified in Section 5 of AWWA C651 as follows:

1. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main. At least one set of samples shall be collected from every 1,200 feet of the new water main, plus one set from the end of the line at lease one set from each branch.

2. All samples shall be tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater, and shall show the absence of coliform organisms.

3. If the initial disinfection fails to produce satisfactory bacteriological results, the new main shall be reflushed and resampled. If check samples also fail to produce acceptable results, the main shall be rechlorinated by the continuous-feed or slug methods until satisfactory results are obtained.

I. Equipment: Provide water pumps with adequate metering devices. Provide chlorination injection pumps which allow accurate measurement of the disinfection solution being introduced to new water main.

J. Personnel: Submit names of personnel or firm to perform disinfection work.

**End of Section**

SECTION 02600 – SEWERS AND DRAINS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK: Provide sanitary sewer system and storm sewer system as shown on the Drawings. This includes:

1. Sanitary sewer pipe
2. Sanitary sewer service pipe
3. Repairs to existing pipe
4. Storm sewer pipe
5. Connection to existing systems
6. Underdrain

1.02 RELATED WORK specified elsewhere includes:

1. Existing Subsurface Conditions Section 02010

2. Handling Contaminated Soils: Section 02110

3. Earthwork: Section 02300

4. Erosion and Sedimentation Control: Section 02370

5. Stormwater Treatment System: Section 02631.

1.03 SUBMITTALS:

A. Manufacturer's product data and installation instructions for all materials prior to the start of construction.

B. Certified copies of tests on pipe and manhole units.

C. Construction Records: Record depth and location of the following:

1. Sanitary sewer pipe and service locations, cleanouts, bends in services, connection points to sewer main, and elevations.
2. Repairs to existing pipes.
3. Storm sewer pipe locations, and elevations.
4. Underdrain pipe locations and connection points to storm drainage system, and elevations.

Record neatly in a permanently bound notebook and submit at Substantial Completion. Provide access to records for ENGINEER at all times. Submit copies to ENGINEER on a weekly basis.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS:

A. General: Provide fittings of same type and class of materials as pipe. Provide commercially manufactured wyes or tee/wyes for service connections. Fitting must have single piece gasket.

B. PVC Non-Pressure Pipe and Services (Sewer and Storm Drain): 4- through 15-inch Diameter: ASTM D3034 or ASTM D3033, 18- through 27-inch Diameter: ASTM F-679, strength requirement SDR 35; push-on joints, ASTM D3212; gaskets, ASTM F477.

C. Underdrain Transport Pipe: Solid-wall, corrugated exterior, polyethylene pipe with smooth wall interior, highway grade, AASHTO M252, ASTM F405, by American Drainage Systems, or approved equal.

D. Reinforced Concrete Pipe: ASTM C76; Class IV, O-ring gasket joints with rubber gaskets, meeting MDOT specifications.

E. Ductile Iron Pipe: AWWA C151; thickness Class 52 AWWA C150; double cement lined, AWWA C104; push-on joints or mechanical joints with rubber gaskets, AWWA C111; fittings, AWWA C110.

F. Underdrain: Materials shall conform to the Drawings and MDOT SECTION 605 – UNDERDRAINS with the following modifications:

1. Fittings: Provide fittings of same type and class of materials as pipe. Provide commercially manufactured wyes or tee/wyes. Fitting must have single piece gasket.

2. Pipe: Underdrain pipe shall be SDR-35 PVC meeting ASTM F789, corrugated polyethylene pipe meeting MDOT 706.06, or equivalent. Coiled pipe shall not be permitted

2.02 MISCELLANEOUS:

A. Flexible Couplings: Use and location shall be approved by ENGINEER.

1. Type A: Dresser Style 253 as manufactured by Dresser, or approved equal.

2. Type B: Neoprene sleeve with stainless steel bands by Fernco, or approved equal.

B. Geotextile Fabric: Propex 4508 by Amoco Fabrics Co., or approved equal.

C. Marking Tape: Lineguard III by Tri-Sales, Inc., 2-inch wide, green; detectable with magnetic locators, or approved equal.

D. Rigid Insulation: Extruded closed-cell rigid foamed polystyrene, 2-inch thickness, width of trench, Styrofoam HI-60, by Dow Chemical, or approved equal.

E. Pipe Supports: Saddle type, steel, painted, adjustable, by ITT Grinnell, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF GRAVITY PIPE AND FITTINGS:

A. Methods: Install in accordance with manufacturer's recommendations. Use a laser beam for line and grade unless otherwise permitted by the ENGINEER. Secure each length of pipe with bedding before placing next length. Plug open ends when work is suspended. Bed pipe as shown on Drawings. A 30-inch minimum cover over the top of PVC pipe and DI pipe should be provided before the trench is wheel-loaded.

B. Grade and Line:

1. Lay pipe to line and grade shown on the Drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points.

2. Line and grade may be adjusted by the ENGINEER as required by field conditions.

C. Conditions: Lay pipe in the dry. Do not use installed pipe to remove water from work area.

D. Flush and clean all pipe and remove all debris and materials. Flushing and cleaning methods approved by ENGINEER. Gravity flushing is not acceptable.

E. Connections to Manholes and Catchbasins: Provide short length of pipe so that joints are located within 3 feet of inside surface of manholes and catch basins for all pipe.

F. Sanitary Sewer Service Fittings and Leads:

1. Size of service leads 6-inch unless otherwise indicated.

2. Depth and location of service to be determined by ENGINEER in field.

3. Provide tee/wye or wye fittings on main line pipe.

4. Provide clean outs as shown and detailed on Drawings.

5. Plug, or cap, and stake ends of new service. Provide stake which extends from plug or cap to 1-foot above ground surface. Assist ENGINEER in measurement of pipe installed and in obtaining swing ties to ends of leads.

G. Underdrain:

1. All work shall conform to the Drawings and MDOT SECTION 605 – UNDERDRAINS

3.02 PIPE UTILITIES TO BE ABANDONED: Close open ends of abandoned underground utilities which are not indicated to be removed. Provide sufficiently strong closures, such as caps or brick and mortar, acceptable to ENGINEER to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed. CONTRACTOR may remove abandoned utilities with written permission of ENGINEER.

3.03 INSULATION:

A. Install as shown on Drawings.

B. Provide 2-inch minimum thickness compacted sand layers for sanitary and storm sewer, directly above and below insulation.

3.04 TESTING OF SANITARY SEWERS:

A. General: Test all sanitary sewer pipes after backfilling. Install service leads on main line before testing. Perform tests in presence of ENGINEER. A maximum of 1000 feet of pipe may be installed but not tested at any time.

B. Gravity Sewer Leakage Tests: Use low pressure air test as follows:

1. Plug ends of section to be tested.

2. Supply air slowly to the pipe to be tested until the air pressure inside the pipe is 4.0 psi greater than the average back pressure of any groundwater submerging the pipe.

3. Disconnect air supply and allow a minimum of two minutes for stabilization of pressure.

4. Following stabilization period measure drop in pressure over the test period within the following times:

| Nominal Pipe Size (in.) | Test Period (min.) |
|---|---|
| 4 | 4 |
| 6 | 4 |
| 8 | 6 |
| 10 | 6 |
| 12 | 7 |
| 15 | 8 |
| 18 | 9 |
| 21 | 11 |
| 24 | 13 |

5. Acceptable drop: No more than 1.0 psi.

C. Deflection Test for PVC Gravity Sewer Pipe: Test 100% of pipe with "GO-NO-GO" gauge allowing maximum deflection per ASTM D3034, Appendix X1, Table X1.1.

D. TV Inspection: All sewers and drains may be inspected by the OWNER using TV pipe inspection. Defects in materials and/or workmanship found during the inspection shall be corrected by the CONTRACTOR.

E. Repair all pipes not passing tests, using materials and methods approved by the ENGINEER, and retest.

**End of Section**

SECTION 02630 – DRAINAGE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK: Provide manholes and precast concrete items as shown on the Drawings. This section includes:

1. Precast Manholes
2. Catch Basins
3. Inverts
4. Risers
5. Frames, Covers, and Grates
6. Area Drain Basins

1.02 RELATED WORK specified elsewhere includes:

1. Existing Subsurface Conditions Section 02010

2. Handling Contaminated Soils: Section 02110

3. Earthwork: Section 02300

4. Erosion and Sedimentation Control: Section 02370

5. Sewers and Drains: Section 02600

6. Stormwater Treatment System: Section 02631.

1.03 QUALITY ASSURANCE:

A. General: Provide complete manhole and precast concrete structures capable of supporting AASHTO H20 loading. All precast concrete shall comply with ASTM C913 "Standard Specification for Precast Concrete Water and Wastewater Structures."

B. Precast Manhole and Catch Basin Components: Comply with ASTM C478.

C. Antifloatation Slab Design Certificate: The CONTRACTOR may provide the precast structures requiring antifloatation slabs as one complete unit. If provided as a monolithic unit, submit a certificate of design signed by a Professional Engineer registered in the State in which the Work is being performed, certifying that the structure including the slab has been designed to withstand all forces including soil, traffic and hydrostatic in accordance with all applicable laws, regulations, rules and codes.

1.04 SUBMITTALS:

A. Shop Drawings: Submit for precast manholes and all precast concrete items. Show components to be used, elevations of top of precast sections, base and pipe inverts, location of pipe penetrations, steps, for each manhole. Verify finish grade elevation at each proposed manhole location in the field.

B. Product Data: Submit manufacturers' product data and installation instructions for frames, covers, grates, precast items, manhole sleeves, joint sealants, and frost barrier.

PART 2 - PRODUCTS

2.01 MANHOLES:

A. Base Sections: Precast monolithic construction with steps.

B. Barrel Sections: Precast with steps.

C. Top Sections: Precast eccentric cone with steps. Alternative flat slab may be used if conditions warrant.

D. Steps: Polypropylene reinforced with steel rod. Meet OSHA requirements, minimum width 16-inches. Cast into concrete.

E. Pipe to Structure Connections: Connections shall be watertight, expandable pipe sleeve with adjustable expansion ring equal to Press-Boot by Press-Seal Gasket Corp., Fort Wayne, Indiana.

F. Joints Between Precast Sections: Watertight, shiplap-type seal with two rings of one-inch diameter butyl rubber sealant.

2.02 CATCH BASINS:

A. Base Sections: Precast monolithic construction.

B. Barrel Sections: Precast monolithic construction.

C. Top Sections: Precast eccentric cone. Alternative flat slab may be used if conditions warrant.

D. Pipe to Structure Connections: Connections shall be watertight, expandable pipe sleeve with adjustable expansion ring equal to Press-Boot by Press-Seal Gasket Corp., Fort Wayne, Indiana.

E. Joints Between Precast Sections: Watertight, shiplap-type seal with two rings of one-inch diameter butyl rubber sealant.

2.03 INVERTS:

A. 180 Degree Straight Through Manholes: One piece molded fiberglass invert with integral pipe connections that are factory precast integral with the manhole base, “Fiberliner 2000 Invert System” as manufactured by Fiberliner 2000 New England, Inc, Tel. (508) 349-7401; or approved equal.

B. Non Straight Through Manholes: One-piece plastic composite invert, “Reliner” as manufactured by Reliner – Duran, Inc. Tel. (860) 434-0277; or approved equal. Provide concrete backfill with brick table.

1. Concrete: 3000 psi.

2. Sewer Brick: ASTM C32, Grade SS, hard brick.

3. Mortar: Type M, ASTM C270. Use Type II portland cement, Type S lime. Proportions for Mortar: 1 part portland cement, 1/4 part hydrated lime, 3 to 3 3/4 parts sand.

2.04 RISERS:

A. General: Precast concrete grade rings, sewer brick risers, or equal

2.05 FRAMES, COVERS, AND GRATES:

A. Material: Cast iron, ASTM A48 Class 30.

B. Manhole Frames and Covers: For manholes 6-feet or more in vertical height, use minimum 24-inch diameter opening. Weight of 350 pounds, labeled with either "DRAIN" or “SEWER” in 3-inch high raised letters on cover for drainage manholes. Standard frames and covers shall be Model E245S by Etheridge Foundry, or approved equal.

C. Catch Basin Frames and Grates: Catch basin frames and grates shall be standard City of Portland catch basin frame and grate Model E245G by Etheridge Foundry, or approved equal. For curbside catchbasins with inlet stones, frames shall be Etheridge DR5A.

2.06 Area Drain Basins:

A. Area Drain Basin: Area Drain Basins shall be factory fabricated from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the specified configuration. The Area Drain Basin shall be H-25 rated. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM 03212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the main body of the drain basin or catch basin. The pipe stock used to manufacture the main body and pipe stubs of the surface drainage inlets shall meet the mechanical property requirements for fabricated fittings as described by ASTM 03034. Standard for Sewer PVC Pipe and Fittinqs; ASTM F1336. Standard for PVC Gasketed Sewer Fittinqs. The diameter of the Area Drain Basin shall be as specified in the Drawings.

B. Area Drain Frame and Grates: The grates furnished for all Area Drain Basins shall be ductile iron grates for sizes 8",10",12", 15", 18",24" and 30" (12" and 15” frames are cast iron) shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for drain basins shall be capable of supporting H-25 wheel loading for heavy-duty traffic or H-10 loading for pedestrian traffic. 12" and 15" grates will be hinged to the frame using pins. Metal used in the manufacture of the castings shall conform to ASTM A536 qrade 70-50-05 for ductile iron and ASTM A-48-83 class 308 for 12" and is" cast iron frames. Grates shall be provided painted black.

C. Installation: The specified PVC surface drainage inlet shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed stone. The surface drainage inlets shall be bedded and back-filled uniformly. The drain basin body will be cut at the time of the final grade so as to maintain a one piece, leak proof structure. No brick, stone or concrete block will be used to set the grate to the final grade height. For H-25 Load rated installations, an 8" to 10" thick concrete ring will be poured under the grate and frame as recommended by details provided from the manufacturer.

2.07 MISCELLANEOUS:

A. Frost Barrier: U.V. resistant, high grade polyethylene, minimum thickness eight (8) mils.

B. Joint Sealants:

1. Butyl Rubber Sealant: One (1) inch diameter strips manufactured by Kent Seal, or approved equal.

2. Butyl Rubber Caulking: Conform to AASHTO M-198, Type B.

C. Sewer Manhole Inverts: Provide inverts as specified or as shown. Configuration to be as required by connecting pipes and as shown on Drawings.

PART 3 - EXECUTION:

3.01 INSTALLATION OF MANHOLES/CATCH BASINS:

A. Placement: Place precast bases and structures on compacted bedding material so bottom of structure is plumb and pipe inverts are at proper elevations. Place manhole barrel and top sections in the appropriate height combinations. Plug all lifting holes inside and out with non-shrink grout. Construct manhole inverts in accordance with specifications.

B. Joints: Follow manufacturer’s instructions for sealing joints between precast sections. Provide two rings of 1 inch diameter butyl rubber sealant. Point joints inside and out with butyl caulk.

C. Frame and Covers:

1. Set to final grade as shown on the Drawings and as specified. Provide adequate temporary covers to prevent accidental entry until final placement of frame and cover is made.

2. Use two rings of 1 inch diameter butyl rubber sealant between frame and rubber riser. Provide downward force to frame so as to compress the joint, provide a watertight seal, and prevent future settlement. Point compressed joint with butyl rubber caulk sealant.

3. Set manhole frames and covers to final grade only after pavement base course has been applied, or after final grading of gravel roads.

D. Inverts: As specified.

E. Steps: Replace any steps that are out of plumb and proper horizontal placement.

F. Frost Barriers: Wrap each manhole to the maximum excavation depth or not less than 4 ½ feet below grade, with a minimum of three layers of 8 mils each of the polyethylene.

1. Clean manhole exterior of all dirt and remove any protrusions.

2. Apply a 6-inch wide vertical strip of bituminous waterproofing adhesive from the top of manhole to the greatest excavation depth, but not in excess of 6 feet.

3. Start poly wrap at adhesive strip and proceed around manhole continuously, overlapping adhesive strip a minimum of 24 inches on the final layer.

4. Tuck and pleat poly at top in a continuous manner, minimizing size of folds. Extend poly past top of manhole frame and temporarily tuck remainder inside frame, until final backfill and paving.

5. Paved areas: Cut poly flush with manhole rim after pavement is in place.

6. Unpaved areas: Pull loose ends of poly together, remove excess air and tie off end with galvanized wire. Bury with manhole below grade.

3.02 LEAKAGE TESTING – MANHOLES/CATCH BASINS:

A. General: Tests must be observed by the ENGINEER. Manholes must be complete, including backfill, for final test acceptance except for shelf and invert brickwork. Plug all pipes and other openings in the manhole walls prior to test.

B. Exfiltration Test:

1. Plug pipes into and out of MH and secure plugs.

2. Lower groundwater table (GWT) to below MH. Maintain GWT at this level throughout test. Provide means of determining GWT level at any time throughout test.

3. Fill MH with water to top of cone.

4. Allow a period of time for absorption (determined by CONTRACTOR).

5. Refill to top of cone.

6. Determine volume of leakage in an 8 hour (min) test period and calculate rate.

7. Acceptable leakage rate: Not more than 1 gallon per vertical foot per 24 hours.

8. ENGINEER reserves the right to require an infiltration test if he is not satisfied with the exfiltration test.

C. Vacuum Test:

1. Manholes may be vacuum tested in lieu of the exfiltration test. The vacuum tests must be performed prior to backfilling the manhole, filling joints, and constructing the manhole inverts and benches. All pipe connections shall be made prior to the test.

2. Plug pipe openings and securely brace the plugs and pipe.

3. Set the tester onto the top section of the manhole and inflate the compression band to effect a seal between the structure and the vacuum base.

4. Connect the vacuum pump to the outlet port, open the valve, start the motor and draw a vacuum of 10-inch mercury.

5. Close the valve and monitor the vacuum gauge.

6. The test shall pass if the vacuum holds at 10-inch mercury or drops no lower than 9 inches within the following times:

| Depth of Manhole (feet) | Time (min.) |
| --- | --- |
| 0 - 10 | 3.0 |
| 10 - 15 | 3.5 |
| 15 - 20 | 4.0 |
| 20 - 25 | 4.5 |
| >25 | 5.0 |

7. If the vacuum drops in excess of the prescribed rate, the CONTRACTOR shall locate the leak, make proper repairs, and retest the manhole.

8. If the unit fails the test after repair, the unit shall be water exfiltration tested.

3.03 REPAIRS:

A. Determine causes of all leaks and repair them. Perform earthwork required if manhole has been backfilled.

B. Perform repairs using methods and materials approved by the ENGINEER. Remove and replace or reconstruct manhole if necessary. Remove and replace defective sections if required by ENGINEER.

**End of Section**

# SECTION 03300 - CAST -IN-PLACE CONCRETE

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

### 1.02 DESCRIPTION OF WORK:

A. Work included: Provide labor, materials, and equipment necessary to complete the work of this Section and, without limiting the generality thereof, furnish and include the following:

1. The extent of cast-in-place concrete work is shown on drawings and includes (but not by way of limitation) formwork, reinforcing, cast-in-place concrete, accessories, finishing, and casting in of items specified under other Sections of the Specifications or furnished by Owner that are required to be built-in with the concrete.

2. Equipment support pads indicated on mechanical drawings to be installed by the Building Contractor.

3. Cast-in-place retaining walls, exterior slabs on grade and other concrete shown on site drawings.

### 1.03 RELATED WORK:

A. Post Tensioned Concrete: Section 03380

B. Metal Fabrications:

1. Expansion Anchors - Section 05120

2. Embedded Items - Section 05500

C. Anchor Bolts: Section 05120

D. Joint Sealants: Section 07900

E. Underslab Vapor Retarders/Wall Waterproofing: Division 7

1.04 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:

1. ACI 362.1R-97 " Guide for the Design of Durable Parking Structures"
2. ACI "Manual of Concrete Practice".
3. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials".
4. ACI 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete."
5. ACI 212.3R "Chemical Admixtures for Concrete."
6. ACI 301 "Specifications for Structural Concrete for Buildings."
7. ACI 302.1R "Guide for Concrete Floor and Slab Construction."
8. ACI 304R "Guide for Measuring, Mixing, Transporting and Placing Concrete."
9. ACI 304.2R "Placing Concrete by Pumping Methods."
10. ACI 306 R "Cold Weather Concreting."
11. ACI 308 "Standard Practice for Curing Concrete."
12. ACI 309R "Guide for Consolidation of Concrete."
13. ACI 315 "ACI Detailing Manual."
14. ACI 318 "Building Code Requirements for Reinforced Concrete."
15. ACI 347R "Guide to Formwork for Concrete."
16. Concrete Reinforcing Steel Institute, "Placing Reinforcing Bars."
17. AISC "Code of Standard Practice for Steel Buildings and Bridges."
18. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Materials and installed work may require testing and retesting, as directed by the Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.05 SUBMITTALS:

A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.

B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.

C. All submittals shall be reviewed and returned to the Architect within 10 working days.

D. Incomplete submittals will not be reviewed.

E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with.

**F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.**

G. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Reinforcement certified mill reports covering chemical and physical properties and yield strength.

2. Patching products.

3. Non-shrink grout.

4. Curing compounds, where applicable.

5. Admixtures.

6. Expansion/Adhesive Anchors.

H. Shop Drawings:

1. Shop Drawing Preparation: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings is prohibited. Shop drawings created from reproduced Construction Documents will be returned without review. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315, showing bar schedules, stirrup and tie spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required at openings through concrete elements. Include supplemental reinforcing and bar supports necessary to support reinforcing steel at proper location within forms or slabs.

   a. Review of the shop drawings will be made for the size and arrangement of reinforcement. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility. **Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.**

   b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided all items listed prior. **Incomplete submittals will not be reviewed.**

I. Mix designs: Submit all laboratory test reports and materials for each mix design listed within. Prepare mixes by the field experience method and/or trial mixtures per the requirements of chapter 5 of ACI 318. Include the calculation of average strength and standard deviation. Proportioning by water cement ratio method will not be permitted.

J. LEED Documentation: Refer to paragraph 1.06 of this section and Section 01352.

K. Samples: Submit samples of materials as specified and as otherwise requested by Architect, including names, sources and descriptions.

L. Curing Methods: Submit documentation of curing methods to be used for review. Account for anticipated project temperature ranges and conditions in curing methods.

M. Contraction/Construction Joints: Submit plan indicating proposed location of contraction and construction joints in walls and slabs.

N. Test Reports: Test reports shall be submitted to the Owner, Architect and Engineer within 48 hour after completion of each test.

1.06 LEED Requirements

A. Material Recycled Content: Slag or Fly Ash Cement Replacement

1. Blast Furnace Slag: Granulated blast furnace slag conforming to ASTM C989, included in the calculation of water-cementitious materials, and shall be included in the concrete mix. The weight of granulated blast-furnace slag shall be 40 percent of cementitious materials. The slag used in the manufacture of a Type IS or ISM blended hydraulic cement conforming to ASTM C595 shall be included in the calculated percentage.

2. Fly Ash: As an alternate to Blast Furnace Slag, Fly Ash and pozzolan conforming to ASTM C618, included in the calculation of water-cementitious materials, shall be included in the concrete mix. If used the Fly ash shall be included in the percentages prescribed above. The fly ash and pozzolan present in ASTM Type IP or IPM blended cement, conforming to ASTM C595, shall be included in the calculated percentage.

3. Concrete mix designs shall indicate the cement replacement percentages.

**4. Substitution of 4,000 psi concrete for 3,000 psi concrete is not acceptable.**

B. Material Recycled Content: Concrete Reinforcing Steel

1. Post-consumer recycled content: 50%

2. The sum of the post industrial and post consumer recycled content:60%

3. Submit invoices and documentation from manufacturer of the amounts of post-consumer and post-industrial recycled content by weight for products with specified recycled content.

C. Local/Regional Materials: Ready-mix concrete supplier shall be located within 500 miles of the project location. Submit documentation of manufacturing locations and origins of materials for products manufactured within 500 miles of the building site.

D. Local/Regional Materials: Concrete reinforcement fabrication shall be located within 500 miles of the project location. Submit documentation of manufacturing locations and origins of materials for products manufactured within 500 miles of the building site.

E. Low emitting adhesives and sealants: Provide water-based, biodegradable form coating with maximum VOC content of 55 grams/liter. Provide cut sheet and/or material safety data sheet for form coating with VOC levels highlighted.

F. Waste Management:

1. Before concrete pours, designate locations or uses for excess concrete. Options include the following:

    a. Additional paving.

    b. Post footing anchorage.

    c. Swale, riprap reinforcing.

    d. Flowable fill.

    e. Footing bottom, retaining wall footing ballast.

    f. Storm structure covers.

    g. Underground utility pipe kickers.

    h. Storm pipe flared end section.

    i. Toe wash protection, and shoulder and toe outfall restraints for temporary erosion pipes.

2. Before concrete pours, designate a location for cleaning out concrete trucks. Options include the following:

    a. Company-owned site for that purpose (meeting environmental standards).

    b. On-site area to be paved later in Project.

3. Collect waste reinforcing steel and place in designated area for recycling.

## PART 2 PRODUCTS

### 2.01 FORM MATERIALS:

A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

    1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.02 REINFORCING MATERIALS:

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric. Provide welded wire fabric in flat sheets.

C. Diamond Dowels/Load Plates: PNA Construction Technologies, Inc.; Manufacturer's representative: (508) 238-6775

D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use plastic, wire bar type supports or concrete block supports complying with CRSI recommendations, unless otherwise specified. Wood, clay brick and other unspecified devices are not acceptable.

1. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

2.03 CONCRETE MATERIALS:

A. Single-Source Supplier: Ready-mix concrete shall be from one supplier unless specific written approval is received from the Structural Engineer.

B. Portland Cement: ASTM C 150, Type I or Type II, unless otherwise approved Use one brand of cement throughout project, unless otherwise acceptable to Architect.

C. Normal Weight Aggregates: ASTM C 33. Provide from a single source for exposed concrete. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, or ochre which can cause stains on exposed concrete surfaces.

D. Light Weight Aggregates: ASTM C 330.

E. Water: Potable.

F. Air-Entraining Admixture: ASTM C 260.

G. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G containing not more than 1% chloride ions.

H. Fiber reinforcement shall be Type III Synthetic Virgin Homopolymer Polypropylene Fibers conforming to ASTM C1116. Fiber reinforcing shall be added and distributed prior to incorporation of Super Plasticizer.

I. Normal range water reducing admixture: ASTM C 494 Type A containing no calcium chloride.

J. Accelerating Admixture: ASTM C 494, Type C or E.

K. Blast Furnace Slag: ASTM C989

L. Fly Ash: ASTM C618, Class C or F

M. Calcium Chloride is not permitted.

2.04 RELATED MATERIALS:

A. Underslab Vapor Retarder: Provide vapor retarder over prepared sub base. Refer to architectural drawings, geotechnical report and/or division 7 specifications for additional requirements and vapor retarder location.

B. Non-Shrink Cement-based Grout: Provide grout consisting of pre-measured, prepackaged materials supplied by the manufacturer requiring only the addition of water. Manufacturer's instructions must be printed on the outside of each bag.

1. Non-shrink: No shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C-827. No shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with CRD-C-621.

2. Compressive strength: A minimum 28 day compressive strength of 5000 psi when tested in accordance with ASTM C-109.

3. Setting time: A minimum initial set time of 60 minutes when tested in accordance with ASTM C-191.

4. Composition: Shall not contain metallic particles or expansive cement.

C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M182, Class 2.

D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171.

1. Waterproof paper.

2. Polyethylene film.

3. Polyethylene-coated burlap.

E. Liquid Membrane-Forming Curing Compound: Liquid type membrane forming curing compound complying with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Curing compound shall not impair bonding of any material, including floor finishes, to be applied directly to the concrete. Demonstrate the non-impairment prior to use.

F. Preformed Expansion Joint Formers:

1. Bituminous Fiber Type, ASTM D 1751.

2. Felt Void, Poly-Styrene Cap with removable top as manufactured by SUPERIOR.

G. Slab Joint Filler: Multi-component polyurethane sealant (self-leveling type).

H. Waterstops shall be Bentonite/Butyl Rubberbased product. Use in conjunction with manufacturer's approved mastic. Acceptable products include

1. "Waterstop Rx," by American Colloid Co.

2. "Adeka Ultra Seal MC-2010," by Asahi Denka Koeyo, Kik MN.

2.05 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 318. Use material, including all admixtures, proposed for use on the project. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Architect.

B. Submit written reports to Architect of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been reviewed by Architect.

C. Proportion design mixes to provide concrete with the following properties:

1. Footings and foundation walls

a. Strength: 3000 psi at 28 days.

b. Aggregate: 3/4"

c. W/C Ratio: 0.54 maximum

d. Entrained Air: 6% +/- 1.5%

e. Slump: 4" maximum

2. Slabs and all other exposed Site Concrete not specified elsewhere:

a. Strength: 5000 psi at 28 days

b. Aggregate: 3/4"

c. W/C Ratio: 0.40 maximum

d. Entrained Air: 6.5% +/- 2.0%

e. Slump: 4" maximum

3. Post-Tensioned Slabs and Beams

a. Strength: 5000 psi at 28 days (minimum)

b. Strength: 3000 psi at 3 days for stressing.

c. Aggregate: 3/4"

d. W/C Ratio: 0.40 maximum

e. Entrained Air: 6.5% +/- 2.0%

f. Slump: 4" maximum

g. Admixture: Corrosion Inhibitor

4. Add air entraining admixture at manufacturers prescribed rate to result in concrete at point of placement having the above noted air contents.

5. Additional slump may be achieved by the addition of a mid-range or high-range water reducing admixture. Maximum slump after the addition of admixture shall be 6 or 8 inches for mid-range or high range water reducing admixtures, respectively.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor, when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Structural Engineer before using in work.

1. Water may be added at the project only if the maximum specified slump and design mix maximum water/cement ratio is not exceeded.

2. Additional dosages of superplastisizer should be used when delays occur and required slump has not been maintained. A maximum of two additional dosages will be permitted per ACI 212.3R recommendations.

2.06 CONCRETE MIXING:

A. Job-Site Mixing will not be permitted.

B. Ready-Mix Concrete: Must comply with the requirements of ASTM C 94, and as herein specified. Provide batch ticket for each batch discharged and used in work, indicating project name, mix type, mix time and quantity.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required by Structural Engineer.

2. When the air temperature is between 85 degrees F. and 90 degrees F., reduce the mixing and delivery time from 1 1/2 hours to 75 minutes, and when the air temperature is above 90 degrees F., reduce the mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 FORMS:

A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.

B. Design, construct, erect, maintain, and remove forms for cast-in-place concrete work in compliance with ACI 347.

C. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

D. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

E. Vertical dovetail slots may be required for masonry tie installation. Coordinate dovetail slot spacing and location with division 4 specifications and Architectural drawings.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, dovetail slots, reglets, recesses, and the like to prevent swelling and for easy removal.

G. Provide temporary openings where interior area of formwork is inaccessible for clean out, for inspection before concrete placement and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

H. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

I. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

   1. Unless otherwise indicated, provide ties for concrete surfaces to be exposed to view in the final condition so portion remaining within concrete after removal is 1" (minimum) inside concrete.

   2. Form ties shall not leave holes larger than 1" diameter in concrete surface. Repair holes left by form ties after removal of formwork.

J. Provision for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

K. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

3.02 PLACING REINFORCEMENT:

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

1. Subgrade tolerance shall conform to a tolerance of +0/-1 1/2". Base tolerance (fine grading) for slabs shall conform to a tolerance of +0”/-3/4” in. Confirm compliance of above tolerances with surveyed measurements taken at 20 ft. intervals in each direction.

2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

3. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

4. Place reinforcement to obtain specified coverage for concrete protection within tolerances of ACI-318. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

5. Install diamond dowels at construction joints and load plates at contraction/control joints in slab-on-grade per manufacturer’s recommendations and as indicated on Drawings.

6. Install welded wire fabric in flat sheets in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.03 JOINTS:

A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Architect. Submit plan indicating proposed location of construction joints for review prior to beginning work.

1. Provide keyways at least 1-1/2" deep in construction joints in walls, and slabs; bulkheads reviewed by the Engineer, designed for this purpose may be used for slabs.

2. Roughened surfaces shall be used between walls and footings unless shown otherwise on the drawings. The footing surface shall be roughened to at least an amplitude of 1/4" for the width of the wall before placing the wall concrete.

3. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.

4. Joints in slabs on grade shall be located and detailed as indicated on the drawings. **All joints in slabs on grade shall be tooled.**

3.04 INSTALLATION OF EMBEDDED ITEMS:

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto. Notify other trades to permit installation of their work. Templates to be utilized for setting of anchorage devices shall be constructed in a manner to allow mechanical consolidation of concrete. <u>“Wet Setting” of embedded items into plastic concrete will not be permitted without special permission from the Engineer.</u>

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface.

C. Provide PVC sleeves where pipes and/or conduit pass through exterior concrete or slabs. Sleeves or penetrations shall not be placed through footings, piers, pedestals, drop caps, columns or pilasters unless specifically noted.

D. Tolerances: Tolerances for Anchor Bolts/Rods, other embedded items and bearing surfaces shall meet the requirement set forth in the latest edition of the American Institute of Steel Construction “Code of Standard Practice for Steel Buildings and Bridges,” and ACI 117. The more stringent criteria from these documents shall apply.

3.05 INSTALLATION OF GROUT

A. Place grout for base plates in accordance with manufacturer's recommendations.

B. Grout below setting plates as soon as practicable to facilitate erection of steel and prior to removal of temporary bracing and guys. If leveling bolts or shims are used for erection grout shall be installed prior to addition of any column load.

C. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.

3.06 PREPARATION OF FORM SURFACES:

A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating material manufacturer's directions. Do not allow excess form coating to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.07 CONCRETE PLACEMENT:

A. Preplacement Review: Footing bottoms are subject to review by the Geotechnical Engineer. Reinforcement and all concrete preparation work shall be subject to review by the Structural Engineer. Verify that reinforcing, ducts, anchors, seats, plates and other items cast into concrete are placed and securely held. Notify Engineer/Project Special Inspector 48 hours prior to scheduled placement and obtain approval or waiver of review prior to placement. Be sure that all debris and foreign matter is removed from forms.

B. Concrete shall be placed in the presence of an approved testing agency.

C. General: Comply with ACI 304, and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to re-handling or flowing.

2. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.

3. Conveying equipment shall be approved and shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operations shall conform to the following additional requirements:

a. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An arrangement shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.

b. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long, and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

c. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete.

d. Concrete shall not be conveyed through pipe made of aluminum alloy. Standby equipment shall be provided on the site.

e. Tined rakes are prohibited as a means of conveying fiber reinforced concrete.

4. Do not use reinforcement as bases for runways for concrete conveying equipment or other construction loads.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment. Hand-spading, rodding or tamping as the sole means for the consolidation of concrete will only be permitted with special permission from the Engineer. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

2. Use vibrators designed to operate with vibratory equipment submerged in concrete, maintaining a speed of not less than 8000 impulses per minute and of sufficient amplitude to consolidate the concrete effectively. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine, generally at points 18 inches maximum apart. Place vibrators to rapidly penetrate placed layer and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion maintain the duration of vibration for the time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix, generally from 5 to 15 seconds. A spare vibrator shall be kept on the job site during all concrete placing operation.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete using internal vibrators during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Do not sprinkle water on plastic surface.

3. Maintain reinforcing in proper position during concrete placement operations.

4. Slab thicknesses indicated on the drawings are minimums. Provide sufficient concrete to account for structure deflection, subgrade fluctuations, and to obtain the specified slab elevation at the flatness and levelness indicated here within.

5. Finish: See “Monolithic Slab Finishes” in this specification for slab finish requirements.

F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F (27degrees C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.

4. All temporary heat, form insulation, insulated blankets, coverings, hay or other equipment and materials necessary to protect the concrete work from physical damage caused by frost , freezing action, or low temperature shall be provided prior to start of placing operations.

5. When the air temperature has fallen to or is expected to fall below 40 degrees F, provide adequate means to maintain the concrete temperature in accordance with Table 3.2.1 of ACI 309.

G. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

3. Wet forms thoroughly before placing concrete.

4. Do not use retarding admixtures without the written acceptance by the Architect.

3.08 FINISH OF FORMED SURFACES:

A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This concrete surface shall have texture imparted by form facing material, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 in. in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, painting or other similar system. This as-cast concrete surface shall be obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Grout Cleaned Finish: Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment. Combine one part Portland cement to 1-1/2 parts fine sand by volume and mix with water to consistency of thick paint. Proprietary additives may be used at Contractor's option. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.

   1. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

D. Related Unformed Surfaces: At tops of walls and grade beams, horizontal offset surfaces occurring adjacent to formed surfaces, strike-off, smooth and finish with a texture matching adjacent unformed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.09 MONOLITHIC SLAB FINISHES:

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds, and as otherwise indicated.

1. After placing slabs, plane surface to a tolerance not exceeding 1/2 in. in 10 ft. when tested with a 10-ft. straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, and as otherwise indicated.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces indicated, including slab surfaces to be covered with carpet, resilient flooring, paint or other thin-film finish coating system.

D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

E. Slab finishes for floor coverings not indicated or exposed to view in the final condition shall be coordinated with the Architect prior to slab placement.

F. Slab Joints: Where indicated, sawn slab contraction joints shall be "soft cut", immediately after concrete surface is firm enough not to be torn or damaged by the blade.

3.10 CONCRETE CURING AND PROTECTION:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 308 as herein specified.

**B.** Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified unless noted otherwise. Curing shall commence as soon as concrete surfaces are sufficiently hard as to withstand surface damage**.** **<u>All Elevated Slabs and Slabs-on-grade shall be cured by moist curing methods.</u>**

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

D. Protection From Mechanical Injury: During the curing period and duration of construction, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

3.11 REMOVAL OF FORMS:

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as joints, slabs and other structural elements, may not be removed in fewer than 14 days or until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and support.

3.12 REUSE OF FORMS:

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and latency, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.13 MISCELLANEOUS CONCRETE ITEMS:

A. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

3.14 CONCRETE SURFACE REPAIRS:

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to the Architect.

1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with approved bonding agent. Place patching mortar after bonding compound has dried.

2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, form tie holes, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, and other projections on surface and stains and other discolorations that cannot be removed by cleaning.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION:

A. Testing Agency/Project Special Inspector shall verify reinforcement, including foundation reinforcement and slab reinforcement (WWF or reinforcing bar). Agent shall verify WWF or reinforcement has been chair/placed with proper clearances.

B. The Owner shall employ a Testing Laboratory to inspect, sample and test the materials and the production of concrete and to submit test reports. Concrete testing shall be performed by technicians certified by the Maine Concrete Technician Certification Board and/or ACI Concrete Field Testing Technician Grade I.

C. Concrete shall be sampled and tested for quality control during placement. Quality control testing shall include the following, unless otherwise directed by the Architect.

D. See Submittals section for report requirements.

E. Sampling Fresh Concrete: ASTM C 172.

1. Slump: ASTM C143; }One test for each set of compressive strength test specimens. Sample shall be taken from middle third of the load **at point of discharge** per ASTM C172. A slump test must be run prior to the incorporation of the CFP fibers per recommendations of ACI 544. A slump test must be run prior to and following the addition of a water reducer (superplasticizer) per recommendations of ACI 301.

2. Air Content: ASTM C231 "Pressure method for normal weight concrete." One test for each set of compressive strength specimens measured at point of discharge.

3. Concrete Temperature: Per ASTM C-1064; One test each time a set of compression test specimens are made.

4. Compression Test Specimen: ASTM C31; one set of **6 standard cylinders** for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. Additional cylinders be requested by the contractor to confirm stressing strength for post-tensioning. Cost for additional cylinders will be the contractors responsibility.

    a. An insulated Cure Box for specimen curing shall be supplied by Testing Agency for initial curing as defined in ACI C31.

    b. Means of heating or cooling the Cure Box shall be provided by the Inspection Agency if required in order to maintain a temperature between 60 and 80 degrees F. Contractor shall provide an electrical source to the Testing Agency when required for temperature control.

    c. A maximum-minimum thermometer shall be provided in the Cure Box by the Testing Agency to record the temperature range of the Cure Box during specimen curing. The Testing Agency shall record the maximum/minimum temperature of the Cure Box when transferring the specimens to the laboratory.

    d. Test Specimens shall be moist cured.

    e. Refer to ACI C31 for additional requirements for Test Specimens.

5. Compressive Strength Tests: ASTM C39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 4,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days, 1 specimen retained in reserve for later testing if required.

6. Pumped concrete shall be tested at point of discharge per ACI 301.

F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

**END OF SECTION**

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**FOR**
**MAINE HEALTH & UNITED WAY**
**SITE ENABLING SPECIFICATIONS**
**PORTLAND, MAINE**



*Specs by Harriman unless otherwise indicated*

** = issued by addendum*

# SECTION 07100 - CEMENTITIOUS WATERPROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes cementitious waterproofing for elevator pits.

### 1.3 SUBMITTALS

A. General: Submit in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: For each type of product indicated, including installation instructions.

C. Qualification Data: For Installer.

### 1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced waterproofing Applicator.

B. Source Limitations: Obtain cementitious waterproofing materials through one source from a single manufacturer.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials and equipment in a single area of project site. Provide adequate means to protect floors and adjacent surfaces of this area from damage.

### 1.6 PROJECT CONDITIONS

A. Weather Limitations: Do not apply waterproofing when effects of freezing or moisture will adversely affect the waterproofing application.

B. Maintain adequate ventilation during preparation and application of cementitious waterproofing materials.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Cementitious Waterproofing: "Five Star Waterproofing" trowel applied negative side cementitious membrane and mixing liquid system manufactured by WCM.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
   1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
   2. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   3. Application of coating to surfaces shall constitute acceptance of surfaces and conditions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surfaces must be clean. Chip or grind off all defective materials and foreign matter. Remove form treatment residue, curing compound, scum and fungus.

B. Repair cracks, breaks, honeycombing, or other surface imperfections with non-expansive patching mortar to attain a finish comparable to adjacent concrete surfaces.

3.3 INSTALLATION

A. Cementitious Waterproofing:
   1. Apply cementitious waterproofing treatment to the floor and walls of elevator pit to a minimum thickness of 1/8-inch after elevator jack hole has been poured around with cast-in-place concrete.
   2. Trowel all surfaces to a smooth, hard finish, free from pits hollows and other defects.
   3. Provide 1-inch by 1-inch cant at intersection of horizontal and vertical surfaces.
   4. Apply in strict accordance with manufacturer's instructions.

3.4 PROTECTION

A. Protect waterproofing from damage by other trades after installation to maintain the integrity of the waterproofing.

END OF SECTION 07100

# SECTION 14212 - ELECTRIC TRACTION HIGH RISE MACHINE ROOM-LESS ELEVATORS

## PART 1 GENERAL

### 1.01 SUMMARY

A. Section Includes: Machine room-less electric traction passenger elevators as shown and specified. Elevator work includes:
   1. Gearless electric traction passenger elevators.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Accessibility provisions for physically disabled persons.
   5. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   6. Materials and accessories as required to complete the elevator installation.
   7. 12 month initial maintenance plus 5 year service maintenance agreement.

B. Related Sections:
   1. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
   2. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
   3. Division 5 Metals:
      a. Providing hoist beams, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
      c. Providing pit ladder.
   4. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
   5. Division 16 Sections:
      a. Providing electrical service to elevators, including fused disconnect switches.
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in machine room, hoistway and pit.
   6. Division 15 Plumbing
      a. Sump pit
   7. Division 15 Heating, Ventilation and Air Conditioning
      a. Heating and ventilating hoistways and machine rooms.

C. Work Not Included:
   The following preparatory work is required in order to properly install the elevator equipment. The cost of this work is not included in the Elevator Company’s proposal, since it is a part of the building construction.
   1. A plumb and legal hoistway, properly framed and enclosed an including a pit of proper depth, for each elevator. Drains, lights, access doors, waterproofing and hoistway ventilation, as required.
   2. Provide a suitable control room with access and ventilation in accordance with all applicable codes and regulations. The control closet shall be maintained at a temperature between 32 F (0 C) and 104 F (40 C). To be measured at 6 feet (1830 mm) above the floor and 1 foot (305

mm) out from the front center of the car controller(s). Relative humidity is not to exceed 95% non-condensing. Local codes may require tighter temperature ranges, and higher ventilation levels, please check with your local code authority for the exact requirements in your area. If your control closet temperatures exceed these requirements, contact your local Elevator sales representative for assistance.

3. Adequate supports in foundations to carry the loads of all equipment, including overhead machine and machine beams located in hoistway including supports for guide rail brackets.
4. Complete 3 phase connections from the electric power mains to each controller, including necessary circuit breakers and fused mainline disconnect switches.
5. Electric power of the same characteristics as the permanent supply without charge for the construction, testing and adjusting.
6. Provide proper piping and conduit.
7. Card readers.
7. Divider beams for rail bracket support as required.
8. Cutting of walls floor, etc. and removal of such obstructions as may be necessary for proper installation of the elevator.
9. Grouting of door sills, hoistway frames, and signal fixtures after installation of the elevator equipment.
10. All painting, except as otherwise specified.
11. Provide hoistway walls designed and constructed in accordance with the required fire rating (including those places where elevator fixture boxes, rail bracket fastings, and any other penetration into the hoistway walls).
12. Temporary enclosures, barricades and other protection from open hoistways and elevator work area during the time the elevator is being installed to meet all permanent installation safety codes.
13. Smoke detector\ sensing devices and contacts wired to elevator control as required by local code. A means to automatically disconnect the main line power supply to the elevator prior to the application of water in the elevator controller room will be furnished by the electrical contractor. This means shall not be self reseting.
14. All telephone wiring to controller room control panel, and installation of telephone instrument or other communication equipment in elevator cab with all connections to elevator in controller room.
15. A standby power source, including necessary transfer switches and auxiliary contact, where elevator operation from an alternate power supply is required.
16. Storage shall be provided by the Elevator Company for all elevator equipment prior to installation at no cost to the Contractor. Contractor shall provide adequate space for the equipment during the installation at ground level within 150 feet of hoistway.
17. Setting of anchors and sleeves.

## 1.02 SUBMITTALS

A. Product data: Provide cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:

1. Show equipment arrangement in the control closet, corridor, pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other

pertinent information.

3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Baked Enamel Selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

D. Plastic Laminate Selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

E. Wood Veneer Selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

F. Metal Finishes: Upon request, standard metal samples provided.

G. Operation and maintenance data. Include the following:
1. Owners manuals and wiring diagrams.
2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years experience in manufacturing, installing, and servicing elevators of the type required for the project.
1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
   a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
2. The manufacturer shall have a documented, on-going quality assurance program.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
2. NFPA 70 National Electrical Code.
3. NFPA 80 Fire Doors and Windows.
4. Americans with Disabilities Act - Accessibility Guidelines (ADAAG).
5. Section 407 in ICC A117.1, when required by local authorities.
6. CAN/CSA C22.1 Canadian Electrical Code.
7. CAN/CSA B44 Safety Code for Elevators and Escalators.

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:
1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing will deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Temporary Use:
1. Provide all necessary protection to prevent damage to each elevator used for construction purposes before Substantial Completion.
2. Provide temporary enclosures, coverings, guards, barriers and other devices required to protect the elevator car enclosures, hoistway entrances, signal fixtures and related materials, components and finishes from damage. Protective materials, methods and procedures shall be approved by the elevator manufacturer and paid for by the user.
3. Maintenance during use, including cleaning, lubricating and adjusting equipment and components for proper elevator operation shall be performed only by the elevator manufacturer. Cost for maintenance shall be paid by the user.
4. Elevators shall be free of damage or deterioration at time of Substantial Completion. Cost to repair damaged materials and finishes and replace worn or defective components to restore elevators to their original condition shall be paid by the user.

1.06 WARRANTY

Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months from date of Substantial Completion.

1.07 MAINTENANCE

A. Furnish maintenance and 24/7 call back service for a period of 12 months for each elevator.
1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.

3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.
4. Submit 5 year full service maintenance agreement of the same coverage in addition to 12 months warranty service. Provide full service coverage which must include mandatory monthly preventative maintenance visits, 5 year load testing, emergency power (if equipped) and annual fire service testing.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Manufacturer:
   1. The drive system shall be of the Variable Voltage Variable Frequency (VVVF) Regenerative.
   2. Basis of Design: ThyssenKrupp Elevator's Synergy "H" series Machine Room Less elevator.
      a. Comparable Product: Provide comparable product meeting the operations, functions and finishes specified:
         i. Otis Gen 2.

### 2.02 MATERIALS, GENERAL

A. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

B. Flooring by Division 9.

### 2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed.

B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Dry, non-lubricated steel, fastened to the building with steel brackets.

D. Guides: Roller guides, with a minimum of three tires, shall be mounted on top and bottom of the car and counterweight frame and be held in contact with the guide rail by adjustable devices.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Machine: The hoisting machine shall be a compact Gearless traction type, consisting of AC motor, brake and driving sheave mounted on a rigid bedplate in the top of the hoistway. A large diameter, forged shaft shall serve as a support for the motor armature and for the removable drive sheave and brake system. It shall be supported by roller bearings mounted in the machine housing.

G. Drive System:
1. The drive system shall be of the Variable Voltage Variable Frequency (VVVF) Regenerative.
2. The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two step process to a variable voltage variable frequency power supply for use by the hoist motor.
3. The speed control shall be by means of vector control providing independent excitation and torque current. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.

H. Motor/Machine:
The motor shall be AC, totally enclosed, non-ventilated with class "F" insulation. The motor armature shall be dynamically balanced and supported by roller bearings of ample capacity. The armature and driving sheave shall be properly balanced for smooth, high-speed elevator performance. The Machine shall be mounted in the top of the hoistway on structural steel beams or channels and bearing plates furnished by the elevator installer. Beams shall be securely fastened to the supports supplied by other trades.

I. Brake:
The brake shall be a spring applied electric brake, held open by an electro-magnet actuated by a digital brake controller and designed to make smooth, positive stops. The Brake shall be designed to automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be used in the actuation of the brake.

J. Ropes:
Provide Steel hoist cables of size and number to ensure proper wear qualities shall be used. Special wedge shackles shall be used. Governor ropes shall be 3/8” iron.

K. Counterweight:
Counterbalance each elevator for smooth and economical operation by using iron or steel plate weights securely fastened in a steel counterweight frame. Counterweight shall equal the weight of the complete elevator car and approximately 40-45 percent of the specified capacity load.

L. Safety and Governor:
Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds.

M. Emergency Terminal Limits:
Place electric limit switches in the hoistway near the terminal landings. Limit switches shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.

N. Automatic Self-Leveling:
   1. Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

2.04 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
   1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.
   2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish.
   3. Typical door & frame finish: Stainless steel panels, no. 4 brushed finish.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
   1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
   2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
   3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.05 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with custom veneered applied panel, species, mahogany premium plain sliced..
      a. Reveals and frieze: Stainless steel, no. 4 brushed finish.
      b. Panel Layout: Similar to ThyssenKrup custom veneer applied panel configuration with 3 vertical panels, 1 horizontal base panel and 1 horizontal rail panel.
   2. Canopy: Cold-rolled steel with hinged exit.
   3. Ceiling: Disklight type, stainless steel metal pans with frosted disk lense.
   4. Cab Fronts, Return,Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
   5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: Stainless steel panels: No. 4 brushed finish.
      b. Cab Sills: Extruded aluminum, mill finish.
   6. Handrail: Provide 1.5" diameter cylindrical metal on side and rear walls on front opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.

7. Ventilation: Manufacturer’s standard 2 speed exhaust fan, mounted on the car top.

B. Car Top Inspection: Provide a car top inspection station with an “Auto-Inspection” switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station will give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

## 2.06 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

1. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

## 2.07 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Provide ADA compliant handsfree phone integral to car operating panel.

C. Card Readers: Provide wiring provisions for card readers provided by security system subcontractor for controlled access.

2.08 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.
3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
4. A car that is stopping for the last hall call in the preference direction, and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call that will maintain the preference. If no car call is registered before the door is almost closed, the car will lose its preference and shall be available to accept calls in either direction.

B. Operation: Selective Collective – ETA based. The system is optimized to get a car to the floor where a hall call has been registered, in the shortest time. The system receives input information from standard call pushbuttons located in the hall, car position and car load information from individual car loadweighers.

When group operation is required, the group supervisory operation shall be embedded within selected car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time for arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car's status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.

1. Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.

2. Artificial Intelligence: Artificial Intelligence shall be an integral part of the group control system software. The enhanced artificial intelligence will optimize the interfloor traffic performance. Inputs for the artificial intelligence shall include accurate passenger load from an electronic loadweigher, probable car calls generated from each hall call, type of building and observed traffic patterns.

C. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.
   1. The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 15 pound (7 Kg.) load change under all conditions.
   2. The load sensor shall use a linear variable differential transformer to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.

D. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.

E. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.

F. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.`

G. Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic loadweigher shall determine the load on the car determining a pre-torque reference to send to the drive.

H. Emergency Power Operation: (Group 10-D4A) Upon loss of normal power, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby power is available, one elevator at a time from each group will be lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed and the car shuts down. The next available car in the group will then be selected to lower, allow passengers to exit, close the doors and shutdown. This process is repeated until all cars in the group have been lowered and parked. At this time, an elevator is automatically allowed to continue service using the building-supplied standby power. A manual selection switch is available to override the automatic selection and allow a car in the group to provide service to the building. When normal power is restored, the elevators automatically resume operation.

2.09 HALL STATIONS

A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
1. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: An electronic dot matrix position indicator shall be provided and mounted for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing which the elevator is stopped or passing. When hall lanterns are provided, the position indicator shall be combined with the hall lanterns in the same faceplate. Faceplates shall match hall stations. Provide at the main landing only.

D. Hall lanterns: A hall lantern with adjustable chime shall be provided at each landing and located adjacent to the entrance. The lanterns, when illuminated, shall indicate the elevator car that shall stop at the landing and in what direction the car is set to travel. When the car reaches a predetermined distance from the floor where it is going to stop, the corresponding hall lantern shall illuminate and the chime shall sound. The hall lantern shall remain illuminated until the car doors close in preparation for leaving the floor. Illumination of the arrow shall be with LED's. Faceplates shall match the hall station finish. Provide at all landings.

2.10 CONTROL ROOM

A. A control room shall be provided adjacent to the hoistway per the Elevator Manufacturer's requirements.

B. Disconnect(s) shall be provided for each elevator in the control room by others.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
   2. Comply with the National Electrical Code for electrical work required during installation.

B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

I. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.06 PROTECTION

At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 2
1. Elevator Model: Synergy H Series 35
2. Elevator Type: Gearless Traction Machine Roomless, Passenger
3. Rated Capacity: 3500 lbs.
4. Rated Speed: 350 ft/min.
5. Operation System: TAC50
6. Travel: 93'-0" ±
7. Landings: 8 total
8. Openings:
   a. Front: 8
   b. Rear: 0
9. Clear Car Inside: 6' - 8" wide x 5' - 5" deep
10. Cab Height: 8 nominal

11. Hoistway Entrance Size: 3' - 6" wide x 7'- 0” high
12. Door Type: Single Speed
13. Power Characteristics: 480 volts, 3 Phase, 60 Hz.
14. Seismic Requirements: IBC 2003; .20 sec Response Acceleration (Ss) = 0.315; 1.0 sec Response Acceleration (S1) = 0.077; Design Spectral Response Acceleration Parameters: SDS = 0.326; SD1 = 0.123; Seismic Design Category = B. (Seismic Zone 2).
16. Pit Depth: 6' - 0"
17. Button & Fixture Style: Traditional

END OF SECTION 14212

# SECTION 14240 - HYDRAULIC ELEVATORS

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.02 SUMMARY

A. This Section includes holed hydraulic passenger elevators.
   1. Elevator jack hole and inner sealed earth casing.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Accessibility provisions for physically disabled persons.
   5. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   6. Materials and accessories as required to complete the elevator installation.
   7. 5 year service maintenance agreement.

B. Related Sections include the following:
   1. Division 3 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
   2. Division 5 Section "Metal Fabrications" for the following:
      a. Structural steel shapes for subsills at each floor.
      b. Hoisting and divider beams.
      c. Pit ladders.
      d. Sump pump cover and frame.
      e. Attachment plates, angle brackets, and other steel framing for supporting guide-rail brackets.
   3. Division 7 Section "Cementitious Waterproofing" for waterproofing elevator pit.
   4. Division 9 for finish flooring in elevator car.
   5. Division 15 Sections for ventilating hoistway and machine room.
   6. Division 16 Sections for electrical service to elevator, including fused disconnect switch, standby power source, transfer switch, convenience outlets, lock out-tag-out switch, and telephone.
   7. Division 16 Sections for smoke detectors in elevator lobbies to initiate emergency recall operation and heat/smoke detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

### 1.03 DEFINITIONS

A. Hydraulic Elevators: Elevators in which cars are hoisted by action of a hydraulic plunger and cylinder (jack); with other components of the Work, including fluid storage tank, pump, piping, valves, car enclosures, hoistway entrances, operation systems, signal equipment, guide rails, electrical wiring, buffers, and devices for operations, safety, security, required performance at rated speed and capacity, and for complete elevator installation.

B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Product Data: Include capacities, sizes, performances, operations, safety features, controls, finishes, and similar information.

C. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

D. Samples: For exposed finishes for car, hoistway doors, and signal equipment; 3-inch square samples of sheet materials; and 4-inch lengths of running trim members.

E. Maintenance Manuals: Include operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 1.

F. Inspection and Acceptance Certificates: Obtain and submit inspection and acceptance certificates and operating permits as required by governing authorities for normal, unrestricted elevator use.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage elevator manufacturer or an experienced Installer approved by elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Regulatory and Accessibility Requirements: All work shall be performed in accordance with the latest revised edition (as of date bids are taken) of the American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks (ANSI A-17), the National Electrical Code, The American Disabilities Act and state and local codes as may be applicable. Elevator shall meet current state laws relating to accessibility to public buildings for the physically handicapped.

1. Seismic: Comply with the applicable requirements of the 2003 IBC Code to resist earthquake loads (Seismic Zone 2).
    a .20 sec Response Acceleration (Ss) = 0.315.

b. 1.0 sec Response Acceleration (S1) = 0.077.
c. Design Spectral Response Acceleration Parameters: SDS = 0.326; SD1 = 0.123.
d. Seismic Design Category = B.

C. In the interest of unified responsibility, Elevator package shall be a nationally recognized United States company regularly engaged in the business of manufacturing elevators of type and character required by these Specifications, and shall manufacture entire power unit, controller, hydraulic cylinder and all other parts of the equipment, including door operators and signal fixtures, and shall so state in his request for approval listing the items he manufactures.

D. Design for Maintenance Requirements: Installation shall be a non-proprietary design that is maintainable by any licensed elevator maintenance company employing journeymen mechanics, without need to purchase or lease additional diagnostic devices, special tools, or instructions from original equipment manufacturer.

## 1.06 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

## 1.07 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Manufacturer's Warranty: Submit a written warranty signed by manufacturer agreeing to repair, restore, or replace defective elevator work within 12 months from date of Substantial Completion.

## 1.08 MAINTENANCE SERVICE

A. Furnish maintenance and 24/7 call back service for a period of 12 months for each elevator.
1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

B. Submit 5 year full service maintenance agreement of the same coverage in addition to 12 months warranty service. Provide full service coverage which must include mandatory monthly preventative maintenance visits, 5 year load testing, emergency power (if equipped) and annual fire service testing.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide high frequency use hydraulic elevators by one of the following:
  1. Basis of Design: ThyssenKrupp Elevator, Marquis 25, Group North America; local distributor, Stanley Elevator Co., Inc., phone: (800) 258-1016.
  2. Comparable Product: Provide comparable product meeting the operations, functions and finishes specified:
     a Otis Elevator Co.; with Series 2 cab.

### 2.02 DESCRIPTION OF EQUIPMENT

A. Passenger Elevators:
  1. Capacity: 2500 lbs. minimum.
  2. Speed: 150 feet per minute full load up.
  3. Operation: Duplex.
  4. Clear Car Inside: 80 inches wide x 51 inches deep.
  5. Travel: 65'-10" ±.
  6. Power Supply: 480 volts - 3 phase - 60 cycles.
  7. Stops and Openings: 7 stops; front opening.
  8. Door Size and Type: 3'-6" x 7'-0", single slide.
  9. Door Operation: D.C. Power Operation.
  10. Signals Vandal resistant: Illuminated buttons, alarm bell, position indicator in car with audible signal, vertical hall lantern and gong at each floor, with position indicator at main floor, brushed stainless steel.
  11. Special Features: Infrared light beam door protection system for full height of door, handicapped requirements (ANSI A117.1), fire-fighters service, emergency lighting with power pack. Standby power operation.
  12. Motor: 40 HP maximum. Include closed transition solid state starting. Note: Manufacturer providing elevator motor with greater H.P. shall be responsible for cost of upgrading disconnect and wiring.

### 2.03 PASSENGER ELEVATOR CAR ENCLOSURES

A. General: Provide manufacturer's standard car enclosures of the selections indicated. Include ventilation, lighting, access doors, doors, power door operators, sills (thresholds), trim, accessories, and wall and ceiling finishes. Provide manufacturer's standard flush-panel horizontal-sliding doors of type indicated. Provide manufacturer's standard protective edge trim system for door and wall panels, except as otherwise indicated.

B. Materials and Fabrication: Provide selections indicated or, if not otherwise indicated, manufacturer's standard welded steel construction with factory finish of synthetic enamel, and provide other materials and fabrication of not less than the following:
1. Walls: 16 ga. No. 4 Stainless steel 5WL rigidized cab walls.
2. Front and Transom: Brushed stainless steel.
3. Doors: Hollow metal construction, brushed stainless steel.
4. Ceiling and Lighting: No. 4 stainless steel island type perimeter ceiling with indirect fluorescent lighting above on four sides..
5. Sill: Aluminum.
6. Flooring: Rubber sheet flooring specified in Division 9.
7. Handrails: Cylindrical metal bar at rear wall, brushed stainless steel.
8. Clear Cab Height: 7'-4".
9. Accessories: Two-speed exhaust fan, brushed stainless steel certificate frame, and ADA compliant, two-way speakerphone, protection pads and stainless steel pad buttons.

2.04 PASSENGER HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard hollow-metal, sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Match car doors for size, number of panels, and door movement. Provide frame size and profile to coordinate with hoistway wall construction.

B. Materials and Fabrication: Provide the following materials and finishes for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment; provide manufacturer's standards, but not less than the following:
1. Satin Stainless-Steel Frames: Formed stainless-steel sheet, 14gage, ASTM A 167, Type 302 or 304, with No. 4 satin finish.
2. Satin Stainless-Steel Panels: Flush construction, fabricated from ASTM A 167, Type 302 or 304 stainless steel, 16 gage, with No. 4 satin finish.
3. Aluminum Sills: Extruded aluminum, with grooved surface, 1/4-inch thickness, mill finish.
4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 for grouting door sills.

2.05 EQUIPMENT

A. Passenger Elevator: Holed hydraulic elevator meeting the following minimum requirements. Interior car finishes shall match those specified; failure to comply will be reason for rejection.
1. Platform and Sling: Platform shall have fabricated frame of formed and structural steel shapes, gusseted and rigidly welded. Provide fire-treated wood subfloor prepared for finish flooring. Finished flooring, installed on top of car platform, shall be provided in Division 9 Section "Carpet." Underside of platform shall be fireproofed. Sling shall consist of heavy steel channel stiles properly affixed to steel crosshead and bolster, with adequate bracing members, to remove all strain from car enclosure. Steel bumper plates shall be affixed to bottom of bolster channels, and a platen plate with clamps and cap screws shall be furnished for fastening sling to plunger.
2. Passenger Car Doors: Car entrance shall be provided with horizontal sliding doors with panel rigidity obtained by suitable steel reinforcements. Doors shall be hung on sheave hangers with polyurethane tires and sheaves not less than 3-1/4" diameter, running on a polished steel track, and guided at bottom by non-metallic shoes sliding in smooth threshold groove.

3. Emergency Alarm Bell: Locate in conformance with ANSI A-17.1 Code requirements and connect to a plainly marked pushbutton in car. Connect emergency alarm bell to emergency lighting power pack.
4. Guides: Roller guides, with a minimum of three tires, shall be mounted on top and bottom of the car and be held in contact with the guide rail by adjustable devices..
5. Power Unit (Oil Pumping and Control Mechanism): Shall be compactly and neatly designed with all components listed below combined in a self-contained unit; structural steel outer base with tank supports; floating inner base for mounting pump assembly; oil reservoir with tank cover and controller compartment with cover; metal drip pan; oil-hydraulic pump; electric motor; oil control unit with following components built into single housing; high pressure relief valve; check valve; automatic unloading upstart valve; lowering and leveling valve; and magnetic controller. Pump shall be specifically designed and manufactured for oil-hydraulic elevator service. It shall be of the positive displacement type, inherently designed for steady discharge with minimum pulsations to provide a smooth and quiet operation. Output of pump shall not vary more than 10% between no load and full load on elevator car. Motor shall be specifically designed for oil-hydraulic elevator service, of standard manufacture, and of duty rating to comply with herein specified speeds and loads. Oil control unit shall consist of following components, all built into single housing. Welded manifolds with separate valves to accomplish each function will not be acceptable under this Specification. All adjustments shall be accessible and shall be made without removing assembly from oil line. Relief valve shall be externally adjustable, and shall be capable of bypassing total oil flow without increasing back pressure more than 10% above that required to barely open valve. Up start and stop valve shall be externally adjustable, and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from jack unit, insuring smooth up starts and up stops. Check valve shall be designed to close quietly without permitting any perceptible reverse flow. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth "Down" starts and stops. Leveling valve shall be designed to level car to floor in direction car is traveling when slowdown is initiated. Electric controller shall be microprocessor integrated circuitry. Silver to silver contacts shall be utilized on all relays and contactors (where provided). Provide thermal overload relays to protect motor. All component switches to be mounted in a steel panel designed for mounting on power unit, wall or floor.
6. Jack Unit: Shall be designed and constructed in accordance with applicable requirements of ANSI A-17.1 Code. It shall be of sufficient size to lift gross load the height specified and shall be factory tested to insure adequate strength and freedom from leakage. No brittle material, such as grey cast iron, shall be used in jack construction. Jack unit shall consist of following parts: plunger of heavy seamless steel tubing accurately turned and polished; stop ring shall be electrically welded to plunger to positively prevent plunger leaving casing; internal guide bearing; packing or seal of suitable design and quality; drip ring around cylinder top; cylinder made of steel pipe and provided with pipe connection and air bleeder. Brackets shall be welded to jack cylinder for supporting elevator on pit channels. Provide auxiliary safety bulkhead in lower end of cylinder, which will limit down car speed to safe value in event of leakage around external bulkhead.
7. Mainline Strainer: Shall be self-cleaning type, equipped with 40-mesh element, for installation in oil line.
8. Failure Protection: Electrical control circuit shall be designed so if malfunction should occur, due to motor starter failure, oil becoming low in system, or car failing to reach landing in up direction within predetermined time, elevator car will automatically descend to lowest

terminal landing. If power operated doors are used, doors shall automatically open when car reaches landing to allow passengers to depart. Doors shall then automatically close and all control buttons, except "Door Open" button in car station, shall be made inoperative.

9. Sound Isolating Couplings: Provide a minimum of two installed in oil line in Machine Room between pump and jack.
10. Oil-Hydraulic Silencer (Muffler Device): Shall be installed in oil line near power unit. It shall contain pulsation-absorbing material inserted in blowout-proof housing arranged for inspecting interior parts without removing unit from oil line. A rubber hose without blowout-proof features will not be acceptable.
11. Vibration Pads: Mount under power unit assembly to isolate unit from building structure.
12. Automatic Terminal Limits: Electric limit switches, placed in hatchway near terminal landings, shall be designed to cut off electric current and stop car should it run beyond either terminal landing.
13. Automatic Self-Leveling: Provide elevator with self-leveling feature that will automatically bring the car to floor landings. Self-leveling shall, within its zone, be entirely automatic and independent of operating device, and shall correct for overtravel or undertravel. Car shall also be maintained approximately level (within 1/2-inch) with landing irrespective of load.
14. Buffers: Provide buffers, complying with ANSI A-17.1 Code requirements, under car in elevator pit. Mount buffers on continuous channels fastened to elevator guide rail or securely anchored to pit floor; provide substantial extensions, if required.
15. Car Top Inspection Station: Provide station with "emergency stop" switch and with constant pressure "up-down" direction buttons which make normal operating devices inoperative and give inspector complete control of elevator.
16. Door Operation: Provide direct current motor-driven, heavy-duty operator designed to operate car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and door operating mechanism shall be arranged for manual operation in event of power failure. Provide full height, infrared light beam door sensing device with automatic non-contact reversal of car and hoistway doors if obstruction enters path of travel for passenger elevators. Doors shall then resume closing cycle. Doors shall automatically open as car arrives at landing and shall automatically close after an adjustable time interval or when car is dispatched to another landing. Direct drive geared operators, AC controlled units with oil checks, or other deviations from above are not acceptable.
17. Interlocks: Each hoistway entrance shall be equipped with approved type interlock tested as required by code. Design interlock to prevent operation of car away from landing until doors are locked in closed position as defined by code and to prevent opening of doors at any landing from corridor side unless car is at rest at that landing or is in leveling zone and is stopping at that landing. Interlocks shall bear Underwriters' Laboratories "B" label of approval.
18. Hoistway Door Unlocking Device: As specified by ANSI A-17.1 Code, shall be provided to permit authorized persons to gain access to hoistway when elevator car is away from landing.
19. Door Hangers and Tracks: For each hoistway sliding door, provide sheave type two-point suspension hangers and tracks complete. Sheaves shall be 3-1/4" in diameter and have polyurethane tires with ball bearings properly sealed to retain grease. Hangers shall have adjustable slide to take up-thrust of doors. Tracks shall be drawn steel shapes with smooth surfaces and shaped to conform to hanger sheaves.

20. Passenger Hoistway Entrances: Provide hollow metal, horizontal sliding type entrances complete at each hoistway opening. Entrances shall be manufacturer's standard design bearing Underwriters' Laboratories' "B" labels. They shall consist of frames, sills, doors, hangers, hanger supports, hanger covers, fascia plates, and all necessary hardware. Entire front wall of hoistway shall be left open or a rough opening provided which is 18" greater in width and 12" greater in height than finished opening, until after entrances are installed. After guide rails are set and lined, install entrance frames in perfect alignment with guide rails. Finish walls shall then be completed by others.
21. Passenger Operation (Selective Collective Automatic Pushbutton): Control of elevator car shall be automatic in operation by means of pushbutton in car marked for each landing level served, an "up-down" button at each intermediate landing, and a call button at each terminal landing, wherein all stops registered by momentary pressure of landing or car buttons shall be maintained until car answers call. Provide emergency stop switch in car pushbutton station which, when in off position, will render elevator inoperative, and which will enable attendant or passenger to stop car at any point during its travel. Opening of this switch shall not cancel registered calls, and when switch is closed, car will continue to answer calls that have been registered. Each landing station shall contain an illuminated push button which shall "light up" when pressed to indicate that a call has been registered to bring car to that particular landing. A time delay, noninterference feature, shall be incorporated in control mechanism to allow ample time for opening and closing car and hoistway doors before it is again placed in motion.
22. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators:
    - a Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a key switch located at main landing.
    - b Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

2.06 SIGNAL EQUIPMENT

A. General: Provide signal equipment for each elevator or group of elevators with hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, non-yellowing translucent plastic.

B. Car Control Stations: Provide manufacturer's standard swing return car control stations. Mount in return panel adjacent to car door, if not otherwise indicated.

C. Emergency Communication System: Provide system that complies with ASME A17.1 and U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)." On activation, system shall dial preprogrammed number of monitoring station and identify elevator location to monitoring station. System shall provide two-way voice communication without using handset and provide visible signals that indicate when system has been activated and when monitoring station has responded. Provide system contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Car Position Indicator: For passenger elevator cars, provide illuminated-signal type, digital-display type, or segmented type, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
   1. Include travel direction arrows if not provided in car control station.

E. Hall Push-Button Stations – Vandal Resistant: Provide illuminated hall push-button stations at each landing for elevator.
   1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
   2. Provide units with direction-indicating buttons; two buttons at intermediate landings; one button at terminal landings.

F. Hall Lanterns – Vandal Resistant: Provide vertical units with illuminated direction indicators, but provide single arrow at terminal landings.
   1. Provide units with flat, satin stainless steel faceplate, vandal-resistant, for mounting with body of unit recessed in wall and with illuminated elements.
   2. Place lanterns beside each hoistway entrance, unless otherwise indicated. Mount at a minimum of 72 inches above finished floor.
   3. With each lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
      a. At manufacturer's option, audible signals may be placed on each car.

G. Hall Position Indicators: Provide illuminated-signal type or digital-display type, located above each hoistway entrance at ground floor. Provide units with flat, satin stainless steel faceplate, vandal-resistant fasteners for mounting with body of unit recessed in wall.

H. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations with text and graphics according to ASME A17.1, Appendix H.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of elevator work. Examine hoistways, hoistway openings, pits, and machine rooms, as constructed. Verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
   1. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance of work.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

A. Comply with manufacturer's instructions and recommendations.

B. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.

C. Excavation for Elevator Jack: Drill excavation in each elevator pit to accommodate installation of plunger-cylinder units.

D. Provide inner sealed earth casing with permanent waterproff seal at bottom of well casing and water stop collar on the outside of the earth casing to seal the casing to the pit floor.

E. Install plunger-cylinder units plumb and accurately centered for elevator car position and travel; anchor securely in place, supported at the pit floor.

F. Install plunger cylinders in protective PVC cylinder casings. Fill void spaces between cylinder casings and cylinders with sand. Provide oil sensor in casing.

G. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

H. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby, eliminate sources of structure-borne noise from elevator system.

I. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent cement fittings.

J. Lubricate operating parts of systems, including ropes, if any, as recommended by manufacturers.

K. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

L. Leveling Tolerance: 1/4-inch, up or down, regardless of load and direction of travel.

M. Set sills flush with finished floor surface at landings. Fill space under sills solidly with nonshrink, nonmetallic grout.

N. Wiring, Piping and Oil: All necessary wiring shall be furnished and installed in the hoistway in accordance with the National Electrical Code, to connect the operating buttons and switches to the control board in the power unit. All wiring shall be in rigid conduit or electric metallic tubing except to movable apparatus, which shall be connected by short lengths of flexible conduit. Provide all necessary pipe and fittings to connect the power unit to jack unit and oil in proper grade. All underground conduit and piping shall be adequately protected against corrosion.

O. Controls: Shall be placed for convenient use of wheelchair operators as required by the State Handicapped Code.

3.03 FIELD QUALITY CONTROL

A. Acceptance Testing: Upon nominal completion of elevator installation, and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by the ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

C. In addition to other requirements, inspections, tests and remedies herein provided, upon completion of elevator installation and before final approval and final payment, the Elevator Subcontractor shall make, in the presence of the Architect or his designated representative, a running speed test with full maximum load on the elevator car to determine whether the elevator equipment, as installed, meets the speed, capacity and all other requirements of the Specifications.

D. In the event the equipment does not meet all requirements of the Specifications, Elevator Subcontractor shall promptly remove from premises, all work condemned by Architect as failing to conform to Contract, and shall promptly replace and re-execute work in accordance with Contract without expense to Owner. Elevator Subcontractor shall bear all expense of making good all work of other Contractors destroyed or damaged by such removal or replacement.

3.04 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete elevator maintenance program. Coordinate instruction with the availability of the Owner's personnel.

B. Make a final check of each elevator operation with Owner's personnel present and just prior to date of Substantial Completion. Determine that operation systems and devices are functioning properly.

3.05 PROTECTION

A. Temporary Use: Do not use elevators for construction purposes.

B. Provide protective coverings, barriers, devices, signs, and other procedures to protect elevator. If, despite such protection, elevator becomes damaged, engage elevator Installer to restore damaged work so no evidence remains of corrective work. Return items that cannot be refinished in field to shop, make required repairs and refinish entire unit, or provide new units as required.

C. Provide final protection and maintain conditions, in a manner acceptable to elevator manufacturer and Installer that ensure elevators are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 14240

# SECTION 15051 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Sleeves.

### 1.3 SUBMITTALS

A. Product Data: For the following:
   1. Mechanical sleeve seals.

B. Welding certificates.

### 1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

### 1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Available Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel . Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Select system components with pressure rating equal to or greater than system operating pressure.

F. Sleeves are not required for core-drilled holes.

G. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
      b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

H. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Verify final equipment locations for roughing-in.

J. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION 15051

# SECTION 15058 - COMMON WORK RESULTS FOR PLUMBING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   6. Supports and anchorages.

### 1.3 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Mechanical sleeve seals.
   3. Escutcheons.

B. Welding certificates.

### 1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

1.7 PERMITS

A. Obtain Plumbing Permit and pay fee. Fee shall be included in the filed sub-bid.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Solvent Cements for Joining Plastic Piping:
1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

D. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.3 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
    a. Cascade Waterworks Mfg. Co.
    b. Dresser Industries, Inc.; DMD Div.
    c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    d. JCM Industries.
    e. Smith-Blair, Inc.
    f. Viking Johnson.
2. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers:
      a. NIBCO INC.
      b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Fernco, Inc.
      c. Mission Rubber Company.
      d. Plastic Oddities, Inc.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.
      e. Hart Industries, International, Inc.
      f. Watts Industries, Inc.; Water Products Div.
      g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.

c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
1. Available Manufacturers:
a. Calpico, Inc.
b. Lochinvar Corp.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
1. Available Manufacturers:
a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

## 2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. PVC Pipe: ASTM D 1785, Schedule 40.

# PART 3 - EXECUTION

## 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping at indicated slopes.

D. Install piping free of sags and bends.

E. Install fittings for changes in direction and branch connections.

F. Select system components with pressure rating equal to or greater than system operating pressure.

G. Sleeves are not required for core-drilled holes.

H. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
      b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
         1) Seal space outside of sleeve fittings with grout.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials.

## 3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 16 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Nonpressure Piping: Join according to ASTM D 2855.

## 3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION 15058

# SECTION 15082 - PLUMBING INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Insulation board.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

A. Extruded polystyrene with a "K" factor of 0.18, with 2.2 lb./cu. ft. density, and 30 psi compressive strength, manufactured by Dow Chemical, or approved equal. ASTM C 578, Type VI.

## PART 3 - EXECUTION

### 3.1 INSULATION BOARD

A. Place a leveling course of sand, 2 inches (50 mm) thick, over subgrade. Finish leveling course to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.
   1. Place leveling course on subgrades free of mud, frost, snow, or ice.

B. Install insulation board in layers with abutting edges and ends along pipelines or other objects to be insulated.

C. Install piping with 4.5 ft. minimum cover, or provide 4” layer of closed-cell polystyrene insulation board over the pipe.

### 3.2 PENETRATIONS

A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

   1. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation

B. Insulation Installation at Floor Penetrations:

   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION 15082

SECTION 15141 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Under-building slab water pipes, tubes, fittings, and specialties inside the building.
2. Sleeves and sleeve seals.

B. LEED Submittal:
1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HIGH DENSITY POLYPROPYLENE PIPE AND FITTINGS

A. Pressure-rated polypropylene tubing conforming to NSF14, NSF 61, and ASTM F 2389 or CSA B137.11, rated for water service at 160 psi sustained pressure. Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in a three layer extrusion process. Domestic hot water and heating piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. When tested with standard un-insulated fittings per CAN/ULC-S102.2-03 or ASTM E84, piping shall have an average Flame Spread Classification of less than 25 and an average Smoke Development rating of less than 50.
1. Fittings shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of

the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

## 2.3 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

A. High-density polyethylene PE 3408 tubing conforming to AWWA C906, SDR-11, rated for water service at 160 psi sustained pressure. For diameters 2"or smaller, use compression type fittings with pipe stiffeners. For diameters larger than 2", use heat-fusion welded joints.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts

## 2.4 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Elkhart Products Corporation; Industrial Division.
      2) NIBCO INC.
   b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
   c. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

C. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

# PART 3 - EXECUTION

## 3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install domestic water piping level and plumb.

C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

D. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

## 3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Pressure-Rated Polypropylene Tubing: Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting type. All fusion-well joints shall be made in accordance with the pipe and fitting manufacturer’s specifications and product standards. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer. Prior to joining, the pipe and fittings shall be prepared in accordance with F 2389 and the manufacturer’s specifications. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer’s specifications.

E. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

## 3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

## 3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow tostand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.6 PIPING SCHEDULE

A. Underground domestic water piping 2” and larger shall be:

1. High-density polyethylene PE 3408 tubing conforming to AWWA C906, SDR-11, rated for water service at 160 psi sustained pressure. For diameters 2"or smaller, use compression type fittings with pipe stiffeners. For diameters larger than 2", use heat-fusion welded joints.

   a. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts

END OF SECTION 15141

# SECTION 15150 - SANITARY AND INDIRECT WASTE AND SANITARY VENT PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following for soil, waste, indirect waste and sanitary vent piping.
   1. Pipe, tube, and fittings.

### 1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

### 1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

B. Soil, Waste, Indirect Waste and Vent Piping: 10-foot head of water 30 kPa or 5 psi.

### 1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. LEED Submittal:
   1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

C. Field quality-control inspection and test reports.

### 1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### 2.2 PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
   2. Solvent Cement and Adhesive Primer:
      a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 EXCAVATION

A. Refer to Division 02 Section "Earth Work" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

A. Underground sanitary waste piping shall be one of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. PIPING INSTALLATION

C. Basic piping installation requirements are specified in Division 15 Section "Common Work Results for Plumbing."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Horizontal Sanitary Drainage Piping: ¼” per foot downward in direction of flow.

I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary and indirect waste drainage and sanitary vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with

water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

3.5 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 15150

# SECTION 15160 - STORM DRAINAGE PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building including vents through the roof.

### 1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

### 1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. LEED Submittal:
   1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

C. Field quality-control inspection and test reports.

### 1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. All cast iron piping and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPS) and be listed by NSF International.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### 2.2 PIPE AND FITTINGS

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
   1. Gaskets: ASTM C 564, rubber.

2. Cast iron conforming to ANSI A112.51, with size, weight and manufacturer's name on each length and fitting and shall conform to ASTM Standard Specifications. Joints shall be Bell and Spigot.

B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
   2. Solvent Cement and Adhesive Primer:
      a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 EXCAVATION

A. Refer to Division 02 Section "Earth Work" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

A. Underground storm drain piping shall be one of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. PIPING INSTALLATION

C. Basic piping installation requirements are specified in Division 15 Section "Common Work Results for Plumbing."

D. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

E. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

G. Install storm drainage at the following minimum slopes, unless otherwise indicated: ¼" per foot downward in direction of flow.

H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

## 3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

## 3.4 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

## 3.5 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 15160

# SECTION 16051 - COMMON WORK RESULTS FOR ELECTRICAL

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Grout.
4. Common electrical installation requirements.

### 1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

### 1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.2 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch nnular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 16051

# SECTION 16060 - GROUNDING AND BONDING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment plus the following special applications:
   1. Overhead-lines grounding.
   2. Underground distribution grounding.

### 1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
   1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
      a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
      b. Include recommended testing intervals.

### 1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC molding. I

D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

### 2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

### 2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, 3/4 inch in diameter by 10 feet in length.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Cast within duct bank when indicated as part of duct-bank installation. Duct banks for use with Central Maine Power Company primary or secondary conductors shall include a No. 4/0 AWG grounded neutral constructor.

C. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 and Central Maine Power Company grounding requirements.

B. Install 2 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms. Minimum separation between ground rods equal to one ground rod length.

C. Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.

D. Ground-Rod Connections: Install welded connectors for underground connections to rods.

E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.

F. Secondary Neutral: Interconnect and connect to grounding conductor.

G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 and Central Maine Power Company grounding requirements.

B. Grounding Manholes and Vaults: Install two driven ground rod through manhole or handhole floor, close to wall, opposite corners, and set rod depth flush or below finished floor. If necessary, install ground rods before manhole or vault is placed and provide No. 4/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Leave a minimum of 6’ of conductor “pigtail” within manholes and vaults. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Duct Banks: Provide No. 4/0 AWG bare, copper conductor cast within each duct bank between each manhole, vault and utility pole. Leave a minimum of 6’ of conductor “pigtail” within manholes and vaults.

D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

## 3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeder circuits.

## 3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or 12” below final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes,

using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

C. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.

      a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

D. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 25 ohms.
   2. Manhole and Vault Grounds: 25 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

# SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Related Sections include the following:
   1. Division 16 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

### 1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

### 1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

### 1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.
   4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   6. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or

greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

## 3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

## 3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 9 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 16073

# SECTION 16074 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:

1. Division 16 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

### 1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

### 1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: B.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.
    a. Component Importance Factor: 1.0.
    b. Component Response Modification Factor: 1.5.
    c. Component Amplification Factor: 1.0.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 31.4%.
4. Design Spectral Response Acceleration at 1.0-Second Period: 7.7%.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

   a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 16 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
   c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

D. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

G. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

K. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

## 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

## 3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

## 3.6 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 16074

# SECTION 16075 - ELECTRICAL IDENTIFICATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

### 1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

### 1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

### 1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
2. Legend: Indicate voltage.

C. Colors for Raceways Carrying Circuits at More Than 600 V:
1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch centers.

D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.2 POWER CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

## 2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
   1. Comply with ANSI Z535.1 through ANSI Z535.5.
   2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
   3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag:
   1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   2. Overall Thickness: 8 mils.
   3. Foil Core Thickness: 0.35 mil.
   4. Weight: 34 lb/1000 sq. ft.
   5. 3-Inch Tensile According to ASTM D 882: 300 lbf, and 12,500 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Metal-Backed, Butyrate Warning Signs:

   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 10 by 14 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36, 42, 48 INCHES."

## 2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.8 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## 2.9 CABLE TIES

A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 9 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use UV-stabilized nylon type.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

J. Painted Identification: Comply with requirements in Division 9 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits 120 V or greater to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Power.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
    a. Color shall be factory applied[ or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit].
    b. Colors for 120/240-V Single Phase Circuits:
        1) Phase A: Black.
        2) Phase B: Red.
    c. Colors for 208/120-V Three Phase Circuits:
        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.
    d. Colors for 480/277-V Three Phase Circuits:
        1) Phase A: Brown.
        2) Phase B: Orange.
        3) Phase C: Yellow.

    e. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting and communication cables.
   1. Install underground-line warning tape for both direct-buried cables and cables in raceway/duct bank.

I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power: Metal-backed, butyrate warning signs.
   1. Comply with 29 CFR 1910.145.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, Stenciled legend 4 inches high.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
      d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
   2. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
      d. Switches.
      e. Circuit breakers.
      f. CT Cabinets.

END OF SECTION 16075

# SECTION 16120 - CONDUCTORS AND CABLES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

### 1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

### 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

### 1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alcan Products Corporation; Alcan Cable Division.
   2. American Insulated Wire Corp.; a Leviton Company.
   3. General Cable Corporation.
   4. Senator Wire & Cable Company.
   5. Southwire Company.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW and USE.

### 2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Hubbell Power Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Electrical Supports and Seismic Restraints."

F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
      a. Single and Three Phase Branch Feeders.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
      a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
      b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 16120

# SECTION 16130 - RACEWAYS AND BOXES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
   1. Division 2 Section "Underground Ducts and Utility Structures" for exterior ductbanks, manholes, and underground utility construction.

### 1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

### 1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
   2. For underground wiring, including the following:
      a. Duct entry provisions, including locations and duct sizes.
      b. Frame and cover design.
      c. Grounding details.

d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For professional engineer and testing agency.

F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.

5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

C. Rigid Steel Conduit: ANSI C80.1.

D. IMC: ANSI C80.6.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel set-screw or compression type.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:
   1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: Rigid steel conduit.
   2. Concealed Conduit, Aboveground: Rigid steel conduit.
   3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
      a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      b. Mechanical and Electrical rooms.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: Rigid steel conduit.
   7. Boxes and Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 16 Section "Electrical Supports and Seismic Restraints."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

L. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

# SECTION 16211 - ELECTRICITY METERING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes equipment for electricity metering by utility company.

### 1.3 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.
   1. Dimensioned plans and sections or elevation layouts.
   2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

C. Field quality-control reports.

D. Operation and Maintenance Data. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

   1. Application and operating software documentation.
   2. Software licenses.
   3. Software service agreement.
   4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

### 1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect, Construction Manager and Owner] no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's, Construction Manager's and Owner's written permission.

1.8 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by Central Maine Power Company.

B. Current-Transformer Cabinets: Comply with requirements of Central Maine Power Company.

C. Meter Sockets: Comply with requirements of Central Maine Power Company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by Central Maine Power Company. Install raceways and equipment according to Central Maine Power Company’s written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."
1. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

END OF SECTION 16211

# SECTION 16289 - TRANSIENT VOLTAGE SUPPRESSION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes field-mounted TVSS for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Sections:

1. Division 16 Section "Panelboards" for factory-installed TVSS.

### 1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Qualification Data: For qualified testing agency.

C. Product Certificates: For TVSS devices, from manufacturer.

D. Field quality-control reports.

E. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

F. Warranties: Sample of special warranties.

### 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

D. Comply with NEMA LS 1.

E. Comply with UL 1283 and UL 1449.

F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed electrical service interruptions.
2. Do not proceed with interruption of electrical service without Architect's, Construction Manager's and Owner's written permission.

B. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

1.7 COORDINATION

A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.

B. Coordinate TVSS devices with Division 16 Sections.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: Three of each size and type installed.

## PART 2 - PRODUCTS

### 2.1 SERVICE ENTRANCE SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB USA.
2. AC Data Solutions.
3. Advanced Protection Technologies Inc. (APT).
4. Atlantic Scientific.
5. Current Technology Inc.; Danaher Power Solutions.
6. Danaher Power Solutions; United Power Products.
7. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
8. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
9. Intermatic, Inc.
10. LEA International.
11. Leviton Mfg. Company Inc.
12. Liebert Corporation; a division of Emerson Network Power.
13. Northern Technologies, Inc.; a division of Emerson Network Power.
14. Siemens Energy & Automation, Inc.
15. Square D; a brand of Schneider Electric.
16. Surge Suppression Incorporated.

B. Surge Protection Devices:

1. Comply with UL 1449.
2. Modular design (with field-replaceable modules).
3. Fuses, rated at 200-kA interrupting capacity.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V.
2. Line to Ground: 800 V for 480Y/277 V.
3. Neutral to Ground: 800 V for 480Y/277 V.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install TVSS devices directly coupled to the equipment served. Install with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide 30-A, 3-pole circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

E. TVSS device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Do not energize or connect service entrance equipment to their sources until TVSS devices are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION 16289

# SECTION 16442 - PANELBOARDS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:
   1. Service Entrance panelboards.
   2. Branch-circuit panelboards.

### 1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

### 1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

### 1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Quality-Control Reports:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

## 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect's, Construction Manager's and Owner's written permission.
3. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   4. Finishes:
      a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      b. Back Boxes: Galvanized steel.
   5. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top.

D. Phase, Neutral, and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 SERVICE ENTRANCE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 LOAD CENTERS

A. Not Allowed.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting:
   1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to panelboards.
   3. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 90 inches above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

J. Comply with NECA 1.

## 3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 16 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads; Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 16 Section"Electrical Identification."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 16 Section "Electrical Identification."

## 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
  1. Test insulation resistance for each panelboard bus, component, connecting supply and feeder.
  2. Test continuity of each circuit.

E. Tests and Inspections:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  3. Perform the following infrared scan tests and inspections and prepare reports:
     a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
     b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
     c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 16442

# SECTION 16461 - LOW-VOLTAGE TRANSFORMERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

### 1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ACME Electric Corporation; Power Distribution Products Division.
2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
3. Controlled Power Company.
4. Eaton Electrical Inc.; Cutler-Hammer Products.
5. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
6. General Electric Company.
7. Hammond Co.; Matra Electric, Inc.
8. Magnetek Power Electronics Group.
9. Micron Industries Corp.
10. Myers Power Products, Inc.
11. Sola/Hevi-Duty.
12. Square D; Schneider Electric.

## 2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

## 2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 16 Section "Electrical Supports and Seismic Restraints."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.
1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: Gray.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency: Comply with NEMA TP 1, Class 1 efficiency levels:
1. Tested according to NEMA TP 2.

I. Wall Brackets: Manufacturer's standard brackets.

J. Fungus Proofing: Permanent fungicidal treatment for coil and core.

## 2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 16 Section "Electrical Identification."

## 2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 16 Section "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Brace wall-mounting transformers as specified in Division 16 Section "Electrical Supports and Seismic Restraints."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 16 Section "Electrical Supports and Seismic Restraints."

## 3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

## 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
   1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
   3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

## 3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

## 3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 16461