Vibration Monitoring Plan

For the Hurricane Shore Protection (HSP) System

New Bedford Marine Commerce Terminal

Prepared For:

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ATTACHMENTS

Attachment 1: "Assessment of Blasting Impacts to the New Bedford-Fairhaven Hurricane Barrier, New Bedford Marine Commerce Terminal, New Bedford Massachusetts." Prepared for Apex Companies, LLC, Boston, Massachusetts. Prepared By: GZA GeoEnvironmental, inc., Providence, Rhode Island, dated October 2012 and updated December 2012 and August 2013.

Attachment 2: Email correspondence providing Apex Companies, LLC responses to USACE review comments on documents from Mr. Chet Myers, Apex Companies, LLC, to Mr. Michael Bachand, USACE, dated February 22, 2013.

Attachment 3: March 1, 2013 letter from Mr. Charles P. Samaris, Colonel, Corps of Engineers to Mr. David Lederer, Remedial Project Manager, USEPA.

Attachment 4: Revised Section 02900 – BLASTING of the NBMCT Contact Documents

Attachment 5: Memorandum Outlining Work Plan for Vibration Monitoring For Blast Induced Vibration Levels, GZA, August 29, 2013

1. INTRODUCTION

The Commonwealth of Massachusetts has been permitted by the United States Environmental Protection Agency (USEPA) via a Final Determination issued November 16, 2012 to construct a multiuse marine facility (i.e. the New Bedford Marine Commerce Terminal or NBMCT) within New Bedford Harbor, in the vicinity of the New Bedford Hurricane Protection System (HPS) in New Bedford Massachusetts (a Corps of Engineers project subject to 33 CFR 208.10 and 33 U.S.C. 408). The Commonwealth anticipates that it will require the use of blasting to assist in the removal of rock in construction of the NBMCT. Pursuant to Section 408, which prohibits the impairment of works built by the United States, MassCEC submitted a detailed engineering assessment to outline a methodology that would allow implementation of blasting without impact to the New Bedford Hurricane Protection System on January 11, 2013, and most recently revised on August 29, 2013, for U.S. Army Corps of Engineers (Corps) review (included as **Attachment 1**).

Subsequent to its review of the engineering assessment, the Corps submitted comments/questions in a February 22, 2013 e-mail, requesting that certain tasks be completed in order to monitor the effects of the blasting program. In response to the Corps' February 22, 2013 request, Apex Companies, LLC submitted an e-mail dated February 22, 2013, outlining that a Vibration Monitoring Plan would be prepared, to address the Corps' requested tasks. A copy of the Corps' February 22, 2013 e-mail and Apex's February 22, 2103 e-mail is included as **Attachment 2**.

On March 1, 2013, the Corps issued a letter to Mr. Dave Lederer indicating that USACE has no objections to the proposed blasting evaluation and blasting program based on the

commitments and responses provided in the email correspondence from February 22, 2013 (see **Attachment 3**). The March 1, 2013 letter from USACE, and an additional clarifying e-mail is also included within **Attachment 3**.

The purpose of this Vibration Monitoring Plan (VMP) is to outline the means and methods to be utilized to monitor vibrations resulting from blasting planned in association with construction of the New Bedford Marine Commerce Terminal (NBMCT) located in New Bedford Harbor, Massachusetts, and to satisfy the commitments made to USACE within the February 22, 2013 email documentation.

1.1. Project Background

The Massachusetts Department of Environmental Protection (MassDEP) requested that EPA include an expansion of the State Enhanced Remedy (SER) of the New Bedford Harbor Superfund Site to allow for the construction of three confined disposal facilities (CDFs) in its anticipated Explanation of Significant Differences (ESD) in 2010. In response to this initial request, EPA conducted a permitting process for the proposed project that resulted in the issuance of a Draft Determination in July of 2012 and a Final Determination in November of 2012. EPA determined that the proposed project was included within the State Enhanced Remedy for the New Bedford Superfund Site; however, EPA also evaluated the proposed project with regard to all substantive requirements and evaluations that would normally be conducted for this proposal as part of the conventional regulatory review and permitting process. On November 16, 2012, EPA issued the *Final Determination for the South Terminal Project* (Final Determination), which constitutes its final approval for the Commonwealth of Massachusetts to construct the NBMCT. The document is currently available for review on the New Bedford

Superfund website at http://www2.epa.gov/new-bedford-harbor. The entity tasked with constructing the New Bedford Marine Commerce Terminal on behalf of the Commonwealth of Massachusetts is the Massachusetts Clean Energy Center.

2. VIBRATION MONITORING PLAN FOR CONSTRUCTION OF THE NBMCT

Although intended to serve as a stand-alone document, this Vibration Monitoring Plan (VMP) has been developed alongside of and consistent with the Contract Specifications and other documents that detail the means and methods to be used during construction of the NBMCT to maintain vibration levels below those that would impact both the HPS in New Bedford, Massachusetts, as well as other structures in the immediate vicinity. The primary mechanisms for management of vibration monitoring are set out within Section 02900 – BLASTING of the Contract Specifications (most recently revised in August of 2013), as included within **Attachment 4**. Additional items have been added to this document in order to outline and satisfy the additional commitments made to USACE within the February 22, 2013 email documentation (**Attachment 2**). In addition to best management practices established for minimizing and mitigating the impacts of blasting during construction activities, this VMP provides guidance for the implementation of a seismic vibration monitoring program during the blasting portion of construction. The VMP will remain continuously in effect until the NBMCT construction blasting is completed.

2.1. Pre-Blast Survey

Section 02900 – BLASTING of the NBMCT Contract Documents (**Attachment 4**) outlines the pre-blast survey requirements, which are intended to document pre-blasting conditions (in order to determine whether surrounding structures are impacted by blasting) by surveying the interior and exterior of all structures within a 1,500 foot radius from the blasting area. Any outstanding architectural defects are required to be documented by video and digital photograph. The elevation of all piers within the vicinity and photograph all vessels within the vicinity.

In addition to the items listed within Section 02900, the following actions will also be taken to satisfy comments/questions from USACE:

- The two navigation gates (West and East abutments) will be included in the Pre-Blast survey.
- A topographic survey of the center line of the Hurricane Barrier (between New Bedford and the West abutment of the navigational gate) with elevations/locations collected approximately every 50 feet along the center line will be conducted both prior to and at the conclusion of the blasting program. The survey will also include three spot elevations along each of the East and West navigation gate abutments.

2.2. Pre-Blast Notification

Section 02900 – BLASTING of the NBMCT Contract Documents (**Attachment 4**) outlines the pre-blast notification requirements, which are intended to notify local property owners and the public in association with the pending blasting. The pre-blast notification involves notifying the property owners near the blasting areas of the preblast survey that blasting is anticipated in the near future. The work includes organization of two Preblast Public Information Meetings, publ8ic advertisements in local newspapers, door hangers for property owners within 1,500 feet

from the blast site, and requests via first-class mail for inspections to property owners within 1,500 feet of the blast site (including follow-up requests, if necessary).

In addition to the items listed within Section 02900, the following actions will also be taken to satisfy comments/questions from USACE:

- USACE's operation division, specifically staff at the navigation gate will be included in the pre-blast notification chain.
- USACE will be copied on all submittals and report associated with the blasting program.

2.3. Vibration Monitoring

Section 02900 – BLASTING of the NBMCT Contract Documents (**Attachment 4**) outlines the vibration control requirements, which are intended to set limits on the vibrations induced during the blasting process to minimize impacts to adjacent structures. The Contractor is required to employ a specialist qualified in vibration control methods capable of analyzing results obtained from a seismograph reading. The Contractor is required to place vibration monitors at least 4-8 locations onshore, which include bulkheads, utilities and historic structures. The following vibration limits are set in the specifications as limits for the work:

1. Historic Structures: PPV < 0.5 in/sec
2. Residential Structures in Massachusetts: PPV < 0.8 in/sec
3. Other Structures: PPV < 2.0 in/sec
4. Additionally, the maximum allowable airblast is not to exceed 129 decibels.

The Contractor is required to monitor the vibrations during the blasting and record the values in tabular form for each blast with additional information, including blast, size, spacing, number,

top and bottom elevations of holes, type of explosives, amount of explosives and stemming per hole and delay, type of delays, sequence and pattern, distance from the blast to the vibration monitoring machine, and other pertinent information.

In addition to the items listed within Section 02900, the following actions will also be taken to satisfy comments/questions from USACE:

- Two vibration monitoring points will be installed along USACE property on the HPS in New Bedford. The first will be at a point along the HPS (shortest distance from the structure to the blast location) and one along the Western abutment to the navigational gate.
- Two monitoring wells will be installed along the UASCE property on the HPS in New Bedford at the same locations as the vibration monitoring points. The monitoring wells will be used to read excess pore water pressures with a piezometer during blasting operations.
- Pre-blast "baseline" monitoring at each of the vibration monitoring points and monitoring wells located on USACE property will be completed. The "baseline" readings will include a minimum of 8 hours of continuous readings.
- A blast monitoring plan (included as **Attachment 5**), will be implemented, as proposed within a Work Plan prepared by GZA, dated August 29, 2013 that includes monitoring with seismographs and piezometers. Initial blast limits have been set in the Blasting Specification based on theoretical estimates of the blasting effects on the HPS as detailed in GZA's Blasting Impacts report (**Attachment 1**), however actual effects will be measured with direct readings of the seismograph and piezometer. Threshold levels are set in the GZA Work Plan referenced above, and included as

Attachment 5. If the Contractor exceeds these levels, they will be required to suspend blasting operations and modify their blasting plan.

Attachment 1

ASSESSMENT OF BLASTING IMPACTS TO THE NEW BEDFORD-FAIRHAVEN HURRICANE BARRIER
NEW BEDFORD MARINE COMMERCE TERMINAL
NEW BEDFORD, MASSACHUSETTS

PREPARED FOR:
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October, 2012
(Revised December, 2012)
(Revised August, 2013)
File No. 33734.03

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GZA
GeoEnvironmental, Inc.

Engineers and Scientists

October 5, 2012
(Revised October 11, 2012)
(Revised December 28, 2012)
(Revised August 29, 2013)
File No. 33734.03

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Re: Assessment of Blasting Impacts to the New Bedford-Fairhaven Hurricane Barrier
New Bedford Marine Commerce Terminal
New Bedford, Massachusetts

Dear Mr. Myers:

GZA GeoEnvironmental, Inc. (GZA) is pleased to provide you with this revised geotechnical letter report pertaining to proposed blasting in the vicinity of the New Bedford-Fairhaven Hurricane Barrier. This report was prepared in accordance with our proposal dated September 4, 2012. The primary objective of this letter report is to present our assessment of blasting induced ground vibrations and its effects on the global stability and liquefaction susceptibility of the existing New Bedford-Fairhaven Hurricane Barrier for the proposed New Bedford Marine Commerce Terminal project. This report is subject to the Limitations presented in Appendix A.

BACKGROUND

The New Bedford-Fairhaven hurricane barrier spans across New Bedford Harbor between New Bedford and Fairhaven, Massachusetts, and is located immediately south of Palmer Island. The barrier was constructed in the 1960's as part of a flood control infrastructure program. It is generally comprised of an earth fill embankment consisting of armor stone, filter stone, and earth fill layers. There is an access roadway that extends the length of the barrier positioned on the harbor side of the embankment. Two gated conduits were incorporated into the barrier which, under normal operating conditions, allows water to easily flow from one side of the barrier to the other during tidal fluctuations. A gated navigation channel is also located on the eastern side of the barrier.

This hurricane barrier is located immediately south of the proposed New Bedford Marine Commerce Terminal project (see Figure 1, Locus Plan). The project involves the

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development of a waterfront parcel into an all purpose marine terminal having specific applications to the offshore wind industry. The development will include the construction of a cellular cofferdam bulkhead and near-shore dredging along the cofferdam bulkhead to facilitate berthing of larger vessels. The proposed bulkhead and limits of dredging are shown in Figure 2 (Apex Figure P-2.6).

In 2011, the U.S. Army Corps of Engineers (USACE) requested a global stability analysis of the hurricane barrier which addressed the potential impacts to the barrier due to the proposed dredge elevations. GZA completed a report addressing this request, titled "Global Stability Analysis, New Bedford-Fairhaven Hurricane Barrier, New Bedford Marine Commerce Terminal, New Bedford, Massachusetts" dated November 23, 2011.

In 2012, the USACE requested that the stability of the hurricane barrier and the susceptibility of the foundation soils to liquefaction be assessed considering vibrations resulting from any proposed blasting activities. Blasting of shallow bedrock may be required at the site in order to meet the proposed dredge elevations.

REVIEW OF EXISTING DOCUMENTATION

Original USACE drawings were provided to GZA by Apex Companies, LLC (Apex). The following drawings were used to develop a cross section of the hurricane barrier for this analysis. These drawings are included in Appendix B.

- "New Bedford-Fairhaven Barrier, General Plan", April 1962
- "New Bedford-Fairhaven Barrier, Harbor Barrier and Dike, Plan and Profile No. 2", 1962
- "New Bedford-Fairhaven Barrier, Harbor Barrier and Dike, Typical Sections No. 1", 1962
- "New Bedford-Fairhaven Barrier, Parking Area, New Bedford", 1962

All current project elevations reference the Mean Lower Low Water (MLLW) datum; however, all of the original USACE drawings and accompanying subsurface information reference the Mean Sea Level (MSL) Datum, which was assumed to be NGVD 1929. These elevations were converted to MLLW using the following information provided by Apex: MLLW = NGVD 1929 + 1.52 ft.

The subsurface boring logs used to generate a design cross section included recent test boring logs by Apex and original USACE borings. The logs and the location plans are included in Appendix C.

In the immediate vicinity of the hurricane barrier (Dredge Area 1), shallow dredging to approximate elevation -14 feet referenced to the Mean Lower Low Water (MLLW) datum is proposed. The dredge areas are shown in Figure 2 (Apex Figure P-2.6). According to Apex, it is possible that in the future, this area could be dredged to elevation -20 feet. In review of the subsurface data provided by Apex, it is likely that bedrock excavation will not be required in Dredge Area 1. Further away from the hurricane barrier, in Dredge Area 3 and Dredge Area 2, the proposed dredge elevations are -30 and -32 feet respectively. Based on the available subsurface data, bedrock elevations range between approximately -25 and -30 feet indicating that up to approximately 7 feet of bedrock may need to be removed to meet the proposed dredge elevations. It is possible that blasting will be allowed during construction to remove the bedrock. The closest distance between the toe of the hurricane barrier and proposed blasting activities in these areas would be approximately 450 feet.

During the summer of 2013, the Contractor, Cashman-Weeks NB, performed a series of borings and probes to determine the depths of rock to be removed for the dredge depths required. This information indicated up to 16 feet of rock to be removed, located approximately 500 feet from the hurricane barrier.

FACTOR OF SAFETY

The literature was reviewed for an acceptable factor of safety for the hurricane barrier under these seismic conditions. The United States Army Corps of Engineers (USACE) Slope Stability Engineering Manual EM 1110-2-1902 dated October 31, 2003 was reviewed. Minimum required factors of safety for new and earth and rock-fill dams were given, but no guidance was given for seismic loading conditions. The manual referred to a USACE Engineering Circular "Dynamic Analysis of Embankment Dams" which was still in preparation at the time of publication. A search of the USACE manuals and guidance documents did not produce the reference. The USACE Engineering Report "Recommended Guidelines for Safety Inspection of Dams", ER 1110-2-106, dated September 26, 1979 (also republished in July 1, 2011, as 33 CFR Ch II, Section 222.6 National Program for Inspection of Non-Federal Dams, Appendix D) recommended a factor of safety of 1.0 for an embankment dam under earthquake or seismic loading. GZA also reviewed the textbook "Soil Strength and Slope Stability" by J. Michael Duncan and Stephen G. Wright published in 2005. In a section devoted to seismic slope stability, the authors recommended a factor of safety of 1.0 or 1.15 for pseudo static analyses such as those used in this report.

The USACE Design Memorandum No. 5 on the New Bedford Hurricane Barrier titled "Embankments and Foundations for the New Bedford, Fairhaven and Acushnet Hurricane Protection Project, New Bedford, Massachusetts" dated November 3, 1961 was also

reviewed. The USACE conducted slope stability analyses of critical portions of the hurricane barrier during the original design of the barrier. The calculated factors of safety of 1.19 and 1.36 (during construction), and 1.33 (after construction) were considered adequate. Seismic conditions were not considered in the original design. Based on the review of the available information, and a range of recommended factors of safety of 1.0 to 1.15, an acceptable factor of safety of 1.15 for seismic conditions was used for these analyses.

For the liquefaction analysis, a factor of safety of 1.1 was used. This factor of safety against liquefaction was chosen based on GZA's past experience and the National Earthquake Hazard Reduction Program (NEHRP) Recommended Seismic Provisions for Buildings and Other Structures. In general, soil elements with low factors of safety (less than or equal to 1.1) will be predicted to liquefy under the design earthquake, or in this case, the blast induced acceleration. Soil elements with high factors of safety (greater than 1.4) are not predicted to liquefy under the design acceleration, and will suffer relatively minor cyclic pore pressure generation. Soil elements with intermediate factors of safety (between 1.1 and 1.4) are considered not liquefiable under the design acceleration, but should be assigned appropriate strength values (residual strength values) for use in stability and deformation analyses as potential flow liquefaction or cyclic strain softening could occur.

SLOPE STABILITY

GZA further refined the computer model used in the 2011 global stability report for these analyses. The cross section of the hurricane barrier modeled is shown on the original USACE drawing "New Bedford-Fairhaven Hurricane Barrier – Parking Area" dated April, 1962 at STA 47+50 (Appendix B). A dredge elevation in the vicinity of the hurricane barrier of -20 feet MLLW was used in the analysis based on possible proposed future dredging elevations. It is GZA's understanding, that although the design plans currently call for a dredge elevation of -14 feet, a lower dredge elevation of -20 may be considered in the future. The lower dredge elevations of -30 and -32 in Dredge Areas 2 and 3 are located far enough away from the hurricane barrier that they are out of the influence of the slope stability analysis.

The effects of seismic forces from earthquakes are commonly modeled in slope stability analyses by applying an inertial force to the slope, which is referred to as a pseudo static analysis. GZA conducted a pseudo static analysis for this study using seismic forces induced from blasting to determine the effect on the stability of the hurricane barrier. The seismic forces were applied in vertical and horizontal directions, and failure of both the ocean side and land side of the embankment was considered. Using a pseudo-static coefficient of 0.5, it was determined that a horizontal acceleration of 0.081 g at the hurricane barrier would result in a factor of safety of 1.35 for slope stability, which is

greater than the allowable factor of safety of 1.15. The results of the slope stability analyses are shown in Figures 3 through 4.

LIQUEFACTION SUSCEPTIBILITY

A Standard Penetration Test (SPT) based liquefaction susceptibility analysis was performed on the fill and foundation soils in the vicinity of the New Bedford-Fairhaven Hurricane barrier. The "simplified method" presented in *Soil Liquefaction during Earthquakes*, Idriss and Boulanger, 2008, was followed. Currently, there is not a published or widely accepted procedure for assessing liquefaction potential due to blast induced ground motions. For this analysis, blasting accelerations were used instead of peak earthquake accelerations in the analyses. "Acceptable" blasting acceleration values were calculated which are defined as the level that yielded an acceptable factor of safety against liquefaction at the site.

Subsurface data used in this analysis included nearby recent borings by Apex (A-2011-B-5, A-2010-B6, A-2010-B7, and A-2011-B28). Available data from the boring logs which included SPT N-values (blows per foot), split-spoon soil sample descriptions, and general notes describing the drilling methods were incorporated into the analysis. This data along with information from USACE Design Memorandum No. 2 – Site Geology, dated February, 1960 and USACE Design Memorandum No. 5 – Embankments and Foundations, dated November, 1961 were used to model the geologic setting at the hurricane barrier. The soil design properties used in these analyses are attached in Appendix D.

Liquefaction susceptibility of the fill materials within the hurricane barrier was also assessed. Two subsurface profiles comprised of material type and SPT N-values were generated around available hurricane barrier cross sections, material descriptions, and construction procedures provided in the USACE design memorandums. Material properties were developed using published correlations between relative density, unit weight, angle of internal friction, and SPT N-value. These estimated material properties were also used in the Slope/W model for the slope stability analyses. Of particular concern was the "dumped earth fill" that was placed below water by end dumping and bulldozing. Due to the reported placement method and lack of subsurface information within the barrier, a relative density of "loose" was assigned with an SPT N-value of 4 blows per foot for this material.

As previously discussed, the acceptable factor of safety against liquefaction was chosen to be 1.1 for this analysis. In a liquefaction analysis, the factor of safety is the ratio of the capacity of soil to resist liquefaction (Cyclic Resistance Ratio, CRR) and the seismic demand (Cyclic Stress Ratio, CSR):

$$FS = \frac{CRR}{CSR}$$

CSR is the ratio of the average shear stress in a soil layer due to an earthquake to the initial effective stress in the soil layer and is calculated as follows:

$$CSR = \frac{\tau_{av}}{\sigma'_{vo}} = 0.65(a_{\max} / g)(\sigma_{vo} / \sigma'_{vo})r_d$$

where: τ_{av} = average shear stress,
a_{max} = peak horizontal acceleration at the ground surface,
g = acceleration of gravity,
σ_{vo} = total vertical overburden stress,
σ'_{vo} = effective vertical overburden stress, and
r_d = stress reduction coefficient which accounts for flexibility in the soil profile with increasing depth.

Microsoft Excel spreadsheets were used to analyze the liquefaction factors of safety for various soil profiles and are attached in Appendix E.

For the liquefaction calculations, a worksheet for a representative soil profile from each boring and two internal profiles was generated. Each profile was subject to a horizontal acceleration of 0.081 g and a minimum factor of safety of 1.19 was found, which is greater than the allowable factor of safety of 1.10.

CONTROL OF BLAST INDUCED VIBRATIONS

The maximum allowable seismic force was related to the proposed blasting forces using a relationship that incorporates weight of the charge per delay and distance to the structure. The maximum allowable seismic force is taken as the maximum allowable acceleration calculated in the pseudo-static slope stability analysis or liquefaction susceptibility analysis. GZA then determined the maximum charge weights that can be used during construction as a function of distance from the hurricane barrier. This approach is described in more detail in the following sections.

Typically, construction vibrations are measured in terms of peak particle velocity having units of inches-per-second (ips) measured some distance from the blast site by portable seismographs. At a minimum, seismographs measure and report particle velocities in three mutually perpendicular directions: lateral, transverse, and vertical. The following equation can be used to convert between peak particle velocity and acceleration, given the assumption that the motion is sinusoidal.

$$PPV = \frac{GA}{2\pi F}$$

Where,
PPV = peak particle velocity, in/sec
G = gravitational constant = 386.1 in/sec^2
A= acceleration coefficient, percentage of g
F = Frequency, Hz

This relationship between acceleration and peak particle velocity was used to generate blasting criteria using the acceleration from the pseudo static analysis. The following empirical formula, as published in the 1971 U.S. Bureau of Mines Bulletin 656, "Blast Vibrations and Structures", relates charge weight, distance, and particle velocity.

$$PPV = H\left[\frac{D}{\sqrt{W}}\right]^{\beta}$$

Where,
D = distance, feet
W = weight of charge per delay, lbs.
β = slope factor
H = peak particle velocity intercept, in/sec, at a value of $D/(W)^{0.5} = 1$ (See Figure 5)

The Bureau of Mines Bulletin reports that vibrations levels are independent of the delay interval, and that the maximum charge weight per delay should be considered in analyzing their effects. For the development of blasting criteria, conservative values for the parameters H and β were used. Data published in the Bulletin collected from blasting at various sites across the country was analyzed by GZA. Typical values of H were found to vary between 20 to 50. GZA used a value of 50 in this report. The value of β was reported to vary approximately between -1.1 and -1.6 (Bureau of Mines 1971 and Wiss 1981). A value of -1.6 was used for this report. The values of β and H are generally site specific and will be verified during a blasting test program.

Based on these assumed values, GZA estimated the maximum allowable charge weights as a function of distance from the hurricane barrier and frequency, see Table 1 below. A maximum value of 200 pounds per delay was also used in the table. The frequency content of a blast is variable; however, frequencies generally range between 30 and 60 Hz.

Table 1. Allowable Charge Weight per Delay as a Function of Distance from Hurricane Barrier.

Dist. (ft)	10 Hz	20 Hz	30 Hz	40 Hz	50 Hz	60 Hz	70 Hz	80 Hz	90 Hz
	Pounds per Delay	Pounds per Delay	Pounds per Delay	Pounds per Delay	Pounds per Delay	Pounds per Delay	Pounds per Delay	Pounds per Delay	Pounds per Delay
250	198	83	50	35	26	21	17	15	13
300	200	120	72	50	38	30	25	21	18
350	200	163	98	69	52	41	34	29	25
400	200	200	128	89	68	54	44	38	32
450	200	200	162	113	86	68	56	48	41
500	200	200	200	140	106	84	69	59	51
550	200	200	200	169	128	102	84	71	61
600	200	200	200	200	152	121	100	85	73
700	200	200	200	200	200	165	136	115	99
800	200	200	200	200	200	200	178	150	130
900	200	200	200	200	200	200	200	190	164
1000	200	200	200	200	200	200	200	200	200
1100	200	200	200	200	200	200	200	200	200
1200	200	200	200	200	200	200	200	200	200

It is GZA's opinion that if the blast levels are kept below these recommended levels, the stability of the hurricane barrier will not be adversely affected, and that negligible settlement of the barrier will result due to blasting activities.

PROJECT BLAST TESTING PROGRAM

GZA recommends that a test blast program be performed in the field by the contractor to verify the input parameters used in these analyses, including the blasting frequencies.

The test blast program should consist of performing small test blasts and measuring particle velocity with distance from the blast with various seismographs. The test blasts

should be located a significant distance away from the hurricane barrier. Portable seismographs capable of measuring peak particle velocity in three mutually perpendicular directions and frequency are recommended for this work.

GZA also highly recommends the installation of two piezometers in the hurricane barrier to monitor excess pore water pressure in the dumped fill material during blasting. This will give a direct measurement of any impacts of blasting, rather than the theoretical impact. The installation of the piezometers will also allow GZA to verify the density of the dumped fill material.

CONCLUSIONS AND RECOMMENDATIONS

The dredging phases of the New Bedford Marine Commerce Terminal Project will require the removal of up to approximately 16 feet of bedrock to meet the proposed dredge elevations at a distance of approximately 500 feet away from the toe of hurricane barrier. Since blasting to remove the bedrock is being considered, GZA conducted an analysis to assess the effect of the vibrations on the hurricane barrier.

GZA evaluated the levels of seismic vibrations that the hurricane barrier can tolerate. These limits were related to proposed blasting operations on the site by an established relationship from the U. S. Bureau of Mines. The recommended charge weights per delay are given in Table 1 of this report. These recommended values were based on conservative parameter values. A test blast program is recommended in order to verify the design parameters and assumption. The installation and monitoring of two piezometers in the hurricane barrier is also recommended. It is GZA's opinion that if these recommendations are followed, vibration levels can be controlled to within safe limits for the hurricane barrier and surrounding structures.

CONTRACT DOCUMENT REVIEW AND CONSTRUCTION SERVICES

GZA would welcome the opportunity to be retained to revise the plans and specifications in accordance with these recommendations. GZA can also provide services that could include vibration monitoring during the blast testing program and production blasting, reduction of the vibration data, preparation of ground calibration parameters, and preparation of final production blasting criteria.

We trust that this report addresses the current geotechnical issues of this project. Please do not hesitate to contact the undersigned with any questions or comments.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

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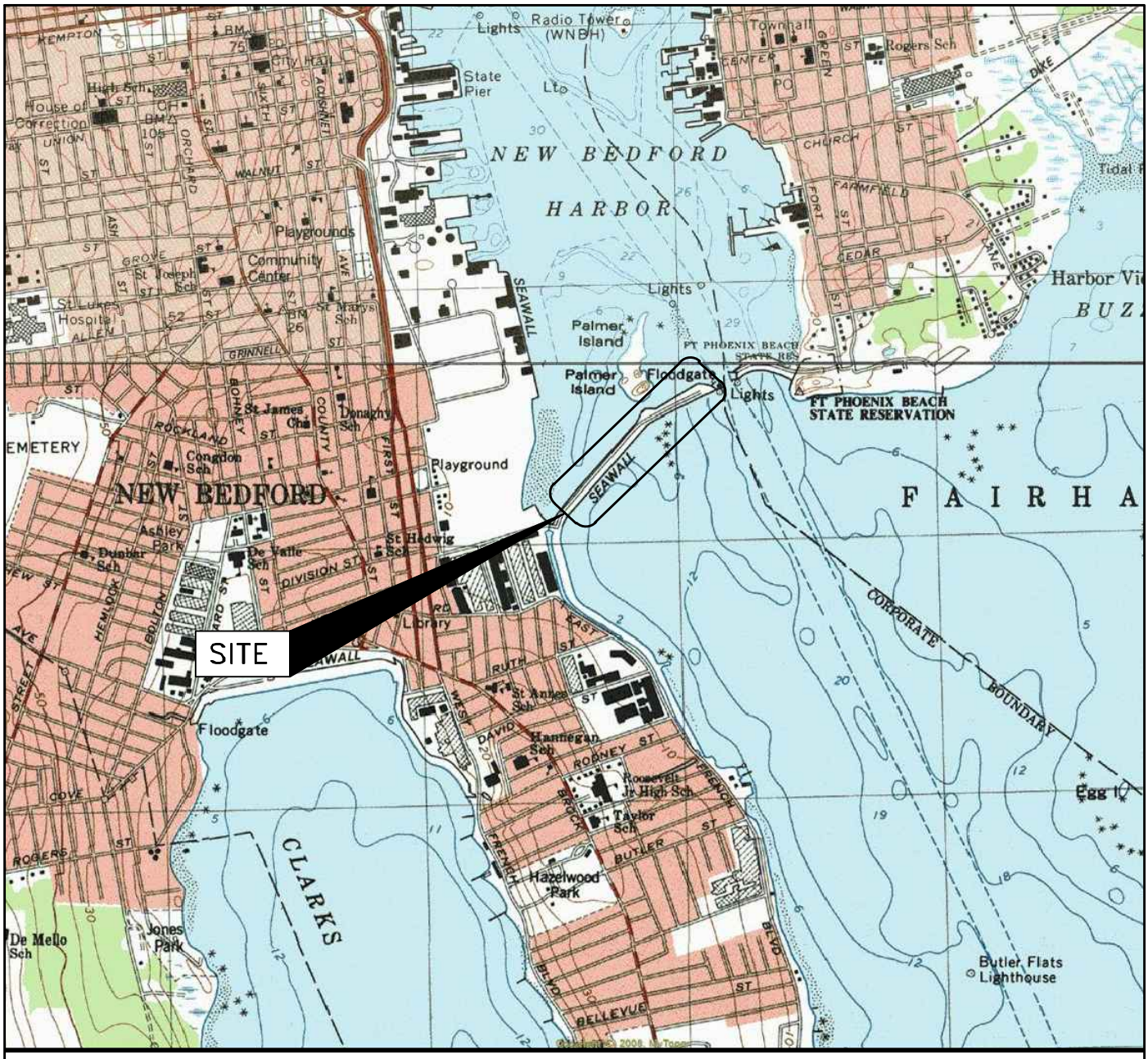
Attachments:	Figure 1:	Locus Plan
	Figure 2:	Bottom of Dredge Plan
	Figure 3:	Slope Stability Run 1
	Figure 4:	Slope Stability Run 2
	Figure 5:	Test Blast Figure
	Appendix A:	Limitations
	Appendix B:	Original USACE Drawings
	Appendix C:	Subsurface Boring Logs
	Appendix D:	Design Soil Properties
	Appendix E:	Liquefaction Calculation Spreadsheets

j:\geo\33734.03.dyb\report\report rev-03 august 2013\final 33734.03 report rev-03.docx

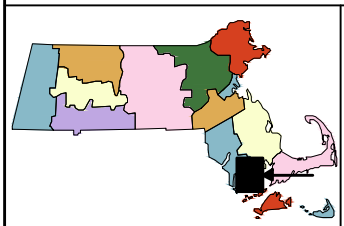
FIGURES



APPROXIMATE SCALE IN FEET

0' 1000' 2000' 4000'

N W E S



MASSACHUSETTS

QUADRANGLE LOCATION

SOURCE:

BASE MAP FROM THE FOLLOWING USGS QUADRANGLE MAP:
NEW BEDFORD SOUTH, MASSACHUSETTS (1977)

DIGITAL TOPOGRAPHIC MAPS PROVIDED MY MAPTECH. INC.

CONTOUR ELEVATIONS REFERENCE NGVD 29,
CONTOURS ARE SHOWN IN FEET AT 10 FOOT INTERVALS

UNLESS SPECIFICALLY STATED BY WRITTEN AGREEMENT, THIS DRAWING IS THE SOLE PROPERTY OF GZA GEOENVIRONMENTAL, INC. (GZA). THE INFORMATION SHOWN ON THE DRAWING IS SOLELY FOR USE BY GZA'S CLIENT OR THE CLIENT'S DESIGNATED REPRESENTATIVE FOR THE SPECIFIC PROJECT AND LOCATION IDENTIFIED ON THE DRAWING. THE DRAWING SHALL NOT BE TRANSFERRED, REUSED, COPIED, OR ALTERED IN ANY MANNER FOR USE AT ANY OTHER LOCATION OR FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF GZA. ANY TRANSFER, REUSE, OR MODIFICATION TO THE DRAWING BY THE CLIENT OR OTHERS, WITHOUT THE PRIOR WRITTEN EXPRESS CONSENT OF GZA, WILL BE AT THE USER'S SOLE RISK AND WITHOUT ANY RISK OR LIABILITY TO GZA.

NEW BEDFORD HURRICANE SHORE PROTECTION
NEW BEDFORD, MASSACHUSETTS

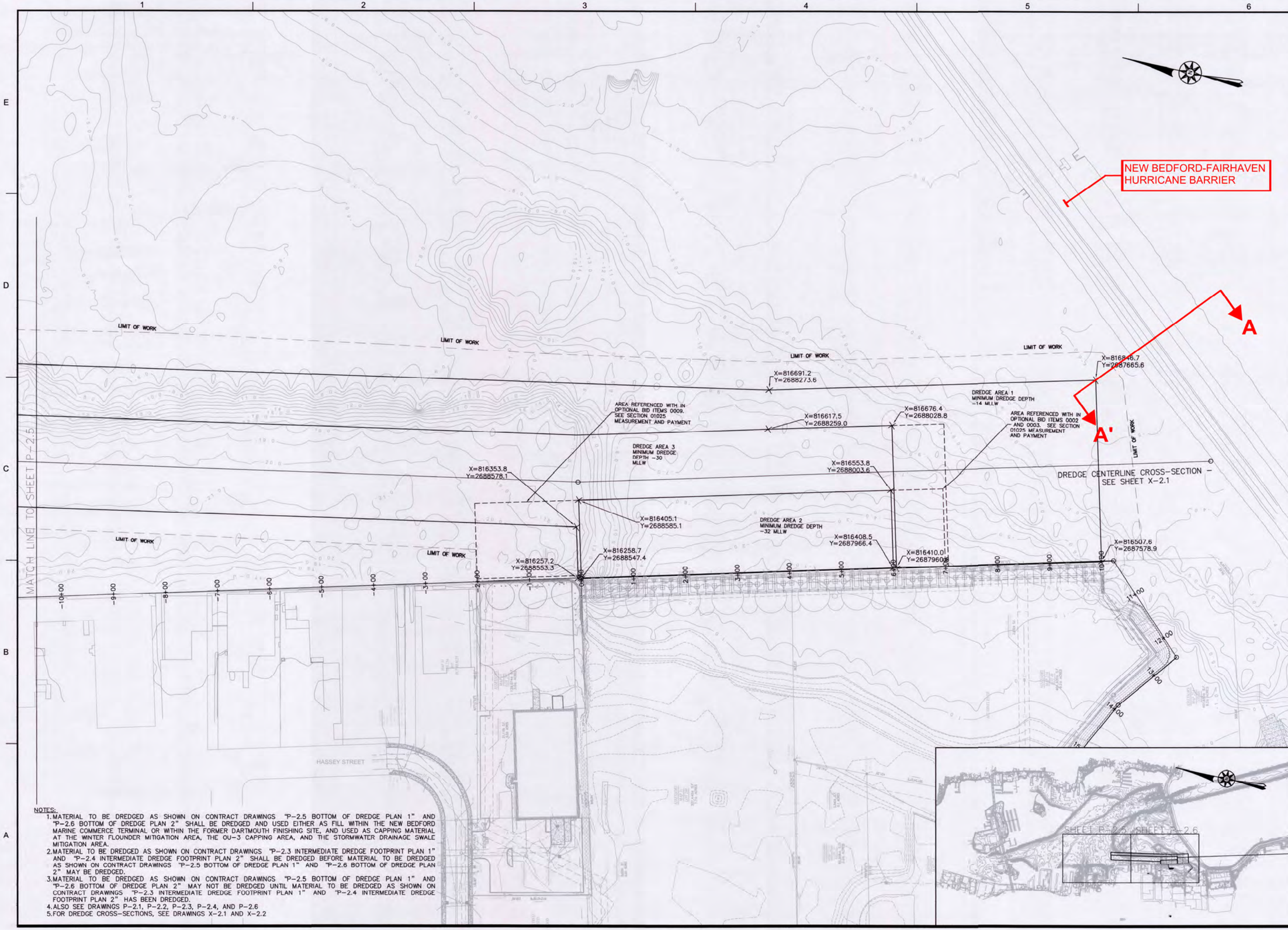
PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
APEX COMPANIES, LLC

LOCUS PLAN

PROJ MGR: DYB	REVIEWED BY: DRC	CHECKED BY: JJM	FIGURE
DESIGNED BY: JJM	DRAWN BY: MEA	SCALE: AS NOTED	1
DATE: AUGUST 2013	PROJECT NO. 33734.04	REVISION NO. 0	SHEET NO.

© 2013 – GZA GeoEnvironmental, Inc. GZA–J:\Geo\33734.04.dyb\Figures\GZA DWGs\33734.04_LOCUS.dwg [LOCUS] August 29, 2013 – 9:53am scott.burton



NOTES:

1. MATERIAL TO BE DREDGED AS SHOWN ON CONTRACT DRAWINGS "P-2.5 BOTTOM OF DREDGE PLAN 1" AND "P-2.6 BOTTOM OF DREDGE PLAN 2" SHALL BE DREDGED AND USED EITHER AS FILL WITHIN THE NEW BEDFORD MARINE COMMERCE TERMINAL OR WITHIN THE FORMER DARTMOUTH FINISHING SITE, AND USED AS CAPPING MATERIAL AT THE WINTER FLOUNDER MITIGATION AREA, THE OU-3 CAPPING AREA, AND THE STORMWATER DRAINAGE SWALE MITIGATION AREA.
2. MATERIAL TO BE DREDGED AS SHOWN ON CONTRACT DRAWINGS "P-2.3 INTERMEDIATE DREDGE FOOTPRINT PLAN 1" AND "P-2.4 INTERMEDIATE DREDGE FOOTPRINT PLAN 2" SHALL BE DREDGED BEFORE MATERIAL TO BE DREDGED AS SHOWN ON CONTRACT DRAWINGS "P-2.5 BOTTOM OF DREDGE PLAN 1" AND "P-2.6 BOTTOM OF DREDGE PLAN 2" MAY BE DREDGED.
3. MATERIAL TO BE DREDGED AS SHOWN ON CONTRACT DRAWINGS "P-2.5 BOTTOM OF DREDGE PLAN 1" AND "P-2.6 BOTTOM OF DREDGE PLAN 2" MAY NOT BE DREDGED UNTIL MATERIAL TO BE DREDGED AS SHOWN ON CONTRACT DRAWINGS "P-2.3 INTERMEDIATE DREDGE FOOTPRINT PLAN 1" AND "P-2.4 INTERMEDIATE DREDGE FOOTPRINT PLAN 2" HAS BEEN DREDGED.
4. ALSO SEE DRAWINGS P-2.1, P-2.2, P-2.3, P-2.4, AND P-2.6
5. FOR DREDGE CROSS-SECTIONS, SEE DRAWINGS X-2.1 AND X-2.2

APEX

ROCKVILLE, MD
SOUTH WINDSOR, CT - BOSTON, MA - NEW BEDFORD, MA - HOLYOKE, MA

184 HIGH STREET, SUITE 502
BOSTON, MA 02210

58H CONNECTICUT AVENUE
SOUTH WINDSOR, CT

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COMMONWEALTH OF MASSACHUSETTS
CHESTER H. MYERS
ENVIRONMENTAL
NO. 45634
8/30/11
REGISTERED PROFESSIONAL ENGINEER

PROJECT
NEW BEDFORD MARINE COMMERCE TERMINAL

OWNER
MASSACHUSETTS CLEAN ENERGY COUNCIL
55 SUMMER STREET, 9TH FLOOR
BOSTON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

PROJECT NO.	6690
CADD FILE	B_I_DREDGE
DESIGNED BY	GCD
DRAWN BY	CWM
CHECKED BY	CHM
DATE	8/30/11
DRAWING SCALE	1"=80'

GRAPHIC SCALE
SCALE: 1"=80'
0 40 80 160

SHEET TITLE
BOTTOM OF DREDGE PLAN 2

DRAWING NO.
P-2.6

P:\Jobs\6690 NBH_ Phase IV\PLANS\FINAL_PLANS\100% Submittal\P-2.5-P-2.6_BOTTOM_DREDGE.dwg

FIGURE 2 - BOTTOM OF DREDGE PLAN

New Bedford South Terminal
File No. 33734.03
File Name: J:\Geo\33734.03.dyb\Work\Blasting Accelerations 2013\Slope Stability 2013\33734.00_Secton A-A'_BLASTING_HORIZONTAL_L-R.gsz

Scenaro 4: Dredge Conditions Based off Drawing P-9
Dredge Elevation -20 feet MLLW
New Bedford-Fairhaven Hurricane Barrier
Slope Stability Analysis: Section A-A'
Minimum Factor of Safety = 1.35
Maximum Horizontal Acceleration = 0.081g
k=0.50, Horizontal Acceleration Applied = 0.041g

GZA GeoEnvironmental, Inc.
By : JJM 08/23/2013
Chk: DYB MM/DD/YY

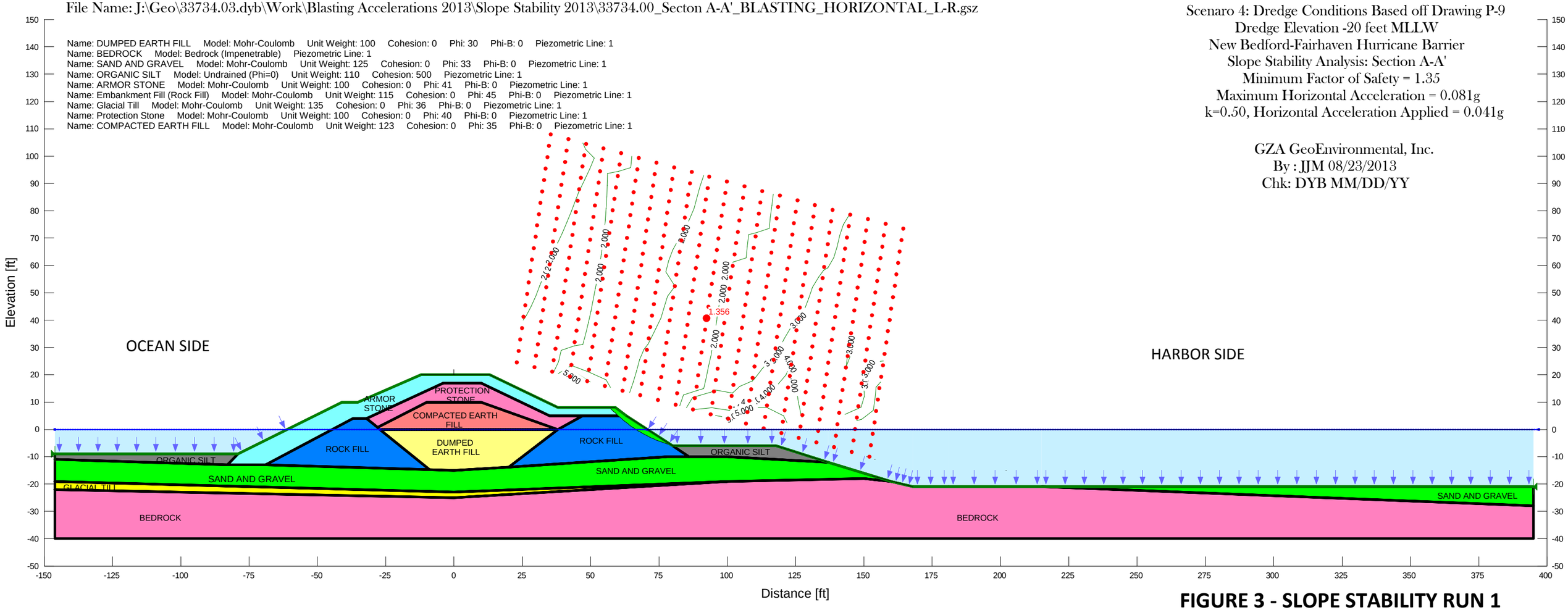


FIGURE 3 - SLOPE STABILITY RUN 1

New Bedford South Terminal
File No. 33734.03
File Name: J:\Geo\33734.03.dyb\Work\Blasting Accelerations 2013\Slope Stability 2013\33734.00_Secton A-A'_BLASTING_HORIZONTAL_R-L.gsz

Scenaro 4: Dredge Conditions Based off Drawing P-9
Dredge Elevation -20 feet MLLW
New Bedford-Fairhaven Hurricane Barrier
Slope Stability Analysis: Section A-A'
Minimum Factor of Safety = 1.37
Maximum Horizontal Acceleration = 0.081g
k=0.50, Horizontal Acceleration Applied = 0.041g

GZA GeoEnvironmental, Inc.
By : JJM 08/23/2013
Chk: DYB MM/DD/YY

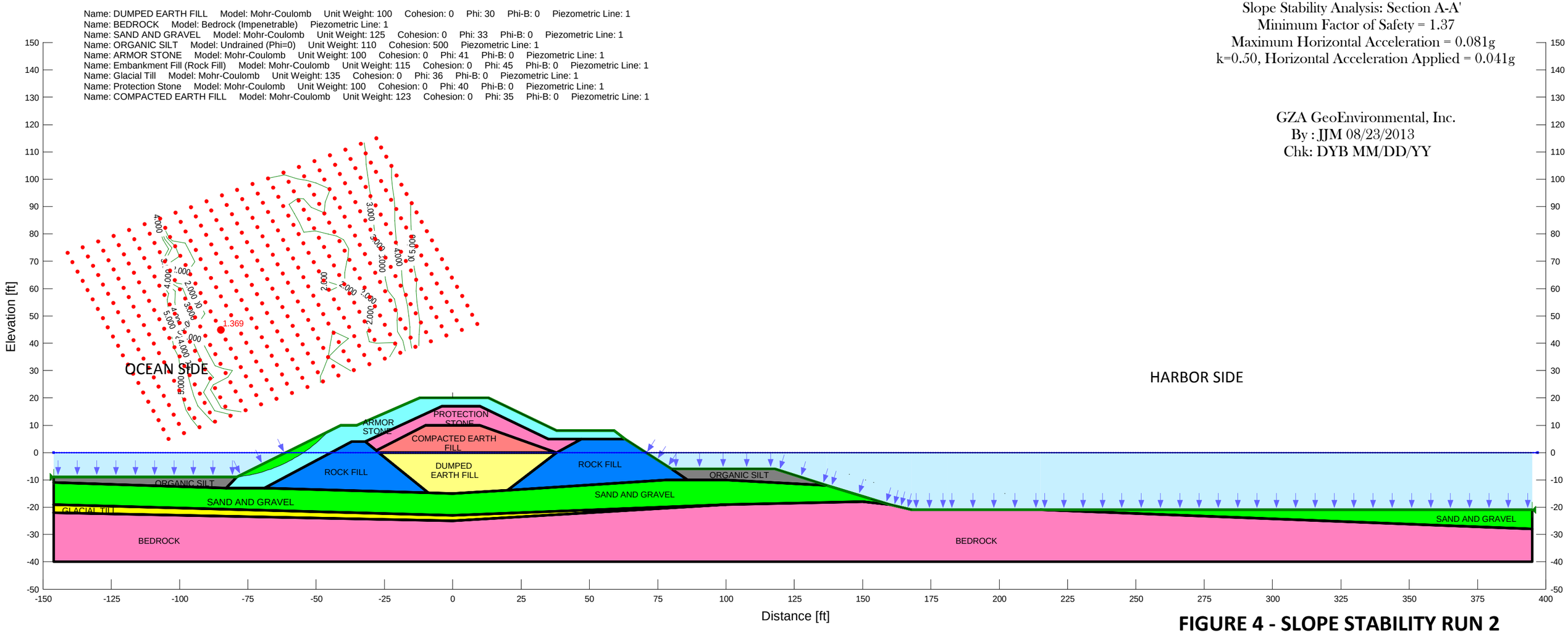


FIGURE 4 - SLOPE STABILITY RUN 2

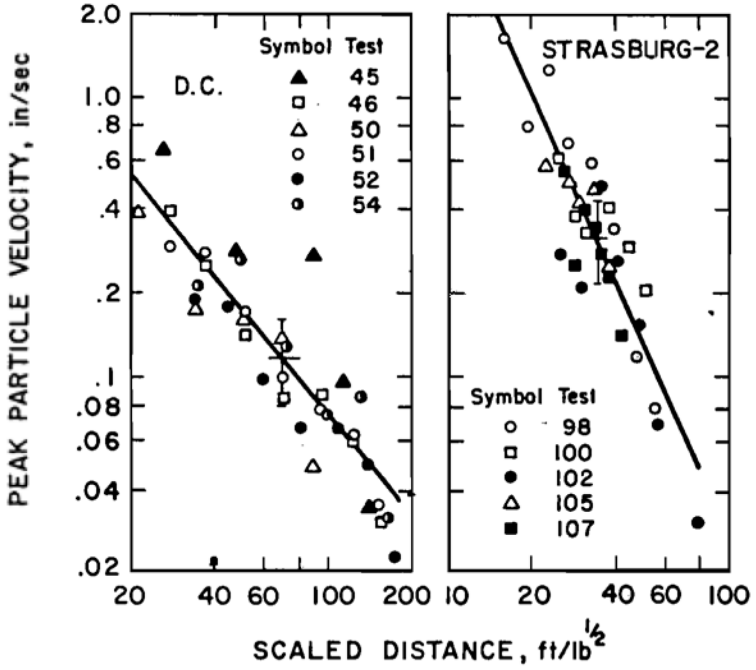


FIGURE 5

EXAMPLE OF SCALED DISTANCE VS.
PEAK PARTICLE VELOCITY
(BUREAU OF MINES, 1971)

APPENDIX A

LIMITATIONS

GEOTECHNICAL LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report,as appropriate, to reflect the unanticipated changed conditions .

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

Subsurface Conditions

4. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs.

5. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

6. Water level readings have been made in test holes (as described in the Report) and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.

7. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.

8. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

9. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

Cost Estimates

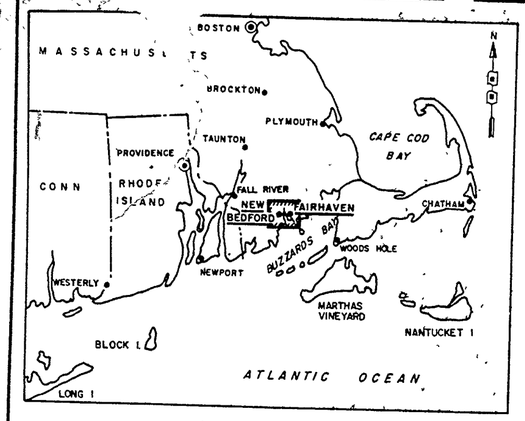
10. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

Additional Services

11. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

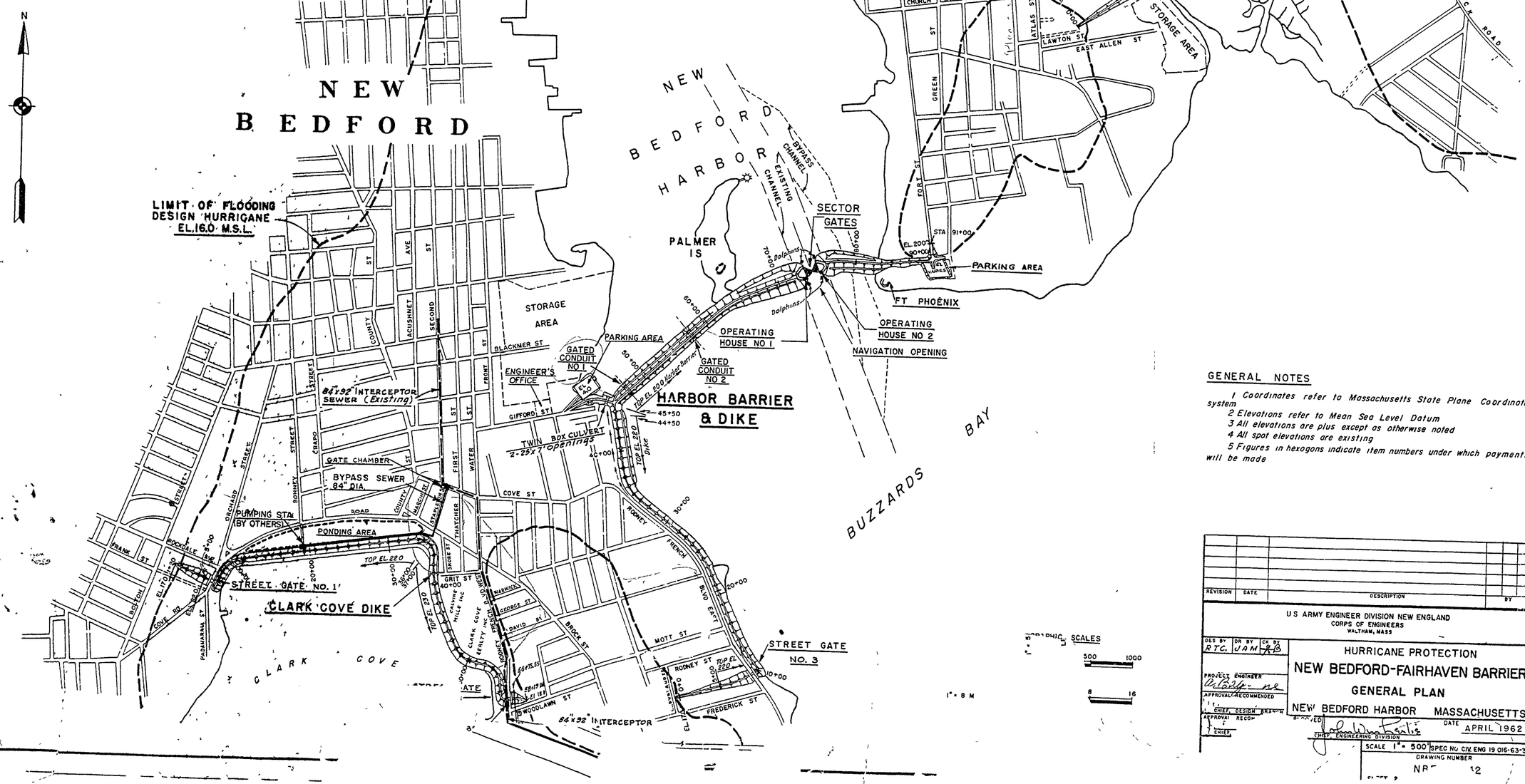
APPENDIX B

ORIGINAL USACE DRAWINGS



LOCATION MAP

SCALE 1" = 8 MILES



GENERAL NOTES

1 Coordinates refer to Massachusetts State Plane Coordinate system
2 Elevations refer to Mean Sea Level Datum
3 All elevations are plus except as otherwise noted
4 All spot elevations are existing
5 Figures in hexagons indicate item numbers under which payments will be made

REVISION	DATE	DESCRIPTION	BY

US ARMY ENGINEER DIVISION NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

DES BY RTC. DR BY JAM CK BY AB

PROJECT ENGINEER

APPROVAL RECOMMENDED

CHIEF, DESIGN BRANCH

APPROVAL RECOMMENDED

CHIEF, ENGINEERING DIVISION

HURRICANE PROTECTION

NEW BEDFORD-FAIRHAVEN BARRIER

GENERAL PLAN

NEW BEDFORD HARBOR MASSACHUSETTS

DATE APRIL 1962

SCALE 1" = 500'

SPEC No CIV. ENG 19 016-63-3

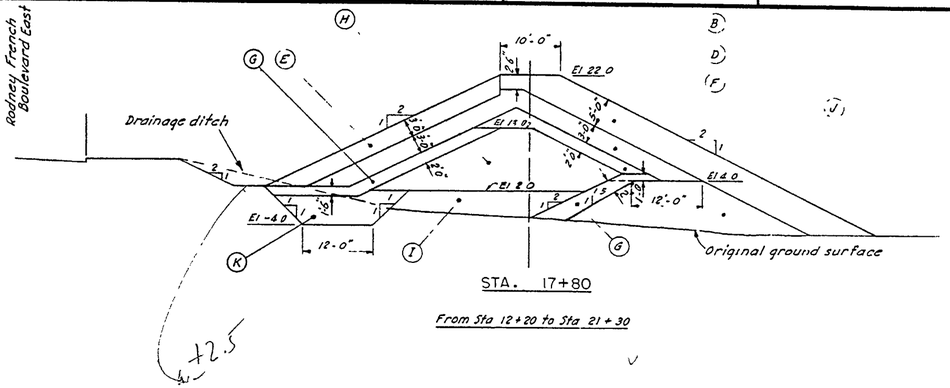
DRAWING NUMBER

NR 12

CORPS OF ENGINEERS
U. S. ARMY
LANDSIDE
HARBORSIDE
OCEANSIDE
Limit of Contractor's work area
PARKING AREA
TWIN BOX CULVERT
METER HOUSE
GIFFORD STREET
BUILDING
Resident Engineer's Office
PLAN — PARKING AREA
SCALE 1" = 40'
STA. 47+50
Typical From Sta. 47+35
STA. 44+00
Typical From Sta. 42+70 to Sta. 44+75
TYPICAL DIKE SECTIONS
SCALE 1" = 20'
STA. 45+25
Typical From Sta. 44+75 to Sta. 45+55
STA. 46+80
Typical From Sta. 46+50 to Sta. 47+35
SECTION B-B
SCALE 1" = 10'
SECTION A-A
SCALE 1" = 20'
CONNECTING BAR
SCALE 1 1/2" = 1'-0"
REINFORCEMENT DETAIL
SCALE 1/2" = 1'-0"
SECTION
SCALE 1 1/2" = 1'-0"
PLAN
SECTION
CONCRETE PLANK RAMP
SCALE 1/8" = 1'-0"
STA. 46+20
SCALE 1" = 10'
Typical From Sta. 46+00 to Sta. 46+50
SECTION D-D
SCALE 1" = 20'
From Sta. 2+38± to Sta. 2+95± (East edge of Twin Box Culvert)
PROFILE ON ℄ ACCESS ROAD
SCALE HOR. 1" = 40' VERT. 1" = 10'
SECTION THRU CONCRETE APRON
SCALE 1/2" = 1'-0"
SECTION C-C
SCALE 1" = 10'
From Sta. 0+79 to Sta. 2+38±
GRAPHIC SCALES
Record Drawing
Contract No. DA-19-016-CIV ENG 63-64
NOTES
1. For general notes see sheet No. 2
2. All Earth fill material placed West of Access Road, Sta. 2+43 and for Parking Area, shall be Random material.
3. For Plan and Section of Twin Box Culvert see sheet Nos. 43 & 44
4. For details of 2" Pipe Barrier, see sheet No. 37
5. For details of Meter House, see sheet No. 96
6. For details of Gated Conduit, see sheet No. 45 & 46
7. For legend of embankment materials see Sheet No. 28.
8. For details of Utilities see Sheet No. 119.
9. Utility relocations to be done by others.
6-15-66 Final Field Corrections
5 11-16-65 Access Road and Ramp changed. Notes revised.
4 9-7-65 Parking Area raised, Access Road and Ramps changed. Sections added and revised.
3 2-9-65 Parking Area and Ramp Paved & Elevations revised.
2 11-20-62 Note revised in accordance with Am. #1.
1 11-20-62 Plan, profile & sections revised (Am #1)
REVISION DATE DESCRIPTION
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
DES. BY R.T.C.
DR. BY J.R. McN.
CK. BY J.R. McN.
HURRICANE PROTECTION
NEW BEDFORD-FAIRHAVEN BARRIER
PARKING AREA
NEW BEDFORD
NEW BEDFORD HARBOR
MASSACHUSETTS
DATE APRIL 1962
SCALE AS SHOWN.
SPEC. NO. CIV. ENG. 19-016-63-3
DRAWING NUMBER
NBF-1-1071
SHEET 41

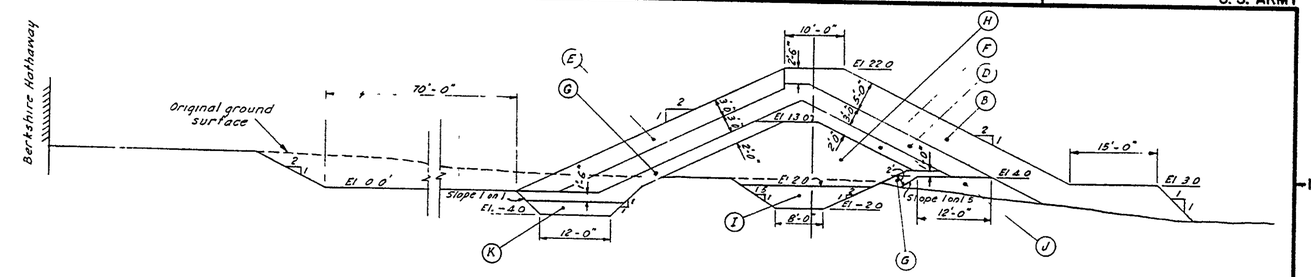
CORPS OF ENGINEERS

U. S. ARMY



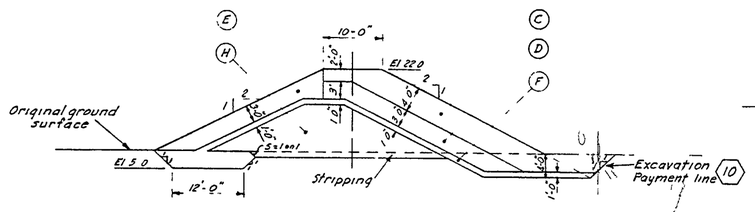
STA. 17+80

From Sta 12+20 to Sta 21+30



STA. 39+75

From Sta 36+70 to Sta 46+30
Transition occurs between Sta. 36+50 & Sta 36+70
Top elevation changes between Sta 44+50 and Sta 45+50

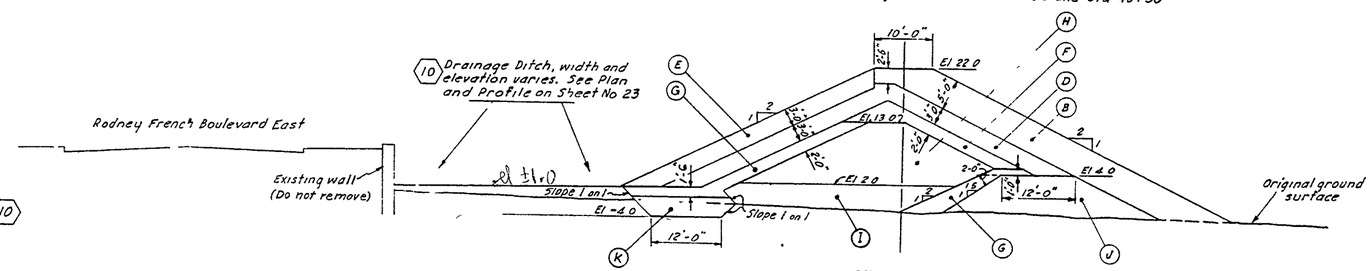


LANDSIDE

STA. 8+60

From Sta 7+20 to Sta. 8+78± (Street Gate No 3)
Transition occurs between Sta. 7+00 and Sta 7+20

OCEANSIDE

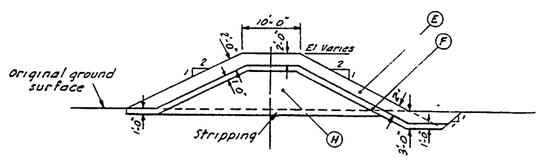


LANDSIDE

STA 30+80

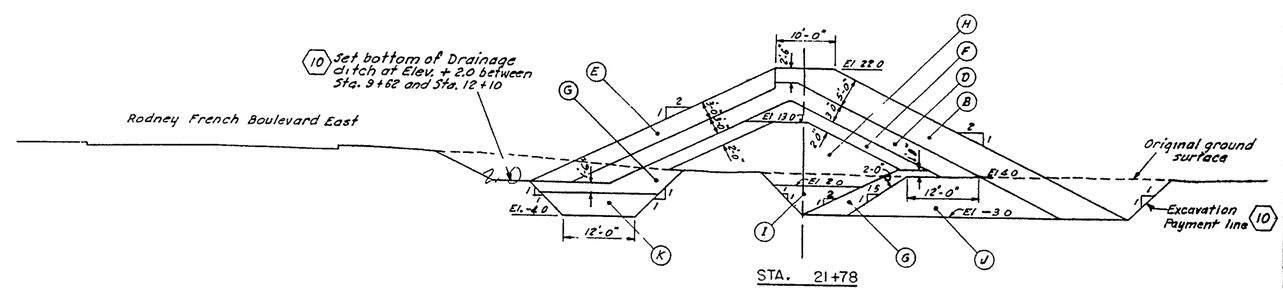
From Sta. 22+50 to Sta 36+50

OCEANSIDE



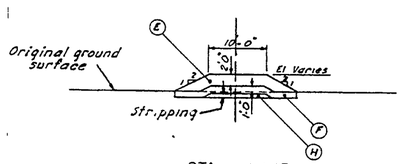
STA 4+55

From Sta. 1+80 to Sta. 7+00



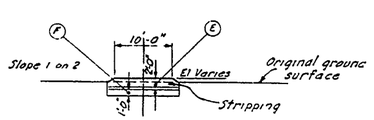
STA. 21+78

From Sta 10+00± (St Gate No 3) to Sta 12+20 & From Sta. 21+30 to Sta 22+50



STA. 1+15

From Sta 0+50 to Sta. 1+80



STA. 0+25

From Sta -0108 57 to Sta. 0+50

NOTES

1. For general notes see sheet No 2
2. Within the foundation area of the Dike, remove all exposed boulders, cobbles and stones above low water and surface and buried grains, walls, masonry, concrete structures and timbers Remove all existing riprap and bedding and strip area as directed by the Contracting Officer
3. For location of Sections see sheet Nos 23, 24 and 41
4. Surfaces of tops and ocean side berms of barrier and dikes and of tops of ramps shall be chinked
5. The barrier and dike between Sta 36+70 and Sta 50+00 above El 4.0 shall not be contructed untill after a period of 60 days after completion below El 4.0
6. For details of Street Gate No 3, see sheet No 63 thru 70
7. For details of access Ramps see Sheet Nos 36 and 41

LEGEND

MATERIAL DESIGNATION	TYPE OF MATERIAL	PAY ITEM NUMBERS
A	Armor Stone, 4.5 to 2.75 tons.	20
B	Armor Stone, 3.0 to 2.0 tons	19
C	Armor Stone, 2.0 to 1.0 tons.	18
D	Bedding Stone	22
E	Protection Stone.	23
F	Gravel bedding	15
G	Filter material	16
H	Compacted Earth fill	6, 6A, 10
I	Dumped Earth fill	6, 7A, 10
J	Rock fill	21
K	Drainage Trench Material.	17
W	Waste Material, dumped	10

TYPICAL SECTIONS
SCALE. 1" = 10'

GRAPHIC SCALE
1" = 1'-0" 10' 0 10 20'

REVISION	DATE	DESCRIPTION

U.S ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

DES BY RTC DR BY RTC CK BY
SUBMITTED
CHIEF PROJECT ENGINEER SECTION
APPROVAL RECOMMENDED CHIEF DESIGN BRANCH
APPROVAL RECOMMENDED CHIEF, ENGINEERING DIVISION

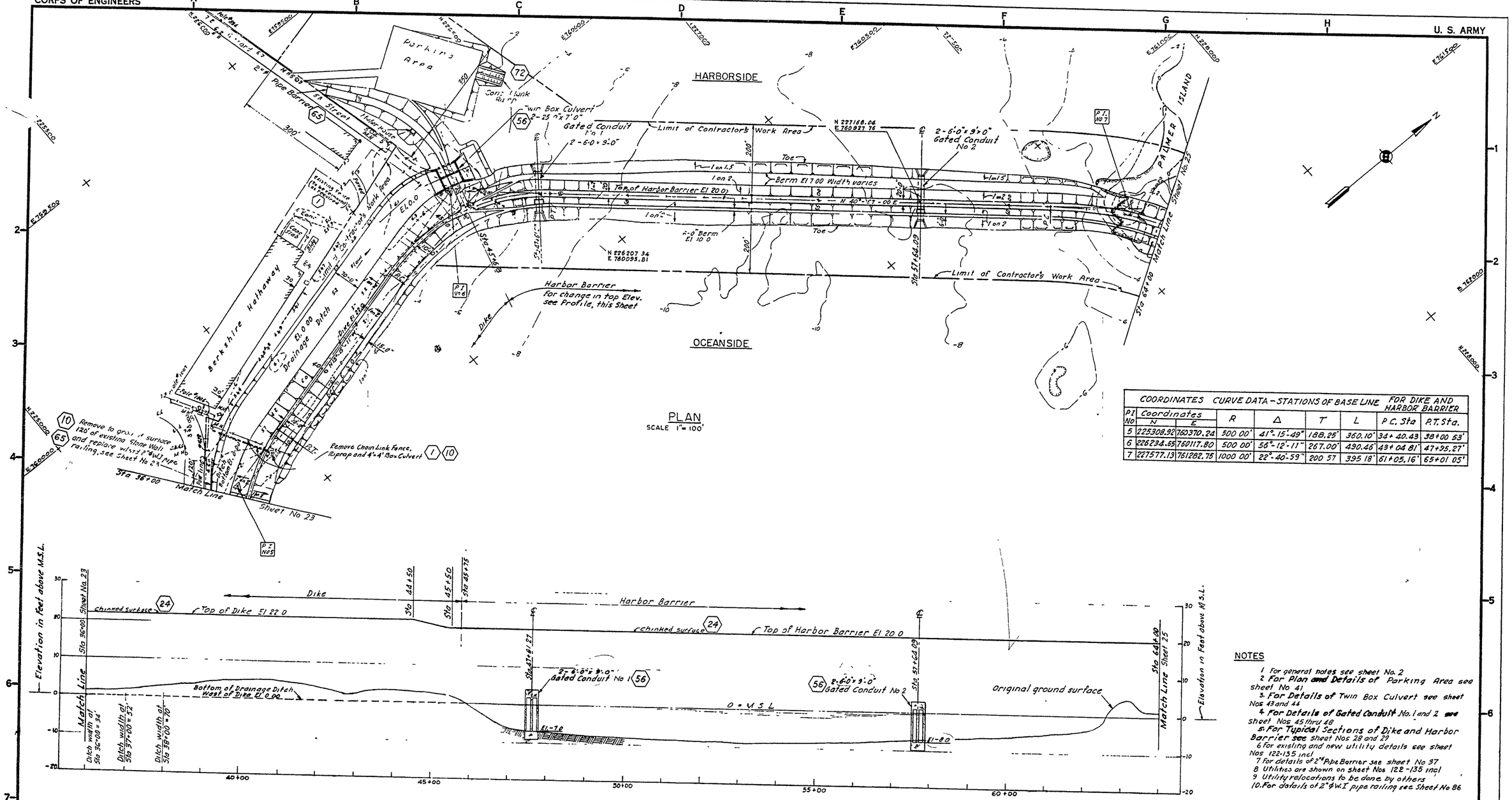
HURRICANE PROTECTION
NEW BEDFORD-FAIRHAVEN BARRIER
HARBOR BARRIER AND DIKE
TYPICAL SECTIONS NO. 1
NEW BEDFORD HARBOR MASSACHUSETTS

APPROVED
CHIEF, ENGINEERING DIVISION
DATE APRIL 1962

SCALE. 1" = 10'
SPEC. NO CIV ENG. 19-016-63-3.
DRAWING NUMBER
NBF-1-1058
SHEET 28

CORPS OF ENGINEERS

U. S. ARMY



PLAN
SCALE 1" = 100'

COORDINATES			CURVE DATA – STATIONS OF BASE LINE FOR DIKE AND HARBOR BARRIER					
PI NO	Coordinates N	Coordinates E	R	Δ	T	L	P.C. Sta	P.T. Sta.
5	225308.92	760370.24	500.00'	41°-15'-49"	188.25'	360.10'	34+40.43	38+00.53'
6	226234.65	760117.80	500.00'	56°-12'-11"	267.00'	490.46'	43+04.81'	47+95.27'
7	227577.13	761282.75	1000.00'	22°-40'-59"	200.57	395.18'	61+05.16'	65+01.05'

PROFILE ON ℄ OF DIKE AND HARBOR BARRIER
SCALES HOR. 1" = 100'
VERT. 1" = 10

NOTES

1. For general notes see sheet No. 2
2. For Plan and Details of Parking Area see sheet No 41
3. For Details of Twin Box Culvert see sheet Nos 43 and 44
4. For Details of Gated Conduit No. 1 and 2 see sheet Nos 45 thru 48
5. For Typical Sections of Dike and Harbor Barrier see sheet Nos 28 and 29
6. For existing and new utility details see sheet Nos 122-135 incl
7. For details of 2" Pipe Barrier see sheet No 37
8. Utilities are shown on sheet Nos 122-135 incl
9. Utility relocations to be done by others
10. For details of 2" ϕ W.I. pipe railing see Sheet No 86

GRAPHIC SCALES
SCALE 1" = 10' 10 0 10 20
SCALE 1" = 100' 100 0 100 200

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

DES BY RTC | DR BY JAM | CK. BY

SUBMITTED
CHIEF, SECTION
PROJECT ENGINEER
APPROVAL RECOMMENDED
CHIEF, DESIGN BRANCH
APPROVAL RECOMMENDED
CHIEF, B & M BRANCH
APPROVED
CHIEF, ENGINEERING DIVISION

HURRICANE PROTECTION
NEW BEDFORD-FAIRHAVEN BARRIER
HARBOR BARRIER AND DIKE
PLAN AND PROFILE NO 2
NEW BEDFORD HARBOR MASSACHUSETTS

DATE APRIL 1962

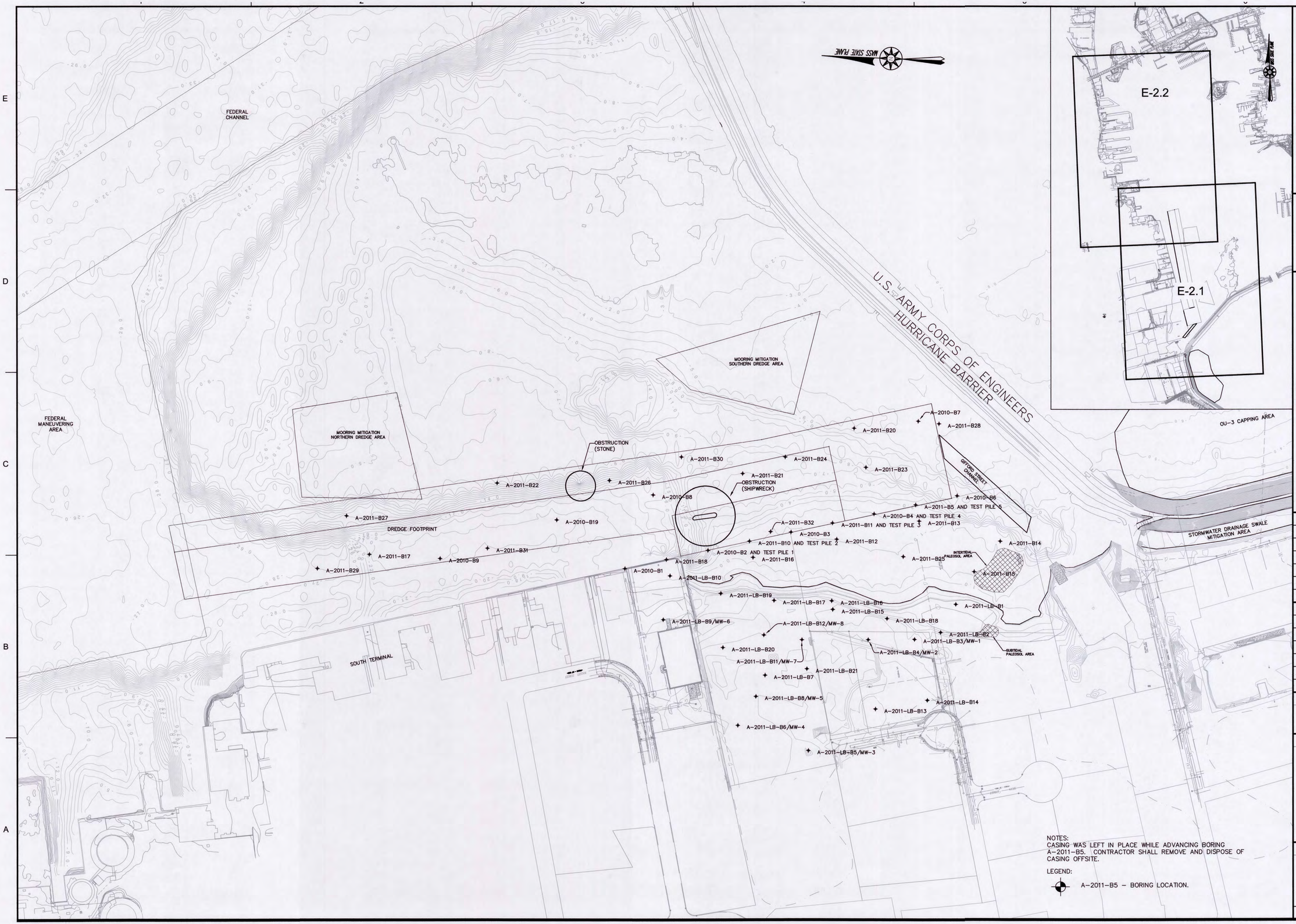
SCALE AS SHOWN | SPEC. NO. CIV. ENG-19-016-63-36

DRAWING NUMBER
NBF-I-1054

SHEET 24

APPENDIX C

SUBSURFACE EXPLORATION LOGS



NOTES:
CASING WAS LEFT IN PLACE WHILE ADVANCING BORING A-2011-B5. CONTRACTOR SHALL REMOVE AND DISPOSE OF CASING OFFSITE.

LEGEND:

A-2011-B5 – BORING LOCATION.

APEX

ROCKVILLE, MD
SOUTH WINDSOR, CT - BOSTON, MA - NEW BEDFORD, MA - HOLYOKE, MA

184 HIGH STREET, SUITE 502
BOSTON, MA 02210

58H CONNECTICUT AVENUE
SOUTH WINDSOR, CT

This drawings prepared by Apex for this project are instruments of Apex's service for use solely with respect to this project, and Apex shall be deemed the author of the Drawing and shall retain all common law, statutory and other reserved rights with respect thereto, including the copyright. The Documents shall not be used on other projects, for additions to this project or for completion of this project by others, except by agreement in writing and with appropriate compensation to Apex.

COMMONWEALTH OF MASSACHUSETTS
CHESTER H. MYERS
ENVIRONMENTAL
NO. 45554
07/17/12
REGISTERED PROFESSIONAL ENGINEER

PROJECT
NEW BEDFORD MARINE COMMERCE TERMINAL

OWNER
MASSACHUSETTS CLEAN ENERGY CENTER
55 SUMMER STREET, 9TH FLOOR
BOSTON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY
3	06/28/12	MOORING MIT. UPDATE	CWM
2	03/05/12	EX. COND. UPDATE	CWM
1	12/23/11	FOR CONSTRUCTION	CHM

PROJECT NO.	6690
CADD FILE	E-1.1-E-2.2_EXISTING_CONDITIONS
DESIGNED BY	GCD
DRAWN BY	GCD
CHECKED BY	CMM
DATE	08/04/2011
DRAWING SCALE	1"=150'

GRAPHIC SCALE
SCALE: 1"=150'
0 75 150 300

SHEET TITLE
EXISTING CONDITIONS DREDGE FOOTPRINT SHEET 1

DRAWING NO.
E-2.1

P:\Jobs\6690 NBH_ Phase IV\PLANS\FINAL_PLANS\100% Submittal\E-1.1-E-2.2_EXISTING_CONDITIONS.dwg

Apex environmental, inc.

BORING LOG

Date: 3/7/2011
Time: 8:30 AM

Project:	Phase IV Dredging	Project No: 6690.008	X: 816478
Location:	South Terminal Expansion		Y: 2687708
Elevation at mudline:	-3.7	Datum: MLLW	
Casing Type: Steel		Boring Depth: -45.30' MLLW	Boring No: A-2011-B5
Casing Diameter:	4"	Drill Rig: CME 45	
Drill Co:	NH Boring	Method: Drill and Wash	Sheet: 1 of 1
Driller:	Norman Stuttard	Log By: GAD	

Depth below mudline (ft)	RQD	Penetration/ Recovery	Blows per 6" / Drill Min. per Foot	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%	Elevation (MLLW)
3		36" 24"	WOR,WOR, WOR,WOR	Black, organic SILT, trace shell hash.	-6.7
5		24" 24"	WOR,WOR, WOR,WOR	Black, organic SILT, trace shell hash, trace gravel.	-8.7
7		24" 12"	3,1,5,10	Black, organic SILT, trace shell hash, trace fine gravel, grades to greenish-grey, fine to medium SAND, trace fine gravel.	-10.7
9		24" 18"	16,29,26,28	Greenish grey, fine to coarse SAND, some fine to coarse gravel, trace silt	-12.7
11		24" 6"	17,8,7,10	Greenish grey, fine SAND some fine to medium sand, little fine gravel	-14.7
13		24" 6"	37,31,20,30	Greenish grey, fine to medium SAND, some coarse sand, some fine gravel, trace silt	-16.7
15		24" 12"	14,10,12,17	Greenish grey, fine to medium SAND, some coarse sand, some fine gravel, trace silt	-18.7
17		24" 0	25,9,8,11	No Recovery	-20.7
19		24" 2"	20,18,21,17	Greenish grey, fine to medium SAND, some coarse sand, some fine gravel, trace silt	-22.7
21		24" 10"	16,16,19,22	Olive grey, medium to coarse SAND, some fine sand, some fine gravel	-24.7
23		24" 12"	7,9,11,8	Olive grey, medium to coarse SAND, some fine sand, some fine gravel	-26.7
25		24" 12"	23,24,21,15	Olive grey, medium to coarse SAND, some fine sand, some fine gravel, transitions to olive grey, fine to medium SAND, trace silt	-28.7
26.25		15" 7"	17,16, 100/3"	Olive grey, fine to medium SAND, some silt, some gravel. Refusal at -29.95.	-29.95
26.60				Drilled with mill tooth roller bit, cleaned hole, and began core run at -30.30.	-30.3
31.60	48%	5.0' 4.4	6,6,7,6,6	Rock Core #1 -30.30' to -35.30' MLLW. 0.0-4.0' intensely to moderately fractured grey, GRANITE, 4.0 to 4.4' intensely fractured moderately weathered grey GRANITE	-35.3
36.60	49%	5.0' 4.35	8-7-8-7-7	Rock Core #2 -35.30' to -40.30' MLLW. 0.0' - 0.6' moderate to heavily weathered, moderately fractured grey, granitic GNEISS, 0.6' - 3.4' fresh, moderately fractured, grey, granitic GNEISS, gneissic banding progressively decreases, 3.4'-4.4' grey GRANITE	-40.3
41.60	74%	5.0' 4.9'	7-8-8-7-7	Rock Core #3 -40.30' to -45.30' MLLW. 0.0-2.2' intensely to moderately fractured grey, granitic GNEISS. 2.2-3.6' gradual transition into and out of intensly to moderately fractured pink and grey granite PEGMATITE, 3.6-4.9' intensely to moderately fractured grey granitic GNEISS	-45.3

Comments: The descriptions of the rock in the cores above are descriptions of the sampled rock in each recovered core length.

Notes:
1). Numbers in "Depth below mudline (ft)" column represent the depth below mudline of the bottom of the respective split-spoon, core run, or drill tool advancement.
2). Numbers in "Elevation (MLLW)" column represent the elevation of the bottom of the respective split-spoon, core run, or drill tool advancement.

Date: 9/23/2010
Time: 9:30 AM

BORING LOG

Project:	Phase IV Dredging	Project No: 6690.005	X: 816518.5
Location:	South Terminal Expansion		Y: 2687561.6
Elevation at mudline:	-9.4	Datum: MLLW	
Casing Type: Steel		Boring Depth: -31.6' MLLW	Boring No: A-2010-B6
Casing Diameter:	4"	Drill Rig: CME 45	
Drill Co:	NH Boring	Method: Drill and Wash	Sheet: 1 of 1
Driller:	Todd Pentacost	Log By: GAD	

Depth below mudline (ft)	RQD	Penetration/ Recovery	Blows per 6" / Drill Min. per Foot	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%	Elevation (MLLW)
2		24" 6"	WOR,WOR, WOR,WOR	0-1' Black, organic SILT 1'-2' Olive grey, medium to coarse SAND, some fine sand, trace silt	-11.4
6		24" 12"	20,22,41,30	Greenish grey, medium to coarse SAND, some fine gravel	-15.4
10		24" 12"	12,16,22,15	Greenish grey, medium to coarse SAND, some fine gravel.	-19.4
12.2				Drove casing to refusal, cleaned hole, and began core run at -21.6 MLLW	-21.6
17.2	73%	60" 51"	7,7,6,5,7	Rock Core #1: -21.6 to -26.6 MLLW - Intensely to moderately fractured grey granitic Gneiss.	-26.6
22.2	27%	60' 50"	8,12,6,7,6	Rock Core #2: -26.6 to -31.6 MLLW - Intensely fractured grey Granitic Gneiss (0"-36"), intensely fractured pink and grey Granite Pegmatite (36" to 50").	-31.6

Comments: Core run was completed at less revolutions per minute than recommended by core barrel manufacturer, drill time is not a good indicator of rock competency.

Notes:
1). Numbers in "Depth below mudline (ft)" column represent the depth below mudline of the bottom of the respective split-spoon, core run, or drill tool advancement.
2). Numbers in "Elevation (MLLW)" column represent the elevation of the bottom of the respective split-spoon, core run, or drill tool advancement.

Apex environmental, inc.

BORING LOG

Date: 9/24/2010
Time: 12:15 PM

Project:	Phase IV Dredging	Project No: 6690.005	X: 816781.1
Location:	South Terminal Expansion		Y: 2687710.6
Elevation at mudline:	-5.5	Datum: MLLW	
Casing Type: Steel		Boring Depth: -28.0' MLLW	Boring No: A-2010-B7
Casing Diameter:	4"	Drill Rig: CME 45	
Drill Co:	NH Boring	Method: Drill and Wash	Sheet: 1 of 1
Driller:	Todd Pentacost	Log By: GAD	

Depth below mudline (ft)	RQD	Penetration/ Recovery	Blows per 6" / Drill Min. per Foot	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%	Elevation (MLLW)
2		24" 12"	WOR,6,8,8	0-1' Black, organic SILT 1'-2' Olive Grey, fine to medium SAND, some shell hash, trace silt	-7.5
4		24" 12"	9/11/12/16	Olive Grey, fine to medium SAND, some shell hash, trace silt	-9.5
6		24" 12"	7/5/7/5	4'-4.5' Olive Grey, fine to medium SAND, some shell hash, trace silt 4.5'-6' Greenish grey, fine SAND and SILT	-11.5
8		24" 17"	15/23/100-5"	6'-7' Olive Grey, fine to medium SAND, some shell hash, trace silt 7'-7.4' Olive grey, fine SAND and SILT	-13.5
10		24" 24"	18/14/12/17	8'-8.5' Greenish grey, fine to medium SAND and fine angular GRAVEL 8.5'-9.5' Light grey, fine to medium SAND, some coarse SAND 9.5'-10' Greenish grey, fine SAND and SILT	-15.5
12		24" 24"	15/18/24/58	10'-11.5' Greenish grey, fine SAND and SILT, trace fine angular gravel 11.5'-12' Olive grey, medium to coarse SAND, trace rock fragments at tip.	-17.5
12.5				Drove casing to refusal, cleaned hole, and began core run at -18.0 MLLW	-18
17.5	88%	60" 56"	11/10/12/15/12	Rock Core #1: -18.5to -23.5 MLLW - Highly to moderately fractured grey and pink Granitic Gneiss	-23
22.5	61%	60" 40"	8/8/7/8/9	Rock Core #2: -23.5 to -28.5 MLLW - Highly to moderately fractured grey and pink Granitic Gneiss	-28

Comments: Core run was completed at less revolutions per minute than recommended by core barrel manufacturer, drill time is not a good indicator of rock competency.

Notes:
1). Numbers in "Depth below mudline (ft)" column represent the depth below mudline of the bottom of the respective split-spoon, core run, or drill tool advancement.
2). Numbers in "Elevation (MLLW)" column represent the elevation of the bottom of the respective split-spoon, core run, or drill tool advancement.

BORING LOG

Date: 3/17/2011
Time: 1:00 PM

Project:	Phase IV Dredging	Project No: 6690.008	X: 816606
Location:	South Terminal Expansion		Y: 2687892
Elevation at mudline:	-10.65	Datum: MLLW	
Casing Type: Steel		Boring Depth: -38.65' MLLW	Boring No: A-2011-B23
Casing Diameter:	4"	Drill Rig: CME 45	
Drill Co:	NH Boring	Method: Drill and Wash	Sheet: 1 of 1
Driller:	Norman Stuttard	Log By: GCD	

Depth below mudline (ft)	RQD	Penetration/ Recovery	Blows per 6" / Drill Min. per Foot	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%	Elevation (MLLW)
2		24" 8"	WOR, WOR, WOR, WOR	Top 4": Black, organic SILT. Last 4": Dark gray, fine to medium SAND and SILT, trace shell hash.	-12.65
7		24" 12"	13,13,17,21	Light gray, fine to coarse SAND.	-17.65
10		0" 0"	100/2"	No recovery.	-20.55
18.25				Obstruction encountered at -23.4 MLLW. Advanced roller bit through a series of obstructions, believed to be either a series of boulders or rock fragments to -28.85 MLLW.	-28.85
18.25		0" 0"	100/0"	No recovery.	-28.85
18.25				Cleaned hole and began core run at -28.85 MLLW.	-28.85
23	65%	4.8' 4.55'	8,9,9,10,11	Rock Core #1: -28.85 to -33.65 MLLW 0.0'-4.8' Intensely to moderately fractured pink grey GRANITE.	-33.65
28	85%	5' 5'	8,8,7,9,9	Rock Core #2: -33.65 to -38.65 MLLW 0.0'-5.0' Moderately fractured pink grey granitic GNEISS.	-38.65

Comments:

Notes: 1). Numbers in "Depth below mudline (ft)" column represent the depth below mudline of the bottom of the respective split-spoon, core run, or drill tool advancement.
2). Numbers in "Elevation (MLLW)" column represent the elevation of the bottom of the respective split-spoon, core run, or drill tool advancement.

BORING LOG

Date: 3/28/2011
Time: 9:29 AM

Project:	Phase IV Dredging	Project No: 6690.008	X: 816775
Location	South Terminal Expansion		Y: 2687636
Elevation at mudline:	-5.2	Datum: MLLW	
Casing Type: Steel		Boring Depth: -24.0' MLLW	Boring No: A-2011-B28
Casing Diameter:	4"	Drill Rig: CME 45	
Drill Co:	NH Boring	Method: Drill and Wash	Sheet: 1 of 1
Driller:	Norman Stuttard	Log By: GCD	

Depth below mudline (ft)	RQD	Penetration/ Recovery	Blows per 6" / Drill Min. per Foot	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%	Elevation (MLLW)
2		24" 14"	WOR, WOR, WOR, WOR	Black, organic SILT, trace fine to coarse sand, trace shell hash.	-7.2
4		24" 16"	10,6,10,12	Grey, fine to medium SAND, little shell hash.	-9.2
6		24" 16"	9,12,11,13	Tan to grey, very fine SAND, trace inorganic silt.	-11.2
8		24" 7"	10,18,17,18	Grey, fine SAND, little inorganic silt, little medium to coarse sand, trace gravel.	-13.2
10		24" 9"	10,20,29,32	Grey fine SAND, little silt, trace coarse gravel.	-15.2
12		24" 12"	20,27,29,43	Grey fine to coarse SAND, little silt, little fine to coarse gravel.	-17.2
13		12" 6"	24,37, 100/0"	Grey, fine to coarse SAND, little silt, little fine to coarse gravel.	-18.2
14.3				Encountered obstruction at -19.5 MLLW. Cleaned hole and began core run.	-19.5
18.8	36%	4.5' 4.5'	5,4,5,5	Rock Core #1: -19.5 to -24.0 MLLW - Intensely to moderately fractured pink grey granitic GNEISS.	-24.0

Comments: Intervals 0-2, 2-4. and 4-6 Sampled using a 3" diameter split spoon sampler, all of the other intervals were sampled using a standard 2" diameter split-spoon.

Notes:
1). Numbers in "Depth below mudline (ft)" column represent the depth below mudline of the bottom of the respective split-spoon, core run, or drill tool advancement.
2). Numbers in "Elevation (MLLW)" column represent the elevation of the bottom of the respective split-spoon, core run, or drill tool advancement.

APPENDIX D

DESIGN SOIL PROPERTIES

NEW BEDFORD MARINE TERMINAL
NEW BEDFORD, MA
GZA File No. 33734.03

APPENDIX D: DESIGN SOIL PROPERTIES USED IN SLOPE STABILITY, BLASTING, AND LIQUEFACTION ANALYSES

SOIL NAME	MATERIAL DESCRIPTION	γ_{SAT} (pcf)	Φ	SPT-N (*)	w% (**)	S_u (psf)	NOTES
"ARMOR STONE"	Ocean side hurrican barrier riprap	100	41	50	-	-	Riprap materials are granitic gneiss. Porosity of riprap 38-40%. Use n=40% and unit weight of stone=165pcf in calculation of unit weight of riprap layer.
"PROTECTION STONE"	Harbor side barrier riprap	100	40	50	-	-	Same as "armor stone".
"ROCK FILL"	Filled embankments below riprap on ocean and harbor side of barrier	115	45	50	-	-	Table 2, Part B, Duncan, J.M., Horz, R.C., Yang, T.L., Shear Strength Correlations for Geotechnical Engineering, Virginia Tech Depoartment of Civil Engineering, August, 1989.
"COMPACTED EARTH FILL"	Compacted fill in core of barrier above MLLW.	123	35	20	7%	-	Table 2, Part B - Classification and Strenght Parameters for Soils Tested Under Drained Conditions, Duncan, J.M., Horz, R.C., Yang, T.L., Shear Strength Correlations for Geotechnical Engineering, Virginia Tech Depoartment of Civil Engineering, August, 1989.
"DUMPED EARTH FILL"	Bulldozed fill in core of barrier below MLLW.	100	30	4	12%	-	Table 4 - Relationship Among Relative Density, Penetration Resistances, Dry Unit Weight, and Angle of Internal Friction of Cohesionless Soils, Duncan, J.M., Horz, R.C., Yang, T.L., Shear Strength Correlations for Geotechnical Engineering, Virginia Tech Depoartment of Civil Engineering, August, 1989.
"SAND AND GRAVEL"	Natural foundation soils	125	33	20	12%	-	Based on recent borings by APEX and original USACE borings (Reference 2).
"GLACIAL TILL"	Natural foundation soils	135	36	50	12%	-	
"ORGANIC SILT"	Natural soil	110	-	4	-	500	Based on original USACE laboratory testing (Reference 2).

References:

1. USACE Design Memo #2 New Bedford-Fairhaven Hurricane Barrier Site Geology, February, 1960.
2. USACE Design Memo #5 New Bedford-Fairhaven Hurricane Barrier Embankments and Foundations, November, 1961.
3. FHWA HEC 11 Design of Riprap Revetments, Appendix C, Chart 4, "Angle of Repose of Riprap on Terms of Mean Size and Shape of Stone".
4. Design & Construction of Ports & Marine Structures, 2nd Ed., Alonzo DeF. Quinn, 1972
5. Duncan, J.M., Horz, R.C., Yang, T.L., "Shear Strength Correlations for Geotechnical Engineering", Virginia Tech Department of Civil Engineering, August, 1989.

Notes:

* SPT N-values based on correlations between internal angles of frcition and relative density (Reference 5).

** Moisture content assumed and saturated unit weight calculated based on tabulated dry unit weights (Reference 5). Moisture content of 12% assumed for fully saturated granular soils.

APPENDIX E

LIQUEFACTION CALCULATION SPREADSHEETS

SPT-Based Liquefaction Susceptibility Calculation

Project:	New Bedford South Terminal	**Project No.:**	33734.03
Location:	New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA		
Calculated By:	JJM	**Date:**	8/23/2013
Checked By:	DYB	**Date:**	mm/dd/yyyy

Purpose: Estimate exploration-specific factor of safety against liquefaction .

Reference:

1. Idriss, I.M. and Boulanger, R.W. (2008). Soil *Liquefaction During Earthquakes.* Earthquake Engineering Research Institute. Oakland, California. EERI Publication No. MNO-12.

2. Idriss, I.M. and Boulanger, R.W. (2004). Semi-Empirical Procedures for Evaluating Liquefaction Potential During Earthquakes. Proceedings of the Joint International Conference on Soil Dynamics & Earthquake Engineering and International Conference on Earthquake Geotechnical Engineering. Berkeley, California. January, 2004. pp.32-56.

Instructions:

1. Create and modify calculation and plot worksheet tabs to accommodate necessary borings and depths.
2. Enter input parameters for each boring.
3. Input data from boring (depths, N, estimated fines content, and interpreted soil strata).
4. Check plots for accuracy and update as necessary.
5. If required, spot-check calculations using the MathCAD calculation verification form.

Input Parameters:

1. Use boring logs A-2011-B5, A-2010-B6. A-2010-B7, and A-2011-B28 for drilling data.

2. Create soil profiles "Internal Profile 1" and "Internal Profile 2" as shown in Figure E-1 based on USACE drawing no. NBF-1-0171 "New Bedford-Fairhaven Hurricane Barrier, Parking Area " dated April 1962. Design soil properties shown in Appendix D.

3. It will be assumed that a safety hammer was used for recent SPTs.

4. Organic silt found to be non-susceptible to liquefaction per Idriss I.M. and Boulanger, R.W., "New Criteria for Distinguishing Between Silts and Clays that are Susceptible to Liquefaction Versus Cyclic Failure", Technologies to Enhance Dam Safety and the Environment, 25th Annual USSD Conference, June, 2005 and available USACE laboratory data (attached).

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID: A-2011-B5

Calculated By: JJM Date: 8/23/2013
Checked By: DYB Date: mm/dd/yy

Elevation Data:
Ground Surface Elevation: -3.7
Groundwater Elevation: -3.7
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 9 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

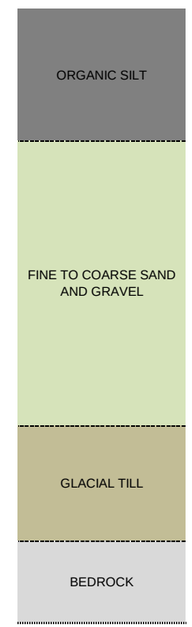
Subsurface Data and Parameter Calculations / Capacity/Demand Ratio (Factor of Safety) Calculations

Depth (mid-SPT interval) ft	Elev. ft	Depth m	Total Stress, σ_v psf	Effective Stress, σ'_v psf	N_{field} blows/ft	C_R	C_B	C_E	C_N	C_S	$(N_1)_{60}$	Fines Content %	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
2.0	-5.7	0.61	220	92.0	0	0.80	1.00	0.95	1.70	1.00	0.0	40	6	0.09	1.00	0.05	1.10	0.10	1.00	0.13	
4.0	-7.7	1.22	440	184.0	0	0.80	1.00	0.95	1.70	1.00	0.0	40	6	0.09	1.00	0.05	1.10	0.10	1.00	0.13	
6.0	-9.7	1.83	660	276.0	6	0.85	1.00	0.95	1.70	1.00	8.2	40	14	0.15	1.00	0.09	1.10	0.16	0.99	0.12	
8.0	-11.7	2.44	880	368.0	55	0.85	1.00	0.95	1.38	1.00	61.1	5	61	4.13	1.00	0.30	1.10	4.55	0.99	0.12	**10.00**
10.0	-13.7	3.05	1100	460.0	15	0.85	1.00	0.95	1.70	1.00	20.6	5	21	0.21	1.00	0.14	1.10	0.23	0.98	0.12	**1.90**
12.0	-15.7	3.66	1320	552.0	51	0.95	1.00	0.95	1.29	1.00	59.4	5	59	4.13	1.00	0.30	1.10	4.55	0.98	0.12	**10.00**
14.0	-17.7	4.27	1540	644.0	22	0.95	1.00	0.95	1.53	1.00	30.4	5	30	0.51	1.00	0.21	1.10	0.56	0.97	0.12	**4.58**
16.0	-19.7	4.88	1760	736.0	17	0.95	1.00	0.95	1.54	1.00	23.6	5	24	0.26	1.00	0.15	1.10	0.29	0.96	0.12	**2.36**
18.0	-21.7	5.49	1980	828.0	39	0.95	1.00	0.95	1.28	1.00	45.1	15	48	4.13	1.00	0.30	1.10	4.55	0.96	0.12	**10.00**
20.0	-23.7	6.10	2200	920.0	35	0.95	1.00	0.95	1.28	1.00	40.3	5	40	4.13	1.00	0.30	1.10	4.55	0.95	0.12	**10.00**
22.0	-25.7	6.71	2420	1012.0	20	0.95	1.00	0.95	1.34	1.00	24.2	5	24	0.27	1.00	0.16	1.10	0.30	0.94	0.12	**2.53**
24.0	-27.7	7.32	2640	1104.0	45	1.00	1.00	0.95	1.17	1.00	49.9	30	55	4.13	1.00	0.30	1.10	4.55	0.93	0.12	**10.00**
26.0	-29.7	7.92	2860	1196.0	100	1.00	1.00	0.95	1.02	1.00	96.6	15	100	4.13	1.00	0.30	1.10	4.55	0.92	0.12	**10.00**

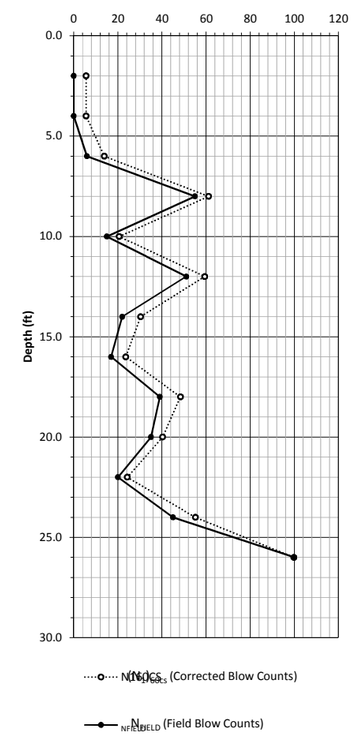
Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.

Results

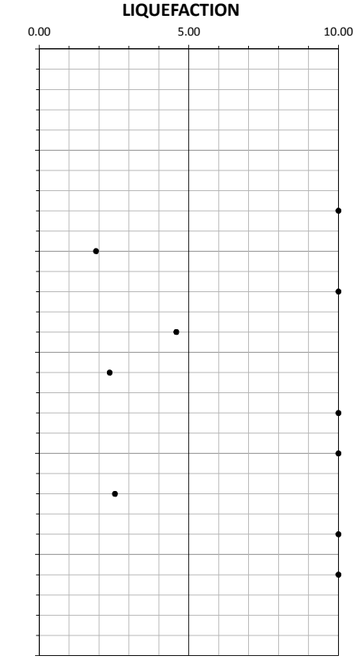
INTERPRETED SOIL PROFILE



SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID:	**A-2011-B6**

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date: 12/27/2012

Elevation Data:
Ground Surface Elevation: -9.4
Groundwater Elevation: -9.4
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 15 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

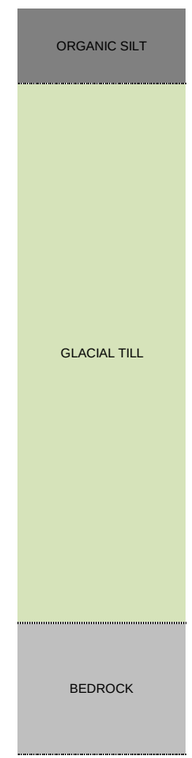
Subsurface Data and Parameter Calculations / **Capacity/Demand Ratio (Factor of Safety) Calculations**

Depth (mid-SPT interval)	Elev.	Depth	Total Stress, σ_v	Effective Stress, σ'_v	N_{field}	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
ft	ft	m	psf	psf	blows/ft							%									
1.0	-10.4	0.30	110	46.0	0	0.85	1.00	0.95	1.70	1.00	0.0	40	6	0.09	1.00	0.05	1.10	0.10	1.00	0.13	
5.0	-14.4	1.52	550	230.0	63	0.95	1.00	0.95	1.31	1.00	74.4	5	74	4.13	1.00	0.30	1.10	4.55	1.00	0.13	**10.00**
9.0	-18.4	2.74	990	414.0	38	0.95	1.00	0.95	1.47	1.00	50.4	5	50	4.13	1.00	0.30	1.10	4.55	0.98	0.12	**10.00**
11.0	-20.4	3.35	1210	506.0	100	0.95	1.00	0.95	1.05	1.00	94.9	5	95	4.13	1.00	0.30	1.10	4.55	0.98	0.12	**10.00**

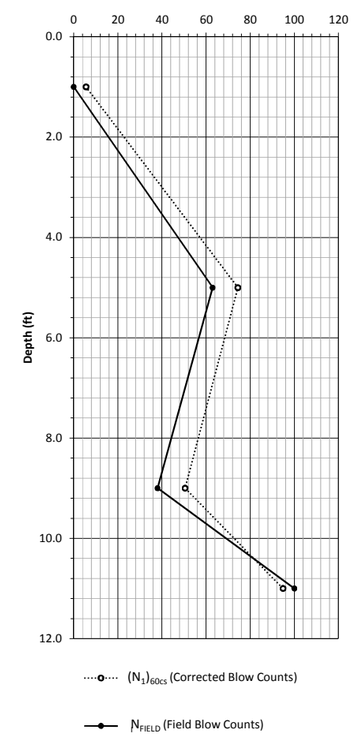
Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.

Results

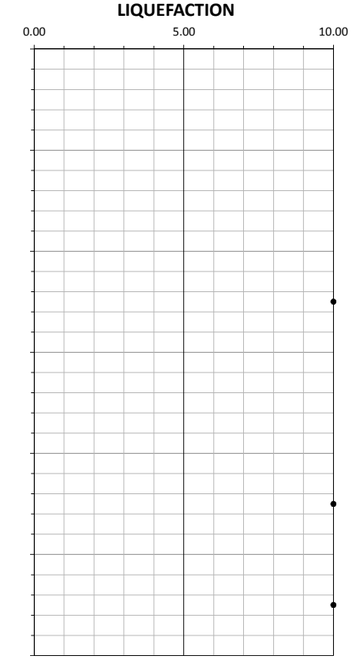
INTERPRETED SOIL PROFILE



SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID: A-2011-B7

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date: 12/27/2012

Elevation Data:
Ground Surface Elevation: -9.4
Groundwater Elevation: -9.4
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 15 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

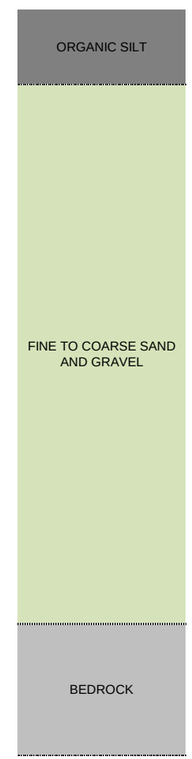
Subsurface Data and Parameter Calculations / **Capacity/Demand Ratio (Factor of Safety) Calculations**

Depth (mid-SPT interval)	Elev.	Depth	Total Stress, σ_v	Effective Stress, σ'_v	N_{field}	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
ft	ft	m	psf	psf	blows/ft							%									
1.0	-10.4	0.30	110	46.0	14	0.85	1.00	0.95	1.70	1.00	19.2	40	25	0.29	1.00	0.13	1.10	0.31	1.00	0.13	
3.0	-12.4	0.91	330	138.0	23	0.85	1.00	0.95	1.70	1.00	31.6	5	32	0.60	1.00	0.22	1.10	0.66	1.00	0.13	**5.28**
5.0	-14.4	1.52	550	230.0	13	0.95	1.00	0.95	1.70	1.00	19.9	5	20	0.21	1.00	0.13	1.10	0.23	1.00	0.13	**1.80**
7.0	-16.4	2.13	770	322.0	100	0.95	1.00	0.95	1.06	1.00	95.8	5	96	4.13	1.00	0.30	1.10	4.55	0.99	0.12	**10.00**
9.0	-18.4	2.74	990	414.0	26	0.95	1.00	0.95	1.64	1.00	38.6	5	39	2.66	1.00	0.30	1.10	2.93	0.98	0.12	**10.00**
11.0	-20.4	3.35	1210	506.0	42	0.95	1.00	0.95	1.38	1.00	52.4	5	52	4.13	1.00	0.30	1.10	4.55	0.98	0.12	**10.00**

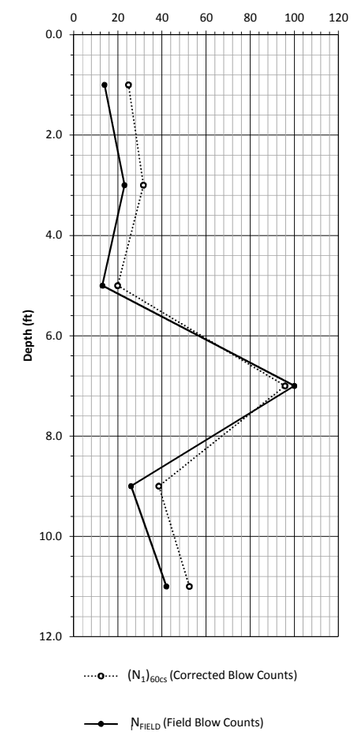
Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.

Results

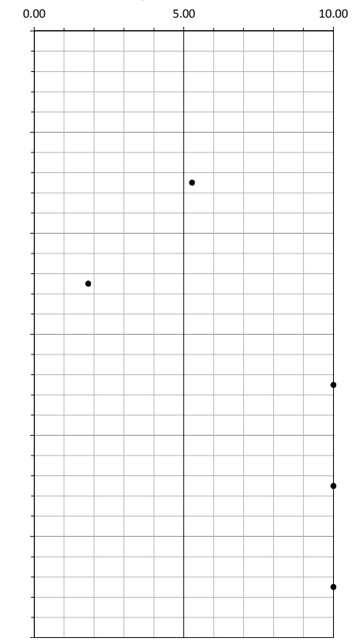
INTERPRETED SOIL PROFILE



SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID:	**A-2011-B28**

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date: 12/27/2012

Elevation Data:
Ground Surface Elevation: -9.4
Groundwater Elevation: -9.4
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 15 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

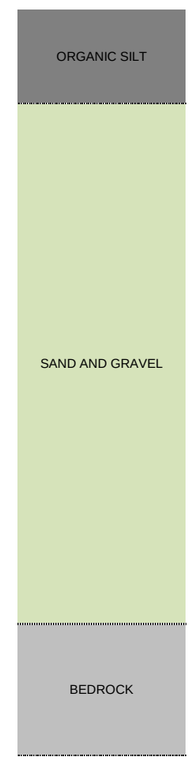
Subsurface Data and Parameter Calculations / **Capacity/Demand Ratio (Factor of Safety) Calculations**

Depth (mid-SPT interval)	Elev.	Depth	Total Stress, σ_v	Effective Stress, σ'_v	N_{field}	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
ft	ft	m	psf	psf	blows/ft							%									
1.0	-10.4	0.30	110	46.0	0	0.85	1.00	0.95	1.70	1.00	0.0	40	6	0.09	1.00	0.05	1.10	0.10	1.00	0.13	
3.0	-12.4	0.91	330	138.0	23	0.85	1.00	0.95	1.70	1.00	31.6	5	32	0.60	1.00	0.22	1.10	0.66	1.00	0.13	**5.28**
5.0	-14.4	1.52	550	230.0	35	0.95	1.00	0.95	1.66	1.00	52.3	5	52	4.13	1.00	0.30	1.10	4.55	1.00	0.13	**10.00**
7.0	-16.4	2.13	770	322.0	49	0.95	1.00	0.95	1.40	1.00	61.9	5	62	4.13	1.00	0.30	1.10	4.55	0.99	0.12	**10.00**
9.0	-18.4	2.74	990	414.0	56	0.95	1.00	0.95	1.30	1.00	65.7	5	66	4.13	1.00	0.30	1.10	4.55	0.98	0.12	**10.00**
11.0	-20.4	3.35	1210	506.0	100	0.95	1.00	0.95	1.05	1.00	94.9	5	95	4.13	1.00	0.30	1.10	4.55	0.98	0.12	**10.00**

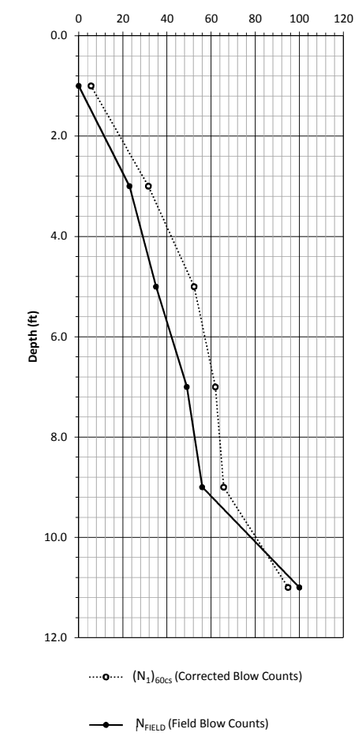
Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.

Results

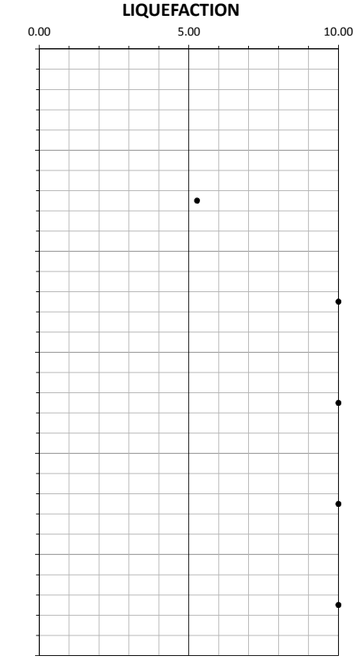
INTERPRETED SOIL PROFILE



SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID:	**FD-6**

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date:

Elevation Data:
Ground Surface Elevation: -7.5
Groundwater Elevation: -7.5
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Donut Hammer
Typical rod stickup during SPT: 15 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

Subsurface Data and Parameter Calculations / **Capacity/Demand Ratio (Factor of Safety) Calculations**

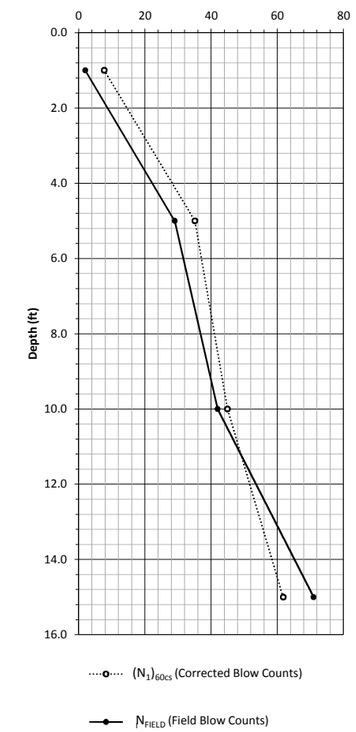
Depth (mid-SPT interval)	Elev.	Depth	Total Stress, σ_v	Effective Stress, σ'_v	N_{field}	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
ft	ft	m	psf	psf	blows/ft							%									
1.0	-8.5	0.30	110	46.0	2	0.85	1.00	0.75	1.70	1.00	2.2	40	8	0.10	1.00	0.07	1.10	0.11	1.00	0.13	
5.0	-12.5	1.52	550	230.0	29	0.95	1.00	0.75	1.70	1.00	35.1	5	35	1.14	1.00	0.26	1.10	1.25	1.00	0.13	**10.00**
10.0	-17.5	3.05	1100	460.0	42	0.95	1.00	0.75	1.50	1.00	45.0	5	45	4.13	1.00	0.30	1.10	4.55	0.98	0.12	**10.00**
15.0	-22.5	4.57	1650	690.0	71	0.95	1.00	0.75	1.22	1.00	61.8	5	62	4.13	1.00	0.30	1.10	4.55	0.97	0.12	**10.00**

Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.

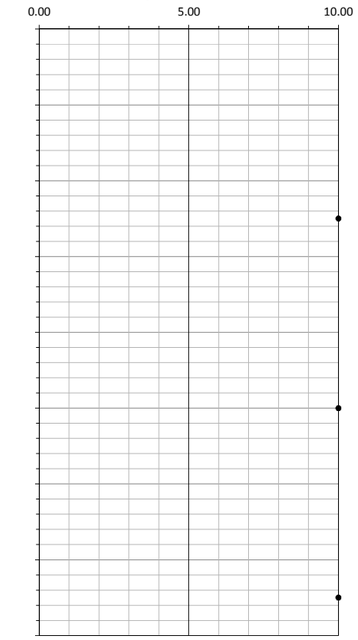
Results

INTERPRETED SOIL PROFILE

SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID: FD-7

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date:

Elevation Data:
Ground Surface Elevation: -5.1
Groundwater Elevation: -5.1
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 15 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

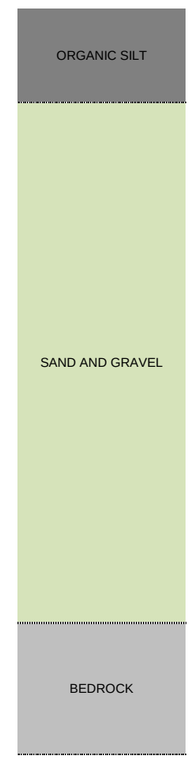
Subsurface Data and Parameter Calculations / **Capacity/Demand Ratio (Factor of Safety) Calculations**

Depth (mid-SPT interval) ft	Elev. ft	Depth m	Total Stress, σ_v psf	Effective Stress, σ'_v psf	N_{field} blows/ft	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content %	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
1.0	-6.1	0.30	110	46.0	0	0.85	1.00	0.75	1.70	1.00	0.0	40	6	0.09	1.00	0.05	1.10	0.10	1.00	0.13	
5.0	-10.1	1.52	550	230.0	14	0.95	1.00	0.75	1.70	1.00	17.0	5	17	0.17	1.00	0.12	1.10	0.19	1.00	0.13	**1.52**
9.0	-14.1	2.74	990	414.0	32	0.95	1.00	0.75	1.66	1.00	37.8	5	38	2.14	1.00	0.30	1.10	2.35	0.98	0.12	**10.00**
14.0	-19.1	4.27	1540	644.0	31	0.95	1.00	0.75	1.50	1.00	33.0	5	33	0.77	1.00	0.24	1.10	0.84	0.97	0.12	**6.90**
19.0	-24.1	5.79	2090	874.0	22	1.00	1.00	0.75	1.43	1.00	23.6	5	24	0.26	1.00	0.15	1.10	0.29	0.95	0.12	**2.39**

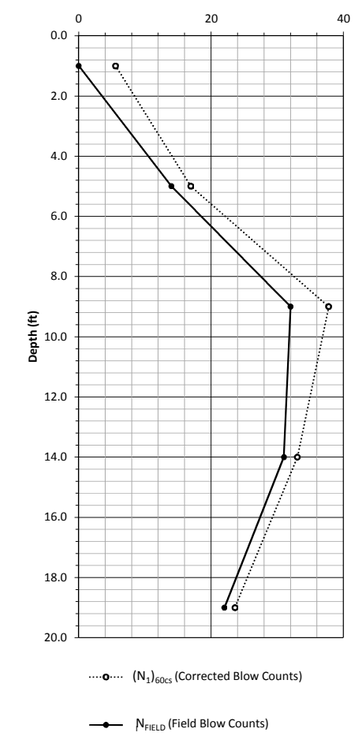
Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.

Results

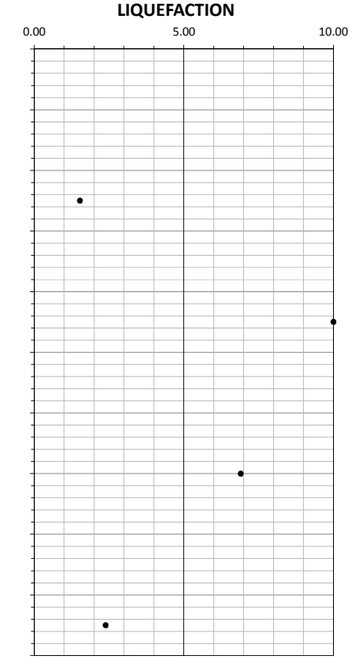
INTERPRETED SOIL PROFILE



SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID:	**FD-93**

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date:

Elevation Data:
Ground Surface Elevation: -9.2
Groundwater Elevation: -9.2
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 15 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

Subsurface Data and Parameter Calculations / **Capacity/Demand Ratio (Factor of Safety) Calculations**

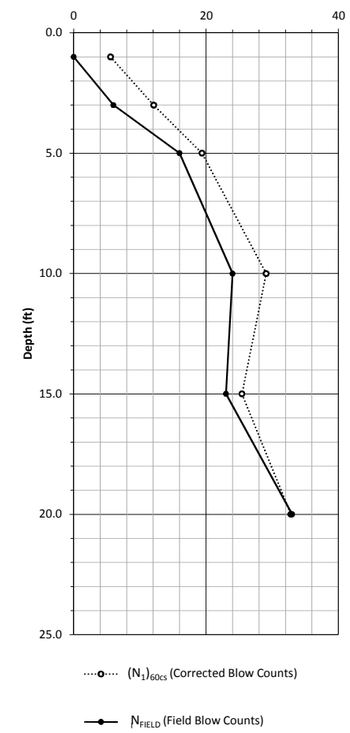
Depth (mid-SPT interval)	Elev.	Depth	Total Stress, σ_v	Effective Stress, σ'_v	N_{field}	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
ft	ft	m	psf	psf	blows/ft							%									
1.0	-10.2	0.30	110	46.0	0	0.85	1.00	0.75	1.70	1.00	0.0	40	6	0.09	1.00	0.05	1.10	0.10	1.00	0.13	
3.0	-12.2	0.91	330	138.0	6	0.85	1.00	0.75	1.70	1.00	6.5	40	12	0.13	1.00	0.08	1.10	0.15	1.00	0.13	**1.16**
5.0	-14.2	1.52	550	230.0	16	0.95	1.00	0.75	1.70	1.00	19.4	5	19	0.20	1.00	0.13	1.10	0.22	1.00	0.13	**1.74**
10.0	-19.2	3.05	1100	460.0	24	0.95	1.00	0.75	1.70	1.00	29.1	5	29	0.43	1.00	0.19	1.10	0.48	0.98	0.12	**3.85**
15.0	-24.2	4.57	1650	690.0	23	0.95	1.00	0.75	1.55	1.00	25.4	5	25	0.30	1.00	0.17	1.10	0.33	0.97	0.12	**2.72**
20.0	-29.2	6.10	2200	920.0	33	1.00	1.00	0.75	1.33	1.00	32.8	5	33	0.74	1.00	0.23	1.10	0.81	0.95	0.12	**6.78**

Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.

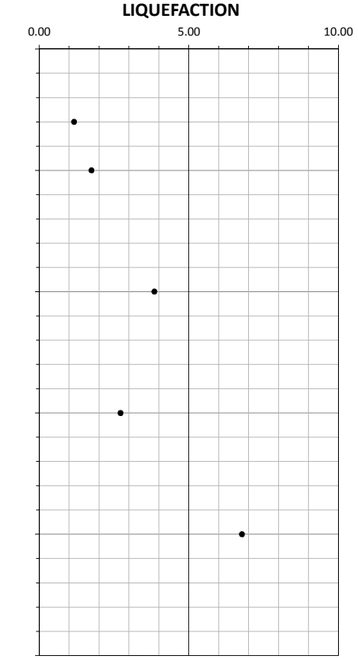
Results

INTERPRETED SOIL PROFILE

SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID: INTERNAL 1

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date: 12/27/2012

Elevation Data:
Ground Surface Elevation: 20.0
Groundwater Elevation: 0.0
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 4 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

Subsurface Data and Parameter Calculations / Capacity/Demand Ratio (Factor of Safety) Calculations

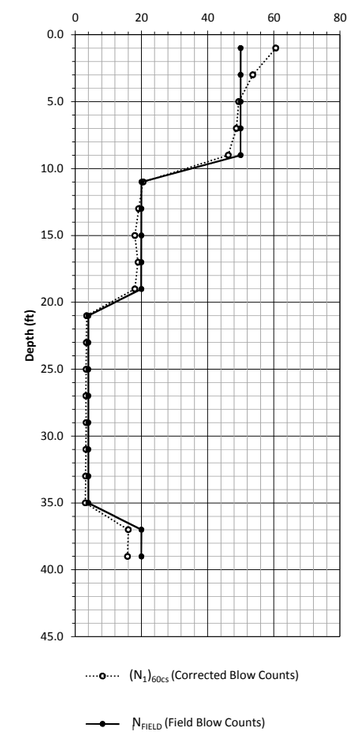
Depth (mid-SPT interval) ft	Elev. ft	Depth m	Total Stress, σ_v psf	Effective Stress, σ'_v psf	N_{field} (*) blows/ft	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content %	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
1.0	19.0	0.30	110	110.0	50	0.75	1.00	0.95	1.70	1.00	60.6	5	61	4.13	1.00	0.30	1.10	4.55	1.00	0.05	**10.00**
3.0	17.0	0.91	330	330.0	50	0.75	1.00	0.95	1.51	1.00	53.6	5	54	4.13	1.00	0.30	1.10	4.55	1.00	0.05	**10.00**
5.0	15.0	1.52	550	550.0	50	0.75	1.00	0.95	1.39	1.00	49.4	5	49	4.13	1.00	0.30	1.10	4.55	1.00	0.05	**10.00**
7.0	13.0	2.13	770	770.0	50	0.80	1.00	0.95	1.28	1.00	48.7	5	49	4.13	1.00	0.30	1.10	4.55	0.99	0.05	**10.00**
9.0	11.0	2.74	990	990.0	50	0.80	1.00	0.95	1.22	1.00	46.2	5	46	4.13	1.00	0.30	1.10	4.55	0.98	0.05	**10.00**
11.0	9.0	3.35	1210	1210.0	20	0.85	1.00	0.95	1.27	1.00	20.5	5	20	0.21	1.00	0.14	1.07	0.23	0.98	0.05	**4.42**
13.0	7.0	3.96	1430	1430.0	20	0.85	1.00	0.95	1.18	1.00	19.1	5	19	0.20	1.00	0.13	1.05	0.21	0.97	0.05	**4.01**
15.0	5.0	4.57	1650	1650.0	20	0.85	1.00	0.95	1.11	1.00	18.0	5	18	0.18	1.00	0.12	1.03	0.19	0.97	0.05	**3.72**
17.0	3.0	5.18	1870	1870.0	20	0.95	1.00	0.95	1.05	1.00	19.0	5	19	0.19	1.00	0.13	1.01	0.20	0.96	0.05	**3.90**
19.0	1.0	5.79	2090	2090.0	20	0.95	1.00	0.95	1.00	1.00	18.0	5	18	0.18	1.00	0.12	1.00	0.18	0.95	0.05	**3.68**
21.0	-1.0	6.40	2310	2246.0	4	0.95	1.00	0.95	0.95	1.00	3.4	5	3	0.08	1.00	0.07	0.99	0.08	0.94	0.05	**1.51**
23.0	-3.0	7.01	2530	2338.0	4	0.95	1.00	0.95	0.93	1.00	3.4	5	3	0.08	1.00	0.07	0.99	0.08	0.94	0.05	**1.43**
25.0	-5.0	7.62	2750	2430.0	4	0.95	1.00	0.95	0.91	1.00	3.3	5	3	0.08	1.00	0.07	0.99	0.08	0.93	0.06	**1.37**
27.0	-7.0	8.23	2970	2522.0	4	0.95	1.00	0.95	0.89	1.00	3.2	5	3	0.08	1.00	0.07	0.99	0.08	0.92	0.06	**1.32**
29.0	-9.0	8.84	3190	2614.0	4	1.00	1.00	0.95	0.87	1.00	3.3	5	3	0.08	1.00	0.07	0.98	0.08	0.91	0.06	**1.29**
31.0	-11.0	9.45	3410	2706.0	4	1.00	1.00	0.95	0.85	1.00	3.2	5	3	0.08	1.00	0.07	0.98	0.07	0.90	0.06	**1.25**
33.0	-13.0	10.06	3630	2798.0	4	1.00	1.00	0.95	0.83	1.00	3.1	5	3	0.08	1.00	0.07	0.98	0.07	0.90	0.06	**1.22**
35.0	-15.0	10.67	3850	2890.0	4	1.00	1.00	0.95	0.81	1.00	3.1	5	3	0.08	1.00	0.07	0.98	0.07	0.89	0.06	**1.19**
37.0	-17.0	11.28	4070	2982.0	20	1.00	1.00	0.95	0.84	1.00	16.0	5	16	0.17	1.00	0.12	0.96	0.16	0.88	0.06	**2.51**
39.0	-19.0	11.89	4290	3074.0	20	1.00	1.00	0.95	0.83	1.00	15.8	5	16	0.16	1.00	0.11	0.96	0.16	0.87	0.06	**2.44**

Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.
2. SPT N-values assumed based on referenced soil properties

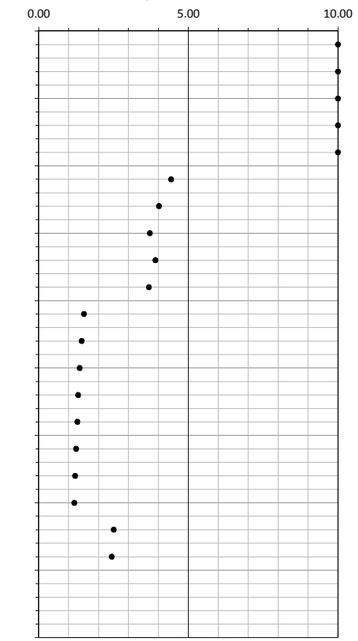
Results

INTERPRETED SOIL PROFILE

SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

SPT-Based Liquefaction Susceptibility Calculation

Project:New Bedford South Terminal
Location: New Bedford-Fairhaven Hurricane Barrier, New Bedford, MA
Project No.: 33734.03
Calculations Reference: Idriss & Boulanger (2008)

Exploration ID: INTERNAL 2

Calculated By: JJM Date: 12/7/2012
Checked By: DYB Date: 12/27/2012

Elevation Data:
Ground Surface Elevation: 14.0
Groundwater Elevation: 0.0
Unit Weight of Water (pcf): 64.0

SPT Correction Factors:
Split Spoon Type: I.D.=1-3/8 in - Standard Sampler
Hammer Type: Safety Hammer
Typical rod stickup during SPT: 4 ft
Borehole Diameter: ≤4.5 in

Material Properties:
Assumed Soil Weight Above Water Table, γ = 110 pcf
Assumed Soil Weight Below Water Table, γ_{sat} = 46.0 pcf
Atmospheric Pressure, P_a = 2088 psf
Effective Friction Angle: 30 deg

Seismic Assumptions (API Preliminary)
Max Accel at Surface, a_{max} (g)= 0.081
Design Earthquake Magnitude, M = 7.5
Is void redistribution significant? Yes
Earthquake Return Period (yrs) n/a

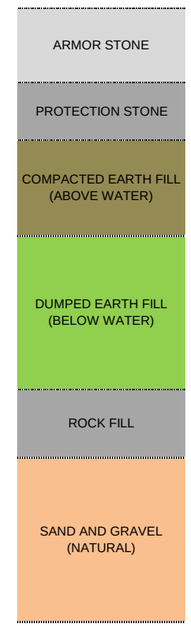
Subsurface Data and Parameter Calculations / Capacity/Demand Ratio (Factor of Safety) Calculations

Depth (mid-SPT interval) ft	Elev. ft	Depth m	Total Stress, σ_v psf	Effective Stress, σ'_v psf	N_{field} (*) blows/ft	C_R	C_B	C_E	C_N	C_s	$(N_1)_{60}$	Fines Content %	$(N_1)_{60CS}$	CRR	MSF	C_σ	K_σ	CRR_{corr}	r_d	CSR	F_s
1.0	13.0	0.30	110	110.0	50	0.75	1.00	0.95	1.70	1.00	60.6	5	61	4.13	1.00	0.30	1.10	4.55	1.00	0.05	**10.00**
3.0	11.0	0.91	330	330.0	50	0.75	1.00	0.95	1.51	1.00	53.6	5	54	4.13	1.00	0.30	1.10	4.55	1.00	0.05	**10.00**
5.0	9.0	1.52	550	550.0	50	0.75	1.00	0.95	1.39	1.00	49.4	5	49	4.13	1.00	0.30	1.10	4.55	1.00	0.05	**10.00**
7.0	7.0	2.13	770	770.0	50	0.80	1.00	0.95	1.28	1.00	48.7	5	49	4.13	1.00	0.30	1.10	4.55	0.99	0.05	**10.00**
9.0	5.0	2.74	990	990.0	50	0.80	1.00	0.95	1.22	1.00	46.2	5	46	4.13	1.00	0.30	1.10	4.55	0.98	0.05	**10.00**
11.0	3.0	3.35	1210	1210.0	20	0.85	1.00	0.95	1.27	1.00	20.5	5	20	0.21	1.00	0.14	1.07	0.23	0.98	0.05	**4.42**
13.0	1.0	3.96	1430	1430.0	20	0.85	1.00	0.95	1.18	1.00	19.1	5	19	0.20	1.00	0.13	1.05	0.21	0.97	0.05	**4.01**
15.0	-1.0	4.57	1650	1586.0	4	0.85	1.00	0.95	1.19	1.00	3.8	5	4	0.08	1.00	0.07	1.02	0.08	0.97	0.05	**1.54**
17.0	-3.0	5.18	1870	1678.0	4	0.95	1.00	0.95	1.15	1.00	4.1	5	4	0.08	1.00	0.07	1.02	0.08	0.96	0.06	**1.47**
19.0	-5.0	5.79	2090	1770.0	4	0.95	1.00	0.95	1.11	1.00	4.0	5	4	0.08	1.00	0.07	1.01	0.08	0.95	0.06	**1.38**
21.0	-7.0	6.40	2310	1862.0	4	0.95	1.00	0.95	1.08	1.00	3.9	5	4	0.08	1.00	0.07	1.01	0.08	0.94	0.06	**1.31**
23.0	-9.0	7.01	2530	1954.0	4	0.95	1.00	0.95	1.04	1.00	3.8	5	4	0.08	1.00	0.07	1.00	0.08	0.94	0.06	**1.25**
25.0	-11.0	7.62	2750	2046.0	50	0.95	1.00	0.95	1.01	1.00	45.4	5	45	4.13	1.00	0.30	1.01	4.16	0.93	0.07	**10.00**
27.0	-13.0	8.23	2970	2138.0	50	0.95	1.00	0.95	0.99	1.00	44.8	5	45	4.13	1.00	0.30	0.99	4.10	0.92	0.07	**10.00**
29.0	-15.0	8.84	3190	2230.0	20	1.00	1.00	0.95	0.97	1.00	18.4	5	18	0.19	1.00	0.13	0.99	0.19	0.91	0.07	**2.72**
31.0	-17.0	9.45	3410	2322.0	20	1.00	1.00	0.95	0.95	1.00	18.1	5	18	0.18	1.00	0.12	0.99	0.18	0.90	0.07	**2.61**
33.0	-19.0	10.06	3630	2414.0	20	1.00	1.00	0.95	0.94	1.00	17.8	5	18	0.18	1.00	0.12	0.98	0.18	0.90	0.07	**2.51**
35.0	-21.0	10.67	3850	2506.0	20	1.00	1.00	0.95	0.92	1.00	17.5	5	17	0.18	1.00	0.12	0.98	0.17	0.89	0.07	**2.43**

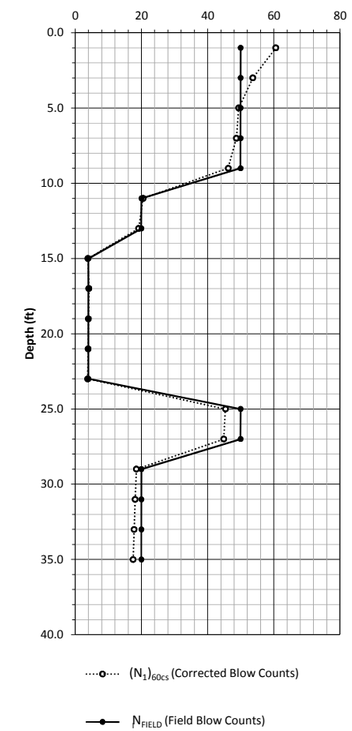
Notes: 1. Factor of safety calculations limited to 10.0. Actual FS may be greater but shown as 10.0.
2. SPT N-values assumed based on referenced soil properties

Results

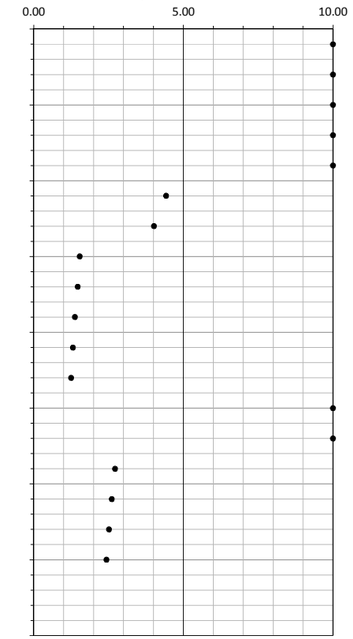
INTERPRETED SOIL PROFILE



SPT PROFILE



FACTOR OF SAFETY AGAINST LIQUEFACTION



Liquefaction Likely (Fs < 1.1)

Possible Flow Liquefaction or Cyclic Strain Softening (1.1 ≤ FS < 1.4)

Attachment 2

Chet Myers

From: Chet Myers
Sent: Friday, February 22, 2013 5:23 PM
To: 'Bachand, Michael L NAE'; Bill White
Cc: 'gary.davis@state.ma.us'; Michalak, Scott C NAE; Christopher Morris
Subject: RE: Follow-Up on NBMCT (UNCLASSIFIED)

Hi Michael,

Thanks so much for your comments/questions.

The Commonwealth will prepare a Hurricane Barrier Vibration Monitoring Plan. The plan will address the means and methods for monitoring vibration at the Hurricane Barrier caused by blasting. The Commonwealth will submit this plan for your review prior to the start of blasting.

At your request, the Plan will include:

1. Inspection of the navigational gate abutments in addition to the items previously described within the Pre-Blast Survey.
2. A topographic survey, as requested, of the center line of the Hurricane Barrier.
3. A minimum of two vibration monitoring points, at least one along the Hurricane Barrier and one along the West abutment of the navigation gate.
4. Pre-blast "baseline" monitoring (at least 8 hours of continuous readings).
5. A policy that USACE is to receive a copy of all submittals and reports associated with the blasting program.
6. A policy that USACE operations division, specifically, staff at the navigation gate be included in the pre-blast notification chain described in a paragraph 3.6.6 of Section 02900.
7. Vibration monitoring limits below the values referenced in paragraph 3.7.3 of Section 02900, that would require the Contractor to review and revise blasting methods to avoid reaching or exceeding the threshold vibration limits in the referenced paragraph.

We will try to prepare the plan and submit it for your review as soon as possible.

Thanks,

Chet Myers
Apex Companies, LLC

O) 617-728-0070 x113 M) 617-908-5778

-----Original Message-----
From: Bachand, Michael L NAE [mailto:Michael.L.Bachand@usace.army.mil]
Sent: Friday, February 22, 2013 4:32 PM
To: Bill White; Chet Myers
Cc: 'gary.davis@state.ma.us'; Michalak, Scott C NAE; Christopher Morris
Subject: RE: Follow-Up on NBMCT (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Bill, Chet,
As we discussed, USACE has reviewed Apex's revised Blasting Evaluation Analysis and Specification Section 02900 and offers the following comments/questions:

1. While they are beyond the 1500-ft radius, USACE requests the two navigation gate (West and East) abutments be included during the Pre-Blast Survey.

2. USACE requests a topographic survey along the centerline of the Harbor Dike (between New Bedford and the West abutment of the navigation gate) approximately every 50-ft, three spot elevations along each of the East and West navigation gate abutments. This survey should be performed prior to any blasting and upon conclusion of the blasting program.

3. USACE requests two vibration monitoring points during all blasting activities along USACE property. First at a point along the Harbor Dike (shortest distance from the Dike to the blast location) and one along the West abutment of the navigation gate.

4. USACE requests that the Contractor or Owner's Representative perform a pre-blast "baseline" reading at each of the vibration monitoring points located on USACE property (1 at the gate and 1 on the dike as requested in #4) . The "baseline" reading should include a minimum of 8-hrs of continuous readings from the vibration monitoring device.

5. USACE requests a copy of all submittals and reports associated with the blasting program.

6. USACE requests that our operations division, specifically, staff at the navigation gate be included in the pre-blast notification chain described in a paragraph 3.6.6 of Section 02900. USACE will follow up with the specific contact information at a later date as a comment to one of the blasting submittals.

7. USACE requests that the Vibration Monitoring Plan establish vibration monitoring limits (PPV values) below the values referenced in paragraph 3.7.3 of Section 02900,that would require the Contractor to review and revise blasting methods to avoid reaching or exceeding the threshold vibration limits in the referenced paragraph.

The comments should be addressed prior to the start of any blasting activities. Please confirm your intent and how (i.e. revised specification, submittal process, etc) you propose to address the comments in a response email. USACE will issue an acceptance letter based on a commitment to addressing these items.

If you have any questions, please don't hesitate to contact me.

Regards,

Michael L. Bachand, P.E.
Levee Safety Program Manager

United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742
Office: 978.318.8075
Cell: 978.551.1656

-----Original Message-----
From: Bill White [mailto:bwhite@MassCEC.com]
Sent: Tuesday, February 05, 2013 8:39 AM
To: Bachand, Michael L NAE
Cc: 'gary.davis@state.ma.us'; 'cmyers@apexcos.com'; Michalak, Scott C NAE; Christopher Morris
Subject: RE: Follow-Up on NBMCT (UNCLASSIFIED)

Mike,

You should receive the design drawing and specs today or tomorrow morning.

Many thanks,

Bill

Bill White
Director, Offshore Wind Sector Development Massachusetts Clean Energy Center
55 Summer Street, 9th Floor, Boston, MA 02110
(617) 315-9330

www.masscec.com

-----Original Message-----
From: Bachand, Michael L NAE [mailto:Michael.L.Bachand@usace.army.mil]
Sent: Monday, February 04, 2013 2:07 PM
To: Bill White
Cc: 'gary.davis@state.ma.us'; 'cmyers@apexcos.com'; Michalak, Scott C NAE
Subject: RE: Follow-Up on NBMCT (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Bill,
I received the hard copies of the APEX report. However, I don't see the design drawings and specifications. Can you send those?

Michael L. Bachand, P.E.
Levee Safety Program Manager

United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742
Office: 978.318.8075
Cell: 978.551.1656

-----Original Message-----
From: Bill White [mailto:bwhite@MassCEC.com]
Sent: Monday, February 04, 2013 1:39 PM
To: Bachand, Michael L NAE
Cc: 'gary.davis@state.ma.us'; 'cmyers@apexcos.com'; Michalak, Scott C NAE
Subject: RE: Follow-Up on NBMCT (UNCLASSIFIED)

Mike,

Today, you should have received via UPS two hard copies of the updated blasting report from Chet Myers at APEX. Please let us know if you need any additional information. We very much appreciate your responsiveness to our request.

Best,

Bill

Bill White
Director, Offshore Wind Sector Development Massachusetts Clean Energy Center
55 Summer Street, 9th Floor, Boston, MA 02110
(617) 315-9330

www.masscec.com

-----Original Message-----
From: Bachand, Michael L NAE [mailto:Michael.L.Bachand@usace.army.mil]
Sent: Friday, February 01, 2013 9:48 AM
To: Bill White
Cc: 'gary.davis@state.ma.us'; 'cmyers@apexcos.com'; Michalak, Scott C NAE
Subject: RE: Follow-Up on NBMCT (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Bill,
I am in the process of downloading the files. To facilitate the review, is it possible to get 2 hard copies? For any drawings, true half size drawings would be preferred but full size is acceptable if you have those accessible.

Thanks - Mike

Michael L. Bachand, P.E.
Levee Safety Program Manager

United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742
Office: 978.318.8075
Cell: 978.551.1656

-----Original Message-----
From: Bill White [mailto:bwhite@MassCEC.com]
Sent: Thursday, January 31, 2013 3:54 PM
To: Michalak, Scott C NAE; Bachand, Michael L NAE
Cc: 'gary.davis@state.ma.us'; 'cmyers@apexcos.com'
Subject: RE: Follow-Up on NBMCT

Michael & Scott,

Thanks very much for your time this morning. As you requested, I wanted to forward the link for information regarding the bid for the New Bedford Marine Commerce Terminal. The plans and specifications, as well as all the addenda, have been loaded onto an electronic repository, due to the size of the documents.

As part of Addendum #1, electronic versions of the plans and specifications were issued as Attachment C. Please note that they are referenced within the repository as "Addendum 1 - Attachment C - Electronic Version of NBMCT(Plans/Specifications)".

This following information will allow access to the electronic repository:

http://dms.apexcos.com
Username: NBMCT
Password: NBMCT

Additionally, USEPA has issued a Final Determination for the New Bedford Marine Commerce Terminal, which (subject to specific conditions) serves as permitting for the project to proceed under the authority of the New Bedford Superfund Site Record of Decision. The Final Determination can be reached at the following link:

http://www.epa.gov/region1/superfund/sites/newbedford/525556.pdf

We appreciate your help. Please let Chet Myers or I know if you have any questions.

Thanks,

Bill

_____

From: Bill White
Sent: Thursday, January 31, 2013 8:14 AM
To: 'Scott.C.Michalak@usace.army.mil'
Cc: 'cmyers@apexcos.com'; 'karen.k.adams@nae02.usace.army.mil'; 'gary.davis@state.ma.us'
Subject: Re: Follow-Up on NBMCT

Scott,

Thanks for the return call yesterday. Would you have time for a brief call this morning anytime btwn 830 and 930?

Thanks,

Bill

----- Original Message -----
From: Bill White
Sent: Wednesday, January 30, 2013 01:04 PM
To: Michalak, Scott C NAE <Scott.C.Michalak@usace.army.mil>
Cc: Chet Myers (cmyers@apexcos.com) <cmyers@apexcos.com>; karen.k.adams@nae02.usace.army.mil <karen.k.adams@nae02.usace.army.mil>; Davis, Gary (DCR) (gary.davis@state.ma.us) <gary.davis@state.ma.us>
Subject: Follow-Up on NBMCT

Scott,

I'm Bill White, and I'm overseeing the New Bedford Marine Commerce Terminal project for the MA Clean Energy Center. At the suggestion of Karen Adams, I left you a voicemail earlier today regarding the note below. I would be grateful if you could call me back on cell today if possible. My cell is 617 610-4413.

Many thanks,

Bill

Bill White
Director, Offshore Wind Sector Development Massachusetts Clean Energy Center
55 Summer Street, 9th Floor, Boston, MA 02110
(617) 315-9330

www.masscec.com

-----Original Message-----
From: Chet Myers [mailto:cmyers@apexcos.com]
Sent: Tuesday, January 29, 2013 10:01 AM
To: Bachand, Michael L NAE
Cc: Ann Williams; Carl Dierker; Cynthia Catri; ElaineT Stanley; Kimberly Tisa; Jackie Leclair; Mike Marsh; Phil Colarusso; Ralph Abele; Sneeringer, Paul J NAE; Davis, Gary (DCR); Jay Borkland; Michalak, Scott C NAE; Keegan, Michael F NAE; Bill White; Gregory Dolan
Subject: RE: New Bedford HPS - 408 Requirements for Acceptance (UNCLASSIFIED)

Hi Mr. Bachand,

Just wanted to check to see if you had had a chance to take a look at the Commonwealth's updated submittal regarding the assessment of the potential impacts to the NB Hurricane Barrier due to blasting associated with the New Bedford Marine Commerce Terminal.

Please see below for information on how to download the report, but hopefully you have had a chance to download and are reviewing.

Thanks so much for your time and effort on this!

Please let us know where we are with regard to review, and what sort of timing you expect for potential approval.

We are currently out to bid on the job, and would very much appreciate additional certainty on whether blasting will be allowable or not.

Chet Myers
Apex Companies, LLC
O) 617-728-0070 x113 M) 617-908-5778

-----Original Message-----
From: Chet Myers
Sent: Friday, January 11, 2013 6:37 PM
To: 'Bachand, Michael L NAE'
Cc: 'Ann Williams'; 'Carl Dierker'; 'Cynthia Catri'; 'ElaineT Stanley'; 'Kimberly Tisa'; 'Jackie Leclair'; 'Mike Marsh'; 'Phil Colarusso'; 'Ralph Abele'; 'Sneeringer, Paul J NAE'; 'Davis, Gary (DCR)'; Jay Borkland; 'Michalak, Scott C NAE'; 'Keegan, Michael F NAE'; 'Bill White'; Gregory Dolan
Subject: RE: New Bedford HPS - 408 Requirements for Acceptance (UNCLASSIFIED)

Mr. Bachand,

The Commonwealth has prepared a revised submission for the potential impacts to the NB Hurricane Barrier due to blasting associated with the New Bedford Marine Commerce Terminal. The revised submission addresses USACE's comments issued within a November 21, 2012 e-mail (see below).

Please note that GZA Geoenvironmental has issued a revised report (included as Attachment 1 to the revised submission).

Also please not that, due to the size of the final document, and a desire on the part of the Commonwealth to retain resolution of the final document, the document is not attached to this e-mail, and has instead been uploaded to Apex Companies' document management site, which can be accessed in the following manner:

To retrieve the document, please use the following internet address:
http://dms.apexcos.com

When prompted, enter the following username and password:

username: hurricanebarrier
password: hurricanebarrier

Please let us know if there is any additional information you require, or if you would like to meet to discuss the results of the report.

Additionally, if you have any problems accessing the site, please contact the undersigned.

Thank you,

Chet Myers
Apex Companies, LLC
O) 617-728-0070 x113 M) 617-908-5778

-----Original Message-----
From: Bachand, Michael L NAE [mailto:Michael.L.Bachand@usace.army.mil]
Sent: Wednesday, November 21, 2012 2:55 PM
To: Chet Myers
Cc: Ann Williams; Carl Dierker; Cynthia Catri; ElaineT Stanley; Kimberly Tisa; Jackie Leclair; Mike Marsh; Phil Colarusso; Ralph Abele; Sneeringer, Paul J NAE; Davis, Gary (DCR); Jay Borkland; Michalak, Scott C NAE; Keegan, Michael F NAE
Subject: RE: New Bedford HPS - 408 Requirements for Acceptance (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Mr. Myers,
USACE has reviewed Apex's submittal pursuant to 33 USC 408 dated October 17, 2012 and offers the following comments:

1. In the cover letter please provide a statement addressing residual risk. The New Bedford HPS has been accredited by FEMA and therefore a statement should be made stating that based on the evaluations performed, no risk and/or damages to the New Bedford HPS will occur, assuming this is your conclusion.

2. The letter presented a slope stability analysis of potential impacts due to blasting. However, no liquefaction analysis was performed. As previously requested, please perform a liquefaction analysis using the test borings collected for the dredging project and test boring data (to the extent possible) from the original design of the New Bedford HSP.

3. The appendices of the PDF file were not readable. Therefore, USACE was not able to review the input parameters used in the analysis.

4. In attachment 1, page 3, last paragraph, it states the dredge elevation in the vicinity of the barrier is -20 feet MLLW. However, during the 8/21/12 meeting, the figures showed the maximum dredge depth to be -32 feet MLLW. Which is correct?

5. In addition to the calculated Charge Weight per Delay, please report the corresponding Peak Particle Velocity (PPV). USACE would like to review the PPV numbers and use the results as guidance when establishing the monitoring program in the blasting specification.

If you would like to discuss or have any questions please don't hesitate to contact me.

Regards,

Michael L. Bachand, P.E.
Levee Safety Program Manager

United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742
Office: 978.318.8075
Cell: 978.551.1656

-----Original Message-----
From: Chet Myers [mailto:cmyers@apexcos.com]
Sent: Thursday, November 08, 2012 5:28 PM
To: Bachand, Michael L NAE; Michalak, Scott C NAE; Keegan, Michael F NAE
Cc: Ann Williams; Carl Dierker; Cynthia Catri; ElaineT Stanley; Kimberly Tisa; Jackie Leclair; Mike Marsh; Phil Colarusso; Ralph Abele; Sneeringer, Paul J NAE; Davis, Gary (DCR); Jay Borkland
Subject: RE: New Bedford HPS - 408 Requirements for Acceptance (UNCLASSIFIED)

Hi Mr. Bachand, Mr. Michalak, and Mr. Keegan,

Just wanted to check to see if you had had a chance to take a look at the Commonwealth's submittal regarding the assessment of the potential impacts to the NB Hurricane Barrier due to blasting associated with the New Bedford Marine Commerce Terminal.

Is there any additional information requested by USACE? Has USACE already reviewed this information?

Do you have an idea what the timetable for USACE review is?

Thanks so much for your time and effort on this!

Chet Myers
Apex Companies, LLC
O) 617-728-0070 x113 M) 617-908-5778

-----Original Message-----
From: Chet Myers
Sent: Wednesday, October 17, 2012 3:02 PM
To: Bachand, Michael L NAE; Michalak, Scott C NAE; Keegan, Michael F NAE

Cc: Ann Williams; Carl Dierker; Cynthia Catri; ElaineT Stanley; Kimberly Tisa; Jackie Leclair; Mike Marsh; Phil Colarusso; Ralph Abele; 'Sneeringer, Paul J NAE'; Davis, Gary (DCR); Jay Borkland
Subject: New Bedford HPS - 408 Requirements for Acceptance (UNCLASSIFIED)

Mr. Bachand, Mr. Michalak, and Mr. Keegan,

Attached please find the Commonwealth's formal submittal of the assessment of the potential impacts to the NB Hurricane Barrier due to blasting associated with the New Bedford Marine Commerce Terminal.

The Commonwealth utilized GZA Geoenvironmental to conduct its geotechnical assessment of the potential impacts. GZA calculated weights of charges at specific distances that could be acceptably utilized while not impacting the factors of safety associated with the Hurricane Protection System in New Bedford Harbor.

The Commonwealth is proposing to set a limit within its specifications, restricting any use of blasting agents to 1/2 of the levels recommended by GZA.

Please let us know if there is any additional information you require, or if you would like to meet to discuss the results of the report.

Thank you,

Chet Myers
Apex Companies, LLC
O) 617-728-0070 x113 M) 617-908-5778

-----Original Message-----
From: Sneeringer, Paul J NAE [mailto:Paul.J.Sneeringer@usace.army.mil]
Sent: Thursday, August 30, 2012 1:45 PM
To: Davis, Gary (DCR); Chet Myers; Jay Borkland
Cc: Ann Williams; Carl Dierker; Cynthia Catri; ElaineT Stanley; Kimberly Tisa; Jackie Leclair; Mike Marsh; Phil Colarusso; Ralph Abele; Bachand, Michael L NAE; Michalak, Scott C NAE
Subject: FW: New Bedford HPS - 408 Requirements for Acceptance (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Gary, Chet, and Jay:

Enclosed for your records is the list of information that the Corps Levee Safety Team will need in order to evaluate potential impacts to the New Bedford Hurricane Protection System ("HPS") (under Section 408) associated with blasting work for the South Terminal Project.

I previously included this list as an attachment to the August 21, 2012 Meeting Note Package, but I wanted to make absolutely sure that you have this information.

Feel free to contact Mike Bachand at (978) 318-8075 if you have additional questions about the required documentation. Thanks.

Paul Sneeringer
(978) 505-9216

-----Original Message-----
From: Bachand, Michael L NAE
Sent: Thursday, August 23, 2012 2:20 PM
To: Keegan, Michael F NAE; Sneeringer, Paul J NAE
Cc: Michalak, Scott C NAE
Subject: FW: New Bedford HPS - 408 Requirements for Acceptance (UNCLASSIFIED)

As discussed during the August 21, 2012 meeting, performing blasting near or adjacent to the New Bedford Hurricane Protection System (HPS) will require USACE acceptance in accordance with guidance and Title 33 United States Code Section 408 (33 USC 408) requirements. It is likely the acceptance will require local (District level) and headquarters approval. To facilitate the approvals under the 408 process, the following information will be needed for review:

1. Test boring logs, detailed engineering drawings, and construction specifications showing the proposed locations, site conditions, and blasting techniques being proposed. The drawings should show all existing structures, utilities, easements/R-O-W, dimensions, and pertinent HPS components located in the vicinity of the proposed work area and/or impacted by the blasting.

2. A technical analysis (liquefaction, post-liquefaction settlement, and seismic/residual slope stability) and summary memorandum on the potential impacts to the existing New Bedford HPS.

3. Discussion of residual risk

4. Discussion of Executive Order 11988 considerations

5. Compliance with Environmental Protection policies.

See the attached the attached 408 Clarification Guidance memo dated November 17, 2008 and attached Submittal Package Guide at the end of Memo for detailed information required for USC 408 review & acceptance. I have also included a copy of 33 USC 408 and a policy memorandum dated October 23, 2006 for your reference.

Finally, USACE will review the draft Proposed Construction Specification for Blasting and provide suggested edits.

Regards,

Michael L. Bachand, P.E.
Levee Safety Program Manager

United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742
Office: 978.318.8075
Cell: 978.551.1656

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Attachment 3

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO
ATTENTION OF

March 1, 2013

Engineering/Planning Division
Geotechnical/Water Resources Branch

Mr. Dave Lederer
Remedial Project Manager
Office of Site Remediation and Restoration
EPA Region 1, Suite 100, OSRR 7-04
5 Post Office Square
Boston, Massachusetts 02176

Dear Mr. Lederer:

This letter is in regards to the proposed New Bedford Marine Commerce Terminal adjacent to the U.S. Army Corps of Engineers (USACE) federally constructed New Bedford Hurricane Shore Protection (HSP) System in the city of New Bedford, Massachusetts.

The proposed project will construct a multiuse marine facility within the limits of New Bedford harbor and directly adjacent to the federally constructed New Bedford HSP System. Construction of the facility may require the use of blasting techniques to remove bedrock required to achieve a maximum proposed draft depth Elevation of -20 ft (MLLW). The proposed blasting is in close proximity to the New Bedford HSP, and thus USACE requested design analysis to address concerns to liquefaction and general blasting impacts to the HSP System and therefore was the sole focus of USACE's review.

The USACE New England District reviewed the information supplied in the following documents:

a. Letter report titled "*Request for District Engineer Review of Engineering Assessment Which Outlines the Procedures that Will Result in No Modification or Alternation to a Corps of Engineers Project: Blasting Associated With Construction of New Bedford Marine Commerce Terminal, New Bedford, MA*" prepared by Apex Companies LLC and GEI Consultants dated, January 11, 2013.

b. For Construction Project Specifications titled "*New Bedford Marine Commerce Terminal, Contract No. MACEC-FY13-001NB* " prepared by Apex Companies LLC, dated December 5, 2012, received via Fedex on February 6, 2013.

c. For Construction Design Drawings titled "*New Bedford Marine Commerce Terminal, Contract No. MACEC-FY13-001NB* " prepared by Apex Companies LLC, dated December 2012, received via Fedex on February 6, 2013.

Printed on Recycled Paper

d. Email correspondence providing Apex Companies, LLC responses to USACE review comments on documents a, b, and c above, from Mr. Chet Meyers, Apex Companies LLC, to Mr. Michael Bachand, USACE, dated February 22, 2013.

USACE has no objections to the proposed blasting evaluation and blasting program based on the commitments and responses provided in the email correspondence (item d above) and provides the following comments:

- No blasting shall occur a minimum of 3 days before a hurricane or significant coastal storm that potentially would require gate closures is forecasted to potentially impact the northeast coastline.

- Any damages to the HSP System or appurtenant components by the activities described above must be immediately repaired to the satisfaction of USACE.

- The issuance of this acceptance does not relieve Apex Companies LLC, the Commonwealth of Massachusetts, or the United States Environmental Protection Agency from its obligation to obtain any other federal, state, or local approvals or permits as may be required for this project, including but not limited to Section 10 and Section 404 permits.

- Any changes or amendments to the above referenced contract documents or drawings shall be submitted to and approved by USACE *prior* to implementation. Additionally, USACE reserves the right to require any and all project submittals for review and acceptance.

- Within 45 days of completion of the blasting program, Apex Companies LLC, shall furnish the District Engineer with two complete hard copy sets and one electronic copy (PDF format) of all blasting reports and evaluations and any other pertinent information requested by the USACE, signed and sealed by a professional engineer/land surveyor. All vertical data shall be in North American Vertical Datum of 1988 (NAVD 88). All post dredged elevations and areas should also be provided on "As-Built" drawings in relation to the HSP.

Be assured that USACE holds life and public safety paramount with regards to protecting the communities behind the New Bedford HPS System. Should you have any further questions or concerns, please feel free to contact me, at (978) 318-8220 or Michael Bachand at (978) 318-8075.

Sincerely,

Charles P. Samaris
Colonel, Corps of Engineers
District Engineer

Copy Furnished:

Ronald H Labelle
City of New Bedford, DPI
Commissioner
1105 Shawmut Avenue
New Bedford, Massachusetts 02746

Jeffrey Osuch
Town Executive
Town Hall, 48 Center Street
Fairhaven, Massachusetts 02719

Steve Fluegel
Project Manager, New Bedford –
Fairhaven Hurricane Barrier
40 Academy Drive
P.O. Box 1555
Buzzards Bay, Massachusetts 02532-1555

Cynthia Catri
Senior Enforcement Counsel
EPA Region 1, Suite 100, OES04-2
5 Post Office Square
Boston, Massachusetts 02176

Chet H. Meyers, PE, LSP
Apex Companies, LLC
125 Broad Street, 5th Floor
Boston, Massachusetts 02110

Bill White
Director, Offshore Wind Sector Development
Massachusetts Clean Energy Center
55 Summer Street, 9th Floor
Boston, Massachusetts 02110

Larry Davis – USACE NAE - OPS

Chet Myers

From: Bachand, Michael L NAE [Michael.L.Bachand@usace.army.mil]
Sent: Friday, March 08, 2013 8:54 AM
To: 'lederer.dave@epa.gov'
Cc: 'Bill White'; Chet Myers; Michalak, Scott C NAE
Subject: RE: USACE Acceptance Letter - Clarification (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Mr. Lederer,
I am writing to clarify USACE's position as stated in March 1, 2013 letter with respect to the maximum dredge depth. USACE's review was focused on two aspects: (1) slope stability of the dredged area directly adjacent to the New Bedford HPS and (2) blasting effects on the New Bedford HPS.

The slope stability evaluations that we reviewed evaluated a maximum dredge elevation of -20 (MLLW) in the area directly adjacent to the New Bedford HPS system. The evaluation stated the area with a maximum dredge elevation of -32 (MLLW) is outside the area of influence from a slope stability perspective and therefore not a concern. The dredge elevation of -20 (MLLW) referenced in the March 1, 2013 letter is relevant to USACE because of its proximity to the barrier and potential slope stability impacts.

The blasting evaluation that was performed is a function of the distance from the New Bedford HPS and not directly connected to the maximum dredge elevation of -32 (MLLW). USACE understands that blasting activities would occur in the area's needed to achieve a dredge elevation of -32 (MLLW). The elevation -32 (MLLW) dredge area is accounted for in the blasting evaluation because the distances measured from the barrier and used in the evaluation encompass the footprint of the elevation -32 (MLLW) dredge area. Therefore, USACE does not have any objections with the dredge elevation of -32 (MLLW) as currently shown on the drawings (referenced in item "c" of our March 1, 2013 letter).

Should you have any questions please don't hesitate to contact me directly.

Regards,

Michael L. Bachand, P.E.
Levee Safety Program Manager

United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742
Office: 978.318.8075
Cell: 978.551.1656

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED

Caveats: NONE

Attachment 4

SECTION 02900

BLASTING

PART 1 GENERAL

1.1 BLASTING REGULATIONS, CONTROLS AND RESPONSIBILITIES

1.1.1 General

In general, the Contractor shall assume that no blasting is allowed in association with the New Bedford Marine Commerce Terminal project, that rock removal in association with the Work must take place utilizing non-blasting methods as outlined within Section 02482 DREDGING, and shall bid the Work accordingly; however, should Optional Bid Item No. 0005 be approved by the Owner, blasting will be allowed in association with the Work, subject to the conditions of Section 02900 BLASTING, the USEPA Final Determination (and subsequent amendments, as applicable), the Performance Standards, as well as other conditions of the Plans and Specifications including, but not limited to, conditions within Section 02482 DREDGING, Section 02470 DRILLED ROCK SOCKETS, Section 02458 CONCRETE FILLED STEEL PIPE PILES, Section 02488 STEEL SHEET PILING, and Section 01135 WATER QUALITY MONITORING AND CONTROL.

When the nature of the material to be dredged requires blasting, the Contractor's blasting progress and methods shall be those necessary to accomplish the excavation shown on the Contract Drawings in accordance with the procedures specified herein. The Contractor shall note that an Operational Blasting Plan shall be submitted for review by the Owner, Owner’s Representative, as well as regulatory oversight authorities as noted in Part 3.9 of this Section. The Contractor will be required to make necessary plans, examinations, surveys, and test blasts to determine the quantity of explosives that can be fired without damaging property, and to thereafter control the quantity of explosives fired in any one blast to prevent injuries to persons or damage to structures, homes, utilities, vehicles, vessels moored or underway, or any property. The Contractor's blasting program shall abide by all Federal, State and Local laws and regulations, which include, but are not limited to, the following applicable codes and regulations:

- Title 29 Code of Federal Regulations Part 1926, Safety and Health Regulations for Construction.
- Federal Occupation Safety and Health Act of 1970.
- Army Corps of Engineers EM-385-1-1, Safety and Health Requirements Manual.
- Institute of Makers of Explosives (IME); Safety Publications.
- Board of Fire Prevention Regulations, Code of Massachusetts Regulations, Title 527, Section 13

1.1.2 Liabilities

The Contractor's attention is called to Article 5 of Section 00700 of the General Conditions entitled “Laws to be Observed”, which defines the Contractor's responsibilities relative to the references listed in paragraph 1.1.1. The Contractor shall assume all liability and hold and save the Owner, its representatives, officers, agents, and employees harmless for any and all claims for personal injuries, property damages, or other claims arising out of, or in connection with, the transportation, storage, and use of explosives under the contract.

1.1.3 The Contractor shall, in addition, process any and all claims of private citizens arising out of said use of explosives promptly in an acceptable time period set by the Owner’s Representative; in particular, all property damage claims shall be acknowledged by the Contractor, or his representative, and be submitted immediately as directed by the Owner’s Representative providing name of claimant, location, time and description of alleged damage, and estimated value. The claimed damage shall be inspected by the Blasting Vibration Consultant (see paragraph 3.7.3) within 48 hours following initial notification, and processed to a conclusion (honored, denied, or compromised) within 90 days after cessation of all blasting on the contract; but, in no case shall the claims remain unresolved for a period exceeding 6 months (180 calendar days). The Contractor shall submit inspection results and actions taken to the Owner’s Representative on a weekly basis.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TRANSPORTATION, STORAGE, AND USE OF EXPLOSIVES

The Contractor will be held responsible to perform the work in compliance with all applicable Federal, State, and local codes and regulations, including, but not limited to, those cited above in paragraph 1.1.1. The Contractor shall have available the documents for inspection at all times, which will pertain to the blasting operation. In case of conflict between codes and regulations, the more stringent will apply.

3.1.1 Daily Summary

The Contractor shall keep a daily record of transactions, to be maintained at each storage magazine. The inventory records shall be updated at close of business each day and furnished to the Owner’s Representative on a weekly basis. Records shall show class and quantities received and issued, and total remaining on hand at end of each day. The remaining stock shall be checked each day, and any discrepancies that would indicate a theft or loss of explosive materials shall be reported immediately. The daily summary shall be done in accordance with the applicable regulations cited in paragraph 1.1.1. Copies of the daily inventory records shall be furnished to the Owner’s Representative.

3.1.2 Report of Loss

Should a loss or theft of explosives occur, all circumstances and details of the loss/theft will be immediately reported to the nearest office of the

Alcohol, Tobacco, Firearms and Explosives (ATF), as well as to the local and State law enforcement authorities and the Owner’s Representative.

ATF Boston Field Office
10 Causeway Street, Room 791
Boston, Massachusetts 02222
Telephone: 617-557-1200

The New Bedford Fire Department should be contacted at the following address:

New Bedford Fire Department
868 Pleasant Street
New Bedford, Massachusetts 02740
Telephone: 508-991-6105, 508-991-6124.

3.2 RESPONSIBILITY

The Contractor shall be responsible for obtaining all licenses, permits, any and all fees, and the keeping of accounts and records, as well as arranging the transportation and protection of all explosives on the contract, and notifying the relevant local, state and federal authorities of its work. Should the Contractor fail to comply with above requirements, the Owner’s Representative may order a suspension of that part of work involved until the deficiencies are corrected. The Contractor's attention is also directed to subparagraph 1.1.2 "Liabilities" for additional specific liability to be assumed by the Contractor. The Contractor must supply to the Owner’s Representative all permits, licenses and approvals which are necessary for this contract as required by the regulations cited in paragraph 1.1.1.

3.3 PREBLAST PUBLIC INFORMATION MEETINGS

3.3.1 The Contractor shall schedule, publicize, coordinate, secure adequate facilities for, and conduct two Preblast Public Information Meetings prior to finalizing his Operational Blasting Plan. The meeting shall be held in New Bedford, Massachusetts. As a minimum, the meetings shall be publicized in advertisements in local newspapers, including the Standard Times, not less than two weeks prior to the scheduled meeting for a period of not less than one week. State and local agencies likely to express an interest in the project shall be contacted in writing directly, including law enforcement, fire prevention, and environmental authorities. The Owner’s Representative will solicit interest from appropriate Federal agencies. In addition, all property owners whose properties border a portion of the contract limits shall be contacted in writing directly. A post test blast public information meeting shall be conducted at the above location, if requested by the Owner’s Representative.

3.3.2 The contents of the advertisements shall be approved by the Owner’s Representative prior to advertisement. Copies of all correspondence publicizing the meetings shall be furnished to the Owner’s Representative.

3.3.3 The purpose of the meetings is to disseminate basic project information to interested members of the public, to solicit comments from the public and evaluate proposed blasting methods in light of any valid concerns, and to identify key representatives of the Contractor and Owner’s Representative who may be contacted for current project information or to report complaints. The Contractor, in conjunction with the Owner’s Representative, shall prepare an agenda for each meeting to address these purposes. A public question-and-answer period shall be held at the conclusion of the public presentation if required by the Owner’s Representative.

3.3.4 The Owner’s Representative will participate in each meeting, and will provide reasonable assistance in planning, scheduling, and coordination with the public.

3.3.5 The proceedings of each meeting shall be recorded verbatim by the Contractor, and transcripts thereof shall be provided to the Owner’s Representative. The Owner’s Representative will review the transcripts, as well as any written comments that may be received, with the Contractor, and may require the Contractor to address specific comments in his Operational Blasting Plan prior to submission.

3.4 PROTECTION FOR ADMINISTRATION OF DRILLING AND BLASTING COMPLAINTS

3.5 PREBLAST SURVEY

The Contractor shall provide one person from his organization and his specialist on vibration control (Seismic specialist, see paragraph 3.7.3) to work as a team with a representative of the Owner’s Representative in making a preblast structural survey. A preblast survey of the interior and exterior of all structures shall be made within a one thousand five hundred (1500) foot radius from the production blasting areas. The Contractor must notify the property owners near the blasting areas of the preblast survey as defined below. All structures that may be affected by the blasting, as well as those enumerated in paragraph 3.7.3, will be inspected and their condition documented. Any existing outstanding architectural defects such as broken or fallen plaster or broken windows shall be photographically documented by digital video and with a minimum 7 mega-pixel digital camera with zoom capabilities. The Contractor shall provide methodology to be used in conducting the preblast survey and listing of structures, determined from the survey to be sensitive, with reasons for these structures being sensitive, within 1500 feet from the blasting areas. Photographs will be taken of all the surveyed structures. The Contractor will determine the elevation of all piers and record with photographs all floating vessels that are in the vicinity and that are vulnerable to wave propagation.

The Contractor shall certify that the survey was prepared prior to the start of any blasting under this contract. A copy of the Preblast survey shall be submitted for the Owner's Representative’s approval in conjunction with the Operational Blasting Plan.

3.5.1 Prior to test blast program and Blasting activities, the following actions regarding property owners located within 1,500 feet of proposed blasting locations are required:

A. Newspaper Advertisements-Advertisements in the local newspapers informing the public about the location, date and time of the Public Information Meetings.

B. Public Information Meetings

C. Door hangers providing information about the blasting and the request for pre-blast property inspection surveys to the property owners residing within 1,500 ft from the blast site.

D. Requests by first class mail to all property owners for pre-blast property inspections within the 1,500 foot radius of blasting

E. Where there has been no response to first requests, second requests by certified letter for pre-blast property inspections.

F. Where there has been no response to second requests, the Contractor shall inform the property owner by certified mail that he has not responded to both requests for inspections and will provide the date and time that blasting will be commencing .

3.5.2 During blasting activities, the process for addressing citizens complaints will be as follows:

A. Citizen complaints will be received through the Contractor.

B. The caller's name, address, phone number, and pertinent information will be recorded in a master complaint log to be maintained by the Contractor.

C. Contractor shall schedule and perform an inspection of the complainant's property within five calendar days of the date of the complaint.

D. The Contractor shall issue an acknowledgement letter not later than seven days from the inspection date as a follow up to the inspection and update the complainant as to the status of the final determination of the inspection results.

E. The Contractor shall provide to the complainant a final determination letter honoring, denying the claim within 90 days after cessation of all blasting on the contract. In no case shall the claims remain unresolved for a period exceeding 180 calendar days.

F. Inspection results, actions taken and all correspondence regarding the complaints shall be furnished to the Owner’s Representative.

3.6 SAFETY

3.6.1 Drill Boat or Barge Safety

3.6.1.1 All onboard magazines shall be permanently secured to the deck as required by the Coast Guard.

3.6.1.2 No high explosives shall be stored on the boat or barge deck in the open except for the one case that is to be loaded immediately into the bore holes. Any explosives remaining on deck shall be returned to the day magazine prior to the firing of any blast.

3.6.1.3 The firing line reel or spool shall be mounted on the rig in a manner that it cannot be lost overboard. An approved blasting machine shall be used for detonation regardless of the number of caps used. An electric blasting system shall not be used.

3.6.1.4 The amount of explosives permitted aboard the drill boat at any one time will be subject to the approval of the ’Owner's Representative, but in no case shall such amount exceed the amount permitted by appropriate codes and regulations.

3.6.1.5 The Contractor shall make necessary arrangements to prevent damage to any vessel, moored or underway, building or structure and preserve the crew or occupants thereon from exposure to injury as a result of the Contractor's operations. The Owner’s Representative may require additional arrangements.

3.6.1.6 The Contractor shall have a certified marine survey of all floating plant proposed for underwater blasting work on this contract performed prior to starting any work, and shall provide the results to the Owner’s Representative.

3.6.1.7 Automatic fire extinguishers of an appropriate type shall be installed on air compressors and in all engine compartments aboard vessels (drill boats, barges) where explosives are stored, handled, and used.

3.6.1.8 Remote fuel shut-offs and fire signaling devices shall be provided aboard the drill boats.

3.6.1.9 Loading of tubes and casings of dissimilar metals shall not be used because of possible transient electric currents from galvanic action of the metals and water.

3.6.1.10 Only water resistant blasting caps and detonating cords shall be used for all marine blasting. Loading shall be done through a non-sparking metal loading tube when a tube is necessary.

3.6.1.11 No blast shall be fired while any vessel under way is closer than 1,500 feet from the blast area. Those on board vessels or craft moored or anchored within 1,500 feet shall be notified before a blast is fired.

3.6.1.12 No blast shall be fired while any swimming or diving operations are in progress in the vicinity of the blasting area. If such operations are in progress, signals and arrangements shall be agreed upon to assure that no blast shall be fired while any person is in the water.

3.6.1.13 A red blasting flag, 18 inches by 30 inches with the word “EXPLOSIVES” thereon in white letters, at least six inches in height, shall be readily visible in all directions.

3.6.1.14 The storage of explosive material shall be in accordance with 527 CMR 13.05(4).

3.6.1.15 When more than one charge is placed in under water, a float device shall be attached to an element of each charge in such a manner that it will b released by firing. Misfires shall be handled in accordance with 527 CMR 13.09(5).

3.6.2 Lightning

The Contractor shall furnish, maintain, and operate lightning-detection equipment during the entire period of blasting operations and during the periods that explosives are stored at the site. The equipment shall be installed where approved by the Owner’s Representative. A lightning detector shall be operated at all times to detect lightning within a 50 mile radius. When the lightning-detection device indicates a blasting hazard potential, the Contractor shall perform the following:

A. Notify the Coast Guard and the Owner’s Representative of the potential hazard.

B. Clear the buoyed area of all vessels and personnel.

C. Terminate all loading of holes and return unused explosives to the day storage area/day magazine.

D. Monitor the blast area to prevent any boat or vessels from inadvertently entering the blasting area during the lightning hazard.

E. Remove the lightning detector from the drill barge with the last evacuation vessel and continuously monitor the potential hazard until the danger has passed.

F. After sounding the All Clear Signal, notify the Coast guard and the Owner’s Representative that the potential hazard has passed.

G. Resume operations only after all potential of hazard has passed.

3.6.3 All other applicable safety requirements shall be implemented in addition to that required above.

3.6.4 Navigation Control during Drilling, Loading, and Blasting Operations

3.6.4.1 The Contractor shall buoy the area with warning signs. The warning signs shall be legible from a distance of 200 feet and shall contain the message "DANGER - EXPLOSIVES IN USE" visible on either side of the sign. The Contractor shall operate two or more patrol boats during blasting operations equipped with a visible yellow flashing light, audible horn, and radio with a hailer, whose sole function shall be to monitor and maintain security in the blast area. Patrol boats shall be stationed at the drill barge and remain in the blasting area during all blasting operations. Land oriented access control and visual observation locations should be determined and approved by the Owner’s Representative. The Contractor shall inspect and ensure there is no boat traffic within the buoyed work area prior to the firing of the blasting caps and until such time as the

Contractor has sounded the "All Clear Signal". The Contractor shall establish and maintain a warning system as required by the Corps of Engineers Safety Manual. The Contractor shall equip and maintain his floating plant with radio equipment capable of communications with the Coast Guard. The Contractor, after each blast, upon inspecting the area, shall immediately notify the Coast Guard and the Owner’s Representative if all clear or misfire is noted.

3.6.4.2 Coordination with the U.S. Coast Guard.

The Contractor shall notify the Coast Guard 24 hours prior to a scheduled shot and 2 hours prior to the actual shot. The channel must be kept open to vessel traffic at all times except as permitted by the Coast Guard and the Owner’s Representative. Contact should be made with:

US Coast Guard New Bedford Marine Safety Unit
New Bedford, Massachusetts
Telephone: 508-999-0072

3.6.5 Contingency Plan in Case of Misfire, Inadvertent Initiator Extraction, or Accidental Loss of Down Lines

All loading of blasting holes shall be done early enough each day to allow time, in case of a misfire, inadvertent initiator extraction, or accidental loss of down lines, to implement a contingency plan for removing or detonating the explosives before dark. The Contractor shall submit a contingency plan to the Coast Guard and Owner’s Representative prior to initiation of any blasting and shall notify both parties in the event of a misfire, inadvertent initiator extraction, or accidental loss of down lines. All undetonated explosives due to misfire, inadvertent initiator extraction, or accidental loss of down lines must be detonated. The Contractor shall immediately notify the Coast Guard upon giving the "All Clear Signal" after correcting the misfire, inadvertent initiator extraction, or accidental loss of down lines.

3.6.6 The Contractor shall notify the public at least 24 hours prior to any scheduled blast, and at least 2 hours prior to an actual blast. As a minimum, the following shall be notified:

New Bedford Police Department
871 Rockdale Avenue
New Bedford, Massachusetts 02740
Tel. (508) 991-6300

New Bedford Fire Department
868 Pleasant Street
New Bedford, Massachusetts 02740
Tel. (508) 991-6124

Fairhaven Police Department
1 Bryant Lane
Fairhaven, Massachusetts 02719
Tel. (508) 997-7421

Fairhaven Fire Department
146 Washington Street
Fairhaven, Massachusttes 02719

Tel: (508) 994-1428

3.6.7 Bulk Product Specifications

A. Bulk blasting agents or explosives delivered to the work area shall be weighed by a certified weigh master at the transfer location nearest the work area to determine the actual quantity of explosives delivered each day.

B. Bulk storage tanks or vessels on barges shall be permanently attached to the barge and electrically grounded. A containment dike shall be erected to contain the maximum rated capacity of the storage vessel and all associated pumps and hoses for transfer operations. Pumps, hoses and valves containing bulk product after transfer operations shall be stored in a locked magazine.

C. All access ports, valves, vents and drains shall be secured to prevent vandalism or theft of the explosive product.

A flow metering device capable of measuring the quantity of explosives to within 0.5% of the actual quantity in pounds shall be utilized for all bulk transfer to or from the bulk storage vessel.

D. The delivery system to load holes on each drill frame shall be designed to load each hole to within 0.5% of the design quantity required for each drill hole.

E. Each drill frame shall measure the quantity of explosives loaded in all holes with weigh scales or flow metering devices to within 0.5% of the design quantity for each hole. The total of all loaded holes shall be checked with the total quantity delivered prior to subsequent bulk deliveries. Should the bulk quantity delivered vary from the recorded quantity loaded and detonated, all measuring devices and or meters shall be recalibrated to within the specified accuracy.

F. Each hole loaded with emulsions or slurry shall be initiated with two separate downlines, caps, boosters and starters. At least one booster shall be secured in the hole with a mechanical lock-in system or spider to prevent extraction of the booster or priming charge.

G. As a minimum the top elevation of the emulsion or slurry product shall be measured to check for voids and actual quantity loaded.

H. The blast plan shall include manufacturer's catalog cuts, data sheets and detailed plans and specifications for the bulk storage vessel and transfer system, drill frame delivery system associated loading tubes and reel systems and measuring devices.

I. All loading tubes or hoses shall be equipped to be retracted from the bottom of the hole to the top of the product as the emulsion or slurry is loaded in the hole. The system shall in effect place the product in each hole in a tremie method.

3.6.8 Surface Blasting

Doby, or Surface Blasting, will not be allowed for the fragmentation of bedrock. Doby blasting is an allowable option for fragmenting boulders or large blast rubble when water depths are at least 30 feet.

3.7 BLASTING CONTROL

3.7.1 General

The blasting program and methods shall be those developed by the test blasting program and procedure to accomplish the excavation shown on the contract drawings in accordance with the procedures specified herein.

3.7.2 Blasting

Blasting shall be confined to daylight hours during the period from 2 hours after sunrise to 1 hour before sunset, but shall not be conducted before 9:00 A.M. or after 4:00 P.M. on the day of blasting. Blasting shall not be conducted when temperature inversions or heavy, low-level cloud cover exists. **Blasting will be prohibited on Saturdays, Sundays and Federal holidays.**

3.7.3 Vibration Control

Where blasting is necessary, the Contractor shall employ a specialist qualified in vibration control methods capable of analyzing results obtained from seismograph readings. A minimum of 30 days prior to commencement of blasting operations, the Contractor shall provide the Owner’s Representative such bona fides of the seismic specialist to include, but not limited to, past experience, training, and education, and have working a knowledge of State and local laws and regulations which pertain to blasting. The acceptability of the specialist is subject to the approval of the Owner’s Representative. The Contractor's seismic specialist shall place vibration monitors on any identified historic structures and shall determine the placement of at least 8 additional vibration monitoring machines per blast area (minimum 4 per shore) with approval of the Owner’s Representative and shall be retained for loss control should contract blasting operations result in claims or complaints. The vibration monitoring plan shall identify the type of anchoring devices to be employed at various monitoring sites. Structures that should have monitoring machines include, at least, bulkheads, hazardous materials storage areas and buried utilities. At least one vibration monitoring machine must be placed between the blast and the nearest structure on a natural ground surface. This may require utilizing underwater locations. The other machines must be secured in the ground near identified sensitive structures. Blasting shall be controlled in such a manner that the maximum vibration level at any vessel or structure which is vulnerable to damage should not exceed the peak particle velocity of the appropriate municipality and geographical jurisdictions, or be subject to an unacceptable vibration frequency. A written and a telephone report on vibration intensity shall be submitted within 24 hours when specifically requested by the Owner’s Representative or, without request, when such intensity exceeds a peak particle velocity of 2.0 inches per second for any one of the 3 perpendicular planes of motion. Peak Particle Velocity of 2.0 inches per second should not become the basis of design. Refer to 527 CMR

13.09 chart (a)for assistance. The Contractor will perform a test blast (paragraph 4) which will determine a safe peak particle velocity (PPV) for all structures within the blast area. If historic structures are to be monitored, they shall be evaluated for sensitivity to vibration and monitored during blasting operations. The Contractor shall follow the following vibration limits for the structures listed below:

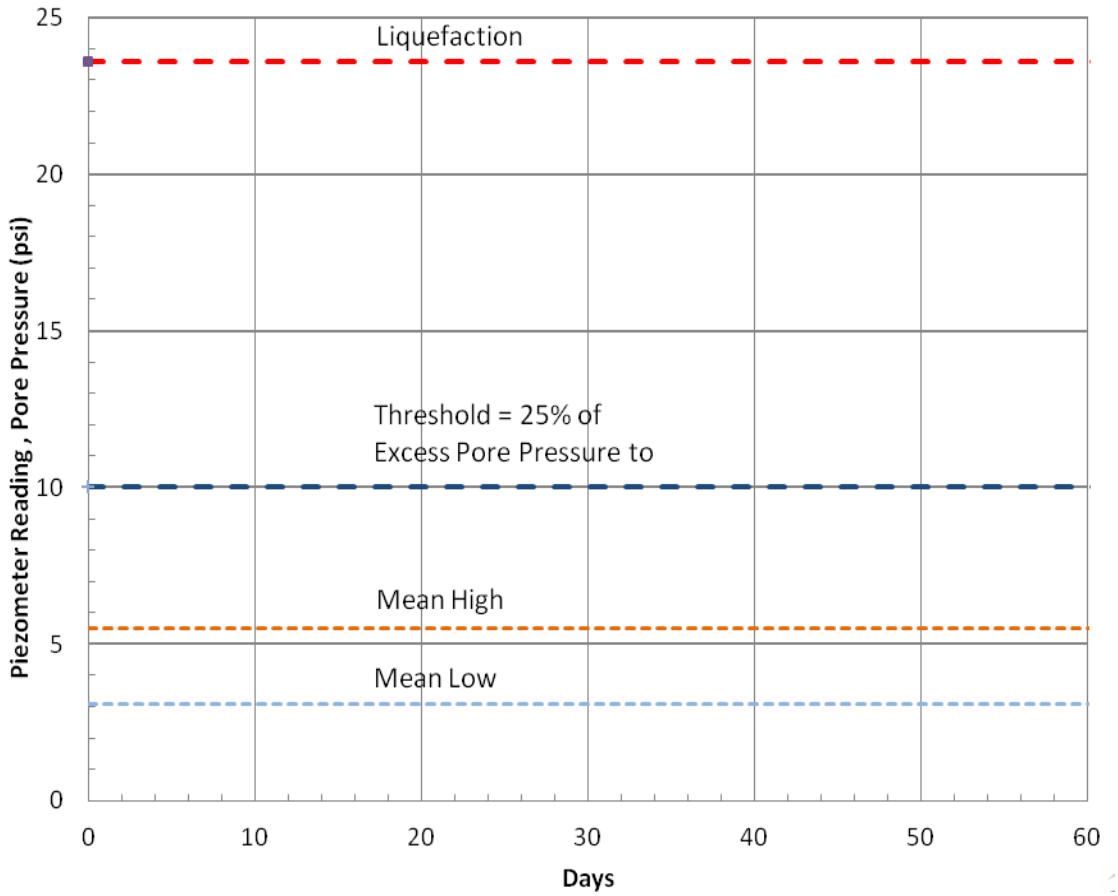
Historic Structures PPV<0.5 in/sec
Residential Structures in Massachusetts PPV<0.8 in/sec
Other Structures PPV<2.0 in/sec

The Contractor shall submit a copy of the record in tabular form for each blast to the Owner’s Representative no later than 24 hours after each blast, with a written report on velocity and vibration effects. This should also include location of blast, size, spacing, number, top and bottom elevations of holes, type of explosives, amount of explosives and stemming per hole and delay, type of delays, sequence and pattern, distance from the blast to the vibration monitoring machine, and any other pertinent information.

3.7.3.1 The Contractor is advised to evaluate the vibration and airblast factors affecting structures and vessels in the vicinity of the blast area as determined in the preblast survey. It is recommended that the Contractor use a blast design that produces the maximum amount of relief practicable. The amount of explosives to be used will be determined during the test blast operation to meet all proper safety and environmental requirements. The Contractor is responsible that the fragmentation resulting from the blasting operation is of suitable size to allow for easy excavation by the Contractor's equipment. The Contractor shall also check water wave propagation to insure that shoreline structures and moored vessels within the blasting area will not be affected during blasting.

3.7.4 All blasting shall be monitored by the Contractor to determine air blast effects using an instrument approved by the Owner’s Representative, operated by an experienced person with a minimum of 3 years of related experience with the type of equipment to be used throughout the project construction and all data furnished to the Owner’s Representative. The instrumentation will be located at seismic station locations as determined in paragraph 3.7.3 and other locations as directed by the Owner’s Representative with at least three (3) monitors located in the area closest to the blast site. Airblast equipment shall record waveform data. Recorded airblast data shall be submitted in conjunction with vibration intensity data as specified in paragraph 3.7.3, within 24 hours of each blast. The maximum allowable airblast shall not exceed 129 decibels.

3.7.5 The Contractor is advised that the owner will be monitoring pore pressure within the core material of the US Army Corps of Engineers Hurricane Protection Structure in two locations. Given the unknown nature of the material in the structure the owner has set a limit associated with the buildup of excess pore pressure of 25% of the liquefaction limit as displayed below. The Contractor shall design its blasting program such that the excess pore water pressure shall not exceed the 25% liquefaction limit:



3.7.6 If the Government decides to have a supplemental blasting monitoring program, under no circumstances will this relieve the Contractor of monitoring and controlling the blasting as specified in this Section or any other requirements.

3.8 TEST BLAST PROGRAM

3.8.1 Purpose

The purpose of the test program is to allow the Contractor to establish safe limits of vibration and airblast overpressure, demonstrate the satisfactory performance of the drill boats and develop an operational blasting plan. The type of explosives and firing systems shall adhere to all applicable codes and regulations including, but not limited to, those cited in paragraph 1.1.1.

3.8.2 Test Blast Plan

3.8.2.1 The Contractor shall submit fifteen (15) copies of the Test Blast Plan for review. The Owner’s Representative shall have 35 days for review after receipt. The Contractor may be required to revise and resubmit the plan. The ’Owner's Representative shall have 21 days review of the revised plan. Concurrence with the revised plan will not relieve the Contractor of his responsibility to produce safe and satisfactory results as set forth by these specifications. The test plan shall include as a minimum all pertinent information listed in paragraphs 3.8.4, 3.9.2 and 3.9.4.

3.8.2.2 Test blast programs shall be conducted by the Contractor for each area of rock such as discontinuity of rock contours and areas and as directed by the Owner’s Representative. An optional test blast program for the glacial till shall be planned if determined by the Owner’s Representative to be necessary. Each blast program shall involve all drill boats that will be used for any portion of the contract. No drill boat shall be used for the contract that has not participated in a test blast program.

3.8.2.3 The Contractor shall notify the Owner’s Representative sufficiently in advance of each test blast in order for the Owner’s Representative to be present during the test blasts. The Contractor shall also invite representatives of the Fire Departments from New Bedford and Fairhaven to the test blasts. The test blasts shall begin with a small number of charges and extend upward to the maximum yield to be used. The final test event shall simulate as close as practicable the explosives charge type, size, overlying water depth, charge configuration, charge separation, initiation methods, and emplacement conditions anticipated for the operational blasting program. During each blast the Contractor will analyze the effect of wave propagation on structures, vessels, etc., and take the appropriate actions to prevent damages.

3.8.2.4 The Contractor shall note additional conditions of the Test Blast Program as noted within Part 3.11 of this Section.

3.8.3 Post Blast Evaluation

3.8.3.1 After each test blast, the Contractor shall examine the structures of the preblast survey that were inspected and documented, to establish whether damage was caused to the structures. All damage resulting from the test blasting shall be reported in detail to the Owner’s Representative, including photographs.

3.8.3.2 After each test shot the Contractor will excavate the fractured material to evaluate breakage, toe and top of cut. This information will be documented and provided to the Owner’s Representative.

3.8.4 Data Recording and Evaluation

The test blast program shall be conducted and reported in strict accordance with procedures outlined in the sections of these specifications covering vibration control and air blast control. The Contractor shall submit the blasting plans showing the location(s) and extent of the blasted areas. The blasting plans shall include the blasting patterns and the locations of patterns shall be drawn on plan sheet(s)(maps) in scale by providing coordinates of at least four (4) corners of the blasted area. Include

information as to the number of holes, bottom and top elevations of holes, coordinates of each hole, amount of explosives and stemming per hole, type of delay in holes, sequence and pattern of delays, maximum peak particle velocity from each instrument, and peak overpressure reading in pounds per square inch and decibels from each airblast sensor. Information provided should also include a written analysis of each blast, including the maximum particle velocity in each plane, associated frequency in each plane and peak true vector sum of particle motion. In addition to the submission of an initial test blast plan, the Contractor is required to submit a documentation of each blast prior to proceeding forward the next blast test. The documentation shall include, but not limited to a written analysis of each blast, all observed test blasting data, examination of structures of the preblast surveys that were inspected, and information about excavation of fractured materials. Four copies of the record of each blast performed shall be submitted no later than 24 hours after completion of each test blast until the test blast program is completed. It is expected that the initial test blast will be used to develop knowledge of ground conditions, propagation characteristics, etc. At the conclusion of the test blast program, the Contractor shall examine all reports, surveys, test data, and other pertinent information. Conclusions reached shall be the basis for developing a completely engineered procedure for blasting. Five copies of the Test Blast Plan and results shall be provided to the Owner’s Representative. In no event shall the operational blasting proceed until the review of the developed procedure for blasting has been completed and the procedures approved.

3.9 OPERATIONAL BLASTING PLAN

3.9.1 The Contractor shall submit to the Owner’s Representative ten (10) copies of the Proposed Operational Blasting Plan for review. The Owner’s Representative shall have 35 days for review after receipt. The Contractor may be required to revise and resubmit the plan. The Owner’s Representative shall have 21 days review of the revised plan. Concurrence with the revised plan will not relieve the Contractor of his responsibility to produce safe and satisfactory results as set forth by these specifications.

3.9.2 Environmental Impact of Blasting

3.9.2.1 The Contractor shall follow the following guidelines and incorporate the following measures when preparing its Operational Blasting Plan and shall use the following measures to minimize its impact to the aquatic environment to the extent possible. These measures include:

1. Evaluate the need to use explosives. If practical alternatives are available and not excessively expensive to remove rock without blasting, the Contractor shall utilize those methods.
2. Plan the blasting program to minimize the total weight of explosive charges per shot and the number of shots for the project.
3. Use angular stemming material of sufficient length in drill holes to reduce energy dispersal to the aquatic environment.
4. Subdivide the charge, using detonating caps with delays or delay connectors with detonating cord, to reduce total pressure. The Contractor shall not use submerged detonation cord unless the Contractor can show that no other method is practicable.

5. The Contractor shall use decking when possible in lengthy drill holes to reduce total pressure.
6. For seismic exploration use non-explosive sources when possible or use linear charges for open water shots or buried charges.
7. Use shaped charges to focus the blast energy when submerged surface charges are necessary, reducing energy released to the aquatic environment during demolition.
8. Contractor shall enclose blast areas with silt curtains and bubble curtains to keep fish species away from the blast area and minimize the pressure wave and turbidity generated from blasting.
9. Contractor shall use non-explosive noise techniques to move fish and marine mammals from the immediate blast zone.
10. All blasting shall be conducted using inserted delays of a fraction of a second per hole.
11. Stemming, in which rock is placed into the top of the borehole to damp the shock wave reaching the water column, thereby reducing fish mortalities from blasting, shall be utilized.
12. All blasting operations shall take place utilizing sonar to identify fish schools and with a fisheries observer (hired by the Contractor) who is approved by the Massachusetts Division of Marine Fisheries (and National Marine Fisheries Services) in attendance. The fisheries observer shall observe for fish mortality. If excessive mortalities (hundreds of fish/event) occur, then additional technologies, bubble curtains shall be considered for use.
13. There shall be no blasting during the passage of schools of fish or when a marine mammal is present as determined by the fisheries observer (as required in item 12 above).
14. Blasting shall be conducted with a fish startle system.

3.9.3 No drilling shall be started before the Owner’s Representative reviews and concurs with the final blasting plan or any revisions to that plan.

3.9.3.1 Any changes to the Contractor's blasting or monitoring procedures, equipment, plant, products or personnel must be reflected in a revised Operational Blasting Plan or supplement and must be approved by the Owner’s Representative prior to implementation.

3.9.4 The Blasting Plan shall include as minimum requirements the following:

1. Proposed method of transportation, storage, and handling of explosives.

2. Plan showing layout of drill hole pattern, timing and sequence, anticipated burden dimensions and depth of subdrilling.

3. Plan for the fragmentation of large boulders and blast rubble.

4. Type of explosives and method of loading and detonating.

5. Type of blasting machine to be used and when last tested.

6. Specific gravity of explosives and manufacturer's technical literature.

7. Initiation system to be used and explosive loading in pounds of explosive per delay.

8. Indication as to whether decking or boosters will be used and the depths of required stemming.

9. Type and number of drilling rigs, including drill hole diameter, and expected production rates/day.

10. Type of instrumentation to be used, manufacturer, and when last calibrated and certified.

11. Procedure for monitoring the blast operations.

12. List of permits and clearances required, when applied for, and date of approval or anticipated approval.

13. A format for maintaining a record of individual blasts throughout the life of the job designed to record pertinent data before, during, and after the blasting operation. Pertinent information shall include, but not limited to, number of holes, bottom and top elevations of holes, coordinates of each hole, amount of explosives and stemming per hole, type of delay in holes, and sequence and pattern of delays.

14. Names and qualifications of specialists for vibration control analysis and airblast over- pressure measurements (refer to paragraph 3.7.3 for exacting requirements).

15. Location plan, manufacturer's literature, and parameters to be used in site selection for seismic instrumentation.

16. Plan showing location of warning signs and signals and the Contractor's land and marine spotters.

17. Name and address of Contractor's representative to which any claims for damage due to blasting should be addressed.

18. The plan, signed off by the Contractor's jobsite authorized representative.

19. The location of monitoring equipment, based on information from the preblast survey.

20. Contingency Plan for Lightning Hazard

21. The 527 CMR 13.00 Uniform Blasting Site Detail Check List – (Attached at the end of this Section).

22. Complete Project Team Organization with duties, responsibilities and authorities clearly defined. This organizational outline shall also include a listing of all

personnel authorized to sign for, receive and use explosives on this contract.

23. Complete list of floating plant involved in production blasting operations.

24. Provide analysis and control of potential hazard due to possibility of undetonated Pourvex remaining from previous deepening.

The Contractor shall submit the blasting plans showing the location(s) and extent of the blasted areas. The blasting plans shall include the blasting patterns and the locations of patterns shall be drawn on the maps in scale by providing coordinates of at least four (4) corners of blasted areas.

3.9.4 If drilling and blasting is required outside the buoyed areas, the Contractor shall submit a plan to maintain **the previous authorized depth**, as part of the Operational Blast Plan. This plan shall include areas where the buoy cannot be removed.

3.10 DRILL LOG AND BLAST REPORT

The Contractor shall prepare and complete drill logs and report for each blast is completed. Information provided on the logs shall include, at a minimum:

1. Name, signature, and Certificate of Competencey Number of the blaster in charge.
2. Blast location, address, city description.
3. Drill rig type, construction of rig, name of driller in charge, location of borehole in Massachusetts State Plane coordinates.
4. Depth of boring in MLLW. Position within borehole of explosives at time of detonation.
5. Date and time of blast.
6. Type of material blasted.
7. Distance in feet, to the nearest inhabited building or structure, neither owned or leased by holder or holder client of the Explosives User Certificate issued by State Fire Marshall.
8. Scaled distance or alternative option used to determine blast design.
9. Type of matting or cover over blast, if applicable.
10. Weather conditions, including temperature, cloud cover, wind direction.
11. Blast plan and sketch showing blast hole diameter, delay, delay patter, and types of detonators, spacing, depth of blast hole, hole pattern and number of holes.
12. Explosive material type, size, total weights of each explosive by hole.
13. Type of initiation system (Methods of firing and type of circuit).
14. Feet of overburden, depth and type of stemming.
15. Maximum weight of explosives detonated within any eight millisecond period.

16. The seismograph(s) location(s) including distance and direction from the seismograph to the closest borehole and from the seismograph to the closest structure.
17. Seismograph readings including peak particle velocity, frequency and airblast.
18. Type of seismograph, instrument make, model serial number, calibration date and sensitivity settings.
19. Name of person taking the seismograph reading. The name and firm analyzing the seismograph record, if applicable.
20. Complaints or comments following blast.

3.11 POTENTIAL IMPACT TO HURRICANE BARRIER

A study regarding the potential impacts to the New Bedford Hurricane Barrier was completed in response to requests from the U.S. Army Corps of Engineers, in order to determine the potential impact to the Hurricane Barrier associated with blasting for this project, and is included within the “Data Report – New Bedford Marine Commerce Terminal”, attached to Section 00800 of the Contract Documents. The study resulted in a determination of the maximum charge weights per delay as a function of distance from the Hurricane Barrier, which were subsequently halved in order to provide an additional factor of safety of 2.

During completion of the Contractor’s Test Blast program, as outlined within Part 3.8 of this Section, the Contractor shall measure particle velocity as a function of distance from the Hurricane Barrier. The Contractor shall advance all borings or other subsurface investigations, as necessary, to collect this data. Portable seismographs capable of measuring peak particle velocity in three mutually perpendicular directions and frequency shall be utilized for this work. After having collected this data, the Contractor shall forward the data to the Owner’s Representative for interpretation.

The Owner’s Representative will generate a site specific graph of scaled distance versus peak particle velocity on a log-log plot. In this context, the scaled distance is the distance in feet from the blast divided by the square root of the weight of the charge per delay in pounds. The data from the test program will be analyzed by fitting a best-fit regression line to provide the site specific values of velocity intercept and slope factor. The frequency of the blast vibrations will also be reviewed and compared to assumed values from the Hurricane Barrier study. The site specific values will be used to determine the final allowable blasting criteria for production blasting at the site. ***If the final allowable blasting criteria are determined to be lower than the values in the table listed below, the Contractor shall use the lower of the two values.***

As a result, the maximum charge weight per delay as a function of distance from the nearest point of the New Bedford-Fairhaven Hurricane Barrier shall not exceed the lower of either the values calculated by the Owner’s Representative during the Test Blast Program (as determined above) or the following tabulated values:

Dist. (ft)	10 Hz Pounds per Delay	20 Hz Pounds per Delay	30 Hz Pounds per Delay	40 Hz Pounds per Delay	50 Hz Pounds per Delay	60 Hz Pounds per Delay	70 Hz Pounds per Delay	80 Hz Pounds per Delay	90 Hz Pounds per Delay
250	198	83	50	35	26	21	17	15	13
300	200	120	72	50	38	30	25	21	18
350	200	163	98	69	52	41	34	29	25
400	200	200	128	89	68	54	44	38	32
450	200	200	162	113	86	68	56	48	41
500	200	200	200	140	106	84	69	59	51
550	200	200	200	169	128	102	84	71	61
600	200	200	200	200	152	121	100	85	73
700	200	200	200	200	200	165	136	115	99
800	200	200	200	200	200	200	178	150	130
900	200	200	200	200	200	200	200	190	164
1000	200	200	200	200	200	200	200	200	200
1100	200	200	200	200	200	200	200	200	200
1200	200	200	200	200	200	200	200	200	200

- End of Section -

527 CMR 13.00 Uniform Blasting Site Detail Check List

Location: _____ Date: ___/___/____

Blaster's Name: _____ Cert. #: _____

Company Name: _____ Time of Blast: __:__

Check List	**Ref. #**	**Violations?**	**YES**	**NO**
Two Way Radio/Warning Signs ("Blasting Zone" "Turn off 2-way Radio")	CMR 13.09(1)(p)		☐	☐
Transport Vehicle(s) (Placards, Fire Marshal Magazine Permit, Attended)	CMR 13.06(2), 13.04(3)		☐	☐
Site Storage (Day Box) (Fire Marshal Magazine Permit, Attended)	CMR 13.04(3)		☐	☐
NO smoking or open flames (within 50ft of explosives)	CMR 13.09(1)(d) 2., 3.		☐	☐
NO unnecessary personnel on the blast site (while boreholes are being loaded or are loaded with explosives)	CMR 13.09(2)(a)		☐	☐
Prior to blasting, excess explosives returned to proper storage	CMR 13.09(2)(f)		☐	☐
Seismograph must be placed between 5&10 ft of nearest inhabited structure	CMR 13.09 (9)(f)		☐	☐
Explosives, persons & equipment must be at a safe distance prior to blast	CMR 13.09(3)(a), (h)		☐	☐
Warning signal (3 long blasts 5 min before blast) Blast Signal (2 blasts 1 min before blast) All Clear Signal (1 prolonged blast)	CMR 13.09(1)(m), (3)(h)(2)		☐	☐
Post Blast Inspection (blaster must inspect site prior to personnel returning)	CMR 13.09(4)		☐	☐
Trash (boxes, bags, non-electric) (shall be picked up and/or destroyed)	CMR 13.09(6)		☐	☐

Seismograph Readings:

PPV: H_____ V_____ R_____ (2.0 in/sec max)
HZ: H_____ V_____ R_____ Airblast: _____Db (133max)

Report any incident involving flyrock, whether or not was an injury or damage, to the Office of the State Fire Marshal at 978-567-3375.
FP-55 (Rev. May '10)

Attachment 5

Memo

To: Mr. Chet Meyers (Apex Companies, LLC)

From: Diane Baxter, David Carchedi, Thomas Billups (GZA GeoEnvironmental, Inc.)

File: 33734.04 Mem-05

Date: August 29, 2013

Re: Blast Monitoring at the Hurricane Barrier
New Bedford Marine Commerce Terminal
New Bedford, Massachusetts

Attachments: Table 1. Allowable Charge Weight per Delay as a Function of Distance from Hurricane Barrier
Figure 1. Example of Threshold Level for Piezometer installed in the middle of the "dumped fill"

GZA GeoEnvironmental Inc. (GZA) is pleased to provide you with this memorandum providing guidance on preparing a work plan that addresses blast monitoring at the New Bedford Marine Commerce Terminal.

Blast Monitoring Plan at the New Bedford-Fairhaven Hurricane Barrier

GZA provided allowable charge weights per delay as a function of distance from the hurricane barrier in our August 2013 report titled "Assessment of Blasting Impacts to the New Bedford-Fairhaven Hurricane Barrier" (attached as Table 1). The Blasting Specification should be modified so that the Contractor will be required to limit the blast weights to below these levels.

During construction, the Contractor is required to conduct a Test Blast Program as outlined in the Blasting Specification. The test blasts will start at distances that are furthest away from the hurricane barrier. GZA will be on site and measure vibrations from the test blasts using seismographs set up at various distances from the blast to develop a site specific attenuation relationship. The scaled distance will be plotted versus the peak particle velocity to verify the parameter values for "H" and "beta" that were assumed and explained in the report.

During blasting operations (and during the Test Blast Program), GZA proposed to measure vibrations (seismograph readings) and excess pore water pressures (piezometer readings) at two locations along the hurricane barrier. The first point will be at the hurricane barrier at the shortest distance from the barrier to the blast location. The second point will be located at the west abutment of the navigation gate.

Vibration levels for blasting operations will be measured and reported in terms of Peak Particle Velocity (PPV) measured in inches-per-second (in/sec), and frequency, measured in cycles per second (hertz). Measurements of ground vibrations will be made by portable seismographs. Acceptable vibration levels are given in the Blasting Specification as follows:

Historic Structure PPV , 0.5 in/sec
Residential Structures in MA PPV<0.8 in/sec
Other Structures PPV,2.0 in/sec

GZA recommends conducting two borings in the hurricane barrier to obtain information on the "dumped fill" in the core, and install monitoring wells in the completed boring for the piezometer readings. The original documentation of the construction of the barrier did not provide data for "dumped fill" in the core. GZA made

conservative assumptions of the material properties of the dumped fill that may have resulted in recommended vibration levels that are overly conservative. The borings would be conducted with a tracked rig from the crest of the hurricane barrier to penetrate the "dumped fill". Temporary observation wells would be installed in the hole after completion of the boring, so that the excess pore water pressures can be monitored with a piezometer during blasting operations. The wells would be installed inside steel stand pipes that would be grouted into place, and locked when not being monitored. After completion of the blasting, the stand pipes would be removed, and the wells grouted.

Significant excess pore water pressure would have to build up in order to trigger a liquefaction event as shown in Figure 1. GZA recommends a threshold level of 25% of the excess pore pressure, as shown in Figure 1.

If the Army Corps of Engineers approves the borings and installation of the wells, a Work Plan and Accident Prevention Plan will be submitted to the Army Corps of Engineers for approval.

Blasting Procedures and Contingency Plan

GZA requests that the contractor submit at least 24 hours prior to blasting, their blasting plan including charge weight and distance from the Hurricane Barrier. If excess pore water pressures are recorded during blasting that are greater than the threshold level shown in Figure 1, GZA will notify the appropriate parties to inform the contractor to suspend blasting operations and modify their blasting program to reduce the charge weights.

Baseline Readings

GZA will conduct baseline readings of vibrations and pore water pressure at each of the monitoring points located on USACE property prior to the start of blasting operations.

We trust that this memo addresses the current needs of your project. Should you have any questions, please feel free to contact Diane Baxter or David Carchedi at 401-421-4140.

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Table 1. Allowable Charge Weight per Delay as a Function of Distance from Hurricane Barrier.

Dist. (ft)	10 Hz Pounds per Delay	20 Hz Pounds per Delay	30 Hz Pounds per Delay	40 Hz Pounds per Delay	50 Hz Pounds per Delay	60 Hz Pounds per Delay	70 Hz Pounds per Delay	80 Hz Pounds per Delay	90 Hz Pounds per Delay
250	198	83	50	35	26	21	17	15	13
300	200	120	72	50	38	30	25	21	18
350	200	163	98	69	52	41	34	29	25
400	200	200	128	89	68	54	44	38	32
450	200	200	162	113	86	68	56	48	41
500	200	200	200	140	106	84	69	59	51
550	200	200	200	169	128	102	84	71	61
600	200	200	200	200	152	121	100	85	73
700	200	200	200	200	200	165	136	115	99
800	200	200	200	200	200	200	178	150	130
900	200	200	200	200	200	200	200	190	164
1000	200	200	200	200	200	200	200	200	200
1100	200	200	200	200	200	200	200	200	200
1200	200	200	200	200	200	200	200	200	200

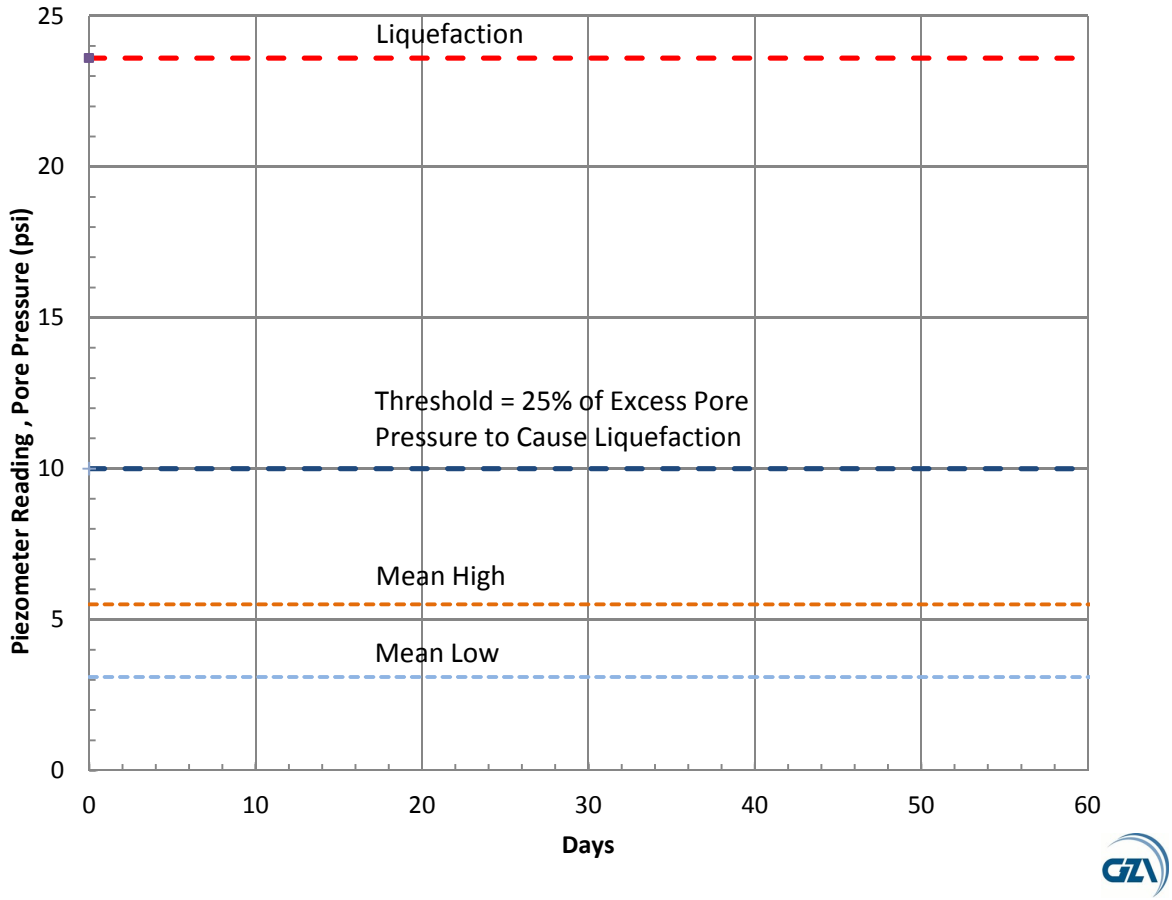

Figure 1. Example of Threshold Level for Piezometer installed in the middle of the “dumped fill”.