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**Final 2011 Bathymetric Survey of Pilot Underwater Cap
New Bedford Harbor Superfund Site**

New Bedford Harbor Superfund Site
New Bedford, MA

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October 26, 27, and December 2, 2011

Attachments

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ACRONYMS AND ABBREVIATIONS

Apex	Apex Companies, LLC
CAD	confined aquatic disposal
CR	CR Environmental Inc.
°F	degrees Fahrenheit
ft	foot
Jacobs	Jacobs Engineering Group, Inc.
MLLW	Mean Lower Low Water
NAE	U.S. Army Corps of Engineers – New England District
NGVD29	National Geodetic Vertical Datum of 1929
NBH	New Bedford Harbor Superfund Site
PCB	polychlorinated biphenyl

1.0 INTRODUCTION

This report is intended to briefly summarize the 2011 bathymetric data collected from the pilot underwater cap area at the New Bedford Harbor Superfund Site (NBH). The pilot underwater cap was placed in 2005 over polychlorinated biphenyl (PCB) contaminated sediments near the Cornell-Dubilier mill, just south of the NBH hurricane barrier. The 2011 bathymetric data set was used to update trends on the cap area and cap thickness, which are presented in this report.

Prior to beginning an analysis of the pilot cap area it is important to define two terms used to describe the capped area. The first is the “Intended Cap Area” which is the sediment area which was originally designated to be capped (Apex 2007). The second term is the “Full Placement Area;” the perimeter of this area is determined during data processing following each survey and signifies the 0.5 foot (ft) contour (cap thickness) around the previously placed material (Apex 2007).

The survey and analysis of the data collected at the pilot underwater cap is in support of ongoing remedial efforts by Jacobs Engineering Group, Inc. (Jacobs) at NBH.

2.0 2011 BATHYMETRIC SURVEY

CR Environmental Inc. (CR) conducted the 2011 bathymetric survey of the pilot underwater cap over the course of 3 days, October 26, October 27, and December 2, 2011. The bathymetric data collected were referenced to Mean Lower Low Water (MLLW) vertical datum relative to control point CP4. Control point CP4 was established in 2005 by Coler and Colantonio surveyors for Apex Companies, LLC (Apex) to conduct the 2005, 2006, and 2007 bathymetric surveys of the pilot underwater cap area. For the 2011 bathymetric survey, Jacobs used a rotary laser level to set a tide board on a fixed wooden pier at the East Rodney French Boulevard boat ramp relative to the MLLW vertical datum measured at control point CP4, which is adjacent to the wooden pier.

The 2011 survey, which was similar to the 2009 and 2010 surveys, gathered data at a line spacing of 25 ft in a northwest to southeast orientation. This survey orientation and

spacing is consistent with historical post-placement surveys of the pilot cap area that were conducted by Apex in 2005, 2006, and 2007 (Apex 2007).

Weather Conditions:

October 26, 2011

Temperature: 45-55 degrees Fahrenheit (°F)

Wind: 10-15 knots from the east-northeast

Seas: 1-2 ft in AM, 1-2 ft in PM

October 27, 2011

Temperature: 50-55 °F

Wind: 10-15 knots from the east-northeast

Seas: 1-2 ft in AM, 1-2 ft in PM

December 2, 2011

Temperature: 40-65 °F

Wind: 5 knots from the west

Seas: 0-1 ft in AM, 1-2 ft in PM

QA/QC Checks:

A summary of quality control analysis results can be found in Table 1.

3.0 DISCUSSION

A pilot underwater cap was placed in 2005 over contaminated sediments to evaluate the performance of an underwater cap in NBH. The cap was placed by split hull dump scows which dropped evenly spaced rows of dredged material [clean “bottom-of-confined aquatic disposal (CAD)” material from navigational CAD cell #1] over the outlined area in Figure 1. Bathymetric surveys have been performed in 2005, 2006, and 2007 by Apex, and in 2009, 2010, and 2011 by CR to monitor the area and thickness of the placed material. The bathymetric survey results were used to compare the pre- and post-placement bathymetry for each year survey data was collected (2005, 2006, 2007, 2009, 2010, and 2011). A bathymetric survey was not conducted at the pilot underwater cap during 2008.

These comparisons generated the following cap statistics for each of these years:

- full placement area (Figure 2),
- percent of Intended Cap Area with thickness greater than 1 ft (Figure 3), and
- percent of Intended Cap Area with thickness greater than 2 ft (Figure 3).

The Apex report presenting these statistics for the 2005, 2006, and 2007 bathymetric surveys are presented as Attachment A (Apex 2007). It should be noted that the statistics presented in Attachment A for 2005 and 2006 are for an area Apex defined as the “Placement Area.” In 2007 the statistics were recalculated for the “Intended Cap Area” and documented in the 2007 report (Attachment A). The areas presented in Figure 3 are relative to the Intended Cap Area. The Jacobs report documenting the 2009 bathymetric survey performed by CR is presented as Attachment B. The Jacobs report documenting the 2010 bathymetric survey performed by CR is presented as Attachment C.

The Full Placement Area is determined following each survey by identifying the 0.5 ft contour (cap thickness) around the placed material (Figure 2). The Full Placement Area for 2011, determined to be 21.85 acres, is a 14.5 percent difference (increase) in area from 2005 (18.90 acres), and a 7.3 percent difference (increase) in area from that measured in 2010 (20.31 acres). Based on the available data through 2010, following placement of the cap material, the Full Placement Area expanded relatively rapidly within the first year or two, between 2005 and 2007 (the full placement area was not calculated for 2006). Following the initial expansion of the Full Placement Area, survey data suggests that any expansion or contraction had slowed. The 2011 survey data suggests that the Full Placement Area expanded more rapidly than anticipated over the past year. Figure 2 shows that the majority of expansion in the Full Placement Area occurred at the southeast edge of the capped area. This apparent increase in the Full Placement Area may be attributed to the natural deposition of sediment (i.e. not cap material) or it may be the result of cap material leveling or sloughing from the interior portions of the Intended Cap Area to the perimeter. Physical evaluation of the material characteristics by the collection of sediment cores may be able to determine the nature of this expansion. Further visual analysis of the Full Placement Area perimeter suggests

that, besides the expansion in the southeast corner, any expansion or contraction has stabilized or is occurring at a relatively slow rate. The Full Placement Area for all years it has been calculated is as follows:

- 2005 = 18.90 acres (Apex 2007),
- 2007 = 20.75 acres (Apex 2007),
- 2009 = 20.41 acres (Jacobs 2010),
- 2010 = 20.31 acres (Jacobs 2011), and
- 2011 = 21.85 acres.

The percentage of area within the Intended Cap Area covered by at least 1 ft of cap material increased from 2010 to 2011 (Figure 3). Similarly, the percentage of area within the Intended Cap Area covered by at least 2 ft of cap material also increased from 2010 to 2011 (Figure 3). However, visual comparison of the Cap thickness between 2010 and 2011 (Figure 4) suggests that the area of the pilot cap with thickness of 4 feet and greater continues to decrease. This is a continuation of the general trend observed where the high ridges of cap material (originally up to 6 ft above the base of the cap as placed) are settling into the valleys between the ridges. Cap thicknesses and coverage percentage (for greater than 1 ft and greater than 2 ft thickness) for the Intended Cap Area are presented on Figure 3.

In the 2007 Apex report (Attachment A) a comparison Profile at Edge of Cap Figure (cross section) was generated to evaluate the “toe-ing” effect from 2005 to 2007 at a select area at the edge of the cap. Apex describes the toe-ing to be the edges of the placed cap material flattening as it seeks a more stable angle of repose. This toe-ing is the expected behavior of the cap material but it has not been determined when or if the cap material will reach a state of equilibrium where only small back and forth changes in cap bathymetry are noted. In order to determine if the toe-ing effect is still ongoing two areas at the edge of the cap were selected for evaluation (Figure 4), these areas are identified as two hundred foot line segments drawn over the edge of the cap area and labeled as A-A’ and B-B’. While the exact location of the Apex generated profile view is not known so a direct comparison of the 2005-2007 to the 2010-2011 data is not possible,

it is however possible to compare the results of the two evaluations. From 2005-2007 it appears that the toe-ing was relatively significant, it is apparent that a ridge approximately six feet high flattened to a height of less than three feet in the same location. In addition to the flattening of ridges it is observed that the edge of the cap had spread outward approximately five feet. Figure 5 illustrates the 2010-2011 cross sectional view of the segments A-A' and B-B' shown on Figure 4. The 2010-2011 cross sections show the cap to be a dynamic object, with some relatively minor changes in cap thickness, angle of repose and location of the edge of the full placement area. Comparing the 2005-2007 to the 2010-2011 cross sections it is evident that while the cap continues to change over time the rate of change has slowed to the point where any toe-ing has become difficult to quantify year to year.

Following the 2009 bathymetric survey it was noted that two sub-areas of the Intended Cap Area, Areas A and B shown on Figure 3, had experienced a reduction in cap thickness between 2007 and 2009 (Jacobs 2010). This thickness reduction was of particular concern as the 2009 cap coverage in portions of Areas A and B were less than 1 ft thick. The 2011 survey results still indicate the cap coverage in these areas remains relatively thin. Figure 6 presents a method to evaluate Areas A and B year to year. Areas A and B were delineated as one hundred and fifty foot diameter areas within the Intended Cap footprint, following delineation the average pilot cap thickness was determined in each area for 2010 and 2011. In Area A the average cap thickness went from 1.70 ft to 1.62 ft from 2010 to 2011, this is an approximately five percent change in thickness. Area B experienced virtually no change in average cap thickness as it went from 1.57 ft to 1.56 ft, a less than one percent change. Given the likelihood of a small degree of uncertainty in collecting and processing the survey data and the amount of percent change in cap thickness it is not possible to conclude with the available data whether Areas A and or B are experiencing unanticipated erosion or are stable. It is recommended that future bathymetric survey evaluations of the Pilot Underwater Cap Area continue to delineate and evaluate Areas A and B as Figure 6 has, this method will allow the observation of long term trends that a year to year comparison does not allow.

On August 28, 2011, two months prior to the initiation of the pilot underwater cap bathymetric survey activities, the south coast of Massachusetts experienced the impacts of Tropical Storm Irene. During the storm, the U.S. Army Corps of Engineers – New England District (NAE) recorded a maximum tide elevation of 5.0 ft NGVD29 (National Geodetic Vertical Datum of 1929), prior to the storm the tide elevation was predicted to be a maximum of 3.0 ft NGVD29 at the New Bedford Harbor Hurricane Barrier. In addition to the tide elevation NAE also recorded a maximum storm surge of 3.9 ft and maximum winds of 50 knots at the hurricane barrier. The barrier is located approximately 500 feet north of the Pilot Underwater Cap (Figure 1). While it is not possible, given the available data, to discern if the storm caused any measurable negative effects to the pilot cap, a comparison of 2010 and 2011 survey data reveals that the percentage of the Intended Cap Area covered by both 1 ft and 2 ft of material increased (Figure 3). In addition to the documented increase in the percentage of the Intended Cap Area covered by both 1 and 2 ft of material, there was a documented increase in the Full Placement Area (Figure 2); therefore no decrease in the level of protection afforded by the cap is suspected. Bathymetric monitoring of the pilot cap is complimented by annual collection of sediment grab samples from the top 3 inches of cap material for PCB chemical analysis. The 2010 data are reported in the *2010 OU3 Cap Monitoring Memorandum* (WHG 2011). Additional investigation including the collection and evaluation of sediment cores may be able to determine if sediment mixing or cap erosion has occurred.

4.0 SUMMARY

Overall the pilot underwater cap continues to behave as expected, with the area of cap which is at least 1 ft thick currently covering 98.7 percent of the Intended Cap Area.

All surveys by all bathymetric contractors have illustrated the process of sediment redistribution over time. This process causes ridges in the Intended Cap Area to decrease in thickness and valleys to increase in thickness, resulting in the general trend of measured increases in percentage of cap areas with thicknesses greater than 1 and 2 ft. The process is assumed to be occurring from the natural behavior of sediment

redistribution in a tidal environment; however, it cannot be confirmed without collection of core samples and observation of redistribution of cap material.

5.0 REFERENCES

Apex Companies, LLC (Apex). 2007 (October). *Bathymetric Survey – EPA Operable Unit #3 (OU#3) New Bedford Harbor Superfund Site.*

Jacobs Engineering Group, Inc. (Jacobs). 2011 (March). *Final 2010 Bathymetric Survey of Pilot Underwater Cap, New Bedford Harbor Superfund Site.* ACE-J23-35BG0706-M17-0003.

———. 2010 (March). *Final 2009 Bathymetric Survey of Pilot Underwater Cap, New Bedford Harbor Superfund Site.* ACE-J23-35BG0702-M17-0009.

Woods Hole Group, Inc. (WHG). 2011 (February) Memorandum to Mark Anderson, USACE, 11 February 2011, 2010 OU3 Cap Monitoring.

FIGURES

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TABLE

Table 1
Summary of Quality Control Analysis Results, Pilot Underwater Cap;
October 26, 27, and December 2, 2011

QC PARAMETER	RESULT	DESCRIPTION
<u>Cross-Tie Comparisons</u>		
Number of Comparisons	831	
Arithmetic Mean of Comparisons, feet (ft)	0.06	Measurement bias within data set. ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.2 feet)
Standard Deviation of Comparisons (ft)	0.22	
Arithmetic Mean of Absolute Values (ft)	0.17	Overall accuracy within data set
Confidence Level (95.0%)	0.02	Confidence in accuracy assessment
RMS 95th Percentile Confidence Level (ft)	0.45	ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.5 feet
<u>Bar / Staff Check</u>		
Number of Comparisons	6	Pre- and Post-Survey
Depth of Comparisons (ft)	5	Suitable for Project Depth.
Echo Sounder vs. Bar Plate (ft)	5.0/5.0/5.0/5.0/5.0/5.0	Bar check plate on stainless cable
<u>Sound Velocity Comparisons</u>		
Number of Comparisons	6	Pre- and Post-Survey
Depth of Comparisons (ft)	Surface, 5, 10, 15, 20	Suitable for Project Depth
Range of Velocity Values, meters per second (m/s)	1478-1501	
Velocities Utilized (m/s)	1497, 1497, 1478	(raw data adjusted

ATTACHMENT A

APEX 2007 SURVEY REPORT

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ATTACHMENT B

JACOBS 2009 SURVEY REPORT

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ATTACHMENT C

**JACOBS 2010 SURVEY REPORT
(Without Attachments)**

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