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U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
Total Environmental Restoration Contract
USACE CONTRACT NUMBER: DACW33-03-D-0006
Task Order No. 0007

Final 2010 Bathymetric Survey of Pilot Underwater Cap New Bedford Harbor Superfund Site

New Bedford Harbor Superfund Site
New Bedford, MA

February 2011

Prepared by
Jacobs Engineering Group
103 Sawyer Street
New Bedford, MA 02746

ACE-J23-35BG0706-M17-0003

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1.0 INTRODUCTION

This report is intended to briefly summarize the 2010 bathymetric data collected from the pilot underwater cap area at the New Bedford Harbor (NBH) Superfund Site. 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 2010 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 placed material (Apex, 2007).

2.0 2010 BATHYMETRIC SURVEY

CR Environmental Inc. completed the 2010 bathymetric survey of the pilot underwater cap on Wednesday, October 13, 2010. 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 to conduct the 2005, 2006, and 2007 bathymetric surveys of the pilot underwater cap area. For the 2010 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 2010 survey, which was similar to the 2009 survey, 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 for the NBH Development Commission (Apex, 2007).

Weather Conditions:
Temperature: 50-60 degrees Fahrenheit
Wind: 5-15 knots from the east and northeast
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 and 2010 by CR Environmental 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, and 2010).

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 Environmental is presented in Attachment B.

The following figures summarize the statistics for the pilot cap area based upon the 2010 bathymetric survey.

Figure 1 illustrates the bathymetry relative to MLLW as surveyed in 2010 over the Intended Cap Area. Figure 2 illustrates each surveyed boundary of the Full Placement Area. The Full Placement Area is determined following each survey by identifying the 0.5 ft contour (cap thickness) around the placed material. The Full Placement Area for 2010, determined to be 20.31 acres, is a 7.2 percent difference (increase) in area from 2005 (18.90 acres), but less than 1 percent difference (decrease) in area from that measured in 2009 (20.41 acres). Based on the available data it would appear that following placement of the cap material the Full Placement Area expanded relatively rapidly within the first year or two. Following the initial expansion of the Full Placement Area, survey data suggests that any expansion or contraction has slowed. Figure 4 graphically depicts changes in the Full Placement Area over time. The Full Placement Area for all years are as follows:

- 2005 = 18.90 acres (Apex, 2007),
- 2007 = 20.76 acres (Apex, 2007),
- 2009 = 20.41 acres (Jacobs, 2010), and
- 2010 = 20.31 acres.

The percentage of area within the Intended Cap Area covered by at least 1 ft of cap material increased from 2009 to 2010. Similarly, the percentage of area within the Intended Cap Area covered by at least 2 ft of cap material also increased from 2009 to 2010. 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 percentages for the Intended Cap Area are presented on Figure 3.

In the 2009 bathymetry it was noted that two sub-areas of the Intended Cap Area, Areas A and B 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 Areas A and B were less than 1 ft thick. The 2010 survey results still present the cap coverage in these areas as relatively thin; however, it appears that the majority of Areas A and B have increased cap thicknesses of greater than 1 ft (Figure 3).

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 reported at 98.1 percent of the Intended Cap Area.

All surveys by all bathymetric contractors have illustrated the process of ridge and valley leveling over time. This process causes ridges 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 leveling 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). 2010 (March). *Final 2009 Bathymetric Survey of Pilot Underwater Cap, New Bedford Harbor Superfund Site*. ACE-J23-35BG0702-M17-0009.

FIGURES

Legend

Pilot Underwater Cap Bathy Data
MLLW Elevation, feet

- -2.5 - -2.0
- -3 - -2.5
- -3.5 - -3
- -4 - -3.5
- -4.5 - -4
- -5 - -4.5
- -5.5 - -5
- -6 - -5.5
- -6.5 - -6
- -7 - -6.5
- -7.5 - -7
- -8 - -7.5
- -8.5 - -8
- -9 - -8.5
- -9.5 - -9
- -10 - -9.5
- -10.5 - -10
- -11 - -10.5
- -11.5 - -11
- -12 - -11.5
- -12.5 - -12
- -13 - -12.5
- -13.5 - -13
- -14 - -13.5
- -14.5 - -14
- -15 - -14.5
- -15.5 - -15
- -16 - -15.5
- -16.5 - -16
- -17 - -16.5
- -17.46 - -17

Pilot Underwater Intended Cap Area

Aerial Photography MASSGIS 2003

N

0 150 300 Feet

1:3,600

JACOBS™

Pilot Underwater Cap Bathymetry Survey (Mean Lower Low Water) October 13, 2010

New Bedford Harbor Superfund Site

NAME: croberts DATE: 12/08/2010

Figure 1

Y:\NEW\Project\355BG07021\20101208\ArcGIS\su3_bathy2010.mxd

OU#3 Cap Footprint	Area (Acres)
2010	20.31
2009	20.41
2007	20.76
2005	18.90

Legend

- 2010 Full Placement Area
- 2009 Full Placement Area
- 2007 Full Placement Area
- 2005 Full Placement Area
- OU#3 Intended Cap Area

0 75 150

Feet

1:1,800

N

JACOBS™

Cap Footprint Full Placement Area Comparisons

New Bedford Harbor Superfund Site

NAME: jpiccuito DATE: 11/10/2010

Figure 2

Y:\NBH\Projects\35BG0801\20101110\ArcGIS\full_placement_comparison_correction20101027.mxd

Area A

Area B

Year	Area of Cap With Thickness > 1 Foot	Area of Cap With Thickness > 2 Feet
2005*	92.6%	58.5%
2006*	97.8%	67.0%
2007*	98.4%	74.6%
2009	96.3%	61.4%
2010	98.1%	68.4%

* 2005, 2006, 2007 Data (Apex, 2007)

Legend

Pilot Underwater Cap Thickness, feet

- 5.5 - 6.4
- 5 - 5.5
- 4.5 - 5
- 4 - 4.5
- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1

Pilot Underwater Intended Cap Area

N

0 75 150

Feet

1:1,800

JACOBS™

2010 Pilot Cap Thickness

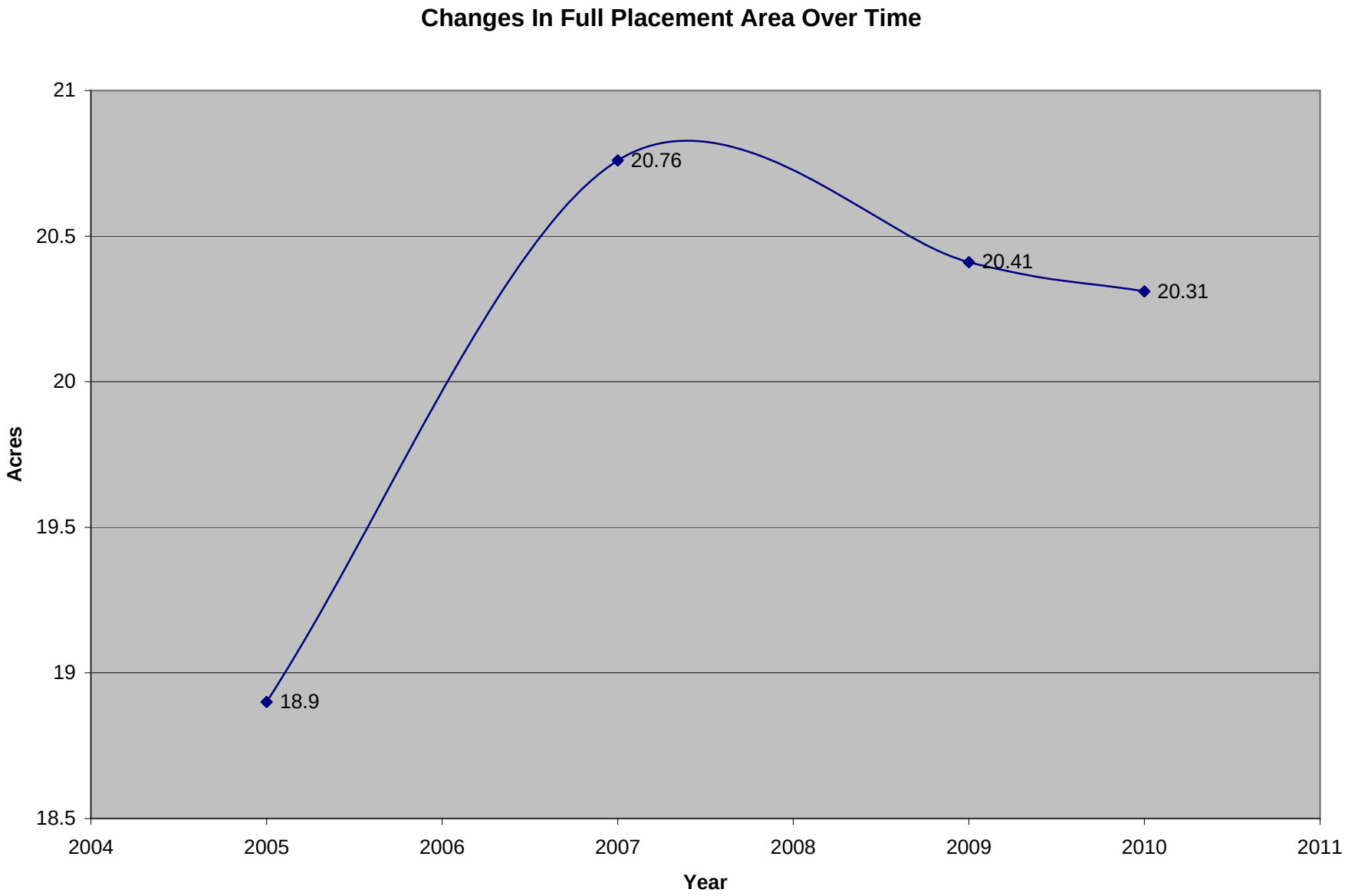
New Bedford Harbor Superfund Site

NAME: croberts DATE: 02/01/2010

Figure 3

Y:\NBH\Projects\35BG08011\20101110\ArcGIS\cu3vertical_correction20101027.mxd

Figure 4


Changes In Full Placement Area Over Time
21
20.5
20
19.5
19
18.5
Acres
20.76
20.41
20.31
18.9
2004
2005
2006
2007
2008
2009
2010
2011
Year

TABLE

Table 1
Sumary of Quality Control Analysis Results
Pilot Underwater Cap;
October 13, 2010

QC Parameter	Result	Description
Cross-Tie Comparisons		
Number of Comparisons	806	
Arithmetic Mean of Comparisons (feet)	0.06	Measurement bias within data set. ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.25 feet)
Standard Deviation of Comparisons (feet)	0.18	
Arithmetic Mean of Absolute Values (feet)	0.15	Overall accuracy within data set
Confidence Level (95.0%)	0.01	Confidence in accuracy assessment
RMS 95th Percentile Confidence Level (feet)	0.19	ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.5 feet
Bar/Staff Check		
Number of Comparisons	2	Pre- and Post-Survey
Depth of Comparisons	5', 15'/5'	Suitable for Project Depth
Echo Sounder vs. Bar Plate	5.0, 15.0 / 5.0	Bar check plate on stainless cable
Sound Velocity Comparisons		
Number of Comparisons	2	Pre- and Post-Survey
Depth of Comparisons	Surface, 13'	Suitable for Project Depth
Range of Values	1505-1506	meters/second
Velocity Utilized	1505	meters/second (raw data adjusted)

ATTACHMENT A

APEX 2007 SURVEY REPORT

115 Broad Street - Suite 200
Boston, MA 02110
One Wamsutta Street
New Bedford, MA 02740
Telephone 617-728-0070
Facsimile 617-728-0080

M E M O R A N D U M

To: Mr. Ken Gaynor, QCSM
Jacobs Engineering
New Bedford Harbor Superfund Site
103 Sawyer Street
New Bedford, MA 02746

From: Apex Companies, LLC
One Wamsutta Street
New Bedford, MA 02740

Date: 23 October, 2007

Re: Bathymetric Survey – EPA Operable Unit #3 (OU#3)
New Bedford Harbor Superfund Site

Bathymetric Survey: New Bedford Harbor: EPA Operable Unit #3

Apex Companies, LLC has completed the bathymetric survey of the EPA Operable Unit #3 (OU#3), per the contract modification dated 9/19/2007 to contract number 35BG0601-S07-0009 between Apex Companies, LLC and Jacobs Engineering. Apex personnel completed the bathymetric survey between Tuesday, October 2, 2007 and Saturday, October 6, 2007. The survey was performed by Apex personnel Kris van Naerssen, Greg Dolan and Josh Ray.

Apex utilized a 19-foot fiberglass survey vessel, ODEC (Bathy500 DF) digital fathometer, Trimble Pro-XRS DGPS survey system, and Hypack Version 6.2 navigation and data collection software for the survey.

The bathymetric survey data is referenced to Mean Lower Low Water vertical datum. Tidal readings were obtained from a tideboard located on the pier outside of the New Bedford Harbor Hurricane Barrier. The tideboard was placed at the eastern end of the pier located near the intersection of Franklin Street and East Rodney French Boulevard. Apex personnel installed the tideboard, which was measured in1/10th foot increments, on September 26, 2007. The tideboard elevation is based upon geodetic control point TS1, which was installed on May 16, 2005 by Coler & Colantonio surveyors.

Weather Conditions:

10/02/07

- Temperature: 75 degrees;
- Cloud Cover: Partially Cloudy
- Wind: Varied. 5 - 15 Knots from northeast

10/03/07

- Temperature: 70 degrees;
- Cloud Cover: Overcast
- Wind: Varied. 10 - 15 Knots from southeast

10/06/07

- Temperature: 80 degrees;
- Cloud Cover: Partially Cloudy
- Wind: Varied. 5 - 10 Knots from northeast

QA/QC Checks:

- At the mooring ball located to the northeast of the East Rodney French Boulevard public boat launch, Apex used the vertical manual depth rods to check the fathometer readings, after initial instrument calibration, which included offset checks and sound velocity adjustments.
- The sound velocity check was conducted at the mooring, to ensure that the survey was ran at a sound velocity setting that reflected the water conditions. After the instrument calibrations, all rod and transducer checks correlated well.
- Fourteen manual (vertical) rod checks were performed at various depths during the survey. A survey rod was used to ensure greater accuracy during the manual rod checks. The field survey equipment passed all rod checks that were performed, as the rod and fathometer depths matched. Field notes with the QA/QC and data check results are attached to this memorandum.
- The pre-survey calibrations were conducted at 4, 5, 6, 10 and 15 feet at Operable Unit #3. Apex repeated the sound velocity checks at the completion of each survey day and prior to conducting surveys on subsequent days.
- Tide measurements were collected approximately every 20-30 minutes at the tide boards established by Apex. Readings are referenced to Mean Lower Low Water.
- Apex performed four latency line checks within the survey area by repeating survey lines in opposite directions. The results of the latency check indicated no latency discrepancies, and corrections were not required.
- Apex ran cross-tie lines in two directions (east and west) at the completion of the survey of OU#3.

Survey Procedures – Comparison to Previous Years

- All survey procedures were consistent with Apex's previous surveys at OU#3. Survey lines were run in a southeast to northwest orientation, to ensure the most bathymetric coverage over the capped area.
- The 25' spacing was consistent with the January 2006 survey. The July 2005 survey of OU#3 was conducted at 12.5' spacing, as this represented the higher resolution "As-Built" survey for the OU#3 Cap Placement Area.
- As with the previous surveys, multiple QA/QC checks (Including Rod Checks, Depth/ Rod Checks, Tide Readings and Latency checks) were performed prior to, during, and after the survey, as described above.

Processing:

Apex processed the survey data on Thursday 10/4/2007 and Wednesday 10/10/2007 using the QA/QC protocols previously noted. Pre-processing was conducted with Hypack software, and post-processing with Oasis Montaj. Corrections were applied in Hypack to account for the increased wave and wake activity at the OU#3 area. "Flyers" were removed from the data-set, and a non-linear filter was applied, removing any soundings that differed by more than 0.2-feet over 1 fiducial (sounding). Apex compared the 2007 survey results with survey data collected previously, by Apex and others, both in plan and section view. Additionally, the data from the survey was compared with the pre-dredge conditions survey. Statistics were performed on the data and the results were reviewed and analyzed. After the data had successfully passed through the QC checks, it was transcribed into the maps which are included with this memo.

Deliverables:

Apex is including with this memo:

- The 10/06/2007 Cap Thickness (Isopach) survey map;
- A copy of the previously produced 01/12/06 Cap Thickness (Isopach) survey map;
- A copy of the previously produced 07/26/05 As-Built Cap Thickness (Isopach) survey map;
- A figure depicting the limits of the 2005 Cap contour vs. 2007 Cap contours.
- Cap thickness cross section, produced from data at the southwestern portion of the Cap;
- A .pdf copy of the field notes, calibration check and data processing sheets.

Discussion - Cap Changes with Time:

OU#3 Pilot Cap surveys and Cap statistics have been conducted for 2005, 2006, and 2007 (see attached). Cap statistics were conducted for both the Intended Cap Area, and for the Full Placement Area. The Intended Cap Area is that area which was designated in the design to be capped. The Full Placement Area was that area which ultimately received cap material during the cap construction.

For the 2007 dataset, the Full Placement Area limits were determined by selecting the 0.5-foot contour around the placed material. The size of the cap area in 2007 (using the 0.5-foot contour interval) was determined to be 20.76 Acres. The capped area footprint in 2005 was 18.9 acres, at the 0.5-foot contour line.

A review of the Cap surveys from 2005 through 2007 indicates that the material placed within the Intended Cap Area is acting generally as expected over time: the "peaks" are decreasing, with the material winnowed from the peaks generally moving into the valleys. The overall effect is that the Cap is flattening out and becoming more uniform within the Intended Cap Area. Statistics indicate that within the Intended Cap Area, by 2007 the Cap exceeds two feet in thickness over nearly 75% of the area, and exceeds one foot in thickness over more than 98% of the area.

In the Full Placement Area, the 2007 Cap statistics indicate that a lower percentage of the overall area is covered by the one and two foot thicknesses. It is thought that this is due to "toe-ing" at

the edges of the Cap, as placed material seeks a more stable angle of repose at the edges over time. This "toe-ing" effect is illustrated on the attached cross sections, which show a flattening of the slope at the very edge of the Cap between the 2005 and 2007 surveys. This phenomenon suggests that future Cap placement efforts in this area should include a provision to extend the Cap beyond the edge of the Intended Cap Area in order to account for "toe-ing" of the Cap at it's edges over time.

Comparison of Statistics:

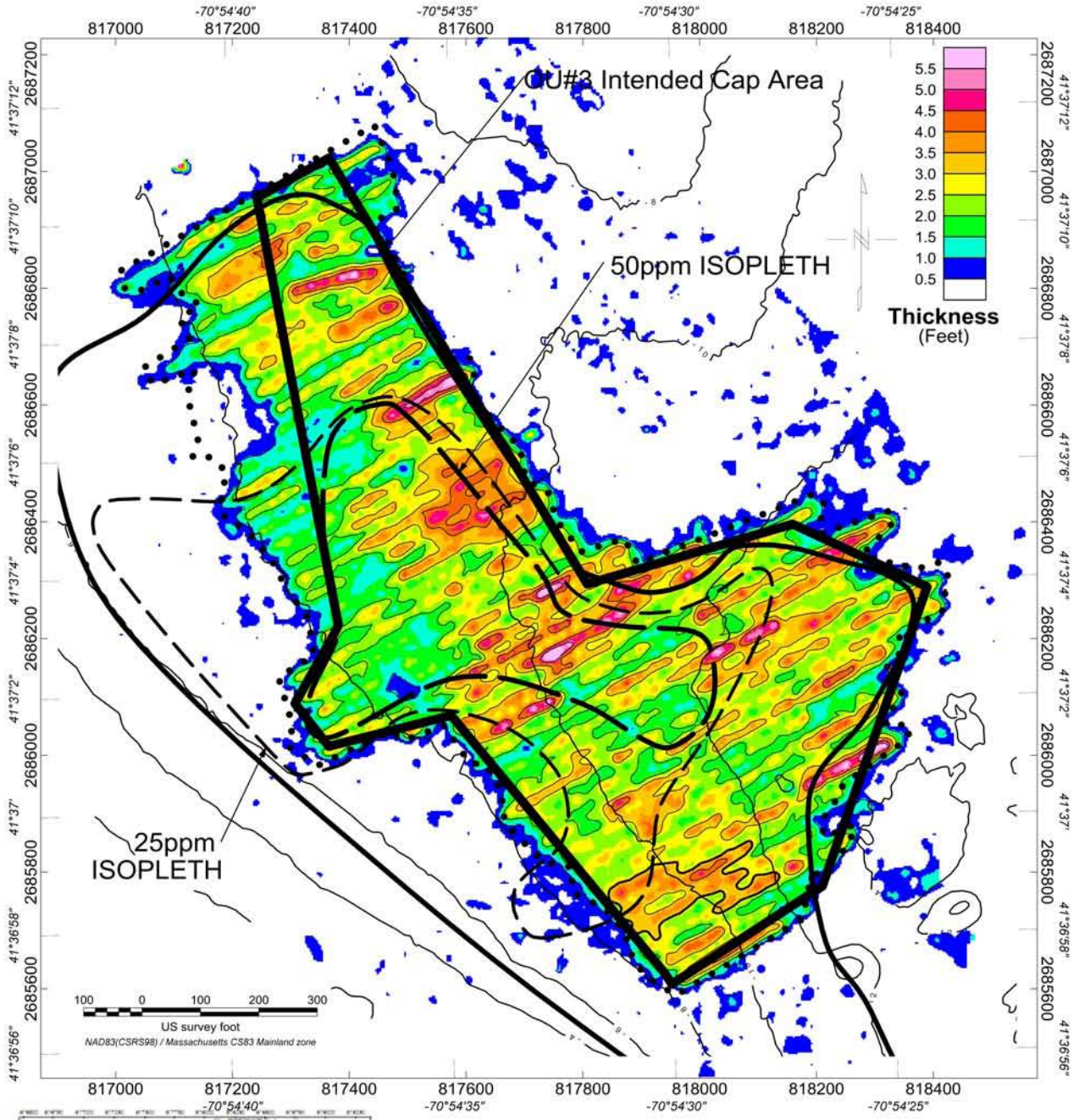
Apex has re-calculated the statistics for the material that was placed within the "Intended Cap Area" for the previous years' surveys. The statistics have been re-calculated, so that a comparison may be made, of the same area over time. The Intended Cap Area, as defined above, is depicted on the 2007 Cap Thickness Map. The coverage percentages for the Intended Cap Area over time are presented below:

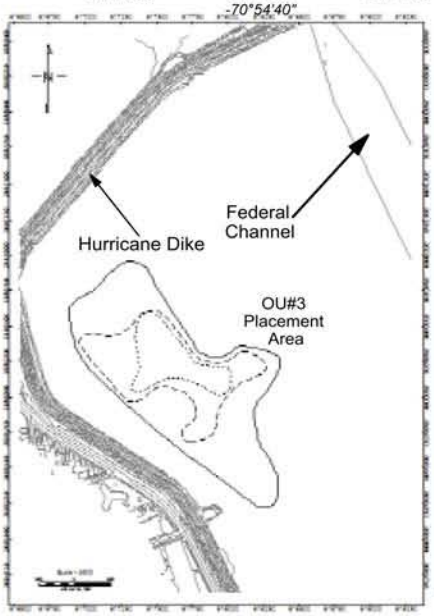
Year	Thickness of Cap > 1' Foot	Thickness of Cap > 2' Foot
2005	92.6%	58.5%
2006	97.8%	67.0%
2007	98.4%	74.6%

If you have any questions concerning the data collection and/or data processing activities described here-in, please do not hesitate to contact either: Kris van Naerssen, Greg Dolan or Jay Borkland (617) 728-0070. Apex is please to support Jacobs in this very important field program. Please do not hesitate to contact us if you have questions or comments.

Sincerely: Jay Borkland, Greg Dolan, Kris van Naerssen

Attachments (email attachments): maps, cross-sections, field notes and calibration forms.





STATISTICS

Intended Cap Area: AREA OF CAP ~15.24 ACRES
THICKNESS OF CAP >1-FOOT 98.4%
>2-FOOT 74.6%

Full Placement Area: AREA OF CAP ~20.76 ACRES
THICKNESS OF CAP >1-FOOT 88.9%
>2-FOOT 61.7%

Statistics Notes:
1. Statistics of "Intended Cap Area" indicates material from "peaks" continues to fill in the "valleys", increasing the overall percentage of "Intended Cap Area" covered by 1' or more of cap.
2. Statistics of the "Full Placement Area" indicates some "winnowing" of material at the edges of the cap, slightly decreasing the cap thickness at the edges as material 'toes-out'.

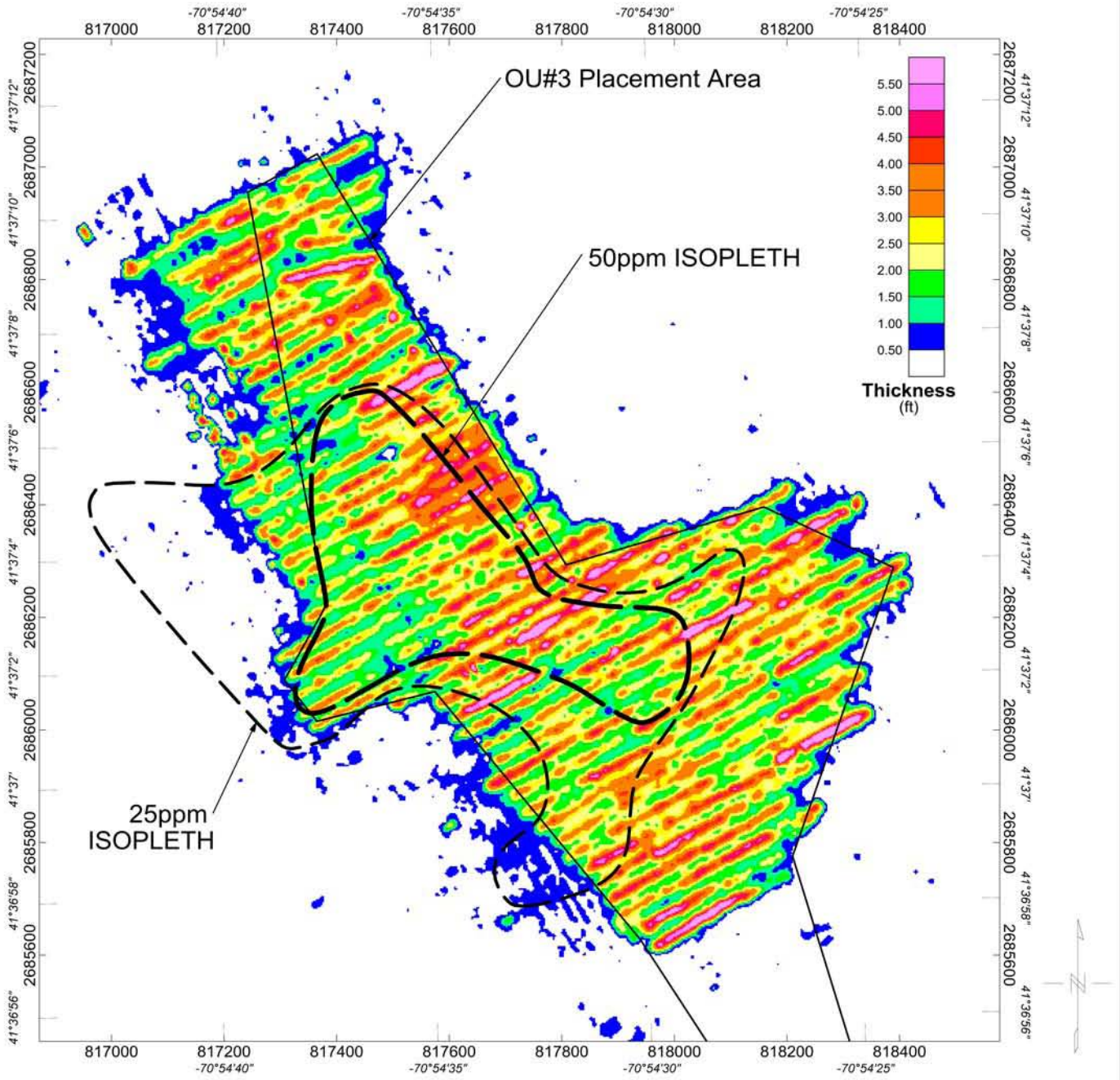
GENERAL NOTES:
1. BATHYMETRIC INFORMATION COLLECTED BY APEX COMPANIES FROM 10/02/07 TO 10/06/07. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING THE 10/02/07 THROUGH 10/06/07 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFT'S OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2007 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. PRE-PLACEMENT BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. 2-FOOT BATHYMETRIC CONTOURS SHOWN ON THE PRE-PLACEMENT SURVEY PERFORMED BY COLER & COLANTONIO 6/23/05. CONTOURS REPRESENT MINIMUM CURVATURE EXISTING CONDITIONS SURFACE CONSTRUCTED BY GEOSOFT'S OASIS MONTAJ.
6. INTENDED CAP AREA = AREA THAT WAS DESIGNATED IN THE DESIGN TO BE CAPPED.
FULL PLACEMENT AREA = AREA THAT ULTIMATELY RECEIVED CAP MATERIAL DURING CAP CONSTRUCTION.

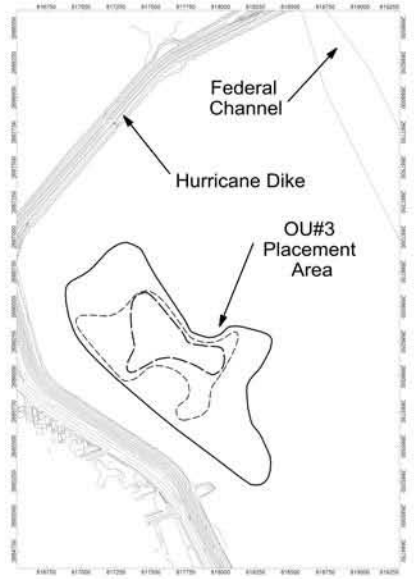
115 Broad Street
Suite 200
Boston
MA 02110

10/06/07 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Post Final Placement Surveys

Apex Companies, LLC





100 0 100 200 300

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

STATISTICS

AREA OF CAP ~18.9 ACRES
THICKNESS OF CAP >1-FOOT 98%
>2-FOOT 70%

NOTES

1. BATHYMETRIC INFORMATION COLLECTED BY APEX ENVIRONMENTAL ON 01/12/06. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO FROM THE DTM CONSTRUCTED BY THE 01/12/06 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFTS OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2005 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. 2-FOOT BATHYMETRIC CONTOURS SHOWN OF THE PRE-PLACEMENT SURVEY PERFORMED BY COLER & COLANTONIO 6/23/05. CONTOURS REPRESENT MINIMUM CURVATURE EXISTING CONDITIONS SURFACE CONSTRUCTED BY GEOSOFT'S OASIS MONTAJ.

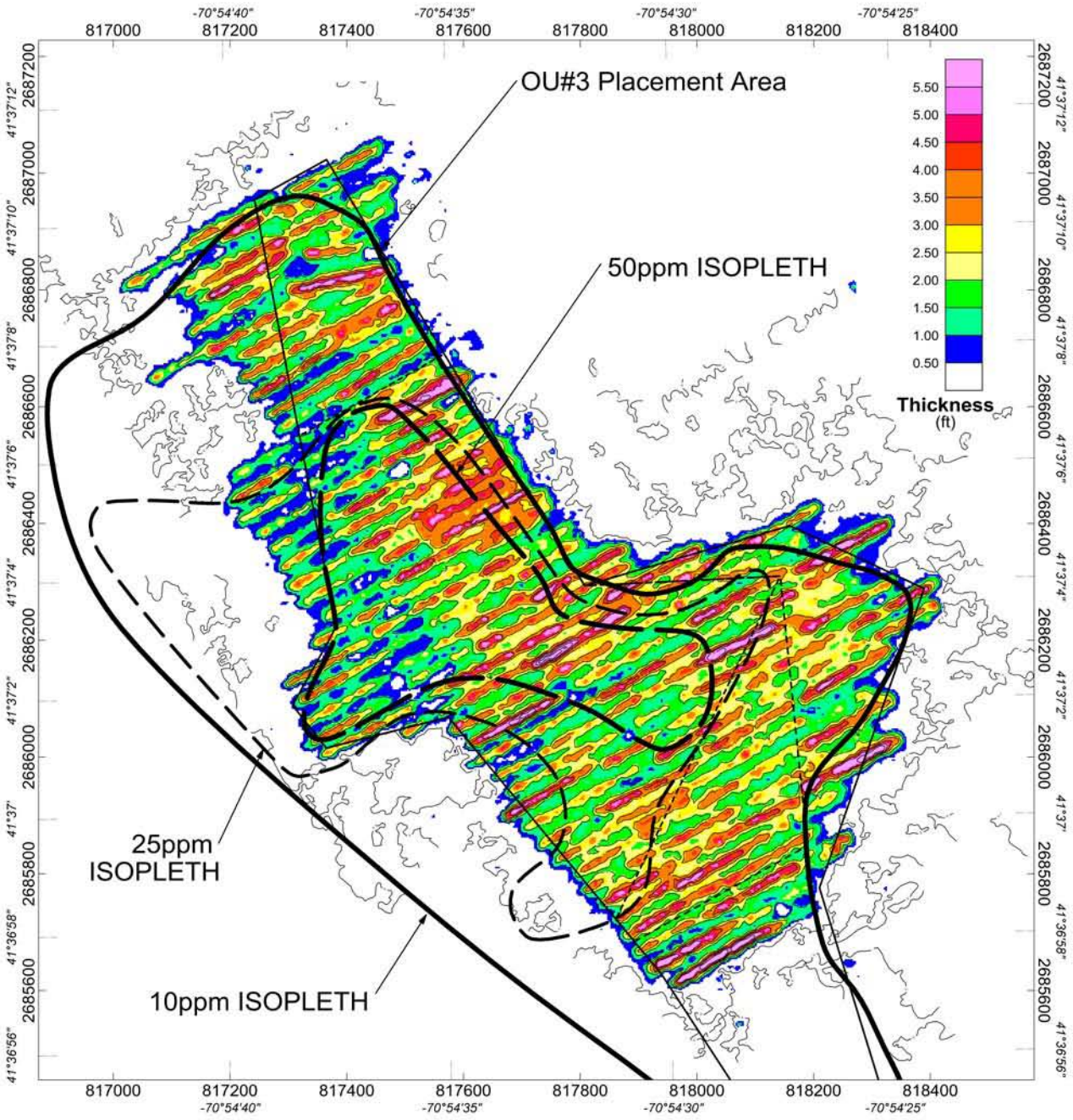
286 Congress St
Suite 610
Boston
MA 02210

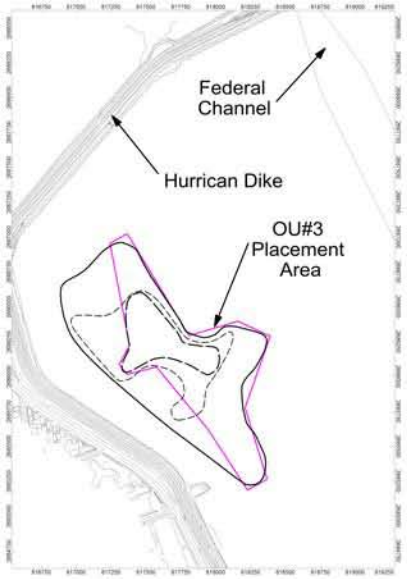
Apex environmental, inc.

01/12/06 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Post Final Placement Surveys

Apex Environmental





Scale 1:2400

100 0 100 200 300

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

STATISTICS

AREA OF CAP ~18.9 ACRES
THICKNESS OF CAP >1-FOOT 95%
>2-FOOT 65%

NOTES

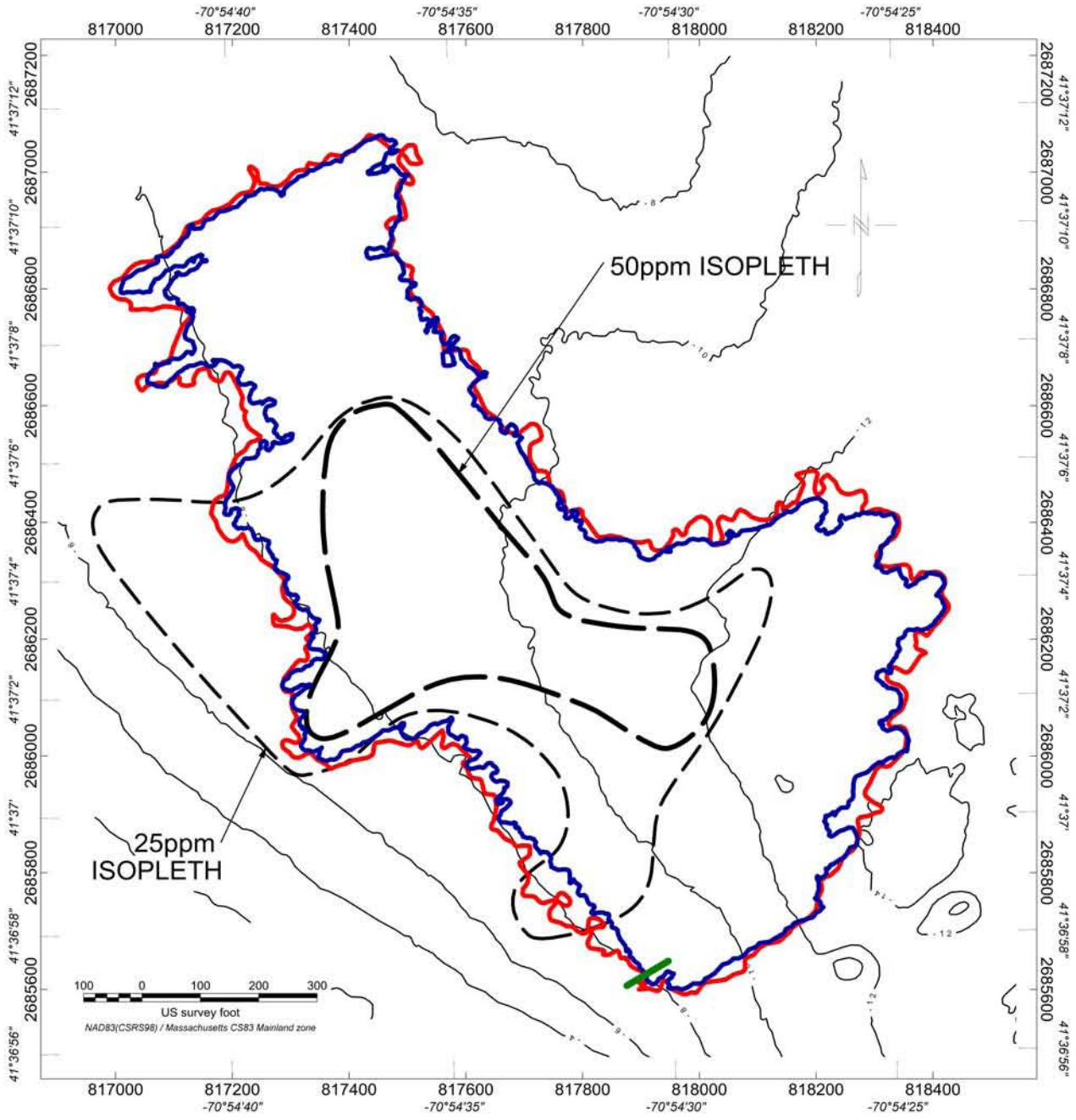
1. BATHYMETRIC INFORMATION COLLECTED BY APEX ENVIRONMENTAL ON 7/26/05. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO FROM THE DTM CONSTRUCTED BY THE 7/26/05 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFTS OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2005 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.

286 Congress St
Suite 610
Boston
MA 02210

07/26/05 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Final Placement Surveys

Apex Environmental



2007 OU#3 CAP Footprint: AREA OF CAP ~20.76 ACRES

2005 OU#3 CAP Footprint: AREA OF CAP ~18.9 ACRES

Cross-Section Location

GENERAL NOTES:

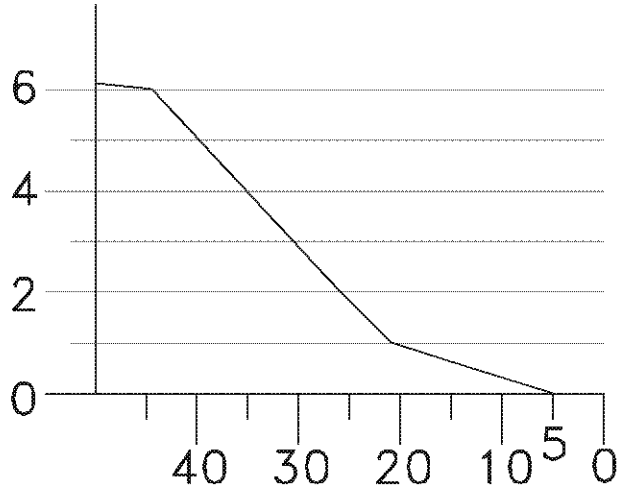
1. CAP FOOTPRINT AREA DETERMINED AT THE 0.5-FOOT CONTOUR INTERVAL.
2. 2007 BATHYMETRIC INFORMATION COLLECTED BY APEX COMPANIES FROM 10/02/07 TO 10/06/07. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE 2007 ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING THE 10/02/07 THROUGH 10/06/07 DATA.
3. THE 2005 ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING BATHYMETRIC DATA COLLECTED BY APEX ON 7/26/2005.
4. PRE-PLACEMENT BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. DTM SURFACES WERE CONSTRUCTED USING GEOSOFT'S OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
6. CAP THICKNESS CROSS SECTIONS WERE CONSTRUCTED IN GEOSOFT'S OASIS MONTAJAND IN AUTOCAD.

CAP Footprint Comparisons
OU#3 Placement Area Survey

2005 vs. 2007 CAP Footprint
CAP Area Constructed at 0.5-Foot Contour Interval

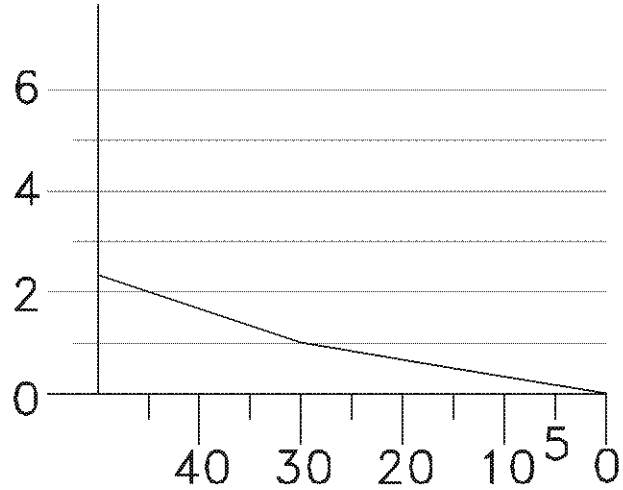
Apex Companies, LLC

2005 PROFILE AT EDGE OF CAP



VERTICAL SCALE EXAGGERATION 5:1

2007 PROFILE AT EDGE OF CAP



VERTICAL SCALE EXAGGERATION 5:1

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1 Wamsutta Street
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Telephone 617-728-0070
Facsimile 617-728-0080

Date of Survey 10/2/07
Date of Processing 10/4/07
Areas Surveyed OU #3
Surveyors KJN + JFK
Processors KJN
Oasis Project Name JACOBS 2007

Hypack Step
Oasis Step

Tide File Created	100267.TID
Sound Velocity File	100267.SVC

1524 m/sec

	Hypack Line	Single-Beam Edits	Exported	Exported from Oasis?
1	43.1143	✓	✓	
2	44.1147	✓	✓	
3	45.1151	✓	✓	
4	46.1212	✓	✓	
5	47.1214	✓	✓	
6	48.1216	✓	✓	
7	43.1218	✓	NO	LATENCY
8	49.1220	✓	✓	
9	50.1222	NO - JUNK	NO	JUNK
10	50A1223	✓	✓	
11	51.1225	✓	✓	
12	52.1230	✓	✓	
13	53.1249	✓	✓	
14	54.1253	✓	✓	
15	55.1300	✓	✓	
16	56.1305	✓	✓	
17	56.1310	✓ ✓	NO	LATENCY
18	56.1314	✓	NO	LATENCY
19	57.1318	✓	✓	
20	58.1324	✓	✓	
21	59.1330	✓	✓	
22	60.1337	✓	✓	
23	61.1342	✓ (WAVES)	✓	
24	62.1351	✓	✓	
25	63.1355	✓	✓	
26	64.1400	✓	✓	
27	64.Mark	✓	✓	
28	65.1410	✓	✓	
29	66.1416	✓	✓	
30	67.1422	✓	✓	
31	67.1429	✓	✓	
32	68.1434	✓	✓	
33	69.1440	✓	✓	
34	70.1441	✓	✓	
	71.1443	✓	✓	
35	71.1452	✓	✓	
36	72.1454	✓	✓	
37	70.1455	✓ (WAVES)	✓	
	69.1457	✓	✓	
38	68.1506	✓ (WAVES)	✓	
39	45.1520	✓	✓	
40	46.1524	✓	✓	
41	47.1527	✓	✓	
42	48.1529	✓ (WAVES)	✓	
43	49.1532	✓	✓	
44	50.1537	✓	✓	
45	52.1540	✓	NO ✓	X-TIE
46	52.1543	✓	NO ✓	X-TIE
47	51.1550	✓	✓	
48				
49				
50				
51				
52				
53				
54				
55				

Oasis Database Name

Oasis New Grid Name

Oasis Previous Week Grid Name

Isopach Grid Name

- a subtracted grid
(previous week minus current week)

Isopach Grid Statistics	
Mean	
Median	
Mode	
Std Dev	

Database Profile View	
Current Data	
Previous Data	
OK?	

Oasis Column for EXPORT

Name of Exported .XYZ files

Sorted to Hypack (.sss)	
North Area	
South Area	

Name of Sorted Files

Time/Date Processing Completed

X, Y, Corr, Raw, TIDE, File
OU#3_100267 + 100307.TXT

Apex Companies, LLC

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Date of Survey 10/3/07
Date of Processing 10/4/07
Areas Surveyed OU #3
Surveyors KJN - GEB
Processors KJN
Oasis Project Name JACOBS 2007

Hypack Step

Oasis Step

3.280' / m

Tide File Created	100307.TID
Sound Velocity File	100307.VEL

1554.48 m / sec

	Hypack Line	Single Beam Edited	Exported	Exported from Oasis?
1	8.1157	✓	✓	
2	9.1159	✓	✓	
3	10.1202	✓	✓	
4	11.1204	✓	✓	
5	12.1205	✓	✓	
6	13.1208	✓	✓	
7	14.1212	✓	✓	
8	15.1214	✓	✓	
9	16.1219	✓	✓	
10	17.1223	✓	✓	
11	18.1229	✓	✓	
12	19A.1253	✓ (Waves)	✓	
13	20.1245	✓ (waves)	NO	(AGENCY
14	20.1251	✓	✓	
15	21.1257	✓	✓	
16	22.1302	✓	✓	
17	23.1305	✓	✓	
18	24.1313	✓	✓	
19	25.1325	✓	✓	
20	26.1330	✓	✓	
21	27.1344	✓	✓	
22	28.1354	✓ (waves)	✓	
23	29.1358	✓	✓	
24	30.1402	✓	✓	
25	31.1407	✓	✓	
26	32.1411	✓	✓	
27	33.1420	✓	✓	
28	33.1424	✓	✓	
29	45.1436	✓	✓	
30	46.1439	✓	✓	
31	47.1442	✓	✓	
32	48.1455	✓	✓	
33	49.1457	✓	✓	
34	50.1500	✓	✓	
	51.1502	✓	✓	
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				

Oasis Database Name

Oasis New Grid Name

Oasis Previous Week Grid Name

Isopach Grid Name

- a subtracted grid
(previous week minus current week)

Isopach Grid Statistics	
Mean	
Median	
Mode	
Std Dev	

Database Profile View	
Current Data	
Previous Data	
OK?	

Oasis Column for EXPORT

Name of Exported .XYZ files

Sorted in Hypack (s)	
North Area	
South Area	

Name of Sorted Files

Time/Date Processing Completed

X, Y, Corr, Raw, TIDE, Final

OU #3_100207+100307.TXT

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Date of Survey 10/6/07
Date of Processing 10/10/07
Areas Surveyed OU #3
Surveyors KJN + GED
Processors KJN
Oasis Project Name JACOBS 2007

Hypack Step

Oasis Step

Tide File Created	100607_ou#3.tid
Sound Velocity File	100607_ou#3.vel

	Hypack Line	Single Beam Lines	Recorded	Exported from Oasis?
1	52-1136	✓	✓	
2	53-1137	✓	✓	
3	54-1138	✓	✓	
4	55-1139	✓	✓	
5	56-1136	✓	✓	
6	57-1138	✓	✓	
7	58-1140	✓	✓	
8	59-1142	✓	✓	
9	60-1144	✓	✓	
10	61-1146	✓	✓	
11	62-1150	✓	✓	
12	63-1152	✓	✓	
13	64-1210	✓	✓	
14	65-1212	✓	✓	
15	1-1216	✓	✓	
16	2-1219	✓	✓	
17	3-1221	✓	✓	
18	4-1223	✓	✓	
19	5-1225	✓	✓	
20	6-1227	✓	✓	
21	7-1230	✓	✓	
22	8-1233	✓	✓	
23	9-1235	✓	✓	
24	10-1237	X-Tie	NO	
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				

Lines

Lines

Oasis Database Name

Oasis New Grid Name

Oasis Previous Week Grid Name

Isopach Grid Name

- a subtracted grid
(previous week minus current week)

Isopach Grid Statistics	
Mean	
Median	
Mode	
Std Dev	

Database Profile View	
Current Data	
Previous Data	
OK?	

Oasis Column for EXPORT

Name of Exported .XYZ files

Sorted in Hypack (SS)	
North Area	
South Area	

Name of Sorted Files

Time/Date Processing Completed

X, Y, Corr, Raw, Tide, File

Apex Companies, LLC
115 Broad Street, Suite 200
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1 Wamsutta Street
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Telephone 617-728-0070
Facsimile 617-728-0080

Project Name	Jacobs Engineering Superfund Dredge - 2007	**Date**	10/2/07
Project #	6539.061	**High Tide Time**	
Surveyors	KVN C/ER	**Low Tide Time**	
Weather	Partly Cloudy 75°F Calm	**Survey Area**	003
Wind	5kn from NE		
Temp	75°F		
Frequency	5000 / sec		
Hypack Prj.	Jacobs 2007		
Line File	Jacobs_2007_003		
Transducer Offset	1.1		
Range	30		

Bar Check

Pre-Survey		Post-Survey	
Depth	Velocity	Depth	Velocity
4	5000	5	5000
5	5000	10	4980
6	5000	15	4980
10	4940		
15	4980		5000 RUN

choppy water

Latency Lines

049-1220
056-1310

Tide	Time	Board	
1	10:20	2.6	- Cod pocket T.L.
2	10:45	2.9	- 003 T. Jobend
3	11:06	3.2	
4	11:38	3.7	
5	12:07	3.9	
6	12:38	4.2	
7	1:24	4.25	
8	1:49	4.1	
9	2:32	3.6	
10	14:46	3.35	
11	15:09	3.0	
12	15:54	2.2	
13			
14			
15			
16			
17			
18			
19			

QC/Rod Check

Line #	Rod	Fatho	Pass/Fail
QAQC	16.1	15.9	P
QAQC	16.3	16.2	P
53	9.8	9.8	P
64	7.1	7.1	P
69	9.2	9.1	P

line 45 - 60

	Hypack Line	Direction	Hypack Line	Direction	Hypack Line	Direction	Hypack Line	Direction
1	043-1143	NW	061-1342	SE	050-1537	SE		
2	044-1147	SE	062-1351	NW	051-1540	SW		
3	045-1151	NW	063-1355	SE	-X TIE			
4	046-1212	NW	064-1400	NW	052-1543	NE		
5	047-1214	SE	064-1408	NW	-X TIE			
6	048-1216	NW	065-1410	SE	051-1550	NE		
7	049-1218	SE	066-1416	NW				
8	049-1220	NW	067-1422	SE				
9	050-1222	REDO	067-1429	SE*				
10	050A1222	SE	068-1438	NW				
11	051-1225	NW	069-1440	SE				
12	051-1228	NW	070-1441	NW				
13	052-1230	SE	071-1445	SE				
14	053-1249	NW	071-1457	SE				
15	054-1253	SE	072-1459	NW				
16	055-1258	NW	070-1455	SE				
17	056-1305	SE	069-1458	NW				
18	056-1310	NW	068-1500	SE				
19	056-1314	NW	045-1526	NW				
20	057-1318	SE	046-1524	SE				
21	058-1328	NW	047-1527	NW				
22	059-1332	SE	048-1529	SE				
23	060-1338	NW	049-1532	NW				

wave/wake 1st line junk

Wavy line

first ½ way line waves

R-redo - N/E/S/W compass heading - noise - wake - aborted - etc

Line 061_1342 SE: waves
070_1455 SE: waves
069_1458 NW: bubbles at start/waves
068_1500 SE: waves
048-1529 SE: waves ½ way thru

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267-1700

Project Name	Jacobs Engineering Superfund Dredge - 2007
Project #	6639.001
Surveyors	K.N + GCD
Weather	Overcast
Wind	16-12 kn - SE
Temp	70°
Frequency	Raw @ 5030
Hypack Prj.	Jacobs Event
Line File	
Transducer Offset	1.1'
Range	300'

Date 10/3/07
High Tide Time 14:14
Low Tide Time 9:45
Survey Area OU#3

Tide	Time	Board
1	11:30	2.35'
2	11:53	2.7
3	12:41	3.45
4	13:21	3.95
5	13:37	4.1
6	14:17	4.15
7	14:49	4.1
8	15:10	3.95
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		

Bar Check

Pre-Survey		Post-Survey	
Depth	Velocity	Depth	Velocity
4.0	5060	5	5050
5.0	5060	10	5000
6.0	5060	15	5000
10.0	5000		
15.0	5000		

Latency Lines

20	125
45	51

QC/Rod Check

Line #	Rod	Fatho	Pass/Fail
QAQC	12.1	12.1	P
27	8.9	8.9	P
33	6.4	6.4	P
51	7.8	7.7	P
51	8.0	8.0	P

	Hypack Line	Direction	Hypack Line	Direction	Hypack Line	Direction	Hypack Line	Direction
1	9_1156	~~SE~~ NW	31_1407	NW				
2	9_1158	SE	32_1413	SE				
3	10_1202	NW	33_1420	NW				
4	11_1204	SE	33_1424	NW				
5	12_1206	NW	45_1436	SE				
6	13_1208	SE	46_1439	NW				
7	14_1212	NW	47_1442	SE				
8	15_1214	SE	48_1455	NW				
9	16_1218	NW	49_1457	SE				
10	17_1223	SE	50_1500	NW				
11	18_1229	NW	51_1502	SE				
12	19A 1233	SE						
13	20_1245	SE						
14	21_1257	NW						
15	22_1302	SE						
16	23_1308	NW						
17	24_1313	SE						
18	25_1325	NW						
19	26_1330	SE						
20	27_1349	NW						
21	28_1354	SE						
22	29_1358	NW						
23	30_1402	SE						

Waves → in middle of line - from wake of ships in channel

Waves →

R/radio - N/E/S/W compass heading - noise - wake - aborted - etc

Waves on 33_1424 NW

Jacobs Bubbles in Water 46_1439

Apex Companies, LLC

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Project Name	Jacobs Engineering Superfund Dredge - 2007
Project #	6637.0001
Surveyors	KJN + GLB
Weather	80, Sunny, Calm
Wind	5 kts fm NE
Temp	90°
Frequency	5000' / SEC
Hypack Prj.	JACOBS 2007
Line File	100607-OU#3
Transducer Offset	1.1'
Range	30'

Date 10/6/07
High Tide Time 12:30
Low Tide Time 11:39
Survey Area OU #3

Tide	Time	Board
1	10:19	0.8'
2	11:20	0.8'
3	12:05	0.95'
4	12:55	1.4'
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		

Bar Check

4' 5090
5' 5070
6' 5070
10 4890

Pre-Survey		Post-Survey	
Depth	Velocity	Depth	Velocity
4'	5040		
5'	5070		
6	5070		
10	4890		

Latency Lines

QC/Rod Check

Line #	Rod	Fatho	Pass/Fail
QAQC	8.4	8.4	P
1	9.4	9.4	P
63	9.0	9.0	P
10	9.5	9.5	P

	Hypack Line	Direction	Hypack Line	Direction	Hypack Line	Direction	Hypack Line	Direction
1	J2 - 1126	NW	10 - 1239	SE				
2	53 - 1128	SE						
3	54 - 1130+	NW						
4	55 - 1133	SE						
5	56 - 1136	NW						
6	57 - 1138	SE						
7	58 - 1140	NW						
8	59 - 1142	SE						
9	60 - 1144	NW						
10	61 - 1146	SE						
11	62 - 1150	NW						
12	63 - 1158	SE						
13	64 - 1210	NW						
14	65 - 1212	SE						
15	01 - 1216	SW						
16	02 - 1219	NE						
17	03 - 1221	SW						
18	04 - 1223	NE						
19	05 - 1225	SW						
20	06 - 1228	NE						
21	07 - 1230	SW						
22	08 - 1233	NE						
23	09 - 1236	SW						

waves start → 4
waves → 6
Waves → 10
Bubbles waves → 12
waves at start → 20

R:redo - N/E/S/W compass heading - noise - wake - aborted - etc

ATTACHMENT B

JACOBS 2009 SURVEY REPORT

JACOBS

US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
Total Environmental Restoration Contract
USACE CONTRACT NUMBER: DACW33-03-D-0006
Task Order No. 0007

Final 2009 Bathymetric Survey of Pilot Underwater Cap New Bedford Harbor Superfund Site

New Bedford Harbor Superfund Site
New Bedford, MA

March 2010

Prepared by
Jacobs Engineering Group
103 Sawyer Street
New Bedford, MA 02746

ACE-J23-35BG0702-M17-0009

TABLE OF CONTENTS

Figures

Table

Attachments

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1.0 INTRODUCTION

This report is intended to briefly summarize the 2009 bathymetric data collected from the pilot underwater cap area at the New Bedford Harbor Superfund Site. These data were used to update information about the cap area and cap thickness, which are presented in this report.

2.0 BATHYMETRIC SURVEY

CR Environmental Inc. completed the bathymetric survey of the pilot cap on Wednesday, March 25, 2009. The bathymetric data collected were referenced to National Geodetic Vertical Datum 1929 (NGVD 29) and were later converted to Mean Lower Low Water (MLLW) vertical datum by Jacobs staff using the local conversion factor of -1.44 feet. This conversion was made because the previous bathymetric surveys conducted by Apex and associated bathymetric data were all presented relative to MLLW.

At the time of the 2009 survey, the GPS used to record the elevation at the point used for survey control (datum) recorded an erroneous value. The elevation of the datum was measured 0.91 feet lower than the true elevation relative to NGVD 29. This offset was realized after the point was surveyed to NGVD 29 by Meridian and Associates on January 27, 2010 (Attachment A). Once the error was discovered, the values of the 2009 MLLW survey were then raised 0.909 feet above the GPS datum measurement such that they represent the true MLLW.

The CR Environmental survey gathered data at a line spacing of 25 feet in a northwest to southeast orientation. This is consistent with historical post-placement surveys of the pilot cap area that were conducted by Apex Companies, LLC for the New Bedford Harbor Development Commission (Apex, 2007).

Weather Conditions:
Temperature: 40º Fahrenheit
Wind: 10-20 knots from the north
Seas: 1-2 feet

QA/QC Checks:
A summary of quality control analysis results can be found in Table 1.

3.0 DISCUSSION

The pilot underwater cap was placed in 2005 to test how well a cap in New Bedford Harbor would perform. The cap was placed by split hull scows which dropped dredged material over the Intended Cap Area (Figure 1). Since the placement of material, there have been bathymetric surveys performed in 2005, 2006, and 2007 by Apex; and in 2009 by CR Environmental Inc. to monitor the size and thickness of the placed material. The Apex figures presenting the 2005, 2006, and 2007 bathymetric surveys are presented in Attachment B. The March 2009 and prior pilot cap bathymetric surveys were used to compare the pre- and post-placement bathymetry for each year a survey was taken (2005, 2006, 2007, and 2009). These comparisons generated cap statistics for each of these years, which were calculated for the Intended Cap Area and the Full Placement Area. The Intended Cap Area is the area which was designated in the original design to be capped (Figure 1).

The Full Placement Area is the area which actually received cap material during the cap construction (Apex, 2007). The boundary of the Full Placement Area was determined yearly by identifying the 0.5 foot contour around the placed material. The Full Placement Area for 2009 was determined to be 20.41 acres which is a 1.7 percent decrease in area from 2007 (20.76 acres). The Full Placement Area for previous years is as follows (Figure 2):

- 2005 = 18.90 Acres (Apex, 2007),
- 2007 = 20.76 Acres (Apex, 2007), and
- 2009 = 20.41 Acres.

The reported thickness of cap material contained within the Intended Cap Area also decreased between 2007 and 2009. This is a change from the previous years (2005 to 2007) where it is theorized that the flattening out of cap peaks provided material which

settled into the valleys therefore increasing the cap thickness in the valleys. Statistics and coverage percentages for the Intended Cap Area are presented on Figure 3.

4.0 SUMMARY

Overall the pilot cap continues to perform well, with the area of cap which is at least 1 foot thick currently reported at 96.3 percent of the Intended Cap Area. There also appears to be some smoothing or erosion of ridge tops in certain cap areas.

The area and thickness of the Intended Cap Area has remained relatively consistent from 2007 through 2009, except for two areas along the western boundary and other smaller areas between ridges (Figure 3). From 2007 to 2009, there was a reduction of the reported area of the cap with a thickness greater than 2 feet from 74.6 percent to 61.4 percent (note that the cap thickness statistics were recalculated by Apex in 2007 to reflect improved site terminology and definitions). This reduction is more evident in the following two areas along the western boundary of the Intended Cap Area:

- Area A, which is located along the northwestern boundary; and
- Area B, which is located along the middle of the western boundary (Figure 3).

The thickness of the cap in these two areas of the Intended Cap Area has changed noticeably from the original July 26, 2005 Apex bathymetric survey through the subsequent January 12, 2006 and October 06, 2007 Apex bathymetric surveys (Attachment B). Some increase in cap thickness was detected in these areas between 2005 and 2006, followed by a general decease in thickness observed in 2007 and 2009.

As reported herein, within the footprint of the Intended Cap Area, the area of cap that is greater than 1 foot in thickness has been slightly reduced from 98.4 percent in 2007 to 96.3 percent in 2009. Similarly, within the same footprint, the area of cap greater than 2 feet in thickness has decreased from 74.6 percent in 2007 to 61.4 percent in 2009.

When evaluated in context with the 2005, 2006, and 2007 bathymetric surveys (Figure 3) the thickness statistics indicate overall stability with year-to-year variability.

All surveys by all bathymetric contractors illustrated the process of ridge and valley leveling over time. This process causes ridges to decrease in thickness and valleys to increase in thickness, resulting in measured increases in cap areas with thicknesses greater than 1 foot in years 2005 through 2007. The leveling 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. The measured decrease in cap area where the thickness is greater than 1 foot in 2009 coincided with a change in bathymetric contractor. Future surveys will likely distinguish whether change in bathymetric contractor was a contributing variable to the summary statistics or whether the trend towards increasing thicknesses noted in previous surveys continues.

5.0 REFERENCES

Apex Companies, LLC., Memorandum, *Bathymetric Survey – EPA Operable Unit #3 (OU#3) New Bedford Harbor Superfund Site*; Jay Borkland, Greg Dolan, Kris van Naerssen; October 23, 2007.

FIGURES

Legend

Pilot Underwater CAP Bathy Data
MLLW Elevation, feet

- -2.5 - -2.451
- -3 - -2.5
- -3.5 - -3
- -4 - -3.5
- -4.5 - -4
- -5 - -4.5
- -5.5 - -5
- -6 - -5.5
- -6.5 - -6
- -7 - -6.5
- -7.5 - -7
- -8 - -7.5
- -8.5 - -8
- -9 - -8.5
- -9.5 - -9
- -10 - -9.5
- -10.5 - -10
- -11 - -10.5
- -11.5 - -11
- -12 - -11.5
- -12.5 - -12
- -13 - -12.5
- -13.5 - -13
- -14 - -13.5
- -14.5 - -14
- -15 - -14.5
- -15.5 - -15
- -16 - -15.5
- -16.5 - -16
- -17 - -16.5
- -17.451 - -17

Pilot Underwater Intended Cap Area

Aerial Photography MASSGIS 2003

N

0 150 300
Feet

1:3,600

JACOBS™

Pilot Underwater CAP Bathymetry Survey (Mean Lower Low Water) March 25, 2009

New Bedford Harbor Superfund Site

NAME: croberts DATE: 02/04/2010

Figure 1

Y:\NBH\Projects\35BG07021\2010\2041\ArcGIS\out3_bathy2009_revision.mxd

OU#3 Cap Footprint	Area (Acres)
2009	20.41
2007	20.75
2005	18.90

Legend

- 2009 Full Placement Area
- 2007 Full Placement Area
- 2005 Full Placement Area
- OU#3 Intended Cap Area

0 75 150

Feet

1:1,800

N

JACOBS™

Cap Footprint Full Placement Area Comparisons

New Bedford Harbor Superfund Site

NAME: jpiccuito DATE: 02/01/2010

Figure 2

Y:\NBH\Projects\35BG0801\20100201\ArcGIS\full_placement_comparison_correction20100201.mxd

Area A

Area B

Year	Area of Cap With Thickness > 1 Foot	Area of Cap With Thickness > 2 Feet
2005*	92.6%	58.5%
2006*	97.8%	67.0%
2007*	98.4%	74.6%
2009	96.3%	61.4%

* 2005, 2006, 2007 Data (Apex, 2007)

Legend

Pilot Underwater Cap Thickness, feet

- 5.5 - 7.4
- 5 - 5.5
- 4.5 - 5
- 4 - 4.5
- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1

Pilot Underwater Intended Cap Area

N

0 75 150

Feet

1:1,800

JACOBS™

2009 Pilot Underwater Cap Thickness

New Bedford Harbor Superfund Site

NAME: croberts DATE: 02/01/2010

Figure 3

Y:\NBH\Projects\35B\G080\120100201\ArcGIS\au3vertical_correction20100201.mxd

TABLE

Table 1
Summary of Quality Control Analysis Results
Pilot Underwater Cap;
March 25, 2009

QC PARAMETER	RESULT	DESCRIPTION
Cross-Tie Comparisons		
Number of Comparisons	649	
Arithmetic Mean of Comparisons (feet)	-0.02	Measurement bias within data set. ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.25 feet
Standard Deviation of Comparisons (feet)	0.23	
Arithmetic Mean of Absolute Values (feet)	0.02	Overall accuracy within data set.
95 Percentile Confidence Level (feet)	0.02	For mean of entire data set. ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.5 feet
Bar/Staff Check		
Number of Comparisons	2	Pre- and Post-Survey.
Depth of Comparisons	5, 10	Suitable for Project Depth.
Echo Sounder vs. Bar Plate	5.2 v. 5.0; 10.2 v. 10.0	Bar plate. Sounding data adjusted for offset.
Sound Velocity Comparisons		
Number of Comparisons	2	Pre- and Post- Survey, during both Flood and Ebb. Survey conducted during rising and falling tides.
Depth of Comparisons	Surface - 10 feet	Mid-water column.
Range of Values	1460 - 1467	meters/second.
Velocity Utilized	1459.3	meters/second (precision limited by echo sounder entry increments).
Maximum possible depth variability at 5 foot depth	0.01	Conservatively assume 7 m/s hypothetical error.
Maximum possible depth variability at 10 foot depth	0.03	Conservatively assume 15 m/s hypothetical error.
Latency Tests		
Number of Comparisons	1	
Range of Results (seconds)	0.3	System has no defensible latency delays. Value within DGPS position accuracy limitation.
Position error (feet) at survey speed (3 MPH)	~2'	Feet along track. This value is substantially less than specified DGPS horizontal accuracy.

ATTACHMENT A

Meridian Associates Survey of Benchmark CP 4

MERIDIAN ASSOCIATES

VIA: Email: steve.fox@jacobs.com

February 1, 2010

Mr. Steve Fox
Jacobs Engineering
New Bedford Harbor Superfund Site
103 Sawyer Street
New Bedford, MA 02746

RE: Fairhaven Dredge Project "CP 4"
East Rodney French Boulevard Public Boat Ramp

Dear Mr. Fox;

The elevation for CP 4 was obtained using traditional differential leveling methods on January 27, 2010. The starting benchmark used to establish the elevation was derived from Federal Emergency Management Agency Flood Insurance Rate Map, Community Panel Number 255216 0014 B, Map revised January 5, 1984. The benchmark is designated as RM 12, with an elevation of 32.04' reported to be based upon the National Geodetic Vertical Datum of 1929 (NGVD29). The elevation for CP 4 was verified with the use of a four (4) hour static GPS observation post processed with the use of National Geodetic Survey Online Positioning User Service to ensure that the elevation for RM 12 was correct.

Station Name CP4 (PK Survey Nail) Elevation is 6.59' (NGVD29)

Sincerely,

MERIDIAN ASSOCIATES, INC.

COMMONWEALTH OF MASSACHUSETTS
KEVIN E. DANAHY
No. 39683
PROFESSIONAL LAND SURVEYOR

2.01.10

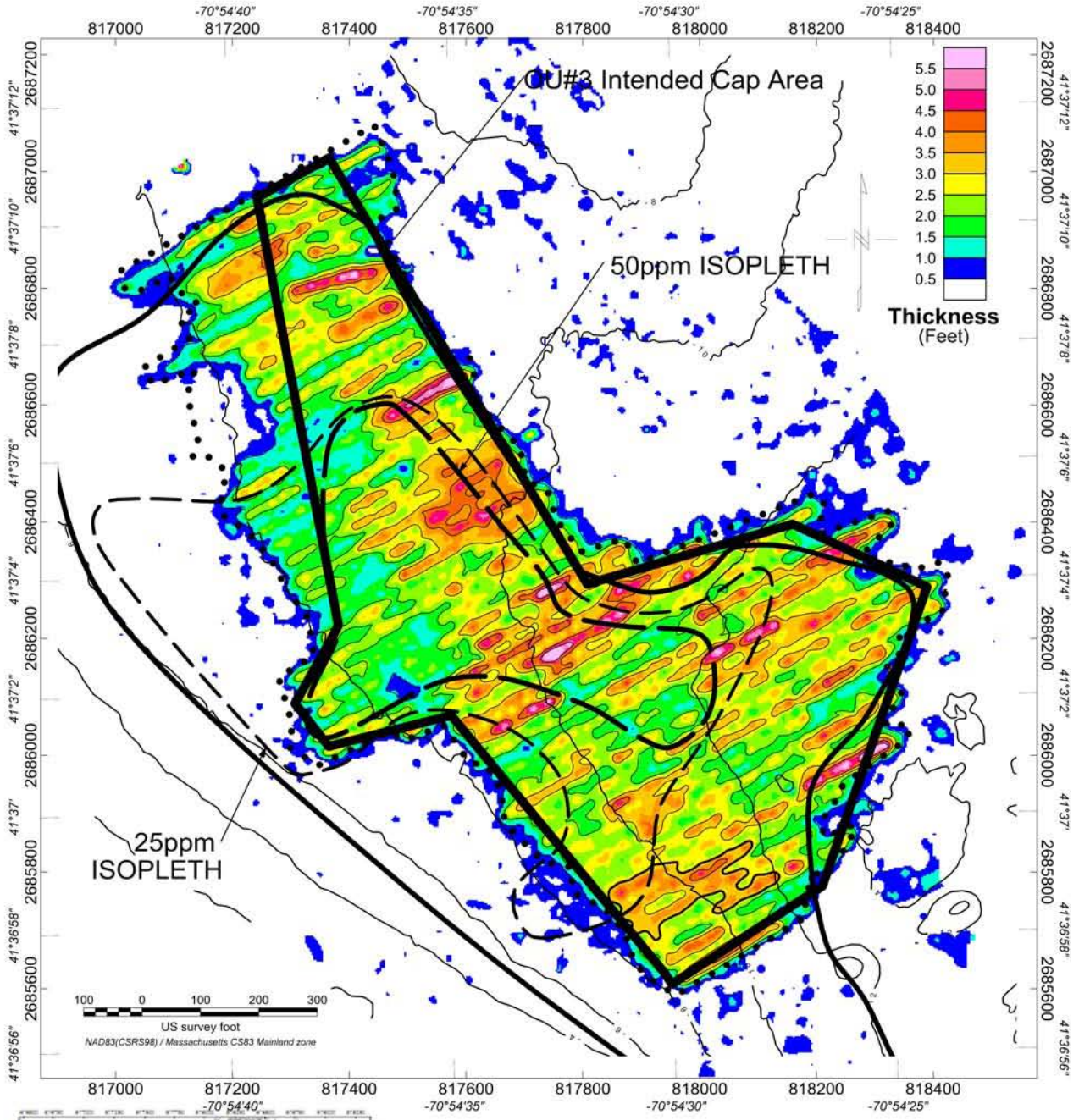
Kevin E. Danahy, PLS
Senior Project Surveyor

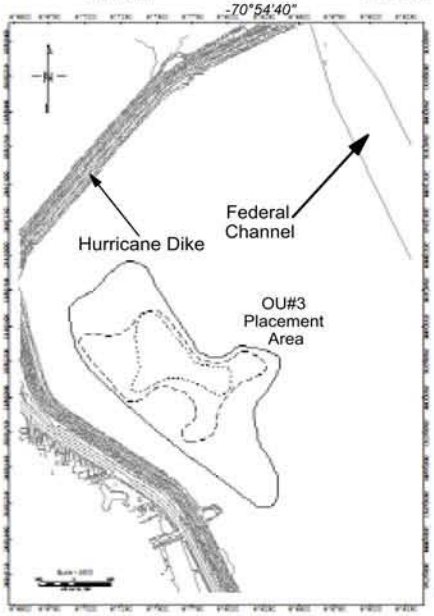
F:\~\4389_S\WORD\letters\Fox_CP4_.doc

152 Conant Street Beverly, Massachusetts 01915 P: (978) 299-0447 F: (978) 299-0567
69 Milk Street, Suite 302 Westborough, Massachusetts 01581 P: (508) 871-7030 F: (508) 871-7039
200 Lake Drive East, Suite 204 Cherry Hill, New Jersey 08002 P: (856) 414-1500 F: (856) 414-1506
www.meridianassoc.com

ATTACHMENT B

Apex Figures; October 2007





STATISTICS

Intended Cap Area: AREA OF CAP ~15.24 ACRES
THICKNESS OF CAP >1-FOOT 98.4%
>2-FOOT 74.6%

Full Placement Area: AREA OF CAP ~20.76 ACRES
THICKNESS OF CAP >1-FOOT 88.9%
>2-FOOT 61.7%

Statistics Notes:
1. Statistics of "Intended Cap Area" indicates material from "peaks" continues to fill in the "valleys", increasing the overall percentage of "Intended Cap Area" covered by 1' or more of cap.
2. Statistics of the "Full Placement Area" indicates some "winnowing" of material at the edges of the cap, slightly decreasing the cap thickness at the edges as material 'toes-out'.

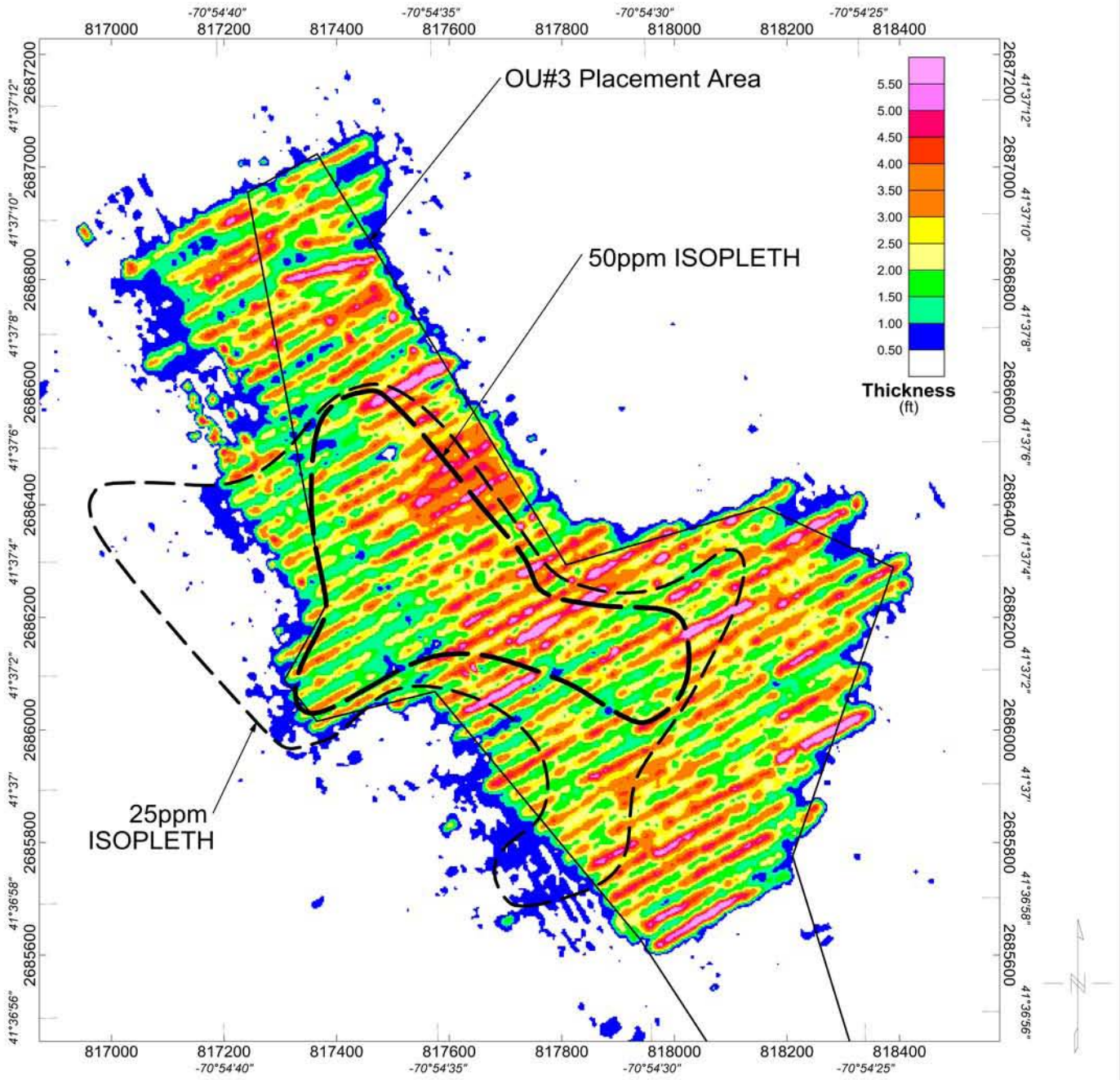
GENERAL NOTES:
1. BATHYMETRIC INFORMATION COLLECTED BY APEX COMPANIES FROM 10/02/07 TO 10/06/07. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING THE 10/02/07 THROUGH 10/06/07 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFT'S OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2007 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. PRE-PLACEMENT BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. 2-FOOT BATHYMETRIC CONTOURS SHOWN ON THE PRE-PLACEMENT SURVEY PERFORMED BY COLER & COLANTONIO 6/23/05. CONTOURS REPRESENT MINIMUM CURVATURE EXISTING CONDITIONS SURFACE CONSTRUCTED BY GEOSOFT'S OASIS MONTAJ.
6. INTENDED CAP AREA = AREA THAT WAS DESIGNATED IN THE DESIGN TO BE CAPPED.
FULL PLACEMENT AREA = AREA THAT ULTIMATELY RECEIVED CAP MATERIAL DURING CAP CONSTRUCTION.

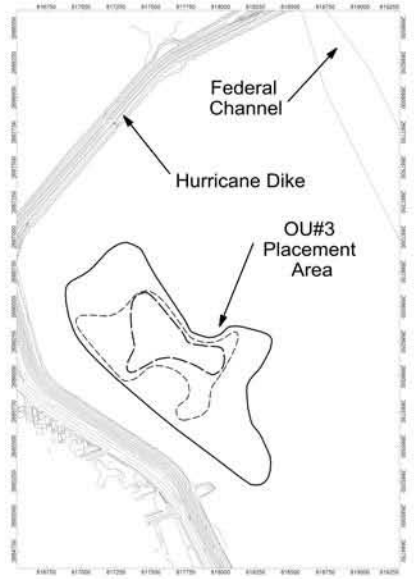
115 Broad Street
Suite 200
Boston
MA 02110

10/06/07 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Post Final Placement Surveys

Apex Companies, LLC





100 0 100 200 300

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

STATISTICS

AREA OF CAP ~18.9 ACRES
THICKNESS OF CAP >1-FOOT 98%
>2-FOOT 70%

NOTES

1. BATHYMETRIC INFORMATION COLLECTED BY APEX ENVIRONMENTAL ON 01/12/06. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO FROM THE DTM CONSTRUCTED BY THE 01/12/06 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFTS OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2005 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. 2-FOOT BATHYMETRIC CONTOURS SHOWN OF THE PRE-PLACEMENT SURVEY PERFORMED BY COLER & COLANTONIO 6/23/05. CONTOURS REPRESENT MINIMUM CURVATURE EXISTING CONDITIONS SURFACE CONSTRUCTED BY GEOSOFT'S OASIS MONTAJ.

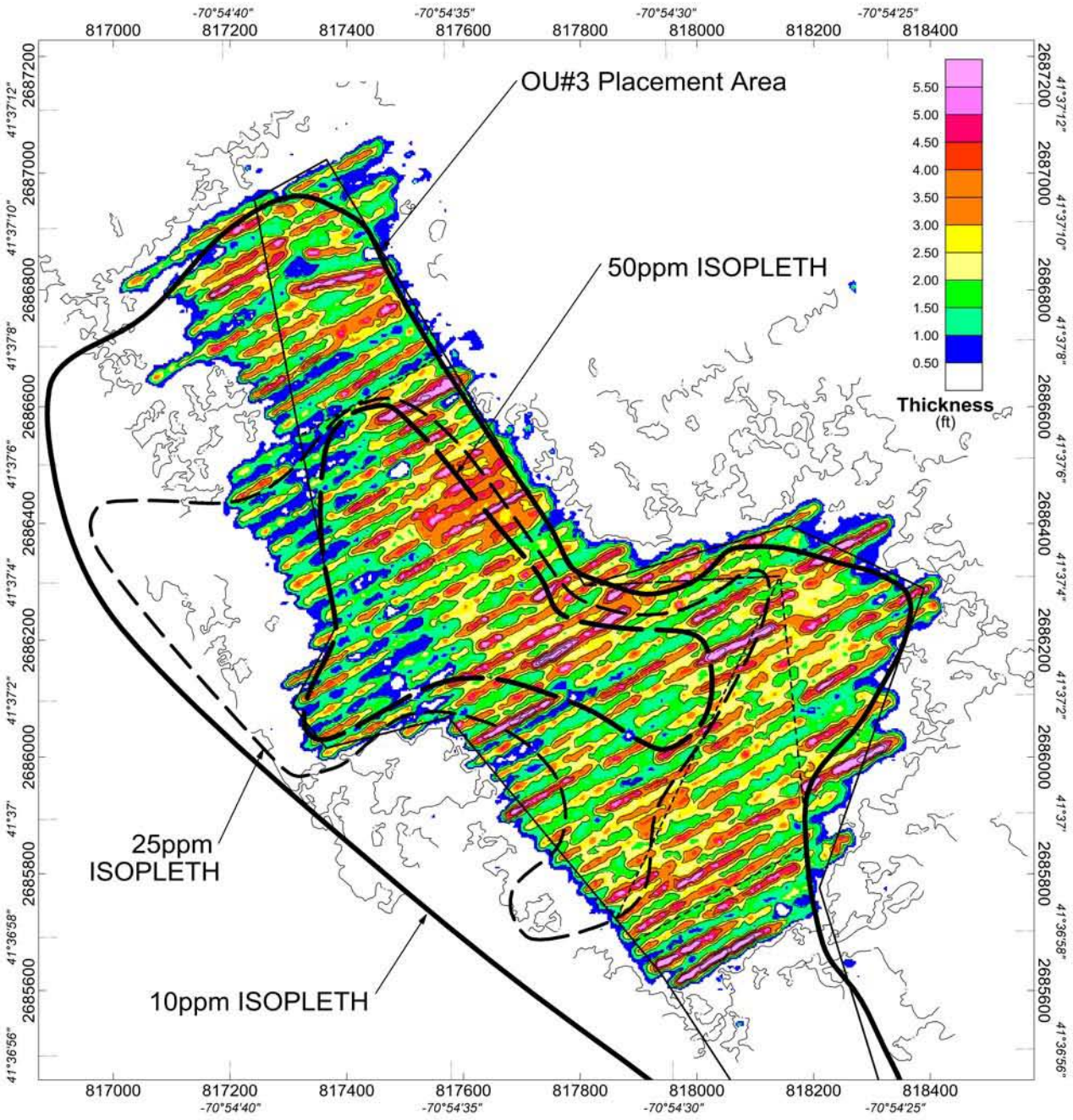
286 Congress St
Suite 610
Boston
MA 02210

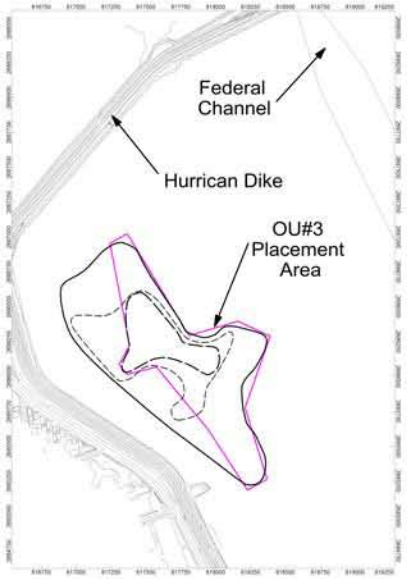
Apex environmental, inc.

01/12/06 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Post Final Placement Surveys

Apex Environmental





Scale 1:2400

100 0 100 200 300

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

STATISTICS

AREA OF CAP ~18.9 ACRES
THICKNESS OF CAP >1-FOOT 95%
>2-FOOT 65%

NOTES

1. BATHYMETRIC INFORMATION COLLECTED BY APEX ENVIRONMENTAL ON 7/26/05. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO FROM THE DTM CONSTRUCTED BY THE 7/26/05 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFTS OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2005 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.

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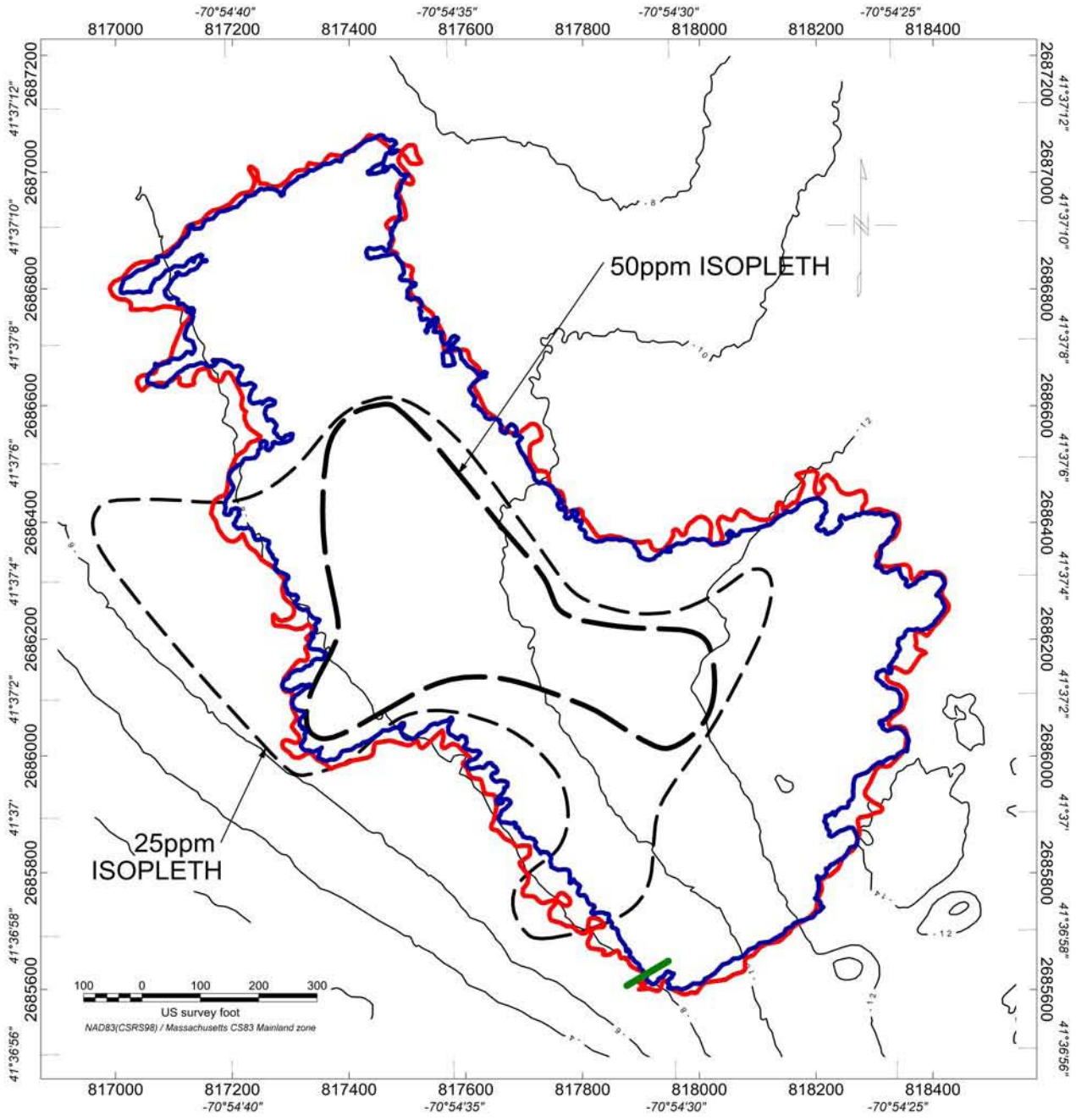
MA 02210

07/26/05 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Final Placement Surveys

Apex Environmental



2007 OU#3 CAP Footprint: AREA OF CAP ~20.76 ACRES

2005 OU#3 CAP Footprint: AREA OF CAP ~18.9 ACRES

Cross-Section Location

GENERAL NOTES:

1. CAP FOOTPRINT AREA DETERMINED AT THE 0.5-FOOT CONTOUR INTERVAL.
2. 2007 BATHYMETRIC INFORMATION COLLECTED BY APEX COMPANIES FROM 10/02/07 TO 10/06/07. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE 2007 ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING THE 10/02/07 THROUGH 10/06/07 DATA.
3. THE 2005 ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING BATHYMETRIC DATA COLLECTED BY APEX ON 7/26/2005.
4. PRE-PLACEMENT BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. DTM SURFACES WERE CONSTRUCTED USING GEOSOFT'S OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
6. CAP THICKNESS CROSS SECTIONS WERE CONSTRUCTED IN GEOSOFT'S OASIS MONTAJAND IN AUTOCAD.

CAP Footprint Comparisons
OU#3 Placement Area Survey

2005 vs. 2007 CAP Footprint
CAP Area Constructed at 0.5-Foot Contour Interval

Apex Companies, LLC