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ENSR®

Summary Report of Independent Observations Phase 1 - Boston Harbor Navigation Improvement Project

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1 INTRODUCTION

The Boston Harbor Navigation Improvement Project (BHNIP), a joint project between the US Army Corps of Engineers and the Massachusetts Port Authority, involves both maintenance and improvement dredging of Boston's Inner Harbor, its tributary channels, and berth areas. The overall project will include dredging of approximately 3 million cubic yards of material from the Harbor with disposal of contaminated sediments into in-channel containment cells and disposal of clean sediments offshore at the Massachusetts Bay Disposal Site. Phase 1 of the BHNIP was designed to deepen the controlling water depth of Berths 11 and 12 at Conley Terminal. This phase of the project included the construction of one in-channel containment cell just south of the Inner Confluence, dredging of Berths 11 and 12, the disposal of materials generated by construction and dredging activities either into the cell or offshore at the Massachusetts Bay Disposal Site (based on material type and quality), and capping of the containment cell (Figure 1). Phase 1 was performed by Weeks Marine (Camden, NJ) and was completed in July 1997. The remainder of the project (Phase 2) is expected to begin early in 1998 and continue for approximately two years.

The Water Quality Certification granted by the Massachusetts Department of Environmental Protection for the BHNIP set performance standards for the dredging, specified environmental monitoring requirements, and stipulated that an Independent Observer be included in the project to monitor dredging and disposal activities from an environmental point of view. Coast Line Engineering (Marion, MA) performed the required environmental monitoring for Phase 1 under subcontract to Weeks Marine. ENSR (Acton, MA) filled the Independent Observer role under contract to Massachusetts Coastal Zone Management.

Although the Phase 1 dredging represents less than 5% of the overall project in terms of cubic yards, most of the major engineering components of the BHNIP were represented (cell construction, dredging of contaminated sediments, dredging of parent material, disposal of parent material into a cell, offshore disposal of parent material, and cell capping). This report provides a summary of Phase 1 activities as well as an evaluation of potential environmental impacts associated with the project. A summary of the dredging operations is provided in Section 2, and a summary of the associated environmental monitoring is presented in Section 3. An overall evaluation of the potential impacts of the project on water quality is presented in Section 4. Specific issues related to the Water Quality Certification that were identified in Phase 1 are presented in Section 5.

2 DESCRIPTION OF DREDGING OPERATIONS

Phase 1 of the Boston Harbor Navigation Improvement Project (BHNIP) was classified as "improvement dredging" for Berths 11 and 12 of Conley Terminal. The objective of Phase 1 was to deepen the controlling water depth at Berth 12 and a portion of Berth 11 to 40 feet below Mean Low Water (MLW) with a deeper trench immediately alongside the pier to a depth of 48 feet below MLW and to deepen the remainder of Berth 11 to 40 feet below MLW. The Phase 1 activities can be divided into the following five components:

- Construction of the disposal cell just south of the Inner Confluence including dredging of surface silts and clean parent material (clay),
- Dredging at Conley Terminal including removal of surface silts and clean parent material (clay and till),
- Disposal of silty sediments into the Inner Confluence disposal cell,
- Disposal of clean parent material at the Massachusetts Bay Disposal Site (MBDS), and
- Capping of the disposal cell with sand.

The dredging contractor selected to complete Phase 1 was Weeks Marine Inc. of Camden NJ. Weeks Marine was formally given the notice to proceed on 30 May 1997. The chronology of each of the Phase 1 components is presented in Table 2-1, and a description of each component is presented in the remainder of Section 2. The complete database of field observations by the Independent Observer and the dredging/disposal record is presented in Appendix A.

TABLE 2-1
Chronological Record of Phase I - BHNIP

Activity	Period of Performance
Construction of Disposal Cell	16 June through 28 June
Dredging at Conley Terminal	28 June through 10 July
Disposal into Cell	28 June through 05 July
Disposal at MBDS	18 June through 10 July
Capping of Disposal Cell	14 July through 25 July

2.1 CONSTRUCTION OF THE DISPOSAL CELL

The disposal cell for the contaminated sediments dredged during Phase 1 is located just south of the Inner Confluence (see Figure 2). The geographic coordinates of the four corners of the disposal cell are listed in Table 2-2 (designated as cell No. 2 in the Federal Environmental Impact Report/Statement for the project). The cell is located on the eastern side of the navigational channel across from Mystic Terminal and adjacent to the facilities for Boston Towing and Transportation Company and the General Ship and Engine Works. The cell has dimensions of 500 by 200 feet and was dredged to an average depth of 57.5 feet below MLW. A conceptualized cross section of the cell is presented in Figure 3.

TABLE 2-2
Geographic Coordinates for the Inner Confluence Disposal Cell

Site	Latitude	Longitude
NE corner	42° 22’ 47.34334” N	071° 02’ 37.17699” W
SE corner	42° 22’ 42.41015” N	071° 02’ 37.50709” W
NW corner	42° 22’ 47.44129” N	071° 02’ 39.83845” W
SW corner	42° 22’ 42.50810” N	071° 02’ 40.16849” W

Accurate position keeping during cell construction was achieved by Weeks Marine through the use of a Trimble GPS Navigation System, with sub-meter accuracy, integrated with Hypack Software to visually display the real-time position of the dredge within the cell. The dredge was maneuvered with tug-tenders and firmly anchored to the bottom with three vertical spuds driven into the bottom during dredging activities. The dredge was re-positioned over the cell using the spuds and/or the tug-tender.

The dredging of contaminated silt materials was performed with the use of a Level Cut/ Environmental Clamshell Bucket manufactured by Cable Arm Inc. (Figure 4, Figure 14). The bucket is outfitted with overlapping jaws and rubber seals and is specifically designed to limit the loss of fine sediment material during bucket closure and while the bucket is drawn up through the water column and hoisted over the dump scow. When fully opened, the bucket yields a 22 by 14 foot footprint on the bottom. The bucket is lightweight and is designed to only remove soft surficial sediments from the bottom, i.e., it did not have the capability to dig into the dense underlying parent materials. The depth of each cut was limited to a 6 inch maximum to minimize the loss of materials during hoisting of the bucket out of the water.

The dredging of the surficial silts began in the evening on 16 June using the environmental bucket with sediments being stockpiled in a large dump scow tied adjacent to the dredge (Figure 4). Dredging of surficial silts over the entire cell footprint was completed within 24 hours (see Table 2-3). The loaded scow was tied up at Mystic Terminal, awaiting disposal after cell construction was completed. Dredging of the underlying parent material (clay) began late on 17 June using a standard open-toothed bucket (Figure 5). The dredged clay was loaded into a dump scow secured to the dredge. Once filled the dump scow was towed to the MBDS for disposal. The use of two dump scows allowed for 24 hour dredging operations.

Increasing amounts of silty sediments were noted in the dredged clay on 19 June (see Section 5 for a discussion of this issue). As a result, Weeks Marine switched back to the environmental bucket, and dredged the cell footprint again. The additional silty sediments that were removed were stockpiled in the dump scow and in an additional storage barge. The dredging with the environmental bucket was completed early on 20 June, and the dump scow and storage barge were tied up at Mystic Terminal. Approximately 3,500 cubic yards of surface sediments were estimated to have been removed from the footprint of the disposal cell during the two rounds of dredging with the environmental bucket.

Dredging of parent material with the open toothed bucket resumed on 20 June and continued through 28 June with 24 hour operations. Approximately 99,000 cubic yards of parent material (clay) were removed in constructing the disposal cell. This material was disposed at the MBDS.

The original design of the disposal cell incorporated sloping sidewalls with dimensions at the top of the cell of 650 by 250 feet and dimensions at the bottom of the cell of 500 by 150 feet. During construction, the parent material (clay) was found to support a nearly vertical cut to the specified cell depth of 57 feet below MLW. The final dimensions of the constructed cell were approximately 500 by 200 feet to an average depth of 57.5 feet below MLW. This provided ample capacity for the silty sediments.

The use of an acoustic fish deterrent system was not required for dredging operations in the Inner Confluence conducted during Phase 1 because the seasonal requirement to operate such a system expired on 15 June.

TABLE 2-3
Dredging Record for Construction of the Inner Confluence Disposal Cell

Period of Performance	16 June through 28 June 1997
Dredging Days (surface silts)	16-17, 19-20 June
Dredging Days (parent clay)	17 June through 28 June
Estimated volume removed (surface silts)	3,500 cubic yards
Estimated volume removed (parent material)	99,000 cubic yards
Average depth of cell	57.5 feet below MLW

2.2 DREDGING OF CONLEY TERMINAL

The Phase 1 improvements to Berths 11 and 12 at Conley Terminal involved dredging an area 1955 feet long by 150 feet wide (Figure 6). Berth 12 (955 feet long) was dredged to 45 feet below MLW along its entire length. Berth 11 (1000 feet long) was dredged to 40 feet below MLW over most of its length with a 115 foot segment abutting to Berth 12 dredged to 45 feet below MLW. The dredging was performed in a manner similar to that described for the disposal cell (Section 2.1); surficial silty sediments were first removed over the entire area with the environmental bucket followed by removal of parent material (clay and till) using an open toothed bucket. Silty sediments were discharged directly to dump scows during the dredging operation and disposed of at the Inner Confluence disposal cell. Parent materials were discharged directly to dump scows and disposed of at the MBDS. The chronology of dredging activities and amounts of material removed at Conley Terminal are presented below in Table 2-4.

Positioning of the dredge was performed in a similar manner as during construction of the disposal cell (sub-meter accuracy with a Trimble GPS Navigation System/ Hypack Software) to visually display the real-time position of the dredge along the berths.

TABLE 2-4
Dredging Record for Conley Terminal (Berths 11 and 12)

Period of Performance	28 June through 10 July 1997
Dredging Days (surface silts) ☞	28 June through 04 July
Dredging Days (parent clay)	04 July through 10 July
Estimated volume removed (surface silts)	23,000 cubic yards
Estimated volume removed (parent material)	43,500 cubic yards

☞ **NOTE:** The progression of the dredging of silty sediments at Conley Terminal can also be referenced from Table 2-5. The record for the disposal of silty sediments at the cell provides information on the origin of the materials, i.e., dredge position at Conley Terminal (station and offset).

TABLE 2-5

Disposal Record for Surface Silts at the Inner Confluence Cell

DISPOSAL NUMBER	DATE	DISPOSAL TIME (hours/min)	OFFSET FROM HIGH TIDE[1] (hours: min)	SCOW NUMBER	SCOW CAPACITY[2] (cubic yards)	ORIGIN	DREDGE STATION AT CONLEY	OFFSET FROM PIER
1	29-Jun-97	0748	0:39	254	3300	Conley	925-635 FT	0-70 FT
2	29-Jun-97	1952	0:13	254	3300	Conley	635-310 FT	0-70 FT
3	29-Jun-97	2052	1:13	257	6000	Cell	N/A	N/A
4	30-Jun-97	0823	0:11	257	6000	Conley	310-0 FT 900-750 FT	0-70 FT 150-70 FT
5	1-Jul-97	0955	0:42	257	6000	Conley	235-815 FT 235-0 FT	0-70 FT 0-70 FT
6	2-Jul-97	1004	-0:07	254	3300	Conley	925-0 FT	0-20 FT
7	2-Jul-97	1102	0:51	257	6000	Conley	925-0 FT	-10-65 FT
8	3-Jul-97	1032	-0:31	258	3000	Conley	1800-1465 FT	-10-65 FT
9	3-Jul-97	1106	0:03	254	3300	Conley	1800-1465 FT	-10-65 FT
10	3-Jul-97	1203	1:00	257	6000	Conley	1800-1465 FT	-10-65 FT
11	4-Jul-97	1151	-0:01	258	3000	Conley	1465-900 FT	-10-65 FT
12	4-Jul-97	1301	1:09	257	6000	Conley	1465-900 FT	-10-65 FT
13	4-Jul-97	1350	1:50	254	3300	Conley	1465-900 FT	-10-65 FT
14	5-Jul-97	1232	-0:04	254	3300	Conley	1770-900 FT	65-160 FT

NOTE: Dredging at Conley Terminal was conducted at Berths 11 and 12. Orientation of dredging activity is defined as Berth 11-Dredge Station 0-885 ft. and Berth 12-Dredge Station 900-1955 ft. Offset range 0-150 ft. Dredge Station 885-900 ft. defined as transition zone between Berths 11 and 12.

[1]Time of high tide based on published values (NOAA).

[2]Because the scows contained both sediment and water, it was difficult to estimate the volume of sediment in each sow. A total of 26,500 cubic yards of silts was estimated to have been disposed into the cell over the 14 events.

2.3 DISPOSAL OF SEDIMENTS INTO THE INNER CONFLUENCE CELL

Approximately 26,500 cubic yards of surficial silts (3,500 from the cell footprint and 23,000 from Berths 11 and 12) were disposed of in the Inner Confluence cell during 14 disposal events (Table 2-5). During each disposal event, the dredge was relocated from Conley Terminal to the disposal cell. The dredge was maneuvered into position over the cell and firmly anchored in place by lowering the three spuds into the bottom. This allowed use of the dredge's sub-meter accuracy positioning system to ensure that the disposal occurred over the cell. It also allowed for a fixed platform to secure the dump scow to prior to disposal.

Disposal events at the cell were only conducted during the period 1-hour prior to 2-hours following a high tide. Disposal activities were generally accompanied by a post-discharge bathymetric survey to monitor conditions within the disposal cell and verify the placement of the discharged load. Bathymetric plots of the disposal cell prior to, and after the completion of disposal activities can be found in the USACE report, "Bathymetric Survey Results at Disposal Cell" (Appendix C to this report).

2.4 DISPOSAL AT THE MASSACHUSETTS BAY DISPOSAL SITE

The underlying parent materials from the construction of the Inner Confluence disposal cell and the dredging of Conley Terminal (Berths 11 and 12) were deemed acceptable for unconfined ocean disposal and were discharged at the Massachusetts Bay Disposal Site (MBDS). During dredging of parent material from the cell and Conley Terminal, two dump scows were cycled between the dredge and the MBDS to allow for 24-hour dredging operations. The scows were towed to the MBDS by a Weeks Marine tug. The MBDS marker buoy was used as the visual reference point in conjunction with GPS for verifying the proper disposal site for the materials.

A total of 43 disposal events occurred at the MBDS during Phase 1. A record of the disposal events is presented in Table 2-6.

TABLE 2-6

Disposal Record for Phase 1 Parent Materials at the Massachusetts Bay Disposal Site (MBDS)

Trip Number	Date	Disposal Time	Scow Number	Wind Speed (knots)	Wind Direction	Sea Conditions (feet)	Visibility	Distance off MBDS Marker
1	18 June	1302	258	10-15	SW	1-3	10mi haze	10yds west
2	18 June	2154	254	10-15	SW	1-3	3mi fog/haze	30yds SE
3	19 June	1018	258	variable	na	1-3	fog <1mi vis.	30yds SE
4	19 June	1826	254	light	SW	calm	clear	75yds SE
5	20 June	1843	258	10-15	SW	1-3	clear	150yds N
6	21 June	0224	254	10-15	SW	1-3	10mi haze	175yds N
7	21 June	1037	258	5-10	SW	1-3	10mi haze	50yds N
8	21 June	1957	254	15-25	SW	2-4	overcast	50yds NE
9	22 June	0305	258	10-15	SW	1-3	5mi haze	100yds N
10	22 June	1123	254	na	na	1-3	10mi haze	75ft NW
11	22 June	1924	258	na	na	2-4	3-5mi hvy rain	25yds SE
12	23 June	0309	254	15-25	SW	2-4	5-10mi scat.rain	125yds N
13	23 June	1031	258	10-20	NW	1-3	light haze	75ft NW
14	23 June	1754	254	10-20	NW	1-2	clear	100ft NW
15	24 June	0155	258	5-15	NW	1-2	clear	100yds NW
16	24 June	0914	254	5-15	NW	1-2	10mi	50ft N
17	24 June	1641	258	5-10	NW	1-2	clear	75ft NW
18	25 June	0031	254	variable	na	1-2	clear	75ft NW
19	25 June	0746	258	light	na	1	clear	50yds NW
20	25 June	1605	254	10-15	SE	1	10mi	10ft NW
21	25 June	2343	258	5-10	SE	1	10mi	25ft N
22	26 June	0730	254	na	na	1	6mi haze	25ft S
23	26 June	1505	258	calm	na	calm	10-12mi	40ft NW
24	26 June	2355	254	15-20	W	1	10mi haze	50ft N
25	27 June	0705	258	15	NW	1	10mi clear	40ft NW
26	27 June	1850	254	10	N	1	clear	25ft S
27	28 June	0415	258	calm	na	calm	clear	10ft NW
28	28 June	1430	254	10	SE	1	clear	5ft W
29	29 June	2150	258	calm	na	1	clear	50ft NW
30	05 July	1740	257	calm	na	0.5	clear	20ft NW
31	06 July	0205	254	5-10	SSW	calm	clear	35ft NW
32	06 July	1154	257	calm	na	calm	clear	25ft SE
33	06 July	1905	254	5	SSE	0.5	clear	75ft SE
34	07 July	0748	257	5	SE	calm	clear	15ft SSE
35	07 July	1445	254	8-10	SE	1	7mi	150ft N
36	08 July	0307	257	variable	na	calm	0.25mi haze	200ft N
37	08 July	0951	254	variable	na	calm	clear	70ft N
38	08 July	1922	257	8-10	ESE	0.5	4-6mi haze	50ft NW
39	09 July	0357	254	12-15	SSW	2	2-4mi haze	60ft NNE
40	09 July	1837	257	18-20	SE	2	2-3mi haze	50ft NNE
41	10 July	0404	254	15-18	NNW	1-2	1-3mi rain	125ft S
42	10 July	1843	257	8-10	NW	1-2	clear	100ft ENE
43	12 July	1720	254	3-5	SSW	calm	clear	150ft NE

2.5 CAPPING OF THE DISPOSAL CELL

The disposal cell in the Inner Confluence remained open until the dredging was completed and certified at Conley Terminal. A bathymetric survey of the disposal cell and the collection of core samples prior to capping was completed by the USACE on 11 July 1997 (see Appendix C). A conceptualized cross section of the cell with disposed silt based on this bathymetry is presented in Figure 7. A side scan sonar survey of the cell was performed on 14 July (Figure 8).

The general approach for capping the cell involved loading a dump scow with sand, positioning it over a portion of the cell, and slowly releasing the sand over the cell. Capping operations began on 14 July 1997. The positioning of the dump scow for the discharge of sand over the disposal cell was conducted in much the same manner as that outlined for the disposal of silty sediments in Section 2.3 (the dredge was spudded down and the scow located alongside). The discharge procedures were modified by restricting the opening of the scow to allow the sand to gradually discharge into the cell to minimize the potential disturbance to the silty sediments contained within the cell. For the relative position of the dump scow within the footprint of the disposal cell during each of the sand dumping events, refer to Appendix C, Figure 2.

Capping material (sand) was obtained locally from Ossippee Aggregate on the Mystic River, and the record of capping activity is summarized in Table 2-7. Some delays were encountered in the receipt of materials due to the heavy volume of materials being handled at the Ossippee facility in support of the construction efforts on-going for the Central Artery Project. Material was delivered to Weeks Marine during periods of the day which did not interfere with the servicing of previous commitments.

Table 2-7

Capping Records for the Inner Confluence Cell

DUMP NUMBER	DATE	TIME	SCOW NUMBER	CAPACITY[1] (tons)	ORIGIN	DREDGE STATION
1	14-Jul-97	15:10-15:45	257	1864	Ossippee	Over Cell
2	15-Jul-97	08:10-08:35	254	3240	Ossippee	Over Cell
3	15-Jul-97	13:30-13:50	257	2256	Ossippee	Over Cell
4	16-Jul-97	10:55-11:50	257	3400	Ossippee	Over Cell
5	17-Jul-97	10:10-10:55	257	2649	Ossippee	Over Cell
6	19-Jul-97	11:00-12:05	257	5232	Ossippee	Over Cell
7	19-Jul-97	17:23-17:43	254	1458	Ossippee	Over Cell
8	24-Jul-97	16:08-17:10	257	1800	Ossippee	Over Cell

[1]A total of 20,919 tons of sand was deposited based on a calculation using draft markings on the scow. A total of 20,100 was delivered as per Ossipee records.

The capping operation was performed from 14 to 24 July 1997. Bathymetric surveys, that were performed during the capping to gage progress, identified a mound of sand over the center of the cell. Some of this material was relocated to the northern portion of the cell using the dredge. Approximately 20,000 tons of sand were deposited over cell during the capping operation. This volume is estimated to cover the entire area of the cell to a depth of nearly 4 feet. The bathymetric plots and cross-sectional plots of the disposal cell during the capping activities are presented in the USACE report (included as Appendix C).

After completion of the capping, Weeks Marine performed a test grab (on 25 July) with the dredge in the southern portion of the cell and discovered a minimum depth of sand cover of 3 feet. A side scan sonar survey was performed on 8 August 8 (Figure 9). A conceptualized cross section of the cell after capping is presented in Figure 10.

3 ENVIRONMENTAL MONITORING

The Water Quality Certification granted for the BHNIP by the Massachusetts Department of Environmental Protection specified a series of monitoring requirements "to maintain water quality, to minimize impact on waters and wetlands, and to ensure compliance with appropriate state law." The Water Quality Certification specified environmental monitoring during the following Phase 1 activities:

- Dredging of surface silts during construction of the first cell
- Dredging of parent material during construction of the first cell
- Disposal of surface silts into the disposal cell

The environmental monitoring for Phase 1 was performed by Coast Line Engineering, Inc. (CLE; Marion, MA) under contract to Weeks Marine. A summary of the monitoring results is presented in the remainder of this section along with the results of ENSR's quality assurance review. A detailed description of the monitoring efforts and data is presented in CLE's summary report, "Water Column Monitoring Report" (July, 1997). The summary tables from the CLE report have been included in Appendix B to this report.

The CLE monitoring effort was performed from a 21 foot Privateer equipped with a positioning system similar to that used on the dredge (Trimble GPS interfaced with Hypack software to yield sub-meter accuracy). *In-situ* measurements of turbidity, temperature, dissolved oxygen (DO), pH, conductivity, and salinity (derived) were performed using a YSI 6000 meter. Water samples were collected using an in-water pump outfitted with a teflon impeller and teflon tubing. Arthur D. Little (Cambridge, MA) performed the analyses for PCB. Bioassays were performed by EnviroSystems, Inc. (Hampton, NH). The Woods Hole Group (Falmouth, MA) performed all other physical and chemical analyses.

3.1 DREDGING OF SURFACE SEDIMENTS

Condition F.2. of the Water Quality Certification specified the following monitoring for the dredging of surface sediments during construction of the first cell:

- Documentation of the spatial and temporal distribution of the sediment plume for the four extremes of tidal currents (high water slack, maximum ebb, low water slack, maximum flood) on two days within the first week of dredging.
- Collection of water samples from the lower half of the water column at two locations - 1000 feet upcurrent of the dredging and 500 feet downcurrent from the dredging.
- Analysis of water samples for total suspended solids (TSS).

CLE performed the monitoring described above on 17 June 1997, the only full day that dredging of surface silts was performed with the environmental bucket. In-situ turbidity measurements ranged from 3 to 5 NTU at the reference station (1000 feet upcurrent of the dredging) and were only slightly elevated at the station 500 feet downcurrent of the dredging ranging from 4 to 11 NTU. TSS ranged from 4 to 5 mg/l at the reference station and from 5 to 9 mg/l at the downcurrent station. Results are presented in Appendix B (Table B-1). In summary, no visible plume was apparent at the surface outside of the immediate vicinity of the dredging operation, and the measurements and sampling revealed that a significant plume could not be detected in the water column.

3.2 DREDGING OF PARENT MATERIALS

Condition F.1. of the Water Quality Certification specified that the following monitoring be performed during the dredging of parent material at the time of the construction of the first cell:

- Documentation of the spatial distribution of the sediment plume for the four extremes of tidal currents (high water slack, maximum ebb, low water slack, maximum flood) during dredging operations and after a period when dredging had been ongoing for at least two hours uninterrupted.
- Collection of water samples from the lower half of the water column at two locations - 1000 feet upcurrent of the dredging and 300 feet downcurrent from the dredging.
- Analysis of water samples for TSS, turbidity, DO, arsenic, and copper.

CLE performed the monitoring described above on 19 June 1997 for low water slack and maximum flood tides and on 24 June for high water slack and maximum ebb tides. CLE's summary of results for this monitoring can be found in Appendix B (Table B-2).

Because of the open configuration of the toothed clamshell bucket used for dredging the parent material, suspended solids in the water column were visible for a greater distance from the dredging. *In-situ* turbidity measurements ranged from 3 to 7 NTU at the reference station (1000 feet upcurrent of the dredging), while 300 feet downcurrent of the dredging turbidity ranged from 8 to 56 NTU. TSS ranged from 8 to 60 mg/l at the reference station and from 19 to 48 mg/l at the downcurrent station. All values were well below the 200 mg/l performance standard set in the Water Quality Certification for a point 500 feet downcurrent of the dredging.

Dissolved oxygen (DO) concentrations varied only slightly between the reference and downcurrent stations. However, DO concentrations varied significantly between tidal stages at both reference and downcurrent stations, ranging from 6.4 mg/l at low water slack to 8.4 mg/l at high water slack. This DO shift is likely due to the expected warmer temperatures of water exiting the Mystic and Chelsea Rivers and the expected higher oxygen demand placed on those waters.

Arsenic concentrations were below the detection limit for all samples. Copper concentrations ranged from 0.8 to 1.2 ug/l with no apparent difference between reference and downcurrent locations. All concentrations were below the acute and chronic water quality criterion for copper (2.4 ug/l).

3.3 DISPOSAL INTO THE INNER CONFLUENCE CELL

Condition E.2. of the Water Quality Certification specified monitoring during the first disposal event for surface silts into a cell in the Inner Confluence. Condition E.3. further specified monitoring for the disposal of surface silts from the first berth dredged. Collectively, these conditions required the following monitoring:

- Monitoring during the first five days of disposal activity for disposal events that occur during daylight hours.
- Collection of water samples from the lower half of the water column at the following four locations and times:
  - a) reference point - may be 1000 feet upcurrent of the cell or 300 feet downcurrent (prior to disposal) - requires measurement of bottom current direction
    - just prior to disposal event (discrete sample)
    - every 2 hours through 12 hours after the disposal event (composite sample)
  - b) 300 feet directly downcurrent of the cell
    - 0.5 hours after disposal event (discrete sample + composite)
    - 1.0 hours after disposal event (discrete sample + composite)
    - hourly from 2 through 12 hours after disposal event (composite)
  - c) 300 feet downcurrent and 200 feet lateral of the cell
    - 1.5 hours after disposal event (discrete sample)
  - d) 1000 feet downcurrent of the cell
    - 2.5 hours after disposal event (discrete sample)
- Analysis of water samples for TSS; DO; total PCB; dissolved arsenic, cadmium, chromium, copper, lead, nickel, and zinc; and total mercury as follows:
  - a) reference point - all parameters
  - b) 300 feet directly downcurrent of the cell - all parameters
  - c) 300 feet downcurrent and 200 feet lateral of the cell - TSS & DO only, others archived
  - d) 1000 feet downcurrent of the cell - TSS & DO only, others archived

Condition E.5. of the Water Quality Certification specified the following monitoring on one day during the first five days of disposal activity for the disposal of surface silts from the first berth dredged:

- Collection of water samples from the lower half of the water column 300 feet downcurrent of the disposal cell at 0.5 and 1.0 hours after disposal and at a reference station.
- Performance of the following bioassays: Sea urchin fertilization test and the seven-day *Mysidopsis bahia* test.

CLE performed the monitoring described above over the first five days of disposal into the Inner Confluence cell as follows:

29 June 1997 - E.2./E.3. monitoring following disposal of one scow

30 June 1997 - E.2./E.3. + E.5. monitoring following disposal of one scow

1 July 1997 - E.2./E.3 monitoring following disposal of one scow

2 July 1997 - E.2./E.3 monitoring following disposal of two scows

3 July 1997 - E.2./E.3 monitoring following disposal of three scows

Specifics of each disposal event (scow capacity, disposal time, origin of material) can be found in Table 2-5. The methods for positioning, in-situ monitoring, and sampling were identical to those used for the monitoring during dredging activities described earlier in the section. A Miniflow current meter was also used to verify the bottom current direction at the reference stations.

A summary of the results of monitoring is provided below, and copies of CLE's data tables for each monitoring effort can be found in Appendix B. The majority of the samples analyzed were found to be below detection limits for the parameters of interest, and all monitoring results were in compliance with the Water Quality Certification for the project. Applicable marine water quality criteria are presented in Table 3-1.

TABLE 3-1
Marine Water Quality Criteria for Monitored Parameters

Parameter	Acute Standard (ug/l)	Chronic Standard (ug/l)
Total PCBs	10	0.030
Arsenic	69	36
Cadmium	42	9.2
Chromium (VI)	1100	50
Copper	2.4	2.4
Lead	210	8.1
Nickel	74	8.2
Zinc	90	81
Mercury	1.8	0.025

Turbidity: Turbidity measurements ranged from 2 to 14 NTU for the reference location with the highest value recorded during the fifth monitoring event. At the location 300 feet downcurrent of the cell, turbidity ranged from 1 to 30 NTU with the highest measurements recorded during the fifth monitoring event. Some of the elevations in turbidity are attributed to vessel traffic unrelated to the project as discussed in Section 4. Plots of the variations in turbidity versus time prepared by CLE are presented in Appendix B.

TSS: Total suspended solids (TSS) concentrations ranged from 3 to 29 mg/l for the reference location with the highest value recorded during the fifth monitoring event. At the location 300 feet downcurrent of the cell, TSS concentrations ranged from 5 to 64 mg/l with the highest concentration recorded during the fifth monitoring event one hour after disposal. As with turbidity, some of the elevations in TSS are attributed to vessel traffic unrelated to the project.

DO: Dissolved oxygen (DO) concentrations ranged from 6.4 to 8.2 mg/l over the five monitoring events. There was no apparent difference between reference and downcurrent locations. Lower DO concentrations were consistently noted at all monitoring locations during the later stages of ebb tide.

PCB: (Total) No PCB were detected in the five monitoring events. Detection limits ranged from 0.016 to 0.021 ug/l and were below the chronic water quality criterion of 0.030 ug/l.

Arsenic: No arsenic was detected in any of the samples collected during the five monitoring events. The detection limit of 2.0 ug/l was below the chronic water quality criterion of 36 ug/l.

Cadmium: No cadmium was detected in any of the samples collected during the five monitoring events. The detection limit of 0.25 ug/l was below the chronic water quality criterion of 9.2 ug/l.

Chromium: (VI) No chromium VI was detected in any of the samples collected during the five monitoring events. The detection limit of 5.0 ug/l was below the chronic water quality criterion of 50 ug/l.

Copper: Copper was detected in the majority of the samples collected, at both the reference and downcurrent sampling locations. The maximum concentration detected was 0.82 ug/l which is well below the chronic water quality criterion of 2.4 ug/l.

Lead: Lead was not detected in the first four monitoring events with a detection limit of 0.02 ug/l. Lead was detected in all samples on the fifth monitoring effort (both reference and downcurrent) with a maximum concentration of 0.06 ug/l. All concentrations were well below the chronic water quality criterion of 8.1ug/l.

Nickel: No nickel was detected in any of the samples collected during the five monitoring events. The detection limit of 1.0 ug/l was below the chronic water quality criterion of 8.2 ug/l.

Zinc: Zinc was detected in all samples collected with a maximum concentration of 2.6 ug/l. There was no obvious difference between reference and downcurrent stations, and all values were well below the chronic water quality criterion of 81 ug/l.

Mercury: (Total) Mercury was not detected in any samples from the first two monitoring events. During the third and fourth monitoring events, mercury was detected in the downcurrent samples collected at 0.5 and 1 hour after the disposal event with a maximum concentration of 0.011 ug/l (below the chronic water quality criterion of 0.025 ug/l). During the fifth monitoring event, mercury concentrations were below detection limits at the reference station and above the chronic water quality criterion for the 0.5 and 1 hour samples at the downcurrent station (at concentrations of 0.04 and 0.034 ug/l, respectively). The 12 hour composite sample from the downcurrent station was 0.01 ug/l. As this composite value was below the chronic water quality criterion, the results are in compliance with the standards set in the Water Quality Certification for the project.

Bioassays: The bioassay tests did not reveal acute or chronic toxicity to the mysid, *Musidopsis bahia* after 7 days exposure. The tests did reveal a chronic sublethal impact on egg fertilization for the purple sea urchin, *Arbacia punctulata*. However, the measured impact was identical at the reference and downcurrent location, i.e. the impact is an apparent background condition of the harbor and not the result of dredging.

3.4 QUALITY ASSURANCE REVIEW

Field Efforts

An Independent Observer was present during all or part of every Coast Line Engineering monitoring effort. The following procedures and equipment were reviewed in detail at least once and generally reviewed daily during the Phase 1 monitoring:

- Water quality instrumentation operation and calibation;
- Turbidity plume definition;
- Station positioning;
- Sample collection equipment and procedures;
- Sample labeling and chain of custody;
- Current meter operation; and
- Electronic data handling.

All practices were found to be in compliance with the monitoring requirements defined in the Water Quality Certification.

Laboratory Data

A quality assurance review was performed on the laboratory data resulting from the monitoring described in Section 3.1 - 3.3. The review included both inorganic and organic data and data analyzed at all labs (Arthur D. Little, EnviroSystems, and Woods Hole Environmental Laboratories). Method verification samples were collected for all parameters (TSS, PCB, and metals) during the dredging of the surface silts at the disposal cells. Collection of these samples was not required, but the samples were intended to be used by the laboratories to verify appropriateness of the analytical methods for the seawater samples. ENSR had proposed to perform full validation on the data for the method verification samples assuming these data would be available for review prior to the analysis of all other samples. However, due to the sampling schedule, data for these samples were received at the same time as the data for all other samples. Therefore, only a limited review was performed on the data for the method verification samples since a subset of the data for all parameters was subsequently reviewed for samples collected during the disposal operations of dredged material from Berths 11 and 12.

The limited review performed on the data (TSS, arsenic, and copper) for the samples collected during dredging of the surface silts at the disposal cell and during dredging of the parent material at the disposal cell did not reveal any notable analytical deficiencies. Several typographical errors in the report (field ID description and laboratory IDs) were noticed.

Full validation was performed on a subset of the data for the samples collected during disposal operations of dredged material from Berths 11 and 12. Samples not receiving full validation were subjected to a limited review. No significant method nonconformances were observed with the TSS and metals analyses. Minor instrument performance issues were noted; however, these issues did not invalidate or affect the usability of the reported results. No significant method nonconformances were observed with the PCB analyses. Minor transcription errors were noted which slightly affected the reported quantitation limits for a few samples.

One issue of concern was the apparent lack of thermal preservation used for the samples after collection. Upon receipt of the samples, the laboratory measured and documented temperatures in the storage and transport cooler (22-25°C) that were significantly higher than method requirements (4°C $\pm$2). Sample degradation/transformation can occur when the sample is maintained at higher temperatures. Sample degradation may lead to false negatives or results that are biased low.

In summary, all laboratory analyses appear to have been performed in an acceptable manner; only minor issues were noted during the data review process. For future sampling efforts, ENSR strongly recommends that ice be used to preserve the samples as required to prevent sample degradation.

4 EVALUATION OF POTENTIAL IMPACTS TO WATER QUALITY

The potential for dredging activities to impact water quality was clearly addressed in the Final Environmental Impact Report/Statement (FEIR/S; USACE and Massport, June 1995). Modeling studies were performed that predicted the potential transport and fate of contaminants introduced into the water column through both dredging and disposal activities (Appendix F, FEIR/S). The modeling included a detailed simulation of the hydrodynamics of Boston Harbor that allowed for prediction of transport of potential contaminants once they were released into the water column.

The constituents that were evaluated included copper, mercury, PCB, naphthalene, and total suspended solids (TSS). The source term for the introduction of contaminants into the water column relied on elutriate testing performed on Boston Harbor sediments (USACE, 1986) for copper, mercury, and PCB and on the analysis performed by Wade (1995) for naphthalene. The source term for the introduction of TSS relied on an assumption of sediment release rate for dredging and disposal based on observations of previous operations and/or previous investigations (Tovalaro, 1984).

A series of analyses were performed with varied dredging and disposal rates with the following results:

- Under continuous loading (release of sediments/contaminants spread evenly over time), no exceedences of chronic water quality criteria were predicted.
- Under instantaneous loading (release of sediments/contaminants at a single point as in a disposal event), no exceedences of chronic water quality criteria were predicted four hours after the release.
- Under the worst expected case of disposal and dredging, the mixing zone (area with potential concentrations greater than the chronic water quality criteria) extended a maximum of one-sixth the distance across the receiving channel width.

Completion of Phase 1 activities allows for an evaluation of the monitoring data presented in Section 3 in relation to the predictive modeling.

Dredging with the Environmental Bucket

The predictive modeling presented in the FEIR/S (Appendix F) assumed a 2 % release rate of dredged material into the water column (Tovalaro, 1984). For dredging of 3000 cubic yards/day, the model predicted the TSS plume presented in Figure 11. For dredging of the surface silts, the measured TSS concentrations during Phase 1 (presented in Section 3.1) were far below the predictions. This offset between the predicted and observed TSS concentrations is attributed to the use of the closed environmental bucket (the 2 % release rate is based on open buckets). It should be noted that the procedures implemented by Weeks Marine in using the environmental bucket (speed lowered/retrieved through the water, drainage at surface, emptying time into scow) further contributed to the reduced suspended solids.

Dredging with the Open Bucket

The open clamshell bucket used to remove the parent material during Phase 1 is similar to that assumed by the predictive modeling performed as part of the FEIR/S (appendix F). The results of the predictive modeling (Figure 11) are in good agreement with the TSS concentrations measured during Phase 1 dredging (presented in Section 3.2). Both the predicted and observed TSS concentrations were well below the performance standard set in the Water Quality Certification (200 mg/l at 500 feet downcurrent of the dredging/disposal operation).

Disposal into the In–Channel Cell

Modeling was also performed in the FEIR/S (Appendix F) to predict the impact of disposal of silty sediments into a disposal cell. Predicted TSS concentrations from the FEIR/S are presented in Figure 12 for various times and downstream distances following the simulated disposal of 3000 cubic yards of sediment at an Inner Confluence cell. These predictions assumed a 5 % release rate of material during a disposal event (based on Johnson, 1990). A comparison of Figure 12 with the monitoring results for Phase 1 presented in Section 3.3 clearly indicates that the actual introduction of material into the water column (TSS) during disposal was much less than predicted.

During an actual disposal event, the release of material to the water column is affected by the following major factors:

<u>Physical/Chemical Characteristics of Material to be Disposed</u> - The water content and percentage silt and clay of the sediment affect the amount that is released into the water column as the sediment sinks from the scow into the cell and impacts the bottom of the cell. These physical characteristics are not expected to vary significantly for surface silts from various portions of the harbor. The chemical concentrations (both in the interstitial pore water of the sediment and adsorbed to the sediment) are expected to vary considerably for surface sediments from different portions of the harbor. The contaminant concentrations in sediments removed from the federal channel during Phase 2 are expected to be comparable or lower than the sediments removed from Conley Terminal during Phase 1. Sediments removed from the Mystic and Chelsea Rivers in Phase 2 may have considerably higher concentrations of some contaminants than those removed from Conley Terminal.

<u>Physical Configuration of the Cell</u> - The depth of the cell (relative to the surrounding bottom) and the side slope are expected to affect the turbidity plume as the sediment impacts the bottom of the cell. Inner Confluence Cell #2 was constructed with nearly vertical sidewalls that ranged from 15 to 20 feet high. This is expected to be an optimal case related to plume containment as future cells may not be as deep or may have shallower side slopes.

Remaining Capacity of the Cell - The exposed height of cell wall above the silt layer decreases with each disposal event. Hence, as the cell nears capacity, there is an increased likelihood that the turbidity plume (created when the disposed silt impacts the bottom) will rise above the top of the cell and be transported away from the cell by any ambient currents. Disposal into the Inner Confluence Cell #2 in Phase 1 ended before the cell was near capacity. Disposal events in Phase 2 may result in more significant turbidity plumes as cells are filled to capacity.

Number of Consecutive Disposals - Following a disposal event, suspended solid concentrations are expected to be elevated in the water above the silt layer in the disposal cell. Some of these suspended solids are carried away from the cell with the ambient tidal current. The water below the top of the cell is less affected by the overlying tidal currents, allowing suspended material to settle to the bottom of the cell. Based on the settling velocities presented in Appendix K of the FEIR/S, (36 ft/hour for silt and 7 ft/hour for clay), it is expected that the suspended solids in the water above the silt would settle to the bottom over the course of several hours. Hence, if one disposal event occurs during a high tide cycle (the Water Quality Certification allows for disposal 1 hour prior to 2 hours after high tide), the water within the cell is expected to have cleared (along with some consolidation of the silt) prior to the next high tide. When multiple disposal events occur during one high tide cycle, it its likely that the later disposals displace some the turbid water from within the cell. Disposal during Phase 1 ranged from one to three disposal events during a high tide cycle. The three disposals into a single cell over a 1.5 to 2 hour time period is likely near the maximum expected during Phase 2.

Current Velocity - As the ambient current increases during a disposal event, transport of suspended solids away from the cell is expected to increase. The current speed and direction over the disposal cells are dependent on both the tidal stage and the location of the cell within the harbor. The current direction will generally be oriented along the long axis of the disposal cells (as cells are generally parallel to the main channel direction). The normal cycle of tidal current speed will vary dependent on tidal stage (1 hour prior to 2 hours after high tide as prescribed in the Water Quality Certification) and on the cell location within the harbor. During Phase 1, all but three of the 14 disposal events occurred slightly before or within 1 hour after high tide.

Maneuvering/Positioning of the Scow over the Cell - As described in Appendix G of the FEIR/S, vessel propeller wash can create significant currents near the harbor bottom. This can suspend solids within the disposal cell as a scow is maneuvered into position before disposal and as the scow is removed from the site. During Phase 1 the dredge was positioned over the cell and scows were secured alongside the dredge for each disposal event. This resulted in lengthy maneuvering over the cell for some disposal events. Maneuvering over the cell during Phase 2 will depend on the method for scow positioning selected by the contractor and on the specific location of a given disposal cell.

In addition to the factors described above, vessel traffic in the vicinity of the cell can impact turbidity in the vicinity of the cell both before and after a disposal event. Harbor sediments are suspended on a routine basis by propeller wash as vessels transit the harbor and are maneuvered for docking. Hence, vessels transiting directly over a cell that is still open can suspend the material within the cell. During Phase 1 large vessels were not observed passing directly over the cell, but tugboat passage and maneuvering over the cell was noted. Large vessel passage with associated turbidity impacts unrelated to the cell were also noted during Phase 1 monitoring.

The relative impact of varying some of the factors described above can be assessed by comparing the turbidity measurements for two of the monitoring events in Phase 1 (Figure 13). For the 30 June disposal event, the cell was nearly empty; there was a single disposal event that occurred 11 minutes after high tide (based on tide tables); there was limited maneuvering by the dredge/scow over the cell; and there was limited vessel traffic in the area. Turbidity monitoring for the 30 June event (upper graph, Figure 13) revealed no discernible plume following the disposal. For the 3 July disposal event, the cell was partially filled; there were three disposal events (ranging from 31 minutes before to 60 minutes after high tide); there was extensive maneuvering of the dredge/scow over the cell following the third disposal; and there was extensive vessel traffic in the area. The peak turbidity value at one hour after disposal for 3 July (lower graph; Figure 13) was likely due to the dredge/scow maneuvering over the cell. The peak turbidity value at 10 hours after disposal was likely due to ship/tug activity in the area (but not over the cell) that did not equally impact the reference location.

In summary, a comparison of the monitoring of disposal events from Phase 1 with the predictive modeling in the FEIR/S, generally reveals the conservative nature of the predictions, i.e. the modeling tended to overestimate the impacts to water quality. However, the actual impacts associated with a disposal event can vary significantly as a function of the controlling factors described above.

5 SPECIFIC ISSUES NOTED DURING PHASE 1

The Water Quality Certification for the project called for the formation of a Technical Advisory Committee to meet weekly and review the progress of the dredging activities and the environmental monitoring data. The Committee is chaired by Massachusetts Coastal Zone Management and is composed of representatives of the project sponsors (Massport and the USACE); the dredging contractor; local, state, and federal agencies; environmental interest groups, and an independent academic participant. This section presents specific issues noted during Phase 1 of the project and discussed by the Technical Advisory Committee.

Environmental Bucket Electronics - The Water Quality Certification for the project stipulated that, "Accessories shall be attached to the approved bucket which give the operator accurate information regarding bucket depth and bucket seal on closure" (condition A.3.(b)). To meet this requirement, the bucket was outfitted with an electronic depth sensor to measure the height of the open bucket above the bottom and an electronic sensor to monitor bucket closure. The depth sensor gave accurate readings during its initial use on 16 June 1997. However, after several cuts with the bucket, the turbidity of bottom waters in the immediate vicinity of dredging increased to the point of interfering with the acoustics of the depth sensor, and the dredging operator was unable to determine the bucket's vertical position in the water column. This resulted in both under and overdredging. A decision was made to return to the traditional method of determining bucket position based on depth of the bucket (as measured by markings on the wire) and the tidal stage (based on real time readings from a tide gage). This method worked successfully for the remainder of the dredging with the environmental bucket.

The bucket electronics (depth and closure seal) required that an electrical connection be maintained between the dredge and the bucket via conducting wire. Apparent in Figure 14 is the array of chain and cable required to operate the bucket. It was difficult for the dredge operator to keep the relatively fragile conducting wire intact while operating the bucket's mechanics and transferring sediment to the scow. After catching on a cleat on the scow, the conducting wire was severed during the first few hours of operation. However, the mechanical/electrical design of the dredge allowed for an alternative method to determine bucket closure. The load sharing design of the dredge is such that the motor for the bucket lift wire can not be fully energized until the bucket is no longer being closed. At this point the operator can gage if the bucket is fully closed based on the position of the lift wire relative to the closure wire. This method was used successfully for the remainder of the dredging with the environmental bucket.

Water Content of Scows - As shown in Figure 4, dredging of the silty surface sediment with the environmental bucket resulted in the discharge of significant amounts of water into the disposal scow. There were concerns that disposal of the turbid water along with the sediment when the scow was emptied into the disposal cell would potentially result in increased release of suspended material to the water column. However, the environmental monitoring did not reveal any obvious impact of disposal of water with sediments.

Debris in Surface Sediments - Debris in surface sediments can prohibit the environmental bucket from fully closing. This results in sediment loss and associated introduction of suspended material into the water column during retrieval of the bucket and transfer to the scow. The ability to detect if the bucket is not fully closed allows the dredge operator to try to achieve full closure before the bucket is retrieved. Some debris was removed during Phase 1 (such as timbers, wire, and chain) that could not be fully enclosed in the bucket and resulted in sediment loss from the bucket during retrieval. However, occurrence of this type/size of debris was infrequent, and associated turbidity impacts were limited.

Residual Silt on Dredged Parent Material - As described in Section 2.1, construction of the disposal cell began with the removal of surface silts over the entire cell footprint with the environmental bucket. After the silts were removed, the contractor switched to an open clamshell bucket to deepen the cell by removing the parent material (clay). Dredging of the parent material began along the mid channel (western) side of the cell and progressed toward shore. As clay was discharged to the scow, traces of surface silts were noted in some of the lifts of clay (Figure 15). Initially, the surface silts were estimated at less than 1 % of the fully loaded scow. The percentage of surface silts in the clay increased as the dredge moved closer toward the shore. The dredging contractor attributed these silts to the following sources:

- Bottom Depressions that Trap Silt - Deposition of the silty material on the harbor bottom tends to fill in irregularities over time. As the previous dredging of the harbor was performed with a clamshell bucket, it can be assumed that the dredging left an irregular, scalloped bottom and that the depressions filled with silt over time. The environmental bucket is designed to scrape across the bottom and not cut into the parent material. Hence, it likely scraped across the top of depressions and left pockets of surface silts that were removed when the conventional clamshell bucket was used.

- Transport of Silt into the Cell - After completion of the initial dredging of the surface silts with the environmental bucket, the cell had definitive sides, particularly on the eastern border where the surface silts were several feet thick. Tugboat activity along this border was heavy at the Boston Towing and Transportation docks. Silt mobilized by the activity along the border of the cell would be expected to spill down the side of the cell and cover the newly exposed parent material (prior to dredging of the parent material).

As the percentage of silt removed with the clay increased, the contractor made the decision to switch back to the environmental bucket and redredge the surface sediments of the inner portion of the cell. The second pass with the environmental bucket yielded a limited amount of additional silty sediments. Following completion of this pass, the contractor switched back to the open bucket and immediately dredged the parent material along the eastern border of the cell to act as a trap for any mobilized silts.

Twelve-Hour Monitoring Requirements after Disposal Events - The monitoring requirements in the Water Quality Certification call for a 12 hour monitoring cycle following a disposal event. The monitoring was designed to track potential short term impacts to water quality with discrete sampling at 0.5 and 1 hour after disposal and potential longer term, chronic impacts with a series of 11 additional hourly samples composited with the 0.5 and 1 hour samples. The monitoring data presented in Section 3.3 and Section 4 for Phase 1 suggest that any potential impacts to water quality following a disposal event are only identifiable for a limited time (less than 2 hours) after disposal. The samples collected later in the 11 hour cycle may have elevated contaminant concentrations (as suggested by the elevated turbidity in Figure 13), but these elevated concentrations can be attributed to other activities within the harbor such as vessel traffic or stormwater discharge.

Reference Sample Location/Current Meter Requirements - The monitoring requirements in the Water Quality Certification call for the use of a current meter to measure bottom current velocity at the reference site during disposal monitoring. Real time current measurements require the use of sophisticated instrumentation (such as an acoustic Doppler current profiler) or the use of a moored current meter array with surface readout. The objective of current measurement in the monitoring is not to provide detail on the actual current velocity, but to verify that the reference sample location is unaffected by the disposal event, i.e. it is upcurrent of the disposal. As the measured currents in Phase 1 were similar to predictions for Boston Harbor and as the measurements were a time-consuming requirement, an alternative methodology for meeting this objective could be used for Phase 2. A potential approach includes more detailed real-time measurements of suspended solids (such as with a towed transmissometer) to allow for better mapping of the plume associated with the disposal event. Mapping of the plume in real-time will allow for greater confidence in the placement of the reference sample location.

Elevated Mercury Concentrations During 3 July 1997 Monitoring Event - As noted in Section 3.3, samples collected downcurrent of the cell at 0.5 and 1 hour after the disposal event on 3 July 1997 exceeded the chronic water quality criterion for mercury (0.025 ug/l). However, as the 12 hour composite sample for that day was 0.01 ug/l (less than the chronic water quality criterion) and since neither the

0.5 hour or 1 hour sample exceeded the acute criterion, the results were in compliance with the Water Quality Certification.

The modeling performed as part of the FEIR/S (Appendix G) did not predict any excursions of mercury above the chronic water quality criterion. However, the modeling used elutriate testing as the basis for the source term for mercury into the water column following a disposal event. As the elutriate testing measured dissolved mercury concentrations, the results of the predictive modeling are also for dissolved concentrations. The Phase 1 monitoring measured total concentrations of mercury in the water samples. Even with relatively low mercury concentrations in sediments, suspension of a limited amount of sediment into the water column will result in total mercury concentrations in the water column in excess of the chronic water quality criterion. For example, assuming an average mercury concentration of 0.52 mg/kg for sediments from Conley Terminal (as reported in the Water Quality Certification), suspension of those sediments into water at 48 mg/l will result in a total mercury concentration in the water of 0.025 ug/l (the chronic water quality criterion). Based on the prevalence of mercury in harbor sediments, total mercury concentrations in the water are expected to exceed the chronic water quality criterion under many harbor conditions that suspend surface silts into the water column. As such, excursions of total mercury concentrations should not be unexpected during Phase 2 operations.

Capping of the Disposal Cell - Prior to the initiation of capping of the Phase 1 disposal cell, concerns were raised at the Technical Advisory Committee meetings on the ability of the silt in the cell to support a sand cap. Because of these concerns, the USACE and Massport proposed to accelerate the schedule of investigations on cap performance that were originally planned for 12 months after closure of the cell. The investigations were moved up to 2 months following capping, and a subbottom acoustic survey was added to the bathymetry and side scan sonar surveys and core collection that were stipulated in the Water Quality Certification. These investigations are currently scheduled for early October 1997 and will be summarized in a separate report.

6 REFERENCES

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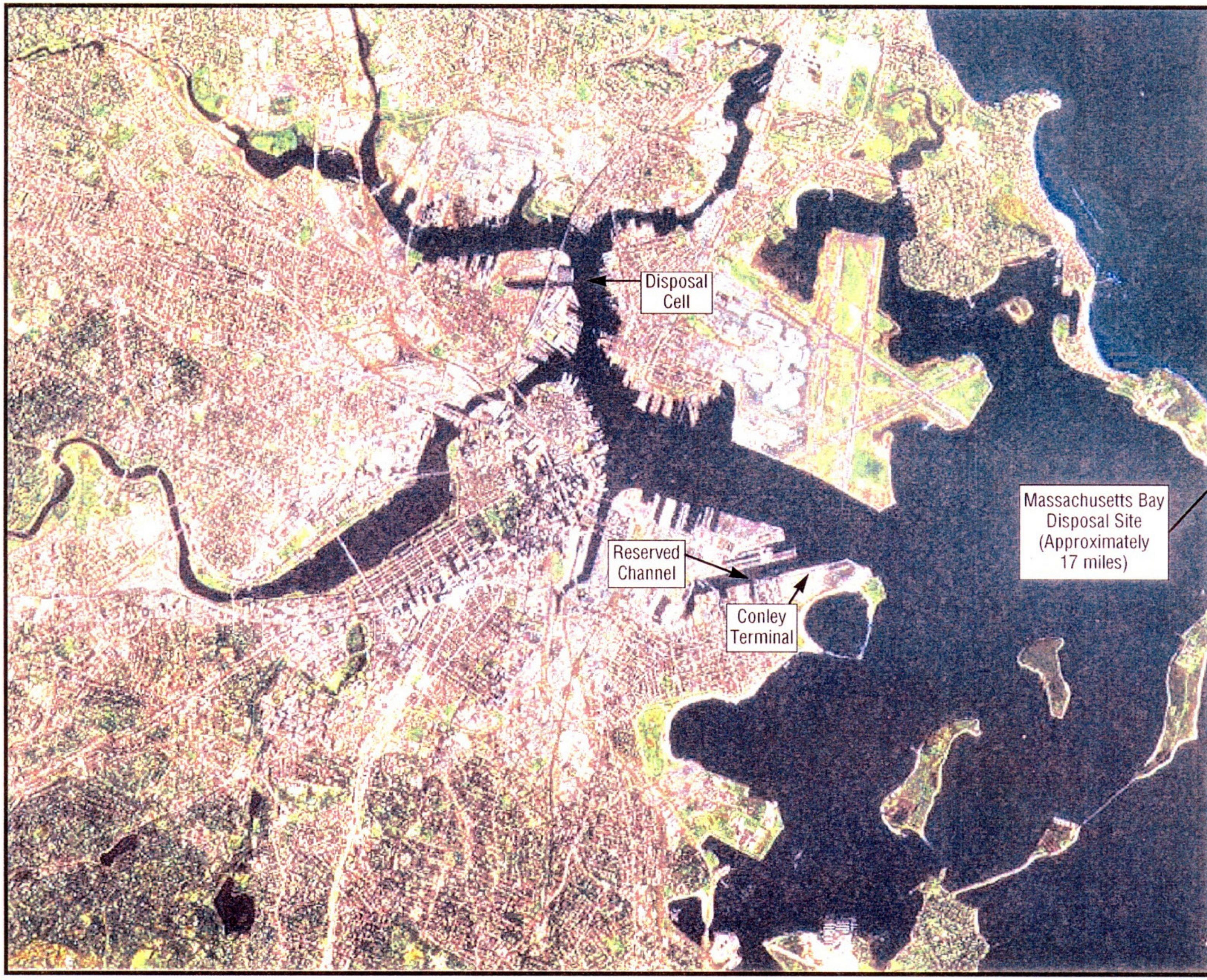

SOURCE: Massachusetts GIS

FIGURE 1

Location of Phase 1 Dredging and Disposal Activities

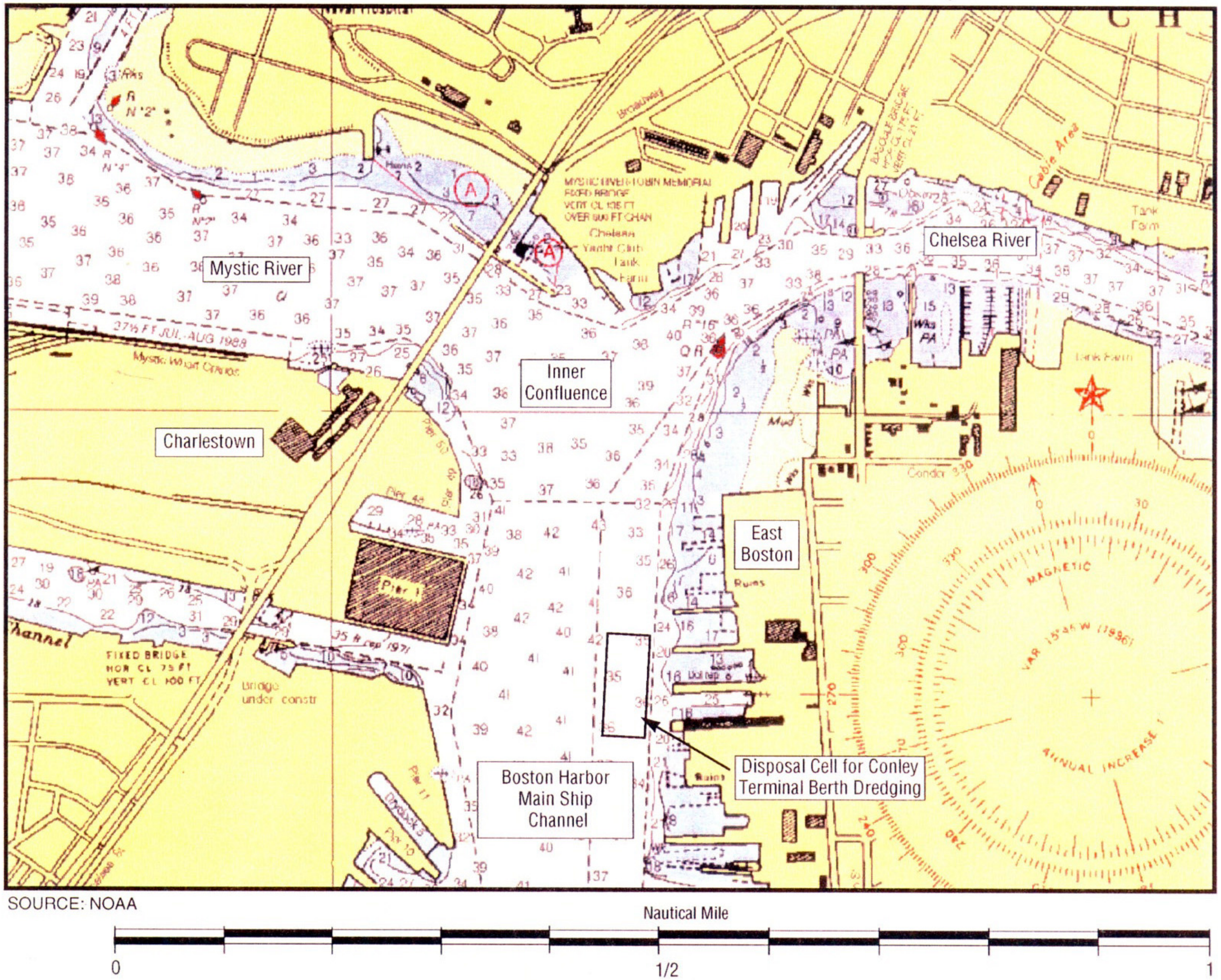

FIGURE 2
Location of the Disposal Cell for Conley Terminal Benth Dredging

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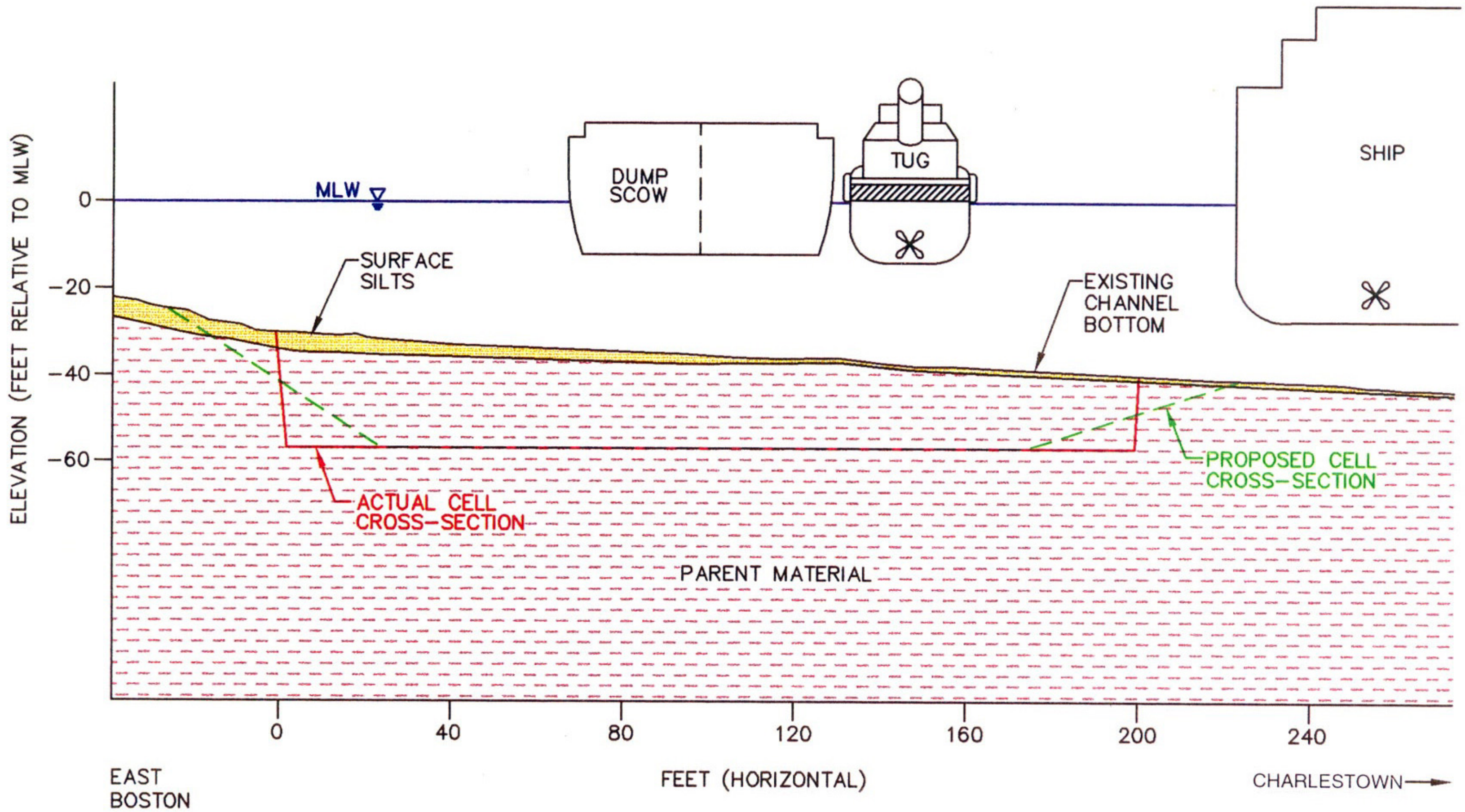

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FIGURE 3
CONCEPTUAL CROSS SECTION SHOWING PROPOSED AND "AS CONSTRUCTED" CELL DIMENSIONS

DRAWN BY:	DATE:	PROJECT NO.

FIGURE 4
Dredging Surface Silts at the Inner Confluence Cell
with the Environmental Bucket

FIGURE 5
Dredging of Parent Material (Clay) at the Inner Confluence Cell
with the Open Toothed Bucket

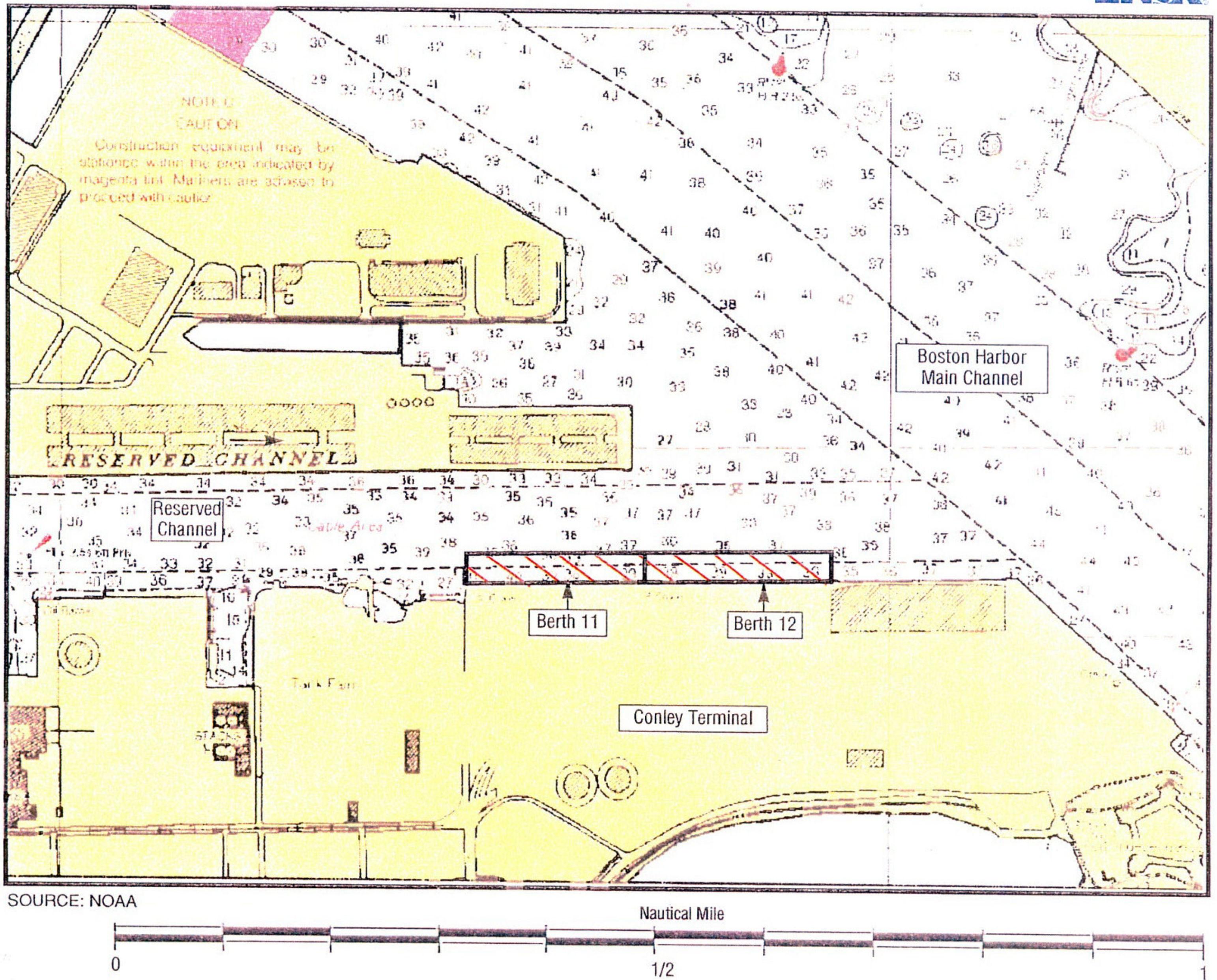

FIGURE 6

Location of Benths 11 and 12 Dredging at Conley Terminal

447902A

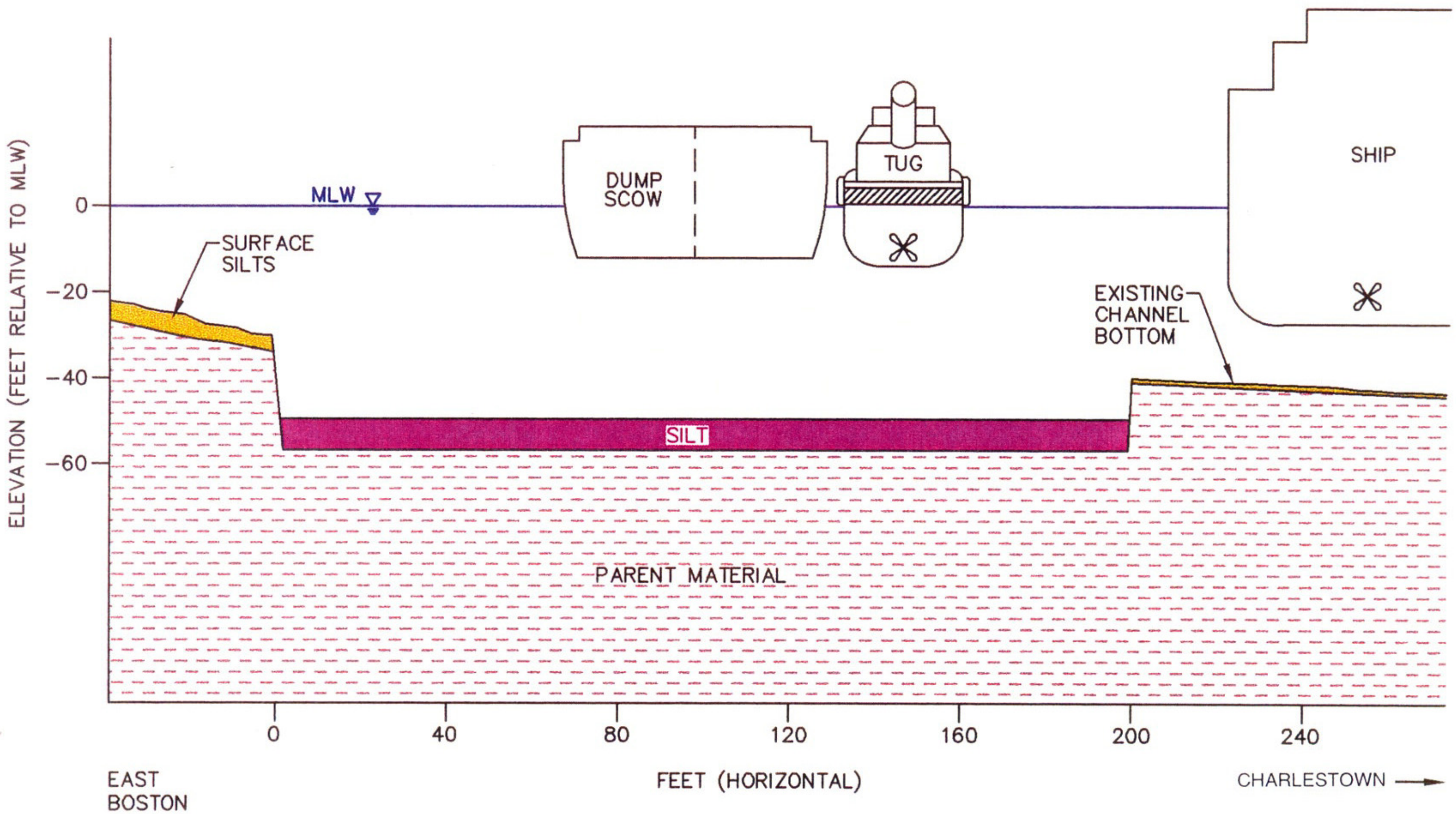

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FIGURE 7
CONCEPTUAL CROSS SECTION OF CELL AFTER DISPOSAL OF SURFACE SILTS

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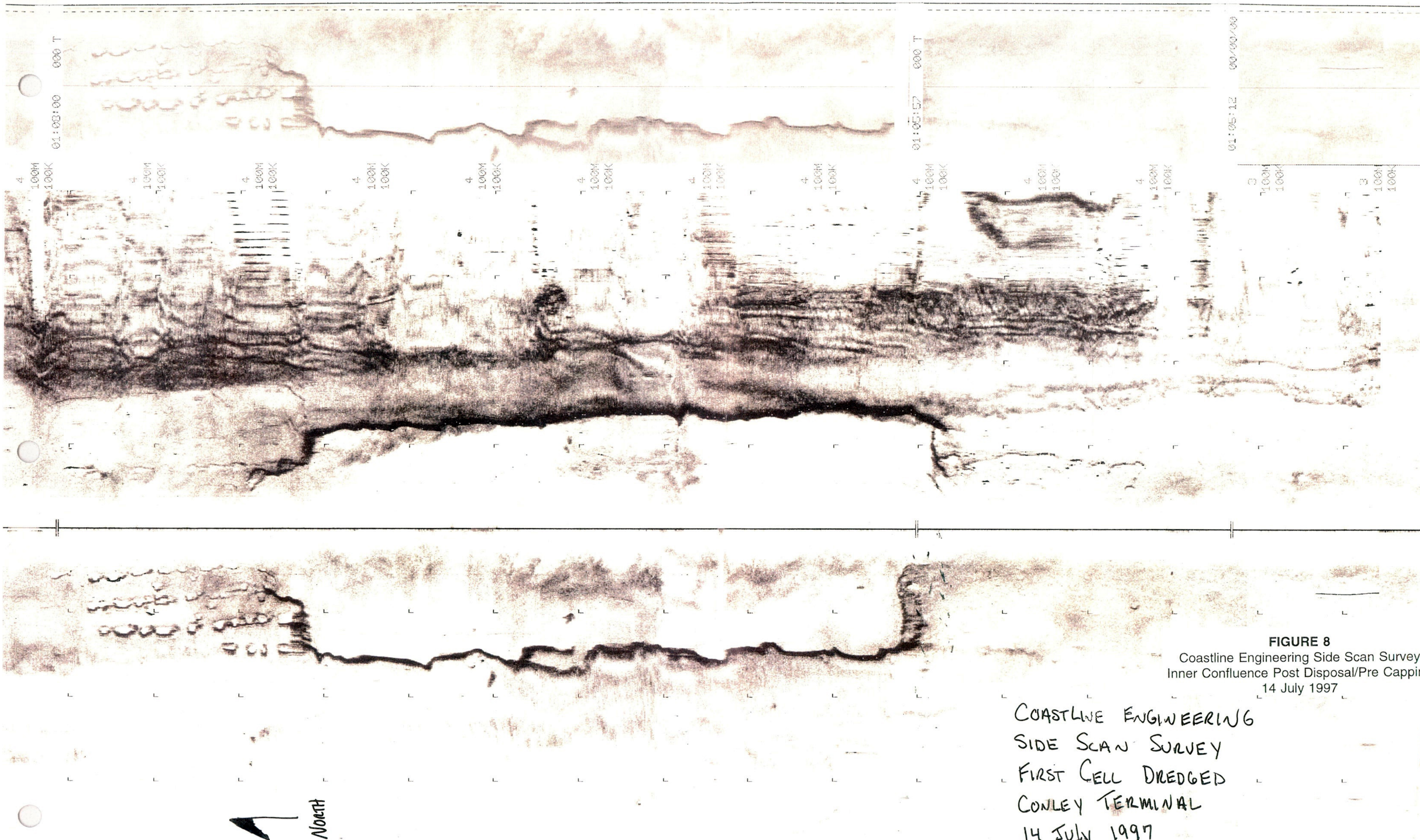

FIGURE 8
Coastline Engineering Side Scan Survey
Inner Confluence Post Disposal/Pre Capping
14 July 1997

COASTLINE ENGINEERING
SIDE SCAN SURVEY
FIRST CELL DREDGED
CONLEY TERMINAL
14 JULY 1997

POST DISPOSAL / PRE CAP

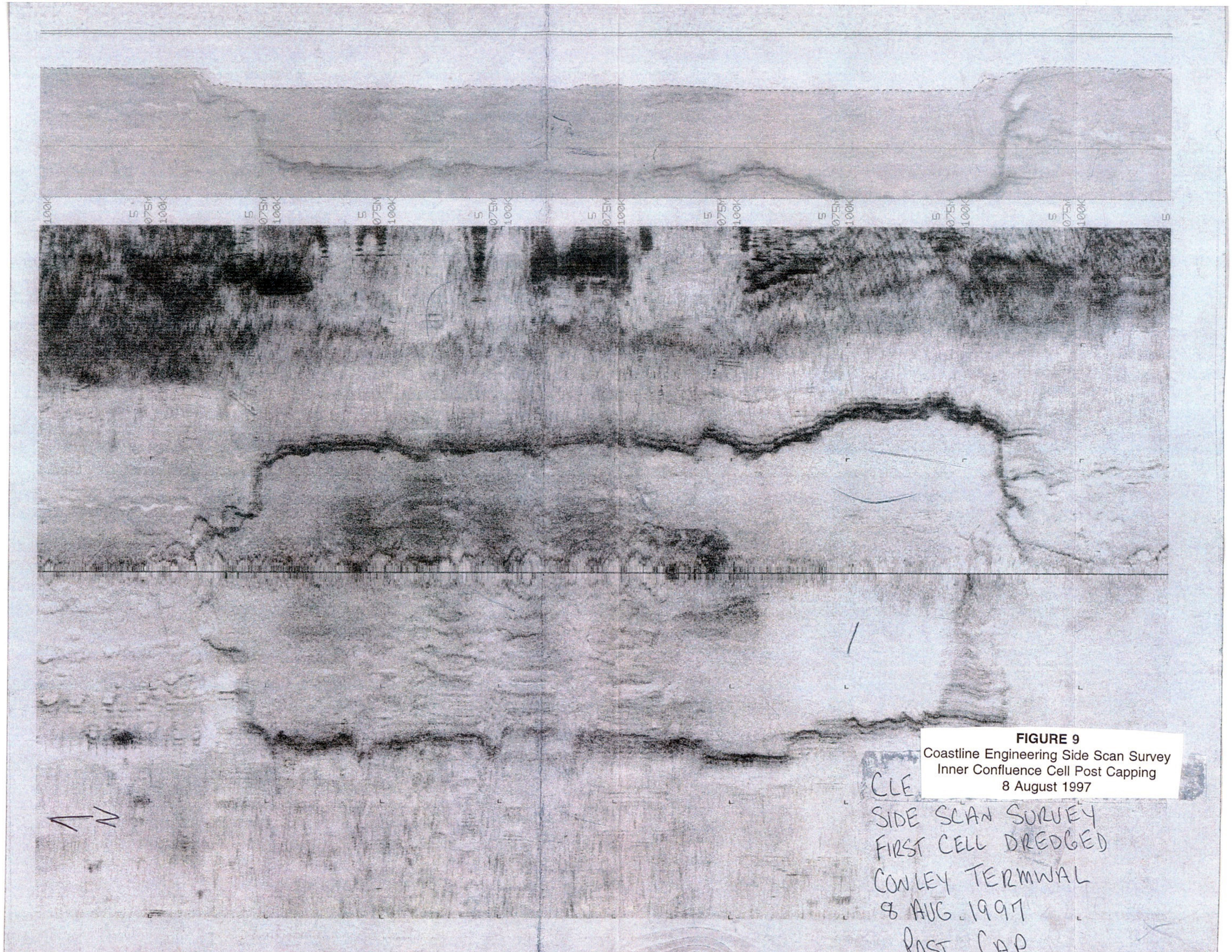

FIGURE 9
Coastline Engineering Side Scan Survey
Inner Confluence Cell Post Capping
8 August 1997

447903A

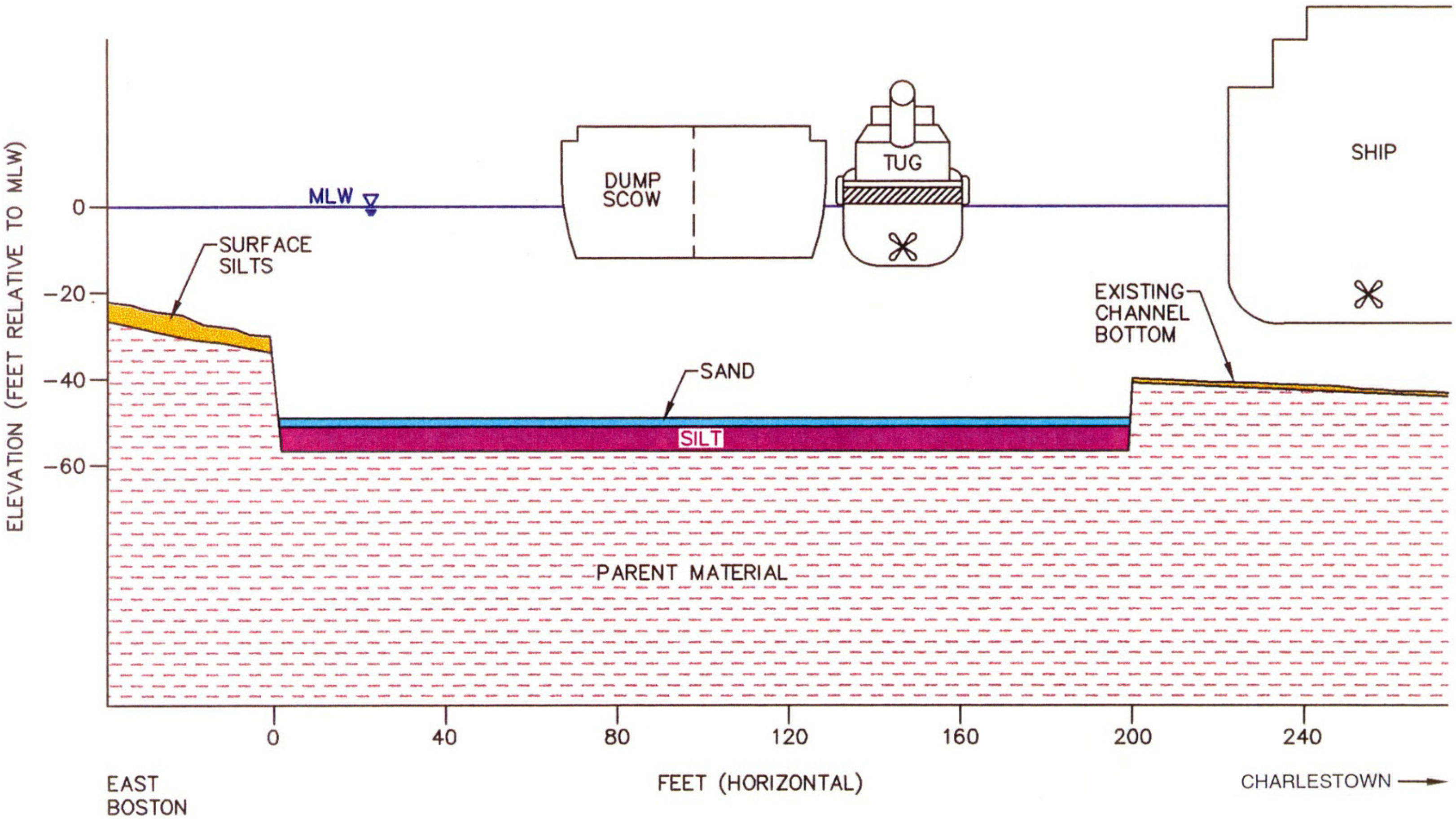

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FIGURE 10
CONCEPTUAL CROSS SECTION OF CELL AFTER CAPPING

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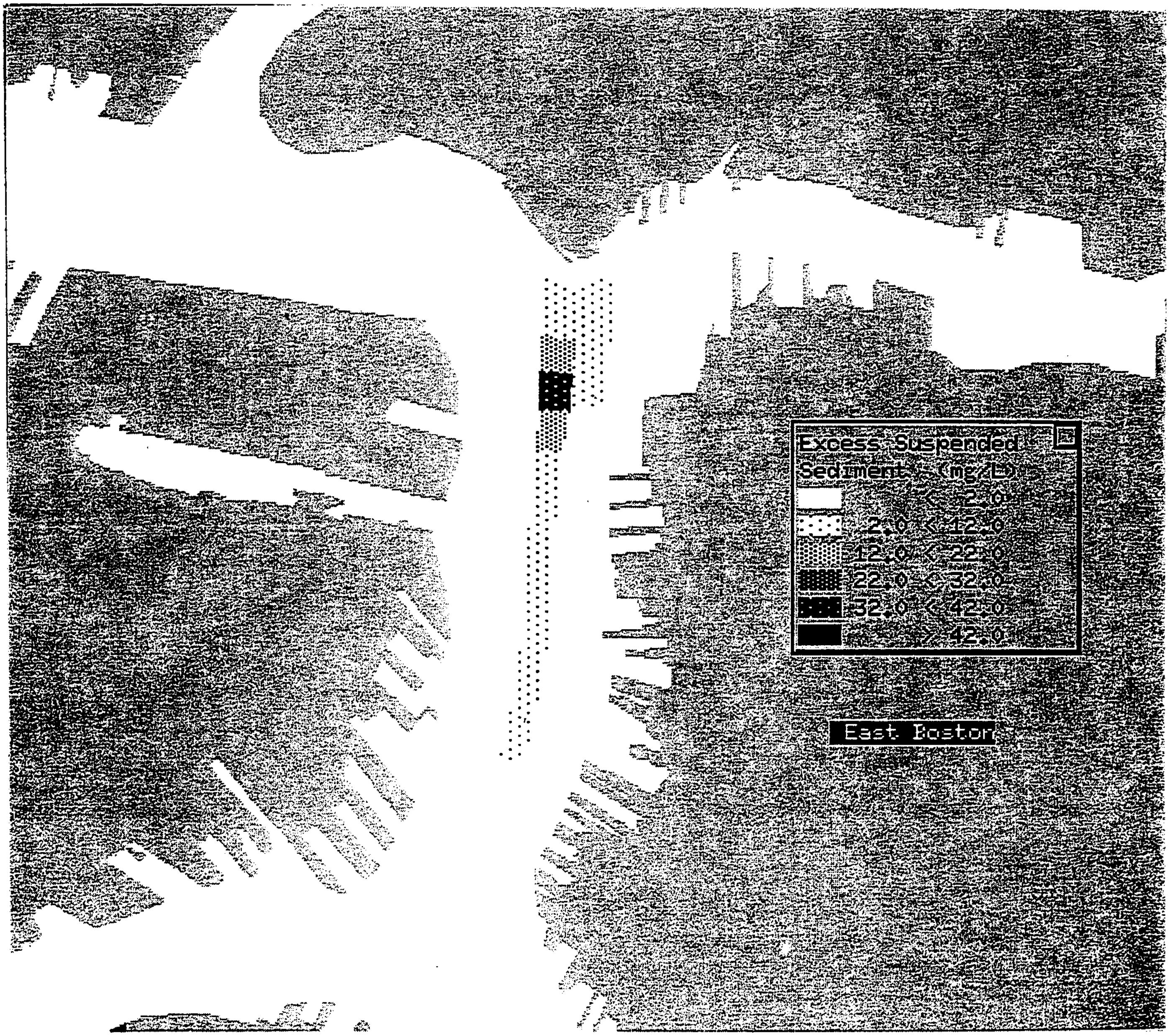


FIGURE 11
Maximum Predicted TSS Concentration for Simulation of Dredging at the Inner Confluence
(Appendix F, FEIR/S)

Note: Presented concentrations assumed constant throughout the water column.

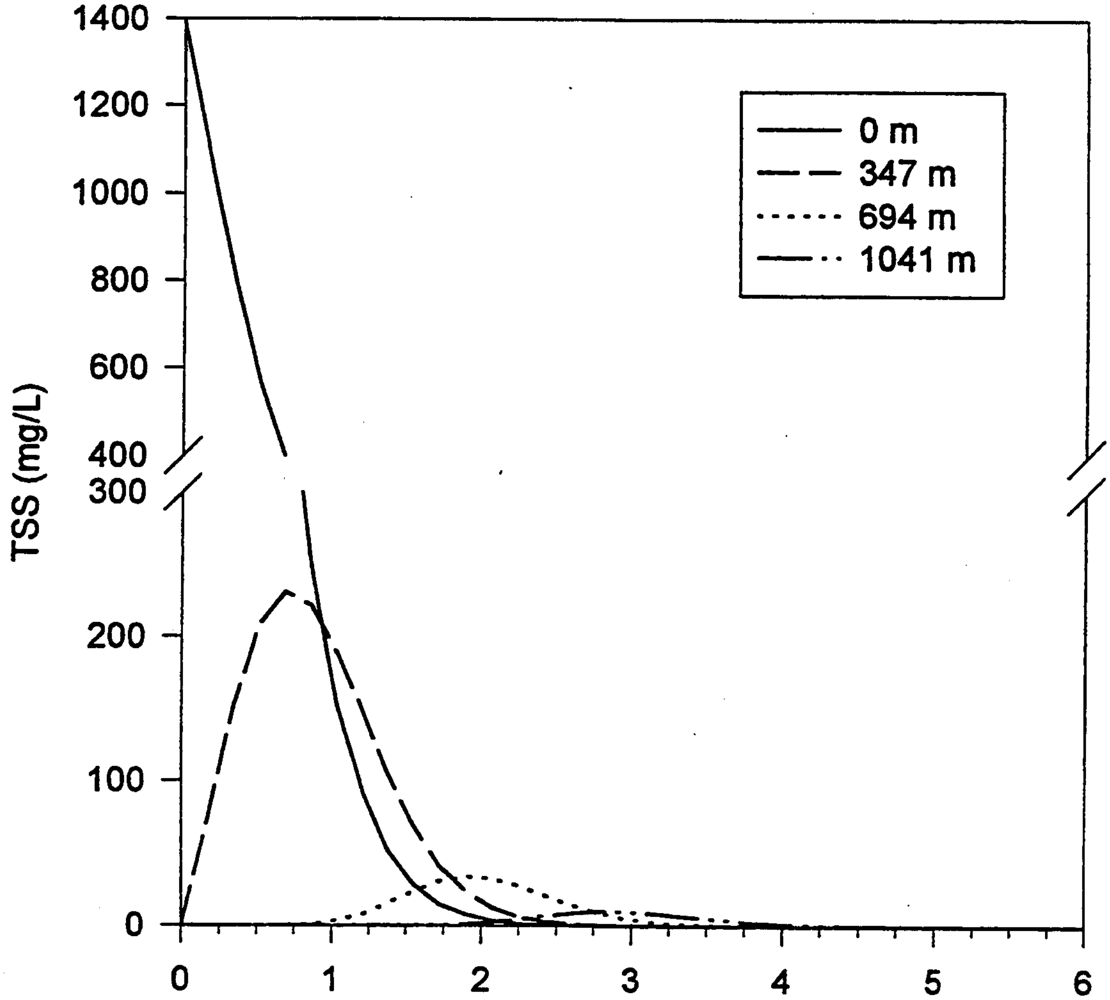
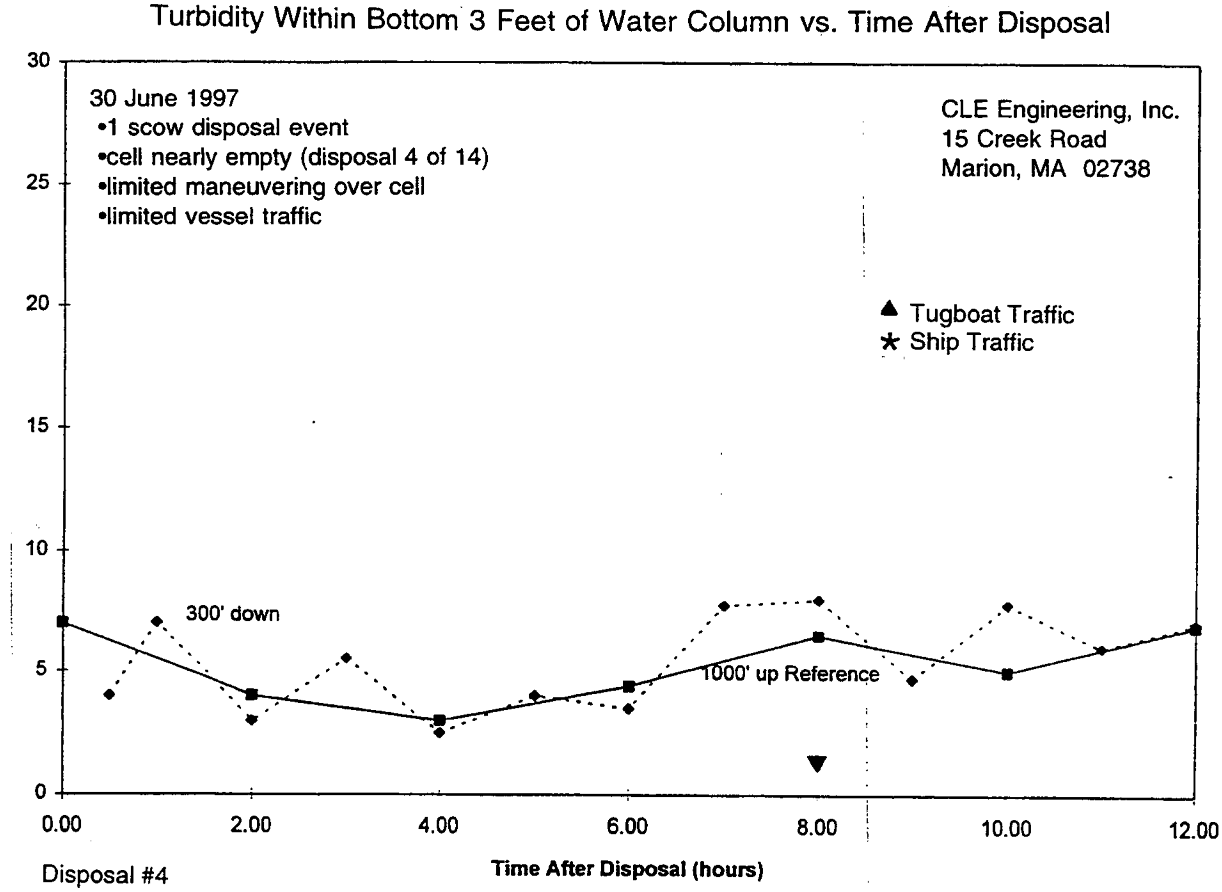


FIGURE 12
Predicted TSS Concentrations for a
Simulated 3,000 Cubic Yard Disposal
(Appendix F, FEIR/S)



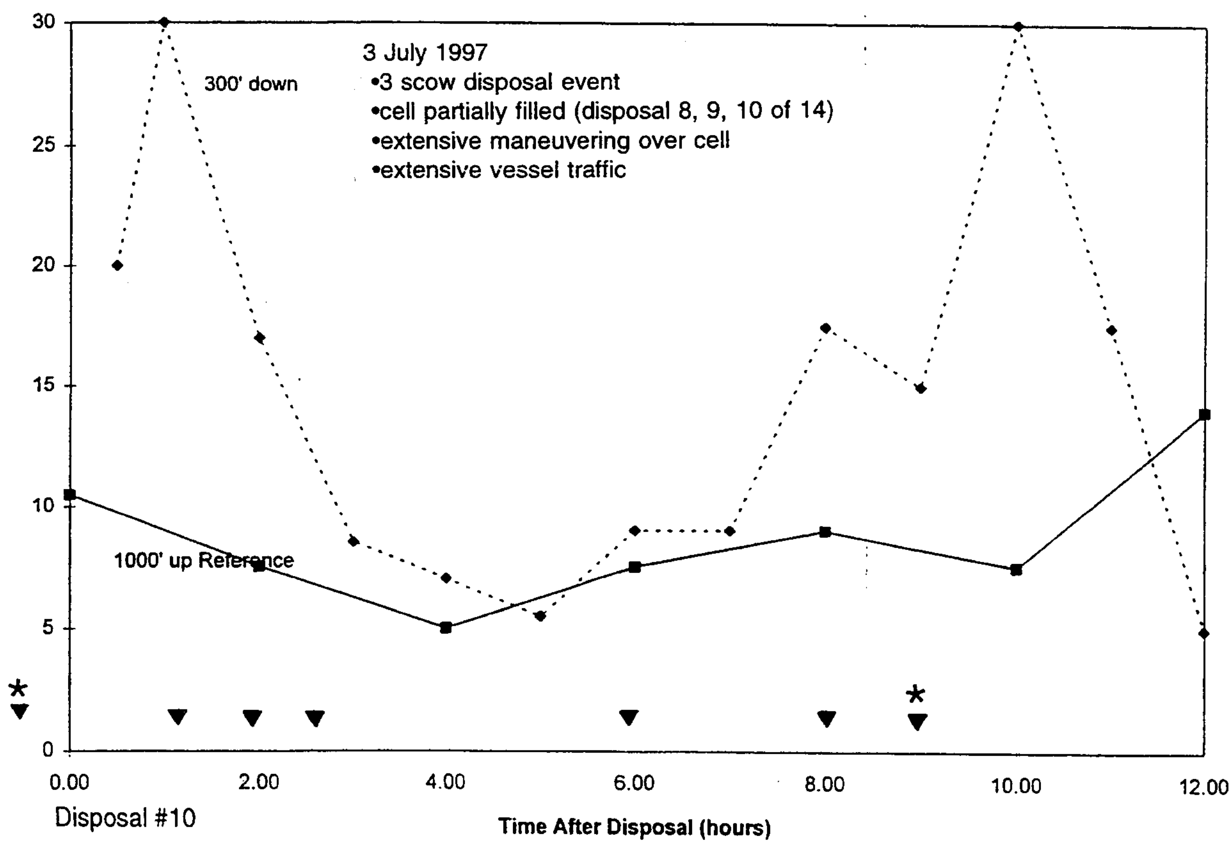


FIGURE 13
Comparison of Turbidity Measurement Following
30 June and 3 July, 1997 Disposal Events
(from Coast Line Engineering)

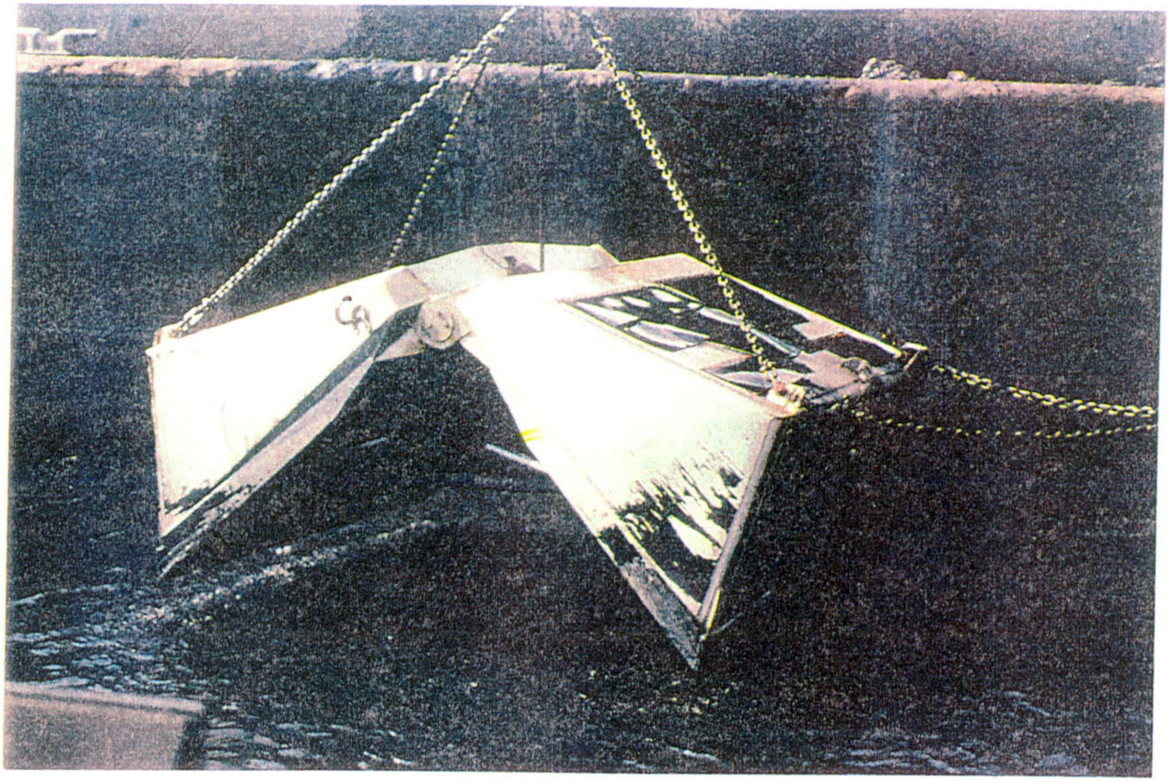


FIGURE 14
The Closed Environmental Clamshell Bucket
Used to Remove Surficial Silt Sediments

FIGURE 15
Parent Material (Clay) Removed from the Inner Confluence Cell
with Traces of Surface Silts

APPENDIX A

PHASE 1 OBSERVATION DATABASE

APPENDIX B

ENVIRONMENTAL MONITORING DATA TABLES

APPENDIX C

BATHYMETRIC SURVEY RESULTS AT DISPOSAL CELL

APPENDIX D

POSTCAP MONITORING OF BHNIP PHASE 1:
ASSESSMENT OF INNER CONFLUENCE CAD CELL (SAIC)