DRAFT

RESTORATION PLAN
AND
ENVIRONMENTAL ASSESSMENT
FOR THE
ISLAND END RIVER FORMER COAL TAR PROCESSING FACILITY

EVERETT, MASSACHUSETTS

Public Review Draft
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Prepared by the:
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EXECUTIVE SUMMARY

This Draft Restoration Plan and Environmental Assessment (Draft RP/EA) has been prepared by the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce to address natural resource injuries caused by releases of hazardous substances at or from the Former Coal Tar Processing Facility Superfund Site located in Everett, Massachusetts (the Site). Pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), NOAA and the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (EEA) share trusteeship authority over the natural resources affected by releases at or from the Site and are collectively referred to as the Natural Resource Trustees ("the Trustees"). See, 42 USC § 9607(f)(2).

Under CERCLA, the Trustees are authorized to act on behalf of the public to assess and recover damages for injury to, destruction of, or loss of natural resources caused by the release, or threatened release, of hazardous substances, and to hold responsible parties liable for those damages including the costs of assessing the damages (42 USC 9607). Natural resource trustees ensure that funds recovered from responsible parties are used to, "restore, replace or acquire the equivalent," of the natural resources that were injured and ecological services that were lost. See, 42 USC § 9607(f) (1).

The Island End River is an approximately 29-acre tidally influenced tributary to the Mystic River which runs into Boston Harbor. The Island End River Former Coal Tarr Processing Facility operated on the filled tidelands for over 70 years between the late 1890's and the 1960's during which time wastewater was discharged directly into the river. Remediation at the site took place between 2006 – 2007 and included extensive dredging of contaminated sub-tidal sediments and the filling of 1.81 acres of the river.

The principal responsible parties for the site are KeySpan Energy Inc. (Keyspan), Honeywell International Inc. (Honeywell), and Beazer East, Inc. (Beazer East). Under CERCLA, Keyspan, Honeywell and Beazer East have joint and several liability and are working together to comply with the requirements of this statute.

NOAA and EEA worked together to investigate and assess potential natural resource injuries attributable to releases at or from the landfill. The Trustees determined that natural resources in the Island End River ecosystem were injured by the release of hazardous substances at or from the Site. The primary natural resource impacts were to subtidal benthic habitat and aquatic species utilizing the water column.

In December 2008, NOAA and the Responsible Parties (RPs) – Keyspan, Honeywell and BeazerEast- entered into Settlement Agreements to resolve the Trustees' NRDA claims under CERCLA relating to the existence, release, or threat of release of hazardous substances at or from the Site. In exchange for the payments of $100,000 each, the RP's received a release from liability for natural resource damages at the site from the Trustees in the form of a NOAA administrative settlement agreement and a letter from the Commonwealth as Trustee indicating that the Commonwealth will take no further action as a Trustee relative to natural resource damages for this site. These payments are to cover NOAA's assessment and restoration costs for

the Site. The RP's have also voluntarily expanded the design, plan and permitting for mitigations to be undertaken on a parcel of land at Oak Island so that, should the Trustee's deem it appropriate and feasible, additional work could be done at Oak Island with the settlement funds to accomplish restoration.

NOAA has identified and evaluated a range of compensatory restoration alternatives to enhance estuarine fish habitat in the area including: a No Action alternative; salt marsh restoration in the Oak Island section of the Rumney Marsh in Revere; and several potential projects in the Mystic and Malden River watersheds. In this document NOAA presents an analysis and evaluation of the restoration alternatives and their potential impact on the surrounding environment. NOAA presents the agency's preferred alternative, restoration of 1.2 acres of the Oak Island salt marsh at an estimated cost of $260,000, which the agency proposes to implement and invites public review and comment.

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1.0 Introduction

1.1 Purpose and Need for Restoration

The purpose of the proposed action is to restore natural resources injured, lost or destroyed at the Island End River Former Coal Tar Processing Facility (FCTPF) Superfund Site and a portion of the surrounding properties in Middlesex County, Everett, Massachusetts, as a result of releases of hazardous substances at and from the Site and subsequent response actions to address the releases. The need to pursue such actions is based upon the implementing regulations of CERCLA. Under CERCLA, the Trustees are authorized to assess liability for the injury to, destruction of, or loss of natural resources caused by releases of hazardous substances and to pursue damages for those injuries. Damages recovered for injury to and loss of natural resources must be used to restore, replace, rehabilitate or acquire equivalent natural resources or services, in accordance with a restoration plan developed by designated natural resource trustees.

In February 2009, NOAA and the Commonwealth of Massachusetts (Trustees) reached a cooperative settlement for natural resource injuries with the Responsible Parties (RPs). Under the settlement, the RPs provided $300,000 to the Trustees for restoration and to reimburse Trustee damage assessment costs. The PRPs have also voluntarily expanded the design, plan and permitting for mitigation actions to be undertaken on a parcel of land on Oak Island so that, should the Trustees deem it appropriate and feasible, additional work could be done at Oak Island with the settlement funds to accomplish NRD restoration. The Trustees are proposing to use these restoration funds, and in-kind services to restore, replace, rehabilitate or acquire equivalent natural resources or services as described in the proposed alternatives in this document.

1.1 Overview and History of the Site

The Island End River Former Coal Tar Processing, also known as Eastern Gas and Fuel, is situated on the tidally influenced Island End River in Everett, Massachusetts, approximately 0.5 miles north of the confluence of the Mystic and Island End Rivers. The FCTPF property is located in an industrial area of Everett; across the river in Chelsea there is an active marina. The property encompasses 8.2 acres with approximately 500 feet of Island End River frontage.

The area that the FCTPF occupied was once a tidal marsh. During the 1890’s the area was filled and developed. For approximately 70 years, companies located in this area processed, stored, and distributed coal tar products. Koppers, later renamed Beazer Materials and Industrial Properties and then Beazer East Inc., operated at the site through the Eastern Gas and Fuel Company (Eastern Enterprises) from 1936 to 1960. Barrett Manufacturing, later taken over by Allied-Signal, Inc. was a third major party at the site. During this time, crude coal tar from the gasification plant was brought to the plant where it was stored until processed. The crude coal tar was then moved from the storage area and processed in the distillation stills into creosote, chemical oils and pitch, with waste water discharged to the river. In 1960, the facility was closed by Koppers and demolished

In 1984 the Coast Guard responded to a complaint of an oil sheen on the Mystic and Island End Rivers. Subsequently, the Commonwealth of Massachusetts Department of Environmental Protection (MassDEP) investigated the site and issued a Notice of Responsibility to the Eastern Gas and Fuel Company. In 1989, MassDEP classified the Site as a Priority Site under 310 CMR 40.544, as specified by Section 3(c)2 of Chapter 21E. This designation resulted in several short-term remedial measures including the placement of a boom, the removal of a subsurface tank, excavation of approximately 438 cubic yards of tar deposits from the shoreline, and installation of slope protection.

1.1.1 Contaminants of Concern

Since 1988, several studies have been conducted and approximately 120 surficial sediment and core samples have been collected and analyzed for various contaminants, particularly total Polycyclic Aromatic Hydrocarbons (PAHs) with a coal tar signature. Reports show that concentrations of total PAHs in surficial sediments in the area adjacent to the FCTPF were as high as 6,000 mg/kg, and dropped at the culvert outfall to the north and the convergence of the Mystic River to the southwest to 300 mg/kg and 200 mg/kg, respectively. In addition, the vertical profiling (i.e., cores) results indicated that the thickness of PAH contamination was greatest in those cores collected closest to the FCTPF. Contaminated sediment was up to approximately 12 feet thick in this area with PAH concentrations exceeding 100,000 mg/kg (i.e., 10%). As with the surficial sampling, PAH concentrations at depth decreased with distance from the FCTPF. Within New England, this site showed the highest concentrations of PAHs found in an estuarine or aquatic environment. The concentrations overwhelmed a modest sediment screening concentration, the Effects-Range Medium of approximately 45 mg/kg that is defined as a probable threshold for benthic toxicity (Long et al., 1998).

NOAA and the Commonwealth of Massachusetts are the designated natural resource trustees for the natural resources actually or potentially impacted by the Site. The Trustees believe the Site has adversely impacted NOAA trust resources, including alewife, winter flounder, striped bass, and benthic species. The Trustees used a Habitat Equivalency Analysis model and using available information and best professional judgement, determined that releases at and from the FCTPF Site injured approximately 13.29 acres of intertidal and subtidal habitat.

1.1.2 Responsible Parties

Various corporate mergers, acquisitions, restructuring and name changes occurred over the years. The principal responsible parties for the site now include KeySpan Energy Inc. (Keyspan), Honeywell International Inc. (Honeywell), and Beazer East, Inc. (Beazer East). Under CERCLA, Keyspan, Honeywell and Beazer East have joint and several liability and are working together to comply with the requirements of the state. The RPs joined the Trustees in a cooperative assessment and restoration planning process. In February 0f 2009, the RPs agreed to resolve their environmental liability for the Site cooperatively and entered into administrative settlement agreements whereby each RP agreed to pay $100,000 to the Trustees. Additionally, the RP’s voluntarily expanded the design, plan and permitting actions for mitigation actions they have been undertaking on a parcel of land on Oak Island so that, should the Trustees deem it appropriate and feasible, additional work could be done at Oak Island with the settlement funds to accomplish NRD restoration.

1.2 Summary of Response Actions

Following short-term remediation described in the site history above, in 2007, under a voluntary agreement with the MassDEP, the responsible parties constructed a Release Abatement Measure (RAM) to address sub-aqueous and intertidal sediment contamination. This action addressed contamination in an approximately 4.2 acre area of the Island End River adjacent to the FCTPF. The RAM involved the construction of shoreline barriers and a 1.81 acre Confined Disposal Facility (CDF) within the river, combined with dredging, stabilization, and on- and off-site disposal of contaminated sediments located outside the footprint of the proposed CDF. Most of the dredged contaminated sediments were placed behind the CDF. The cost of the project was approximately 47 million dollars. The remedy eliminated the chronic release of coal tar from the site and eliminated much of the sediment contamination and tar mats but high concentrations of PAHs remain in the sediment downstream of the facility. The approximately 4.38 acres wetland restoration compensatory mitigation project at Oak Island for the remediation related impacts on wetland values was constructed in the fall of 2013.

1.3 Legal Authority

This Draft RP/EA was prepared by NOAA pursuant to the agency's respective authority and responsibility as a natural resource trustee under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601 *et seq*.; the Federal Water Pollution Control Act, 33 U.S.C. § 1251, *et seq*. (also known as the Clean Water Act or CWA), and other applicable federal laws, including Subpart G of the National Oil and Hazardous Substances Contingency Plan (NCP), at 40 C.F.R. §§ 300.600 through 300.615, and DOI's CERCLA natural resource damage assessment regulations at 43 C.F.R. Part 11 (NRDA regulations), which provide guidance for the natural resource damage assessment and restoration planning process under CERCLA.

1.4 Public Coordination/Participation

On behalf of the Trustees, NOAA has prepared this Draft RP/EA for public review and comment. In this document, NOAA presents information regarding: the role and authority of natural resource trustees, the natural resource damage assessment process, the natural resource injuries and service losses attributable to the Site, the restoration alternatives that NOAA identified and considered, NOAA's evaluation of the restoration alternatives and the potential environmental impacts on the surrounding environment that could result from implementing the various restoration alternatives, and NOAA's proposed preferred alternative for implementation, including the rationale behind its selection. Public review of this Draft RP/EA is the means by which NOAA seeks comment on the restoration action the agency proposes to implement to restore the impacted environment and compensate the public for the natural resources injuries and services losses. As such, it is an integral and important part of the Natural Resource Damage Assessment (NRDA) process and is consistent with all applicable state and federal laws and regulations, including the National Environmental Policy Act (NEPA) and its implementing regulations, and the regulations guiding assessment and restoration planning under CERCLA at 43 C.F.R. Part 11.

This Draft RP/EA is being made available for review and comment by the public for a period of 30 days. The deadline for submitting written comments on the Draft RP/EA is specified in one or more public notices (UPDATE WHEN DETERMINED WHAT PUBLIC NOTICES WILL BE USED) issued by the Trustees to announce its availability for public review and comment.

NOAA will consider all written comments received within the comment period prior to developing and publishing a Final Restoration Plan/Environmental Assessment (Final RP/EA). Assuming an EIS is not necessary, written comments received and NOAA's response to those comments, whether in the form of plan revisions or written explanations, will be summarized in the Final RP/EA.

1.5 Administrative Record

NOAA has maintained records documenting the information considered and actions taken by the trustee agency during this assessment and restoration planning process. These records collectively comprise NOAA's administrative record (AR) supporting this Draft RP/EA. Public comments submitted on this Draft RP/EA, as well as the Final RP/EA, will be included in this AR. The AR records are available for review by the public. Interested persons can access or view these records at the NOAA/National Marine Fisheries Service, Northeast Regional Office, at the following address:

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55 Great Republic Drive
Gloucester, MA 01930
Email: Eric.Hutchins@noaa.gov
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Arrangements must be made in advance to review or obtain copies of these records by contacting the person listed above. Access to and copying of these records is subject to all applicable laws and policies including, but not limited to, laws and policies relating to copying fees and the reproduction or use of any material that is copyrighted.

2.0 Injury and Service Loss Evaluation

This section of the Draft RP/EA describes the Trustees' assessment of natural resource injuries resulting from the release of hazardous substances at or from the FCTPF.

The evaluation and estimate of potential natural resource injuries presented in this section was developed by NOAA and the Commonwealth of Massachusetts, within a Trustee and RP technical workgroup formed as part of a cooperative NRDA process. Although developed cooperatively within the workgroup, the assessment approach and resource injury and loss evaluation presented in this section is that of the Trustees, as the Trustees are solely responsible for ensuring that this assessment plan and its outcome are consistent with the goals of the NRDA process.

2.1 Scope of Injury Assessment

This section includes a description of the Trustees' assessment strategy, including the approach used to evaluate injuries to natural resources affected by hazardous substance releases from the Site. NOAA undertook assessment activities to: reliably identify the nature and extent of natural resource injuries and service losses attributable to releases of hazardous substances into the natural environment from the FCTPF; identify additional injuries arising from response actions planned or undertaken at the Site; quantify the resulting resource and ecological service losses[1]; and, provide the technical basis for determining the need for, type of, and amount of restoration appropriate to compensate the public for those losses. In the remainder of this section NOAA discusses the Trustees' assessment strategy for the Site, including the approaches used to evaluate potential injuries to specific resources, quantify associated losses, and identify the preferred restoration alternative proposed in Section 5 of this document.

2.2 Pathway to Trust Resources

A contaminant *pathway* is defined as the route or medium (for example, water or soil) through which hazardous substances are transported from the source of contamination to the natural resource of concern (43 C.F.R. § 11.14).

The Former Coal Tar Processing Facility lies on the banks of the Island End River, approximately one half mile north of the confluence of the Mystic River and the Island End River. The Mystic River joins Boston Harbor and the Chelsea River 0.6 miles east of the Island End River. This point in Boston Harbor is 13.9 miles from the Atlantic Ocean. The river and connected waterways provide spawning and nursery habitat for fish such as alewife (*Alosa pseudoharengus*), winter flounder (*Pseudopleuronectes americanus)*, striped bass (*Morone saxatilis)*, and benthic species.

Contamination from the Former Coal Tar Processing Facility has adversely impacted natural resources, including NOAA trust resources using the Island End River, Mystic River and Boston Harbor. The primary pathways of contaminant migration from the Site are direct release into the Island End River, as well as groundwater discharge and surface water runoff. A hydrogeologic connection existed between the groundwater and the Island End River adjacent to the FCTPF. The tidal fluctuations affected the hydraulic gradient in the area of the bulkhead and the dock; a steep hydraulic gradient at low tide caused the seep of coal tar-contaminated groundwater from behind the bulkhead to the IER. A sheetpile wall was installed in late 1992 to replace the timber bulkhead to cease the interchange of contaminated groundwater on the property with the IER, but seepage was ongoing until the remediation project was completed in 2007.

The 1991 Ecological Risk Assessment states that "the conditions in this area have impacted a local food supply for winter flounder and other demersal fish species, hence such fish will tend

[1] *Ecological services* means the "physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource". (43 C.F.R. § 11.14(nn)).

to avoid the area because of the lack of food and the because of the oily nature of the sediments." A report completed by the Woods Hole Oceanographic Institute shows numerous internal and external tumors caused by Site-related PAH contamination in local forage fish (killifish). It is therefore very likely that recreational fishery resources and supporting habitat in the Mystic River have been adversely affected by historic releases from the Site.

2.3 Evaluation of Injury and Natural Resource Damage Settlement

In order to quantify the injury caused by the discharge of an undetermined volume of oil seeping from upland soils of the Former Coal Tar Processing Facility into the tidal waters, subtidal sediments and intertidal sediments of Island End River, the Trustees utilized a Habitat Equivalency Analysis (HEA)[2] model.

The Trustees determined that 13.29 acres of the 29.0-acre Island End River sediments were adversely impacted by PAHs from the Facility. The total area of injured sediment was divided into three subgroups as follows:

1) Intertidal sediments (7.21 acres),
2) Subtidal sediments – not dredged (1.88 acres), and
3) Subtidal sediments - dredged (4.20 acres),

Utilizing sediment and biota data from the site in question and the best professional judgment, the Trustees estimate that 13.29 acre area experiencd 100% service loss.

Through cooperative negotiations, the Trustees and PRPs agreed that each PRP would pay $100,000 to the Trustees to resolve their liability for the Site.

2.3.1 Scaling of the Restoration

Utilizing the HEA model, the Trustees initially determined that 25.09 acres of salt marsh would need to be created to compensate for the sediment habitat injury due to the release from the Former Coal Tar Processing Facility.

However, the PRPs contested the HEA findings on both legal and scientific grounds. The Trustees agreed to revise the HEA and proposed a settlement to the PRPs, which was signed in February of 2009. Under the terms of the negotiated settlement, the Trustees recovered

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[2] Habitat Equivalency Analysis, or HEA, (NOAA, 2000) is an accounting procedure that allows parties to identify "debits" (estimating habitat injuries or other resource service losses) due to exposure to hazardous substances, and to identify the scale of restoration required to compensate for assessed injuries or losses. It also allows the "debits' to be balanced against the ecological services to be gained (credited as 'compensation') from proposed habitat restoration projects. The scale, or size, of a restoration project should be such that it provides enough ecological service gains to offset the total of the losses.

The ecological service losses quantified using a HEA are used to identify the restoration requirements needed to compensate for injuries (generally in the form of habitat acreage). In this context, restoration is scaled to provide comparable habitat resources and ecological services (equivalency) between the lost and restored habitat resources and ecological services, adjusted through discounting to account for the difference in time when services gained through restoration are delivered. HEA also applies discounting to make losses occurring in different time periods comparable, resulting in a determination of "discounted service-acre-years", or DSAYs, lost.

The Trustees consider the HEA procedure to be an appropriate analytical tool for use to assess benthic resource losses for this Site. To quantify losses using the HEA method, information or estimates of ecological service losses used to define the resource injuries are needed.

$300,000 to be used to reimburse the Trustees' past assessment costs and restore the injured natural resources. The Trustees will use the restoration funds for restoration planning, implementation, monitoring and oversight costs.

Although primarily subtidal habitat in the Island End River was injured, due to the developed nature and current industrial activity at the Site, the Trustees believe that resolving natural resource damage liability by instead restoring the nearby Oak Island salt marsh would be both ecologically beneficial and cost efficient. By coupling the natural resource damage restoration project with the proposed mitigation project associated with the remediation of the Island End River Site, a larger area of salt marsh can be restored and time and equipment mobilization can be reduced. Further, the experience that the Trustees have with salt marsh restoration in the state of Massachusetts is documented and highly successful. Therefore, instead of restoring the injured habitats 'in-kind' (*i.e.*, restoring injured benthic habitat with benthic habitat), the trustees believe it would be most ecologically beneficial and cost efficient to restore the injured habitats 'out-of-kind' (*i.e.*, restoring injured benthic habitat with salt marsh).

To scale an 'out-of-kind' restoration project to the injured habitat, the Trustees proposed primary production to equate one habitat to the other. For this HEA, the Trustees asserted that primary production of salt marsh is on the order of 2.5 times more productive than subtidal sediment, and therefore, which resulted in the initial calculation of 25.09 acres of restored salt marsh would be required. However, as mentioned above the settlement resulted in a $300,000 cash settlement rather than funds for a specific number or restored wetland acres.

3.0 Affected Environment

This chapter presents a brief description of the physical, biological, and cultural environment for the waterways and ecosystems adjacent to the Former Coal Tar Processing Facility Site as required by NEPA (42 U.S.C. Section 4321, et seq.). Natural resource injuries occurred within the Mystic River basin. Restoration activities will within the same area or nearby coastal watershed with similar conditions.

3.1 The Physical Environment

The Island End River lies adjacent to the FCTPF. It has an area of 29 acres and a length of 0.5 miles. Freshwater flows into the Island End River via stormwater runoff including an upstream outfall pipe that catches much of the city's drainage. The west bank of the river (where the FCTPF was located) is primarily surrounded by industrial facilities, and most of the shoreline is hardened. The east bank consists primarily of intertidal mudflats.

3.2 The Biological Environment

While there is limited information on the fisheries usage of the Island End River, it is potentially habitat for all species found in the Mystic River, since species using the Mystic River could travel up the Island End River. Alewife (*Alosa pseudoharengus*) migrates up the Mystic River each year in April and May, and spawns in the Mystic Lakes. Winter flounder

(*Pseudopleuronectes americanus)*, bluefish (*Pomatomus saltatrix)*, striped bass (*Morone saxatilis)*, and possibly juvenile lobster *(Homarus americanus)* may, on occasion, move into the Island End River. Presently, the benthic community is very stressed relative to other Boston Harbor areas; hence, most of these fish may avoid the Island End River due to the resulting lack of food. The Island End River has soft-shell clam beds that have been closed due to bacterial contamination. There are limited areas of wetland remaining along the Island End and Mystic Rivers. The area is inhabited by invertebrates including shellfish which provide food for transitory finfish species.

3.3 The Cultural and Human Environment

The Island End River houses a marina on the Chelsea side of its shores, and supports recreational boating and occasional fishing. The Island End River is not generally used for recreational fishing because the numbers of fish are low. These reduced numbers reflect the subtidal sediment contamination caused by the FCTPF site. Winter flounder and other fish tend to avoid the area because of the lack of food (reduced benthic animal populations) and because of the oily nature of the sediments.

The Island End River adjacent to the FCTPF site is part of the Mystic River Designated Port Area. The area has been subject to extensive development and industrialization, and is not known to contain any historic resources.

3.4 Threatened and Endangered Species

There are no known threatened or endangered species in the Island End River (NHESP, 2003).

3.5 Essential Fish Habitat

The Magnuson-Stevens Act (including 1996 amendments) strengthened the ability of the National Marine Fisheries Service (NMFS) and the New England Fishery Management Council, Mid-Atlantic Fishery Management Council, and South Atlantic Fishery Management Council to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat" and is broadly defined by NMFS to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Act requires the Councils to describe and identify the essential habitat for the managed species, minimize to the extent practicable adverse effects on EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of EFH. The Act also establishes measures to protect EFH. The NMFS must coordinate with other federal agencies to conserve and enhance EFH, and federal agencies must consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Additionally, NMFS must provide recommendations to federal and state agencies on such activities to help conserve EFH. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from actions or proposed actions authorized, funded, or undertaken by that agency.

The Island End River is a tidal tributary of the Mystic Harbor, which is part of the Boston Inner Harbor system. Boston Inner Harbor has been designated as Essential Fish Habitat (EFH) for 26

commercially-important fishery species (NMFS, 2005), as defined under the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.). The shallow water areas of the Island End River serve as important spawning, foraging, shelter and juvenile development habitat areas for species such as winter flounder (Pseudopleuronectes americanus), bluefish (Pomatomus saltatrix), striped bass (Morone saxatilis), and alewife (Alosa pseudoharengus).

4.0 The Restoration Planning Process

The objective of the restoration planning process is to identify restoration alternatives to restore, rehabilitate, replace or acquire natural resources and their services equivalent to natural resources injured or lost as a result of the release of hazardous substances. The restoration planning process may involve two components: primary restoration and compensatory restoration.

Primary restoration actions are actions designed to assist or accelerate the return of resources and services to their pre-injury or baseline levels. In contrast, compensatory restoration actions are actions taken to compensate for interim losses of natural resources and services, pending return of the resources and their services to baseline levels.

For the Island End River injury, remedial actions undertaken at the Site should protect natural resources in the vicinity of the Site from further or future harm and allow natural resources to return to pre-injury or baseline conditions within a reasonable period of time. Since appropriate on-site restoration and mitigation was performed as part of the remedial actions at the Site, it was unnecessary for the Trustees to plan for primary restoration. Accordingly, this Draft RP/EA addresses only compensatory restoration.

4.1 Restoration Alternatives

Because contaminants from the FCTPF potentially impacted commercially and recreationally important fishery species and their habitat in the Island End River, NOAA sought restoration alternatives that would benefit these species and their habitat within the same region. The fish habitat injury (*i.e*., injury to the surface waters and sediments of the Island End River) began at the time of Site releases and continued until remedial actions at the Site were completed. Compensatory restoration will serve to make the public whole for resources lost between the time the injury began and completion of the remedial actions at the Site. Restoring the same or ecologically similar resource within the same region as the injured communities can provide compensation for the interim loss of ecological services.

In order to identify sites and evaluate restoration alternatives, NOAA conducted a site selection process using the best available information from local, state and federal sources. Eight restoration alternatives have been identified based on the selection criteria, including a No Action alternative, as required under NEPA. The preferred restoration alternative is described in section 5.1. Details of the projects considered by the Trustees, but deemed not appropriate or not feasible, are listed in Appendix A of this document. These alternatives were considered in conjunction with the alternatives analysis conducted as part of the RAM mitigation process, in order to take advantage of economies of scale. With the No Action alternative, NOAA would

take no direct action to restore the natural resource injuries or compensate for lost services pending environmental recovery, and so would rely only on natural recovery and resource management conditions to occur. The No Action Alternative is the primary restoration alternative that all other alternatives are compared to. NOAA must decide if the cost and effort of undergoing compensatory restoration is more beneficial to the injured resource than simply allowing the injured area to recover on its own.

4.2 Evaluation Criteria

Consistent with the NRDA regulations, the following criteria were used to evaluate restoration project alternatives and identify the project preferred for implementation under this plan:

The extent to which each alternative is expected to meet the Trustees' restoration goals and objectives: The primary goal of any compensatory restoration project is to provide a level and quality of resources and services comparable to those lost due to the assessed injuries. In meeting that goal, the Trustees consider the potential relative productivity of the habitat to be restored and whether the habitat is being created or enhanced. Proximity to the injury and future management of the restoration site are also considered because management issues can influence the extent to which a restoration action meets its goals.

The cost to carry out the alternative: The benefit of a project relative to its cost is a primary factor in evaluating restoration alternatives. Factors that can affect and increase the costs of implementing the restoration alternatives may include project timing, access to the restoration site (*e.g.,* with heavy equipment or for public use), acquisition of state or federal regulatory permits, acquisition of land necessary to complete a project, measures necessary to provide for long-term protection of the restoration site, and the potential liability from project construction.

The likelihood of success of each project alternative: Trustees consider technical factors that represent risk to successful project construction, project function, or long-term viability and sustainability of the restored habitat. Alternatives that are susceptible to future degradation or loss through contaminant releases or erosion are considered less or non viable. Trustees also consider whether difficulties in project implementation are likely and whether any long-term maintenance of project features is likely to be necessary and/or feasible.

The extent to which each alternative will avoid collateral injury to natural resources as a result of implementing the alternative: Restoration actions should not result in additional losses of natural resources and should minimize the potential to affect surrounding resources during implementation. Projects with no or minimal potential to adversely impact surrounding resources are generally viewed more favorably. Compatibility of the project with the surrounding land use and potential effects on endangered species are also considered.

The extent to which each alternative benefits more than one natural resource or service: This criterion addresses the inter-relationships among natural resources, and between natural resources and the services they provide. Projects that provide benefits to more than one resource and/or yield more beneficial services overall, are viewed more favorably. For example, although recreational benefits are not an explicit objective in this Draft DARP/EA, the potential for a

restoration project to enhance recreational use of an area (e.g., recreational fishing or wildlife photography) is considered favorably.

<u>The effect of each alternative on public health and safety</u>: Projects that would negatively affect public health or safety are not appropriate.

The NRDA regulations give Trustees discretion to prioritize these criteria and to use additional criteria as appropriate. In developing this Draft RP/EA, NOAA gave the first two criteria listed primary consideration since they are paramount to ensuring that the restoration action will compensate the public for the injuries attributable to Site releases.

5.0 Evaluation of Reasonable Range of Restoration Alternatives

The Trustees' review of restoration alternatives considered both geography and habitat type with the goal of replacing wetland functions and values in relatively close proximity to the area of impact in the Island End River. The analysis initially focused on restoration opportunities in the IER and then expanded geographically. Where on-site or adjacent sites lacked opportunity, the search was expanded to the watershed. When applicable sites were not available in the watershed, a review was conducted in immediately adjacent watersheds.

The following section provides information on those restoration alternatives which were originally vetted by the Trustees, using the evaluation criteria described in section 4.2. Although the Trustees deemed the following alternatives unsuitable as the preferred restoration alternative, they are presented here for comparison purposes. The table below summarizes the alternatives analysis and significantly more detail about the alternatives analysis can be found in Appendix A.

Table 1. Summary of restoration alternatives considered

Alternative	Attributes	Conclusion
Island End River	Developed shoreline, maritime industrial uses	No feasible sites
Tidal Mystic River	Developed shoreline, maritime industrial uses	No feasible sites
Monsanto Site	Contaminated soils, privately owned	Not feasible
Earhart Dam Locking Protocol	Owned and operated by DCR, restricts tidal and salt flow upstream	Not feasible due to ownership; does not mitigate for winter flounder
Malden River Sites	Freshwater wetlands, fill, buried streams, *Phragmites*	Potentially feasible but will not mitigate for winter flounder; likely to create more *Phragmites* without long-term maintenance

Inner Boston Harbor	Developed shoreline, maritime industrial uses	No feasible sites
No Action	Would not result in compensation for lost aquatic functions and values	Deemed inappropriate because the Trustees recovered funds which must be used to restore, replace or acquire aquatic resources.
Oak Island (preferred)	Hydrology constraints to salt marsh function and value	Feasible resulting in restoration of winter flounder nursery habitat

potential sites in the Mystic River watershed are either infeasible due to contamination (e.g., Monsanto Site) or pose serious implementation problems due to the presence of the Earhart Dam. The Massachusetts Department of Conservation and Recreation determines operating and locking protocols at the Earhart Dam, which may facilitate the passage of anadromous fish, but not marine species such as winter flounder. While the Malden River sites may be feasible, they do not present opportunities to restore winter flounder habitat. The No Action alternative was deemed inappropriate because the settlement funds were explicitly targeted at restoring, acquiring or replace wetland habitat.

With extensive detail provided in Appendix A, the alternatives review evaluated opportunities in the Island End River/Mystic River, Malden River, and adjacent coastal watersheds. Identifying restoration alternatives in this heavily developed and industrialized area is a challenge. No meaningful mitigation opportunities for replacing the affected habitat were identified in or along the Island End River itself. Therefore the preferred restoration alternative is "offsite". Opportunities for replacing marine habitat functions and values in the watershed are limited due to the extensively developed and heavily utilized shoreline downstream and the abrupt termination of marine habitats upstream as the result of the Amelia Earhart Dam. Restoration opportunities exist in the Malden River upstream of the dam; however, these opportunities are not representative of the marine habitats impacted by the injury. Significant opportunities for replicating marine habitats do exist in the nearby Rumney Marsh, which has been impacted historically by a variety of transportation and development-related activities. While out of the watershed, wetland restoration in the Rumney Marshes Area of Critical Environmental Concern (ACEC) is most appropriate for replacing the marine wetland functions and values that were be impacted by the release. This alternatives analysis was completed by the RP in a cooperative process with the Trustees in association with their need to identify compensatory mitigation for the impacts associated with their remedial actions and is applicable to the needs of this RP/EA.

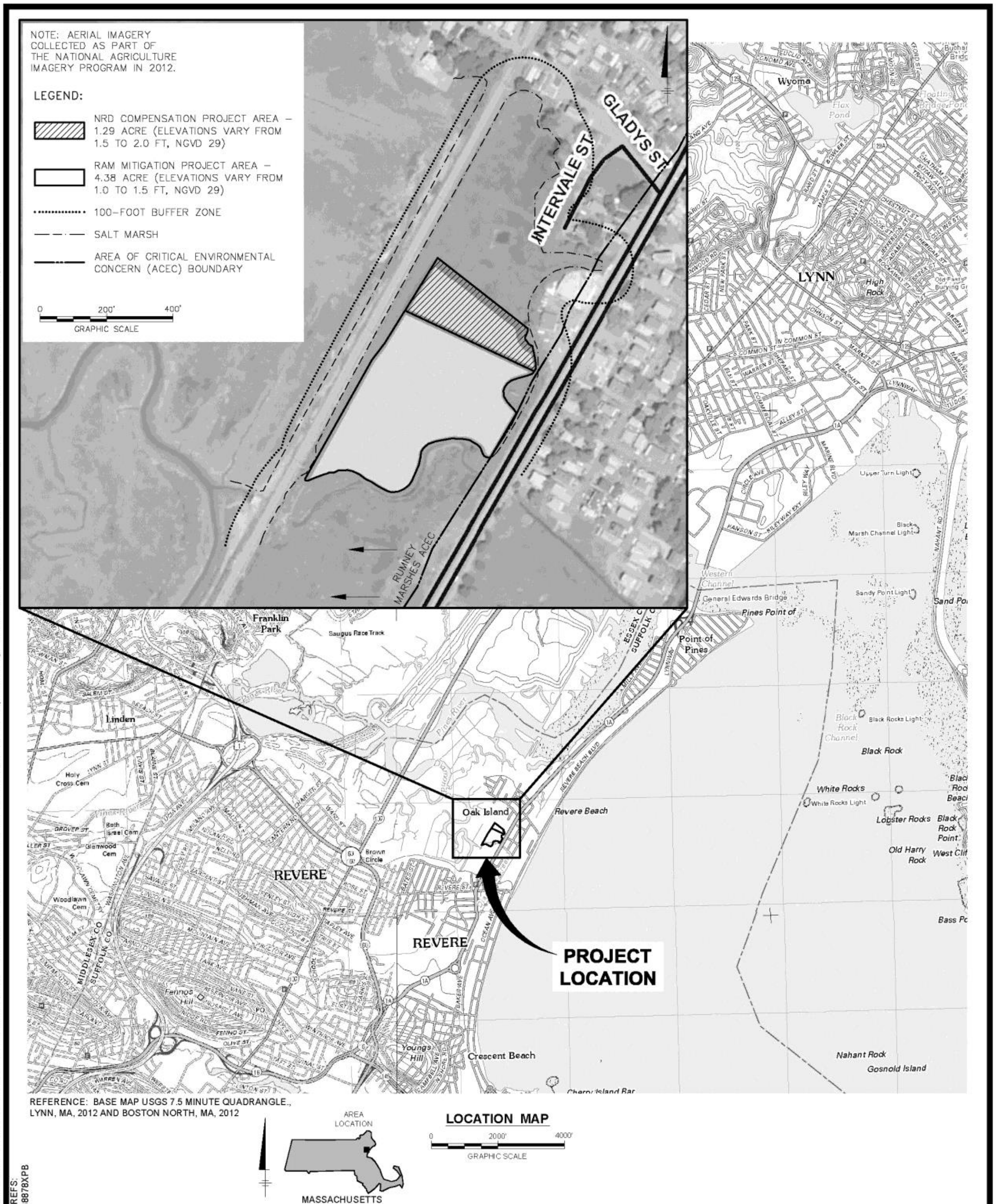
5.1 Preferred Restoration Alternative: Oak Island Salt Marsh Restoration, Revere, MA

This alternative is a project to restore salt marsh habitat to address winter flounder and other fish species injuries resulting from Site releases. Details about the preferred alternative as well as non-prefered alternative can be found in Appendix A.

5.1.1 Restoration Site Location and Characteristics

Oak Island site is a 20-acre site (See Figure #1) located in the city of Revere, Massachusetts, which abuts Everett to the northeast. It is part of the 2,600 acre Rumney Marshes Area of Cr

Figure 1



PURPOSE:
SALT MARSH RESTORATION FOR RELEASE ABATEMENT MEASURE MITIGATION PROJECT

ARCADIS
6723 TOWPATH ROAD
P.O. BOX 66
SYRACUSE, NY 13214–0066
TEL: 315.446.9120

SITE LOCATION AND ACEC

APPLICATION BY: KHB VENTURE, LLC.

RELEASE ABATEMENT MEASURE MITIGATION PROJECT

IN: OAK ISLAND
AT: REVERE, SUFFOLK COUNTY, MASSACHUSETTS

SHEET 1 OF 13 DATE: 12/07/12

itical Environmental Concern (ACEC), an area historically dominated by vegetated wetlands that has been degraded due to filling, dumping and ditching. Rumney Marsh has been the focus of targeted restoration supported by a variety of local, state and federal agencies, and has been identified by the U.S. Fish and Wildlife Service as one of the most significant coastal areas of biodiversity in Massachusetts. A fisheries survey of Rumney Marsh conducted by the Massachusetts Division of Marine Fisheries in 1968-69 documented 20 fish species in the marsh and associated waterways (Chesmore et al., 1972). Estuarine species such as Atlantic silversides, mummichogs, striped killifish and threespine stickleback were most abundant, but anadromous fish including alewives and rainbow smelt were also present. In addition, significant numbers of immature winter flounder were collected, indicating that the Rumney Marsh ACEC is an important nursery area for immature winter flounder.

The Oak Island site, located on the eastern edge of the ACEC between the MBTA railroad tracks and Route 1A, has been targeted as a restoration priority because it has several large areas of salt marsh to which tidal flow has been restricted due to the roadway and railroad crossings. Such tidal flow restriction has led to proliferation of the common reed *(Phragmites australis)*, an invasive plant that negatively impacts natural salt marsh habitats. Historic filling has increased the marsh elevation, further contributing to growth of the common reed which prefers less saline habitats. The combined impacts of restricted flow, artificially high marsh elevation and presence of common reed have led to a decline in the quantity and quality of habitat available for estuarine fish species.

In 2004, the City of Revere, assisted by state and federal agencies, installed a self-regulating tidegate and new culvert under the MBTA railroad tracks to enhance tidal flow into the upstream salt marsh. During the spring and summer of 2005, minor adjustments were made to the tidegate to maximize flooding elevation in the marsh without flooding nearby private property. The increased tidal flow allowed some additional flooding of the upstream salt marsh, but the benefits have been limited by the presence of historic fill. In addition, not long after installation, the 2004 tidegate malfunctioned and was subject to vandalism. A redesigned electrically-operated tidegate was installed in the fall of 2010.

Approximately 4.38 acres of the Oak Island site north of Diamond Creek was restored in the fall of 2013 as mitigation for EFH impacts sustained during the construction of the RAM in Island End River. The EFH mitigation project involved excavating some of the historic fill to reestablish a natural marsh elevation and allow the marsh surface to be flooded by the incoming tide on a regular basis.

The Trustees propose to commit the restoration funds towards the completion of approximately 1.2 acres of salt marsh restoration adjacent to Oak Island in Revere, Massachusetts. As mitigation for the impact to the environment resulting from necessary remedial activities at the FCTPF site, the RPs restored 4.38 acres of salt marsh in an adjacent parcel, so planning, designing, and obtaining permits for the mitigation and the proposed restoration activities as one project allows the parties to take advantage of the efficiencies of scale. Keyspan, Honeywell, and Beazer East, voluntarily expanded the scope of their planning, project design, and permitting efforts for the mitigation project in a good faith effort to partner with NOAA and the Commonwealth to accomplish the restoration of approximately 1.2 additional acres of the north

parcel of Oak Island, a significant urban estuary. Construction designs, permits and approvals are all in place for completion of the preferred alternative.

5.1.2 Restoration Action Description

This alternative involves the removal of fill from approximately 1.2 acres of the north parcel of Oak Island (See Figure #2). The fill removal and re-grading of the marsh platform will expand the area subject to tidal flow and increase the salinity to the detriment of common reed and the benefit of natural salt marsh vegetation. These actions will in turn benefit estuarine fish and wildlife species that depend on tidal flow and a diversity of marsh vegetation zones. Once the fill is removed, the water level can be further controlled through a newly installed tide gate to ensure adequate tidal flushing. Planting is not required, since *Spartina alterniflora* is already present at the site and will quickly re-establish once the necessary elevation is restored.

5.1.3 Evaluation of the Alternative

Oak Island is the nearest and most appropriate site for performing restoration, and takes advantage of economies of scale by building upon the adjacent restoration taking place as EFH mitigation for remediation activities at the FCTPF. This restoration would restore approximately 1.2 acres of tidal wetlands benefiting a diversity of fish species, including anadromous species and winter flounder that were impacted in the Island End River, while also providing for increased flood storage capacity. This would alleviate the current frequent flooding of nearby homes and infrastructure. The newly-installed tide gate at the downstream end of the site provides an additional means of regulating water levels in the marsh to maximize ecological benefits.

The No-Build Alternative would involve no excavation of sediment and soils to lower the surface of the salt marsh to an elevation which allows sufficient tidal flooding to promote the growth of salt marsh grasses. Under this alternative, the salt marsh would continue to be dominated by the invasive *Phragmites* vegetation which has very low habitat value. No benefit to the larger Rumney Marsh would be realized. The newly-installed tide gate would continue at the current water levels, which do not support salt marsh vegetation at the current soil elevations of the marsh. Public benefits derived from salt marsh colonization by native salt marsh grasses and intertial mud flats (such as enhanced microhabitat diversity, improved water quality, recolonization of native salt marsh grasses, fisheries improvements, greater flood storage capacity etc.) would not be realized.

Project Design

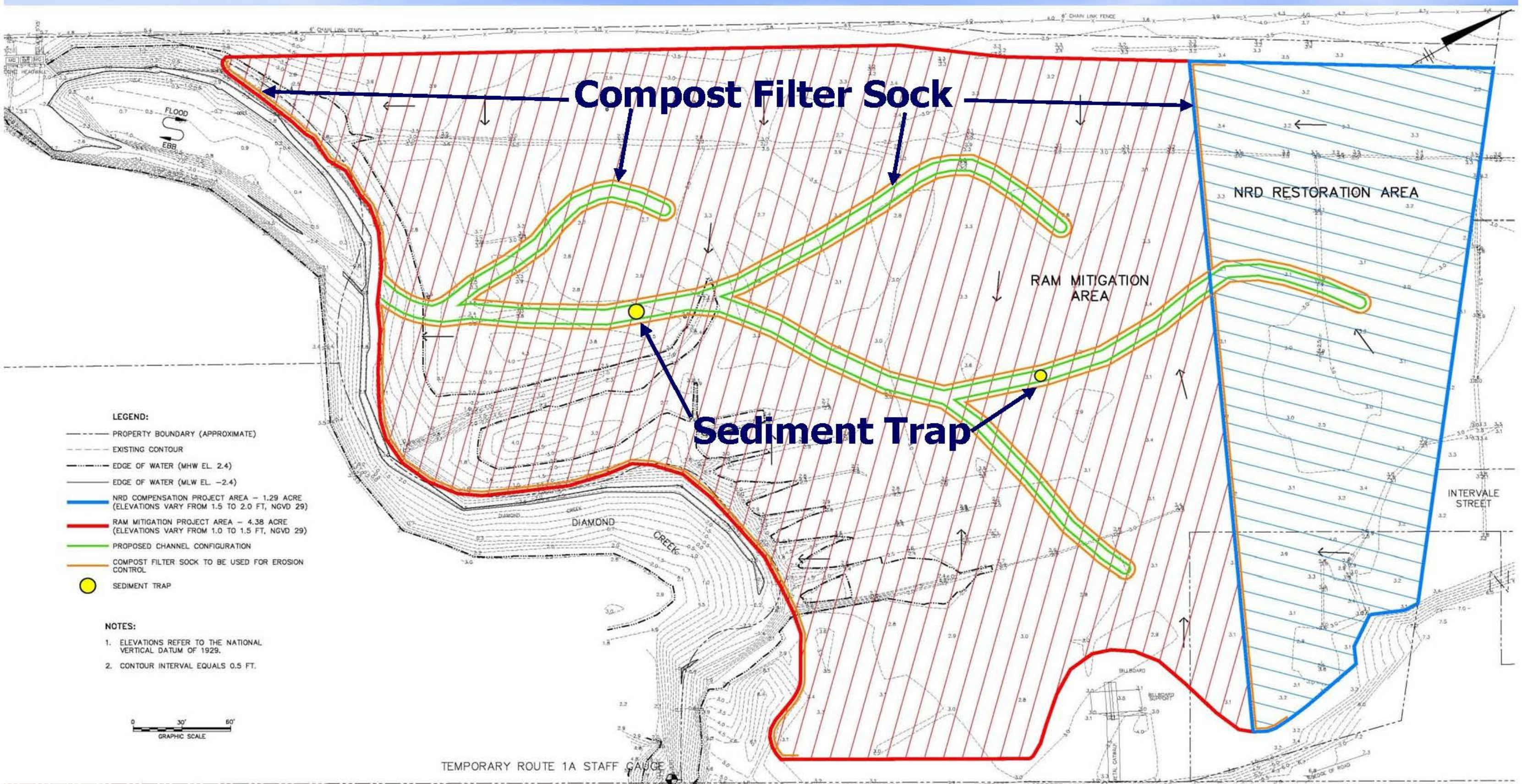


Figure 2

6.0 Environmental Consequences

Federal agencies preparing an EA must consider the direct effects of all components of a proposed action as well as indirect and cumulative effects.

Direct

According to the CEQ NEPA Regulations, direct effects are caused by the action and occur at the same time and place as the action. 40 C.F.R. 1508.8(a).

Indirect

According to the CEQ NEPA Regulations, indirect effects are caused by the action but "occur later in time or are farther removed in distance but are still reasonably foreseeable" Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate. 40 C.F.R. 1508.8(b).

Cumulative

According to the CEQ NEPA Regulations, cumulative effects are those effects that result from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes such actions.

The Trustees evaluated the potential for the proposed restoration action to impact the natural environment, the built environment and public health and safety.

Water Quality: In the short term, during the period of construction, earth moving activities will increase turbidity in the immediate vicinity of the marsh grading, though actions during construction will minimize this effect. These conditions may affect fish and filter feeders in the local area, by clogging gills, increasing mucus production and smothering organisms found in the shallow open-water area. Mobile fish and invertebrates would probably not be affected, since these would most likely leave the area, and return after project completion. After construction is completed, the sediments should generally be stable and there would be no long term water quality impact resulting from the proposed action

Water Resources: During the construction phase of this project, short-term and localized adverse impacts will occur. However, completion of this project will result in approximately 3-acre feet of additional flood storage area. There are well over 100 residential properties located in the watershed upstream of the Oak Island tide gate and any additional flood storage will minimize flood elevations and subsequent infrastructure damage during storm events.

Air Quality: Minor temporary adverse impacts would result from the proposed construction activities. Exhaust emissions from earth-moving equipment contain air pollutants, but these emissions would only occur during the construction phase of the project, the amounts would be

small, and should be quickly dissipated by prevailing winds. There would be no long-term negative impacts to air quality.

Noise: Noise associated with earth-moving equipment represents a short-term adverse impact during the construction phase. It may periodically and temporarily disturb wildlife in the immediate vicinity of the site, or cause movement of wildlife away from the site to other ecologically suitable areas. Similarly, recreating humans may avoid this area due to noise during construction, but as with wildlife, such disruption will be limited to the construction phase. . Increased noise levels due to the operation of earth-moving equipment would also cause mobile fish to leave the area until operations (the source of the noise) end. No long-term effects would occur as a result of noise during construction.

Geology: None of the components of the proposed restoration actions includes activities with the potential to directly or indirectly affect, positively or negatively, the geology of the area.

Recreation: The noise and increased turbidity of surface waters arising from earth-moving activities during project construction are expected to discourage and decrease recreational activities in the vicinity of the site during construction. Any such affect will be limited to the period of construction and should be minor. Over the longer term, the proposed restoration action will increase the quality, productivity and quantity of fish and wildlife in this area. The improvement in site conditions will enhance opportunities for, and quality of, a variety of recreational uses.

Traffic: Traffic will occur or increase at the site during the period of construction. The area and constituents most affected by the traffic will be the residents and owners of the buildings adjacent to the construction staging area. Because of the extensive traffic already present along Route 1A, increased traffic associated from the restoration efforts will likely go un-noticed.

Precedential Effects of Implementing the Project: Regrading projects are regularly implemented along the North Atlantic coast to address previous wetland filling, and have been used as a means of compensating the public for other natural resource damage claims arising in New England and Northern Atlantic. Therefore, the proposed project does not in and of itself represent or create a precedent for future settings of a type that would significantly affect the quality of the human environment.

Cumulative Impacts : Project effects will be cumulative in the sense that the re-establishment of tidal flushing and diverse salt marsh vegetation at this site will provide ecological services into the future. The proposed project is not expected to have a significant cumulative effect on the human environment since it alone, or in combination with other salt marsh restoration projects in the vicinity, should not change the larger current pattern of hydrologic discharge, economic activity or land-use in the watershed. The actions proposed are intended to compensate the public, *i.e.*, make the public and the environment whole, for resources injuries caused by releases of hazardous substances into nearby waters. The proposed restoration action is not part of any systematic or comprehensive plan for salt marsh restoration in Massachusetts or the larger Southern New England coast.

6.1 Non-Preferred Restoration Alternative: No Action

NEPA requires NOAA to evaluate a No Action Alternative, and it is also an option that can be selected under CERCLA. With the No Action alternative, NOAA would take no direct action to restore the natural resource injuries or compensate for lost services pending environmental recovery, and so would rely only on natural recovery and resource management conditions to occur. While natural recovery would occur over varying time scales for the various injured estuarine resources, the interim losses incurred would not be compensated for under the No Action Alternative. This alternative would cost the least because no action would be taken, but such savings must be weighed against the potential for recovering loss.

6.2.1 Evaluation of No Action Alternative

NOAA's responsibility to seek compensation for interim losses pending environmental recovery is clearly set forth in CERCLA, and cannot be addressed through a No Action Alternative. The No Action Alternative is rejected for compensatory restoration since substantial interim losses occurred during the period of recovery of the Site contamination. Technically feasible and cost-effective alternatives exist to compensate for these losses, and have been addressed through the project alternatives as discussed in Section 6.1.

Under the Consent Decree, the Trustees were paid $300,000 for assessment and restoration costs, which must be directed towards natural resource damage restoration.

6.3 Other Non-Preferred Alternatives Considered

Other non-preferred restoration alternatives and their associated environmental consequences and comparisons are found in Appendix A.

7.0 Environmental Compliance

Anadromous Fish Conservation Act

The Anadromous Fish Conservation Act (16 USC 757a *et seq*.) provides authority to conserve and enhance anadromous fishery resources.
Compliance: The preferred alternative will directly conserve, develop, and enhance anadromous fishery resources.

Archeological Resources and Historical Preservation

Numerous acts afford protection to antiquities, abandoned shipwrecks, archeological resources, historic buildings and historic sites. These include the Abandoned Shipwreck Act of 1987 (43 USC 2102 *et seq*.), the Archeological Resources Protection Act of 1979 (16 USC 470, *et seq*.), the Historic Sites Act of 1935 (16 USC 461-467), the Historical and Archeological Data Preservation Act (16 USC 469-469c), and the National Historic Preservation Act of 1966 as amended (16 USC 470-470t, 110). Any proposed action that may potentially affect any property with historic, architectural, archeological, or cultural value that is listed on or eligible for listing on the National Register of Historic Places (NRHP) must comply with the procedures for consultation and comment issued by the Advisory Council on Historic Preservation, usually through consultation with the state historic preservation officer.

Compliance: As part of the state and federal project permitting process NOAA coordinated with the Massachusetts Historical Commission (MHC) to identify any properties that may be affected by the preferred restoration alternative that are listed or eligible for listing on the NRHP. The proposed project was determined by NOAA to not affect any properties listed or eligible under the NHPA.

Clean Air Act

The Clean Air Act (42 USC 7401 *et seq*.) directs USEPA to set limits on air emissions to ensure basic protection of health and the environment.

Compliance: Public notice of the availability of this draft RP/EA to the Environmental Protection Agency is required for compliance pursuant to Sections 176C and 309 of the Act. All construction activity will be done with conventional equipment in compliance with all local ordinances.

Clean Water Act

The Clean Water Act (33 U.S.C. § 1251, *et seq*.) is the principal law governing pollution control and water quality of the Nation's waterways. Section 404 of the law authorizes a permit program for the beneficial uses of dredged or fill material in navigable waters. The U.S. Army Corps of Engineers (USACE) administers the program.

***Compliance**:* Coordination with the Army Corps of Engineers has been completed pursuant to Section 404 of this Act. All joint federal/state permits have been obtained for this project. All construction activity will be done in compliance with Section 404 of the law.

Coastal Zone Management Act

The goal of the federal Coastal Zone Management Act (CZMA) (16 U.S.C. § 1451, *et seq*., 15 C.F.R. Part 923) is to preserve, protect, develop and, where possible, restore and enhance the Nation's coastal resources. The federal government provides grants to states with federally approved coastal management programs. Section 1456 of the CZMA requires any federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone to be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. It states that no federal license or permit may be granted without giving the State the opportunity to concur that the project is consistent with the State's coastal policies. The regulations outline the consistency procedures.

***Compliance**:* The Trustees believe the project selected for implementation is consistent with Massachusetts CZMA programs. Consistency has been determined/obtained for the project as part of the Army Corps permitting process

Endangered Species Act

The federal Endangered Species Act (16 USC 1531, *et seq*., 50 CFR Parts 17, 222, 224) directs all federal agencies to conserve endangered and threatened species and their habitats and encourages such agencies to utilize their authority to further these purposes. Under the Act, both the National Marine Fisheries Service (NMFS) and USFWS publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these two agencies to minimize the effects of federal actions on endangered and threatened species.

Compliance: Except for occasional transient individuals, no federally listed or proposed endangered or threatened species are known to exist in the restoration project areas. In addition, no habitat in the project impact areas is currently designated or proposed as "critical habitat" in

accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended; 16 USC 1531 *et seq*.). This project underwent Endangered Species Act review by the USFWS and NMFS as part of the Clean Water Act permit process by the Army Corps of Engineers. Therefore, no Biological Assessment or further Section 7 consultation under the Endangered Species Act is required. Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered.

Estuary Protection Act
The Estuary Protection Act (16 USC 1221-1226) highlights the values of estuaries and the need to conserve natural resources. It authorizes the Secretary of the Interior, in cooperation with other federal agencies and the states, to study and inventory estuaries of the US, to determine whether such areas should be acquired by the Federal Government for protection, to assess impacts of commercial and industrial developments on estuaries, to enter into cost-sharing agreements with states and subdivisions for permanent management of estuarine areas in their possession, and to encourage state and local governments to consider the importance of estuaries in their planning activities related to federal natural resource grants.
***Compliance**:* The restoration activities will enhance estuarine, marine, and anadromous fish populations and thus benefit estuarine resources.

Fish and Wildlife Conservation Act
The Fish and Wildlife Conservation Act of 1980 (16 USC 2901 and 50 CFR 83) provides for the consideration of impacts on wetlands, protected habitats and fisheries.
Compliance: The Trustees believe the restoration project will enhance habitats and survivorship, thereby benefiting natural resources. Coordination with FWS, NMFS and MA fish and wildlife agencies signifies compliance with this Act.

Fish and Wildlife Coordination Act
The Fish and Wildlife Coordination Act (16 USC 661, *et seq*.) states that wildlife conservation shall receive equal consideration with other features of water-resource development. The Act requires federal permitting and licensing agencies to consult with NMFS, USFWS, and state wildlife agencies before permitting any activity that in any way modifies any body of water to minimize the adverse impacts of such actions on fish and wildlife resources and habitat.

Compliance: NOAA has worked cooperatively with the USFWS and MA Department of Fish and Game to evaluate various restoration projects and in selecting the preferred alternative (s). The preferred alternative (s) is not expected to have any long-term adverse affects on fish and wildlife resources habitat and is expected to result in long-term or permanent beneficial impacts to fish and wildlife resources by enhancing marine, estuarine and anadromous fish populations. Coordination with the NMFS was completed as part of the federal Clean Water Act permitting process by the Army Corps of Engineers.

Magnuson-Stevens Fishery Conservation and Management Act
The Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801, *et seq*.) as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297), established a program to promote the protection of essential fish habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to

affect such habitat. After EFH has been described and identified in fishery management plans (FMPs) by regional Fishery Management Councils, federal agencies are obligated to consult with the Secretary of the U.S. Department of Commerce with respect to any action authorized, funded, or undertaken or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH.
Compliance: The Trustees evaluated and coordinated restoration designs with the NMFS Greater Atlantic Region prior to project implementation to comply with the EFH provisions of the MSA. Construction related impacts were considered minimal and not forml EFH recommendations were provided as part of the Clean Water Act permitting process other than a time of year restriction to minimize turbidity impacts to juvenile winter flounder.

Marine Mammal Protection Act
The Marine Mammal Protection Act (16 USC 1361, *et seq*.) establishes a moratorium on the taking and importation of marine mammals and marine mammal products, with exceptions for scientific research, allowable incidental taking, subsistence activities by Alaskan natives, and hardship. The Act provides authority to manage and protect marine mammals, including maintenance of the ecosystem.
Compliance: No interaction with marine mammals in the area of the proposed restoration is expected. The proposed restoration project will have no adverse effects on marine mammals.

Migratory Bird Treaty Act
The Migratory Bird Treaty Act (16 USC 715, *et seq*.) provides for the protection of migratory birds. The Act does not specifically protect the habitat of these birds but may be used to consider time of year restrictions for remedial activities on sites where it is likely migratory birds may be nesting and/or to stipulate maintenance schedules that would avoid the nesting seasons of migratory birds.
Compliance: Consultation with the USFWS constitutes compliance with this Act. If restoration construction activities are deemed to adversely impact migratory birds, time of year restrictions will be issued for these activities.

National Environmental Policy Act
The purpose of the proposed action is to restore natural resources injured, lost or destroyed within the Former Coal Tar Processing Facility Superfund Site and a portion of the surrounding properties in Middlesex County, Everett, Massachusetts, due to releases of hazardous substances and subsequent response actions to address the releases. The need to pursue such actions is based upon the implementing regulations of CERCLA. CERCLA establishes liability for the injury to, destruction of, or loss of natural resources caused by releases of hazardous substances. Damages recovered for those losses must be used to restore, replace, rehabilitate or acquire equivalent natural resources or services, in accordance with a restoration plan developed by designated natural resource trustees.

Congress enacted the National Environmental Policy Act (NEPA; 42 USC 4321 *et seq*.) in 1969 to establish a national policy for the protection of the environment. NEPA applies to federal agency actions that affect the human environment. Federal agencies are obligated to comply with NEPA regulations adopted by the Council on Environmental Quality (CEQ). NEPA requires that an Environmental Assessment (EA) be prepared in order to determine whether the proposed

restoration actions will have a significant effect on the quality of the human environment. If an impact is considered significant, then an Environmental Impact Statement (EIS) will be prepared. If the impact is considered not significant, then a Finding of No Significant Impact (FONSI) is issued.
Compliance: NOAA has integrated this Restoration Plan and Environmental Assessment to summarize current environmental conditions, describe the purpose and need for a restoration action, identify alternative restoration activities, assess their applicability and environmental consequences, and summarize opportunities for public participation on the decision-making process.

Rivers and Harbors Act
The Rivers and Harbors Act (RHA; 33 USC 401, *et seq.*) regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the USACE with authority to regulate discharges of fill and other materials into such waters.
Compliance: Restoration actions that require Section 404 Clean Water Act permits are likely also to require permits under Section 10 of the RHA. However, a single permit usually serves for both. Therefore, NOAA can ensure compliance with the RHA through the same mechanism. These restoration activities were addressed under Rivers and Harbors Act permit issued by the Army Corps of Engineers.

Executive Order 11514 Protection and Enhancement of Environmental Quality, as amended by Executive Order 11911 Relating to Protection and Enhancement of Environmental Quality
Executive Orders 11514 and 11991 require that federal agencies monitor, evaluate and control their activities to protect and enhance the quality of the Nation's environment to sustain and enrich human life; inform the public about these activities; share data gathered on existing or potential environmental problems or control methods; and cooperate with other governmental agencies.
Compliance: Releasing the draft restoration plan and environmental assessment for public comment fully addresses the intent of the Executive Order.

Executive Order 11988 Floodplain Management
Executive Order 11988 is a flood-hazard policy requiring federal agencies to take action to reduce the risks of flood losses; to restore and preserve the natural and beneficial values served by floodplains; and to minimize flood impacts on human safety, health, and welfare.
Compliance: Floodplain impacts have been considered prior to the selection of the preferred restoration activities and their implementation is not expected to have any adverse impacts on floodplains.

Executive Order 11990 Protection of Wetlands
Executive Order 11990 (40 CFR 6392 (a) and Appendix A) requires federal agencies to avoid the adverse impacts associated with the destruction or loss of wetlands, to avoid new construction in wetlands if alternatives exist, and to develop mitigative measures if adverse impacts are unavoidable.
Compliance: The preferred restoration activities will result in the restoration of high quality wetlands once dominated by the invasive plant *Phragmites* and largely cut off from regular tidal

flushing. The preferred restoration actions are in compliance with, and fully address, the intent of the Executive Order.

Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations and Executive Order 12948 Amendment to Executive Order No. 12898

Executive Orders 12898 and 12948 require each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority and low-income populations.

Compliance: NOAA has concluded that no low income or ethnic minority communities would be adversely affected by implementing the preferred restoration activities.

Executive Order 12962 Recreational Fisheries

Executive Order 12962 requires that federal agencies, to the extent permitted by law and where practicable, and in cooperation with states and tribes, improve the quantity, function, sustainable productivity, and distribution of the Nation's aquatic resources for increased recreational fishing opportunities.

Compliance: The preferred restoration activities will enhance marine, estuarine and anadromous fish populations, and contribute to improving recreational fisheries.

Executive Order Number 13112 Invasive Species

The purpose of Executive Order 13112 is to prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Compliance: The preferred restoration project includes the removal of the invasive wetland plant *Phragmites* through earth moving and regrading of the marsh surface. Construction activities will not cause or promote the introduction or spread of invasive species. The lowering of the marsh elevation and increased tidal flushing will additionally control the spread of *Phragmites*.

8.0 Literature Cited

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Long, E.R., L.J. Field,and D.D. MacDonald. 1998. Predicting toxicity in marine sediments with numerical sediment quality guidelines. Environmental Toxicology and Chemistry 17: 714-727.

Natural Heritage and Endangered Species Program (NHESP). 2003. Massachusetts Natural Heritage Atlas. 11th Edition. Part 1 – Eastern Massachusetts. July 1, 2003.

National Marine Fisheries Service (NMFS). 2005. Designation of Essential Fish Habitat. http://www.nero.noaa.gov/hcd/index2a.htm

9.0 Agencies, Organizations and Parties Consulted

City of Revere, Revere, MA
MA Department of Conservation and Recreation, Boston, MA
MA Department of Ecological Restoration, Boston, MA
USEPA, Boston, MA
MA Historic Commission, Boston, MA
MA DEP, Boston, MA
NOAA/ NMFS, Office of Habitat Conservation, Gloucester, MA
NOAA Restoration Center, Gloucester, MA

10.0 List of Preparers

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Appendix A: Additional Restoration Alternatives Initially Vetted

Appendix A

Attachment G

Mitigation Plan

Mitigation Plan

Release Abatement Measure

Island End River, Everett and Chelsea, MA

Section 10/401/404 U.S. Clean Water Act (33 USC 1344)

Prepared for:

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c/o Harvard Project Services
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October 27, 2005

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EXECUTIVE SUMMARY

KHB Venture, LLC (Proponent) is proposing to implement a Release Abatement Measure (RAM) under the Massachusetts Contingency Plan (310 CMR 40.0000 et. seq.) (MCP) for portions of the Island End River (IER) in Everett and Chelsea, MA (the "Project"). The purpose of the Project is to achieve three fundamental and related objectives for sediments in the IER: (1) to eliminate conditions of substantial hazard as defined in the MCP; (2) to eliminate or substantially control the chronic appearance of sheens in the portion of the IER proximate to the Former Coal Tar Processing Facility (FCTPF); and (3) to achieve a Class C Response Action Outcome under the MCP. The Project proposes to dredge and remove approximately 72,000 cubic yards of sediment in the river and dispose of the majority of the sediment in a Confined Disposal Facility ("CDF") along the western shoreline of the IER within the Mystic River Designated Port Area. The CDF will result in the filling of 1.9 acres of primarily subtidal lands. To mitigate for the unavoidable adverse impacts of the CDF, the Proponent will undertake wetland mitigation to replicate for the loss of wetland functions and values.

The Proponent has undertaken a broad assessment of potential opportunities to address the Project's wetland mitigation objectives, which are to compensate for lost wetland functions in the IER. The most recognized wetland function that will be impacted by the CDF is potential winter flounder spawning and juvenile development habitat. Due to the developed nature and current marine industrial uses of the Project area, no mitigation opportunities exist within the IER and the Mystic River. However, the nearby Rumney Marshes provide excellent prospects for wetland mitigation due to extensive salt marsh habitat and history of filling. As a precedent, the Central Artery Project conducted wetland mitigation in the Rumney Marshes to compensate for wetland impacts associated with that project. After extensive discussions with wetland restoration experts from state and federal agencies, the Proponent has selected the Oak Island site in the Rumney Marshes of the City of Revere as the best candidate to fulfill the Project's wetland mitigation objectives.

This mitigation plan describes the Proponent's assessment of wetland mitigation opportunities. It demonstrates that potential sites in the Mystic River watershed are infeasible either due to contamination (e.g., the Monsanto Property) or lack of practical ability to implement due to the presence of the Earhart Dam. The state Department of Conservation and Recreation determines operating and locking protocols at the Earhart Dam, which may facilitate the passage of anadromous fish but not marine species such as winter flounder. While the Malden River sites may be feasible, they do not present opportunities to restore winter flounder habitat. Conversely, the Department of Marine Fisheries' 1972 Monograph of Lynn-Saugus Harbor concluded that small, immature winter flounder utilize the shallower waters of the salt marsh system like those found at the Oak Island site.

Consistent with general federal policy and with more specific guidance received from the USACE and resource agencies connected to this Project, Oak Island is the best practicable mitigation alternative.

Summary Table of Restoration Alternatives and Attributes

Alternative	Attributes	Conclusion
Island End River	Developed shoreline, maritime industrial uses	No feasible sites
Tidal Mystic River	Developed shoreline, maritime industrial uses	No feasible sites
Monsanto Site	Contaminated Soils, privately owned	Not feasible
Earhart Dam Locking Protocol	Owned and Operated by DCR, restricts tidal and salt flow upstream	Not feasible due to ownership; does not mitigate for winter flounder
Malden River Sites	Freshwater wetlands, fill, buried streams, Phragmites	Potentially feasible, but will not mitigate for winter flounder, likely to create more Phragmites w/o long-term maintenance
Inner Boston Harbor	Developed shoreline, maritime industrial uses	No feasible sites
Oak Island	Filled Salt Marsh	Feasible resulting in restoration of winter flounder nursery habitat

1.0 INTRODUCTION

In conjunction with its Section 10/404 Permit Application for a Release Abatement Measure (RAM) for portions of the Island End River (IER) in Everett and Chelsea, MA (the "Project"), KHB Venture, LLC (Proponent) respectfully submits this Mitigation Plan (see Figure 1). The Project is being undertaken as a RAM under the Massachusetts Contingency Plan (310 CMR 40.0000 et. seq.) (MCP), and is intended to achieve three fundamental and related objectives for sediments in the IER: (1) to eliminate conditions of substantial hazard as defined in the MCP; (2) to eliminate or substantially control the chronic appearance of sheens in the portion of the IER proximate to the Former Coal Tar Processing Facility (FCTPF); and (3) to achieve a Class C Response Action Outcome (RAO) under the MCP (the "RAM Objectives").

As detailed below, the Project will lead to some loss of degraded wetland resource areas. This Mitigation Plan describes these wetland impacts, mitigation alternatives, and a proposal for mitigating the loss of wetland functions and values resulting from the Project.

1.1 Project Description

The Project consists of the following elements, presented essentially in the order in which they would be completed:

- Construction of an approximately 1.9-acre Confined Disposal Facility ("CDF") along the western shoreline of the IER (1.8 acres of which will be below present Mean High Water) within the Mystic River Designated Port Area (DPA) (see Figure 2);
- Stabilization of sediment within the CDF footprint to reduce the mobility of contaminants and to provide structural integrity for the CDF itself;
- Dredging and removal of approximately 72,000 cubic yards ("CY") of sediment adjacent to the CDF footprint;
- Processing dredged sediment along the western shoreline of the IER in proximity to the CDF but outside the USACE jurisdictional area;
- Transportation of approximately 20,000 CY of processed sediment to an approved off-site upland disposal facility;
- Placement of the remaining processed sediment (approximately 52,000 CY) into the CDF; and
- Placement of a 1-foot-thick layer of sand in the dredged area to provide a sandy bottom and to stabilize the dredge footprint.

The Project represents the proposed full-scale implementation of a Pilot Program previously reviewed and approved by the USACE, which was conducted in September 2004. Information and experience gained as a result of the Pilot Program have informed the

content of this application, which sets forth the basis for a finding that the Project is consistent with applicable provisions of the Section 404(b)(1) Guidelines, the Massachusetts Coastal Zone Management ("MCZM") Policies, and Section 106 of the National Historic Preservation Act.

1.2 Loss of Subtidal and Intertidal Areas

The Project will fill subtidal area (53,856 square feet [sf]) and intertidal area (24,728 sf, inclusive of a small area of tidal flat seaward of the existing Hoesch Wall). The existing bulkhead will also be filled; however, conditions associated with it will be replicated by a new bulkhead. In general, the Project will significantly improve environmental conditions in the IER. Dredging and capping with clean sand will improve sediment and water column habitat quality and substantially reduce marine life's risk of exposure to toxic chemicals. Construction of the CDF in the nearshore will effectively isolate sediment containing the highest PAH concentrations, negating the need to dredge this material and greatly reducing the risk of releases into the water column during dredging and to the air during sediment handling and processing. The proposed actions also support the DPA status of this segment of the IER.

While important environmental improvements will occur as a result of the Project, the Proponent recognizes that wetland functions and values will be lost to accommodate sediment disposal in a CDF, and wetland mitigation to replace lost wetland functions and values is appropriate.

1.3 Purpose of Report

Section 2.0 provides a Wetland Functions and Values Assessment of the wetlands to be affected by the Project.

Section 3.0 describes the mitigation alternatives and proposal for compensatory mitigation.

2.0 WETLAND FUNCTION AND VALUE ASSESSMENT

Wetland functions are defined as a process or series of processes that take place in a wetland. Wetland values are the benefits that wetlands provide to people and the environment. *The Highway Methodology Workbook Supplement: Wetland Functions and Values, A Descriptive Approach* (The Workbook Supplement) (USACE, 1999) provides guidance for assessing wetland functions and values. The Workbook Supplement identifies eight (8) functions and five (5) values potentially provided by wetland resource areas. These functions and values are:

- Groundwater Recharge/Discharge;
- Floodflow Alteration;
- Fish and Shellfish Habitat;
- Sediment/Toxicant Retention;
- Nutrient Removal;
- Production Export;
- Sediment/Shoreline Stabilization;
- Wildlife Habitat;
- Recreation;
- Educational/Scientific Value;
- Uniqueness/Heritage;
- Visual Quality/Aesthetics; and
- Endangered Species Habitat.

The Workbook Supplement also indicates that Functions and Values can be "principal" if they are an important component of a wetland ecosystem function and/or are considered of special value to society from local, regional, and/or national perspectives.

The following section describes each of these wetland functions and values and identifies those functions and values that may be affected by the Project.

2.1 Wetland Functions and Values Description

The following is a list of wetland functions and values with descriptions summarized by the USACE in the Workbook Supplement.

Groundwater Recharge/Discharge

This function considers a wetland's ability to provide groundwater recharge and discharge characteristics. Specific attributes to consider for this function include the presence of gravelly or sandy soils, signs of groundwater discharge, quality of groundwater and existence of water supply resources.

Floodflow Alteration

This function considers the wetland's effectiveness in providing buffering and storage capabilities to reduce effects from watershed flooding. Specific attributes to consider for this function include proximity of the wetland in the watershed, presence of hydric soils and vegetation to retain flood waters, flat topography with flood storage capabilities, and existence of structures and property downstream.

Fish and Shellfish Habitat

This function addresses the ability of the wetland to support fish and shellfish habitat. Attributes for consideration of marine habitats include suitability for spawning, presence of commercially and recreationally important species, presence of prey species which support higher trophic levels, presence of anadromous fish, and designation of Essential Fish Habitat (EFH).

Sediment/Toxicant Retention

This function addresses the wetland's ability to reduce or prevent water quality degradation. Attributes to consider include the ability to trap sediments, presence of fine-grained organic sediment, effectiveness of flood storage, presence of vegetation for trapping sediments, and presence of toxicants.

Nutrient Removal

This function addresses the wetland's ability to trap and process nutrients in runoff, thereby minimizing concentrations in downstream flow. Attributes to consider include the ability to trap sediments, presence of nutrient sources, presence of lush vegetation for nutrient uptake, and reduced residence time of water flow.

Production Export

This function addresses the wetland's capacity to produce food for use by humans or other high trophic organisms. Attributes to consider include the presence of fish and shellfish, high vegetation density, the presence of a permanent outlet, and output of economically important products from the wetland.

Sediment/Shoreline Stabilization

This function considers the wetland's effectiveness in stabilizing stream banks and shorelines against erosion. Specific attributes to consider for this function include the quality of the bank or slope, presence of vegetation, width of bordering wetland, and presence of potential sediment sources upstream or upgradient.

Wildlife Habitat

This function addresses wetland qualities that provide for wildlife habitat. Attributes to consider include the proximity to other wetlands and development, availability of wildlife food sources, habitat variation in the landscape, and abundance and diversity of vegetation.

Recreation

This value addresses the wetland's ability to support recreational activities. Considerations when evaluating the applicability of this value include the wetland's role in supporting fishing, hunting, and wildlife, as well as its ecological health and proximity to parkland and undeveloped areas.

Educational/Scientific Value

This value considers the wetland's qualities to support an "outdoor classroom" or scientific research. Characteristics that would support this value include habitat and species diversity, lack of disturbance, parking and public access, and absence of safety hazards near the wetland.

Uniqueness/Heritage

This value considers the wetland's ability to provide certain special values not addressed elsewhere. These might include archaeological sites, endangered species habitat, overall health and appearance, or its role in the larger ecological system. Sites that provide special values may include several of the functions described above.

Visual Quality Aesthetics

This value considers the visual and aesthetic quality or usefulness of the wetland. Characteristics used to evaluate the applicability of this value include an undisturbed

natural setting, lack of trash, absence of unpleasant odors, low noise level, and pleasing undisturbed landscape surrounding the wetland.

Endangered Species Habitat

This value considers the ability of the wetland to provide endangered species habitat. The primary consideration is whether or not federal- or state-listed endangered species are present in the wetland or could be present in the wetland based on available habitat.

2.2 Wetland Functions and Values Associated with the Proposed Action

The Project includes, in part, dredging in a Federal Navigation Channel and disposal of dredged material in a CDF. The proposed work will occur in waters subject to the jurisdiction of the USACE.

These activities are proposed in wetlands associated with marine environments. The majority of the Project area is classified by federal wetland definitions as "Estuarine-Subtidal" with a small band of "Estuarine-Intertidal" (Cowardin et. al, 1979). Because many of the functions and values described in the Workbook Supplement are related to freshwater wetlands located within a watershed, characteristics providing a function or benefit to downstream watershed areas are generally not applicable in marine wetlands.

The following section describes wetland functions and values for the existing and proposed conditions in the dredging and disposal areas.

2.2.1 Dredging Area

The area of proposed dredging is a subtidal habitat of approximately 183,000 sf. It is comprised of silty sediments located in marine waters at depths between 12 and 28 feet below Mean Low Water (MLW). The area is a confined marine river in an urban setting which is subject to urban runoff and residual pollutants associated with marine transportation. A marina providing fuel service is located adjacent to the Project area. The area has also been actively managed as part of a Federal Navigation Project.

Table 2.2-1 lists the wetland functions and values described in the Workbook Supplement and the applicability of these characteristics to the wetlands affected by the proposed Project. Some of these functions, including groundwater recharge/discharge, floodflow alteration, and sediment / toxicant retention, are more applicable to freshwater wetlands and do not provide the same ecological and/or social values in marine habitats. Fish and Shellfish Habitat and Production Export are the two wetland functions identified as being primary, meaning that these functions are most important. As such, the goal of wetland mitigation will be to replace these most important functions and values.

The proposed dredging will result in a net gain in wetland functions and values. While many of the functions and values are either not applicable due to marine location or are

insignificant, the assessment focuses on Fish and Shellfish Habitat and Production Export. By removing contaminated sediment and capping the area with clean sand, the proposed action will improve subtidal habitat associated with the IER. During and shortly after the construction activity, there will be a temporary period of impact when marine invertebrates are absent. However, re-colonization of the Project area by organisms from neighboring areas is expected within a short period of time.

Table 2.2-1 Wetland Functions and Values Associated with Dredge Area

Function / Value	Existing			Proposed		
	Applicability	*Primary*	*Description*	*Applicability*	*Primary*	*Description*
Groundwater Recharge / Discharge	Yes	No	Groundwater likely seeps from upland areas to the wetland, except in the Hoesch Wall area. Groundwater does not provide a function that is intrinsic to the wetland's existence.	Yes	No	The existing wetland functions and values will not be affected by the anticipated installation of a cut-off wall to eliminate seepage of groundwater.
Floodflow Alteration	Yes	No	Floodflow is modified by the existence of tidal waters, however it does not provide a function that is intrinsic to the wetland's existence nor does it provide an ecological or social value.	Yes	No	The existing wetland functions and values will not be substantively changed by the proposed action. Although CDF construction will impact 1.8 acres of subtidal and intertidal area, dredging will deepen the river channel.

Table 2.2-1 (continued) Wetland Functions and Values Associated with Dredge Area

Fish and Shellfish Habitat	Yes	Yes	The area is inhabited by invertebrates including shellfish which provide food for transitory finfish species (Normandeau, 1995). The area is designated as Essential Fish Habitat for 23 commercially-important finfish species (NMFS, 2005).	Yes	Yes	The habitat value of the area will be enhanced by the proposed action by removal of contaminated sediment and placement of clean sand.
Sediment / Toxicant Retention	Yes	No	While sediment flowing from the IER watershed is likely deposited in the tidal river, it does not provide a function that is intrinsic to the wetland's existence nor does it provide an ecological or social value.	Yes	No	The existing wetland functions and values will not be substantively changed by the proposed action.
Nutrient Removal	No	No	The subtidal area is not characterized by lush wetland vegetation that provides for the function of nutrient removal.	No	No	Functions unchanged in the future condition.

Table 2.2-1 (continued) Wetland Functions and Values Associated with Dredge Area

Production Export	Yes	Yes	The subject wetland provides biomass which is foraged by transitory fish and exported offshore.	Yes	Yes	The area will continue to provide this function in the future condition.
Sediment / Shoreline Stabilization	No	No	The dredging area does not stabilize the shoreline.	No	No	Functions unchanged in the future condition.
Wildlife Habitat	No	No	The dredging area does not provide wildlife habitat functions (see Fish and Shellfish Habitat).	No	No	Functions unchanged in the future condition.
Recreation	No	No	The dredging area does not provide recreation value.	No	No	Functions unchanged in the future condition.
Education / Scientific	No	No	The dredging area does not provide educational or scientific value.	No	No	Functions unchanged in the future condition.
Uniqueness / Heritage	No	No	The dredging area does not provide uniqueness or heritage value.	No	No	Functions unchanged in the future condition.
Visual / Aesthetics	No	No	The dredging area does not provide visual or aesthetic value.	No	No	Functions unchanged in the future condition.
Endangered Species	No	No	The dredging area does not provide habitat for endangered species (NHESP, 2003).	No	No	Functions unchanged in the future condition.

2.2.2 Disposal Area

The proposed CDF area primarily includes subtidal habitat, with a much smaller area of intertidal habitat also present. Similar to the dredge area, the roughly 53,856 sf of subtidal area proposed for CDF construction is comprised of silty sediment at depths up to approximately 10 feet below MLW. The small area of intertidal mudflat (approximately 4,500 sf) being impacted is characterized by coarse-grained sand, and a smaller area of tidal flat containing finer-grained sediment is also present. The CDF area also includes intertidal habitat associated with the existing bulkhead, which provides a hard substrate suitable for growth of macroalgae and invertebrates which are associated with naturally occurring rocky tidal shores.

Table 2.2-2 lists the wetland functions and values associated with the CDF area. Similar to the analysis of the dredging area, some of the functions listed for the CDF area are more applicable to freshwater wetlands and do not provide the same ecological and/or social value in marine habitats. However, Fish and Shellfish Habitat and Production Export are the two primary wetland functions, meaning they are most important.

Table 2.2-2 Existing Wetland Functions and Values Associated with CDF Area

Function / Value	Existing			Proposed		
	Applicability	*Primary*	*Description*	*Applicability*	*Primary*	*Description*
Groundwater Recharge / Discharge	Yes	No	Groundwater likely seeps from upland areas to the wetland, except in the Hoesch Wall area. Groundwater does not provide a function that is intrinsic to the wetland's existence.	Yes	No	The existing wetland functions and values will be unaffected by the proposed action, even with the installation of a cut-off wall to eliminate seepage of groundwater.
Floodflow Alteration	Yes	No	Floodflow does not provide a function that is intrinsic to the wetland's existence nor does it provide an ecological or social value.	Yes	No	The existing wetland functions and values will not be substantively changed by the proposed action.

Table 2.2-2 (continued) Existing Wetland Functions and Values Associated with CDF Area

Fish and Shellfish Habitat	Yes	Yes	The CDF area is inhabited by invertebrates including shellfish which provide food for transitory finfish species (Normandeau, 1995). The area is designated as Essential Fish Habitat for 23 commercially-important finfish species (NMFS, 2005).	No	No	The habitat value of the area will be lost as a result of the filling required for disposal.
Sediment / Toxicant Retention	Yes	No	While sediment flowing down from the IER watershed is likely deposited in the tidal river including the proposed CDF area, it does not provide a function that is intrinsic to the wetland's existence nor does it provide an ecological or social value.	Yes	No	The existing wetland functions and values will not be substantively changed by the proposed action.
Nutrient Removal	No	No	The proposed CDF area is not characterized by lush wetland vegetation that provides for the function of nutrient removal.	No	No	Functions unchanged in the future condition.

Table 2.2-2 (continued) Existing Wetland Functions and Values Associated with CDF Area

Production Export	Yes	Yes	Plants and animals inhabiting the proposed CDF area provide biomass foraged by transitory fish and exported offshore.	No	No	The export functions of the area will be lost as a result of sediment disposal.
Sediment / Shoreline Stabilization	No	No	The area provides for sediment stabilization primarily due to the existence of the shoreline bulkhead.	No	No	Functions unchanged in the future condition.
Wildlife Habitat	No	No	The CDF area does not provide wildlife habitat functions (see Fish and Shellfish Habitat).	No	No	Functions unchanged in the future condition.
Recreation	No	No	The CDF area does not provide recreation value.	No	No	Functions unchanged in the future condition.
Education / Scientific	No	No	The CDF area does not provide educational or scientific value.	No	No	Functions unchanged in the future condition.
Uniqueness / Heritage	No	No	The CDF area does not provide uniqueness or heritage value.	No	No	Functions unchanged in the future condition.
Visual / Aesthetics	No	No	The CDF area does not provide visual or aesthetic value.	No	No	Functions unchanged in the future condition.
Endangered Species	No	No	The CDF area does not provide habitat for endangered species (NHESP, 2003).	No	No	Functions unchanged in the future condition.

2.3 Function and Value Assessment Summary

The Function and Value Assessment completed for the subtidal wetland area in the IER that is proposed for filling associated with the Project identifies two primary functions that are relevant to the mitigation plan: Fish and Shellfish Habitat and Production Export. While other functions and values have been identified (e.g., groundwater recharge/discharge, floodflow alteration, and sediment/toxicant retention), these functions are not intrinsic to the health or function of the wetland nor do they provide an ecological or social value.

The area of proposed dredging will exhibit the same functions and values in existing and proposed conditions. The most significant change will be an improvement in functions for fish and shellfish habitat as the result of contaminated sediment removal and capping with clean sand. This action will likely improve the health of the benthic community, which will support transitory finfish species and enhance Production Export. Overall, the dredging work associated with the remediation will restore subtidal habitats for macroinvertebrates, finfish, and other marine organisms.

The area of the CDF footprint does not provide unique functions relative to similar areas in the IER, and wetland functions and values will generally be the same in existing and future conditions. However, the area does provide habitat for a resident marine invertebrate community and a transitory finfish community which utilizes the subtidal habitat seasonally for purposes of foraging and shelter. Some of the other functions and values may be observable at the wetland (e.g., groundwater discharge, sediment retention), but only on a marginal scale; therefore, these functions and values are not relevant. Mitigation strategies should be principally targeted to replace the Fish and Shellfish Habitat and Production Export functions that predominate at the wetland within the proposed CDF footprint.

3.0 WETLAND MITIGATION ALTERNATIVES

As described in Section 2.0, wetland functions and values will be both gained and lost as a result of the Project. The removal of contaminated sediments from the IER and capping of the riverbed with clean sand will improve habitat functions and values in the river channel. Installation of a cut-off wall will prevent the migration of potentially contaminated groundwater into wetland areas. CDF construction along the shoreline will require filling 1.8 acres of tidal area to allow for dredged material disposal, which will result in a loss of functions and values from this area. As compensation for impacts from the disposal activity, a mitigation plan is proposed to replace the lost functions and values.

The following review of mitigation alternatives considers both geography and habitat type with the general goal of replacing wetland functions and values in relatively close proximity to the area of impact in the IER. The analysis initially focuses on mitigation opportunities in the IER and then expands geographically. Where on-site or adjacent sites lack opportunity, the search is expanded to the watershed. When applicable sites are not available in the watershed, a review is conducted in adjacent watersheds.

As summarized below, the review evaluated opportunities in the IER/Mystic River, Malden River, and adjacent coastal watersheds. Identifying mitigation alternatives in this heavily developed and industrialized area is a challenge. As explained below, no meaningful mitigation opportunities for replacing the affected habitat exist in or along the IER itself. Mitigation must therefore occur "off-site". Opportunities for replacing marine habitat functions and values in the watershed are limited due to the extensively developed and heavily utilized shoreline downstream and the abrupt termination of marine habitats upstream as the result of the Amelia Earhart Dam. Restoration opportunities exist in the Malden River upstream of the dam; however, these opportunities are not representative of the marine habitats impacted by the Project. Significant opportunities for replicating marine habitats do exist in the nearby Rumney Marsh, which has been impacted historically by a variety of transportation and development-related activities. While out of the watershed, wetland mitigation in the Rumney Marshes ACEC is most appropriate for replacing the marine wetland functions and values that will be impacted by the Project. Each potential mitigation area evaluated by the proponent is discussed below.

3.1 Island End River and Tidal Areas Downstream of the Amelia Earhart Dam

There are limited opportunities for wetland mitigation in the IER and in the tidal areas downstream of the Amelia Earhart Dam. The following discussion describes the existing conditions in the IER, Lower Mystic, Upper Mystic, Chelsea River, and Boston Inner Harbor. Figure 3 provides an overview of these areas and the existing shoreline habitats.

3.1.1 Island End River

The western side of the IER is within the City of Everett's municipal borders and consists of DPA and other industrial/commercial uses. The shoreline is entirely developed and historic filling of wetlands or Tidelands has been licensed through the Chapter 91 Waterways program for these uses. Existing wetland areas consist primarily of tidal flats and subtidal

area. There are no degraded wetlands in or associated with the Everett side of the IER that are suitable candidates for restoration activities.

On the eastern side of the IER within the City of Chelsea, the shoreline consists of Mary O'Malley Park (see Photo 1 in Appendix 2), Admiral's Hill Marina and a small salt marsh north of the marina (see Photo 2 in Appendix 2). As with the western side of the IER, the remainder of this shoreline consists of tidal flat and subtidal area. The isolated salt marsh at the upper end of the river was created for mitigation purposes in the early 1980s. Discussions with restoration specialists suggest that consequential effort to restore salt marsh or other healthy marine habitats in the area will likely be ineffective due to the extent of development in adjacent areas. In addition, there are no opportunities to convert upland to marine habitat, which constrains restoration options to converting one marine habitat type (e.g. intertidal flat) to another (e.g., salt marsh). Thus, there are no likely wetland restoration candidate sites on the eastern side of the IER.

While the IER itself presents no viable mitigation opportunities, the Proponent has agreed to fund certain shoreline restoration projects at Mary O'Malley Park focused on decreasing erosion and enhancing aesthetics.

3.1.2 Lower Segment Tidal Mystic River

For purposes of this discussion, the Lower Tidal Mystic River is defined as the river segment upstream of the Tobin Bridge and downstream of Malden Bridge (Route 99).

As shown in Figure 3, nearly all of the shoreline in this segment of the Mystic River is identified as either "exposed, solid man-made structures" or "sheltered man-made structures". Wetland habitats are limited to subtidal lands seaward of the armored shoreline. Furthermore, a large portion of the shoreline has been defined as a DPA under 301 CMR 25.00 for the promotion of commercial fishing, shipping, and other vessel-related activities associated with water-borne commerce. The Mystic River DPA includes the western side of the IER in Everett and large portions of the river shoreline in Everett and Boston (Charlestown) (see Figure 3). Land uses adjacent to the water are exclusively industrial and commercial, and include loading and unloading facilities to support shipping activities. Because these areas are reserved for port activities, conversion of these lands to other uses is inconsistent with their designated purpose.

3.1.3 Upper Segment Tidal Mystic River

The Upper Tidal Mystic River is defined in this report as the river segment between the Malden Bridge and the Amelia Earhart Dam. This area has characteristics similar to the lower segment of the Mystic River, with the exception being that the majority of the Upper Mystic has not been established as a DPA. The entire shoreline along the southern and western side of this reach in Somerville and Boston is identified as "exposed rocky

shore/man-made structures." Two small coves on the northern/eastern side of the segment in the City of Everett include areas of salt marsh and beach.

The shoreline in Everett directly adjacent to the Amelia Earhart Dam, which is bisected by an MBTA commuter rail line, is part of the former Monsanto Industrial Chemicals Co. (Monsanto) and now includes the Gateway Mall. Appendix 3 contains a detailed analysis of the Monsanto site. The Monsanto property was once an approximately 87-acre property where a variety of chemicals were manufactured and process-derived waste was disposed. The Monsanto property has been identified as a hazardous materials site under the Massachusetts Contingency Plan (MCP) with multiple oil and hazardous material (OHM) release tracking numbers (RTN) assigned. Contamination identified on-site includes bis 2-ethyl hexyl phthalate (BEHP), naphthalene and phthalic anhydride still bottoms, materials which carry the RCRA hazardous waste codes U028, U165 and K024, respectively. Concentrations as high as 10,000 milligrams per kilogram (mg/kg) of BEHP, 30,000 mg/kg of naphthalene, and 60,000 mg/kg of phthalic acid have been detected in soil and sediment samples collected at the site. The potential hazards associated with this parcel are numerous due to over one hundred years of industrial use and historical waste disposal practices.

Two parcels of the former Monsanto property include shoreline in this river segment downstream of the Earhart Dam. A 4.8-acre parcel adjacent to the dam was identified in the USACE's Malden River Ecosystem Restoration Feasibility Study as a potential restoration site. Section 3.2 of the USACE report indicates that the parcel is not considered a current source of release of oil or hazardous materials to the river; however, no data or supporting references are provided to substantiate this claim.

After reviewing the Massachusetts Department of Environmental Protection's (MADEP's) files related to this site, it was found that various analytical data have been collected and observations have been reported. These include the following:

- Between the 1893 and 1969 the tidal flat was filled with dredged material and alum mud, according to the Phase II Site Investigation: Tidal Flat South of Monsanto Plant. Sulphur, iron ore, pyrite and cinders were also stockpiled opposite the tidal flat along the railroad tracks. The Monsanto outfall discharged waste process water and other waters to this area until 1971. In 1988, ten sub-surface (0.5 – 1.0 ft) sediment samples were collected from this area. Total petroleum hydrocarbon (TPH) concentrations ranged from 171 to 3,341 mg/kg (median 540 mg/kg); DEHP concentrations ranged from 1.5 to 4,605.2 mg/kg (median 287.3 mg/kg); and polychlorinated biphenyl (PCBs) concentrations ranged from 0.24 to 12.7 mg/kg (median 1.37 mg/kg). Additional sediment samples were collected by Monsanto in 1987 in 18 locations in six-inch increments from the top 2.5 feet of material. DEHP was detected in 42 of 60 samples with concentrations ranging from 0.691 to 5,960 mg/kg, as well as two other phthalates (butyl benzyl phthalate and di-n-octyl phthalate) which were detected with less frequency and at lower concentrations

than DEHP. In general, concentrations were found to decrease with increasing depth (see Appendix 3, Attachment A).

- According to a 1985 memo prepared by David Chapman, black, white, red, purple and gelatinous sediment, as well as sheen and black viscous liquid, the outline of a fiber drum, and barrel-shaped pieces of an unknown brown solid were observed along the shoreline. It was noted that nothing was growing along a section of the shoreline and an unknown substance was observed covering the area. The substance appeared to have solidified upon contact with the river water was coating the river bank (see Appendix 3, Attachment B). In 1984, this property was excavated and 56 tons of K024 hazardous wastes were removed from above the high-water level, but part or all of this waste was left in the river below that level (see Appendix 3, Attachment C).

A 30 to 35-acre parcel of the overall Monsanto property is located east of the commuter rail and includes shorelines. Few analytical data have been located in the files for this parcel; however, according to the 1987 Phase I Preliminary Site Assessment and Site Inspection Report prepared by Wehran Engineering Corporation, the property was filled with waste from various manufacturing processes by Monsanto. Priority pollutant analysis of the fill material indicated the presence of phthalates and volatile organic compounds (see Appendix 3, Attachment C). In 1980, GZA prepared a Preliminary Geotechnical Engineering Report for a railroad bridge (i.e., Draw 7) replacement project, in which the typical soil profile encountered on the Everett side of the river was reportedly found to consist of 10 to 20 feet of fill on top of natural material. Additionally, in 1987, Wehran Engineering Corporation noted that this various spills have occurred on this property likely resulting in the release of PCBs and phthalates to the Mystic River (see Appendix 3, Attachment D). The shoreline of this parcel was also subjected to contamination disposed of in the upstream parcel described above (i.e., Parcel 1) through tidal action of this river prior to construction of the Amelia Earhart Dam in the mid-1960s.

The 30 to 35-acre parcel is currently owned by Mystic Landing, LLC and managed by Modern Continental. After being vacant for a period of time, the property was recently used to store construction materials and was identified as being in need of significant cleanup (Boston Business Journal, September, 2003). The property has also been targeted for development since the early 2000s, and was initially discussed as a potential location for a new Fenway Park. Recent plans for the property include a mixed-use brownfield redevelopment project. The developer's plans include a combination of commercial and residential properties, a marina, a waterfront park, and other water-dependent uses. The proposal has been identified as an important example of smart growth development in Massachusetts.

Based on the nature of chemical constituents identified on the former Monsanto property, the lack of definitive data documenting that the 4.8-acre parcel just below the Amelia Earhart Dam does not contain contamination and would not require some form of remediation, and the acknowledgment that Mystic Landing redevelopment would require significant cleanup, this area does not appear viable for mitigation. Since the Mystic

Landing site is slated for development, including siting a marina along its waterfront, wetland restoration/creation in this area would be a conflict.

3.1.4 Chelsea Creek

Chelsea Creek includes the northeastern tributary to Boston's Inner Harbor upstream of the McArdle Bridge. As shown on Figure 3, nearly the entire creek shoreline is developed and has been established as a DPA. Remnant salt marsh occurs in its upper reaches above the MBTA commuter rail bridge. Due to space constraints caused by the densely developed nature of adjacent lands, opportunities for increasing habitat area and functions are limited. The most viable management option for this area would be to develop and implement a stormwater management plan for runoff draining from the Cities of Chelsea and Revere as well as from state highways, including Route 1. Because of the magnitude of upfront planning necessary to adequately address this issue, stormwater remediation is not recommended as a viable mitigation measure to replace intertidal and subtidal fish habitats impacted by the proposed Project.

3.1.5 Boston Inner Harbor

Boston Inner Harbor includes those areas subject to tidal action located downstream of the Tobin and McArdle Bridges. Wetland habitats are confined to subtidal areas seaward of existing bulkheads and wharfs. As illustrated in Figure 3, the shoreline is highly developed and heavily utilized for maritime, commercial and industrial development. The shorelines include portions of three DPAs: Chelsea Creek, East Boston, and Mystic River. Wetland restoration in this area is not feasible.

3.2 Malden River and the Amelia Earhart Dam

The Everett Conservation Commission has suggested that the Proponent may be able to undertake some wetland restoration efforts upstream of the Amelia Earhart Dam in the Malden River, located in Everett to the west of the Project site (see Figure 4). Modifications to the Amelia Earhart Dam have also been proposed as potential mitigation. The following is a description of opportunities in the Malden River and those associated with the Amelia Earhart Dam.

3.2.1 Malden River

The USACE has recently completed Phase I of a Habitat Restoration Study of the Malden River (USACE, 2004), a freshwater river which empties into the Mystic River upstream from the IER (see Figure 4). The report is a useful planning effort for assessing restoration opportunities in the Malden River. The entire USACE study is expected to be completed by the end of this year. As part of the USACE's $5 million obligation for the study, wetland restoration work will be performed in North Creek, a tributary of the Malden River. The City of Everett has expressed a general interest in wetland restoration in South Creek and

Mall Creek, two additional Malden River tributaries which have been neglected and degraded. These creeks are located near Route 16 in Everett.

Historically, the Malden River was a tidally-influenced saltwater environment with broad expanses of salt marsh with cordgrass species *Spartina alterniflora* and *Spartina patens* (USACE, 2004). These wetlands provided functions and values associated with tidal estuarine environments including estuarine habitat, rapid nutrient cycling, dilution and stabilization of toxicants, floodwater storage, erosion prevention and maintenance of a complex benthic community. However, demand for riverside construction projects resulted in the filling of many wetlands, and the 1966 construction of the Amelia Earhart Dam, intended to alleviate upstream flooding, effectively eliminated tidal cycling and saline influences on the Malden River. Loss of wetlands, river channelization, and urbanization all reduced the effectiveness of the wetlands to provide high-value functions. Wetland functions and values in the Malden River are now entirely associated with freshwater emergent and riverine lower perennial habitats, as evidenced by the dominance of Phragmites.

While final recommendations for restoration funding have not yet been determined, Everett and the USACE have been evaluating a variety of restoration efforts in the Malden River including fill removal, daylighting streams, trash and debris removal, and benthic habitat improvements. Everett officials have also identified wetland restoration opportunities in Mall Creek in the vicinity of the Route 16 bridge where high-volume stormwater runoff has contributed to sedimentation of the wetlands. The City has been in contact with the USACE to discuss price-per-acre estimates for wetland restoration.

While numerous wetland restoration opportunities have been identified in the Malden River as detailed in the Corps Phase I Habitat Restoration Study (USACE, 2004), the sites are not ideal as compensatory mitigation for the proposed Project due to the significant difference between the type of habitat that will be impacted (marine) and the type associated with the Malden River (freshwater). The restoration of specific sites like South Creek would daylight streams improving their functions for stream habitat and flood mitigation, but would not produce the area of wetlands needed to mitigate for the CDF. In addition, restoration of these freshwater systems that are already overwhelmed by common reed (*Phragmites australis*) will require a long-term commitment to managing the phragmites. Unlike tidal restriction and tidal fill removal projects where salt water is effective at discouraging phragmites growth, freshwater restoration in areas already dominated by phragmites require cutting, herbicide application, and potentially burning over long periods of time to discourage phragmites.

3.2.2 Amelia Earhart Dam

Another option for improving habitats in the Malden and Mystic Rivers upstream of the Amelia Earhart Dam is to enhance tidal flow by instituting "locking protocols" at the dam.

The purpose of implementing locking protocols is to increase the passage of migrating fish species upstream and downstream of the obstruction.

Many dams have been constructed or retrofitted with fish ladders designed to simulate a natural passageway that fish encounter in rapids or falls. The ladders are constructed with a series of bays gradually stepped up from the downstream water elevation over the dam. Fish are attracted to the water flowing through the bays, which provides olfactory and sensory triggers to guide their migration. The major problem with fish ladders is that they require regular inspection and maintenance, and upgrades and replacement can be costly.

Fish are also able to pass upstream and downstream of dams with passing vessels through locks. Typically, the success of fish passage through locks is dictated by the timing of vessel passage. In waterways where recreational boats predominate, lock passage occurs most frequently during the summer months. Different operating schedules occur for commercial shipping depending upon cargo type, capacity, and location.

Locking protocols have been adopted for the Charles River Dam (Reback et. al, 2005). The locking protocol is implemented between March 15 and June 30 when anadromous fish species are migrating to spawn upstream (USACE, 1992). The protocols are used for just one of three locks in the dam, due to poor water quality in two of them. This locking protocol requires opening the lock for 30 minutes, increasing water in the lock to basin (upstream) levels, and then opening the lock for a 10 minute period. Procedures vary during any particular 24-hour period based on species migration (e.g., smelt migrate at night). In general, the locking protocol is conducted each hour of the day during the migration period. In general, salt water intrusion upstream of the Charles River Dam has increased periodically, but not to an extent that would cause adverse impacts due to typically lower water elevations in the harbor compared to the basin (USACE, 1992).

Locking protocols are likely important for restoring anadromous fish passage at the Amelia Earhart Dam, since the fish ladder on the dam is not operational (Reback et al., 2005). Fish passage does presently occur when boats pass through the locks; however, no formal locking protocol has been adopted. Implementing locking protocols at the dam may be feasible if regulatory agencies and the dam operator (the MA Department of Conservation and Recreation) could agree to protocols. However, locking protocols have little relevance to mitigation related to the proposed Project, as such protocols would not increase habitat functions and values for fish species adversely impacted by construction of the CDF. Specifically, locking protocols would enhance fish passage for anadromous species but not for winter flounder, which require a sustained saline habitat upstream to provide suitable spawning habitat.

Consideration for increasing saltwater flow upstream of the dam also risks negating long-term efforts to improve problems with water quality associated with saline stratification in Lower Mystic Lake. Beginning in the 1860s, saline stratification was observed in the lake when saltwater was trapped in deep pools, preventing turnover and mixing within the water

column. Under certain natural conditions, the lack of mixing produced a release of hydrogen sulfide causing nuisance and potentially hazardous air quality. These events also produced periodic large-scale kills of aquatic organisms. Significant efforts have been undertaken to resolve this condition, including construction of the Amelia Earhart Dam to restrict flow of marine waters upstream to Lower Lake Mystic. A water pumping program implemented in the 1970s removed remnant saltwater left from before the dam's construction. Any proposal that might increase salt intrusion upstream must be carefully studied to avoid a reoccurrence of past problems.

Because of the risks associated with enhancing marine waters upstream of the dam and the volumes that would be necessary to replicate high-salinity conditions favored by winter flounder, augmenting saltwater flow upstream of the Amelia Earhart Dam through implementation of locking protocols is not recommended as mitigation for this project.

3.3 Rumney Marshes Area of Critical Environmental Concern

Candidate wetland mitigation sites identified by the Massachusetts Wetlands Restoration Program (WRP) were also reviewed for appropriate mitigation sites. Some potential wetland mitigation sites have been identified by the WRP in the Boston Harbor area; however, many of these sites are already being restored by corporate sponsors. The nearest potential wetland mitigation site offering meaningful opportunities in terms of the functions and values in question is the 2,600-acre Rumney Marshes ACEC. This ACEC is located in several nearby communities including Revere, which abuts Everett to the northeast (see Figure 4). The ACEC comprises the wetland systems known as Rumney Marsh and Belle Isle Marsh.

Located in the North Coastal Watershed of Massachusetts, the ACEC receives water from an approximately 65-square-mile area, much of which is characterized by dense urban development providing non-point source pollution (MWRP, 2002). Rumney Marsh and Belle Isle Marsh, the two separate marsh systems making up the ACEC, once dominated nearly all land within the ACEC boundary; presently, due to filling, dumping, and ditching, vegetated wetlands cover only 43% of the ACEC.

A detailed fisheries survey of the Rumney Marsh and Lynn Harbor was completed by the MA Division of Marine Fisheries (DMF) in 1968-69 (Chesmore et al, 1972). The study documented 31 species in the study area with 20 of those occurring in Rumney Marsh and associated waterways (Pines and Saugus Rivers). The most abundant species were those which characterize salt marsh fisheries communities (Atlantic silverside, mummichog, striped killifish, and threespine stickleback). Anadromous fish collected included alewife and rainbow smelt. DMF also collected a significant number of immature winter flounder in the Rumney Marsh estuary and the report concluded that the Rumney Marshes ACEC is an important nursery area for juvenile winter flounder.

A Salt Marsh Restoration Plan has been developed by the MA Department of Conservation and Recreation (DCR) for the Rumney Marshes ACEC and was approved by the Executive Office of Environmental Affairs. The preferred mitigation option is to provide direct funding for a level of mitigation within the Rumney Marshes ACEC sufficient to replace values and functions lost as a result of this Project. The mitigation work would be carried out by state agencies already actively restoring these marshes.

3.3.1 Rumney Marshes ACEC Restoration

The goals of wetland restoration are often multi-faceted and consist of ecological benefits such as water quality improvements, improved flood storage, mosquito control and habitat restoration as well as public benefits such as recreation, fire safety, and aesthetic improvements. In the case of the Rumney Marshes ACEC, salt marsh restoration consists of efforts to reverse effects from filling and tidal flow restrictions. Thus, salt marsh restoration may consist of multiple strategies, including:

- Excavation of filled salt marshes: Fill placed in wetlands can be excavated, restoring salt marsh function and controlling the common reed, *Phragmites australis*, an invasive plant species. Enlarging salt marshes by removing fill can increase the range of microhabitats present and enhance water quality, flood control, etc.;

- Removal of tidal restrictions: Undersized culverts or inadequate tide gates may impinge tidal flow into a marsh, lowering salinity and contributing to establishment of *Phragmites australis*. Enlarging culverts or installing self-regulating tide gates (SRTs), which has been accomplished in Revere, can help restore and maintain salt marsh while still providing adjacent communities with flood protection;

- Enhancement of natural drainage patterns: Ditched marshes channel drainage and reduce contact between water, vegetation and soil. Plugging ditches can restore overland sheet flow, enhancing a marsh's effectiveness in regard to sediment deposition, pollutant uptake, and nutrient/carbon exchange; and

- Open Marsh Water Management: Marshes can be restored using OMWM techniques intended to enhance mosquito control. These techniques include restoring salt pannes, improving salt marsh drainage, and increasing tidal flushing, which will decrease ponding and stagnation of water (prime mosquito breeding habitat) while enhancing predatory killifish habitat.

3.3.2 Rumney Marshes ACEC Restoration Sites

For several years, restoration of Rumney Marsh has been supported by a variety of local, state and federal agencies, including the City of Revere, Massachusetts Wetlands Restoration Program, Massachusetts Department of Conservation and Recreation (DCR) (and its predecessors, the Department of Environmental Management and Metropolitan District Commission), U.S. Environmental Protection Agency, and the National Marine

Fisheries Service. Northeast Massachusetts Mosquito Control (NMMC) has been working closely with these agencies and the City of Revere to improve degraded salt marshes and manage existing marshes with the specific intent of reducing mosquito populations and reducing fire hazards posed by Phragmites; objectives which are consistent with salt marsh restoration. In addition, the U.S. Fish and Wildlife Service has identified the Rumney Marshes ACEC as one of the most significant coastal areas of biodiversity in Massachusetts (Gulf of Maine, 2005). This broad-based support has contributed to the successful restoration of over 120 acres of the marsh system, although more restoration work is needed.

To assess potential feasibility and appropriateness of mitigation sites in the Rumney Marshes ACEC, the Proponent reviewed the Salt Marsh Restoration Plan prepared by DCR and collected information from state and federal agency representatives who are active in wetland restoration activities in the area. This work led to three potential restoration sites which were investigated in the field, including a coordinated site visit with agency staff at one of the sites. During follow-up discussions, a preferred site was identified in the Rumney Marshes ACEC to provide compensatory mitigation for the RAM Project.

3.3.3 Preferred Restoration Site - Oak Island Marsh

Due to the unique opportunity to significantly enhance existing wetland restoration efforts and continue the high degree of success, the Proponent proposes to conduct restoration activity in the Oak Island Marshes (see Figure 5).

The Oak Island Restoration site is a 20-acre degraded marsh in Revere that has been impacted by placement of fill associated with a variety of construction activities as well as alterations to tidal flow (EOEA, 2002). The restoration site is an isolated marsh on the eastern edge of the Rumney Marshes ACEC (see Figure 5). The primary segment of the restoration site is located between the MBTA railroad tracks and Route 1A, while a smaller segment of marsh is located east of Route 1A. Further to the east is the Revere Beach Parkway and Revere Beach.

The marshes are hydrologically connected to the larger expanse of Rumney Marsh by a relatively broad and well-defined tidal creek identified on the USGS topographical map as Diamond Creek. Several secondary creek channels branch off from the main creek. Historic ditching of the Oak Island Marshes for the purposes of mosquito control and to facilitate roadway drainage is also evident. The marshes are bordered by dense residential development to the north, east, and south.

The surfaces of the marshes have been colonized by the invasive plant known as common reed (*Phragmites australis*) which, as a brackish and freshwater species, often inhabits marshes degraded by restricted tidal flow. By restoring tidal flow and flooding the roots and stems of common reed on a regular basis, growth of this invasive plant can be stunted and over time replaced with natural high salt marsh plant species. Presence of the reed is both

an indicator of poor habitat quality and a risk of fire danger. For these reasons, but primarily to reduce build-up of wildfire fuel, the NMMC mows the marshes annually.

In 2004 the City of Revere, with assistance from state and federal agencies, installed a self-regulating tidegate and new culvert under the MBTA railroad tracks to enhance tidal flow into the upstream salt marshes (see Photo 3 in Appendix 2). During the spring and summer of 2005, the project partners have been making minor adjustments to the tidegate to maximize the flooding elevation in the marsh without flooding nearby private property. While the increased tidal flow has allowed some additional flooding of the upstream salt marshes, the benefits have been limited by the presence of historic fill, which raised the marshes' surface elevation and provided refuge for common reed.

The Project partners have also been looking at restoration of the marsh. They have determined that a significant amount of fill removal will be necessary to expose the marsh surface and root systems to tidal flow. During installation of the tide gate, fill on an island in the marsh was excavated and removed as a test plot for fill removal and vegetation response. Furthermore, NMMC has also considered preliminary plans for open water marsh management on Oak Island.

The Proponent proposes to fund excavation of some of these filled areas consistent with a larger plan to restore the Oak Island Marsh to reestablish a natural marsh elevation and allow the marsh surface to be flooded by the incoming tide on a regular basis. The current surface of the restoration area is hummocky and uneven. Additional analysis of this wetland system will be required to determine the most feasible area for mitigation for this project.

3.4 Compensatory Wetlands Mitigation Alternatives Analysis

The developed nature of the Project area and its designation for marine industrial uses severely limits the feasibility of implementing meaningful wetland restoration in the immediate vicinity of the Island End River. Armored shorelines are infeasible for restoration due to the necessity of existing structures, densely developed nature of the shoreline, and existing maritime uses. DPA shorelines are unsuitable for restoration because of conflicts with construction and operation of port facilities. Single-site restoration in highly developed coastal areas also lacks the cumulative benefits afforded by adjacent habitats as resulted from the creation of a small salt marsh area in the upper Island End River. Restoration efforts in urban shoreline areas must be coordinated through a master planning effort, which has not occurred in the tidal Mystic River. Table 3.4-1 summarizes the feasibility of implementing wetland mitigation in the areas described above.

The information described above demonstrates that there is no feasible alternative for compensatory wetland mitigation in the IER or in the tidal portions of the Mystic River. The mitigation evaluation has identified two distinct, alternative approaches to providing mitigation for the proposed filling of 1.8 acres of subtidal and intertidal areas in the IER.

One approach would restore degraded freshwater wetlands located in Everett and associated with South Creek or Mall Creek, both tributaries to the Malden River. The other would restore select portions of the Oak Island Tidegate site in Rumney Marsh.

Table 3.4-1 Feasibility of Potential Wetland Mitigation Areas

Area	Advantages	Disadvantages	Conclusion
Island End River	Close to area of impact	DPA, developed shoreline, isolated habitats	Infeasible due to existing development and uses
Lower Segment Tidal Mystic River (including Monsanto Site)[1]	Proximate to area of impact	DPA, developed shoreline, isolated habitats	Infeasible due to existing development and uses
Upper Segment Mystic River	Same watershed as area of impact	Developed shorelines, soil contamination, property ownership	Infeasible due to existing and proposed uses, soil contamination
Malden River	Same watershed as area of impact, large planning effort already undertaken	Freshwater habitats dissimilar to those impacted by project	Feasible for mitigation of of project with freshwater impacts, but not appropriate for winter flounder mitigation
Amelia Earhart Dam	Same watershed as area of impact	Risk of producing habitat impacts and public health hazards upstream; ownership of the dam	Infeasible due to potential negative impacts of salt intrusion
Chelsea River / Boston Inner Harbor	Same watershed as area of impact	DPA, developed shoreline, isolated habitats	Infeasible due to existing development and uses
Rumney Marshes	Extensive planning already undertaken, site of successful off-site mitigation projects that set precedent, restored salt marsh provides high habitat value	Outside of watershed where impacts will occur	Feasible

[1] See Appendix 3 (Monsanto Site Analysis).

Either approach would improve water quality, fish and wildlife habitat, and aesthetics. The South Creek/Mall Creek alternative would focus these benefits in the City of Everett and within the Mystic River watershed where the Project is located, but without compensating for the wetland habitat types that will be impacted. The Rumney Marsh alternative would focus the benefits on salt marsh resources that provide the same functions and values as the wetlands at the Project site. The following is a discussion of the functions and values associated with each option.

3.4.1 Functions/Values and Habitat Benefits of Proposed Mitigation

Functions and values provide information on habitat alternatives for restoration. Habitat is "the area or environment where an organism or ecological community normally lives or occurs." The CDF will primarily impact subtidal habitats that are utilized by macroinvertebrates, finfish such as winter flounder, and other aquatic organisms, and therefore the goal of Project mitigation is to restore habitats that can provide similar attributes.

Proposed mitigation actions in the Malden River or Rumney Marshes ACEC would enhance the functions and values (and therefore the habitat) of these wetlands. In general, both areas provide important wetland functions and values because they are part of a larger urban ecosystem. Table 3.4-1 summarizes the functions and values that might be enhanced by the proposed compensatory mitigation. It also includes the functions and values that will be gained and lost as a result of the Project.

3.4.2 Alternatives Analysis

Table 3.4-2 demonstrates that habitats in both the Rumney Marsh and the Malden River exhibit a diversity of wetland functions and values that could be restored thus enhancing the larger wetland systems. The primary difference between the two alternatives is that mitigation in the Rumney Marsh will more closely replace the wetland functions and values that will be impacted as a result of the proposed remediation Project in the IER.

Mitigation in the Malden River would not replace lost functions associated with Project activities in the IER. Because the Malden River has been converted to a freshwater system by filling and by construction of the Amelia Earhart Dam almost 40 years ago, surrounding wetlands once dominated by salt marsh vegetation now almost exclusively contain Phragmites and other invasive species (USACE, 2004). While the Malden River and its tributaries once likely supported populations of white perch, American shad, rainbow smelt, Atlantic salmon and Atlantic sturgeon, construction of the dam and changes in the system's salinity have for decades significantly impeded upstream migration of such species. The system does support a resident, pollution-tolerant warm water fishery consisting of carp, yellow perch, brown bullhead, and American eel. Anadromous river herring species which are able to pass through the dam to spawning locations up in the Mystic River may use portions of the Malden River for forage and shelter; however, this has not been well

documented and there is no record of anadromous fish spawning. Multiple factors contribute to the Malden River's inability to support a good-quality anadromous fishery, including: poor water quality and removal of saline influences, lack of good-quality spawning habitat, lack of deep pools, and lack of flow volume. The Malden River does not provide suitable habitat for winter flounder.

In comparison, Rumney Marsh provides a diversity of marine habitat functions and values including those that will be impacted by the proposed CDF. As described in the DMF fisheries report, Rumney Marsh is inhabited by a diversity of fish species including anadromous species and winter flounder that are of interest in the IER. Moreover, the Rumney Marshes ACEC, while partially degraded, provides a substantial amount of suitable healthy fisheries habitat, while the IER is likely to be sparsely used due to its developed and impacted condition. Therefore, restoration in Rumney Marsh is expected to provide direct and measurable habitat enhancement. In addition, Rumney Marsh provides ample opportunity to capitalize on existing federal and state restoration programs to achieve a greater ecosystem-wide benefit.

Another important consideration is the likelihood of success for the mitigation project. Restoration of freshwater systems like the Malden River that are already overwhelmed by common reed (*Phragmites australis*) will require a long-term commitment to managing the phragmites. Unlike tidal restriction and tidal fill removal projects where salt water is effective at discouraging phragmites growth, freshwater restoration in areas already dominated by phragmites require cutting, herbicide application, and potentially burning over long periods of time to discourage phragmites. There is a greater risk that restoration at the Malden River will result in creation of phragmites marshes, whereas Oak Island is likely to create salt marsh.

Restoration of a 2-acre area in either Rumney Marsh or the Malden River would provide a substantial net gain in functions and values compared to the minor loss associated with proposed filling in the IER. However, due to the opportunity to replace the lost functions associated with the IER filling, specifically enhancement of fish and shellfish habitat utilized by winter flounder, striped bass, herring and other finfish, the applicant proposes to fund approximately two acres of compensatory mitigation work consisting of fill removal in Rumney Marsh at the Oak Island Tidegate site. The estimated cost to be funded is $170,000. The basis for this cost estimate is provided in Table 3.4-3.

Based on feedback received at a meeting with the USACE and resource agencies on June 15, 2005 regarding use of Oak Island as a possible mitigation site, the Proponent initiated a more detailed analysis of the Oak Island area. The Proponent has been in contact with Frank Stringi, the Planning Director for the City of Revere (which owns the Oak Island property) to discuss possible use of this area for mitigation. The City granted permission for the Proponent to conduct a topographic survey of the property and to collect soil samples to characterize the site. A summary of this Oak Island investigation is provided as Appendix 4. Topographic surveying indicated ground-level elevations throughout the

majority of the surveyed marsh are approximately 3 feet above mean sea level. Soil sampling conducted in the southwest portion of the Oak Island site north of Diamond Creek revealed no reportable concentrations of chemical constituents, save for an arsenic value detected in one of the soil samples (see Appendix 4). An evaluation of potential removal options for this 2-acre mitigation area within this wetland system supports the maximum removal volume of approximately 10,000 cubic yards. The approximate study area is shown in Figure 6. Photos 4-5 in Appendix 2 illustrate general views of potential mitigation areas at Oak Island. Figure 7 shows a near-field aerial view of the area with a potential perimeter ditch (PDa) and a disposal stock pile area (DSA2) noted by NMMC.

Table 3.4-2 Wetland Functions and Values Gained at Rumney Marsh and Malden River

Function / Value	Rumney Marsh Salt Marsh		Malden River Freshwater Marsh		Island End Functions / Values Impacted	
Groundwater Discharge / Recharge	Not Present		Present – Primary		Present – Not Primary	
Floodflow Alteration	Present – Not Primary		Present – Primary		Present – Not Primary	
Fish and Shellfish Habitat	Present – Primary	Marine Species: Winter Flounder, Anadromous Species	Present – Primary	Freshwater Species: Carp, Yellow Perch	**Present – Primary**	Marine species: Winter flounder
Sediment / Toxicant Retention	Present – Primary		Present – Primary		Present – Not Primary	
Nutrient Removal	Present – Primary		Present – Primary		Not Present	
Production Export	Present – Primary	Benthic community / Vegetation exported offshore	Present – Primary	Production retained in freshwater system	**Present – Primary**	Benthic community exported offshore
Sediment / Shoreline Stabilization	Present – Primary		Present – Primary		Not Present	
Wildlife Habitat	Present – Primary		Present – Primary		Not Present	
Recreation	Present – Primary		Present – Primary		Not Present	
Educational / Scientific	Present – Primary		Present – Primary		Not Present	
Uniqueness / Heritage	Present – Primary		Present – Primary		Not Present	
Visual Quality / Aesthetics	Present – Primary		Present – Not Primary		Not Present	
Endangered Species Habitat	Not Present		Not Present		Not Present	

Table 3.4-3 Restoration Cost Estimates for the Oak Island Tidegate Site in Rumney Marsh.

Restoration Site	Depth of Fill (average)	Average Fill Removal Costs	Average Total Cost (includes $70K for design and permitting)
Oak Island	Two feet	$98,123	$168,123

Assumptions:

1. Removal costs are based on restoration of a two-acre area.
2. Unit fill removal costs range between $12.23 and $18.18 per cubic yard.
3. Removal costs include excavation, hauling, and disposal.
4. Design and permitting costs are for fill removal only and not for any proposed structures associated with restoration that may require engineering.
5. Design and permitting costs include the cost of material and labor for planting the area with appropriate salt marsh species.
6. Costs assume that no existing infrastructure (e.g., telephone, electrical lines) must be removed or relocated.

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Figures

Scale 1:12000
1 inch = 1000 feet

500 0 500 1,000 Feet

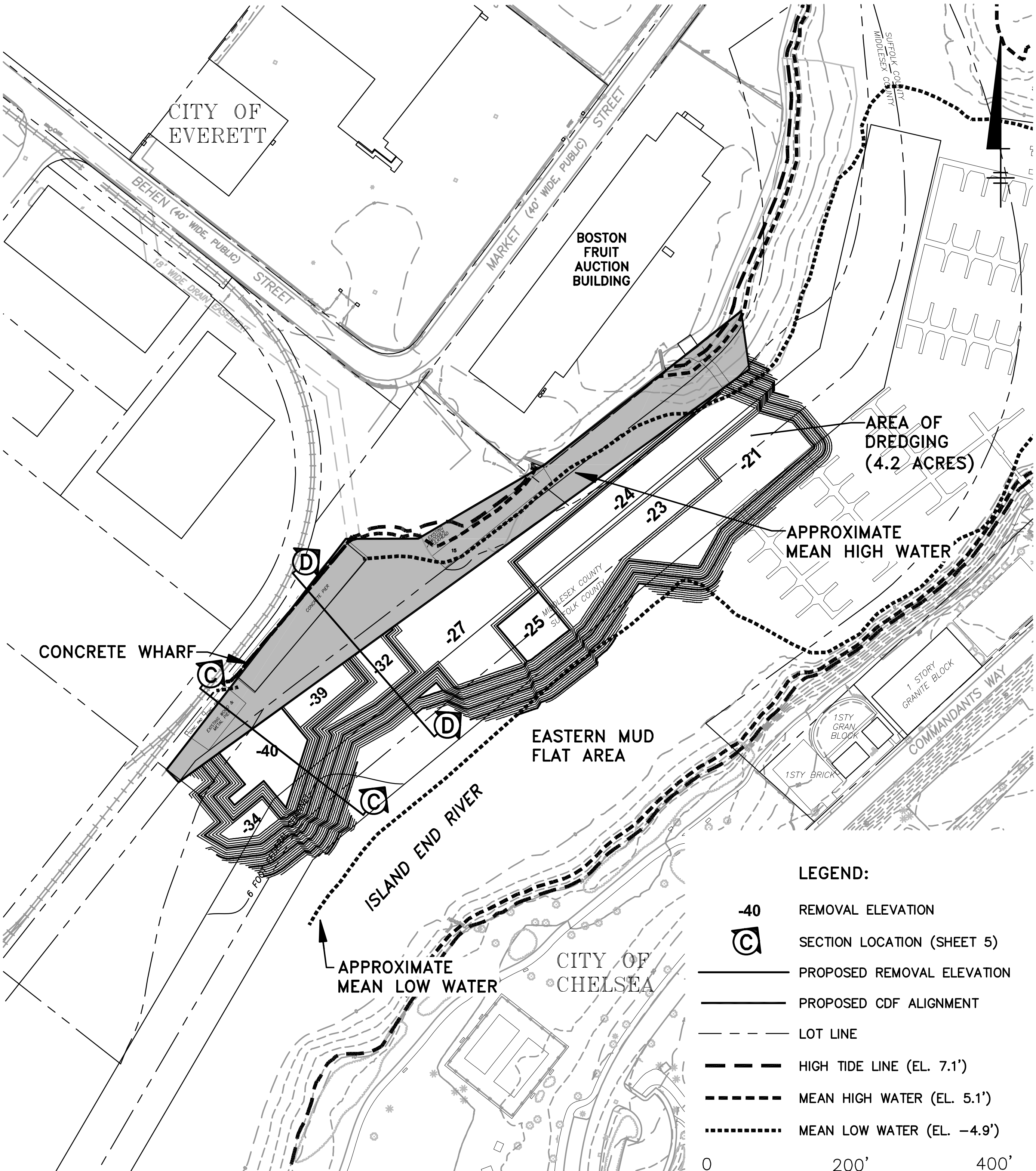
N W E S

USGS Quadrangles, 1985

Figure 1 - USGS Locus Map

Island End
Chelsea & Everett, Massachusetts

EPSILON ASSOCIATES INC. Engineers Environmental Consultants



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38878015/PERMIT/OCT05/38878G13.DWG

NOTE:
FOLLOWING DREDGING A 1-FOOT LAYER OF CLEAN SAND WILL BE PLACED WITHIN THE DREDGING FOOTPRINT.

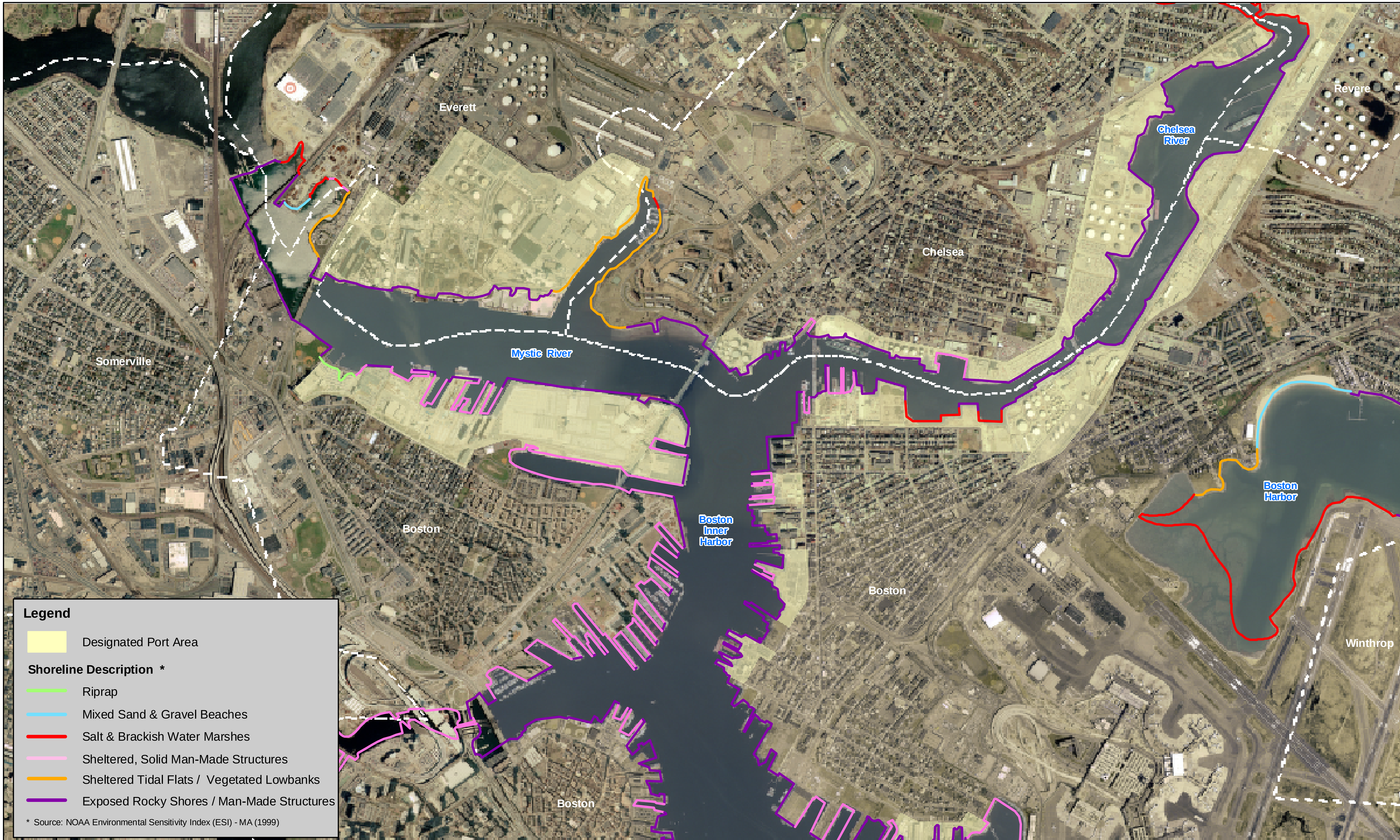
PURPOSE: CREATION OF CONFINED DISPOSAL FACILITY AND DREDGING IN ISLAND END RIVER FOR RELEASE ABATEMENT MEASURE

BBL
Blasland, Bouck & Lee, Inc.
100 Cummings Center Suite 135P
Beverly, MA 01915-6112

Release Abatement Measure Layout

APPLICATION BY:
KHB VENTURE, LLC.

Figure 2



Scale 1:18,000
1 inch = 1,500 feet
750 0 750 1,500
Feet

Figure 3
ESI Shoreline Habitats

RAM Project
Island End River

Basemap : 2001 Orthophotography, MassGIS

Epsilon ASSOCIATES INC.

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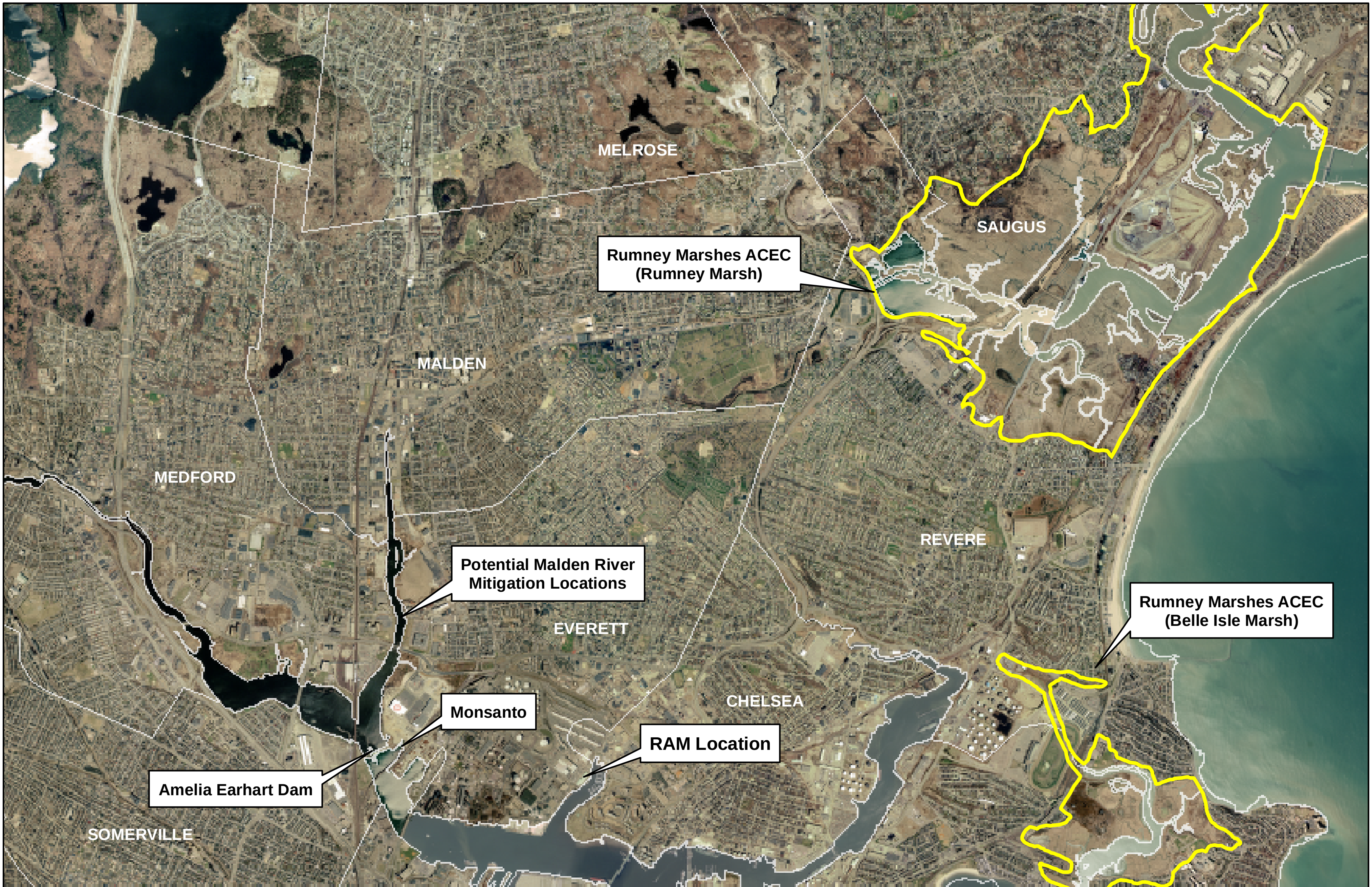

Scale 1:48,000
1 inch = 4,000 feet
2,000 0 2,000 4,000 Feet

Figure 4
Potential Wetland Mitigation Locations

RAM Project
Island End River

Basemap: 2001 Orthophotography, MassGIS

Epsilon ASSOCIATES INC.

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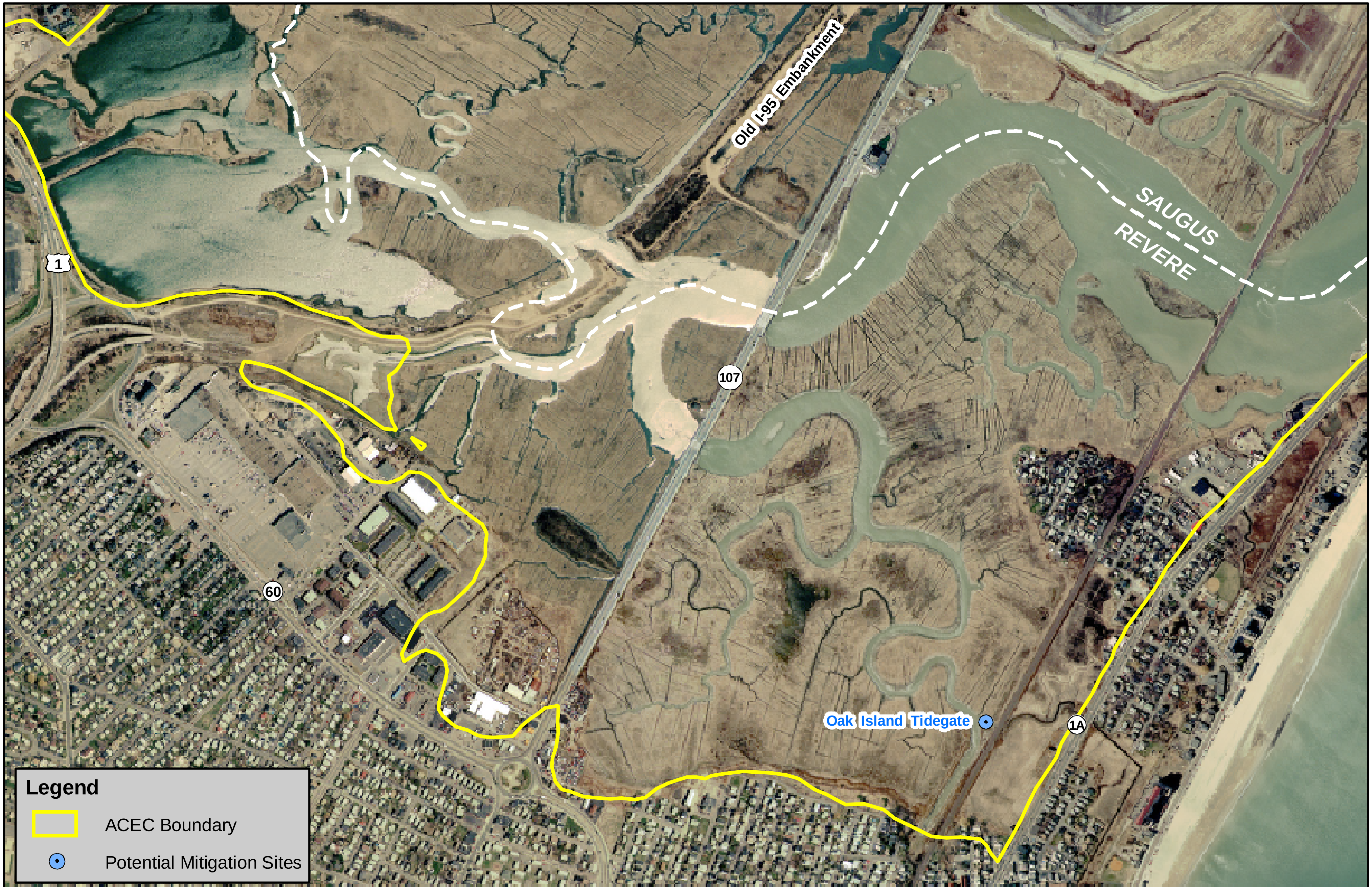

Scale 1:12,000
1 inch = 1,000 feet
500 0 500 1,000 Feet

Figure 5

Oak Island Restoration Site Locus

RAM Project
Island End River

Basemap: 2001 Orthophotography, MassGIS

Epsilon Associates Inc.

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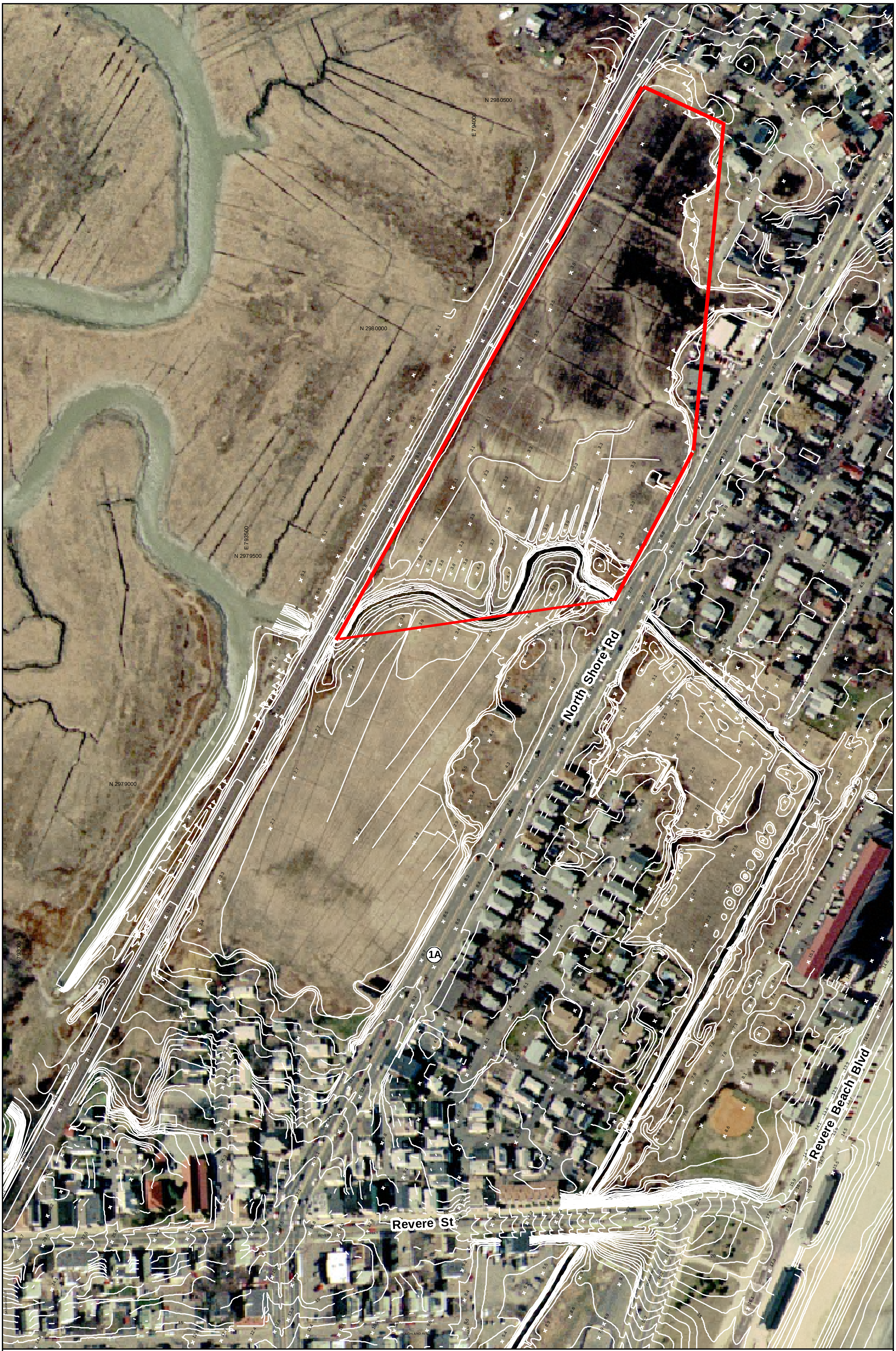
06/28/05



Scale 1:2,400
1 inch = 200 feet

100 0 100 200 Feet

Figure 6

Approximate Study Area in Oak Island Marshes

RAM Project
Island End River

Basemap: 2001 Orthophotography, MassGIS

Epsilon ASSOCIATES INC.

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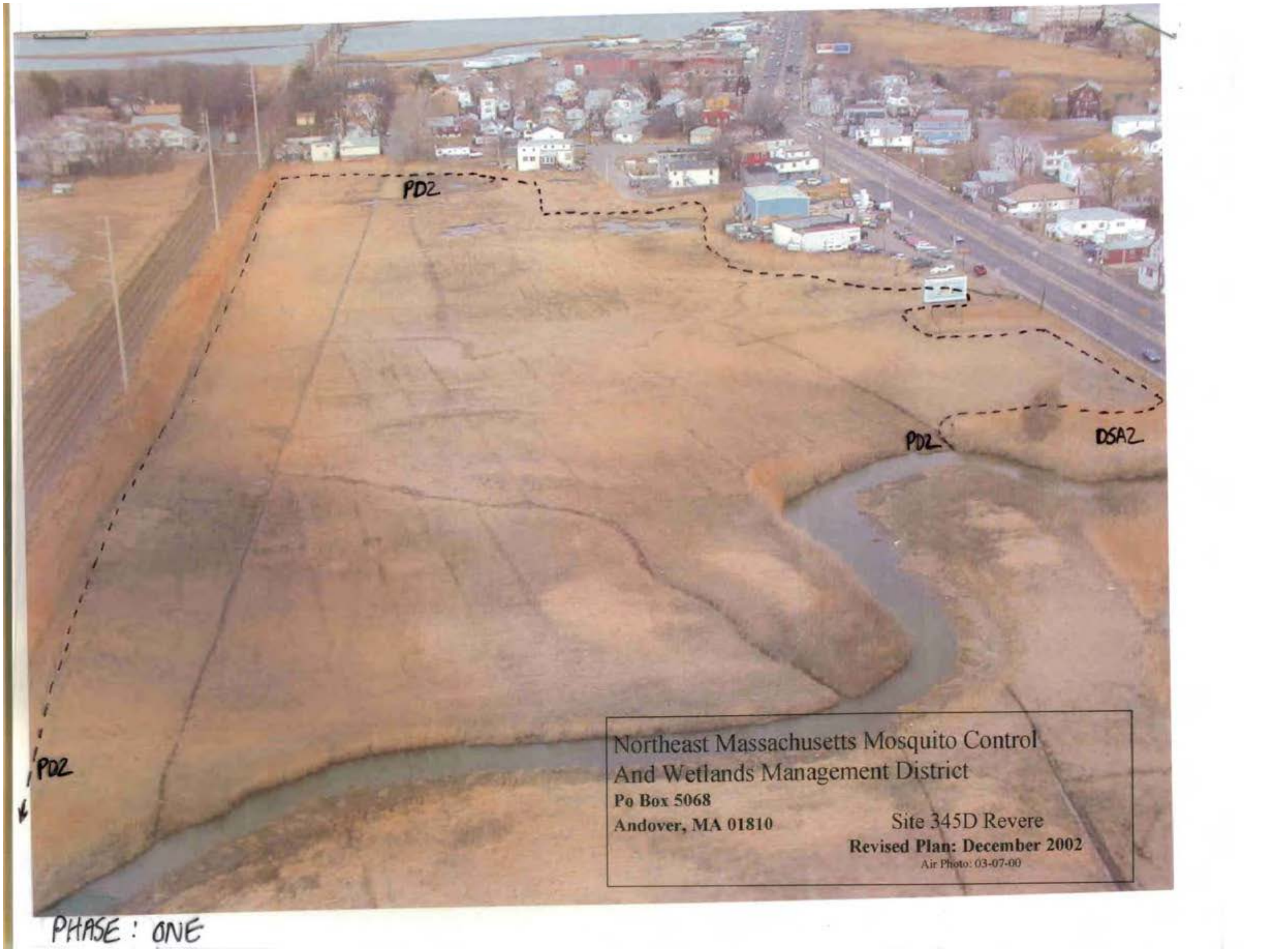

Figure 7
Aerial View of Oak Island Site
RAM Project
Island End River

Epsilon ASSOCIATES INC.

Appendix 1

USACE Wetland Functions and Values Form

Wetland Function-Value Evaluation Form

Total area of wetland__1.9 acres_ Human made?__No___ Is wetland part of a wildlife corridor?___No__ or a "habitat island"?___No__

Adjacent land use___Designated Port Area_______________ Distance to nearest roadway or other development__~200 feet____

Dominant wetland systems present_Estuarine, Subtital Flat, Unconsolidated Bottom_ Contiguous undeveloped buffer zone present_No_

Is the wetland a separate hydraulic system?__No_____ If not, where does the wetland lie in the drainage basin?___Tidal Area___

How many tributaries contribute to the wetland?__One_____Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D._____IER-1_______

Latitude_42.39214N_ Longitude_-71.05172W_

Prepared by:_S. Barrett__ Date_April 19, 2005_

Wetland Impact:
Type____Fill________Area___1.9 acres____

Evaluation based on:
Office___X_____ Field____X_____

Corps manual wetland delineation completed? Y__X__ N______

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge		X			
Floodflow Alteration		X			
Fish and Shellfish Habitat	X		3,4,5,6		Species occurring in Island End River and Mystic River systems include: winter flounder, soft-shelled clam, striped bass, alewife
Sediment/Toxicant Retention		X			
Nutrient Removal		X			
Production Export	X		5,6		The area likely provides habitat for marine invertebrates which support higher trophic levels.
Sediment/Shoreline Stabilization		X			
Wildlife Habitat		X			
Recreation		X			
Educational/Scientific Value		X			
Uniqueness/Heritage		X			
Visual Quality/Aesthetics		X			
ES Endangered Species Habitat		X			
Other					

Notes:

* Refer to backup list of numbered considerations.

Appendix 2

Photographs

Photo 1: Rubble and debris are strewn along the shoreline of Mary O'Malley Park on the eastern (Chelsea) side of the Island End River.

Photo 2: A tire can be seen in the center of the salt marsh at the northern end of the IER.

Photo 3: Self-Regulating Tidegate at Oak Island in Rumney Marsh.

Photo 4: Hummocky fill at Oak Island must be removed to return the area to salt marsh elevation.

Photo 5: Rising tidewaters flow through the SRT at Oak Island, but hummocky fill means much of the area is above salt marsh elevation.

Appendix 3

Monsanto Site Analysis

MEMORANDUM

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

To: A. Fowler

Date: 10/24/2005

From: J. Leidner

cc: T. Cosgrave
L. Smith

Re: Former Monsanto Industrial Chemical Co. Mystic View Road Everett, MA

The former Monsanto Industrial Chemicals Co. (Monsanto) property was once an approximately 87 acre property where a variety of chemicals were manufactured and process derived wastes were disposed. The former Monsanto site has since been subdivided into at least three different parcels and at least two of the parcels have been identified as hazardous materials sites under the Massachusetts Contingency Plan (MCP) each with multiple oil and hazardous material (OHM) release tracking numbers (RTN) assigned. The potential hazards associated with this parcel are numerous due to over one hundred years of industrial use and historical waste disposal practices.

Parcel 1

The largest parcel is bounded by the Boston and Maine (B&M) Railroad to the east and the Malden and Mystic rivers to the west and Route 16 to the north. This portion of the property now contains the Gateway Mall (approximately 30 acres). The Monsanto facility was closed in November 1992 and remediation was conducted in portions of the property under the MCP during the 1990s. Contamination detected at the facility included bis 2-ethyl hexyl phthalate (DEHP), naphthalene and phthalic anhydride still bottoms, materials which carry the Resource Conservation and Recovery Act (RCRA) hazardous waste codes U028, U165 and K024, respectively. Concentrations as high as 10,000 milligrams per kilogram (mg/kg) of BEHP, 30,000 mg/kg of naphthalene, and 60,000 mg/kg of phthalic acid have been detected in soil and sediment samples collected at the site. A portion of this property, a 4.8-acre parcel known as the tidal flats located approximately 300 feet downstream of the Amelia Earhardt Dam was identified in the United States Army Corps of Engineer's (USACE's) Malden River Ecosystem Restoration

Feasibility Study as a potential restoration site. Section 3.2 of the USACE report indicates that the parcel is not considered a current source of release of OHM to the river. However, no data or supporting references were provided to substantiate this claim.

After reviewing the Massachusetts Department of Environmental Protection's (MADEP's) files related to this site, it was found that various analytical data have been collected and observations have been reported:

- Between the 1893 and 1969 the tidal flat was filled with dredged material and alum mud, according to the Phase II Site Investigation: Tidal Flat South of Monsanto Plant. Sulphur, iron ore, pyrite and cinders were also stockpiled opposite the tidal flat along the railroad tracks. The Monsanto outfall discharged waste process water and other waters to this area until 1971. In 1988, ten subsurface (0.5 – 1.0 ft) sediment samples were collected from this area. Total petroleum hydrocarbon (TPH) concentrations ranged from 171 to 3341 mg/kg (median 540 mg/kg); DEHP concentrations ranged from 1.5 to 4605.2 mg/kg (median 287.3 mg/kg); and polychlorinated biphenyl (PCBs) concentrations ranged from 0.24 to 12.7 mg/kg (median 1.37 mg/kg). Additional sediment samples were collected by Monsanto in 1987 in 18 locations in six inch increments from the top 2.5 feet of material. DEHP was detected in 42 of 60 samples with concentrations ranging from 0.691 to 5960 mg/kg, as well as two other phthalates (butyl benzyl phthalate and di-n-octyl phthalate) which were detected with less frequency and at lower concentrations than DEHP. In general, concentrations were found to decrease with increasing depth (Attachment A).

- According to a 1985 memo prepared by David Chapman, black, white, red, purple and gelatinous sediment, as well as sheen and black viscous liquid, the outline of a fiber drum, and barrel-shaped pieces of an unknown brown solid were observed along the shoreline. It was noted that nothing was growing along a section of the shoreline and an unknown substance was observed covering the area. The substance appeared to have solidified upon contact with the river water and was coating the river bank (Attachment B).

Parcel 2

The approximately 35 acre parcel located east of the B&M Railroad was initially sold to Boston Edison. Few analytical data have been located in the files for this parcel; however, according to the 1987 Phase I Preliminary Site Assessment and Site Inspection Report prepared by Wehran Engineering Corp., the property was filled with waste from various manufacturing processes by Monsanto. Priority pollutant analysis of the fill material indicated the presence of phthalates and volatile organic compounds (Attachment C). In 1980, GZA prepared a Preliminary Geotechnical Engineering Report for a railroad bridge (i.e., Draw 7) replacement project, in which the typical soil profile encountered on the Everett side of the river was reportedly found to consist of 10 to 20 feet of fill on top of natural material. Additionally, in 1987, Wehran Engineering Corp. noted that various spills have occurred on this property likely resulting in the release of PCBs and phthalates to the Mystic River (Attachment D).

After a number of changes in ownership, this parcel appears to be currently owned by Mystic Landing, LLC, and managed by Modern Continental. After being vacant for a period of time, the property was most recently used to store construction materials and was identified as needing significant cleanup (Boston Business Journal, September, 2003). The property has also been targeted for development since the early 2000s. Recent plans for the property include a mixed-use brownfield redevelopment project. The developer's plans include a combination of commercial and residential properties, a marina, a waterfront park, and other water-dependent uses.

Parcel 3

A one acre parcel located along the river bank adjacent to Mystic View Road was purchased by the Massachusetts Metropolitan District Commission (MDC) in 1963. Prior to the purchase, Monsanto had disposed of several drums of black gelatin and tar-like residues and other process related wastes on the property. In 1984, this property was excavated and 1,200 tons of K024 hazardous wastes were removed from above the high-water level, but part or all of this waste was left in the river below that level (Attachment C).

Conclusion

Based on the historical information, reported observations, and analytical data presented above, the entire shoreline of the former Monsanto property contains various forms of contamination that would likely require some form of remediation. As such, the tidal portions of the Mystic River downstream of the Amelia Earhardt Dam do not appear to be viable locations for mitigation of the Former Coal Tar Processing Facility (FCTPF) Release Abatement Measure (RAM) Project.

Attachment A

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

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PHASE II SITE INVESTIGATION;
TIDAL FLAT SOUTH OF MONSANTO PLANT
EVERETT, MASSACHUSETTS

1.00 INTRODUCTION

In accordance with our authorization from the Monsanto Company, Goldberg-Zoino & Associates, Inc. (GZA) has performed a Phase II study of the Tidal Flat area south of the Monsanto plant in Everett, Massachusetts. This study is intended to meet the requirements of 310 CMR 40.545 of the Massachusetts Contingency Plan (MCP) for Phase II studies.

This work is a follow-up to the Phase I study prepared by the Monsanto Environmental Science Center which identified elevated levels of phthalate esters, particularly bis(2-ethylhexyl) phthalate, in the upper sediments of the Tidal Flat.

The purpose of this study was:

1. to build on the earlier work by the Monsanto Environmental Science Center by further assessing the nature and distribution of organic and inorganic compounds in sediments of the Tidal Flat area; and

2. to assess the potential risk to human health and the environment posed by identified chemicals in the Tidal Flat.

This report is subject to the limitations in Appendix A.

2.00 BACKGROUND

2.10 SITE DESCRIPTION

The Tidal Flat site is located on the Mystic River several hundred feet south of the confluence of the Malden and Mystic Rivers approximately 300 feet south of the Amelia Earhart Dam. The site is bordered by the Monsanto Plant on the north; by the Mystic River on the east; and by the Boston and Maine Railroad tracks on the south and west. Wetlands associated with the Malden River abut the Plant and the Tidal Flat to the northwest.

The site is a flat, low lying wetland with the ground surface between elevation 0 and 4 NGVD. The exposed Tidal Flat surface area (shown on Figure 2) varies from approximately 4.5 acres at low tide to 0 acres at high tide. The Tidal Flat area is traversed by several small runoff channels (shown on Figure 2) and a larger channel associated with the Monsanto outfall. Access to the site from the Monsanto facility is restricted by a chain link fence.

2.20 SITE HISTORY

Prior to 1852, the Tidal Flat was an island (Atwood Island) in the Mystic River. The now abutting railroad bridge was constructed by Eastern Railroad between 1853 and 1854. Between the early 1890's and early 1920's, wetlands bordering the Mystic and Malden Rivers, including the site area, were filled. Sediments were routinely dredged from the rivers to enable water-borne cargo transport to and from commerce establishments. The dredged sediments were typically deposited in wetlands adjacent to the river.

Between 1893 and 1923, portions of the Tidal Flat area were filled to make improvements on the Eastern Railroad bridge. Alum mud, a white mineral derived waste from the production of alum, was used as a fill material in the area of the Tidal Flat between 1930 and 1969. Sulphur, iron ore, pyrite and cinders were also stockpiled opposite the Tidal Flat on the east side of the railroad tracks.

The outfall in the northwest corner of the Tidal Flat received waste process water and other waters from the Monsanto Plant until 1971.

2.30 PREVIOUS STUDIES

Reports prepared in conjunction with previous investigations of the Monsanto property and the Mystic and Malden Rivers were reviewed for data on the geology of the Tidal Flat area and on the nature and distribution of chemical compounds on the Tidal Flat.

2.31 Summary of March, 1988 Monsanto Environmental Sciences Center Report

Monsanto's Environmental Sciences Center of St. Louis, Missouri performed an environmental assessment of the Tidal Flat, (Monsanto, 1988). In 1986, Monsanto contracted BCM Eastern, Inc. of Plymouth Meeting, Pennsylvania to collect sediment samples from a depth of 0.5 to 1.0 feet at 10 locations (designated TF-1 through TF-10) from the northeast half of the Tidal Flat and from the north bank of the outfall channel. The sample locations are shown on Figure 3. The samples were analyzed by Environmental Testing and Certification, Inc. of Edison, New Jersey for total petroleum hydrocarbons (TPH), phthalates, and PCBs. The results of these analyses are summarized in Table 2-1.

Detected concentrations of TPH measured in 9 of 10 samples ranged from 171 to 3341 mg/kg with a median value of 540 mg/kg. Concentrations of bis(2-ethylhexyl) phthalate (DEHP), also detected

in 9 of 10 samples, ranged from 1.5 to 4605.2 mg/kg with a median value of 287.3 mg/kg. PCB concentrations, detected in 8 of 10 samples, ranged from 0.24 to 12.7 mg/kg with a median value of 1.37 mg/kg.

Additional sediment samples were collected by Monsanto Environmental Science Center personnel in 1987 at 18 locations (designated 1 through 18) on the northeast half of the Tidal Flat (shown on Figure 3). Water samples were collected from four points along the outfall channel. Sediment samples were collected in 6-inch increments from the top 2.5 feet of material (i.e., 5 samples, designated A through E, per location). Selected samples were analyzed for priority pollutant base/neutral compounds. Analytical results are summarized in Table 2-2. DEHP was detected in 42 of 60 samples, with concentrations ranging from 0.691 to 5960 mg/kg. Two other phthalates, butyl benzyl phthalate and di-n-octyl phthalate, were also detected with less frequency and at a lower concentrations than DEHP. The results indicated a trend of decreasing concentration with depth.

Low concentrations (typically less than 1 mg/kg) of polynuclear aromatic hydrocarbons (PAH) were detected in samples from 5 sampling locations.

2.32 Summary of 1980 GZA Report

In 1980 GZA prepared a Preliminary Geotechnical Engineering Report for a proposed railroad bridge over the Mystic River approximately 2000 feet south of the site. This report includes geologic descriptions of the subsurface conditions in the Tidal Flat area. Seventeen borings were completed on the Somerville and Everett sides of the Mystic River and in the river itself.

Soil profiles were developed based on the results of the drilling program. The typical soil profile encountered in borings on the Everett side of the river was 10 to 20 feet of fill underlain by 20 to 30 feet of organic silt, underlain approximately 25 feet of silty clay, underlain with up to 45 feet of glacial till. Bedrock, described as argillite and diabase was encountered at depths ranging from approximately 50 to approximately 100 feet below ground surface. The bedrock surface in certain areas rise rapidly with occasional outcrops exposed at low tide.

3.00 WORK SCOPE

To achieve the objectives of this Phase II study, the following tasks were completed:

1. a field investigation program in which Tidal Flat hydrogeology was assessed and sediments and water samples collected and analyzed for organic and inorganic compounds (refer to Sections 4.00, 5.00 and 6.00);

2. an assessment of the potential for migration of the compounds in Tidal Flat sediments to the water column (refer to Section 7.00); and

3. an evaluation of potential migration pathways, receptors, and impacts of Tidal Flat compounds on human and environmental receptors (refer to Sections 8.00 and 9.00).

4.00 FIELD INVESTIGATION PROGRAM

The field program was designed to supplement existing information to permit:

1. an evaluation of the hydrological characteristics of the Tidal Flat, and

2. an evaluation of the aerial and vertical distribution of chemicals in sediment and water in the Tidal Flat.

4.10 SAMPLING PROGRAM

4.11 Sediment Sampling

Sediment samples were obtained from depths of up to 3.5 feet at 35 locations (shown on Figure 3) on the Tidal Flat. Sample locations were designated S-1 through S-6 and TF-7 through TF-35. Sample collection measurement details are provided in Table 4-1.

Samples were collected using precleaned, stainless steel hand trowels. After collecting each sample, the trowel was cleaned using sequential rinses of potable water, alkonox solution, methanol and distilled water. To collect samples below a depth of one foot, a shovel was used to the desired depth and samples were obtained with a hand trowel.

Samples were collected in glass or plastic containers and preserved on ice for transportation to the laboratory.

4.12 Water Sampling

Surface water samples were obtained during low tide from the northernmost runoff channel on the Tidal Flat, shown on Figure 3. The samples were collected in pre-cleaned 8-ounce glass jars, 40-ml glass vials with Teflon septa, and 500-ml plastic bottles.

4.13 Piezometer Installations

On August 25, 1989, four piezometers were installed at locations designated PZ-1 and PZ-2, shown on Figure 3. Two piezometers were installed at each location to assess hydraulic gradients in the Tidal Flat sediments. The piezometers were

TABLES

TABLE 2-1
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES
COLLECTED BY BCM, APRIL 1986

ANALYSIS	TF-1 (mg/kg)	TF-2 (mg/kg)	TF-3 (mg/kg)	TF-4 (mg/kg)	TF-5 (mg/kg)	TF-6 (mg/kg)	TF-7 (mg/kg)	TF-8 (mg/kg)	TF-9 (mg/kg)	TF-10 (mg/kg)
TOTAL PETROLEUM HYDROCARBONS	2354	493	3341	539	<40	493	1139	303	171	540
PHTHALATES:										
Dimethyl phthalate	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Diethyl phthalate	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dibutyl phthalate	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Butyl benzyl phthalate	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Di-(ethylhexyl) phthalate	62.1	418.2	4130.3	203.3	<0.005	22.5	1.5	<0.005	287.3	4605.2
Di-n-octyl phthalate	<0.005	<0.005	92.8	42.8	<0.005	161.9	6.5	97.2	6.8	3.1
TOTAL PCBs	12.7	1.08	7.87	0.80	<1.0	1.97	0.97	1.37	0.24	<5

NOTES:

1. "<" indicates that the compound was not detected, and that the concentration is less than the indicated value (the method detection limit).

2. Sampling Depth: 0.5' -1'

3. Source: Staples, C.A., "Everett Tidal Flat Assessment," Monsanto Chemical Company, March 24, 1988. Sampling conducted by BCM Eastern Inc. (BCM Project No. 00-4393-03).

All compounds included in the analysis are listed.

TABLE 2-2
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES COLLECTED
BY MONSANTO - MARCH 1987

0-.5 .5-1 1.0-1.5 1.5-2.0 2.0-2.5

ANALYSIS AND COMPOUNDS DETECTED	1A (mg/kg)	1B (mg/kg)	1C (mg/kg)	1D (mg/kg)	1E (mg/kg)	2A (mg/kg)	2B (mg/kg)	2C (mg/kg)	2D (mg/kg)	2E (mg/kg)
SEMIVOLATILE ORGANICS										
Priority Pollutant B/Ns										
PAHs:										
Acenaphthene	<0.089	0.186	<0.091	NA	NA	<0.070	<1.90	NA	NA	NA
Anthracene	<0.089	0.428	<0.091	NA	NA	<0.070	<1.90	NA	NA	NA
Benzo(a)anthracene	0.863	1.40	<0.370	NA	NA	<0.290	<7.90	NA	NA	NA
Benzo(a)pyrene	0.908	2.16	<0.120	NA	NA	<0.092	<2.50	NA	NA	NA
Benzo(b)fluoranthene	1.94	3.09	<0.480	NA	NA	<0.372	<10.0	NA	NA	NA
Benzo(ghi)perylene	0.972	1.67	<0.200	NA	NA	<0.150	<4.20	NA	NA	NA
Chrysene	0.776	1.74	<0.120	NA	NA	<0.092	<2.50	NA	NA	NA
Fluoranthene	1.42	2.05	<0.110	NA	NA	<0.081	<2.20	NA	NA	NA
Fluorene	<0.089	0.176	<0.091	NA	NA	<0.070	<1.90	NA	NA	NA
Indeno(1,2,3-c,d)pyrene	0.913	1.63	<0.220	NA	NA	<0.170	<4.80	NA	NA	NA
Naphthalene	1.09	0.694	0.097	NA	NA	<0.059	<1.60	NA	NA	NA
Phenanthrene	0.656	1.75	<0.260	NA	NA	<0.200	<5.50	NA	NA	NA
Pyrene	<0.089	1.61	<0.091	NA	NA	<0.070	<1.90	NA	NA	NA
Phthalates:										
Bis(2-ethylhexyl)phthalate	1970	478	19.4	NA	NA	15.9	41.4	NA	NA	NA
Butyl benzyl phthalate	<0.521	<0.500	<0.480	NA	NA	<0.370	<10.0	NA	NA	NA
Di-n-octyl phthalate	20.3	2.33	<0.480	NA	NA	10.9	<10.0	NA	NA	NA

TABLE 2-2 (CONTINUED)
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES COLLECTED
BY MONSANTO – MARCH 1987

ANALYSIS AND COMPOUNDS DETECTED	4A (mg/kg)	4B (mg/kg)	4C (mg/kg)	4D (mg/kg)	4E (mg/kg)	5A (mg/kg)	5B (mg/kg)	5C (mg/kg)	5D (mg/kg)	5E (mg/kg)
SEMIVOLATILE ORGANICS										
Priority Pollutant B/Ns										
PAHs:										
Acenaphthene	0.256	<0.096	<0.100	<0.090	NA	<0.840	NA	<0.093	<0.091	NA
Anthracene	<0.110	<0.096	<0.100	<0.090	NA	<0.840	NA	<0.093	<0.091	NA
Benzo(a)anthracene	<0.440	<0.400	<0.410	<0.370	NA	<3.40	NA	<0.380	<0.370	NA
Benzo(a)pyrene	<0.140	<0.130	<0.130	<0.120	NA	<1.10	NA	<0.120	<0.120	NA
Benzo(b)fluoranthene	<0.570	<0.510	<0.530	<0.480	NA	<4.40	NA	<0.490	<0.480	NA
Benzo(ghi)perylene	<0.230	<0.210	<0.220	<0.190	NA	<0.180	NA	<0.200	<0.200	NA
Chrysene	<0.140	<0.130	<0.130	<0.120	NA	<1.10	NA	<0.120	<0.120	NA
Fluoranthene	<0.120	<0.110	<0.120	<0.100	NA	<0.970	NA	<0.110	<0.110	NA
Fluorene	0.229	<0.096	<0.100	<0.090	NA	<0.840	NA	<0.093	<0.091	NA
Indeno(1,2,3-c,d)pyrene	<0.270	<0.240	<0.250	<0.220	NA	<2.10	NA	<0.230	<0.230	NA
Naphthalene	<0.090	<0.081	<0.084	<0.076	NA	<0.710	NA	<0.078	<0.077	NA
Phenanthrene	0.553	<0.270	<0.280	<0.260	NA	<2.40	NA	<0.260	<0.260	NA
Pyrene	<0.110	<0.096	<0.100	<0.090	NA	<0.840	NA	<0.093	<0.091	NA
Phthalates:										
Bis(2-ethylhexyl)phthalate	213	6.23	1.71	1.42	NA	81.6	<MDL	0.691	17.8	NA
Butyl benzyl phthalate	2.33	<0.510	<0.530	<0.480	NA	<4.40	NA	<0.490	<0.480	NA
Di-n-octyl phthalate	5.97	<0.510	<0.530	<0.480	NA	6.19	NA	<0.490	0.972	NA

TABLE 2-2 (CONTINUED)
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES COLLECTED
BY MONSANTO - MARCH 1987

ANALYSIS AND COMPOUNDS DETECTED	6A (mg/kg)	6B (mg/kg)	6C (mg/kg)	6D (mg/kg)	6E (mg/kg)	7A (mg/kg)	7B (mg/kg)	7C (mg/kg)	7D (mg/kg)	7E (mg/kg)
SEMIVOLATILE ORGANICS										
Priority Pollutant B/Ns										
PAHs:										
Acenaphthene	NA	<2.20	<0.100	NA	NA	0.214	<0.089	<0.084	<0.093	NA
Anthracene	NA	<2.20	<0.100	NA	NA	<0.087	<0.089	<0.084	<0.093	NA
Benzo(a)anthracene	NA	<9.10	<0.410	NA	NA	<0.360	<0.360	<0.340	<0.380	NA
Benzo(a)pyrene	NA	<2.90	<0.130	NA	NA	<0.110	<0.120	<0.110	<0.120	NA
Benzo(b)fluoranthene	NA	<12.0	<0.530	NA	NA	<0.460	<0.470	<0.440	<0.490	NA
Benzo(ghi)perylene	NA	<4.80	<0.220	NA	NA	<0.190	<0.190	<0.180	<0.200	NA
Chrysene	NA	<2.90	<0.130	NA	NA	<0.110	<0.120	<0.110	<0.120	NA
Fluoranthene	NA	<2.60	<0.120	NA	NA	<0.100	<0.100	<0.097	<0.110	NA
Fluorene	NA	<2.20	<0.100	NA	NA	0.296	<0.089	<0.084	<0.093	NA
Indeno(1,2,3-c,d)pyrene	NA	<5.50	<0.250	NA	NA	<0.220	<0.200	<0.210	<0.230	NA
Naphthalene	NA	<1.90	<0.084	NA	NA	<0.073	<0.075	<0.070	<0.079	NA
Phenanthrene	NA	<6.30	<0.280	NA	NA	0.545	<0.250	<0.240	<0.270	NA
Pyrene	NA	<2.20	<0.100	NA	NA	<0.087	<0.089	<0.084	<0.093	NA
Phthalates:										
Bis(2-ethylhexyl)phthalate	<MDL	652	612	NA	NA	747	5960	4230	69.3	NA
Butyl benzyl phthalate	NA	<12.0	<0.530	NA	NA	<0.460	<0.470	<0.440	<0.490	NA
Di-n-octyl phthalate	NA	14.7	2.34	NA	NA	35.7	939	56.4	2.52	NA

TABLE 2-2 (CONTINUED)
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES COLLECTED
BY MONSANTO - MARCH 1987

ANALYSIS AND COMPOUNDS DETECTED	8A (mg/kg)	8B (mg/kg)	8C (mg/kg)	8D (mg/kg)	8E (mg/kg)	10A (mg/kg)	10B (mg/kg)	10C (mg/kg)	10D (mg/kg)	10E (mg/kg)
SEMIVOLATILE ORGANICS										
Priority Pollutant B/Ns										
PAHs:										
Acenaphthene	<1.70	<0.089	<0.098	<0.088	<0.092	<0.100	<0.084	<0.110	<0.097	NA
Anthracene	<1.70	<0.089	<0.098	<0.088	<0.092	<0.110	<0.084	<0.110	<0.097	NA
Benzo(a)anthracene	<7.10	<0.360	<0.400	<0.360	<0.380	<0.440	<0.350	<0.470	<0.400	NA
Benzo(a)pyrene	<2.30	<0.120	<0.130	<0.120	<0.120	0.375	<0.110	<0.150	<0.130	NA
Benzo(b)fluoranthene	<9.10	<0.470	<0.520	<0.470	<0.490	0.584	<0.440	<0.600	<0.510	NA
Benzo(ghi)perylene	<3.70	<0.190	<0.210	<0.190	<0.200	<0.230	<0.180	<0.250	<0.210	NA
Chrysene	<2.30	<0.120	<0.130	<0.120	<0.120	0.452	<0.110	<0.150	<0.130	NA
Fluoranthene	<2.00	<0.100	<0.110	<0.100	<0.110	0.444	<0.097	<0.130	<0.110	NA
Fluorene	<1.70	<0.089	<0.098	<0.088	<0.092	<0.110	<0.084	<0.110	<0.097	NA
Indeno(1,2,3-c,d)pyrene	<4.30	<0.220	<0.240	<0.220	<0.230	<0.260	<0.210	<0.280	<0.240	NA
Naphthalene	<1.50	<0.075	<0.083	<0.074	<0.078	0.128	<0.071	0.160	<0.081	NA
Phenanthrene	<4.90	<0.250	<0.280	<0.250	<0.260	<0.300	<0.240	<0.330	<0.270	NA
Pyrene	<1.70	<0.089	<0.098	<0.088	<0.092	0.688	<0.084	<0.110	<0.097	NA
Phthalates:										
Bis(2-ethylhexyl)phthalate	3060	9.44	260	65.0	<0.490	32.9	472	890	50.4	NA
Butyl benzyl phthalate	<9.10	<0.470	<0.520	<0.470	<0.490	<0.560	<0.440	<0.600	<0.510	NA
Di-n-octyl phthalate	34.0	<0.470	4.27	0.622	<0.490	0.609	3.86	21.3	<0.510	NA

TABLE 2-2 (CONTINUED)
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES COLLECTED
BY MONSANTO - MARCH 1987

ANALYSIS AND COMPOUNDS DETECTED	11A (mg/kg)	11B (mg/kg)	11C (mg/kg)	11D (mg/kg)	11E (mg/kg)	12A (mg/kg)	12B (mg/kg)	12C (mg/kg)	12D (mg/kg)	12E (mg/kg)
SEMIVOLATILE ORGANICS										
Priority Pollutant B/Ns										
PAHs:										
Acenaphthene	<0.090	<0.100	<0.100	<0.095	NA	NA	<0.170	NA	<0.091	<0.100
Anthracene	<0.090	<0.100	<0.100	<0.095	NA	NA	<0.170	NA	<0.091	<0.100
Benzo(a)anthracene	<0.370	<0.420	<0.420	<0.390	NA	NA	<0.680	NA	<0.370	<0.410
Benzo(a)pyrene	<0.120	<0.130	<0.130	<0.120	NA	NA	<0.220	NA	<0.120	<0.130
Benzo(b)fluoranthene	<0.470	<0.530	<0.530	<0.500	NA	NA	<0.880	NA	<0.480	<0.530
Benzo(ghi)perylene	<0.190	<0.220	<0.220	<0.200	NA	NA	<0.360	NA	<0.200	<0.220
Chrysene	<0.120	<0.130	<0.130	<0.120	NA	NA	<0.220	NA	<0.120	<0.130
Fluoranthene	<0.100	<0.120	<0.120	<0.110	NA	NA	<0.190	NA	<0.100	<0.120
Fluorene	<0.090	<0.100	<0.100	<0.095	NA	NA	<0.170	NA	<0.091	<0.100
Indeno(1,2,3-c,d)pyrene	<0.220	<0.250	<0.250	<0.230	NA	NA	<0.410	NA	<0.220	<0.250
Naphthalene	<0.076	<0.085	<0.085	<0.080	NA	NA	<0.140	NA	<0.076	0.126
Phenanthrene	<0.260	<0.290	<0.290	<0.270	NA	NA	<0.470	NA	<0.260	<0.280
Pyrene	<0.090	<0.100	<0.100	<0.095	NA	NA	<0.170	NA	<0.091	<0.100
Phthalates:										
Bis(2-ethylhexyl)phthalate	26.1	<0.530	<0.530	56.2	NA	3940	20.0	4.00	20.0	4810
Butyl benzyl phthalate	<0.470	<0.530	<0.530	<0.500	NA	NA	<0.880	NA	<0.480	<0.530
Di-n-octyl phthalate	0.612	<0.530	<0.530	1.82	NA	NA	<0.880	NA	<0.480	58.0

TABLE 2-2 (CONTINUED)
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES COLLECTED
BY MONSANTO - MARCH 1987

ANALYSIS AND COMPOUNDS DETECTED	17A (mg/kg)	17B (mg/kg)	17C (mg/kg)	17D (mg/kg)	17E (mg/kg)	18A (mg/kg)	18B (mg/kg)	18C (mg/kg)	18D (mg/kg)	18E (mg/kg)
SEMIVOLATILE ORGANICS										
Priority Pollutant B/Ns										
PAHs:										
Acenaphthene	<0.081	<0.091	<0.093	<0.096	NA	<0.079	<0.089	<0.093	<0.100	<0.100
Anthracene	<0.081	<0.091	<0.093	<0.096	NA	<0.079	<0.089	<0.093	<0.100	<0.100
Benzo(a)anthracene	<0.330	<0.370	<0.380	<0.390	NA	<0.330	<0.360	<0.380	<0.430	<0.420
Benzo(a)pyrene	<0.110	<0.120	<0.120	<0.130	NA	<0.100	<0.120	<0.120	<0.140	<0.130
Benzo(b)fluoranthene	<0.420	<0.480	<0.490	<0.500	NA	<0.420	<0.470	<0.490	<0.550	<0.530
Benzo(ghi)perylene	<0.170	<0.200	<0.200	<0.210	NA	<0.170	<0.190	<0.200	<0.230	<0.220
Chrysene	<0.110	<0.120	<0.120	<0.130	NA	<0.100	<0.120	<0.120	<0.140	<0.130
Fluoranthene	<0.093	<0.110	<0.110	<0.110	NA	<0.092	<0.100	<0.110	<0.120	<0.120
Fluorene	<0.081	<0.091	<0.093	<0.096	NA	<0.079	<0.089	<0.093	<0.100	<0.100
Indeno(1,2,3-c,d)pyrene	<0.200	<0.230	<0.230	<0.240	NA	<0.200	<0.220	<0.230	<0.260	<0.250
Naphthalene	<0.068	<0.077	<0.078	<0.080	NA	<0.067	<0.075	<0.078	<0.088	<0.085
Phenanthrene	<0.230	<0.260	<0.260	<0.270	NA	<0.220	<0.250	<0.260	<0.300	<0.290
Pyrene	<0.081	<0.091	<0.093	<0.096	NA	<0.079	<0.089	<0.093	<0.100	<0.100
Phthalates:										
Bis(2-ethylhexyl)phthalate	162	0.572	0.918	1.35	NA	2450	5.48	0.498	4.13	5.24
Butyl benzyl phthalate	<0.420	<0.480	<0.490	<0.500	NA	<0.420	<0.470	<0.490	<0.550	<0.530
Di-n-octyl phthalate	6.44	<0.480	<0.490	<0.500	NA	152	<0.470	<0.490	<0.550	<0.530

TABLE 2-2 (CONTINUED)
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES COLLECTED
BY MONSANTO - MARCH 1987

NOTES:

1. NA = Not Analyzed

2. "<" indicates that the compound was not detected, and that the concentration is less than the indicated value (the method detection limit).

   "<MDL" indicates that the compound was not detected, and that the concentration is less than an unspecified value (the method detection limit).

3. Sampling Depths:

"A"	0.0'	to	0.5'
"B"	0.5'	to	1.0'
"C"	1.0'	to	1.5'
"D"	1.5'	to	2.0'
"E"	2.0'	to	2.5'

4. Source: Staples, C.A., "Everett Tidal Flat Assessment," Monsanto Chemical Company, March 24, 1988. Sampling conducted by Monsanto Chemical Company. Analyses completed by Environmental Testing and Certification, Inc. (Edison, New Jersey).

   Only compounds detected in at least one sample are listed.

   Results for samples 5B and 6A were not included in the report. Bis (2-ethylhexyl) phthalate results taken from summary table in report.

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TABLE 4-1

SEDIMENT SAMPLING DETAILS

Sample No(s).	Date Sampled	Sample Depth (ft.)	Sample Type
S-1-6	3/8/89	0-0.5	unconsolidated sediment
TF-7-14	7/26/89	T = 0-0.5 M = 2-2.5 B = 3-3.5	unconsolidated sediment natural soil natural soil
TF-15-20	8/9/89	1-1.3	unconsolidated sediment
TF-21-35 (except 33W, 35T and 35W)	10/3/89	T = 0-1 M = 1-2	unconsolidated sediment unc. sed./natural soil
TF-33W	10/3/89	0-1	white silt-like substance
TF-35T	10/3/89	0-0.25	unconsolidated sediment
TF-35W	10/3/89	0.25-1	white silt-like substance
Channel Water	8/9/89	NA	surface water

Notes:

1. "unconsolidated sediment" = multi-colored, silty sand found on the surface of the flat at all locations except TF-33.

2. "natural soil" = compact, gray sandy silt with abundant clam shells, observed beneath the unconsolidated sediment at all locations except TF-33, where a brown-black fine sand was observed.

3. "white silt-like substance" = white substance observed only in the northernmost portion of the tidal flat (TF-33 and 35).

TABLE 4-2

ANALYSES PERFORMED ON SEDIMENT AND WATER SAMPLES

Analysis	EPA Analytical Method No.	Laboratory	Samples Analyzed
Adipate/ Phthalates		GZA	S-1 to S-6
SVOC Screening	Modified 8100		TF-7T to TF-14T TF-7M to TF-14M TF-7B to TF-14B (except TF-10B) TF-20 Channel Water
Pesticides/ PCBs	Modified 8080	GZA	TF-7T to TF-14T TF-7M to TF-14M TF-7B to TF-14B (except TF-10B) TF-20 Channel Water
VOC Screening	NA	GZA	TF-7T, TF-8T, TF-9T, TF-13T TF-7M, TF-11M, TF-13M Channel Water
Priority Pollutant VOCs	624	GZA	TF-8M TF-7B, TF-8B, TF-11B, TF-13B TF-15 to TF-20 Channel Water
Priority Pollutant Metals	200.0, 200.7, 245.1	E^3I	TF-7T, TF-8T TF-11T, TF-13T TF-7M, TF-8M, TF-11M, TF-13M TF-7B, TF-8B, TF-11B, TF-13B TF-15 to TF-20 Channel Water

TABLE 4-2 (Continued)
ANALYSES PERFORMED ON SEDIMENT AND WATER SAMPLES

Total Phenols	420.1	E^3I	TF-7T, TF-8T TF-11T, TF-13T TF-7M, TF-8M TF-11M, TF-13M TF-7B, TF-8B TF-11B, TF-13B TF-15 to TF-20 Channel Water
Total Cyanide	335.3	E^3I	TF-7T, TF-8T TF-11T, TF-13T TF-7M, TF-8M TF-11M, TF-13M TF-7B, TF-8B TF-11B, TF-13B TF-15 to TF-20 Channel Water
Metals:		E^3I	TF-21T to TF-35T TF-21M to TF-34T to TF-33W, TF-35W
Copper	6010/200.7		
Lead	7421/239.2		
Zinc	6010/200.7		
Thallium	7841/271.2		
Arsenic	7060/206.2		

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TABLE 5-1

PIEZOMETER SURVEY DATA

Station	Measuring Pt. Elevation (ft.)	Groundwater Depth (ft.)	Groundwater El. (ft. NGVD)
W-20-15	12.30	9.11	3.19
PZ-1S	7.57	4.92	2.65
PZ-1D	7.63	4.77	2.86
PZ-2S	2.29	4.20	-1.91
PZ-2D	1.90	0.40	1.50

Notes:

1. All elevations are relative to the measuring point at W-20-15 (top of inside casing), which had an elevation of 12.30 feet above NGVD on January 29, 1988.
2. The measuring point for PZ-1S, 1D, 2S and 2D was the top of the piezometer pipe.
3. All groundwater depths are relative to the measuring points.
4. Survey performed by GZA at approximate time of low tide on October 17, 1989.

TABLE 6-1
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES
COLLECTED BY GZA - MARCH 1989

ANALYSIS	S-1 (mg/kg)	S-2 (mg/kg)	S-3 (mg/kg)	S-4 (mg/kg)	S-5 (mg/kg)	S-6 (mg/kg)
SEMIVOLATILE ORGANICS						
Adipate/Phthalate GC Screening						
Phthalates:						
Di(n-butyl) phthalate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis (2-ethylhexyl) phthalate	11	1500	240	51	200	2800
Butyl benzyl phthalate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Adipates:						
Di(n-hexyl) adipate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) adipate	<0.5	<0.5	3.0	<0.5	14	<0.5
Di(C7-C9 alkyl) adipates	<1	<1	<1	<1	<1	<1

NOTES:

1. "<" indicates that the compound was not detected, and that the concentration is less than the indicated value (the method detection limit).

2. Sampling Depth: 0' TO 0.5'

3. GC Screening for Adipate and Phthalate esters in soils completed by GZA's Environmental Chemistry Laboratory (Newton, Massachusetts).

   All compounds included in the analysis are listed.

4. Samples collected by GZA on March 8, 1989.

TABLE 6-2
SUMMARY OF ANALYTICAL RESULTS
SURFACE SEDIMENT AND WATER SAMPLES
COLLECTED BY GZA - JULY & AUGUST 1989

ANALYSIS AND COMPOUNDS DETECTED	SEDIMENTS TF-7T (mg/kg)	SEDIMENTS TF-7M (mg/kg)	SEDIMENTS TF-7B (mg/kg)	SEDIMENTS TF-8T (mg/kg)	SEDIMENTS TF-8M (mg/kg)	SEDIMENTS TF-8B (mg/kg)	SEDIMENTS TF-9T (mg/kg)	SEDIMENTS TF-9M (mg/kg)	SEDIMENTS TF-9B (mg/kg)	SEDIMENTS TF-10T (mg/kg)	SEDIMENTS TF-10M (mg/kg)	SEDIMENTS TF-10B (mg/kg)
SEMIVOLATILE ORGANICS												
<u>GC Screening</u>												
Bis (2-ethylhexyl) phthalate	57	1400	80	220	<1	<1	72	17	<1	150	150	NA
Di-n-hexyl adipate	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	NA
VOLATILE ORGANICS												
<u>8240 - Priority Pollutants, Hazardous Substance List</u>												
Acetone	NA	NA	0.21	NA	0.045	<0.01	NA	NA	NA	NA	NA	NA
Carbon Disulfide	NA	NA	0.031	NA	0.11	6.7	NA	NA	NA	NA	NA	NA
<u>GC Screening</u>												
1,1-Dichloroethene	0.07	*0.025	NA	NA	NA	NA	<0.01	NA	NA	NA	NA	NA
PCBs / PESTICIDES												
<u>Modified 8080</u>												
Aroclor 1254	0.48	2.4	<0.5	4.1	<0.05	<0.05	3.0	*0.125	<0.05	0.89	0.35	NA
Aroclor 1248	*0.125	3.3	<0.5	0.37	<0.05	<0.05	4.6	<0.05	<0.05	*0.125	<0.05	NA
TOTAL PHENOLS	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	NA	NA	NA	NA	NA	NA
INORGANICS												
Antimony	<13	<15	<11	**19	<11	<12	NA	NA	NA	NA	NA	NA
Arsenic	12	63	188	96	5.8	10	NA	NA	NA	NA	NA	NA
Beryllium	**0.3	<0.2	**0.2	**0.3	<0.2	<0.2	NA	NA	NA	NA	NA	NA
Cadmium	<0.9	<1	**3	1	<0.8	<0.8	NA	NA	NA	NA	NA	NA
Chromium	24	68	27	104	28	24	NA	NA	NA	NA	NA	NA
Copper	83	359	748	779	9.9	19	NA	NA	NA	NA	NA	NA
Cyanide	<2	<2	2	<2	<1	<1	NA	NA	NA	NA	NA	NA
Lead	243	3130	171	358	5.5	18	NA	NA	NA	NA	NA	NA
Mercury	**0.2	**0.5	**0.4	**0.8	<0.1	**0.2	NA	NA	NA	NA	NA	NA
Nickel	**11	52	**10	42	**14	**11	NA	NA	NA	NA	NA	NA
Selenium	**0.3	**0.8	**1	**2	**0.3	<0.3	NA	NA	NA	NA	NA	NA
Silver	<1	<1	**2	**2	<0.9	<0.9	NA	NA	NA	NA	NA	NA
Thallium	<0.4	<0.6	**0.6	**0.9	<0.4	**0.5	NA	NA	NA	NA	NA	NA
Zinc	119	729	369	676	42	41	NA	NA	NA	NA	NA	NA

TABLE 6-2 (continued)
SUMMARY OF ANALYTICAL RESULTS
SURFACE SEDIMENT AND WATER SAMPLES
COLLECTED BY GZA - JULY & AUGUST 1989

ANALYSIS AND COMPOUNDS DETECTED	SEDIMENTS TF-11T (mg/kg)	SEDIMENTS TF-11M (mg/kg)	SEDIMENTS TF-11B (mg/kg)	SEDIMENTS TF-12T (mg/kg)	SEDIMENTS TF-12M (mg/kg)	SEDIMENTS TF-12B (mg/kg)	SEDIMENTS TF-13T (mg/kg)	SEDIMENTS TF-13M (mg/kg)	SEDIMENTS TF-13B (mg/kg)	SEDIMENTS TF-14T (mg/kg)	SEDIMENTS TF-14M (mg/kg)	SEDIMENTS TF-14B (mg/kg)
SEMIVOLATILE ORGANICS												
GC Screening												
Bis (2-ethylhexyl) phthalate	1600	17	200	1200	<1	21	<1	<1	<1	9.9	<1	210
Di-n-hexyl adipate	62	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
VOLATILE ORGANICS												
8240 - Priority Pollutants, Hazardous Substance List												
Acetone	NA	NA	<0.01	NA	NA	NA	NA	NA	<0.01	NA	NA	NA
Carbon Disulfide	NA	NA	<0.005	NA	NA	NA	NA	NA	0.079	NA	NA	NA
GC Screening												
1,1-Dichloroethene	<0.01	<0.01	NA	NA	NA	NA	2.6	<0.01	NA	NA	NA	NA
PCBs / PESTICIDES												
Modified 8080												
Aroclor 1254	*2.5	*0.125	<0.05	*2.5	<0.05	<0.05	<0.05	<0.05	<0.05	*0.125	<0.05	<0.05
Aroclor 1248	<1.0	<0.05	*0.125	<1.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
TOTAL PHENOLS	<1.2	21.4	<1.2	NA	NA	NA	2.94	<1.2	<1.2	NA	NA	NA
INORGANICS												
Antimony	<15	<15	<13	NA	NA	NA	<15	<12	<14	NA	NA	NA
Arsenic	155	180	75	NA	NA	NA	200	15	9.2	NA	NA	NA
Beryllium	1.1	<0.2	**0.2	NA	NA	NA	<0.2	<0.2	<0.2	NA	NA	NA
Cadmium	<1	**4	24	NA	NA	NA	**2	<0.9	<1	NA	NA	NA
Chromium	70	17	14	NA	NA	NA	19	15	27	NA	NA	NA
Copper	1170	2060	2250	NA	NA	NA	1250	28	12	NA	NA	NA
Cyanide	<2	<2	<2	NA	NA	NA	<2	<2	<1	NA	NA	NA
Lead	259	176	113	NA	NA	NA	186	7.9	6.4	NA	NA	NA
Mercury	**0.4	**0.3	**0.2	NA	NA	NA	**0.6	<0.1	**0.2	NA	NA	NA
Nickel	36	23	**13	NA	NA	NA	**8	**9	**15	NA	NA	NA
Selenium	1.7	2.7	2.8	NA	NA	NA	**2	<0.3	<0.3	NA	NA	NA
Silver	**3	**4	9.8	NA	NA	NA	**5	<1	<1	NA	NA	NA
Thallium	**0.8	**0.8	**0.8	NA	NA	NA	**0.9	<0.4	<0.4	NA	NA	NA
Zinc	770	1280	1220	NA	NA	NA	593	40	45	NA	NA	NA

TABLE 6-2 (continued)
SUMMARY OF ANALYTICAL RESULTS
SURFACE SEDIMENT AND WATER SAMPLES
COLLECTED BY GZA - JULY & AUGUST 1989

ANALYSIS AND COMPOUNDS DETECTED	SEDIMENTS						WATER	
	TF-15 (mg/kg)	TF-16 (mg/kg)	TF-17 (mg/kg)	TF-18 (mg/kg)	TF-19 (mg/kg)	TF-20 (mg/kg)	SHALLOW (mg/l)	CHANNEL (mg/l)
SEMIVOLATILE ORGANICS								
GC Screening								
Bis (2-ethylhexyl) phthalate	NA	NA	NA	NA	NA	7.1	<0.1	NA
Di-n-hexyl adipate	NA	NA	NA	NA	NA	<1	<0.1	NA
VOLATILE ORGANICS								
8240 - Priority Pollutants, Hazardous Substance List								
Acetone	<1.15	<1.1	<1.1	<1.4	<0.01	<1.1	NA	<0.01
Carbon Disulfide	<0.575	<0.55	<0.55	<0.7	0.02	<0.55	NA	<0.005
GC Screening								
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
PCBs / PESTICIDES								
Modified 8080								
Aroclor 1254	NA	NA	NA	NA	NA	*0.125	<0.01	NA
Aroclor 1248	NA	NA	NA	NA	NA	<0.05	<0.01	NA
TOTAL PHENOLS	<1.2	<1.2	<1.2	2.2	15.4	<1.2	NA	<0.005
INORGANICS								
Antimony	<15	**32	<13	70	<12	<10	NA	0.05
Arsenic	339	202	4.7	221	47	6.4	NA	0.004
Beryllium	<0.2	**0.4	**0.4	<0.2	<0.2	<0.2	NA	<0.0007
Cadmium	13	10	5.3	14	**2	<0.7	NA	<0.004
Chromium	8.0	73	41	14	35	17	NA	<0.005
Copper	1040	1830	252	666	192	53	NA	**0.004
Cyanide	<2	<2	<2	**7	<2	<1	NA	NA
Lead	135	1360	218	2250	130	12	NA	<0.0008
Mercury	**0.4	1.0	**0.5	2.2	**0.7	**0.1	NA	NA
Nickel	<4	36	31	**13	18	**9	NA	<0.014
Selenium	2.0	3.7	**0.7	1.7	**0.8	**0.5	NA	<0.001
Silver	6.6	6.7	**2	6.2	NA	<0.8	NA	<0.004
Thallium	<0.6	3.4	<0.5	7.7	<0.5	<0.4	NA	<0.002
Zinc	840	1130	234	771	148	40	NA	0.047

TABLE 6-2 (continued)
SUMMARY OF ANALYTICAL RESULTS
SURFACE SEDIMENT AND WATER SAMPLES
COLLECTED BY GZA - JULY & AUGUST 1989

NOTES:

1. NA = Not Analyzed

2. "<" indicates that the compound was not detected, and that the concentration is less than the indicated value (the method detection limit).

3. "*" indicates that the compound was detected at "trace" levels - levels between one and five times the method detection limit, and that the measurement was assigned a value equal to 2.5 times the method detection limit.

4. "**" indicates that the compound was detected at a concentrations within five times the method detection limit and therefore of less precision.

5. Sampling Depths:

   "T" 0' to 0.5'
   "M" 2' to 2.5'
   "B" 3' to 3.5'

   TF-15 to TF-20 samples:
   ALL 1' to 1.3'

6. Laboratory analyses:

   GC Screening for Semivolatile Organic Compounds, GC Screening and 8240 for Volatile Oraganic Compounds, and Modified 8080 for PCBs/Pesticides completed by GZA's Environmental Chemistry Laboratory (Newton, Massachusetts).

   Analyses for Phenols and Inorganic Compounds completed by Energy and Environmental Engineering, Inc. (Somerville, Massachusetts).

   Only compounds detected in at least one sample are listed.

TABLE 6-3
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES
COLLECTED BY GZA - OCTOBER 1989

COMPOUNDS	TF-21T (mg/kg)	TF-21M (mg/kg)	TF-22T (mg/kg)	TF-22M (mg/kg)	TF-23T (mg/kg)	TF-23M (mg/kg)	TF-24T (mg/kg)	TF-24M (mg/kg)	TF-25T (mg/kg)	TF-25M (mg/kg)
Arsenic	205	177	321	130	253	168	329	412	103	71
Copper	1510	570	2090	313	1580	269	1680	1180	6090	1760
Lead	262	422	318	335	270	301	182	190	1070	104
Thallium	0.7	0.7	1	<0.6	0.8	0.8	2	2	2	0.6
Zinc	584	693	714	411	564	455	782	527	3100	790

COMPOUNDS	TF-26T (mg/kg)	TF-26M (mg/kg)	TF-27T (mg/kg)	TF-27M (mg/kg)	TF-28T (mg/kg)	TF-28M (mg/kg)	TF-29T (mg/kg)	TF-29M (mg/kg)	TF-30T (mg/kg)	TF-30M (mg/kg)
Arsenic	95	68	64	122	170	174	98	310	87	91
Copper	2370	2610	1460	1470	1600	1950	1290	2700	2610	3020
Lead	161	178	265	498	728	255	215	407	135	89
Thallium	<0.7	0.6	0.6	1	3	2	<0.7	<0.8	<0.6	2
Zinc	926	902	614	785	836	733	904	2210	1290	1270

COMPOUNDS	TF-31T (mg/kg)	TF-31M (mg/kg)	TF-32T (mg/kg)	TF-32M (mg/kg)	TF-33W (mg/kg)	TF-33M (mg/kg)	TF-34T (mg/kg)	TF-34M (mg/kg)	TF-35T (mg/kg)	TF-35W (mg/kg)
Arsenic	87	76	81	100	2	27	101	190	57	0.9
Copper	3770	4270	3550	1360	28	1080	1640	718	1050	47
Lead	225	388	40	197	59	39	1140	687	300	110
Thallium	0.9	0.9	<0.5	0.6	<0.5	<0.5	0.7	0.7	<0.5	<0.6
Zinc	1060	1710	1030	744	31	463	1000	698	542	45

NOTES:

1. "<" indicates that the compound was not detected, and that the concentration is less than the indicated value (the method detection limit).

2. Sampling Depths:

   "T" 0' to 1.0'
   "M" 1.0' to 2.0'

3. Samples were analyzed at E3I Laboratory, Somerville, MA.

TABLE 6-4
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES
COLLECTED BY MONSANTO – SEPTEMBER 1989

ANALYSIS AND COMPOUNDS DETECTED	Samples #1 (mg/kg)	#2 (mg/kg)	#3 (mg/kg)	#4 (mg/kg)
TOTAL RCRA METALS				
Arsenic	98	46	25	172
Barium	101	137	280	116
Cadmium	1.3	0.96	9.8	2.6
Chromium	32	23	19.7	33
Lead	129	50	306	222
Mercury	<0.4	<0.4	<0.4	<0.4
Selenium	1.1	0.05	<0.01	<0.01
Silver	0.86	1.1	1.1	1.5

ANALYSIS AND COMPOUNDS DETECTED	Samples #1 (mg/l)	#2 (mg/l)	#3 (mg/l)	#4 (mg/l)
EP TOXICITY RCRA METALS				
Arsenic	<.0010	0.0040	0.062	0.370
Barium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01
Lead	<0.05	<0.05	<0.05	<0.05
Mercury	<.0010	<.0010	<.0010	<.0010
Selenium	<.0010	<.0010	<.0010	<.0010
Silver	<0.01	<0.01	<0.01	<0.01

NOTES:

1. "<" indicates that the compound was not detected, and that the concentration is less than the indicated value (the method detection limit).

2. All compounds included in the analysis are listed.

3. Metals analysis performed by Stevens Analytical Laboratories, Inc. Stoneham, MA.

TABLE 6-5
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES

COMPOUND	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS (mg/kg)	AVERAGE SEDIMENT CONCENTRATION (mg/kg)	METHOD DETECTION LIMIT (mg/kg)
VOLATILE ORGANICS:				
Acetone	2 / 18	0.045 - 0.21	0.14	0.01 to 1.4
Carbon Disulfide	5 / 11	0.02 - 6.7	0.63	0.005 to 0.575
1,1-Dichloroethene	3 / 18	0.02 - 2.6	0.15	0.01
SEMIVOLATILE ORGANICS:				
Adipates and Phthalates				
Bis(2-ethylhexyl) adipate	2 / 30	3.0 - 14	0.57	0.5,1.0
Di-n-hexyl adipate	1 / 30	- 62	2.1	0.5,1.0
Bis(2-ethylhexyl) phthalate	72 / 87	0.498 - 5960	591	0.005 to 1.0
Butyl benzyl phthalate	1 / 83	- 2.33	0.0281	0.005 to 12.0
Di(n-octyl) phthalate	30 / 77	0.609 - 939	23.3	0.005 to 10.0
Total Petroleum Hydrocarbons	9 / 10	171 - 3341	937.3	
PAHs				
Acenapthene	3 / 67	0.186 - 0.256	0.00979	0.070 to 1.90
Anthracene	1 67	0.428	0.00639	0.070 to 1.90
Benzo(a)anthracene	2 / 67	0.863 - 1.40	0.0338	0.290 to 7.90
Benzo(a)pyrene	3 / 43	0.375 - 2.16	0.0801	0.092 to 2.50
Benzo(b)fluoranthene	3 / 67	0.584 - 3.09	0.0838	0.372 to 10.0
Benzo(g,h,i)perylene	2 / 43	0.972 - 1.67	0.0614	0.150 to 4.20
Chrysene	3 / 67	0.452 - 1.74	0.0443	0.092 to 2.50
Fluoranthene	3 / 67	0.444 - 2.05	0.0584	0.081 to 2.20
Fluorene	3 / 67	0.176 - 2.96	0.0105	0.070 to 1.90
Indeno(1,2,3-c,d)pyrene	2 / 43	0.913 - 1.63	0.0591	0.170 to 4.80
Naphthalene	6 / 67	0.0970 - 1.09	0.0343	0.059 to 1.60
Phenanthrene	4 / 67	0.545 - 1.75	0.0523	0.200 to 5.50
Pyrene	2 / 67	0.688 - 1.61	0.0343	0.070 to 1.90
Total PAHs	8 / 67	0.0970 - 18.6	0.497	--
Carcinogenic PAHs	3 / 67	1.41 - 11.7	0.291	--
PCBs				
Aroclor 1248	6 / 24	0.125 - 4.6	0.36	0.05
Aroclor 1254	12 / 24	0.125 - 4.1	0.70	0.05
Total PCBs	21 / 34	0.125 - 12.7	1.54	--
Other Compounds:				
Phenols	4 / 18	2.2 - 21.4	2.33	1.2
INORGANICS:				
Antimony	3 / 18	19 - 70	6.7	10 to 15
Arsenic	48 / 48	0.9 - 412	125	0.5
Beryllium	7 / 18	0.2 - 1.1	0.16	0.2
Cadmium	10 / 18	1 - 24	4.4	0.7 to 1.0
Chromium	18 / 18	8 - 104	34.7	4
Copper	48 / 48	9.9 - 6090	1430	2
Cyanide	2 18	2 7	0.5	1 to 2
Lead	48 / 48	5.5 - 3130	382	2
Mercury	16 / 18	0.1 - 2.2	0.48	0.1
Nickel	17 / 18	8 - 52	20	4
Selenium	15 / 18	0.3 - 3.7	1.3	0.3
Silver	10 / 18	2 - 9.8	2.6	0.8 to 1
Thallium	29 / 48	0.5 - 7.7	0.83	0.4 to 0.6
Zinc	48 / 48	31 - 3100	740	4

TABLE 6-5 (continued)
SUMMARY OF ANALYTICAL RESULTS
SEDIMENT SAMPLES

NOTES:

1. All samples were used in this summary.

2. Frequency of detection for individual compounds indicates the number of samples in which the compound was detected, divided by the total number of samples analyzed for that compound. Frequency of detection for groups of compounds (PAHs, PCBs) indicates the number of samples in which one or more of the individual compounds included in the total were detected, divided by the total number of samples analyzed for that group of compounds.

3. Average concentrations were calculated using all data. Measurements below the method detection limit were assigned a value of zero.

   Average Total PAH and Carcinogenic PAH concentrations were calculated using data from both the samples analyzed for all PAHs and samples screened for a subset of the PAH compounds. No PAH compounds were detected in any of the screened samples; since PAH compounds generally occur in groups, compounds not analyzed for were assigned a value of zero.

TABLE 6-6
SUMMARY OF ANALYTICAL RESULTS
SURFICIAL SEDIMENT SAMPLES

COMPOUND	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS (mg/kg)	AVERAGE SEDIMENT CONCENTRATION (mg/kg)	METHOD DETECTION LIMIT (mg/kg)
VOLATILE ORGANICS:				
1,1-Dichloroethene	2 / 4	0.07 - 2.6	0.67	0.01
SEMIVOLATILE ORGANICS:				
Adipates and Phthalates				
Bis(2-ethylhexyl) adipate	2 / 14	3.0 - 14	1.2	0.5,1.0
Di-n-hexyl adipate	1 / 14	- 62	4.4	0.5,1.0
Bis(2-ethylhexyl) phthalate	24 / 26	9.9 - 3940	800	0.005 to 1.0
Butyl benzyl phthalate	1 / 24	- 2.33	0.0971	0.005 to 12.0
Di(n-octyl) phthalate	10 / 18	0.609 - 152	15.2	0.005 to 10.0
PAHs				
Acenapthene	2 / 18	0.214 - 0.256	0.0261	0.070 to 1.90
Benzo(a)anthracene	1 / 18	- 0.863	0.0479	0.290 to 7.90
Benzo(a)pyrene	2 / 10	0.375 - 0.908	0.128	0.092 to 2.50
Benzo(b)fluoranthene	2 / 18	0.584 - 1.94	0.140	0.372 to 10.0
Benzo(g,h,i)perylene	1 / 10	- 0.972	0.0972	0.150 to 4.20
Chrysene	2 / 18	0.452 - 0.776	0.0682	0.092 to 2.50
Fluoranthene	2 / 18	0.444 - 1.42	0.104	0.081 to 2.20
Fluorene	2 / 18	0.229 - 0.296	0.0292	0.070 to 1.90
Indeno(1,2,3-c,d)pyrene	1 / 10	- 0.913	0.0913	0.170 to 4.80
Naphthalene	2 / 18	0.128 - 1.09	0.0677	0.059 to 1.60
Phenanthrene	3 / 18	0.545 - 0.656	0.0974	0.200 to 5.50
Pyrene	1 / 18	- 0.668	0.0382	0.070 to 1.90
Total PAHs	4 / 18	1.04 - 9.54	0.795	--
Carcinogenic PAHs	2 / 18	1.41 - 6.37	0.432	--
PCBs				
Aroclor 1248	4 / 8	0.125 - 4.60	0.652	0.05
Aroclor 1254	7 / 8	0.125 - 4.10	1.70	0.05
Total PCBs	7 / 8	0.125 - 7.60	2.35	--
Other Compounds:				
Phenols	1 / 4	- 2.94	0.735	1.2
INORGANICS:				
Antimony	1 / 4	- 19	4.8	10 to 15
Arsenic	19 / 19	2 - 329	132	0.5
Beryllium	3 / 4	0.3 - 1.1	0.42	0.2
Cadmium	2 / 4	1 - 2	0.8	0.7 to 1.0
Chromium	4 / 4	19 - 104	54.2	4
Copper	19 / 19	28 - 6090	1870	2
Lead	19 / 19	40 - 1140	338	1 to 2
Mercury	4 / 4	0.2 - 0.8	0.5	0.1
Nickel	4 / 4	8 - 42	24	4
Selenium	4 / 4	0.3 - 2	1.5	0.3
Silver	3 / 4	2 - 5	2	0.8 to 1
Thallium	12 / 19	0.6 - 3	0.8	0.4 to 0.6
Zinc	19 / 19	31 - 3100	849	4

TABLE 6–6 (continued)
SUMMARY OF ANALYTICAL RESULTS
SURFICIAL SEDIMENT SAMPLES

NOTES:

1. Samples taken at a depth of 0.0 to 0.5 feet were selected for evaluation of public health risks from direct contact exposures.

2. Frequency of detection for individual compounds indicates the number of samples in which the compound was detected, divided by the total number of samples analyzed for that compound. Frequency of detection for groups of compounds (PAHs, PCBs) indicates the number of samples in which one or more of the individual compounds included in the total were detected, divided by the total number of samples analyzed for that group of compounds.

3. Range of concentration includes trace levels.

4. Average arithmetic mean concentrations were calculated using all data. Measurements below the method detection limit were assigned a value of zero.

   Average Total PAH and Carcinogenic PAH concentrations were calculated using data from both the samples analyzed for all PAHs and samples screened for a subset of the PAH compounds. No PAH compounds were detected in any of the screened samples; since PAH compounds generally occur in groups, compounds not analyzed for were assigned a value of zero.

TABLE 7 – 1
A COMPARISON OF PAH AND PCB CONCENTRATIONS IN THE TIDAL FLAT TO CONCENTRATIONS IN OTHER URBAN ESTUARIES

Compound (ug/kg)	Tidal Flat Range	Gloucester Harbor Range	Puget Sound Range	Elizabeth River Estuary Range	Overall Urban Estuaries Range	Buzzards Bay Range
Acenaphthene	186 - 256	160 - 190	83 - 920		0 - 920	
Anthracene	428 - 428	1300 - 1600	200 - 510		0 - 1600	7 - 170
Benzo(a)anthracene	863 - 1400	1800 - 3400		93 - 11000	0 - 11000	41 - 330
Benzo(a)pyrene	375 - 2160	2400 - 5900	170 - 550	84 - 8700	0 - 8700	75 - 370
Benzo(b)fluoranthene	584 - 3090		670 - 1900	89 - 12000	0 - 12000	
Benzo(ghi)perylene	972 - 1670		89 - 320	28 - 1600	0 - 1600	66 - 280
Chrysene	452 - 1740	2200 - 2900		160 - 19000	0 - 19000	40 - 240
Fluoranthene	444 - 2050	1100 - 6800	2000 - 4700	290 - 42000	0 - 42000	
Fluorene	176 - 2960	410 - 770	150 - 1100		0 - 1100	
Indeno(1,2,3-c,d)pyrene	913 - 1630					
Naphthalene	97 - 1090		230 - 3800		0 - 3800	
Pyrene	688 - 1610	1000 - 5600	1500 - 4100	250 - 28000	0 - 28000	100 -
Phenanthrene	545 - 1750	1300 - 3100		86 - 25000	0 - 25000	33 -
Total PAH	6723 - 21834	11670 - 30260	5092 - 17900	1080 - 147300	0 - 154720	362 - 1390
Total PCB	125 12700	200 - 9000	29 - 200		0 - 9000	360 - 2100

NOTES:

1. Gloucester Harbor Data from Massachusetts Division of Water Pollution Control.
2. Puget Sound Data from Malins et al., 1985.
3. Elizabeth River Estuary Data from Hugget et al., 1984.
4. Buzzards Bay Data from Sims and Overcash, 1980. Maximum PCB value from NOAA, 1988..

TABLE 7 – 2
A COMPARISON OF PAH AND PCB CONCENTRATIONS IN THE TIDAL FLAT TO CONCENTRATIONS IN OTHER AREAS IN BOSTON HARBOR

Compound (ug/kg)	Tidal Flat Range	Off Charles River Mouth Average	Fort Point Channel Average	Off Fort Point Channel (Mystic River) Average	Mouth of Boston Inner Harbor Average	Off Logan Airport Average
Acenaphthene	186 - 256	876		300	300	
Anthracene	428 - 428	315		245	57	
Benzo(a)anthracene	863 - 1400					45000
Benzo(a)pyrene	375 - 2160	7159	94984	1949	1418	45000
Benzo(b)fluoranthene	584 - 3090	3340		70	70	100000
Benzo(ghi)perylene	972 - 1670					
Chrysene	452 - 1740	4995	364726	2582	883	51000
Fluoranthene	444 - 2050	1453	84515	1120	631	6400
Fluorene	176 - 2960					5000
Indeno(1,2,3-c,d)pyrene	913 - 1630					
Naphthalene	97 - 1090	<10	43628		<10	
Pyrene	688 - 1610	4419	66831	3195	1559	7200
Phenanthrene	545 - 1750	1971	63683	957	208	34000
Total PAH	6723 21834	24528	718367	10418	5126	293600
Total PCB	125 - 12700				70.4	139

NOTES:

1. PAH data for Charles River Mouth, Fort Point Channel, Mystic River and Boston Inner Harbor from Shiaris and Jambard-Sweet, 1986

2. Off Charles River Mouth value for Acenapthene is sum of Acenaphthene & Fluorene; value for Chrysene is sum of chrysene plus benzanthracene.

3. Data for Off Logan Airport from Boehm, 1984.

TABLE 7 – 3
COMPARISON OF METAL CONCENTRATIONS IN THE TIDAL FLAT
TO CONCENTRATIONS IN OTHER URBAN ESTUARIES
AND BOSTON HARBOR

Compound (mg/kg)	Tidal Flat Range	Selected Estuaries Range	Boston Inner Harbor Range	Gloucester Harbor Range	Offshore Areas ("Background") Range
Antimony	19 - 70				
Arsenic	0.9 - 412		27 - 39	1.21 - 21	
Beryllium	0.2 - 1.1		0.57 - 1.1		
Cadmium	1.0 - 24	4.1 - 850	11 - 12	0.3 - 2.7	0.1 - 3200
Chromium	8 - 104	90 - 3200	97 - 150		0.7 - 1300
Copper	9.9 - 6090	1400 - 12000	150 - 190		2.3 - 650
Cyanide	2 - 7				
Lead	5.5 - 3130	560 - 30500	270 - 390	18 - 480	1 - 540
Mercury	0.1 - 2.2	0.4 - 3.8	0.41 - 0.777		0.13 - 6.1
Nickel	8 - 52		45 - 64	5.8 - 24	0.4 - 110
Selenium	0.3 - 3.7		6.1 - 11		
Silver	2 - 9.8	7 - 190	1.1 - 2.2	0.2 - 0.8	0.04 - 18
Thallium	0.5 - 7.7		0.61 - 1.1		
Zinc	31 - 3100	2300 - 118000	850 - 1700	35 - 730	

NOTES:

1. Selected Estuaries data from Forstner and Wittmann, 1981.
2. Boston Inner Harbor data from DEQE, 1987.
3. Offshore Areas include: Boston Outer Harbor, Massachusetts Bay, Chesapeake Lower Bay, California Reference Areas, and New York Bight.

TABLE 7 - 4
CALCULATED CONCENTRATIONS OF ORGANIC COMPOUNDS IN PORE WATER, OVERLYING WATER AND FINFISH/SHELLFISH ON THE TIDAL FLAT

COMPOUND	AVERAGE SEDIMENT CONC. (mg/kg)	WATER CONCENTRATIONS Kow	PORE WATER (ug/l)	WATER COLUMN (ug/l)	TISSUE CONCENTRATIONS BCF	SHELLFISH BASED ON PORE WATER (ug/kg)	FINFISH BASED ON WATER COLUMN (ug/kg)
PAH Compounds:							
Acenaphthene	0.010	10000	0.032	5.216E-04	242	7.65	0.13
Anthracene	0.00639	28184	0.007	1.207E-04	2410	17.62	0.29
Benzo(a)anthracene	0.034	398107	0.003	4.519E-05	16516	45.23	0.75
Benzo(a)pyrene	0.080	1148154	0.002	3.713E-05	4143	9.32	0.15
Benzo(b)fluoranthene	0.084	1148154	0.002	3.885E-05	10331	24.32	0.40
Benzo(g,h,i)perylene	0.061	3235937	0.001	1.010E-05	88634	54.25	0.90
Chrysene	0.044	407380	0.004	5.788E-05	7335	25.73	0.42
Flouranthene	0.058	79433	0.024	3.913E-04	1150	27.27	0.45
Fluorene	0.011	15849	0.021	3.526E-04	1300	27.78	0.46
Indeno(1,2,3-c,d)pyrene	0.059	3162278	0.001	9.947E-06	87096	52.51	0.87
Naphthalene	0.034	2344	0.472	7.788E-03	364	171.73	2.83
Phenanthrene	0.052	28840	0.058	9.652E-04	2630	153.85	2.54
Pyrene	0.034	75858	0.015	2.407E-04	8172	119.20	1.97
Phthalates:							
Bis(2-ethylhexyl)phthalate	591.000	77625	245.60	4.052E+00	11	2627.90	43.36
Butyl benzyl phthalate	0.028	3981	0.23	3.757E-03	11	2.50	0.04
Di-n-octyl phthalate	23.300	77625	9.68	1.598E-01	11	106.51	1.76
PCB	1.060	1584893	0.02	3.560E-04	100000	2157.47	35.60
Phenols	2.33	29	2606.12	4.300E+01	1.4	3648.57	60.20

NOTES:

[pore water] = [sediment]/(Foc * 0.62 * Kow) (from Karickhoff et al., 1979)
log(BCF) = 0.76 * log(Kow) - 0.23
Foc = fraction organic carbon (assumed as 5%)
Kow = octanol water partition coefficients

Sources of Kow:
Superfund Public Health Evaluation Manual October, 1986
ASTDR Toxicological Profile for DEHP, Draft Report, 1988
Chemical Manufacturers Association, Measurements of Kow of Phthalate Esters, 1984

Measured BCF's used for Acenaphthene, Fluoranthene, Fluorene, Phenanthrene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Pyrene, Benzo(b)fluoranthene, PCB, and Bis(2-ethylhexyl)phthalate, and Phenol

TABLE 7 – 5
CALCULATED FLOW FROM PORE WATER SEEPS
AT THE TIDAL FLAT

AREA 1		Length=	164.7	centimeters	
	DEPTH (cm)	WIDTH (cm)	TRAVEL TIME (s)	FLOW (cm3/s)	FLOW m3/low tide
	1.8	16	4.65		
	3	14	5.32		
	1.5	15	4.57		
	2		5.21		
			5.47		
Average	2.075	15	5.0	1016.3	22.0

AREA 2		Length=	183	centimeters	
	DEPTH (cm)	WIDTH (cm)	TRAVEL TIME (s)	FLOW (cm3/s)	FLOW m3/low tide
	3.5	23	4.65		
	3.5	21	4.36		
	2.25	28	4.75		
	2.25	30	4.31		
			4.3		
Average	2.875	25.5	4.5	2998.7	64.8

AREA 3A		Length=	183	centimeters	
	DEPTH (cm)	WIDTH (cm)	TRAVEL TIME (s)	FLOW (cm3/s)	FLOW m3/low tide
	2	10.5	5.4		
	1.5	9.5	5.61		
	1	14	5.59		
	1.5	14	5.98		
	1.8		5.63		
Average	1.56	12	5.6	607.2	13.1

AREA 3B		Length=	166.225	centimeters	
	DEPTH (cm)	WIDTH (cm)	TRAVEL TIME (s)	FLOW (cm3/s)	FLOW m3/low tide
	1.5	8.5	6.39		
	1.8	10	5.89		
	1.8	8.5	6.31		
	1.8	7	6.42		
	1.8		6.66		
Average	1.74	8.5	6.3	388.1	8.4

TABLE 7 - 5 (cont'd)
CALCULATED FLOW FROM PORE WATER SEEPS
AT THE TIDAL FLAT

AREA 4A		Length=	210.45	centimeters	
	DEPTH (cm)	WIDTH (cm)	TRAVEL TIME (s)	FLOW (cm3/s)	FLOW m3/low tide
	1.5	17	6.91		
	1.5	20	7.01		
	1.5	18	6.3		
	1.5	17	7.07		
			7.75		
Average	1.5	18	7.0	810.8	17.5

AREA 4B		Length=	186.05	centimeters	
	DEPTH (cm)	WIDTH (cm)	TRAVEL TIME (s)	FLOW (cm3/s)	FLOW m3/low tide
	1.1	12	5.5		
	1.3	14	5.69		
	1.5	18	5.55		
	1.3	14	5.82		
	2		5.66		
Average	1.44	14.5	5.6	688.3	14.9

	Cubic meters per tidal cycle (6 hrs.) =	140.6

TABLE 7 - 6

STEADY STATE MYSTIC RIVER INCREMENTAL CONCENTRATIONS DUE TO LOADINGS FROM THE TIDAL FLAT

Compound (mg/kg)	Water Column Conc.	Sediment Conc.	Suspended Sediment Conc.	Biota Conc.
Bis(2-ethylhexyl) phthalate	4.470E-04	1.640E-02	5.540E-01	4.922E-03
Di-n-octyl phthalate	2.330E-07	2.170E-01	4.380E-01	2.560E-06
Phenol	1.350E-04	6.420E-05	6.410E-05	1.870E-04

TABLE 7 - 7

A COMPARISON OF SEDIMENT PARTITION COEFFICIENT USED IN ASSESSMENT TO COEFFICIENTS BASED ON VARYING SEDIMENT SOLIDS CONCENTRATION

COMPOUND	Partition Coefficient From Assessment	Partition Coefficient Based on Varying Solids Concentration		
		30 percent solids 450 mg/l	50 percent solids 750 mg/l	60 percent solids 900 mg/l
PAH Compounds				
Acenaphthene	310	653	469	417
Anthracene	874	1840	1321	1174
Benzo(a)anthracene	12341	25985	18662	16583
Benzo(a)pyrene	35593	74941	53822	47825
Benzo(b)fluoranthene	35593	74941	53822	47825
Benzo(g,h,i)perylene	100314	211212	151691	134788
Chrysene	12629	26590	19097	16969
Flouranthene	2462	5185	3724	3309
Fluorene	491	1034	743	660
Indeno(1,2,3-c,d)pyrene	98031	206404	148238	131720
Naphthalene	73	153	110	98
Phenanthrene	894	1882	1352	1201
Pyrene	2352	4951	3556	3160
Phthalates				
Bis(2-ethylhexyl) phthalate	2406	5067	3639	3233
Butyl benzyl phthalate	123	260	187	166
Di-n-octyl phthalate	2406	5067	3639	3233
PCB	49132	103447	74295	66016
Phenols	1	2	1	1

TABLE 7 – 8
A COMPARISON OF MEASURED TO CALCULATED
BIOCONCENTRATION FACTORS

Compound	Calculated BCF	Measured BCF
Acenaphthene	1096	141
Benzo(a)anthracene	18030	16516
Benzo(a)pyrene	40327	4143
Benzo(b)fluoranthene	40327	10331
Chrysene	18348	7335
Fluoranthene	5296	1150
Fluorene	1556	1300
Phenanthrene	2452	2630
Pyrene	5111	8172
PCB	51000	100000
Phenol	1.4	0.88

TABLE 7 - 9
A COMPARISON OF MEASURED BODY BURDENS IN MUSSELS TO VALUES CALCULATED FROM SYNOPTICALLY OBTAINED SEDIMENT CONCENTRATIONS

Compound	Calculated BCF	Measured BCF
Anthracene	14893	524
Benzo(a)anthracene	19138	25264
Benzo(a)fluoranthene	26513	56509
Benzo(a)pyrene	36766	20846
Benzo(e)pyrene	35407	22990
Benzo(g,h,i)perylene	33178	6017
Chrysene	30075	27501
Fluoranthene	32586	20122
Phenanthrene	38125	1130
Pyrene	21857	8164

TABLE 8 - 1
SUMMARY OF DOSE-RESPONSE INFORMATION
FOR INGESTION EXPOSURE
FOR COMPOUNDS DETECTED IN SURFACE SEDIMENTS

COMPOUND	NONCARCINOGENIC REFERENCE DOSE (mg/kg/day)	NONCARCINOGENIC HEALTH EFFECTS OF CONCERN	CARCINOGENIC POTENCY FACTOR (mg/kg/day)-1	CARCINOGENIC WEIGHT OF EVIDENCE CLASS
VOLATILE ORGANICS:				
1,1-Dichloroethene	9E-03 a	Liver lesions	6.0E-01 a	C
SEMIVOLATILE ORGANICS:				
Adipates and Phthalates				
Bis(2-ethylhexyl) adipate	7E-01 a	Decreased body weight	NA	NA
Di-n-hexyl adipate	NA	NA	NA	NA
Bis(2-ethylhexyl) phthalate	2E-02 a	Increased relative liver weight	1.4E-02 a	B2
Butyl benzyl phthalate	2E-01 a	Body weight gain; liver, kidney, testes effects	NA	C
Di(n-octyl) phthalate	NA	NA	NA	D
Total PAHs (Naphthalene)	4E-01 b	Ocular and internal lesions	NA	NA
Carcinogenic PAHs (B(a)P)	NA	NA	NA	B2
Total PCBs	NA	NA	7.7E+00 a	B2
Phenols	6E-01 a	Reduced fetal body weight	NA	NA
INORGANICS:				
Antimony	4E-04 a	Reduced lifespan; altered blood chemistry	NA	NA
Arsenic	NA	Keratosis; hyperpigmentation	1.8E+00 a	A
Beryllium	5E-03 a	None observed	NA	B2
Cadmium (in food)	1E-03 b	Renal damage	NA	D
Cadmium (in water)	5E-04 b	Renal damage	NA	D
Chromium	1E+00 a	Hepatotoxicity	NA	NA
Copper	4E-02 b	Local gastrointestinal irritation	NA	D
Lead	NA	Central nervous system effects	NA	B2
Mercury	NA	Kidney effects	NA	D
Nickel	2E-02 a	Reduced body and organ weights	NA	NA
Selenium	3E-03 b	Hair and nail loss; dermatitis	NA	NA
Silver	3E-03 a	NA	NA	D
Thallium	7E-05 b	Increased liver enzymes (SGOT, serum LDH)	NA	NA
Zinc	2E-01 b	Anemia	NA	NA

NOTES:

1. References Doses, Health Effects of Concern, Carcinogenic Potency Factors and Classifications obtained from:

   a. U.S. EPA, Integrated Risk Information System (IRIS). Chemical Files. October 1989.
   b. U.S. EPA, Health Effects Assessment Summary Tables. Third Quarter FY 1989, July 1989.
   RfD for copper developed from drinking water standard and standard exposure assumptions:
   RfD = 1.3 mg/l x 2 l/day x 1/70 kg body weight = 0.04 mg/kg/day
   CPF for arsenic developed from the proposed unit risk and standard exposure assumptions:
   CPF = 5E-5/ug/l x days/2l x 70 kg x 1 ug/0.001 mg = 1.8E00 (mg/kg/day)-1

2. Weight of Evidence Classification: Group A: Human Carcinogens; Group B: Probable Human Carcinogens; Group C: Possible Human Carcinogens; Group D: Not Classified; Group E: No evidence of Human Carcinogenicity

3. NA = Not Available.

TABLE 9-6

COMPARISON OF CONCENTRATIONS OF CONTAMINANTS IN WATER ON TIDAL FLAT TO ACUTE AND CHRONIC CRITERIA AND REVIEWED TOXICITIES

COMPOUND	CALCULATED PORE WATER CONCENTRATION (ppb)	CALCULATED TIDAL FLAT WATER COLUMN CONCENTRATION (ppb)	ACUTE WATER QUALITY CRITERIA (ppb)	CHRONIC WATER QUALITY CRITERIA (ppb)	TOXIC RANGES FOR VARIOUS MARINE GROUPS (ppb) MARINE PLANTS	MARINE INVERTEBRATES	MARINE FISH
PAH Compounds							
Acenaphthene	0.032	5.216E-04	970	710	500	970	2230
Anthracene	0.007	1.207E-04					
Benzo(a)anthracene	0.003	4.519E-05					
Benzo(a)pyrene	0.002	3.713E-05					
Benzo(b)fluoranthene	0.002	3.885E-05					
Benzo(g,h,i)perylene	0.001	1.010E-05					
Chrysene	0.004	5.788E-05					
Flouranthene	0.024	3.913E-04	40	16		40 to 1090	
Fluorene	0.021	3.526E-04			45000		1680
Indeno(1,2,3-c,d)pyrene	0.001	9.947E-06					
Naphthalene	0.472	7.788E-03	2350		2300 to 199000		2 to 20 *
Phenanthrene	0.058	9.652E-04				100 * to 370	
Pyrene	0.015	2.407E-04					
Phthalates							
Bis(2-ethylhexyl)phthalate	245.60	4.052E+00	2944 **	3.4 ***	> 1%	1000 to 300000	10000 to 550000
Butylbenzylphthalate	0.23	3.757E-03	2944 **	3.4 ***	170 to 5000	700 to 9630	100 * to 470000
Di-noctylphthalate	9.68	1.598E-01					
PCB	0.02	3.560E-04	10	0.03	0.1 to 100	10.2 to 60	0.06 to 15 *
Phenols	2606.12	4.300E+01	5800			5800 to 330000	8000 to 11000

NOTES:

1. (*) denotes chronic range
2. (**) denotes total phthalate esters
3. (***) denotes no effect level for one marine species of marine algae

TABLE 9-5
TOXIC RESPONSES OF ESTUARINE ORGANISMS
TO PCB SEDIMENT CONCENTRATIONS

ORGANISM	COMMOM NAME	RESPONSE MEASURED	TOXIC RESPONSE CONCENTRATION	SOURCE
Nereis virens	sea worm	survival	7.28.	Rubinstein et al., 1983
Mercenaria mercenaria	quahog	survival	7.28	Rubinstein et al., 1983
Palaemontes pugio	grass shrimp	survival	7.28	Rubinstein et al., 1983
Ampelisca abdita	amphipod	survival	66	Hansen et al., 1986
Ampelisca abdita	amphipod	survival and emergence	7.31	Hansen et al., 1986
Parophyrus vetulus	Pacific sole	survival	2.2	Stein et al., 1987
Cyprinodont variegatus	minnow	survival	30.9	Hansen et al., 1986
Uca pugnax	fiddler crab	survival	1.04	Clark et al., 1986
Uca pugilator	fiddler crab	survival	0.97	Clark et al., 1986

Attachment B

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

MEMORANDUM

TO: Richard Chalpin, Acting Regional Environmental Engineer

THRU: John Fitzgerald, Principal Sanitary Engineer

FROM: David Chapman, Senior Sanitary Engineer

DATE: April 9, 1985

SUBJECT: EVERETT - Monsanto Site - Inspection Report

On April 9, 1985 the writer, Robert Kubit and Robert Maietta, both of the DWPC inspected the Monsanto site. The purpose of the inspection was to observe, photograph and screen for volatile organic compounds the soil and water along the shoreline of the Mystic and Malden Rivers adjacent to Monsanto. An H-Nu Model 101 PID was used to screen for VOC's.

The writer observed black, white, red and purple sediment on the north bank of the channel by Monsanto's wastewater outfall. The sediment in photograph number eight was gelatinous. See photo

A sheen was observed on water at photograph location three and along the shoreline fifty feet southwest of there.

In the cove west of the outfall a number of waste materials were seen. There were three or four barrel-shaped pieces of the brown solid shown in photograph ten. Another solid material is shown in picture eleven.

On the river bank south of the cove a black viscous liquid was seen. The liquid, along with the outline of a fiber drum is shown in photograph twelve.

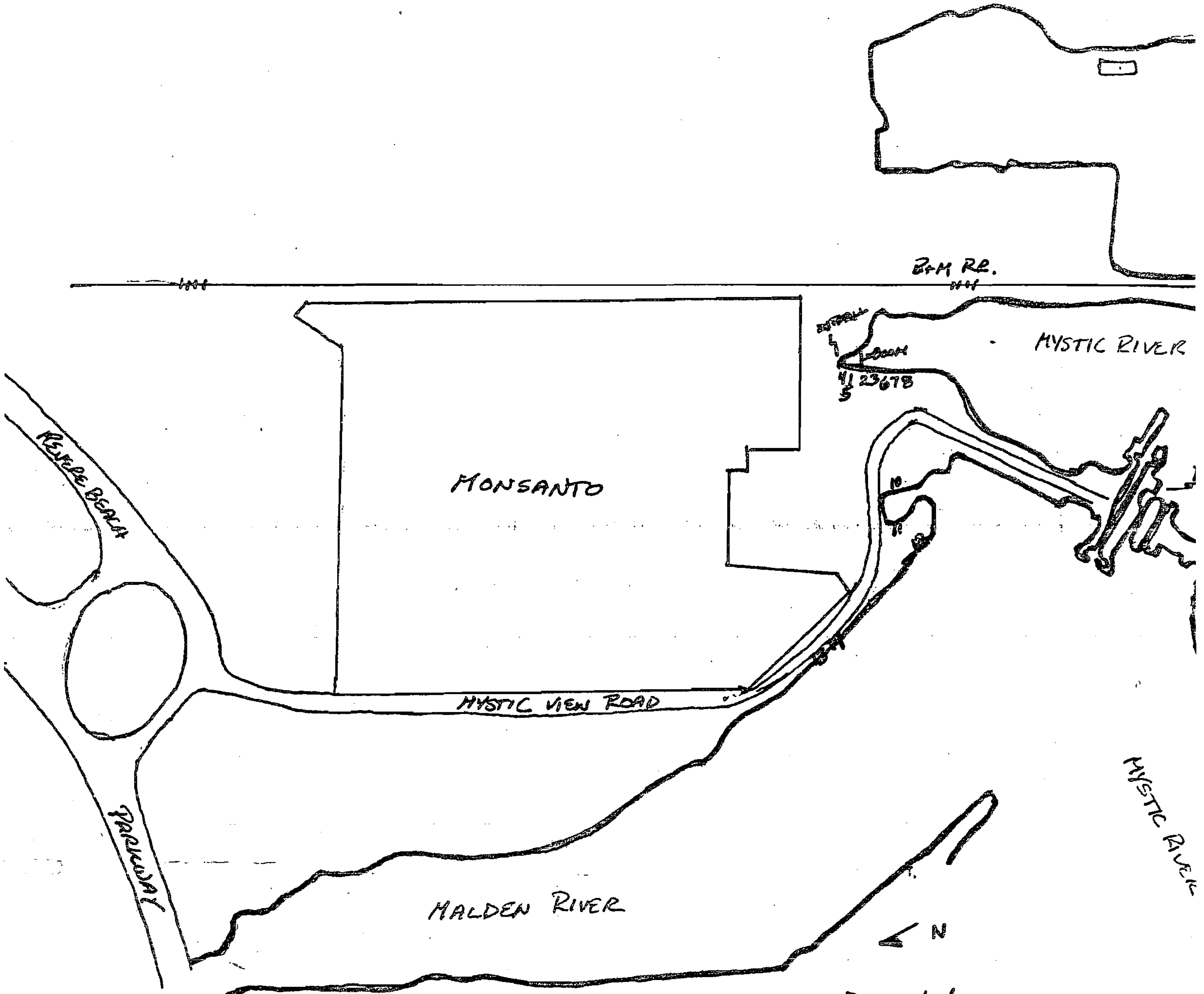
The black liquid and the solids observed in the cove may be the same type of material that Monsanto excavated from the shoreline in June of 1984. Approximately 56 tons of material (described as "miscellaneous debris" in a letter from Monsanto to the Mayor of Everett dated June 29, 1984) and manifested as k024, (distillation bottoms from the production of phthalic anhydride from napthalene) was removed and disposed-of as hazardous waste. Monsanto apparently removed this k024 waste from the shoreline above the high water level but left part or all of the waste in the river below that level.

Photograph thirteen shows a section of riverbank where nothing is growing. Picture fourteen, taken at the same location shows a solid with the appearance of lead though lighter and more brittle, which appears to have solidified upon contact with the river water.

Petroleum odors were noted at photograph location eight. No elevated H-Nu levels were observed.

DC/ae

EVERETT - MONSANTO SITE



DVC 4/9/85

1-14 : Approximate location of Photos Taken @ 4/19/85

April 9, 1985 ①
Polaroid
Everett: Monsanto Site - MDC Property
Witness: Robert Kubit
David V. Chapman

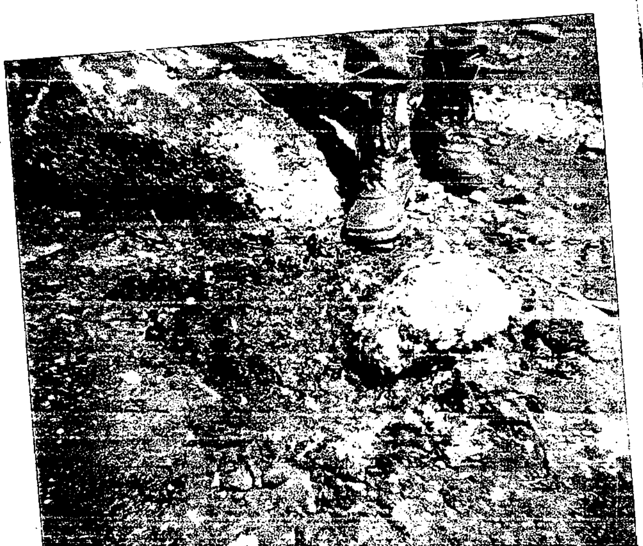
April 9, 1985 ②
Polaroid
Everett: Monsanto Site - MDC Property
Witness: Robert Kubit
David V. Chapman

April 9, 1985 ③
Polaroid
Everett: [illegible]
Witness: Robert Kubit

April 9, 1985 [illegible]
Polaroid
Everett: Monsanto Site - MDC Property
Witness: [illegible]
David [illegible]

April 9, 1985 ⑥
Polaroid
Everett: Monsanto Site - ADC Property
Witness: Robert Lubit
David V. Chapman

April 9, 1985 ⑤
Polaroid
Everett: Monsanto Site - ADC Property
Witness: Robert Lubit
David V. Chapman



April [illegible]
[illegible]

April 9, 1985 [illegible]
[illegible]
Everett: Monsanto Site - [illegible] Property
[illegible]

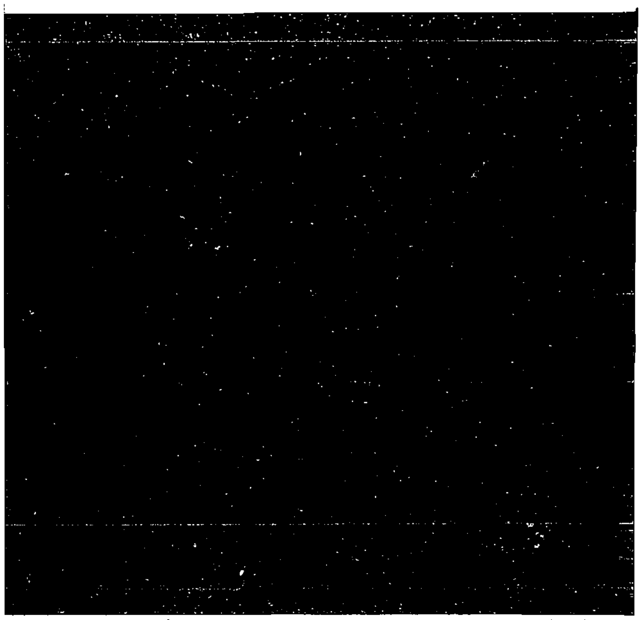
April 9, 1985 (10)
Polaroid
Everett: Monsanto Site - MDC Property
Witness: Robert Kubit
David V. Chapman

April 9, 1985 (11)
Polaroid
Everett: Monsanto Site - MDC Property
Witness: Robert Kubit
David V. Chapman

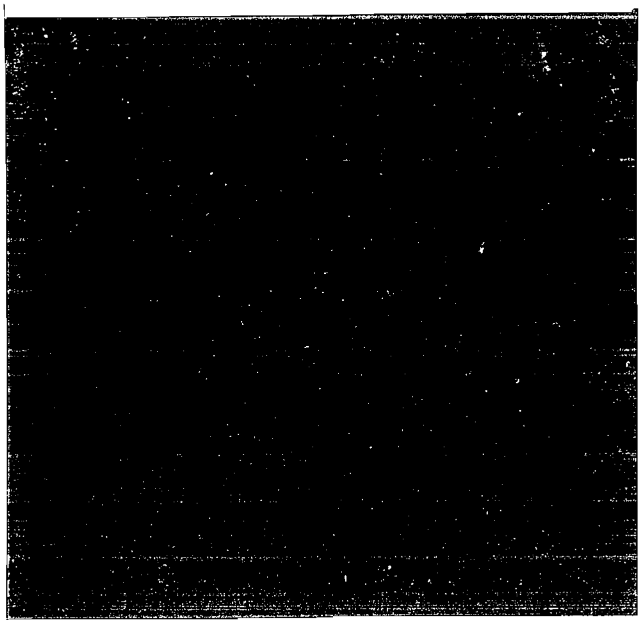
April 9, 1985 (12)
Polaroid
Everett: [illegible] Site - MDC Property
Witness: [illegible]

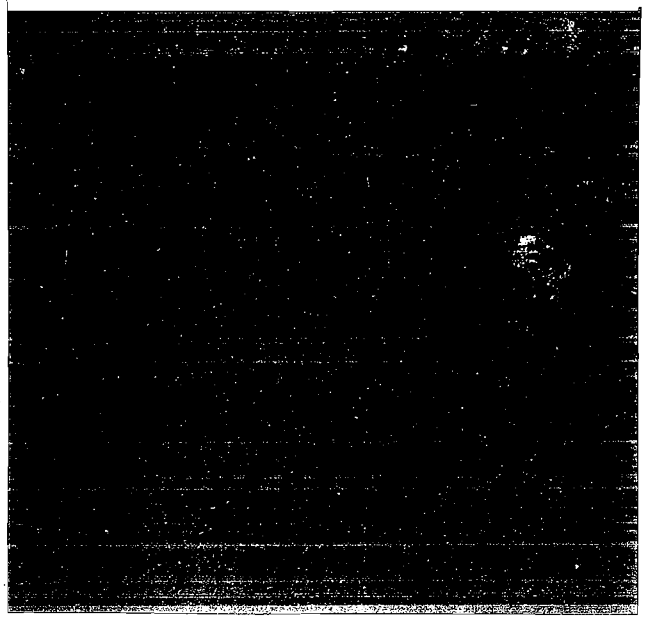
April 9, 1985 (13)
Polaroid
Everett: [illegible]
[illegible]

April 9, 1985 (14)
Polaroid
Everett: Monsanto Site - MDC Property
Witness: Robert Nesbit
David V. Chapman



10





Attachment C

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment C

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

PHASE I
PRELIMINARY ASSESSMENT
AND
SITE INSPECTION REPORT
For the
MONSANTO INDUSTRIAL CHEMICALS CO. SITE
Mystic View Road
Everett, Massachusetts

MARCH 1987

DEQE · MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING

MASSACHUSETTS

FIELD INVESTIGATION TEAM

WEHRAN ENGINEERING CORP.
Engineers & Scientists
Methuen, MA 01844

1.0 SITE DESCRIPTION

The Monsanto Industrial Chemical Company Site encompasses at least three parcels, all under different ownership and a total of approximately 87 acres. It is situated in an industrial area of Everett, along the eastern river bank of the Mystic River and Malden River confluence. The three parcels are briefly described below.

1) A fifty-two acre parcel currently owned by Monsanto Industrial Chemical Company is bounded by the Boston and Maine Railroad to the east, the Mystic and Malden rivers to the west, and the Revere Beach Parkway (Rt. 16) to the north (see Figure 1.1). This facility has been utilized since 1863, for the purpose of manufacturing a variety of chemicals. The potential hazards associated with this parcel are numerous due to over one hundred years of industrial use and historical waste disposal practices and are further described in this section. In general site investigations have found industrial waste such as phthalates, polyaromatic hydrocarbons, PCB's, cyanide, and volatile organic compounds (see Table 4.7.1 for analytical results).

2) A thirty-four acre parcel, located east of the B & M railroad tracks, was purchased from Monsanto by the Boston Edison Co. in 1983. Little file information exists regarding this parcel; however, a 1982 site assessment performed by E.C. Jordon Inc. for Boston Edison indicates that the property was once filled by Monsanto with waste from various manufacturing processes. Thirty tests pits were excavated and evaluated by E.C. Jordan, Inc. Soil samples collected from each test pit revealed the presence of heavy metals, volatile and semi-volatile organic compounds (see Table 4.7.2 for analytical results). (Ref. 81)

3) A one acre parcel located along the river bank adjacent to Mystic View Road was purchased by the Massachusetts Metropolitan District Commission (MDC) from Monsanto in 1963. Prior to the purchase, Monsanto had disposed of several drums of black gelatin and tar-like residue which contained significant concentrations of phthalates and polyaromatic hydrocarbon (PAH) compounds (see Table 4.7.6 for analytical results). (Ref. 34) In May of 1984 Rollins Environmental Inc. excavated twelve hundred tons of material from that stretch of land (Ref. 36). Two hundred tons of excavated material was subsequently manifested by the EPA as K024 hazardous waste. K024 waste is defined by the Code of Federal Regulations (CFR-40) as distillation bottoms from the production of phthalic anhydride from naphthalene. These residues are possibly from a Monsanto operation involving the production of phthalate esters which ceased in 1964.

Based upon the lack of file information, parcel 2) will not be discussed in further detail, however, to describe parcel 1) further, the major areas of concern, identified in the BCM report (1986), on-site include:

1. An 80,000 sq. ft. area near the therminol heater unit (area G in Figure 1.1) in which PCB contamination in the soil exceeds 6150 ppm (see Table 4.7.5 for the analytical results). (Refs. 115 and 119). Possible remedial actions for this contaminated area are currently being assessed by Monsanto. The original source of PCB's was a cooling tower which has been removed from the location. No continuing discharge of PCB's to the area presently exists.

2. A 6,400 sq. ft. 2 area referred to as the on-site surface impoundment or unlined lagoon (area C in Figure 1.1). This unpermitted lagoon was historically utilized as a collection area for yard spills and stormwater in the plasticizer production area. However, acid waste water from the production of H-acid (a textile intermediate last produced in 1965) was neutralized with lime, and clarified in the lagoon. And waste from the production of alum from Bauxite ore was reportedly neutralized and clarified in the lagoon. At one time this water from the lagoon discharged to the Mystic River via a stormwater outfall system. A study by Perkins and Jordan Inc. in 1984 revealed concentrations of phathalate and PAH compounds in the thousands of parts per million range, cyanide concentrations of 1.0 to 126 ppm and arsenic concentrations of 5.0 to 26.3 ppm (Ref. 29a). During Wehran's site inspection of June 13, 1986 a rainbow colored sheen was observed on the lagoons surface and a sulphur like odor was evident (Ref. 118).

Presently, the lagoon is isolated and receives no waste or storm water. Monsanto has contracted with Perkins and Jordan Inc. to develop a lagoon remedial action/closure plan.

3. The tank farm area located north of the Monometrics Department (areas B and G in Figure 1.1) was the scene of a 30,000 gallon polymeric plasticizer spill in February of 1984. The product was identified by Monsanto representatives as Sanitizer 367 which leaked from storage tank No. 7. As of March 1984 7,500 gallons of this material was recovered (Refs. 29 and 30).

Pursuant to MGL Chapter 21E, the DEQE ordered Monsanto to perform a hydrogeologic study of the spill site (Ref. 29). Monsanto subsequently received a proposal from Ground Water Technology Inc. for such a study, which was approved by DEQE. This study is for a recovery/treatability pilot project to develop information necessary to design approximate ground-water treatment systems.

Approximately 400 gallons of this material was released to a tidal flat area along the Mystic River via the storm drain and outfall system. Any spills to this system are considered to be a violation of Monsanto's National Pollution Discharge Elimination System (NPDES) permit. (Ref. 27a). The quantity recovered as of August 1986 is unknown, however, the spill was verified by a recent telephone conversation with Chief Petty Officer Mike Shoul of the U.S. Coast Guard (Ref. 20). Emergency procedures regarding spills, emissions or leaks which occur at the plant are currently covered under Monsanto's contingency plan (August, 1984), which is required under it's RCRA Part A interim status permit.

4. The tidal flat and headwall (areas V and W in Figure 1.1) located near the B & M railroad tracks and the confluence of the Mystic and Malden rivers. The headwall is a NPDES permitted outfall which currently discharges approximately 200,000 gallons per day of stormwater, non-contact cooling water, steam condensate, cooling tower blowdown and ground-water infiltration to the system. Based upon a recent

discussion with Jack Duggan of the DEQE the discharge from the outfall has decreased as of 1985 from 7,000,000 gallons per day to the 200,000 gallons per day rate in order to meet the newly revised, draft-NPDES permit regulations. The discharge prior to 1985 consisted of water from the lagoon and process water generated from the following four industrial operations: 1) plasticizers used in the housing automotive and food industry. 2) water treatment chemicals such as deflocculating agents. 3) industrial acids such as sulfuric acid and possibly cyanuric acid and 4) paper resin. Other accidents which were violations of the NPDES outfall include an estimated 700 gallon sulfuric acid spill (presumably in areas I or A in Figure 1.1) which entered the storm water drainage system, then discharged to the Mystic River (Refs. 1 and 2). Also released to the outfall in April of 1979 was 1 to 2 gallons of No. 6 fuel oil (Ref. 29b). During Wehran's site inspection of June 13, 1986 a rainbow colored sheen was observed on the surface water flowing from the headwall. (Ref. 118) The NPDES permit is presently under review by the USEPA. Hearings were held in the fall of 1986 and the issuance of a revised permit should be forthcoming.

The tidal flat area has been studied by the following consultants for Monsanto; BCM Inc. (April 1986), Skinner and Sherman Laboratories Inc. (September 1984) and Marco Kaltofen Inc. (August 1984). The major compounds identified during the most recent sampling event by BCM Inc. indicates the presence

of PCB's ranging from .24 to 12.7 ppm, phthalate and PAH compounds ranging from below detection limit to 4,130.3 ppm. (See Table 4.7.7 for analytical results). (Refs. 40, 46 and 119a.)

5. The groundwater from the monitoring well installed by BCM Inc. (W-5-8 in Figure 1.1) was sampled and determined through laboratory analysis to contain both adipate plasticizer and phthlate plasticizer. Monsanto has performed additional investigations in this area for the purpose of developing a remediation plan.

Areas A through X (depicted in Figure 1.1) have been investigated to varying degrees by BCM Inc. A few of these areas are discussed below:

6. A 15 acre area (area A in Figure 1.1) on the northern portion of the site. This is the location of a May 3, 1985 brush fire which exposed approximately 60 drums presumably containing Melamin formaldehyde resin. A report by Roy F. Weston (May 1985 indicated that all of the drums which were exposed were removed. (see references 66, 67, 68, 74, 74a).

7. A 960 sq. ft. outdoor waste pile (area D in Figure 1.1) located on the northern portion of the plant. This area was reportedly utilized as a holding area for fiber drums containing un-solidified styrene-maleic anhydride copolymer, but has not been used since 1981 (Refs. 5 and 37). A RCRA inspection on October 20, 1983 showed that the waste had been removed from the pile.

8. An 800 sq. ft. indoor storage room (near area K in Figure 1.1) located on the southwest portion of the plant. This room was reportedly utilized for the storage of bagged and drummed asbestos from old plant insulation. (Refs. 5 and 37). A closure plan is currently being developed for this area under Monsanto's RCRA Part A permit.

9. The former wetland and intertidal zone (area X in Figure 1.1) on the south side of the Monsanto property. This area was filled with dredged material from the Mystic River when the Amelia Erhart Dam was constructed (see Photo 5.0 in Appendix B).

The marsh land (area A in Figure 1.1) north of the plant which was reportedly filled with an unknown quantity of calcium sulphate sludge. This sludge was generated in the lagoon during treatment of wastes from acid production. This area, which encompasses area C in Figure 1.1

also contains two tons of burned, cyanuric acid purification process waste. Disposal of this waste occurred in 1965 by Monsanto (Refs. 5 and 37). In 1979 the process was modified to recover the sludge. This waste which was generated by chemical manufacturing processes, was addressed in the DEQE RCRA file information; however, the disposal areas north of the plant are not RCRA permit.

10. The sewer system beneath the Monsanto plant: Waste water from the production of Dequest (produced in building 37), plasticizers, and polymers (produced in buildings 62 and 63) is collected in sewers, neutralized and discharged to the MWRA

sewer system (formerly the MDC sewer system). Waste water from isocyanuric acid (last produced in 1982) also flowed into the MDC sewer system (see Section 4.2 and 5.0 for further discussion on sewers as pathways for migration). Ref. 33). This system is associated with Monsanto's NPDES and MWRA permits, however, can be addressed as a CERCLA issue due to the nature of contaminant migration to the Mystic River.

To describe parcel 3) the major area of concern includes:

- The river bank (area S in Figure 1.1): This is where sulfuric acid, chlorosulfonic acid, lead sulfate and iron oxide from acid production was allegedly disposed of by Monsanto. During Wehran's site investigation of June 13, 1986 sulphur crystals on rocks along the shore line were observed (see Photo 6.0 in Appendix B) (Refs. 5 and 37). Based upon a May 16, 1984 memorandum by Bill Sirull of the DEQE, distillation bottoms from high vacuum fractional distillation bottoms from high vacuum fractional distillation of phthalic anhydride processes, as well as insoluble material (80% maleic acid, 15% phthalic acid) from an off-gas scrubber were disposed of along the river bank between 1937 and 1955 (Ref. 33).

Hydrogeologic investigations performed by Dames and Moore (January 1986) and BCM Inc. (January 1986) and Perkins Jordan Inc. (April 1984) indicate that the entire facility, including the Boston Edison property is underlain by five to fifteen feet of contaminated fill material (see

References 79, 90a, 81). In general the fill material based upon laboratory analysis of soil and ground water samples contains calcium sulfate, metal debris, high levels of phalthalates and PAH compounds with lower levels of volatile organic compounds. Also identified were cyanide, arsenic and PCB's. Section 4.5 describes the appearance of fill material more completely. Table 4.7.1 provides an analytical summary of soil and ground-water samples collected on the fifty-two acre parcel owned by Monsanto.

1966 to maintain constant water levels upstream, to control tides and to reclaim tidal flats and wetland areas for recreational and industrial uses. The dam represents a freshwater/saltwater boundary line in which portions of the site lie both upstream and downstream of it.

Sediment samples were collected by Goldberg-Zoino and Associates from the Mystic River at locations of proposed piers 4, 7 and 14 (downstream of the dam and headwall) for the Draw 7 replacement in Somerville and Everett. Analysis indicates the presence of contaminants similar to those identified in soil and ground-water samples collected on-site. For example, PCB's (22 to 860 ppb), arsenic (2.9 to 96 ppm) naphthalene (3,500 ppb) and phthalate and PAH compounds in the hundreds of parts per million range (see Section 4.7 for further interpretation of analysis).

Based upon telephone conversations with members of the Mystic River Watershed Association, the Everett Water Department and the MWRA, neither the Mystic River or Malden Rivers are being utilized by the community for a drinking water supply, however, the potential exists that these water ways are being utilized for industrial purposes. The MWRA supplies drinking water to Everett and its neighboring cities via the Quabbin Reservoir in central Massachusetts. The Mystic River, however, is classified as a river which may be used for recreational purposes, i.e. fishing and boating (Refs. 123 and 124).

4.3 Groundwater

Studies performed by BCM Inc. (1986) and Dames and Moore Inc. (1980), indicate that the direction of shallow ground-water flow is from the northwest corner of the site to the southwest, towards the Mystic and

Malden rivers. However, a conflicting report by Perkins and Jordan Inc. (1984) suggests that a portion of the site, specifically the plasticizer lagoon area may flow in a northerly direction towards a marshy area and then towards the Malden river. Perkins and Jordan's conclusion was based upon data collected from six piezometers installed around the lagoon's periphery. Dames and Moore based their conclusion upon data collected from eight shallow monitoring wells and BCM Inc. upon data collected from nine deep and seventeen shallow monitoring wells. The mounding effect of the ground-water table near the unlined lagoon area may be caused by the collection of precipitation in the lagoon which could be acting as a recharge area.

Dames and Moore calculations assumes an estimated hydraulic gradient of seven to thirteen feet per mile in the shallow ground-water regime. BCM's calculations for velocity of ground-water flow was 0.47 to 4.7 feet per day in the shallow regime and 0.4 to 1.7 feet per day in the deep regime. BCM Inc. identified the directional flow of the deeper water bearing zone as southerly and that the potentiometric head in the shallow zone is generally several feet higher than in the deeper zone. This situation typically provides a potential driving force for downward migration of contaminants. Dames and Moore pointed out that the existence of over two-hundred old foundation boreholes could be a conduit for vertical migration of contaminants through the clay sequence which overlies most of the property.

Analysis of soil samples collected from test pits and borings and ground-water samples collected from on-site monitoring wells indicates that ground-water within the vicinity of the site is contaminated with

acid, base/neutral compounds, volatile organic compounds, heavy metals and PCB's, which can potentially migrate in the same southerly direction of ground-water flow, towards the Mystic and Malden Rivers (See Section 4.7 for analytical results).

The possible use of ground-water within the vicinity of the site is discussed in Section 4.6.

4.4 Bedrock Geology

The bedrock geologic map of the Boston North, Boston South and Newton Quadrangles, Massachusetts by Clifford A. Kaye, 1980 indicates that three distinct bedrock formations underlie the site. The major formation (As) is characterized as an Argillite and Sandstone or Quartzite formation. The other two (Asr) (depicted in the central portion of Monsanto's property) and (SQ) (shown underlying Boston Edison's property) are referred to as Red Beds and sandstone or quartzite respectively. The Argillite formation is also referred to as Cambridge slate, which is the upper formation of the Boston Bay group. This formation was probably deposited as clay during the Paleozoic Epoch in either a lake or marine embayment and lithofied due to compaction of the overlying sediments.

During BCM Inc.'s 1985 hydrologic investigation, two different bedrocks were identified. The Cambridge argillite formation was encountered between 68 to 89 feet below the ground surface and the other formation, classified by BCM Inc. as a diorite, was encountered between 24 and 32 feet below the ground surface. The diorite was apparently more resistant to weathering than the deeper argillite bedrock.

Based upon the Dames and Moore January 1985 report and U.S.G.S. Bulletin 839 on the geology of the Boston Massachusetts by Lawrence LaForge, there exists a complex history of deformation including faulting, folding, volcanic activity and intrusions of previously molten rock throughout the Boston Basin area. Therefore the extent of weathering, fracturing and deformation of the bedrock may be variable throughout the site.

4.5 Soils and Surficial Sediments

Classification of on-site soils was based primarily upon data from two surface geophysical surveys, thirty-four test pits, twenty-three soil borings and six hand auger borings performed by BCM Inc. in 1985, a test pit excavation program conducted by E.C. Jordan in 1982, and a hydrogeologic report by Dames and Moore in December 1980 (Refs. 79, 83, 90a).

In general, the strata underlying the site, from grade to bedrock, consists of 40 to 84 feet of the following sediments:

- 5 to 15 feet of man-made fill. The fill beneath the Monsanto property was described by BCM as having lenses of reddish black liquid material, black viscous matrix-phthalic anhydride, powdered cement, white liquid-gypsum, purple sand and black oily material with a naphthalene odor. The fill material on Boston Edison's property was described by E.C. Jordan as having layers of bright reddish-purplish sandy size material, multi-colored fragments of yellow, pink, reddish and black wood, gravel, bricks and asphalt, and yellowish-orange sandy size material. Priority pollutant analysis of the fill

material on both properties indicates the presence of phthalates and volatile organic compounds. See Section 4.7 for greater detail.

- 5 to 15 feet of dark brown organic silt and peat which are considered tidal marsh or riverine deposits.
- 10 to 30 feet of gray-blue highly plastic impermeable clay with occasional lenses of silt and sand.
- 10 to 44 feet of silt, sand and gravel.
- Bedrock was encountered at shallower depths in the middle portion of the site, therefore, the sediments thicken towards the rivers. These sediments overlying the bedrock are of the pleistocene age probably deposited during the Wisconsin glaciation when the ice lobes were retreating and the rivers were being formed.

4.6 Water Supplies

Based upon telephone conversations with representatives from the DEQE, the Mystic River Water Shed Association, the Everett Board of Health, the Metropolitan District Commission (MDC), and Massachusetts Water Resource Authority (MWRA), all drinking water obtained within a three mile radius of the site is municipally supplied by the MWRA (See references 121, 122 and 123).

The MDC is supplied water via an underground aqueduct which originates at the Quabbin and Wachusett reservoirs located in Central Massachusetts. These water sources and the Ware River supply water to 46 communities in the greater Boston area, including the cities of Everett, Chelsea, Medford, Malden, Revere and Somerville. Everett is supplied by

7.0 SUMMARY AND CONCLUSIONS

Based upon Wehran's extensive file review and a recent critique of the BCM February 1986 report, the historical use of this site since 1868 by industry has caused a condition whereby industrial and/or hazardous wastes, can be found throughout the study area. The DEQE data base regarding the impact of the Monsanto lands (former and/or present) on the external environment provides sufficient evidence of a release of toxic materials to the groundwater and the environment. It has not yet been determined whether this release of hazardous materials has the potential to cause a significant detrimental effect on the environment. The Monsanto facility is considered by DEQE to be one of many nearby potential contributers to the pollution of the Malden/Mystic Rivers. The DEQE has assigned Wehran Engineering the task of developing a more regional investigation to determine the overall environmental condition of the area. Should Monsanto or any other source clearly be demonstrated to be causing a pollution condition, having a negative public health or environmental effect, appropriate remedial actions will be directed by DEQE.

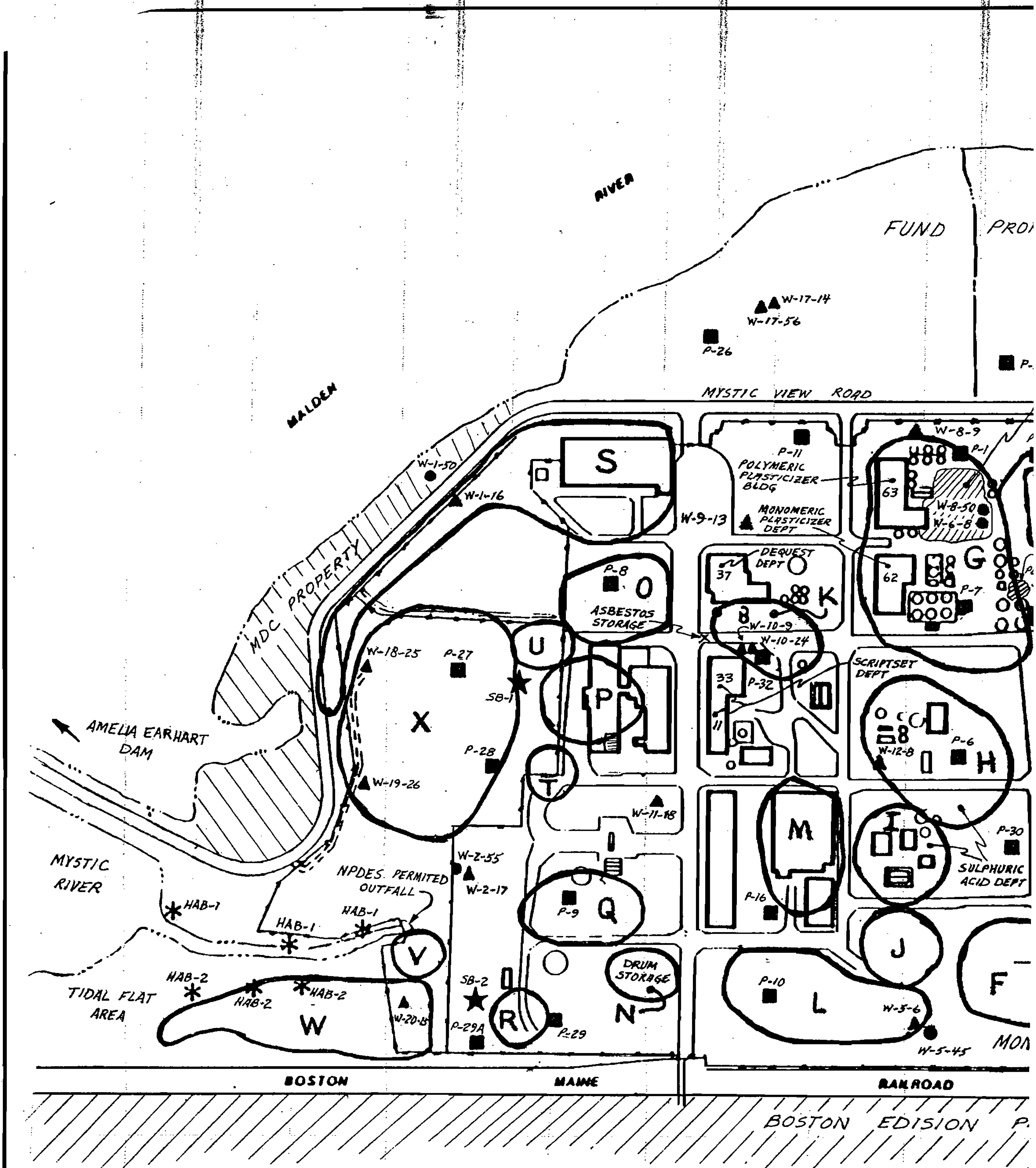
Further delineation of Monsanto source areas, not covered by RCRA, such as the lagoon, is recommended. Those areas; however, which may be covered by RCRA, such as the 30,000 gallon plasticizer spill, should be addressed as a CERCLA issue based upon the potential impact on the surrounding environment. Those areas temporarily utilized as storage facilities for hazardous waste would be addressed by RCRA. The numerous tanks observed on-site which are used for the purpose of storing chemicals are also covered under Monsanto's RCRA - Part A permit and permits with the Everett Fire Department.

The overall direction of ground-water flow on-site is south-southwest towards the Mystic and Malden River. Based upon the BCM report (1986) the directional flow of ground-water in the shallow aquifer is southwesterly with the possible exception of the lagoon area which may have a northerly component of flow, towards a tributary to the Malden River. The directional flow of groundwater in the deeper zone is southerly towards the Mystic River. Surface water and ground-water which infiltrates the storm drain system, flows to the NPDES outfall located in the tidal flat area on the Mystic River. Those contaminants which are widely prevalent throughout the site, have also been identified in the tidal flat and river bank areas. These contaminants include base/neutral extractable compounds such as phthalates and polyaromatic hydrocarbons, volatile organic compounds, heavy metals and PCB's. Similar contaminants were also identified in the Mystic River sediments by GZA Inc. in February 1986.

Contaminants reaching the Mystic and Malden Rivers via discharge of contaminated ground-water and surface runoff can accumulate in the river sediments and possibly enter the food chain. Ultimately, sufficient contaminant loadings from Monsanto, as well as other urban and industrial sources, could adversely affect aquatic life and create a pathway to humans via ingestion of contaminated fish. In a recreational sense, individuals with access to the tidal flat and shoreline areas or any on-site location where waste materials are exposed, could potentially be affected by contaminants generated by Monsanto processes and past disposal practices.

All drinking water within a three mile radius of the site is municipally supplied by the MWRA. The MWRA is supplied water via an underground aqueduct system which originates at the Quabbin and Wachusetts reservoirs located in Central, Massachusetts. A slight possibility exists that private industries are utilizing ground-water wells and the Mystic and Malden Rivers for industrial purposes within the vicinity of the site. If so, a potential exists that the site has impacted these water supplies.

In summary, additional investigations should be integrated to meet the regulatory objectives and provide a sound basis for developing long-term remedial alternatives beyond the simple removal actions completed to date.



WEHRAN ENGINEERING
CONSULTING ENGINEERS

SCALE

0 100 200 ft.

9

MASSACHUSETTS FIT CONTRACT

PHASE I PRELIMINARY ASSESSMENT AND SITE INVESTIGATION REPORT

MONSANTO INDUSTRIAL CHEMICAL CO. SITE

EVERETT, MASSACHUSETTS, MIDDLESEX COUNTY

DEQE Project Number 86-01-074-096

WE Project Number 50074.10

Wehran Overall Task Manager: Jeffrey Gram

DEQE Task Manager: Jack Duggan

September 1986

Approvals

Wehran	Kevin M. Burger, C.E.P.	Project Manager	______________________
DEQE	Richard Bates,	Contract Administrator	______________________

TABLE 4.7.1

Chemical Analysis of Soils and Ground-water
at the Monsanto Industrial Chemical Company Site

Contaminants	BCM - February 1986 Report Maximum Concentrations Soils (~36 samples)	Ground-water (~21 samples)	Dames and Moore - January 1980 Maximum Concentrations Surface Water (from Mystic River's edge) (1 sample)	Ground-water (~7 samples)	Soil (1 sample)
BASE/NEUTRAL COMPOUNDS (ppb)					
Acenaphthene	1,540	--	--	--	--
Acenaphthylene	1,240	--	--	--	--
Anthracene	5,300	--	--	--	--
Benzo(a)anthracene	19,900	--	--	--	--
Benzo(a)pyrene	22,500	--	--	--	--
Benzo(b)fluoroanthene	35,000	--	--	--	--
Benz(k)fluoranthene	37,700	--	--	--	--
bis(2-Ethylhexyl)phthalate	1,380,000	63,800	38	50	18
chrysene	17,400	--	--	--	--
Dibenzo(a,h)anthracene	81,800	--	--	--	--
Di-n-butyl phthalate	4,350	634	--	53	--
2,4-Dinitrotoluene	--	15.5	--	--	--
Di-n-octyl phthalate	2,300,000	48,400	--	22	--
Fluoranthene	19,500	23.1	--	--	--
Fluorene	10,100	6.31	--	--	--
Indeno (1,2,3,-c,d)pyprene	11,400	--	--	--	--
Naphthalene	385,000	715	--	--	--
Phenanthrene	21,800	19.4	--	--	--
Pyrene	25,700	14.8	--	--	--
Butyl benzl phthalate	141,000	12,300	38	28	--
VOLATILE ORGANIC COMPOUNDS (ppb)					
Benzene	66.8	15.3	--	--	--
Ethylbenzene	243	--	--	--	--
Methylene chloride	4,880	50.6	--	--	--
Tetrachloroethylene	30.1	5.73	--	--	--
Toluene	19,500	25.6	--	--	--
1,1,1-Trichloroethane	--	--	--	--	--
Trichloroethylene	--	2.15	--	--	--
ACID COMPOUNDS (ppb)					
2,4-Dimethylphenol	--	25.4	--	--	--
p Chloro-m-Cresol	--	--	--	--	--
phenol	19,400	311	--	--	--
PCB's/PESTICIDES (ppb)					
PCB-1248	21,300	--	--	--	--

TABLE 4.7.1 (cont.)

Chemical Analysis of Soils and Ground-water
at the Monsanto Industrial Chemical Company Site

Contaminants	BCM - February 1986 Report Maximum Concentrations Soils (~36 samples)	Ground-water (~21 samples)	Dames and Moore - January 1980 Maximum Concentrations Surface Water (from Mystic River's edge) (1 sample)	Ground-water (~7 samples)	Soil (1 sample)
INORGANICS (ppb)					
Sulfates	14,600.00	19,000,000.00	.027	2,507,000.00	--
Cyanide	10,000.00	3,690.00	--	24.00	--
Arsenic	31,500.00	1,100.00	--	180.00	--
Formaldehyde	53,040.00	920.00	--	--	--
Zinc	912,000.00	160.00	--	203,000.00	--
Lead	354,000.00	36.00	--	370.00	--

TABLE 4.7.2

Chemical Analysis Soils & Ground-water
at Monsanto Industrial Chemical Company Site

- Samples collected on Boston Edison Property - Perkins Jordon, Inc. - May 1982

Maximum Concentrations

Contaminants	Soils (37 samples)	Ground-water (3 samples from test pits)
SULFATE (ppb)	1,452,000	--
METALS (ppb)		
Lead	9,700	56,000
Arsenic	380	--
VOLATILE ORGANIC COMPOUNDS (ppb)		
dichloromethane		1,700,000
1,1-dichloroethane	--	2,000
trans-1,2-dichloroethylene	--	17,000
chloroform	--	25,000
trichloroethylene	--	25,000
benzene	--	3,000
toluene	140,000	4,000
chlorobenzene	16,600,000	--
Ethylbenzene	--	2,000
SEMI-VOLATILE ORGANIC COMPOUNDS (3 samples) (ppb)		
hexachloroethane	28,000	--
acenaphthene	2,200,000	--
4-chlorophenyl phenylether	67,000	--
dibutyl phthalate	200,000	--
bis (2-ethylhexyl) phthalate	3,500,000	--

TABLE 4.7.3

Analysis of Mystic River Sediments

Goldberg-Zoino Associates Inc. - February 1986

Contaminants	Maximum Concentrations		
	Sediments from the East Side of Mystic River (ppb) [1-sample]	Sediments from the Middle of Mystic River (ppb)[1-sample]	Sediments from the west side of Mystic River (near bank)(ppb)[1-sample]
BASE/NEUTRAL COMPOUNDS (ppb)			
Naphthalene	--	--	3,500
fluorene	--	--	3,100
phenanthrene	--	110	16,000
anthracene	--	--	6,100
fluoranthene	1,300	230	30,000
pyrene	1,600	210	26,000
benzo(a)anthracene	--	--	14,000
bis (2-ethylhexl) phthalate	360,000	34,000	540,000
chrysene	--	150	12,000
di-n-octyl phthalate	--	--	14,000
benzo(b) fluoranthene	--	--	2,000
benzo(a) pyrene	--	--	12,000
ideno (1,2,3-c,d) pyrene	--	--	7,000
benzo (ghi) perylene	--	--	7,000
ACID COMPOUNDS (ppb)	--	--	--
TOTAL OIL AND GREASE (mg/g)	3	1	14
TOTAL VOLATILE RESIDUE (%)	7.7	20	25
PESTICIDES/PCB's (ppb)			
PCB-1248	390	22	200
PCB-1254	400	46	860
METALS (ppb)			
Arsenic	96,000	29,000	27,000
Cadmium	59,000	< 500	3,700
Chromium	31,000	5,800	83,000
Copper	680,000	10,000	190,000
Lead	220,000	13,000	380,000
Zinc	650,000	19,000	360,000

TABLE 4.7.4

Chemical Analysis Soils and Lagoon Sludge

Perkins and Jordan - April 1984

Contaminants	8 Soil Borings Surrounding Lagoon (8 samples) MAXIMUM CONCENTRATIONS	Surfacewater Runoff (5 samples) MAXIMUM CONCENTRATIONS	Lagoon Sludge (1 sample)
VOLATILE ORGANIC COMPOUNDS (ppb)			
Toluene	--		4,000
ethylbenzene	--		10,000
xylene	--		85,000
SEMI-VOLATILE ORGANICS (ppb)			
anthracene/phenanthrene	2,200		--
bis (2-ethyl hexyl) phthalate	5,800	2,400	9,300,000
butyl benzyl phthalate	--	--	6,000,000
2-4-dimethylphenol	81,000		--
di-n-butylphthalate	49,000	500	2,000,000
di-octyl phthalate	--	1,000	3,700,000
phenol	34,000		--
pyrene	450		--
fluoranthene	820		--
INORGANICS (ppb)			
arsenic	26,300	--	27
chromium	29,500	8	18
copper	18,200	26	--
lead	18,400	55	10
nickel	36,600	--	--
zinc	50,400	170	--
cyanide	126,000	--	--
OIL AND GREASE (ppb)		340,000	

TABLE 4.7.5

PCB Concentrations in the Terminol Heater Area

BCM Inc. - June 1986

Sample Depth	Maximum Concentration of PCB's per Sample depth (ppb)
0.0 - 1.0	6,150,000
1.0 - 3.0	2,630,000
3.0 - 4.0	37,000
4.0 - 6.0	740,000
6.0 - 8.0	19,000
8.0 - 10.0	ND

TABLE 4.7.6

Chemical Analysis of Samples Collected from MDC Property, Along River Bank

E.C. Jordon - April 1984

Contaminants	Maximum Concentrations Black Tar Solid (2 samples)	Getatine-like Material (1 sample)
VOLATILE ORGANIC COMPOUNDS (ppm)	< 40	< 40
SEMI-VOLATILE ORGANIC COMPOUNDS (ppb)		
Anthracene/Phenanthrene	47,000	--
Acenaphthene	140,000	--
Butyl Benzyl phthalate	450,000	--
Di-octylyphthalate	800,000	--
Naphthalene	1,200,000	--
Bis (2-Ethylhexyl) phthalate	1,100,000	2,600
Di-N-Butylphthalate	35,000	700
METALS (ppm)		
Arsenic	1,000	--
Chromium	6,500	6,500
Copper	15,700	19,200
Lead	39,300	134,000
Zinc	114,000	19,700
Cyanide	14,000	10,000
Nickel	1,000	10,400
FLASHPOINT (Degrees F)	> 140	> 140

TABLE 4.7.7

Analytical Results of Tidal Flat Soil Samples

Contaminants Detected (ppb)	Skinner & Sherman Laboratories, Inc. September 1984 Maximum Concentrations (6 samples) Sample depth = 2 feet	BCM Inc. - August 1986 Maximum Concentrations (10 samples) Sample depth = 1 - 2 feet
Di-(Ethylhexl) Phthlate	--	4,130,300
Di-N-Octyl Phthalate	--	161,900
Total PCB's	2,500	7,870

TABLE 4.7.7

Analytical Results of Tidal Flat Soil Samples

Contaminants Detected (ppb)	Skinner & Sherman Laboratories, Inc. September 1984 Maximum Concentrations (6 samples) Sample depth = 2 feet	BCM Inc. - August 1986 Maximum Concentrations (10 samples) Sample depth = 1 - 2 feet
Di-(Ethylhexl) Phthlate	--	4,130,300
Di-N-Octyl Phthalate	--	161,900
Total PCB's	2,500	7,870

Attachment D

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

NO Report ?

SAMPLING AND QA/QC PLAN

Sediment Sampling

Of the

Mystic, Malden, and Island End Rivers

November, 1987

DEQE - MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING

MASSACHUSETTS

FIELD INVESTIGATION TEAM

WEHRAN ENGINEERING CORP.
Engineers & Scientists
Methuen, MA 01844

and sub-bottom data in the Malden River where optical survey control is not applicable in any event. In this manner, it can be determined if the sub-bottom profiling is at all feasible. If it is found to be feasible, this technique would be used throughout the survey.

2.3 SEDIMENT SAMPLING

Forty-four (44) sampling locations are proposed in this sampling program (see Plate 1). These locations were selected based on potential source areas. Minor deviations from these locations may be indicated by the results of the bathymetric survey. The specific rationale for sampling locations is described in Section 3.0.

The sampling device that will be utilized to collect river sediments will be a portable vibracorer consisting of a mechanical vibrator and a 3-inch diameter aluminum pipe. The portable corer is capable of obtaining 8-10 feet of sample in silty sands, muds, and soft clays. Vibracores will be taken to a depth of 10 feet below the mud line, or to refusal. Refusal is defined as achieving a rate of penetration which is less than 6 inches per minute.

As a backup system, EG&G will also furnish a gravity corer equipped with 200 pounds of core weights. This system will permit coring in water depths greater than 25-30 feet, which is the maximum depth for the portable vibracorer.

Continuous samples obtained by either sampling method will represent, assuming complete recovery, a complete stratagraphic record of sedimentation. The samples obtained will be geologically classified utilizing the Burmister Classification, and logged and screened in the field. Sediment sections of six inches will be collected for chemical analysis. In addition, the continuous sediment samples should enable cross correlation between sampling locations and the possibility of sampling similar horizons both upgradient and downgradient from potential contaminant sources.

Surface sections (0-6") will be sampled at all 44 locations. If it appears that settling has occurred in the core to a depth of greater than 6 inches, a grab sampler will be used to collect sediment at this depth. In addition, two 6" sections will be sampled from the cores at one third of the stations, for 30 additional samples. The locations where these additional samples will be taken, as well as their depth, will be decided as the samples are collected.

All samples will be analyzed for base neutral extractables, PCB's, and total organic carbon (TOC's). Samples taken from 13 of the locations will be analyzed for priority pollutant metals. The locations selected for metals analyses are numbered 3, 5, 6, 7, 17, 20, 23, 28, 34, 39, 41, 42, and 44 (see Plate 1) based on suggested sources of these contaminants identified in the Record Search. Samples taken from 12 locations (to be determined) will be analyzed for acid extractables.

2.4 SURVEY CONTROL

The successful completion of any marine geophysical survey is based on the accuracy of the survey control. The survey control for this project will be provided by ASEC Corporation of Boston, Massachusetts. In order to relate this and other future surveys, as well as past surveys, it is recommended that area wide survey control be established for this project. The existing MDC photogrammetric survey previously described will provide an adequate survey base for the upper portion of the Mystic River study. To establish appropriate survey control in the lower Mystic River, a survey control baseline will be established throughout the project area so that control is established and future surveys or locationing activities can be referenced to a permanent common set of control points. It is also recommended that this survey control be tied in with photogrammetry of the project area in order to provide an on-site and off-site permanent reference base which will include all of the surrounding industrial areas.

The Mystic River near the General Electric Company and Mystic River Reservation in Medford:

The reservation has historically been used as a dump site for both municipal waste (1940's) and dredged river sediments. Based upon sediment analysis of the Mystic River and its proximity to the Monsanto site, the sediment disposal area could be a source of phthalate and PCB contamination. Sediment samples collected by YWC, Inc. on July 27, 1987 from the storm sewer system of the G.E. facility indicated concentrations of PCBs ranged from 75 ppb to 19,700 ppb. The reservation is located approximately 0.80 of a mile upstream of Monsanto Industrial Chemical Company. The sampling locations in proximity to these areas are numbered 28, 29, 31, and 33. Locations 31 and 33 also represent areas that were filled with dredged sediment.

The Mystic River along Interstate 93:

Prior to the construction of this highway, sediments were dredged from the Mystic River and used as fill material. These sediments may be a source of phthalate contamination originally stemming from areas contaminated by spills from the Monsanto facility. This area is located approximately 0.8 of a mile upstream of Monsanto Industrial Chemical Company. These sampling locations are numbered 32, 33, and 34.

The Mystic River adjacent to the docks and property of Revere Sugar Company, Amstar Corp., Atlantic Cement Company:

Although these industries do not have any records of PCB or phthalate spills and their operations are unrelated to these contaminants, PCBs have been identified in sediment samples, at concentrations as high as 3,000 ppb, from the Mystic River in that area. In addition, dredged river sediments may have

been used as fill material for the construction of Amstar Corp. These properties are located approximately 0.80 of a mile downstream of Monsanto Industrial Chemical Company. Associated sampling locations are numbered 8 and 11.

The Mystic River near Boston Edison Company (an electric generating facility):

This facility has numerous transformers on its property. Spills which have occurred on-site (i.e. 2/16/84) have contaminated soils and have required removal programs. Releases of PCBs and phthalates to the Mystic River from historical spills is likely. This facility is located adjacent to and approximately 2,000 feet downstream of the Monsanto outfall, which was historically shared by the Boston Edison Company. The sampling location in proximity to this facility is numbered 13.

The Mystic and Island End Rivers in the vicinity of Prolerized NE, Distrigas and Exxon Company:

This highly industrialized area has been utilized by coke and iron work plants, oil refineries and tanning operations. The by-products from these industries, such as coal tar, are the major contaminants prevalent in the area, however, PCB contamination has also been identified in the river sediments. Samples collected at the Exxon pier in May of 1982, revealed concentrations of 650 ppb of PCBs. The sampling locations associated with these source areas are numbered 4, 5, 6, 7, and 10.

The Mystic River in the Vicinity of Monsanto Chemical Company

Several source areas and sampling locations have been identified in the vicinity of Monsanto. Location number 37 is near a tributary on their property, number 38 is at old outfall location, number 24 is near a filled area called little Cape Cod, number 23 is adjacent to the Monsanto property and upstream of the Amelia Earhart Dam, numbers 21 and 22 are also upstream of the dam and may represent a depositional area, numbers 18, 19, and 20 are near the Monsanto outfall and the tidal flat area, and numbers 14 and 16 are downstream of the dam near the City of Somerville outfall.

In addition to the above source areas, samples will be taken at locations 1, 2, and 3 parallel to the Tobin Bridge, marking the beginning of the study area. Samples will also be taken from the middle of the channel in the Mystic River at locations 9 and 12.

Appendix 4

Oak Island Investigation Summary

MEMORANDUM

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

To:	Mr. Timothy Cosgrave (Harvard Project Services)	**Date:**	September 13, 2005
From:	Alan Fowler	**cc:**	J.S. Holden (BBL)
Re:	Oak Island Investigation Summary		

In July 2005, Blasland, Bouck & Lee, Inc. (BBL) performed limited investigations of a portion of the Oak Island area in Revere, Massachusetts (Figure 1) to characterize this area as a candidate location for mitigating impacts associated with the planned Release Abatement Measure (RAM) for the Island End River (IER) in Everett and Chelsea, Massachusetts. The initial investigations included topographic survey of an approximately 12 acre area plus sampling and analysis of samples from four locations in the southwestern portion of the targeted investigation area.

The topographic survey was performed by Harry R. Feldman, Inc. relative to the National Geodetic Vertical Datum of 1929 (NGVD29). Field survey was performed to provide topographic contours at 6-inch vertical intervals. The resulting contour map is provided as Figure 2. As indicated, the ground elevation throughout the majority of the surveyed marsh area is approximately 3 feet above mean sea level (amsl). Slightly higher ground surface elevations (up to approximately 4.3 feet amsl) are present in the southwestern portion of the survey area near Diamond Creek.

BBL collected samples of marsh soils from four locations on July 11, 2005. The four sample locations (OIS-1 through OIS-4) are shown on Figure 2. The samples were located in the southwest portion of the 12-acre investigation area, which was preliminarily identified as the candidate location for mitigation measures. The target sampling interval for each location was 0 to 3 feet below ground surface. Descriptions of the soils at each location are as follows:

Location	Description of Recovered Soils
OIS-1	0-6”: black silt, some medium sand; organic rich; moist and cohesive 6-9”: reddish brown silt, some clay and organics; moist and cohesive 9-12”: grayish brown clay, some silt, sand, and organics; moist and cohesive 12-36”: same as 9-12 inches; wet and soft
OIS-2	0-4”: black silt, some organics; moist and cohesive 4-36”: grayish brown clay, little silt and organics; moist and cohesive (wet at 1.5 ft)
OIS-3	0-3”: brown organics, some silt; moist and spongy 3-12”: black medium to coarse sand, little silt and organics; moist to wet 12-24”: grayish brown clay, some silt and roots; moist and cohesive 24-36”: no recovery due to saturated nature of soils
OIS-4	0-3”: black silt, some organics; moist and cohesive 3-24”: gray/brown clay, some silt and organics; moist to wet (at 1.5 ft) and cohesive 24-36”: grayish brown clay and fine roots; moist and cohesive; firm

Samples from the four locations were collected and submitted to Severn Trent Laboratories of Westfield, Massachusetts for the following analyses:

Sample ID	Source	Analyses
OISD-1, OISD-2, OISD-3, and OISD-4	Discrete samples from locations OIS-1, OIS-2, OIS-3, and OIS-4, respectively	- Volatile Petroleum Hydrocarbons (VPH) (MADEP Method)
OISC-1	Composite sample from locations OIS-1 and OIS-2	- Extractable Petroleum Hydrocarbons (EPH) (MADEP Method); - Resource Conservation and Recovery Act (RCRA) metals (USEPA Methods 6010B and 7471A); - pesticides (USEPA Method 8081A); and - PCBs (USEPA Method 8082).
OISC-2	Composite sample from locations OIS-3 and OIS-4	- EPH (MADEP Method); - RCRA metals (USEPA Methods 6010B and 7471A); - pesticides (USEPA Method 8081A); and - PCBs (USEPA Method 8082).

The resulting analytical data are summarized in Table 1. As indicated, no VPH constituents, pesticides, or PCBs were detected in any of the samples. Low concentrations of 2-methylnaphthalene and naphthalene were detected in OISC-1 and low concentrations of C_{11}-C_{22} Aromatics and C_{19}-C_{36} Aliphatics were detected in OISC-2 as part of the EPH analysis. Mercury, arsenic, barium, chromium, and lead were detected in composite samples OISC-1 and OISC-2. Concentrations of detected constituents are below their respective Massachusetts Contingency Plan (MCP) Reportable Concentrations listed at 310 CMR 40.1600. Note, however, that concentrations of arsenic in sample OISC-2 and chromium in OISC-1 and OISC-2 equal or exceed the proposed MCP Reportable Concentrations for these constituents, as identified in the MADEP's May 2004 Public Hearing Draft of proposed changes to the MCP. With respect to chromium, this assumes that the chromium is present in hexavalent (Cr^{+6}) form, which is unlikely; the detected concentrations do not exceed the proposed Reportable Concentrations for trivalent chromium (Cr^{+3}).

Representative photographs of the Oak Island investigation area are provided in Attachment A.

Please feel free to contact me with any questions regarding the preliminary Oak Island investigation.

JSH/

TABLE 1
OAK ISLAND CHARACTERIZATION SAMPLES
REVERE, MASSACHUSETTS

Constituent	Units	OISD-1	OISD-2	OISD-3	OISD-4	OISC-1	OISC-2[(a)]
Extractable Petroleum Hydrocarbons							
C9-C18 Aliphatics	mg/Kg	-	-	-	-	<6.1	<7.6
C11-C22 Aromatics	mg/Kg	-	-	-	-	<6.1	22
C19-C36 Aliphatics	mg/Kg	-	-	-	-	<6.1	10
Acenaphthene	mg/Kg	-	-	-	-	<0.61	<0.76
Acenaphthylene	mg/Kg	-	-	-	-	<0.61	<0.76
Anthracene	mg/Kg	-	-	-	-	<0.61	<0.76
Benzo(a)anthracene	mg/Kg	-	-	-	-	<0.61	<0.76
Benzo(a)pyrene	mg/Kg	-	-	-	-	<0.61	<0.76
Benzo(b)fluoranthene	mg/Kg	-	-	-	-	<0.61	<0.76
Benzo(g,h,i)perylene	mg/Kg	-	-	-	-	<0.61	<0.76
Benzo(k)fluoranthene	mg/Kg	-	-	-	-	<0.61	<0.76
Chrysene	mg/Kg	-	-	-	-	<0.61	<0.76
Dibenzo(a,h)anthracene	mg/Kg	-	-	-	-	<0.61	<0.76
Fluoranthene	mg/Kg	-	-	-	-	<0.61	<0.76
Fluorene	mg/Kg	-	-	-	-	<0.61	<0.76
Indeno(1,2,3-cd)pyrene	mg/Kg	-	-	-	-	<0.61	<0.76
2-Methylnaphthalene	mg/Kg	-	-	-	-	0.075J	<0.76
Naphthalene	mg/Kg	-	-	-	-	0.098J	<0.76
Phenanthrene	mg/Kg	-	-	-	-	<0.61	<0.76
Pyrene	mg/Kg	-	-	-	-	<0.61	<0.76
Volatile Petroleum Hydrocarbons							
C5-C8 Aliphatic Hydrocarbons	mg/Kg	<4.8	<4.8	<6.9	<5.8	-	-
C9-C12 Aliphatic Hydrocarbons	mg/Kg	<4.8	<4.8	<6.9	<5.8	-	-
C9-C10 Aromatic Hydrocarbons	mg/Kg	<4.8	<4.8	<6.9	<5.8	-	-
Methyl tert-butyl ether (MTBE)	mg/Kg	<0.19	<0.19	<0.28	<0.23	-	-
Benzene	mg/Kg	<0.48	<0.48	<0.69	<0.58	-	-
Toluene	mg/Kg	<0.48	<0.48	<0.69	<0.58	-	-
Ethylbenzene	mg/Kg	<0.48	<0.48	<0.69	<0.58	-	-
p/m-Xylene	mg/Kg	<0.48	<0.48	<0.69	<0.58	-	-
o-Xylene	mg/Kg	<0.48	<0.48	<0.69	<0.58	-	-
Naphthalene	mg/Kg	<0.96	<0.95	<1.4	<1.2	-	-
Metals							
Mercury	mg/Kg	-	-	-	-	0.071	0.27
Arsenic	mg/Kg	-	-	-	-	11	20
Barium	mg/Kg	-	-	-	-	50	48
Cadmium	mg/Kg	-	-	-	-	<1.1	<1.4
Chromium	mg/Kg	-	-	-	-	38	39
Lead	mg/Kg	-	-	-	-	50	93
Selenium	mg/Kg	-	-	-	-	<5.4	<7.2
Silver	mg/Kg	-	-	-	-	<5.4	<7.2

TABLE 1
OAK ISLAND CHARACTERIZATION SAMPLES
REVERE, MASSACHUSETTS

Constituent	Units	OISD-1	OISD-2	OISD-3	OISD-4	OISC-1	OISC-2[(a)]
Pesticide							
Aldrin	μg/Kg	-	-	-	-	<17	<23
alpha-BHC	μg/Kg	-	-	-	-	<17	<23
beta-BHC	μg/Kg	-	-	-	-	<17	<23
delta-BHC	μg/Kg	-	-	-	-	<17	<23
gamma-BHC (Lindane)	μg/Kg	-	-	-	-	<17	<23
Chlordane, total	μg/Kg	-	-	-	-	<87	<110
4,4'-DDD	μg/Kg	-	-	-	-	<17	<23
4,4'-DDE	μg/Kg	-	-	-	-	<17	<23
4,4'-DDT	μg/Kg	-	-	-	-	<17	<23
Dieldrin	μg/Kg	-	-	-	-	<17	<23
Endosulfan I	μg/Kg	-	-	-	-	<17	<23
Endosulfan II	μg/Kg	-	-	-	-	<17	<23
Endosulfan sulfate	μg/Kg	-	-	-	-	<17	<23
Endrin	μg/Kg	-	-	-	-	<17	<23
Endrin ketone	μg/Kg	-	-	-	-	<17	<23
Heptachlor	μg/Kg	-	-	-	-	<17	<23
Heptachlor epoxide	μg/Kg	-	-	-	-	<17	<23
Hexachlorobenzene	μg/Kg	-	-	-	-	<17	<23
Methoxychlor	μg/Kg	-	-	-	-	<35	<45
PCB							
Aroclor 1016	μg/Kg	-	-	-	-	<170	<230
Aroclor 1221	μg/Kg	-	-	-	-	<170	<230
Aroclor 1232	μg/Kg	-	-	-	-	<170	<230
Aroclor 1242	μg/Kg	-	-	-	-	<170	<230
Aroclor 1248	μg/Kg	-	-	-	-	<170	<230
Aroclor 1254	μg/Kg	-	-	-	-	<170	<230
Aroclor 1260	μg/Kg	-	-	-	-	<170	<230
Aroclor 1262	μg/Kg	-	-	-	-	<170	<230
Aroclor 1268	μg/Kg	-	-	-	-	<170	<230

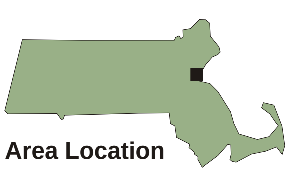
Notes:

1. Samples collected by BBL on 7/11/005. Laboratory analyses performed by Severn Trent Laboratories. Data validation has not been performed.
2. Extractable and Volatile Petroleum Hydrocarbons analyses conducted using MADEP EPH and VPH Methods, respectively.
3. Metals analyses conducted using Methods 7471A and 6010B.
4. Pesticide analysis conducted using Method 8081A.
5. PCB analysis conducted using Method 8082A.

[(a)] = Surrogate recovery for Cloro-octadecane was below the method control limit for the EPH analysis on this sample.
mg/Kg = milligram per kilogram
μg/Kg = microgram per kilogram
J = the estimated concentration is below the laboratory reporting limit

REFERENCE: Base Map USGS 7.5 Min. Quad., TOPO® 2003 National Geographic (www.nationalgeographic.com/topo)

1 Mile 0 1 Mile



Area Location

FORMER COAL TAR PROCESSING FACILITY
EVERETT, MASSACHUSETTS

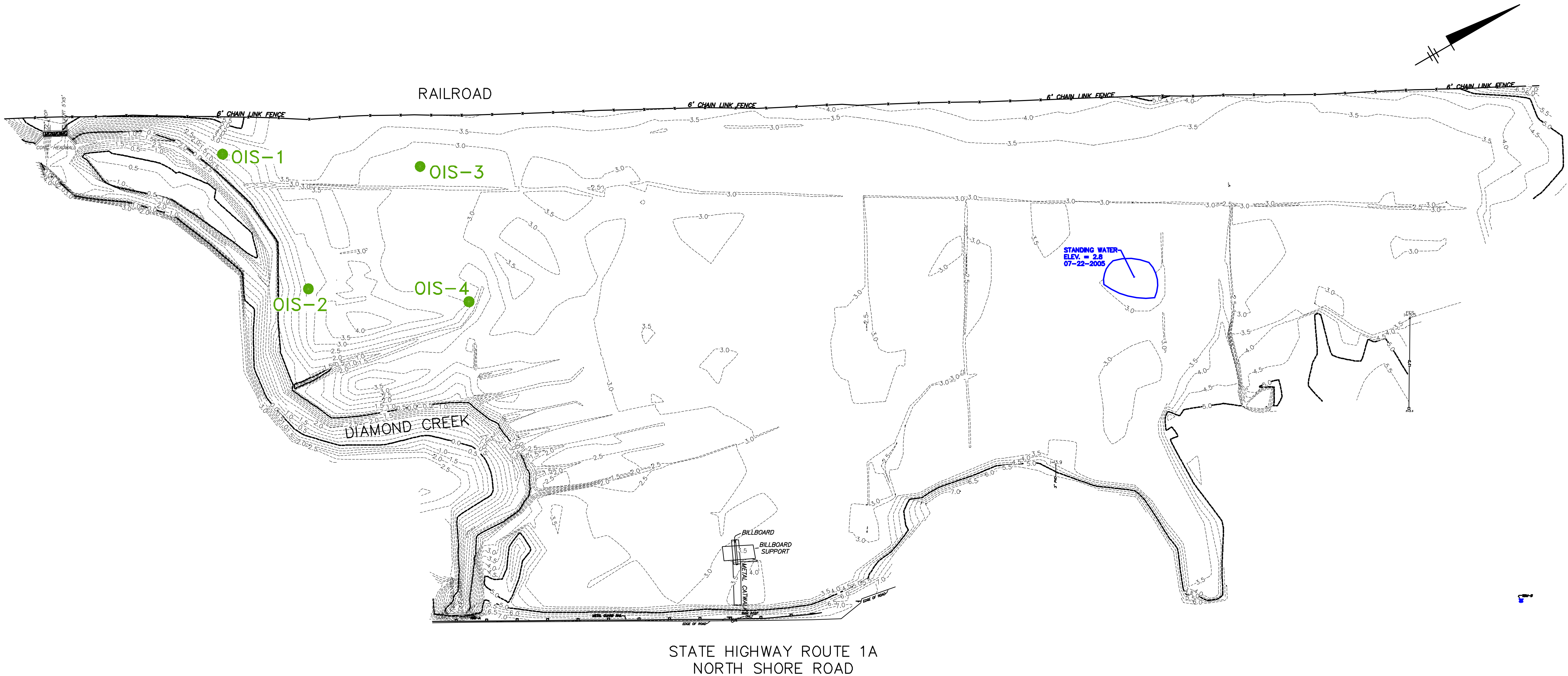
RAM STATUS REPORT

LOCATION PLAN

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1

09/12/05 SYR-D85-DJH
38878015/38878n01.cdr



NOTES:

1. BENCH MARK INFORMATION:
GPS BASE STATION ON THE ROOF OF 112 SHAWMUT AVENUE BOSTON, MASS
ELEVATION = 101.38

BENCH MARK SET :

TBM-A : CHISELED SQUARE ON THE CORNER OF THE HEADWALL ON THE NORTHWEST SIDE OF ROUTE 1A
ELEVATION = 4.86

TBM-B : X-CUT ON HYDRANT AT CORNER OF ROUTE 1A AND GLADYS STREET
ELEVATION = 10.65

TBM-C : PK NAIL SET AT CORNER OF TIMBER WALL IN FRONT OF HOUSE #137 AT THE CORNER OF GLADYS STREET AND GLENDALE STREET
ELEVATION = 6.98

2. ELEVATIONS REFER TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929.

3. CONTOUR INTERVAL EQUALS 0.5 FEET.

LEGEND:

□	CATCH BASIN
○FA	FIRE ALARM MANHOLE
●	SOIL CORES
	SIGN
FES	FLARED END SECTION
MG	METAL GRATE
CONC.	CONCRETE
——x——	FENCE
	GUARD RAIL

0 100' 200'
GRAPHIC SCALE

KHB VENTURE, LLC
RELEASE ABATEMENT MEASURE
MITIGATION PLAN

OAK ISLAND TOPOGRAPHIC CONTOURS AND SAMPLE LOCATIONS

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FIGURE
2

X: NONE
L: ON=*, OFF=REF*, PNTS*, TNET*, BREAKLINE
P: PAGESET/PLT-BL1
9/14/05 ANNAP-90-TMD SYR-85-LJP
38878015/WETLAND/38878G01.DWG

Attachment A
Representative Photographs of Oak Island Investigation Area

Attachment A

Representative Photographs of Oak Island Investigation Area