MALDEN RIVER

ECOSYSTEM RESTORATION

MALDEN, MEDFORD, AND EVERETT

MASSACHUSETTS

DRAFT

ENVIRONMENTAL ASSESSMENT

FINDING OF NO SIGNIFICANT IMPACT

&

404(B)(1) EVALUATION

US Army Corps of Engineers
New England District
Concord, Massachusetts

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ACRONYMNS AND ABBREVIATIONS

ACOE	Army Corps of Engineers
BMPs	Best Management Practices
CERCLA	Comprehensive Environmental Response, Compensation, and Recovery Act (Superfund)
Cfs	Cubic feet per second
Cy	Cubic yard
COPEC	Chemicals of potential ecological concern
CSO	Combined sewer overflow
DEP	Department of Environmental Protection (Massachusetts)
DO	Dissolved oxygen
EA	Environmental Assessment
FONSI	Finding of No Significant Impact
Ft.	Feet
HEP	Habitat Evaluation Procedure
HIS	Habitat Suitability Index
HUs	Habitat Units
MADWPC	Massachusetts Division of Water Pollution Control
MBTA	Massachusetts Bay Transportation Authority
MG	Million gallons
mg/kg	Milligram/kilogram (= ppm)
mg/l	Milligram/liter (= ppm)
MWRA	Massachusetts Water Resources Authority
MVDC	Mystic Valley Development Commission
NED	New England District
NED	National Economic Development Plan
NER	National Ecosystem Restoration Plan
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
OHM	Oils and Hazardous Materials

PAHs	Polynuclear aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PEC	Probable Effects Concentration
Ppb	Parts per billion
Ppm	Parts per million
SOD	Sediment Oxygen Demand
TCLP	Toxic Characteristics Leaching Procedure
TKN	Total Kjeldahl nitrogen
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
*u*g/l	Microgram per liter (= ppb)
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VPH	volatile petroleum hydrocarbons

1.0 INTRODUCTION

1.1 Project Purpose

The Malden River is a small waterway located in the Malden, Medford, and Everett, MA metropolitan area (See Section 10 – Environmental Assessment Figures, Figure 1-1). The Malden River watershed has been subject to the effects of gradual urbanization for several centuries. The results of development on river and aquatic resources have been significant. All tributary streams and associated wetlands have been filled or culverted to varying degrees. Construction of the Amelia Earhart Dam in the 1960's converted the waterway from a tidally influenced salt-water estuary to a freshwater system. Water quality has deteriorated as an array of natural and man-made compounds are carried off the land surface during rainstorms and deposited into the river. Poor water quality and sediment quality, and degraded fish and benthic invertebrate communities have also been documented. Non-native invasive species of flora such as *Phragmites* have proliferated, crowding out native species, and limiting the diversity of riparian and wetland plant communities.

The proposed project is derived from numerous engineering and historical studies of the project area's problems including the River's Edge (formerly TeleCom City) Master Plan ("the Master Plan"), and studies by the Army Corps of Engineers (the Corps), Mystic Valley Development Commission (MVDC), Nangle Associates, and the cities of Malden, Medford, and Everett. The Malden River Feasibility Report and Environmental Assessment are designed to address a number of these problems. However, the principal objective of the proposed Federal project is the restoration of aquatic and riparian habitats in and along the Malden River.

1.2 Purpose of the Environmental Assessment

This draft Environmental Assessment (EA) was prepared to comply with Council of Environmental Quality and Corps of Engineers regulations for implementing the National Environmental Policy Act of 1969 (NEPA). NEPA requires Federal agencies to consider the environmental effects of a proposed action and solicit comments during the planning process from government agencies and the interested public.

The EA serves as a disclosure document that describes the proposed action and alternatives, environmental resources in the affected area, and the environmental effects of the proposed action. The EA also provides decision makers with sufficient information to determine whether a Finding of No Significant Impact (FONSI) or a more elaborate review, culminating in preparation of an Environmental Impact Statement (EIS), is appropriate.

The EA describes the alternatives considered (Section 2.0), the recommended plan (Section 3.0), the affected environment (Section 4.0), the environmental effects of the proposed plan and alternative plans (Section 5.0), measures to minimize adverse

environmental effects (Section 6.0), and coordination with agencies and the interested public (7.0).

The draft EA will be available for public review for a 30-day period. The Corps will carefully consider all comments received during the public review period, and modify the draft EA, as appropriate. Based on anticipated impacts, the Corps expects to issue a FONSI upon completion of the EA.

2.0 FORMULATION OF ALTERNATIVES AND SELECTION OF RECOMMENDED PLAN

Selection of the recommend plan involved the following steps, each of which is discussed in the following sections:

- Identification of Project Objectives (Section 2.1)
- Screening of Available Measures (Alternatives) to Meet Objectives (Section 2.2)
- Identification of Feasible Alternatives (Section 2.3)
- Plan Selection (Section 2.4)

2.1 Project Objectives

The overall objective of this study is to develop a comprehensive ecosystem restoration plan for the Malden River. The principal objective of the proposed Federal project is the restoration of aquatic and riparian habitats in and along the Malden River.

The aquatic and riparian habitats of the Malden River are currently degraded. The wetland areas of the river are currently dominated by invasive species (i.e., *Phragmites*) and the sediment quality of the river bottom is poor. A detailed description of the River's habitat impairments are detailed in Section 4.1.2 of the Detailed Project Report (DPR). The degraded conditions that exist in the River (the No Action Alternative) will remain static unless restoration efforts are undertaken.

2.1.1 Aquatic and Riparian Habitat Restoration

Like many urban waterways, the Malden River is beset by a host of environmental problems. These problems include poor water quality, poor sediment quality, proliferation of invasive species, and the loss of aquatic and wetland habitat due to filling and sedimentation. The selected restoration plan should address as many of these problems as possible.

The overall recommended habitat restoration plan must be cost effective, minimize adverse environmental effects, be acceptable to the Sponsors, public, and regulatory authorities, and be consistent with all applicable Federal and state laws and regulations.

2.2 Screening of Measures (Alternatives) to Meet Objectives

2.2.1 Aquatic and Riparian Habitat Restoration Measures

This section identifies measures that could improve water quality, sediment quality, and aquatic and riparian habitat in the Malden River.

2.2.1.1 Measures to Improve Water Quality

Several measures to improve water quality were identified and evaluated. These are: flow augmentation, aeration, sediment removal (dredging), natural filtration, and upstream source control (source control devices and implementation of best management practices).

Flow Augmentation

Significantly increasing the rate of water flow in the river could improve flushing and water quality. To be effective, the water flushed through the system should be relatively clean (i.e., low in toxics and biochemical oxygen demand (BOD)), high in DO, and be available during the summer when observed water quality problems in the Malden River are at their worst. Two sources of water were considered: freshwater from the upper watershed and seawater exchange with the estuarine portion of the Mystic River below the Dam.

A review of information on upstream areas indicated that there is no ready sources of stored freshwater upstream of the Malden River (i.e., Spot Pond) that could be released to enhance circulation. The Spot Pond watershed is not much larger than the pond itself, resulting in limited inflow into and recharge of the pond. Because the pond is an emergency water supply for MWRA, there are strict operating standards imposed in the pond, and no realistic prospect to regularly release water during low flow conditions to improve conditions in the Malden River.

Reintroduction of tidal flushing was also evaluated as a potential option to increase water circulation in the Malden River. The implementation of this option would involve a change in operation or a retrofit of the Amelia Earhart Dam. However, due to concerns over water quality in the lower Mystic Lake, as well as recreational and aesthetic concerns (exposure of mudflats, odors, fluctuating water levels, potential for corrosion of recreational vehicles), and human health concerns regarding exposure to materials in the sediments, tidal flushing is not likely to provide a feasible alternative for water circulation improvement.

Aeration (Instream)

Instream aeration involves using compressors to pump air through discharge lines placed within a body of water. Aeration could increase DO levels to over 5 mg/l in localized areas. Compressors could be placed within existing structures, in new aboveground structures, or underground. Siting opportunities for new structures would be limited due to the urbanized nature of the area. Aeration lines could be placed in open water areas or under bridges.

Sediment Removal (Dredging)

Removal of accumulated sediment can improve water quality in several ways. Dredging of organic rich sediment reduces sediment oxygen demand (SOD) and increases water volume, both of which can increase DO levels in surface waters. Benefits of dredging gradually decline over time as sediment oxygen demand increases due to deposition of organic matter from external sources (*e.g.*, leaf fall and non-point runoff) and internal production (algae and aquatic vegetation). This necessitates maintenance dredging to maintain long-term water quality benefits.

Dredging also reduces nutrient availability, alleviating water quality problems associated with excessive growth of aquatic weeds and algae. Dredging also can reduce contaminant levels (*e.g.*, metals) in surface waters by removing contaminants in sediment that may be released into the water.

Material would be dredged from the system using mechanical or hydraulic dredging equipment and would be dewatered on site. The majority of the material would likely be reused onsite for other project features. A portion of the material may be disposed of at an upland landfill.

Wetland Filtration

Natural filtration involves improving water quality by passing portions of a waterbody through wetlands and allowing contaminants to settle in the wetland sediments or by allowing the wetland vegetation to uptake contaminants or excess nutrients that contribute to poor water quality. The restoration of typical wetland functions to areas in the Malden River as well as the creation of additional wetland areas in the river will improve water quality.

Upstream Source Controls (Point Sources)

Point sources, such as storm drains, combined sewer overflow, and industrial discharges can degrade surface water quality by loading organic matter, pathogens, nutrients, and contaminants. In addition to the upstream flow entering via two stormwater culvert systems at the head of the Malden River, there are numerous stormwater inputs to the River or its tributaries along its entire length. These include, but are not limited to, stormwater inputs to Little Creek, North Creek and South Creek, runoff from local streets and highways, as well as directed runoff from large parking areas and buildings located along Corporation Way, the Revere Beach Parkway, and Gateway Center.
Unless treated, these watershed stormwater inputs could lead to surface water and sediment impacts. Future development in the watershed will include Phase I stormwater management to treat stormwater to standards for new site development. For the purposes of the Feasibility Study, it is assumed that all stormwater treatment and management will be successfully implemented in the long-term.

Upstream Source Controls (Best Management Practices)

BMP's include a variety of practices that can reduce loading of sediment, organic material, nutrients, and contaminants to surface waters from non-point sources. They include both structural measures such as installation of particle separators from storm drains and non-structural practices such as street sweeping, catch basin maintenance, regulatory reform and public education. Collectively, implementation of BMP's can improve both water quality and sediment quality. It is assumed that BMP's will be successfully implemented in the long-term.

2.2.1.2 Measures to Improve Sediment Quality

Environmental Dredging

Dredging can improve sediment quality by removing contaminated surficial sediments and exposing less contaminated underlying material. Studies conducted by Nangle (2000, 2003) and the Corps (Appendix F) indicate that removal of various depths of sediment from several areas of the Malden River would greatly improve sediment quality. After dredging, non-point pollution from the highly urbanized Malden River watershed would gradually increase contaminant levels in sediments. However, instituting BMP's would reduce non-point loading of contaminants and maintain long-term sediment quality.

Sediment Capping

Poor sediment quality can be improved by capping sediment with clean material. This option is only practical in locations were adequate water depth is available to insure a thick enough cap to effectively contain sediment contaminants. Capping was incorporated into the project design to capture ecological benefits from sediment quality improvements (see Appendix E).

Best Management Practices (BMP's)

BMP's (see above) can reduce loading of contaminants from non-point sources to surface waters and, ultimately, the accumulation of contaminants in sediment.

Innovative Technologies

Research studies suggest that it may be possible to enhance microbial degradation (bioremediation) of organic compounds such as PAHs in sediment. Both in place (in-situ) treatment of sediment and treatment of dredged material are under study. Use of plants to remove metals and other contaminants from dredged material is also under study. While pilot studies show promise, application of this technology in the Malden River is not yet feasible.

Another innovative technology under investigation is sediment washing. This involves using various mechanical and chemical processes to reduce contaminant levels in dredged material. The "washed material" may be suitable for placement back in an aquatic system, for use in manufactured topsoil, or use as fill material. Again, this experimental technology shows promise, but is not yet feasible for application in the Malden River.

2.2.1.3 Measures to Manage Invasive Vegetation

A variety of invasive species has proliferated in the Malden River wetland areas. These include *Phragmites*, European buckthorn (*Rhamnus frangula*), tree-of-heaven (*Ailanthus altissima*), purple loosestrife (*Lythrum salicaria*), water chestnut (*Trapa natans*) and oriental knotweed. Previous studies, such as *Natural Resource Inventory/ Assessment* (Wetlands and Wildlife, 1999) confirm this condition. Control of these species would increase species diversity of riparian and wetland plant communities and improve wildlife habitat. Measures available to manage these species and their efficacy are discussed below.

Phragmites

Glyphosate herbicides can effectively control *Phragmites*. The herbicides may be applied from hand sprayers, backpack sprayers, painted on leaves or cut stems with a brush or sponge, or injected into hollow cut stems with a syringe. Glyphosate herbicides are used to control *Phragmites* and are considered safe. Commercially available formulations have low toxicity to aquatic life and quickly degrade in the environment to non-toxic by-products. The effectiveness of herbicide is enhanced when application is combined with cutting. Treatment occurs in late summer. Repeated cutting and follow-up herbicide applications, over several growing seasons, can eradicate even well established stands.

Excavation of rhizomes may also effectively control *Phragmites*. In wetland areas excavation to depths of 1.5 to 2 feet will remove most of the rhizomes and roots. On steep slopes, however, rhizomes may grow several feet or more below the ground surface, making eradication through excavation difficult and expensive. In all excavated areas, follow-up control with spot herbicide application is essential for eradication since viable rhizomes will likely remain and can quickly reestablish the stand.

Combined use of dredging to remove *Phragmites* in wetland areas, cutting and herbicide application in riparian areas and follow-up monitoring and herbicide application should result in substantial eradication of *Phragmites* from the Malden River. Eradication is expected to take 3 – 5 years. Follow-up monitoring would be needed to guard against re-infestation.

Control using cutting and plastic shading can be effective for very small stands. However, large-scale experimental efforts to control *Phragmites* by cutting and shading

with black plastic have been unsuccessful (Cortell, 1996). There are currently no biological control measures available to control *Phragmites.*

Oriental Knotweed

Knotweed can be controlled by repeated glyphosate herbicide applications. Cutting may enhance efficacy of herbicide application. Long-term control efforts may reduce abundance of knotweed and allow establishment of more desirable native vegetation. It is extremely difficult, if not impossible, to eradicate large established stands of Oriental knotweed. Control efforts should also focus on monitoring and eradication of small, newly established stands. There are currently no biological control measures available for oriental knotweed.

Purple Loosestrife

Small newly established stands of Purple loosestrife can be controlled by application of glyphosate herbicide and mechanical control (pulling). Eradication by chemical or mechanical measures is difficult since loosestrife produces enormous numbers of small seeds and readily regrows from perennial rhizomes. In recent years, biological control using *Galerucella* beetles and other insects has become the accepted control measure for well-established stands growing in wet meadow or shallow water habitats. Once established, beetles can greatly reduce density of loosestrife, allowing recolonization by more desirable native species. *Galerucella* beetles have been released at several locations in Massachusetts.

2.2.1.4 Other Measures to Enhance Aquatic and Riparian Habitat

Removal and/or placement of Fill to Restore or Create Wetland Habitat

Wetland habitat that has been filled by past “reclamation” projects can be restored by removal of the fill material. To create wetland, the site must be excavated to a sufficient depth to restore adequate hydrology to assure development of wetland (hydric) soils and vegetation. Restored areas can be planted or seeded with native vegetation or allowed to re-vegetate naturally. Planting or seeding is often desirable to reduce colonization of newly created habitat by undesirable invasive species.

The creation of additional wetland areas in the system is also feasible, but wetland creation would come at the cost of filling open water habitat. However, in the case of the Malden River, candidate open water areas that could be converted to wetland habitat are extremely shallow and contain sediments with high concentrations of contaminants. The creation of wetlands in these areas would serve to cap contaminated sediments, as well as help filter storm water that enters the river.

Riparian Habitat Revegetation

Loss of tree and shrub cover along streambanks can have adverse effects on water quality, aquatic habitat, streambank stability, and wildlife habitat. Often loss of tree cover is a result of cultural practices (*e.g.*, mowing, grazing) that can be altered to allow natural reestablishment of woody vegetation. Regrowth of woody vegetation can be accelerated by planting native trees and shrubs. Bank stabilization measures and invasive species control may be needed in conjunction with plantings.

Structural Habitat Improvement

Aquatic habitat can be improved by adding "structure" and/or appropriate substrate to provide underwater cover and/or an appropriate physical setting for fish spawning. Structure provides fish protection from predators, resting areas, feeding sites, and can enhance productivity and diversity of aquatic invertebrate communities. Methods to provide cover include installing boulders, logs, root wads, or commercially available artificial structures. Installation of partially exposed habitat logs to provide basking sites for turtles and amphibians is also beneficial. If carefully placed, the logs would not have an adverse visual impact. The placement of gravel or sand in select locations will increase the diversity of bottom substrate type (as the majority of the substrate is currently silt) and act as a potential spawning area for fish, such as Centrachids, which utilize coarser sediments as spawning habitat.

Improvement of Anadromous Fish Passage

One of the consequences of the installation of the Amelia Earhart Dam was an obstruction to upstream migration of anadromous fish, principally alewife and smelt. Considerable public and regulatory interest exist for enhancement of these runs into the Mystic River system. This enhanced passage could also improve the Malden River fish community.

The Amelia Earhart dam was designed to allow for the passage of migratory fish into the Malden and Mystic Rivers. It is generally believed that this design has never been effective at allowing fish to pass. However, the lock operators will open the locks to let the fish upstream when they gather below the dam, and this system has been effective for alewives. To improve fish passage for all species, and allow passage independent of the operators, the dam could be retrofitted with an effective fish ladder.

Three primary alternatives were considered to improve anadromous fish passage through the Amelia Earhart Dam, and included: 1) operational changes to the existing lock system, 2) installation of a fish structure, such as an Alaskan steep pass or Denil fishway within dam, and 3) installation of a rock bypass channel to the east of the dam, culverted beneath the existing dam service road.

Based upon discussions with the Massachusetts Division of Marine Fisheries (MADMF) and the National Marine Fishery Service (NMFS), there was consensus that improving

the current procedures used to use the existing lock system via standardized practices is generally preferable to installation of a fish passage structure at the dam for two specific reasons. First, installation of a structure may unintentionally induce a lapse in the current non-standardized, but nonetheless effective, practice of passing fish through the dam. While not optimal, this practice is known to be effective, at least for blueback herring migrating to Lower Mystic Lake. Secondly, there is some consensus that the lack of flow and/or lack of control of water elevation on either side of the Dam will make a new fishway ineffective. Therefore, the preparation of a management plan for increasing fish passage was considered to be more effective rather than retrofitting the existing fishway or constructing a physical structure.

2.3 Formulation of Feasible Project Alternatives

2.3.1 Ecosystem Restoration

Based upon Phase I recommendations and local sponsor interest, a no action alternative and five ecosystem measures and were retained for alternatives analysis. The no action alternative would involve no restoration measures in the river which would leave the Malden River ecosystem in its degraded condition. The action measures would restore the Malden River ecosystem to the highest quality that the system can reasonably support and sustain. The five action measures include:

- Fish Habitat Enhancement – This measure includes the removal of existing trash and debris in riparian wetland areas and placement of potential spawning substrate (i.e., clean gravel/sand substrate) at tributary confluences or other relevant sites;

- Invasive Species Control (wetland & riparian) – This measure includes invasive species (i.e., *Phragmites*) removal by either cutting, clearing, herbicide spraying, burning and/or regrading followed by re-establishment of native wetland and riparian species;

- Wetland Restoration – This measure involves the restoration of existing degraded palustrine scrub-shrub swamps (PSS) located along the river. Restoration will involve the removal of invasive species and the excavation of material to remove the root systems of the invasive species. The wetland areas will be backfilled with soils, graded to appropriate elevations, and planted with native wetland species;

- Wetland Creation – This measure involves the creation of palustrine emergent marsh (PEM) wetland within the confines of the former natural channel of the Malden River Oxbow and may contribute to water quality improvement through the natural filtration of the created wetland.

- Improvement of Fish Passage – This measure includes the preparation of a management plan for increasing fish passage through the existing Amelia Earhart Dam.

During the Phase I to Phase II transition, the project delivery team reevaluated the "building block" concept and its relationship to the five measures described above. This reevaluation resulted in compartmentalizing the project study area into six (6) sub areas. This compartmentalizing method allows the evaluation process to consider each of the six ecosystem restoration measures in addition to the overall Master Plan goals developed by MVDC. Sediment quality data was used to develop the compartmentalization process in conjunction with the rationale of implementing the six ecosystem restoration measures. The restoration measures within each sub-area are illustrated in figures labeled 5-4 through 5-9 (Refer to Section 10 – Environmental Assessment Figures).The following provides a brief description of each sub-area:

Sub-Area 1 – Sub-area 1 represents the input or northerly limits of the Malden River study area immediately adjacent to and downstream of the Medford Street Bridge crossing. These portions of the Malden River were straightened and deepened under the U.S. Rivers and Harbors Act (June 14, 1880). Sub-area 1 consists of approximately 60,000 square feet of surface area, with an average depth of 6.2 feet ± along the river centerline. Sub-area 1 contains approximately 900 linear feet of bordering banks. Elevated concentrations of coal gasification residuals were identified within the sediment deposits along the easterly and westerly banks of the Medford Street Bridge.

Sub-Area 2 – Sub-area 2 extends southerly from Sub-area 1 to River's Edge (formerly TeleCom City) Parcel 5-2 and encompasses a majority of the early 1970's dredging project. Sub-area 2 consists of approximately 221,000 square feet of surface area, with an average depth of 7.0 feet ±. Sub-area 2 contains approximately 2,200 linear feet of bordering banks. The advancement of test borings within Sub-area 2 revealed a high degree of river bed competency reflective of the historic dredging activities that have been conducted in this portion of the project study area.

Sub-Area 3 – Sub-area 3 represents the Little Creek portion of the project study area. Sub-area 3 consists of approximately 208,500 square feet of surface area, with an average depth of 4.6 feet ±. Sub-area 3 contains approximately 1,400 linear feet of bordering banks. The greatest degree of sediment variations and contaminant accumulation within the Malden River exists at its confluence with Little Creek. Sediment accumulation is highest along the easterly banks of the Malden River, reflective of once tidal dispersion and settling patterns. During Nangle Consultant Associates, Inc initial assessment of baseline characteristics, Sub-area 3 was identified as a target area for further evaluation due to the nature of sediment deposition and corresponding magnitude of coal tar constituents. The evaluation of contaminant distribution in Sub-areas 1 and 3 suggests that separate and discrete source conditions are responsible for contaminant distribution identified during site characterization.

Sub-Area 4 – Sub-area 4 is described as an oxbow of the original Malden River that appears to have not been disturbed during the historic dredging activities. This oxbow receives surface water recharge from an unnamed creek (Report referenced as North Creek) situated along the northerly boundary of River's Edge Parcel 2-5. Sub-area 4

consists of approximately 250,400 square feet of surface area, with an average depth of 2.4 feet ±. Sub-area 4 contains about 4,100 linear feet of bordering banks.

Sub-Area 5 – Sub-area 5 extends southerly from Sub-area 3 to Route 16 Revere Parkway Bridge. Sub-area 5 consists of approximately 682,000 square feet of surface area, with an average depth of 8.4 feet ±. Sub-area 5 contains approximately 6,400 linear feet of bordering banks. Sub-area 5 receives surface water recharge from unnamed creek (Report referenced as South Creek) situated along the southerly boundary of Parcel 2-5.

Sub-Area 6 – Sub-area 6 extends southerly from Route 16 Revere Parkway Bridge to the Amelia Earhart Dam. Sub-area 6 consists of approximately 1,995,000 square feet of surface area, with an average depth of 9.5 feet ±. Sub-area 5 contains approximately 8,500 linear feet of bordering banks. Sub-area 6 receives surface water recharge from unnamed creek (Report referenced as Mall Creek) situated along the northerly boundary of the Gateway Mall.

There are five management plans being evaluated to improve environmental conditions in each sub area of the Malden River. The management plans are removal of invasive species, removal of invasive species coupled with restoration of wetlands, creation of wetlands, placement of gravel or sand, and provision for fish passage. Project description, costs, and habitat units created by each plan are shown in Table EA-1.

Table EA-1 Alternative Costs and Outputs

Plan ID	*Description*	*Cost ($000)*	*HU*
A1	Removal of Invasive Species (Sub-area 2)	792.7	0.54
B1	Removal of Invasive Species (Sub-area 3)	1,096.8	0.67
C1	Removal of Invasive Species (Sub-area 4)	1,443.9	1.02
D1	Removal of Invasive Species (Sub-area 5)	1,091.3	2.57
E1	Removal of Invasive Species (Sub-area 6)	8,080.1	4.12
F1	Removal of Invasive Species & Restore Wetland (Sub-area 2)	812.1	3.65
G1	Removal of Invasive Species & Restore Wetland (Sub-area 3)	1,150.4	8.52
H1	Removal of Invasive Species & Restore Wetland (Sub-area 4)	1,500.5	9.26
I1	Removal of Invasive Species & Restore Wetland (Sub-area 5)	1,137.1	12.05
J1	Removal of Invasive Species & Restore Wetland (Sub-area 6)	8,279.7	39.41
K1	Create Wetland (Sub-area 4)	1,322.2	15.71
L1	Place Gravel/Sand (Sub-area 1)	7.8	0.70
M1	Place Gravel/Sand (Sub-area 3)	75.1	0.69
N1	Place Gravel/Sand (Sub-area 4)	76.7	0.84
O1	Place Gravel/Sand (Sub-area 5)	48.7	0.42
P1	Place Gravel/Sand (Sub-area 6)	84.1	0.79
Q1	Fish Passage (entire project site)	716.4	49.04

2.4 Plan Selection

2.4.1 Ecosystem Restoration

The incremental cost analysis identified 276 (out of a possible 31,104) alternatives as cost effective plans. A plan is not cost effective if compared with another alternative, it provides fewer or the same number of habitat units at a higher cost. Best buy plans are a subset of cost effective plans. For each best buy plan, there are no other plans that will give the same level of output at a lower incremental cost. There are 13 best buy plans including the no action alternative.

Table EA-2 shows incremental cost for each best buy alternative.

Table EA-2 Incremental Costs

*****Plan Components are identified in Table EA-1

Plan	*Plan Components**	*HU*	*Cost*	*Incremental Cost*	*Incremental Output*	*Cost Per Output*
1	No Action	0.00	0.0	0.0	0	0.0
2	L1	0.70	7.8	7.8	0.7	11.1
3	L1 Q1	49.74	724.2	716.4	49.04	14.6
4	K1 L1 Q1	65.45	2,046.4	1,322.2	15.71	84.2
5	K1 L1 N1 Q1	66.29	2,123.1	76.7	0.84	91.3
6	I1 K1 L1 N1 Q1	78.34	3,260.2	1,137.1	12.05	94.4
7	I1 K1 L1 N1 P1 Q1	79.13	3,344.3	84.1	0.79	106.5
8	I1 K1 L1 M1 N1 P1 Q1	79.82	3,419.4	75.1	0.69	108.8
9	I1 K1 L1 M1 N1 O1 P1 Q1	80.24	3,468.1	48.7	0.42	116.0
10	G1 I1 K1 L1 M1 N1 O1 P1 Q1	88.76	4,618.5	1,150.4	8.52	135.0
11	G1 H1 I1 K1 L1 M1 N1 O1 P1 Q1	98.02	6,119.0	1,500.5	9.26	162.0
12	G1 H1 I1 J1 K1 L1 M1 N1 O1 P1 Q1	137.43	14,398.7	8,279.7	39.41	210.1
13	F1 G1 H1 I1 J1 K1 L1 M1 N1 O1 P1 Q1	141.08	15,210.8	812.1	3.65	222.5

3.0 RECOMMENDED PLAN

3.1 Plan Features

Based upon the results of the incremental cost analysis, thirteen plans were identified as Best Buy Plans. For ecosystem restoration projects, the National Ecosystem Restoration (NER) plan is defined as the plan that reasonably maximizes ecosystem restoration outputs and associated benefits compared to costs, consistent with the Federal objective. The selected plan must be shown to be cost effective and justified to achieve the desired level of output. The NER plan meets planning objectives, constraints and reasonably maximizes environmental benefits, while passing tests of cost effectiveness, incremental cost analysis, and significance of outputs, acceptability, completeness, efficiency, and effectiveness.

The NER plan for the Malden River Ecosystem Restoration Feasibility Study is Plan 11 (Table EA-2). Mystic Valley Development Commission has also selected Plan 11 as the "Locally Preferred Plan". This NER plan consists of the following actions:

- Removal of 36,000 cubic yards of invasive species along 14.9 acres of the riverbank corridor within sub-areas 3, 4, and 5;
- Replanting of 14.9 acres with native wetland species within sub-areas 3, 4, and 5;
- Creation of 5.4 acres of emergent wetland within the existing oxbow (sub-area 4);
- Placement of 4,400 cubic yards of gravel/sand substrate to create 2.8 acres of fish spawning habitat within sub-areas 1, 3, 4, 5, and 6;
- Debris removal and disposal within construction work limits; and
- Operational changes at the Amelia Earhart Dam to improve fish passage.

The NER plan (Alternative 11) has a construction cost estimated at $3,940,000, which includes an escalation rate of 3.1%. Figure 6-1 depicts the restoration components of the NER plan (Refer to Section 10 – Environmental Assessment Figures).

3.2 Waste Disposal

The material to be excavated from Malden River wetlands has undergone limited chemical testing. Based on these data and from studies from adjacent upland areas and for feasibility level estimates, the Corps assumes that portions of the material will be available for reuse in the wetland construction phase of the project and some of the material may require disposal at an EPA approved landfill.

It is expected that wastewater generated during dewatering of excavated material will be discharged back to the Malden River after treatment to remove suspended sediment. It is anticipated that required permits will limit the suspended solids in return filtrate to 50 mg/l as an annual average and a maximum of 100 mg/l. Discharge standards for other parameters may also be established by regulatory authorities. Permit requirements and wastewater treatment processes will be determined during project design.

3.3 Monitoring

Construction Period: Monitoring will assess construction impacts on surface water quality and compliance with any performance standards established by regulatory authorities.

Post Construction (0 - 3 years) by Corps: A monitoring program will be established and require periodic observations of the restored native plant wetlands and the eradication of the Phragmites. The monitoring program would require periodic inspections for 3 years commencing 3 months after substantially completion has been obtained. A three-person team will conduct inspections from both the land side and by the river. A minimum of 4 inspections per year is anticipated. An annual monitoring inspection report would be prepared and distributed to the local sponsor. The observations will be evaluated based on the general goals of the restoration work:

- Reduce the current extent and rate of expansion of Phragmites,
- Improve waterfowl habitat,
- Improve fish habitat,
- Improve benthic habitat, and
- Restore native wetland species.

Post Construction (long-term) by Local Sponsor: The entire Malden River should be surveyed annually each August for presence of *Phragmites*.

3.4 Operation and Maintenance Requirements

Operation and maintenance of the project is the responsibility of the non-Federal sponsors and can be divided into three major categories: (1) monitoring of the operations of the Amelia Earhart dam fish passing procedures; (2) continued vigilance to prevent the reintroduction of invasive species such as *Phragmites*; and (3) maintenance of shorelines and riparian vegetation.

4.0 AFFECTED ENVIRONMENT

4.1 Introduction

This section contains a baseline description of environmental resources of the study area. Information was obtained from previous studies of the Malden River, discussions with knowledgeable officials and citizens, and field and laboratory investigations.

4.2 General Description of Study Area

4.2.1 Malden River Watershed

The Malden River watershed is a sub-basin of the much larger Mystic River watershed. The Malden River watershed is approximately 11 square miles, located in the towns of Wakefield, Stoneham, Melrose, Malden, Medford and Everett (refer to Figure 1-1). The Malden River originates from Spot Pond in the Fells Reservation and passes beneath or through the cities of Melrose and Malden in underground culverts or channelized conveyances through much of the upper watershed. It daylights from two sets of storm water culverts south of Malden Center and flows for approximately 2 miles as open surface water through the densely populated cities of Malden, Everett and Medford prior to its confluence with the Mystic River, just upstream of the Amelia Earhart Dam. Four small tributaries flow into the Malden River below Malden center, Little Creek on the western side, two unnamed tributaries that enter from the east, and a small drainage flows between the Revere Beach Parkway and the Gateway Mall.

Spot Pond is located in the Middlesex Fells Reservation in Stoneham, MA. The surface area of Spot Pond is approximately 298 acres, the largest pond in the Mystic River Watershed. The drainage area (including pond surface area) is approximately 369 acres (CDM, 2002). Spot pond discharges into Spot Pond Brook where is flows for approximately 1 mile in a channel before entering culverts and becoming the Malden River.

The Malden River channel is approximately 6 feet deep by 100 to 150 feet wide from the Medford Street Bridge in Malden to its confluence with the Mystic River (Fort Point Associates, 2003). In locations out side the channel, water depths have been observed to be as shallow as two feet (D. Klinch, pers. observation). The Malden River has an estimated surface area of 54 acres from the storm water culvert to the confluence with the Mystic River, and an approximated volume of 14,700,000 cubic feet (110 million gallons), based upon preliminary provisional USGS bathymetric data.

Construction of the Amelia Earhart dam in 1966 has resulted in a complete ecosystem alteration from a tidally flushing estuarine river into a freshwater impoundment with poor flushing, circulation and water quality.

4.2.2 Topography

Topography in the study area is controlled by the effects of the last glaciations. Generally, the glaciers blanketed the existing bedrock topography with drift. Deposits, filling in bedrock valleys and leaving a complex assortment of deposits, ranging from: poorly sorted sandy and gravely till deposits, and plastic, glaciomarine clay deposits; to stratified, well sorted sand and gravel outwash deposits. At the end of the last glacial period, there was a resultant rise in sea level, which created large expanses of tidal flats in the widened river estuaries, where organic silt and peat were deposited.

Elevations in the Malden River watershed range from approximately 279 feet NGVD in the northern part of the basin in Stoneham to sea level at the confluence of the Malden River with the Mystic River. There are small hills scattered throughout the upper basin with flat lands prevailing in the area below the culverts where the river daylights. Other than Spot Pond, the only major water body directly connected to the Malden River is the Mystic River.

4.2.3 Climate

The Malden River watershed has a variable climate characterized by a wide range of temperature and frequent, but usually short, periods of precipitation. The watershed lies in the path of the "prevailing westerlies" and air masses move over it primarily from the interior. The area is also exposed to coastal storms of tropical origin; that is, hurricanes that travel up the Atlantic seaboard as well as storms of extra-tropical origin known locally as "nor'easters". The watershed's mean annual temperature is about 50 degrees F. The range of mean monthly temperatures is wide, from the mid 70's in July to the mid 20's during January and February. Temperature extremes in the area range from a maximum of 102 degrees F. to a minimum of -21 degrees F. Average annual precipitation in Boston is 42 inches distributed uniformly throughout the year. Much of the winter precipitation is in the form of snow. The mean annual snowfall at Boston is about 40 inches.

4.3 Land Use

The Malden River was originally an estuarine coastal stream that flowed into the Mystic River, winding through a dendritic network of tidal flats and wetland marshes. About 100 years ago the bordering cities of Malden, Everett, and Medford, working with the Federal and state governments, deepened and straightened a mile-long section of the Malden River to create a new Federal river channel for emerging chemical production, coal gasification and manufacturing firms. These industrial usages include tanneries, naval munitions storage, general petroleum storage, and diverse chemical production (e.g. Allied Chemical, Monsanto, DuPont ad Converse Rubber). Additional facilities located within the river corridor included the Solvent Chemical Corporation, Bell Rock Leather & Tanning, the Barrett Corporation, U.S. Steel Casting (later General Electric Aircraft Engines) Boston Rubber Company, Huggins Asphalt, and AVCO (NCA, 1996; 1997; 2000a). Thus, the reconfigured channel of the Malden River became an important

industrialized waterway and navigational route from Boston Harbor to the emerging industries developed on land created through the filling of tidal wetlands along its banks.

The ecological cost to the Malden River due to channel reconfiguration, industrial development, and urban land use was high. The combined effects of filling of wetlands and waterways , industrial discharges and disposal practices, channelization and dredging, and unregulated runoff from urban areas, led to the loss of most of the historic estuarine wetland habitats and their associated values to fish and wildlife resources. Alteration of the natural river course and degradation of historic spawning and nursery habitat areas negatively impacted anadromous fish populations. Additional impacts to local biota have been created by high volumes of poorly treated urban storm water, historic releases of OHM from adjacent land use activities, and toxic sediments. Finally, the construction of the Amelia Earhart dam in1966 resulted in a complete ecosystem alteration as the tidally flushing estuarine river was converted into a freshwater impoundment with poor flushing, circulation and water quality.

Presently the area of the upper watershed is primarily residential and commercial with the Fells Reservation at the source. The lower watershed consists mostly of industrial and commercial development with some open space (consisting of wetlands or fill) in areas immediately adjacent to the Malden River.

Due to limited public access and environmental quality concerns particularly as they pertain to sediments, extensive recreational usage of the river is not provided nor promoted by the three neighboring communities. However, the River is accessible by boat from the Mystic River, from the bridges and associated abutments, and from unregulated access from the shoreline. Currently, the primarily used for the Malden River involves structured or controlled access boating in the form of crew or rowing activities. Apparently due to the nature of sediment deposition outside the main channel, only limited motorized boating has been observed. The Tufts University crew team practices on the Malden River, and is currently building a permanent boathouse along the river. Motorboat access may be limited due to shallow depth in the channel. There is no fish stocking or recreational fishery maintained in the Malden River, but there is likely to be a poorly developed urban fishery in existence.

4.4 Air Quality

Ambient air quality is protected by Federal and state regulations. The U.S. Environmental Protection Agency (EPA) has developed National Ambient Air Quality Standards (NAAQS) for certain air pollutants, with the NAAQS setting concentration limits that determine the attainment status for each criteria pollutant. The six criteria air pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead.

The entire State of Massachusetts, including Suffolk County, is designated as a non-attainment area for ozone. Effective June 15, 2004, all of Eastern Massachusetts were designated by the EPA as moderate non-attainment areas for the 8-hour ozone standard,

including Malden, Medford, and Everett where the project is located (U.S. Environmental Protection Agency, 2005).

Under the Federal Clean Air Act and its associated amendments (42 USC 7401 et seq.), the Federal Environmental Protection Agency (EPA) regulates six “criteria” air pollutants:

- Nitrogen dioxide (NO2)
- Sulfur dioxide (SO2)
- Lead (Pb)
- Carbon monoxide (CO)
- Particulate matter with a diameter of 10 microns or less (PM10)
- Ozone (O3)

Pollutants can be categorized as "local" or "regional". For example, carbon monoxide is a local pollutant because it forms quickly at the source (automobile exhaust) and dissipates rapidly to the atmosphere. Conversely, ozone is a regional pollutant because its formation involves a long chemical process that results is a chemically stable compound that is transported by prevailing winds. Ozone is formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight. The resulting compound is ozone (O_3), which can negatively affect the respiratory system if present at high concentrations over a prolonged period of time.

The EPA has established health-based National Ambient Air Quality Standards (NAAQS) for these pollutants and the Commonwealth of Massachusetts has in turn adopted its own air standards that mimic the Federal Ambient Air Quality Standards and are administered by the DEP. Based upon comparing the results of monitoring to the NAAQS, areas are categorized as either “attainment” or “non-attainment”. The cities in the project area are in attainment for all the criteria pollutants except ozone, as is true for the entire Commonwealth. Most of the northeastern United States is in serious non-attainment for ozone.

While all of Massachusetts is designated a non-attainment, it should be noted that ambient air ozone concentrations are largely controlled by prevailing meteorological conditions (e.g., wind direction, amount of sunlight, and temperature) rather than local emissions. The statewide non-attainment of ozone standards is likely influenced by the transport of emissions from densely populated urban areas of the New York metropolitan area as well as industrial stack emissions from Pennsylvania and West Virginia.

4.5 Hydrology

4.5.1 Introduction

No recent or systematic hydrologic study of the Malden River is available. Further, conducting such a study is likely to be complicated due to the urbanized nature of the watershed and the flow and elevation changes dictated by the operations at the Amelia

Earhart dam. The following provides a brief overview of three important hydrological features of the Malden River watershed – the Malden River's source at Spot Pond, the confluence with the Lower Mystic River and the changes caused by the presence and operation of the downstream Amelia Earhart Dam.

4.5.2 Hydrologic Features

Information about the hydrology of each section of the Malden River is provided below.

4.5.2.1 Spot Pond and Upper Watershed

The Malden River originates from Spot Pond, in the Middlesex Fells Reservation in Stoneham, MA. The surface area of Spot Pond is approximately 298 acres, the largest pond in the Mystic River watershed. The natural watershed of Spot Pond was historically 1175 acres. However, due to a series of drainage diversions for flood control of surrounding areas, the actual drainage area of the pond (including the pond surface area) is approximately 369 acres (CDM, 2002). Spot Pond discharges into Spot Pond Brook, where it flows for approximately 1 mile in a channel before entering culverts. Spot Pond Brook becomes Malden River within the culvert system, and remains underground for approximately 3 miles until it emerges in the Malden River channel.

Spot Pond was historically used as potable water conveyance in the MWRA system. Since 1997, the pond has been taken off line, and is now used to receive flows from the distribution system, either as part of a flushing event or a system failure and as an extreme emergency source, if there is a loss of suction from other facilities in the system or a transmission failure. If needed as an emergency drinking water supply, the water will be passed through a disinfection process and will require boiling before consumption. MWRA currently operates the pond such that an 8-day emergency water supply is available at all times. For this reason, releases of water from the pond can be restricted.

4.5.2.2 Lower Mystic Lake and Influence of Amelia Earhart Dam

Historically, the Malden River and Lower Mystic River were tidal estuaries supporting brackish aquatic biota. Saltwater intrusion in the rivers led to saline stratification in the Lower Mystic Lake, first observed in 1860 and consistently present until its reduction in the 1980s. The presence of the saline stratification caused the saltwater to be trapped in the deep pools of the lake, and prevented biannual turnover and complete mixing. At times (during the right combination of strong winds and low lake levels), there were releases of hydrogen sulfide (H_2S) from Lower Mystic Lake, causing public nuisance conditions and possible health hazards. Following a 1965 release, a major kill of alewives and barnacle growth on boats and pilings were observed.

The installation of the Craddock Dam in 1908 (on the Mystic River approximately 3 miles downstream of the lake) did not isolate the lake, and periodic excursions of saltwater into the lake occurred when the locks were open. The Amelia Earhart Dam was

completed in 1966 (approximately 5 miles downstream of the lake, below the confluence of the Mystic and Malden Rivers) with flood control (i.e., protection from storm surge) as its primary function. The dam maintains the lake level ~1 m above mean low water, which prevents intrusion of tidal seawater and negates the possibility of reintroduction of saline stratification into the Lower Mystic Lakes. However, this effectively eliminates tidal flow into and flushing of the Mystic and Malden Rivers, and the elimination of saltwater quickly changed the ecosystem from its natural brackish state to freshwater. For this reason, runoff and flushing by up-gradient freshwater flows now dominates the system. Based on the presence of the Malden River on the Massachusetts 303(d) list for waters not meeting state water quality standards, it appears that the present rate of flushing is insufficient to maintain good water quality in the Malden River.

In the late 1970s, the Lower Mystic Lake Saltwater Removal Project (MDC, 1994) was designed and implemented by MDC and EPA to reduce the volume of saltwater trapped in the deep holes of the lake, as well as the potential for H_2S releases. A combination of pumping (removing 240,000 m^3) and a large storm event (removing 456,000 m^3) resulted in the removal of approximately 90% of the saltwater from the holes in the Lower Mystic Lake. This removal led to a larger lake volume available for freshwater habitat and elimination of H_2S releases due to the larger depth of freshwater overlying the remaining salt water and a smaller reservoir of sulfide-laden water.

The current operation of the Earhart Dam permits the passage of small volumes of salt water when the locks open. This small volume tends to sink into the deep hole located just upstream of the dam, and does not make its way up the rivers. This water is periodically pumped to the seaward side of the dams during efforts to lower the upstream water level.

Due to the persistent water quality problems in the lake and the extensive effort expended to address these issues, there is considerable concern that any alteration in the operation of the Earhart Dam that allowed more salt water inflow could result in a reintroduction of saline stratification in the Lower Mystic Lake. This concern is driven by historical experience and the fact that there is very little elevation change between the dam and the lake, indicating that the tidal salt water will likely migrate to the lake.

4.6 Water Quality

This section provides a brief review of existing water quality conditions and the factors, which control water quality in the Malden River.

4.6.1 Water Quality Classification

The Malden River is classified by the State of Massachusetts as Class B waters, designated as a habitat for fish, other aquatic life and wildlife, required to meet swimming and boating standards, suitable for irrigation, agricultural and industrial uses and have “consistently good aesthetic value.” Massachusetts Class B standards require a minimum dissolved oxygen (DO) concentration of 5.0 mg/l for warm water fisheries, pH

in the range of 6.5 to 8.0 standard units or as naturally occurring, fecal coliform not to exceed 200 colonies/100 ml, and color, turbidity, and suspended solids in concentrations that would exceed the recommended limits of the most sensitive receiving water use. Also, Class B waters shall be free of floating oils, grease, petrochemicals, and pollutants that form objectionable deposits or nuisances. However, water quality results (Nangle, 2003a) indicate that the river does not support its designated uses, and is listed on the Massachusetts 303(d) list for organic enrichment/low DO, pathogens, oil and grease, taste, odor, color, suspended solids, and "objectionable deposits."

4.6.2 Water Quality Studies

Water quality in the Malden River is generally considered degraded, owing to several sources of contamination, (i.e., contaminated sediments, storm water, historic releases of OHM) as well as poor flushing. There are more than 70 pipe discharges into the Malden River, including two combined sewer overflows (Harris, 2000). Although an extensive water quality study of the Malden River has not been performed, several focused studies (e.g. NCA, 2000b) indicate degraded water quality conditions in the river; primarily due to poor mixing and storm water run-off contributions.

Dissolved Oxygen

The USEPA has established several dissolved oxygen criteria to protect warm water fish (USEPA, 1986). For early life stages the 7 day mean concentrations should not drop below 6.0 mg/l, and should be maintained above 5 mg/l at all times (1 day minimum). For other life stages, the 30-day mean is 5.5 mg/l, the 7-day minimum is 4.0 mg/l, and the 1-day minimum is 3.0 mg/l. DO levels should be maintained above 4 mg/l to avoid acute mortality of sensitive invertebrates and early life stages of fish, and above 3 mg/l to avoid acute mortality of other life stages. The criteria are meant to protect sensitive species such as white catfish and largemouth bass. Other species, including common carp and others, which inhabit the study area, are able to tolerate temporary exposure to much lower dissolved oxygen levels.

MRWA has been regularly collecting data throughout the Mystic River Watershed since 1999, including one station above the Amelia Earhart Dam. At this location, they have collected continuous dissolved oxygen (DO) data during the summer months of 2002 and 2003. The DO sensor was located in 3-6 feet of water, in the lower portion of the water column. In 2002, a dry year, there were 3-4 weeks in July when the DO fell below 5.0 mg/L (the Class B water quality standard). In 2003, a wet year, there were only a few excursions in July when DO fell below the water quality standard. These data indicate that low DO conditions are present at this location, likely on an annual basis. However, the low DO condition does not appear to persist throughout the summer season. Nor does storm water inflow appear to drive low DO at this location. It is possible that low DO persist further upstream in the Malden River, where there is no influence from the Mystic River. Point measurements of DO collected throughout the watershed on 10/28/03 indicate that DO in the central reach of the Malden River is considerably lower than at other locations in the Malden River and the Mystic River.

4.6.3 Key Factors Affecting Water Quality

Water quality of the Malden River is controlled by numerous factors including: 1) lack of flushing 2) organic loading from storm drains, illegal sewer connections, and combined sewers; 3) other pollutant loads (nutrients, heavy metals, oils, floatables) from storm drains and combined sewers; 4) sediment oxygen demand (SOD); 5) release of nutrients from anaerobic sediment; 6) organic loading from extensive emergent (*Phragmites*) vegetation, and leaf fall from deciduous trees and shrubs; 8) waste from wildlife; and 9) overland loading of sediment and nutrients from surrounding land and erosion from unprotected shoreline. Each of these is briefly discussed below.

Lack of Flushing

The lack of flushing of the Malden River is the one of the most important factors influencing water quality. The small, highly impervious nature of the watershed prevents freshwater base flow into the Malden River for extended periods, and groundwater inflow that does occur may be of degraded quality. Low flow rate in combination with the pond like character of the river prevents flushing of sediments and organic material from the system. The relatively stagnant conditions result in low dissolved oxygen levels, which in turn lead to nutrient (phosphorus and ammonia) release from sediments.

Pollutant Loads

Solids, metals, floating debris, nutrients and oils enter the Malden River through storm water run off and seepage from contaminated sediment. The river receives storm water run off from the surrounding urban area.

Seeps and groundwater migration from filled areas were historically a major contributing factor to water quality. The extensive fill in the tidal wetlands included various waste materials. Pollutants from these fill materials may have seeped directly into the river or dissolved in groundwater then migrated into the river. Seeps of non-aqueous phase liquids into culverts and ultimately into the river have occurred. Efforts to address specific source areas are ongoing.

Atmospheric deposition is also a factor. Metals from coal burning power plants and other sources may accumulate in river sediments.

Sediment Oxygen Demand (SOD)

Because of the stagnant nature of the river, low volume to surface area ratio, and the high organic content of the sediments, sediment oxygen demand has a significant impact on DO levels in surface waters. Biological activity associated with decomposition of organic material utilizes oxygen and exert a drain (sediment oxygen demand) on the DO within the water column. Other factors, specifically, respiration of plants (algae), and chemical and organic releases into the river from overland source and storm drains, cause

an added demand on DO. High SOD also leads to anaerobic conditions within the sediments.

Nutrient and Contaminant Release from Anaerobic Sediments

Anaerobic conditions in sediment, caused by the decomposition of large amounts of organic matter, lead to release of phosphorus, ammonia, and hydrogen sulfide into the water column. Phosphorus and ammonia are plant nutrients that can stimulate growth of algae and aquatic plants. Ammonia and hydrogen sulfide may be toxic to aquatic life.

Plant Growth

Growth of algae, aquatic plants, emergent plants, and leaf fall from trees and shrubs add organic material to the Malden River system. Given the flow regime, much of this matter settles out in the sediments, exerting a sediment oxygen demand from bacterial degradation in the sediments. Low DO levels resulting from high SOD stimulate release of nutrients that in term, may stimulate growth of algae and other aquatic vegetation. This positive feedback loop is characteristic of highly eutrophic aquatic ecosystems such as the Malden River.

Emergent and aquatic vegetation slow water velocity, allowing suspended solids to settle out of the water column more readily and accumulate in sediment deposits. This may improve water quality, but can have a long-term, adverse effect on aquatic habitat as nutrients and contaminants accumulate in sediment as water volume decreases.

Waste from Wildlife

Waste from geese and ducks in the Malden River can increase coliform levels in surface waters. Waste from domestic animals may also contribute to elevated coliform levels.

Pollutant Load from Adjacent Parkland Shoreline Erosion

Overland nutrient and sediment loads from surrounding parkland are relatively minor factors affecting water quality and implementation of best management practices will further reduce their effect on the river. Erosion from unprotected shoreline is generally minor and occurs near the entrances and exits of culverts; most notably during storm discharges. There may also be some minor erosion near the banks caused by wildlife activity along the shoreline. The material eroded away usually settles out quickly in the area near the shore.

4.7 Sediment Quality

Data on sediment quality is available from a variety of sources (TRC, 1985; Haley and Aldrich, 2001, Nangle, 2003a; 2003b). River sediments have been sampled for metals, cyanide, volatile organic compounds (VOCs), PCBs, petroleum hydrocarbon fractions,

and pesticides. The primary pollutants of concern in the Malden River are semi-volatile organic compounds (SVOCs) and metals. These pollutants are discussed in detail below. During Phase I of the Malden River Ecosystem Restoration project, ENSR compared observed pollutant concentrations to generic soil criteria from the Massachusetts Contingency Plan (MCP) and suggested ecological benchmarks provided in Massachusetts Department of Environmental Protection (MA DEP) technical updates (MA DEP, 2002). However, since soil criteria are not directly applicable to sediments the Corps chose to use probable effects based criteria to evaluate the Malden River sediments (see Appendix F).

4.7.1 Sediment Studies

Sediment depths and characteristics have been partially characterized for the Malden River. A cross section depicting sediment in the upper section of the river (from Malden River Culvert Outfall to Medford Street Bridge) is provided in Phase I Appendix D (Haley & Aldrich, 2001). The depth of water in the upper section is 5 feet or less. Sediments include organic silt, sands, clayey organic silts and clay (Haley & Aldrich, 2001). The depth of sediments (defined as the depth to clay) varies from 2 feet to over ten feet in the upper section of the river. The thickness of sediment increases with distance from the culvert outfall. The top layer of sediment is primarily sand at the culvert outfall and immediately to the south. Further south the top layer of sediment is primarily organic silt.

A profile depicting sediment in the River's Edge (formerly TeleCom City) section (from Medford Street to Revere Beach Parkway) is provided in Phase I Appendix D (NCA, 2003a). The depth of water in the River's Edge (formerly TeleCom City) section is five to ten feet. The depth of water generally increases from north to south. The thickness of sediment in the River's Edge (formerly TeleCom City) section ranges from approximately 7 to 18 feet. The sediment layer is thickest near the Medford Street Bridge and in the area of the confluence of Little Creek. The top layer of sediment is primarily organic silts. A layer of sand is present below the organic silts in some areas.

Sediment from Malden River contains elevated levels of metals and petroleum hydrocarbons. Concentrations of contaminants vary with depth depending on location. Accumulation of contaminants in sediment is believed to be the result of years of loading from storm drains, combined sewer overflows, point source discharges , and atmospheric deposition (dust and precipitation). Conditions are exacerbated by the highly urbanized nature of the watershed, sluggish nature of the Malden River and resulting lack of significant flushing, and low dissolved oxygen levels which slow decomposition of petroleum hydrocarbons and other organic contaminants.

<u>Metals</u>

Elevated levels of arsenic, cadmium, chromium, lead, nickel, zinc and mercury can be found in various reaches of the Malden River. Data from Nangle (Nangle Consulting

Associates, Inc., June 2003a, Environmental Data and Information Malden River Study Area.) illustrates that the areas with elevated levels of metals are distributed in discrete portions of the river as well discrete depths. To evaluate the possibility of removing sediments from the Malden River, data from Nangle was used to characterize the sediments from the sediment-water interface to a depth of 4 feet. The data used in this evaluation is presented in Table EA-3 and an explanation of its evaluation is presented in Appendix F. The following ranges were observed in the data set used:

Metal	*Range of concentration in the Malden River sediments*
Arsenic	35 mg/kg – 250 mg/kg
Cadmium	7 mg/kg – 14 mg/kg
Chromium	78 mg/kg – 536 mg/kg
Copper	220 mg/kg – 476 mg/kg
Lead	850 mg/kg – 1970 mg/kg
Nickel	43 mg/kg – 295 mg/kg
Zinc	1100 mg/kg – 3610 mg/kg

PCBs

The PCB data available for Malden River sediments is limited. However, PCBs have not been identified as a contaminant of concern within the Malden River Corridor.

PAHs

Highly elevated levels of PAHs occur in Malden River sediments. Concentrations in the sediment data that was used to evaluate dredging alternatives ranged between 917 and 4604 mg/kg (Table EA-3). Pyrene, flouranthene, chrysene, benzo (a) anthracene, and phenanthrene are the most abundant PAHs detected. As with metals, PAH concentrations are distributed in discrete portions of the river as well discrete depths

4.7.2 Sediment Quality Evaluation

Multiple lines of evidence indicate that chemicals in Malden River sediments pose a risk to biota. Sediment is likely to adversely affect fish and benthic invertebrates in all areas. Principal lines of evidence in support of this assessment are comparison with probable effect concentrations (PECs) developed by McDonald et al. (2000) and comparison with state sediment quality criteria. Levels of metals, and PAHs in sediment from the river generally exceed PECs. In many cases, PECs are exceeded several fold, making adverse impacts on benthic invertebrate communities probable.

Table EA-3. Sediment Chemistry Values Used in Predictive Toxicity Model. Initial concentrations represent composite data from 0-4 feet in each sub-area.

Area	Chemical	Initial Concentration (mg/kg)
Sub-area 1	Total PAHs	3610.00
	Total PCBs	0.050
	Arsenic	35.0
	Cadmium	12.00
	Chromium	78.00
	Copper	310.00
	Lead	1100.00
	Nickel	43.00
	Zinc	1100
Sub-area 2	Total PAHs	1446
	Total PCBs	0.050
	Arsenic	27.500
	Cadmium	11.000
	Chromium	116.000
	Copper	343.000
	Lead	1970
	Nickel	56.00
	Zinc	2838.00
Sub-area 3	Total PAHs	4604.00
	Total PCBs	0.050
	Arsenic	234.20
	Cadmium	7.00
	Chromium	242.00
	Copper	467.00
	Lead	1120.00
	Nickel	47.00
	Zinc	2300.00
Sub-area 4	Total PAHs	3103.0
	Total PCBs	0.532
	Arsenic	250.00
	Cadmium	7.30
	Chromium	140.00
	Copper	220.00
	Lead	850.00
	Nickel	46.00
	Zinc	1100.00
Sub-area 5	Total PAHs	917.00
	Total PCBs	0.050
	Arsenic	43.20
	Cadmium	14.00
	Chromium	536.00
	Copper	275.00
	Lead	1100.00
	Nickel	295.00
	Zinc	3610.00

4.8 Biological Resources

4.8.1 Habitat

Existing Wetland Habitat

Historically, the Malden (and Mystic) Rivers consisted of tidal systems with broad expanses of salt marsh and a much different saltwater-driven hydrological ecosystem. Since industrialization, filling of wetlands has been completed to allow riverside construction, including making space for portions of the Revere Beach Parkway and adjacent industrial developments. Historic Coast and Geodetic Survey maps from 1860-1893 illustrate broad expanses of wetlands associated with the river's floodplain, and subsequent wetland loss from the development of railroads, industrial facilities, residential development, and parks. Construction of the Amelia Earhart Dam in 1966 to alleviate upstream flooding and provide long-term flood protection of infrastructure and residents effectively converted what wetlands remained from a tidally derived saltwater environment into a freshwater system.

Functions performed by the in-stream and adjacent wetlands within the study area include the filtering and transformation of nutrients and some toxic substances in storm water entering the river, provision of nesting, breeding, and foraging habitat for wildlife, storing floodwater during storm events, and prevention of shoreline erosion. Unvegetated wetland resources, such as river bottom and unvegetated exposed banks, may provide habitat for wildlife and invertebrate species, provide a substrate for spawning or nesting, and may act as a filter for storm water. The historic loss of wetlands, however, along with river channelization and urbanization of the watershed has reduced the overall effectiveness of the existing wetlands to effectively perform many of these functions effectively. As evidenced by the poor water and sediment quality in the river, and the lack of quality habitat for fish and wildlife, the existing wetlands are insufficient in area and distribution to prevent long-term habitat deterioration.

Currently, wetlands contiguous to the Malden River and its tributaries as well as wetlands isolated in its floodplain exist in limited quantities relative to the river's size. In addition, wetlands communities are predominantly composed of invasive species, primarily common reed (*P. australis*). The bulk of existing wetlands are located on the east side of the river, both above and below the Amelia Earhart Dam. A plan dated October 5, 1999 and produced by Toomey-Munson & Associates (Wetlands and Wildlife, 1999) provides survey data on wetland boundaries at that time, and extends from the Medford Street Bridge to the north and to the Revere Beach parkway to the south (Appendix E). The following sections provide a description of the different types and characteristics of vegetated wetlands and other protected wetland resources present within the Malden River study area.

In-stream Habitat

Existing vegetated wetland habitat within the Malden River study area can be classified into several main types. The most predominant type of wetland is riverine scrub-shrub, represented by non-continuous narrow (5 to 30 feet wide) bands of wetlands along the banks of the river, typically at elevations which allow annual or semi-annual flooding to permeate the wetlands. In addition, several other types of wetlands are present, including riverine emergent wetlands, comprised primarily of *Phragmites* spp. dominated narrow bands along the Malden's banks, and lesser amounts of emergent wetland islands, also composed primarily of *Phragmites*, and submergent aquatic bed wetlands, comprised of vegetation growing from the river's sediment in scattered locations. Submerged aquatic vegetation (SAV) beds are typically located in areas along the shoreline with water depths less than 6 feet, and include such species as water shield (*Brasenia schreberi*) and coontail moss (*Ceratophyllum* spp.).

The great majority of in-stream wetlands in the Malden River are hydrologically sustained by root zone saturation as a result of their proximity and elevation relative to the Malden River, while other a smaller area of wetlands are maintained via seasonal flooding. A minor contribution to the hydrology of in-stream wetlands is also present in the form of storm water runoff.

Adjacent Habitat

In addition to those wetlands within or immediately adjacent to the main stem of the Malden River, significant wetlands also are present along or adjacent to the river's tributaries, including North and South Creeks, Mall Creek, and several smaller unnamed tributaries. The majority of these wetlands are dominated by palustrine scrub-shrub vegetative communities, although a significant percentage of them are dominated by the invasive species *Phragmites*. Hydrologic conditions in adjacent wetlands are sustained by shallow groundwater and storm water runoff, with lesser contributions from seasonal flooding. Several of the tributaries to the river appear to be sustained almost entirely by storm water runoff and overland flow from surrounding areas.

Non-Vegetated Wetland Resources

In addition to vegetated wetlands, other types of resources, which have state and federal protection as wetland resources, exist within the Malden River study area. The riverbed itself and its banks up to the mean annual high water elevation represent state and federally-protected aquatic resources. These areas, being primarily unvegetated soft sediment along the river bottom and the riverbanks in their various forms, provide habitat for fish benthic organisms, mammals, reptiles, and amphibians. In addition, state regulatory "Riverfront Area" protection under the wetlands program exists for all of the land located within 25 linear feet of the top of the Malden River's banks, beginning at the river's bankfull elevation.

4.8.2 Fish

The Malden River currently supports a resident, pollution-tolerant warm water fishery. The Massachusetts Division of Marine Fisheries (MADMF) considers the Malden to be a primarily warm water system known to harbor selected freshwater fishes, such as carp (*Cyprinus carpio*), yellow perch (*Perca flavescens*), brown bullhead (*Ictalurus nebulosus*), and the catadromous species American eel (*Anguilla rostrata*) (MADMF, 2003). Correspondence with the Massachusetts Natural Heritage & Endangered Species Program (NHESP) included in the *Natural Resource Inventory/Assessment* (Wetlands and Wildlife, 1999) completed for the MVDC indicate the potential presence of several other warmwater game fish, including largemouth bass (*Micropterus salmoides*) and chain pickerel (*Esox niger*). Based upon discussions with regulators and local individuals, some limited sport fishing for striped bass (*Morone saxatilis*) and other species previously noted does occur in the Malden River, though no population data is known to be available for the species believed present. Anecdotal evidence of the presence of blueback herring (*Alosa aestivalis*) and alewife (*Alosa pseudoharengus*) has been presented by Mystic River Watershed Association (MyRWA) volunteers. Based upon the observations of MyRWA, herring and potentially other anadromous fish are present annually in the fall and spring months near outfalls and creek mouths along the Malden River in readily observable numbers. It is unknown whether these fish enter the Malden after passing through the Earhart Dam, or are emigrated from the Mystic River.

Historically, a significant anadromous fishery was likely present. Fish species such as white perch (*Morone americana*), American shad (*Alosa sapidissima*), rainbow smelt (*Osmerus mordax*), Atlantic salmon (*Salmo salar*), and Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) historically used Atlantic coastal river systems, though construction of dams and other impacts to their habitat have significantly reduced their overall presence in New England (NMFS, 2004). While the Mystic River and Lower Mystic Lake system is currently known to support a limited anadromous fish run, including blueback herring and alewife state and federal regulatory agencies are unaware of any significant fishery in the Malden River at this time (MADMF/NMFS, 2003).

Currently, the sole means of passing anadromous fish through the dam is via lock operation by the Department of Conservation and Recreation (former Metropolitan District Commission). While the frequency and duration of lock operations and the number of fish passed is not known, it is known that blueback herring numbering over one million arrive at the Lower Mystic Lake to spawn each year (MADMF, 2003). Amelia Earhart dam operations occur in the daytime hours only, inhibiting night-migrating anadromous fish such as smelt from moving upstream. Based upon discussions with the MADMF, numbers of smelt and shad that were known to migrate upstream prior to dam construction became nonexistent within several years of installation. There is an existing sluice structure within the Amelia Earhart Dam which, based upon discussion with state and federal regulators (MADMF and National Marine Fisheries Service) (NMFS, 2004), is reportedly inoperative. While the efficacy of the sluice is not known, there may be concerns over allowing too much saltwater upstream as a result of its use. As described in Section 4.1.1.4, there have been historical difficulties

resulting from saltwater intrusion into the Lower Mystic Lake. Consequently, fish passage through the dam is facilitated through lock operation only.

While fish passage impairment and the removal of tidal flushing through the dam are assumed to be a significant factor in the absence of a good quality anadromous fishery in the Malden River, lack of flow and suitable habitat (as exists in the Mystic River) may be of equal importance. Although the lower reach of the Malden River at its confluence with the Mystic may at some time temporarily contain transient anadromous species, there is consensus among regulators such as DMF and the NMFS that the Malden River is presently unlikely to attract and support a significant population of anadromous fishes due to four primary reasons: 1) poor water quality/removal of saline influences, 2) lack of good quality spawning habitat, 3) lack of deep pools, and 4) lack of flow volume. While some of these issues may be addressed through restoration efforts, the Mystic River system may continue to be more attractive and hospitable to anadromous species than the Malden River even if improved fish passage is accomplished at the Amelia Earhart Dam.

4.8.3 Benthic Invertebrates

Based upon the most recent study (Pratt, 2003), the dominant benthic species present in the Malden River are oligochaetes, a type of annelid worm capable of living in very low oxygen and polluted environments. In addition to the oligochaetes, midges (*Chironomidae*) and copepods (*Harpacticoida*) were also present in noticeable quantities. Overall, the 2003 study illustrated low diversity and low relative abundance, with significantly lower totals downstream. The average individual per sample decreased from 1590 at the Medford Street sampling point to 2.3 at the Route 16 sampling point. Sediment substrate downstream of the confluence of Little Creek is described in the 2003 report as “a surface layer of liquid mud,” observed to severely inhibit the benthic community.

It should be noted that a previous study completed in 2002 (Larsen, 2002) that is referenced in the 2003 study showed a larger and more diverse group of macroinvertebrates in the Malden River than was observed in the 2003 study. This may be due to the method of sample collection in the 2002 study, which included the placement and retrieval of a substrate which attracts macroinvertebrates. However, no species known to be intolerant of poor water quality, such as mayfly, caddis fly, or stonefly (the intolerant Ephemeroptera, Plecoptera, and Trichoptera taxa) was observed in either the 2002 or 2003 studies.

4.8.4 Wildlife

Minimal existing information is available regarding the present use of the Malden River by mammals, reptiles and amphibians, or avian species. It has been directly observed that a significant variety of common species tolerant of anthropogenic habitat changes use the Malden River corridor, including a variety of waterfowl and water-dependant species (kingfisher (*Ceryle alcyon*), black-crowned night heron (*Nycticorax nycticorax*)); small mammals, including muskrats (*Ondatra zibethica*); and reptiles (Northern water snake

(*Nerodia sipedon*) mud turtle ( ), and snapping turtle (*Chelydra serpentina*)). Disturbance-intolerant species and wetland/riparian habitat dependant species are not presently know to make significant use of the Malden River corridor, likely as a result of lack of wetland area and contiguous vegetated riparian buffer habitat.

4.8.5 Protected Species

A preliminary determination has been made that there are no threatened or endangered species within the project area. Coordination with US Fish and Wildlife Service and National Marine Fisheries Service should corroborate this determination.

4.9 Historical and Archaeological Resources

The Malden River was originally an estuarine coastal stream that flowed into the Mystic River, winding through a dendritic network of tidal flats and wetland marshes. The Mystic River drainage and the coastal zone were utilized by prehistoric populations for at least 9,000 years. Eleven prehistoric sites have been identified in Malden, Medford, and Melrose. Only one, 19 MD-366, the Rock Hill site in Medford can be positively identified to the Late Archaic period (5,000 to 3,000 Before Present [BP]). Most of the known prehistoric sites in the northern Boston Basin are located in close proximity to coastal zone estuarine environments, major rivers, and ponds. The distribution of known sites indicates that core areas of prehistoric settlement/subsistence activity were located near the major rivers (Mystic, Charles, Saugus) entering Boston Harbor and adjacent sections of the coastal zone. Other areas of concentrated prehistoric settlement were on the margins of large ponds like Spy Pond and Fresh Pond (Arlington and Cambridge). Several of these sites contain evidence of recurrent occupation over thousands of years. The inventory of known prehistoric sites in the hilly, upland sections of the northern Boston Basin and Mystic River drainage is limited. However, there are several clusters of prehistoric quarry/lithic workshop sites near outcrops of fine-grained rocks (rhyolite) in the Melrose and Wakefield sections of the Middlesex Fells uplands. Large, base camp sites were located around ponds or the head of estuaries. Smaller, task specific sites are found on small tributaries or upland areas. During the Contact Period (1500 to 1620), the Mystic River drainage was one of two concentrations or core areas of settlement in the Boston Basin, the other being on the Neponset River. The Mystic River core also probably extended inland from the estuary to include adjacent uplands with large pond (Spot Pond) and tributary stream systems, such as the Malden River. It is likely that prehistoric sites were once present along the original course of the Malden River, however, any evidence of these sites has likely been destroyed by channelization and industrial development.

Malden's first grist mill was located on Spot Pond Brook (Malden River) in 1640. That same year, a ferry service was established to cross the Mystic River. Agriculture remained the primary economic activity in the the town until the early nineteenth century with the opening of the Salem and Newburyport Turnpikes through Malden, and the construction of the Charles River bridge and the Malden Bridge by c. 1804. Industries became established along the Malden River, including silk dying by William Barrett, and

a nail rolling and slitting mill established by the Odiorne Brothers on the same mill seat as the 1640 grist mill. In 1812, the production of shoe lasts by Samuel Cox ushered in shoemaking as a major industry that survived into the twentieth century. Tinware was also manufactured in Malden beginning in 1819.

The Saugus Branch railroad was extended from Malden to Salem through Revere in 1854. The railroad allowed for significant industrial expansion in Malden through the remainder of the nineteenth century. These industries included the Boston Rubber Shoe Company established by Elisha Converse, Malden Chemical Works, tanneries, dye houses, nail factories, forges, machine shops, and factories producing tinware and brittaniaware. Shoemaking became a major industry in Malden by 1837.

Establishment of a street railway system during the late nineteenth century led to an increase in a residential population in Malden, paricularly in the highlands section of Oak Grove. Malden was incorporated as a city in 1881.

In 1900, the Boston Rubber Shoe Company was the largest maker of rubber shoes in the world. Other firms produced paint and varnish, soap, and linen fire hose. In 1907, the Malden Knitting Mills opened on Eastern Avenue, which expanded to four mills between 1915 and 1925. During this period, the Malden River was deepened and straightened to creat a new Federal river channel for these manufacturers as well as chemical manufacturers, coal gasification, and general petroleum storage.

Little new industrial growth occurred during the twentieth century. In Malden, the Edgeworth Tannery, Naval Ordinance depot, and the New England Flint Paper Works all closed, while the manufacture of rubber boots and shoes, knit goods, and paint and varnish continued until at least mid-century.

4.10 Socio-Economic Setting

Population and income data for Malden, Medford, and Everett are summarized in Table EA-3. The populations of both areas grew by about 1 percent from 1990 to 2000. Slow or no growth in the population is expected to occur in the coming decades.

Table EA-4: Socio-Economic Data for Malden, Medford, and Everett (2000 Census)

Parameter	Malden	Medford	Everett
Population	56,340	55,756	38,038
Median Household Income	$45,645	$52,476	$40,661

The Malden River is situated near commercial properties, residential neighborhoods, and many prominent Boston institutions (Table EA-4). These include 10 universities or colleges, eight hospitals, and two major art museums. Residential neighborhoods near the study area are diverse, ranging from upper middle to lower middle class. Access to

the area is provided by several major highways, bus service, and Massachusetts Bay Transportation Authority (MBTA) subway stations.

Table EA-5: Prominent Institutions near the Study Area

Colleges and Universities	Hospitals	Other Institutions
Northeastern University Harvard Medical School New England Conservatory of Music Wentworth Inst. Of Technology Emanuel College Wheelock College Simmons College Massachusetts College of Art Massachusetts College of Pharmacy Forsyth Dental School The Cotting School Berklee College of Music Boston University Boston Conservatory of Music	Brigham & Womens Children's Beth Israel Danna Farber Cancer Inst. New England Deconess New England Baptist Veterans Administration Massachusetts Osteopathic	Museum of Fine Arts Isabella Stewart Gardner Museum Symphony Hall Fenway Park Christian Science Mother Church Arnold Arboretum Boston Public Latin H.S. New England Home for Little Wanderers Museum of Native Americans

4.11 Recreational Resources

Due to limited public access, the Malden River does not provide extensive recreational use. However, the River is accessible by boat from the Mystic River, from the bridges and associated abutments, and from unregulated access from the shoreline. In addition, the general development plan of River's Edge (formerly TeleCom City) provides for increased public access via the development of the Malden River Park. This will include public parkland along the river, a "river walk" trail, scenic overlooks, benches, and other amenities. Currently, the Malden River is primarily used for non-motorized boating, specifically crew, canoeing, and kayaking. The Tufts University crew team practices on the Malden River, and is in the construction phase of a permanent boathouse along the river. Motorboat access may be limited due to shallow depth in the channel. There is no fish stocking or recreational fishery maintained in the Malden River, but there is likely to be a poorly developed urban fishery in existence.

4.12 Public Health and Safety

Human health risk issues associated with releases of OHM in the river system are being evaluated by others as a part of ongoing MCP responses actions. Based upon the review of available information, primary health risks are believed to be associated with potential exposure to contaminants in the surface water or sediments due to skin contact or fish consumption. There is no evidence that contact recreation (swimming, wading) is conducted at the Malden River on a regular basis, so it is expected that any potential exposure to surface water or sediments would be incidental and slight. Consumption of fish is a potential human health risk but is likely limited by the lack of public access and the poor state of the Malden River fishery. A human health risk assessment has been conducted for the upper Malden River north of the Medford Street Bridge (Haley and Aldrich, 2001). The risk assessment concluded a condition of No Significant Risk for

recreational contact with surface water (child receptor) but could not demonstrate this condition for ingestion of fish caught in the Malden River. Human health risk issues in the lower reaches of the Malden River are currently being studied by MVDC, through their consultant NCA and others associated with the implementation of response actions to address historic releases of OHM within the river system.

4.13 Aesthetics

Growth of *Phragmites* is generally regarded as having a highly adverse visual impact on the Malden River area. The tall, dense, stands obscure views of the water along almost the entire stretch of the river. The only area where *Phragmites* may have some benefit is in areas where it blocks major roads or industrial buildings.

During warm dry weather periods the odor of hydrogen sulfide released from anaerobic sediment is an aesthetic concern. Odors from major storm drains and petroleum hydrocarbons are also sometimes a problem. Also of concern is accumulation of floatables and scum on water surfaces.

4.14 Farmland Soils

The project area consists of the Malden River. The soils within the River are subaqueous and do not qualify as prime agricultural soils.

4.15 Protection of Children and Environmental Justice

Executive Order 13045 “Protection of Children from Environmental Health Risks and Safety Risks” seeks to protect children from disproportionately incurring environmental health or safety risks that might arise as a result of Army policies, programs, activities and standards. Environmental health risks and safety risks include risks to health and safety attributable to products or substances that a child is likely to come in contact with or ingest. Risks associated with the Malden River are limited to those associated with any natural body of water.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 Introduction

This section identifies and evaluates the potential environmental benefits and impacts of the recommended plan. Effects on land use, water quality, aquatic and riparian habitat, biological resources, archaeological and historic resources, socio-economic resources, recreation, and aesthetics are discussed.

The recommended plan includes elements of removing invasive plant species from degraded freshwater wetland areas, restoring wetland areas by planting with native wetland species, and the creation of new wetland areas. A report detailing the process of evaluating and choosing these elements is provided in Appendix E.

5.2 Land Use

5.2.1 Construction Impacts

Several staging areas may be established to support construction activities. These areas will be used to house temporary project offices, store construction equipment and materials, and to process material and other debris removed. The primary staging location is shown on Figure 6-2. All proposed staging areas are previously developed and/or disturbed upland areas. Project construction may take up to 2 yeas to complete and the areas may be used for some or all of this period.

Temporary staging areas were identified during this phase of the study. These staging areas were evaluated due their proximity to the individual restoration sites and availability for consideration. Table EA-5 identifies the parcel, ownership, functioning sub-area, and availability.

Table EA-6 Temporary Staging Areas

Parcel	Ownership	Functioning Sub-area	Availability
Block 5/4 &4A	City of Malden	Sub-area 2 & 3	Moderate
Block 2/ 5	National Grid	Sub-area 2, 3 & 4	Moderate
Block 2/ 7-10	MVDC	Sub-area 4 & 5	High
Block 6/ 8	Gateway Mall Properties	Sub-area 6	Moderate

The National Grid parcel (Block 2/5) is the most favorable staging site due to its approximation to the proposed work activities, lot size, availability, and estimated real estate costs (Refer to Section 10 – Environmental Assessment Figures, Figure E-6). The National Grid parcel (2 acres) will be considered as a temporary staging area for a one-year construction season.

All staging areas and other disturbed areas will be restored. Topography, landscape features, and vegetation will be restored in-kind. .

5.2.2 Long-term Effects

The NER plan for the Malden River Ecosystem Restoration Feasibility Study consists of the following actions:

- Removal of 36,000 cubic yards of invasive species along 14.9 acres of the riverbank corridor within sub-areas 3, 4, and 5;
- Replanting of 14.9 acres with native wetland species within sub-areas 3, 4, and 5;
- Creation of 5.4 acres of emergent wetland within the existing oxbow (sub-area 4);
- Placement of 4,400 cubic yards of gravel/sand substrate to create 2.8 acres of fish spawning habitat within sub-areas 1, 3, 4, 5, and 6;
- Debris removal and disposal within the construction work limits; and
- Operational changes at the Amelia Earhart Dam to improve fish passage.

The recommended plan will have no long-term adverse impacts on land use. However, several long-term beneficial impacts such as improved wildlife habitat quality, improved fishery resources, and a more aesthetically pleasing landscape will be gained as a result of this project.

5.3 Hydrology

Implementation of the recommended plan is anticipated to have minimal impact on the Malden River hydrology, its tributaries and upstream watershed as long as implementation of the recommended plan conforms to the recommendations described below.

5.3.1 Construction Impacts on Hydrology

Impacts to hydrology are not anticipated during construction. The Contractor will be required to avoid obstructing stormwater flow to the Malden River to ensure localized hydrology is not impacted.

5.3.2 Long-term Effects on Hydrology

Water levels in the Malden River are regulated by the Amelia Earhart Dam, which maintains water levels between 104 and 106 feet NGVD during both normal and storm conditions. As described in section 4.2.1, the Malden River in approximately 6 feet deep by 100 to 150 feet wide with an estimated surface area of 54 acres between the Medford Street Bridge in Malden and its confluence with the Mystic River.

The recommended plan actions were evaluated for any long-term effects on hydrology to the Malden River, its tributaries or upstream watershed. Recommendations to minimize long-term effects to hydrology are listed below.

• Removal of 14.9 acres of invasive species and replanting of 14.9 acres of native wetland within sub-areas 3, 4, and 5.

No long-term adverse effects to hydrology are anticipated assuming the proposed elevations for the proposed native wetland approximate the elevations of the existing invasive species and any existing stormwater outfalls are free of obstructions.

• Creation of 5.4 acres of emergent wetland within the existing oxbow (sub-area 4).

No long-term adverse effects to hydrology are anticipated, however, it is recommended a channel adequate to convey stormwater flows discharging from the existing north creek (tributary) outfall be incorporated into the wetland design to ensure the wetland does not obstruct flow resulting in backwater flooding.

• Placement of 4,400 cubic yards of gravel/sand to create 2.8 acres of habitat within sub-area 1, 3, 4, 5, 6 .

No long-term adverse effects to hydrology are anticipated assuming the gravel/sand is spread evenly across the indicated sub-areas to minimize increasing the river invert elevation.

5.4 Water Quality

Implementation of the recommended plan will have both long-term benefits and short-term impacts to water quality. The short-term negative impacts to water quality described below will be localized and will not create a significant adverse effect to the Malden River. Long-term benefits described in section 5.4.2 greatly outweigh adverse short–term impacts.

5.4.1 Construction Impacts to Water Quality

During construction, Malden River water quality may be affected by staging area runoff, turbidity generated during removal of *Phragmites* root mat and debris removal, turbidity generated during the creation of new wetland areas, and turbidity associated with sand and gravel placement for fish habitat. The Contractor will be required to submit a plan to avoid and minimize adverse effects on water quality. The plan will address erosion and sedimentation control, wastewater treatment, and spill prevention and control. The plan will be reviewed and approved by the Corps, the MA DEP and the Malden, Medford, and Everett Conservation Commissions before construction is allowed to proceed.

Staging Area Runoff

Several staging areas will be established in the project area (See Figure E-6). In order to provide a workable surface, it is expected that the Contractor may place an impermeable geotextile fabric and a layer of crushed stone over the existing ground. Underlying soil will remain essentially undisturbed. Runoff from staging areas will be directed to sedimentation/infiltration basins and/or grassy swales. These measures are very effective at treating runoff, and discharge of sediment or contaminants into surface waters will be minimal.

Phragmites and Debris Removal

Disturbance of sediment during removal of *Phragmites* root mats and large debris (e.g., submerged logs, tires, shopping carts) will generate turbidity. Work will likely be conducted in stages, with the work areas isolated by silt curtains in order to contain turbidity.

Mechanical removal of *Phragmites* in wetland areas will likely be conducted in two steps. First the stalks are cut and trucked offsite for disposal (composting). The second step will involve the removal of the root mat from the water by a low ground pressure or barge mounted excavator. Substantial turbidity will be generated during excavation of the root mat. Silt curtains along the perimeter of the root mat will be used to minimize turbidity effects outside the work area. Material will typically be moved to a staging area and dewatered before being transported off-site. At the staging areas, excess water will drain into a sump from which it will be pumped into the tanks. Tank water will be treated on-site prior to discharge back into the Malden River.

Turbidity from Wetland Creation Activities

The recommended plan will place approximately 26,000 cy of excavated wetland material in areas that are currently open water to create wetland habitat. The water in the areas to be filled will be gradually displaced by sediment and flow to adjacent areas. This will produce elevated levels of TSS and turbidity in the areas adjacent to the created wetland areas. The area of created wetland will be encompassed by silt curtains to

contain suspended solids and minimize elevated turbidity levels in adjacent waters. Therefore, adverse impacts to water quality should be minimized.

Turbidity from sand and Gravel Placement for Fish Habitat

Minimal amounts of gravel and sand will be placed in various locations throughout the river for fish habitat enhancement. Impacts to water quality from this activity will be short-term and highly localized. No significant adverse impacts are expected as a result of this activity.

5.4.2 Long-term Effects on Water Quality

Water quality problems in the Malden River have been documented in Section 4.4.

Water quality is an important component of the ecosystem system and water quality improvements have been identified and evaluated. However, water quality improvements measures associated with urban and industrial nonpoint/point pollutants sources can not be implemented under the Corps Ecosystem Restoration Program. The problems associated with these improvement measures are the responsibilities of other parties who have a legal responsibility for remediation or other compliance responsibility.

The goal of the Mystic River Watershed Collaborative is to achieve and maintain a "Class B" level of water quality in the Mystic River and its tributaries by 2010. Class B status will allow the waters to be considered "fishable and swimmable". To attain Class B status, all combined sewer overflows (CSOs) must be eliminated. The Mystic River Watershed Association is requesting a commitment from the Massachusetts Department of Environmental Protection and the Massachusetts Water Resource Authority to eliminate CSO discharges in to the watershed.

A NPDES Phase II Permit has been issued to the City of Malden (NPDES Permit # MA 041046). Measures included Public Education and Outreach Programs, Public Involvement and Participation, Illicit Discharge Detection and Elimination, Construction Site Stormwater Runoff Control, and Post-Construction Stormwater Management in New Development and Redevelopment.

Long-term adverse impacts from this project are not anticipated. However, many long-term beneficial effects are expected in combination with the efforts performed by MVDC, MyRWA, PRPs and the cities. The creation of new wetland areas in sub-area 4 of this study will act as a natural filter for stormwater discharge and runoff. This filtering action will remove nutrients from these discharges as well as help trap pollutants. Additionally, the creation of the wetland will effectively cap the underlying contaminated sediments in sub-area 4 and stop re-suspension of these contaminants to the water column.

5.5 Sediment Quality

Sediment testing in the Malden River (Nangle, 2003a; 2003b) shows that river sediments contain elevated levels of contaminants, including metals, petroleum hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), and pesticides. Elevated contaminant levels result from years of loading from storm drains, combined sewer overflows, point and non-point source runoff, and atmospheric deposition. Although the direct removal of all contaminated sediments is beyond the scope of this study's authority, some elements of this project will benefit the long-term sediment quality in the Malden River. The implementation of separate sediment quality improvement projects in the river will add to the restoration of functions and values to the Malden River system.

5.5.1 Construction Impacts on Sediment Quality

Impacts to sediment quality from construction activities associated with the proposed project should be short-term and localized. The removal of invasive species and their associated soils and sediments may impact the sediment quality in the study area by exposing contaminants and/or distributing minimal amounts of contaminated sediments to the river. However, best management practices such as managing runoff, using silt curtains, and treating dewatered effluent will help minimize impacts to sediment quality.

The placement of sandy material in open water to create wetland habitat and the placement of gravelly sand for fish spawning will change the sediment characteristics in sub-area 4 of the Malden River from silt to sand.

5.5.2 Long-term Sediment Quality Benefits

No long-term adverse impacts on sediment quality are expected. All long-term impacts to sediment quality are anticipated to be beneficial. The creation of wetland in sub-area 4 will effectively cap the contaminated sediments that currently exist in the area. In addition, the wetland that develops in sub-area 4 will serve as a biological filter to storm water entering the Malden River from North Creek. This will benefit the sediment quality of the river by reducing the contaminant loads that the system currently experiences. Implementation of BMPs in the system will also reduce loading, but given the highly urbanized nature of the watershed, significant loading of many contaminants will likely continue.

5.6 Biological Resources

5.6.1 Habitat

The recommended ecosystem restoration plan will enhance fish, wildlife, and plant communities in the project area. Benefits will result from the elimination of *Phragmites* from riparian and wetland habitats, increased quality of aquatic habitat, improved sediment quality, and improved water quality. The long-term benefits to fish, wildlife, and plant communities will outweigh short-term adverse impacts of project construction.

The NER plan for the Malden River Ecosystem Restoration consists of the following:

- Removal of 14.9 acres of invasive species along the riverbank corridor within sub-areas 3, 4, and 5;
- Replanting of 14.9 acres with native wetland species within sub-areas 3, 4, and 5;
- Creation of 5.4 acres of emergent wetland within the existing oxbow (sub-areas 4);
- Placement of gravel/sand substrate to create 2.8 acres of fish spawning habitat within sub-areas 1, 3, 4, 5, and 6;
- Debris removal and disposal within the construction work limits; and
- Operational changes at the Amelia Earhart Dam to improve fish passage.

5.6.2 Benthic Invertebrates

5.6.2.1 Construction Impacts

The benthic invertebrate community includes a wide array of organisms living in close association with the sediments and soils. Many of these organisms burrow into sediments, while others live at the sediment-water interface. The removal of *Phragmites* in the wetland areas and the placement of fill to create wetland habitat in sub-area 4 will destroy the existing benthic community in the construction area. Direct impacts on the benthic invertebrates will be burial by sediments for the wetland creation area and removal of invertebrate communities in the *Phragmites* excavation areas. Turbidity impacts on the benthic communities adjacent to the fill and wetland excavation areas will also occur as sediment is suspended in the water column. However, since the existing invertebrate communities in the project area are stress tolerant assemblages, impacts should be localized and minimal. Silt curtains will limit the aerial extent of the impact of high turbidity levels and no significant mortality from exposure to high-suspended sediment levels is expected.

5.6.2.2 Long-term Effects

The impacts of changing existing open-water habitat to wetland habitat will negatively affect benthic communities in the area of wetland creation. Benthic organisms will not be able to colonize the area, as it will no longer contain stands of deep water. Benthic organisms outside of the wetland creation area will experience long-term beneficial

effects as the wetland areas aid in the improvement of water quality in the system and the highly contaminated sediments in sub-area 4 are capped.

5.6.3 Fish

5.6.3.1 Construction Impacts

Construction impacts to the fish communities in the Malden River are anticipated. Fish near the work area (for wetland restoration, wetland creation, and placement of sand and gravel) will be exposed to elevated levels of suspended sediment during excavation and filling activities. Silt curtains will limit the aerial extent of this impact, however, minimal mortality from exposure to high suspended-sediment levels is expected as well as burial of individuals during filling activities. Although some individuals may be lost, construction should not eliminate any fish populations from the Malden River.

5.6.3.2 Long-term Effects

There will be some negative long-term effects to fish populations from this project. The filling of approximately 5.4 acres of open water to create wetlands will result in the loss of some fish habitat. However, fish communities in the project area will also experience the long-term benefit from improved water quality, sediment quality, and improved physical habitat quality.

The creation of wetland habitat in sub-area 4 will provide many valuable benefits to the fish community in the Malden River. The wetland will cap a 5.4- acre of river bottom that is currently contaminated with various metals and PAHs. This will reduce the contaminant load in the system and reduce the contaminant stress on the fish populations. The wetland will also serve as a filter for the stormwater runoff from North Creek. This will aid in the improvement of water quality in the river and therefore, the habitat quality of the river for fish resources.

The implementation of new locking procedures at the Amelia Earhart dam will also be a positive benefit for the fish populations in the Malden River. More frequent openings of the locks at several times of the day (i.e., daytime openings and nighttime openings) will allow more migratory fish such as alewives and river herring to enter the Malden/Mystic River system.

The recommended plan will also provide approximately 2.75 acres of gravel-sand habitat for fish species (e.g., bluegill, bass) that use these types of substrate as spawning habitat. The gravel-sand habitat will also provide a diversity of habitat in the system for multiple fish species. Ten sites are recommended throughout the project limits, of which three sites will require “work by others.” There are ongoing discussions with Potentially Responsible Parties (PRPs) to perform the “work by others.” “Work by others” will include removing a minimum of 3 feet of contaminated sediment and replace it with clean gravel material. Sub-area 2 near Medford St Bridge and Sub-area 3 near Little

Creek confluence would require efforts by the PRPs prior to implementing the Federal project.

Overall, the recommended plan will have a positive effect on the Malden River migratory and resident fish communities, improving both habitat quantity and quality. Over the 50-year project life for the recommended plan, a HEP Analysis (Habitat Evaluation Procedure) calculated a significant gain in fish habitat units (see Appendix J for details). The benefits result from increased fish habitat area.

5.6.4. Vegetation

5.6.4.1 Submerged Aquatic Vegetation

The filling of 5.4 acres of open water to create wetland habitat will destroy any submerged aquatic vegetation (SAV) within the fill area. However, SAV in this area is limited to small patches of water lily and pond weeds. No re-growth of SAV will occur, as the wetland creation area will be filled to elevations that will support wetland plant species.

The placement of gravel and sand as substrate for fish habitat enhancement may displace some areas of SAV.

5.6.4.2 *Phragmites* and Other Emergent Vegetation

Phragmites

The recommended plan will eradicate 14.9 acres of *Phragmites* by physical removal and concurrent application of a glyphosate herbicide (ROUNDUP). In wetland areas, *Phragmites* and associated contaminated sediment will be removed by excavation. In riparian areas that are not being excavated, *Phragmites* will be controlled initially by cutting and herbicide (ROUNDUP) application using a backpack sprayer. Herbicide will be applied only under low-no wind conditions to minimize drift and impact on adjacent vegetation. Some shoots will survive the initial control measures, and follow-up work will be required for several years to completely eradicate *Phragmites* from the riparian areas. Follow-up control will rely on cutting and targeted herbicide application. Stems will be cut and painted or injected with ROUNDUP. This technique allows precise treatment of individual plants with no effect on adjacent vegetation.

Use of cutting and ROUNDUP to eradicate *Phragmites* in riparian areas is the least damaging effective control method. Use of cutting and black plastic shading to eradicate *Phragmites* proved ineffective in experimental studies conducted for the Boston Parks Department (Cortell, 1996). Use of ROUNDUP would have no adverse environmental effects. It is approved for use in and near surface waters, has low toxicity, degrades quickly after use, and does not bioaccumulate. ROUNDUP is routinely used to control *Phragmites* by organizations such as The Nature Conservancy, MA Natural Heritage

Program, and the New England Wildflower Society. All work would be supervised by a Massachusetts registered pesticide applicator.

5.6.4.3 Riparian and Terrestrial Vegetation

The recommended plan will require some clearing of existing riparian vegetation in order to gain access to the river. Access points will be selected to avoid and minimize impact to trees and shrubs as much as possible. Cutting of larger trees (> 4" diameter at breast height, DBH) will be avoided wherever possible. Appropriate trees and shrubs will be planted to mitigate for any unavoidable damage to woody vegetation. Many shrubs that are cut will not need to be replanted since they will quickly regrow from the cut stems.

To avoid damage to the root zone of larger trees, no heavy equipment will be allowed to traverse inside the drip zone (canopy edge) of the trees without matting to prevent soil compaction. Special care will be taken to avoid any impact to heritage trees (trees with > 32 inch DBH).

Staging areas will be sited exclusively in grassed areas and should have no impacts on trees or shrubs. Turf will be restored as soon as possible after staging areas are no longer needed.

5.6.5 Wildlife

5.6.5.1 Construction Impacts on Wildlife

Clearing of vegetation, other construction activities, and noise will disturb mammals, waterfowl and songbirds near active work areas. Most animals will relocate to nearby undisturbed habitat and not be harmed. During May through July, some active nests may be abandoned or destroyed by construction. Some turtles and amphibians may be disturbed by the excavation work in the wetlands and the creation of new wetland habitat. Bottom dwelling species like mud turtle are most at risk. Impacts will be greatest in early spring and late fall when turtles and amphibians are lethargic or in hibernation and less able to avoid impacts. During the rest of the construction season, most turtles and amphibians should avoid the active work area. Construction activities should not eliminate the populations of any wildlife species from the Malden River.

5.6.5.2 Long-term Effects on Wildlife

This project will eliminate about 10.4 acres of emergent wetland dominated by *Phragmites*. This impact will be mitigated by planting higher wildlife value food plants such as bureed, pickerelweed, and arrowweed in the 14.9 acres. In addition, a 5.4 acres of open water will be converted to wetland habitat, increasing the overall acreage of wetlands in the Malden River system. The stands of emergent wetland created, however, will have less cover value than the existing *Phragmites* stands, and provide wildlife less of a buffer from human activities. The loss of open water habitat may displace some

wildlife such as ducks and geese. However, large expanses of open water habitat will remain.

The recommended plan will also remove debris such as tires, shopping carts, and other trash items in the wetlands. The value of this debris as basking sites for turtles and amphibians will be lost. To mitigate for this impact, habitat logs will be installed in areas where they will provide basking sites but not affect floodflows.

5.6.6 Protected Species

The Recommended Plan will have no significant adverse impact on any protected species occurring in the Malden River study area.

5.7 Historic and Archaeological Resources

The Malden River was originally an estuarine coastal stream that flowed into the Mystic River, winding through a network of tidal flats and wetland marshes. However, the river was reconfigured, dredged, straightened, and wetlands were filled during the industrialization of the riverbanks in the late nineteenth and early twentieth centuries. Based on the degree of disturbance within the proposed project area, it is anticipated that the proposed ecosystem restoration plan should have no effect on historic properties. The Massachusetts State Historic Preservation Officer and the federally recognized, Wampanoag Tribal Historic Preservation Officer concurred with the no effect determination on April 3, 2006 (Appendix A).

5.8 Socio-economic Resources

5.8.1 Construction Impacts

The plan would have very limited impact on the local or regional economy. The estimated Total Project Cost for implementing the NER Plan, $ 5,750,000 dollars, is a small fraction of multi-billion dollar regional economy. However, several hundred temporary construction and related support jobs would be created by the project.

Impacts on traffic, recreation, and aesthetics are discussed in Section 5.9 and 5.10.

5.8.2 Long-term Effects

Eradication of *Phragmites*, creation of new wetland habitat, improved fish habitat, and improved water quality would have substantial aesthetic and ecological benefits to the Malden River System. This would indirectly benefit the many colleges, hospitals, museums, and other institutions located near the study area. Property owners in the area would also benefit from improved conditions along the river, although there would probably be no significant impact on property values.

5.9 Recreational Resources and Aesthetics

5.9.1 Construction Impacts

Construction of the recommended plan would have a short-term adverse impact on recreation in the project area. Public use of portions of the riparian zone will be restricted during construction. Continued public access to pedestrian pathways will be maximized during construction, or alternative routes provided when access must be restricted. Work areas will be signed to control, direct, and protect the public during construction. Traffic Control Officers will also help to assure public safety. Objectionable odors generated during the removal of *Phragmites* stands will likely affect public use. The odor of hydrogen sulfide may be pervasive near removal and staging areas.

The presence of excavation equipment, dewatering equipment, transport trucks, and construction trailers will detract from aesthetics during the 2-year construction period. However, project construction will offer a unique environmental education opportunity in an urban setting.

5.9.2 Long-term Effects

The recommended plan would benefit the recreational fishery in the Malden River. Additionally, the removal of *Phragmites* would restore intended open water viewscapes and greatly enhance aesthetics of the area.

5.10 Traffic

Project construction will add traffic to the regional roadways providing access to the study area and to local roadways abutting the Malden River. The project should have no long-term effect on any roadway or traffic flow.

5.11 Resource Utilization and Waste Generation

The recommended plan will generate about 450 tons of debris consisting of tires, appliances, shopping carts, automobile parts, and others will be disposed in a landfill. Landfill capacity is a highly limited resource in New England and measures will be employed to dispose of the material as efficiently as possible, without undo burdens to in-state or out of state landfills.

5.12 Air Quality

The Malden River restoration project is subject to Clean Air Act requirements. An air quality conformity analysis (Appendix G) was completed to demonstrate compliance. The conformity analysis details projected emissions that would result from the construction of the proposed project. These data are then compared to Federal and State air quality standards to determine impacts to air quality.

The project would have no long-term impacts on air quality. During construction equipment operating on the site would emit pollutants including nitrogen oxides that can lead to the formation of ozone. In order to minimize air quality effects during construction, construction activities would comply with applicable provisions of the Massachusetts Air Quality Control Regulations pertaining to dust, odors, construction, noise, and motor vehicle emissions (Appendix G). This project therefore conforms to the Federal requirements for activities under the Clean Air Act within the Massachusetts State Implementation Plan.

5.13 Cumulative Impacts

The current degraded condition of the Malden River ecosystem is a direct result of the adverse cumulative impact of cultural development within the watershed. These impacts include the loss of riverine wetlands by filling and the degradation of water quality by changes in the system's hydrology as well as the introduction of urban and industrial point/nonpoint pollutant sources. The proposed project would address these cumulative impacts in a restoration program, designed to provide long-term improvements to the habitat of the ecosystem. In addition to the proposed restoration efforts to be undertaken as described within this environmental documentation, the MVDC, which comprises the cities adjacent to the river system, as well as identified PRPs are undertaking additional remedial measures designed to ensure the enhancement and preservation of the long-term benefits of the restoration program. The cumulative impact of all the restoration projects proposed in the ecosystem are expected to have long term positive effects on the Malden River.

It is expected that this project will not significantly contribute to potential negative cumulative effects in the Malden River. The existing water level will be maintained, which will avoid the impacts associated with losing aquatic habitat. The use of silt curtains will contain the suspended solids within the areas of active excavation. It is likely that most of the motile fish and wildlife species will avoid these areas. Other activities apart from this restoration project which could potentially have cumulative negative effects on the system, include maintenance of the Earhart dam and possible maintenance or remedial dredging of the Malden River or the Mystic River. Construction activities associated with dam maintenance would be confined to the area of the dam itself, and if done without lowering the water level would be unlikely to cause significant negative impacts to the ecosystem since the area would most likely be contained using a cofferdam. Therefore it is unlikely that there will be significant cumulative impacts resulting from the restoration activities in the Malden River.

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6.0 MEASURES TO MINIMIZE ADVERSE CONSEQUENCES

The construction activities will include shoreline stabilization, the restoration of emergent wetland by placement of manufactured wetland soil and planting, planting vegetation in restored or disturbed riparian areas, restoration of vegetation and landscape features in disturbed upland areas, eradication of *Phragmites* through clearing and a long-term cutting/herbicide application plan, and post construction monitoring. The following plans will be prepared by the construction contractor in accordance with requirements in project plans and specifications:

- Wastewater Management /Pollution Prevention Plan
- Wetland, Shoreline and Landscape Restoration Plan
- Rodent Control Plan
- Traffic Control and Recreational Use Management Plan
- Noise Control Plan

The plans will be reviewed and approved by the Corps, the Sponsor, and (as appropriate) regulatory authorities. Each of these plans is briefly described below. Final measures to minimize and avoid adverse effects will not be determined until plans and specifications are prepared and necessary state and local permits and approvals are obtained.

6.1 Wastewater Management/Pollution Prevention Plan

Wastewater generated by dewatering processes will be treated to remove sediment before discharge back in to the Malden River. The plan will describe the treatment plan design, operation, performance standards, and monitoring and reporting requirements. The plan will also describe measures to minimize turbidity impacts during wetland clearing and wetland creation (i.e., floating silt curtains), monitor water quality, manage runoff from staging areas, control erosion from disturbed areas, manage hazardous materials stored on site, and decontaminate construction equipment. The plan will also include a spill control plan that will be implemented if petroleum products or other hazardous materials are inadvertently released into the environment.

6.2 Wetland, Shoreline, and Landscape Protection and Restoration Plan

Vegetation and landscape features disturbed by construction activities will be restored. The restoration plan will include plans showing significant landscape features in the work area, measures to protect vegetation and other landscape features during construction, restoration requirements, restoration materials and construction techniques, performance standards, and post-construction monitoring to assure compliance with performance standards.

It is anticipated staging areas will be created by placing an impermeable geotextile and moderately dense layer of gravel and stone over the existing ground. The underlying soil will remain essentially undisturbed and will be not contaminated. Once work is complete the stone and geotextile will be removed, the soil uncompacted, and reseeded.

6.3 Rodent Control

The stands of *Phragmites* and adjacent areas contain rats, muskrats and other rodents. In order to prevent the displacement of rodents to adjacent areas where they may become a nuisance to adjacent lands, the Contractor will conduct a program to control rodents within the project limits. In order to prevent poisoning of domestic pets and other non-target organisms, rodenticides will not be used.

6.4 Traffic Control and Recreational Use Management Plan

The contractor will prepare a detailed plan to minimize construction impacts on traffic and recreational use (walking, biking) of project area. The plan will be fully coordinated with Malden, Medford, and Everett police and parks departments. The following issues and others identified during plans and specifications will be addressed: 1) use of traffic control officers, 2) timing and location of road and lanes closures, 3) signal timing adjustments, 4) use of traffic control signs, 5) measures to avoid delays to emergency vehicles, 6) temporary relocation of paths for recreational use, 7) time of work restrictions (evenings, weekends), 8) truck queuing locations, 9) idling of truck engines, 10) location of contractor parking areas, and 11) coordination during construction with police and parks department personnel.

6.5 Noise Control Measures

A plan to minimize noise impacts on nearby institutions and residences will be prepared. Regulation for the Control of Noise in the Cities of Malden, Medford and Everett will be adhered to for all construction activities.

7.0 Coordination

7.1 Summary of Study Coordination

Coordination efforts have essentially been ongoing since the Corps initial reconnaissance study was conducted in 2001. Following this initial effort, a Phase I study was commissioned to document potential restoration efforts in the Malden River. A Phase I report was prepared by ENSR and the advisory team in 2002. The Corps then assessed environmental restoration needs from 2002 to 2006. This work has cumulated in this draft Detailed Project Report/Environmental Assessment for habitat restoration. This plan was closely coordinated with state and Federal resource agencies and interested parties through a series of stakeholder meetings and advisory team meetings.

The following is a list of agencies and groups that participated in coordination meetings held during the Corps studies;

- U. S. Fish and Wildlife Service
- U. S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- Commonwealth of Massachusetts
  - Executive Office of Environmental Affairs
  - Department of Environmental Management
  - Department of Environmental Protection
  - Massachusetts Historical Commission
  - Massachusetts Division of Fish and Wildlife
- Massachusetts Water Resources Authority
- Metropolitan District Commission
- City of Malden
- City of Medford
- City of Everett
- Citizens' Groups
- Mystic River Watershed Association
- River’s Edge (formerly TeleCom City)
- Mass Electric

In addition to meetings to discuss the status of the study, the advisory group was the primary method of updating study participants of the study status and obtaining feedback concerning publicly acceptable plans. This group met frequently to discuss and coordinate the efforts of individuals involved in preparing the draft Phase I report for the Malden River project and Corps efforts to prepare a Feasibility Report and Environmental Assessment. Information obtained during the many meetings was very important in developing the plan recommended in this report.

Significant meetings during the project study process include the following:

Public stakeholder involvement was an important component of this Malden River Feasibility Study. Three invited stakeholder meetings were held to allow comment and discussion on the project. A brief summary of these two meetings and the stakeholder issues raised are given below, while the minutes and attendance list of each meeting are included in Appendix A-2 Public Involvement.

COORDINATED SITE MEETING, MALDEN TOWN HALL

On September 25, 2003, the MVDC, USACE, and ENSR hosted a working meeting of resource agencies and stakeholders in the Malden City Hall, Malden MA to discuss restoration alternatives and measures being considered for evaluation in the Malden River Ecosystem Restoration Feasibility Study. The invited participants were selected on the basis of prior involvement in the study to date, watershed involvement, relevant experience, and/or representation of regulatory agency interest. The purpose of the meeting was to discuss the spectrum of potential ecosystem restoration measures and discuss how these could be combined into ecosystem restoration alternative plans. Participants also had the opportunity to raise other issues of interest at the meeting or to provide written comments at a later date. Comments raised or later received included those on: the mandatory No Action alternative, on watershed best management practices, rerouting/bypassing of stormwater flows, watershed flow management for Spot Pond, operations and fish passage at the Amelia Earhart Dam, use of in situ chemical and biological treatment, monitored natural recovery, use of herbicides for *Phragmites* control, and the importance of the human heath aspect of restoring the River.

ALTERNATIVE ANALYSIS MEETING, USACE HEADQUARTERS

On December 10, 2003, USACE hosted a Sponsor/Stakeholder's meeting to present the ecosystem restoration measures being considered as part of the feasibility process. The invited stakeholders were allowed an opportunity to comment on the candidate ecosystem restoration alternative plans being considered for the Feasibility Study. The five alternative plans presented were the No Action, Invasive Species Replacement and Fish Habitat Enhancement, Wetland Restoration and Fish Habitat Enhancement, Wetland Restoration /Creation and Benthic and Fish Habitat Enhancement, and Benthic and Fish Habitat Enhancement. Stakeholders also had the opportunity to raise other issues of interest at the meeting or to provide written comments at a later date. Comments raised or later received included those on: the amount (volume vs. mass) of toxic materials proposed for dredging, potential disposal of dredged material, impact of actions on water column DO, the appearance of the proposed created wetlands, the potential for treating stormwater via wetland treatment in Little Creek, evaluation of the potential for anadromous fish passage at the Amelia Earhart Dam.

PLAN FORMULATION MEETING, USACE HEADQUARTERS

On July 13, 2005, the MVDC and USACE hosted a presentation to the stakeholders at the USACE headquarters in Concord, MA. The purpose of this presentation was to discuss the results of the plan formulation and incremental cost analysis process. This initial process identified 39 cost effective restoration plans of which eight were considered Best

Buy Plans. However, several minor inconsistencies required adjustments/corrections to the incremental analysis process. The final analysis identified 276 cost effective plans and thirteen Best Buy Plans.

7.2 Public Notice

A public notice announcing the availability of the Environmental Assessment for public review will be issued. The notice will be sent to all parties known to have an interest in the Malden River project, and a general mailing list maintained by New England District Regulatory Division. Copies of the Feasibility Study and draft Environmental Assessment will be available upon request.

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9.0 COMPLIANCE WITH FEDERAL ENVIRONMENTAL STATUTES, EXECUTIVE MEMORANDUM AND EXECUTIVE ORDERS

9.1 Federal Statutes

1. Archaeological Resources Protection Act of 1979, as amended, 16 USC 470 et seq.

Compliance: Issuance of a permit from the Federal land manager to excavate or remove archaeological resources located on public or Indian lands signifies compliance. Not applicable to this project.

2. Preservation of Historic and Archeological Data Act of 1974, as amended, 16 U.S.C. 469 et seq.

Compliance: Project has been coordinated with the State Historic Preservation officer. No impacts to archaeological resources are expected.

3. American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996.

Compliance: Must ensure access by native Americans to sacred sites, possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. Not applicable to this project.

4. Clean Air Act, as amended, 42 U.S.C. 7401 et seq.

Compliance: Public notice of the availability of this report to the Environmental Protection Agency is required for compliance pursuant to Sections 176c and 309 of the Clean Air Act.

5. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

Compliance: A Section 404(b)(1) Evaluation and Compliance Review has been incorporated into the project report. An application shall be filed for State Water Quality Certification pursuant to Section 401 of the Clean Water Act.

6. Coastal Zone Management Act of 1782, as amended, 16 U.S.C. 1451 et seq.

Compliance: A CZM consistency determination shall be provided to the State for review and concurrence that the proposed project is consistent with the approved State CZM program.

7. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Compliance: Coordination with the U.S. Fish and Wildlife Service (FWS) and/or National Marine Fisheries Service (NMFS) will determine formal consultation requirements pursuant to Section 7 of the Endangered Species Act.

8. Estuarine Areas Act, 16 U.S.C. 1221 et seq.

Compliance: Applicable only if report is being submitted to Congress.

9. Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.

Compliance: Public notice of availability to the project report to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

10. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Compliance: Coordination with the FWS, NMFS, and State fish and wildlife agencies signifies compliance with the Fish and Wildlife Coordination Act.

11. Land and Water Conservation Fund Act of 1965, as amended, 16 U.S.C. 4601-4 et seq.

Compliance: Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

12. Marine Protection, Research, and Sanctuaries Act of 1971, as amended, 33 U.S.C. 1401 et seq.

Compliance: Applicable if the project does involves the transportation or disposal of dredged material in ocean waters pursuant to Sections 102 and 103 of the Act, respectively. Not applicable to this project.

13. National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.

Compliance: Coordination with the State Historic Preservation Office signifies compliance.

14. Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3000-3013, 18 U.S.C. 1170

Compliance: Regulations implementing NAGPRA will be followed if discovery of human remains and/or funerary items occur during implementation of this project.

15. National Environmental Policy Act of 1969, as amended, 42 U.S.C 4321 et seq.

Compliance: Preparation of an Environmental Assessment signifies partial compliance with NEPA. Full compliance shall be noted at the time the Finding of No Significant Impact or Record of Decision is issued.

16. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

Compliance: No requirements for projects or programs authorized by Congress. The proposed aquatic ecosystem restoration project is being conducted pursuant to the Congressionally-approved authority.

17. Watershed Protection and Flood Prevention Act as amended, 16 U.S.C 1001 et seq.

Compliance: Floodplain impacts must be considered in project planning. No floodplain impacts will occur.

18. Wild and Scenic Rivers Act, as amended, 16 U.S.C 1271 et seq.

Compliance: Not applicable. No designated wild or scenic rivers occur in the project area.

19. Magnuson-Stevens Act, as amended, 16 U.S.C. 1801 et seq.

Compliance: Not applicable. No species federally managed by National Marine Fisheries Service will be affected by this project.

9.2 Executive Orders

1. Executive Order 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971

Compliance: Coordination with the State Historic Preservation Officer signifies compliance.

2. Executive Order 11988, Floodplain Management, 24 May 1977 amended by Executive Order 12148, 20 July 1979.

Compliance: Public notice of the availability of this report or public review fulfills the requirements of Executive Order 11988, Section 2(a) (2).

3. Executive Order 11990, Protection of Wetlands, 24 May 1977.

Compliance: Public notice of the availability if this report for public review fulfills the requirements of Executive Order 11990, Section 2 (b).

4. Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, 4 January 1979.
Compliance: Not applicable to projects located within the United States.

5. Executive Order 12898, Environmental Justice, 11 February 1994.

Compliance: Not applicable, the project is not expected to have a significant impact on minority or low income population, or any other population in the United States.

6. Executive 13007, Accommodation of Sacred Sites, 24 May 1996

Compliance: Not applicable unless on Federal lands, then agencies must accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and avoid adversely affecting the physical integrity of such sacred sites.

7. Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks. 21 April, 1997.

Compliance: Not applicable, the project would not create a disproportionate environmental health or safety risk for children.

8. Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.

Compliance: Consultation with Indian Tribal Governments, where applicable, and consistent with executive memoranda, DoD Indian policy, and USACE Tribal Policy Principles signifies compliance.

9.3 Executive Memorandum

Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, 11 August 1980.

Compliance: Not applicable, the project does not involve or impact agricultural lands.

White House Memorandum, Government-to-Government Relations with Indian Tribes, 29 April 1994.

Compliance: Consultation with Federally Recognized Indian Tribes, where appropriate, signifies compliance.

10.0 ENVIRONMENTAL ASSESSMENT FIGURES

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Insert Figure 6-1 – NER Recommended Plan

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Insert Figure 6-2 – Real Estate Work Limits

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