Detailed Project Report and Environmental Assessment

Ecosystem Restoration
Ten Mile River
East Providence, Rhode Island

September 2005

US Army Corps of Engineers
New England District

DETAILED PROJECT REPORT
AND
ENVIRONMENTAL ASSESSMENT

ECOSYSTEM RESTORATION
TEN MILE RIVER

EAST PROVIDENCE, RHODE ISLAND

September 2005

EXECUTIVE SUMMARY

The Ten Mile River watershed, with a total drainage area of about 56 square miles, is located in southeastern Massachusetts and northeastern Rhode Island. About 51 square miles of this drainage area is situated in Massachusetts and the remaining 5 square miles is located in Rhode Island. For over 200 years, dams have blocked anadromous river herring (blueback herring and alewives) and American shad from their historic spawning grounds in the Ten Mile River watershed. These anadromous fish live as adults in salt water, but must return to freshwater to spawn. The study area includes the lower portion of the Ten Mile River watershed, with a specific focus toward providing anadromous fish passage at the first (lowest) three dams on the river. These dams are Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam.

During evaluation of the anadromous fish restoration needs of the Ten Mile River, all potentially feasible measures to restore fish passage were evaluated. Fish passage alternatives included no action, adding fishways or fish lifts to the existing dams, and dam removal. Based on an analysis of the impacts of each alternative, and an assessment of public views and desires, providing Denil fishways at Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam was selected as the recommended plan to restore anadromous fish passage to the lower Ten Mile River.

The recommended Denil fishways will provide for upstream migration of adult Blueback Herring, Alewife, and American Shad to historic spawning areas. Migrant slots would also be cut into the existing spillways at Omega Pond and Turner Reservoir to facilitate downstream migration of juveniles. A migrant slot is not required at Hunts Mill Dam as the shape and irregularities of the existing spillway will provide sufficient water depth for downstream passage. In addition, as anadromous returns to the Ten Mile River are likely to exceed available spawning grounds, a fish trap is included at Hunts Mill Dam to relocate excess fish to other watersheds.

Each Denil fishway would be 4 feet wide and have a 1 vertical on 8 horizontal floor slope to allow the passage of both river herring (blueback herring and alewives) and American shad. A Denil fishway consists of the following major features:

- Entrance channel – The entrance channel is flat and located as close as possible to the base of the dam. It is designed so that at minimum operating flows, there is two feet of water in the channel. It is also designed so that the attraction jet of water exiting the fishway is stronger than any other flow vectors so that migrating fish can easily locate the entrance.

- Denil baffle sections – At the upstream end of the entrance channel, the Denil baffle section begins. The concrete floor has a 1 vertical on 8 horizontal slope, and baffles are placed along this sloped section every 30-inches at a 45-degree angle. The clear opening

between the sides of each baffle is 28 inches. A second Denil section will be required at each dam due to the height of each dam. A turning section is provided at the top of the first baffle section to allow the fish a rest before moving upstream again.

- Exit channel – The uppermost Denil section terminates at a level exit channel that is cut into the existing spillway. The width of the fishway at this point remains at 4 feet. The channel is designed to have a minimum of 2 feet of water depth at minimum pool operating levels.

The recommended plan will restore anadromous fish populations to the lower Ten Mile River up to the Golf Club Dam in Pawtucket, Rhode Island. This would allow anadromous alewives access to about 340 acres of spawning habitat within Omega Pond, Hunts Mill Pond and Turner Reservoir/Central Pond, and provide approximately three miles of riverine spawning habitat for blueback herring and American shad. Based on projections by the Rhode Island Department of Environmental Management, these habitat areas will support a fish run of over 200,000 herring. The number of American shad that will return is unknown, but the fishways are capable of passing about 25,000 shad.

The District Engineer recommends that the selected anadromous fish restoration plan be authorized for implementation as a Federal project at a total estimated first cost of $1,900,000. As costs for environmental restoration projects are shared 65 percent Federal and 35 percent non-Federal, costs would be apportioned $1,235,000 Federal and $665,000 non-Federal. The recommendation is also subject to the non-Federal sponsor assuming full responsibility for the project including all future operation, maintenance, repair, rehabilitation and replacement (OMRR&R) costs which are estimated at $28,000 annually. The non-Federal sponsor, the Rhode Island Department of Environmental Management, understands and agrees with these requirements, and is anxious to move forward with the recommended plan. Based on the scope and cost of the selected plan, the District Engineer recommends that project implementation be pursued under Section 206 of the Water Resources Development Act of 1996.

DETAILED PROJECT REPORT
ECOSYSTEM RESTORATION, TEN MILE RIVER
EAST PROVIDENCE, RHODE ISLAND

TABLE OF CONTENTS

Page

SECTION I - INTRODUCTION

Study Authority 1

Purpose and Scope 2

Study Area 2

Pertinent Prior Studies and Reports 2

Report and Study Process 3

SECTION II - PLANNING SETTING AND PROBLEM IDENTIFICATION

General Study Area Setting 4

Topography and Geology 4

Climatology 5

Water Quality 5

Sediment Quality 6

Biological Resources 6
- Fish 6
  - Turner Reservoir/Central Pond 7
  - Hunts Mill Pond 7
  - Omega Pond 8
- Vegetation 8
- Wildlife 9
- Reptiles and Amphibians 9
- Threatened and Endangered Species 9
- Essential Fish Habitat 10

Historic and Archaeological Resources 10

Cultural, Economic and Recreational Resources 11

TABLE OF CONTENTS (continued)

Page

Expected Future Conditions Without a Project 12

SECTION III – PLAN FORMULATION

Identification of Restoration Objectives 13

Formulation and Evaluation of Alternatives 13
- No Action 13
- Dam Removal 14
  - Omega Pond Dam 14
  - Hunts Mill Dam 14
  - Turner Reservoir Dam 15
- Construction of Fishways 15
  - Omega Pond Dam 15
  - Hunts Mill Dam 16
  - Turner Reservoir Dam 16
- Other Fish Passage Alternatives 17

Selection of an Anadromous Fish Restoration Plan 17

SECTION IV - DESCRIPTION OF RECOMMENDED PLAN

Plan Features 19

Design Considerations 20

Construction Considerations 20

Operation, Maintenance, Repair, Replacement and Rehabilitation Requirements 21

Summary of Plan Costs, Accomplishments, Benefits and Impacts 21

- Project Costs 21
  - Total Project Costs 21
  - Apportionment of Costs 22
  - Operation, Maintenance, Repair, Replacement and Rehabilitation Costs 22
- Plan Accomplishments and Benefits 22

TABLE OF CONTENTS (continued)

Page

Adverse Environmental and Other Impacts 23

Regulatory Requirements 25

Real Estate 25

Financial Analysis 25

View of the Sponsor 25

Implementation Schedule 26

SECTION V - SUMMARY OF STUDY COORDINATION

Summary of Study Coordination 27

SECTION VI - FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Findings and Conclusions 29

Recommendations 30

LIST OF TABLES

Page

1 Fishway Design Elevations 20
2 Total Project Costs 21

LIST OF FIGURES

Follows Page

1 Study Area 2
2 Anadromous Fish Passage Restoration Sites 2

TABLE OF CONTENTS (continued)

LIST OF PLATES

		Follows Page
1	General Site Plan – Omega Pond	33
2	Fishway Site Plan – Omega Pond Dam	33
3	Omega Pond Dam, Sections and Details	33
4	Hunts Mill Dam – General Plan	33
5	Hunts Mill Fishway Details	33
6	Hunts Mill Fishway Views	33
7	Turner Reservoir General Plan	33
8	Turner Reservoir Dam	33
9	Turner Reservoir Fishway Details	33
10	Turner Reservoir Fishway Details	33

ATTACHMENTS

Environmental Assessment, FONSI, Section 404 (b)(1) Evaluation, Record of Non-Applicability (RONA) for Clean Air Act conformity, and Public Notice

APPENDICES

A Pertinent Correspondence

B Hydrologic Analysis

C Cost Estimates

D Geotechnical Design Summary Memorandum

E Real Estate Plan

F Sediment Test Results, Omega Pond and Hunts Mill Pond

SECTION I

INTRODUCTION

For over 200 years, dams have blocked anadromous river herring (blueback herring and alewives) and American shad from their historic spawning grounds in the Ten Mile River watershed. Anadromous fish live as adults in salt water, but must return to freshwater to spawn. Three dams that prevent the upstream migration of these anadromous fish along the lower Ten Mile River in East Providence, Rhode Island, include Omega Pond Dam, Hunts Mill Dam and the dam at Turner Reservoir. These dams were constructed to provide water supply and/or waterpower for various municipal and industrial purposes, but have eliminated the capacity of this coastal river to support thousands of anadromous fish. This report discusses options to restore this lost productivity.

A December 2002 report, prepared by the Rhode Island Department of Environmental Management (RIDEM), states that the Ten Mile River watershed "is a standout for anadromous restoration". Alewives and blueback herring have been observed at the mouth of the river, and local fishermen from the Slater Mill Fishing Club regularly net the herring and lift them over the dam to spawn in Omega Pond. This activity has helped preserve remnants of earlier fish runs. River herring were also stocked into Turner Reservoir in the mid 1990's by RIDEM to evaluate the spawning and rearing habitat. Juveniles were successfully observed and captured confirming the viability of the river system.

Study Authority

This report was prepared under authority contained in a September 12, 1969 resolution by the United States Senate Committee on Public Works. This resolution authorized the Corps of Engineers to investigate water resources improvements within the southeastern New England region "with due consideration for enhancing the economic growth and quality of the environment."

Restoring anadromous fish passage along the lower Ten Mile River was one of numerous environmental restoration opportunities identified in a July 1999 Rhode Island Ecosystem Restoration Reconnaissance Report, Section 905(b) (WRDA 86) Analysis. This report was prepared by the Corps in response to guidance contained in the Energy and Water Development Appropriations Act for fiscal year 1999. Of the eighteen potential restoration sites identified in this report for further feasibility study, the Rhode Island Department of Environmental Management selected restoring fish passage to the Ten Mile River as their highest priority.

Selection of this site for feasibility scope studies resulted in the preparation of a Feasibility Cost Sharing Agreement. This Agreement specified that feasibility study costs would be shared on a 50/50 basis between the Federal government and the Rhode

Island Department of Environmental Management, the non-Federal sponsor of the study. The Agreement was executed on March 15, 2001.

Purpose and Scope

The purpose of this study was to prepare a feasibility document that evaluates fish passage alternatives, and satisfies the requirements of NEPA. An additional purpose was to establish the level of support and willingness of the non-Federal sponsors to participate in recommended improvements.

Study Area

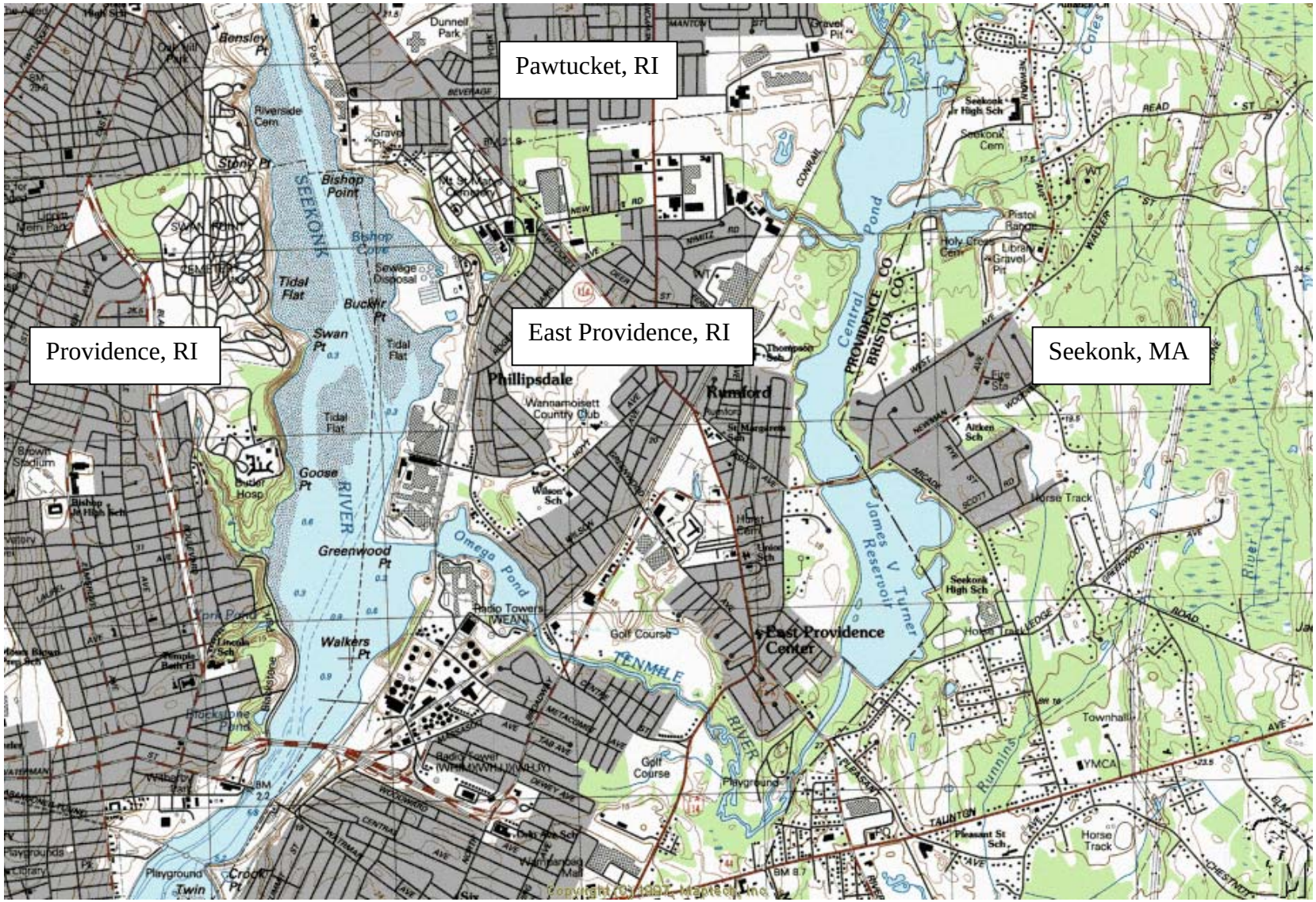
The Ten Mile River is located in East Providence, Rhode Island at the head of Narragansett Bay directly to the east of Providence, Rhode Island. The study area includes the lower portion of the Ten Mile River watershed, with a specific focus toward providing anadromous fish passage at the first (lowest) three dams on the river. These dams are Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam. The study area is shown on Figure 1, and Figure 2 shows the location of the first three dams (fish passage restoration sites) on the Ten Mile River.

The Ten Mile River watershed has a total drainage area of about 56 square miles, with 51 square miles situated in the southeastern portion of Massachusetts and the remaining 5 square miles located in northeast Rhode Island. Adjacent watersheds include the Blackstone, Charles and Taunton Rivers, and the Narragansett Bay watersheds. The Ten Mile River originates at Cargill Pond in Plainville, Massachusetts at an elevation of about 230 feet. From this point the river flows south through urbanized portions of North Attleboro, Attleboro and Seekonk, Massachusetts before entering Rhode Island. In Rhode Island, the river flows south through Pawtucket and then into Turner Reservoir/Central Pond in East Providence. Outflow from Turner Reservoir Dam enters the small pond behind Hunts Mill Dam, flows from there to Omega Pond, and then discharges directly into the Seekonk River at tidewater. Primary tributaries of the Ten Mile River are the Bungay and Sevenmile Rivers.

The three dams under study for fish passage are all situated in the city of East Providence and are currently owned by the City.

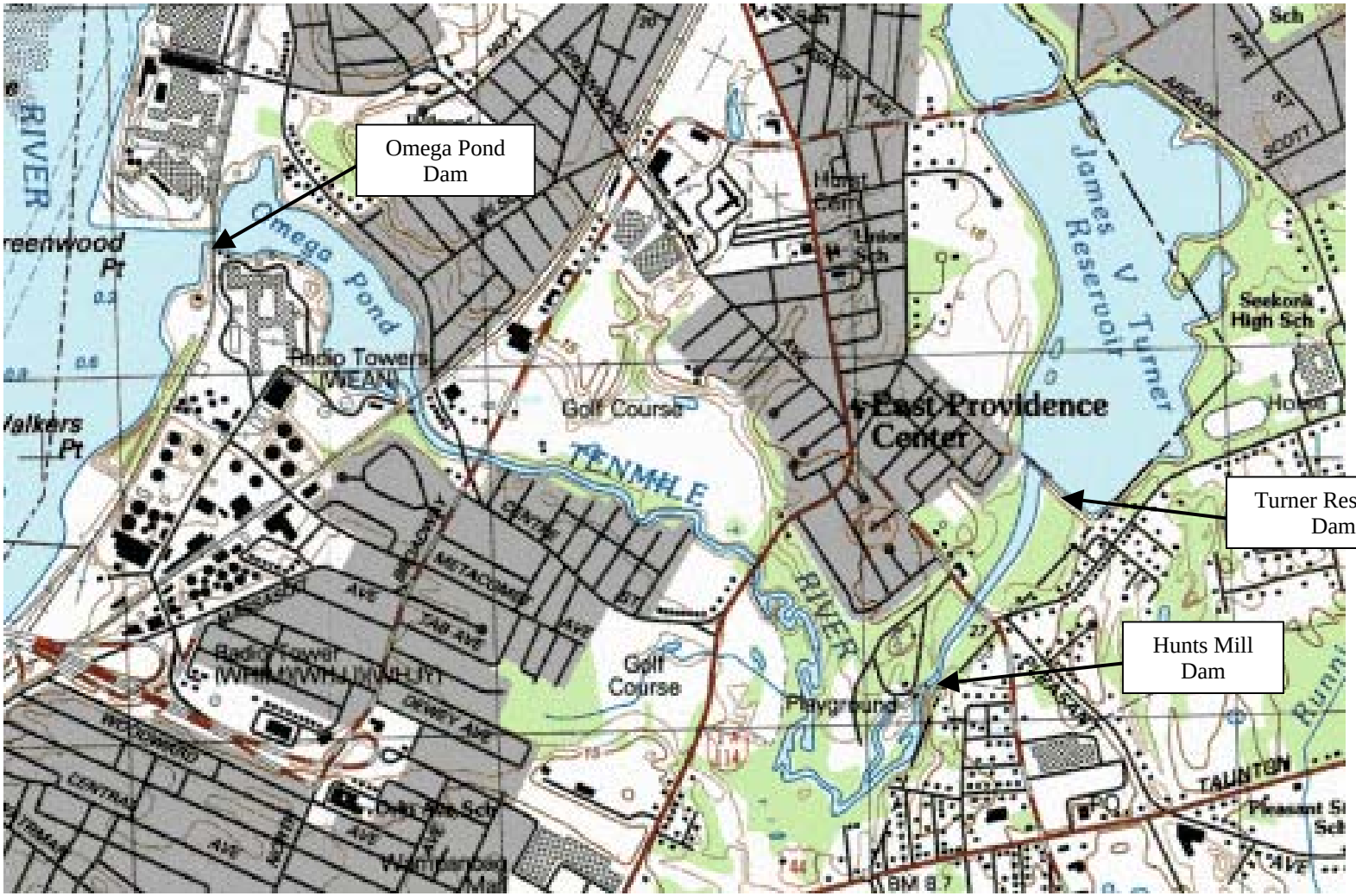
Pertinent Prior Studies and Reports

Strategic Plan for the Restoration of Anadromous Fishes to Rhode Island Coastal Streams – This report, dated December 2002, was prepared by Dennis E. Erkan, Principal Marine Biologist, Rhode Island Department of Environmental Management, Division of Fish and Wildlife. The report identified Rhode Island watersheds with the potential to



Ten Mile River Feasibility Study
Study Area

Figure 1



Ten Mile River Feasibility Study, East Providence, Rhode Island
Anadromous Fish Passage Restoration Sites

Figure 2

restore or enhance anadromous fish populations through upstream passage for migrating adults and downstream passage for juveniles.

Turner Reservoir Study, East Providence, Rhode Island – This Planning Assistance to States report was completed by the New England District, Corps of Engineers in February 2001. The study evaluated the reservoir's potential as a back-up water supply for the city of East Providence and as a recreational area. The preliminary investigation determined that Turner Reservoir and the Central Pond well fields may be suitable for back-up water supply, but would require thorough treatment of the water. Although the water's appearance in some areas is not attractive due to large amounts of aquatic weeds and waterfowl use, the investigation did not find any water quality problems that would prevent recreational use, such as swimming. In addition, the reservoir appears to support a good largemouth bass population that could provide a recreational warmwater fishery.

Rhode Island Ecosystem Restoration Reconnaissance Report, Section 905(b) (WRDA 86) Analysis – This report, completed in July 1999 by the New England District, Corps of Engineers, identified potential ecosystem restoration sites in coastal and riverine areas within the Pawcatuck, Moshassuck, Ten Mile and Woonasquatucket River Watersheds, and the coastline of Narragansett Bay in Rhode Island. Restoring anadromous fish to the lower Ten Mile River was one of the major recommendations of this report.

Ten Mile River Basin, 1997 Water Quality Assessment Report – This assessment was prepared by the Commonwealth of Massachusetts Department of Environmental Protection to provide basic information for focusing resource protection and remediation activities to be executed as part of the watershed management planning process.

Report and Study Process

This Detailed Project Report serves a dual purpose. It provides the basis on which the Chief of Engineers approves a project for construction and also the basis for proceeding to the plans and specifications phase. The main report reflects the planning process, beginning with a description of the ecosystem restoration opportunity, identification of planning objectives and constraints, development and evaluation of alternative solutions, and selection of a recommended plan. Technical and nontechnical information is presented in the main report to support the analysis of alternatives and conclusions recommending Federal participation in an ecosystem restoration project. The Environmental Assessment satisfies the requirements of NEPA, and report appendices provide detailed information that supports both plan formulation and design. The level of detail and extent of engineering work reflected in the technical appendices is sufficient to proceed directly to the preparation of plans and specifications.

SECTION II

PLANNING SETTING AND PROBLEM IDENTIFICATION

General Study Area Setting

Development within the Ten Mile River watershed is varied, with the upper watershed being less developed than the lower watershed. Portions of the upper watershed are over 50 percent forested as compared to the East Providence area that is almost completely developed and has only about 5 percent open land. The river enters the northeast corner of East Providence at Central Pond, flows under Broadway and enters Turner Reservoir. Most of the reservoir is situated in East Providence with a portion of the eastern shore located in the town of Seekonk, Massachusetts. From Turner Reservoir Dam the river flows about one half mile to Hunts Mill Dam and then turns westerly to flow through Omega Pond and enter the Seekonk River.

The river and adjacent open areas have a high recreational value. Walking trails and scenic vistas are present along the western shore of Turner Reservoir, and a city park is located at Hunts Mill Dam. Facilities present at this site include the historic Hunt House, picnic tables, parking and excellent views of the river and the historic dam. Residences line the western shore of Omega Pond and many abutters fish in the pond. The area below Omega Pond Dam is also a popular fishing spot when the herring are running as they attract larger game fish.

Topography and Geology

Ten Mile River elevations range from 250 feet at its headwaters to sea level in East Providence. The river flows through moderately flat terrain along most of its 21-mile length, with much of this area characterized by gently rolling small hills of glacial origin. The highest elevation in the 56 square mile watershed is approximately 450 feet at Red Brush Hill in Plainville, Massachusetts near the headwaters of the river. The city of East Providence is relatively flat as the river gains less than 50 feet in elevation along the 2.5-mile reach from the outflow of Omega Pond Dam to Turner Reservoir.

The Ten Mile River Basin is underlain primarily by sedimentary rock of paleozoic and precambrian origin. The upper section contains igneous and meta-sedimentary rock from the same period. At Hunts Mill and Turner Reservoir Dams, bedrock consists of sandstone with some interbedded shale at the dam at Turner Reservoir. Surficial geology is typified primarily by deposits resulting from the last glacial recession. Bedrock is overlain primarily by sands, gravels and glacial till, and many areas in the immediate vicinity of the river and its tributaries are overlain by flood plain alluvium.

Climatology

The city of East Providence has a cool semi-humid climate typical of New England. Based on Providence data, the mean annual temperature is about 51 degrees. Average annual precipitation in Providence is about 47 inches, distributed uniformly throughout the year. The mean annual snowfall at Providence is about 36 inches. East Providence's location on the Narragansett Bay coastline exposes it to coastal storms that move northeasterly up the Atlantic coast and produce heavy rains, winds and accompanying high tides.

Water Quality

The Ten Mile River has been designated as Class B, Warmwater Fishery, High Quality from the source waters in Plainville, to the Whiting Dam, and Class B, Warmwater Fishery, from the Whiting Dam to the state line by the Massachusetts Department of Environmental Protection (DEP) according to the Massachusetts Surface Water Quality Standards. Class B waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.

The Rhode Island Department of Environmental Management (RIDEM) Division of Water Resources designated the river as Class B from the Newman Avenue Dam upstream from Turner Reservoir to its outlet on the Seekonk River below Omega Pond. These water quality designations are goals, and do not necessarily mean that a water body is meeting a particular designation. Sections of the Ten Mile River upstream from Turner Reservoir as well as the reservoir itself are on the state of Rhode Island's list of impaired waters (303(d) List), having elevated levels of lead, copper, phosphorus, and coliform bacteria, as well as low dissolved oxygen levels.

A 1999 water quality survey by the Corps of Engineers at Turner Reservoir found elevated levels of nutrients and several metals (zinc, nickel, copper, chromium and cadmium). The survey also included measurements of temperature, pH, conductivity and dissolved oxygen from several locations at various depths. All of the parameters measured were at acceptable levels for survival of most warmwater fish species, as well as other aquatic life. Sources of water quality impairment on the lower Ten Mile River include nutrients from wastewater treatment discharges upstream in Attleboro, and non-point sources such as road runoff and fertilizers from lawns. In addition, some of the sediment contamination is the result of past industrial discharges into the river.

Similar to Turner Reservoir, Omega Pond supports a warmwater fishery indicating that the basic water quality criteria necessary to support aquatic life are being met. During the summer of 2001, temperature, pH, conductivity and dissolved oxygen

levels were measured. The results were generally within acceptable criteria for the survival of most fish species.

With implementation of the Clean Water Act and closing of many industries in the watershed, the river is significantly cleaner now than it was in the 1960's. Additional information concerning water quality is contained in the Environmental Assessment.

Sediment Quality

The sediment samples collected at Turner Reservoir during the summer/fall of 1999 were found to have elevated concentrations of chromium, nickel, copper, zinc, cadmium and lead. The historic industrial discharges upstream from Turner Reservoir as well as the other dams are believed to be the sources of the elevated metals concentrations in the sediments.

Sediments collected in Omega Pond and Hunts Mill Pond by the Corps of Engineers in 2001 also had elevated concentrations of metals as well as other contaminants (see Appendix F). Levels of chromium, nickel, copper, zinc, and cadmium in the sediments of Omega Pond were generally one half of the concentration of the sediment in Turner Reservoir, but they were still above many of the levels where biological effects would occur in the life stages of sensitive aquatic organisms. Lead levels in sediments from Omega Pond were generally higher than those from both Turner Reservoir and Hunts Mill Pond. The absence of additional point or non-point sources of metal contamination downstream from Turner Reservoir indicates that the general reduction in sediment contaminant levels in both Hunts Mill and Omega Ponds could be due to the successive settling out of these materials behind the dams, with most of it settling at Turners, and the remaining settling out in successive downstream areas. The fact that Hunts Mill Pond sediments generally contained the lowest levels of most of the contaminants could be due to it being the lowest head dam of the three thereby providing the least amount of depth for sediment to collect. Most suspended sediments would therefore be carried over the dam and continue downstream to Omega Pond.

Biological Resources

Fish

The Ten-Mile River is designated as Class B, Warmwater Fishery in both Massachusetts and Rhode Island. The numerous ponds and impoundments along the river provide habitat to many warmwater fish species. These include chain pickerel, redfin pickerel, largemouth bass, bluegill, yellow perch and white sucker. The lower section of the river from Turner Reservoir/Central Pond to tidewater at the Seekonk River supports a warmwater fishery. The following paragraphs describe the fishery at each impoundment along this lower section of the river.

Turner Reservoir/Central Pond - Both RIDEM and the Corps of Engineers have conducted fisheries surveys of Turner Reservoir and Central Pond. These surveys indicated the presence of a typical warmwater fish assemblage. Species collected included yellow perch, white perch, largemouth bass, white sucker, bluegill, pumpkinseed, yellow bullhead, golden shiner, American eel, and black crappie. The data from the Corps 1999 fisheries survey of Turner Reservoir indicated that largemouth bass were the most abundant species collected. In addition, the length frequency distribution of these fish indicated the presence of several year classes (including young of year) with some of the larger fish being in the size class of fish that could range from approximately 7 to 10 years old (49 centimeters) in temperate climates (Carlander, 1977, from USACE, 2001). Also, the largemouth bass that were collected had condition factors that were comparable with those from other New England lakes that have healthy largemouth bass populations. This would generally indicate the presence of a suitable food supply to sustain these fish. Although the condition of these fish indicated sufficient forage in the lake, relatively few of the common forage species (such as golden shiner and white sucker) preyed on by largemouth bass were collected. This suggests that the largemouth bass in Turner Reservoir and Central Pond may be relying on species such as young bluegill, pumpkinseed and yellow perch as their primary food source. Therefore, the reestablishment of anadromous alewives and shad would further benefit the ecosystem by providing additional forage for the existing largemouth bass population, as well as other predator species (e.g. black crappie) in the reservoir.

Additional fisheries data were also collected by RIDEM from Turner Reservoir and Central Pond during April of 2001. For Turner Reservoir, the species collected were the same as in the 1999 Corps sampling with the exception of American eel, a single goldfish and two white catfish that were found in the 2001 sampling. In addition, the predominant species caught in 1999 was largemouth bass, whereas in 2001 it was white perch. However, the largemouth bass collected were generally larger than those collected in 1999. This may be due to the fact that the lake was sampled in April before largemouth bass spawning season, and the sample did not have the large numbers of young of year that generally predominate in the summer.

Central Pond was also sampled by RIDEM in April of 2001. Species not previously collected in the past samplings of Turner Reservoir included golden shiner, of which only one representative was collected. The size range for largemouth bass from this sampling was greater including individuals that were smaller, possibly being from the previous summer's young of year. The most abundant species from Central Pond was yellow perch.

Hunts Mill Pond - Fisheries data was also collected from the section of the Ten Mile River between Turner Reservoir and Hunts Mill Dam by RIDEM during August of 2000. Species collected were similar to those that were common to Turner Reservoir, and included bluegill, largemouth bass, white perch, American eel, pumpkinseed, white catfish, golden shiner and yellow bullhead. A warmwater fish assemblage for this area would be expected as the impoundment created by Hunt's Mill Dam extends upstream to the base of Turner Dam.

Omega Pond – The Corps of Engineers sampled Omega Pond for fish on August 29, 2001. A typical warmwater fish assemblage was found that included black crappie, bluegill, golden shiner, largemouth bass, pumpkinseed, yellow perch, and the catadromous American eel. A length frequency distribution of the largemouth bass collected from Omega Pond indicated the presence of several age classes ranging from young of year to 4-9 years old. This distribution indicates that the basic water quality and habitat criteria necessary to support a reproducing population of largemouth bass are being met in Omega Pond. Several juvenile black crappie were also collected from this location indicating that there is natural reproduction of black crappie in either Omega Pond, or upstream in the Ten Mile River.

Vegetation

Major vegetation types within the Ten Mile River watershed include deciduous forest, evergreen forest, scrub-shrub wetland and agricultural fields. Large areas of emergent and aquatic bed wetlands are also situated along the river and its major tributaries, and many impoundments contain large areas of fringing scrub-shrub and emergent wetland vegetation.

Wetland vegetation includes red maple wetlands, and willow, alder, dogwood, witch hazel and sweet pepper bush in scrub-shrub areas. Emergent vegetation closer to the ponds and tributaries includes cattail, sedges, skunk cabbage and pickerel weed. Aquatic bed vegetation present in the various ponds and impoundments include water lily, bladderwort and pondweed.

In the immediate vicinity of the study sites at Omega Pond, Hunts Mill and Turner Reservoir, vegetation types vary as a result of residential and industrial development. Turner Reservoir is bordered by a combination of residential and wooded land, most of it upland, except for large sections of emergent and scrub-shrub wetlands at a large delta area at the upstream end of the reservoir. Predominant emergent vegetation in this delta area consists of cattail with sedges. Surrounding upland in remaining areas of the pond is vegetated with a combination of mixed hardwoods and smaller shrubs. Under-story throughout this area includes abundant stands of poison ivy and sumac. These vegetation types continue through the small pond at Hunts Mill and at Omega Pond. In addition large willows are present in the embankments bordering Omega Pond.

At all three dams, wetland vegetation is limited to small areas along and adjacent to the riverbank. At Turner Dam, the river cascades onto a concrete walled rocky channel, which extends approximately 25 feet downstream from the dam. This precludes the establishment of a large amount of wetland vegetation. A similar situation exists at Hunts Mill Dam, where the downstream channel consists of rocky substrate with naturally occurring bedrock banks that slope down to the river. Only marginal wetland vegetation can be found within the edge of the channel, interspersed with the existing rocky channel. At Omega Pond Dam, the river discharges onto a granite base as it enters tidewater. Two concrete headwalls extend approximately 50 feet from the spillway

channeling the river. These preclude the establishment of significant amounts of estuarine wetland vegetation, although estuarine wetlands are present along the margins of the Seekonk River into which the Ten Mile River flows.

Wildlife

The semi-urban location of the three dams limits the types and numbers of terrestrial wildlife species to those that can exist in close proximity to human population. Species include smaller mammals such as gray squirrel, eastern chipmunk, woodchuck, striped skunk and raccoon. In less populated areas and sections of the upper watershed, mammals can also include muskrat, beaver, river otter, cottontail rabbit, white tailed deer, red fox, gray fox, and coyote.

Turner Reservoir, and to a lesser extent Hunts Mill and Omega Pond, provide habitat to large numbers of waterfowl including mallard ducks, Canada geese as well as domestic ducks, geese and swans. These birds have become extremely prolific in Turner Reservoir, and may be contributing to the less than ideal water quality in some portions of the reservoir.

Reptiles and Amphibians

Reptiles common to the watershed include turtles and snakes, which inhabit many of the freshwater ponds and wetlands as well as some of the wooded upland areas. Turtle species common to the watershed include common snapping turtle, stinkpot turtle, spotted turtle, eastern painted turtle, wood turtle, and eastern box turtle. Snakes common to the watershed include the eastern garter snake, hognose snake, northern water snake, milk snake, northern brown snake, eastern ribbon snake and northern ringneck snake. Most of these are upland species are found in areas adjacent to wetland and aquatic habitats. Amphibian species that can be found in the study area include American toad, spring peeper, grey treefrog, green frog, wood frog, and pickerel frog. Common salamanders that may be found in the watershed include spotted, two lined and redback.

Threatened and Endangered Species

Coordination with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Rhode Island Department of Environmental Management has indicated that no Federally-listed threatened or endangered species under the jurisdiction of the U.S. Fish and Wildlife Service and National Marine Fisheries Service occur in the vicinity of the proposed project, with the exception of occasional transient bald eagles (see coordination letters in Appendix A).

Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Fishery Conservation Management Act strengthen the ability of the National Marine Fisheries Service and the New England Fishery Management Council to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat", and is broadly defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The estuarine and marine areas downstream of the Ten Mile River (i.e. the Seekonk and Providence River estuaries) provide Essential Fish Habitat for adults and juvenile life stages of winter flounder, summer flounder, windowpane flounder, bluefish, scup, Atlantic mackerel, black seabass, king mackerel, and Spanish mackerel.

Historic and Archaeological Resources

The federation of the Wampanoag Indians occupied the land area east of the Seekonk River, which includes the lower Ten Mile River watershed. In the 1670's, the area inhabited by the Wampanoag stretched from Pawtucket on the north, to Cape Cod on the east, and south to Newport. Villages were typically small, seasonal campsites that were situated near bodies of water for most of the year, and moved inland during the winter.

The first settlement of East Providence by Europeans was in 1636 when Roger Williams and his followers founded a new community called "Seacunke" (Seekonk) along the shore of a cove that is today Omega Pond northwest of the current project location. Several months later, Williams and his entourage relocated nearby to what would become the city of Providence. In 1643, Puritans purchased a tract of land from Massasoit, chief of the Wampanoags, which encompassed the communities of Rehoboth and Seekonk, Massachusetts, most of East Providence, and portions of Pawtucket. In 1645 the township's name was changed from Seacunke to Rehoboth.

Agriculture was the main subsistence practice in the early years of the settlement through to the mid-20th Century. Gristmills were constructed along the Ten Mile River shortly after settlement. Richard Wright, a prominent member of the early community, erected the first mill at the mouth of the Ten Mill River. Shortly thereafter, a second mill was constructed further up the river at what is now Hunts Mill. No traces of buildings from the initial period of settlement remain.

The study area is located within the bounds of the Rumford Historic District (Rhode Island Historical Preservation Commission 1976). This district contains the largest concentration of 18th and early 19th Century buildings in the city. Among the notable buildings are the John Hunt house on Hunts Mill Road, a circa 1770, 2-story, 5-bay Georgian dwelling with center chimney and gable roof (listed on the National Register of Historic Places), and an 1893 pumping station built by the East Providence Fire District consisting of a 1-story stone building with hip roof and large rear stack. The

National Register nomination form for the Rumford Historic District describes the buildings and surrounding grounds at Hunts Mill as "a property of special significance…closely associated with local industrial history and recreational activity [serving] as a mill privilege, amusement park, and waterworks from the seventeenth century until the early 1970's." The Hunts Mill Dam, although modified since its original construction, would be considered a contributing element to the district as a component of the Hunts Mill built environment. The current dam dates from 1849-50 and was likely associated with the establishment of the Rumford Chemical Works.

Mills have occupied the site of the Hunt House since the late 17th Century. The Hunt family, among the earliest settlers of Rehoboth, MA purchased a gristmill and fulling mill here in 1713. In 1873, the Rumford Chemical Company purchased Hunts Mill. By 1893, the last of the mill buildings were demolished and the 1893 pumping station built to supply water to the Rumford Company and to the new factories in Phillipsdale north of the present study area.

Hunts Mill became a prime recreation area and in 1900, a carousel, picnic grounds, and dance hall were constructed and comprised the Hunts Mill Amusement Park. The Ten Mile River was dotted with canoe houses and refreshment stands all the way to Omega Pond. In 1925 the dance hall burned down and the amusement park was closed forever. In 1928, the town of East Providence took over the water company and families that operated the company used the Hunt House. In 1936 the Hunt House became the offices for the East Providence Water Department until the mid-1980's when the water department moved to new offices. The city of East Providence owns the Hunts Mill area including the Hunt House and adjacent Caleb Williams House. Since 1989, the East Providence Historical Society has been restoring the house to its original appearance and operating it as a museum.

The river was dammed at Omega Pond during the early 20th Century to create an industrial water supply. Conversely, Turner Reservoir was created as a drinking water supply for the city of East Providence. The dam at this site dates from about 1930. Turner Reservoir is no longer used as a back-up water supply for East Providence.

Cultural, Economic and Recreational Resources

The city of East Providence had a population of 48,688 people in 2000, ranking it fifth among Rhode Islands 39 cities and towns. With a land area of 13.41 square miles, this results in a population density of 3,632 persons per square mile. The City also contains 3.21 square miles of water surface area. Major employers in 2000 were educational, health and social services (21.1 percent), manufacturing (19.4 percent), and retail trade (11.7 percent). A significant number of people are also employed in the professional, scientific and technical areas, and the health care, administrative and retail service areas.

The Ten Mile River is a major feature of the City, initially flowing southerly along the eastern border of the City and then flowing westerly through the City to the Seekonk River. Along its course it provides significant recreational and cultural resources for the city. Turner Reservoir/Central Pond is used heavily for recreation, including non-powered boating, canoeing, recreational fishing, hiking and bird watching. A trail on the west side of the reservoir provides access to less developed areas adjacent to the impoundment. Access to the spillway area at Turner Dam is restricted due to safety concerns associated with the height of the abutment walls and spillway. The area surrounding Hunts Mill Dam includes a well-used park that provides areas for picnicking, walking and other forms of passive recreation. The restored John Hunt House containing the Museum of East Providence History is also located near the dam. Omega Pond is used for recreational fishing and non-power boating, as well as passive recreation. All sites provide scenic natural vistas that are welcome within this highly developed community.

Expected Future Conditions Without a Project

If anadromous fish passage is not restored at the three dams along the lower Ten Mile River, a prime spawning and nursery habitat will remain seriously underutilized. The remnant river herring population that is currently being netted over Omega Dam by volunteers would be the only way that anadromous river herring would be able to spawn in Omega Pond and the section of the Ten Mile River below Hunts Mill Dam. The section of river upstream of Hunts Mill Dam and the 297 acres of lacustrine habitat in Turner Reservoir would be inaccessible to these river herring. In addition, as netting herring over Omega Pond Dam is very time consuming, the number of herring that can be lifted over the dam is limited. Therefore, without a project, a self-sustaining population of anadromous river herring could not be established in the Ten Mile River upstream from Omega Pond and no American shad would enter the river. In addition, the ecological benefits associated with restoring these fish to the river would not be realized.

SECTION III

PLAN FORMULATION

This section describes the plan evaluation and selection process. Formulation of a plan to restore anadromous fish to the lower Ten Mile River involved the following steps:

- Identification of Objectives
- Formulation of Alternative Plans
- Evaluation of Alternative Plans
- Selection of a Recommended Environmental Restoration Plan

Each of these steps is discussed below. Plan formulation and selection of the recommended plan was thoroughly coordinated with the interested public, local and state officials and resource agencies.

Identification of Restoration Objectives

The primary ecosystem restoration objective of the study is to restore anadromous fish passage at the lowest three dams on the Ten Mile River. As approximately 90 percent of the suitable anadromous fish spawning habitat is located upstream from the third dam (Turner Reservoir Dam), the expressed goal of the state of Rhode Island, city of East Providence and Save the Bay, Inc. is to restore passage at all three dams. Based on the available habitat in this portion of the river, the target restoration species are blueback herring, alewives and American shad.

Formulation and Evaluation of Alternatives

At each dam location, three alternatives were identified for evaluation. These are: no action, dam removal and providing fish passage at the existing structure. Each of these alternatives is evaluated below.

No Action

In the no action alternative, limited use of the habitat below Hunts Mill Dam would continue as it is expected that volunteers would continue to net herring over Omega Pond Dam. Habitat areas upstream of Hunts Mill Dam, which represent the majority of available habitat, would not be utilized. Under this alternative, a self-sustaining population of river herring would not be established in the Ten Mile River upstream from Omega Pond. Other species, such as American shad and Atlantic salmon, would also be denied access to spawning and habitat areas.

Dam Removal

In this alternative, one or more of the three dams that are currently blocking upstream migration of anadromous fish would be removed. The habitat would change from lacustrine (impounded lakes) to riverine as the impoundments drain and the river is restored to free flowing. Removal of each dam is discussed in the following paragraphs.

Omega Pond Dam - Removing Omega Pond Dam would relocate the head of tide about 2500 upstream to a point near the Conrail railroad bridge. The pond would revert back to a salt marsh that would be under both tidal and freshwater influence. The former Omega Pond would become repopulated with estuarine species, and anadromous fish would have access to this area and an additional 2 miles of riverine habitat up to Hunts Mill dam. Removal of the dam would cause a large amount of sediment to be naturally flushed downstream into the Seekonk River estuary, unless it was removed prior to dam removal. To assess the impact that this would cause, seven sediment samples were collected and analyzed (see Appendix E). This testing determined that there are elevated levels of arsenic as well as other potential contaminants in the sediment. Allowing these sediments to naturally flush into the estuary would not be acceptable and these sediments would need to be removed and disposed of in a suitable landfill. This would substantially increase the cost of dam removal. Many of the abutters to Omega Pond are opposed to dam removal due to the loss of the impoundment and the benefits it offers (scenic views and a stable environment). Based on the above impacts, the state of Rhode Island, city of East Providence and Save the Bay, Inc. have eliminated the option of removing Omega Pond Dam as a potential alternative for restoring fish passage.

Hunts Mill Dam – Removal of Hunts Mill Dam would eliminate the small impoundment behind the dam and open up an additional half-mile of riverine habitat upstream to Turner Reservoir. The habitat immediately upstream from the dam would change from lacustrine to riverine, exposing the former riverbed containing rock and gravel, with associated pools and riffles. Sediments behind the dam are relatively shallow and less contaminated than those at Omega Pond (see Appendix E). However, removal by dredging would be preferable to allowing them to naturally disperse downstream and impact water quality and habitat.

Hunts Mill Dam and abutting historic structures are on the National Register of Historic Places, and the existing Hunt House serves as a public museum. In addition, the city of East Providence (the current owner of the dam and property) has created a public park/recreation area at this location, with the curved spillway, associated waterfalls, and the small impoundment serving as aesthetic resources. There are also plans to make additional improvements at the site, with the intention of enhancing and maintaining the dam as an historic landmark. Based primarily on historic concerns, the state of Rhode Island (Historical Preservation and Heritage Commission), and the city of East Providence have eliminated removing the dam as a potential alternative for restoring fish passage.

Turner Reservoir Dam – Removing Turner Reservoir Dam would transform the 297-acre Turner Reservoir/Central Pond to about two miles of historic riverine habitat and adjacent riparian areas. This would allow free passage for up-migrating river herring and shad to the new habitat area within the former impoundment, plus an additional mile of existing riverine habitat upstream from Central Pond. Similar to the two other downstream dams noted above, a large amount of sediment has accumulated behind the Turner Reservoir Dam. This sediment has been tested, and found to contain elevated levels of several metals, including cadmium, lead, copper and zinc. Many of these metals are at levels above those where biological effects would be expected to occur in sensitive aquatic life. Therefore, it would be necessary to dredge this sediment and dispose of it in an appropriate disposal site prior to dam removal to prevent it from contaminating downstream areas of the Ten Mile River. This would increase the cost of the proposed fish passage project beyond the scope of the available resources to implement it. The Turner Reservoir/Central Pond complex is also a significant recreational resource and a back up water supply for the city of East Providence. The reservoir is heavily used by recreational fishers and boaters, and a moderately used walking trail runs along the East Providence side of the impoundment. Dam removal would eliminate this resource. Based on the above cost and societal impacts, the State and the City have eliminated the removal of Turner Reservoir Dam as a viable fish passage alternative.

Construction of Fishways

In this alternative, concrete Denil fishways would be constructed at each of the three dams. This would open up a riverine migratory corridor extending approximately three miles from Omega Pond Dam to Turner Reservoir, and an additional mile from Turner Reservoir/Central Pond to the Golf Club Dam in Pawtucket, Rhode Island. In addition, anadromous alewives, which spawn in slower moving waters of rivers, and in lakes and ponds, would have unimpeded access to approximately 340 acres of lake spawning habitat in Omega Pond, Hunts Mill Pond, and Turner Reservoir. As anadromous fish returns to the Ten Mile River are likely to exceed available spawning grounds, a fish trap is included at Hunts Mill Dam to relocate excess fish to other coastal watersheds. This supports Rhode Island's strategic plan for the restoration of anadromous fishes to coastal streams.

Omega Pond Dam - In this alternative, a 4-foot wide concrete Denil fishway would be constructed adjacent to the left abutment of the spillway to provide upstream fish passage (see Plate 1). The entrance channel to the fishway would be 30-inches wide and be situated at the base of the spillway at a 45-degree angle to the direction of flow. The fishway would then widen to 4 feet as it turns 135 degrees. After a 10-foot level section, the fishway would ascend parallel to the spillway/bridge abutment for a length of 42.5 feet. At the top of this lower leg of the fishway, the fishway turns 180 degrees at a 10-foot long turning/resting pool. From this point, the fishway would ascend along an additional 57.5 feet to an 8.5-foot long exit channel into Omega Pond. The exit channel would be cut into the existing stone spillway. For downstream passage, a 3-foot wide by 1-foot deep downstream migrant slot would be cut into the spillway about 20 feet from the left abutment. Due to the stepped downstream face of the spillway, a smooth surface

flume and plunge pool would also be included to provide safe downstream passage for juveniles.

With the proposed fish ladder, up-migrating fish would be allowed free access to areas upstream of Omega Dam, which includes the approximately 2 miles of riverine habitat upstream from Omega Pond as well as the 33 acres of lacustrine habitat in Omega Pond. During periods of upstream migration, Denil baffles would be installed and water would be allowed to flow through the fishway by opening the stop log control structures at each end of the fishway. This would enable fish to migrate through the fishway. A fishway of this size could potentially pass between 250,000 and 400,000 river herring and about 25,000 shad.

Hunts Mill Dam - For this alternative, a similar Denil fishway would be constructed adjacent to the right end of the dam, and include a fish trap (see Plate 4). The exit channel of this concrete fishway and fish trap would fit into the existing headworks structure adjacent to the right end of the concrete spillway. The remainder of the fishway would continue past this structure along the right bank and then turn back to its entrance at the base of the spillway. Specific features include a 30-inch entrance channel that widens from 30-inches to 4 feet and turns 135 degrees before it ascends 35 feet parallel to the riverbank. The fishway then turns 180 degrees at a 10-foot turning/resting pool, and ascends an additional 32.5 feet before entering a 10-foot level section. This is followed by an 8-foot wide by 10-foot long fish trap with lifting brails to facilitate the transfer of fish. The exit channel from the fish trap would be 3 feet wide. The fish ladder would allow anadromous river herring and shad access to an additional 10 acres (0.5 river miles) of lacustrine spawning and nursery habitat in Hunts Mill Pond, extending to the base of Turner Reservoir Dam. The fishway ladder would be operated in a similar fashion as the one proposed at Omega Pond Dam, and during the same time period. This would allow up-migrating river herring and shad to continue their migration to the base of Turner Reservoir Dam. A downstream migrant slot is not required at Hunts Mill Dam because the shape and irregularities of the existing spillway will provide sufficient water depth for downstream passage.

Turner Reservoir Dam - Upstream passage would be provided by a 4-foot wide concrete Denil fishway that would be placed adjacent to the left abutment of the concrete spillway (see Plate 8). The entrance to the fishway would be situated in the stilling basin at the base of the spillway. As the inlet faces downstream at a 45-degree angle, the fishway makes a 135-degree turn before ascending 47.5 feet to a 10-foot turning pool. The upper sloping leg of the fishway is 60 feet long and terminates at an exit channel about 11 feet long. This exit channel would be cut into the spillway about 2.1 feet. During periods of upstream migration, the fishway would be operated concurrently with the fishways at Hunts Mill and Omega Pond. Downstream passage would be provided via a 3-foot wide by one-foot deep notch in the spillway. This notch would be situated about 19 feet from the left spillway abutment.

Construction of a fishway at Turner Reservoir will enable up-migrating anadromous fish on the Ten Mile River to continue their migration from areas above the

lower two dams to expansive spawning areas above this dam. This includes approximately 297 acres of lacustrine spawning habitat within Turner Reservoir for anadromous alewives, and about a mile of riverine habitat upstream from the reservoir.

The Rhode Island Department of Environmental Management has estimated that providing anadromous fish passage at the lower three dams on the Ten Mile River would support a run size of about 205,000 river herring.

Other Fish Passage Alternatives

Another alternative method of fish passage would be the installation of fish lifts at the dams. The primary disadvantage of a fish lift is that it requires manual operation as compared to Denil fishways that passively allow fish to migrate after the fishway is put into operation. Most fish lifts are operated periodically during the day, and rarely at night. This requires up-migrating fish to wait at the lift gates until they are opened for transport. This creates less than optimal conditions as fish can become crowded during the waiting period. This can result in increased predation, temporary reduction in dissolved oxygen levels in the waiting area, aggressive behavior (fin nipping) due to crowding, and scale abrasion. These stress conditions can have long term effects by lowering the fish's resistance to disease or generally weakening the fish. Although crowding may not be significant during most transport operations, the fact that crowding is inherent in fish lift operations is a disadvantage when compared to a fishway that allows unobstructed upstream movement. Another major disadvantage is the high cost associated with operating and maintaining fish lifts.

Selection of an Anadromous Fish Restoration Plan

Selection of a fish restoration plan for the lower Ten Mile River involved the evaluation of fish passage efficiency, public input, existing uses and historic resource concerns. Fishway alternatives such as Denil fishways are generally 70%-90% efficient at passing shad and river herring when compared to having no dam in place. Consequently, fishways would be less effective than complete dam removal, which would allow unobstructed upstream and downstream fish migration. Dam removal would also provide benefits associated with restoration of the historic riverine habitat. Construction of fishways, in comparison, would retain the existing lacustrine habitat and associated warmwater fishery, as well as the extensive riparian and wetland areas that surround the existing impoundments. The municipal and recreational resources associated with these impoundments, particularly at Turner Reservoir, would also be maintained. As previously stated, Turner Reservoir/Central Pond is heavily used by recreational fishers and boaters, for hiking and walking along the periphery, and is a back up water supply. At Hunts Mill Dam, the historic significance of the dam and extensive recreational use reduce the net benefits of removal. Removal would also require upland disposal of the large amount of contaminated sediment that has accumulated behind these dams. Because of the high cost of removal and the loss of substantial values provided by

these dams and impoundments, dam removal is not the recommended option to restore fish passage to the lower Ten Mile River.

In summary, as the no action alternative would not meet the goals of the study, and dam removal is not acceptable due to high cost, impoundment uses, public opposition, and historic significance, providing fish passage via a Denil fishway at each of the three dams is the recommended plan.

SECTION IV

DESCRIPTION OF RECOMMENDED PLAN

Plan Features

The recommended plan consists of providing a Denil fishway at Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam. Each fishway would be 4 feet wide and have a 1 vertical on 8 horizontal floor slope to allow the passage of both river herring (blueback herring and alewives) and American shad. The fishway consists of the following major features:

- Entrance channel – The entrance channel is flat and located as close as possible to the base of the dam. It is designed so that at minimum operating flows, there is two feet of water in the channel. It is also designed so that the attraction jet of water exiting the fishway is stronger than any other flow vectors so that migrating fish can easily locate the entrance.

- Denil baffle section – At the upstream end of the entrance channel, the Denil baffle section begins. The concrete floor is now sloped, with the slope varying to suit the target fish. In this case, American shad are relatively weak swimmers so the slope is 1 vertical on 8 horizontal. Baffles are placed along this sloped section every 30-inches at a 45-degree angle. For the 4-foot wide Denil, the clear opening between the sides of the baffle is 28 inches. A second Denil section will be required at each dam due to the height of each dam. A turning section is provided at the top of the first baffle section to allow the fish a rest before moving upstream again.

- Exit channel – The uppermost Denil section terminates at a level exit channel that is cut into the existing spillway. The width of the fishway at this point remains at 4 feet. The channel is designed to have a minimum of 2 feet of water depth at minimum pool operating levels.

- A downstream migrant slot would also be notched into the spillway at Turner Reservoir and Omega Pond dams. This slot will be 3 feet wide by 1 foot deep and would facilitate downstream movement of juveniles. A migrant slot is not required at Hunts Mill Dam as the shape and irregularities of the existing spillway will provide sufficient water depth for downstream passage.

These features are shown on Plates 1 through 10.

As suggested by the National Marine Fisheries Service (see Appendix A, letter dated September 23, 2005), appropriate measures to improve American eel passage will be incorporated at each fishway during preparation of plans and specifications.

The following table lists the entrance channel, turning pool and exit channel elevations of each fishway.

Table 1: Fishway Design Elevations (feet NAVD 88)

Location	Entrance Channel	Turning Pool	Exit Channel
Omega Pond Dam	-4.35	0.96	8.15
Hunts Mill Dam	23.36	27.74	31.80
Turner Reservoir Dam	32.00	37.95	45.45

Design Considerations

The following summarizes the design considerations developed for major project features. Additional surveys, and detailed structural and mechanical design will be accomplished as required during the plans and specifications phase to complete design of these features.

The proposed fishways will not derive structural support from existing spillways, abutments or other features of the dams. Each fishway has been designed based on foundation conditions at the site. At Omega Pond Dam, bedrock is deep and the structure will be supported on cast-in-place concrete caissons placed 34 feet into the streambed. Since bedrock is fairly close to the surface at Hunts Mill Dam, this structure will be supported by footings placed directly on bedrock. At Turner Reservoir Dam, cast-in-place caissons drilled 5 feet into bedrock will support the fishway. Based on the depth to bedrock, the total depth of these caissons will be about 35 feet.

Installation of fishways at the three dams will have no impact on current operations as all dams are currently operated as run-of-river dams where inflow effectively equals outflow. In addition, based on an assessment at each dam, the Denil fishways and appurtenant structures are considered to have no net impact on flood elevations upstream or downstream of the dams (see Appendix B).

As currently proposed, construction activities at Hunts Mill Dam will include removal of several existing structures. These include a reinforced concrete pipe that penetrates the dam and runs along the west bank of the river and a concrete cistern like structure that this pipe enters below the dam. These structures are in poor condition and should be removed to construct the fishway.

Construction Considerations

Construction would require a moderately sized work force with varied construction skills, largely in the heavy equipment, and semi-skilled and skilled labor

trades. Within the Providence area there are a sufficient number of workers that could commute to work and not require housing in the project area. Since the Hunts Mill Dam project area is open to the public, maximizing safety will be a major concern. Entrance to the Omega Dam and Turner Reservoir Dam sites is partially controlled by existing fences, but construction site safety will also need to be addressed at these locations. Access to the staging areas identified in this report will also need to be controlled.

The control of water will be a major consideration during construction of the fishways. It is anticipated that the majority of water will be controlled by the use of portable dams or cofferdams. Construction of the fishway at Omega Dam will require the use of low-head drilling/caisson equipment for work beneath the railroad bridge, and may require the construction of a temporary access road. Construction at Omega pond will require coordination with the railroad for such items as flagmen, restricted construction hours, equipment restrictions, and other items.

Operation, Maintenance, Repair, Replacement and Rehabilitation Requirements

Operation and maintenance of the project can be divided into two major categories: (1) operation of the fishway during fish migration periods; and (2) periodic inspection and maintenance of the fishway to ensure effective operation as required. These activities will include installation and removal of baffles and stoplogs as required, periodic cleaning of the facility, monitoring during fish migration, and maintaining records concerning the numbers of fish that transit the fishway.

Repair, replacement and rehabilitation of all project features will be the responsibility of the non-Federal sponsors. Repair entails those activities of a routine nature that maintain the project in a well-kept nature: replacement includes activities taken to replace worn-out project elements or portions thereof; and rehabilitation includes activities necessary to bring a deteriorated project back to its original condition. Since major project features are expected to last for the 50-year project life, repair, replacement and rehabilitation costs should not be significant.

Summary of Plan Costs, Accomplishments, Benefits and Impacts

Project Costs

Total Project Costs - Total project costs of the recommended plan are shown in Table 2. These costs, totaling $1,900,000, include direct construction costs with escalation; contingencies of 25 percent; preparation of plans and specifications; construction management; and real estate acquisition. A detailed breakdown of construction costs at each dam is included in Appendix C.

Table 2
Total Project Costs
(05/2004 Price Levels With Escalation)

Work Items	Cost
Construction Cost of Fishways	$1,400,000
Prepare Plans and Specifications	300,000
Construction Management	150,000
Real Estate Cost	50,000
Total Cost	$1,900,000

Apportionment of Costs – Costs for environmental restoration projects are shared 65 percent Federal and 35 percent non-Federal. The apportionment is, therefore, $1,235,000 Federal and $665,000 non-Federal.

Operation, Maintenance, Repair, Replacement and Rehabilitation Costs - Estimated operation, maintenance, repair, replacement and rehabilitation (OMRR&R) costs include operating the structures to allow fish passage, maintaining the structure and all appurtenances (baffles, stop logs, etc.), periodic cleaning, and maintenance of records concerning fish that transit the fishway.

The average annual cost of the above maintenance items is estimated at approximately $25,000 for monitoring and control during fish migration, periodic maintenance and cleaning, and oversight of the fish migration program for the lower Ten Mile River. Since major rehabilitation of the fishway is not expected during its 50-year project life, an additional $3,000 per year has been added for miscellaneous repair to project features, particularly those at the fish trap at Hunts Mill dam. Total OMRR&R costs are therefore approximately $28,000 annually. Under existing regulations, these costs would be a non-Federal responsibility.

Plan Accomplishments and Benefits

The recommended plan to construct Denil fishways at Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam will restore anadromous fish populations to the lower Ten Mile River up to the Golf Club Dam in Pawtucket, Rhode Island. This would allow anadromous alewives access to about 340 acres of spawning habitat within Omega Pond, Hunts Mill Pond and Turner Reservoir/Central Pond, and approximately three miles of riverine spawning habitat for blueback herring and American shad. Based on projections by the Rhode Island Department of Environmental Management, these habitat areas will support a fish run of over 200,000 herring. The number of American shad that will return is unknown, but the fishways are capable of passing about 25,000 shad.

Additional benefits to the ecosystem would also be incurred by the provision of fish passage on the Ten Mile River. A fishway on the Westfield River in Massachusetts

(a tributary to the Connecticut) has passed, in addition to the species noted above, American eel, white sucker, largemouth bass, smallmouth bass, brook trout, brown trout, rainbow trout, carp and striped bass (Slater, 2001). These fish have been observed using the fishway for spawning and/or seasonal migrations (e.g. during high temperatures and lower flows, many salmonid species will seek refuge in colder water tributaries upstream from a larger river). It is presumed that similar usage may occur in the Ten Mile River, since fish from one impoundment will be able to move upstream beyond Turner Reservoir/Central Pond.

Other ecological benefits include the increase in productivity associated with the re-establishment of anadromous fishes to their historical habitat. If shad and blueback herring become established in this river, the out-migrating juveniles would provide forage not only for resident warmwater species in the Ten Mile River (including the impoundments of Turner Reservoir and Omega Pond) but for marine and estuarine fish in the Seekonk and Providence Rivers downstream from Omega Pond. In addition, returning adults would provide forage for larger fish in Narragansett Bay and other marine waters. These fish would include striped bass, which move into the areas around the same time as many of the returning alosid species, as well as many federally managed species inhabiting the area. The overall benefits would not only be to an ecosystem, but for anadromous fish, which by definition (ER 1105-2-200) are a federally significant resource. Therefore, the project outputs are in the federal interest.

Providing fish passage at the three dams is also in accordance with the overall Coastal America cooperative effort to restore anadromous fish to the Northeast, as well as the restoration plans of various other state and local government agencies. Objective 3.2 of Goal 3 in the Ten Mile River Draft Five Year Watershed Action Plan (2002-2006) (prepared by the Commonwealth of Massachusetts Executive Office of Environmental Affairs, Ten Mile River Watershed Team Action Planning Subcommittee) is to "create physical characteristics to fully support aquatic life." This includes those characteristics necessary to restore anadromous fish to their historical habitat.

Adverse Environmental and Other Impacts

The proposed installation of fishways at Turner Reservoir Dam, Hunts Mill Dam, and Omega Pond Dam, is not expected to have any long-term adverse effects on the existing environment of the Ten Mile River and the associated impoundments. Each fishway will allow anadromous fish to access spawning habitat in sections of the Ten Mile River and impoundments upstream from each of the respective dams. The construction of fishways at these three dams is expected to have a positive effect on the overall ecosystem of the Ten Mile River as well as the city of East Providence. The most substantial effect will be the contribution to estuarine and marine food webs from fish spawned in the Ten Mile River. The passage of anadromous fish at these dams will also provide an additional recreational opportunity where visitors will be able to observe the upstream migration of anadromous fish. Installation of interpretive signs would further explain the purpose and need for the fishways.

The construction of three fishways on the Ten Mile River at Turner Reservoir Dam, Hunts Mill Dam and Omega Pond Dam, is not expected to have any long-term negative effect on the existing vegetation, wildlife, amphibians or reptiles in the project area.

The construction of a fish ladder at each of the three dams, Turner's Reservoir, Hunts Mill Dam and Omega Pond Dam, is not expected to have any significant long-term negative effect on the overall hydrology of the Ten Mile River in these locations. The fishways will notch into the existing spillways of the dams, and will not alter the existing pool levels. An analysis of the structures and their function (see Appendix B) also determined that they would not impact peak flood water surface elevations.

The proposed project is not expected to have any long-term negative effects on the water quality of the Ten Mile River in the vicinity of and downstream from the three dams. Fish ladder construction will involve the temporary construction of a cofferdam at each construction location in order to conduct the work in the dry, and minimize any potential negative effects to water quality. The resulting flow configuration of the fish ladders may actually improve water quality in the immediate vicinity of the fish ladders and downstream by providing additional aeration as the water flows through the baffles of the Denil fishway.

The proposed construction of fish ladders at the three dams on the Ten Mile River will not involve significant disturbance of the existing sediments either downstream or upstream from the construction area, and it is not anticipated that the project will cause any significant sediment releases into the Ten Mile River.

The construction of fish ladders at Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam is not expected to have any long-term negative effects on the aquatic and/or wetland vegetation in the vicinity of the project footprint(s).

The historic significance of Hunts Mill Dam and the surrounding area will require an intensive archaeological investigation of the riverbank area that would be disturbed for the fishway structure. This will be accomplished prior to construction. Further consultation during the Plans and Specifications phase of the project will lead to the preparation of a Memorandum of Agreement (MOA) between the Corps, the RI State Historic Preservation Office (SHPO), the East Providence Historic Properties Commission, other interested parties, and potentially, the Advisory Council on Historic Preservation (ACHP).

The project will have no long-term impacts on air quality. During construction, equipment operating on the site will emit pollutants including nitrogen oxides that can lead to the formation of ozone. The Rhode Island State Implementation Plan has no permit requirements for construction projects. Therefore, this project conforms to the Clean Air Act, Rhode Island State Implementation Plan. In order to minimize air quality effects during construction, construction activities will comply with applicable provisions

of the Rhode Island Air Quality Control Regulations pertaining to dust, odors, construction, noise, and motor vehicle emissions.

Regulatory Requirements

The following permits are required for project construction:

- Water quality certification from RIDEM pursuant to Section 401 of the Clean Water Act
- CZM consistency determination from the RI Coastal Resources Management Council pursuant to the Coastal Zone Management Act
- RIDEM stormwater permit
- Section 404(b)(1) evaluation, provided as an attachment to the EA

Real Estate

The Rhode Island Department of Environmental Management (RIDEM) is the non-Federal sponsor and is responsible for providing all lands, easements, rights-of-way and disposal areas needed for project construction. The proposed construction activities will require temporary and permanent easements for construction, and access for operation and maintenance of the completed project. For planning purposes, the Real Estate Report (Appendix F) estimated that total real estate costs would be $50,000.

Financial Analysis

The non-Federal sponsor, the Rhode Island Department of Environmental Management (RIDEM), has indicated its willingness to execute a Project Cooperation Agreement (PCA) for this project (see Appendix A, RIDEM letter dated August 15, 2005). RIDEM has partnered with the New England District on environmental restoration projects that are now complete. Accordingly, RIDEM is aware of its obligations to implement this project and is able to meet its financial obligations.

View of the Sponsor

The non-Federal sponsor, the Rhode Island Department of Environmental Management (RIDEM), is committed to improvement and restoration of habitat in Narragansett Bay and coastal watersheds. The recommendation to restore anadromous fish to the lower Ten Mile River represents an important opportunity to further that objective. RIDEM desires to participate in this restoration project, which is also strongly supported by the city of East Providence and Save the Bay, Inc.

Implementation Schedule

Implementation of the recommended plan is subject to the Corps of Engineer's review, approval and funding processes, and sponsor participation, including execution of a Project Cooperation Agreement (PCA). Upon receiving approval from the Corps North Atlantic Division, the New England District will prepare plans and specifications prior to solicitation of construction bids and contract award. Subject to the availability of funds, construction of the restoration project could begin as soon as the spring of 2007.

SECTION V

SUMMARY OF STUDY COORDINATION

Coordination efforts have been ongoing since completion of the Rhode Island Ecosystem Restoration Report, Section 905(b), WRDA 86 Analysis, in July 1999. Restoring anadromous fish to the Ten Mile River was a major recommendation of this report and a Feasibility Cost Sharing Agreement for this study was executed in March 2001.

Efforts to restore anadromous fish to the Ten Mile River have broad support as evidenced by the study cost sharing partners. Funds and support have been provided by the Rhode Island Department of Environmental Management, the city of East Providence through an Aqua Fund Grant, and Save the Bay, Inc., a non-profit group whose mission is to ensure that the environmental quality of Narragansett Bay and its watershed is restored and protected. These agencies have been very active during the study process. To obtain the maximum coordination and cooperation with and between interested agencies and individuals, coordination meetings were held periodically during the study period. The following is a list of agencies and groups that participated in coordination meetings held during the study:

Federal Agencies
- U. S. Fish and Wildlife Service
- U. S. Environmental Protection Agency
- National Marine Fisheries Service

State of Rhode Island
- Department of Environmental Management
- Historical Preservation and Heritage Commission
- Division of Fish and Wildlife

City of East Providence
- Planning Department
- City Engineer
- Parks and Recreation Department
- Historical Properties Commission

Non-Governmental Organizations
- Save the Bay, Inc.

The study was coordinated with Federal and state fish and wildlife resource agencies to obtain design criteria and their comments. The US Fish and Wildlife Service provided alternative fishway designs, and participated in numerous meetings with the RI Division of Fish and Wildlife and other State and local officials. This coordination included meetings to discuss alternative designs and plans, and plan selection.

State and local officials, and Save the Bay, Inc. have been very involved in the study through participation at coordination and working group meetings. Significant meetings during the study process include the following:

- April 25, 2001 – Press event at Hunts Mill Dam to announce initiation of the Ten Mile River fisheries restoration study.

- May 1, 2002 – Site visit with State legislators and City councilors.

- January 21, 2003 – Meeting with Save the Bay, Inc, and the East Providence Conservation Commission to discuss fishway designs.

- March 18, 2003 – Meeting with the East Providence City Council to present the status of the study and the proposed fishway designs.

- April 24, 2003 – Meeting with the Rhode Island SHPO, and the East Providence Historical Properties Commission and the Department of Planning and Economic Development at Hunts Mill Dam to discuss the fishway design.

- October 22, 2003 – Meeting with USFWS, Rhode Island SHPO, and the East Providence Historical Properties Commission and the Department of Planning and Economic Development to finalize the design features of the fishway at Hunts Mill Dam.

SECTION VI

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

FINDINGS AND CONCLUSIONS

During evaluation of the anadromous fish restoration needs of the Ten Mile River, all potentially feasible measures to restore fish passage were evaluated. Fish passage alternatives included no action, adding fishways or fish lifts to the existing dams, and dam removal. These alternatives were discussed at periodic coordination meetings with study participants.

Evaluation of alternatives was done based on an evaluation of basic data at each dam site and a determination of agency and public opinion regarding each alternative. Initial data collection activities focused on the analysis of sediments behind the dams, assembling fisheries information and conducting topographic surveys. Once data collection was complete at each dam, study participants were able to discuss and evaluate alternatives. An item that became evident early in the study was that dam removal would require removal or stabilization of accumulated sediments to prevent downstream movement and contamination of the Seekonk River estuary.

Removal of dams would cause other impacts. At Omega Pond, abutters opposed dam removal as loss of the impoundment would eliminate the scenic views and stability it offers. Dam removal would also impact the railroad bridge situated immediately downstream of the dam by increasing flow velocities. Removal of Hunts Mill Dam would impact the historic integrity of the site and impact existing recreational usage. Impacts at Turner Reservoir Dam include loss of a back up water supply and significant changes to a major recreational resource. For these reasons, the state of Rhode Island, city of East Providence and Save the Bay, Inc. oppose removal of dams as a means of restoring fish passage.

Evaluation of various methods of providing fish passage at the three dams determined that Denil type fishways would be the most effective method. Denil fishways are highly efficient, allow passive migration of target species, and are acceptable to State and local agencies and other concerned individuals.

The no action alternative would not meet the goal of the study sponsors and anadromous fish migration would be limited to Omega Pond where local fishermen catch and lift river herring over the dam. The effectiveness of this informal activity would also be limited by the schedules and resources of volunteers, and the labor-intensive nature of the work.

Based on the above analysis and public views and desires, providing Denil fishways at Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam was selected

as the recommended plan to restore anadromous fish passage to the lower Ten Mile River. It is also concluded that since the cost and scope of the recommended plan are within the limits of Section 206 of the Water Resources Development Act of 1996, that it is appropriate to recommend implementation under this authority.

RECOMMENDATIONS

I recommend that the aquatic ecosystem restoration plan, selected herein to restore anadromous fish to the lower Ten Mile River in East Providence, Rhode Island, be authorized for implementation as a Federal project, with such modifications as the Chief of Engineers may deem advisable, at a total estimated first cost of $1,900,000. In addition, based on the scope and cost of the selected plan, it is recommended that such implementation be pursued under Section 206 of the Water Resources Development Act of 1996.

The plan consists of providing Denil fishways at the three lowest dams on the Ten Mile River: Omega Pond Dam, Hunts Mill Dam and Turner Reservoir Dam. These fishways will provide for upstream migration of adult Blueback Herring, Alewife, and American Shad to historic spawning areas. Migrant slots would also be cut into the existing spillways at Omega Pond and Turner Reservoir to facilitate downstream migration of juveniles. A migrant slot is not required at Hunts Mill Dam as the shape and irregularities of the existing spillway will provide sufficient water depth for downstream passage. As anadromous returns to the Ten Mile River are likely to exceed available spawning grounds, a fish trap is included at Hunts Mill Dam to relocate excess fish to other watersheds. Measures to improve upstream passage of American eel will also be incorporated at each fishway during detailed design.

This recommendation is subject to the provision that qualified non-Federal sponsors agree to the following items of local cooperation and provisions of the Water Resources Development Acts of 1986 and 1996.

1. Provide 35 percent of total project costs allocated to environmental restoration, as further specified below:

(a) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(b) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project; and

(c) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the total project cost allocated to environmental restoration.

2. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

3. Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

4. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

5. Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

6. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

7. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

8. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

9. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair,

replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

10. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the level of ecosystem restoration, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or the addition of facilities which would degrade the benefits of the project.

11. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act. Crediting for relocations performed within the Project boundaries is subject to satisfactory compliance with applicable Federal labor laws covering non-Federal construction, including, but not limited to the Davis-Bacon Act (40 USC 276a et seq), the Contract Work Hours and Safety Act (40 USC 327 et seq), and the Copeland Anti-Kickback Act (40 USC 276c). Crediting may be withheld, in whole or in part, as a result of the non-Federal Sponsor's failure to comply with its obligations under these laws.

12. Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal participation and implementation of flood plain management plans. The non-Federal sponsor is also required to comply with all applicable Federal labor standards and requirements including but not limited to the Davis-Bacon Act (40 USC 276a et seq), the Contract Work Hours and Safety Act (40 USC 327 et seq), and the Copeland Anti-Kickback Act (40 USC 276c). Crediting may be withheld, in whole or in part, as a result of the non-Federal Sponsor's failure to comply with its obligations under these laws.

13. Provide the non-federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement.

14. Do not use Federal funds to meet the non-Federal sponsor’s share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

15. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

I have considered all significant aspects including overall public interest; environmental, social and economic effects; and engineering and financial feasibility in concluding that the recommended plan meets the objectives of this study.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Chief of Engineers as proposals for authorization and implementation funding. However, prior to transmittal to the Chief of Engineers, the sponsors, the States, interested Federal agencies, and other parties will be advised of any modification and will be afforded an opportunity to comment further.

_____
Date

_____
Curtis L. Thalken
Colonel, Corps of Engineers
District Engineer

15. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

I have considered all significant aspects including overall public interest; environmental, social and economic effects; and engineering and financial feasibility in concluding that the recommended plan meets the objectives of this study.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Chief of Engineers as proposals for authorization and implementation funding. However, prior to transmittal to the Chief of Engineers, the sponsors, the States, interested Federal agencies, and other parties will be advised of any modification and will be afforded an opportunity to comment further.

30 Sep 05
Date

Curtis L. Thalken
Colonel, Corps of Engineers
District Engineer

E 536,000

OMEGA POND

PROPOSED CONTRACTOR
STAGING AREA (TYPICAL)

PROPOSED CONTRACTOR
ACCESS (TYPICAL)

E 536,000

DEXTER RD.

SPILLWAY

5

5

NEW HAVEN RR

LOCATION OF PROPOSED
FISHWAY

SEEKONK RIVER

N 275,000

100 50 0 100 200FT

SCALE: 1"= 100'

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

WATER RESOURCES DEVELOPMENT PROJECT
RHODE ISLAND ECOSYSTEM RESTORATION
EAST PROVIDENCE, RHODE ISLAND
TEN MILE RIVER FISH PASSAGE

GENERAL SITE PLAN - OMEGA POND

1/10

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OMEGA POND

MIGRANT SLOT

GRANITE DAM SPILLWAY

Probes

P1

P2

RAILROAD BRIDGE
STEEL GIRDER

4' wide Denil baffles @ 30" c to c
floor slope is 1 on 8
total length = 42.5'
total # of baffles required = 18

CONCRETE HEADWALL

RAILROAD BRIDGE
STEEL GIRDER

Boring B3

4' wide Denil baffles @ 30" c to c
floor slope is 1 on 8
total length = 57.5'
total # of baffles required = 24

STREAM GUAGE

FLOOD

EBB

TEN MILE RIVER

PROPOSED 4' WIDE
DENIL FISHWAY

10 5 0 10 20FT

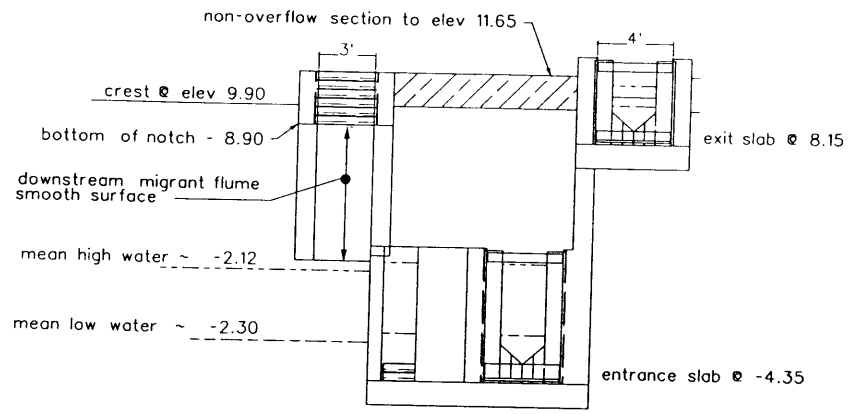
SCALE: 1"= 10'

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

WATER RESOURCES DEVELOPMENT PROJECT
RHODE ISLAND ECOSYSTEM RESTORATION
EAST PROVIDENCE, RHODE ISLAND
TEN MILE RIVER FISH PASSAGE

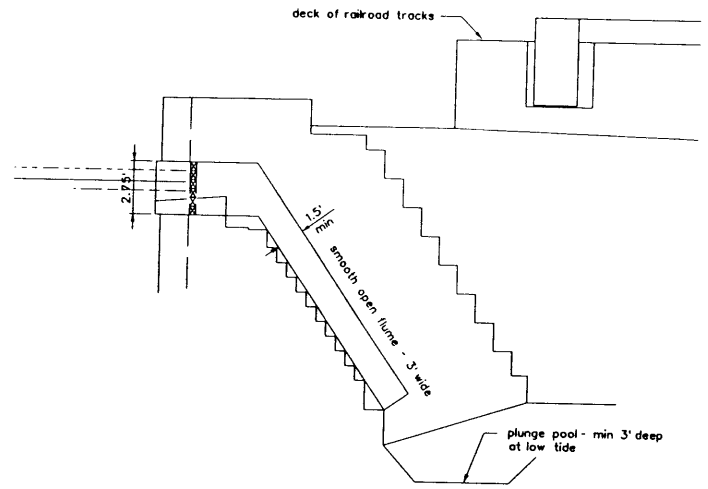
FISHWAY SITE PLAN - OMEGA POND DAM

2/10



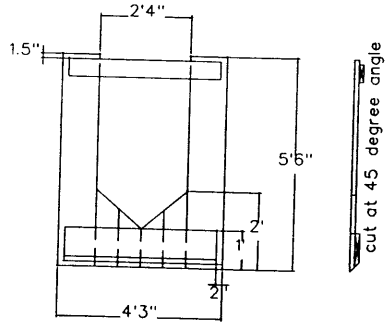
VIEW LOOKING @ D/S FACE DAM W/ FISHWAY

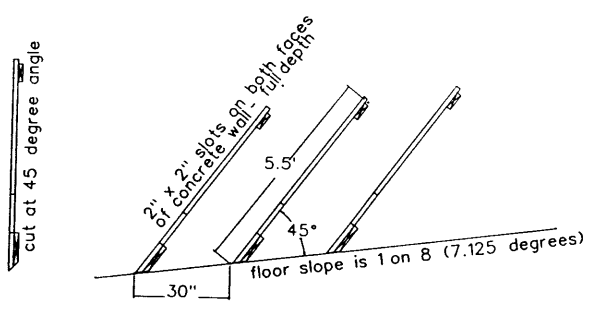
Scale 1"=10'



SECTION VIEW - THRU D/S MIGRANT SLOT

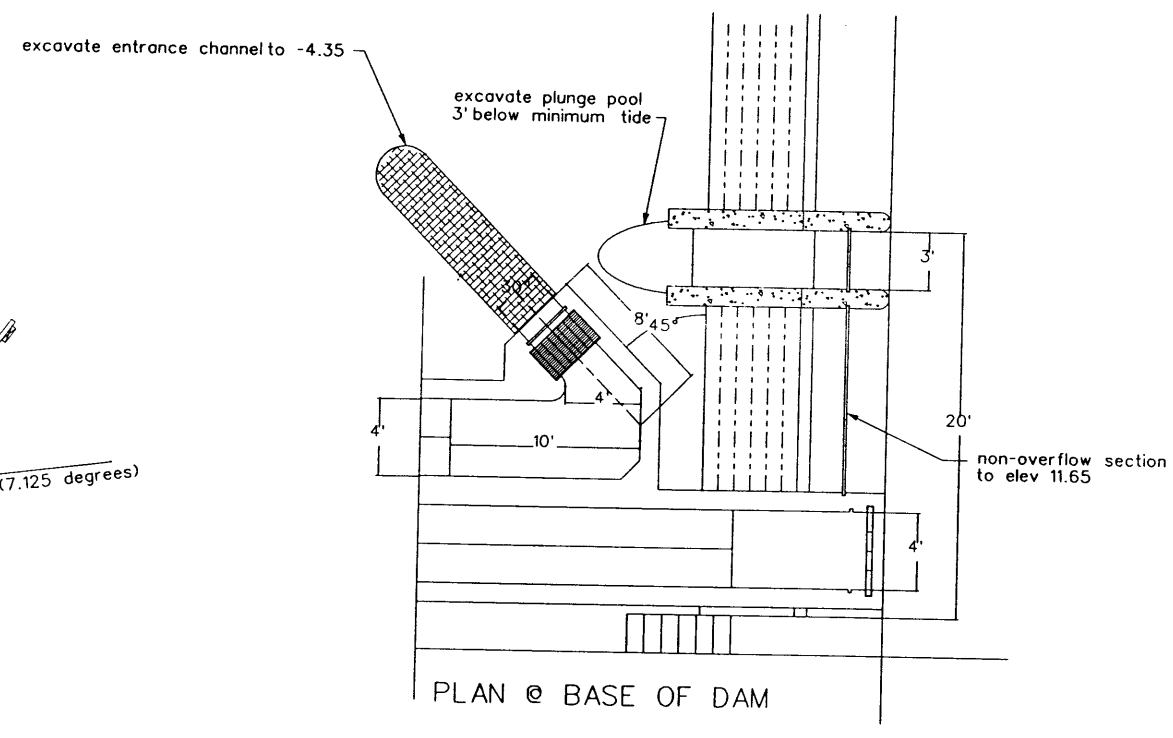
Scale 1"=10'





DENIL BAFFLE DETAILS

Scale 1"=5'



PLAN @ BASE OF DAM

Scale 1"=10'

GRAPHIC SCALE:

1" = 10' 10 0 10 20

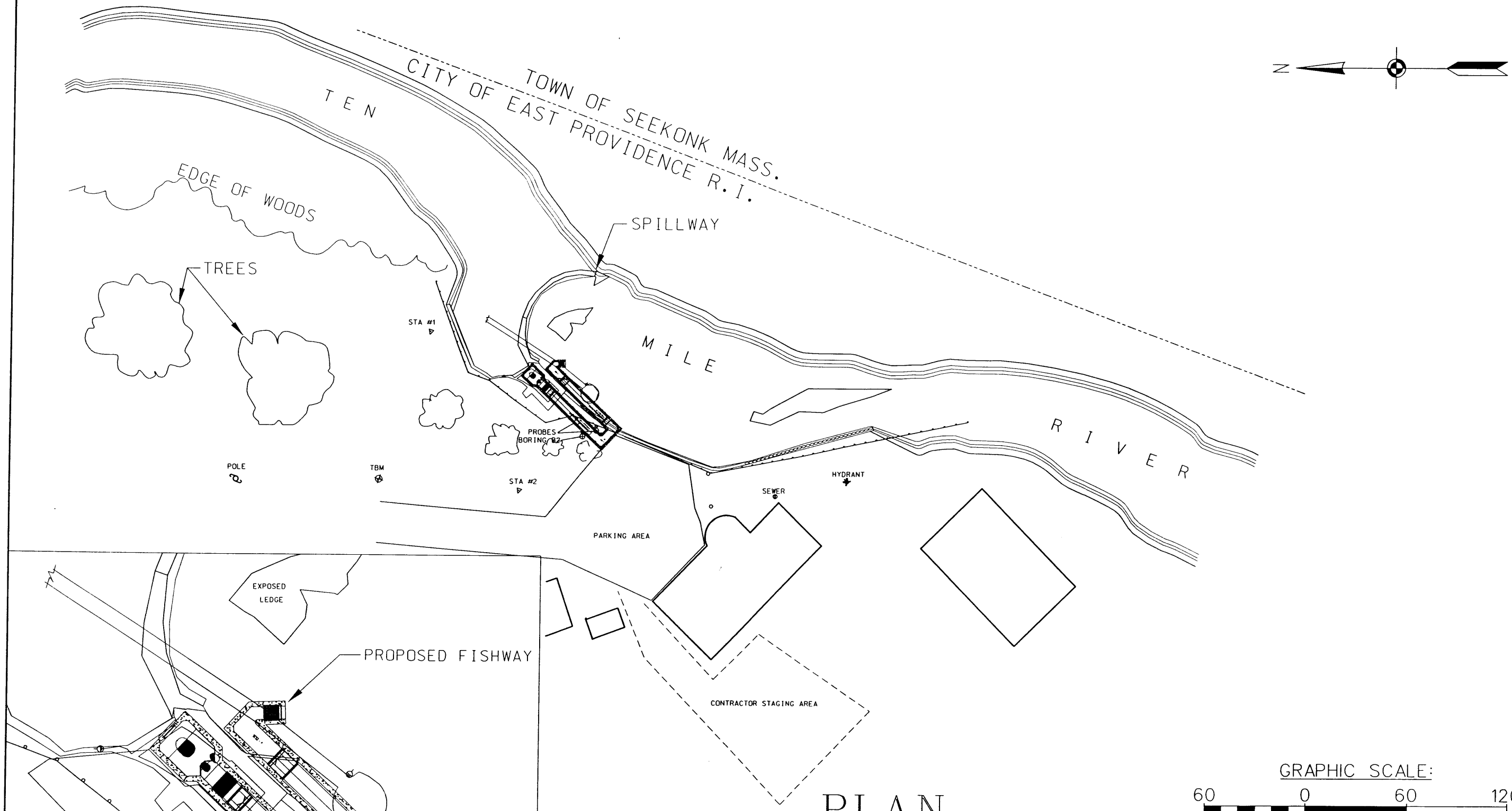
1" = 5' 5 0 5 10

Note: Elevations refer to NAVD 88

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

WATER RESOURCES DEVELOPMENT PROJECT
RHODE ISLAND ECOSYSTEM RESTORATION
EAST PROVIDENCE, RHODE ISLAND
TEN MILE RIVER FISH PASSAGE
OMEGA POND DAM
SECTIONS AND DETAILS

3/10



PLAN

SCALE: 1"=60'

GRAPHIC SCALE:

1" = 60' 60 0 60 120

1" = 20' 20 0 20 40

DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS	WATER RESOURCES DEVELOPMENT PROJECT RHODE ISLAND ECOSYSTEM RESTORATION EAST PROVIDENCE, RHODE ISLAND TEN MILE RIVER FISH PASSAGE HUNT'S MILL DAM - GENERAL PLAN	4 10

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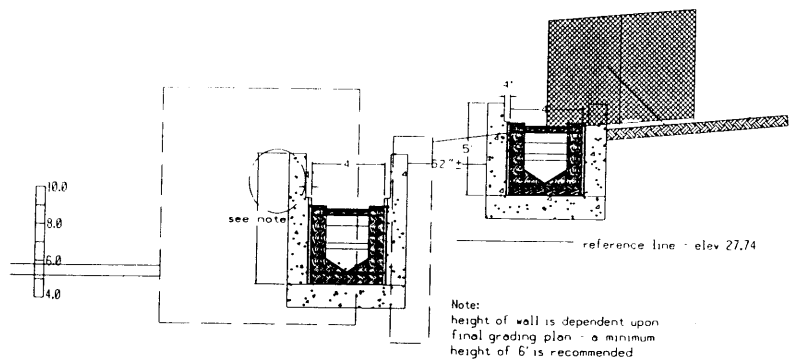
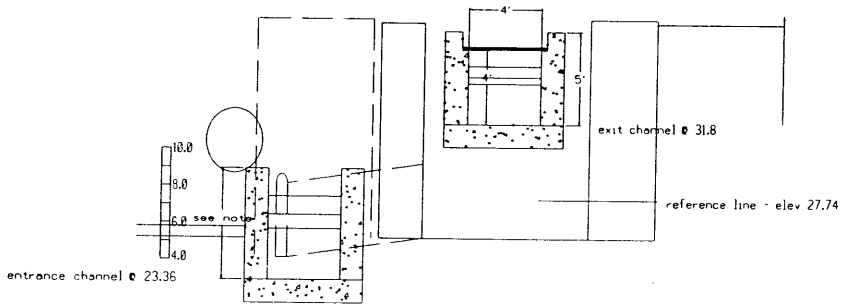


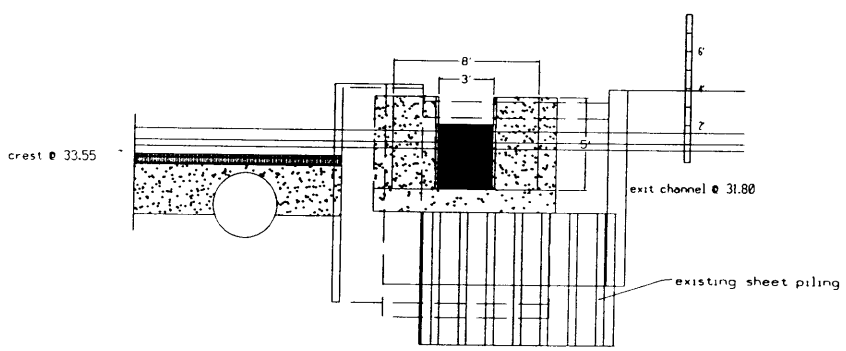
Note:
height of wall is dependent upon final grading plan - a minimum height of 6' is recommended

SECTION C - C

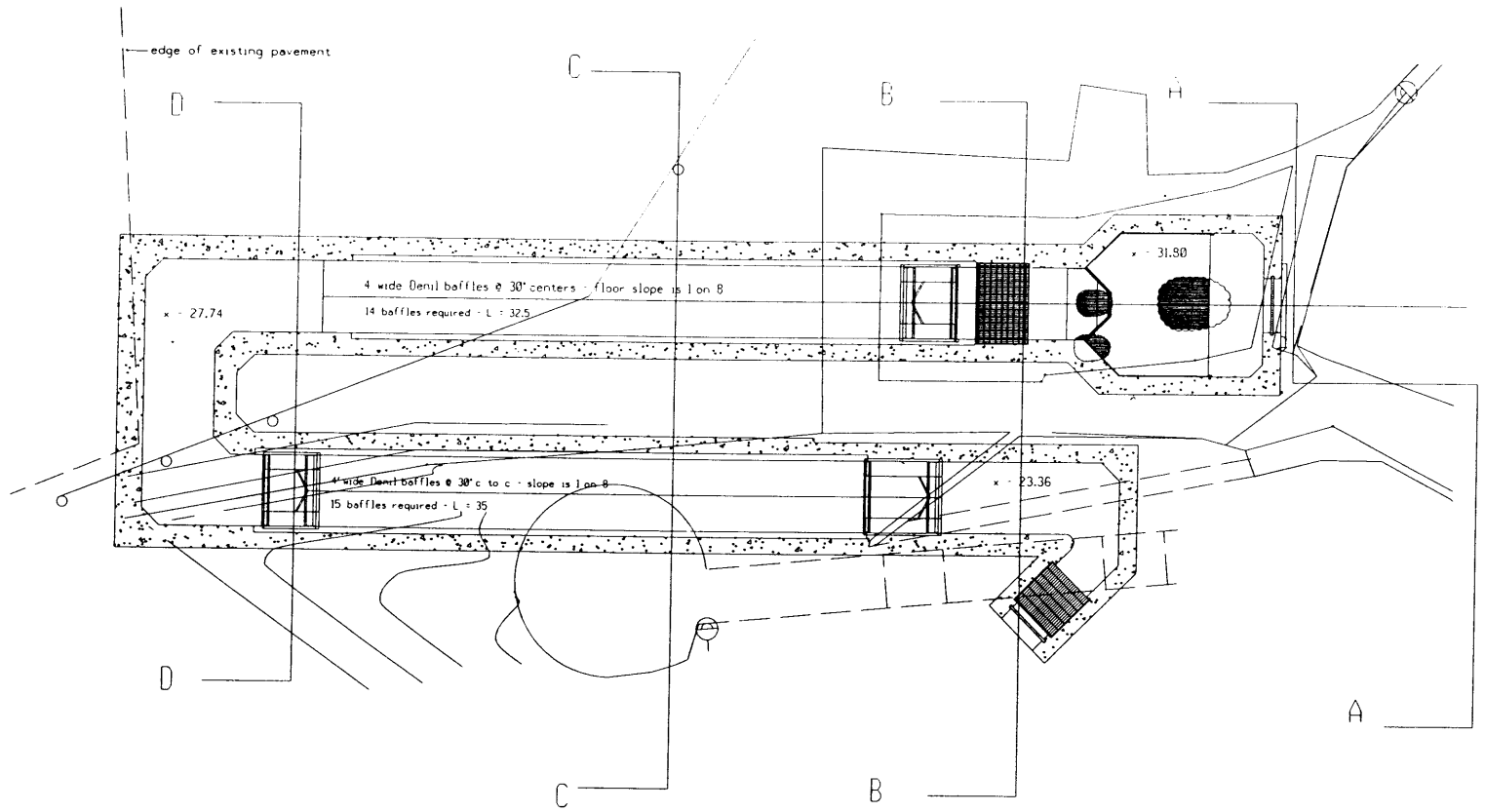


Note:
height of wall is dependent upon final grading plan - a minimum height of 6' is recommended

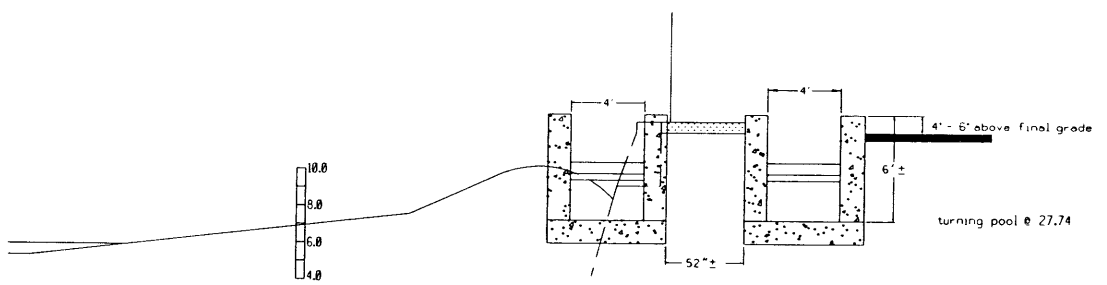
SECTION B - B



SECTION A - A



PLAN VIEW
w/ FISHWAY



SECTION D - D

NOTE: Elevations refer to NAVD 88

GRAPHIC SCALE:

1" = 10'

10 0 10 20

DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS	WATER RESOURCES DEVELOPMENT PROJECT RHODE ISLAND ECOSYSTEM RESTORATION EAST PROVIDENCE, RHODE ISLAND TEN MILE RIVER FISH PASSAGE HUNTS MILL FISHWAY DETAILS	5/10

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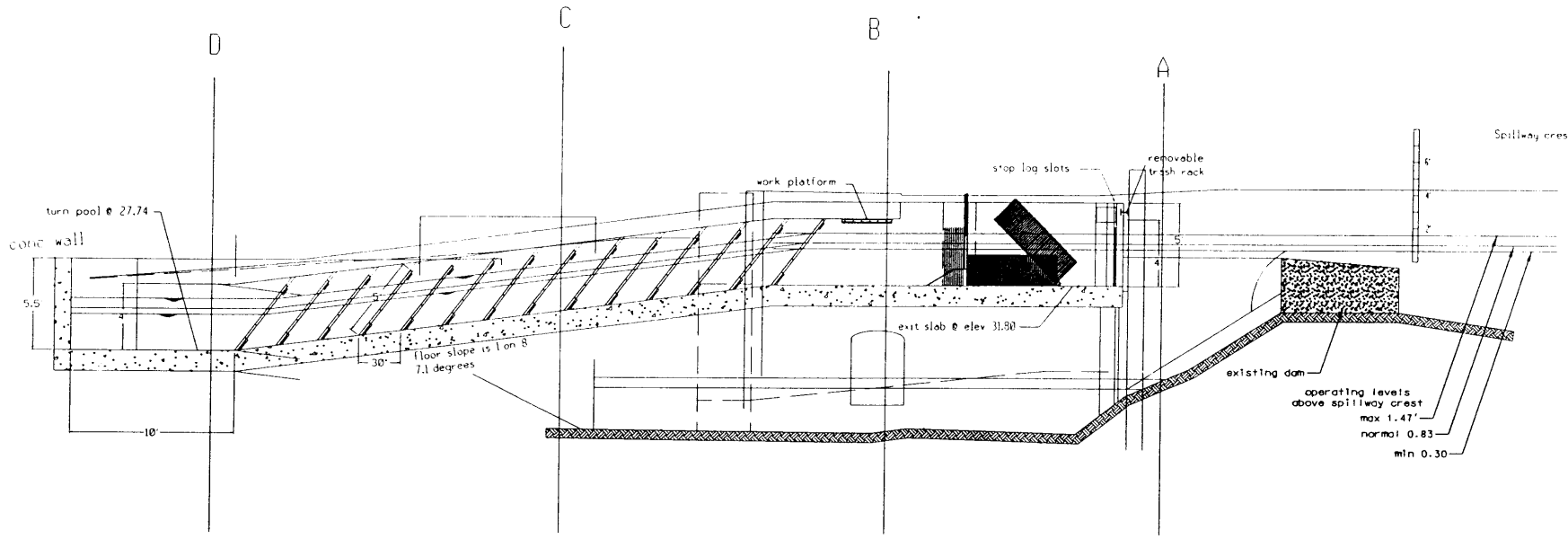
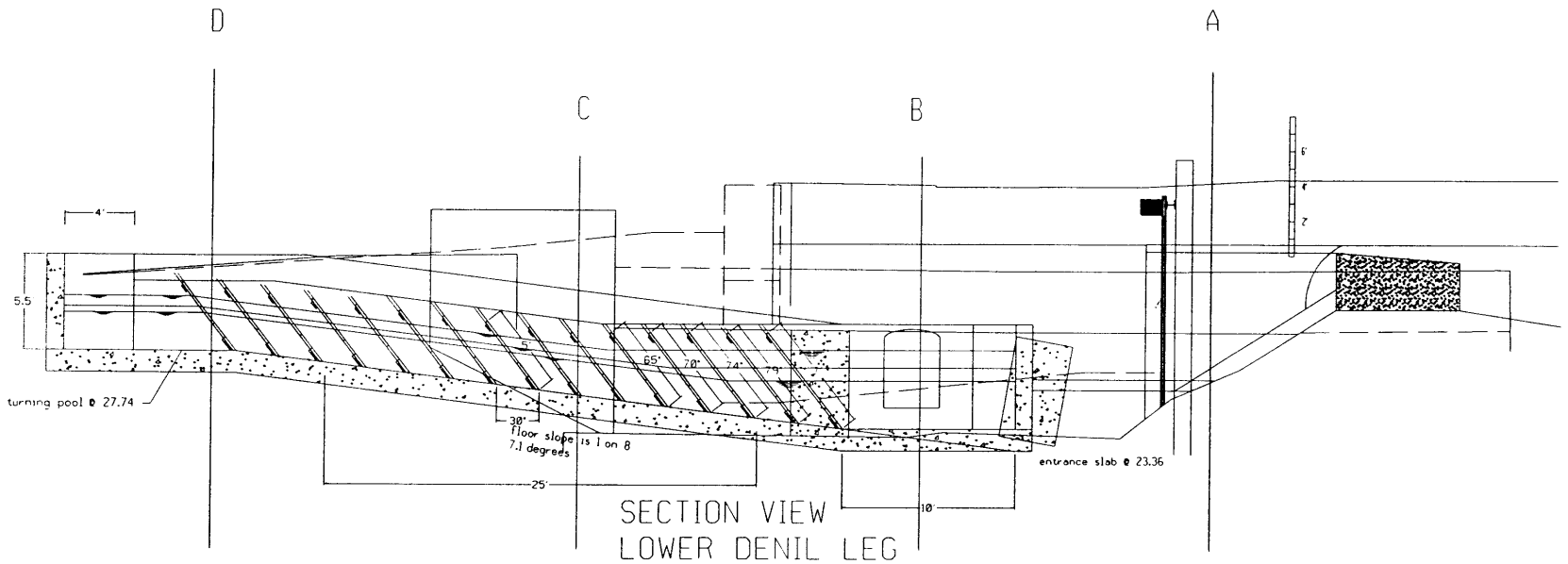
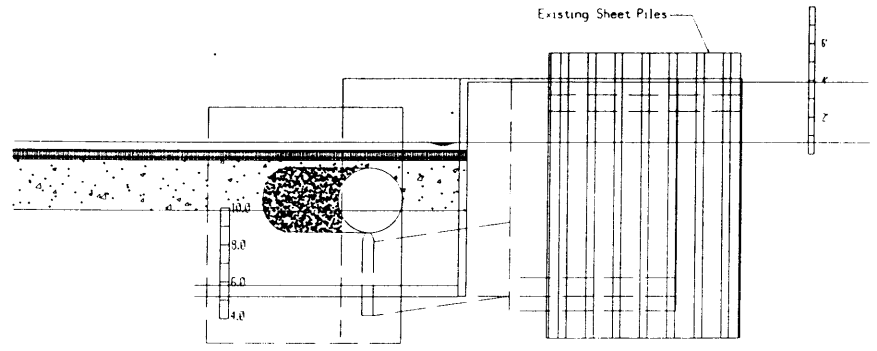


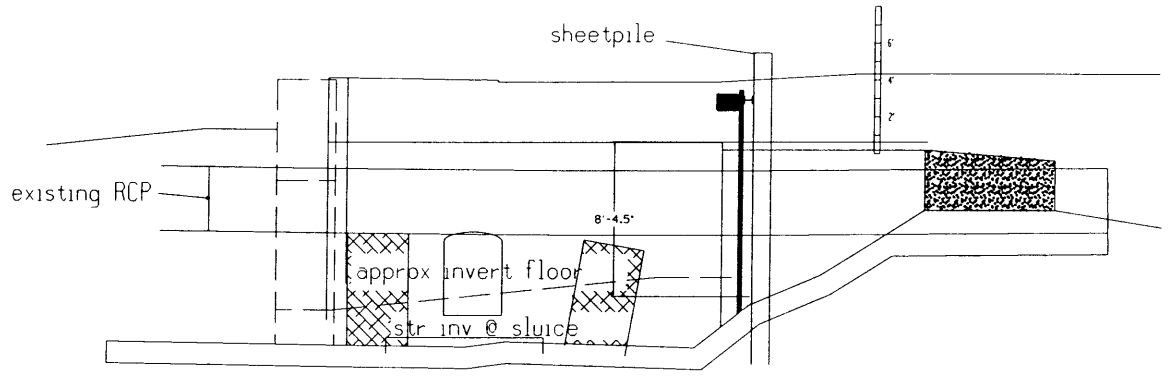
SECTION VIEW
UPPER DENIL LEG



SECTION VIEW
LOWER DENIL LEG

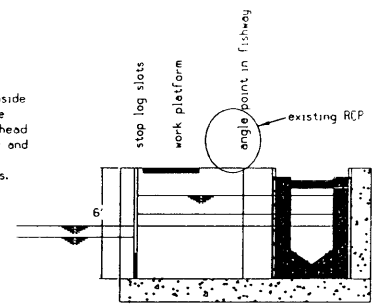


SECTION VIEW FROM HEADPOND



SECTION VIEW FROM RIVER

Note:
stop logs must be placed inside of fishway entrance structure so as to create a 4' to 6' head difference between tailwater and WSE inside of fishway - at normal to low operating flows.

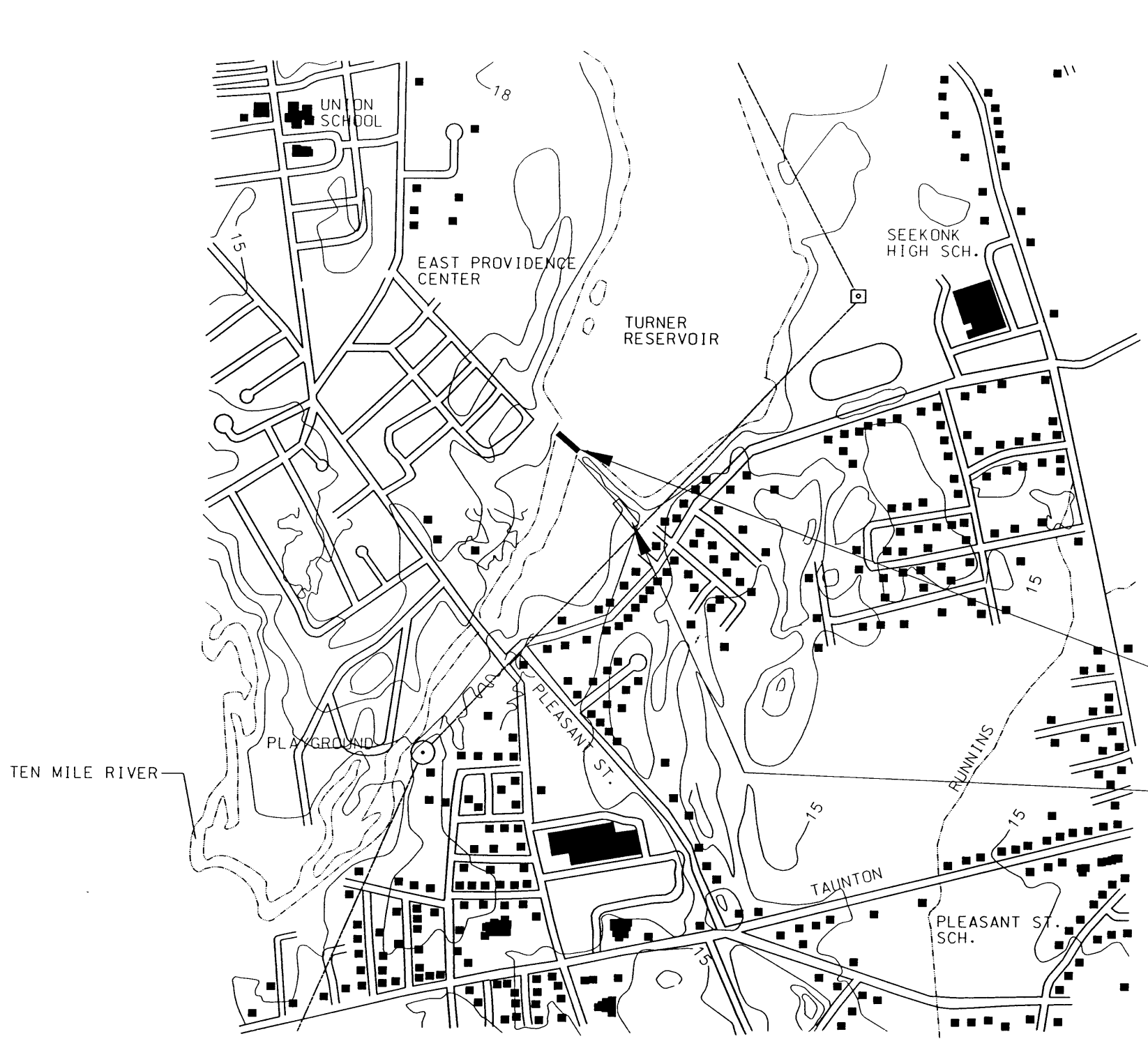


SECTION VIEW
ENTRANCE CHANNEL

NOTE: Elevations refer to NAVD 88

GRAPHIC SCALE:
1" = 10'
10 0 10 20

DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS	WATER RESOURCES DEVELOPMENT PROJECT RHODE ISLAND ECOSYSTEM RESTORATION EAST PROVIDENCE, RHODE ISLAND TEN MILE RIVER FISH PASSAGE HUNTS MILL FISHWAY VIEWS	6 10

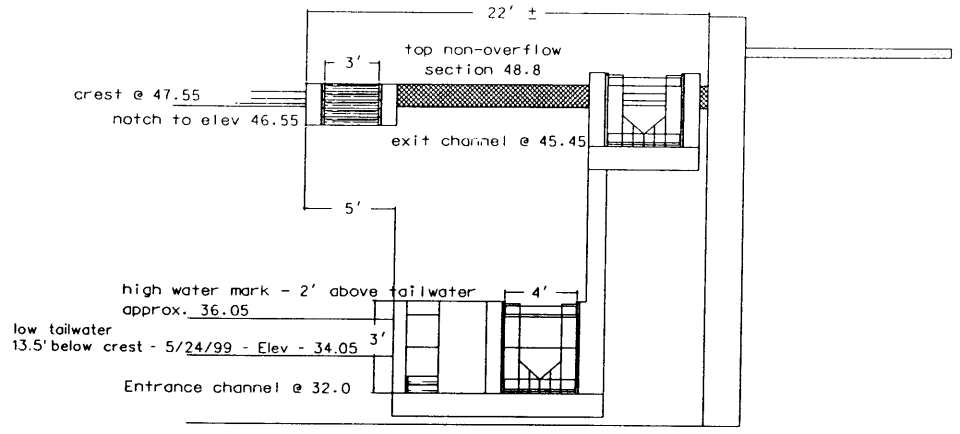


GRAPHIC SCALE:

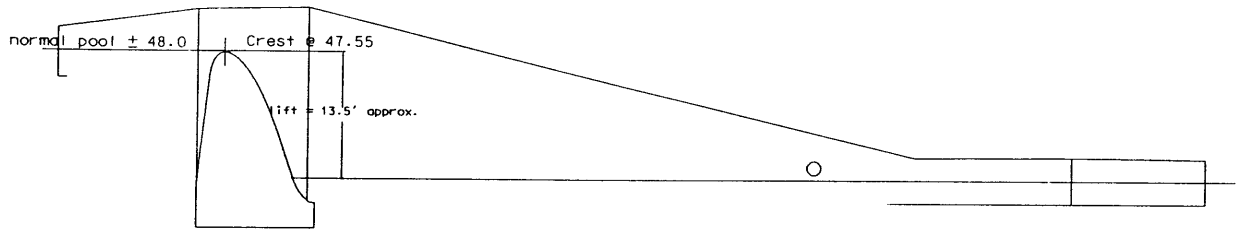
800 0 800 1600

1" = 800'

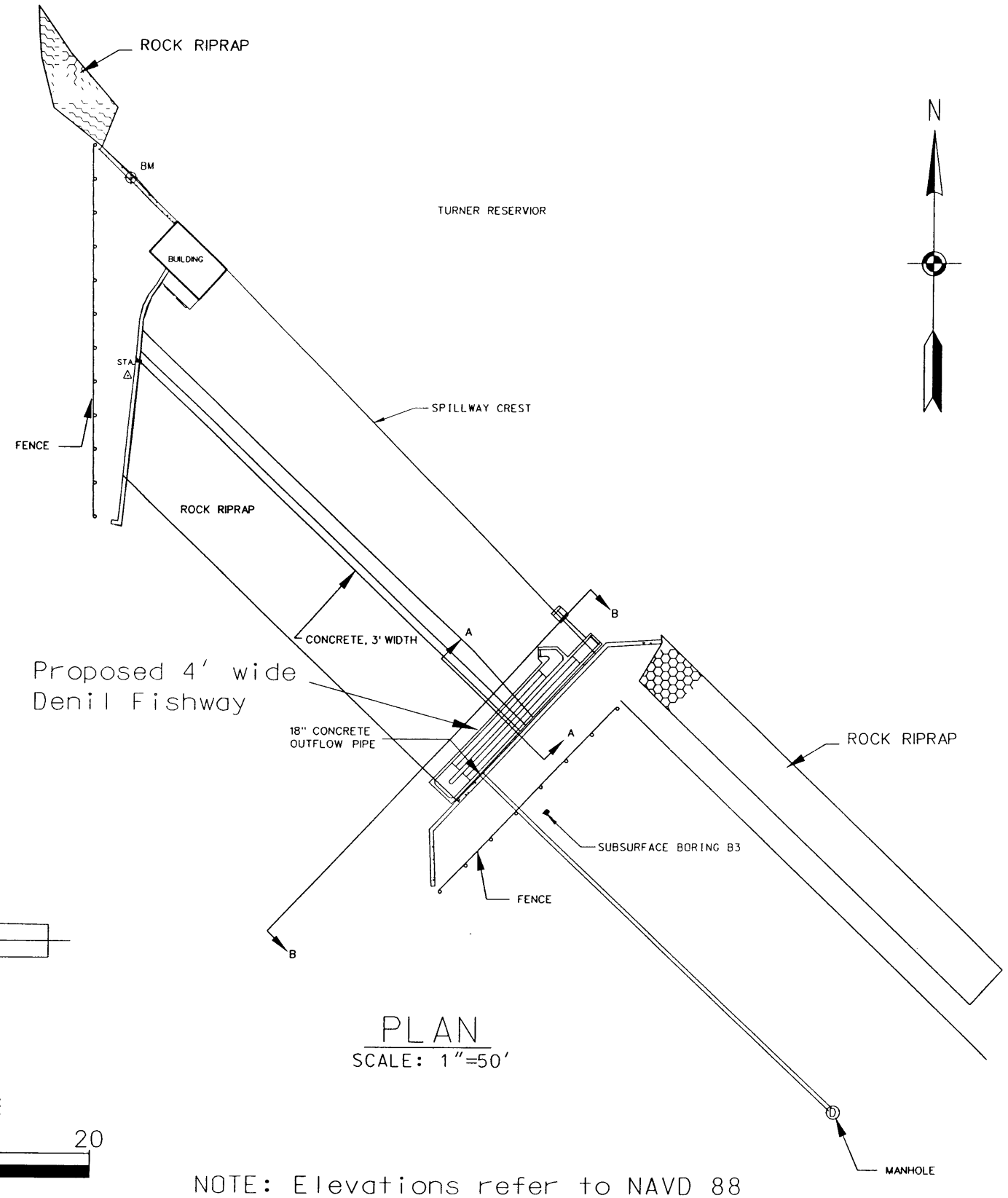
DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS	WATER RESOURCES DEVELOPMENT PROJECT RHODE ISLAND ECOSYSTEM RESTORATION EAST PROVIDENCE, RHODE ISLAND TEN MILE RIVER FISH PASSAGE TURNER RESERVOIR GENERAL PLAN	7/10



SECTION A-A
Scale: 1"=10'



SECTION B-B
Scale: 1"=20'



PLAN
SCALE: 1"=50'

GRAPHIC SCALES:

1" = 10' — 10 0 10 20

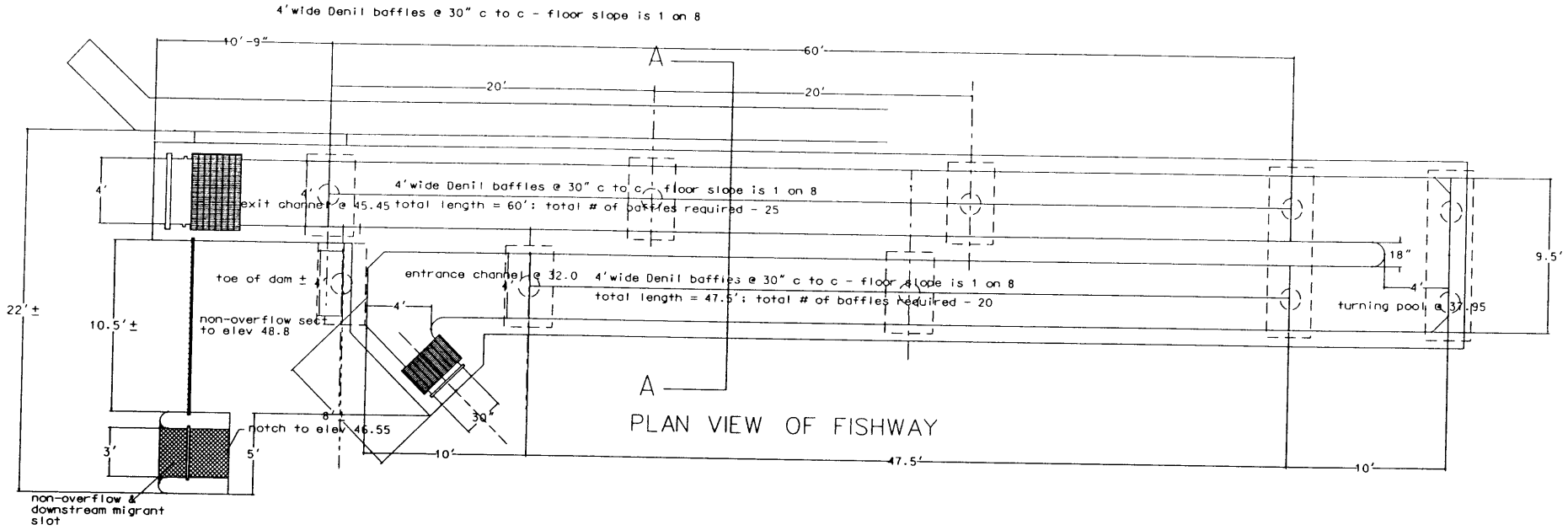
1" = 20' — 20 0 20 40

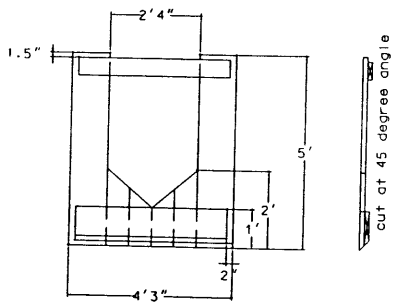
1" = 50' — 50 0 50 100

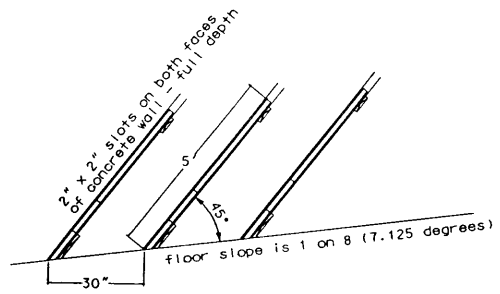
NOTE: Elevations refer to NAVD 88

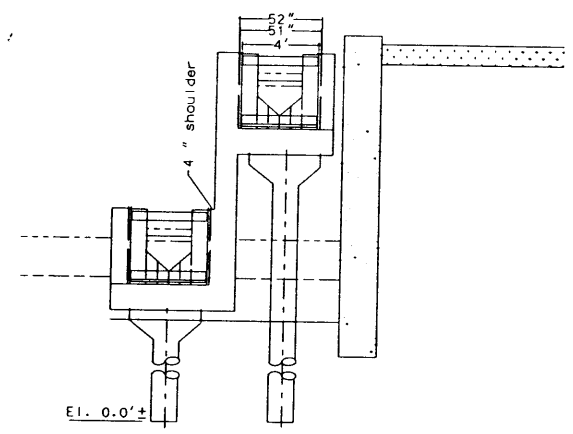
DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS	WATER RESOURCES DEVELOPMENT PROJECT RHODE ISLAND ECOSYSTEM RESTORATION EAST PROVIDENCE, RHODE ISLAND TEN MILE RIVER FISH PASSAGE TURNER RESERVOIR DAM	8/10

...\206\Ri\10MiR\Civil\10Mc403.s07 06/29/2004 12:57:46 PM

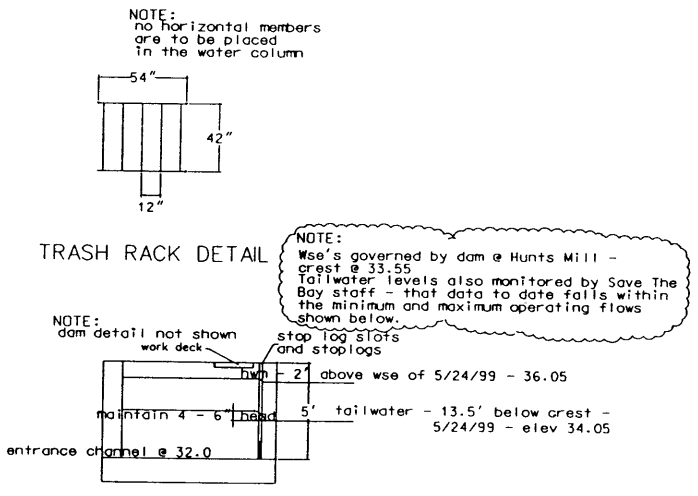








SECTION A - A



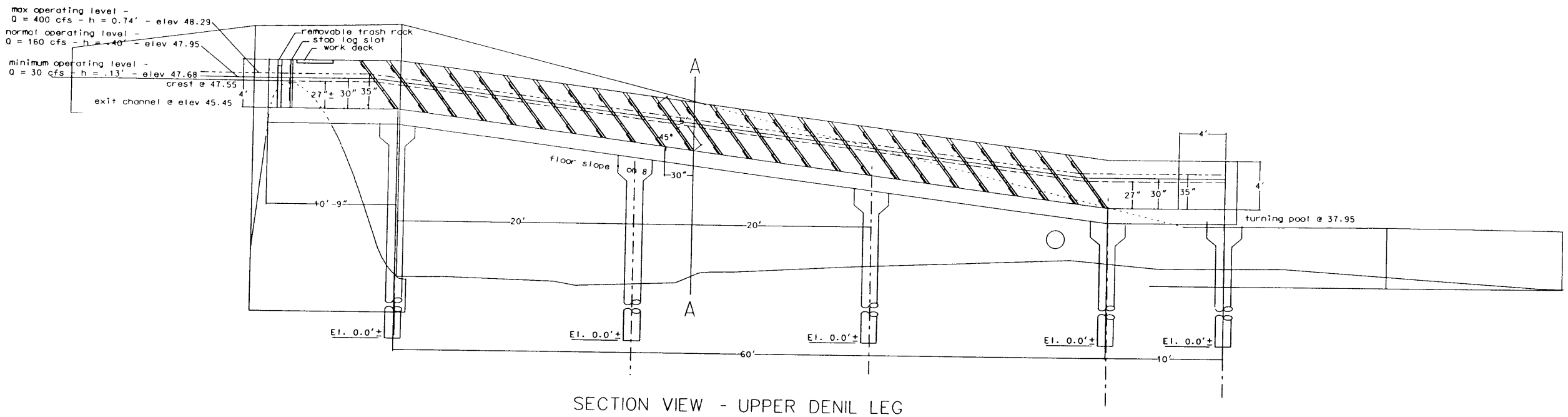
SECTION VIEW - @ ENTRANCE CHANNEL

GRAPHIC SCALE:

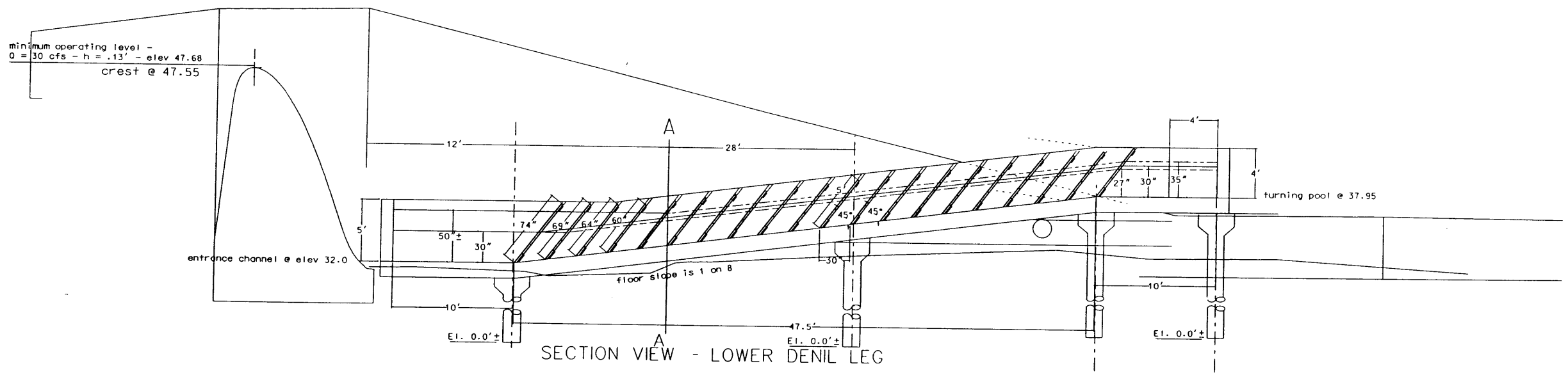
1" = 10'

10 0 10 20

DEPARTMENT OF THE ARMY NEW ENGLAND DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS	WATER RESOURCES DEVELOPMENT PROJECT RHODE ISLAND ECOSYSTEM RESTORATION EAST PROVIDENCE, RHODE ISLAND TEN MILE RIVER FISH PASSAGE TURNER RESERVOIR FISHWAY DETAILS	9 10



SECTION VIEW - UPPER DENIL LEG



SECTION VIEW - LOWER DENIL LEG

GRAPHIC SCALE:

1" = 10'

10 0 10 20

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

WATER RESOURCES DEVELOPMENT PROJECT
RHODE ISLAND ECOSYSTEM RESTORATION
EAST PROVIDENCE, RHODE ISLAND
TEN MILE RIVER FISH PASSAGE

TURNER RESERVOIR FISHWAY DETAILS

10/10