APPENDIX F: ESSENTIAL FISH HABITAT ASSESSMENT FOR THE HERRING RIVER RESTORATION PROJECT

INTRODUCTION

Many aquatic habitats are critical to the productivity and sustainability of marine fisheries. The Magnuson-Stevens Fishery Conservation and Management Act, amended by the Sustainable Fisheries Act in 1996 (the Act), requires the National Oceanic and Atmospheric Administration National Marine Fisheries Services (NMFS) and eight regional fishery management councils (Councils) to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. Essential Fish Habitat (EFH) is defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Act requires the Councils to describe and identify the essential habitat for the managed species, minimize to the extent practicable adverse effects on EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of EFH. As required by the Act, federal agencies must consult with NMFS on all actions or proposed actions authorized, funded, or undertaken that may adversely affect EFH. In return, NMFS must provide recommendations including measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from the proposed actions. The New England Fishery Management Council (NEFMC) identifies and protects EFH for all species within the federal 200-mile limit off the coasts of Maine, New Hampshire, Massachusetts (including the project area), Rhode Island and Connecticut.

In compliance with Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (1996 amendments), the Herring River Restoration Committee (HRRC) and the National Park Service (NPS) is providing this assessment of the potential effects of restoring native tidal wetland habitat to large portions of the Herring River flood plain in and adjacent to Cape Cod National Seashore (the Seashore) on essential fish habitats.

PROJECT BACKGROUND

The Herring River estuary is located in the towns of Wellfleet and Truro on Cape Cod, Massachusetts. The river, along with its flood plain, tributary streams, and associated estuarine habitats encompasses approximately 1,100 acres, with approximately 80 percent of the river's flood plain located within the boundary of the Seashore (Figure 1). The river itself extends from Wellfleet Harbor northeast for nearly 4 miles to Herring Pond in north Wellfleet. The dike at Chequessett Neck Road separates Wellfleet Harbor from the majority of the river. The dike consists of three 6-foot wide box culverts, each with an attached flow control structure. One culvert has an adjustable sluice gate that is currently set partially open at 2 feet and allows limited bi-directional tidal flow. The remaining two culverts have tidal flap gates, designed to permit flow only during the outgoing (ebbing) tide. In addition to the Herring River's upper, middle, and lower basins, the estuary is composed of other important sub-basins including Mill Creek, Duck Harbor, Lower and Upper Pole Dike Creek, and Lower and Upper Bound Brook (Figure 2).

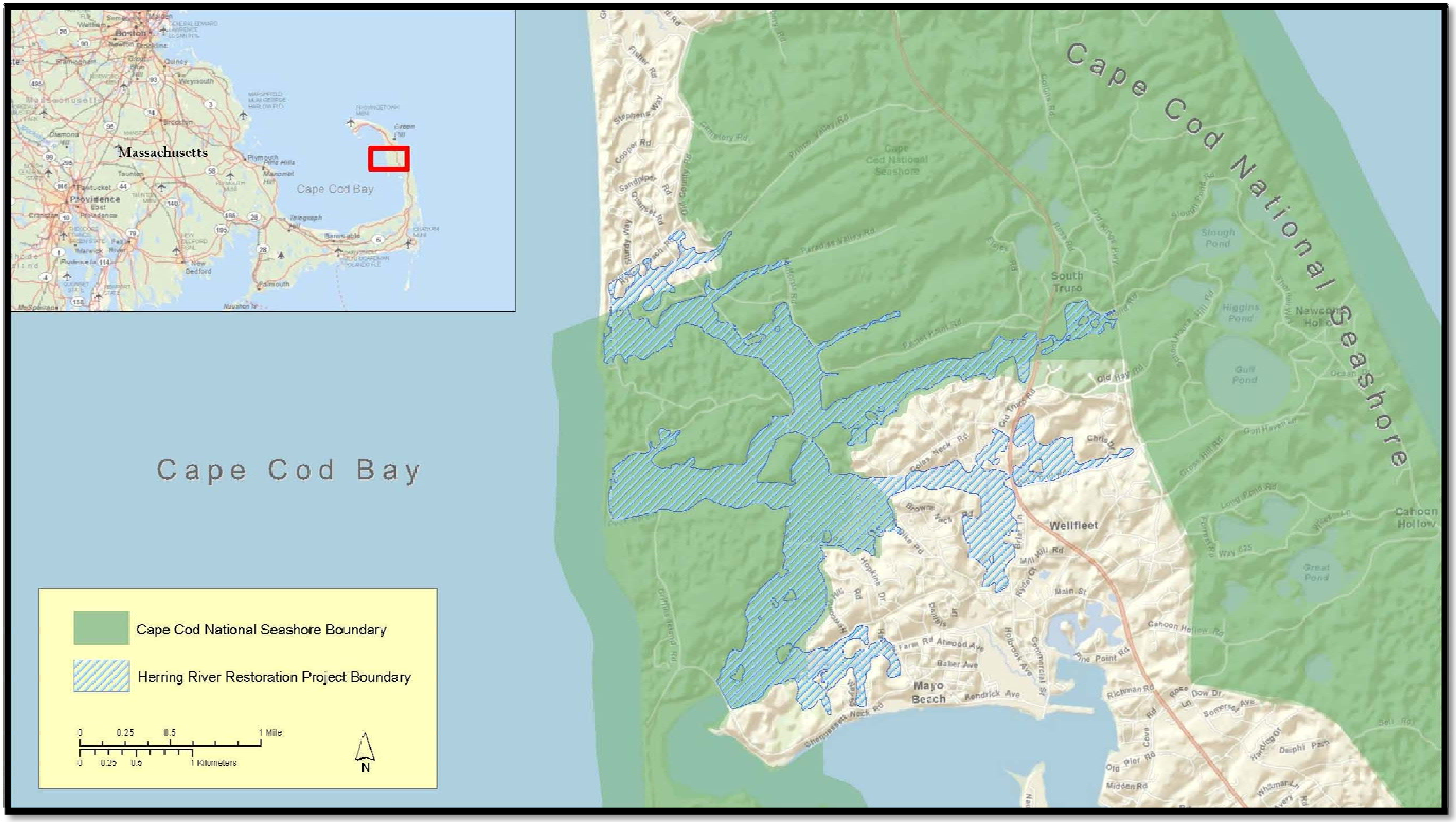

FIGURE 1. HERRING RIVER RESTORATION PROJECT AREA

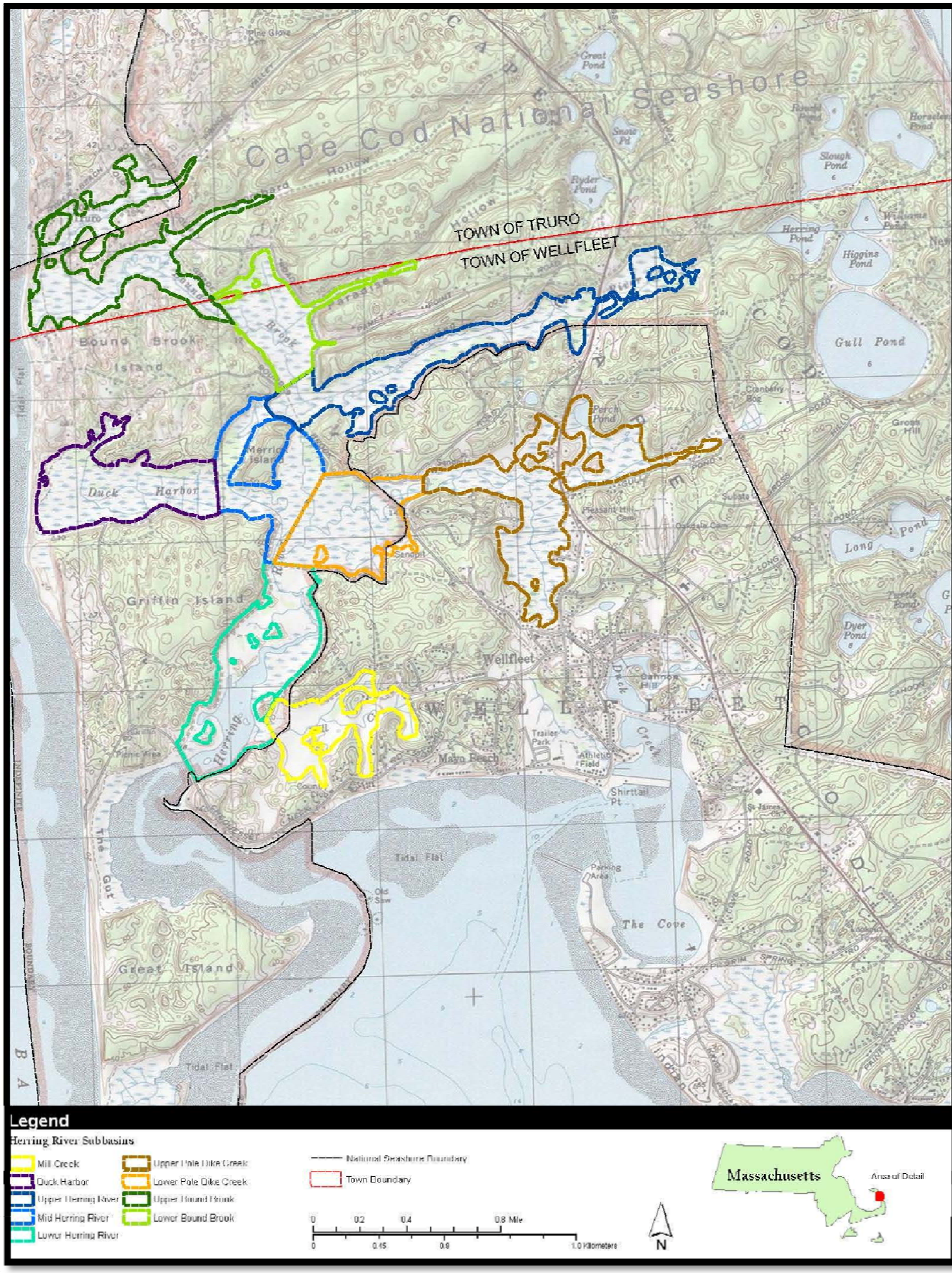

FIGURE 2. HERRING RIVER SUB-BASINS

Since the dike at Chequessett Neck Road was constructed in 1909, the river's wetland resources and natural ecosystem functions have been severely altered and damaged by 100 years of tidal restriction and salt marsh drainage. Adverse ecological effects include but are not limited to:

- Lack of tidal inflow and outflow – tidal range restriction. The Chequessett Neck Road Dike restricts the tidal range in the Herring River from more than 10 feet on the downstream, harbor side, to about 2 feet upstream of the dike. With the tidal restriction, seawater only reaches approximately 3,000 feet upstream of the dike. Under the original natural conditions, seawater reached upstream beyond present-day Route 6 and supported estuarine plants and animals throughout the flood plain.
- Loss of estuarine habitat. The original Herring River estuary included about 1,100 acres of salt marsh, intertidal flats, and open water habitats. The total estuarine habitat (sub-tidal and intertidal habitat) now totals about 70 acres and is confined to the Lower Herring River immediately upstream of the Chequessett Neck Road Dike.
- Degradation of water quality. The elimination of salt water input to the estuary and marsh dewatering has resulted in highly acidic waters which in the past has caused fish kills and causes the leaching of toxic metals, further degrading the water quality. The lack of tidal flushing has also resulted in low summertime dissolved oxygen levels.
- Impediments to fish passage and river herring migration. The Chequessett Neck Road Dike physically impedes fish passage and creates an artificially abrupt transition from seawater to fresh river water.
- Plant community changes, including loss of salt marsh vegetation and increase in non-native invasive species. Only about seven acres of salt marsh remain in the Herring River system. Much of the original Herring River wetlands have been converted from salt marsh to forest and shrublands dominated by opportunistic upland species. Large portions of the original sub-tidal and intertidal substrates between the dike and High Toss Road have been converted to monotypic stands of common reed (*Phragmites australis*).
- Elimination of natural sediment processes and salt marsh surface subsidence. Diking of the river has effectively blocked the transport of inorganic sediment from reaching the salt marshes in the Herring River basin, which along with other processes, has contributed to the severe historic and continuing subsidence in the Herring River's diked wetlands.

PROJECT DESCRIPTION

The proposed project is to develop and implement actions for the restoration of self-sustaining coastal habitats in a large portion of the 1,100-acre Herring River estuary in the towns of Wellfleet and Truro, Massachusetts. Besides the dike, there are more than five miles of roadway, an abandoned railroad embankment, several tidally restrictive culverts and berms, channelized stream reaches, and acres of invasive, non-native vegetation that impact the Herring River flood plain. There are multiple options for addressing each of these issues. As a result of having multiple options to select from, the specific impacts of the project are unknown, so impacts are addressed in more general terms in this assessment. The major components and focus areas of the Herring River project include:

Chequessett Neck Road Dike: Reconstruction of the dike to allow greater tidal exchange is the primary element of the restoration project. Reconstruction of the dike would involve installing a 165-foot-wide series of culverts to allow passage of Wellfleet Harbor tides. The objective of the project, depending on the alternative selected through the National Environmental Policy Act

(NEPA) process, is to ultimately reach either a mean high spring tide of 4.8 feet and a 100-year storm driven tide of 6.0 feet in the Lower Herring River or alternatively a mean high spring tide of 5.6 feet and a 100-year storm driven tide of up to 7.5 feet. To achieve the desired tidal ranges the tide gates would be opened gradually and according to guidelines set forth in an adaptive management plan (see appendix A).

- Mill Creek Sub-basin: This sub-basin has a number of private properties that could be subject to flooding without protective measures. If the selected goal for the Lower Herring River through the NEPA process is achieving a mean high spring tide of 4.8 feet, then no dike construction at the mouth of Mill Creek would be needed, or would occur. However, if a mean high spring tide of 5.6 feet in Lower Herring River is the goal selected, then a dike would be constructed across the mouth of Mill Creek. The dike would either completely eliminate tidal influence to the sub-basin, or it would allow partially restored tidal flow to the sub-basin by using a combination tide gate at this location. In this instance, mean high water spring tides would be limited to a maximum of 4.7 feet and 100-year storm driven events would be limited to a maximum of 5.9 feet in Mill Creek.
- High Toss Road: Complete removal of the tidal restriction at High Toss Road is another major component of the project. The five-foot diameter circular culvert at High Toss Road would need to be removed or enlarged to maximize tidal circulation upstream. The roadway itself would be impacted by restored tidal exchange and could either be elevated or removed.
- Upper Pole Dike Creek Sub-basin: Under certain restoration scenarios and tidal conditions, flood protection measures might be required in Upper Pole Dike Creek sub-basin to protect low lying properties. Any significant flood impacts will be addressed on a property-specific basis or by restricting tide flow at Pole Dike Road with either the existing road culvert or a tide control gate.
- Pole Dike Creek, Old County, and Bound Brook Island Roads: Culverts under these low-lying roads could need to be enlarged if future monitoring shows the existing culverts are impeding tidal flows or altering other ecological processes. Preliminary engineering analyses show that approximately 8,000 linear feet of road surfaces would need to be elevated or relocated to remain passable during high tides.
- Management of Flood Plain Vegetation: Measures would be taken to remove woody shrubs and trees that die during transition to a more saline and/or wetter environment. Potential techniques include cutting, chipping, and burning.
- Restoration of Tidal Channel Structure and Marsh Surface Elevation: Measures would be taken to restore the natural configuration of tidal channels to maximize water circulation and promote elevation of subsided marsh surfaces. Potential actions to be taken include, but are not limited to, the following:
  - Dredging of accumulated sediment to establish a natural bottom of the Herring River channel at the appropriate depth to maximize ebb tide drainage.
  - Creation of small channels and ditches to improve tidal circulation.
  - Restoring natural channel sinuosity.
  - Removing lateral ditch dredge spoil berms and other anthropogenic material on the marsh surface to facilitate drainage of ponded water.
  - Applying thin layers of dredged material to build up subsided marsh surfaces.

- Chequessett Yacht and Country Club (CYCC): Any action that allows tidal influence to be restored to Mill Creek under the Herring River project would allow salt water to inundate low portions of the CYCC golf course during most high tides unless action is taken to protect it from tidal flooding. Two options for addressing the impacts to the CYCC include elevating affected portions of the facility by providing necessary quantities of fill, regrading, and replanting the areas. Approximately 150,000 cubic yards of fill and 32 acres of disturbance for grading and site preparation would be required. The other option is to relocate the affected portions of the facility to upland locations currently owned by the CYCC. This would involve clearing, grading, and planting of new golf holes and a practice area.

ADAPTIVE MANAGEMENT

Reintroduction of tidal influence to the Herring River estuary would be adaptively managed over a long-term, phased process that would take several years. Gradual opening of adjustable tide gates at the Chequessett Neck Road Dike would incrementally increase the tidal range in the river. This would allow monitoring of the system so that unexpected and/or undesirable responses could be detected and appropriate response actions taken. An Operations and Maintenance Plan will also be developed to ensure that the project's habitat restoration and flood protection goals are achieved.

CONSTRUCTION METHODS AND TIMEFRAME

Standard construction methods and equipment would be used to construct the infrastructure needed to implement the components of the restoration project and would include additional activities such as bank excavation/stabilization, culvert replacement, vegetation clearing, dredging, and the use of temporary fill. Earth-moving equipment, graders, cranes, dump trucks, cement trucks, and other equipment would be operated and staged in project areas. Fill, armor stones, and other construction materials would also be staged in preparation for use. To the extent possible, previously disturbed areas would be used to stage equipment and materials; however, clearing of vegetation will be needed for some of the actual construction activities. For dike construction, the sites (Chequessett Neck Road Dike and/or Mill Creek) would be de-watered using coffer dams and pumps, or other common methods for dike construction, though provisions would be made to ensure that the existing level of fish passage would continue to occur during construction activities.

Preliminary engineering guidance suggests construction of the new dike at Chequessett Neck Road Dike would be expected to take approximately 12-18 months to complete. Elevation or changes to low-lying roads would take approximately 6-12 months to complete. At Mill Creek, if construction of a dike is required it would take approximately 6-12 months. It is likely that individual construction elements would be phased in over time and would not occur concurrently. Elevation construction of some of the roads that are in the more upstream reaches of the flood plain could be delayed or phased with the later incremental dike openings. All low-lying roads do not need to be elevated at the start of the incremental tidal restoration.

ASSESSMENT OF IMPACTS TO ESSENTIAL FISH HABITATS

PHYSICAL ENVIRONMENT

Water Quality—Long term, the proposed action would have beneficial impacts to water quality within the Herring River estuary. Restored tidal flushing would be expected to reduce acidification within the mid-portion of the Herring River where salt water would again saturate drained peat and increase the pH of porewater and surfaces waters (Portnoy and Giblin 1997). With restored salinities, aluminum and iron would no longer be leached from the soils to receiving waters in concentrations that stress aquatic life. Modeling also indicates that the project would reduce the system resident times upstream of High Toss Road by at least a factor of 25 (4,801 hours vs. 191 hours) (Woods Hole Group 2011). Regular tidal flushing of the Herring River estuary with well-oxygenated water from Wellfleet Harbor is expected to maintain dissolved oxygen (DO) concentrations above state water quality standards at all times, benefitting resident fish, diadromous fish and invertebrates.

During the restoration process some short-term adverse impacts on water quality would be expected to occur. Portnoy and Giblin (1997) demonstrated that renewed tidal flushing of acid sulfate soils would allow ammonium-nitrogen to be released into receiving waters, at least in the short term. While this would benefit growth of salt marsh vegetation in the restored marsh, if large volumes of sea water were introduced suddenly, abundant nutrient release and sulfide production could promote algal blooms both in the river and downstream into Wellfleet Harbor that could temporarily reduce DO levels. The gradual reintroduction of tidal exchange through the adaptive management process should allow ammonium-nitrogen to be slowly released; avoiding nitrogen loading that could contribute to algal blooms in receiving waters in Herring River. Increased concentrations of released nutrients would likely be short-lived (probably months) and not persist beyond an initial adjustment period. Wellfleet Harbor is open to Cape Cod Bay and well flushed. With small incremental increases in tidal exchange, informed by appropriate water quality monitoring under adaptive management, the release of nutrients from the estuary would likely be small and would not result in persistent algae blooms in Wellfleet Harbor.

There has likely been historical use of pesticides throughout the Herring River watershed. During restoration, sediment is expected to be mobilized within the estuary in response to increased volume of tidal exchange. Mobilized sediment is expected to mostly be transported upgradient onto the marsh surface and partially downgradient toward Wellfleet Harbor. Potential impacts on the aquatic ecosystem from chemicals bound to mobilized sediments will be assessed once background levels of pesticides have been determined by ongoing efforts of the Seashore.

Sediment—Over 100 years of diking on the Herring River likely has resulted in extensive siltation with the river channel. Restoring the estuary and allowing more tidal flow through the dike would mobile these sediments within the system as suspended load and suspended fines. Modeling indicates that coarser-grained sediment would be transported primarily as bedload along the bottom of the tidal channels. Some of the bedload transport from areas just upstream and downstream of the dike would be slightly seaward toward Wellfleet Harbor, whereas finer-grained suspended sediments would be transported upstream to settle out in the upper sub-basins of the Herring River. Very fine particles would remain in suspension and may be transported upstream into the Herring River or downstream toward the harbor, and eventually out into Cape Cod Bay. The degree and rate of sediment mobilization would largely be determined by the amount of tidal influence and rate of incremental opening of the tide gates that would occur under the adaptive management process. The tide gates would be used to manage water levels and flows minimize the potential of mobilizing and resuspending large volumes of sediment at once and to promote deposition of sediment upstream of the dike. An adaptive management process would be informed by appropriate monitoring, evaluating both upstream and downstream transport and deposition of sediment during the incremental dike opening process.

Sediment and soil could also be mobilized during the reconstruction of the Chequessett Neck Road Dike and other construction activities (e.g., roads, construction of Mill Creek Dike, etc.), potentially resulting in local increases in turbidity in the adjacent water bodies, causing short-term adverse impacts on water quality. However, construction related impacts are expected to be minimal as Best

Management Practices (BMPs) would be employed to minimize the amount of stormwater runoff, as well as control in-water sediment disturbance. Stormwater management plans would be employed to reduce runoff carrying sediment to the receiving waters during construction activities. BMPs would also be put into place to minimize potential fuel or hydraulic fluid leaks from equipment. Coffer dams would be used for in-water activities during the reconstruction of the Chequessett Neck Road Dike as well as construction of a new Mill Creek Dike, if that alternative is selected. During the construction of the coffer dams there would be some temporary increases in turbidity from disturbed sediments; however, this would have a relatively short duration. Once the coffer dams are in place, construction activities would then be conducted in "dry" conditions and would not impact turbidity levels in the surrounding waters.

Bathymetry/Water Depth—Other impacts expected from the proposed project include changes to the bathymetry and morphology of the Herring River. Long term, as tidal flows are restored to the estuary and water velocities increase, erosion of the river banks and bed would be expected to occur, increasing both the width and depth of the restored tidal channels from just below the Chequessett Neck Road Dike upstream to the Middle Herring River and Lower Pole Dike Creek sub-basins.

Estuarine Habitat—Opening the tide gate structure at Chequessett Neck Road Dike to allow increases in the mean spring tide would provide long-term benefits by changing the Herring River estuary from a largely freshwater system to a largely tide-influenced system with saline water extending much farther upstream than under current conditions. Salinity values would range from approximately 15 to 30 parts per thousand (ppt) in the lower sub-basins (Lower Herring River, Mill Creek under alternatives where tidal flow is restored to this sub-basin, Middle Herring River, and Lower Pole Dike Creek), increasing the amount of estuarine habitat (sub-tidal and intertidal habitat) from the existing 70 acres confined to the Lower Herring River basin below High Toss Road to somewhere between approximately 790 acres to 885 acres, depending on the alternative selected through the NEPA process. Restored habitat would also include approximately 10.6 miles to 11.5 miles, depending on the alternative, of mainstem tidal creek. This is an increase from the existing 1.4 miles of estuarine tidal creek habitat currently confined to the Lower Herring River basin below High Toss Road.

Restored tidal flow and improved water quality would also beneficially impact three other important habitat types: salt marsh, submerged aquatic vegetation (SAV), and intertidal mudflats. Restored inter-tidal habitat subjected to higher salinity waters, generally 18 ppt and higher, would be expected to transition to salt marsh, greatly increasing the amount of this habitat type within the system from the 13 acres that currently exists in the Lower Herring River sub-basin. With the reintroduction of tides into the Herring River estuary, the occurrence and distribution of wideon grass (*Ruppia maritime*), an SAV which is currently found in the open waters of the Lower Herring River sub-basin, would likely increase in coverage and biomass in high salinity areas and experience a general migration towards brackish areas. Eelgrass (*Zostera marina*), another SAV, is currently not found in the Herring River upstream of the dike, but is found in small isolated patches downstream of the dike just north of Great Island. With the introduction of higher salinities and improved water quality, *Zostera* could become re-established in the Lower Herring River sub-basin. In addition to higher high tides, restoration would also result in lower low tides upstream of the dike, greatly increasing the amount of intertidal mudflat habitat.

BIOLOGICAL ENVIRONMENT

Prey species—The abundance and/or distribution of prey species for fish for which EFH has been designated may be impacted by restoration of the Herring River estuary. As estuarine habitat increases upstream of the Chequessett Neck Road Dike so would the amount of spawning and nursery habitat for finfish prey species such as the mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), Atlantic silversides (*Menidia menidia*) and other common tidal salt marsh species, as well as for macroinvertebrate species; greatly increasing their populations throughout the Herring River estuary. Movement of finfish prey species from downstream of the dike to upstream of the dike, and vice versa, would also be enhanced. During construction activities for the new dike(s) (Chequessett Neck Road and/or Mill Creek) and any other infrastructure improvements such as upstream culverts or road relocations, some short-term adverse impacts on prey species could occur in the vicinity of the construction. Finfish and macroinvertebrate prey species could be temporarily displaced from habitat due to construction noise and vibrations, and some mortality of sedentary and less mobile species through burial could occur. However, most fish species are highly mobile and would just avoid the areas. Once construction was completed, species would be expected to readily recolonize and use the affected area. Overall, the project would have long-term benefits to prey species and subsequently to EFH species that forage on them.

Anadromous species including alewife (*Alos pseudoharengus*), blueback herring (*Alosa aestivalis*), hickory shad (*Notemigonus chrysoleucas*), and white perch (*Morone Americana*), along with one catadromous species American eel (*Anguilla rostrata*) are found in the Herring River during spring and fall adult and juvenile migrations. Design of the new Chequessett Neck Road Dike would benefit all species of anadromous and catadromous fish through better fish passage. In addition to allowing more fish to move upstream, the new tide gates would reduce the direct mortality of emigrating juveniles and post-spawning adults. Improved water quality upstream of the High Toss Road would decrease the mortality of juvenile and post-spawning adult river herring as well as American eels. With increased salinity during spring high tides expanding into the upper reaches of Upper Herring River, the creek channels leading to the headwater ponds where river herring spawn would likely become free of the emergent and submergent freshwater aquatic plants that often choke and block the waterway. This would benefit juvenile river herring as they emigrate from the ponds and move down stream. The increased amount of estuarine habitat and tidal creeks would also increase the amount of nursery habitat for juvenile fish. Increased fish passage and estuarine nursery habitat would also increase the utilization of the Herring River estuary by white perch and hickory shad. Though total suspended sediments (TSS) from sediment mobilized during the initial increased flushing of the system could temporarily adversely impact adult and juvenile anadromous and catadromous species, small, incremental openings of the tides gates under adaptive management would help mitigate these temporary impacts. Construction of the coffer dam for construction of the dike(s) could temporarily increase TSS, adversely impacting anadromous and catadromous species; however, these impacts would be short-lived and coordinating with the Massachusetts Division of Marine Fisheries (MA DMF) and NMFS to appropriately time in-water construction activities would help to minimize any impacts. Additionally, measures would be taken to ensure the existing level of fish passage would continue to occur during all construction activities at the dike as well as at culverts upstream of the dike. Therefore, impacts to EFH species that prey on anadromous and catadromous species would not be significantly adversely impacted during the short-term and overall would experience long-term benefits from the likely increases in anadromous and catadromous species populations resulting from the restoration of the Herring River estuary.

Shellfish also serve as prey items for EFH species. Shellfish populations upstream of the Chequessett Neck Road Dike are very limited due to low salinity and the availability of suitable substrate. With increased salinity ranges upstream of the Chequessett Neck Road Dike resulting from the proposed project, oysters (*Crassostrea virginica*), which are rare upstream of the dike, could potentially recolonize areas where salinity values fall within their preferred range of 10 ppt to 30 ppt, especially if cultch is laid down. Hard clams (*Mercenaria mercenaria*), which are absent upstream of the dike, would likely be able to reestablish populations in tidal creek habitat upstream of the dike within its preferred salinity range of 15 ppt to 35 ppt. During the period in 1973 when increased salinity occurred upstream of the dike due to the disrepair of the dike, soft shelled clams (*Mya arenaria*) occurred along an approximately 0.5-acre area of sub-tidal sandy shoreline in the Lower Herring River sub-basin (Gaskell 1978), indicating that with restoration, the soft shelled clam would also likely be able to expand its population upstream of the dike. Other prey species such as blue mussels (*Mytilus edulis*) would also benefit and increase in population from restoration of the estuary.

With restoration, increased tidal flows would erode sediments in the existing tidal creeks upstream and downstream of the dike, both deepening and widening them. While a large portion of these sediments would likely be moved upstream in this flood-dominated system, some sediment would be transported and deposited downstream of the dike and in Wellfleet Harbor. Species such as hard clams and softshelled clams can move up and down in the sediment column and would not likely be adversely impacted by sedimentation or erosion. While they may become temporarily buried deeper than preferred, or exposed by erosion, they would move up or down in the sediment column to adjust to the new substrate. Oysters, however, are sedentary and would be susceptible to burial by excessive sedimentation. However, because of the generally finer grain size of the mobilized sediment in Herring River as compared to the current sediment in Wellfleet Harbor, these sediment accumulations would likely be temporary in nature. The accumulated sediment would be expected to eventually be redistributed by currents and waves in the harbor with the finest particles either flushed out into Cape Cod Bay, or transported into tidal estuaries surrounding the harbor. Small, incremental openings in the tide gates through adaptive management would also minimize the amount of sediment mobilized at once, reducing the likelihood that large amounts of sediment would be mobilized and deposited on shellfish downstream of the dike all at once.

Shellfish would be adversely impacted by construction activities as well, though most impacts would occur below the dike as currently few species occur upstream of the dike. During construction, direct mortality of shellfish (oysters and hardclams) in the vicinity of the dike would occur through burial or other in-water construction activities. However, using a coffer dam during construction, as well as employing BMPs as part of a stormwater management plan, would reduce the amount of sedimentation and result in only short-term adverse impacts. Consequently, no significant adverse impacts are expected to occur within shellfish populations in the Herring River estuary or Wellfleet Harbor, and overall, shellfish populations would see long-term benefits from the restoration of the estuary.

ESSENTIAL FISH HABITAT SPECIES

EFH-designated species and life history stages in the proposed project area were identified based on a list in the NOAA Guide to Essential Fish Habitat Designations in the Northeastern United States (NOAA 2011). The guide identifies the managed species and their life stages that have EFH in selected 10-minute by 10-minute squares of latitude and longitude (referred to as "blocks"). These designations were completed by the NEFMC and the Mid-Atlantic Fishery Management Council. The project area falls within Block 41507000 (Table 1 and Figure 3) and species with EFH designated in this block are presented in Table 2. Because this block encompasses both offshore and nearshore estuarine waters, specific habitat conditions may indicate that EFH does not exist for some of these species or life stages within the proposed project area.

TABLE 1. TEN MINUTE SQUARE COORDINATE DESIGNATION ENCOMPASSING THE PROJECT AREA

Block Number	North	East	South	West
41507000	42° 00.0′N	70° 00.0′W	41° 50.0′N	70° 10.0′W

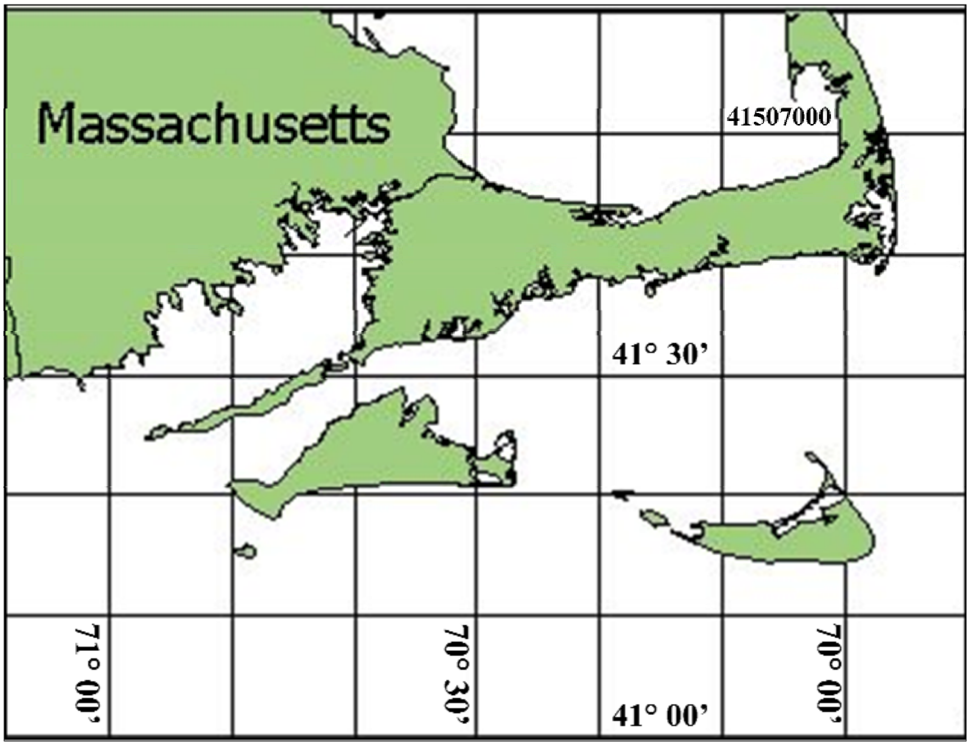

FIGURE 3. NMFS 10 × 10 MINUTE BLOCKS FOR EFH DESIGNATION

TABLE 2. SPECIES WITH IDENTIFIED EFH IN BLOCK NUMBER 4150700

Species	Scientific Name	Eggs	Larvae	Juveniles	Adults
Atlantic cod	*Gadus morhua*	X	X	X	X
Haddock	*Melanogrammus aeglefinus*	X	X		
Pollock	*Pollachiius virens*		⊗	⊗	⊗
Whiting	*Merluccius bilinearis*	X	X	X	X
Red hake	*Urophycis chuss*	X	⊗	⊗	⊗
White hake	*Urophycis tenuis*	X	X	△⊗	△⊗
Winter flounder	*Pleuronectes americanus*	△⊗	△⊗	△⊗	△⊗
Yellowtail flounder	*Pleuronectes ferruginea*	X	X	X	X
Windowpane flounder	*Scopthalmus aquosus*	⊗	⊗	⊗	⊗
American plaice	*Hippoglossoides platessoides*	X	X	X	X
Ocean pout	*Macrozoarces americanus*	X	X	⊗	⊗
Atlantic halibut	*Hippoglossus hippoglossus*	X	X	X	X
Atlantic sea scallop	*Placopecten magellanicus*	X	X	X	X
Atlantic sea herring	*Clupea harengus*	X	X	X	X
Monkfish	*Lophius americanus*	X	X	X	

Species	Scientific Name	Eggs	Larvae	Juveniles	Adults
Bluefish	*Pomatomus saltatrix*			△⊗	△⊗
Long finned squid	*Loligo pealei*	n/a	n/a	X	X
Short finned squid	*Ilex illecebrosus*	n/a	n/a	X	X
Atlantic butterfish	*Peprilus triacanthus*	⊗	X	⊗	X
Atlantic mackerel	*Scombrer scombrus*	⊗	⊗	⊗	⊗
Summer flounder	*Paralicthys dentatus*				△⊗
Scup	*Stenotomus chrysops*	n/a	n/a	⊗	⊗
Black sea bass	*Centropristus striata*	n/a			X
Surf clam	*Spisula solidissima*	n/a	n/a	⊗	⊗
Ocean quahog	*Artica islandica*	n/a	n/a		
Spiny dogfish	*Squalus acanthias*	n/a	n/a	⊗	⊗
Blue shark	*Prionace glauca*				X
Bluefin tuna	*Thunnus thynnus*			X	X

n/a This notation in the tables indicates some of the species either have no data available on the designated life stages, or those life stages are not present in the species' reproductive cycle.

X – indicates EFH for this life stage exists in Block Number 4150700

○ - indicates EFH for this life stage exists in Wellfleet Harbor

△ - indicates EFH for this life stage exists in Herring River

Unless otherwise cited, all of the EFH information below is from the Guide to Essential Fish Habitat Designations in the Northeastern United States (NOAA 2011).

Atlantic Cod

Eggs—EFH for Atlantic cod eggs include waters around the perimeter of the Gulf of Maine, Georges Bank, and the eastern portion of the continental shelf off southern New England. Generally, Atlantic cod eggs can be found in water temperatures below 54 degrees (°) Fahrenheit (F), water depths less than 361 feet, and within a salinity range between 32 ppt and 33 ppt. Within the project area, eggs would only be found in Wellfleet Harbor in areas within the salinity range; however, based on best professional judgment, the MA DMF concludes that they are not present (Evans et al. 2011). Therefore, there would be no impact.

Adults—EFH for adult Atlantic cod include bottom habitats with a substrate of rocks, pebbles, or gravel in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Delaware Bay. They are also found across a wide range of oceanic salinities and in areas where generally water temperatures are below 50° F and depths range from 33 feet to 492 feet. Given the depths where cod are found, they would generally only be found in the deeper portions of Wellfleet Harbor; however, based on best professional judgment, the MA DMF concludes that they are not present (Evans et al. 2011). Therefore, there would be no impact.

Though EFH has been designated for both larvae and juvenile Atlantic cod, they are generally found in depths (minimum depth 98 feet and 82 feet respectively) that are greater than what is found in the project area; therefore, there would be no adverse impacts associated with the proposed projects.

Haddock

Water depths for which EFH is designated for eggs and larvae exceeds those which occur in the project area (eggs: 164 feet to 295 feet; larvae: 98 feet to 295 feet; juveniles: 115 feet to 328 feet; adults: 131 feet to 492 feet). Therefore, no EFH exists in the project area.

Pollock

Larvae—EFH for the larvae of pollock has been designated for the waters of the Gulf of Maine and Georges Bank. Generally the larvae are found in areas where the sea surface temperatures are less than 63° F and water depths range between 33 feet and 820 feet. Pollock larvae are often observed from September to July with peaks from December to February. Within the project area, larvae could be found in Wellfleet Harbor near the mouth where depths are deep enough. This area would not be impacted by restoration activities and would therefore not impact EFH for larvae.

Juveniles—For juvenile pollock, EFH has been designated for bottom habitats with aquatic vegetation or a substrate of sand, mud or rocks in the Gulf of Maine and Georges Bank. They are also generally found where water temperatures are less than 64° F, salinities range from 29 ppt to 32 ppt, and depths range from 0 feet to 820 feet. Within the project area, those areas in Wellfleet Harbor with salinities in the above range are designated as EFH. No impacts to Wellfleet Harbor would occur from restoration activities other than some small amount of sedimentation in areas close to the mouth of Herring River. While juvenile pollock are daytime sight feeders, turbidity levels in Wellfleet Harbor are not expected to increase much as a result of sediment mobilized during restoration. Small incremental openings of the tide gate structures would further reduce the impacts of turbidity reaching Wellfleet Harbor. Therefore, adverse impacts, if any, to EFH for juvenile pollock is anticipated to be minimal and short-term.

Adults—Bottom habitats in the Gulf of Maine and Georges Bank and hard bottom habitats (including artificial reefs) off southern New England and the middle Atlantic south to New Jersey are designed as EFH for adult pollock. Water temperatures below 57° F, salinities between 31 ppt and 34 ppt, and depths between 49 feet and 1,197 feet are also found in the EFH designations. Given the depth designations, only the deeper portions or Wellfleet Harbor are classified as EFH. For reasons described above for juveniles, impacts, if any, to EFH for adult pollock are anticipated to be minimal and short-term.

Whiting

Water depths for which EFH is designated for all life stages of whiting exceeds those which occur in the project area (eggs: 164 feet to 492 feet; larvae: 164 feet to 427 feet; juveniles: 66 feet to 886 feet; adults: 98 feet to 1,066 feet). Therefore, no EFH exists in the project area.

Red hake

Eggs—EFH for red hake eggs includes surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras and are most frequently seen during the months from May to November. Preferred conditions for red hake eggs include sea surface temperatures below 50° F along the inner continental shelf with salinities less than 25 ppt. Red Hake eggs are not likely to be found in Herring River or Wellfleet Harbor.

Larvae—EFH for red hake larvae includes surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras where water temperatures are below 66° F, depths are less than 656 feet, and salinities are greater than 0.5 ppt. They are most often observed during the months from May through December with peaks in September and October. Although EFH may encompass part of the project area, red hake likely do not occur in Herring River or Wellfleet Harbor. Therefore, no more than minimal impact on EFH for red hake larvae is anticipated as a result of the proposed project.

Juveniles—Red hake juveniles are found in bottom habitats with a substrate of shell fragments, including areas with an abundance of live scallops. Water temperatures below 61° F, depths less than 328 feet and a salinity range from 31 ppt to 33 ppt are preferred by red hake juveniles. Although EFH may encompass part of the project area in Wellfleet Harbor, red hake juveniles likely do not occur in the harbor and none were collected during the 1968-1969 survey by Curley et al. (1972). Therefore, no more than minimal impact on EFH for red hake juveniles is anticipated as a result of the proposed project.

Adults—Adult red hake are generally found in bottom habitats in depressions with a substrate of sand and mud; water temperatures below 54° F, and depths from 33 feet to 427 feet. They also have a preference for salinities in the range of 33 ppt to 34 ppt. Although EFH may encompass part of the project area in Wellfleet Harbor, adult red hake likely do not occur in the harbor and none were collected during the 1968-1969 survey by Curley et al. (1972). Therefore, no more than minimal impact on EFH for adult red hake is anticipated as a result of the proposed project.

White hake

Eggs—EFH for white hake eggs includes surface waters of the Gulf of Maine, Georges Bank and southern New England, and are most often observed in August and September. During trawl surveys eggs were most often collected in water depths between 33 feet and 820 feet (Chang et al. 1999). Eggs are unlikely to be found in Herring River and Wellfleet Harbor.

Larvae—EFH for larvae is pelagic waters where temperatures are between 50° F and 64° F in water depths between 33 feet and 492 feet. They are unlikely to be found in inshore or nearshore waters (Chang et al. 1999), and therefore would not be found in Herring River or Wellfleet Harbor.

Juveniles—EFH is designated for two life stages of juveniles: the pelagic stage and the demersal stage. White hake juveniles in the pelagic stage are most often observed from May through September within pelagic waters. Demersal stage juveniles tend to occupy bottom habitats with seagrass beds or a substrate of mud or fine-grained sand. These juvenile stages are found in waters with temperatures between 46° F to 66° F and depths from 16 feet to 738 feet. Although EFH may encompass part of the project area, white hake juveniles were not collected in any surveys (Curley et al. 1972, Roman 1987, Raposa 1999 unpublished data, Gwilliam 2005 unpublished data) and likely do not occur in the harbor or Herring River. Therefore, no more than minimal impact on EFH for red hake juveniles is anticipated as a result of the proposed project.

Adults—EFH for white hake adults includes bottom habitats with a substrate of mud or fine-grained sand, as well as water temperatures of 41° F to 57° F and depths from 16 feet to 1,066 feet. Although EFH may encompass part of the project area, white hake adults were not collected in any surveys (Curley et al. 1972, Roman 1987, Raposa 1999 unpublished data, Gwilliam 2005 unpublished data) and likely do not occur in the harbor or Herring River. Therefore, no more than minimal impact on EFH for red hake juveniles is anticipated as a result of the proposed project.

Winter flounder

Eggs—Winter flounder eggs are found in bottom habitats with a substrate of sand, muddy sand, mud, and gravel on Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the middle Atlantic south to Delaware Bay. They generally tend to occur in waters with temperatures less than 50° F, water depths less than 16 feet, and salinities between 10 ppt and 30 ppt. Eggs are often observed from February to June. Herring River and Wellfleet Harbor likely provide EFH for this species. Winter flounder are rare upstream of the Chequessett Neck Road Dike, so any impact from construction activities or sedimentation to EFH for winter flounder eggs would be minimal upstream of the dike. Downstream of the dike and in Wellfleet Harbor, eggs could be impacted through burial during construction of the dike and through sedimentation processes. However, much of the sedimentation in Wellfleet Harbor would likely occur in proximity to the mouth of Herring River and would be minimized by small incremental openings in the tide gates through adaptive management. Coordination with MA DMF and NMFS for appropriate in-water construction time periods and periods when the tide gates would be incrementally opened would also help to mitigate impacts to EFH for winter flounder eggs. With these measures, any impact to EFH for eggs is anticipated to be minimal and temporary. Over the long-term, restoration of Herring River estuary would provide better fish passage and dramatically increase the amount of estuarine habitat upstream of the dike, providing better access to areas upstream of the dike, as well as more spawning habitat and EFH for eggs.

Larvae—Winter flounder larvae are found in pelagic and bottom waters of Georges Bank and the inshore areas of the Gulf of Maine, where sea surface temperatures are less than 59° F, depths are less than 20 feet, and salinities are between 4 ppt and 30 ppt. Winter flounder larvae are often observed from March to July. EFH for the larvae of this species is likely found in Herring River and Wellfleet Harbor, though currently the occurrence of winter flounder upstream of the dike is rare. While increased turbidity during construction activities could impact EFH for larvae, impacts would be temporary in nature and localized, with areas of impact mostly just downstream of the Chequessett Neck Road Dike. Turbidity is not expected to increase very much in Wellfleet Harbor as a result of the project and would be minimized by the small incremental openings of the tide gates under adaptive management. Coordination with MA DMF and NMFS for appropriate in-water construction timeframes and periods when the tide gates would be incrementally opened would also help to minimize any potential impacts to EFH. In the long-term, the project would increase the amount of estuarine habitat upstream of the dike, providing beneficial impacts to EFH for larvae.

Juveniles—EFH is designated for two stages of winter flounder juveniles have been identified. Winter flounder young-of-the-year occupy bottom habitats with a substrate of mud or fine grained sand, within waters where the temperature is below 82° F, depths are from 0.3 feet to 33 feet, and salinities ranging between 5 ppt and 33 ppt. The second juvenile stage of winter flounder is the Age 1-plus juvenile found in inshore areas in waters with temperatures below 77° F, depths from 3 feet to 164 feet, and salinities between 10 ppt to 30 ppt. Winter flounder were collected during the surveys in 1968-1969 and 1984 and 2005, with the majority of them being juveniles and found downstream of the Chequessett Neck Road Dike (Curley et al. 1972, Roman 1987, Gwilliam 2005 unpublished data); therefore, Herring River and Wellfleet Harbor likely provide EFH for juvenile winter flounder. Juvenile winter flounder are mobile and would likely be temporarily displaced from construction activity, avoiding direct impacts such as mortality. During construction of the Chequessett Neck Road Dike measures will be taken to ensure that existing levels of fish passage continue, allowing winter flounder to access suitable habitat upstream of the dike. Localized increases in turbidity from in-water construction activities and sediment mobilization during restoration may affect feeding success. It may also restrict habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality. However individuals are mobile and would likely flee the area to neighboring waters where feeding and other impacts will be less problematic. Therefore, no more than minimal impact to juvenile flounder EFH is anticipated. During restoration, increased fish passage at the dike would allow greater access to areas upstream of the dike, and estuarine habitat upstream of the dike would expand and increase the quality of EFH for juveniles, providing long-term beneficial impacts.

Adults—Adult winter flounder occur in bottom habitats including estuaries with a substrate of mud, sand, and gravel, with water temperatures below 77° F depths, from 3 feet to 328 feet, and salinities between 15 ppt and 33 ppt. Spawning winter flounder adults are found in waters with temperatures below 59° F, depths less than 20 feet (except on Georges Bank where they spawn as deep as 262 feet), and salinities between 5.5 ppt and 36 ppt. Spawning occurs in January through May, with an optimal temperature being 38° F to 42° F and optimal salinity 11 ppt to 33 ppt. Adults have been collected in the project area, and the Herring River and Wellfleet Harbor likely provide EFH for adult and spawning adult winter flounder. Impacts would be similar to those described above for juveniles, resulting in minimal short-term adverse impacts and long-term beneficial impacts to EFH for adult winter flounder.

Yellowtail flounder

Yellowtail flounder are rare in most estuaries and rivers in the North Atlantic, although they are common in the Sheepscot River and Casco Bay and abundant in Boston Harbor (Johnson et al. 1999). Given the depth preferences for eggs (98 feet to 295 feet), larvae (33 feet to 295 feet), juveniles (66 feet to 164 feet) and adults (66 feet to 164 feet), Herring River and Wellfleet Harbor do not provide EFH for any life stage of yellowtail flounder.

Windowpane flounder

Eggs—EFH designated for windowpane flounder eggs includes surface waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras with temperatures ranging between 43° F and 68° F and water depths less than 230 feet. Although EFH may encompass part of the project area windowpane flounder eggs likely do not occur in Wellfleet Harbor or Herring River. Therefore, no more than minimal impact on EFH for windowpane flounder eggs is anticipated as a result of the proposed project.

Larvae—EFH for windowpane flounder larvae includes pelagic waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras with temperatures less than 68° F and water depths less than 230 feet. Although EFH may encompass part of the project area in Wellfleet Harbor, windowpane flounder larvae likely do not occur in harbor. Therefore, no more than minimal impact on EFH for windowpane flounder larvae is anticipated as a result of the proposed project.

Juveniles—EFH for juveniles includes bottom habitats around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras with substrates consisting of mud or fine-grained sand. Juveniles are common from June through October at temperatures below 77° F, depths from 3 feet to 328 feet, and salinities between 5.5 ppt to 36 ppt. Juvenile windowpane flounder were sampled at all stations except in Herring River downstream of the dike by Curley et al. (1972). They were also not sampled in Herring River in 1984, 1999, or 2005 (Roman 1987, Raposa 1999 unpublished data, Gwilliam 2005 unpublished data); therefore it is likely that only Wellfleet Harbor provides EFH for juveniles. Turbidity levels in Wellfleet Harbor are not expected to increase much as a result of in-water construction or sediment mobilization processes associated with restoration of Herring River; therefore, adverse impacts to feeding habits/success in juveniles is expected to be minimal and temporary. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. With the project resulting in increased fish passage at Chequessett Neck Road dike and increased estuarine habitat upstream of the dike, EFH for juvenile window pane flounder would likely expand to areas upstream of the dike, resulting in long-term benefits.

Adults—For adult windowpane flounder EFH is designated as bottom habitats with a substrate of mud or fine-grained sand in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to the Virginia-North Carolina border. Water temperatures are generally below 80° F, water depths generally range from 3 feet to 246 feet, and salinities range from 5.5 ppt to 36 ppt. Wellfleet Harbor likely provides EFH for adult windowpane flounder. Impacts to EFH for adult windowpane flounder would be similar to those for juvenile window pane flounder discussed above and result in long-term benefits by expanding potential EFH upstream of the Chequessett Neck Road dike.

American plaice

Water depths designated as EFH for American plaice eggs (98 feet to 295 feet), larvae (98 feet to 427 feet), juveniles (148 feet to 492 feet) and adults (148 feet to 574) are greater than what exist in Herring River and Wellfleet Harbor. Therefore, EFH for this species does not exist within the project area.

Ocean pout

Eggs—EFH consists of bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Due to low fecundity, relatively few eggs (< 4200) are laid in gelatinous masses, generally in hard bottom sheltered nests, holes, or crevices where they are guarded by either female or both parents. Additionally, water temperatures are generally below 50° F, depths are generally less than 164 feet, and salinities range from 32 ppt to 34 ppt. Given the habitat requirements, it is not expected that eggs would occur in the project area.

Larvae—For larvae, EFH consists of bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay that remains in close proximity to the hard bottom nesting areas. Where larvae are found, water temperatures are generally below 50° F, depths are less than 164 feet, and salinities are greater than 25 ppt. Given the bottom habitats, no EFH is found within the project area.

Juveniles—EFH for juveniles consists of bottom habitats, often smooth bottom near rocks or algae in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay where water temperatures are below 57° F, depths less than 262 feet, and salinities are greater than 25 ppt. Although EFH may encompass part of the project area in Wellfleet Harbor, ocean pout juveniles likely do not occur in the harbor and none were collected in the surveys conducted in the harbor in 1968-1969 or 1984 (Curley et al. 1972, Roman 1987). Therefore, no more than minimal impact on EFH for ocean pout juveniles is anticipated as a result of the proposed project.

Adults—Bottom habitats for adult EFH occur in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay where the substrate is sand, gravel, or a rough bottom, but are rarely found over mud (Steimle et al. 1999). Additionally, the following conditions exist where ocean pout adults are found: water temperatures below 59° F, depths less than 361 feet, and a salinity range from 32 ppt to 34 ppt. Although EFH may encompass part of the project area in Wellfleet Harbor, ocean pout adults likely do not occur in the harbor and none were collected in the surveys conducted in the harbor in 1968-1969 or 1984 (Curley et al. 1972, Roman 1987). Therefore, no more than minimal impact on EFH for ocean pout adults is anticipated as a result of the proposed project.

Atlantic halibut

Eggs and Larvae—Atlantic halibut spawn offshore (Cargnelli et al. 1999) Atlantic halibut eggs are generally observed between late fall and early spring, in waters with temperatures between 39° F and 45° F, depths less than 2,297 feet, and salinities less than 35 ppt. EFH for larvae is the surface water of the gulf of Main and Georges Bank where salinities are between 30 ppt and 35 ppt. Because Atlantic halibut spawn offshore, it is unlikely that eggs or larvae would be found within the project area.

Juveniles—Juvenile halibut tend to emigrate from nursery areas between 3 and 4 years of age. They prefer sand and coarse sediment in the Gulf of Main and Georges Bank where depths range from 66 feet to 197 feet and water temperatures are above 36° F. There is no EFH for juveniles in the project area as preferred depths are greater than found in Wellfleet Harbor.

Adults—Adult Atlantic halibut, as well as spawning adults tend to occupy waters with temperatures below 56° F, depths from 328 feet to 2,296 feet, and salinities between 30.4 ppt and 35.3 ppt. Due to preferred depths, no EFH exists within the project area.

Atlantic sea scallops

Sea scallops are an offshore species inhabiting water depths typically ranging from 59 feet to 361 feet, but may also occur in waters as shallow as seven feet in estuaries and embayments along the Maine coast and in Canada. In southern areas, scallops are primarily found at depths between 148 feet to 246 feet, and are less common in shallower water (82 feet to 148 feet) due to high temperature (Hart and Chute 2004). Because they are an offshore species, there is no EFH for them in the project area.

Atlantic sea herring

Although juvenile Atlantic herring were sampled during the 1968-1969 survey in Wellfleet Harbor (Curley et al. 1972), water depths for which EFH is designated for all life stages exceeds those which occur in the project area (eggs: 66 feet to 262 feet; larvae: 164 feet to 295 feet; juveniles: 49 feet to 443 feet; adults: 66 feet to 427 feet). Therefore, no EFH exists in the project area.

Monkfish

Water depths for which EFH is designated for all life stages of monkfish exceeds those which occur in the project area (eggs: 49 feet to 3,281 feet; larvae: 82 feet to 3,281 feet; juveniles: 82 feet to 656 feet; adults: 82 feet to 656 feet). Therefore, no EFH exists in the project area.

Bluefish

Eggs and Larvae—Eggs and larvae are generally not collected in estuarine waters, thus there is no EFH designation inshore for these life stages.

Juveniles and Adults—EFH for juveniles and adults is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. In North Atlantic estuaries, juvenile and adult bluefish generally occur from June through October in the "mixing" (0.5 ppt to 25 ppt) and "seawater" (> 25 ppt) zones. Therefore, Herring River and Wellfleet Harbor serve as EFH for juvenile and adult bluefish. They were sampled downstream of the dike in 1984 (Roman 1987) and in Wellfleet Harbor in 1968-1969 (Curley et al. 1972). Localized increases in turbidity associated with in-water construction activities and sediment mobilization processes during restoration could affect feeding success. It may also restrict habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality. However, these impacts would be localized and temporary. Juveniles and adults would are highly mobile and also likely flee impacted areas to surrounding waters where feeding and other impacts are less problematic. Therefore, any short-term adverse impact is anticipated to be minimal. However, the restoration project would have long-term beneficial impacts on EFH for juvenile and adult bluefish as the project would result increased fish passage at Chequessett Neck Road Dike, providing greater access to the increased amount of estuarine habitat and prey species populations resulting from the project.

Long finned squid

There is no EFH for long finned squid in the project area as EFH for pre-recruits and recruits is pelagic waters found over the continental shelf (from the coast out to the limits of the Exclusion Economic Zone (EEZ)), for the Gulf of Maine through Cape Hatteras, North Carolina.

Short finned squid

There is no EFH for short finned squid in the project area as EFH for pre-recruits and recruits is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), for the Gulf of Maine through Cape Hatteras, North.

Atlantic butterfish

Eggs—Inshore, EFH for eggs is the "mixing" (0.5 ppt to 25 ppt) and/or "seawater" (25 ppt) portions of all the estuaries where butterfish eggs are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the Estuarine Living Marine Resources (ELMR) database (NOAA 2010). Butterfish eggs pelagic and are generally collected from shore to 6,000 ft and temperatures between 52° F and 63° F, though they have been collected from temperatures up to 73° F (Cross et al. 1999). For the seawater portions of Cape Cod Bay, eggs are common during the months of July to September (NOAA 2010); therefore, they could potentially be present in the seawater portions of Wellfleet Harbor. However, the harbor is on the upper end of the temperature range during those months. Butterfish eggs are not present in the mixing portion of Cape Cod Bay estuaries (NOAA 2010). Turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Therefore, any impact to EFH for eggs is expected to be minimal and short-term.

Larvae—Inshore, EFH is designated as the "mixing" (0.5 ppt to 25 ppt) and/or "seawater" (> 25 ppt) portion of all the estuaries where Atlantic mackerel eggs are "common," "abundant," or "highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Larvae are generally found from 33 feet to 6,000 feet in areas where water temperatures range from 48° F to 66° F. For the seawater portions of Cape Cod Bay, butterfish larvae are rare, and they are not present in the mixing portion of the estuaries; therefore there is no EFH in the project area (NOAA 2010).

Juveniles—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portion of all the estuaries where Atlantic mackerel eggs are “common,” “abundant,” or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Juvenile fish are generally found in depths between 33 feet and 1,200 feet in areas where water temperatures range from 37° F to 82° F. For Cape Cod Bay, juveniles are common in both the seawater and mixing portions of its estuaries (NOAA 2010); therefore, while butterfish juveniles were not collected during the surveys conducted in 1968-1969 (Curley et al. 1972) or 1984 (Roman 1987), they could potentially occur in Wellfleet Harbor. Depths are too shallow for Herring River. Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile butterfish is expected to be minimal and short-term.

Adults—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portion of all the estuaries where Atlantic mackerel eggs are “common,” “abundant,” or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Adult butterfish are generally found in depths between 33 feet and 1,200 feet in areas where water temperatures range from 37° F to 82° F. For Cape Cod Bay, adults are common in both the seawater and mixing portions of its estuaries (NOAA 2010). Therefore, while adult butterfish were not collected during the surveys conducted in 1968-1969 (Curley et al. 1972) or 1984 (Roman 1987), they could potentially occur in Wellfleet Harbor. The depths are too shallow in Herring River for EFH. Impacts to EFH for adult butterfish would be the same as described above for juveniles and are expected to be minimal and short-term.

Atlantic mackerel

Eggs—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where Atlantic mackerel eggs are “common,” “abundant,” or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, Atlantic mackerel eggs are collected from shore to 50 ft and temperatures between 41° F and 73° F. Eggs are common in the mixing portion of the estuaries and abundant to highly abundant in the seawater portion of the estuaries May through August (NOAA 2010). Therefore, they could be present in Wellfleet Harbor. Turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Therefore, any impact to EFH for eggs is expected to be minimal and short-term.

Larvae—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where Atlantic mackerel larvae are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, Atlantic mackerel larvae are collected in depths between 33 feet and 425 feet and temperatures between 43° F and 72° F. In Cape Cod Bay, larvae are common in the mixing portion of estuaries and common to highly abundant in the seawater portion May through August (NOAA 2010); therefore, larvae could be found in the deeper portions of Wellfleet Harbor. Turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Therefore, any impact to EFH for eggs is expected to be minimal and short-term.

Juveniles—Inshore, EFH is designated as the "mixing" (0.5 ppt to 25 ppt) and/or "seawater" (> 25 ppt) portions of all the estuaries where juvenile Atlantic mackerel are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, juvenile Atlantic mackerel are collected from shore to 1,050 feet and temperatures between 39° F and 72° F. In Cape Cod Bay, juveniles are common in the mixing portion of estuaries May through October and common to abundant in the seawater portion May through November (NOAA 2010). Juvenile mackerel were collected in Wellfleet Harbor in the 1968-1969 survey (Curley et al. 1972) and one was collected in Herring River downstream of the dike during the 1984 survey (Roman 1987). EFH exists in the project area. Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas downstream of the dike and in Wellfleet Harbor to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile Atlantic mackerel is expected to be minimal and short-term. Long-term benefits to EFH for juvenile Atlantic mackerel are expected from the increased populations of prey species resulting from the restoration of Herring River estuary.

Adults—Inshore, EFH is designated for the "mixing" (0.5 ppt to 25 ppt) and/or "seawater" (> 25 ppt) portions of all the estuaries where adult Atlantic mackerel are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, adult Atlantic mackerel are collected from shore to 1,250 feet and temperatures between 39° F and 61° F. In Cape Cod Bay, adult mackerel are common in the mixing portion of estuaries during May through August and common to abundant in the seawater portion of estuaries from May through November (NOAA 2010). Adult mackerel could potentially occur in Wellfleet Harbor during the fall when temperatures fall below 60° F, otherwise water temperatures are too warm in the harbor and Herring River for adult mackerel. Feeding success in adults could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Adults are highly mobile and would also likely flee any impacted areas downstream of the dike and in Wellfleet Harbor to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for adult Atlantic mackerel is expected to be minimal and short-term. Long-term benefits to EFH for adult Atlantic mackerel are expected from the increased populations of prey species resulting from the restoration of the Herring River estuary.

Summer flounder

No EFH is designated for eggs, larvae or juveniles in Cape Cod Bay and its estuaries.

Adults—Inshore, EFH for adult summer flounder is designated for the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where adult summer flounder are “common,” "abundant," or "highly abundant” according to the ELMR database. Generally, summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer continental shelf at depths of 500 feet in colder month. The ELMR database does not provide any data for summer flounder in Cape Cod Bay (NOAA 2011). Though no summer flounder were collected during the 1968-1969 and 1984 surveys (Curley et al. 1972, Roman 1987), given the species preference for shallow coastal and estuarine habitats during the warmer months, and the fact that MA DMF considers the shoal waters of Cape Cod Bay and the region east and south of Cape Cod, including all estuaries, bays and harbors thereof, as critically important habitat (Packer et al. 1999) summer flounder could potentially be found in Wellfleet Harbor and possibly Herring River; therefore these areas should be considered as EFH for this species. Feeding success in adults could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Turbidity in Herring River would be localized and temporary in nature as well. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Adults are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for adult summer flounder is expected to be minimal and short-term. Long-term benefits to EFH for adult summer flounder are expected from the increased populations of prey species resulting from the restoration of Herring River estuary. Increased fish passage at Chequessett Neck Road Dike and increased estuarine habitat upstream of the dike would also increase the amount of EFH available to adult summer flounder.

Scup

Juveniles—Inshore, EFH is designated as the estuaries where scup are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing"(0.5 ppt to 25 ppt) and "seawater"(>25 ppt) salinity zones. In general during the summer and spring, juvenile scup are found in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel and eelgrass bed type substrates, in water temperatures greater than 45° F and salinities greater than 15 ppt. In Cape Cod Bay, juvenile scup are common in the mixing and seawater portion of estuaries during July through September (NOAA 2010) and scup were collected in Wellfleet Harbor by Curley et al. (1972). Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile scup is expected to be minimal and short-term. Long-term benefits to EFH for juvenile scup are expected to occur. Restoration of Herring River would increase salinity levels upstream of the Chequessett Neck Road Dike and would increase fish passage at the dike as well. This would potentially expand suitable habitat for scup to access. Restoration of Herring River estuary would also increase populations of prey species for scup, providing long-term benefits to EFH for juvenile scup.

Adults—Inshore, EFH is designated as the estuaries where scup were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing"(0.5 ppt to 25 ppt) and "seawater"(>25 ppt) salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45° F. In Cape Cod Bay, adult scup are common in the seawater portion of estuaries from June through September (NOAA 2010) and scup were collected in Wellfleet Harbor by Curley et al. (1972). Impacts to EFH for adult scup from the proposed project would be the same as those described above for juvenile scup.

Black sea bass

Adults—Inshore, EFH is designated for the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 43° F appear to be the minimum requirements. Structured habitats (natural and man-made), sand and shell are usually the substrate preference. Black sea bass are uncommon in the cooler waters north of Cape Cod (Drohan et al. 2007) and the ELMR database does not provide distribution information for areas of Cape Cod Bay. Therefore, there is no EFH for this species in the project area.

Surf clam

Juveniles/adults—EFH for surf clam juveniles and adults is designated throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ. Surf clams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low. They also only occur in salinities greater than 28 ppt (Cargnelli et al. 1999). The higher salinity areas of Wellfleet Harbor could serve as EFH for this species. Though some sedimentation is expected to occur in Wellfleet Harbor in the vicinity of the mouth of Herring River, it would be minimized by small incremental openings in the tide gates under adaptive management. Surf clams are able to move up and down in the substrate; therefore, it is not anticipated that they would be affected by any sedimentation that would occur. Thus, any impact to surf clams is anticipated to be minimal and short-term.

Ocean quahog

No EFH is designated for any life stage of ocean quahog in Cape Cod Bay and its estuaries.

Spiny dogfish

Juveniles—Inshore, EFH is the "seawater" (>25 ppt) portions of the estuaries where dogfish are common or abundant on the Atlantic coast, from Passamaquoddy Bay, Maine to Cape Cod Bay, Massachusetts. Generally, juvenile dogfish are found at depths of 33 feet to 1,280 feet in water temperatures ranging between 37° F and 82° F. Though no spiny dogfish have been collected in the project area (Curley et al. 1972, Roman 1987), they could potentially be found in the deeper portions of Wellfleet Harbor. Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile spiny dogfish is expected to be minimal and short-term.

Adults—Inshore, EFH is the "seawater" (.25 ppt) portions of the estuaries where dogfish are common or abundant on the Atlantic coast, from Passamaquoddy Bay, Maine to Cape Cod Bay, Massachusetts. Generally, adult dogfish are found at depths of 33 feet to 1,476 feet in water temperatures ranging between 37° F and 82° F. Though no spiny dogfish have been collected in the project area (Curley et al. 1972, Roman 1987), they could potentially be found in the deeper portions of Wellfleet Harbor. Impacts to EFH for adult spiny dogfish would be similar to those for juvenile spiny dogfish discussed above and are expected to be minimal and short-term.

Blue shark

Adults—The blue shark is a pelagic species that inhabits clear, deep, blue waters, usually in temperatures of 50° F to 68° F, at depths greater than 590 feet. EFH is designated in localized areas in the Atlantic off Florida and Georgia, and from South Carolina to the Gulf of Maine. Based on the mapping for this species, there is no EFH for adult blue sharks in the project area (NOAA 2009).

Bluefin tuna

Juveniles/Subadults—EFH juvenile/subadult bluefin tuna consists of all inshore and pelagic waters warmer than 53.6° F off the Gulf of Maine and Cape Cod Bay, from Cape Ann, MA (~42.75 N) east to 69.75 W (including waters of the Great South Channel west of 69.75 W), continuing south to and including Nantucket Shoals at 70.5 W to off Cape Hatteras, NC (approximately 35.5 N), in pelagic surface waters warmer than 53.6° F, between the 82 and 328 foot isobaths. No EFH exists in the estuarine waters of Wellfleet Harbor and Herring River.

Adults—Adult bluefin tuna are found from Newfoundland to Brazil, but have EFH for adults in pelagic waters of the Gulf of Maine from the 164 foot isobath to the EEZ boundary, including the Great South Channel, then south of Georges Bank to 39 N from the 164 foot isobath to the EEZ boundary. No EFH exists in the estuarine waters of Wellfleet Harbor and Herring River.

CUMULATIVE EFFECTS

Cumulative impacts are those resulting from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. Other projects and plans in the area with the potential to beneficially affect EFH include the Town of Wellfleet Comprehensive Wastewater Management Plan, the Mayo Creek and East Harbor salt marsh restoration projects, and oyster spawning experiments in Wellfleet Harbor. Wellfleet's wastewater management plan would improve water quality in the project area waters by reducing the potential for nutrient loading and domestic sewage contamination of local surface waters, improving the habitat for estuarine fish and macroinvertebrate species as well as shellfish. The May Creek and East Harbor restoration projects, similar to the Herring River restoration project, would improve and increase the amount of habitat available for all aquatic species. The oyster spawning experiments in Wellfleet Harbor could directly enhance the local population of oysters and provide additional spat that could settle in restored areas of Herring River. The oysters used in the experiments could also potentially improve the overall local water quality by filtering nitrogen out of the water; improving habitat conditions for all aquatic species.

Recurrent dredging of the federal navigation channel between the Town Pier and Wellfleet Harbor, which has occurred four times since 1971, has the potential to adversely affect EFH through temporary disturbance, decreases in local water quality, sedimentation and direct mortality. Although these effects are temporary, they recur with each dredging event, resulting in long-term, intermittent impacts. Mobile species, both fish and macroinvertebrates, would temporarily move out of the area while the dredging occurs; returning once the activities are over. This would temporarily impact both prey species as well as EFH species, but once the dredging is over, species would readily return. Dredging delivers sediment to the water column and increases turbidity. Fine sediments would likely be transported out of Wellfleet Harbor on ebbing tides while coarser sediments could settle to the bottom within the harbor. Increased turbidity can adversely impact aquatic species, including shellfish, and sedimentation can adversely affect shellfish through burial. While feeding for species with designated EFH would be impacted, these species would likely flee the impacted areas to surrounding waters where feeding is less problematic, resulting in minimal adverse impacts that would be temporary in nature. Dredging would also result in the direct mortality of some benthic species that are not mobile enough to move out of the area; again impacting feeding resources for species with designated EFH. However, once dredging activities cease, species would quickly recolonize the affected area.

Overall, the proposed action when combined with the projects in the vicinity of the proposed action would have long-term beneficial impacts on EFH, as any adverse impacts would be temporary and localized in nature and would not result in a cumulative impact that was significant.

CONCLUSIONS

Long-term, the proposed restoration of the Herring River estuary is expected to provide numerous benefits to EFH for species occurring in the area, including improved quality and quantity of EFH. Through increased tidal flow and flushing rates water quality upstream of the Chequessett Neck Road Dike as well as upstream of High Toss Road would improve. Salinity values would increase throughout much of the system with values ranging from 15 ppt to 30 ppt in most of the lower sub-basins, increasing the amount of estuarine habitat (sub-tidal and intertidal habitat) by approximately 790 acres to 885 acres, depending on the alternative selected through the NEPA process. This new estuarine habitat in turn would result in an increase in the population of prey species, including finfish, macroinvertebrates and shellfish, which species with EFH feed on. Fish passage at the Chequessett Neck Road dike would also increase, decreasing potential mortality rates for anadromous and catadromous species and increasing access to estuarine habitat upstream of the dike for both prey species and species for which EFH is designated.

Although some adverse impacts to species with designated EFH would occur, they are expected to be minimal and short-term in nature. During construction activities less mobile prey species would likely be buried or directly killed during in-water construction activities. Sediment disturbance would increase turbidity in the surrounding waters, adversely impacting the feeding behaviors of species with EFH, as well as other species. It may also restrict habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality. However, this would be temporary and localized and species would likely flee to neighboring waters where feeding and other impacts are less problematic. As tidal flows increase with restoration, sediments would be mobilized, and though most would be transported upstream onto the marsh system, some would be transported downstream of the dike and into Wellfleet Harbor, with coarser sediments settling out and finer sediments likely flushing out to Cape Cod Bay. However, with small incremental openings in the tide gates under adaptive management, impacts would be minimized and benthic species would be expected to recolonize areas readily.

ACRONYMS

BMPs	Best Management Practices
CYCC	Chequessett Yacht and Country Club

DO	dissolved oxygen
EFH	Essential Fish Habitat
MA DMF	Massachusetts Division of Marine Fisheries
NEPA	National Environmental Policy Act
NEFMC	New England Fishery Management Council
NMFS	National Oceanic and Atmospheric Administration National Marine Fisheries Service
ppt	parts per thousand
TSS	total suspended solids

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