APPENDIX B

ESSENTIAL FISH HABITAT ASSESSMENT
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ESSENTIAL FISH HABITAT ASSESSMENT REPORT

Fore River Bridge Replacement Project
Route 3A
Quincy and Weymouth, Massachusetts

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1.0 INTRODUCTION

The purpose of this report is to provide an Essential Fish Habitat (EFH) assessment that evaluates the impacts on EFH from construction of the Fore River Bridge Replacement Project. The Magnuson-Stevens Act of 1976 was established to promote conservation of marine fishery (shellfish and fish) resources along the United States coastlines. This included the establishment of eight regional fishery management councils (FMCs) that develop fishery management plans (FMPs) to properly manage fishery resources within their jurisdictional waters. The 1986 and 1996 amendments to the Magnuson Act, renamed the Sustainable Fisheries Act, recognized that many fisheries are dependent on nearshore and estuarine habitats for at least part of their life cycles and included evaluation of habitat loss and protection of critical habitat. The marine environments important to marine fisheries are referred to as EFH and are defined to include “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” The act further mandates National Marine Fisheries Service (NMFS) to coordinate with other federal agencies to avoid, minimize, or otherwise offset effects on EFH that could result from proposed activities. To delineate EFH for life stages of shellfish and fish, coastal waters were mapped by regional FMCs and superimposed with ten minute by ten minute (10’x10’) square coordinate grids. Therefore, the objectives of this EFH Assessment are to describe how the actions of the proposed bridge replacement Project may affect any local portions of the Massachusetts Bay EFH that were designated and mapped by NMFS.
2.0 BRIEF OVERVIEW OF THE PROPOSED PROJECT

In summary, the Fore River Bridge Replacement Project (the Project) has been funded to be complete by 2015. The Project is considered part of the Accelerated Bridge Program under the Massachusetts Department of Transportation (MassDOT), Highway Division (formerly Massachusetts Highway Department). This is considered a “footprint” bridge replacement project; with the new bridge carrying the same number of vehicular travel lanes along the same alignment as the 1936 bridge (the currently existing temporary bridge is currently located just south of this alignment). In-water work associated with the construction of the new, permanent bridge is likely to consist of the following activities:

- Channel dredging for navigation channel widening to install fender system,
- Dredging for the temporary navigation channel for short-term use during construction,
- Removal of existing inactive utility lines buried in the channel,
- Removal of existing select remnants of original bridge foundations,
- Removal of the temporary bridge structure, foundations, fender systems, and dolphins,
- Installation of a submarine cable between the proposed bridge towers,
- Installation of sheet pile coffer dams for dolphin installations,
- Dredging of material within coffer dams for dolphin installations,
- Installation of drilled shafts for bridge foundations
- Installation of drilled shafts for fender system,
- Installation of sheeting to protect existing electric tunnel during construction, and
- “Spudding” of barges which will provide work platforms for the performance of these construction activities.

As part of the permitting and environmental assessment process, including the 401 Water Quality Certificate Application (pending submittal), potential impacts and mitigation measures for the in-water work have been considered, and in accordance with the initial consultation letter received from the Division of Marine Fisheries dated July 10, 2009, MassDOT is incorporating a timing restriction window for silt producing activities from February 15 to September 15. MassDOT is considering silt producing activities to be channel dredging, removal of buried utility lines, extraction of select remnants of the 1936 bridge foundation systems, and installation of the submarine cable.
3.0 POTENTIAL OCCURRENCES OF ESSENTIAL FISH HABITAT AND EFH SPECIES/LIFE STAGES AT THE PROJECT SITE

Regional mapping of Essential Fish Habitat (EFH) by the NMFS, provided online via the Essential Fish Habitat Mapper [http://www.nmfs.noaa.gov/habitat/habitatprotection/efh/GIS_mapper.html], identifies EFH at the scale of 10’x10’ USGS map quadrants that contain areas designated by NMFS as EFH for one or more life stages of marine invertebrate and fish species. Regional distribution maps for each species and life stages are posted at the EFH mapper website along with EFH summary documents produced by the New England Fisheries Management Council (NEFMC, 1998) for each of the EFH species. Other documents produced and/or used by NMFS to obtain data needed to designate and map EFH are identified below as a “primary source” document for each species.

The NEFMC EFH descriptions and NMFS source documents are the primary sources of information for this report and are presented below. The Primary Sources listed below in bold are the primary sources that NEFMC used to develop the habitat requirements and life history information for “EFH species” of fish and invertebrates for designated Massachusetts Bay EFH. Although these documents are the best available data source for habitat requirements of fishes, the habitat requirements for many of these organisms are not well known. The EFH documents provide descriptions of the habitat for locations where these organisms have been found in some degree of abundance. The mere occurrence of fish in a particular habitat is not an indication that it is essential or even preferred habitat, it is only an indication that the fish was found in a particular habitat when sampling occurred. Despite these data limitations, the EFH Source Documents remain the best available descriptions of the habitat requirements for selected EFH species. Based on EFH Mapper queries and a review of the NEFMC EFH descriptions and source documents, the lifestages of each EFH species that may inhabit or visit the project site appear in Table 3-1.

The project occurs within a portion of one 10’x10’ latitudinal/longitudinal designated EFH quadrant in Weymouth which encompasses Massachusetts Bay and Boston Harbor, and includes the Weymouth Fore River. Although this Massachusetts Bay quadrant is designated as EFH for the 16 species (as identified in Table 3-1), not all of the estuarine and sub-tidal marine habitats found within the quadrant designated as EFH provide life-stage specific habitat requirements, such as water depth and temperature, needed by one or more of the 16 EFH species. Because the scale of the EFH mapping cannot precisely indicate which areas within an EFH quadrant actually are suitable for and inhabited by the EFH species and life stages, the 16 EFH species in Table 3-1 should be considered to have the potential to occur at the project site only if and when habitat conditions at the site are suitable for each life stage of these species. Thus, despite falling within the boundaries of the Massachusetts Bay mapped as EFH by NMFS, the Fore River Bridge project site may not provide habitats that can support one or more of the life stages and species listed in Table 3-1. Comments are provided in Table 3-1 to clarify the potential for the site to provide suitable habitat for one or more life stages of these 16 EFH species, as a basis for evaluating the likelihood that the project site is actually inhabited and/or used by one or more life stages of these 16 EFH species. The comments are based on the location of the Fore River Bridge, within the confines of the in-water work area.
<table>
<thead>
<tr>
<th>Species with Designated EFH in Massachusetts Bay</th>
<th>Life Stages Reported within EFH</th>
<th>Notes on Potential Local Occurrences at Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea scallop <em>(Placopecten magellanicus)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>American plaice <em>(Hippoglossoides platessoides)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Atlantic bluefin tuna <em>(Thunnus thynnus)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Atlantic cod <em>(Gadus morhua)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Atlantic halibut <em>(Hippoglossus hippoglossus)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Atlantic herring <em>(Clupea harengus)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Haddock <em>(Melanogrammus aeglefinus)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Ocean pout <em>(Macrozoarces americanus)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Pollock <em>(Pollachius virens)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Red hake <em>(Urophycis chuss)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>Silver hake (aka whiting) <em>(Merluccius bilinearis)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
<tr>
<td>White hake <em>(Urophycis tenuis)</em></td>
<td>Eggs  X</td>
<td>Larvae  X</td>
</tr>
</tbody>
</table>
### Table 3-1.
Potential Local Occurrences of Shellfish and Finfish Species and Life Stages
with Designated Essential Fish Habitat in Massachusetts Bay

<table>
<thead>
<tr>
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<th>Life Stages Reported within EFH</th>
<th>Notes on Potential Local Occurrences at Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Shark <em>(Carcharodon carcharias)</em></td>
<td>X X X X</td>
<td>EFH Mapper query indicated All Life Stages but posted NMFS document noted insufficient data to identify EFH for neonates and adults. Site is presumably too shallow for juvenile white sharks, based on their reported occurrence at depths of 25-100 meters in New York Bight Area.</td>
</tr>
<tr>
<td>Windowpane flounder <em>(Scophthalmus aquosus)</em></td>
<td>X X X X</td>
<td>Site-specific habitat features, such as water depths and temperature, may support these life stages</td>
</tr>
<tr>
<td>Winter flounder <em>(Pleuronectes americanus)</em></td>
<td>X X X X</td>
<td>Site-specific habitat features, such as water depths and temperature, may support these life stages</td>
</tr>
<tr>
<td>Yellowtail flounder <em>(Pleuronectes ferruginea)</em></td>
<td>X X X X</td>
<td>Site-specific habitat features, such as water depths and temperature, may support these life stages</td>
</tr>
</tbody>
</table>

**Notes:**
1 – An asterisk (*) indicates that the Massachusetts Bay EFH also was reported as Adult Spawning Habitat for this species.

**Source:** NMFS Essential Fish Habitat Mapper – [http://www.nmfs.noaa.gov/habitat/habitatprotection/efh/GIS_mapper.html](http://www.nmfs.noaa.gov/habitat/habitatprotection/efh/GIS_mapper.html)
4.0 BIOLOGICAL PROFILES OF ESSENTIAL FISH HABITAT SPECIES AND
POTENTIAL FOR ONSITE IMPACTS TO EFH

Atlantic sea scallop (*Placopecten magellanicus*) – Primary source: Hart and Chute (2004). The Atlantic sea scallop or deep sea scallop is distributed from Labrador to Cape Cod south to Cape Hatteras, North Carolina. Sea scallops typically occur at depths from 18-110 meters, but may occur in waters as shallow as 2 meters in estuaries and embayments along the Maine coast and in Canada. Designated EFH for egg, larval, juvenile, and adult life stages of sea scallop includes waters from the Gulf of Maine and southern New England, including Massachusetts Bay, south to the Virginia/North Carolina border, including estuaries with salinities greater than 25 parts per trillion (“ppt”) (NEFMC, 1998).

EFH for eggs includes bottom habitats with water temperatures less than 17°C. Eggs of sea scallop are negatively buoyant and remain on the seafloor for about 30 days until they develop into free-swimming larvae. Eggs are common in Massachusetts Bay from July through September (Jury et al. 1994).

Larvae are pelagic for about a month after hatching. At the end of the pelagic larval stage, larvae settle on areas of gravelly sand with shell fragments. EFH for larvae includes pelagic waters and bottom substrates of gravelly sand, shell hash, red algae, and biological structures such as amphipod tubes, hydroids, and bryozoans, sea surface temperatures of 18°C and salinities between 16.9 ppt and 30 ppt. Larvae are common in Massachusetts Bay from July through November (Jury et al. 1994).

Juveniles and adults occur year-round in Massachusetts Bay. Juvenile scallop EFH includes cobble, shell hash, coarse/gravelly sand, and sand substrates, water temperatures less than 15°C, and water depths between 18 and 110.

Adult scallop EFH includes cobble, gravel, rock, shell hash, and silt substrates at water depths between 18 and 110 m., with water temperatures less than 21°C and salinities greater than 16.5 ppt. Adults are common year-round in Massachusetts Bay and spawning adults are common in Massachusetts Bay from July through September (Jury et al. 1994). EFH for spawning adults occurs in Massachusetts Bay and includes the same water depths, substrate, and salinities as adults, but water temperatures less than 16°C.

Potential for Onsite Occurrence and Impacts. The habitat requirements for sea scallop eggs, juveniles, and adults are relatively similar: firm substrate, gravelly sand with small rocks and shell fragments. Although the project site contains areas with suitable substrate conditions, it may not contain any significant areas of sea scallop EFH due to its shallow depths (mostly < 25 meters) whereas scallops typically require a minimum depth of 18 meters, except in cooler, more northerly estuarine waters. Because sea scallop larvae are pelagic for about a month and generally settle to the bottom by the end of November, there is only a small seasonal window for pelagic larvae from deeper subtidal habitats to be carried into the project site on tidal currents. If this were to occur during the silt-producing work from September 15th and early December, any exposures of scallop larvae to increased turbidity would be brief, highly localized, and likely insignificant.

American Plaice (*Hippoglossoides platessoides*) - Primary source: Johnson et al. (1999a). The American plaice is a commercially important flatfish ranging found in western North Atlantic from Labrador south to Cape Cod and Narragansett Bay, Rhode Island (Bigelow and Schroeder 1953). Massachusetts Bay contains EFH for all life stages of American plaice, including spawning adults in estuaries with salinities greater than 25 ppt. (NEFMC, 1998).

EFH for American plaice eggs is surface waters with temperatures less than 12°C, a wide range of salinities, and water depths ranging from 30-90 meters. American Plaice eggs are found over depths
ranging from 10 to 180 meters, with the majority occurring between 50 to 90 meters. Eggs occur year-
round in the Gulf of Maine with peaks in March through June in Massachusetts Bay (Jury et al. 1994). Because the eggs and larvae are pelagic, there is no recorded substrate preference as EFH for spawning, egg, or larval habitat.

Eggs and larvae are abundant from March through July, with peak numbers of eggs during April and May (Jury et al. 1994). Larvae are found at depths ranging from 30 to 210 meters, but typically occur between 50 to 90 meters throughout most of the year (NEFMC, 1998).

Juveniles and adults are highly abundant year-round in Massachusetts Bay and Boston Harbor (Jury et al. 1994). In the Massachusetts DMF bottom trawl survey, juveniles were found over depths ranging from 10 to 80 meters, with the majority occurring between 45 to 60 meters. Juveniles and adults prefer fine grained sediment or a substrate of sand and gravel, and are found to a lesser extent on sand, silt, and clay. In Massachusetts Bay they were rare on Scotian shelf drift, a mixed substrate. EFH for juveniles includes sand, gravel, and fine-grained substrates at depths between 45 and 150 m. and water temperatures below 17°C with a wide range of salinities (NEFMC, 1998).

EFH for adults is similar to that for juveniles except that water depths range from 45-175 meters. American plaice are opportunistic feeders and feed primarily on benthic organisms including echinoderms, mollusks, amphipods, shrimp, and polychaetes. Fish are not a major food item. Adults spawning in Massachusetts Bay and Boston Harbor from March through June use a wide range of bottom habitats and salinities, with water depths from 30-130 meters and temperatures less than 14°C.

Potential for Onsite Occurrence and Impacts. Because EFH for all life stages of American plaice require water depths of at least 30 meters, the shallower habitats (< 25 meters) found at the Fore River Bridge site are very unlikely to serve as EFH for any life stage of this species. Assuming there are deeper areas with suitable substrate in nearby reaches at the mouth of the Fore River, it is conceivable that some short-term turbidity from silt-producing activities would reach potential pelagic habitats for plaice eggs and larvae but any such short term disturbance from work at the project site would not significantly affect any local EFH for these life stages. However, it is not expected that dredging or new bridge construction will affect any adjacent EFH of juvenile and adult American plaice at even greater water depths (> 45 meters).

Atlantic Bluefin Tuna (Thunnus thynnus) – Primary source: Collette and Klein-MacPhee (2002). Since the project site occurs within Massachusetts Bay, it is mapped as potentially containing EFH for juvenile and adult Atlantic bluefin tuna. The Atlantic bluefin tuna is a large, pelagic, highly migratory, piscivorous sport fish that can be found throughout the western Atlantic from Gulf of St. Lawrence to Florida and occurs in the Gulf of Maine in the summer and fall. The EFH for juveniles is all inshore and pelagic surface waters warmer than 12°C of the Gulf of Maine and Cape Cod Bay, Massachusetts between the 25 and 200 meter isobaths. The EFH for adult bluefin includes pelagic waters of the Gulf of Maine deeper than the 50 meter isobaths.

Potential for Onsite Occurrence and Impacts. Because bluefin tuna have no strong association with any substrate and occur mostly at depths greater than 50 meters, it is unlikely that they would inhabit or visit the shallower waters of the project site (< 25 meters) so that the disturbance of the substrate and silt-producing activities are extremely unlikely to directly or indirectly affect this highly mobile, pelagic fish. Therefore, it is very unlikely that the project poses any risk of impacts to juvenile or adult Atlantic bluefin tuna or result in adverse modifications to their designated EFH.

Atlantic Cod (Gadus morhua) – Primary source: Fahay et al. (1999). Atlantic cod are a commercially important ground fish on both sides of the North Atlantic from West Greenland south to Cape Hatteras
Massachusetts Bay is designated as EFH for the egg, larval, juvenile, adult, and spawning adult life stages of this common demersal fish (see Table 3-1; NEFMC, 1998).

EFH for Atlantic cod eggs occurs in waters with depths less than 110 meters with surface temperatures below 12°C and salinity of 32-33 ppt. Most eggs occur offshore in areas of water depths ranging from 60 to 110 meters, but may occur in shallower waters during the winter. In Massachusetts Bay and Boston Harbor, eggs were present every month except August through October, being most common from December through June (Jury et al. 1994).

In Massachusetts Bay and Boston Harbor, cod larvae are found during every month except September and October (Jury et al. 1994). Cod larvae are pelagic and their EFH is defined as water depths from 30 to 70 meters with water temperatures below 10°C and salinity of 32-33 ppt. Most cod larvae are found from March through May, with the lowest larval densities in Massachusetts Bay occurring during August and September (Jury et al., 1994).

Juvenile and adult Atlantic cod are demersal, occurring year-round in Boston Harbor and Massachusetts Bay, where they prefer cobbles compared to finer grain sediments and use vegetation to avoid predation (Jury et al. 1994). EFH for juveniles includes bottom substrates of cobbles or gravel at depths from 25-75 meters with water temperatures less than 20°C and salinity from 30 – 35 ppt (NEFMC, 1998).

EFH for adult cod includes bottom habitats with rocks, pebbles or gravel at depths from 10-150 meters with water temperatures less than 10°C but a wide salinity range. Adult cod occur year-round in Massachusetts Bay but are rare from July-September and January-February (Jury et al. 1994).

Spawning adults occur in the same areas but prefer smooth sand, rocks, pebbles, or gravel for spawning. Spawning is most frequently observed during fall, winter, and early spring (NEFMC, 1998).

Atlantic cod fed on a variety of benthic and pelagic organisms including crustaceans, amphipods, mysids, and decapods. As Atlantic cod mature, fish including Atlantic herring, American sand lance, and silver hake become more important food items. Survival appears enhanced in structurally complex habitats.

Potential for Onsite Occurrence and Impacts. Since Atlantic cod eggs and larvae are pelagic and not associated with any particular substrate, it is expected that disturbance of the substrate by removal of structures, dredging, and new bridge construction activities will not affect any cod egg and larval EFH that may occur nearby. Because cod larvae and juveniles are most common at depths from 25 to 75 meters, these life stages are unlikely to inhabit the shallower waters of the project site (< 25 meters), so that the site might be reasonably expected to provide potential EFH only for adult cod and eggs. However, the substrates to be dredged and disturbed during the project vary significantly from silty mud to sand, gravel, stones and wood chips, so that the site probably does not provide significant areas of the complex rocky, cobbled areas that are the preferred habitat of juvenile and adult/spawning Atlantic cod. Although the project site at the mouth of the Fore River is unlikely to represent EFH for all life stages of Atlantic cod or support significant numbers of adult cod and their eggs, it is assumed that adult cod may inhabit the project area because their local occurrence in the Weymouth Fore River area was verified in the 1970’s by the DMF (Source: Iwanowicz, H.R., R.D. Anderson, and B.A. Ketschke. A Study of the Marine Resources of Hingham Bay. Monograph Series Number 14, Division of Marine Fisheries, Boston, MA, 1973). But it is very unlikely that significant EFH for non-adult cod life stages occurs at this shallow water site and/or will be significantly disturbed by removal of existing structures, dredging, or new bridge construction.

Atlantic Halibut (Hippoglossus hippoglossus) – Primary source: Cargnelli et al. (1999a). Atlantic halibut is a boreal and subarctic species of flatfish historically ranging from Labrador to Chesapeake Bay
in North America. Massachusetts Bay contains EFH for all life stages of Atlantic halibut, including spawning adults in the estuaries with salinity >25 ppt (NEFMC, 1998). It is worth noting that only 18 Atlantic halibut, all juveniles, have been taken during Massachusetts inshore trawl surveys between 1978 and 1997.

The EFH for Atlantic halibut eggs is pelagic waters with water temperatures between 4-7°C, water depths less than 700 meters and salinities less than 35 ppt (NEFMC, 1998). Eggs occur from late fall to early spring with peak numbers in November and December. Unfertilized eggs are negatively buoyant and are spawned on harder substrates of sand, gravel, and clay where males fertilize them. After fertilization eggs become bathypelagic (i.e., buoyant) and drift in the water column at depths mostly greater than 54 meters.

Atlantic halibut larvae are pelagic and are found within 50 meters of the water surface. EFH for larvae is surface waters with salinities between 30 and 35 ppt, but there is no documented association of larvae with any particular substrate type (NEFMC, 1998).

Characteristics of the EFH for juvenile Atlantic halibut in the Gulf of Maine and Georges Bank include a substrate of sand, gravel, or clay at water depths ranging from 20-60 meters with temperatures greater than 2°C (NEFMC, 1998). Juveniles prey primarily on invertebrates including decapods, annelids, and mollusks until they are about 30 centimeters in length.

EFH for adult Atlantic halibut occurs typically at depths of 100 to 700 meters with water temperatures less than 13.6°C and salinities between 30.4 and 35.3 ppt (NEFMC, 1998). Adults are found on sand, gravel, or clay substrates, but not on soft mud or rock bottom. Most commercial catches occur at depths of 200 to 300 meters, but NMFS ground fish surveys in the Gulf of Maine have captured adult halibut between 25 to 200 meters, with most caught between 50 and 100 meters.

Spawning occurs from late fall to early spring, with peaks in November and December (NEFMC, 1998). The water depths of spawning EFH are not well known, but appear to be from 180 to 700 meters, with water temperatures less than 7°C and salinities less than 35 ppt (NEFMC, 1998). Spawning adults use bottom habitats with a substrate of soft mud, clay, sand, or gravel, and soft mud, clay, sand, or gravel substrates in the Gulf of Maine and Georges Bank, as well as rough or rocky bottom locations along the slopes of the outer banks. Larger halibut are more piscivorous and prey on silver hake, longhorn sculpin, American sand lance, ocean pout, and alewife.

Potential for Onsite Occurrence and Impacts. Although Massachusetts Bay has been designated as EFH for all life stages of halibut, including spawning adults, the project site at the mouth of the Fore River does not provide the preferred depths for spawning adults, eggs and larvae. Since there also is no documented association of halibut larvae with any substrate type, disturbance of the substrate by construction activities is not expected to affect EFH for eggs, larvae or spawning adults. The site also may be too shallow for juvenile halibut that typically inhabit water depths of 20 to 60 meters. A worst case scenario is that the project could pose a minor, short-term disturbance to any juvenile halibut that may inhabit deeper reaches of the Fore River estuary and/or feed in the project area. Therefore, disturbance of the substrate by removal of existing structures, dredging, and new bridge construction should not directly or indirectly affect EFH for eggs, larvae, nor spawning adult halibut and poses only a low risk of short-term impact to the shallowest reaches of any juvenile halibut EFH that might occur within deeper areas at the mouth of the Fore River.

Atlantic Sea Herring (Clupea harengus) – Primary source: Reid et al. (1999). The Atlantic sea herring is a schooling, pelagic, commercially important coastal species ranging from northern Labrador to
North Carolina in North America. Estuarine locations in Massachusetts Bay with salinities greater than 25 ppt contain EFH for larvae, juvenile, and adult Atlantic sea herring (NEFMC, 1998).

EFH for Atlantic sea herring eggs includes water depths ranging from 20-80 m. with gravel, sand, cobble and shell fragment substrate, as well as aquatic macrophytes, temperatures below 15°C, and salinities between 32-33 ppt (NEFMC, 1998). Demersal eggs occur mainly from July through November, usually in tidal currents from 1.5 to 3.0 knots. EFH for Atlantic herring larvae overlaps that of eggs and includes water depths ranging from 50-90 meters with temperatures less than 16°C and salinities around 32 ppt.

Atlantic herring larvae are pelagic and free floating, lacking any known association with a particular substrate type. The larval stage can last from four to eight months with early spawned herring (August) having the shortest larval stage and late spawned herring (December) having a longer larval stage. In Massachusetts Bay and Boston Harbor, larvae are observed mainly from October through May, with peaks from October through June. They have been collected over bottom depths from 10 to 250 meters, although most were collected over 50 to 90 meters (Jury et al. 1994). Larval Atlantic herring metamorphose into juveniles at 40 to 50 millimeters (total length) in April through May in coastal waters throughout the Gulf of Maine.

Juvenile Atlantic herring are pelagic and schooling behavior begins at metamorphosis. By the summer and fall, juvenile herring move out of nearshore waters to overwintering habitats in deeper offshore waters in southern New England. EFH for juveniles includes pelagic and bottom waters ranging in depth from 15-135 meters with temperatures below 10°C and salinities ranging from 26-32 ppt. Juvenile and adult Atlantic herring in Massachusetts Bay and Boston Harbor are present year-round, abundant September through May, but less abundant in the summer (Jury et al. 1994). Both the juvenile and adult life stages are plankton feeders in the water column.

Adult herring are also pelagic and undergo extensive migrations associate with feeding, spawning, and overwintering. Prey items include zooplankton, copepods, euphausiids, decapods, and bivalve larvae. The coastal stock of herring in the Gulf of Maine appears to migrate southwest along the coast after spawning and overwinter south of Cape Cod Bay. EFH for adults include pelagic waters and bottom habitats at depths from 20-130 meters with water temperatures less than 10°C and salinities greater than 28 ppt (NEFMC, 1998).

Although spawning occurs from July through November and EFH for spawning adults is the same as that for eggs, spawning adults and eggs have not been collected in Massachusetts Bay, which is not classified as EFH for Atlantic herring eggs nor spawning adults (NEFMC, 1998; Jury et al. 1994).

Potential for Onsite Occurrence and Impacts. Since Atlantic sea herring larvae are typically found at depths exceeding 50 meters, the project site and adjacent areas at the mouth of the Fore River are likely too shallow to function as EFH for these larvae. However, since juvenile and adult sea herring inhabit waters as shallow as 15 to 20 meters, the water column at the project site could serve as EFH for these life stages and/or serve as a source of planktonic prey. Because neither the juvenile nor adult life stages of Atlantic sea herring has any documented association with a particular benthic habitat or substrate type, the benthic habitat impacts associated with dredging and construction should not directly affect EFH for larval, juvenile, or adult Atlantic sea herring that may occur in the general vicinity of the project site at the mouth of the Fore River. Thus, a worst case impact scenario for the project would be short-term stress of any juvenile and adult Atlantic sea herring that may encounter temporary increases of surface water turbidity caused by silt-producing activities. However, since these temporary water quality impacts will be highly localized within the project area, the ability and behavioral tendency of pelagic fish to avoid turbid waters should significantly mitigate the risk of harm to this species.
Haddock (*Melanogrammus aeglefinus*) – Primary source: Cargnelli et al. (1999b). Haddock are a commercially important ground fish ranging from Newfoundland to Cape Hatteras in North America. Portions of Massachusetts Bay, inclusive of the project site, are designated as EFH for haddock eggs and larvae, but there is no EFH for juveniles, adults, or spawning adults that includes the project site (NEFMC, 1998; see Table 3-1). According to Jury et al. (1994), all life stages of haddock are rare in Massachusetts Bay and Boston Harbor, with adult haddock EFH occurring further offshore at depths from 40-150 meters in Georges Bank, the eastern side of Nantucket Shoals, and the Gulf of Maine.

Haddock eggs are present (although rare) in Massachusetts Bay from March through May but most abundant in April. Eggs are spawned over pebble and gravel substrates, then rise through the water column, so that early stage eggs become concentrated near the surface and later egg stages are distributed throughout the water column (Jury et al. 1994). EFH for haddock eggs occurs at depths from 50-90 meters with surface water temperatures below than 10°C and salinity from 34-36 ppt (NEFMC, 1998).

Designated EFH for haddock larvae includes Massachusetts Bay and other surface waters from Georges Bank southwest to Delaware Bay. Haddock larvae are pelagic and found primarily at water depths from 30-90 meters with salinity ranges from 34-36 ppt and surface water temperatures less than 14°C. Larvae are mostly found in Massachusetts Bay from January through July, with peak numbers in April and May.

Potential for Onsite Occurrence and Impacts. Because haddock eggs and larvae typically occur at water depths exceeding 50 meters, the project site at the mouth of the Fore River is too shallow to serve as EFH for these life stages. Given this water depth requirement of the eggs and larvae, it is not expected that any disturbance of the substrate or indirect effects on water quality at the mouth of the Fore River due to removal of structures, dredging or new bridge will affect haddock eggs, larvae or their EFH.

Ocean Pout (*Macrozoarces americanus*) – Primary source: Steimle et al. (1999c). The ocean pout is a boreal species ranging from Labrador to Delaware. Massachusetts Bay contains EFH for all life stages of ocean pout, including estuaries with salinity greater than 25 ppt that also support spawning adults (NEFMC, 1998). All life stages of ocean pout have a close association with the substrate.

EFH for eggs includes bottom habitats in water depths less than 50 meters with sea surface temperatures less than 10°C and salinities from 32-34 ppt (NEFMC, 1998). Due to low fecundity, relatively few eggs (< 4,200) are laid in gelatinous masses, generally in hard bottom sheltered nests, holes, or crevices where they are guarded by either the female or both parents (NEFMC, 1998). Eggs occur from August through December in Massachusetts Bay and Boston Harbor (Jury et al. 1994), but are rarely collected because of their deposition in demersal masses. The eggs may hatch directly to the juvenile stage without a true larval stage and newly hatched ocean pout remain in close proximity to hard bottom nesting areas.

EFH for Ocean pout larvae is similar to that for eggs, with water depths less than 50 meters and temperatures below 10° C, but having a greater range of salinities (greater than 25 ppt). Ocean pout larvae are most often observed from September through February (Jury et al. 1994).

Juvenile and adult ocean pout are common year-round in Massachusetts Bay and Boston Harbor (Jury et al. 1994). EFH for juveniles can include smooth bottom habitats near rocks or algae in water depths of less than 80 meters with water temperatures below 14°C and salinities greater than 25 ppt. Juvenile ocean pout appear to prefer habitat that provides cover, commonly being found sheltered under rocks, or associated with mollusk shells and algae. Prey items for juvenile ocean pout include small benthic organisms such as amphipods and polychaetes.
EFH for adults is demersal habitats with water depths less than 110 meters, temperatures below 15°C, and salinities ranging from 32-34 ppt. Adults are found on sand, gravel, and rough bottom, but rarely on mud. Food items for adults include echinoderms, mollusks, and crustaceans. EFH for spawning adults is hard bottom substrate, including artificial reefs and shipwrecks, at water depths less than 50 meters with temperatures below 10°C and salinities from 32-34 ppt (NEFMC, 1998). Ocean pout spawn from late summer through early winter, with peaks in September and October. Spawning in Massachusetts Bay was observed from August through October (Jury et al. 1994).

**Potential for Onsite Occurrence and Impacts.** Although all life stages of ocean pout may inhabit waters as shallow as those at the project site, the variable but often soft bottom substrates within the project impact footprint are not expected to serve as EFH for eggs or larvae that would be the least mobile and thus most vulnerable life stages. Any rocky habitat in the project vicinity that would be preferred for ocean pout eggs and larvae will not be directly affected by demolition, dredging or new bridge construction activities of the project. However, since any spawning of adult ocean pout in the project area may coincide with a portion of the silt-producing activities (from September 15th to October), any hard-bottomed spawning habitats that may occur within the mouth of the Fore River might experience some brief periods of elevated turbidity from project activities. There is unlikely to be any significant use of soft, silty mud or sandy substrates by juvenile or adult ocean pout within the disturbance footprint of the project and the lack of direct project impacts to any areas of hard benthic substrate that might be used for adult spawning and larval development. However, if juvenile and adult ocean pout occur at the site they are sufficiently mobile to avoid localized, short-term disturbances and areas with elevated turbidity caused by dredging or other silt-producing work activities, thus reducing the risk that they may be harmed by those activities.

**Pollock (Pollachius virens) – Primary source: Cargnelli et al. (1999c).** Pollock is a commercially and recreationally important species occurring from Greenland to North Carolina. Pollock are intermediate in their lifestyle between pelagic and demersal modes so that only the spawning habitat appears to be directly dependent on a specific substrate. Since Massachusetts Bay is designated as EFH for all life stages of pollock the project site has the potential to contain EFH for all pollock life stages.

Pollock eggs and larvae are pelagic and buoyant but not known to be associated with any specific substrate type. EFH for eggs is pelagic waters of the Gulf of Maine and Georges Bank, at water depths from 30-270 meters with temperatures less than 17°C and eggs are often observed from October through June, with peaks from November to February (NEFMC, 1998). In Massachusetts Bay and Boston Harbor, eggs generally occur in the water column from December through March, with peak numbers from December through February (Jury et al. 1994).

Pollock larvae are present in Massachusetts Bay from December through April, with highest numbers during December through February (NEFMC, 1998; Jury et al. 1994). EFH for pollock larvae is similar to that for eggs, with water depths from 10-250 meters and water temperatures less than 17°C, conditions that typically occur from December to April (NEFMC, 1998). Transformation from the larval to juvenile stage is gradual with no dramatic morphological changes, there is no obvious settlement to the bottom, and pollock is not strongly bottom-oriented in any life-history stage (Able and Fahay, 1998).

Juvenile and adult pollock inhabit the water column, feed primarily on pelagic prey, and can occur in Massachusetts Bay any month of the year (Jury et al. 1994). Juvenile pollock do not appear to be dependent upon a specific substrate type but are found in bottom habitats with aquatic vegetation and a substrate of sand, mud or rocks in the Gulf of Maine and Georges Bank. EFH for juveniles includes water depths up to 250 meters with temperatures below 18°C and salinities from 29 – 32 ppt (NEFMC, 1998). Numbers of juvenile pollock in Massachusetts Bay and Boston Harbor peaked in April through
June and September and October (Jury et al. 1994). The primary food items for juvenile pollock are euphausiids and other crustaceans, as well as amphipods, chaetognaths, and squid to a lesser degree.

Adult pollock occur year-round in Massachusetts Bay and Boston Harbor, but are fewest in summer (Jury et al. 1994). Adult pollock show little preference for bottom type but tend to inhabit deeper waters in spring and summer than in winter and typically occur further offshore than juveniles. EFH for adults includes hard substrate at water depths from 15-365 meters with temperatures less than 14°C and salinities from 31 – 34 ppt. Spawning occurs over hard, stony, or rocky bottom when water temperatures are less than 8°C, generally from September to April, with peaks from December to February (NEFMC, 1998). Adult pollock food includes pelagic prey such as euphausiids, other crustaceans, fish, and squid.

Potential for Onsite Occurrence and Impacts. Because pollock eggs and larvae are pelagic and buoyant, but not known to be associated with any specific substrate type, benthic habitat disturbances from dredging and bridge construction are not likely to directly impact the pelagic habitats of pollock eggs or larvae. However, since most pollock eggs occur at depths exceeding 30 meters, it also is unlikely that pollock eggs will occur in the relatively shallow waters at the project site. Both juvenile and adult pollock inhabit the water column and feed primarily on pelagic prey, so that they may be exposed to increased turbidity if they feed in the water column at the project site during periods of silt-producing activity. But since most juveniles inhabit water depths of 25 to 75 meters in Massachusetts Bay, significant numbers of juvenile pollock are not expected to inhabit the relatively shallow waters (< 25 meters) of the project site at the mouth of the Fore River. Any pollock eggs and larvae inhabiting the water column at the project site from November to February may be unable to avoid these localized areas of increased turbidity during silt-producing activities and thus may be adversely affected by short-term exposures to reduced surface water quality. In contrast, because juvenile and adult pollock can avoid these local impact areas, the project poses little or no overall risk of significant short or long term impact to any resident pollock population at the mouth of the Fore River.

Red Hake (Urophycis chuss) – Primary source: Steimle et al. (1999d). The red hake occurs in continental waters from the Gulf of St. Lawrence to the middle Atlantic States (Bigelow and Schroeder 1953). Based on the EFH maps, Massachusetts Bay is designated as EFH for all life stages of red hake. Estuaries and embayments in the project area that have salinity levels greater than 25 ppt also support EFH for larvae, juveniles, and adults.

Although the life stage summary table contradicts the EFH mapping for eggs, by not having listed EFH for eggs in the summary table, the designation of Massachusetts Bay as EFH for spawning adults corroborates its status as EFH for Red hake eggs. Red hake eggs are buoyant and float near the surface, but red hake eggs and larvae cannot be distinguished from the closely related white hake. EFH for eggs is defined as surface temperatures less than 10°C and salinity less than 25 ppt and red hake eggs are most often from May - November with peaks in June and July (NEFMC, 1998).

EFH for red hake larvae includes conditions of surface water temperatures less than 19°C, salinity greater than 0.5 ppt, and water depths less than 200 meters (NEFMC, 1998). Red hake larvae are common in the Middle Atlantic Bight and less so in the Gulf of Maine, suggesting that spawning in the Mid-Atlantic produces the majority of recruits to the Gulf of Maine stock. Red hake larvae are also pelagic and most often observed from May through December, with peaks in September - October (NEFMC, 1998). Since larval red hake associate with floating debris, sargassum and jellyfish, there is no known association between substrate type and the occurrence of red hake eggs and larvae.

Red hake juveniles occur year-round in Massachusetts Bay (Jury et al. 1994). EFH for juveniles includes water temperatures less than 16°C, depths less than 100 meters, and salinity from 31-33 ppt (NEFMC,
Newly metamorphosed juveniles remain pelagic until they reach lengths of 35-40 millimeters between September and December. At this size they begin to settle to the bottom on fine, silty sand at depths <120 meters. The presence of shelter is an important habitat requirement. Depressions in the substrate can be used as shelter for newly settled juveniles while older juveniles are found in association with structure or are found inquiline with sea scallops. The preferred substrate consists of shell fragments substrate and an abundance of live scallops. The association with sea scallops lasts until the red hake are about 10 to 13 centimeters in length. Food items for juvenile red hake include euphausiids, amphipods, decapods, and mysids.

Adult red hake occur year-round in Massachusetts Bay (Jury et al. 1994). Adult red hake are most common on soft substrate and less common on gravel or hard bottoms, where they can be found in depressions in soft sediments and may also use shell beds. Although adults prefer depths of 30 to 130 meters, they have been collected from 5 to 300+ meters. Adults are not often found on open sandy bottoms. Adult red hake prey on invertebrates similar to juveniles, but also feed on demersal fish and squid. EFH for adults includes bottom habitats in depressions with sand and mud substrates at depths from 10-130 meters with salinities from 33-34 ppt. Adults occur year-round in Boston Harbor and Massachusetts Bay (Jury et al. 1994). Local occurrences of red hake were reported by the Massachusetts Division of Marine Fisheries (DMF) during a 1970’s survey of the fisheries resources in the Weymouth Fore River area (Source: Iwanowicz, H.R., R.D. Anderson, and B.A. Ketschke. *A Study of the Marine Resources of Hingham Bay*. Monograph Series Number 14, Division of Marine Fisheries, Boston, MA, 1973).

EFH for spawning adults includes the same substrate and depth characteristics as adults, with water temperatures less than 10°C and salinity less than 25 ppt. Red hake commonly spawn from May-November with peaks in June and July (NEFMC, 1998).

Potential for Onsite Occurrence and Impacts. Due to the lack of clear associations of red hake eggs and larvae with specific substrate types, project impacts to benthic habitats are not expected to adversely affect EFH for these life stages. In contrast, juvenile and adult red hake are common fish found in close association with the bottom and given affinity for soft substrates they probably can be found at the mouth of the Fore River and within the project area, except for any bedrock areas. As noted above, in 1970 DMF reported red hake from the Weymouth Fore River area. Thus, dredging and bridge construction impacts to the benthic habitats within the project area may not directly disturb red hake egg or larval EFH but may cause short term impacts to EFH for juvenile and adult red hake.

Silver Hake or Whiting (*Merluccius bilinearis*) – Primary source: Lock and Packer (2004). Silver hake, also known as whiting, are distributed on the continental shelf of the northwest Atlantic and along coasts of the Gulf of Maine from the west coast of Nova Scotia to Cape Cod and south to Cape Hatteras (Bigelow and Schroeder 1953). Massachusetts Bay is designated as EFH for all life stages of silver hake, including spawning adults.

Silver hake eggs are pelagic and there is no known association between substrate characteristics and occurrence of eggs, which occur in Massachusetts Bay all year, with peak numbers from June through October (NEFMC, 1998). EFH for eggs is defined as water depths from 50-130 meters with temperatures less than 20°C.

Silver hake larvae are initially pelagic but become benthic at about 17 to 20 millimeters in length. There is no proven correlation between substrate characteristics and occurrence of silver hake larvae, which are observed all year, with peaks from July through September (NEFMC, 1998). EFH for larvae has the same temperature criterion as eggs (<20°C) but a narrower depth range of 50-130 meters (NEFMC, 1998).
Designated EFH for juveniles in Massachusetts Bay is defined as depths of 20-270 meters with water temperatures below 21°C and salinities greater than 20 ppt but there are no well documented substrate preferences (NEFMC, 1998). Juveniles were common in Massachusetts Bay and Boston Harbor from April through November (Jury et al. 1994). Juvenile silver hake prey primarily on crustaceans such as euphausiids and shrimp.

Adult silver hake can be found on almost all bottom types, but occur most often on silts and clay. As silver hake grow they become more piscivorous and individuals greater than 35 centimeters feed almost exclusively on fish. Designated EFH for adults and spawning adults in Massachusetts Bay is bottom habitats of all substrate types at depths of 30-325 meters (NEFMC, 1998). Adults occur at water temperatures below 22°C whereas spawning adults occur in cooler water temperatures below 13°C. Adults were common in Massachusetts Bay and Boston Harbor from April through December and spawning adults were common from May through September (Jury et al. 1994).

Potential for Onsite Occurrence and Impacts. Due to the relatively shallow waters at the site (< 25 meters), EFH is unlikely to occur for most life stages of silver hake due to the minimum water depth preferences of eggs and larvae (> 50 meters) or adults/spawning adults (> 30 meters). However, it is conceivable that the deeper waters of the project site or adjacent areas at the mouth of the Fore River may provide habitat for juvenile silver hake inhabiting the shallowest reaches of its EFH, which occurs over a wide range of substrate types at depths ranging from 20 to 270 meters. The ability of the juvenile and adult fish to avoid localized areas of elevated turbidity will significantly reduce their exposure to and potentially adverse effects of temporary water quality impacts.

White Hake (*Urophysis tenuis*) – Primary source: Chang et al. (1999a). Massachusetts Bay has been designated as EFH for egg, larval, juvenile, and adult life stages of white hake, but not for spawning adults.

EFH for white hake eggs and larvae are the surface waters of the Gulf of Maine, Georges Bank, and southern New England. White hake eggs and larvae cannot be distinguished from the closely related red hake. White hake eggs are buoyant and remain near the surface, being most often observed in August and September (NEFMC, 1998).

EFH for white hake larvae are the surface waters of the Gulf of Maine, Georges Bank, and southern New England, with larvae being most common in the Gulf of Maine and Georges Bank during August and September (NEFMC, 1998). Larval white hake are difficult to distinguish from red hake, but are pelagic and have no known association with a specific substrate.

Juvenile white hake are pelagic after transformation from the larval stage, becoming demersal at about 50 to 60 millimeters (total length). EFH for pelagic juveniles, which are most common from May through September, is similar to EFH for eggs and larvae (NEFMC, 1998). EFH for juveniles in their demersal stage includes muddy or fine-grained sand substrates with seagrass beds (eelgrass) at depths from 5-225 meters with water temperatures less than 19°C (NEFMC, 1998). Demersal juveniles feed primarily on polychaetes, shrimp and other crustaceans.

Adult white hake occur year-round in Boston Harbor and Massachusetts Bay but are most common in Massachusetts Bay from March through September (Jury et al. 1994). Adults are found most often on fine grained, muddy substrate, with EFH defined as mud or fine-grained sand substrates at depths from 5-225 meters with water temperatures less than 14°C. Adult white hake prey on fish, shrimps and other crustaceans.
EFH for spawning adults also is bottom habitats with a substrate of mud or fine-grained sand at depths from 5 - 325 meters with water temperatures below 14° C in the Gulf of Maine, the southern edge of Georges Bank, and southern New England to the middle Atlantic. White hake are most often observed spawning during the months April - May in the southern portion of their range and August - September in the northern portion of their range (NEFMC, 1998).

Potential for Onsite Occurrence and Impacts. Due to the lack of association between the eggs and larval life stages and any particular substrate, it is unlikely that disturbance of the substrate in the Port area or along the Pipeline Lateral corridor will directly impact egg and larval EFH of white hake. However, because EFH for all life stages of white hake includes shallow waters such as those found at the project site, it is possible that short-term impacts to water quality caused by silt-producing activities could adversely affect one or more life stages of white hake. Since eggs and larvae are less mobile than juvenile and adult fish, they are more vulnerable to localized turbidity increases, whereas the ability of the juvenile and adult fish to avoid localized areas of elevated turbidity will significantly reduce their exposure to and potentially adverse effects of temporary water quality impacts.

White Shark (*Carcharodon carcharias*) – Primary source: Consolidated HMS FMP (NMFS, 2006). Although the EFH mapper query indicated that Massachusetts Bay provides EFH for all life stages of the white shark, there is significant uncertainty as to both its EFH requirements and potential to occur at the site. An EFH summary document and species biological profile for the white shark is not yet available at the NMFS EFH Mapper website, but the EFH appendix from the Consolidated HMS FMP (NMFS, 2006) was posted by NMFS as a source of available information on the white shark. The following species biological profile for the white shark was derived from this document.

The white shark is the largest of the lamnid, or mackerel, sharks. It is a poorly known apex predator found throughout temperate, subtropical, and tropical waters, present sporadically throughout its range, with a few localities (e.g., off California, Australia, and South Africa) where it is seasonally common. Large adults prey on seals and sea lions and are sometimes found around their rookeries. The white shark is also a scavenger of large dead whales. It has been described as the most voracious of the fish-like vertebrates and has been known to attack bathers, divers, and even boats.

White sharks are believed to mature at between 370 and 430 cm at an estimated age of nine to ten years. Very little is known of its reproductive processes because only two gravid females have been examined by biologists in modern times, both of which contained seven embryos, although recent observations show that white sharks carry seven to ten embryos that are born at 120 to 150 cm. The types of habitats and locations of nursery areas are unknown. It is likely that the nurseries will be found in the warmer parts of the range in deep water.

The white shark is a prized game fish due to its size and is occasionally caught in commercial long lines or in near-shore drift gillnets, but must be released in a manner which maximizes its survival. Preliminary observations show that populations may be small, highly localized, and vulnerable to overexploitation. There are no published population assessments, or even anecdotal reports, indicating any population decreases of the white shark, but as a scarce, long-lived species of apex predator with limited reproductive potential it is vulnerable to long lines.

NMFS (2006) reported the status of Essential Fish Habitat designations for White Shark as:

- Neonate (> 166 cm TL): At this time, available information is insufficient for the identification of EFH for this life stage.
- Juveniles (167 to 479 cm TL): Offshore northern New Jersey and Long Island, NY in pelagic waters from the 25 to 100 meter isobath in the New York Bight area, bounded to the east at 71.5°W and to the south at 39.5°N; also, offshore Cape Canaveral, FL between the 25 and 100 m isobaths from 29.5° N south to 28°N.

- Adults (≤ 480 cm TL): At this time, available information is insufficient for the identification of EFH for this life stage.

Potential for Onsite Occurrence and Impacts. Although the EFH mapper query indicated that Massachusetts Bay provides EFH for all life stages of the white shark, significant uncertainty remains as to its EFH requirements and potential to occur at the site. Given the rarity of this species and reports that juvenile white sharks inhabit pelagic waters at depths from the 25 to 100 meter isobath in the New York Bight area, it is reasonable to expect that white sharks would not inhabit or use the much shallower waters at the site (< 25 meters) for feeding or any other activity. Although the project is not expected to have any adverse effects on EFH for juvenile white sharks, potential risks to other life stages cannot be evaluated due to a lack of species biological information. Given the documented rarity of this species, it is unlikely that any individuals would inhabit or visit the project area, but any that do could easily avoid localized areas where silt-producing activities cause short-term turbidity increases.

Windowpane Flounder (*Scopthalmus aquosus*) – Primary source: Chang et al. (1999b). Windowpane flounder is a coastal flatfish species distributed from the Gulf of St. Lawrence to South Carolina (Bigelow and Schroeder 1953). Massachusetts Bay is designated as EFH for all life stages of windowpane flounder, including EFH for spawning adults in estuaries with salinities greater than 25 ppt (NEFMC, 1998).

EFH for eggs and larvae in the project area is surface waters with temperatures less than 20°C and water depths of less than 70 meters (NEFMC, 1998). Windowpane flounder eggs are often observed from February to November, with peaks in May and October in the middle Atlantic and July - August on Georges Bank (NEFMC, 1998). Windowpane eggs are buoyant and pelagic and are most common at depths less than 70 meters. The larvae are also pelagic up to a length of about 10 millimeters (total length) after which they settle on the bottom and develop into juveniles.

Juvenile and adult windowpane flounder are common year-round, with adults being most common from March through November (Jury et al. 1994). EFH for juvenile windowpane is found on muddy and fine sandy sediment at depths less than 100 meters with water temperatures below 25°C and salinities of 5.5-36 ppt (NEFMC, 1998). Amphipods, mysids, and decapod shrimp are primary food items for juvenile windowpane flounder.

Adult windowpane occur year-round in Massachusetts Bay at depths less than 75 meters but are most common from March through November (Jury et al. 1994). Adults are found on muddy and fine sandy sediments and designated EFH for adults and spawning adults are water depths from 1-75 meters with salinities of 5.5-36 ppt (NEFMC, 1998). Adults occur at water temperatures below 26.8°C, while spawning adults are found in cooler waters below 21°C (NEFMC, 1998). Windowpane flounder are most often observed spawning during the months February – December, with a peak in May in the middle Atlantic (NEFMC, 1998). Primary food items of adult windowpane are small crustaceans and fish larvae.

Potential for Onsite Occurrence and Impacts. Because pelagic eggs and larvae of windowpane flounder are not associated with specific types of benthic habitat or bottom substrate, the dredging and bridge construction should not directly alter or physically affect any egg and larval EFH that may occur at the mouth of the Fore River. A variety of substrate types occurs within the impact footprint of the project,
including the mud or fine-grained sands used by juvenile, adult and spawning adult windowpane, so that

direct impacts to and/or alteration of these benthic habitats may result from dredging and bridge
construction activities. However, since all life stages have the potential to occur in shallow habitats such
as those at the project site, indirect impacts to one or more life stages inhabiting the bottom or water
column also could be mediated by temporary, localized increases in turbidity silt-producing activities. In
the case of both direct impacts to benthic habitat and indirect impacts mediated by increased turbidity, the
juvenile and adult fish are less likely to be adversely affected than eggs and larvae, due to their greater
mobility and avoidance behavior. Thus, the potential risk of short-term impacts to windowpane flounder
is greater than that for juvenile and adult fish.

**Winter Flounder (Pleuronectes americanus) – Primary source: Pereira et al. (1999).** Winter flounder

is an economically important flatfish occurring in coastal waters from the Strait of Belle Isle south to
Georgia, being ubiquitous in inshore areas from Massachusetts to New Jersey (Bigelow and Schroeder 1953).
Massachusetts Bay is designated as EFH for all life stages of winter flounder, including spawning
adults (see Table 3-1; NEFMC, 1998).

EFH for winter flounder eggs includes bottom substrates of sand, muddy sand, mud and gravel at depths
less than 5 meters with water temperatures less than 10°C and salinities ranging from 10-30 ppt (NEFMC,
1998). Eggs of winter flounder are demersal, adhesive and closely associated bottom substrates, so that
all shallow waters less than 5 meters deep can be considered as potential EFH for winter flounder eggs.
Eggs most commonly occurred in Massachusetts Bay and Boston Harbor from January through July, with
peak numbers from February through May (Jury et al. 1994).

EFH for larvae in the project area is inshore areas in southern New England, where sea surface
temperatures are less than 15°C, salinities range between 4 and 30 ppt, and water depths are less than 6m.
Larvae occur from February through August with peaks from March through May in Boston Harbor and
Massachusetts Bay (Jury et al. 1994). Winter flounder larvae do not disperse far from egg habitat and
remain in close association with the bottom. Assuming that larval winter flounder remain close to the egg
habitat, the same areas considered to be egg habitat/EFH are also larval habitat/EFH.

Juvenile winter flounder were highly abundant year-round in Boston Harbor and Massachusetts Bay (Jury
et al. 1994). Juveniles do not appear to have a well-defined preference for substrate, but they are reported
to be most abundant on mud and sand substrate and disperse to depths of 18 meters. EFH for YOY
winter flounder juveniles is bottom habitat with a substrate of mud or fine grained sand at depths from 0.1
- 10 meters with water temperatures below 28°C and salinities between 5 – 33 ppt (NEFMC, 1998). EFH
for juveniles is mud or fine-grained sand bottom habitats at depths from 1-50 meters with water
temperatures less below 25°C and salinities between 10-30 ppt (NEFMC, 1998). Juvenile winter flounder
prey on sand dollars, bivalve siphons, polychaetes, amphipods and shrimp.

Adult winter flounder also were highly abundant year-round in Boston Harbor and Massachusetts Bay
(Jury et al. 1994). Adult winter flounder can occur on mud, sand, cobble, rocks, and boulder substrates,
but it appears that they are more common on soft substrate such as muddy sand. Local occurrences of
winter flounder were reported by the Massachusetts DMF during a 1970’s survey of the fisheries
resources in the Weymouth Fore River area (Source: Iwanowicz, H.R., R.D. Anderson, and B.A.
Ketschke. A Study of the Marine Resources of Hingham Bay. Monograph Series Number 14, Division of
Marine Fisheries, Boston, MA, 1973). Prey items for adult winter flounder include amphipods,
polychaetes, bivalves, fish eggs, and crustaceans.

Designated EFH for adults is bottom habitats with mud or fine grained sand at depths from 1-100 meters
with temperatures less below 25°C and salinities between 15-33 ppt (NEFMC, 1998). EFH for spawning
adults is bottom habitats with sand, muddy sand, sand, mud or gravel at depths less than 6 meters in
inshore areas with temperatures below 15°C and salinities between 5.5-36 ppt (NEFMC, 1998). Spawning most commonly occurs during February through June. According to a July 2009 letter from the Massachusetts DMF, the Weymouth Fore River serves as migratory and spawning habitat for several species of anadromous and estuarine-spawning finfish, including winter flounder.

Potential for Onsite Occurrence and Impacts. Because pelagic eggs and larvae of winter flounder are not associated with specific types of benthic habitat or bottom substrate, the dredging and bridge construction should not directly alter or physically affect any egg and larval EFH that may occur at the mouth of the Fore River. As noted above, DMF reported local occurrences of winter flounder during a 1970 survey of the fisheries resources in the Weymouth Fore River area and has documented this area as migratory and spawning habitat for winter flounder. Since substrate types within the impact footprint of the project include mud or fine-grained sands used by juvenile, adult, and spawning adult winter flounder, direct impacts to and/or alteration of these benthic habitats may result from dredging and bridge construction activities. Since all life stages have the potential to occur in shallow habitats such as those at the project site, indirect impacts to one or more life stages inhabiting the bottom or water column also could be mediated by temporary, localized increases in turbidity silt-producing activities. In the case of both direct impacts to benthic habitat and indirect impacts mediated by increased turbidity, the juvenile and adult fish are less likely to be adversely affected than eggs and larvae, due to their greater mobility and avoidance behavior. Thus, the potential risk of short-term impacts to any locally occurring winter flounder eggs and larvae will be greater than that for juvenile and adult fish.

Yellowtail Flounder (Pleuronectes ferruginea) – Primary source: Johnson et al. (1999b). In North America, yellowtail flounder range from Labrador to the Chesapeake Bay (Bigelow and Schroeder 1953), being most abundant on the western half of Georges Bank, the western Gulf of Maine, east of Cape Cod, and southern New England. Massachusetts Bay is designated as EFH for all life stages, including spawning adults found in estuaries with salinities greater than 25 ppt (NEFMC, 1998).

Yellowtail flounder eggs are pelagic, occurring near the surface in waters 10-750 meters deep, but appear more frequently in waters 30-90 meters deep. Designated EFH for eggs includes areas with water depths ranging from 30-90 meters, sea surface temperatures below 15°C, and salinities ranging from 32.4-33.5 ppt (NEFMC, 1998). Eggs occur in surface waters in Boston Harbor and Massachusetts Bay from April to September with peaks from May to July (Jury et al 1994).

EFH for yellowtail flounder larvae in Massachusetts Bay includes water depths from 10-90 meters with sea surface temperatures below 17°C and salinities ranging from 32.4-33.5 ppt (NEFMC, 1998). There is no proven correlation between substrate type and yellowtail flounder eggs and larvae. Larvae are observed in surface waters from May through July in Southern New England (NEFMC, 1998).

Juvenile yellowtail flounder become demersal at lengths of 11.6 to 16 millimeters (standard length). EFH for juveniles in the Gulf of Maine, Georges Bank and the southern New England shelf is bottom habitat with sand or sand and mud substrates at water depths ranging from 20-50 meters with temperatures below 15°C and salinities from 32.4-33.5 ppt (NEFMC, 1998). Juveniles are abundant in Boston Harbor and Massachusetts Bay year-round (Jury et al. 1994). Prey for juvenile yellowtail flounder include benthic macrofauna such as amphipods, polychaetes, and sand dollars.

Adult yellowtail flounder have substrate and depth preferences similar to juvenile fish and are abundant year-round in Massachusetts Bay (Jury et al. 1994). EFH for spawning adults is similar to that for juveniles and adults except that water depths range from 10-125 meters with temperatures below 15°C
Spawning adults are most common in Boston Harbor and Massachusetts Bay from April through August (Jury et al. 1994).

**Potential for Onsite Occurrence and Impacts.** Since EFH for yellowtail flounder eggs occurs at depths from 30-90 meters, the relatively shallow water at the site (< 25 meters) may not provide EFH capable of supporting these eggs. Because pelagic eggs and larvae of yellowtail flounder are not associated with specific types of benthic habitat or bottom substrate, the dredging and bridge construction should not directly alter or physically affect any egg and larval EFH that may occur in any adjacent, deeper waters at the mouth of the Fore River. A variety of substrate types occurs within the impact footprint of the project, including the mud or fine-grained sands used by juvenile, adult and spawning adult yellowtail flounder, so that direct impacts to and/or alteration of these benthic habitats may result from dredging and bridge construction activities. However, since all yellowtail life stages except eggs have the potential to occur in shallow habitats such as those at the project site, indirect impacts to one or more life stages inhabiting the bottom or water column also could be mediated by temporary, localized increases in turbidity silt-producing activities. In the case of both direct impacts to benthic habitat and indirect impacts mediated by increased turbidity, the juvenile and adult fish are less likely to be adversely affected than larvae, due to their greater mobility and avoidance behavior. Thus, the potential risk of short-term impacts to any local populations of yellowtail flounder larvae will be greater than that for juvenile and adult fish.
5.0 SUMMARY OF POTENTIAL PROJECT IMPACTS TO EFH AND PROPOSED MITIGATION

Although Massachusetts Bay is designated EFH for various life stages of 16 species of shellfish and fish, the intertidal and subtidal habitats at the Fore River Bridge project site are too shallow (< 25 meters) to serve as EFH for most or all life stages belonging to six of these fish species (American plaice, Atlantic bluefin tuna, Atlantic halibut, haddock, silver hake (aka whiting), and white shark; NEFMC, 1998; see Table 3-1). However, the shallow water and diversity of substrates found at the site and/or in deeper adjacent waters at the mouth of the Fore River could serve as EFH for one or more life stages of the other ten species for which Massachusetts Bay is designated as EFH: Atlantic sea scallop, Atlantic cod, Atlantic sea herring, ocean pout, pollock, red hake, white hake, windowpane flounder, winter flounder and yellowtail flounder. Several of these EFH species were found by the Massachusetts Division of Marine Fisheries (DMF) during a 1970’s survey of the fisheries resources in the Weymouth Fore River area, including Atlantic cod, red hake and winter flounder (Source: Iwanowicz, H.R., R.D. Anderson, and B.A. Ketschke. *A Study of the Marine Resources of Hingham Bay.* Monograph Series Number 14, Division of Marine Fisheries, Boston, MA, 1973).

Species-specific comments on the potential for each life stage of all 16 species to occur at the project site and be directly or indirectly affected by project activities were provided in the previous EFH and species descriptions. These evaluations form the basis for the following overview of the relative risk and nature of potential impacts to life stages of those nine species for which the site could conceivably serve as EFH.

5.1 Overview of Potential Project Impacts to EFH

Open estuarine water and subtidal habitats in the Fore River will be temporarily and permanently affected by the project. Permanent impacts on potential EFH at the project site may result from channel dredging, the placement of bridge pier foundations, dolphins, and fenders. As a bridge replacement project, however, these structures represent only a minimal permanent change to the existing estuarine habitats at the mouth of the Fore River. No areas of submerged aquatic vegetation (SAV) such as eelgrass or macroalgae, nor vegetated tidal wetlands occur in or adjacent to the project. The nearby tidal flats will not be disturbed by the project and any fine sediment transported to this area will represent a small pulse not dissimilar to that which occurs during regular storm events. Since no direct impacts to these tidal marshes and flats will occur, the project will not adversely affect any portions of these habitats that may function as Massachusetts Bay EFH that supports one or more life stages of the ten EFH species with the greatest potential to occur in the vicinity of the project.

Construction impacts on EFH may include direct contact of EFH species with construction and dredging equipment, increased sedimentation and water turbidity in the immediate vicinity of the construction work area, remobilization of existing sediment contamination or inadvertent introduction of pollutants to EFH, and impacts to relatively immobile prey resources of EFH species that cannot escape these localized impacts. Because EFH varies significantly among the life stages of the species based on water depth, salinity, water temperatures, and the seasonal abundance of each life stage, the timing of work activities will determine the potential duration/severity of risk and impacts that the project will have on local areas of EFH and EFH life stages. The primary risk of impacts to EFH are dredging and other activities that temporarily increase suspended sediments in the water column, whereas this bridge replacement will not result in an ecologically significant net loss of EFH.

In water construction activities will temporarily affect the water quality of the Fore River, marine aquatic habitats, and the benthic community. In water construction activities also will physically impact these resources in the immediate location of the bridge, so that any local areas of EFH and/or resident life stages of EFH species may also be impacted by the temporary disturbances and alterations of benthic...
habitats. Yet, the substrate and banks of the channel and Navigation Channel will continue to provide the same types of habitats, ecological functions and values as existed prior to the bridge replacement project, so that no significant net loss nor degradation of local EFH is anticipated.

5.2 Potential Risks of Physical Impacts to Benthic Habitats and EFH

Temporary disturbances of benthic substrates that may serve as EFH for some species and life stages, such as all three EFH species of flounder, will result from the removal of existing structures while permanent alterations or losses of benthic substrate will result from dredging and construction of new bridge supports and other structures. For example, winter flounder are reported to forage and spawn in the Weymouth Fore River area and this species has demersal eggs that can be harmed by smothering if excessive sediment deposition occurs. Eggs that are present on the substrate in dredging areas would suffer mortality during dredging activity. Although demersal life stages of EFH fish species (e.g., flounder) and macroinvertebrates (sea scallop) may be lost within the dredging footprint area, the more mobile life stages and EFH species will be able to avoid the physical impacts and turbidity increases from dredging and construction activities. Despite their immobility, it is unlikely that benthic EFH and demersal stages of EFH species in areas subject to sedimentation would suffer mortality since resettlement rates would be slow enough to enable them to remain unburied or gradually move away from the impact areas.

5.3 Potential Risks of Impacts versus Benefits from Sediment Removal

Conventional dredging will increase suspended sediment concentrations to varying degrees depending on the grain sizes of material removed. Sands and gravels would be deposited within and immediately adjacent to the work area while silts and clays would be dispersed and resultant turbidity decreased by tidal currents and river flow. The dredging of sediments may result in the inadvertent loss of any Atlantic sea scallops, demersal fish eggs, and juvenile or adult fish of bottom feeding species that may occur at the site (e.g., flounder species).

Sediment disturbance from dredging and vessel positioning also temporarily reduce the abundance of benthic macro-invertebrate prey of EFH fish species, due to the removal and/or smothering of these benthic organisms. However, benthic infaunal invertebrates would recolonize the Fore River habitats with fine-grained sediments and the benthic community would be expected to recover quickly due to the presence of pioneering species with high reproductive capacities that reside near the sediment surface and are adapted to recovering from frequent stresses (e.g., Streblospio benedicti and Polydora sp.) A benthic analysis was performed in November 2009 and these species were found to be abundant.

Due to the low to moderate levels of inorganic and organic sediment contamination at the project site, sediment removal also represents a beneficial impact on the benthic habitats that may serve as EFH for scallops and several life stages of other EFH species. For example, the mean concentrations of several polynuclear aromatic hydrocarbons (PAHs) exceed published sediment ecotoxicity thresholds compiled by NOAA (Buchman, 2008), such as the Apparent Effects Threshold (AET) for marine biota, including echinoderms and bivalves, by an order of magnitude or greater. Mean inorganic concentrations, however, pose less potential risk since they slightly exceed only the threshold effect levels (TELs), which are the lowest, most conservative and protective sediment benchmark criteria. Finally, the inorganic and organic contaminants that become suspended should not have any bioaccumulation effects on local, pelagic food chains due to the low bioaccumulation potential of the metals and PAHs, as well as the insolubility of the PAHs that will remain adsorbed to organic carbon in the sediment particles while suspended only briefly.
5.4 Potential Risks of Water Quality-Mediated Impacts from Silt-producing Activities

During construction of the new Fore River Bridge, several in-water activities will occur, ranging from removal of the temporary bridge footings, to installation of new dolphins, foundations, and channel dredging. After reviewing each in-water activity for potential impact to the environment, six “silt producing” activities were identified that have the greatest potential impact or environmental consequence.

Silt producing activities include:

- Dredging for widening the navigation channel to install the proposed fender system,
- Dredging for the temporary channel for short-term use during construction
- Removal of existing submarine utility cables
- Removal of the temporary bridge fender system, dolphins, and foundations
- Extraction of select remnants of the 1936 bridge foundations
- Installation of submarine cable (approximately 8-feet deep) between proposed bridge towers

These activities will cause localized, short-term impacts to water quality due to increases of turbidity from sediment resuspension and also may result in redeposition of suspended sediment onto benthic portions of EFH that may be used by one or more life stages of EFH species. Pelagic finfish larvae and adults of EFH species would be minimally affected by the project. Pelagic and demersal larvae of EFH species may be unable to avoid localized areas of turbidity and suspended solids and thus be adversely affected, whereas adults could avoid construction activities and be only temporarily displaced. However, diminished water quality is expected to be temporary, highly localized, and has been scheduled to occur outside of the sensitive spawning and developmental periods for many of these EFH species. Since many life stages of EFH species feed on benthic macroinvertebrates any short-term water quality impacts to benthic biota may result in a temporary but very localized and ecologically insignificant reduction in benthic prey species populations. Benthic re-colonization of the macroinvertebrate prey of these EFH species can commence within weeks to months following construction.

Since inorganic contaminants in the sediments have the highest solubility, turbid waters may experience a brief increase in dissolved metal concentrations, but given the low, non-toxic levels of metals in these sediments, any short term increases are unlikely to have an adverse effect on pelagic EFH for free-swimming life stages of fish species. In contrast, the organic sediment contaminants such as PAHs, although occurring at higher concentrations that may pose existing risk to benthic biota, are very insoluble in water so that sediment resuspension is very unlikely to result in localized increases in dissolved and thus bioavailable concentrations of PAHs in the water column. Thus, the short-term, localized increases in turbidity may adversely affect pelagic stages of eggs and larvae of EFH species, but are unlikely to have a significant adverse impact on juvenile and adult life stages of EFH species since these fish are sufficiently mobile to escape the turbidity.

Mitigation measures to reduce temporary water quality impacts from sediment resuspension, turbidity, and sediment redeposition within EFH may include containing all silt-producing work within bottom anchored silt-curtains and cofferdams, where feasible. If containment methods are not feasible at this site, timing restrictions may be imposed to avoid in-water, silt-producing work during seasonal periods of vulnerability for EFH species. For example, as part of permitting and environmental assessment process potential impacts and mitigation measures for the in-water work have been considered. Based on the initial consultation letter received from the DMF dated July 10, 2009, MassDOT will apply a timing restriction window for silt-producing activities from February 15 to September 15th. This restriction is based on the need to avoid and/or minimize impacts to sensitive life stages of marine fisheries resources,
including spawning periods for EFH species such as winter flounder (February 15 to June 30). Although sensitive life stages of several other EFH species do occur in Massachusetts Bay during the proposed periods of silt-producing activity, the seasonal restrictions on silt-producing activity will help to reduce the duration of exposures of several EFH life stages to localized turbidity increases.

5.5 Potential Risks of Contaminant Releases

There is also a possibility for localized impacts to local EFH and sensitive life stages of EFH species from accidental spills of fuel, lubricants, or hydraulic fluid from boats, barges and construction equipment. Accidental spills of construction-related fluids (e.g., oil, gasoline, or hydraulic fluids) onto the shoreline landscape or directly into water bodies could have harmful or toxic effects on fish and shellfish, depending on the type and quantity of the spill, and the dispersal and attenuation characteristics of the water body. To reduce and mitigate the risk of spills, boats, barges and construction equipment will have spill kits readily available for use in the case of smaller accidental spills, while an on-call contractor will be available for larger emergency spill responses. All accidental spills will be reported to the appropriate state and federal agencies in accordance with state and federal regulations and a Project specific Spill Prevention Control and Countermeasure Plan (SPCC Plan) will be developed and incorporated into the construction requirements of the project.
6.0 CONCLUSIONS

Although Massachusetts Bay is designated as EFH for the Atlantic sea scallop and 15 species of fish, only ten of these species have one or more life stages for which the Fore River Bridge project site has the water depths and/or other habitat features needed to serve as EFH for one or more life stages:

- Atlantic sea scallop - Placopecten magellanicus
- Atlantic cod - Gadus morhua
- Atlantic sea herring - Clupea harengus
- ocean pout - Macrozoarces americanus
- pollock - Pollachius virens
- red hake - Urophycis chuss
- white hake - Urophycis tenuis
- windowpane flounder - Scopthalmus aquosus
- winter flounder - Pleuronectes americanus, and
- yellowtail flounder - Pleuronectes ferruginea

Massachusetts Bay is designated as EFH for all life stages for eight of these species but not for eggs and spawning adults of Atlantic herring, nor for spawning adults of white hake. However, as noted in Table 3-1, despite having EFH elsewhere in Massachusetts Bay, the water depths at the project site are likely too shallow to provide EFH for a few life stages of some of these ten species:

- Atlantic cod larvae and juveniles, which generally occur at depths of 25 to 75 meters (82 to 246 feet)
- Atlantic herring larvae, mostly found at depths of 50 to 90 meters (164 to 295 feet), and
- pollock eggs, typically occurs at depths of 30 to 270 meters (98 to 886 feet).

Because the bridge replacement will not cause a net loss of benthic habitat that may serve as EFH for one or more life stages of the ten species having the greatest potential to inhabit or visit the site, no permanent impacts on EFH habitat are expected from the project. The primary risks of adverse, short-term impacts to EFH and the least mobile, most vulnerable life stages of EFH species will be short-term stressors such as physical habitat disturbances and highly localized exposures to degraded surface water quality caused by increases in turbidity from silt-producing activities. Although some losses of the most sensitive life stages of one or more species may occur, such as eggs, larvae or demersal juveniles that are unable to avoid localized disturbances, juvenile and adult fish are very unlikely to be harmed by these impacts due to their mobility and behavioral tendency to move away from active work areas and areas with degraded water quality. Finally, temporary reductions in the abundance of benthic macroinvertebrate prey that may support local populations of bottom-feeding EFH species will be minor and ecologically insignificant for all life stages and EFH species of bottom-feeding fish.

Therefore, the most appropriate conservation measure that the Project can allow is to incorporate a time of year restriction on silt-producing activities. The project is proposing to avoid major silt producing activities during the winter flounder and migratory fish period of February 15 to September 15. Therefore, major silt producing activities—such as channel dredging, removal of buried submarine utility lines, installation of the submarine cable, and extraction of select remnants of the 1936 bridge foundation—will take place outside of fish spawning and migratory windows (such work will occur during fall and winter months from 9/15 to 2/15).
7.0 REFERENCES


National Marine Fisheries Service (NMFS). July 2006. Consolidated Atlantic Highly Migratory Species Fishery Management Plan, Appendix B Essential Fish Habitat. [Note: This partial document was posted at NMFS EFH Mapper website, without a full source citation, as EFH data source for sharks and tuna.]


