NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency:	Federal Highway Administration (lead), Army Corps of Engineers, New England District
Activity Considered:	Maine Department of Transportation Replacement of the Grist Mill Bridge in Hampden, Maine **NER-2018-14994**
Conducted by:	National Marine Fisheries Service Greater Atlantic Regional Fisheries Office
Date Issued:	NOV 2 3 2018
Approved by:	

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TABLE OF CONTENTS

FIGURES

TABLES

1.0 INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of your (Federal Highway Administration (FHWA)) proposed replacement of the Grist Mill Bridge, which carries U.S. Route 1A over the Souadabscook Stream in Hampden, Maine. Maine Department of Transportation (MaineDOT) is proposing the replacement; however, you are funding the project, and the project will require a permit from the U.S. Army Corps of Engineers (USACE) under their Section 404 permitting process. In an email sent August 14, 2018, USACE agreed that you would be the lead Federal action agency for ESA section 7 formal consultation. This Opinion is based on your Biological Assessment (BA) received by us on August 2, 2018, the revised BA with an updated project description received on September 25, 2018, and additional information received via email on October 1 and October 4, 2018. Those analyses, along with scientific papers and other sources of information as cited in the references section, form the basis of this Opinion. A complete administrative record of this consultation will be kept at our NMFS Greater Atlantic Regional Fisheries Office.

2.0 ESA CONSULTATION HISTORY

Prior to your submission of the BA, our agencies took part in several pre-consultation coordination meetings, inclusive of project site visits and conference calls. On May 18, 2018, we received a draft of your BA for review and comment. Following a site visit on June 22, 2018, we provided comments on the draft BA on July 11, 2018. On August 2, 2018, you submitted a final draft of your BA and a letter requesting initiation of formal consultation. Formal consultation regarding the replacement of the Grist Mill Bridge is appropriate as you have determined the project is likely to adversely affect the endangered Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic salmon and critical habitat designated for the GOM DPS of Atlantic salmon. You have determined that the project is not likely to adversely affect endangered shortnose sturgeon or the GOM DPS of Atlantic sturgeon. Lastly, you determined the project would not affect critical habitat designated for the GOM DPS of Atlantic sturgeon.

All information required to initiate formal section 7 consultation was included in your August 2, 2018, letter and BA, or is otherwise accessible for our consideration and reference; therefore, the date of the August 2, 2018, correspondence served as the commencement of the formal consultation process.

3.0 DESCRIPTION OF THE PROPOSED ACTION

FHWA proposes to fund MaineDOT construction of a new bridge to replace the existing Grist Mill Bridge, which carries U.S. Route 1A over the Souadabscook Stream in Hampden, Maine. USACE will permit the construction.

3.1 Description of the Existing Bridge

The existing Grist Mill Bridge (Figure 1) is a single span buried concrete T-beam structure that is 51 feet in length and 30.2 feet in width curb-to-curb. The abutments are concrete-jacketed granite masonry abutments with attached concrete wingwalls on three of the four corners. The abutments and wingwalls rest directly on bedrock. The corner without a concrete wingwall has a stacked granite retaining wall. A previously connected dam immediately upstream of the bridge was removed in the late 1990s. Remnants of the dam are still present beneath the bridge, including part of a concrete sluiceway at the downstream southern abutment.

Figure 1: Downstream view of the existing Grist Mill Bridge and sluiceway wall

The condition of the current superstructure is rated "poor" and the substructure is rated "fair." Corrosion is visible in many locations. You are proposing this project concurrently with an overlapping highway reconstruction project (WIN 11577.00), which is recommending 5-ft shoulder and 11-ft lanes as well as the introduction of a 5-ft sidewalk along the west edge of the roadway. This roadway width across the bridge is narrower than the proposed highway reconstruction project. Also, the sidewalk that is planned for the corridor cannot be accommodated within the existing bridge footprint.

3.2 Description of the Proposed Replacement Bridge

The proposed bridge is a 37-foot wide, 75-foot long single span steel plate girder structure with full height abutments and wingwalls on spread footings. The approximate bankfull width of the channel in the vicinity of the bridge is 100 feet. The vertical and horizontal alignments of the proposed structure will closely match existing conditions. The proposed structure will increase the hydraulic opening at this crossing due to the longer span, proposed 1.75:1 slopes within the structure from the face of the abutments to the streambed, and the elevation of the bottom of the proposed structure being approximately 5 feet higher than existing. The face of the south abutment is proposed to be located approximately 12 feet behind the face of the existing abutment, with minimal riprap in front of the abutment to help reduce south abutment wingwall lengths. The north abutment would be positioned further behind the existing abutment to allow for riprapped fill slopes extending to 2 feet beneath the low chord of the girders, thereby minimizing wingwall lengths and avoiding conflicts with the existing abutment during construction. The concrete sluiceway that was part of the former dam will be removed as part of this project.

The bridge will be closed during construction, and you are not proposing to erect a temporary bridge for traffic control. While the bridge is closed, a signed detour route will be provided on Maine Route 9, US Route 202, and I-395. You are planning to adopt Accelerated Bridge Construction techniques to minimize the duration of construction. Construction is tentatively scheduled to begin in spring 2019. Construction will be completed in approximately 4 months, which will include an in-water work duration of 10 to 15 days. Although the construction start date is not yet known, and final construction sequencing will be determined by the contractor, it is anticipated that in-water work will take place 10 to 13 weeks from the start of work, which will likely result in the in-water work being completed between July 1 and September 30. The concurrent highway project, which we consider part of the proposed action and analyzed here, includes reconstruction of approximately 1.7 miles of Route 1A in Hampden. The only portion of the reconstruction work that may affect endangered species is the installation of a riprap downspout for a drainage pipe. The downspout includes 25 square feet of riprap that is placed being at or below the Highest Annual Tide (HAT) line approximately 75 feet from the riprap being placed at the bridge replacement project.

3.2.1 Construction

This project will be going out to bid through the MaineDOT public bidding process. In order to maintain competitiveness during the bid process, you have not finalized the means and methods of construction, giving contractors the ability to propose specific methods and equipment. Although construction methods are flexible during the bidding process, the winning bidder must adhere to MaineDOT's established specifications and effective conservation measures during construction activities.

All elements of the project will be conducted in compliance with MaineDOT's Standard Specifications (MaineDOT 2014[1]). The Standard Specifications is a textual compilation of provisions and requirements for the performance of any MaineDOT work and includes general Avoidance and Minimization Measures (AMMs). AMMs are measures that prevent or reduce the impact of a project on listed species or habitats. AMMs can be precautionary, avoidance, or protection procedures, such as timing restrictions or buffers around sensitive habitats and habitat features that are important to listed species. In addition to following MaineDOT AMMs, construction actions also include implementation of best management practices (BMPs). BMPs are methods, facilities, build elements, and techniques implemented or installed during project construction to prevent or reduce project impacts on natural resources, such as water quality, soil, and animal habitats. AMMs and BMPs are measures that are considered part of the proposed activity that will be implemented. Each description below is followed by, or references, previous appropriate AMMs that address potential impacts from construction actions. AMMs are stated and numbered in order to ensure they can be clearly transferred to MaineDOT's contract process.

3.3 In-Water Activity Descriptions and Related AMMs

3.3.1 Project Timing and Duration

[1] Source: Maine DOT (http://maine.gov/mdot/contractors/publications/standardspec/)

Construction of this project is tentatively scheduled to begin in 2019 and will be completed within 4 months. The duration of the construction schedule includes, but is not limited to, contractor mobilization and demobilization, roadway approach work, deconstruction of superstructure, concrete sluiceway and abutments, construction of abutments and superstructure, and other repairs. Not all of these activities will involve in-water work, as described below.

AMM 1: In-water work will be limited to the fewest number of days possible within the July 1 to September 30 in-water work window (current estimate is 15 days of in-water work during this period).

3.3.2 Pre-Construction Plans and Review

AMM 2: Prior to the beginning of construction, the contractor will schedule a pre-construction meeting. Also, the contractor will submit a Soil Erosion and Water Pollution Control Plan (SEWPCP) for MaineDOT to review.

AMM 3: MaineDOT shall hold a pre-construction meeting with appropriate MaineDOT Environmental Office staff, other MaineDOT staff, and the MaineDOT construction crew or contractor(s) to review all procedures and requirements for avoiding and minimizing effects to listed species, and to emphasize the importance of these measures for protecting listed fish species. USACE and NMFS staff will be notified of and attend this meeting as practicable.

AMM 4: As a component of the SEWPCP required for each project, contractors will create a plan and implement BMPs in accordance with the MaineDOT manual Best Management Practices for Erosion and Sedimentation Control (2008), which outlines means and methods to prevent sedimentation in streams during construction or heavy precipitation. The manual can be found at the following link: http://www.maine.gov/mdot/env/docs/bmp/BMP2008full.pdf.

AMM 5: As a component of the SEWPCP required for each project, MaineDOT or their contractor will develop and implement a Spill Prevention Control and Countermeasure Plan (SPCCP) designed to avoid stream impacts from hazardous chemicals, such as diesel fuel, oil, lubricants, and other hazardous materials. All refueling or equipment maintenance will take place away from waterbodies and in a careful manner that prevents chemical or other hazardous materials from entering the stream. These measures include the following:

- All vehicle and equipment refueling activities shall occur more than 100’ from any waterbody;
- All vehicles carrying fuel shall have specific equipment and materials needed to contain or clean up any incidental spills at the project site. Equipment and materials would include spill kits appropriately sized for specific quantities of fuel, shovels, absorbent pads, straw bales, containment structures and liners, and/or booms; and,
- During use, all pumps and generators shall have appropriate spill containment structures and/or absorbent pads in place.

3.3.3 Bridge Construction

3.3.3.1 Removal of the Existing Bridge

Once the existing bridge is closed to all traffic, demolition of the existing bridge will begin by removing the bridge deck. This will likely be completed by cutting the deck into pieces to be removed with an excavator. Appropriate measures will be taken to ensure that debris does not enter the river during the demolition process. These measures include lifting the bridge away from the river and containing debris with items such as tarps placed underneath the bridge. The contractor will also be required to submit a demolition plan to MaineDOT for review prior to the start of demolition. The plan will include measures the contractor plans to implement to contain demolition debris. It is not anticipated that the removal of the superstructure will require any in-water work.

As described below, excavation for the new abutments will be located behind the existing abutments. The existing abutments and wingwalls will remain in place during this excavation to serve as cofferdams. Once the new abutments are in place, the existing abutments and wingwalls will be removed down to the top of the substrate. An excavator mounted hydraulic breaker may be used to break large pieces of concrete to facilitate removal and hauling. Removal of the existing abutments, wingwalls, and sluiceway will be completed during low tide. During low tide, only the southwest wingwall and sluiceway are still in the water. The wingwalls in the other three bridge quadrants, as well as the abutments, are out of the water during low tide.

The substrate and flow conditions do not allow for cofferdam construction on the sluiceway and southwest wingwall. The river substrate consists of exposed bedrock and large boulders and the tides fluctuate up to 10 feet in each cycle. Water depths are too deep for cofferdams that consist of sandbags. Sheetpile cofferdams cannot be driven into bed rock. The removal of the sluiceway and bottom portions of the southwest wingwall will occur in the wet. The contractor will contain as much debris as possible and will collect any debris that falls into the river during demolition. The photos in Appendix C illustrate the items to be removed.

There are portions of the abutment under the bridge that are also in the water at all flows. High tides will inundate them. A portion of the low flow channel through the bedrock keeps water flow against the southern abutment at all times.

Though cofferdams are not feasible for the removal of the downstream wing wall and sluiceway, the area directly under the existing bridge can be cofferdammed using conventional methods (sandbags). Cofferdams will be placed prior to any removal of the material that can be contained.

AMM 6: Demolition and debris removal and disposal will comply with Section 202.03 of MaineDOT's Standard Specifications. The contractor will contain all demolition debris, including debris from wearing surface removal, saw cut slurry, dust, etc., and will not allow it to discharge to any resource. The Contractor will dispose of debris in accordance with the Maine Solid Waste Law (Title 38 M.R.S.A., Section 1301 et. seq.). The demolition plan, containment, and disposal of demolition debris will be addressed in the Contractor's SEWPCP.

AMM 7: Every day prior to work in the water, MaineDOT environmental staff will be on site to survey the immediate area to ensure endangered species are not present. If endangered species are observed, in-water work will be delayed until the species have left the action area. This AMM applies to work in the channel that is not behind a cofferdam. The in-water portion of the work is likely to take 10-15 days to complete.

3.3.3.2 Erosion and Sediment Controls
Due to the short construction duration and the presence of bedrock, sheet pile cofferdams will not be used.

Excavation for the new abutments will be located behind the existing abutments and will not require in-water work. Removal of the existing abutments, wingwalls, and sluiceway will be completed at low tide. During low tide, only the southwest wingwall, sluiceway, and southwestern abutment are still in the water.

Tidal flows will be maintained throughout the duration of construction.

AMM 8: All work located in the channel will be completed at low tide.

AMM 9: MaineDOT will inspect cofferdammed areas for the presence of listed species. It is expected that juvenile Atlantic salmon could be present in cofferdammed areas. Therefore, MaineDOT will complete a fish evacuation following the protocol found in Appendix B. Fish evacuation procedures will occur once before cofferdams are dewatered, and again if water levels in the stream overtop the cofferdammed area.

3.3.3.3 Construction of the New Bridge
As described by FHWA, in accordance with 23 CFR 771.113, final design will not be completed until ESA consultation and NEPA are complete. Preliminary design plans can be found in Appendix D. Excavation for the new abutments and wingwalls will be located behind the existing abutments and wingwalls. Integral abutments will be used to support the replacement bridge and they will be founded on piles driven (see AMM 10) to bedrock. After the abutment piles are driven, forms are placed and the concrete portions of the abutments will be constructed. All abutment and wingwall construction work will take place behind the existing abutments and wingwalls without in-water work, so cofferdams will not be needed for this component of the work. Fill will then be placed behind the abutments and wingwalls to support the roadway.

After construction of the new abutments is complete, the existing abutments will be removed (see Section 1.3.3.1). Riprap will be placed in front of each new abutment and wingwall for scour protection purposes. No excavation will be required in the channel before placing the riprap. Riprap is generally placed using an excavator bucket. Any riprap that is placed in the stream will be inspected for cleanliness prior to its installation (see AMM 12). Riprap will be placed at low tide (see AMM 8). The project will result in approximately 3,000 square feet of riprap below the HAT. Since all riprap will be located along the edge of the channel, in-water placement will be minimal and primarily on the downstream side. In-water riprap placement will take approximately 10 to 15 days.

The proposed bridge will have a 75-foot span from abutment to abutment. The superstructure will be constructed and attached to the new abutments. No in-water work is expected for the construction of the new superstructure. Pavement will then be placed on top of the deck to create the road surface.

AMM 10: Piles required for the new abutments will be located behind the existing abutments and will be driven in the dry.

AMM 11: As per Standard Specification 656.3.6 (e), the contractor will not place uncured concrete directly into a water body. The contractor shall not wash tools, forms, or other items in or adjacent to a water body or wetland.

AMM 12: Riprap placed in the channel must be cleaned prior to installation.

3.3.3.4 Construction of riprap downspout as part of the approach work/highway project

Drainage from the highway project (WIN 11577.00) requires that riprap be placed below the HAT approximately 75 feet from the bridge replacement project. This riprap will be placed in the intertidal zone but will be installed out of the water during low tide.

3.3.3.5 Project Closeout

Once bridge construction is complete, contractors will begin removing construction equipment and preparing the roadway for traffic.

AMM 13: Any disturbed soils at the site that were temporarily stabilized during construction will be permanently stabilized using approved methods. Areas planned for riprap as a final soil stabilization treatment are shown on the preliminary plan in Appendix D. All other areas will be stabilized with a treatment such as hay mulch and re-vegetated.

3.3.4 Summary of AMMs

For ease of reference, we have an included a summary of all proposed AMMs below, as well as in Appendix A:

Table 1: Summary of Avoidance and Minimization Measure (AMMs)

Avoidance and Minimization Measure (AMMs)	**Description of AMM**
Project Timing and Duration	
1	In-water work will be limited to the fewest number of days possible within the July 1 to September 30 in-water work window (current estimate is 15 days of in-water work during this period).
Pre-Construction Plans and Review	
2	Prior to the beginning of construction, the contractor will schedule a pre-construction meeting. Also, the contractor will submit a Soil Erosion and Water Pollution Control Plan (SEWPCP) for MaineDOT to review.
3	MaineDOT shall hold a pre-construction meeting with appropriate MaineDOT Environmental Office staff, other MaineDOT staff, and the MaineDOT construction crew or contractor(s) to review all procedures and requirements for avoiding and minimizing effects to listed species, and to emphasize the importance of these measures for protecting listed fish species. USACE and NMFS staff will be notified of and attend this meeting as practicable.

4	As a component of the SEWPCP required for each project, contractors will create a plan and implement BMPs in accordance with the MaineDOT manual Best Management Practices for Erosion and Sedimentation Control (2008), which outlines means and methods to prevent sedimentation in streams during construction or heavy precipitation. The manual can be found at the following link: http://www.maine.gov/mdot/env/docs/bmp/BMP2008full.pdf.
5	As a component of the SEWPCP required for each project, MaineDOT or their contractor will develop and implement a Spill Prevention Control and Countermeasure Plan (SPCCP) designed to avoid stream impacts from hazardous chemicals, such as diesel fuel, oil, lubricants, and other hazardous materials. All refueling or equipment maintenance will take place away from waterbodies and in a careful manner that prevents chemical or other hazardous materials from entering the stream. These measures include the following: • All vehicle and equipment refueling activities shall occur more than 100' from any waterbody; • All vehicles carrying fuel shall have specific equipment and materials needed to contain or clean up any incidental spills at the project site. Equipment and materials would include spill kits appropriately sized for specific quantities of fuel, shovels, absorbent pads, straw bales, containment structures and liners, and/or booms; and, • During use, all pumps and generators shall have appropriate spill containment structures and/or absorbent pads in place.
Removal of the Existing Bridge	
6	Demolition and debris removal and disposal will comply with Section 202.03 of MaineDOT's Standard Specifications. The contractor will contain all demolition debris, including debris from wearing surface removal, saw cut slurry, dust, etc., and will not allow it to discharge to any resource. The Contractor will dispose of debris in accordance with the Maine Solid Waste Law (Title 38 M.R.S.A., Section 1301 et. seq.). The demolition plan, containment, and disposal of demolition debris will be addressed in the Contractor's SEWPCP.
7	Every day prior to work in the water, MaineDOT environmental staff will be on site to survey the immediate area to ensure endangered species are not present. If endangered species are observed, in-water work will be delayed until the species have left the action area. This AMM applies to work in the channel that is not behind a cofferdam. The in-water portion of the work is likely to take 10-15 days to complete.
Erosion and Sediment Controls	
8	All work located in the channel will be completed at low tide.
9	MaineDOT will inspect cofferdammed areas for the presence of listed species. It is expected that juvenile Atlantic salmon could be present in cofferdammed areas. Therefore, MaineDOT will complete a fish evacuation following the protocol found in Appendix B. Fish evacuation procedures will occur once before cofferdams are dewatered, and again if water levels in the stream overtop the cofferdammed area
Construction of the New Bridge	
10	Piles required for the new abutments will be located behind the existing abutments and will be driven in the dry.
11	As per Standard Specification 656.3.6 (e), the contractor will not place

	uncured concrete directly into a water body. The contractor shall not wash tools, forms, or other items in or adjacent to a water body or wetland.
12	Riprap placed in the channel must be cleaned prior to installation.
Project Closeout	
13	Any disturbed soils at the site that were temporarily stabilized during construction will be permanently stabilized using approved methods. Areas planned for riprap as a final soil stabilization treatment are shown on the preliminary plan in Appendix D. All other areas will be stabilized with a treatment such as hay mulch and re-vegetated.

3.4 Action Area

3.4.1 Defining the Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area (project area) involved in the proposed action" (50 CFR 402.02). The action area for this consultation includes the area affected by both construction of the new bridge and removal of the existing Grist Mill Bridge, inclusive of underwater noise, sedimentation and turbidity, and temporary and permanent habitat modification. The area also encompasses the footprint and area affected by the riprap downspout for the highway project.

The Grist Mill Bridge is located over Souadabscook Stream (44.748685, -68.832944), approximately 2,000 feet (610 m) upstream from its confluence with the Penobscot River (approximately river kilometer (rkm) 31). At the location of the Grist Mill Bridge crossing, Souadabscook Stream has a drainage area of 153 square miles.

For this project, the action area consists of:

- The 3,000 square feet directly impacted by abutment protection (riprap). The footprint of riprap in the channel along the bank in each quadrant of the bridge, which will total approximately 3,000 square feet, extending approximately 100 feet upstream and 200 feet downstream.
- The areas temporarily impacted by increased levels of suspended sediments from the removal of the sluiceway and southwest wingwall (impacted areas will be limited to waters immediately surrounding these structures).
- The area impacted by the placement of 25 square feet of riprap for the downspout of a drainage pipe associated with the highway reconstruction project
- The area receiving hydroacoustic noise greater than 150 dB re 1 μPa RMS. We estimate an ensonified area extending 184 feet up and downstream from the hoe ram used for removal of the in-water southwest wingwall and sluiceway (NMFS 2018a; CalTrans 2015).

Given the information you provided, we created Figure 2 depicting our best estimate of the spatial distribution of the action area given the information, above. We estimate this area to be approximately 71,330 square feet (1.64 acres).

Figure 2: Estimate of the Action Area

To show the relative position of the action area to the mainstem Penobscot River, we prepared Figure 3.

Figure 3: Boundaries of the action area (in blue) in relation to the Penobscot River

3.4.2 Habitat in the Action Area

Souadabscook Stream originates northwest of the project area in Carmel, Maine and flows primarily in a southeasterly direction to the Penobscot River, with its confluence located at rkm 31 of the Penobscot. The overall length of Souadabscook Stream is approximately 20 miles. Tributaries include Tracey Brook, Slate Quarry Brook, Black Stream, and Wheeler Stream, all of which are located over 4 miles upstream from the Grist Mill Bridge.

The head of tide on the Souadabscook Stream is at the Grist Mill Bridge, with no tidal influence upstream of the bridge. The stream flows over exposed bedrock that begins under the bridge and creates a natural cascade with a drop of approximately 9 feet on the downstream side of the bridge, starting 20 feet from the bridge. At high tide, this drop is unlikely to be a barrier to upstream fish passage for certain species including Atlantic salmon, although Maine Department of Marine Resource (MDMR) considers this to be a barrier to sturgeon (G. Wippelhauser, per. comm. 2016). The channel substrate on the upstream side primarily consists of a mix of cobble, gravel, and bedrock, and 10% silt/clay/mud and sand. A gravel island is located approximately 130 feet upstream.

The approximate bankfull width of the channel in the vicinity of the bridge is 100 feet. The active channel is 5 to 10 feet in width under the bridge during low flows. During a field review in September 2016, MaineDOT estimated a stream velocity of 0.8 feet/second. Water depth at that time was approximately 2 feet. The action area includes a few pools with depths greater than 2 feet but most pools contained limited cover. Much of the action area consists of riffles, runs, and cascades.

While you were not able to provide us with seasonal water temperatures in Souadabscook Stream, you noted that the riparian area upstream of the bridge is primarily forested, and the water temperature just upstream of the bridge was 69^{o}F (20.6^{o}C) during a field review in September 2016.

You did not collect site specific salinity values for the project area; however, upstream of the bridge is freshwater. The area downstream of the bridge is tidally influenced. The Penobscot River is influenced by tides as far north as Bangor, 30 miles above the confluence with Penobscot Bay. Salinities were measured in the Penobscot River in 2007 by the Maine Department of Environmental Protection (MDEP 2008). The study found negligible salinity from Bangor to South Brewer, which is located approximately 3 miles upstream of Souadabscook Stream. The first measurable salinity was observed at North Orrington, located a mile upstream from the Souadabscook, where the average salinity was 1.69 parts per thousand (ppt). Salinities were 4.98 ppt at Bald Hill Cove, approximately 3.5 miles downstream from the Souadabscook. Based on this study, it can be assumed that salinities in the Souadabscook at the Grist Mill Bridge, located 2,000 feet from the Penobscot, are generally less than 2 ppt.

The National Wetlands Inventory classifies the Souadabscook Stream as R3UBH (freshwater riverine, upper perennial, unconsolidated bottom, permanently flooded water regime) with an adjacent PEM1E (palustrine, emergent, persistent vegetation, seasonally flooded/saturated) on the upstream side of the Grist Mill Bridge and as E2US3N (estuarine, intertidal, unconsolidated shore, mud, with a regularly flooded water regime) on the downstream side. The highest annual tide (HAT) at the bridge is 9.55 feet NAVD88. The action area is not located within an area mapped by MDMR as shellfish habitat. Eelgrass beds have not been documented by MDMR in the vicinity of the Grist Mill Bridge.

4.0 STATUS OF LISTED SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

We have determined that the action being considered in this biological opinion may affect the following endangered or threatened species and critical habitat under our jurisdiction (Table 2):

Table 2: ESA-listed species and critical habitat in the action area

ESA-Listed Species	Latin Name	Distinct Population Segment (DPS)	Federal Register (FR) Citation	Recovery Plan
Atlantic Salmon	*Salmo salar*	Gulf of Maine	74 FR 29344	Draft Recovery plan: NMFS & U.S. FWS 2016
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine	77 FR 5880	N/A
Shortnose Sturgeon	*Acipenser brevirostrum*	Listed Range-wide (no DPSs)	32 FR 4001	NMFS 1998
Designated Critical Habitat (species)	**Latin Name**	**Distinct Population Segment (DPS)**	**Federal Register (FR) Citation**	**Recovery or River Unit**
Atlantic Salmon	*Salmo salar*	Gulf of Maine	74 FR 29300	Penobscot Bay Salmon Habitat Recovery Unit

We have determined that the proposed action being considered in this Opinion is not likely to adversely affect shortnose sturgeon (*Acipenser brevirostrum*) or Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). We have also determined that the proposed action will not affect critical habitat designated for the Gulf of Maine DPS of Atlantic sturgeon. The following discussions are our rationale for these determinations.

4.1 Species and Critical Habitat Not Likely to be Adversely Affected by the Proposed Action

4.1.1 Shortnose Sturgeon in the Action Area

Shortnose sturgeon occur in rivers and estuaries along the east coast of the United States and Canada. In the United States, they are listed as endangered throughout their range. Shortnose sturgeon prefer slower moving riverine, estuarine, and nearshore marine habitat of large river systems, migrating into faster moving freshwater areas to spawn.

Shortnose sturgeon spawn in freshwater, but feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawn at discrete sites within their natal river (Kieffer and Kynard 1996). In the Penobscot River, habitat consistent with known sturgeon spawning habitat exists between the site of the former Veazie Dam (approximately rkm 46)(UMaine 2015) and the existing Milford Dam, which is the current upstream limit of shortnose sturgeon in the Penobscot River. However, to date, spawning of shortnose sturgeon has not been documented in the Penobscot River. At least some of the adult shortnose sturgeon tagged in the Penobscot River have been tracked emigrating from the Penobscot to the Kennebec River to spawn.

Wippelhauser *et al.* (2015) describes 21 of 104 Shortnose Sturgeon tagged in the Penobscot River making migrations to the Kennebec River in either the spring or late fall, typically overwintering in the Kennebec before making a purported spawning run.

The general pattern for shortnose sturgeon in the Penobscot River is a downstream movement in spring (to the Winterport area, approximately rkm 15) and upstream movement from late June to the end of August. Lachapelle (2013) documented shortnose sturgeon overwintering at rkm 36.5 from 2008 to 2010 and at rkm 42 in 2011. They then migrate downstream by April and move upstream again in late June (Fernandes *et al.* 2010). Overwintering typically occurs in deep river segments and deep depressions at depths of 10m to 30m (Dadswell *et al.* 1984). In the northern part of its range, shortnose sturgeon are seldom found in shallow water once temperature exceeds 22°C (Dadswell *et al.* 1984).

Telemetry data shows that shortnose sturgeon are in the mainstem anywhere from rkm 24.5-45 from late June to the end of August (Souadabscook Stream is at rkm 31), feeding mostly on worms associated with soft substrate (G. Wippelhauser, pers. comm.).

As explained above, the action area is limited to a portion of Souadabscook Stream. There is no available information on the use of Souadabscook Stream by shortnose sturgeon specifically, or use of tributaries to the Penobscot River generally. However, shortnose sturgeon do occur in the lower reaches of tributaries to other mainstem rivers (e.g., Sassanoa River entrance off the Kennebec River, Deerfield River off the Connecticut River). Therefore, we assume that at least occasional individual sturgeon are present in Souadabscook Stream. However, given that the substrate in the immediate vicinity of the bridge is primarily bedrock the area would not be used by foraging shortnose sturgeon. The lower reaches of the action area have muddy substrate which presumably supports potential sturgeon forage. As such, occasional shortnose sturgeon may be present during the summer and fall in this portion of the action area and these individuals may forage opportunistically. The shallow depths of the action area make it inconsistent with known overwintering areas. As such, we do not anticipate any sturgeon present in the action area between November and April. The salinity in the accessible portions of the action area mean that no early life stages will be present. Therefore, the only sturgeon that could be exposed to effects of the project are transient individuals who may be opportunistically foraging in the lower reaches of the action area.

4.1.2 Atlantic Sturgeon in the Action Area

There are five DPSs of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) listed as threatened or endangered. Atlantic sturgeon originating from the New York Bight, Chesapeake Bay, South Atlantic and Carolina DPSs are listed as endangered; the Gulf of Maine DPS is listed as threatened. The marine range of all five DPSs extends along the Atlantic coast from Canada to Cape Canaveral, Florida. We have considered the best available information on the distribution of Atlantic sturgeon and have determined that most Atlantic sturgeon in the action area will be of Gulf of Maine (GOM) DPS origin (Damon-Randall *et al.* 2013). However, it is also likely that some Atlantic sturgeon in the action area are Canadian in origin (and therefore not listed under the ESA), and a smaller portion of Atlantic sturgeon in the action area are New York Bight (NYB) DPS origin (Damon-Randall *et al.* 2013). For this consultation, we consider effects of the proposed action on the GOM and NYB DPSs of Atlantic sturgeon.

Atlantic sturgeon spawning has not been documented in the Penobscot River to date. However, suitable spawning habitat is present in the river. The range of Atlantic sturgeon in the river is limited by the Milford Dam. The general pattern for adult and subadult Atlantic sturgeon in the Penobscot River is immigration in the spring and summer (average date of May 15) and emigration from the river in fall (average date of September 16)(Altenritter *et al.* 2017; Wippelhauser *et al.* 2017). While in the river, telemetry data shows they concentrate between rkm 20-25, while 90-98% of the detections occurred between rkm 15-29, just downstream of the Souadabscook Stream (located at rkm 31). This section of the river has muddy substrate and a high density of polychaete worms, making it optimal foraging habitat for sturgeon (Altenritter *et al.* 2017). Consistent with the discussion of shortnose sturgeon above, the lower reaches of the action area may be used by occasional transient Atlantic sturgeon. The salinity in the accessible portion of the action area precludes the presence of early life stages. The action area is inconsistent with overwintering habitat. Therefore, the only Atlantic sturgeon that may be exposed to effects of the action would be a limited number of occasional transient individuals present in the lower reaches of the action area.

4.1.3 Critical Habitat Designated for the Gulf of Maine DPS of Atlantic Sturgeon

On August 17, 2017, we issued a final rule to designate critical habitat for the threatened Gulf of Maine DPS of Atlantic sturgeon, the endangered New York Bight DPS of Atlantic sturgeon, the endangered Chesapeake Bay DPS of Atlantic sturgeon, the endangered Carolina DPS of Atlantic sturgeon, and the endangered South Atlantic DPS of Atlantic sturgeon (82 FR 39160). The rule was effective on September 18, 2017. We designated the mainstem Penobscot River from the Milford Dam downstream for 53 rkms to where the mainstem river discharges at its mouth into Penobscot Bay as part of the critical habitat for the Gulf of Maine DPS. However, because the action area is restricted to the Souadabscook Stream and does not extend to the mainstem of the Penobscot, the action does not overlap with critical habitat designated for the Gulf of Maine DPS of Atlantic sturgeon.

4.1.4 Effects of the Proposed Action on ESA-Listed Sturgeon

If listed sturgeon are present in the lower portion of the action area when work is occurring, they may be exposed to underwater noise (sound pressure), minor increases in suspended sediments/turbidity, and habitat modification. Underwater noise (from the use of a hoe ram) and minor turbidity (from the removal of the sluiceway and placement of riprap) will result in short-term environmental stressors. Underwater sound pressure levels will not exceed the injury threshold for sturgeon (206 dB re 1 µPa Peak; 187 dB re 1µPa^2-s cSEL), and will be limited to 12-hour periods for approximately 15 days (see Section 7.2 for further details). Sound levels produced from removal of the concrete wingwall and sluiceway using a hoe ram could exceed the threshold for behavioral effects to fish (150 dB re 1µPa RMS) up to 184 feet from the hoe ram activity (for sound pressure estimates and a discussion of the sound pressure behavioral threshold for fish, see Section 7.2). If sturgeon were to enter the action area to opportunistically forage within 184 feet of hoe ram activity, we would expect them to temporarily avoid the area until hoe ram work ceased. However, as we mainly expect sturgeon to use the mainstem of the Penobscot and rarely enter the Souadabscook, any effects on sturgeon fitness from avoiding the action area due to temporary increases in sound pressure will extremely unlikely to occur, and are discountable.

We expect minor increases in total suspended sediments (TSS) of 5-10 mg/L, which, when added to baseline conditions, will be well below the levels we expect to cause injury (580 mg/L for the most sensitive species, with 1,000 mg/L more typical)(Burton 1993; EPA 1986), and only lasting for a period of a few minutes before resettling and returning to baseline conditions. Given the rarity with which we expect sturgeon to enter the action area, and the temporary nature of the turbidity/TSS, it is extremely unlikely that sturgeon will be exposed to the stressors. Therefore, effects are discountable.

The removal of the sluiceway will result in temporary effects to habitat from the use of an excavator to remove concrete sluiceway debris that may fall into the stream. Because substrate in this area of the stream is dominated by bedrock, boulders, and cobble, and does not support sturgeon forage items, we anticipate any sturgeon in the action area to occur further downstream where there are potential forage items; therefore, exposure to these effects is extremely unlikely and effects of habitat disruption are discountable.

To summarize, as we expect all effects of the proposed action on sturgeon to be discountable, we conclude that the project is not likely to adversely affect shortnose sturgeon or the GOM or NYB DPSs of Atlantic sturgeon.

4.2 Atlantic Salmon (Gulf of Maine DPS)

The GOM DPS of anadromous Atlantic salmon was initially listed by U.S. FWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). A subsequent rule issued by the Services (74 FR 29344, June 19, 2009) expanded the geographic range for the GOM DPS of Atlantic salmon. The GOM DPS of Atlantic salmon is defined as all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment. The marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland. Included in the GOM DPS are all associated conservation hatchery populations used to supplement these natural populations; currently, such conservation hatchery populations are maintained at Green Lake National Fish Hatchery (GLNFH) and Craig Brook National Fish Hatcheries (CBNFH), both operated by the U.S. FWS, as well as private watershed-based facilities (Downeast Salmon Federation’s East Machias and Pleasant River facilities). Excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry (74 FR 29344, June 19, 2009).

Coincident with the June 19, 2009 endangered listing, we designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009). The final rule was revised on August 10, 2009. In this revision, designated critical habitat for the expanded GOM DPS of Atlantic salmon was modified to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009).

4.2.1 Life History

Atlantic salmon spend most of its adult life in the ocean and returns to freshwater to reproduce.

Atlantic salmon have a complex life history that includes territorial rearing in rivers to extensive feeding migrations on the high seas (Figure 4). During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements.

Spawning

Adult Atlantic salmon return to rivers in Maine from the Atlantic Ocean and migrate to their natal streams to spawn. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July (Meister 1958; Baum 1997), but may enter at any time between early spring and late summer. Early migration is an adaptive trait that ensures adults have sufficient time to reach spawning areas (Bjornn and Reiser 1991). Salmon that return in early spring spend nearly five months in the river before spawning, often seeking cool water refuge (e.g., deep pools, springs, and mouths of smaller tributaries) during the summer months.

From mid-October to mid-November, adult females select sites in rivers and streams for spawning. Spawning sites are positioned within flowing water, particularly where upwelling of groundwater occurs, allowing for percolation of water through the gravel (Danie *et al.*1984). These sites are most often positioned at the head of a riffle (Beland *et al.* 1982), the tail of a pool, or the upstream edge of a gravel bar where water depth is decreasing and water velocity is increasing (McLaughlin and Knight 1987; White 1942). The female salmon creates an egg pit (redd) by digging into the substrate with her tail and then deposits eggs while male salmon release sperm to fertilize the eggs. After spawning, the female continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel. Females produce a total of 1,500 to 1,800 eggs per kilogram of body weight, yielding an average of 7,500 eggs per two sea-winter (SW) female (an adult female that has spent two winters at sea before returning to spawn) (Baum and Meister 1971). After spawning, male and female Atlantic salmon either return to sea immediately or remain in fresh water until the following spring before returning to the sea (Fay *et al.* 2006).

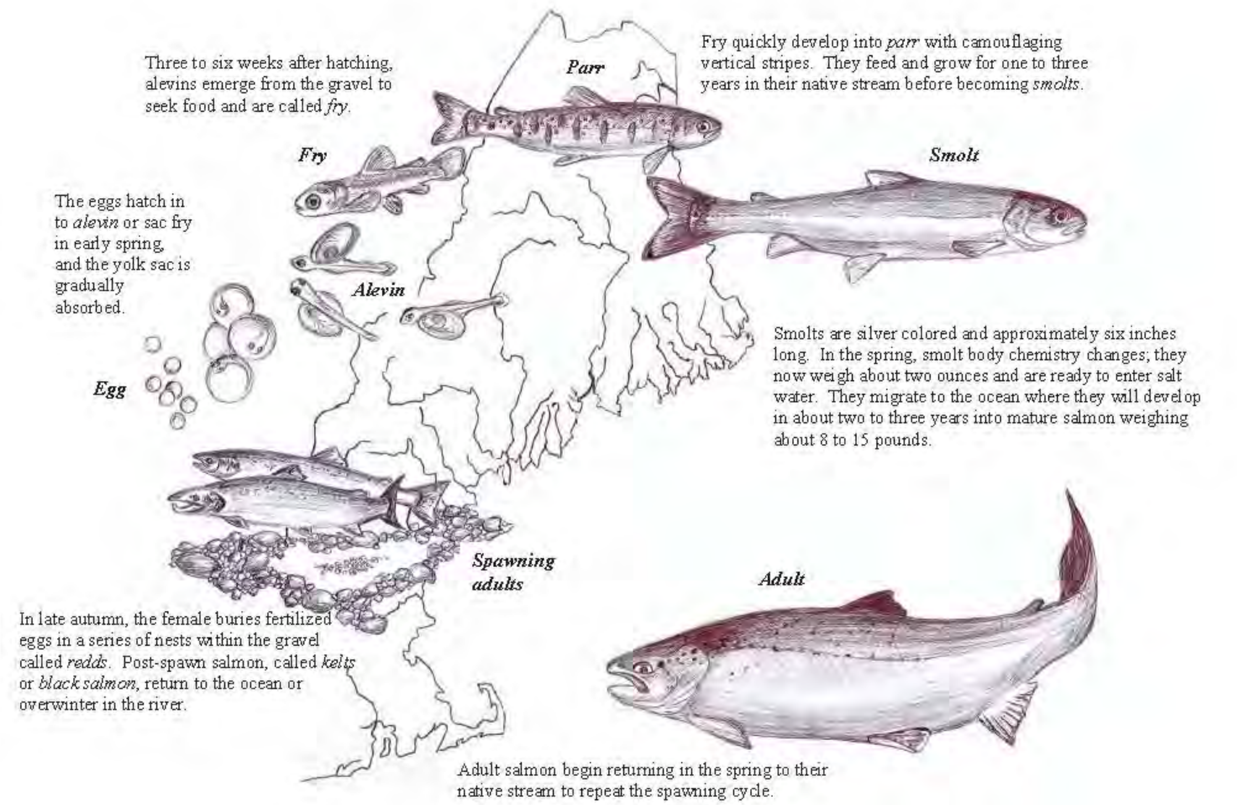

Figure 4: Life Cycle of the Atlantic salmon (diagrams courtesy of Katrina Mueller)

After spawning, the adults ("kelts") move downstream toward the sea. Movement may be triggered by increased water temperatures or flows. Some migrate toward the sea immediately, either moving partway downstream or returning to the ocean (Ruggles 1980; Don Pugh, U.S. Geological Survey (USGS) personal communication). Most kelts, however, overwinter in the river and return to the sea in the spring. Kelts that remain in the river appear to survive well through the winter (Ruggles 1980; Jonsson *et al.* 1990). The relative survival of kelts, however, has not been calculated for Maine rivers. After reaching the ocean, few kelt survive as indicated by the lack of repeat spawners in the GOM DPS (NMFS and U.S. FWS 2005).

Eggs

The fertilized eggs develop in the redd for a period of 175 to 195 days, hatching in late March or April (Danie *et al.*1984).

Alevins and Fry

Newly hatched salmon, also referred to as sac fry, remain in the redd for approximately six weeks after hatching and are nourished by their yolk sacs (Gustafson-Greenwood and Moring 1991). In three to six weeks, they consume most of their yolk sac, travel to the surface to gulp air to fill their swim bladders, and begin to swim freely; at this point they are called "fry."

Survival from the egg to fry stage in Maine is estimated to range from 15 to 35% (Jordan and Beland 1981).

Parr

When fry reach approximately 4 cm in length, the young salmon are termed "parr" (Danie *et al.* 1984). Most parr remain in the river for two to three years before undergoing smoltification, the process in which parr go through physiological changes in order to transition from a freshwater environment to a saltwater marine environment. Some male parr may not go through smoltification and will become sexually mature and participate in spawning with sea-run adult females. These males are referred to as "precocious parr."

Smolts

During the smoltification process, parr markings fade and the body becomes streamlined and silvery with a pronounced fork in the tail. Naturally reared smolts in Maine range in size from 13 to 17 cm, and most smolts enter the sea during May to begin their first ocean migration (USASAC 2004). The spring migration of smolts to the marine environment takes 25 to 45 days. Most smolts migrate rapidly, exiting the estuary within several tidal cycles (Hyvarinen *et al.* 2006; Lacroix and McCurdy 1996; Lacroix *et al.* 2004, 2005).

Post-smolts

Smolts are termed post-smolts after ocean entry to the end of the first winter at sea (Allan and Ritter 1977). Post-smolts generally travel out of coastal systems on the ebb tide and may be delayed by flood tides (Hyvarinen *et al.* 2006; Lacroix and McCurdy 1996; Lacroix *et al.* 2004, 2005). Lacroix and McCurdy (1996), however, found that post-smolts exhibit active, directed swimming in areas with strong tidal currents. Studies in the Bay of Fundy and Passamaquoddy Bay suggest some aggregation and common migration corridors related to surface currents (Hyvarinen *et al.* 2006; Lacroix and McCurdy 1996; Lacroix *et al.* 2004). Post-smolt distribution may reflect water temperatures (Reddin and Shearer 1987) and/or the major surface-current vectors (Lacroix and Knox 2005). Post-smolts travel mainly at the surface of the water column (Renkawitz *et al.* 2012) and may form shoals, possibly of fish from the same river (Shelton *et al.* 1997). Post-smolts grow quickly, achieving lengths of 30-35 cm by October (Baum 1997). Smolts can experience high mortality during the transition to saline environments for reasons that are not well understood (Kocik *et al.* 2009; Thorstad *et al.* 2012).

During the late summer and autumn of the first year, North American post-smolts are concentrated in the Labrador Sea and off of the west coast of Greenland, with the highest concentrations between 56 N. and 58 N. (Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1993, Sheehan *et al.* 2015). Atlantic salmon located off Greenland are primarily composed of non-maturing first sea winter (1SW) fish, which are likely to spawn after their second sea winter (2SW), from both North America and Europe, plus a smaller component of previous spawners who have returned to the sea prior to their next spawning event (Reddin 1988; Reddin *et al.* 1988). The following spring, 1SW and older fish are generally located in the Gulf of St. Lawrence, off the coast of Newfoundland, and on the east coast of the Grand Banks

(Reddin 1985; Dutil and Coutu 1988; Ritter 1989; Reddin and Friedland 1993; and Friedland *et al.* 1999).

Adults

Some salmon may remain at sea for another year or more before maturing. After their second winter at sea, the salmon likely over-winter in the area of the Grand Banks before returning to their natal rivers to spawn (Reddin and Shearer 1987). Reddin and Friedland (1993) found non-maturing adults located along the coasts of Newfoundland, Labrador, and Greenland, and in the Labrador and Irminger Sea in the later summer and autumn.

The average size of Atlantic salmon is 71-76 cm (28-30 inches) long and 3.6-5.4 kg (8-15 pounds) after two to three years at sea. Although uncommon, adults can grow to be as large as 30 pounds (13.6 kg). The natural life span of Atlantic salmon ranges from two to eight years (ASBRT 2006). Following spawning in the fall, Atlantic salmon kelts may immediately return to the sea, or over-winter in freshwater habitat and migrate in the spring, typically April or May (Baum 1997).

4.2.2 Reproduction, Distribution, and Abundance of Atlantic salmon

The reproduction, distribution, and abundance of Atlantic salmon within the range of the GOM DPS have been generally declining since the 1800s (Fay *et al.* 2006). A comprehensive time series of adult returns to the GOM DPS dating back to 1967 exists (Fay *et al.* 2006, USASAC 2013). Contemporary abundance levels of Atlantic salmon within the GOM DPS are several orders of magnitude lower than historical abundance estimates. For example, Foster and Atkins (1869) estimated that roughly 100,000 adult salmon returned to the Penobscot River alone before the river was dammed, whereas estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay *et al.* 2006, USASAC 2013).

After a period of population growth between the 1970s and the early 1980s, adult returns of salmon in the GOM DPS peaked between approximately 1984 and 1991 before declining during the 2000s. Adult returns have fluctuated over the past decade. Presently, the majority of all adults in the GOM DPS return to a single river, the Penobscot, which accounted for over 90% of all adult returns to the GOM DPS over the last decade. The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from GLNFH (constructed in 1974). Marine survival remained relatively high throughout the 1980s, and salmon populations in the GOM DPS remained relatively stable until the early 1990s. In the early 1990s, marine survival rates decreased, leading to the declining trend in adult abundance observed throughout the 1990s and early 2000s. The increase in abundance of returning adult salmon observed between 2008 and 2011 may be an indication of improving marine survival; however the declines –since 2011 may suggest otherwise. Returns to U.S. waters in 2013 were only 611 fish, which ranks 43rd in the 47-year time-series (USASAC 2014). A total of 450 adults returns were estimated for 2014; the lowest for the 1991- 2014 time series. The returns in 2015 were somewhat higher at 881, and then dropped again in 2016 to 614 (USASAC 2016, 2017). In 2017, an estimated total of 1,008 adults returned (208 natural; 800 hatchery origin)(USASAC 2018). Despite consistent smolt production, there has been extreme variability in annual returns.

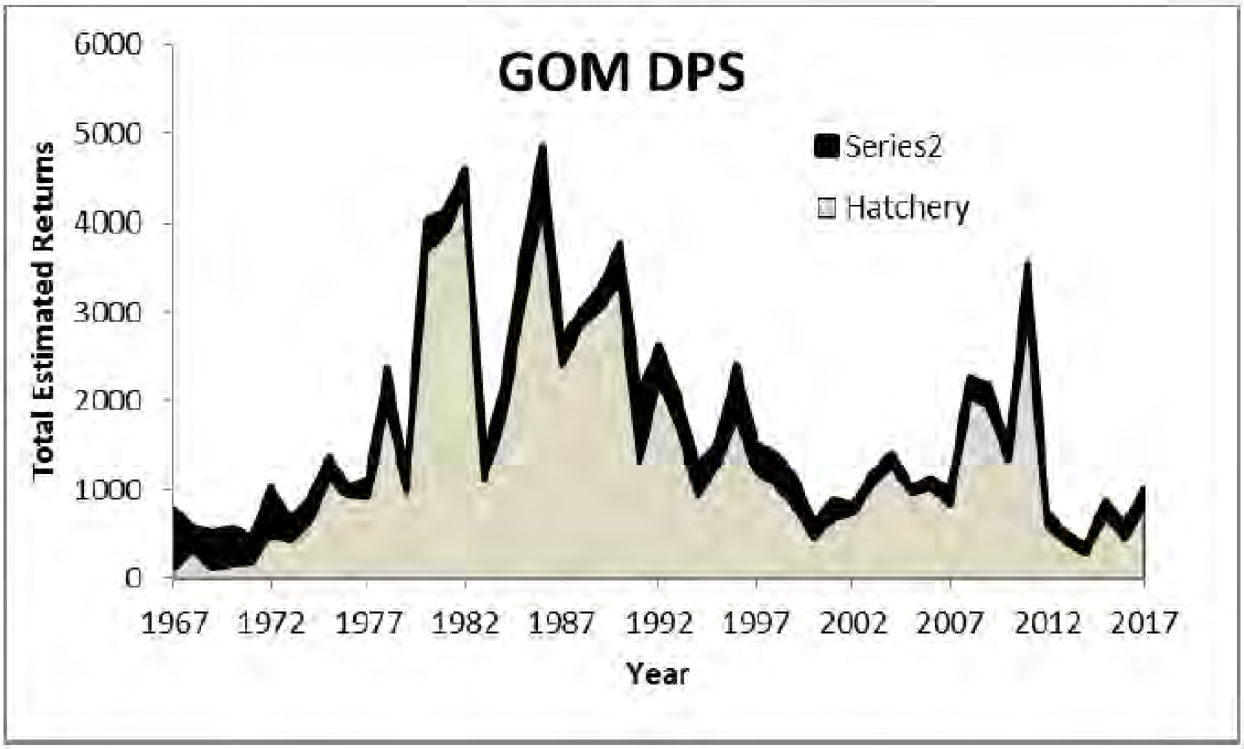

Figure 5: Time-series of total estimated returns to the GOM DPS of Atlantic salmon illustrating the dominance of hatchery-reared origin Atlantic salmon compared to naturally-reared (wild, egg stocked, fry stocked) origins (USASAC 2018)

Since 1967 when numbers of adult returns were first recorded, the vast majority of adult returns have been the result of smolt stocking; only a small portion of returning adults were naturally reared (Figure 5). Natural reproduction of the species is contributing to only a fraction of Atlantic salmon returns to the GOM DPS. The term naturally reared includes fish originating from both natural spawning and from stocked hatchery fry (USASAC 2012). Hatchery fry are included as naturally reared because hatchery fry are not marked, and therefore cannot be distinguished from fish produced through natural spawning. Low abundances of both hatchery-origin and naturally reared adult salmon returns to Maine demonstrate continued poor marine survival.

In recent decades, the abundance of Atlantic salmon in the GOM DPS has been low; however, in the past five years the proportion of fish in the Penobscot that are of natural origin has stabilized to an average of approximately 10% of total returns (USASAC 2014-2018). The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels. However, stocking of hatchery fry and smolts has not contributed to an increase in the overall abundance of salmon and, as yet, has not been able to substantially increase the naturally reared component of the GOM DPS. Continued reliance on the conservation hatchery program is expected to prevent extinction in the short term, but recovery of the GOM DPS will not be accomplished without significant increases in naturally reared salmon.

The historic distribution of Atlantic salmon in Maine has been described extensively by Baum

(1997) and Beland (1984), among others. In short, substantial populations of Atlantic salmon existed in nearly every river in Maine that was large enough to maintain a spawning population. The upstream extent of the species' distribution extended far into the headwaters of even the largest rivers. Today, the spatial structure of Atlantic salmon is limited by obstructions to passage and also by low abundance levels and the majority of all adults return to the Penobscot River. Within the range of the GOM DPS, the Kennebec, Androscoggin, Union, and Penobscot Rivers contain dams that severely limit passage of salmon to significant amounts of spawning and rearing habitat. Atlantic salmon presently have unobstructed access to only about 8% of their historic spawning and rearing habitat in the Maine (NMFS 2016b).

4.2.3 Salmon Habitat Recovery Units

As part of the 2009 GOM DPS listing and designation of critical habitat, we defined three Salmon Habitat Recovery Units (SHRU): the Merrymeeting Bay SHRU, the Penobscot Bay SHRU, and the Downeast SHRU (Figure 6). As defined in the Endangered Species Consultation Handbook[2], a Recovery Unit is a "management subset of the listed species that is created to establish recovery goals or carry out management actions." The NMFS Interim Recovery Plan Guidance[3] goes on to state that recovery units are frequently managed as management units, though makes the distinction that recovery units are deemed necessary to both the survival and recovery of the species, whereas management units are defined as not always being "necessary" to both the survival and recovery.

[2] http://www.nmfs noaa.gov/pr/pdfs/laws/esa_section7_handbook.pdf
[3] http://www.nmfs noaa.gov/pr/pdfs/recovery/guidance.pdf

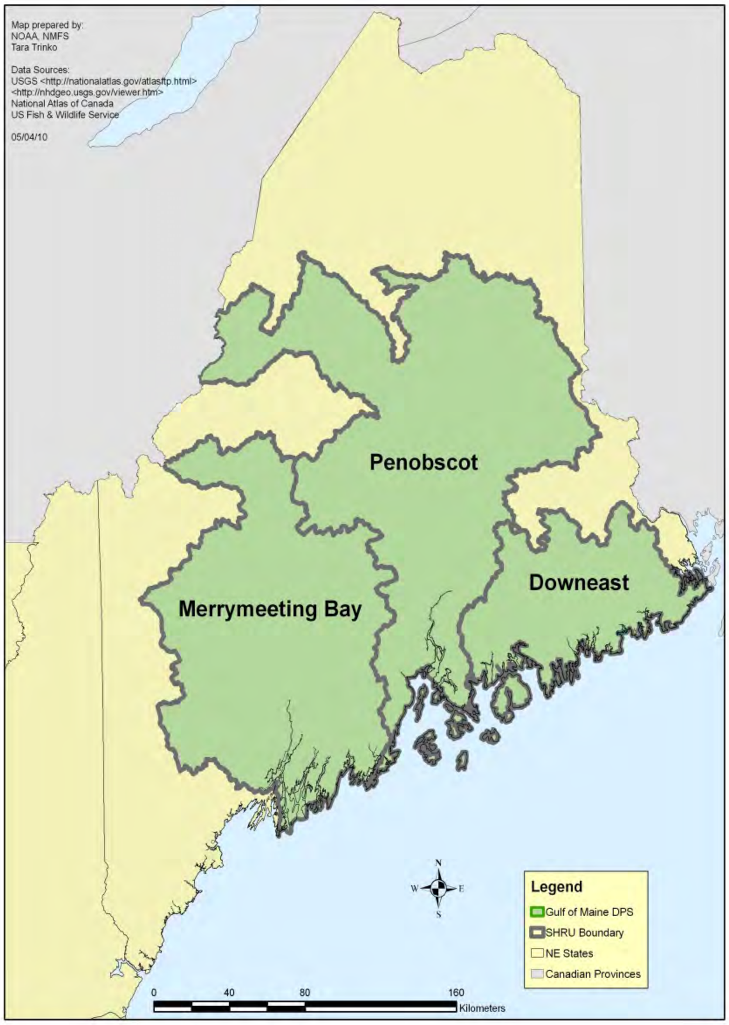

Figure 6: Location of Atlantic salmon Habitat Recovery Units (SHRU) in the GOM DPS

Merrymeeting Bay SHRU

Today, dams are the greatest impediment, outside of marine survival, to the recovery of salmon in the Penobscot, Kennebec, and Androscoggin river basins (Fay *et al.* 2006). Hydropower dams in the Merrymeeting Bay SHRU significantly impede the migration of Atlantic salmon and other diadromous fish and either reduce or eliminate access to roughly 352,000 units of historically accessible spawning and rearing habitat. In addition to hydropower dams, agriculture and urban development largely affect the lower third of the Merrymeeting Bay SHRU by reducing substrate and cover, reducing water quality, and elevating water temperatures. Additionally, smallmouth bass and brown trout introductions, along with other non-indigenous species, significantly degrade habitat quality throughout the Merrymeeting Bay SHRU by altering natural predator/prey relationships.

Downeast Coastal SHRU

Impacts to substrate and cover, water quality, water temperature, biological communities, and migratory corridors, among a host of other factors, have impacted the quality and quantity of habitat available to Atlantic salmon populations within the Downeast Coastal SHRU. Two hydropower dams on the Union river, and, to a lesser extent, the small ice dam on the lower Narraguagus River, limit access to roughly 18,500 units of spawning and rearing habitat within these two watersheds. In the Union River, which contains over 12,000 units of spawning and rearing habitat, physical and biological features have been most notably limited by high water temperatures and abundant smallmouth bass populations associated with impoundments. In the Pleasant River and Tunk Stream, which collectively contain over 4,300 units of spawning and rearing habitat, pH has been identified as possibly being the predominate limiting factor. The Machias, Narraguagus, and East Machias rivers contain the highest quality habitat relative to other HUC 10s in the Downeast Coastal SHRU and collectively account for approximately 40 percent of the spawning and rearing habitat in the Downeast Coastal SHRU.

Penobscot Bay SHRU

The mainstem Penobscot has the highest biological value to the Penobscot SHRU because it provides a central migratory corridor crucial for the entire Penobscot SHRU. Dams, along with degraded substrate and cover, water quality, water temperature, and biological communities, have reduced the quality and quantity of habitat available to Atlantic salmon populations within the Penobscot SHRU. A combined total of 20 FERC-licensed hydropower dams in the Penobscot SHRU significantly impede the migration of Atlantic salmon and other diadromous fish to nearly 300,000 units of historically accessible spawning and rearing habitat. Agriculture and urban development largely affect the lower third of the Penobscot SHRU below the Piscataquis River sub-basin by reducing substrate and cover, reducing water quality, and elevating water temperatures. Introductions of smallmouth bass and other non-indigenous species significantly degrade habitat quality throughout the mainstem Penobscot and portions of the Mattawamkeag, Piscataquis, and lower Penobscot sub-basins by altering predator/prey relationships. Similar to smallmouth bass, recent Northern pike introductions threaten habitat in the lower Penobscot River. Of the 323,700 units of spawning and rearing habitat (within 46 HUC 10 watersheds), approximately 211,000 units of habitat are considered to be currently occupied (within 28 HUC 10 watersheds). Of the 211,000 occupied units within the Penobscot SHRU, NMFS calculated these units to be the equivalent of nearly 66,300 functional units or approximately 20 percent of the historical functional potential.

4.2.4 Survival and Recovery of the GOM DPS

In light of the 2009 GOM DPS listing and designation of critical habitat, the Services issued a new recovery plan for Atlantic salmon on March 31, 2016 for public review and comment. The draft 2016 Recovery Plan presents a recovery strategy based on the biological and ecological needs of the species as well as current threats and conservation accomplishments that affect its long-term viability. The plan is based upon a planning approach recently endorsed by the U.S. FWS and, for this plan, by us. The new approach, termed the Recovery Enhancement Vision (REV), focuses on the three statutory requirements in the ESA, including site-specific recovery actions; objective, measurable criteria for delisting; and time and cost estimates to achieve recovery and intermediate steps. The 2016 Recovery Plan is based on two premises: first, that recovery must focus on rivers and estuaries located in the GOM DPS until the Services have a better understanding of the threats in the marine environment, and second, that survival of Atlantic salmon in the GOM DPS will be dependent on conservation hatcheries through much of the recovery process. In addition, the scientific foundation for the plan includes conservation biology principles regarding population viability, an understanding of freshwater habitat viability, and threats abatement needs.

Under the 2016 draft Recovery Plan, reclassification of the GOM DPS from endangered to threatened will be considered when all of following criteria are met:

1. The DPS has a total annual escapement of at least 1,500 naturally reared adults spawning in the wild, with at least 2 of the 3 SHRUs having at least 500 naturally reared adults.
2. The population in each of at least two of the three SHRUs has a population growth rate of greater than 1.0 in the 10-year period preceding reclassification.
3. Adults originating from hatchery-stocked eggs, fry, and parr are included when estimating population growth rates.
4. Sufficient suitable spawning and rearing habitat for the offspring of the 1,500 naturally reared adults is accessible and distributed throughout designated Atlantic salmon critical habitat, with at least 7,500 accessible and suitable habitat units (Hus) in each of at least two of the three SHRUs, located according to the known and potential migratory patterns of returning salmon.

There are a wide variety of factors that have and continue to affect the current status of the GOM DPS and its critical habitat. The potential interactions among these factors are not well understood, nor are the reasons for the seemingly poor response of salmon populations to the many ongoing conservation efforts for this species.

Threats to the Species

The recovery plan for the previously designated GOM DPS (NMFS and U.S. FWS 2005), the latest status review (Fay *et al.* 2006), and the 2009 listing rule all provide a comprehensive assessment of the many factors, including both threats and conservation actions, that are currently affecting the status and recovery of listed Atlantic salmon. The 2016 draft Recovery Plan provides the most up to date list of significant threats affecting the GOM DPS. These are the following:

- Dams
- Inadequacy of existing regulatory mechanisms for dams
- Continued low marine survival rates for U.S. stocks of Atlantic salmon
- Lack of access to spawning and rearing habitat due to dams and road-stream crossings

In addition to these significant threats there are a number of lesser stressors. These are the following:

- Degraded water quality
- Aquaculture practices, which pose ecological and genetic risks

- Climate change
- Depleted diadromous fish communities
- Incidental capture of adults and parr by recreational anglers
- Introduced fish species that compete or prey on Atlantic salmon
- Poaching of adults in DPS rivers
- Conservation hatchery program (potential for artificial selection/domestication)
- Sedimentation of spawning and rearing habitat
- Water extraction

Fay *et al.* (2006) examined each of the five statutory ESA listing factors and determined that each of the five listing factors is at least partly responsible for the present low abundance of the GOM DPS. The information presented in Fay *et al.* (2006) is reflected in and supplemented by the final listing rule for the new GOM DPS (74 FR 29344; June 19, 2009). The following gives a brief overview of the five listing factors as related to the GOM DPS.

1. **Present or threatened destruction, modification, or curtailment of its habitat or range –** Historically and, to a lesser extent currently, dams have adversely impacted Atlantic salmon by obstructing fish passage and degrading riverine habitat. Dams are considered to be one of the primary causes of both historic declines and the contemporary low abundance of the GOM DPS. Land use practices, including forestry and agriculture, have reduced habitat complexity (e.g., removal of large woody debris from rivers) and habitat connectivity (e.g., poorly designed road crossings) for Atlantic salmon. Water withdrawals, elevated sediment levels, and acid rain also degrade Atlantic salmon habitat.

2. **Overutilization for commercial, recreational, scientific, or educational purposes –** While most directed commercial fisheries for Atlantic salmon have ceased, the impacts from past fisheries are still important in explaining the present low abundance of the GOM DPS. Both poaching and by-catch in recreational and commercial fisheries for other species remain of concern, given critically low numbers of salmon.

3. **Predation and disease –** Natural predator-prey relationships in aquatic ecosystems in the GOM DPS have been substantially altered by introduction of non-native fishes (e.g., chain pickerel, smallmouth bass, and northern pike), declines of other native diadromous fishes, and alteration of habitat by impounding free-flowing rivers and removing instream structure (such as removal of boulders and woody debris during the log-driving era). The threat of predation on the GOM DPS is noteworthy because of the imbalance between the very low numbers of returning adults and the recent increase in populations of some native predators (e.g., double-crested cormorant), as well as non-native predators. Atlantic salmon are susceptible to a number of diseases and parasites, but mortality is difficult to assess in the wild and therefore is primarily documented at conservation hatcheries, fish culture facilities and commercial aquaculture facilities.

4. **Inadequacy of existing regulatory mechanisms –** The ineffectiveness of current federal and state regulations at requiring fish passage and minimizing or mitigating the aquatic habitat impacts of dams is a significant threat to the GOM DPS today. Furthermore, most dams in the GOM DPS do not require state or federal permits. Although the State of

Maine has made substantial progress in regulating water withdrawals for agricultural use, threats still remain within the GOM DPS, including those from the effects of irrigation wells on salmon streams.

5. **Other natural or manmade factors –** Poor marine survival rates of Atlantic salmon are a significant threat, although the causes of these decreases are unknown. he role of ecosystem function among the freshwater, estuarine, and marine components of the Atlantic salmon's life history, including the relationship of other diadromous fish species in Maine (e.g., American shad, alewife, sea lamprey), is receiving increased scrutiny in its contribution to the current status of the GOM DPS and its role in recovery of the Atlantic salmon. While current state and federal regulations pertaining to finfish aquaculture have reduced the risks to the GOM DPS (including eliminating the use of non-North American Atlantic salmon and improving containment protocols), risks from the spread of diseases or parasites and direct genetic effects from farmed salmon escapees interbreeding with wild salmon still exist.

4.2.5 Summary of Rangewide Status of Atlantic salmon

The GOM DPS of Atlantic salmon currently exhibits critically low spawner abundance, poor marine survival, and is confronted with a variety of additional threats. The abundance of GOM DPS Atlantic salmon has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is extremely low (approximately 10% on average over the past 5 years)(USASAC 2014-2018). The spatial distribution of the GOM DPS has been severely reduced relative to historical distribution patterns. The conservation hatchery program assists in slowing the decline and helps stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS. Continued reliance on the conservation hatchery program could prevent extinction in the short term, but recovery of the GOM DPS must be accomplished through increases in naturally reared salmon.

4.3 Critical Habitat Designated for the GOM DPS of Atlantic salmon

Coincident with the June 19, 2009 endangered listing, we designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009)(Figure 7). The final rule was revised on August 10, 2009. In this revision, designated critical habitat for the expanded GOM DPS of Atlantic salmon was reduced to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009).

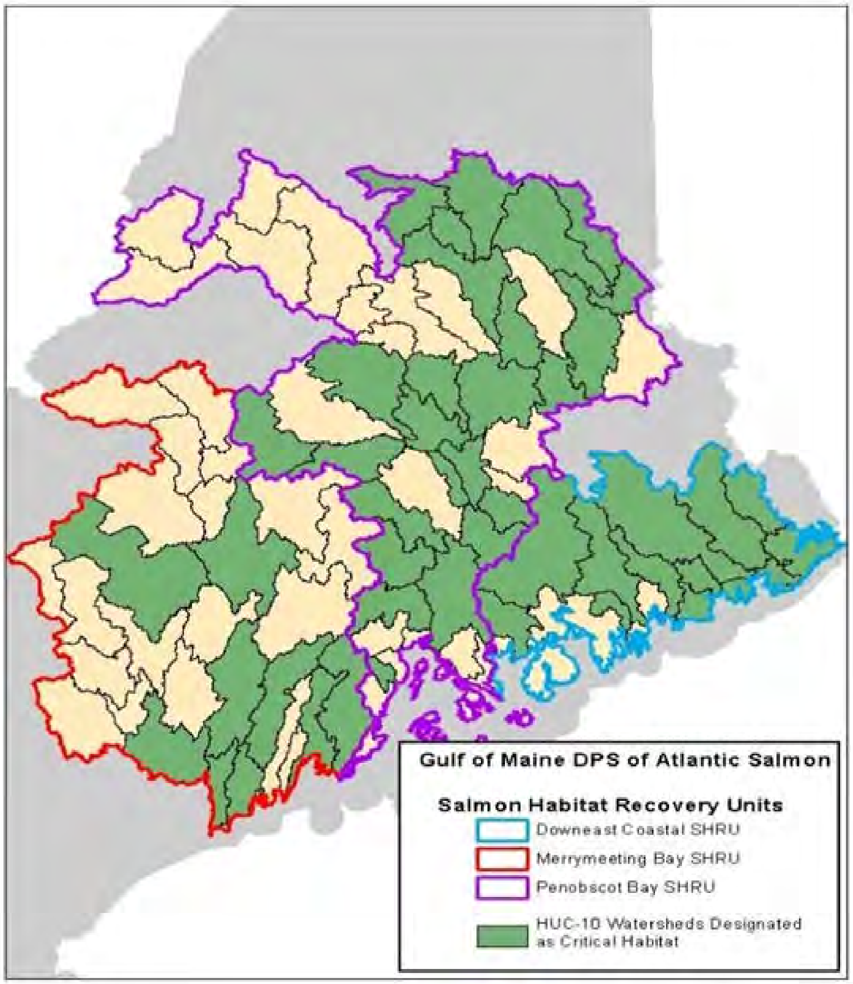

Figure 7: HUC-10 Watersheds Designated as Atlantic Salmon Critical Habitat and Salmon Habitat Recovery Units within the GOM DPS

4.3.1 Essential Features of Atlantic Salmon Critical Habitat

Designation of critical habitat is based on the known physical and biological features within the occupied areas of a listed species that are deemed essential to the conservation of the species. When we designated critical habitat for Atlantic salmon, we used the term primary constituent element (PCE). Subsequently, in 2016, we revised our critical habitat regulations (81 FR 7414) and replaced the term primary constituent element with the term physical or biological features (PBFs). "However, the shift in terminology does not change the approach used in conducting a 'destruction or adverse modification' analysis, which is the same regardless of whether the original designation identified primary constituent elements, physical or biological features, or both" (81 FR 7214). In this opinion, consistent with our revised critical habitat regulations, we use the term PBF to describe features essential to the conservation of Atlantic salmon.

For the GOM DPS, the physical and biological features (PBFs) essential for the conservation of Atlantic salmon are: 1) sites for spawning and rearing, and, 2) sites for migration (excluding marine migration[4]). We chose not to separate spawning and rearing habitat into distinct PBFs, although each habitat does have distinct features, because of the GIS-based habitat prediction model approach that was used to designate critical habitat (74 FR 29300; June 19, 2009). This model cannot consistently distinguish between spawning and rearing habitat across the entire range of the GOM DPS.

The physical and biological features for Atlantic salmon critical habitat are as follows:

Table 3: Physical and Biological Features of Atlantic Salmon Critical Habitat

PBFs for Spawning and Rearing (SR) Habitat	
SR1	Deep, oxygenated pools and cover (*e.g.*, boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
SR2	Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.
SR3	Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development, and feeding activities of Atlantic salmon fry.
SR4	Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
SR5	Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.
SR6	Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
SR7	Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.
PBFs for Migration (M) Habitat	
M1	Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.
M2	Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (*e.g.*, boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.
M3	Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.
M4	Freshwater and estuary migration sites free from physical and biological barriers that

[4] Although successful marine migration is essential to Atlantic salmon, we were not able to identify the essential features of marine migration and feeding habitat or their specific locations at the time critical habitat was designated.

	delay or prevent emigration of smolts to the marine environment.
M5	Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.
M6	Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Habitat areas designated as critical habitat must contain one or more physical and biological features within the acceptable range of values required to support the biological processes for which the species uses that habitat. Critical habitat includes all perennial rivers, streams, and estuaries and lakes connected to the marine environment within the range of the GOM DPS, except for those areas that have been specifically excluded as critical habitat. Critical habitat has only been designated in areas (HUC-10 watersheds) considered currently occupied by the species. Critical habitat includes the stream channels within the designated stream reach and includes a lateral extent as defined by the ordinary high-water line or the bankfull elevation in the absence of a defined high-water line. In estuaries, critical habitat is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

To facilitate and standardize determinations of effect for section 7 consultations involving Atlantic salmon critical habitat, we developed the "Matrix of Essential Features for Designated Atlantic Salmon Critical Habitat in the GOM DPS" (Table 4). The matrix lists the physical and biological features (essential features) of Atlantic salmon habitat, and the potential conservation status of critical habitat within an action area. Two essential features in the matrix (spawning and rearing, and migration) are described in regards to five distinct Atlantic salmon life stages: (1) adult spawning; (2) embryo and fry development; (3) parr development; (4) adult migration; and, (5) smolt migration. The conservation status of the essential features may exist in varying degrees of functional capacity within the action area. The three degrees of functional capacity used in the matrix are described in ascending order: (1) fully functioning; (2) limited function; and (3) not properly functioning.

We have determined that spawning and rearing PBFs 1 and 4-7, as well as migration PBFs 1-6 are present in the action area. We explain this determination and discuss these features and their current status in the action area below in the Environmental Baseline (Section 5).

Table 4: Matrix of essential features for assessing the environmental baseline of the action area

Essential Features	Conservation Status Baseline: Fully Functioning	Limited Function	Not Properly Functioning
A) Adult Spawning (October 1st - December 14th)			
Substrate	highly permeable course gravel and cobble between 1.2 to 10 cm in diameter	40- 60% cobble (22.5-256 mm dia.) 40-50% gravel (2.2 – 22.2 mm dia.); 10-15% course sand (0.5 -2.2 mm dia.), and <3% fine sand (0.06-0.05mm dia.)	more than 20% sand (particle size 0.06 to 2.2 mm), no gravel or cobble
Depth	17-30 cm	30 - 76 cm	< 17 cm or > 76 cm
Velocity	31 to 46 cm/sec.	8 to 31cm/sec. or 46 to 83 cm/sec.	< 5-8 cm/sec. or > 83cm/sec.
Temperature	7° to 10°C	often between 7° to 10°C	always < 7° or > 10°C
pH	> 5.5	between 5.0 and 5.5	< 5.0
Cover	Abundance of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Limited availability of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Absence of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
B) Embryo and Fry Development: (October 1st - April 14th)			
Temperature	0.5°C and 7.2°C, averages nearly 6oC from fertilization to eye pigmentation	averages < 4oC, or 8 to 10°C from fertilization to eye pigmentation	>10°C from fertilization to eye pigmentation
D.O.	at saturation	7-8 mg/L	< 7 mg/L
pH	> 6.0	6 - 4.5	< 4.5
Depth	5.3-15cm	NA	<5.3 or >15cm
Velocity	4 – 15cm/sec.	NA	<4 or > 15cm/sec.
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species

Table 1 continued…

	Conservation Status Baseline		
Essential Features	Fully Functioning	Limited Function	Not Properly Functioning
C) Parr Development: (All year)			
Substrate	gravel between 1.6 and 6.4 cm in diameter and boulders between 30 and 51.2 cm in diameter. May contain rooted aquatic macrophytes	gravel < 1.2cm and/or boulders > 51.2. May contain rooted aquatic macrophytes	no gravel, boulders, or rooted aquatic macrophytes present
Depth	10cm to 30cm	NA	<10cm or >30cm
Velocity	7 to 20 cm/sec.	< 7cm/sec. or > 20 cm/sec.	velocity exceeds 120 cm/sec.
Temperature	15° to 19°C	generally between 7-22.5oC, but does not exceed 29oC at any time	stream temperatures are continuously <7oC or known to exceed 29oC
D.O.	> 6 mg/l	2.9 - 6 mg/l	< 2.9 mg/l
Food	Abundance of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Presence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Absence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows
Passage	No anthropogenic causes that inhibit or delay movement	Presence of anthropogenic causes that result in limited inhibition of movement	barriers to migration known to cause direct inhibition of movement
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species

Table 1 continued…

Essential Features	Conservation Status Baseline: Fully Functioning	Limited Function	Not Properly Functioning
D) Adult migration (April 15th- December 14th)			
Velocity	30 cm/sec to 125 cm/sec	In areas where water velocity exceeds 125 cm/sec adult salmon require resting areas with a velocity of < 61 cm/s	sustained speeds > 61 cm/sec and maximum speed > 667 cm/sec
D.O.	> 5mg/L	4.5-5.0 mg/l	< 4.5mg/L
Temperature	14 – 20°C	temperatures sometimes exceed 20oC but remain below 23°C.	> 23°C
Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
E) Juvenile Migration: (April 15th - June 14th)			
Temperature	8 - 11oC	5 - 11°C.	< 5oC or > 11oC
pH	> 6	5.5 - 6.0	< 5.5
Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts

4.3.2 Factors Affecting Atlantic salmon and Critical Habitat

Threats Faced by Atlantic Salmon Throughout Their Range

Atlantic salmon face a number of threats to their survival, most of which are outlined in the Recovery Plan (NMFS and U.S. FWS 2005) and the latest status review (Fay *et al.* 2006)(we summarize these threats above in Section 4.2.4).

A wide variety of activities have focused on protecting Atlantic salmon and restoring the GOM DPS, including (but not limited to) hatchery supplementation; removing dams or providing fish passage; improving road crossings that block passage or degrade stream habitat; protecting riparian corridors along rivers; reducing the impact of irrigation water withdrawals; limiting effects of recreational and commercial fishing; reducing the effects of finfish aquaculture; outreach and education activities; and research focused on better understanding the threats to Atlantic salmon and developing effective restoration strategies.

Starting in the 1960s, Greenland implemented a mixed stock Atlantic salmon fishery off its western coast (Sheehan *et al.* 2015). The fishery primarily takes 1 sea winter (1 SW) North American and European origin Atlantic salmon that would potentially return to natal waters as mature, 2 SW spawning adults or older. Because of international concerns that the fishery would have deleterious on the contributing stock complexes, a quota system was agreed upon and implemented in 1976, and since 1984, catch regulations have been established by the North Atlantic Salmon Conservation Organization (NASCO) (Sheehan *et al.* 2015). In recent years, Greenland had limited the mixed stock salmon fishery for internal consumption only, which in the past has been estimated at 20 metric tons.

In 2015, Greenland unilaterally set a 45 ton quota for a mixed stock Atlantic salmon fishery for 2015, 2016, and 2017 (Sheehan *et al.* 2015). Based on historic harvest estimates, it is estimated that on average, approximately 100 U.S. origin adult Atlantic salmon will be harvested annually under a 45 ton quota. With recent U.S. returns of Atlantic salmon averaging less than 1,500 individuals per year, the majority of which originated from hatcheries, this harvest constitutes a substantial threat to the survival and recovery of the GOM DPS. The U.S. continues to negotiate with the government of Greenland and participants of the fishery both within and outside of NASCO to ultimately establish agreed upon measures that will curtail the impact of the fishery on U.S. origin fish.

The final rule designating critical habitat for the GOM DPS identifies a number of activities that have and will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Most of these activities have or still do occur, at least to some extent, throughout the Gulf of Maine.

5.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: actions that impact water quality, scientific research, and recreational fishing.

5.1 Scientific Studies

MDMR is authorized under the U.S. FWS' endangered species blanket permit (No. 697823) to conduct monitoring, assessment, and habitat restoration activities for listed Atlantic salmon populations in Maine. The extent of take from MDMR activities during any given year is not expected to exceed 2% of any life stage being impacted; for adults, it would be less than 1%. MDMR will continue to conduct Atlantic salmon research and management activities in the GOM DPS while the proposed action is carried out. The information gained from these activities will be used to further salmon conservation actions.

U.S. FWS is also authorized under an ESA section 10 endangered species blanket permit to conduct the conservation hatchery program at the Craig Brook and Green Lake National Fish Hatcheries. The mission of the hatcheries is to raise Atlantic salmon parr and smolts for stocking into selected Atlantic salmon rivers in Maine. Over 90% of adult returns to the GOM DPS are currently provided through production at the hatcheries. Approximately 600,000 smolts are stocked annually in the Penobscot River. The hatcheries provide a significant buffer from extinction for the species.

5.2 State or Private Activities in the Action Area

5.2.1 State of Maine stocking program

In Souadabscook Stream, 200 fry are released each year at rkm 3.49 (at the Paper Mill) as part of the Atlantic Salmon Federation's Fish Friends Program. Through this program, hatcheries provide local schools with a small number of Atlantic salmon eggs so that students can learn about the salmon life cycle and participate in the recovery effort by returning salmon fry to nearby streams.

Competitive interactions between wild Atlantic salmon and other salmonid fishes, especially introduced species, are not well understood in Maine. State managed programs supporting recreational fisheries often include stocking non-indigenous salmonid fish into rivers containing anadromous Atlantic salmon. Interactions between wild Atlantic salmon and other salmonids include; indigenous brook trout (*Salvelinus fontinalis*) and landlocked Atlantic salmon (*Salmo salar sebago*) and hatchery reared non-indigenous brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). Competition can play an important role in habitat use by defining niches that are desirable for optimal feeding, sheltering and spawning; however, we are not aware of any state managed stocking programs in or upstream of the action area, aside from the Fish Friends Program.

Limited resources may also increase competitive interactions which may act to limit the time and energy fish can spend obtaining nutrients essential to survival. This is most noticeable shortly after fry emerge from redds, when fry densities are at their highest (Hearn 1987) and food availability is limited. Prior residence of wild salmonids may infer a competitive advantage during this time over domesticated hatchery juveniles (Letcher 2002; Metcalfe 2003); even though the hatchery reared individuals may be larger (Metcalfe 2003). This may limit the success of hatchery cohorts stocked annually to support the recovery of Atlantic salmon.

Domesticated Atlantic salmon produced by the commercial aquaculture industry that escape from hatcheries or net pens also compete with wild Atlantic salmon for food, space and mates.

5.2.2 Private Recreational Fishing

While there is no information on levels of recreational fishing in the stream, it is possible that anglers use the Souadabscook (likely upstream of the action area) as a fishing area.

5.2.3 Contaminants and Water Quality

Pollutants discharged from point sources have the potential to affect water quality within the action area of this consultation. Common point sources of pollutants include publicly operated waste treatment facilities, overboard discharges (OBD), and industrial sites and discharges. The Maine Department of Environmental Protection (MDEP) issues permits under the National Pollutant Discharge Elimination System (NPDES) for licensed point source discharges. Conditions and license limits are set to maintain the existing water quality classification.

Generally, the impacts of point source pollution are greater in the larger rivers of the GOM DPS; the Souadabscook Stream has minimal upstream development and infrastructure, and as such, MDEP classifies it as a Class AA water body. Class AA waters is the highest classification, and is, "…applied to waters which are outstanding natural resources and which should be preserved because of their ecological, social, scenic or recreational importance" (MDEP 2018). As a Class AA water body, the Souadabscook has additional restrictions on direct discharges of pollutants that are designed to protect and maintain the stream's high quality habitat for aquatic life, as well as its human uses (e.g., drinking water, fishing, recreation)(MDEP 2018).

5.3 Status of Atlantic Salmon and Critical Habitat in the Action Area

A summary of the status of the species rangewide and designated critical habitat in its entirety was provided above. This section will focus on the status of Atlantic salmon and designated critical habitat in the action area; however, attention will also be paid to the status of Atlantic salmon and critical habitat in the Penobscot Bay Salmon Habitat Recovery Unit (SHRU), as this context is necessary to understand salmon movements and habitat usage in the Souadabscook Stream.

5.3.1 Upstream Migrating Adults

The Penobscot River watershed supports the largest runs of Atlantic salmon in the GOM DPS, with 866 returns in 2017 (USASAC 2018). This is due to the large amount of available habitat and large-scale stocking program that includes smolt, parr, fry, and restocking of captured sea-run adults after spawning at the Craig Brook National Fish Hatchery (CBNFH). Roughly 600,000 smolts are stocked in the Penobscot River watershed annually. In addition, approximately two million fry and parr are stocked in the Penobscot River watershed annually.

In the most recent year, 2017, these numbers had gone down slightly as 253,304 parr, 569,662 smolts, 574,821 egg eyed, and 409,130 fry were released into the Penobscot watershed (total of 1,806,917)(USASAC 2018).

Table 5: Documented returns from trap and redd-count monitoring for GOM DPS Atlantic salmon by SHRU for return year 2017

SHRU	Hatchery	Natural	Sub Totals
Downeast Coastal	28	55	83
Penobscot Bay	761	105	866
Merrymeeting Bay	11	48	59
Gulf of Maine DPS	**800**	**208**	**1,008**

All adults returning to the Penobscot River are collected at the Milford Dam fish lift. Adults captured at the lift are either taken to CBNFH for captive breeding or returned to the river upstream of the Milford Dam to spawn naturally in the Penobscot River. Operation of the Milford Dam fish lift in began in 2014, following the removal of the Veazie and Great Works Dams. Prior to 2014, adult Atlantic salmon returns were recorded at the Veazie Dam fishway. Over the past decade, adult returns to the Penobscot have ranged from a low of 261 (2014) to a high of 3,125 (2011)(USASAC 2018, Table 6).

Table 6: Adult Atlantic salmon returns by origin to the Penobscot River recorded from 1968 to 2017 (USASAC 2018)

	Hatchery Origin				Wild Origin				
Penobscot	**1SW**	**2SW**	**3SW**	**Repeat**	**1SW**	**2SW**	**3SW**	**Repeat**	**Total**
1968-2007	11,296	44,415	288	709	726	3,842	35	99	**61,410**
2008	713	1,295	0	4	23	80	0	0	**2,115**
2009	185	1,683	2	1	12	74	1	0	**1,958**
2010	409	819	0	11	23	53	0	0	**1,316**
2011	696	2,167	3	12	45	201	1	0	**3,125**
2012	8	531	6	2	5	69	0	3	**624**
2013	54	275	3	2	3	44	0	0	**381**
2014	82	153	2	2	1	21	0	0	**261**
2015	110	552	7	1	9	52	0	0	**731**
2016	208	218	2	1	10	68	0	0	**507**
2017	301	451	9	0	9	79	0	0	**849**
Total	**14,062**	**52,559**	**322**	**745**	**866**	**4,583**	**37**	**102**	**73,276**

5.3.2 Post-Spawned Adults

Following spawning in the fall, Atlantic salmon kelts may immediately return to the sea, or over-winter in freshwater habitat and migrate in the spring, typically April or May (Baum 1997). High spring flows can facilitate downstream passage of kelts at dams by providing spillage (Shepard 1989). Downstream passage success of kelts was assessed as part of radio tag studies conducted for smolts in the Penobscot (GNP 1989, Shepard 1989, Hall and Shepard 1990). Kelts tended to move downstream early in the spring (mostly mid-April through late May), regardless of whether fish were tagged in the spring or fall (i.e., most radio-tagged study fish generally stayed in the river near where they were placed until the following spring). Because kelt passage occurred during periods of spill at most dams, a large portion of study fish (90%) passed dams via spillage (i.e., over the dam). Kelt attraction to, and use of, downstream passage facilities was highly variable depending on facility, year of study, and hydrological conditions (e.g., spill or not). At the upstream confluences (i.e., the Stillwater Branch and the main stem), kelts followed the routes in approximate proportion to flow in the two channels.

5.3.3 Atlantic salmon spawning and rearing

Atlantic salmon utilize free-flowing rivers and streams for spawning and juvenile rearing. The lacustrine condition of the impoundments created by the Milford, West Enfield, Medway, Orono and Stillwater dams has largely eliminated suitable spawning or rearing habitat for Atlantic salmon in the lower reaches of the Penobscot River. We estimate that there are 397,092 total spawning and nursery habitat units (100 m^2) in the Penobscot Bay SHRU, of which approximately 18,600 (4.7%) are suitable and accessible to date (NMFS 2018b).

5.3.4 Downstream Migrating Smolts

Out-migrating Atlantic salmon smolts in the Penobscot River watershed are the result of wild production following natural spawning and juvenile rearing, or from stocking fry, parr, and smolts (Fay *et al.* 2006). The majority of the salmon run on the Penobscot are the result of stocked smolts; current management plans call for stocking 600,000 hatchery reared smolts at various locations in the main stem above Veazie Dam and in the Pleasant River (Piscataquis River sub-drainage) (MDMR and MDIFW 2009). Based on unpublished data from smolt-trapping studies in 2000 – 2005 by NMFS, smolts migrate from the Penobscot between late April and early June. The majority of the smolt migration appears to take place over a three to five-week period after water temperatures rise to 10°C. Stich *et al.* (2015) found that smolt survival during their downstream migration in the Penobscot River has been highest at temperatures between 10°C and 20°C and at intermediate river flows.

Rotary screw traps (RSTs) were used by NMFS during 2000-2005 to monitor downstream migrating smolts in the Penobscot River (Figure 8). Traps were deployed 0.87, 1.54, and 1.77 kilometers below the former Veazie Dam. During the sampling period, the number of smolts captured in RSTs ranged from 72 to 3,165 annually. RST sampling in the Piscataquis River by MDMR in 2004 and 2005 captured 497 and 315 smolts, respectively. It is not currently possible to estimate the total number (wild and stocked) of smolts emigrating in the Penobscot or Piscataquis River, but the run is certainly related to the number of fish stocked annually.

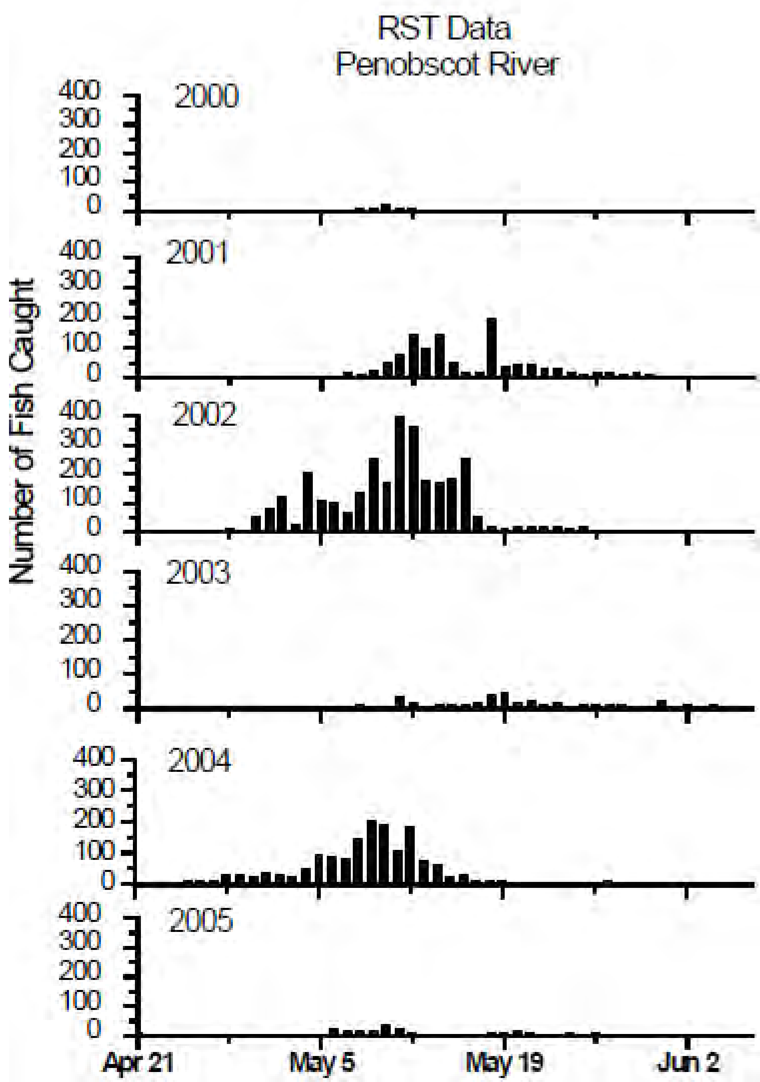

Figure 8: Total number of smolts collected using rotary screw traps in the Penobscot River from 2000 to 2005

5.3.5 Threats faced by Atlantic salmon within the Penobscot Bay SHRU

Dams and Hydroelectric Facilities

The Penobscot River Basin has been extensively developed for hydroelectric power production. There are over 100 dams in the Penobscot River watershed; approximately 20 of these dams operate under a FERC hydropower license or exemption (Fay *et al.* 2006). Hydroelectric dams are known to impact Atlantic salmon through habitat alteration, fish passage delays, and entrainment and impingement.

According to Fay *et al.* (2006), the greatest impediment to self-sustaining Atlantic salmon populations in Maine is obstructed fish passage and degraded habitat caused by dams. In addition to direct loss of production in habitat from impoundment and inundation, dams also alter natural river hydrology and geomorphology, interrupt natural sediment and debris transport processes, and alter natural temperature regimes (Wheaton *et al.* 2004). These impacts can have profound effects on aquatic community composition and adversely affect entire aquatic ecosystem structure and function. Furthermore, impoundments can significantly change the prey resources available to salmon due to the existing riverine aquatic communities upstream of a dam site which have been replaced by lacustrine communities following construction of a dam. Anadromous Atlantic salmon inhabiting the GOM DPS are not well adapted to these artificially created and maintained impoundments (NRC 2004). Conversely, other aquatic species that can thrive in impounded riverine habitat will proliferate, and can significantly change the abundance and species composition of competitors and predators.

The Souadabscook Stream is located below the first dam on the Penobscot River at Milford.

Habitat Alteration

While we estimate that nearly 400,000 units of spawning and nursery habitat exist in the Penobscot Bay watershed, only 18,600 of those units are suitable and accessible, as historical and present day dams have eliminated or degraded vast, but to date unquantified, reaches of suitable rearing habitat (NMFS 2018b). FERC (1997) estimated that 27% (19 miles) of main stem habitat (i.e., not including the Stillwater Branch segment) is impounded by the five dams between head-of-tide and the confluence of the East and West Branches in Medway. On the West Branch, approximately 57% of the 98 river miles is impounded (USACE 1990). Approximately 11% of the approximately 74 miles of the Piscataquis River main stem, 28% of the approximately 43 miles of the Sebec River tributary to the Piscataquis, and 8% of the approximately 25 miles of the Passadumkeag River (below natural barrier at Grand Falls) is impounded (USACE 1990).

Impoundments created by these dams limit access to habitat, alter habitat, and degrade water quality through increased temperatures and lowered dissolved oxygen levels. Furthermore, because hydropower dams are typically constructed in reaches with moderate to high underlying gradients, approximately 50% of available gradient in the main stem, and 41% in the West Branch, is impounded (USACE 1990, FERC 1997). These moderate to high gradient reaches, if free-flowing, would likely constitute the highest value as Atlantic salmon spawning, nursery, and adult resting habitat within the context of all potential salmon habitat within these reaches.

Compared to a natural hydrograph, the operation of dams in a store-and-release mode on the East Branch, and especially on the West Branch of the Penobscot River, results in reduced spring runoff flows, less severe flood events, and augmented summer and early fall flows. Such operations in turn reduce sediment flushing and transport and physical scouring of substrates, and increase surface area and volume of summer and early fall habitat in the main stem. Water drawn from impoundments in the West Branch often constitutes half or more of the streamflow in the main stem during the otherwise drier summer months (data analyzed from FERC 1996).

The extent to which these streamflow modifications in the upper Penobscot watershed impact salmon populations, habitat (including migratory corridors during applicable seasons), and restoration efforts is unknown. However, increased embeddedness of spawning and invertebrate colonization substrates, diminished flows during smolt and kelt outmigration, and enhanced habitat quantity and, potentially, “quality” for non-native predators such as smallmouth bass, are likely among the adverse impacts to salmon. Conversely, higher summer and early fall stream flows may provide some benefits to Atlantic salmon or their habitat within affected reaches, and may also help mitigate certain potential water quality impacts (e.g., dilution of harmful industrial and municipal discharges).

Migratory Delay and Timing

Early migration is an adaptive trait that ensures adult Atlantic salmon have sufficient time to effectively reach spawning areas despite the occurrence of temporarily unfavorable conditions that naturally occur within rivers (Bjornn and Reiser 1991). Gorsky (2005) found that migration of Atlantic salmon was significantly affected by flow and temperature conditions in the Penobscot River. He found that high flow led to a decrease in the rate of migration and that rates increased with temperature up to a point (around 23° C) where they declined rapidly. To avoid high flows and warmer temperatures in the river, Atlantic salmon have adapted to migrating in the late spring and early summer, even though spawning does not occur until October and November. Between 2007 and 2010, 78% of migrating Atlantic salmon migrated past the first dam on the Penobscot River in May and June.

To access high quality summer holding areas close to spawning areas in the GOM DPS, Atlantic salmon must migrate past multiple dams. Delay at these dams can, individually and cumulatively, affect an individual's ability to access suitable spawning habitat within the narrow window when temperature and flow conditions in the river are suitable for migration. In addition, delays in migration can cause over ripening of eggs, which can lead to increased chance of egg retention, and reduced egg viability in pre-spawn female salmonids (deGaudemar and Beall 1998). It is not known what level of delay at each dam would significantly affect a migrant's ability to access suitable spawning habitat, as it would be different for each individual and tributary, and would vary from year to year depending on environmental conditions.

Dams can also delay smolt migration to the ocean, which can lead to delayed mortality by affecting physiological health or preparedness for marine entry and migration (Budy *et al.* 2002). Delays in migration may cause salmon to lose physiological smolt characteristics due to high water temperatures during spring migration, and can result in progressive misalignment of physiological adaptations to seawater entry; thereby, reducing smolt survival (McCormick *et al.* 1999). In addition to direct mortality sustained by Atlantic salmon at dams, Atlantic salmon in the GOM DPS sustain delayed mortality as a result of repeated passage events at multiple dams. Lastly, because Atlantic salmon often encounter multiple dams during their migratory life cycle, losses are cumulative and often biologically significant (Fay *et al.* 2006).

Predation

In addition to direct mortality during downstream passage, dams can expose kelts and smolts to indirect mortality caused by sub-lethal injuries, increased stress, and/or disorientation. A large proportion of indirect mortality is a result of disorientation caused by downstream passage, which can lead to elevated levels of predation immediately downstream of the project (Mesa 1994; Blackwell and Juanes 1998). Predation upon Penobscot River smolts has been studied by Blackwell *et al*. (1997), as it relates to double crested cormorants, and by Van den Ende (1993) for certain fish species. In addition, the Penobscot River smolt migration studies described above have documented high smolt loss rates throughout the river system including free-flowing sections which implicate these same predators.

Smallmouth bass and chain pickerel are each important predators of Atlantic salmon within the range of the GOM DPS (Fay *et al.* 2006). Smallmouth bass are a warm-water species whose range now extends through north-central Maine and well into New Brunswick (Jackson 2002). Smallmouth bass are very abundant in the Penobscot River—smallmouth bass inhabit the entire main stem migratory corridor as well as many of the juvenile Atlantic salmon rearing habitats such as the East Branch Penobscot River and the Piscataquis River. Smallmouth bass likely feed on fry and parr though little quantitative information exists regarding the extent of bass predation upon salmon fry and parr. Smallmouth bass are important predators of smolts in main stem habitats, although bioenergetics modeling indicates that bass predation is insignificant at 5°C and increases with increasing water temperature during the smolt migration (Van den Ende 1993).

Chain pickerel are known to feed upon smolts within the range of the GOM DPS and certainly feed upon fry and parr, as well as smolts, given their piscivorous feeding habits (Van den Ende 1993). Chain pickerel feed actively in temperatures below 10°C (Van den Ende 1993, MDIFW 2002). Smolts were, by far, the most common item in the diet of chain pickerel observed by Barr (1962) and Van den Ende (1993). However, Van den Ende (1993) concluded that, "daily consumption was consistently lower for chain pickerel than that of smallmouth bass," apparently due to the much lower abundance of chain pickerel.

Northern pike were illegally stocked in Maine, and their range now includes Pushaw Lake which drains to the Lower Penobscot River (Fay *et al.* 2006). Northern pike have expanded their range in the Penobscot River to include the Pushaw Stream outlet, nearby Mud Pond and probably portions of the main stem Penobscot River, since there are no barriers to their movement. Northern pike are ambush predators that rely on vision and thus, predation upon smolts occurs primarily in daylight with the highest predation rates in low light conditions at dawn and dusk (Bakshtansky *et al.*1982). Hatchery smolts experience higher rates of predation by fish than wild smolts, particularly from northern pike (Ruggles 1980, Bakshtansky *et al.* 1982).

Many species of birds prey upon Atlantic salmon throughout their life cycle (Fay *et al.* 2006). Blackwell *et al.* (1997) reported that salmon smolts were the most frequently occurring food items in cormorant sampled at main stem dam foraging sites. Cormorants were present in the Penobscot River during the spring smolt migration as migrants, stopping to feed before resuming northward migrations, and as resident nesting birds using Penobscot Bay nesting islands (Blackwell *et al.* 1997, Blackwell and Krohn 1997). The abundance of alternative prey resources such as upstream migrating alewife, likely minimizes the impacts of cormorant predation on the GOM DPS (Fay *et al.* 2006). Common mergansers and belted kingfishers are likely the most important predators of Atlantic salmon fry and parr in freshwater environments.

Contaminants and Water Quality

As summarized above in Section 5.2.3, MDEP issues permits under the National Pollutant Discharge Elimination System (NPDES) for licensed point source discharges; however, as a Class AA water body (the highest rating), the Souadabscook has high quality, clean stream habitat and receives additional state protections limiting point source discharge. Because the Souadabscook Stream does not have substantial upstream development or infrastructure, it is likely more vulnerable to nonpoint pollution, such as runoff from roadways and agriculture.

Nonpoint pollution has not had a notable impact to date, as the stream has maintained its Class AA status.

Summary of Threats
Adult returns for the GOM DPS remain well below conservation spawning escapement (CSE). For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay *et al.* 2006), which is further indication of their poor population status. The abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades; while the proportion of fish that are of natural origin has stabilized in the past 5 years to an average of approximately 10%. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to a substantial increase in the overall abundance of salmon or the proportion of the naturally reared returning fish from GOM DPS.

A number of activities within the Penobscot Bay SHRU will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture.

Dams, along with degraded substrate and cover, water quality (see Section 5.3.3), water temperature, and biological communities, have reduced the quality and quantity of habitat available to Atlantic salmon populations within the Penobscot Bay SHRU. Hydroelectric dams, in particular, have a significant negative effect on listed Atlantic salmon, as well as critical habitat, within the Penobscot River. The removal of the Veazie and Great Works Dams and the breach of the Howland Dam are expected to facilitate recovery efforts of Atlantic salmon and other diadromous species in the Penobscot watershed (Penobscot River Restoration Trust 2008). Already, significant increases in adult river herring (alewife and blueback herring) numbers have been documented at the Milford Dam fish lift each spring since it went into operation in 2014 (over 1.2 million in 2016). Additionally, the number of American shad captured at Milford has also increased dramatically from approximately 800 fish passed upriver in 2014 to over 7,000 fish counted in 2016. However, while passage has improved, there are still over 100 dams in the Penobscot River watershed.

5.3.6 Atlantic Salmon and Critical Habitat in the Action Area (Souadabscook Stream)
As stated above, the Souadabscook Stream originates in Carmel, Maine and flows primarily in a southeasterly direction to the Penobscot River. The overall length of Souadabscook Stream is approximately 32.2 km (20 miles). The Grist Mill Bridge is approximately 610 meters upstream from the confluence with the Penobscot. Upstream of the bridge, the stream is freshwater, while downstream of the bridge is tidally influenced, with an estimated salinity of less than 2 ppt. A dam was removed at the site of the bridge in 1999, vastly improving passage on the stream. More recently, a fishway was installed along the stream in Carmel, further improving passage for Atlantic salmon, river herring, and brook trout (Maine Sea Grant 2016).

Using the Maine Stream Habitat Viewer supplied by Maine Department of Marine Resources

(MDMR), there are approximately 631 units (1 unit = 100 m^2) of surveyed Atlantic salmon rearing habitat upstream of the action area, along with 40 units of surveyed Atlantic salmon spawning habitat (i.e., MDMR analyzed the entire Souadabscook and determined the action area did not contain spawning or rearing habitat). As stated on their website, "this dataset provides Atlantic salmon rearing and spawning habitat locations from surveys conducted by field biologists within and outside of the Gulf of Maine Atlantic salmon Distinct Population Segment. The surveys were intended to document the presence of adequate habitat, not the presence of Atlantic salmon using the habitat" (MDMR 2017). As noted above, none of the surveyed spawning or rearing habitat overlaps with the action area; however, the most downstream portion of the surveyed rearing habitat is just 92.5 m upstream of the Grist Mill Bridge, and 25 m upstream of the action area (the upstream limit of where we expect acoustic impacts above the behavioral threshold for salmon to be experienced). The closest surveyed spawning habitat is approximately 392 m upstream of the bridge.

While surveyed spawning and rearing habitat does not equate to Atlantic salmon use of the habitat, MDMR conducts redd surveys and electrofishing approximately every other year. Peter Ruksznis, who conducts the surveys and electrofishing in the Souadabscook for MDMR, provided the following data (Note: MDMR uses the Souadabscook's confluence with the Penobscot as rkm 0 (Grist Mill Bridge would be approximately rkm 0.6)(P. Ruksznis pers. comm. 9/25/2018):

Table 7: Electrofishing Results in the Souadabscook Stream (2010-2017)

Year	Date	RKM	YOY Caught	Parr Caught
2017	17-Aug	5.95	0	0
	17-Aug	5.5	0	0
	17-Aug	3.71	2	1
2013	8-Oct	3.62	0	0
2010	23-Aug	3.66	7	0
	23-Aug	3.5	3	0

Table 8: Test Pit and Redd Surveys in the Souadabscook Stream (2009-2017)

Year	RKM	Test Pit	Redd
2017	6.25	1	1
	3.49	1	0
2013	6.25	0	3
2011	1-6.27	0	9*
2009	1.42	0	1

*Peter Ruksznis (MDMR) stated that numerous redds were found in 2009, and estimated 9 during a phone call (9/25/2018)

In the USASAC 2018 report, the authors interpret MDMR's test pit and redd data from 2017, and using the Return to Redds model, estimate a return of four adult salmon to Souadabscook

Stream for that year. We use the estimated return of four adult salmon in 2017 as the best available estimate for the number of adults that may enter the action area during the work window.

Expected Seasonal Distribution of Atlantic Salmon in the Action Area
The discussion below summarizes the expected seasonal distribution of Atlantic salmon in the action area.

As noted in the project description, MaineDOT is proposing to conduct in-water work for the replacement of the Grist Mill Bridge between July 1 and September 30. Atlantic salmon adult and smolt life stages move through the action area during their spawning and outmigration periods. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July (Meister 1958; Baum 1997), but may enter at any time between early spring and late summer. Salmon that return in early spring spend nearly five months in the river before spawning, often seeking cool water refuge (e.g., deep pools, springs, and mouths of smaller tributaries) during the summer months. The action area includes a few pools with depths greater than two feet, but most pools contain limited cover. Much of the action area consists of riffles, runs, and cascades. Therefore, the action area may function as low value refuge habitat for adult salmon, and migrating adults could be present from April through November. Therefore, adult salmon may be present in the action area during the work window; however, we expect no more than four adults to be present during this period.

After spawning, male and female Atlantic salmon (kelts) either return to sea immediately or remain in fresh water until the following spring before returning to the sea (Fay *et al.* 2006). As described above, radio tag studies conducted for smolts in the Penobscot demonstrated that kelts tended to move downstream early in the spring (mostly mid-April through late May), regardless of whether fish were tagged in the spring or fall (i.e., most radio-tagged study fish generally stayed in the river near where they were placed until the following spring).

Because the closest surveyed spawning ground is 392 m upstream of the bridge, we do not expect spawning to occur in the action area. Therefore, we do not expect Atlantic salmon eggs, alevin, or fry to be in the action area, as these life stages stay in the spawning area. When fry reach approximately 4 centimeters (1.6 inches) in length, the young salmon are termed parr (Danie *et al.* 1984). Parr overwinter beneath stones and while movement is limited between December and April, it occurs primarily between dusk and dawn for feeding (Cunjak 1988, Heggenes 1990) as ice formation reduces total habitat availability (Whalen *et al.* 1999). Parr remain in the river for 2 to 3 years before undergoing smoltification, a process where parr go through physiological changes when transitioning from a freshwater environment to a saltwater marine environment. For parr to undergo smoltification, they must reach a critical size of 10 centimeters (4 inches) in length at the end of the previous growing season (Hoar 1988). The upper portion of the action area contains suitable habitat for rearing Atlantic salmon parr and there is documented rearing habitat located 250 feet upstream of the Grist Mill Bridge. MDMR has stated that there is potential for parr to be present in the upstream vicinity of the bridge at any time of year (P. Ruksznis, pers. comm.). As the section of the stream immediately downstream of the bridge is a minor cascade that empties into tidally influenced waters with salinities less than 2ppt, we do not expect parr downstream of the bridge. Therefore, parr may be present in the upper portion of the action area during the work window.

Once smoltification occurs, smolts begin their downstream migration between April and June. Most smolts enter the sea during May to begin their first ocean migration (USASAC 2004). Based on data from a MDMR 2004 study, the latest date smolt were caught on the Penobscot River downstream of the action area was June 17 (P. Ruksznis, pers. comm.). Therefore, we do not expect smolts to be present in the action area during the in-water work window.

Table 9: Timing of Atlantic salmon lifestages and behaviors in the action area

Lifestage/Behavior	**Time of Year Present in Action Area**	**Behavior in Action Area**
Adults	Year-round	Migration of spawning adults in the spring-fall; outmigration of kelts in the fall and spring; post-spawn overwintering for spring kelts
Smolts	April 1-June 30	Outmigration to marine waters
Parr	Year-round	Rearing, foraging, overwintering

Physical and Biological Features of Atlantic Salmon Critical Habitat in the Action Area
As detailed in Section 4.2, we have designated critical habitat for Atlantic salmon in the Penobscot River watershed, including the action area.

The listed PBFs for Atlantic salmon considered essential to the conservation of the species include physical and biological features of: 1) spawning and rearing; and 2) migration requirements. As described above, spawning sites are most often positioned at the head of a riffle (Beland *et al.* 1982), the tail of a pool, or the upstream edge of a gravel bar where water depth is decreasing and water velocity is increasing (McLaughlin and Knight 1987; White 1942). Table 4 describes fully functioning spawning habitat as having a depth of 17-30 cm, with limited function at 30-76 cm. Similarly, optimal habitat for embryo, larval, fry, and parr development occur at depths less than or equal to 30 cm. Based on the best available information, all potential salmon spawning habitat in the Souadabscook Stream occurs upstream of the Grist Mill Bridge and project action area. Therefore, the two PBFs relevant to spawning sites and development of salmon eggs, alevin, or fry (i.e., SR2 and SR3) are not present in the action area (see Table 3).

Though parr are typically stream dwellers, they also use pools within rivers and streams, dead-waters (sections of river or stream with very little to no gradient), and lakes within a river system as a secondary nursery area after emergence. While the nearest surveyed rearing habitat in the Souadabscook is approximately 92.5 m upstream of the Grist Mill Bridge (25 m upstream of the action area), the portion of the action area underneath and upstream of the bridge is accessible to parr, and could be used for foraging or shelter; parr could be present in this area year round.

Therefore, within the action area, the following PBFs are present:

Table 10: Physical and Biological Features of Atlantic Salmon Critical Habitat in the Action

Area

PBFs for Spawning and Rearing (SR) Habitat	
SR1	Deep, oxygenated pools and cover (*e.g.*, boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
SR4	Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
SR5	Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.
SR6	Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
SR7	Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.
PBFs for Migration (M) Habitat	
M1	Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.
M2	Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (*e.g.*, boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.
M3	Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.
M4	Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.
M5	Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.
M6	Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

We have determined that all of the Atlantic salmon critical habitat PBFs present in the action area are fully functioning, with the exception of SR1 and M2. As described above, while the portion of the action area downstream of the bridge does have some pools with depths greater than a few feet (depending on the tide and flows), there is very little cover vegetative cover (over hanging trees, logs) and no submerged vegetation. Therefore, the current condition of SR1 and M2 is “limited.”

6.0 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change on listed species and critical habitat in the action area over the lifespan of the proposed project (approximately four months in 2019). Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion, below.

6.1 Background Information on Global climate change

In its Fifth Assessment Report (AR5) from 2014, the Intergovernmental Panel on Climate Change (IPCC) stated that the globally averaged combined land and ocean surface temperature data has shown a warming of 0.85°C (likely range: 0.65° to 1.06°C) over the period of 1880-2012. Similarly, the total increase between the average of the 1850-1900 period and the 2003-2012 period is 0.78°C (likely range: 0.72° to 0.85°C). On a global scale, ocean warming has been largest near the surface, with the upper 75 meters of the world's oceans having warmed by 0.11°C (likely range: 0.09° to 0.13°C) per decade over the period of 1971-2010 (IPCC 2014). In regards to resultant sea level rise, it is very likely that the mean rate of global averaged sea level rise was 1.7 millimeters/year (likely range: 1.5 to 1.9 millimeters/year) between 1901 and 2010, 2.0 millimeters/year (likely range: 1.7 to 2.3 millimeters/year) between 1971 and 2010, and 3.2 millimeters/year (likely range: 2.8 to 3.6 millimeters/year) between 1993 and 2010.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next several decades. The global mean surface temperature change for the period 2016-2035 relative to 1986-2005 will likely be in the range of 0.3° to 0.7°C (medium confidence). This assessment is based on multiple lines of evidence and assumes there will be no major volcanic eruptions or secular changes in total solar irradiance. Relative to natural internal variability, near-term increases in seasonal mean and annual mean temperatures are expected to be larger in the tropics and subtropics than in mid- and high latitudes (high confidence). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has also resulted in increased river discharge and glacial and sea-ice melting (Greene *et al.* 2008). The strongest ocean warming is projected for the surface in tropical and Northern Hemisphere subtropical regions. At greater depths, the warming will be most pronounced in the Southern Ocean (high confidence). Best estimates of ocean warming in the top 100 meters are about 0.6° to 2.0°C, and about 0.3° to 0.6°C at a depth of about 1,000 meters by the end of the 21st century (IPCC 2014).

Under Representative Concentration Pathway (RCP) 8.5, the projected change in global mean surface air temperature and global mean sea level rise for the mid- and late 21st century relative to the reference period of 1986-2005 is as follows. Global average surface temperatures are likely to be 2.0°C higher (likely range: 1.4° to 2.6°C) from 2046-2065 and 3.7°C higher (likely range: 2.6° to 4.8°C) from 2081-2100. Global mean sea levels are likely to be 0.30 meters higher (likely range: 0.22 to 0.38 meters) from 2046-2065 and 0.63 meters higher (likely range: 0.45 to 0.82 meters) from 2081-2100, with a rate of sea level rise during 2081-2100 of 8 to 16 millimeters/year (medium confidence).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (IPCC 2007; Greene *et al.* 2008). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the Earth's atmosphere caused by anthropogenic forces (IPCC 2007). The NAO impacts climate variability throughout the Northern Hemisphere (IPCC 2007). Data from the 1960s through the 2000s showed that the NAO index increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2007). This warming extends over 1,000 meters deep and is deeper than anywhere in the world's oceans and is particularly evident under the Gulf Stream/North Atlantic Current system (IPCC 2007). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (IPCC 2007; Greene *et al.* 2008). There is evidence that the NADW has already freshened significantly (IPCC 2007). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the entire world (Greene *et al.* 2008).

There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007). These trends have been most apparent over the past few decades, although this may also be due to increased research. Information on future impacts of climate change in the action area is discussed below.

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the action area, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Additional information on potential effects of climate change specific to the action area is discussed below. Warming is very likely to continue in the U.S. over the next 50 years regardless of reduction in greenhouse gases, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 50 years, and it is possible that they will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

Expected consequences of climate change for river systems could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources along the U.S. Atlantic coast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2^{o}C per decade; and 3) a rise in sea level (NAST 2000). Sea level is expected to continue rising; during the 20th century global sea level has increased 15 to 20 centimeters. It is also important to note that ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing *et al.* 2015). New projections for the U.S. Northeast Shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average and thus existing projections from the IPCC may be too conservative (Saba *et al.* 2015).

6.2 Anticipated Effects to Atlantic Salmon and Critical Habitat

Atlantic salmon may be especially vulnerable to the effects of climate change in New England, since the areas surrounding many watersheds where salmon are found are heavily populated and have already been affected by a range of stresses associated with agriculture, industrialization, and urbanization (Elliot *et al.* 1998). Climate effects related to temperature regimes and flow conditions determine juvenile salmon growth and habitat (Friedland 1998). One study conducted in the Connecticut and Penobscot rivers, where temperatures and average discharge rates have been increasing over the last 25 years, found that dates of first capture and median capture dates for Atlantic salmon have shifted earlier by about 0.5 days/ year, and these consistent shifts are correlated with long-term changes in temperature and flow (Juanes *et al.* 2004). Temperature increases are also expected to reduce the abundance of salmon returning to home waters, particularly at the southern limits of Atlantic salmon spatial distribution (Beaugrand and Reid

2003).

A study conducted in the United Kingdom that used data collected over a 20-year period in the Wye River found Atlantic salmon populations have declined substantially and this decline was best explained by climatic factors like increasing summer temperatures and reduced discharge more than any other factor (Clews *et al.* 2010). Changes in temperature and flow serve as cues for salmon to migrate, and smolts entering the ocean either too late or too early would then begin their post-smolt year in such a way that could be less optimal for opportunities to feed, predator risks, and/or thermal stress (Friedland 1998). Since the highest rate of mortality affecting Atlantic salmon occurs in the marine phase, both the temperature and the productivity of the coastal environment may be critical to survival (Drinkwater *et al.* 2003). Temperature influences the length of egg incubation periods for salmonids (Elliot *et al.* 1998) and higher water temperatures could accelerate embryo development of salmon and cause premature emergence of fry.

Since fish maintain a body temperature almost identical to their surroundings, thermal changes of a few degrees Celsius can critically affect biological functions in salmonids (NMFS and U.S. FWS 2005). While some fish populations may benefit from an increase in river temperature for greater growth opportunity, there is an optimal temperature range and a limit for growth after which salmonids will stop feeding due to thermal stress (NMFS and U.S. FWS 2005). Thermally stressed salmon also may become more susceptible to mortality from disease (Clews *et al.* 2010). A study performed in New Brunswick found there is much individual variability between Atlantic salmon and their behaviors and noted that the body condition of fish may influence the temperature at which optimal growth and performance occur (Breau *et al.* 2007).

The productivity and feeding conditions in Atlantic salmon's overwintering regions in the ocean are critical in determining the final weight of individual salmon and whether they have sufficient energy to migrate upriver to spawn (Lehodey *et al.* 2006). Survival is inversely related to body size in pelagic fishes, and temperature has a direct effect on growth that will affect growth-related sources of mortality in post-smolts (Friedland 1998). Post-smolt growth increases in a linear trend with temperature, but eventually reaches a maximum rate and decreases at high temperatures (Brett 1979 in Friedland 1998). When at sea, Atlantic salmon eat crustaceans and small fishes, such as herring, sprat, sand-eels, capelin, and small gadids, and when in freshwater, adults do not feed but juveniles eat aquatic insect larvae (FAO 2012). Species with calcium carbonate skeletons, such as the crustaceans that salmon sometimes eat, are particularly susceptible to ocean acidification, since ocean acidification will reduce the carbonate availability necessary for shell formation (Wood *et al.* 2008). Climate change is likely to affect the abundance, diversity, and composition of plankton, and these changes may have important consequences for higher trophic levels like Atlantic salmon (Beaugrand and Reid 2003).

In addition to temperature, stream flow is also likely to be impacted by climate change and is vital to Atlantic salmon survival. In-stream flow defines spatial relationships and habitat suitability for Atlantic salmon and since climate is likely to affect in-stream flow, the physiological, behavioral, and feeding-related mechanisms of Atlantic salmon are also likely to be impacted (Friedland 1998). With changes in in-stream flow, salmon found in smaller river systems may experience upstream migrations that are confined to a narrower time frame, as small river systems tend to have lower discharges and more variable flow (Elliot *et al.* 1998). The changes in rainfall patterns expected from climate change and the impact of those rainfall patterns on flows in streams and rivers may severely impact productivity of salmon populations (Friedland 1998). More winter precipitation falling as rain instead of snow can lead to elevated winter peak flows which can scour the streambed and destroy salmon eggs (Battin *et al.* 2007, Elliot *et al.* 1998). Increased sea levels in combination with higher winter river flows could cause degradation of estuarine habitats through increased wave damage during storms (NSTC 2008). Since juvenile Atlantic salmon are known to select stream habitats with particular characteristics, changes in river flow may affect the availability and distribution of preferred habitats (Riley *et al.* 2009). Unfortunately, the critical point at which reductions in flow begin to have a damaging impact on juvenile salmonids is difficult to define, but generally flow levels that promote upstream migration of adults are likely adequate to encourage downstream movement of smolts (Hendry *et al.* 2003).

Humans may also seek to adapt to climate change by manipulating water sources, for example in response to increased irrigation needs, which may further reduce stream flow and biodiversity (Bates *et al.* 2008).Water extraction is a high level threat to Atlantic salmon, as adequate water quantity and quality are critical for all life stages of Atlantic salmon (NMFS and U.S. FWS 2005). Climate change will also affect precipitation, with northern areas predicted to become wetter and southern areas predicted to become drier in the future (Karl *et al.* 2009). Droughts may further exacerbate poor water quality and impede or prevent migration of Atlantic salmon (Riley *et al.* 2009).

We anticipate that these climate change effects could significantly affect the functioning of the Atlantic salmon critical habitat. Increased temperatures will affect the timing of upstream and downstream migration and make some areas unsuitable as temporary holding and resting areas. Higher temperatures could also reduce the amount of time that conditions are appropriate for migration ($<23^{o}$ Celsius), which could affect an individual's ability to access suitable spawning habitat. In addition, elevated temperatures will make some areas unsuitable for spawning and rearing due to effects to egg and embryo development.

6.2.1 Anticipated Effects to Atlantic Salmon and Critical Habitat in the Action Area

Information on how climate change will impact the action area is extremely limited. According to Fernandez *et al.* (2015), the Intergovernmental Panel on Climate Change (IPCC) models predict that Maine's annual temperature will increase another 3.0–5.0 °F (1.7–2.8 °C) by 2050. The IPCC models predict that precipitation will continue to increase across the Northeast by 5–10% by 2050, although the distribution of this increase is likely to vary across the climate zones (Fernandez *et al.* 2015); model predictions show greater increases in precipitation in interior Maine. Total accumulated snow is predicted to decline in Maine especially along the coast where total winter snow loss could exceed 40% relative to recent climate (Fernandez *et al.* 2015). Since 2004, sea surface temperatures in the Gulf of Maine have accelerated to 0.41 °F (0.23 °C) per year; a rate that is faster than 99% of the world's oceans (Fernandez *et al.* 2015).

According to the most recent National Climate Assessment (Melillo *et al.* 2014), a global sea level is projected to rise an additional 0.5 to 2.0 feet (0.2 to 0.6 meters) or more by 2050. Rising sea levels would likely shift the salt wedge in the Penobscot River and other rivers in the GOM

DPS; the lower portion of the action area is currently in a mesohaline portion of the river, experiencing low levels of salinity (estimated at less than 2 ppt) depending on tides and flow levels in the Souadabscook. As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on Atlantic salmon.

In the action area, it is possible that changing seasonal temperature regimes could result in changes in the timing of seasonal migrations for the GOM DPS of Atlantic salmon in Maine. There could be shifts in the timing of spawning; presumably, if water temperatures stay warm further in the fall, and water temperature is a primary spawning cue, spawning migrations could occur earlier in the year and spawning events could occur later. However, because salmon spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature or river flow alone will affect the seasonal movements of salmon throughout the action area.

Atlantic salmon are cold water fish and have a thermal tolerance zone where activity and growth is optimal (Decola 1970). Temperature can be a stimulant for salmon migration, spawning, and feeding (Elson 1969). Temperature can also significantly influence egg incubation success or failure, food requirements and digestive rates, growth and development rates, vulnerability to disease and predation, and may be responsible for direct mortality (Garside 1973; Spence *et al.* 1996; Peterson *et al.* 1977, Whalen *et al.* 1999). When temperatures exceeded 23 °C, adult Atlantic salmon can cease upstream movements. Salmon mortalities were associated with daily average temperatures of 26 °C to 27 °C.

As described above, over the long term, global climate change may affect Atlantic salmon and critical habitat by affecting the location of the salt wedge, distribution of prey, water flows, temperature and quality. However, there are no measurable changes anticipated during 2019, and we anticipate conditions will be consistent with those summarized in the status of the species and environmental baseline.

7.0 EFFECTS OF THE ACTION

This section of the Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR § 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR § 402.02). We have not identified any interrelated or interdependent actions. This Opinion examines the likely effects (direct and indirect) of the proposed action on the GOM DPS of Atlantic salmon and critical habitat designated for the GOM DPS of Atlantic salmon. In the Integration and Synthesis section of this Opinion, we consider these effects on the species and their habitat within the context of the species status now and projected over the course of the action, the environmental baseline and cumulative effects.

As explained in the “Description of the Proposed Action” section (3.0), the action under consideration is the construction of a new bridge to replace the existing Grist Mill Bridge, which carries U.S. Route 1A over the Souadabscook Stream in Hampden, Maine. MaineDOT expects all in-water work to occur between July 1 and September 30, 2019.

In our effects analysis below, we consider the co-occurrence of each species, lifestage, behavior and critical habitat physical and biological features (PBFs) with the in-water work window and the timing of each potential project-related stressor. We also consider the long-term direct and indirect effects associated with the permanent structures resulting from the proposed action. We have divided the following sections by the project related stressors we have identified that may have an effect on listed species or critical habitat.

7.1 Sedimentation and Turbidity

7.1.1 Proposed activities that may produce sedimentation and turbidity

During the Grist Mill Bridge replacement project, several activities associated with construction of the new structure and demolition of the existing structure may disturb sediments and increase turbidity. These actions include:

- Removal of the existing abutments, wingwalls, and sluiceway; and
- Placement of riprap.

With the proposed bridge structure's span (75 feet) exceeding that of the existing bridge, excavation for the new abutments will be located behind the existing abutments. As such, the existing abutments and wingwalls will remain in place during this excavation to serve as cofferdams. Once the new abutments are in place, the process of removing the existing abutments and wingwalls to the substrate level may require an excavator-mounted hydraulic breaker to break away and remove large pieces of concrete. This work will be completed during low tide, at which time only the southwest wingwall and sluiceway are still in the water. The wingwalls in the other three bridge quadrants, as well as the abutments, are out of the water during low tide, and demolition of these structures will not cause sedimentation or turbidity in the stream.

The removal of the sluiceway and bottom portions of the southwest wingwall will occur in the wet. While the contractor will contain as much debris as possible, it is likely that this process will result in some debris falling into the stream during demolition. The contractor will remove any debris that does enter the stream. There are portions of the abutment under the bridge that are also in the water at all flows; the contractor will put sandbag cofferdams in place prior to any removal of the material, which should contain most or all of the sedimentation and turbidity from this portion of the project footprint.

Riprap will be placed in front of each new abutment and wingwall for scour protection purposes. This work will occur at low tide using an excavator bucket. Since all riprap will be located along the edge of the channel, in-water placement will be minimal and primarily on the downstream side. In-water riprap placement will take approximately 10 to 15 days.

As described above, substrate within the existing and proposed bridge footprint is predominately bedrock. The substrate upstream of the bridge (i.e., mix of cobble, gravel, and bedrock, and 10% silt/clay/mud and sand) will not be exposed to in-water work that may produce turbidity. The area downstream of the bridge, including waters adjacent to the existing sluiceway and riprap, is composed of bedrock, boulders, and cobble, and likely some small pockets of gravel and sand.

The removal of the sluiceway and southwest wingwall may result in some direct disturbance of the substrate, as well as debris entering the stream. The placement of riprap may also disturb bottom sediments. The disturbed substrate will mostly be exposed bedrock, boulders, smaller cobbles, gravel, and coarse sand. Due to the coarse nature of the bottom material in the area, we expect very little sediment to be suspended in the water column and there to be very little, if any, increase in background turbidity or suspended sediment levels. We expect any sediment that is disturbed to quickly dissipate in downstream flows and settle back on the riverbed in a matter of several minutes.

7.1.2 Effects of Turbidity and Suspended Sediments on Salmon

Turbidity and TSS effects to Atlantic salmon worsen with increased levels of turbidity (Newcomb 1994). Juveniles and adults salmonids show minor physiological stress and sublethal effects at suspended sediment concentrations of 7 mg/L for a six-day exposure and at 55 mg/L for a seven-hour exposure (Newcomb and Jensen 1996). MaineDOT's Programmatic Biological Assessment (ATS PBA 2016) outlined biological responses for Atlantic salmon and classified them into three major categories. The three categories are behavioral responses, sub-lethal effects, and potential mortality, as defined below.

Behavioral response - The range of turbidity releases expected to result in behavioral reactions ranging from a startle response to avoidance.

- 1-20 mg/L for 1 hour
- 1 mg/L for 24 hours

Sub-lethal effects – The ranges of turbidity releases expected to result in sub-lethal effects including stress, reduction in feeding rates, and increased respiration rates.

- 20-22026 mg/L for 1 hour
- 1 mg/L for 6 days

Potential mortality - A higher range of releases has the potential to result in fish mortality.

- >22026 mg/L for 1 hour
- 7 mg/L for 30 months

We do not expect parr to enter the downstream portion of the action area where hoe ram and excavator work will produce minor increases in sedimentation and turbidity. Furthermore, the sandbag cofferdam combined with fish evacuation procedures should largely prevent parr exposure to increased turbidity/TSS during the removal of the abutments. Adults may migrate through the action area during in-water work. In order for any salmon to be affected by increased turbidity, they would need to be exposed to an increase in turbidity for at least an hour. Given that any increase in turbidity in the action area will be limited to minutes at a time, it is extremely unlikely that any salmon that do occur in the action area would be exposed to turbidity levels that could result in any negative effects. Therefore, effects are discountable.

7.2 Underwater Noise

The use of a hydraulic rock breaker (hoe ram) may result in elevated underwater sound pressure during construction.

7.2.1 Available Information on Effects of Sound Pressure on Fish

Salmon have a physostomous (open) swim bladder, meaning there is a connection between the swim bladder and the gut (Halvorsen *et al.* 2012a). Fish with physostomous swim bladders are able to expel air, which can diminish tension on the swim bladder and reduce damaging effects during exposure to impulsive sounds. Fish with physostomous swim bladders are expected to be less susceptible to injury from exposure to impulsive sounds, such as pile driving, than fish with physoclistous (no connection to the gut) swim bladders (Halvorsen *et al.* 2012a).

If a noise is within a fish's hearing range and is loud enough to be detected, effects can range from mortality to a minor change in behavior (e.g., startle), with the severity of effects increasing with the loudness and duration of the exposure to the noise (Hastings and Popper 2005). The actual nature of effects and the distance from the source at which they could be experienced will vary and depend on a large number of factors. Factors include fish hearing sensitivity, source level, how the sounds propagate away from the source, the resultant sound level at the fish, whether the fish stays in the vicinity of the source, and the motivation level of the fish.

7.2.1.1 Criteria for Assessing the Potential for Physiological Effects to Sturgeon and Salmon

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, U.S. FWS, FHWA, and the California, Washington, and Oregon DOTs, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed a Memorandum of Agreement documenting criteria for assessing physiological effects of pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted that these are onset of physiological effects (Stadler and Woodbury 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 µPa).
- cSEL: 187 decibels relative to 1 micro-Pascal-squared second (dB re 1µPa^2-s) for fishes above 2 grams (0.07 ounces).
- cSEL: 183 dB re 1µPa^2-s for fishes below 2 grams (0.07 ounces).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to salmon from exposure to impulsive noise, such as pile driving, are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness, to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer the fish is to the source, and the greater the duration of the exposure, the higher likelihood of significant injury.

Since the FHWG criteria were published, two papers relevant to assessing the effects of pile driving noise on fish have been published. Halvorsen *et al.* (2011) documented effects of pile driving sounds (recorded by actual pile driving operations) under simulated free-field acoustic conditions where fish could be exposed to signals that were precisely controlled in terms of number of strikes, strike intensity, and other parameters. The study used Chinook salmon and determined that onset of physiological effects that have the potential of reduced fitness, and thus a potential effect on survival, started at above 210 dB re 1μPa^2-s cSEL. Smaller injuries, such as ruptured capillaries near the fins, which the authors noted were not expected to impact fitness, occurred at lower noise levels.

Halvorsen *et al.* (2012b) exposed lake sturgeon to pile driving noise in a laboratory setting. Lake sturgeon used in this experiment were 3 to 4 months old and were approximately 60-70 mm in length and weighed 1.2 -2.0 grams (n=141). Tested fish were exposed to five treatments of 960 pile strikes with cSEL ranging from 216 dB re 1μPa^2-s to 204 dB re 1μPa^2-s. Following testing, fish were euthanized and examined for external and internal signs of barotrauma. None of the lake sturgeon died as a result of noise exposure. Lake sturgeon exhibited no external injuries in any of the treatments but internal examination revealed injuries consisting of hematomas on the swim bladder, kidney, and intestines (characterized by the authors as “moderate” injuries) and partially deflated swim bladders (characterized by the authors as “minor” injuries). Injuries were only observed in lake sturgeon exposed to cSEL greater than 210 dB re 1μPa^2-s. All sturgeon were exposed to all 960 pile strikes and only cumulative sound exposure was tested during this study. No behavioral responses are reported in the paper. Results from Halvorsen *et al.* (2012a) suggest that the overall response to noise between chinook salmon and lake sturgeon is similar (sturgeon and salmon are hearing generalists with physostomous swim bladders).

It is important to note that both Halvorsen papers (2012a, 2012b) used a response weighted index (RWI) to categorize injuries as mild, moderate, or mortal. Mild injuries (RWI 1) were determined by the authors to be non-life threatening. The authors made their recommendations for noise exposure thresholds at the RWI 2 level and used the mean RWI level for different exposures. We consider even mild injuries to be physiological effects and we are concerned about the potential starting point for physiological effects and not the mean. Therefore, for the purposes of carrying out section 7 consultations, we will use the FHWG criteria to assess the potential physiological effects of noise on Atlantic salmon and not the criteria recommended by Halvorson *et al.* (2012a, 2012b). Following the FHWG criteria, we will consider the potential for physiological effects upon exposure to impulsive noise of 206 dB re 1μPa^2-s Peak. Use of the 187 dB re 1μPa^2-s cSEL and 183 dB re 1μPa^2-s cSEL threshold (salmon 2 grams or smaller) is a cumulative measure of cumulative impulsive sound (such as impact pile driving) and is not appropriate for blasting. As explained here, physiological effects from noise exposure can range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality or result in death.

7.2.1.2 Criteria for Assessing the Potential for Behavioral Effects to Salmon

Results of empirical studies of hearing of fishes, amphibians, birds, and mammals (including humans), in general, show that behavioral responses vary substantially, even within a single species, depending on a wide range of factors, such as the motivation of an animal at a particular time, the nature of other activities that the animal is engaged in when it detects a new stimulus, the hearing capabilities of an animal or species, and numerous other factors (Brumm and Slabbekoorn 2005). Thus, it may be difficult to assign a single criterion above which behavioral responses to noise would occur.

In order to be detected, a sound must be above the "background" level. Additionally, results from some studies suggest that sound may need to be biologically relevant to an individual to elicit a behavioral response. For example, in an experiment on responses of American shad to sounds produced by their predators (dolphins), it was found that if the predator sound is detectable, but not very loud, the shad will not respond (Plachta and Popper 2003). But, if the sound level is raised an additional 8-10 dB, the fish will turn and move away from the sound source. Finally, if the sound is made even louder, as if a predator were nearby, the American shad go into a frenzied series of motions that probably helps them avoid being caught. It was speculated by the researchers that the lowest sound levels were those recognized by the American shad as being from very distant predators, and thus, not worth a response. At somewhat higher levels, the shad recognized that the predator was closer and then started to swim away. Finally, the loudest sound was thought to indicate a very near-by predator, eliciting maximum response to avoid predation. Similarly, results from Doksaeter *et al.* (2009) suggest that fish will only respond to sounds that are of biological relevance to them. This study showed no responses by free-swimming herring (*Clupea* spp.) when exposed to sonars produced by naval vessels; but, sounds at the same received level produced by major predators of the herring (killer whales) elicited strong flight responses. Sound levels at the fishes from the sonar in this experiment were from 197 dB to 209 dB re 1µPa RMS at 1,000 to 2,000Hz.

For purposes of assessing behavioral effects of pile driving at several West Coast projects, NMFS has employed a 150dB re 1 µPa RMS SPL criterion at several sites including the San Francisco-Oakland Bay Bridge and the Columbia River Crossings. Several studies (Andersson *et al.* 2007, Purser and Radford 2011, Wysocki *et al.* 2007) support our use of the 150 dB re 1 µPa RMS as a threshold for examining the potential for behavioral responses. We will use 150 dB re 1 µPa RMS as a guideline for assessing when behavioral responses to pile driving noise may be expected. The effect of any anticipated response on individuals will be considered in the effects analysis below. For the purposes of this consultation we will use 150 dB re 1 µPa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects. That is not to say that exposure to noise levels of 150 dB re 1 µPa RMS will always result in behavioral modifications or that any behavioral modifications will rise to the level of "take" (i.e., harm or harassment) but that there is the potential, upon exposure to noise at this level, to experience some behavioral response. Behavioral responses could range from a temporary startle to avoidance of an ensonified area.

7.2.2 Underwater Noise from Hydraulic Rock Breaker

Hydraulic breakers, or hoe rams, are used to fracture bedrock or concrete structures into small pieces. Typical applications include removal of underlying bedrock during bridge construction, or the demolition of concrete elements of decommissioned bridges. A hoe ram may be used during the demolition of the existing Grist Mill Bridge substructure. This work will be completed during low tide, when only the southwest wingwall and sluiceway are still in the water. The demolition work that takes place out of the water is not expected to result in any increase in hydroacoustic noise that would result in any measurable or detectable effects on salmon.

MaineDOT has not conducted hydroacoustic monitoring during bridge demolition activities with a hoe ram. To assess the potential sound levels that may occur from removal of the southwest wingwall and sluiceway, Table 11 presents acoustic data from concrete pier demolition in the State of Washington (Escude 2012). The Manette Bridge piers were removed using a hoe ram when the piers were located above the waterline. Sound level measurements were taken during low tide.

Table 11: Summary of sound level measures for removal of Manette Bridge piers with hoe ram (Escude 2012)

Site	**Water depth**	**Distance measured (m)**	***Behavioral Impacts***	***Physical Injury***		
			RMS (dB)	**Peak (dB)**	**Cumulative SEL (dB)**	**Single Strike SEL (dB)**
		Thresholds:	**150**	**206**	**183 (Fish <2g)* 187 (Fish >2g)**	
Pier 5A	6 to 14'	33	173	183 (average)	195 (3,012 strikes)	160
Pier 6	6 to 14'	33	186	197 (average)	196 (707 strikes)	171

*Parr will be greater than 2g, so this threshold is not relevant for this project.

While cumulative SEL on this project did exceed thresholds for physical injury to fish, this measure is based on the total number of strikes with the hoe ram (3,012 strikes for Pier 5A and 707 strikes for Pier 6). The highest recorded SEL for a single strike was below the threshold for injury. The piers in this study supported a 1,573-foot long five-span steel truss bridge and were significantly larger than the wingwall and sluiceway to be removed at the Grist Mill Bridge. It was noted that the cumulative SEL exceeded the 187 dB re $1\mu Pa^2$-s cSEL threshold after 190 strikes (Escude 2012). MaineDOT anticipates that fewer than 100 strikes with the hoe ram will be necessary for the removal of the wingwall and sluiceway. It was also noted that the hoe ram used for Pier 6 was larger than the one used for Pier 5, resulting in higher sound levels (Escude 2012). MaineDOT expects that the removal of a wingwall and sluiceway will require a smaller hoe ram than what would be used for the removal of a large bridge pier, so it is reasonable to assume that sound levels produced from the removal of Pier 5A would be more comparable to sound levels produced at the Grist Mill Bridge. Based on this comparison, sound levels produced from removal of the concrete wingwall and sluiceway using a hoe ram are not expected to exceed accepted thresholds for physiological effects to fish (Peak or cSEL dB) (Table 12).

Table 12: Predicted sound pressure levels from NOAA GARFO Acoustics Tool

Type of Impact	**Estimated Peak Noise Level (dB_{Peak})**	**Estimated Pressure Level (dB_{RMS})**	**Estimated Single Strike Sound Exposure Level (dB_{sSEL})**	**Estimated Cumulative SEL (dB_{cum})**
Hoe Ram	183	173	160	180
To obtain the estimated Cumulative SEL, sound levels (RMS, Peak, and Single Strike SEL dB) measured at Pier 5a of the Manette Bridge (Escude 2012) were entered into the calculator and 100 was used for the number of strikes.				

Sound levels produced from removal of the concrete wingwall and sluiceway using a hoe ram could exceed the accepted threshold for behavioral effects to fish (150 dB re 1 µPa RMS). Using the sound pressure estimates summarized in Table 12, the GARFO Acoustics Tool estimates that the behavioral threshold could be exceeded up to 184 feet from the hoe ram activity.

7.2.2.1 Effects of Hydraulic Breaker Underwater Noise on Salmon
We expect that both parr and adult salmon may enter the action area during in-water work. Parr would only be entering the action area to opportunistically forage, and we do not expect them to travel past the bridge. Therefore, we would expect that upon encountering sound pressure above 150 dB re 1 µPa RMS, parr would move back upstream away from the bridge and in-water work. Given that there are approximately 631 units (1 unit = 100 m^2) of surveyed Atlantic salmon rearing habitat upstream of the Grist Mill Bridge, any effects on parr development or fitness stemming from the preclusion from the action area for 15 days of in-water work will be too small to be meaningfully measured or detected, and will be insignificant.

As noted above, we expect that up to four adult Atlantic salmon may attempt to migrate through the action area during in-water work on their way to upstream spawning grounds. While we do not anticipate sound pressure from the hoe ram to result in injurious levels of noise, adult salmon may be temporarily deterred from passing upstream while the hoe ram is operating. In-water work will not exceed 12 hours (i.e., 12 hours on, 12 hours off, no night work). Further, every day prior to work in the water, MaineDOT environmental staff will be site to survey the immediate area to ensure endangered species are not present (AMM 7). If adult salmon are spotted, in-water work will not start until they have left the action area. While these measures will minimize the exposure of adult Atlantic salmon to hoe ram noise, they will not prevent exposure. As such, in the worst case, up to four adult Atlantic salmon will encounter the disturbing levels of noise and either move downstream or hold just below the noisy area. We expect that when the noise stops, these fish will resume their upstream movements. Therefore, the maximum extent of the delay will be 12 hours.

Migratory delay can affect an individual's ability to access suitable spawning habitat within the narrow window when conditions in the river are suitable for migration. In addition, delays in migration can cause over-ripening of eggs, increased chance of egg retention, and reduced egg viability in pre-spawn female salmonids (deGaudemar and Beall 1998). However, given the short duration of the delay, the time between upstream migration and anticipated spawning, and the short distance between the area where salmon would hold and the available spawning habitat upriver of the Grist Mill Bridge (i.e., the closest upstream spawning habitat is approximately 392 m upstream, while the redd that was documented last year was approximately 6 km upstream), it is unlikely that delay caused by the in-water work would result in any reduction in spawning or spawning output or otherwise significantly affect the ability of these motivated fish to access spawning grounds in a timely manner.

7.3 Water Quality and Exposure to Contaminants

Use of heavy equipment in or near a water body increases the risk of introducing contaminants (e.g., fuel, oil, etc.). Chemical contaminants can enter into waterbodies through direct contact with contaminated surfaces or by the introduction of storm or washwater runoff and can remain in solution in the water column or deposit on the existing substrate. Research has shown that exposure to contaminants can reduce reproductive capacity, growth rates, and resistance to disease, and may lead to lower survival rates for salmon (Arkoosh *et al.* 1998). The risk for contaminants entering the Souadabscook Stream may potentially increase during construction.

As noted in AMM #5, MaineDOT will require the contractor to follow several BMPs to reduce the potential for introducing contaminants into the river during construction activities including:

- All vehicle and equipment refueling activities shall occur more than 100' from any waterbody.
- All vehicles carrying fuel shall have specific equipment and materials needed to contain or clean up any incidental spills at the project site. Equipment and materials would include spill kits appropriately sized for specific quantities of fuel, shovels, absorbent pads, straw bales, containment structures and liners, and/or booms.
- During use, all pumps and generators shall have appropriate spill containment structures and/or absorbent pads in place.

With the protection measures proposed by MaineDOT, we believe any exposure of listed species to harmful contaminants to be extremely unlikely; therefore, effects are discountable.

The placement of the drainage pipe associated with the highway reconstruction project will introduce runoff from the highway to the Souadabscook Stream. MaineDOT has determined that there will be no change from the baseline condition, as there is a pre-existing roadway and bridge. Therefore, when added to baseline conditions, any effects to ESA-listed species or critical habitat will be too small to be meaningfully measured or detected, and are insignificant.

7.4 Entrapment in Cofferdams

Existing structure removal and riprap placement directly under the existing bridge will occur inside of a dewatered sandbag cofferdam. The in-water area enclosed within the cofferdam will be approximately 1,000 square feet.

Isolation of a stream area within a cofferdam is a conservation measure intended to minimize the overall adverse effects of construction activities on aquatic species including Atlantic salmon and their habitat. Dewatering of stream habitat inside a cofferdam could have a lethal effect on any fish within the enclosed area. To avoid the death of fish caught inside a cofferdam as a result of dewatering, MaineDOT or a qualified consultant will attempt to limit the potential entrapment of salmon by using nets to push and persuade fish from being in the cofferdammed area prior to/during cofferdam placement. Staff will also use electrofishing to remove any salmon trapped in the cofferdam. Parr may be present in the portion of the action area year-round, and may be deterred from the area and/or subject to electrofishing and removal. We do not expect any adult Atlantic salmon to be exposed to this deterrence or electrofishing, as it is extremely unlikely that these brief activities will occur at the same moment an adult makes its spawning run through the action area; additionally, adult Atlantic salmon are large enough, and the stream shallow and narrow enough, that we expect they can be visually observed and work can be avoided until they depart the area.

Capturing and handling salmon can cause physiological stress and lead to physical injury or death, including cardiac or respiratory failure from electrofishing (Snyder 2003). Studies have shown that all aspects of fish handling are stressful and can lead to immediate or delayed mortality (Murphy and Willis 1996), including when fish are handled roughly, not properly restrained, sedated during handling, or kept out of the water for extended periods. Fish injured during handling, in association with a disease epizootic, typically die within one to fourteen days. Examples of injuries that can lead to disease problems are loss of mucus, loss of scales, damage to the integument, and internal damage.

Despite precautions, some mortality is possible during the removal of fish from within cofferdams. MDMR annually reports juvenile salmon mortality rates associated with electrofishing activities in GOM DPS waters. While MDMR usually handles a few thousand juvenile salmon each year during electrofishing, mortalities are usually less than two percent of total fish captured. From 2001-2009, MDMR's electrofishing mortality during young of the year (YOY) and parr population estimation and broodstock collection has ranged from 3.33% (2001) to 0.82% (2006) with an average mortality rate of 1.70% for both life stages combined over that period (Trial 2010). The vast majority of the mortality is YOY which do not occur in the action area.

Baum (1997) reported that Maine Atlantic salmon rivers support, on average, between five and ten parr per 100 m^2 of habitat (or one salmon habitat unit), based on data collected by the MDMR. MDMR calculated juvenile salmon densities within multiple rivers within all three SHRUs in the GOM DPS (Table 13). The GOM DPS average (2007-2015) for Atlantic salmon parr median densities is 7.51 salmon/100 m^2. These data were obtained from electrofishing efforts in many streams and rivers located in watersheds throughout the GOM DPS and represent the best available scientific information to assist in determining the number of juvenile Atlantic salmon that are likely to be displaced or collected and relocated when a portion of a stream is dewatered within a cofferdam.

Table 13: Atlantic salmon parr densities (parr/100m^2) sampled from within streams and rivers in the Penobscot SHRU (USASAC 2016)

	N	**MIN**	**MEDIAN**	**MAX**
2007	49	0	0	33.73
2008	11	0	6.69	17.75
2009	10	0	7.89	20.39
2010	11	0	11.5	22.07
2011	5	0	6.99	14.9
2012	13	0	1.47	12.99
2013	10	0	10.61	25
2014	7	0	7.39	16.37
2015	7	0	15.08	40.12
AVERAGE	13.67	0.00	7.51	22.59

Capture and relocation of parr during cofferdam construction and dewatering could result in injury and/or mortality of those individuals. The number of parr likely to be captured, and potentially injured, or killed can be quantified based on the estimated area affected and the SHRU-specific median densities (Table 13) that may occur during capture and relocation. MaineDOT estimates that a maximum of 1,000 square feet of instream habitat that will be isolated within the cofferdam for this project. This area equates to 92.9 m^2, or 0.93 Atlantic salmon habitat units.

We assume for this project all salmon parr within the cofferdam would be subject to some level of stress during the capture and relocation process. The number of injuries or mortalities can be quantified based on SHRU-specific estimates of juvenile densities, as well as the estimated mortality that may occur during capture and relocation. Based on the best available information, we assume that no more than 1.70% of the salmon that are captured will suffer injury or death (Trial 2010).

The median parr density in the Penobscot Bay SHRU between 2007 and 2015 ranged between 0 and 15.08 parr/unit (average median of 7.51 juveniles/unit) based on sampling conducted by MDMR in several rivers (Table 13). Assuming this average density, we anticipate that up to 7 Atlantic salmon parr (7.51 parr/unit x 0.93 habitat units affected) may be trapped within the cofferdam, exposed to electrofishing and subsequent handling, and removed from the cofferdam.

Given a 1.70% mortality rate, we anticipate that no more than one (1.7% x 7 fish = 0.119 fish) salmon parr will be injured or killed.

7.5 Habitat Modification from In-Stream Structures and Work

As described in Section 3, a number of activities associated with the replacement of the Grist Mill Bridge will require the placement of structures and materials (temporary and permanent) into aquatic habitat. The project will install riprap in each of the four quadrants of the new bridge, resulting in approximately 3,000 square feet of impact below the Highest Annual Tide (HAT) elevation. In three quadrants, proposed riprap will match the toe of the existing slope and tie into the edge of the existing channel. Approximately 200 square feet of the 3,000 square feet (6.7%) will represent new habitat conversion (i.e., bedrock, cobble, boulder, to riprap). The remaining riprap area will cover areas that are currently riprap, sluiceway, wingwall, or abutment. The construction of a riprap downspout for the highway reconstruction drainage pipe will result in 25 square feet of impacts below HAT.

In the areas where riprap will be placed, the channel is approximately 25-64 feet wide (low-high tide estimates). The proposed riprap will constitute 4-5 feet of the overall channel width. Further, the project will increase the opening at the bridge by replacing the existing 51-foot span with a 75-foot span. This will result in an additional 16 feet of channel width beneath the bridge, creating approximately 650 square feet of new foraging and migration habitat (500 square feet of newly exposed bedrock, 150 square feet of riprap).

Temporary habitat modifications include the placement of the sandbag cofferdam encompassing 1,000 square feet of in-stream habitat by the southwest abutment under the bridge, as well as the potential for demolished sections of the sluiceway to fall into the stream. Any debris that enters the stream will be promptly removed by an excavator.

7.5.1 Effects of Habitat Modification on Salmon Migration

The presence of foraging Atlantic salmon parr is possible in the portion of the action area upstream of the falls throughout the in-water work window. Similarly, adult Atlantic salmon may migrate through the action area on their way to upstream spawning grounds throughout the in-water work window. We generally expect kelts in the Penobscot to migrate out of their spawning grounds the following spring, but it is possible some may exit in the fall immediately after spawning; however, fall emigrants would likely depart after in-water work in Souadabscook Stream has concluded in September. While not present during in-water work, smolts migrate out of the Souadabscook through the action area April through June.

Parr will be temporarily excluded from approximately 1,000 square feet of potential foraging habitat because of a temporary cofferdam and deterrence/removal (electrofishing); however, in-water work is only expected to take 15 days, and will not continue past September 30. Furthermore, once the project is complete, there will be an additional 650 square feet of accessible stream habitat (500 square feet of newly exposed bedrock, 150 square feet of riprap). Because parr are opportunistic foragers, consuming a combination of benthic invertebrates, terrestrial insects that enter the water, and drift items (e.g., invertebrates, exuvia of aquatic and terrestrial insects, algae, and various plant remains), we expect them to be able to use in-stream habitat over both bedrock and riprap (Orlov *et al.* 2006). Orlov *et al.* (2006) found that the stomach contents of wild Atlantic salmon parr in Russia were made up of benthic invertebrates (2%), terrestrial insects (24%), and drift prey items (67%). Overall, we expect that any effects on parr fitness from the temporary exclusion from 1,000 square feet of habitat will be too small to be meaningfully measured or detected. At the conclusion of the project, parr will benefit from the increased availability of foraging grounds.

The sandbag cofferdam will temporarily narrow the width of the channel beneath the bridge. Similarly, the presence of construction equipment and potential debris will at times enter the channel next to the sluiceway, potentially limiting the availability of habitat for upstream migration. MaineDOT has agreed to maintain tidal flows through accessible migratory stream habitat throughout the duration of construction. Also, AMM #7 requires MaineDOT environmental staff to survey the immediate construction area to ensure endangered species are not present. Work will cease if endangered species are spotted until they have left the action area. Lastly, work will not exceed 12 consecutive hours. While it is possible that up to four adult salmon will enter the action area during in-water construction, there will be accessible migratory habitat at all times, and the aforementioned protection measures further reduce the likelihood of migratory delays. Therefore, adverse effects to Atlantic salmon habitat from temporary and permanent modifications are extremely unlikely to occur, and are discountable. At the conclusion of the project, there will be additional accessible habitat available to adult salmon and smolts for up and downstream migrations.

7.6 Effects of the Proposed Action on Critical Habitat

In this analysis, we consider the direct and indirect effects of the action, on the critical habitat PBFs we determined to be in the action area in the Environmental Baseline (Section 5.3.5). For each PBF, we identify those activities that may affect the PBF. For each feature that may be affected by the action, we then determine whether any negative effects to the feature are insignificant, discountable, or entirely beneficial and if not, consider the consequences of those adverse effects. In making this determination, we consider the action's potential to affect how each PBF supports Atlantic salmon's conservation needs in the action area. Part of this analysis is consideration of the conservation value of the habitat and whether the action will have effects on the ability of Atlantic salmon to use the feature, temporarily or permanently, and consideration of the effect of the action on the action area's ability to develop the feature over time.

7.6.1 Effects to Critical Habitat Designated for the Gulf of Maine DPS of Atlantic Salmon

In Section 5.3.5, we determined that the action area contains both migratory (M) and spawning and rearing (SR) physical and biological features (PBFs). We summarized this information in Table 10. Below, we analyze the potential effects of the proposed action on each of the PBFs in the action area.

7.6.1.1 PBF SR1

Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.

In Section 5.3.5, we established that the portion of the action area downstream of the bridge does have some pools with depths greater than a few feet (depending on the tide and flows) and boulders; however there is very little cover vegetative cover (overhanging trees, logs) and no submerged vegetation. Therefore, the current baseline condition of PBF SR1 is "limited" (see Table 4).

During the in-water work window, from July 1 through September 30, we expect that as many as four adult Atlantic salmon may pass through the action area. These salmon may hold in the pools below the Grist Mill Bridge, either to rest or to wait for the appropriate environmental conditions (e.g., water temperature, diurnal cues, etc.). While there will be a MaineDOT environmental staff member surveying the immediate area for endangered species each day before in-water work commences, the detection rate will not be 100%. Therefore, the use of a hydraulic rock breaker (hoe ram) producing underwater sound pressure waves above the behavioral threshold of salmon up to 184 ft (56 m) from the source (see Section 7.2) may deter up to four adult salmon from using a portion of the lower pool area for resting/holding for up to 12 hours at a time. However, this deterrence will only be experienced for 12 hours a day for up to 15 days. During in-water work, we expect adult salmon will be able to move further downstream into portions of the lower pool (beyond 184 ft from the hoe ram) to rest or hold without experiencing levels of underwater sound pressure that will affect their behavior. Based on the best available information, this habitat is of the same "limited" baseline condition as the habitat in the action area. Once the noise producing activities stop, this habitat will regain its full functionality. In sum, any negative effects to the conservation function of PBF SR1 will be minor and temporary, and too small to be meaningfully measured or detected. Therefore, effects are insignificant.

7.6.1.2 PBF SR4

Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
As noted in Section 5.3.5, MDMR surveyed approximately 631 units (1 unit = 100 m2) of Atlantic salmon rearing habitat upstream of the Grist Mill Bridge. None of this surveyed habitat overlaps with the action area; however, the most downstream portion of the surveyed rearing habitat is just 92.5 m upstream of the Grist Mill Bridge, and 25 m upstream of the action area (the upstream limit of where we expect acoustic impacts above the behavioral threshold for salmon to be experienced). While MDMR did not classify the action area as rearing habitat, we do expect parr to potentially be present year-round, using the areas under the bridge and immediately upstream for foraging.

Parr will experience a temporary loss of rearing habitat (approximately 1,000 square feet), when they are deterred from entering the project area or removed during electrofishing. However, at the completion of the project, the action area will have 16 feet of additional channel width beneath the bridge, and 650 square feet of additional foraging habitat. Any effects to the conservation function of PBF SR4 in the action area from the temporary loss of approximately 1,000 square feet of rearing habitat will be too small to be meaningfully measured or detected, and are insignificant.

7.6.1.3 PBF SR5

Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.
The temporary exclusion of parr from a small portion of the action area from the use of a sandbag cofferdam and deterrence/electrofishing displacement will not affect parr’s ability to occupy different niche habitats in rivers, streams, or lakes, nor will it affect the production of parr. Therefore, the action has no effect on SR5.

7.6.1.4 PBF SR6

Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
The proposed action will slightly modify the flows of the stream through the action area during in-water work through the placement of a sandbag cofferdam; however, tidal flows will be maintained at all times. The in-water work will not occur during the anticipated timeframe for smolt migration. Following the completion of the project, the action area will have 16 feet of additional channel width beneath the bridge, and 650 square feet of additional in-stream habitat. We do not expect these habitat modifications to have a measurable or detectable effect on water temperature, dissolved oxygen levels, or flows through the action area. Therefore, effects are insignificant.

7.6.1.5 PBF SR7

Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

As noted in Section 7.5.1, parr will be temporarily excluded from approximately 1,000 square feet of potential foraging habitat because of a temporary cofferdam and deterrence/removal (electrofishing); however, in-water work is only expected to take 15 days, and will not continue past September 30. Furthermore, once the project is complete, there will be an additional 300 square feet of bedrock habitat and 150 square feet of accessible channel with riprap substrate. Because parr are opportunistic foragers, consuming a combination of benthic invertebrates, terrestrial insects that enter the water, and drift items, we expect they will be able to make use of all the expanded habitat for foraging following the completion of the project.

Therefore, we expect that any effects the conservation function of PBF SR7 from the temporary loss of 1,000 square feet of foraging habitat will be too small to be meaningfully measured or detected, and are insignificant. At the conclusion of the project, parr will benefit from the increased availability of foraging grounds.

7.6.1.6 PBF M1

Migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations

In Section 7.5.1, we provide an analysis concluding that temporary and permanent modifications to habitat from in-water construction (i.e., sandbag cofferdams, in-water use of an excavator, sluiceway debris) are extremely unlikely to inhibit or delay the upstream spawning migration of adult salmon and that therefore, effects are discountable. Furthermore, at the conclusion of the project, there will be additional habitat (16 feet of channel width beneath the bridge, and 650 square feet of new migration habitat area) accessible to adult salmon for upstream spawning migrations.

While we do not expect migratory delays from physical obstructions, we do expect that the use of a hydraulic rock breaker (hoe ram) on a concrete wingwall and the sluiceway may produce underwater sound pressure waves above the behavioral threshold of salmon up to 184 ft (56 m) from the source (see Section 7.2). Given the width of the channel in this area (25-64 ft), this ensonified area will extend across the entire migratory pathway for adult salmon. Even with proposed protection measures, we expect that the upstream migration of up to four adult salmon will be delayed (not abandoned); however, this delay should not last longer than 12 hours, as we expect the salmon will have an opportunity to pass upstream when there is a break in in-water work. As explained above in Section 7.2.2, given the short duration of the delay, the time between upstream migration and anticipated spawning, and the short distance between the area where salmon would hold and the available spawning habitat upriver of the Grist Mill Bridge, it is unlikely that delay caused by the in-water work would result in any reduction in spawning or spawning output or otherwise significantly affect the ability of these motivated fish to access spawning grounds in a timely manner. In sum, any negative effects to the conservation function of PBF M1 will be minor and temporary, and too small to be meaningfully measured or detected. Therefore, effects are insignificant.

7.6.1.7 PBF M2

Freshwater and estuary migration sites with pool, lake, and in-stream habitat that provide

cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon. In Section 5.3.5, we established that the portion of the action area downstream of the bridge does have some pools with depths greater than a few feet (depending on the tide and flows) and boulders; however there is very little cover vegetative cover (over hanging trees, logs) and no submerged vegetation. Therefore, the current baseline condition of PBF M2 is "limited" (see Table 4).

During the in-water work window, from July 1 through September 30, we expect that as many as four adult Atlantic salmon may pass through the action area. These salmon may choose to hold in the pools below the Grist Mill Bridge, either to rest or to wait for the appropriate environmental conditions (e.g., water temperature, diurnal cues, etc.). While there will be a MaineDOT environmental staff member surveying the immediate area for endangered species each day before in-water work commences, the detection rate will not be 100%. Therefore, the use of a hydraulic rock breaker (hoe ram) producing underwater sound pressure waves above the behavioral threshold of salmon up to 184 ft (56 m) from the source (see Section 7.2) may deter up to four adult salmon from using a portion of the lower pool area for resting/holding for up to 12 hours at a time. However, this deterrence will only be experienced for 12 hours a day for up to 15 days. During in-water work, we expect adult salmon will be able to move further downstream into portions of the lower pool (beyond 184 ft from the hoe ram) to rest or hold without experiencing levels of underwater sound pressure that will affect their behavior. Once the noise producing activities stop, this habitat will regain its full functionality. In sum, any negative effects to the conservation function of PBF M2 will be minor and temporary, and too small to be meaningfully measured or detected. Therefore, effects are insignificant.

7.6.1.8 PBF M3

Migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation
Adult alewives, blueback herring, American shad, American eel, and rainbow smelt all may be present in the action area during their upstream migration period. Alewives generally move upstream in the Penobscot River during May. American shad and blueback herring tend to run during the latter part of the spring (i.e., late May and June).

MDMR provided the following counts of fish (anadromous and resident) from electrofishing surveys in the Souadabscook Stream (Atlantic salmon are removed, as those data are presented in Table 7)(P. Ruksznis pers. comm.).

Table 14: MDMR Electrofishing Counts of Anadromous and Resident Species in the Souadabscook Stream (2010-2017)

Year	Date	RKM	BND*	BUL	CCB	CMS	EEL	FLF	SMB	SUN	WHS
2017	17-Aug	5.95	30	0	0	20	32	12	24	0	12
	17-Aug	5.5	0	0	0	0	15	0	12	0	0
	17-Aug	3.71	61	0	0	0	60	10	3	0	4
2013	8-Oct	3.62	1	0	8	22	0	2	1	0	0
2010	23-Aug	3.66	30	0	30	30	30	30	20	0	30
	23-Aug	3.5	40	3	6	25	10	0	2	6	13

* BND = Blacknose dace; BUL = Brown Bullhead; CCB = Creek chub; CMS = Common shinner; EEL = American eel; FLF = Fallfish; SMB = Smallmouth bass; SUN = Sunfish species; WHS = White sucker

The proposed in-water work window (July 1 – September 30) avoids the spawning migration of the most important native fish communities that serve as a protective buffer against Atlantic salmon predation (i.e., alewife, blueback herring, and American shad). We do not expect the temporary or permanent physical stressors (e.g., excavator, underwater noise, turbidity) to impede or delay the upstream or downstream passage of these species. Therefore, we do not expect the proposed project to affect diverse native fish communities' ability to serve as a protective buffer against salmon predation.

7.6.1.9 PBF M4

Migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

The proposed time of year for in-water work, July 1 through September 30, will avoid the emigration of smolts from the Souadabscook to the marine environment, which we expect to occur between April 1 and June 30 (the latest date smolt were caught on the Penobscot River downstream of the action area was June 17 (P. Ruksznis, pers. comm.)). Following the completion of the project, the action area will have 16 feet of additional channel width beneath the bridge, and 650 square feet of additional migration habitat. Therefore, the outcome of the action will be beneficial for the conservation function of PBF M4 in the action area.

7.6.1.10 PBF M5

Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.

The proposed action will slightly modify the flows of the stream through the action area during in-water work through the placement of a sandbag cofferdam; however, tidal flows will be maintained at all times. The in-water work will not occur during the anticipated timeframe for smolt migration. Following the completion of the project, the action area will have 16 feet of additional channel width beneath the bridge, and 650 square feet of additional in-stream habitat.

We do not expect these habitat modifications to have a measurable or detectable effect on water temperature or flows through the action area. Therefore, effects are insignificant.

7.6.1.11 PBF M6

Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.
As noted above for PBF M5, the proposed action will slightly modify the flows of the stream through the action area during in-water work through the placement of a sandbag cofferdam; however, tidal flows will be maintained at all times. While the action area has a freshwater to mesohaline transition on either side of the falls that could support sea water adaptation of smolts, we do not expect the in-water work or the permanent habitat modifications to have a measurable or detectable effect on the water chemistry of the action area. Therefore, effects are insignificant.

7.6.1.12 Summary of Effects of Proposed Activities on Atlantic Salmon Critical Habitat
We have determined that all of the effects of the proposed replacement of the Grist Mill Bridge on Atlantic salmon critical habitat PBF SR1, SR4, SR6, SR7, M1, M2, M5, and M6 are insignificant. The action will not affect PBF SR5 or M3. We concluded that the effects of the project on PBF M4 will be entirely beneficial.

8.0 CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. The effects of future state and private activities in the action area that are reasonably certain to occur are continuation of recreational fisheries and the discharge of pollutants. It is important to note that the definition of "cumulative effects" in the section 7 regulations is not the same as the NEPA definition of cumulative effects.

Impacts to Atlantic salmon from non-federal activities are largely unknown in the Penobscot River watershed (including the action area). It is possible that occasional recreational fishing for anadromous fish species may result in the illegal capture of these species. Within the action area, despite strict state and federal regulations, both juvenile and adult Atlantic salmon remain vulnerable to injury and mortality due to incidental capture by recreational anglers.

Evidence suggests that Atlantic salmon are also targeted by poachers (NMFS and U.S. FWS 2005). Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic salmon as bycatch. No estimate of the numbers of these ESA-listed species caught incidentally in recreational or commercial fisheries exists.

Pollution from point and non-point sources has been a major problem in the greater Penobscot Bay watershed, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Atlantic salmon are vulnerable to impacts from pollution and are likely to continue to be impacted by water quality impairments in the Penobscot River and its tributaries. Contaminants may enter the action area from industrial development along the waterfront elsewhere in the watershed.

PCBs, heavy metals, and waste associated with point source discharges and refineries are likely to be present in the future due to continued operation of industrial facilities. In addition, many contaminants such as PCBs remain present in the environment for prolonged periods of time and thus would not disappear even if contaminant input were to decrease. Other potential sources of contamination include atmospheric loading of pollutants, stormwater runoff from development, groundwater discharges, and industrial development.

While exposure to pollutants and contaminants has negative impacts on salmon survival and recovery in the Penosobcat Bay watershed, MDEP classifies the Souadabscook as a Class AA water body, recognizing its extremely high water and habitat quality, and adding additional protections from point source discharges. We have no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past.

9.0 INTEGRATION & SYNTHESIS

In the effects analysis outlined above, we considered potential effects from the following sources: (1) construction of the new bridge abutments and placement of riprap; and (2) the removal of the existing bridge abutments, wingwalls, and sluiceway, including the use of a temporary sandbag cofferdam and associated salmon removal (electrofishing).

We expect that the project will result in the capture of up to seven Atlantic salmon parr due to entrapment in cofferdams and the injury or mortality of no more than one of those individuals. In the discussion below, we consider whether the effects of the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the GOM DPS of Atlantic salmon.

The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of any listed species in the action area or result in destruction or adverse modification of critical habitat. In the NMFS/U.S. FWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as, "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter." Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act."

Below, for the GOM DPS of Atlantic salmon, we summarize the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of that species. We then consider whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of that species, as those terms are defined for purposes of the federal ESA.

9.1 Atlantic Salmon (Gulf of Maine DPS)

GOM DPS Atlantic salmon currently exhibit critically low spawner abundance, poor marine survival, and are confronted with a variety of additional threats. The abundance of GOM DPS Atlantic salmon has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is extremely low (approximately 10% on average over the past 5 years). The conservation hatchery program assists in slowing the decline and helps stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS.

The proposed bridge replacement will result in the capture and potential injury of seven Atlantic salmon parr, and the mortality of no more than one individual. First, we consider the effect of the loss of this single parr on the reproduction, numbers and distribution of the GOM DPS. The reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in the numbers of individuals. The loss of one Atlantic salmon parr would have the effect of reducing the amount of potential reproduction, as any dead Atlantic salmon would have no potential for future reproduction. However, this reduction in potential future spawners is so small it is likely undetectable; this is due to the high natural mortality of juvenile Atlantic salmon, the low adult return rate (i.e., the number of juveniles that return to spawn as adults) and that it is limited to only one juvenile. Given this, we expect that the future reduction in the number of eggs laid or juveniles produced in future years would have an undetectable effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the action, any effect to future year classes is anticipated to be undetectable.

Based on the information provided above, the death of one Atlantic salmon parr will not appreciably reduce the likelihood of survival of the GOM DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic salmon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic salmon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one parr is an extremely small percentage of the population and will not change the status or trends of the species as a whole; (2) the loss of one parr will not result in the loss of any age class; (3) the loss of one parr will not have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one parr in 2018 will have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; and (5) the actions will have an insignificant effect on the ability of GOM DPS Atlantic salmon to shelter or forage.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the action will not appreciably reduce the likelihood that the GOM DPS will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (threatened) is no longer appropriate. Thus, we have considered whether the action will appreciably reduce the likelihood that the species can rebuild to a point where the GOM DPS of Atlantic salmon is no longer in danger of extinction throughout all or a significant part of its range.

The 2016 draft Atlantic salmon recovery plan explicitly calls out road stream crossings that impede fish passage as an impediment to recovery (NMFS 2016a). While the current Grist Mill Bridge and its remnant sluiceway do not prevent salmon passage, they infringe upon the natural channel width of the Souadabscook Stream. The replacement of the bridge will introduce temporary stressors that negatively impact passage through the action area for a period of approximately 15 days; however, the end result will be 16 ft of increased channel width, totaling 650 square feet of recovered in-stream habitat. This will provide an improvement to the baseline condition of passage in the action area. We have determined that short-term effects to foraging habitat from loss of prey are insignificant. We do not anticipate the proposed action resulting in any detectable changes to salinity, dissolved oxygen, or temperature. The proposed action will not affect Atlantic salmon outside of the Penobscot Bay SHRU, or affect habitats outside of the Souadabscook Stream. Because it will not reduce the likelihood that Penobscot Bay SHRU population can recover, it will not reduce the likelihood that the GOM DPS as a whole can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic salmon can be brought to the point at which they are no longer listed as endangered or threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

10.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to adversely affect shortnose sturgeon, the GOM or NYB DPSs of Atlantic sturgeon, or critical habitat designated for the GOM DPS of Atlantic salmon. The proposed action may adversely affect, but is not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon.

11.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof." 16 U.S.C. §1532(8). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. On December 21, 2016, we issued *Interim Guidance on the Endangered Species Term "Harass"*[5]. For use on an interim basis, we interpret "harass" to mean to "…create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering". Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA.]" 16 U.S.C. § 1538(g). See also 16 U.S.C. § 1532(13)(definition of "person").

11.1 Amount or Extent of Take

This ITS exempts the following take of GOM DPS Atlantic salmon during the construction activities associated with the replacement of the Grist Mill Bridge:

- Capture and injury of up to 7 Atlantic salmon parr
- Mortality of 1 Atlantic salmon parr

11.2 Reasonable and Prudent Measures, Terms and Conditions, and Justifications

We believe the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize and monitor impacts of incidental take resulting from the proposed action. In order to be exempt from prohibitions of section 9 of the ESA, you must comply with the following Terms and Conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These Terms and Conditions are non-discretionary.

The RPMs, with their implementing Terms and Conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where in-water work is taking place and will require you to report any take in a reasonable amount of time. The third column below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by you.

[5] http://www.nmfs noaa.gov/op/pds/documents/02/110/02-110-19.pdf

Table 15: RPMs, Terms and Conditions, and Justifications

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
1. We must be contacted prior to the commencement of any in-water work and again upon completion of the activity.	1. You must contact us at incidental.take@noaa.gov within 3 days of the commencement of in-water work and again within 3 days of the completion of the activity. This correspondence will serve both to alert us of the commencement and cessation of activities and to give us an opportunity to provide you with any updated contact information or reporting forms.	These RPM and TCs are necessary and appropriate because they serve to ensure that we are aware of the commencement and completion of activities that may result in take. This will allow us to monitor the duration in-water work activities as well as give us an opportunity to provide you with any updated species information or contact information for our staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve occasional e-mails between you and our staff.
2. MaineDOT or its contractors must adhere to all of the Avoidance and Minimization Measures (AMMs) proposed in the Biological Assessment (BA) and included in this Biological Opinion (BO).	2. MaineDOT must report on any incidences when AMMs were not implemented as described in the BA/BO to incidental.take@noaa.gov. 3. All AMMs must be incorporated into contract requirements for contractors and as permit conditions into any permit issued by the USACE.	These RPM and TCs are necessary and appropriate because they will allow us to monitor adherence to the proposed action and whether or not any triggers for reinitiation have been met. This is only a minor change because it is not expected to result in any delay to the project and will merely involve occasional e-mails between you and our staff.
3. In-water work will not exceed 12 hours in any 24-hour period.	4. MaineDOT or its contractors must not exceed 12 hours of in-water work in any 24-hour period to allow for the undisturbed passage of Atlantic salmon through the action area.	These RPM and TCs are necessary and appropriate because they serve to minimize the harassment, injury, and lethal take of an ESA-listed species. These RPMs and TCs represent only a minor change as compliance will not change or delay the project.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
4. A sufficient zone of passage must be maintained at all times during the project to allow for unimpeded migration of Atlantic salmon through the action area.	5. Unless natural tidal/weather conditions prevent it (e.g., low tide, low flow conditions from a drought), MaineDOT or its contractors must maintain sufficient stream flow through the action area at all times to allow for the upstream and downstream passage of Atlantic salmon.	These RPM and TCs are necessary and appropriate because they serve to minimize the harassment, injury, and lethal take of an ESA-listed species. These RPMs and TCs represent only a minor change as compliance will not change or delay the project.
5. All live salmon captured during the project must be released back into the Souadabscook Stream at an appropriate location away from any construction activity that avoids the additional risk of death, injury, or harassment.	6. MaineDOT must coordinate with MDMR to implement a plan for relocation of any Atlantic salmon removed from the work area to minimize subsequent exposure to effects of the project.	These RPM and TCs are necessary and appropriate because they serve to minimize the harassment, injury, and lethal take of an ESA-listed species. These RPMs and TCs represent only a minor change as compliance will not change or delay the project.
6. All salmon captures, injuries, or mortalities must be reported to us within 24 hours.	7. MaineDOT must report to us (via email: incidental.take@noaa.gov) within 24 hours of any interactions with Atlantic salmon, including the capture and release of live fish. This report must include the date of the interaction as well as the life stage and fate (i.e., live, dead, injured) of the fish and, if dead, information on the disposition of the fish. Within one week of the interaction, MaineDOT must provide us (via email: incidental.take@noaa.gov) with a take reporting form, found at: www.greateratlanticfisheries.noaa.gov/protected/section7/reporting.html	These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. These RPMs and TCs represent only a minor change as compliance will not change or delay the project.

12.0 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As such, we recommend that you, consistent with your authorities, consider implementing the following Conservation Recommendations:

1. Prioritize funding for future restoration projects in Atlantic salmon critical habitat to help address the threat of barriers and improve the likelihood of recovery of the species. Restoration activities should address the priorities identified in the draft 2016 Recovery Plan and Atlantic salmon Species in the Spotlight Action Plan.

13.0 REINITIATION OF CONSULTATION

This concludes formal consultation on your proposal for the replacement of the Grist Mill Bridge. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

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15.0 APPENDICES

Appendix A

Summary of Avoidance and Minimization Measure (AMMs)

Avoidance and Minimization Measure (AMMs)	**Description of AMM**
Project Timing and Duration	
1	In-water work will be limited to the fewest number of days possible within the July 1 to September 30 in-water work window (current estimate is 15 days of in-water work during this period).
Pre-Construction Plans and Review	
2	Prior to the beginning of construction, the contractor will schedule a pre-construction meeting. Also, the contractor will submit a Soil Erosion and Water Pollution Control Plan (SEWPCP) for MaineDOT to review.
3	MaineDOT shall hold a pre-construction meeting with appropriate MaineDOT Environmental Office staff, other MaineDOT staff, and the MaineDOT construction crew or contractor(s) to review all procedures and requirements for avoiding and minimizing effects to listed species, and to emphasize the importance of these measures for protecting listed fish species. USACE and NMFS staff will be notified of and attend this meeting as practicable.
4	As a component of the SEWPCP required for each project, contractors will create a plan and implement BMPs in accordance with the MaineDOT manual Best Management Practices for Erosion and Sedimentation Control (2008), which outlines means and methods to prevent sedimentation in streams during construction or heavy precipitation. The manual can be found at the following link: http://www.maine.gov/mdot/env/docs/bmp/BMP2008full.pdf.
5	As a component of the SEWPCP required for each project, MaineDOT or their contractor will develop and implement a Spill Prevention Control and Countermeasure Plan (SPCCP) designed to avoid stream impacts from hazardous chemicals, such as diesel fuel, oil, lubricants, and other hazardous materials. All refueling or equipment maintenance will take place away from waterbodies and in a careful manner that prevents chemical or other hazardous materials from entering the stream. These measures include the following: • All vehicle and equipment refueling activities shall occur more than 100' from any waterbody; • All vehicles carrying fuel shall have specific equipment and materials needed to contain or clean up any incidental spills at the project site. Equipment and materials would include spill kits appropriately sized for specific quantities of fuel, shovels, absorbent pads, straw bales, containment structures and liners, and/or booms; and, • During use, all pumps and generators shall have appropriate spill containment structures and/or absorbent pads in place.
Removal of the Existing Bridge	
6	Demolition and debris removal and disposal will comply with Section 202.03 of MaineDOT's Standard Specifications. The contractor will contain all

	demolition debris, including debris from wearing surface removal, saw cut slurry, dust, etc., and will not allow it to discharge to any resource. The Contractor will dispose of debris in accordance with the Maine Solid Waste Law (Title 38 M.R.S.A., Section 1301 et. seq.). The demolition plan, containment, and disposal of demolition debris will be addressed in the Contractor's SEWPCP.
7	Every day prior to work in the water, MaineDOT environmental staff will be on site to survey the immediate area to ensure endangered species are not present. If endangered species are observed, in-water work will be delayed until the species have left the action area. This AMM applies to work in the channel that is not behind a cofferdam. The in-water portion of the work is likely to take 10-15 days to complete.
Erosion and Sediment Controls	
8	All work located in the channel will be completed at low tide.
9	MaineDOT will inspect cofferdammed areas for the presence of listed species. It is expected that juvenile Atlantic salmon could be present in cofferdammed areas. Therefore, MaineDOT will complete a fish evacuation following the protocol found in Appendix B. Fish evacuation procedures will occur once before cofferdams are dewatered, and again if water levels in the stream overtop the cofferdammed area
Construction of the New Bridge	
10	Piles required for the new abutments will be located behind the existing abutments and will be driven in the dry.
11	As per Standard Specification 656.3.6 (e), the contractor will not place uncured concrete directly into a water body. The contractor shall not wash tools, forms, or other items in or adjacent to a water body or wetland.
12	Riprap placed in the channel must be cleaned prior to installation.
Project Closeout	
13	Any disturbed soils at the site that were temporarily stabilized during construction will be permanently stabilized using approved methods. Areas planned for riprap as a final soil stabilization treatment are shown on the preliminary plan in Appendix D. All other areas will be stabilized with a treatment such as hay mulch and re-vegetated.

Appendix B

Maine DOT's Atlantic Salmon Evacuation Plan and Disinfection Procedures

1. An adequate number of qualified MaineDOT Environmental Office staff will be onsite during construction and dewatering of all cofferdams and for fish salvage activities.

2. If it is possible that an adult salmon could be present in the work area, a visual survey of the work area to inspect for the presence of an Adult salmon will be completed. Further precautions for adult salmon will be followed after the visual inspection to ensure that adult salmon are removed from the work area prior to electro fishing.

3. MaineDOT Environmental Office staff will follow the Maine Atlantic Salmon Commission Disinfection Procedures (MASC 2005).

4. Following installation of the upstream block net, haze fish out of the proposed dewatered sections by walking seines downstream from the upstream block net location to the end of the work site in an attempt to 'herd' fish out of the worksite. A downstream block net will then be installed, followed by efforts to capture remaining fish with dip-nets. Fisheries biologists experienced with work area isolation, and competent to ensure the safe handling of all ESA-listed fish will conduct or supervise the operation.

5. Install a block net or cofferdam downstream of the project site immediately after the sweep to ensure fish will not move back into the project area. The block net will be secured to the stream channel, bed, and banks until fish capture and transport activities are complete. Size and place the block net in the stream in such a way as to exclude ESA-listed juvenile salmonids expected to occur within the project vicinity at the time of work without otherwise impinging these fish on the net. Monitor the block net once a day to ensure that it is properly functioning and free of organic accumulate. Block nets will be placed were water levels allow. Cofferdams also act to exclude ESA-listed juvenile salmonids out of the work area.

6. Stream depths may dictate that evacuation activities cannot commence until water control devices have been installed and the water levels have been lowers to safe levels for netting and electrofishing. Some water control devices will not allow for dewatering. In cases when water depths are >2-3 feet, only netting, herding, and trapping strategies can be employed to haze fish out of the work area.

Use one or a combination of the following methods to most effectively capture ESA-listed fish and minimize harm (Figure 1). Fish salvage shall proceed from the least invasive method to most invasive.

a) <u>Hand Netting</u>. Collect fish by hand or dip-nets, as the area is slowly dewatered.

b) <u>Seining</u>. Seine using a net with mesh of such a size as to ensure entrapment of the residing ESA- listed fish. The bottom or lead line has lead weights strung or crimped onto it to weight the net. The top or float line includes cork, polystyrene foam, or plastic floats to keep the top of the seine near the water surface. The net is attached to wood or metal poles to handle the seine. Two persons hold the seine in a vertical position above the water and perpendicular to the flow at the downstream edge of a riffle. They then thrust the poles and lead line of the seine to the stream bottom. The poles are allowed to slant downstream so that the flow forms a slight pocket in the seine. This procedure is continued from one shoreline across the width of the channel to the other shoreline so that the entire riffle is sampled. The seine is then lifted out of the water and the fish removed (Bramblett and Fausch 1991).

c) Trapping. Minnow traps (or gee-minnow traps) are net or wire enclosures that trap live fish. Fish swim through the funnel shaped openings and are guided to a narrow opening at the center of the trap. These traps are best suited for collecting juvenile fish or small adult fish in pool habitat. Traps should be baited and fished overnight. In areas of moderate to high fish densities, maximum catches in minnow traps are approached within one to two hours, with catches dropping sharply when traps are fished longer than 24 hours between checks. For bait, salmon eggs are most widely used, but hamburger, canned cat food, salmon flesh, canned corn, shrimp, and sardines have been used successfully (Magnus *et al.* 2006).

d) Electrofishing. Before dewatering, electrofishing will be used as the last evacuation measure following the above other means of fish capture and if they are not practical or effective following NMFS (2000) guidelines found at: http://www.nwr.noaa.gov/ESA-Salmon-Regulations-Permits/4d- Rules/upload/electro2000.pdf.

- Prior to the start of sampling at a new location, water temperature and conductivity measurements must be taken to evaluate electroshocker settings and adjustments.
- Each electrofishing session must start with all settings (voltage, pulse width, and pulse rate) set to the minimums needed to capture fish. These settings should be gradually increased only to the point where fish are immobilized and captured, and generally not allowed to exceed conductivity-based maxima indicated in the NMFS (2000) guidelines. Only direct current (DC) or pulsed direct current (PDC) should be used.
- Electrofishing activities will be avoided if stream temperatures exceed 23 degrees Celsius. Electrofishing will take place before 9:00 AM to take advantage of daily temperature swings.
- Electrofishing will not commence if the presence of an adult Atlantic salmon is suspected.

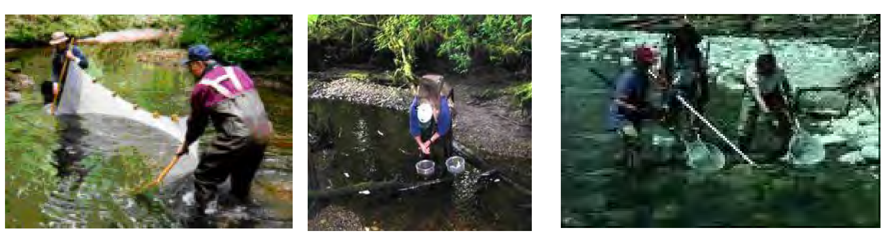

Figure 1. Examples of fish salvaging methods.

7. Handling of fish:

a) Juvenile Atlantic salmon will be netted (1/4" knotless nylon) and immediately placed in a disinfected 5-gallon bucket filled with aerated stream water of ambient temperature.

b) Adult Atlantic salmon will be crowded into a handling device utilized by Maine Department of Marine Resources. The device consists of a rubber tube that is closed on one end and open on the other (Figure 2). Small holes are placed in the closed end to allow some water out but allow all of the water to drain. Any adults salmon captured this way will be moved immediately outside of the exclusion with the handling device and will not be held.

c) All other fish species will be placed in a disinfected 5-gallon bucket with aerated stream water of ambient temperature and released upstream is possible or downstream of the project if the upstream does not contain suitable habitat under assessment by the on-site biologist.

d) Minimize the number of fish stored in each 5-gallon buckets used for handling bucket to prevent overcrowding. If an Atlantic salmon is captured, it will be immediately relocated.

e) Handling time will be minimized. Monitor water temperature in buckets and well-being of captured fish.

f) Release fish from the isolated reach into a pool or area that provides cover and flow refuge after fish have recovered from stress of capture. Fish release upstream of the project site is preferred as sediment impacts would not likely affect individuals upstream of the crossing, but downstream release may be necessary if upstream reach is not suitable habitat for release.

Figure 2- 'Rubber sock' for adult salmon handling.

Photo courtesy of Maine Department of Marine Resources.

8. If need be, all salmonids will be clearly photo-documented for identification purposes. Photos will not be taken of Adult Atlantic salmon to ensure minimal handling time.

9. A report and any photographs of transferred salmon will be submitted to US Fish & Wildlife Service, National Marine Fisheries Service, the Maine Department of Marine Resources, the Maine Department of Inland Fisheries & Wildlife and the appropriate action agencies (USACE and FHWA).

Due to variability in construction timing, potential scheduling conflicts, and other potential unforeseen issues, to ensure coverage and eliminate project delays several MaineDOT employees or their designees will be available during construction and dewatering of cofferdams. MaineDOT or consultant staff will be reviewed for proper experience prior to completing a fish evacuation.

In addition to the staff listed above, other Environmental staff members, including qualified fisheries consultants, may be added pending U.S. FWS approval. Anyone electrofishing will be required to have experience electrofishing salmonids in Maine. The Proponents may solicit the aid of fisheries biologists from the U.S. FWS, NMFS or MDMR if agency staff is available to assist at the necessary time.

Biosecurity guidelines are practical steps that can be taken to minimize the spread of unwanted organisms. The guidelines below are designed to provide direction to MaineDOT biologists working in Maine's lakes, rivers, and streams to minimize the potential for spread of aquatic species, particularly invasive species. These guidelines were adapted from the Maine Department of Inland Fisheries and Wildlife guidelines and have been written to separate aquatic plants, aquatic animals, and aquatic pathogens.

Equipment:

Portable hand-pump sprayer for field disinfection

Large stiff bristle brush

Spray bottle

Rubbing alcohol

Nolvasan disinfectant

Procedures to minimize the spread of aquatic plants

Personnel – visual inspection of personal equipment (i.e. boots/waders/gloves) with hand removal of plants before leaving area.

Other Equipment- *same as above*

Dip nets, trap nets and leads – aquatic plants must be removed from nets before they are moved between waters. Nets should be visually inspected on land with hand removal of plants before leaving the sampling area. After seasonal use, nets will be cleaned, thoroughly dried in direct sun or indoor storage area, and re-inspected to remove any remaining plant material. Ensure all net sections and components are thoroughly dry for a minimum of 3 days. When possible, clean/dry nets and leads should be used between waters.

Reporting Requirements – Aquatic plants of unknown species or plants known to be aquatic nuisance species should not be transported unless placed in a sealed container. Small specimens may be transported to the Maine Department of Environmental Protection for species identification (MDEP contact: John McPhedran (207) 287-2813).

Waters with Documented Infestations – Biological staff should be extra diligent when working on waters with known infestations to prevent the further spread of invasives. When possible, staff should minimize contact and disturbance of aquatic invasive plant beds to reduce the risks of spreading the plant within the water being sampled and elsewhere. A current list of known plant infestations is available at MDEP's website (www.maine.gov/dep/blwq/topic/invasives/doc.htm).

Procedures to minimize the spread of aquatic animals

Personnel- personal equipment (i.e. boots/waders/gloves) should be rinsed clean of all visible mud and aquatic debris.

Other Equipment – rinsed clean of mud and aquatic debris.

Dip nets, trapnets and leads – Remove as much mud and aquatic debris as possible on site. After seasonal use, trapnets should be transported to maintenance camp or other suitable location and cleaned, thoroughly dried in direct sun or indoor storage area, and re-inspected to remove any remaining material. Ensure all net sections and components are thoroughly dry for a minimum of 3 days. When possible, clean/dry nets and leads should be used between waters.

a. Reporting Requirements- Unknown specimens and known aquatic invasive species should be transported in sealed containers for identification. Identification of invasive aquatic species should be reported to Maine Department of Inland Fisheries and Wildlife

b. Waters w/ Documented Infestations – Biological staff should be extra diligent when working on waters with known infestations to prevent the further spread of invasives. In this case, nets should be cleaned, soaked in salt brine (3%) overnight to destroy freshwater aquatic organisms, rinsed, and dried in sunlight between uses.

Procedures to minimize the spread of aquatic pathogens

a. Equipment – Field equipment that comes in constant contact with stream or lake water (i.e. waders, nets, seines, gloves, shocker wand and tail, buckets, measuring boards, etc.) should be cleaned & disinfected before use between waters. Disinfection for most equipment is accomplished with a 2oz. Nolvasan/gallon water solution in the large trashcan. Equipment should be allowed to set in solution for 10 minutes then rinsed thoroughly.

Equipment will be sprayed with a hand-pump style sprayer and allowed to set during transit to the new water.

Delicate equipment such as electronic scales, conductivity meters, thermometers, etc., should be sprayed with alcohol and allowed to air dry.

b. Dip nets, trapnets and leads – are too large to be soaked and unlikely to get reasonable disinfection with a spray system. After seasonal use, trapnets should be transported to the regional headquarters, cleaned, thoroughly dried in direct sun or indoor area, and re-inspected to remove any remaining material. Ensure all net sections and components are thoroughly dry for a minimum of 3 days. When possible, clean/dry nets and leads should be used between waters.

c. Reporting Requirements – Fish encountered with lesions of reportable pathogens, or unknown pathogens should be preserved in 10% buffered formalin for storage or sent for immediate necropsy to the MDIF&W Fish Health Laboratory. Fish with obvious signs of clinical disease should be disposed of on land, rather than returned to the water to spread the pathogen.

d. Waters with Documented Pathogens – Biological staff should be extra diligent with disinfection procedures when working on waters with known pathogen issues to prevent the further spread of the organisms.

Questions regarding proper cleaning and/or disinfection of field equipment should be addressed with the equipment manufacturer.

Maine Statutes

The "Invasive Aquatic Plants" provisions are codified in a number of places in Maine Revised Statutes Annotated:

38 MRSA 410-N – Aquatic nuisance species control

38 MRSA 419-C – Prevention of the spread of invasive aquatic plants

38 MRSA Chapter 20-A – Program to prevent infestation of and to control invasive aquatic plants

38 MRSA 20-B – Invasive aquatic plants and nuisance species control

Amendments from the 2003-2004 legislative session:

Chapter 627. An Act to Amend the Laws Regarding Invasive Aquatic Species (effective July 30, 2004)

Chapter 655. An Act to Revise the Fish and Wildlife Laws to Complement the Recodification of those laws (IN PART) (effective April 22, 2004)

Reference:

Chapter 136. An Act Regarding the Development and Implementation of an Eradication Plan for Invasive Aquatic Plants (effective September 13, 2003).

Chapter 434. An Act to Prevent Infestation of Invasive Aquatic Plants (effective June 20, 2001)

Chapter 722, An Act to Prevent the Spread of Invasive Aquatic Plants (effective April 14, 2000).

The “Chapters” are in the form that a bill is enacted and signed. They contain temporary provisions, such as report and budget provisions, which are not codified into MRSA.

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MASC (Maine Atlantic Salmon Commission). 2005. Standard operating procedure for juvenile Atlantic salmon sampling by electrofishing in wade able streams. Maine Atlantic Salmon Commission, Bangor, Maine, USA. 21 July.

National Marine Fisheries Service (NMFS). 2000. Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act.

<http://www.westcoast.fisheries.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2 000.pdf>. Accessed 16 March 2015.

NMFS (National Marine Fisheries Service). 2008. Anadromous salmonid passage facility design. National Marine Fisheries Service, Northwest Region, Portland, Oregon, USA. February.

<http://www.habitat.noaa.gov/pdf/salmon_passage_facility_design.pdf>. Accessed 16 March 2015.

Appendix C

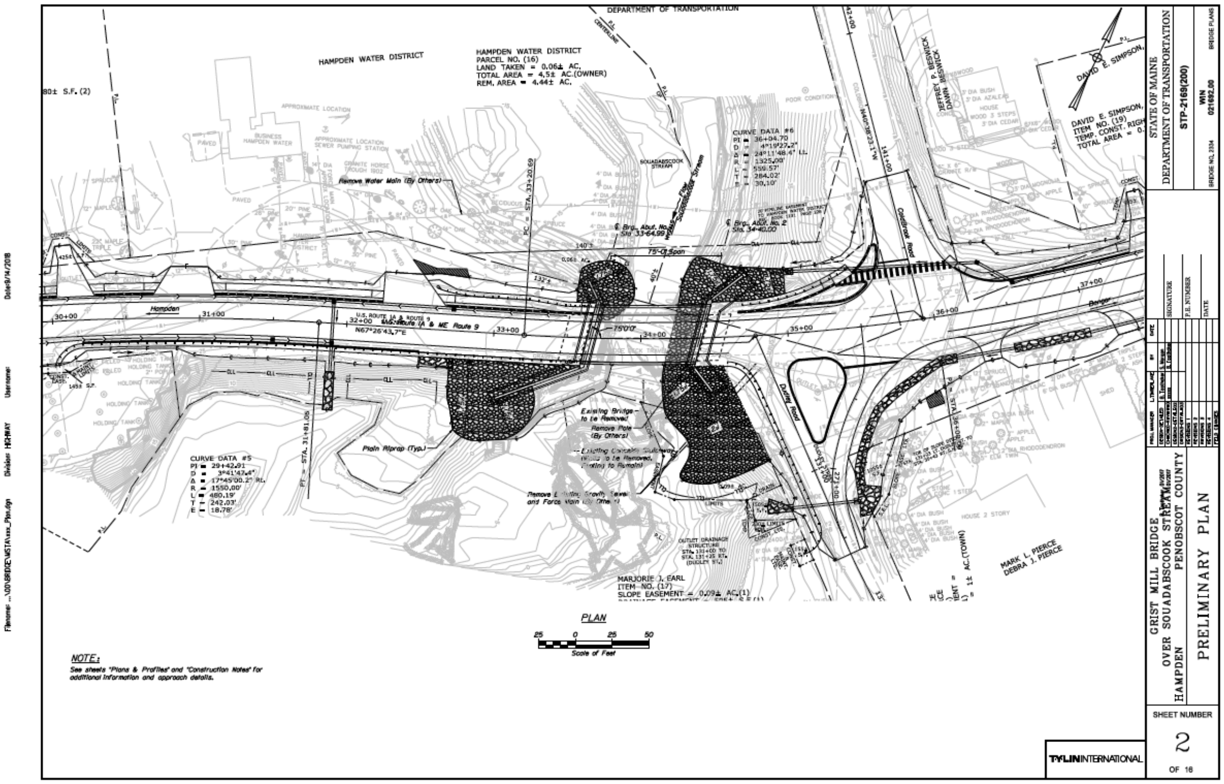
Additional Photos

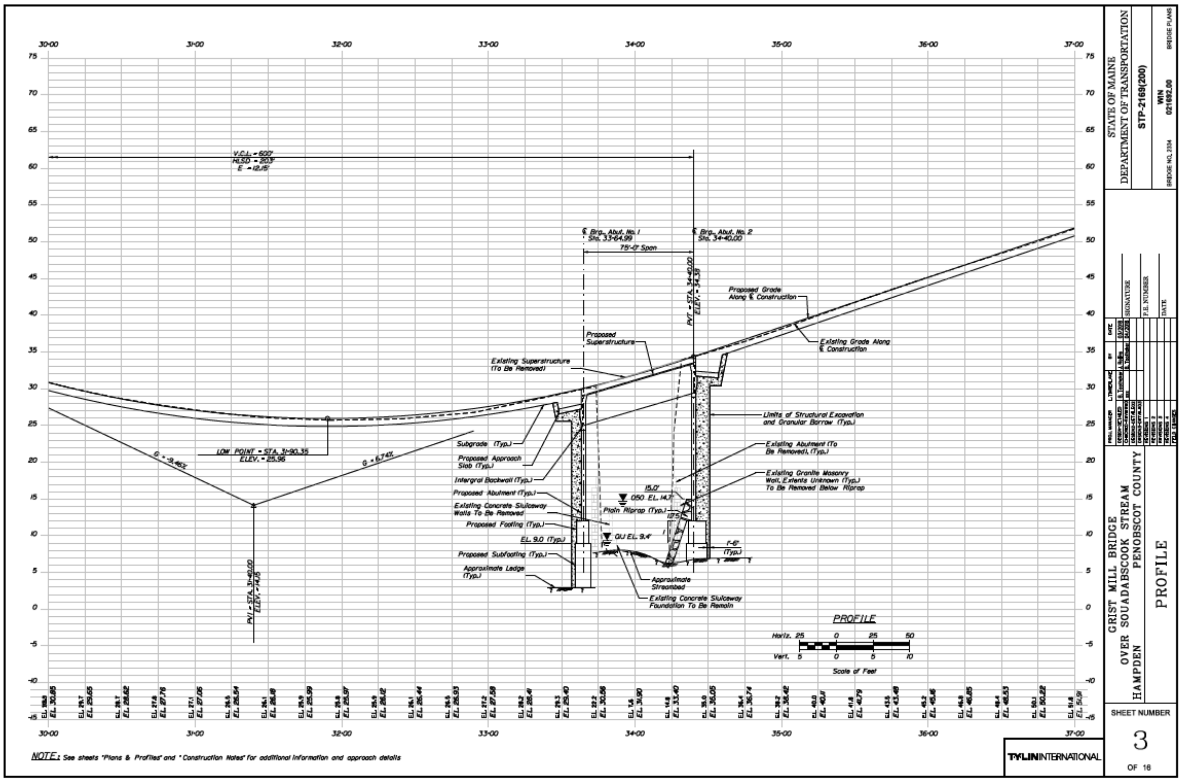

Stacked Large Riprap
(Remove & Regrade)
Sluiceway Wall
(Remove)
Sluiceway Footing Under Water
(Leave in place)
Near High Tide, Low Flow 6/6/16
Looking Downstream


High Tide El 6
Sluiceway Wall
(Remove)
Sluiceway Footing on
Ledge (Top El 3)
(Leave in place)
Low Tide, Low Flow 6/22/16
Looking Upstream

Appendix D

Preliminary Plans

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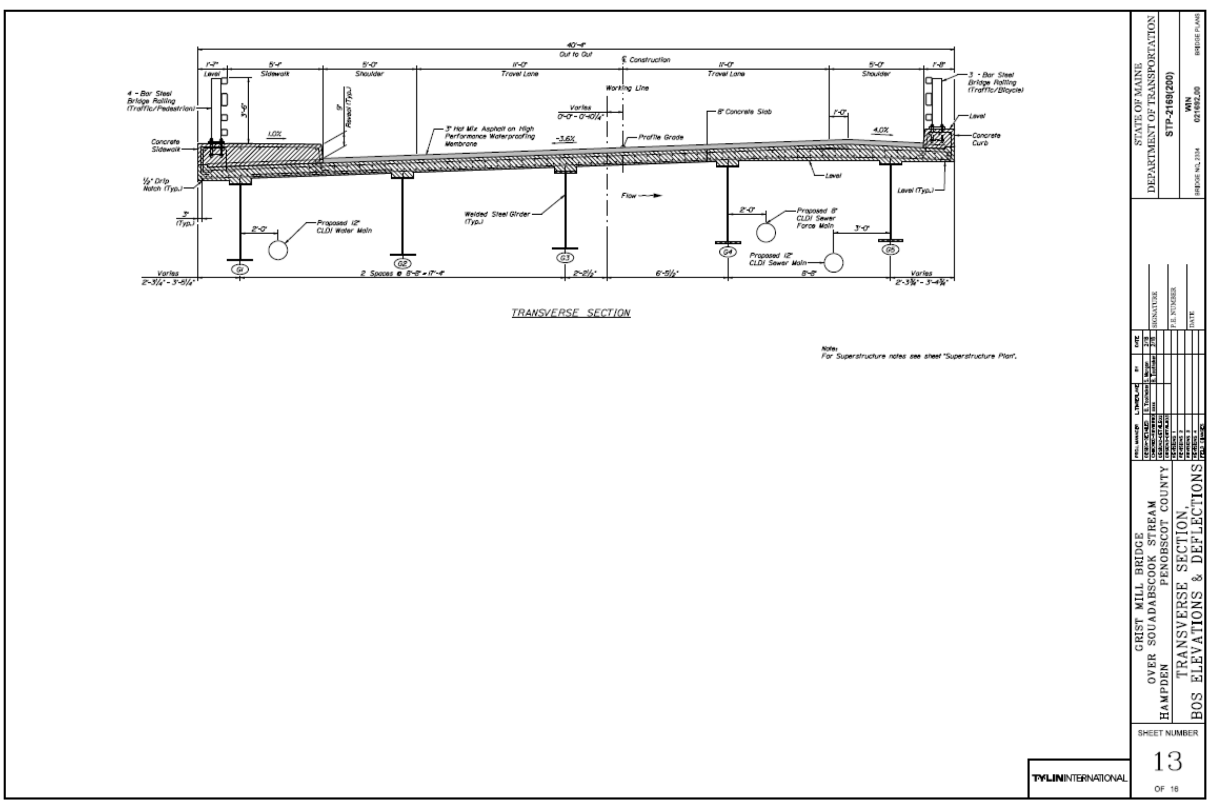
DEPARTMENT OF TRANSPORTATION
STP-2169(200)
WIN 021692.00
BRIDGE PLANS
GRIST MILL BRIDGE
OVER SOUADABSCOOK STREAM
HAMPDEN PENOBSCOT COUNTY
PROFILE
SHEET NUMBER
3
OF 16
PROFILE
Scale of Feet
NOTE: See sheets "Plans & Profiles" and "Construction Notes" for additional information and approach details
TYLININTERNATIONAL


STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
STP-2169(200)
WIN 021692.00
BRIDGE PLANS
GRIST MILL BRIDGE
OVER SOUADABSCOOK STREAM
HAMPDEN PENOBSCOT COUNTY
TRANSVERSE SECTION,
BOS ELEVATIONS & DEFLECTIONS
SHEET NUMBER
13
OF 16
TRANSVERSE SECTION
Notes:
For Superstructure notes see sheet "Superstructure Plan".
TYLININTERNATIONAL