## NMFS/FHWA Best Management Practices (BMPs) for Transportation Actions in the Greater Atlantic Region

Comparison of transportation project types, and links between project components with resource effects and conservation measures

<table>
<thead>
<tr>
<th>Activity/Sub-Activity</th>
<th>Components</th>
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<tbody>
<tr>
<td><strong>Bridge Repair, Demolition, and Replacement:</strong> Bridge work may include structural repairs; pile driving and removal; demolition; excavation for and installation of bridge abutments; temporary fills; riprap placement; constructing bridge columns; constructing stormwater facilities; approach widening; paving with asphalt concrete; and complete replacement. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.</td>
<td>Substructures/footings</td>
<td>Habitat alteration and loss</td>
<td>Behavior modification, reduced fitness</td>
<td>Loss of habitat, altered flow dynamics, affected prey resources</td>
<td>See sections on underwater noise, impingement/entrainment, turbidity and sedimentation, reduced water quality, habitat alteration, and vessel interaction</td>
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<td>Reducing water quality/ pollutant materials discharge</td>
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<td></td>
<td>Beam/deck panel placement</td>
<td>Underwater noise</td>
<td>Temporary behavior modification/avoidance, reduced fitness</td>
<td>Temporary localized habitat alteration, affected prey resources</td>
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<td>Deck pour/paving and painting</td>
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<td>Hazardous material exposure, physical injury, and mortality, temporary behavior modification, reduced fitness</td>
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### Culvert Repair and Replacement: Work on culverts may involve vegetation and sediment removal, pavement and roadbed removal, culvert extraction, placing new culverts or outflow pipes, backfilling and patching the pavement, installing armoring and headwalls, planting, and dewatering the work area and establishing a flow bypass prior to initiating work. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.

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### Docks, Piers, and Waterway Access Projects:

Docks, piers, and waterway access projects may be associated with boardwalks, bicycle/pedestrian paths or bridges, other docks and piers, boat ramps, overlooks, viewpoints, and/or historical markers. These activities may include at-grade or elevated trails including boardwalks (piles with decking), fill/ stabilization, and excavation. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.

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<td><strong>Slope Stabilization:</strong> Stabilization techniques include placing or resetting riprap, abutment caps, bulkheads, scour countermeasures, concrete mattresses, or other structures to protect and restore eroded slopes or to protect slopes that are vulnerable to erosion. Non-structural shoreline stabilization measures that do not use hard components such as the placement of sand fill, coir logs, and/or native shell may also be incorporated. Stabilization structures can be installed from land, temporary structures, or water via shallow-draft barges. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.</td>
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<td>See sections on underwater noise, impingement/entrapment, turbidity and sedimentation, reduced water quality, habitat alteration, and vessel interaction</td>
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<tr>
<td>Removal/excavation of structures &amp; riprap</td>
<td>Turbidity and sedimentation</td>
<td>Physical injury and mortality, temporary behavior modification/avoidance, reduced fitness</td>
<td>Affected water quality, affected prey resources</td>
<td>See Turbidity and Sedimentation BMPs (Section 6.3)</td>
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<td>Reduced water quality/resuspended contaminants</td>
<td>Hazardous material exposure, physical injury and mortality, temporary behavior modification, reduced fitness</td>
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<td>See Reduced Water Quality BMPs (Section 6.4)</td>
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<td>Temporary access roads/work areas</td>
<td>Turbidity and sedimentation</td>
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<td>Barges/vessels &amp; crane/timber mats</td>
<td>Habitat alteration/vegetation smothering and sediment compaction, vessel interaction</td>
<td>Temporary behavior modification, reduced fitness</td>
<td>Loss of bottom habitat, altered sediment transport, affected prey resources, foraging, sheltering and spawning habitat</td>
<td>See Habitat Alteration and Vessel Interaction BMPs (Sections 6.5 and 6.6)</td>
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<td>Spuds/spudding</td>
<td>Habitat alteration/vegetation smothering and sediment compaction</td>
<td>Temporary behavior modification, reduced fitness</td>
<td>Alteration of bottom habitat, altered sediment transport, affected prey resources, foraging, sheltering and spawning habitat</td>
<td>See Habitat Alteration BMPs (Section 6.5)</td>
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<td>Earthwork</td>
<td>Turbidity and sedimentation</td>
<td>Physical injury, temporary behavior modification, reduced fitness</td>
<td>Affected water quality, affected prey resources</td>
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<td>modification, reduced fitness</td>
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<tr>
<td>Stabilization/riprap</td>
<td>Habitat alteration/altered connectivity, altered sediment deposition</td>
<td>Behavior modification/avoidance, reduced fitness</td>
<td>Shoreline habitat loss, affected foraging, sheltering and spawning habitat, affected prey resources</td>
<td>See Habitat Alteration BMPs (Section 6.5)</td>
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<td>Fill/disposal</td>
<td>Turbidity and sedimentation</td>
<td>Physical injury, temporary behavior modification/avoidance, reduced fitness</td>
<td>Affected water quality, localized habitat loss and alteration (burying/covering), affected prey resources</td>
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<td>Physical injury, temporary behavior modification, reduced fitness</td>
<td>Affected prey resources, foraging, sheltering and spawning habitat</td>
<td>See Vessel Interaction BMPs (Section 6.6)</td>
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<tr>
<td>Water Diversions/Cofferdams:</td>
<td>Cofferdams create isolated work areas that can be dewatered to allow work to be done in-the-dry. Cofferdams may consist of sandbags, causeways/earthen structures, and/or large casings or structures created out of sheet piles. They may be installed with hammers, by crane and excavator, or placed by hand, depending on size. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.</td>
<td>See sections on underwater noise, impingement/entrapment, turbidity and sedimentation, reduced water quality, habitat alteration, and vessel interaction</td>
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<tr>
<td>Cofferdam construction/installation</td>
<td>Underwater noise</td>
<td>Temporary localized habitat alteration, affected prey resources</td>
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<td>Turbidity and sedimentation</td>
<td>Physical injury, temporary behavior modification, reduced fitness</td>
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<tr>
<td>Cofferdam in place</td>
<td>Habitat alteration/barriers</td>
<td>Temporary behavior modification, delayed movements</td>
<td>Temporary localized habitat loss</td>
<td>See Habitat Alteration BMPs (Section 6.5)</td>
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<tr>
<td>Cofferdam removal</td>
<td>Turbidity and sedimentation</td>
<td>Physical injury, temporary behavior modification, reduced fitness</td>
<td>Affected water quality, affected prey resources</td>
<td>See Turbidity and Sedimentation BMPs (Section 6.3)</td>
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<td>Reduced water quality/pollutant materials discharge</td>
<td>Hazardous material exposure, physical injury, and mortality, temporary behavior modification, reduced fitness</td>
<td>Affected water quality, localized habitat alteration, affected prey resources</td>
<td>See Reduced Water Quality BMPs (Section 6.4)</td>
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<tr>
<td>Dewatering, cofferdam pump-out</td>
<td>Impingement/entainment, turbidity and sedimentation, reduced water quality</td>
<td>Physical injury and mortality, trapping/harassment, temporary behavior modification, reduced fitness</td>
<td>Temporarily affected water quality, temporary localized habitat alteration</td>
<td>See Impingement/Entrainment and Vessel Interaction, Turbidity and Sedimentation, and Reduced Water Quality BMPs (Sections 6.2, 6.3, and 6.4)</td>
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<td>Temporary access roads/work areas</td>
<td>Turbidity and sedimentation</td>
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<td>See Reduced Water Quality BMPs (Section 6.4)</td>
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</tbody>
</table>
## Activity/Sub-Activity

**Demolition:** Demolition occurs by mechanical dismantling of structures from an adjacent structure or barge, or via land or through blasting. Structural components may be removed using a variety of methods such as cutting/sawing, blasting/chemical expansion (bentonite), hydraulic drilling, excavating, or by using a hoe ram, wrecking ball, clamshell dredge, or splitting wedges and hydraulic impact hammer. Demolition debris is typically barged or trucked offsite for disposal. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Mechanical removal or blasting</td>
<td>Underwater noise</td>
<td>Physical injury and mortality, temporary behavior modification, reduced fitness</td>
<td>Temporary localized habitat alteration, affected prey resources</td>
<td>See Underwater Noise BMPs (Section 6.1)</td>
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<td>Turbidity and sedimentation</td>
<td>Physical injury, temporary behavior modification, reduced fitness</td>
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<td>Reduced water quality/resuspended contaminants and pollutant materials discharge</td>
<td>Hazardous material exposure, physical injury, and mortality, temporary behavior modification, reduced fitness</td>
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<td>See Reduced Water Quality BMPs (Section 6.4)</td>
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<tr>
<td>Excavation</td>
<td>Turbidity and sedimentation</td>
<td>Physical injury, temporary behavior modification/avoidance, reduced fitness</td>
<td>Affected water quality, localized habitat loss and alteration (burying/covering), affected prey resources</td>
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<td>Habitat alteration/altered connectivity, altered sediment deposition</td>
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<td>Impingement and entrapment</td>
<td>Physical injury and mortality, trapping/harassment, temporary behavior modification, reduced fitness</td>
<td>Temporarily affected water quality, temporary localized habitat alteration</td>
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### Activity/Sub-Activity

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<td>Vessel interaction</td>
<td>Physical injury, temporary behavior modification/avoidance, reduced fitness</td>
<td>Affected prey resources, foraging, sheltering and spawning habitat</td>
<td>See Vessel Interaction BMPs (Section 6.6)</td>
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<td></td>
<td>Excavation/drilled-shafts/columns/piers</td>
<td>Underwater noise</td>
<td>Physical injury and mortality, temporary behavior modification, reduced fitness</td>
<td>Affected water quality, temporary localized habitat alteration, affected prey resources</td>
<td>See Underwater Noise BMPs (Section 6.1)</td>
</tr>
</tbody>
</table>

**Pile Driving/Removal:** Piles support decking, provide temporary support during construction, serve as fenders and dolphins to protect structures, support navigation markers, and may support cofferdams, breakwaters, and bulkheads. They can be made of steel, concrete, wood, or plastic, and may be in the form of single piles or sheets. Piles can be driven into the substrate by impact or vibratory hammers, water jetting, or drilled/augured in by drilled shafts or rock sockets and may be removed by vibratory hammer, direct pull, clamshell bucket grab, cutting/breaking below the mudline, or mechanical demolition. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.

**Pile installation via vibratory or impact hammer, water jetting:**

- Underwater noise

**Underwater noise**

- Physical injury and mortality, temporary behavior modification, reduced fitness
- Temporary localized habitat alteration, affected prey resources

See Underwater Noise BMPs (Section 6.1)

**Turbidity and sedimentation**

- Physical injury, temporary behavior modification, reduced fitness

See Turbidity and Sedimentation BMPs (Section 6.3)

**Reduced water quality/resuspended contaminants**

- Hazardous material exposure, physical injury, and mortality, temporary behavior modification, reduced fitness
- Affected water quality, localized alteration, affected prey resources

See Reduced Water Quality BMPs (Section 6.4)

**Excavation/drilled-shafts/columns/piers**

- Underwater noise

- Physical injury and mortality, temporary behavior modification, reduced fitness
- Affected water quality, temporary localized habitat alteration, affected prey resources

See Underwater Noise BMPs (Section 6.1)
### Activity/Sub-Activity

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<tr>
<td>Dredging/Excavation:</td>
<td>Dredging is typically done with hydraulic or mechanical equipment to remove naturally accreting sediment, deepen or widen a waterway, or to return an area to pre-construction conditions. Dredging or excavation may be associated with the installation of sub-structures, placement of erosion and scour control measures or utility lines or cables, or to remove debris. Excavation is often necessary to key in stabilization materials. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.</td>
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<td>See sections on underwater noise, impingement/entainment, turbidity and sedimentation, reduced water quality, habitat alteration, and vessel interaction</td>
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<td>Habituation alteration/altered connectivity, altered sediment deposition</td>
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<td>Vessel interaction</td>
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<td>See Impingement/Entrainment and Entanglement BMPs (Section 6.2)</td>
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</tr>
<tr>
<td><strong>Fill/Stabilization:</strong> Fill and grading may be required prior to stabilization. Construction of temporary access fills and roads may be required to provide a working platform or access for machinery. Scour repair measures including fill and stabilization structures may be necessary. Fill may also be associated with disposal of excavated or dredged material. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.</td>
<td>Fill/disposal</td>
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<td>Habitat alteration/altered connectivity, altered sediment deposition</td>
<td>Temporary behavior modification/avoidance, reduced fitness</td>
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<td>Shoreline habitat loss, affected foraging, sheltering and spawning habitat, affected prey resources</td>
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<td>Vessel interaction</td>
<td>Physical injury, temporary behavior modification, reduced fitness</td>
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</table>

**Vessel Activities:** Construction and maintenance of transportation projects can increase vessel traffic. Equipment access may be from barges, depending on site characteristics. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.

See sections on underwater noise, impingement/entainment, turbidity and sedimentation, reduced water quality, habitat alteration, and vessel interaction.
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<td>Reduced water quality/ pollutant materials discharge</td>
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**Habitat Restoration, Establishment, and Enhancement:** Habitat restoration, establishment, or enhancement may be done to restore areas impacted temporarily during the construction of a project, or as compensatory mitigation or to create mitigation banks. This may include excavation, fill, planting, invasive plant removal, channel reconstruction, shell placement, and living shorelines. Habitat restoration may also include demolition of abandoned or obsolete structures, debris removal, and/or sediment remediation. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.

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<td>Substructures</td>
<td>Habitat alteration, turbidity and sedimentation</td>
<td>Behavior modification, reduced fitness</td>
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<td>Dredging/excavation</td>
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<td>The use of scientific measurement devices or survey activities may be necessary to collect data at a project site in advance of project design or construction or as a part of required monitoring. Such devices or survey activities may include staff or current gages, water recording and biological observation devices, soil borings, core sampling, historic resource surveys, and side scan sonar. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.</td>
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</table>
**Activity/Sub-Activity**: Staging areas may need to be established for delivery and storage of construction materials and equipment, contractor office and storage trailers, and parking. Staging areas vary in size and may require vegetation clearing, grubbing, grading, or excavation to level the site, and installation of drainage improvements. Refer to the other applicable activities/sub-activities to ensure all aspects of a project are included.

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<td></td>
<td>Earthwork</td>
<td>Turbidity and sedimentation</td>
<td>Physical injury, temporary behavior modification, reduced fitness</td>
<td>Affected water quality, affected prey resources</td>
<td>See Turbidity and Sedimentation BMPs (Section 6.3)</td>
</tr>
<tr>
<td>Activity/Sub-Activity</td>
<td>Components</td>
<td>Stressors</td>
<td>Species Effects</td>
<td>Habitat Effects</td>
<td>Best Management Practices</td>
</tr>
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<tr>
<td></td>
<td>Reduced water quality/ resuspended contaminants</td>
<td>Hazardous material exposure, physical injury and mortality, temporary behavior modification, reduced fitness</td>
<td>Affected water quality, localized alteration, affected prey resources</td>
<td>See Reduced Water Quality BMPs (Section 6.4)</td>
<td></td>
</tr>
</tbody>
</table>