Appendix R ATLANTIC STURGEON MONITORING AND IMPACT AVOIDANCE PLAN FOR PROPOSED INFRASTRUCTURE IMPROVEMENTS

ATLANTIC STURGEON MONITORING AND IMPACT AVOIDANCE PLAN FOR PROPOSED INFRASTRUCTURE IMPROVEMENTS AT THE SOUTH BROOKLYN MARINE TERMINAL

Brooklyn, NY

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1.0 INTRODUCTION

The New York City Economic Development Corporation (NYCEDC) proposes infrastructure improvements at the South Brooklyn Marine Terminal (SBMT) to enable it to serve as a staging facility and operations-and-maintenance base for the offshore wind (OSW) industry (Proposed Project). SBMT is an existing marine terminal located in upper New York Bay, roughly spanning the waterfront area between 29th and 39th Streets in the Sunset Park neighborhood of Brooklyn, New York (Fig. 1). The central location, existing solid fill "piers", and access to existing highways and marine vessel traffic lanes make SBMT an ideal location for an OSW staging and servicing facility. The Proposed Project will provide the necessary structural capacity and sufficient water depth to allow SBMT to receive, stage, and assemble OSW components; and provide berthing for cargo carrying vessels (CCV), barges, service operations vessels (SOV), and crew transfer vessels (CTV). The Proposed Project is needed to support the development of OSW energy capacity by 2035, the United States' goal of 30 gigawatts of OSW capacity by 2030, and New York City's Offshore Wind Vision Plan.

The Proposed Project will require the following in-water work:

- Dredging of accumulated sediment at the ends of the existing solid fill "piers" and in select inter-pier areas,
- Placement of a one-foot clean sand cap post-dredging in select areas to address contaminated sediments,
- Pile driving to replace and reinforce existing bulkheads,
- Removal of an existing cofferdam and associated fill to offset fill required elsewhere on the site, and
- Installation of receiving platforms, wharves, and required fenders.

Details of the proposed work are provided in a Joint Permit Application (JPA) submitted to the U.S. Army Corps of Engineers (USACE) and the New York State Department of Environmental Conservation (NYSDEC) on October 3, 2022 (AECOM, 2022a). All of the proposed in-water work will be in shoreline areas adjacent to the existing solid fill "piers".

Empire Offshore Wind LLC's (Empire's) Empire Wind 1 and 2 projects will be the first OSW projects to use the improved SBMT port. NYSDEC's recommended Time of Year Restrictions (TOYR) for Atlantic sturgeon for this Project are from March 1 to June 30 and October 1 to November 30 in waters of any depth. However, adherence to the TOY construction recommendations would extend the Proposed Project's in-water construction over three years (2024, 2025, and 2026), making it impossible for SBMT to support the construction schedule for Empire Wind 1. Accordingly, NYCEDC has requested that work at SBMT be allowed in June, October, and November (Fig. 2) with implementation of an approved Atlantic Sturgeon Monitoring and Impact Avoidance Plan. Extending the in-water work window to June, October, and November will allow completion of in-water construction by the end of 2025, meeting the schedule for Empire Wind 1 and allowing work to be sequenced more safely and efficiently. Allowing work activities during this period with implementation of an approved Atlantic Sturgeon Monitoring and Impact Avoidance Plan will result in a shorter overall

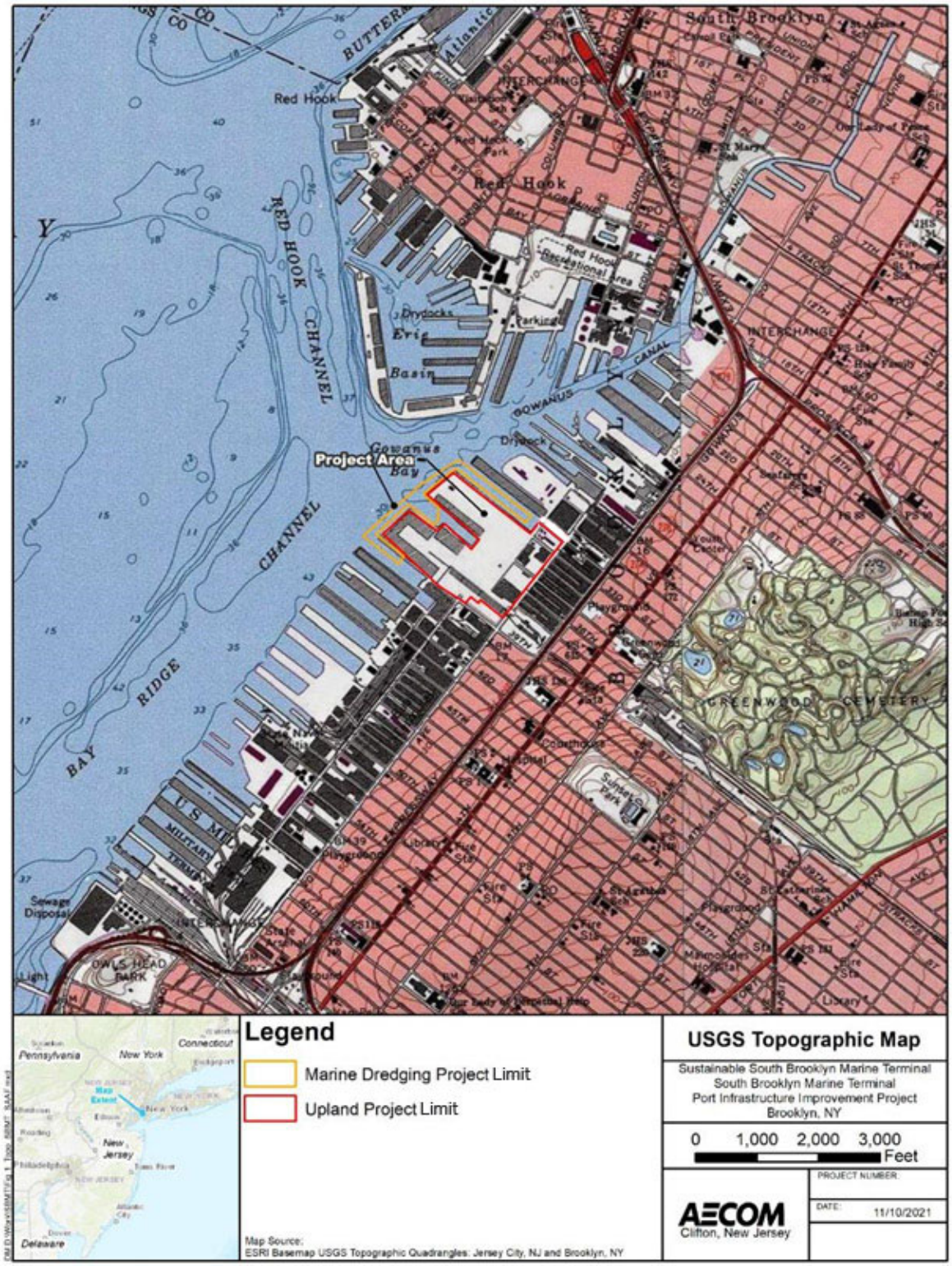

Figure 1. Location of the South Brooklyn Marine Terminal (SBMT), Brooklyn, NY. Source: AECOM, 2022b).

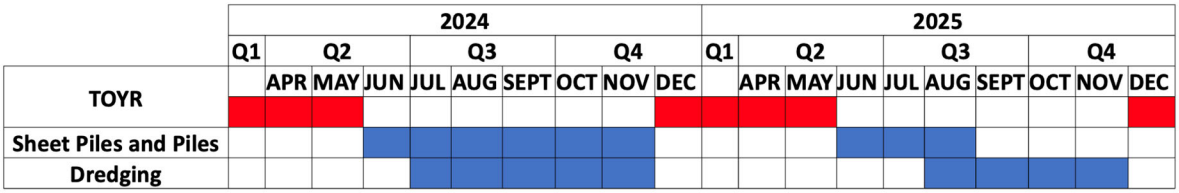

Figure 2. Proposed schedule for in-water construction at SBMT with implementation of an Atlantic Sturgeon Monitoring and Impact Avoidance Plan.

construction period, minimizing the overall disturbance of marine resources. This document presents the NYCEDC's Atlantic Sturgeon Monitoring and Impact Avoidance Plan to be implemented during the months of June, October, and November.

2.0 OCCURRENCE OF ATLANTIC STURGEON IN UPPER NEW YORK BAY

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a large (historically reaching lengths up to 4.6 m) anadromous sturgeon that inhabits large rivers and coastal environments along the Atlantic Coast from Labrador, Canada to Cape Canaveral, Florida (Hilton et al., 2016). Spawning and rearing of eggs, larvae, and early juveniles occurs in fresh water. Juveniles develop a tolerance to salinity as they age and most migrate to the sea for the first time when they are 2 or 3 years old. Older juveniles, referred to as subadults, and adults spend a significant portion of their lives in marine waters, and may undertake extensive migrations along the Atlantic Coast. Adults return to tidal fresh water to spawn and some subadults may seasonally return to tidal rivers to forage (Bain, 1997; Hilton et al., 2016).

The National Marine Fisheries Service (NMFS) delineated U.S. populations of Atlantic sturgeon into five Distinct Population Segments (DPSs) based on genetic studies: Gulf of Maine, New York Bight, Chesapeake Bay, South Atlantic, and Carolina (77 FR 5880 and 77 FR 5914, February 6, 2012). Gulf of Maine Atlantic sturgeon were listed as threatened and the other DPSs were listed as endangered under the federal Endangered Species Act (ESA) in 2012. Individuals from the various DPSs mix extensively along the Atlantic Coast and within some coastal rivers (Hilton et al., 2016).

Adult and subadult Atlantic sturgeon are the only life stages likely to occur in upper New York Bay near SBMT (NMFS, 2022). Adults and subadults use deeper main-channel waters (the main river channel is located approximately 2.8 km west of SBMT) as a migratory corridor when seasonally moving between the ocean and spawning/foraging areas in the Hudson River, located well upriver of SBMT. The literature indicates that younger Atlantic sturgeon remain in the freshwater to lower salinity portions of the Hudson River (Haley et al., 1996; Bain, 1997). Nevertheless, a younger Atlantic sturgeon, probably of Hudson River origin, was recently captured in Jamaica Bay, New York (Lisa Bonacci, NYSDEC, pers. comm., October 3, 2022), indicating that this life stage may rarely occur in New York Bay. No Atlantic sturgeon aggregations are documented near SBMT (NMFS, 2022).

Acoustic telemetry studies indicate that Atlantic sturgeon migrate inbound through upper New York Bay towards upriver spawning and foraging areas in May, continuing into June. They use deeper main-channel waters for this in-migration and are unlikely to occur in the shoreline areas where work at SBMT will be occurring. Atlantic sturgeon migrate back to the ocean during summer through fall, again using main-channel waters as their travel corridor. Their likelihood of occurrence near SBMT is anticipated to be particularly low in October and November, as many will have moved back to the nearshore ocean prior to those months (Breece et al., 2021; Frisk et al., 2020; NMFS, 2022).

During late fall and winter, Hudson River Atlantic sturgeon typically occupy deeper waters off the coasts of New York (Ingram et al., 2019) and New Jersey, or move south along the Atlantic Coast (Breece et al., 2016; Dunton et al., 2010, 2015).

3.0 MONITORING FOR ACOUSTICALLY-TAGGED ATLANTIC STURGEON DURING CONSTRUCTION

Although the occurrence of Atlantic sturgeon near SBMT is unlikely, NYCEDC proposes to actively monitor for the presence of acoustically-tagged Atlantic sturgeon during in-water construction in the months of June, October, and November. Substantial research interest in Atlantic sturgeon combined with advances in acoustic telemetry technology have resulted in the acoustic tagging of a large number of Atlantic sturgeon throughout the species' range. Tagging and detection data for many of these sturgeon have been archived in the Atlantic Cooperative Telemetry (ACT) Network database, which merged with the Mid-Atlantic Acoustic Telemetry Observation System (MATOS). Recent records from ACT/MATOS indicate that there are over 1,900 Atlantic sturgeon (or tags that are assumed to be Atlantic sturgeon) currently at large with active acoustic tags along the Atlantic Coast.

Acoustic telemetry has been used to study the distribution, habitat preferences, and movements of Atlantic sturgeon in a number of research studies in the New York Bight and the Hudson River, and has proven to be an effective methodology allowing the collection of data that could not feasibly be obtained by other methods (Breece et al., 2021; Dunton, 2014; Dunton et al, 2010, 2015; Frisk et al., 2019, 2020; Ingram et al., 2019; Melnychuk et al., 2017). Moreover, acoustic tag monitoring has been approved by NYSDEC and NMFS as a sturgeon protection measure for various projects, including monitoring for Atlantic sturgeon during vibracoring for the Empire Wind 1 project in New York Bay (Tetra Tech, 2021), and monitoring for Atlantic and shortnose (*Acipenser brevirostrum*) sturgeons during rock blasting in the Delaware River (ERC, 2015).

3.1 Acoustic Monitoring Equipment and Procedures

Monitoring for Atlantic sturgeon near SBMT construction operations will be conducted from a survey vessel using a Vemco (now Innovasea Systems, Inc., Shad Bay, Nova Scotia, Canada) VR100 Acoustic Receiver and a Vemco VH165 omnidirectional 69-kilohertz (kHz)

hydrophone (see Attachment A for receiver and hydrophone specifications). Most adult and subadult Atlantic sturgeon have been tagged with Vemco V16 acoustic transmitters, which, based on Frisk et al. (2019), have a nominal detection range of at least 0.6 km, although detection distance can vary with background noise, sea state/wind, and bottom type (DeCelles and Zemeckis, 2014). A nominal detection range of 0.6 km will provide an adequate area to detect Atlantic sturgeon near SBMT construction.

Each day of work in June, October, and November prior to the start of monitoring, the Sturgeon Monitor (approved by NYSDEC) will verify the proper operation of the VR100 receiver and hydrophone using a test tag. The survey vessel will then be maneuvered to the area where construction will be taking place, the hydrophone will be lowered below the hull of the boat, and the Sturgeon Monitor will initiate the first of three 10-minute monitoring periods. The first two periods will be used to determine if tagged Atlantic sturgeon (or tags assumed to be Atlantic sturgeon) are in the area and the final period to determine if any Atlantic sturgeon have entered the area or any observed in the first two periods have left the area of the survey vessel. The VR100 receiver will display the unique tag-specific code of any detections, which the Sturgeon Monitor can immediately cross-reference against the database of over 1,900 acoustically-tagged Atlantic sturgeon. If no tagged Atlantic sturgeon (or tags assumed to be Atlantic sturgeon) are detected during the middle and/or final 10-minute interval, the Sturgeon Monitor will transmit an "all-clear" to the Field Construction Supervisor via cellular phone or marine radio, and construction operations can commence. A log of all monitoring activities and results, including monitoring times, locations (as determined by Global Positioning System [GPS]), detections of any tags, and environmental conditions will be maintained by the Sturgeon Monitor.

If a tag is detected during the middle and/or final monitoring period, its code will be cross-referenced against the ACT/MATOS database (maintained onboard the survey vessel in both paper and digital formats) to determine if the detected fish is an Atlantic sturgeon or a tag assumed to be an Atlantic sturgeon. The above monitoring procedure will be repeated every four hours during the working day while construction activities are in progress.

If it is determined that the detected fish is an Atlantic sturgeon or presumed Atlantic sturgeon, and site conditions allow for this to be performed safely, an attempt will be made to determine the approximate location of the fish by triangulation using a pole-mounted Vemco VH110 directional 69-kHz hydrophone (see Attachment A for hydrophone specifications) and/or evaluation of relative signal strength with distance from the survey vessel. The approximate coordinates of the detected fish, as determined by GPS, will be recorded in the log. If triangulation indicates that the Atlantic sturgeon or presumed Atlantic sturgeon is further than approximately 200 m from the work area (greater than the maximum calculated distance to behavioral effect from pile driving [185 m] [see GARFO Acoustics Tool analysis in AECOM, 2022b]), an "all-clear" will be issued. Although construction can commence at that time, monitoring will be continued to ensure that the sturgeon remains further than 200 m from the work area. If continued monitoring indicates that the sturgeon has moved closer than approximately 200 m to the work area, construction activities will be delayed or suspended until the sturgeon moves further than 200 m from the work area.

The Field Construction Supervisor will make best efforts to comply with an equipment shutdown request from the Sturgeon Monitor unless safety and/or equipment integrity is potentially compromised by the shutdown. In that event, the Field Construction Supervisor reserves the right to delay or override the shutdown request. All decisions and actions related to equipment shutdown and re-start will be recorded in the log.

3.2 Responsibilities of the Sturgeon Monitor

The Sturgeon Monitor will:

- Be a NMFS Endangered Species Act (ESA) Section 10 Research Permit holder (or sub-permittee) and approved by NYSDEC,
- Be trained on the use of the acoustic monitoring equipment and procedures,
- Comply with all safety requirements and procedures,
- Maintain a log of all monitoring activities, including monitoring times and locations, tags detected, environmental conditions, and actions taken in the event of a tag detection,
- Communicate the presence of Atlantic sturgeon to the Field Construction Supervisor and enforce actions taken in response to the detection of an Atlantic sturgeon,
- Make visual observations while on the water, and report any injured or deceased sturgeon (or other protected species) in accordance with the procedures given in Section 3.5 below, and
- Notify the point of contact provided by NYSDEC, via email, of any Atlantic sturgeon detections and actions taken, at the end of each monitoring day (as applicable).

3.3 Outreach to Atlantic Sturgeon Researchers

NYCEDC is aware that not all Atlantic sturgeon acoustic tag codes have been uploaded to ACT/MATOS. Accordingly, researchers who are known to have acoustically tagged Atlantic sturgeon were contacted to request permission to use their tag codes for this monitoring program and to request any tag codes that have not been uploaded to ACT/MATOS (Table 1).

Table 1. Researchers contacted regarding use of Atlantic sturgeon acoustic tag codes.

Researcher	Organization	Response
Gayle Zydelewski	University of Maine	Response pending
James Sulikowski	Arizona State University	Permission granted, recommended obtaining codes from ACT/MATOS
Micah Kieffer	U.S. Geological Survey	Response pending
Tom Savoy	CT Dept. Energy and Environmental Protection	Response pending

Table 1. Continued.

Researcher	Organization	Response
Amanda Higgs	New York State Dept. of Environmental Conservation	Permission granted, recommended obtaining codes from co-investigator Dewayne Fox
Dewayne Fox	Delaware State University	Permission granted, recommended obtaining codes from ACT/MATOS
Keith Dunton	Monmouth University	Permission granted, recommended obtaining codes from ACT/MATOS
Mike Frisk/ Evan Ingram	Stony Brook University	Response pending
Hal Brundage	Environmental Research and Consulting, Inc.	Permission granted, codes provided
Ian Park	Delaware Division of Fish and Wildlife	Permission granted, codes provided with reply e-mail
Chuck Stence	Maryland Dept. of Natural Resources	Permission granted, codes provided with reply e-mail
Eric Hilton	Virginia Institute of Marine Science	On sabbatical. Response received from co-investigator Pat McGrath
Pat McGrath	Virginia Institute of Marine Science	Permission granted, codes provided with reply e-mail
Jason Kahn	National Marine Fisheries Service	Permission granted, codes provided with reply e-mail
Chris Hager	Chesapeake Scientific	Permission granted, will provide codes when tagging field work has been completed
Matt Balazik	Virginia Commonwealth University	Permission granted, recommended obtaining codes from ACT/MATOS
Carter Watterson	U.S. Navy	Permission granted, recommended obtaining codes from co-investigator Jason Kahn
Mike Loeffler	NC Dept. Environmental and Natural Resources	Permission granted, codes provided with reply e-mail
Bill Post	SC Dept. Natural Resources	Permission granted, codes provided with reply e-mail
Adam Fox	University of Georgia	Response pending

NYCEDC intends to maintain the confidentiality of the data provided by these researchers. Only species (Atlantic sturgeon) and life stage (adult or subadult) will be publicly reported for any detections during the monitoring program. Tag codes will not be publicly reported. However, information on detections including tag codes will be provided to the owner of any tag(s) detected.

3.4 Data Delivery and Reporting

Any Atlantic sturgeon detections will be reported to the designated NYSDEC contact, via email, at the end of the monitoring day. A narrative report of Atlantic sturgeon acoustic tag monitoring activities for the SBMT project will be submitted to NYSDEC within 30 days of completion of monitoring. This report will contain all of the data collected during the monitoring effort, including the date, time, and location of each monitoring event and any Atlantic sturgeon detected. The report will also discuss any work delays/stoppages or other actions taken in response to the detection of an Atlantic sturgeon. Data will also be provided to NYSDEC in Excel file format.

3.5 Reporting Injured or Dead Atlantic Sturgeon

Sightings of any injured or dead protected species, including Atlantic sturgeon, will be reported to NYSDEC and NMFS (via NMFS' Sturgeon Salvage Program, 978-281-9238 or by email to noaa.sturg911@noaa.gov) within 24 hours of sighting, regardless of whether the injury or death is caused by a project-related vessel or construction activity.

The following information will be recorded (to the extent possible) on any injured or dead Atlantic sturgeon (or other protected species) observed:

1. Contact
2. Species identification
3. Fork length/weight
4. Condition of specimen/description of animal
5. Fish decomposed (Y/N)
6. Tagged (Y/N) and tag number
7. Genetic samples collected (Y/N)
8. Location transmitted to and date
9. Name and type of platform
10. Date/time animal observed and/or collected
11. Environmental conditions at time of observation
12. Water temperature/depth
13. Description of the location of the animal and events 24 hours leading up to and after the incident
14. Photos
15. Date/time reported to NYSDEC and NMFS.

4.0 IMPACT AVOIDANCE MEASURES

Although the occurrence of Atlantic sturgeon in the vicinity of SBMT is unlikely, the following impact avoidance measures and environmental best management practices will be implemented during the extended in-water work window for June, October, and November.

4.1 Use of a Cushioned Hammer and Pile Tapping During Pile Driving

Piles at SBMT will be installed using a combination of vibration and cushioned impact driving or equivalent. Vibratory driving, which is less "noisy" than impact driving, will be used to drive the piles to refusal and, if required, a cushioned impact hammer will be used to drive the piles to their final design depth. Cushion blocks will consist of multiple layers of plywood approximately one foot (30.5 cm) in thickness. The use of wood cushion blocks has been shown to reduce the underwater sound pressure produced by pile driving by 11 to 26 decibels (dB) compared to that produced by an unattenuated impact hammer (ICF Jones & Stokes, 2009).

In addition, pile tapping (also referred to as a "soft-start" procedure) will be used during initiation of pile driving. This procedure involves initially operating the pile driving equipment at reduced energy to serve as a warning and provide an opportunity to any Atlantic sturgeon (or other protected species) nearby to move from the area before the equipment is ramped up to full energy. For vibratory driving, sound will be initiated for 15 seconds at approximately 50 percent energy followed by a 30 second waiting period. This procedure will be repeated two additional times. For impact driving, an initial set of three strikes will be made at approximately 50 percent energy, followed by a 30 second waiting period, then three subsequent reduced energy strikes. This reduced energy "soft start" will be implemented at the start of each day's pile driving and at any time following cessation of pile driving for a period of one hour or longer.

4.2 Use of a Bubble Curtain During Pile Driving

Bubble curtains can significantly reduce the sound propagated into the water by pile driving (ICF Jones & Stokes, 2009). Air streaming from closely spaced release points creates a "fence" of bubbles that surround (for pipe piles) or are adjacent to (for sheet pile) the pile being driven. Because air and water have a substantial acoustic impedance mismatch, the bubble curtain reflects the sound back towards the point source. Bubbles also absorb sound energy by resonating in response to sound. Up to a 30 dB reduction in sound pressure has been measured when bubble curtains are deployed during pile driving (ICF Jones and Stokes, 2009), although attenuation in the range of 10-15 dB is more likely based on studies for the Tappan Zee Bridge replacement project (Martin et al., 2013) and the Paulsboro Marine Terminal (Giard, 2015). Sound attenuation resulting from the use of a cushioned hammer combined with an air bubble curtain is expected to significantly reduce the sound levels resulting from pile driving at SBMT, with concomitant reductions in fish physiological and behavioral effect distances.

4.3 Use of a Silt Curtain

A silt curtain composed of geotextile material will be deployed, where feasible. The silt curtain will be equipped with suitable flotation and ballast (Francingues and Palermo, 2005) to keep it extended vertically through the water column from the surface to the bay bottom. The silt curtain is intended to minimize the dispersion of suspended sediment (reducing water turbidity) and at the same time deter Atlantic sturgeon (in the unlikely event they occur there) from entering the area where work is being performed. Silt curtains are assumed to be effective in the bays between the piers, while tidal currents outside of the inter-pier areas may affect the feasibility or effectiveness of a silt curtain.

4.4 Other Environmental Best Management Practices

Other environmental best management practices that will be employed during in-water construction at SBMT at any time include:

- Use of a closed environmental bucket and slow speed of bucket withdrawal during dredging, reducing the amount of suspended sediment. Other measures to be employed during dredging include:
  - No barge overflow,
  - No draining of the bucket over the water column, and
  - Careful placement of the dredge material onto the scows.
- Vessel operation at slow and controlled speeds.
- Concurrent scheduling of in-water work to reduce the duration of in-water work. Dredging activities will be scheduled to occur 24 hours a day and 7 days a week to reduce the construction timeline to two seasons instead of three (if using typical TOYR windows).
- Capping of exposed sediments in select areas to reduce potential exposure to contaminants.
- Use of upland pre-cast concrete elements for wharves and dolphins in lieu of in-situ cast structures, where feasible, to reduce the risk of dispersing unhardened concrete pour to the water column.

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ATTACHMENT A

Vemco VR100 Receiver, VH165 Omnidirectional Hydrophone, and VH110 Directional Hydrophone Specifications

VR100 Acoustic Receiver and Deck Box

Acoustic receiver for real-time tracking and remote communication

The VR100 is a general purpose acoustic receiver designed for manual tracking of aquatic animals from small boats or for recording laboratory data.

It is also required as a **surface communication deck box for remote communications with the VR2Tx (receiver and transmitter) and the VR2AR (recveiver, transmitter and acoustic release).** With the VR100 you can now communicate with these receivers while deployed to locate receivers, get health and detection statistics and provide easy, remote release of the VR2AR.To communicate with the VR2Tx and VR2AR, a VHTX transponding hydrophone is also required (sold separately).

The VR100 can be used to track coded (both 69 and 180 kHz) tags as well as continuous tags simultaneously on a wide variety of animals ranging from salmon smolts to sharks. Depending on the transmitter type, the receiver can also collect telemetry data such as temperature, depth and acceleration.

The VR100 is used with the VH165 (50-85 kHz) and VH180 (180 kHz) omni-directional hydrophones, the VHTx (50-85 kHz) transponding omni-directional hydrophone, and the VH110 (50-85 kHz) and VH180-D directional hydrophones. Directional hydrophones extend the receiver's capabilities for real-time animal tracking studies. All VEMCO hydrophones are sold separately.

Features

- Wide dynamic range permitting simultaneous detection of near and distant tags without gain adjustment
- GPS time and position display and data logging
- Improved sensitivity and noise rejection over conventional analog receivers
- Splash proof case
- USB communication link
- VR100 PC Host Software compatible with Windows Vista, Windows 7, and Windows 8

How to Order the VR100

When ordering the VR100, please specify the frequency range of the tags you are using and the hydrophone type needed (omni-directional, directional or transponding omni-directional).

Physical Specifications	
Frequency range	12 to 200 kHz
Dimensions (approx.)	34 cm x 32 cm (with handle extended) x 15 cm
Weight with gel cell	6.5 kg
Battery Life	Approximately 12 hours with backlight off
PC communication	Computer controlled via USB connection
Gain control	Automatic or manual
Hydrophone type	Omni-directional: VH165 (50-85 kHz), VH180 (180 kHz), VHTx Transponding (50-85 kHz) Directional: VH110 (50-85 kHz), VH180-D (180 kHz)
Hydrophone cable length	10 metres - standard length (except VHTx which is 25 metres)
Display	4 x 20 character LCD display
Signal strength meter	LCD screen displays relative signal strength numerically and graphically
Water resistance	Splash resistance
Software	VR100 PC Host Software Windows Vista/7/8

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VH165 and VH180 Omni-directional Hydrophones

Accessories

The VH165 and VH180 are omni-directional hydrophones for use with the VR100 acoustic receiver for active tracking of VEMCO acoustic transmitters on passing fish or equipment.

The VH165 operates between 50 kHz to 85 kHz and the VH180 operates at the 180 kHz. The VH165 is encased in a black 16 mm diameter epoxy tube at a length of 100 mm and the VH180 is encased in a green 16 mm diameter epoxy tube at a length of 100 mm.

VH165

VH180

Specifications

Frequency range	VH165: 50kHz – 85kHz VH180: 180kHz
Tag compatibility	VH165: V7, V8, V9, V13, V16 69 kHz VH180: V5-180, V9-180
Receiver compatibility	VR100
Operational temperature range	-5°C to +40°C (water must not freeze)
Case (dimensions and material)	VH165: 16 mm diameter x 100 mm black epoxy tube VH180: 16 mm diameter x 100 mm green epoxy tube
Weight in air	550 g
Cable type and available lengths	Shielded twisted pair, polyurethane jacket; Lengths (m): 5, 10 (standard), 30
Uses	Omni-directional hydrophone "hears" pings from any direction. Best for determining if a tag is in the area.
Maximum tow speed	Not recommended
Preamplifier gain	50 dB nominal

Tips

1. Attach hydrophone to a weighted rope to counteract buoyancy and put hydrophone to depth. Do not put strain on hydrophone cable! Amount of weight needed depends on flow rate in area.
2. Turn off boat motor and depth sounder to reduce acoustic interference.

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VH110 and VH180-D Directional Hydrophones

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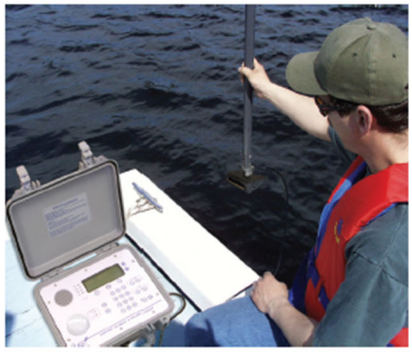
Accessories

The VH110 and VH180-D directional hydrophones are hydro-dynamically shaped so they can be easily moved through water while receiving acoustic signals.

The VH110 and VH180-D are used with the VR100 receiver to locate and track ultrasonic transmitters on passing fish or equipment. The frequency range for the VH110 is 50 to 84 kHz, which makes it suitable for reception of V7, V8, V9, V13, and V16 69 kHz transmitters. The frequency range of the VH180-D is 180 kHz for use with V5-180 and V9-180 transmitters.



The VH110 and VH180-D hydrophones are used with a VR100 receiver to track the full range of VEMCO tags.

Specifications

Frequency range	VH110: 50kHz – 85kHz VH180-D: 180kHz
Tag compatibility	VH110: V7, V8, V9, V13, V16 69 kHz VH180-D: V5-180, V9-180
Receiver compatibility	VR100
Operational temperature range	-5°C to +40°C (water must not freeze)
Case (dimensions and material)	Hydrodynamic black anodized aluminum; 95 x 83 x 32 mm
Weight in air	VH110-10m: 840 g VH180-D-10m: 830 g
Cable type and available lengths	Shielded twisted pair, polyurethane jacket; Length 10m
Uses	Directional hydrophone "hears" pings from only one side of case. Best for actively tracking a tagged animal.
Recommended max. tow speed	5 knots if mounted to a pole
Preamplifier gain	50 dB nominal
Beam pattern (±10%) *(See figures on Page 2)*	69kHz: Horizontal ± 20°; Vertical ± 50° 180kHz: Horizontal ± 15°; Vertical ± 30°

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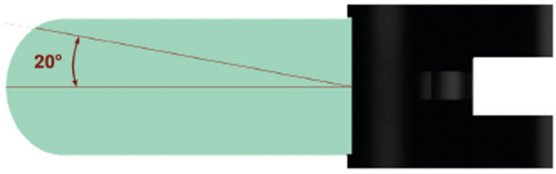
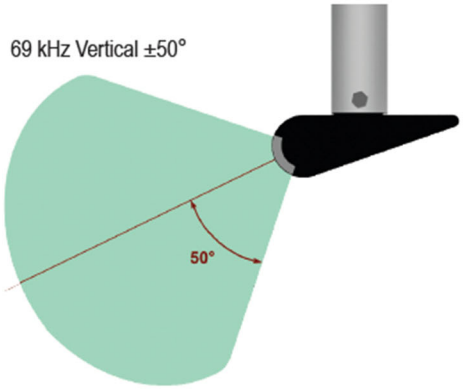
Beam Pattern Figures

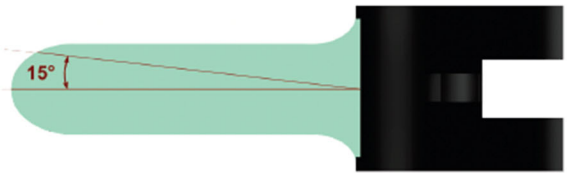
69 kHz Horizontal ±20°



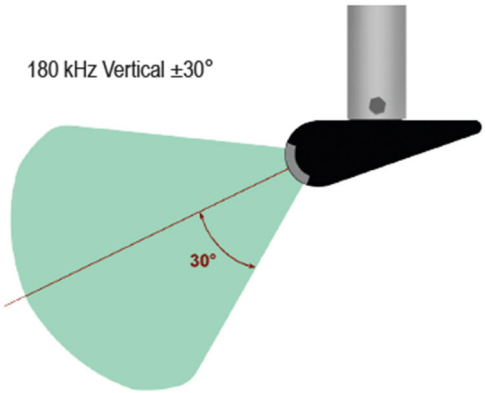
69 kHz Vertical ±50°



180 kHz Horizontal ±15°



180 kHz Vertical ±30°



Tips

1. Turn off boat motor and depth sounder to reduce acoustic interference.
2. The attachment hole is 11/16" diameter. The figure (right) shows one method used to mount the hydrophone to a pole.