UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
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SEP 1 8 2014

Brian Mills
National Electricity Delivery Division, OE-20
Office of Electricity Delivery and Energy Reliability
U.S. Department of Energy
Washington, D.C. 20585

Re: Champlain Hudson Power Express project – Endangered Species Act Section 7 Consultation

Dear Mr. Mills,

We have completed an Endangered Species Act (ESA) section 7 consultation in response to your request for concurrence letter and final biological assessment (BA) for the proposed Champlain Hudson Power Express (CHPE) project, which were received by our office on July 17, 2014, as well as a final environmental impact statement (EIS) for the proposed project, which was received on August 11, 2014. We concur with your determination that the proposed action may affect, but is not likely to adversely affect, any species listed by us as threatened or endangered under the ESA of 1973, as amended. In addition, there is no designated critical habitat under our jurisdiction in the project area, so none will be affected. Our supporting analysis in regards to effects of the proposed action on ESA-listed species is provided below.

**Proposed Action**

The U.S. Department of Energy (DOE) is serving as the lead Federal action agency for this project. The proposed Federal action by the DOE is the issuance of a Presidential permit that would authorize the applicant, Champlain Hudson Power Express, Inc., to construct, operate, and maintain the proposed CHPE high-voltage electric transmission line from the U.S./Canada border to New York City. The applicant proposes to develop the proposed CHPE project as a merchant transmission facility to connect renewable sources of power generation in Canada with load centers in the New York City metropolitan area. The proposed CHPE project has an expected life span of 40 years or more, after which the applicant proposes to de-energize and abandon the proposed transmission line in place following the expiration of its useful life. The U.S. Army Corps of Engineers, New York District is serving a cooperating agency in this project, and will be issuing permit NAN-2009-01089-EYA pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act to cover shore-based and in-water construction activities associated with the project.

The proposed CHPE project involves the construction, operation, and maintenance of an approximately 336-mile long electric-power transmission system. This system includes a high-voltage direct current (HVDC) transmission line that would run from the U.S./Canada border to Astoria, Queens, New York, and associated equipment, such as cooling stations, a proposed converter station, improvements to the Astoria Annex Substation, and high-voltage alternating current interconnection from this substation to Consolidated Edison's (ConEd) Rainey Substation in Queens, New York. The proposed CHPE project transmission line would be installed using both aquatic (underwater) and terrestrial (underground) portions of the route. The underwater portions of the proposed transmission line would be buried in the beds of Lake Champlain and the Hudson, Harlem, and East Rivers. The terrestrial portions of the transmission line would be buried principally in railroad right-of-ways (ROWs) and to a lesser extent roadway ROWs. The proposed CHPE project would be owned and operated in the U.S. by the applicant.

The transmission system would consist of a 1,000-megawatt HVDC transmission line, one communications cable, and ancillary aboveground facilities, including cooling stations at selected locations where required and a direct current (DC) to alternating current (AC) converter station. The transmission line would be a bipole consisting of two transmission cables, one positively charged and the other negatively charged. The entire length of the transmission system would be buried, with the majority of the route beneath Lake Champlain and the Hudson River, with the exception of bridge attachments and ancillary aboveground facilities, such as at the converter station and cooling stations. A new HVDC converter station would be constructed in Queens, New York, to convert the electrical power from DC to AC and then connect to two points of interconnection within the New York City electrical grid. The cooling stations that would be installed along the transmission line route would be for certain locations to disperse accumulated heat in long cable segments installed by horizontal directional drilling (HDD).

In the final BA and EIS, the CHPE transmission line route was divided into four geographically distinct segments: (1) Lake Champlain, (2) Overland, (3) Hudson River, and (4) New York City Metropolitan Area (Harlem and East Rivers) (DOE 2014a, 2014b). However, since ESA-listed species under our jurisdiction are not known to occur in Lake Champlain or in any overland areas, this consultation and analysis will focus specifically on the Hudson River and New York City Metropolitan Area segments of the project (Figures 1 and 2).

The Hudson River segment begins at CHPE project mile post (MP) 228 near the town of Catskill, New York. Here, the HVDC transmission line would enter and be buried in the bottom of the Hudson River for approximately 67 miles to Stony Point, New York. From there, the transmission line would be routed upland along the CSX Transportation railroad ROW and the U.S. Route 9W roadway ROW between project MPs 295 and 303. The transmission line would be buried underground through this eight-mile stretch before re-entering the Hudson River. The transmission line would re-enter the Hudson River at project MP 303 and run along the river bottom for approximately 21 miles until it reaches the end of the Hudson River segment at Spuyten Duyvil Creek and the Harlem River in New York City at project MP 324.

The New York City Metropolitan Area segment begins at Spuyten Duyvil Creek at MP 324, where the HVDC transmission line would enter the Harlem River and continue south in the river for a distance of approximately six miles to a point north of the Willis Avenue Bridge in the borough of the Bronx at MP 330. The transmission line would exit the river and proceed east through the New York State Department of Transportation (NYSDOT) railroad corridor and rail yards along the northern side of the Bronx Kill to the East River at MP 331. Finally, it would proceed to the southeast through a short, one-mile segment entirely under the East River to the site of the ConEd Charles Poletti Power Plant in Astoria, Queens, New York, at MP 332.

**Figure 1. Hudson River Segment of the CHPE project (DOE 2014a)**

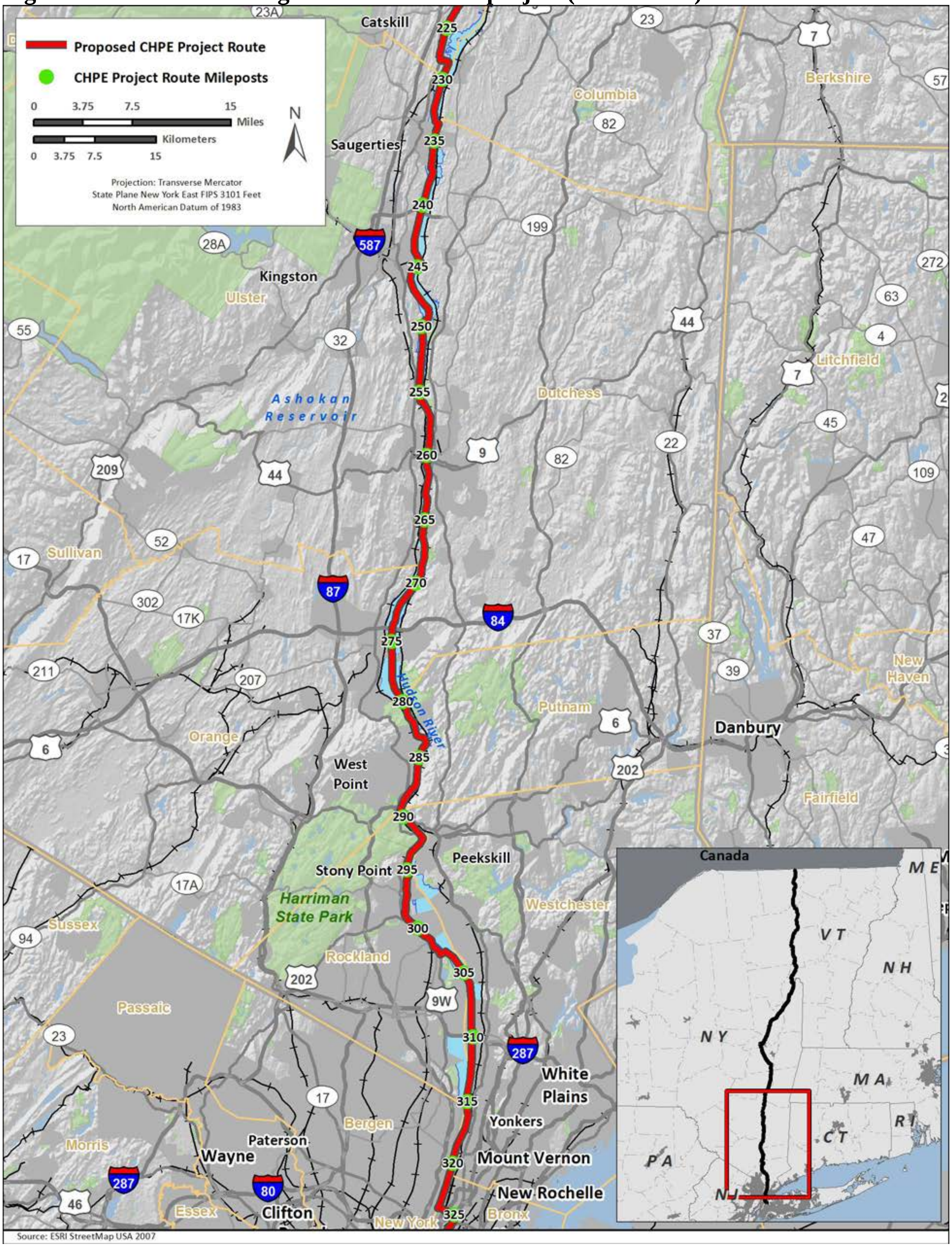
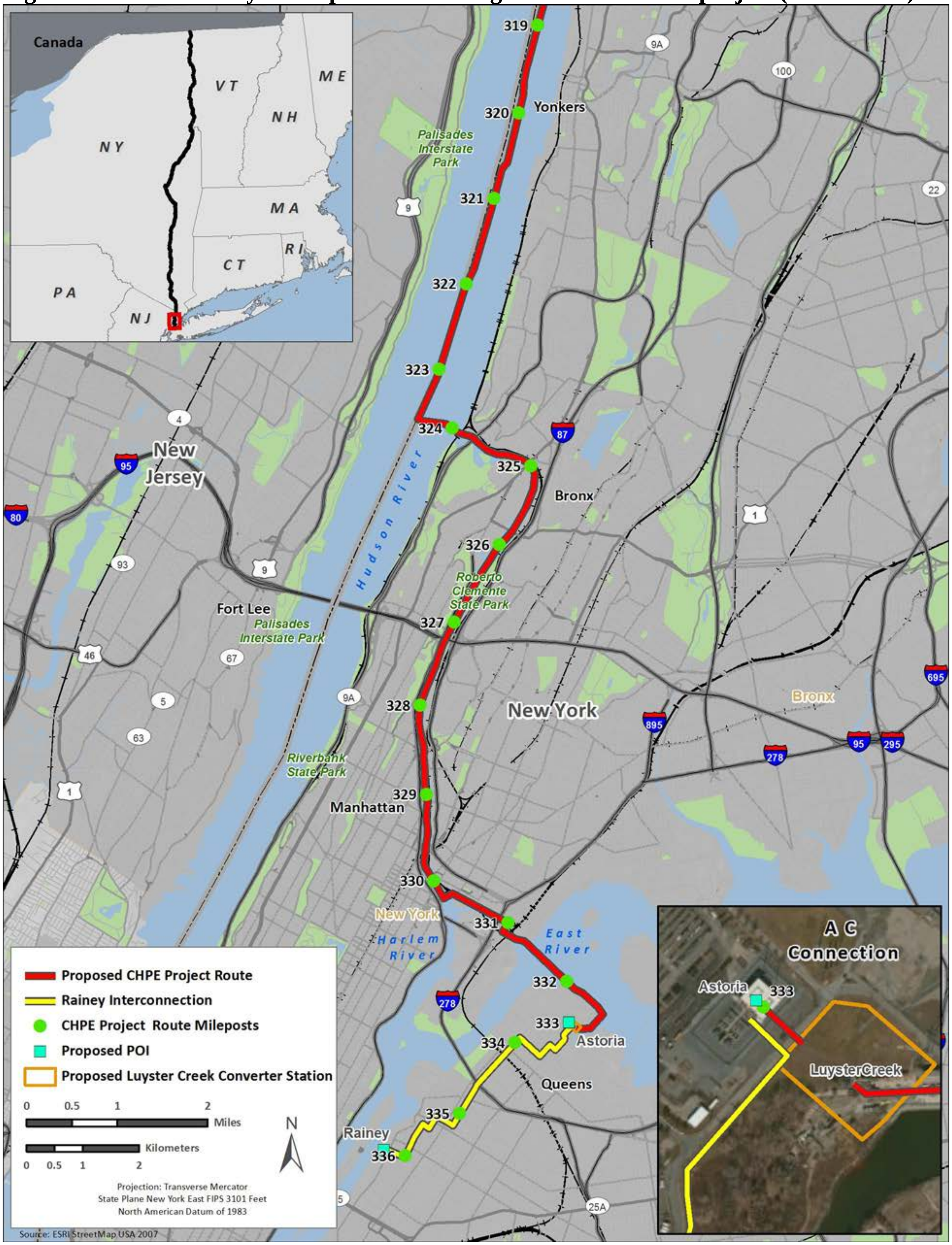


**Figure 2. New York City Metropolitan Area Segment of the CHPE project (DOE 2014a)**



Along the bottom of the Hudson and Harlem Rivers, the transmission line will be installed via jet plowing. Under the mile-long stretch of the East River and at transition areas between aquatic and terrestrial portions of the proposed CHPE project route (both water-to-land and land-to-water), HDD methods will be used to install the transmission cables. Along the banks of the Hudson River, HDD is proposed to occur at project MPs 228, 295, and 303. The applicants plan to begin cable installation in these aquatic areas in the summer and fall of 2015 (following preliminary route clearing in the fall of 2014), and anticipate completion of the project and the commencement of commercial operations by 2017.

***Aquatic Transmission Cable Construction***
The transmission cables proposed for installation in the Hudson River and New York City Metropolitan Area segments would be cross-linked polyethylene HVDC cables rated at 300-320 kilovolts. The first step in the installation of the aquatic transmission cables would involve conducting a pre-installation route clearance operation using a pre-lay grapnel run. During this phase of the operation, scheduled to occur in the fall of 2014 preceding installation the following three years, the route is cleared of debris (*e.g.*, logs and out-of-service cables) by dragging a grapnel along the route. Following debris removal, the transmission cables would be buried beneath the beds of the Hudson and Harlem Rivers at a depth of at least six to eight feet to prevent disturbance to the cables from unrelated marine operations in the waterway. Cables installed in the Hudson River sediment bed would be buried to a minimum depth of seven feet. Cable installation in the Harlem River would be entirely within the federally maintained navigation channel at minimum depths of eight feet in the sediment and six feet in rock. Cables would be installed along the entire East River route using HDD; therefore, minimum trench burial depths would not apply. The depth of burial that can be achieved would depend on available marine construction equipment, soil types and depth to bedrock, existing utilities, and the types of marine activities occurring and their potential threat to cable integrity.

Where the transmission cables cross bedrock (approximately 11 locations in the Hudson River) or an existing utility such as a pipeline or another cable (approximately 66 locations in the Hudson River and 26 locations in the Harlem River), it would be laid over the rock or existing utility and a protective covering, such as an articulated concrete mat, would be installed over the cable crossing. The concrete mats would be 40 feet long, eight feet wide, and nine inches thick. An average of three concrete mats would be placed lengthwise end-to-end over each crossing. Physical surveys, including diver surveys of each utility, would be performed prior to cable installation in an attempt to reduce the requirement for concrete mats.

*Debris removal*. In the year preceding transmission line installation, debris would be removed from portions the route where jet plowing will occur (*i.e.*, route clearing). Debris removal would occur between September 15 and October 30 of 2014 in the Hudson River within the appropriate construction windows, and would be accomplished in 20 calendar days during 12-hour shifts. Debris removal would occur in the Harlem River during a construction window from May 31 to November 30 in 2014. Since the transmission line would be installed underneath the entire one-mile East River segment using HDD, debris removal is not required for that portion of the route. Route clearing could require one to three stages based on the site conditions. All stages of route clearing would use a tug and barge equipped with cutter wheel equipment, or with a smaller tug if possible. Support vessels would include a crane barge to remove larger debris as required or a debris barge to transport recovered riverbed debris. The initial stage of route clearing is designed to find and remove debris lying on and just below the river floor. This stage is performed with large grapnel equipment. In areas of extensive debris or suspect areas, a second stage clearing would be performed with a de-trenching grapnel. This grapnel provides penetration of up to three feet into the riverbed. After completion of the grapnel runs, a third stage of clearing (*i.e.*, plow pre-rip) would be required if the site conditions indicate the potential for sub-surface debris. The plow pre-rip is designed to clear and prove the entire route to the full burial depth, and would be performed in the Hudson and Harlem Rivers using a jet plow but without the cables loaded.

Transit routes for the route-clearing equipment would vary based on the location of marine-based equipment staging areas or yards along the route, but the yards would generally be no more than 50 miles from the equipment's location. Temporary marine yards would be set up and moved as the route-clearing operation progresses. Transit speeds would be no faster than 8-12 knots depending on weather, currents, and barges in tow. Vessel drafts would vary from eight feet for supply barges to 16 feet for supply tug boats, with four-foot drafts for local push tugs. Work barges would generally draw 12 feet, depending on the load. This level of activity and associated vessel speeds are consistent with existing vessel use on the Hudson and Harlem Rivers. During debris removal, the barge would proceed at a speed of 1.5 knots or less. In areas with significant side-scan and magnetometer targets, the speed would be reduced to less than one knot. The route transected for clearing would follow the path of the proposed transmission line.

*Trenching/Hydroplowing*. Following debris removal, aquatic installation and burial of the transmission line would occur via jet plow in the Hudson and Harlem Rivers, via HDD at water-to-land transitions (including at the mile-long project terminus underneath the East River), lain on the surface over bedrock or utility line crossings and covered with concrete mats (total of 3.0 miles), or via blasting of 460 feet of trench at MP 324.5 in the Harlem River. The jet plow is fitted with hydraulic pressure nozzles that create a downward and backward flow to fluidize the sediment within a trench approximately two feet wide and six to eight feet deep depending on the burial requirements, allowing the transmission cables to settle to the bottom of the trench under their own weight before the sediments settle back into the trench.

The applicant would employ a fleet of approximately four vessels, including the cable-laying vessel, survey boat, crew boat, and tugboat or tow boat, which would be used to coordinate the laying of cable. The plowing process would be conducted using a dynamically positioned cable barge and towed plow device that simultaneously lays and embeds the aquatic transmission cables in a trench. The transmission cables composing the bipole would be deployed from the vessel to a funnel device on the plow. The plow is lowered to the riverbed and the plow blade cuts into the riverbed while it is towed along the pre-cleared route to carry out a simultaneous lay-and-burial operation. The plow would bury both cables of the bipole in the same trench at the same time. Burial depths could vary in response to site-specific factors (*e.g.*, presence of existing infrastructure or archaeological resources, environmental concerns, localized geological or topographical obstacles) identified along the proposed CHPE project route. Where the transmission cables would cross areas that contain surficial bedrock or existing infrastructure (*e.g.*, other cables, pipelines), the transmission cables would generally be laid atop the existing bedrock or infrastructure and protected by material placed over the transmission cables.

Protective material could include concrete (*e.g.*, rip-rap, grout mattresses), protective cable ducts, or other low-impact protective armoring.

The burial depth for the area of rock excavation in the Harlem River is likely to be six feet below the waterbody bottom. The proposed transmission line would cross exposed bedrock for approximately 460 feet. Blasting trials would be conducted using a pre-packaged chemical demolition agent that would be inserted into holes drilled into rock. These packaged demolition agents would be loaded into boreholes and when ignited would generate an expansive force to fracture the rock. The rock fragments would then be removed by long-reach hydraulic excavating buckets and deposited in a barge. If the trials are successful, a vertical pattern of holes would be drilled into the rock to form a trench. The broken rock would be dredged sequentially from each end of the trench progressing towards the middle with the rock fragments placed into a barge. Turbidity would be generated as a result of operations. However, impacts are expected to be minimal because of the crystalline nature of the rock and because silt curtains would be used to surround the operations to avoid the spread of a turbidity plume.

In the event that trials with the pre-packaged chemical demolition agent are unsuccessful, due to the rock's hardness or other reasons, it would be necessary to use water gel dynamites to fracture the rock so it can be dredged. The dynamite would produce a shock wave upon detonation. The force of the shock wave could be decreased by stemming the top of the blast holes with pea gravel, which could require an increase in the number of boreholes to be drilled in order to achieve the powder factor (pounds of dynamite per cubic yard of rock) required to break the rock. Each blast hole would be detonated in a controlled sequence to move the rock towards the open end of the trench and to minimize vibrations that would travel towards the shoreline. Explosives would be detonated during each delay (typically eight milliseconds apart).

The blasting program in the Harlem River is estimated to take up to ten weeks, requiring approximately 300 drill holes with each drill taking 30-60 minutes to complete. Nominal noise, vibration, and turbidity are expected from the drilling process, which would employ small diameter drill holes (~1.5 inches) that generate a small amount of suspended sediment. The sediment would be contained by means of floating silt curtains. Air compressors mounted on the barge would generate additional construction noise. Drilling is anticipated to be conducted from a barge on spuds. Prior to blasting, the barge would be moved off the drilled holes for each blast with clearance of the vicinity as required by the local fire marshal and harbormaster.

The blast events are anticipated to have duration of only a few seconds, but they would be preceded by warnings and clearings of the area prior to and after the blast for inspections, all of which may last approximately two hours. The exact production schedules would be developed by the blasting construction contractor. Preliminary construction sequencing studies indicate that 15-20 separate blasts could be required. Peak ground vibrations are predicted to range from 0.25 inches per second at a distance of 200 feet from the trench, one inch per second at a distance of 75 feet, two inches per second at 50 feet, and four inches per second at 30 feet. Peak water pressures are predicted to be 10 pounds per square inch (psi) at 200 feet, 30 psi at 75 feet, 50 psi at 50 feet, and 85 psi at 30 feet from the trench.

Following clearance by the blaster, removal of blasted trench materials would be done with long-reach backhoes to lift debris out of the trench and, if the fragmentation is good, put it to the side. Large rocks would require removal to shore and disposal. An estimated 1,200 tons of rock material is anticipated to be removed from the trench and temporarily stored on the river bottom adjacent to the trench. The cables would be laid over a sand backfill and covered with sand layer. Thereafter, the remainder of the trench would be backfilled with the blasted aggregate materials.

The New York State Public Service Commission (NYSPSC) Certificate issued for the proposed CHPE project established construction work schedule windows identifying times of the year when work associated with the underwater portion of the transmission line may take place. These work windows were subsequently supplemented through consultation with us and the New York State Department of Environmental Conservation (NYSDEC). These established work windows and time of year restrictions (Table 1) were developed to avoid impacts on overwintering, spawning, and larval stages of ESA-listed fish species in the Hudson and Harlem Rivers as well as other environmental concerns. Overall, cable installation activities in the Hudson River segment of the project are expected to take up to five months in total, while those in the New York City Metropolitan Area are expected to take up to seven months in total. However, with the agreed-upon construction windows in place, installation of the cable in these two project segments is anticipated to occur over a three-year period from 2015-2017.

***HDD***

The HDD operation at a water-to-land transition would include an HDD drilling rig system, a drilling fluid collection and recirculation system, temporary cofferdam installed at the water exit to maintain exit pit stability following dredging of the pit, and associated support equipment. For each proposed HDD location, two separate drill holes would be required, one for each cable. During installation, a drill rig would be placed on shore behind a temporary fluid return pit and a 40-foot drill pipe with a cutting head would be set in place to begin the drilling process. As the initial pilot borehole is drilled, slurry composed of water and bentonite would then be pumped into the hole to transport the drill cuttings to the surface, to aid in keeping the borehole stable, and to lubricate the drill. After the final drill length has been achieved, high-density polyethylene (HDPE) conduits would be pulled into the drilled hole. Once the HDPE conduits are in place, the transmission cables would be pulled through these pipes and into a transition splice vault, which would remain in place to protect the transmission cable.

Cofferdams would be installed in the Hudson River at approximate MPs 228, 295, and 303. The anticipated dimensions of each cofferdam would be approximately 16 feet by 30 feet (480 square feet). Dredging activities associated with the proposed CHPE project would only be for cofferdam installation, which is expected to last from 5-10 days using a single dredge and result in a total dredged area limited to less than one acre in the Hudson River. Dredging and cofferdam installation would occur during the construction windows established for this project, which are outside of the sturgeon spawning seasons.

**Table 1. Underwater construction windows for the Hudson and Harlem Rivers.**

| Project Milepost | Location | Construction Window | Primary Construction Method | Species lifestage protected |
|---|---|---|---|---|
| 228 to 245 | Hudson River: Cementon (Catskill) to Kingston | August 1 to October 15 (2015-2017) | Jet Plow | *Shortnose sturgeon:* spawning adults, eggs, and larvae (spring); adults and juveniles (early summer). *Atlantic sturgeon:* spawning adults, eggs, and larvae and early juveniles (spring and early summer). |
| 245 to 269 | Hudson River: Kingston to New Hamburg | September 14 to October 15 (2015-2017) | Jet Plow | *Shortnose sturgeon:* spawning adults, eggs, and larvae (spring); adults and juveniles (early summer). *Atlantic sturgeon:* spawning adults, eggs, and larvae and early juveniles (spring and early summer). |
| 269 to 295 | Hudson River: New Hamburg to Stony Point | September 15 to November 30 (2015-2017) | Jet Plow | *Shortnose sturgeon:* adults and juveniles (summer). *Atlantic sturgeon:* adults, eggs, larvae, and juveniles (spring and summer); early juveniles (winter). |
| 303 to 324 | Hudson River: Clarkstown to Harlem River | July 1 to October 31 (2015-2017) | Jet Plow | *Shortnose sturgeon:* adults and juveniles (winter and early summer). *Atlantic sturgeon:* early juveniles (winter and spring). |
| 324 to 330 | Harlem River | May 31 to November 30[a] (2015-2017) | Jet Plow | Proposed blasting would avoid sturgeon spawning migration. |

a. Blasting would take place between July 1 and November 30 (2015-2017).

Material would be dredged using a closed clamshell dredge (environmental bucket) and removed by barge to an appropriately permitted processing facility. Dredging would be conducted during eight- to twelve-hour shifts daily. The cofferdam would extend six feet below the mudline. Approximately 107 cubic yards would be removed from within each cofferdam, for a total of 321 cubic yards of dredge material removed from all three cofferdam sites on the Hudson River. A barge or dredge scow could hold up to 2,500 cubic yards of material. Therefore, only one barge trip should be needed to remove all material. Silt curtains would be used as required around the work area; however, it is not anticipated that any silt would escape from within the cofferdam.

Sheet piles used to construct the cofferdams would be installed with a vibratory hammer, and would be installed in pairs with 8-10 pairs of sheets installed per day. Each pair of sheets would provide a wall four feet wide and approximately 50 feet tall. A single pair of sheets can be installed in 30-120 minutes depending on the geotechnical conditions. After the vibratory penetration, each sheet would be “seated” into hard strata as required. Approximately 4-6 strikes per pair of sheets would be required to “seat” the pile wall. The applicant has committed to using soft starts for vibratory installation. Each cofferdam would be constructed within 25-30 days, for a total duration of sheet pile installation of 75-90 days for all three cofferdams. All cofferdams would be inspected for trapped fish following installation. It is anticipated that the cofferdam would be cut at the mudline using divers and underwater cutting or burning equipment such as exothermic rods when installation activities are completed.

A visual and operational monitoring program would be developed and conducted during HDD operations to detect any losses of drilling fluid. Visual observations of drilling fluid in the water, or excessive loss of volume or pressure in the borehole would trigger response actions by the HDD operator, including halting drilling activities and initiating cleanup of released bentonite. A barge with a pumping system would be positioned at the cofferdam during drilling to collect any drilling fluid released into the cofferdam enclosure.

HDD in the East River will occur entirely underneath the river bottom and thus will not impact any aquatic areas of the river. The initial drill holes will be bored in upland areas at the NYSDOT rail yard in the Bronx and at the ConEd power plant in Queens; after which a conduit located several feet beneath the river floor will be created, through which the transmission cable will be pulled.

***Additional Engineering Details***

*Heat*. Ambient water temperatures in the Hudson and Harlem Rivers range from 32°F in January to a July maximum of 81°F. The proposed CHPE project's HVDC cables would be designed to operate at a normal temperature of 158°F. Under limited durations (*i.e.*, maximum of two hours) of emergency overload conditions, the temperature would be limited to 176°F. At these temperatures, heat must be carried away from the conductors for them to operate efficiently, and soils in and around a trench perform this for underground cables. It is estimated that that for cable burial at depths between four and eight feet, the maximum expected temperature change would be less than 1°F in the water column above the riverbed, approximately 1.8°F at the riverbed surface, and between 4°F and 9°F at 0.66 feet below the riverbed surface.

Where the transmission cables cannot be buried to their full depth due to utilities or bedrock and must be covered with concrete mats, the estimated increase in water temperature surrounding the cables covered by the concrete mats is expected to be negligible (less than 0.25°F). This is expected to be within the range of daily variation of water temperatures experienced in the Hudson and Harlem Rivers. The highest increase in ambient temperature in the top two inches of sediment along the sides of the concrete mat is expected to be 1.26°F or less.

*Electric and Magnetic Fields*. Operation of the proposed CHPE project transmission line would produce both electric and magnetic fields. Electric field strength is reduced by shielding or by intervening objects such as structures and vegetation. The transmission line cables would be shielded within a lead-alloy sheath and either buried or covered with concrete mats, which would make any exposure to an increased electric field negligible. Like electric fields, magnetic fields diminish with distance from the source. Unlike electric fields, however, intervening objects between the source and the receptor, such as structures or soil over a buried transmission line, do not reduce magnetic field strength. Therefore, the proposed transmission line is expected to produce a magnetic field of approximately 162 milligauss (mG) at the sediment-water interface.

***Operations and Maintenance (Transmission Cable Repairs)***

While not anticipated, it is possible that over the lifespan of the proposed CHPE project, the transmission cables could be damaged, either by human activity or natural processes. Before operation of the proposed CHPE project begins, an Emergency Repair and Response Plan would be prepared to identify procedures and contractors necessary to perform maintenance and emergency repairs. In the event of aquatic cable repair, the location of the problem would be identified and crews of qualified repair personnel would be dispatched to the work location. A portion of the cable would be raised to the surface, the damaged portion of the cable cut, and a new cable section would be spliced in place by specialized jointing personnel. Once repairs were completed, the cable would be reburied using a remotely operated vehicle jetting device.

***Mitigation Measures and Best Managements Practices***

The applicant has proposed measures to avoid or minimize impacts on aquatic ESA-listed species and their occupied habitats in the Hudson and Harlem Rivers. Additionally, the NYSPSC Certificate requires the applicant to undertake a series of pre- and post-installation compliance monitoring studies: benthic and sediment monitoring; bathymetry, sediment, temperature, and magnetic field; and Atlantic sturgeon pre-installation and post-energizing hydrophone. The Atlantic sturgeon study would document the species' movements in relation to cable operation. The post-energizing benthic surveys would be conducted at the following milestones: (a) three years after installation assuming cable energizing, and (b) when the transmission system is operating at 500 to 1,000 megawatts if it is not doing so three years after installation. Sediment post-energizing sampling would be conducted three years after installation during the same season as the first benthic sampling event. All studies would be developed in consultation with appropriate natural resources agencies.

The overall objective of the surveys would be to obtain the highest quality hydrographic data using commercially available equipment and techniques. Equipment that would be used includes a high-resolution side-scan sonar system with a dual frequency (100 and 500 kiloHertz) towfish, a vessel motion sensor (heave, pitch, and roll) and heading sensor, real time kinematic geographic positioning system (GPS), and a shore-based GPS receiver. The entire cable route would be surveyed in the first year to compare with the bottom elevations of the pre-installation survey. Segments where the substrate has returned to the pre-installation configuration would not be resurveyed. Segments that have not returned to pre-installation condition after three years would be resurveyed after five and eight years after cable installation. Each survey would take about 35 days and would likely be conducted in the late summer and early fall. The speed of the vessel conducting the survey would depend on the water current speed and the weather. It is expected that the average speed of the vessel while surveying would be about 3-4 knots. Transit speeds would be 8-10 knots. The side-scan sonar system would be operated with a towfish height above the bottom that provides adequate coverage.

In addition, the following measures have been proposed by the applicant to avoid or minimize impacts on aquatic ESA-listed species:

- The applicant would continue to work closely with Federal and state agencies to establish measures prior to construction starting to avoid or minimize impacts on aquatic threatened and endangered species along the proposed CHPE project route.
- Reduced in-water pressure and jetting speeds (*e.g.*, less than four knots) would be used to reduce turbidity when crossing sensitive areas such as Significant Coastal Fish and Wildlife Habitat (SCFWHs), which contain important breeding habitat for protected and sensitive species. The most appropriate speeds would be coordinated with the construction contractor, who would consider existing sediment conditions, cable weight, and multiple other factors to arrive at an installation speed that allows for a reduction in impacts and safe and efficient cable installation. Reductions in total suspended solids (TSS) would be calculated after the installation specifications have been set as part of the construction design phase. Proposed areas where construction modifications could occur would be identified in plan and profile drawings.
- During nighttime construction activities, vessels would be outfitted with identification lights and working decks would be illuminated for safety. Lights would not be directed into surrounding waters, thereby reducing the potential for effects on benthic communities and fish.
- Commencement of in-river work north and south of the Haverstraw Bay SCFWH would occur between high tide and ebb tide to avoid or minimize impacts of resuspended sediments on Haverstraw Bay, which contains important habitat for protected and sensitive species.
- The Environmental Inspector would have the authority to modify or suspend construction if it is anticipated that any aquatic threatened and endangered species would be impacted in any way by construction activities.
- A Standard Operating Procedures manual would be prepared to outline monitoring and reporting methods to be implemented during the proposed CHPE project construction. This manual would be coordinated with and reviewed by the National Marine Fisheries Service (NMFS), Protected Resources Division.
- If new aquatic threatened and endangered species-occupied habitat is identified, the environmental management and construction plan would be updated to show the new occupied habitat(s), and consultation with NMFS and state agencies would commence.
- All personnel associated with the project would be advised of the potential presence of aquatic threatened and endangered species and the need to avoid collisions. All construction personnel would be responsible for observing water-related activities for the presence of ESA-listed species. All construction personnel would also be updated on the locations of any new aquatic threatened and endangered species or occupied habitats that are identified. These areas would be reported to the applicable resource agencies.
- The applicant would train and educate transmission system contractors and subcontractors to identify aquatic invasive species and site-specific prescriptions for preventing or controlling their transport throughout or off of the proposed CHPE project site.
    - Require that vessels, equipment, and materials be inspected for, and cleaned of, any visible vegetation, algae, organisms, and debris before bringing them to the proposed CHPE project area.

- Train transmission system contractors and subcontractors on the various cleaning or decontamination methods to be used on a site-by-site basis for the proposed CHPE project.
- Require that vessels, equipment, and materials be inspected for, and cleaned of, any visible vegetation, algae, organisms, and debris before leaving the waterbody for another.

- All vessels associated with the construction project would operate at "no wake/idle" speeds (*i.e.*, less than four knots) at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. In areas with substantial objects recorded in side-scan sonar and magnetometer surveys, the speed would be reduced to less than one knot. All vessels would preferentially follow deepwater routes (*e.g.*, marked channels) whenever possible.

**Description of 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 involved in the action" (50 CFR§402.02). More specifically, the action area includes not only the footprint of the proposed CHPE project, but also the distance that sediment plumes, underwater noise, elevated temperatures, and electromagnetic fields can travel outward from the footprint in each of the aquatic segments. Shortnose and Atlantic sturgeon occur only in the Hudson River and New York City Metropolitan Area segments. As a result, the action area for the Hudson River segment encompasses waters of the Hudson River from roughly Catskill, New York south to Spuyten Duyvil Creek, minus the eight-mile stretch of river between project MPs 295 and 303 in which the transmission cable will run over land. For the New York City Metropolitan Area segment, the action area encompasses the six-mile stretch of the Harlem River. We have excluded from the action area the roughly one-mile stretch of the East River under which the transmission cable will extend, as all construction will take place via HDD beneath the river bottom (much like a road tunnel project under a river, bay, or channel) where shortnose and Atlantic sturgeon are not known to occur. .

The project footprint includes the underwater areas to be cleared via grapnel, those where the transmission cable will be buried via jet plow or lain atop the sediment, and (c) those through which support vessels will traverse. The action area also includes the underwater areas expanding outward from the project footprint where effects of hydroplowing, water-to-land and land-to-water HDD, dredging, pile driving, blasting, vessel traffic, cable operation, and any potential cable repairs during the 40+ year lifespan of the project will be experienced. The associated environmental stressors from these activities include increases in suspended sediments and turbidity (including contaminated sediments), underwater noise, water temperature, and electromagnetic fields.

The project proponents anticipate the localized temporary disturbance of approximately 569 acres of river bottom in the Hudson and Harlem Rivers as a result of the project. As set forth in the final BA, water quality modeling indicates that, on average, any increases in suspended sediment in the Hudson and Harlem Rivers should be confined to an area within 500 feet of the two-foot wide jet plow/trench (NYSPSC 2013). Increases in suspended sediment due to the towing of the grapnel during route clearing are expected to be significantly less than those for the cable trenching. The exact size of the suspended sediment plume created during jet plowing will depend on a variety of variables, including sediment type and current, and is likely to vary throughout the project, but it is expected to be within 500 feet of either side of the cable along the cable path. In addition, as indicated by underwater noise studies referenced by the project proponent, elevated levels of noise from this project may reach up to 450 feet from either side of the transmission line, depending on conditions and the use of thrusters on the cable-laying vessel as well as noise associated with the construction of cofferdams around the HDD areas and underwater blasting of bedrock in the Harlem River. The distances from the underwater cable in which increases in water temperature and electromagnetic fields would be experienced by ESA-listed species are believed to be much smaller and would be encompassed in the 1,000-foot wide swath along the cable path.

Thus, we have more specifically defined the action area for this project as consisting of an approximately 1,000-foot wide swath centered along the path where route clearing and cable entrenchment via jet plowing will occur, as well as 500-foot radius areas surrounding HDD underwater exit and entry points, and any portions of the water column through which tow lines will be suspended. These areas are expected to encompass all of the effects of the proposed project.

**NMFS Listed Species in the Action Area**

Shortnose and Atlantic sturgeon are the only two ESA listed species under our jurisdiction that occur in the action area for this project (which includes segments of the Hudson and Harlem Rivers). There are no designated critical habitats under our jurisdiction in the action area and no listed species under our jurisdiction occur in Lake Champlain or the overland areas where project construction activities will also occur.

***Shortnose sturgeon***

A population of the federally endangered shortnose sturgeon occurs in the Hudson River from upper Staten Island (approximately river kilometer [rkm] 4.8) to the Troy Dam (approximately rkm 245). From late fall to early spring, adult shortnose sturgeon concentrate in a few overwintering areas. The largest overwintering area is just south of Kingston, New York, near Esopus Meadows (rkm 139-152) (Dovel *et al*. 1992). The fish overwintering at Esopus Meadows are mainly spawning adults. Captures of shortnose sturgeon during the fall and winter from Saugerties to Hyde Park (greater Kingston reach), indicate that additional smaller overwintering areas may be present (Geoghegan *et al*. 1992). Both Dovel *et al*. (1992) and Geoghegan *et al*. (1992) also confirmed an overwintering site in the Croton-Haverstraw Bay area (rkm 54-61). Fish overwintering in areas below Esopus Meadows are mainly thought to be pre-spawning adults. Typically, movements during overwintering periods are localized and fairly sedentary.

When water temperatures reach 46º-48ºF, typically in late March through mid-April, reproductively active adults begin their migration upstream to the spawning grounds that extend from below the Federal Dam at Troy to about Coeymans, New York (rkm 245-212) (Dovel *et al*. 1992). Spawning typically occurs at water temperatures between 50º-64ºF, generally from late April through May, after which adults disperse quickly down river into their summer range. Dovel *et al*. (1992) reported that spawning fish tagged at Troy were recaptured in Haverstraw Bay in early June. The broad summer range occupied by adult shortnose sturgeon extends from approximately rkm 38-177. Similar to non-spawning adults, most juveniles occupy the broad region of Haverstraw Bay (rkm 54-61) by late fall and early winter (Dovel *et al*. 1992; Geoghegan *et al*. 1992). Juveniles are distributed throughout the mid-river region during the summer (rkm 38-152) and move back into the Haverstraw Bay region during the late fall (Geoghegan *et al*. 1992; Bain *et al*. 1998). Eggs and larvae are expected to be present within the vicinity of the spawning grounds for approximately four weeks post spawning (*i.e.*, at the latest, through mid-June).

There have been no documented captures of shortnose sturgeon in the Harlem River. As a result, their occurrence in the Harlem River during the proposed construction window is extremely unlikely.

***Atlantic Sturgeon***

Use of the Hudson River by Atlantic sturgeon has been described by several authors. Briefly, spawning likely occurs in multiple sites within the river from approximately rkm 56 to rkm 182 between May and July (Dovel and Berggren 1983; Van Eenennaam *et al.* 1996; Kahnle *et al.* 1998; Bain 1997; Bain *et al.* 2000). Male sturgeons begin upstream spawning migrations when waters reach approximately 43ºF, and remain on the spawning grounds throughout the spawning season. Females begin spawning migrations when temperatures are warmer at 54º-55ºF, make rapid spawning migrations upstream, and quickly depart following spawning (Greene *et al*. 2009). Selection of sites in a given year may be influenced by the position of the salt wedge (Dovel and Berggren 1983; Van Eenennaam *et al.* 1996; Kahnle *et al.* 1998). The area around Hyde Park (MP 254) has consistently been identified as a spawning area through scientific studies and historical records of the Hudson River sturgeon fishery (Dovel and Berggren 1983; Van Eenennaam *et al.* 1996; Kahnle *et al.* 1998; Bain *et al.* 2000). Habitat conditions at the Hyde Park site are described as freshwater year round with bedrock, silt, and clay substrates and waters depths of 40-80 feet (Bain *et al.* 2000). Bain *et al.* (2000) also identified a spawning site at rkm 112 based on tracking data. The rkm 112 site, located to one side of the river, has clay, silt, and sand substrates, and is approximately 69-89 feet deep (Bain *et al.* 2000). Within the proposed CHPE project area, spawning likely occurs from MPs 254 to 269. Larvae are expected to occur from June through August in the vicinity of the spawning area (Bain *et al*. 2000).

Young of the year (YOY) and juvenile Atlantic sturgeon have been recorded in the Hudson River between approximate MPs 245 (near Kingston, New York) and 295 (north of Haverstraw Bay), which includes some brackish waters; however, larvae must remain upstream of the salt wedge because of their low salinity tolerance (Dovel and Berggren 1983, Kahnle *et al*. 1998, Bain *et al*. 2000). Catches of immature sturgeon (age 1 and older) suggest that juveniles use the estuary from Kingston to the Tappan Zee Bridge (MPs 245 to 310). Seasonal movements are apparent with juveniles occupying waters from MPs 270 to 295 during summer months and then moving downstream as water temperatures decline in the fall, primarily occupying waters in the vicinity of the proposed CHPE project from MPs 290 to 324 (Dovel and Berggren 1983, Bain *et al*. 2000). Based on river-bottom sediment maps (Coch 1986), most juvenile sturgeon habitats in the Hudson River have clay, sand, and silt substrates (Bain *et al*. 2000). Newburgh and Haverstraw Bays in the Hudson River are areas of known juvenile sturgeon concentrations. Sampling in spring and fall revealed that highest catches of juvenile Atlantic sturgeon occurred during the spring in soft-deep areas of Haverstraw Bay, even though this habitat type composed only 25% of the available habitat in the bay. Overall, 90% of the total 562 individual juvenile

Atlantic sturgeon captured during the course of this study came from Haverstraw Bay (Sweka *et al*. 2007). At around three years of age, Hudson River juveniles exceeding 28 inches in length begin to migrate to marine waters (Bain *et al*. 2000). It has also been reported that older juveniles and post-spawn adult sturgeon congregate in deepwater habitat during the summer in the Hudson River (Bain *et al*. 2000). Sonic-tagged spawning adults were detected in the river as early as April and as late as October (ASMFC 2008). After emigration from the natal estuary, sub-adults and adults travel within the marine environment, typically in waters less than 164 feet in depth, using coastal bays, sounds, and ocean waters.

Atlantic sturgeon adults are likely to migrate up the Hudson River in the spring as they move from oceanic overwintering sites to upstream spawning sites. They then migrate back downstream to lower reaches of the estuary or oceanic areas in the late spring and early summer. Atlantic sturgeon adults are most likely to occur in the action area from May through September. Tracking data from tagged juvenile Atlantic sturgeon indicates that during the spring and summer individuals are most likely to occur within rkm 60-170. During the winter months, juvenile Atlantic sturgeon are most likely to occur between rkm 19 and 74. This seasonal change in distribution may be associated with seasonal movements of the saltwedge and differential seasonal use of habitats.

The New York Bight distinct population segment (DPS) of Atlantic sturgeon is the only DPS of Atlantic sturgeon that spawns in the Hudson River and thus, the information provided above generally applies to this DPS. However, other DPSs of Atlantic sturgeon (*e.g.*, Gulf of Maine, Chesapeake Bay, Carolina, and South Atlantic) are known to be present within the Hudson River and nearby waters, and, based on recent tracking data from April 2014 (memo from J. Crocker, Section 7 Consultation Biologist to M. Colligan, Assistant Regional Administrator for Protected Resources, May 13, 2014), could occur as far up the Hudson River as the Troy Dam. As such, subadult and adult Atlantic sturgeon from any DPS may be present within all portions of the action area. However, like shortnose sturgeon, their occurrence in the Harlem River during the proposed construction windows is extremely unlikely due to a lack of documented captures and low habitat suitability.

**Effects of the Action**

Because shortnose and Atlantic sturgeon spawn, forage, and rest in benthic environments, activities that interact with the river bottom have the potential to impact them. In addition, any activities in the water column could affect these species. The construction, operation, and maintenance of the proposed cable has the potential to affect shortnose and Atlantic sturgeon directly through interactions with project equipment and vessels as well as exposure to elevated levels of underwater noise and turbidity, and indirectly through impacts to benthic habitat and water quality.

***Construction Impacts***

As described below, sediment disturbance, temporary increases in turbidity and associated water quality degradation, sediment redeposition, noise and vibration, vessel strikes, and accidental release of hazardous materials may have effects on shortnose and Atlantic sturgeon in the action area. The applicant has consulted with New York state resource agencies and NMFS to identify construction windows that avoid periods when sensitive species would use different areas of the

Hudson and Harlem Rivers. Table 1 above illustrates the life history stages of shortnose and Atlantic sturgeon that would be avoided based on the construction windows.

The construction window is from August 1 to October 15 (2015-2017) for the area between Catskill (MP 228) and Kingston Point (MP 245) and from September 14 through October 15 (2015-2017) for the area between Kingston Point (MP 245) and New Hamburg (MP 269). Shortnose sturgeon spawning is expected to be complete by the end of May and eggs and larvae are not expected to occur in these portions of the river by the end of June. Atlantic sturgeon are expected to spawn in the area between Kingston Point and New Hamburg from May through July. Atlantic sturgeon larvae are expected to be in that area (MP 245-269) through August. As such, spawning adults, eggs, and larvae of Atlantic sturgeon would be avoided by the proposed construction windows. The latter construction window would also avoid most of the time period when juvenile Atlantic sturgeon are expected to occur from Kingston through Peekskill from July through September.

The construction window is September 15 to November 30 (2015-2017) for the area from New Hamburg to Verplanck (MP 295). Shortnose sturgeon spawning is expected to be complete by May and eggs and larvae are expected to be absent by June. Atlantic sturgeon spawning is expected to be finished in this area by the end of July and sturgeon eggs and larvae are expected to be absent by the end of August. By the fall, juvenile shortnose sturgeon are expected to occupy Haverstraw Bay (Bain 1997), which is avoided by construction due to overland bypass of the transmission line. The transmission line avoids Haverstraw Bay, which is an important nursery area and overwintering area for shortnose and Atlantic sturgeon. The construction window is July 1 to October 31 for the area from Clarkstown (MP 303) to the Harlem River (MP 324). Adult shortnose and Atlantic sturgeon could transit through this area during this construction window, but would be much less susceptible to adverse impacts from the CHPE project than younger life stages.

Both shortnose and Atlantic sturgeon larvae and YOY must remain upstream of the salt wedge because of their low salinity tolerance. During the 2011 and 2012 Hudson River Estuary Monitoring Program, the salt front location during September through November was generally in the Tappan Zee to West Point reach, and no YOY sturgeon were captured downstream of MP 286 near West Point (ASA 2013, 2014); therefore jet plow encounters with YOY sturgeon south of approximately MP 286 would be extremely unlikely due to the position of the salt front during the transmission line construction window. As a result, effects on these life stages of shortnose and Atlantic sturgeon during the proposed construction windows in the Hudson River would be insignificant or discountable.

The applicant has proposed that the transmission line would enter the Hudson River in Catskill, New York, bypassing the Inbocht Bay and Duck Cove SCFWHs. The line would exit the Hudson River north of Haverstraw Bay, in Stony Point, New York, to avoid the high-value Haverstraw Bay SCFWH. These SCFWHs were included in “exclusion zones” of highly sensitive areas identified by NYSDEC and avoided by the proposed CHPE project transmission line. The route also avoids traversing 18 of the 22 SCFWHs in the Hudson River.

*Sturgeon Swimming Capabilities*. While avoiding most SCFWHs and restricting construction activities to the specific construction windows provided in Table 1 protects spawning adults, eggs, and larvae from April through August, installation activities could occur where juveniles are expected to occur. However, juveniles are expected to be able to avoid the jet plow due to their swimming capabilities and the available zone of passage in areas of the Hudson River beyond the width of the jet plow path.

Even though juvenile sturgeon might occur in the construction area during the construction window, the potential for an interaction with the jet plow is expected to be extremely unlikely as juvenile sturgeon are capable of swimming away from and avoiding the stressors of noise and turbidity without disrupting any essential life behaviors; thus, all effects would be discountable. Juvenile sturgeon are not expected to be entrained by the jet plow because the water intake would be located near the surface of the water column and attached to a construction barge or other vessel. As the early life stages for benthic and demersal fish, such as sturgeon, are generally near the river bottom, the risks of entrainment of these species is anticipated to be minimal. This is especially true for sturgeon as winter approaches, and they move toward and congregate in deepwater portions of the river during October and November (ASMFC 2012). Given the location of the intake near the water surface and the fact that egg and larval forms of sturgeon will have matured into mobile juvenile life stages that can avoid the jet plow by the middle of September, jet plow impingement or entrainment is not expected to occur.

Furthermore, juvenile sturgeon are expected to have the ability to avoid the jet plow. Installation of the transmission line via jet plow will proceed at a rate of 1-3 miles per day. At this pace, the jet plow will move at a rate of 0.06 to 0.2 feet/second. YOY sturgeon would need to be capable of swimming at speeds greater than 0.2 feet/second to avoid the jet plow. By September, juvenile shortnose and Atlantic sturgeon can range from 3.9 inches in length to as large as 11.7 inches. Based on Deslauriers and Kieffer (2012), sturgeon should be able to attain swimming speeds of 1.5 times their body length per second. As a result, a 3.9-inch sturgeon is capable of swimming approximately 0.5 feet/second, which is over two times faster than the 0.2 feet/second maximum speed of the jet plow.

Additional swimming speed analyses by Kynard *et al.* (2005), Hoover *et al.* (2011), and Entergy (2012) conclude that yearling sturgeon and older can escape intake velocities of 1.0 foot/second, which is more than 5.0 times the fastest expected jet plow speed. Even smaller white sturgeon juveniles (3.1 to 3.5 inches) exhibit the ability to swim at speeds in the range of 1.3 to 1.5 feet/second, as demonstrated in studies by Boysen and Hoover (2009) to assess the ability of small white sturgeon to avoid hydraulic dredge flow fields. Using more likely scenarios of larger sturgeon and slower jet plow speeds, it is clear that sturgeon are able to avoid jet plow installation in the September through November construction window.

*Benthic Surveys*. The applicant has agreed to a series of pre- and post-installation compliance monitoring studies in the aquatic portions of the transmission line route, including benthic and sediment monitoring, bathymetry and sediment temperature studies, and magnetic field surveys. The applicant has also proposed Atlantic sturgeon pre-installation and post-energizing hydrophone surveys in the Hudson River. In addition, transmission line installation and burial in the Hudson and Harlem Rivers would temporarily disturb or alter the sediment and bottom substrates. The bulk of the sediment disturbed would resettle in the trench created by the jet plow, and natural processes that control scour and deposition would be expected to re-establish the original bottom contours along the transmission line route. Post-installation bathymetric surveys would be used to monitor recovery of the bottom substrate. The energized transmission cables would also have the potential to impact magnetic fields in the vicinity of the cable and dissipate heat to the surrounding substrate. Monitoring would provide the measurement of the magnetic field and sediment temperature for comparison with modeling predictions and conditions prior to cable operation. Benthic recovery and recolonization of impacted areas along the installation route would be expected to begin to occur within months after construction activities have ceased.

Analyses of impacts on sturgeon for each phase or type of construction activity that could result in impacts: sediment disturbance, turbidity, contaminated sediments, concrete mats, noise, blasting, vessel strikes, and accidental spills, are presented below.

*Sediment Disturbance*
Debris removal would occur in the fall preceding installation activities the next year. During the initial phase of debris removal, the riverbed would be disturbed less than during installation activities. If plow pre-rip is also required and the jet plow is used, impacts would be similar to water jetting, with a similar or smaller impact corridor. Depending on the debris found, it is expected that the total riverbed area disturbed would be a maximum of 15 feet wide along the 94-mile portion of the transmission line corridor in the Hudson and Harlem Rivers, for a maximum total of 171 acres. Along most of the route, it is likely that little or no large debris would be found and the disturbance would be limited to the three-foot grapnel penetration, which would be much narrower than 15 feet. Assuming a disturbance width of five feet, this equates to 57 acres. This would all occur within the same area to be disturbed by actual transmission line installation within the following year.

Installation of the proposed aquatic transmission line would result in up to 569 acres of riverbed disturbance in the Hudson and Harlem Rivers, which is approximately 0.9% of the total surface area of the Hudson River (533 acres) and 10% of the total surface area of the Harlem River (36 acres). This represents the acreage within a 50-foot construction corridor along the transmission line route and includes trenching and the adjacent area where a substantial majority of sediment from the trench would settle. For the Hudson River segment, the depth of the transmission line trench would be approximately seven feet with one foot or less of horizontal separation between the two bipole cables, which would be collocated in the same trench. The transmission line would be buried eight feet in sediment in the Harlem River. The primary installation method in the Hudson River segment is proposed to be water jetting technology, which has been shown to minimize impacts on marine habitat and excessive dispersion of bottom sediments relative to dredging activities. The bottom area directly disturbed by water jetting or mechanical plowing varies, depending upon sediments and depth of installation, but would range from 12 to 16 feet in width. Water jetting for the proposed CHPE project is anticipated to create sediment plumes that would be short-lived and remain fairly close to their source (*i.e.*, within 500 feet of the trench).

Barge positioning, anchoring, anchor cable sweep, and the pontoons on the jet plow could result in additional sediment disturbance. Vessel positioning and anchorage during installation of the transmission line could be used in the event that bottom conditions are encountered that either stop forward progress at reasonable tow tension or result in excessive rolling or pitching of the jet plow. In such a case, the barge would be stopped, anchors deployed to hold the barge in position, and obstructions investigated and remedied. Anchors would also be employed during idle periods due to weather conditions. Open water anchorages are not envisioned as a common event. Areas where anchorage is also anticipated include construction of the four temporary water-to-land transition cofferdams, where cable is spliced, and possibly along the 460-foot length of bedrock trenching in the Harlem River (MP 324.5). The collective length of all work areas where anchors may be deployed and potentially result in impacts on benthic habitat is projected to be less than 1% of the approximately 197-mile aquatic portion of the installation route. Once stabilized following deployment, the anchors would have a total impact area of approximately 15 square feet per deployment. Spud anchors would be used during the installation of the cofferdam and cable landing at the water-to-land transition. Each barge would include two spud anchors with three-foot diameters. Anchors also require approximately 200 square feet (20 feet by 10 feet) to dig in and stabilize. For four anchors, that is a total of 800 square feet or 0.02 acres. Midline buoys would be used to prevent anchor chain sweeps that might otherwise affect benthic habitat. Therefore, the total benthic habitat area of the Hudson and Harlem Rivers affected by anchorage during cable installation would be extremely minor compared to the extent of the river areas involved. The minor effects would be also temporary (on the scale of a few hours), and thus would result in insignificant impacts to the benthos.

Riverbed disturbance would also include the redeposition of suspended sediment. The estimated thickness of the sediment as it settles back to the riverbed would not be expected to exceed 0.4 inches. The majority of the sediment redeposition would occur in the 569-acre area that would be disturbed by the jet plow. The effects of increased sedimentation on fish could include reduced water quality, reduced ability to locate food, decreased gas exchange, toxicity to aerobic species, reduced light intensity in the water column, physical abrasion, and smothering of benthic and demersal species present at the time of the activity (Wilber *et al*. 2006). Additionally, some fish species, such as shortnose and Atlantic sturgeon, deposit demersal eggs that remain on the bottom until larval hatching; some of these eggs, if present, could be smothered as well. Redeposition of sediments causes larval mortality by clogging gill tissues and through gill abrasion (Reine *et al*. 1998). For example, previous experiments have shown that a viable hatch of winter flounder eggs is reduced when the eggs are buried by as little as one half of one egg diameter, approximately 0.02 inches of sediment (USFWS 2002; Berry *et al*. 2003). However, in areas where deposition of suspended sediments could impact demersal fish eggs and larvae, the applicant will avoid construction during the early spring via the use of construction windows (see Table 1), which would avoid the potential impacts associated with sediments covering these eggs. As such, the impact of sediment redeposition on immobile stages of sturgeon eggs and larvae would be insignificant.

The impacts of sedimentation on benthic invertebrates could include smothering, toxicity from exposure to anaerobic sediments, reduction of filtering rates, toxicity from exposure to anaerobic sediments, reduced light intensity, and physical abrasion (Berry *et al*. 2003). Redeposition of sediments could also change the bottom composition of the riverbed if existing coarser grains lie on top of finer grains. The layering could be reversed after sediments are disturbed because finer grains take longer to settle out of the water column. Such a change would affect the species composition of the benthic community, and locally would be composed of those that could thrive in this sediment. Mobile species that prefer coarser sediment grains would likely relocate to areas with coarser grains. Sessile (immobile) species would likely die off locally if they could not adapt to the new sediment conditions (Germano and Cary 2005). However, this effect is expected to be localized and the affected area would be minimal relative to the total available foraging habitat. As a result, all effects to foraging sturgeon and their prey from sediment redeposition will be insignificant or discountable.

The proposed CHPE project would have temporary localized effects on the following SCFWHs in the Hudson and Harlem Rivers: Esopus Estuary (MPs 234 to 235), Kingston-Poughkeepsie Deepwater Habitat (MPs 245 to 267 and MPs 268 to 270), Hudson Highlands (MPs 276 to 295), and Lower Hudson Reach (MPs 317 to MP 325). The Kingston-Poughkeepsie Deepwater Habitat SCFWH provides wintering habitat for shortnose and Atlantic sturgeon. Both shortnose and Atlantic sturgeon are found in the Esopus Estuary SCFWH in the waters north and south of the Esopus Creek mouth. Construction and the temporary impacts would occur from August 1 through October 15, but the construction activities would ultimately avoid impacts on sturgeon at the Kingston-Poughkeepsie Deepwater Habitat and Esopus Estuary SCFWHs due to the timing of construction activities in those areas. The adjacent deepwater area of the Hudson River serves as post-spawning and wintering habitat for shortnose sturgeon. The deep areas of the Hudson Highlands SCFWH are used as migratory routes by shortnose and Atlantic sturgeon and are important nursery areas and summering areas for juvenile Atlantic sturgeon and summering areas for post-spawn adults. Construction and the temporary impacts would occur from September 15 through November 30, but impacts would be avoided on susceptible life stages of sturgeon at this SCFWH due to the time of year restriction in place. Transmission line installation activities would avoid the Haverstraw Bay SCFWH, which is a major nursery and overwintering area for Atlantic sturgeon. Shortnose sturgeon also overwinter in the Haverstraw Bay SCFWH. In recognizing the importance of Haverstraw Bay and its SCFWH as important habitat for fish nurseries (including for shortnose and Atlantic sturgeon), the applicant has included in its project plans an approximately eight-mile overland bypass of Haverstraw Bay through the Town of Stony Point, Town and Village of Haverstraw, and the Town of Clarkstown.

*Impacts on Sturgeon Spawning Habitat.* Sediment disturbances from jet plowing, anchoring, cofferdam construction, dredging, and sediment redeposition, as described above, would primarily disturb soft benthic sediments including silts, clays, and sands. There could be some areas with mixed sand and gravel or silt and clay with cobbles, or shell hash mixed with silt and clay, although these areas are not expected to be common and the project is designed to avoid these areas to facilitate jet plowing. During the marine survey conducted by the applicant in 2010, only two sediment cores in the Hudson River contained cobble or gravel in surficial sediments, located at approximate MP 234 in shortnose sturgeon spawning habitat. Because cobble and gravel are not common within the transmission line route and rock outcroppings would be avoided wherever possible, the effects on sturgeon spawning habitat are expected to be negligible. This is because sturgeon spawning in the Hudson River occurs exclusively over cobble and gravel habitats. Pre-installation hydrographic surveys conducted prior to debris removal would provide additional information on the sediments being disturbed. Upon completion of in-water activities in a given area, estuarine depositional processes would, over time, return the benthic habitat to its pre-construction condition. The temporary disturbance of an area would represent a minor fraction of similar adjacent habitat in the Hudson River, and for these reasons, impacts on sturgeon spawning habitat from sediment disturbance are expected to be insignificant.

*Impacts on Sturgeon Prey*. Sediment disturbances from jet plowing, anchoring, cofferdam construction, dredging, and sediment redeposition would result in a short-term loss of benthic organisms and shellfish that serve as forage for shortnose and Atlantic sturgeon. These impacts result from crushing, killing, or displacing benthic organisms. The temporary sediment disturbance in benthic habitat which supports benthic prey items for shortnose and Atlantic sturgeon would remain usable as potential shortnose and Atlantic sturgeon foraging habitat. Temporary and localized reductions in available benthic food sources are anticipated, since some mortality of benthic infaunal organisms that serve as prey for shortnose and Atlantic sturgeon would occur. The majority of these impacts would occur within the 50-foot project corridor as a result of jet plowing. Mortality of invertebrates is expected to be greatest within the two-foot wide trench, but could also occur to either side of the trench, particularly near the trench where greater concentrations of sediment are expected to settle. The temporary disturbance of an area would represent a minor fraction of similar adjacent habitat in the Hudson River. Only a small portion (0.9% of the Hudson River and 10% of the Harlem River in the vicinity of the proposed CHPE project) of sturgeon feeding habitat would be affected by sediment disturbance associated with the transmission line.

Benthic communities in the Hudson River are already adapted to human disturbances and other impacts such as degraded water quality, dredging, shoreline hardening, and invasive species. Upon completion of in-water activities in a given area, estuarine depositional processes would, over time, return the benthic habitat to its pre-construction condition. Functional communities would be expected to recolonize these areas over time. Complete recovery times for the benthic communities vary from several months to several years depending on the community composition and severity and frequency of disturbance (Newell *et al*. 2004, Carter *et al*. 2008). Recovery rates of benthic macroinvertebrate communities following dredging range from a few weeks or months to a few years, depending upon the type of bottom material, the physical characteristics of the environment, and the timing of disturbance (Hirsch *et al*. 1978, LaSalle *et al*. 1991). In a two-year study in the lower Hudson River, Bain *et al*. (2007) reported that within a few months following dredging, the fish and benthic communities at a dredged location were no different from seven nearby sites that had not been dredged, and that there were no indications of a lasting effect at the dredged site.

Because the habitat disturbance would affect a relatively small amount of the river, and because of the temporary nature of the disturbance, installation of the transmission line is expected to result in negligible reductions in benthic shellfish and infaunal organisms that serve as prey for shortnose and Atlantic sturgeon. As such, impacts on benthic resources which serve as sturgeon prey from sediment disturbance are expected to be insignificant.

*Turbidity*

Impacts from debris removal and transmission line installation in the Hudson and Harlem Rivers, including anchor impacts, would include localized increases in turbidity, associated water quality degradation, and downstream sediment resuspension during cable installation. However, these rivers already typically experiences periods of naturally occurring increases in suspended sediments from storm events. During jet plowing, approximately 70%-80% of the disturbed sediment would be expected to remain within the limits of the trench under limited water movement conditions (depending on particle size), with 20%-30% of suspended sediment traveling outside the footprint of the area directly impacted by the cable plow (HTP 2008). Smaller sediment particles would remain suspended longer, and thus be transported farther from the original site of deposition. The extent of the turbidity plume generated would depend on the amount of sediment disturbed, the grain size, and the mass of the disturbed sediment particles, along with construction methods and ambient riverine conditions. Sediment concentrations in the plume can be initially high, and rapidly decrease with distance.

Water quality modeling by the project proponent has indicated that, on average, the initial sediment plume would be approximately one mile long and 500 feet wide (an area of about 60 acres). The maximum suspended sediment concentrations would range from 80 to 200 mg/L above background (depending on sediment properties) in the water column immediately above the sediment bed where the jet plow would be operating. The plume concentrations would be highest near the river bottom. At the surface, concentrations would be approximately one-tenth of the bottom values. The discernible plume width at the bottom would be approximately 500 feet wide. Because maximum concentrations are expected to be 200 mg/L, installation is not expected to exceed 200 mg/L above background at the edge of the 500-foot mixing zone, as required by the Clean Water Act Section 401 Water Quality Certification issued for the proposed CHPE project. At approximately 4,500 feet downstream, which is near the edge of the discernible plume, the maximum concentration would be 10 mg/L above background condition and by approximately one mile downstream the concentrations would be back to background.

TSS levels would be approximately 15 mg/L or less at nine hours following installation, based on the assumption of 24-hour-per-day installation operations. However, if installation activities cease for longer than two hours, the plume would dissipate before operations would be restarted. Plumes would be continually affected by tidal action and over the course of a tidal cycle, they would reverse direction.

Reduced jetting speeds (*e.g.*, less than four knots) would be used to reduce turbidity when crossing sensitive areas such as SCFWHs. The most appropriate speeds would be coordinated with the construction contractor. The construction contractor would consider existing sediment conditions, cable weight, and multiple other factors to arrive at an installation speed that allows for a reduction in impacts and safe and efficient cable installation. Reductions in TSS would be calculated after the installation specifications have been set as part of the construction design. Furthermore, the transmission line is routed on land to avoid the Haverstraw Bay SCFWH, which provides valuable habitat nursery and overwintering habitat for shortnose and Atlantic sturgeon. The applicant has proposed that commencement of in-river work immediately outside the Haverstraw Bay SCFWH would occur during the high, or flood, tide condition to avoid or minimize impacts of resuspended sediments in Haverstraw Bay, which contains important habitat for ESA-listed fish species.

Transmission line installation would avoid 18 of 22 SCFWHs in the Hudson and Harlem Rivers in the proposed CHPE project area. As described, the maximum concentrations of TSS as a result of jet plowing are expected to reach 200 mg/L and the discernible turbidity plume is expected to have temporary and localized impacts on water quality. The effects would be further minimized within the SCFWHs because the applicant is proposing measures to reduce turbidity in SCFWHs by reducing jetting speed and jetting pressure. Additionally, turbidity plumes are not expected to extend over long distances and are not expected to result in any type of barriers to fish movement in any area of the river and more specifically in SCFWHs because of these measures. Cable installation could temporarily disturb the substrate within the Hudson River; however, this disturbance is expected to occur over a short time period in any one location given the speed at which water jetting occurs and would be localized to the immediate area of the water jetting device or conventional dredge trenching operations. With the exception of areas that would require installation of concrete mats or rip-rap to cover portions of the transmission line that cannot be buried (*e.g.*, on bedrock or when crossing over existing utility lines), no losses of habitat or permanent impacts are expected from cable installation.

Turbidity associated with anchors and the installation of sheet piles is expected to be similar. Turbidity levels during these activities would be expected to be less than 50 mg/L above background, diminishing to 5-10 mg/L above background within a few hundred feet.

An environmental bucket, a variation of the conventional clamshell dredge bucket that has been developed to limit spillage and leakage of dredged material, would be used for the dredging associated with the cofferdams. The enclosed dredge bucket features covers designed to prevent material from spilling out of the bucket while it is raised through the water column. The design also employs rubber gaskets or tongue-in-groove joints that reduce leakage through the bottom of the closed bucket. Environmental buckets were used for the two dredges used for 91 days of dredging associated with the Tappan Zee Bridge construction in 2013. None of the TSS samples at the 500-foot mixing zone were more than 200 mg/L over background conditions and more than 90% of the TSS samples were less than 100 mg/L over background (TZC 2014). There were also no observations of turbidity resulting in substantial visible contrasts from ambient conditions to the Hudson River outside of the 500-foot mixing zone from dredging. However, sediment properties are site-specific variables that cannot be controlled. In general, fine-grained, less-cohesive sediments have the greatest potential for resuspension and would travel farther before resettling to the bottom. The goal would be to eliminate or minimize to the greatest extent practical sediment resuspension during clamshell dredging. The applicant proposes to achieve this goal by limiting the amount of dredging to only three small cofferdam locations, dredging only inside the cofferdam, positioning the receiving barge as close to the dredging site as possible to minimize dripping into open water, and using well-trained and experienced dredge operators as smooth and controlled hoisting can limit resuspension during clamshell dredging.

The applicant has developed and would implement a Water Quality Monitoring Plan for the installation of the proposed CHPE project transmission line. If TSS concentrations exceed 200 mg/L beyond the 500-foot mixing zone, the applicant would employ one or more of the following measures: changing the rate of advancement of the jet plow, modifying hydraulic pressures, or implementing other reasonable operational controls to reduce suspended sediments.

*Impacts on Sturgeon.* As described, the sediment plume is expected to be relatively localized given the depth and width of the Hudson River (*i.e.*, it is not expected to consume the entire river). While the plume would be 500 feet wide (defined at the edges by TSS concentrations of 15 mg/L above background), maximum concentrations would range from 80 to 200 mg/L above background only in the water column immediately above the sediment bed where the jet plow would be operating. Based on the localized and temporary nature of any sediment suspension (*i.e.*, the plume would persist for nine hours, given 24-hour per day installation operations), no hindrance of sturgeon movements is expected during underwater cable installation. Turbidity associated with anchors, installation of sheet pile, and dredging, is expected to be less.

The sensitivity of fish to suspended sediment is species- and life-stage-specific, and depends on abiotic factors of the sediment, sediment concentration, and duration of exposure. Common impacts on fishes can be classified as biological/physiological or behavioral. Biological/ physiological impacts include abrasion of gill membranes resulting in a reduction in the ability to absorb oxygen, decrease in dissolved oxygen concentrations in the surrounding waters, and effects on growth rate. Behavioral responses by fishes to increased suspended sediment concentrations include impairment of feeding, impaired ability to locate predators, and reduced breeding activity. Fish larvae are more sensitive to suspended sediments than eggs, juveniles, or adult fish (Berry *et al*. 2003). Adult and juvenile fish might leave the area to avoid an increase in turbidity. Fish, however, are mobile and generally avoid unsuitable conditions in water, such as large increases in suspended sediment and noise (Clarke and Wilber 2000). Juvenile and adult shortnose and Atlantic sturgeon are highly mobile and would be able to move into adjacent areas away from construction-related activities (as described under *Sturgeon Swimming Capabilities*).

Shortnose and Atlantic sturgeon are found in turbid waters (Dadswell *et al*. 1984) and feed on benthic invertebrates and are, therefore, tolerant of suspended sediment at the levels that are temporarily generated by marine construction activities. Concentrations of total suspended sediments that would be expected to show adverse impacts on fish would be 580.0 mg/L for the most sensitive species, with 1,000 mg/L being more typical (EPA 1986; Burton 1993). Given that water jetting and other activities associated with installation of the CHPE transmission line would result in suspended sediment levels of less than 200 mg/L, impacts on sturgeon are expected to be insignificant and discountable.

Furthermore, increases in turbidity associated with jet plowing, cofferdam installation, and anchoring would be temporary and would occur outside of spawning season. As such, temporary increases in turbidity are expected to have no effect on sturgeon spawning habitat. Temporary increases in turbidity could occur when juvenile sturgeon occur in the Hudson River from Kingston to Peekskill. As described, juvenile sturgeon are expected to be able to outswim the jet plowing operations. Any effects of behavior modification and habitat avoidance would be insignificant because increased turbidity would be very temporary and because there would be a substantial amount of other, non-affected habitat that could be used by these highly mobile species.

*Impacts on Sturgeon Prey.* Increased turbidity could reduce light levels in aquatic habitats and temporarily impact water pH and reduced dissolved oxygen levels. The aquatic habitats directly affected by cable installation would primarily be confined to the footprint of the jet and shear plows. Reductions in benthic infaunal organisms that serve as prey for shortnose and Atlantic sturgeon would occur associated with the turbidity plume. However, the greatest effects on benthic organisms would be from the direct effects of sediment disturbance associated with jet plowing. The impacts associated with the turbidity plume would be temporary (occurring for up to approximately nine hours at a given point while the jet plow is in operation). The maximum turbidity concentrations would be limited to the 50-foot wide active construction corridor where sediment disturbance would be greatest and the area immediately around and approximately 500 feet downstream of the active transmission line installation work zone (where the applicant is required to monitor TSS levels), depending on currents and tides. The NYSPSC Certificate for the proposed CHPE project requires that a water quality monitoring plan be carried out as part of pre-installation trials of the jet plows, and that suspended sediment levels be monitored during transmission line installation to ensure that the 200 mg/L suspended sediment guideline is not exceeded within 500 feet of the installation operation. Because benthic organisms are adapted to the dynamic physical oceanography and turbid conditions of the Hudson River and because the persistence of the turbidity plume would be temporary, impacts on sturgeon and their prey associated with turbidity would be negligible.

*Contaminated Sediments*

Contaminants that occur in the sediments could be mobilized and become bioavailable as a result of sediment disturbance during both route clearing and installation of the transmission line. If contaminated sediments became bioavailable or biotransferred within food chains, impacts might occur, such as behavioral alterations, deformities, reduced growth, reduced fecundity, reduced egg viability, and reduced survival of larval fish (Sindermann 1994). Several characteristics of shortnose and Atlantic sturgeon (*e.g.*, long lifespan, extended residence in estuarine habitats, benthic predation) predispose the species to long-term and repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell *et al*. 1984). However, as discussed below, water quality modeling predicted that no exceedances of Section 401 certificate water quality standards would occur. Water quality sampling and monitoring would be conducted during jet plow and shear plow pre-installation trials and during cable installation. Contaminants modeled in the upper Hudson River were arsenic, cadmium, mercury, benz(a)anthracene, pyrene, 4,4-DDE, copper, lead, phenanthrene, and PCBs. Contaminants modeled in the lower Hudson River were 4,4-DDE, copper, lead, phenanthrene, PCB, naphthalene, fluorine, nickel, dioxin, and acenaphthene.

Water quality modeling by the project proponents for the proposed transmission cable installation indicates that concentrations of PCBs would not exceed the water quality standards required by the Section 401 Water Quality Certificate of 0.09 micrograms per liter (μg/L) from MP 228.5 to MP 272.3 and 0.2 μg/L per aroclor from MP 272.3 to MP 330. Water quality modeling also indicates that the chronic exposure standards for PCBs (0.5 μg/L) established by the U.S. Environmental Protection Agency (USEPA) and New York State would not be exceeded. These standards have been established to account for long-term, chronic exposures of aquatic life to PCBs. Since the proposed CHPE project involves short-term construction activities, the more relevant guideline for assessing PCB concentrations would be the Engineering Performance Standard set by the USEPA for dredging resuspension at the Hudson River PCBs Superfund Site. Following these guidelines, it is expected that PCB concentration increases from resuspension of sediments would be well below the performance standard. No other state water quality standards would be exceeded as a result of transmission line installation activities.

Impacts from the resuspension of contaminated sediments on sturgeon and sturgeon prey are expected to be insignificant. The Section 401 Water Quality Certification water quality standards are not expected to be exceeded. Water quality sampling and monitoring would be conducted during jet plow pre-installation trials and during cable installation. If water quality certificate standards are exceeded, additional water quality sampling would take place at the location of the exceedance.

*Use of Concrete Mats to Cover the Transmission Line*
Installation of transmission lines via jet plowing might not be feasible in areas of exposed bedrock and over existing submerged lines in the Hudson River segment. In such areas, concrete mats or rip-rap would be installed to help protect the transmission line. Concrete mat coverage would be small relative to the total available habitat for ESA-listed fish species in the Hudson and Harlem Rivers. Approximately 1.8 miles and 1.7 acres of concrete mats would be installed in the 88-mile aquatic portion of the project route in the Hudson River. Approximately 0.6 miles and 0.6 acres of concrete mats would be installed in the six-mile aquatic portion in the Harlem River. This represents approximately 2.5% of the entire aquatic portion of the transmission line route in the Hudson and Harlem Rivers and approximately 0.4% of the total area of disturbance for the aquatic portion of the transmission line in the Hudson and Harlem Rivers. Of the total to be installed in the Hudson River, approximately 1.0 mile and 1.0 acre of concrete mats would be installed as protective covering for the transmission line in SCFWHs, or less than 0.01% of the total acreage of the affected SCFWHs. SCFWHs that would be affected are the Kingston-Poughkeepsie Deepwater, Hudson Highlands, and Lower Hudson Reach SCFWHs. Because the area of concrete mat coverage would be small relative to the total available habitat for ESA-listed fish species in the Hudson and Harlem Rivers, impacts are expected to be insignificant.

The majority of the concrete mats would be associated with existing infrastructure areas. As stated, the majority of the survey corridor is composed of soft benthic sediments, including silts, clays, and sands. There could be some areas with mixed sand and gravel or silt and clay with cobbles, or shell hash mixed with silt and clay, although these areas are not expected to be common. Only one sediment core contained cobble gravel in surficial sediments; this was located at approximate MP 234 in shortnose sturgeon spawning habitat. Because cobble and gravel are not common within the transmission line route, and sturgeon spawn exclusively over cobble and gravel habitats, the effects on sturgeon spawning habitat from the placement of concrete mats are expected to be discountable. Pre-installation hydrographic surveys would be conducted prior to debris removal and would provide additional information on the sediments being disturbed.

Other areas not suitable for cable burial are generally associated with rock outcroppings. The applicant is committed to burying the cable where possible, as burial provides the greatest protection against interactions with vessels (*e.g.*, anchor drops or snags). Rock outcroppings would be avoided wherever possible. In the case of the Harlem River, designated cable and pipeline areas extend over substantial areas or occur frequently along the length of the river, so that the placement of protection over the exposed transmission line can be continuous over several adjacent infrastructure elements. The design plan would optimize the placement of protection to minimize the area of the bottom covered by concrete mats.

Placement of concrete mats would bury the benthic community, including potential prey for Atlantic and shortnose sturgeon. Although individuals among the existing benthic communities might be impacted, installation of the concrete mats would not preclude the survival of benthic infaunal species and shellfish. Shortnose and Atlantic sturgeon would be able to use adjacent areas for foraging and other activities. Installation of these materials could cause a permanent change in benthic habitat from soft sediments to the hard substrate of the concrete mats within the footprint of the concrete mats. The concrete mats would extend up to nine inches above the river bottom. Concrete mats provide hard substrate habitat, and gaps in the mats provide velocity refuge and cover for aquatic invertebrates and small fishes (Fischenich 2003), possibly including benthic prey for shortnose and Atlantic sturgeon. Where concrete mats would be installed, habitat could be permanently altered, but the area requiring concrete mats is very small relative to the available habitat for shortnose and Atlantic sturgeon. When the concrete mats are placed in areas of fine sediment, the spaces between the individual concrete elements would be filled by suspended sediment and the surficial habitat would be partially restored. It is likely that some sediment would accumulate on the concrete mats, resulting in some benthic habitat re-colonization. New and functional communities would be expected to recolonize these areas over time. Recovery times for the benthic communities vary from several months to several years depending on the community composition and severity and frequency of disturbance (Newell *et al*. 2004, Carter *et al*. 2008). Post-installation monitoring efforts for the Long Island Replacement Cable in 2010 suggested that concrete mats were not a major disturbance to benthic communities after two years (ESS Group 2011).

In addition, the concrete mats would be used on top of bedrock or areas disturbed by previous utility line placement activities and the presence of existing habitat could already be low. For this reason and that the extent of the route where concrete mats would be installed represents only 2.5% of the entire aquatic transmission line route, the changes resulting from their use are not expected to be significant. The mats could change the river bottom topography over limited areas and alter local hydraulic conditions so that some sediment deposition or scouring could occur around the mats or rip-rap. However, the overall change in bottom topography would be insignificant because the concrete mats would extend only a short height above the river bottom and functional benthic habitat is expected to develop on top.

Recolonization and community composition is dependent upon numerous factors such as the stability of disturbed areas, the tolerance of organisms to physical changes, and the availability of recruits. Recovery times for the benthic communities vary from several months to several years depending on the community composition and severity and frequency of disturbance (Newell *et al*. 2004, Carter *et al*. 2008). Further, because impacts from installation of concrete mats are expected to be small and localized, and the materials to be used (concrete blocks and cables or synthetic ropes) would not promote the introduction of invasive species any more than other species, significant changes to the benthic community's species composition would not be expected. The communities recolonizing the new hard bottom created by the mats are expected to be similar to pre-construction conditions. Results of monitoring in 2010 of the Long Island Replacement Cable (completed in fall 2008) suggested that concrete mats were not a major disturbance to benthic communities. That monitoring revealed that benthic macroinvertebrate assemblages did not differ significantly in overall abundance, species richness, or community composition between the control and impacted sites. Furthermore, no major seasonal differences in the macroinvertebrate communities were observed. This report did not indicate any observations of invasive species, with the exception of a naturalized macroalgae that was observed in control and impacted sites. No major seasonal differences in the macroinvertebrate communities were observed (ESS Group 2011). The placement of the concrete mats would be very limited and generally sporadic in the Hudson River, and, therefore, would have an insignificant impact sturgeon foraging and migration. It is important to note that even in areas where such protective covering may extend some distance, the width of the covering would only extend over a small ROW in the vicinity of the proposed aquatic transmission cable, leaving ample undisturbed foraging habitat available on either side. Because habitat is expected to recover, no impacts on overwintering habitat are expected. Furthermore, the Haverstraw Bay is being avoided, which is important overwintering habitat for both shortnose and Atlantic sturgeon.

The use of concrete mats would be expected to have insignificant impacts on sturgeon spawning substrate, foraging habitat, or overwintering area because of the very small area to be affected and the only minor long-term changes expected to occur. A pre- and post-energizing benthic monitoring program would be developed in accordance with the NYSPSC Certificate for the proposed CHPE project to evaluate impacts of construction on benthic communities.

*Underwater Noise*

Continuous noise associated with vessels and machinery would result from the installation of the transmission line under all proposed installation methods and the vibratory installation of the sheet piles that compose the cofferdams. Noise could also result from cavitations (*i.e.*, the sudden formation and collapse of low-pressure bubbles in the water from rotation of the vessel propeller) during vessel starts and stops. As with other cable installation projects (Merck and Wasserthal 2009), the primary source of underwater noise during cable installation activities is expected to be the cable-laying vessel. Research indicates that the underwater noise temporarily generated by the construction vessels used for cable laying would be similar to that of other ships and boats (*e.g.*, pleasure boats, fishing vessels, tug boats, and ferries) already operating in the action area (JASCO 2006, Popper and Hastings 2009).

Few measured data on hearing in sturgeon species are available; however, initial studies measuring responses of the ear using physiological methods suggest that sturgeon species might be able to detect sounds from below 100 Hertz (Hz) to as much as 1,000 Hz (Popper 2005). The following are NMFS criteria for physiological impacts on fish:

- Peak sound pressure level (SPL): 206 decibels relative to 1 micropascal (dB re 1 μPa, the measurement unit for underwater noise in decibels).
- Cumulative sound exposure level (cSEL) for fish above 0.07 ounces (2 grams): 187 decibels relative to 1 micropascal-squared second (dB re 1μPa2-s).
- cSEL for fish below 0.07 ounces (2 grams): 183 dB re 1μPa2-s.

NMFS uses a root mean square (rms) SPL of 150 dB re 1 μPa 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 would always result in behavioral modifications or that any behavioral modifications would 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.

For the Vancouver Island Transmission Reinforcement Project in British Columbia, underwater noise generated by dynamic positioning cable-laying vessels, with an assumed source level of 177 dB re 1 μPa while thrusters were in use, was similar to that of other ships and boats (*e.g.*, container ships, tug boats, fishing vessels, and recreational boats) already operating in the area (JASCO 2006). The report does not note the ship propulsion system that was monitored or the horsepower of the ship engines, but we expect similar noise levels for the vessels to be used in this project. Due to the acoustic source levels there would be no potential for the construction vessels to exceed either the peak SPL of 206 dB re 1 μPa or the cSEL or 187 dB re 1 μPa2-s or 187 dB re 1 μPa2-s. Therefore, physiological impacts or injury to sturgeon are not expected to occur from the cable-laying barge and all effects will be discountable.

Behavioral responses could range from a temporary startle to avoidance of an area affected by noise from a project. Noise modeling of a dynamic positioning cable-laying vessel similar to the one to be used in the proposed CHPE projct assumed a source level of 177 dB re 1 μPa while thrusters were in use. Modeling done by JASCO (2006) indicates that 95% of the noise louder than 130 dB re 1 μPa would occur within 1,250 feet of the vessel. This is an average, based on a range from 853 to 1,640 feet. Per back calculations done by the project proponents, the distance to the 150 dB rms SPL isopleth indicates a radial distance of 100 feet from the cable-laying ship during dynamic positioning. LGL and JASCO (2005) modeled broadband source levels for a dynamically positioned vessel. The source level was 188 dB re 1 μPa at 3.3 feet during dynamic positioning (using two bow thrusters and two stern thrusters). Based on a worst-case scenario distance to the 120 dB re1 μPa rms isopleth of 3.7 miles (at the worst case, sounds of 120 dB re1 μPa rms or higher would extend a maximum distance of 3.7 miles from the dynamically positioned cable laying vessel, similar to the one to be used during this project), the back calculated distance to the 150 dB re 1 μPa isopleth is approximately 450 feet, which is the estimated extent of underwater noise expected from the project as indicated in the description of the action area. This is considered the worst-case noise scenario for all sources of noise associated with cable installation.

Noise from the work boat and from vibratory sheet pile installation would have a smaller distance where behavioral effect can occur. The width of the Hudson River at Magazine Point near West Point is approximately 1,300 feet. This is one of the narrowest areas along the transmission line route that a sturgeon would transit. Based on a worst-case scenario zone of behavioral effects of 450 feet on either side of the transmission line, sturgeon would still have zones of passage approximately 200 feet wide on either side of the transmission line to transit. However, these narrow points only occur in several locations. The average width of the lower Hudson River is approximately 4,900 feet and the average zone of passage would be more than 2,000 feet on either side of the transmission line. Installation of the line would not be scheduled during sturgeon spawning migration and would avoid behavioral effects on spawning adults and larvae. Additionally, cable installation would progress at a rate of 1-3 miles per day. Therefore, it is not expected to create any barriers to movement (*i.e.*, extensions of noise isopleths across the entire width of the river that would disrupt essential life behaviors such as migration and foraging) at narrow parts of the river for prolonged periods of time. It is assumed that dynamic positioning would be used most of the time during transmission line installation; however, as noted, impacts would be localized (*i.e.*, very close to the vessel).

In the final BA, noise propagation was also modeled for a single workboat, such as a Yamaha FC-26 with a source level of a 157 dB re 1 μPa at 3.3 feet. The 95% range from a single workboat to the 110 dB noise level contour was less than 360 feet. Based on this information, back calculating the distance to the 150 dB rms SPL isopleth indicates a radial distance of approximately seven feet from the workboat. Therefore, the area where behavioral effects associated with the workboat is a much smaller area than the area for a cable-laying ship.

As described in *Sturgeon Swimming Capabilities*, sturgeon have the ability to leave the area when underwater activities that create noise and sound pressure are occurring and returning when activities cease, thereby further reducing effects. Currently, there are no clear indications that noise impacts related to the installation of transmission cables pose a high risk for harming aquatic fauna (Merck and Wasserthal 2009). Because the anticipated noise levels associated with cable laying are relatively minimal, and because the Hudson River is normally subject to substantial commercial and recreational vessel noise, any incremental increases in sound associated with the cable-laying barge would not cause physical injury from noise and any effects on sturgeon will be insignificant (Popper and Hastings 2009). Fish in the action area experience an acoustic environment that is generally highly energetic under “normal” conditions. The ambient sound levels in the lower estuary are produced by the high volume of existing commercial shipping traffic within the tidal Hudson River and New York Harbor, and these do not appear to affect the behavior or migration of sturgeon that bypass this active region each year. As the Hudson River is subject to substantial commercial and recreational vessel noise under these conditions, any incremental sound associated with vessel traffic related to the cable installation is not expected to affect sturgeon. Additionally, the construction windows have been developed to avoid impacts on sensitive life stages of sturgeon.

Noise from cofferdam installation and rock drilling would not result in injury to fish and would likely only trigger a behavioral response. Sheet pile cofferdams would be installed with a vibratory hammer. The project proponents indicate that a pair of sheets would take 30-120 minutes for installation. Vibratory installation noise levels have been measured at 170 to 185 dB re 1 μPa peak SPL at 33 feet, which is well below the threshold expected to cause injury to fish. The maximum 90% rms SPL ranged from 158 to 169 dB re 1 μPa at 33 feet and dropped to 106 to 130 dB re 1 μPa at 2,500 feet. The footprint of an area where noise greater than 150 dB re 1 μPa rms SPL is experienced is within 33 feet of the sheet pile being installed and it is extremely unlikely that the behavior of any individual sturgeon would be affected by noise associated with the installation of sheet piles with a vibratory hammer. Even if a sturgeon was within 33 feet of the pile being installed, the behavioral response would, at most, be limited to movement outside the area where noise greater than 150 dB re 1 μPa rms SPL would be experienced (*i.e.*, moving to an area at least 33 feet from the pile). Cofferdam construction would be limited to the three HDD water-to-land transition locations in the Hudson River at Catskill, Stony Point, and Clarkstown. The narrowest location is at Catskill, where the Hudson River is 3,450 feet wide. If it is assumed that the area where behavioral effects occur is 33 feet from the sheet pile installation, the smallest zone of passage during sheet pile installation would be approximately 3,400 feet.

Rock drilling, such as that required for blasting, has been measured at 165 dB re 1 μPa peak SPL and 151 dB re 1 μPa rms SPL at 231 feet (Martin *et al*. 2012). Therefore, behavioral effects are expected to be localized. Measures to startle fish or keep fish away immediately prior to blasting activities, such as use of sparkler guns or bubble curtains, would be used as conditions dictate. Additionally, rock drilling would only occur in the Harlem River, where the presence of all life stages of sturgeon is expected to be rare.

Underwater construction is being scheduled to avoid impacts on spawning migrations, spawning activity, and larval stages of shortnose and Atlantic sturgeon. Noise impacts associated with transmission line installation would be either temporary or intermittent and localized, and would not cause a measurable or detectable change in fish behavior. Thus, they would have an insignificant effect on these species. After installation activities have been completed, any displaced shortnose and Atlantic sturgeon would likely return to the area. The applicant's proposed construction windows (Table 1) would avoid noise impacts from proposed construction activities to Atlantic sturgeon and shortnose sturgeon during their spawning migration.

Equipment proposed to be used for the bathymetric pre- and post-installation surveys includes a high-resolution side-scan sonar system with a dual frequency (100 and 500 kiloHertz) towfish. These frequencies are much higher than the range that sturgeon can detect. Vessel noise could result in avoidance of the immediate survey area, but this would be a temporary and short-term effect for only the immediate area between the research vessel and the river bottom. If any behavioral effects occur, they would be short-term, localized changes in swimming direction that would not produce a measurable or detectable change in behavior, and thus all effects would be insignificant.

*Blasting*
Fish injury and mortality associated with underwater blasting is related to pressure, energy flux density, and impulse (large, rapid pressure variations) (Keevin and Hempen 1997). Energy flux density is the rate of transfer of energy through a surface and determines the intensity of the shock wave (rate of energy transfer per unit area). The most common injury is swim bladder damage, although other organs, such as gills, kidney, liver, and spleen, can also be damaged. In fish with less well-developed swim bladders, neither the kidneys nor air bladder are injured, indicating that the presence of a swim bladder plays an important role in to injuries to other organs. The thickness, location, and physiological connections of the swim bladder also play a role in the occurrence of injuries. Fish with swim bladders connected to the circulatory system appear to be more susceptible to injuries than fish with swim bladders connected to the esophagus. External injuries related to blasting appear to be species-specific and related to the magnitude of the pressure wave. The presence of the swim bladder might also be related to external injuries. Factors such as size, age, general health, water temperature, and reproductive condition may influence fish mortality related to blasting. Underwater explosions can also result in structural abnormalities and mortality of fish eggs. In general, mortality decreases with distance away from the explosion (Keevin and Hempen 1997).

The only area where blasting is proposed to occur is in the Harlem River. As no spawning occurs in this area and eggs, larvae, and YOY are unable to tolerate the higher salinity in these waters, there will be no effects to those life stages. As for sturgeon adults, these life stages are not likely to occur in the Harlem River due to their rare and transient nature. Therefore, any effects from blasting on ESA-listed species would be extremely unlikely and discountable.

*Vessel Strikes*

The Hudson River cable installation vessel would consist of one dynamic positioning 100- by 300-foot cable-laying deck barge with a 12-foot draft. The barge would be outfitted with a 3,500 horsepower, Class II dynamic positioning system and three static cable holding tanks – one static tank for fiber and two additional static tanks each capable of holding 34 miles of HVDC cable and various equipment for tensioning and handling the cable during installation. Based on anticipated installation conditions, the cable-laying barge would be equipped with six azimuthing thrusters. Additional vessels anticipated as part of the proposed cable installation for the Hudson River would include the following:

- 60-foot support/supply tug: typically, minimum of 1,000 HP (9- to 16-foot draft)
- 58-foot crew boat (four-foot draft)
- 26-foot outboard powered work skiff (two-foot draft)
- 40-foot crew boat with support systems sufficient for three divers (four-foot draft).

The type and number of vessels could be subject to change based on vessel availability, personnel availability, installation location, and schedule. Each vessel employed would travel into water depths consistent with their purposes (*i.e.*, crew boats to local servicing yards and installation barge principally along the alignment/approved commercial dockage). All vessels would operate fully in compliance with safe navigational practices.

The installation barge would principally reside on the installation route and would make approximately two round trips between the mobilization and demobilization ports. It would also make about six trips to and from the local cable-loading ports and, in cases where it is deemed prudent, return to shore due to weather conditions. At all other times, the cable lay barge's transit route would typically follow the proposed transmission line alignment within the Hudson River.

The applicant anticipates that crew boats would make multiple daily trips to and from a nearby marina to transport personnel and supplies to the installation barge (approximately three to six round trips per day). Other vessels such as the skiff and the dive boat might also make daily trips between the marina and the installation barge (possibly one round trip per day). The frequency of vessel trips is subject to change. However, the estimates provided are indicative of what is currently anticipated. Support and supply vessels would transit in the navigable channels. Transit routes would vary based on the location of applicable marine-based staging yards (*e.g.*, docking areas, equipment yards) along the route, but the yards would generally be no more than 50 miles from the location of the installation barge.

Vessel speeds in the construction area would be consistent with "no wake" requirements, and in all cases would be less than four knots. During transmission line installation, the cable-laying barge would operate at 0.07 knots inside the construction area (*i.e.*, the aquatic construction zone with a nominal 50-foot width centered along the cable alignment). The applicant anticipates the vessel speeds outside the construction area to be in the following ranges:

- Lay barge under tow: 5-6 knots
- Support/Supply tug: 6-10 knots
- Crew boat: 12 knots or in conformance with general navigational practices/rules
- Outboard-powered work skiffs: 12 knots or in conformance with general navigational practices/rules
- Dive boat: 12 knots, assuming a vessel similar to a crew boat.

A similar number or fewer vessels would be used during debris removal as would be used during installation. Transit routes for the route-clearing equipment would vary based on the location of marine-based yards along the route, but the yards would generally be no more than 50 miles from the equipment's location. Transit speeds would be no faster than 8-12 knots depending on weather, currents, and barges in tow. This level of activity and associated vessel speeds are consistent with existing vessel use on the Hudson River. During debris removal, the barge would proceed at a speed of 1.5 knots or less. In areas with significant side-scan and magnetometer targets, the speed would be reduced to less than one knot. The route transected for clearing would follow the path of the proposed transmission line.

Pre-installation surveys would be conducted prior to debris removal and post-installation bathymetric surveys would be conducted one and three years after installation and, if necessary, five and eight years after transmission line installation. Surveys would be conducted outside of spawning season in the summer and early fall. The speed of the vessel conducting the survey would depend on the water current speed and the weather. It is expected that the average speed of the vessel while surveying would be about 3-4 knots. Transit speeds would be 8-10 knots. The side-scan sonar system would be operated with a towfish height above the bottom that provides adequate coverage, meaning that it would be a height above the riverbed that would allow clearance for sturgeon above the riverbed.

Large vessels with deep drafts (up to 40 to 45 feet) relative to smaller vessels (less than 20 feet) have been implicated in vessel collisions with demersal fishes and fishes that prefer to feed along the bottom but also occur in the water column (*e.g.*, sturgeon), even in deep water (Brown and Murphy 2010). However, vessel strikes have only been identified as a significant concern in the Delaware and James Rivers in the U.S. Northeast and Mid-Atlantic where several vessel-struck individuals are found each year, possibly because unique geographic features in these areas (*e.g.*, potentially narrow migration corridors combined with shallow and narrow river channels) that increase the risk of interactions between vessels and Atlantic sturgeon. Vessel strikes are not considered to be a significant threat in the Hudson River. Smaller vessels and those with relatively shallow drafts provide more clearance with the river bottom and reduce the probability of vessel strikes. Because the construction vessels used for installation of the proposed CHPE project transmission line (*e.g.*, tug boats, barge crane, hopper scow) have relatively shallow drafts, and sturgeon are generally found within 3.3 feet of the bottom in the deepest available water, the probability of vessel-related mortalities to fish is expected to be extremely unlikely.

Although Atlantic and shortnose sturgeon are demersal fishes and spend most of their time at the bottom of the water column, it should be noted that Atlantic sturgeon in the Suwannee River (Florida) have been reported to jump out of the water, and, during jumping episodes, individuals are located at or near the surface of the water, where they are more vulnerable to strikes (Brown and Murphy 2010). The applicant has proposed measures to minimize impacts from construction vessels on shortnose and Atlantic sturgeon, including that all vessels associated with the proposed construction project would operate at “no wake/idle” speeds (less than four knots) at all times in the construction area and in-water depth areas where the draft of the vessel provides less than a four-foot clearance from the bottom. In areas with substantial objects recorded in side-scan sonar and magnetometer surveys, the speed would be reduced to less than one knot. Decreased vessel speeds in shallow waters would provide shortnose and Atlantic sturgeon an opportunity to move out of the way of moving vessels, thereby making it unlikely that a collision would occur. Construction would not occur during spawning migration (see Table 1), avoiding this vital and sensitive portions of their lifecycle.

Based on the types of vessels to be employed and their relatively shallow draft, there should always be sufficient clearance between vessels and the river bottom. The typical draft of the cable installation barge is approximately 12 feet, and the Hudson River has a maintained depth of at least 32 feet in its navigation channel. Additionally, reduced vessel speeds would help to avoid vessel strikes for sturgeon near the surface. As such, the possibility of a vessel striking shortnose or Atlantic sturgeon during cable installation or bathymetric surveys is discountable.

*Accidental Spills*

Minor releases of hydrocarbons (*e.g.*, diesel fuel and lubricants) could result in impacts on ESA-listed fish species. During installation of the aquatic transmission line, approximately four vessels, such as a cable vessel, survey boat, crew boat, and tugboat with barge, would be employed. Each of these vessels contains fuel, hydraulic fluid, and potentially other hazardous materials and, therefore, has the potential for spills. The impacts associated with releases of hydrocarbons are caused by either the physical nature of the oil (physical contamination and smothering) or by its chemical components (toxic effects and bioaccumulation). It is anticipated that the immediate response reaction of fish to water contaminated with hydrocarbon would be avoidance. Oil has the potential to impact spawning success because of the physical smothering and the toxic effects on eggs and larvae. Minor releases of hydrocarbons could also affect the food sources of ESA-listed fish. Benthic communities could also be affected by clean-up operations or through physical damage to the habitats in which plants and animals live. This could, in turn, decrease the foraging ability of ESA-listed fish species. A Spill Control Plan will be implemented prior to the commencement of the proposed project. The Plan would include applicant proposed best management practices to quickly contain and clean up hazardous materials in the event of a spill, such as construction crews having sufficient supplies of absorbent and barrier materials available. As such, the impacts of an accidental spill on shortnose and Atlantic sturgeon, in the unlikely event one were to occur, would be insignificant.

***Operations, Maintenance, and Emergency Repair Impacts***

Increased temperature, magnetic fields, and a weak induced electric field generated from the magnetic field would have insignificant effects on shortnose and Atlantic sturgeon for the reasons discussed below. Maintenance activities would have no effect on these species, because the proposed transmission line would be maintenance-free. Emergency repair activities would have insignificant effects on shortnose and Atlantic sturgeon. During emergency repairs of the proposed aquatic transmission line, the cables would be brought to the surface for repair, a new section of line would be spliced in, and the line would be reburied. Sediment disturbance resulting in temporarily increased turbidity, decreased water quality due to disturbance of contaminated sediments, and noise would have impacts similar to those described for construction and installation activities, but on a smaller scale and over a shorter duration, and thus would also be insignificant.

*Magnetic and Electric Fields*
The proposed aquatic transmission cable would emit magnetic fields. Due to cable shielding and burial, a weak induced electric field would be generated which can be detected by certain aquatic organisms. Information on the effects of magnetic and electric fields on aquatic species, including shortnose and Atlantic sturgeon is limited (Fisher and Slater 2010; Cada *et al*. 2011). Available evidence indicates that the magnetic and electric fields that would be generated during operation of the proposed transmission line may be detected by shortnose and Atlantic sturgeon, but that all effects are expected to be minor and not cause measurable or detectable changes in sturgeon behavior.

*Magnetic Fields*. The magnetic field emitted by the proposed aquatic transmission line has the potential to affect the way the natural magnetic field of the Earth is sensed by animal species, and this modified magnetic field could occur continuously within about ten feet of the cable. For the Hudson River segment, the depth of the trench would be approximately seven feet. For the Harlem River in the New York City Metropolitan Area segment, the depth of the trench would be approximately eight feet. There would be one foot or less of horizontal separation between the two cables, which would be collocated in the same trench, in both segments. Because the magnetic field is strongest at the transmission line and declines rapidly with distance, deeper burial would reduce the magnetic field, but not eliminate it entirely (CMACS 2003; Normandeau *et al*. 2011). In addition, placing the cables in close proximity to each other allows the magnetic field of each of the bipoles to partially cancel each other out, further lowering the magnetic field. In areas where concrete mats would be placed over the cables because target cable burial depths cannot be achieved, magnetic field levels in the water column would also be reduced due to the thickness and solid nature of the concrete (Normandeau *et al*. 2011). The estimated magnetic field levels at the riverbed surface directly over the transmission line centerline were calculated to be less than 162 mG at a burial depth of 3.25 feet and a cable spacing of 3.25 feet, and 600mG above concrete mats. The greater depths proposed for the transmission line would further reduce magnetic field levels at the sediment surface, but in order to be conservative in regards to effects on sturgeon, the field level at a lower burial depth and greater cable spacing has been used.

Demersal fish, such as sturgeon, are more likely to be exposed to higher magnetic field strengths, which are closer to the river bottom where the transmission line would be buried, as compared to pelagic species, which are found higher in the water column (Normandeau *et al*. 2011). Sturgeons are electrosensitive and use electric signals to locate prey. However, information on the impacts of magnetic fields on fish is limited. A number of fish species, including sturgeons, are suspected of being sensitive to such fields because they have magnetosensitive or electrosensitive tissues, have been observed to use electrical signals in seeking prey, or use the Earth's magnetic field for navigation during migration (EPRI 2013). Only limited research has been done and the current state of knowledge about potential impacts on fish from magnetic and electric fields emitted by underwater transmission lines is variable (Fisher and Slater 2010; Cada *et al*. 2011). However, the strengths of electromagnetic fields that were shown to have an effect on fish as documented in several studies (*e.g.*, Cada *et al*. 2011, 2012; Bevelhimer *et al*. 2013) were much more intense than the fields that would be produced by the proposed transmission line, which would be less than 162 mG at the sediment-water interface or 600 mG at the surface of a concrete mat directly above the buried transmission cables (which are orders of magnitude weaker than fields that triggered a reaction in a number of freshwater species such as lake sturgeon, trout, carp, and pike).

Laboratory experiments that indicate that magnetic fields can affect the behavior of adult fish and the development of eggs and larvae used exposures orders of magnitude higher than the magnetic field strengths of those expected from the proposed CHPE project transmission line. Therefore, the negligible increase in magnetic field associated with the CHPE transmission line as compared to the Earth's natural magnetic field is expected to have insignificant effects (both short-term and long-term) on eggs, larvae, or adults.

Magnetic fields associated with the operation of the transmission line could impact shellfish and benthic organisms that serve as sturgeon prey. According to studies, the survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Normandeau *et al*. 2011). Several marine benthic invertebrates, including the blue mussel and North Sea prawn, survived exposure to 37,000 mG with no apparent effects (Bochert and Zettler 2004). However, physiological changes (20% decrease in hydration and a 15% decrease in amine nitrogen values) were detected in blue mussels exposed to magnetic fields of 58,000, 80,000, and 800,000 mG. Experiments that exposed two freshwater mollusks, the Asiatic clam and the freshwater snail, to 360,000 mG showed no evidence of changes in activity (Cada *et al*. 2011). In these cases, experimental exposure values for magnetic fields are much more intense than those expected from the proposed CHPE project transmission line in the Hudson River, which is calculated at less than 160 mG at the sediment-water interface directly above transmission cables buried at 3.25 feet or 600 mG above concrete mats. This field would be extremely localized. According to studies, the survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Bochert and Zettler 2004, Normandeau *et al*. 2011). Results from the 30-month post-installation monitoring for the Cross Sound Cable Project in Long Island Sound indicated that the benthos within the transmission line corridor for this project continues to return to pre-installation conditions. The presence of amphipod and worm tube mats at a number of stations within the transmission line corridor suggest construction and operation of the transmission line did not have a long-term negative effect on the potential for benthic recruitment to surface sediments (Ocean Surveys 2005). Monitoring surveys conducted for the Long Island Transmission Line Project revealed recolonization of concrete mats to preconstruction conditions within two years. Therefore, no impacts (short-term or long-term) of magnetic fields on sturgeon prey are expected. A pre- and post-energizing benthic monitoring program would be developed in accordance with the NYSPSC Certificate Condition to evaluate operational impacts on benthic communities.

*Induced Electric Current*. The movement of charges in a magnetic field can cause an induced electric current. Induced electric fields can be created by water currents such as waves and tides, or the movement of an organism through the Earth's naturally occurring geomagnetic field. Induced electric fields can be increased with the perpendicular movement of an organism or water current relative to a magnetic field associated with a DC transmission line. Induced electric fields can vary with sediment or substrate type (Normandeau *et al*. 2011). Small increases in the induced electric currents would result from operation of the proposed CHPE project transmission line.

Based on the prevailing geomagnetic field in the area of the proposed CHPE project, a fish moving east to west perpendicular across the transmission cables at a rate of 4.5 feet per second (2.7 knots) would incur a naturally occurring induced electric current of 72 x 10-5 millivolts/centimeter (mV/cm); a fish moving north to south at the same rate would incur an induced electric current of 67 x 10-5 mV/cm. The maximum induced electric current associated with water or a fish moving parallel to the transmission cables at a rate of 1.38 feet per second (0.8 knots) would be 11.5 x 10-5 mV/cm over that produced by the geomagnetic field at one foot above riverbed at the centerline of the cables. The induced electric field would decrease to 2.8 x 10-5 mV/cm or less at ten feet from the cable system and continue to decrease with distance from the centerline. The induced electric field from the transmission cables would therefore contribute, at most, a 17% increase in the total induced electric field at all locations compared to the induced electric field due to earth's geomagnetic field in these scenarios (11.5 x 10-5 mV/cm [the maximum induced electric field]/67 x 10-5 mV/cm [the ambient induced electric field that results in the maximum percent increase]) (Bailey and Cotts 2012).

Evidence indicates that electrosensitive organisms such as sturgeon can detect induced electric fields (CMACS 2003, Normandeau *et al*. 2011). In experiments based on AC cables, starlet and Russian sturgeon responded to 50-Hz electric fields that ranged from 0.2 to 6.0 mV/cm (Normandeau *et al*. 2011). At range frequencies of 1.0-4.0 Hz and 16-18 Hz with field intensities of 0.2-3.0 mV/cm, the sturgeon response was to search for the source and begin active foraging. At 50 Hz and field intensities of 0.2-0.5 mV/cm, the response was to search for the source and to begin active foraging. At 50 Hz with field intensities of 0.6 mV/cm or greater, the response was to avoid the source (Basov 1999).

In the context of the environment around the proposed CHPE project cables, these studies suggest that sturgeon would likely be able to detect induced electric fields from the ambient geomagnetic field and other existing ambient sources in the environment, and to detect alterations in this field by the cable system. However, the change in the induced electric field calculated from the proposed CHPE project is a small increase (17%) over that produced by the ambient geomagnetic field and quickly diminishes with distance from the transmission cables. Therefore, the incremental increase in the ambient marine electric field even over the buried cable would not be a unique or novel stimulus nor would it be strong enough to produce physiological responses (Bailey and Cotts 2012).

While there is no known literature on the effects of induced electric currents on shellfish and benthic organisms, effects are expected to be negligible. The increase in induced electric current is negligible and is only 17% higher than an induced electric current from the naturally occurring geomagnetic field. Additionally, only the area directly above the transmission line is expected to be affected. Results from the 30-month post-installation monitoring for the Cross Sound Cable Project in Long Island Sound indicated that the benthos within the transmission line corridor for this project continues to return to pre-installation conditions. The presence of amphipod and worm tube mats at a number of stations within the transmission line corridor suggest construction and operation of the transmission line did not have a long-term negative effect on the potential for benthic recruitment to surface sediments (Ocean Surveys 2005). Monitoring surveys conducted for the Long Island Transmission Line Project revealed recolonization of concrete mats to preconstruction conditions within two years. Therefore, no impacts (short-term or long-term) of magnetic fields on sturgeon prey are expected. A pre- and post-energizing benthic monitoring program would be developed in accordance with the NYSPSC Certificate to evaluate operational impacts on benthic communities.

*Thermal Impacts*
Increases in temperature associated with the operation of the proposed aquatic transmission line at the sediment-water interface would have an insignificant effect on Atlantic and shortnose sturgeon, which as demersal species, would occur close to the bottom of the river bed. Although there would be some change in temperature in the sediment immediately surrounding a cable, the depth of the cable's burial and insulating factors of the cable would minimize impacts on the benthic habitats in the immediate vicinity. The cables would produce heat during operation, but it would dissipate with depth so in the top six inches of the sediment, where most benthic infauna occur, there would be a negligible temperature increase. It is estimated that for cable burial at four and eight feet, the maximum expected temperature change would be less than 0.001°F in the water above the riverbed, approximately 1.8°F at the riverbed surface, and 9°F and 4°F, respectively, at eight inches below the riverbed surface. However, these estimated rises in riverbed surface temperature and the increase in the water column are an overestimation of the natural condition because they do not taken into account the cooling effect from the natural flow of the Hudson River. The small increase in riverbed and water column temperature is considered to be within normal ranges of variation and no residual effects are predicted (SSE 2009). The potential increase in temperature associated with operation of the transmission line when buried using jet plowing techniques in at least seven feet of sediment in the Hudson and Harlem Rivers would be within the normal temperature range of all life stages of shortnose and Atlantic sturgeon. The predicted amount of local heat generation would not pose a physical barrier to fish passage, and would allow benthic organisms to colonize and demersal fish species (including demersal eggs and larvae) to use surface sediments without being affected. Impacts on reproduction or feeding are not anticipated, and therefore, impacts on sturgeon would also be negligible.

Where the transmission cables cannot be buried to their full depth due to utilities or bedrock and must be covered with concrete mats, the estimated increase in ambient water temperature surrounding the cables covered by the concrete mats is expected to be negligible (less than 0.25°F). This is expected to be within the range of the seasonal variation of water temperatures experienced in the Hudson and Harlem rivers. The highest increase in ambient temperature in the top two inches of sediment along the sides of the concrete mat is expected to be 1.3°F or less (Exponent 2014). Because the area of concrete mats is so small, any effects would be localized and any impacts on sturgeon would be insignificant.

Ambient water temperatures in the Hudson and Harlem rivers range from 32°F in January to a maximum of 81°F in July. Atlantic sturgeon spawn in water temperatures of 55°F to 79°F (Van Eenennaam *et al*. 1996; Bain *et al*. 2000; ASMFC 2012). Adult sturgeon have been found in water temperatures as high as 91°F. While beyond this, temperature tolerances for adult and juvenile sturgeon are not fully known, these life stages are mobile and have the ability to avoid the narrow area directly above the transmission line. Atlantic sturgeon eggs have been found to tolerate temperatures from 59°F to 75°F, and larvae tolerate temperatures from 37°F to 82°F (ASMFC 2012). The potential increase in water temperature associated with operation of the transmission line when buried with concrete mats and when combined with the ambient temperature ranges of the Hudson and Harlem rivers would be within the normal temperature range of all life stages of shortnose and Atlantic sturgeon (Bain *et al*. 2000). Therefore, no effects on any life stage of sturgeon are expected as a result of the negligible increase in water temperature directly above the transmission line.

Temperature increases associated with operation of the transmission line would not have more than a negligible impact on shellfish and benthic communities. The temperature increase in the top eight inches of sediment where most benthic infauna (bottom-dwelling aquatic animals) occur would be less than 9°F, diminishing to 1.8°F above ambient conditions at the sediment surface directly above the cables. The highest increase in ambient temperature in the top two inches of sediment along the sides of the concrete mat is expected to be 1.3°F or less (Exponent 2014). Under normal conditions, near-surface sediments (0-2 inches) closely follow the temperature profile of the overflowing water (Lenk and Saenger 1998 and Clark *et al*. 1999 as cited in McDonough and Dzombak 2006). As such, any increase in temperature at the sediment water interface would be expected to be well within the range of variation throughout the year. Further, this temperature increase would be narrowly focused directly over the cable line and would dissipate rapidly with distance to either side of the centerline. Any measurable amount of local heat generation would not pose a physical barrier to fish passage and would allow submerged aquatic vegetation, macroalgae, and benthic organisms to colonize and demersal fish species (including demersal eggs and larvae, such as for winter flounder) to use surface sediments without being affected. Organisms living 2-6 inches below the riverbed surface might be adversely affected but this would be limited to within a few feet of the transmission line in sediment. Results from the 30-month post-installation monitoring for the Cross Sound Cable Project in Long Island Sound indicated that the benthos within the transmission line corridor for this project continues to return to pre-installation conditions. The presence of amphipod and worm tube mats at a number of stations within the transmission line corridor are indicators that suggest construction and operation of the transmission line did not have a long-term negative effect on the potential for benthic recruitment to surface sediments (Ocean Surveys 2005). As mentioned under construction impacts, monitoring surveys conducted for the Long Island Transmission Line Project revealed colonization of concrete mats used during the project. It is anticipated that a similar situation would take place for the proposed CHPE project. Therefore, the small increase in riverbed temperature in a localized area immediately over the transmission line is considered to be within normal ranges of variation and would not significantly result in long-term effects on the forage base for sturgeon (SSE 2009). Again, a pre- and post-energizing benthic monitoring program would be developed in accordance with the NYSPSC Certificate to evaluate operational impacts from magnetic fields and heat during the lifespan of the transmission line on benthic communities.

Any negligible amount of local heat generated by operation of the proposed CHPE project transmission line would not pose a physical barrier to ESA-listed fish passage, would only occur directly adjacent to the transmission line, and would allow benthic organisms to recolonize and demersal fish species (including their eggs and larvae) to utilize surface sediments without being affected. Impacts on reproduction or feeding of ESA-listed fish are not anticipated. Therefore, effects on ESA-listed fish would be insignificant. No impacts on these species would be expected from decommissioning of the transmission line, as it would be de-energized and abandoned in place.

**Conclusions**

Based on the analysis that all effects of the proposed project will be insignificant or discountable, we concur with your determination that the CHPE project is not likely to adversely affect any ESA-listed species under our jurisdiction during construction or over the lifetime of its operation. Therefore, no further consultation pursuant to section 7 of the ESA is required.

Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: if (a) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (c) a new species is listed or critical habitat designated that may be affected by the identified action. No take is anticipated or exempted. If there is any incidental take of a listed species, reinitiation would be required. Should you have any questions about this correspondence please contact William Barnhill of my staff at 978-282-8460 or by e-mail (William.Barnhill@noaa.gov).

The NMFS Habitat Conservation Division (HCD) is responsible for overseeing programs related to essential fish habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act and other NMFS trust resources under the Fish and Wildlife Coordination Act. Coordination with HCD has been completed and EFH conservation recommendations were sent to the Department of Energy on August 19, 2014. If you wish to discuss those recommendations further, please contact Melissa Alvarez at (732) 872-3116 or Melissa.Alvarez@noaa.gov.

Sincerely,

for John K. Bullard
Regional Administrator

ec: Alvarez, NER/HCD
Julie Smith, DOE
Jodi McDonald, ACOE

File Code: H:\Section 7 Team\Section 7\Non-Fisheries\DOE\Champlain Hudson Cable
PCTS NER-2014-11471

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