WEST POINT PARTNERS, LLC

WEST POINT TRANSMISSION PROJECT

EXHIBIT 4 – ENVIRONMENTAL CONDITIONS AND IMPACTS

PREPARED PURSUANT TO SECTION 86.5

TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS
(Continued)

SECTION **PAGE**

TABLE OF CONTENTS
(Continued)

SECTION | **PAGE**

TABLE OF CONTENTS
(Continued)

SECTION

TABLES

TABLE OF CONTENTS
(Continued)

SECTION

FIGURES

APPENDICES

EXHIBIT 4 – ENVIRONMENTAL CONDITIONS AND IMPACTS

4.1 Introduction

The West Point Transmission Project (the Project) has been sited and designed to avoid or minimize potential impacts to environmental resources within the Project area and along the Project route. Where impacts are unavoidable, the Project has been designed to minimize them to the greatest extent practicable. The use of low impact installation methodologies, such as jet plow embedment and horizontal directional drilling, will limit potential Project impacts in the Hudson River and the associated resources along the proposed linear route. A summary of the proposed construction methods and associated potential impacts is provided below.

The In-River Cable will be buried to specific target depths below the river bed of the Hudson River largely in state-owned submerged lands below the river's High Water Mark. Low impact jet plow embedment will be utilized for the majority of the In-River Cable Route. Horizontal Directional Drilling (HDD) will be used at the Northern and Southern Landfalls to minimize any direct disturbance of natural aquatic habitat and adjacent shoreline areas. Jet plow embedment is considered to be the most effective and least environmentally damaging method when installing underwater electric transmission cables when compared to traditional mechanical dredging and trenching. Jet plow embedment is proposed for installing the In-River Cable to specific subsurface burial depths to avoid or minimize conflicts with general navigation in the river, to avoid potential mechanical damage to the cable from vessel transit or anchoring, and to minimize near surface impacts to aquatic resources. It also produces orders of magnitude less suspended sediment turbidity than conventional dredging or trenching methods. This method of laying and burying underwater cables installs the cable system at the target burial depth with minimum bottom disturbance and with the majority of fluidized sediment settling vertically back into the jet plow trench once the cable is laid on its bottom. Temporarily re-suspended *in situ* sediments (approximately 70%) are largely contained within the vertical limits of the trench. Any re-suspended sediments that may leave the limits of the incised jet plow trench have been shown to settle out quickly in the immediate vicinity of the trench on the adjacent riverbed and typically within 100 to 500 feet of the route centerline.

HDD will be utilized at the Northern and Southern Landfalls to avoid direct installation impacts to nearshore areas at the vicinity of the landfall locations in the Hudson River. It will also be used for the Northern AC Transmission Cable to avoid or minimize impacts to freshwater wetlands between the Leeds Substation and the Northern Converter Station. HDD is a trenchless method that involves drilling a sub-terranean borehole between pre-designated entry and exit points within which protective conduits and the transmission cable are installed. This method allows the cables to be pulled from between the entry and exit points and where it can be spliced to the adjacent project components.

The HDD process will involve the use of inert drilling fluid (mud/water slurry) to transport drill cuttings to the surface, to aid in stabilization of the surrounding borehole soils, and to provide lubrication for the HDD drill. The drilling fluid is composed primarily of water and a small amount of bentonite clay. The bentonite clay is a naturally occurring mineral compound that is not environmentally harmful. In addition to standard HDD impact mitigation methods, the HDD operation will include environmental and water quality monitoring of the borehole/conduit excavation processes to minimize the potential for drilling muds leaking out into the water column or sediments that are above the drill hole trajectory.

Temporary cofferdams will be installed in-river at the endpoint of each HDD conduit exit point in the river prior to the beginning of the HDD borehole construction, and will remain in place until jet plow embedment installation of the In-River Transmission Cable is complete. The cofferdams will be constructed using steel sheet piles driven from a barge-mounted crane. The cofferdams are designed to contain dredged natural river sediments, to facilitate the jet plow engagement and to facilitate cable pulling through the HDD conduit to the landfall locations.

Approximately 6,500 cubic yards of sediment will be dredged from each cofferdam using mechanical dredging methods to expose the in-water end of the borehole. Disposal of the dredged material from within both Temporary Cofferdams will be arranged with landfills licensed for the type of material involved. The Temporary Cofferdams will remain in place for the duration of the In-River Transmission Cable installation. The location of the cofferdams will be marked to warn vessels of the Temporary Cofferdam's presence. After installation of the In-River Transmission Cable is complete, the Temporary Cofferdams will be removed. After cofferdam removal is complete, the dredged areas within the Temporary Cofferdam will be backfilled with imported clean backfill material to restore the riverbed to preconstruction grade.

The project installation activities will comply with applicable agency "time of year" restrictions to avoid potential project impacts to aquatic and benthic resources. In-River work is scheduled to occur from August through November to avoid in-water work during sensitive bird nesting and fish spawning and nursery periods in this area of the Hudson River, which generally extends from April through August. Given the anticipated time of year restrictions and the need for certain installation activities to occur uninterrupted (e.g., HDDs and jetting), it is projected that cable installation activities will occur twenty four hours per day/seven days per week in most areas, with nighttime shutdowns occurring only in select sensitive receptor areas, during the allowable work window. This will require that nighttime lighting be used. To the extent possible, directed lighting will be employed to minimize lighting of areas outside of the workspace. The continuous construction schedule will also result in the operation of heavy machinery and equipment (e.g., generators, water pumps, and vessel engines) during day and night activities. Certain activities may be limited to daytime periods depending upon noise sensitivity of nearby areas.

To avoid impacts to recreational and commercial navigation occurring in the River along the Project's linear route, the In-River Cable will be buried in the riverbed to a minimum depth of 15 feet below the authorized Federal Navigation Channel depth at that location, and to a depth of 8 feet below present river bottom in areas of the riverbed located outside of the Federal Navigation Channels. Once the In-River Cable makes landfall at either end of the In-River Cable Route, it will be spliced to the associated Land Cables that will connect with the converter stations. The Land Cables will be installed underground within existing public and private rights-of-way using HDD (Northern AC Transmission Cables) and conventional open cut trenching methods. Installation activities for the Land Cables will involve the following: initial site/ROW clearing (if required), installation of stormwater and erosion control measures, trench excavation (or HDD for northern AC Interconnect), cable installation, backfilling with appropriate materials and site grade restoration and revegetation. The cleared width within the Land Cable's linear routes will be kept to the minimum necessary to provide space for storage, staging, assembly, and other activities associated with cable installation. Final design and implementation of the stormwater and erosion controls for the Land Cable segments will be submitted as part of the EM&CP.

The width of the Land Cable trench will be designed to allow for the proper depth and separation required for the burial and safe thermal operation of the buried cables. Subsequent to installing the cables in the vertical trench, it will be backfilled with clean thermal backfill material (sand). Once the cable is backfilled within the trench limits, there will be no visible above ground components and therefore no visual or land use impacts. Also, all temporary laydown areas and construction activity workspaces will be restored and revegetated to pre-excavated conditions.

A description of the potential environmental impacts associated with the installation and operation of the West Point project is described in detail in the following sections. Where impacts have been determined to be unavoidable and minimized, mitigation has been incorporated into the Project planning details. Environmental compliance monitoring measures will be employed before, during, and after installation activities, in compliance with anticipated permit conditions.

4.2 Geology, Topography and Soils

This section provides an overview of the geologic setting of the Project Area and specifically describes the existing geology, topography, and soils present along the Northern and Southern Land Transmission Cable Routes. Geology along the In-River Transmission Cable Route is provided in Sections 4.4 and 4.5. This section also identifies and assesses potential impacts to geology and soils both during construction and during operation and maintenance activities.

4.2.1 Existing Conditions

The following information is based on existing published information, literature review, and correspondence with regulatory agencies.

4.2.1.1 Geologic Setting

The Land Transmission Cable portions of the Project are located within the Hudson Valley Section of the northeast region’s Valley and Ridge province, extending south to the New England Uplands Section of the New England province.

During the last two million years at least twenty episodes of continental glaciation covered the earth, and the last of these episodes, the Wisconsin glaciation, was responsible for the surficial geology of the region where the Project is located. These glaciers scoured out and incised the Hudson River Valley during their slow movement across the region. This one-mile thick sheet of ice reached its southernmost extent in nearby New York City and Long Island approximately 20,000 years ago. Glacial till was deposited by these meltwaters for both advancing and retreating ice sheet movement, often directly scouring the surface soil’s underlying bedrock. During the retreat of the ice sheets (melting), abundant unconsolidated sedimentary deposits combined with an enormous flux of glacial meltwater contributed to the deposition of glaciolacustrine (lacustrine) and glaciofluvial (riverine) deposits that form a veneer of varying thickness atop the underlying glacial till and/or bedrock in the river valley complex (Surficial Geology Map of New York 1989).

Along the Northern Land Transmission Cable Route, the surficial geology is characterized by unconsolidated glacial till, glaciolacustrine silts and clays, and exposed bedrock. The bedrock is characterized as the Austin Glen Formation containing greywackes and shales. Along the Southern Land Transmission Cable Route, the surficial geology is characterized by unconsolidated glacial till and glaciolacustrine sands, and exposed bedrock. The bedrock is characterized as the Inwood Marble containing metamorphosed dolostones and limestones; Balmville Limestone; and Manhattan Schist containing sillimanite, garnet, and biotite (Geologic Map of New York 1995). The area of the Southern Landfall is also characterized by numerous bedrock fracture faults that are oriented along bedding and orthogonal to bedding. Subhorizontal fractured zones commonly are present in the upper part of the bedrock in this area (USGS 2008).

4.2.1.2 Topography and Soils

The existing topography along the Northern Land Transmission Cable Route is generally rolling hills with gentle to moderate sloping terrain. The range of topographic elevations along this route from the Leeds Substation to the Hudson River is between 0 feet (adjacent to the Hudson River) to approximately +220 feet (NAVD 88). The soils along this portion of the route are characterized by various native soils and are outlined in Table 4.2-1 (Soil Survey of Greene County 1993).

The existing topography along the Southern Land Transmission Cable Route is characterized by natural terrain elevations of 0 feet (Hudson River) to approximately +100 feet (NAVD 88). The soils along this portion of the route are characterized by various native soils, urban fill and urban land and are outlined in Table 4.2-1.

Present day native soils were formed from parent material associated with the unconsolidated deposits (till, glaciofluvial and glaciolacustrine deposits, recent fluvial deposits, etc.) at both landfall location areas. Urban soils and Udorthents are located within the Southern Land Transmission Cable Route and are associated with historic filling, soil grading, and excavation activities on previously disturbed land. Soils along the Land Transmission Cable Routes exhibit drainages ranging from poorly to excessively drained. No hydric soils are located along either of the Land Transmission Cable Routes (Soil Survey of Putnam and Westchester Counties 1993).

Table 4.2-1: Soil Types Along Overland Transmission Cable Route

Soil	Map Symbol	Description	Slope	Drainage
Northern Overland Transmission Cable Route				
Covington and Madalin	Co	Soils formed in glaciolacustrine sediments	0 to 3%	Covington – poorly drained Madalin – very poorly drained
Elmridge	EnA	Soils formed in glaciolacustrine sediments of silt and clay	0 to 3%	Moderately well drained
Hudson and Vergennes	HvB	Soils formed in glaciolacustrine sediments of silt and clay	3 to 8%	Moderately well drained
Hudson and Vergennes	HvC	Soils formed in glaciolacustrine sediments of silt and clay	8 to 15%	Moderately well drained
Hudson and Vergennes	HvE	Soils formed in glaciolacustrine sediments of silt and clay	25 to 50%	Moderately well drained
Kingsbury and Rhinebeck	KrB	Soils formed in glaciolacustrine sediments of silt and clay	3 to 8%	Somewhat poorly drained
Nassau channery	NaC	Gravely till derived mainly from local slate or shale	5 to 15%	Somewhat excessively drained
Riverhead loam	RhC	Soils formed in sandy and gravelly glacial outwash	Rolling	Well drained
Shaker	Sh	Soils formed in glaciolacustrine sediments of silt and clay	0 to 3%	Somewhat poorly drained
Udorthents	Ur	Soils are covered by structures and altered by the addition of manufactured materials	0 to 8%	Somewhat excessively drained
Valois-Nassau complex	VdB	Soils formed in glacial till	Undulating	Somewhat excessively drained
Valois-Nassau complex	VdD	Soils formed in glacial till	Hilly	Somewhat excessively drained
Southern Overland Transmission Cable Route				
Charlton-Chatfield complex	CrC	Soils formed in glacial till atop shallow bedrock	Rolling	Charlton – Well drained Chatfield – Well drained and somewhat excessively drained
Hinkley gravelly loamy sand	HnB	Soils formed in sandy and gravelly glacial outwash	3 to 8%	Excessively drained
Udorthents	Ub	Soils have been altered by cutting and filling	Smoothed	Excessively drained to moderately well drained
Udorthents	Uc	Soils have been altered mainly by filling	Wet substratum	Somewhat poorly drained and very poorly drained
Urban land	Uf	Soils are covered by at least 60% with buildings and structures	Variable	Variable

Soil	Map Symbol	Description	Slope	Drainage
Urban land-Charlton-Chatfield complex	UlC	Soils are covered by structures and altered by the addition of manufactured materials	2 to 15%	Charlton – Well drained Chatfield – Well drained and somewhat excessively drained
Urban land-Riverhead complex	UvB	Soils are covered by structures and altered by the addition of manufactured materials	2 to 8%	Well drained

Sources: Soil Survey of Greene County, New York – USDA_SCS, February 1993 and Soil Survey of Putnam and Westchester Counties, New York – USDA-SCS, September 1994

4.2.2 Environmental Impacts and Mitigation

The potential impact to geologic resources and soils from the installation and operation of the Land Transmission Cable would be negligible to minor. Additional details are provided in the following sections.

4.2.2.1 Potential Construction Impacts and Mitigation

Along the Land Transmission Cable Routes, underground cables will be installed using standard construction techniques: open-cut trench excavation and HDD. Typically, the trench will be 2 feet, 6 inches wide for the AC cable, 4 feet, 6 inches wide for the DC cable and approximately 5 feet deep to allow for the proper depth and separation required for the placement of the cables in the trench (Figures 4.14-1 and Figure 4.14-2). Where HDD is required along the Land Transmission Cable for the Northern AC Interconnect, the HDD operation at each location will include a land-based HDD drilling rig system, drilling fluid recirculation systems, residuals management systems, and associated support equipment. Most of the Land Cable and the Transition Vaults will be installed within existing paved roads and other previously disturbed land or roadway areas. The proposed locations of the Project’s two (2) Converter Stations will also be constructed within previously disturbed land areas.

The Land Transmission Cable Routes, the Transition Vaults, and the Converter Stations are located predominantly in geologic materials (soils overburden) that can be easily worked with standard construction equipment and techniques. All land-based trenching and backfilling will be performed using standard construction equipment, including excavators and backhoes. Excavated soils will be examined to determine their suitability for reuse as structural or thermal backfill material or, if not, for proper offsite disposal. The Land Cables will be installed in conduits, which will be bedded in screened sand or other clean thermally-conducive backfill material. The balance of the backfilling will utilize excavated native soil materials, to the extent possible.

Due to the segmented nature of constructing the Land Cables (completed in 200- foot reaches or so per day), there is only a limited potential for erosion of the work sites. Soil erosion and sedimentation control devices will be installed prior to the commencement of construction activities. The work activities will be monitored for environmental compliance by the owner or general contractor. Erosion/Sedimentation control measures will be installed within and between the work areas/stockpiled soils and downslope wetlands and/or water bodies to reduce the risk of soil erosion and siltation. Typical soil erosion and sediment control devices to be included as part of the impact mitigation include:

- Hay bale and/or silt fence barriers;
- Protection (covering) of soil stockpiles;

- Stabilized construction entrances/ access roads;
- Drainage catch basin inspection/ maintenance/protection; and/or
- Fencing and screening protection of existing surrounding vegetation.

Upon completion of the installation of the Land Transmission Cable, the surface of the right-of-way disturbed by construction activities will be restored to pre-construction conditions or better to match the original topographic contours to the extent practical. Segregated topsoil will be returned or replaced as appropriate, and soils that have been compacted by construction equipment traffic will be tilled, if necessary. Repaving or re-vegetation will also be performed to match conditions existing prior to the performance of the construction activities. Similar restoration activities will be performed following the construction of the underground Transition Vaults and the Converter Stations.

These mitigation measures will be fully described in an Erosion and Sedimentation Control and Storm Water Management Plan, which will be provided as part of the Environmental Management and Construction Plan (EM&CP). This plan will incorporate applicable Best Management Practices (BMPs) from the NYSDEC Technical and Operational Guidance Series (TOGs) for erosion control and stormwater management during construction.

Subsurface geologic conditions (soil overburden) along the Land Transmission Cable Routes and at the Converter Stations appear to be very conducive to ease of burial and backfill construction of the transmission system. Geotechnical investigations will be performed along the Land linear routes to confirm location or site-specific subsurface geologic conditions. Detailed geotechnical evaluations will also be performed within the structural footprint of the proposed Converter Stations and their associated electrical interconnect equipment. Rock material that may be encountered along the Northern or Southern Land Transmission Cable Routes during cable trenching and installation will be removed using one or more of the following techniques:

- Conventional excavation with a backhoe;
- Impact hammering with a pointed tractor attachment followed by backhoe excavation; or,
- Bedrock blasting followed by bucket excavation.

Based on the shallow depths of the proposed excavations and the findings of the routes natural geologic setting, it is anticipated that bedrock blasting will not be required to complete the land-based construction activities.

4.2.2.2 Potential Operational Impacts and Mitigation

Following installation of the Land Cables, there will be no visible above ground components. There will be no impacts related to geology, topography or soils from Project operation. Project operation will not require trench re-excavation.

4.3 Wetlands and Water Resources

This section describes inland and coastal shoreline wetlands and water resources (other than the Hudson River) within the Project Area. This includes fringing tidal wetlands, freshwater wetlands, floodplains, streams, and groundwater conditions. It also identifies and assesses potential impacts and proposed mitigation to these resources during Project construction, operation, and maintenance activities. The following information is based on existing published information, literature review, and project–specific field investigations performed in support of the Project.

4.3.1 Existing Conditions

The existing conditions for the wetland and water resource areas within the defined Project Area were initially assessed through a desktop review of GIS data and maps. Following this initial review, inland freshwater wetlands within or near the Project Areas were delineated in the field during site visits conducted in 2013. Desktop data sources included:

- Tidal wetlands of the Hudson River Estuary: The NYSDEC Hudson River Estuary Program in collaboration with numerous partners mapped vegetated habitats of the Hudson River Estuary.
- NYSDEC Wetland Maps: Wetlands must meet a minimum size requirement of 12.4 acres (5 hectares) in order to fall under the jurisdiction of the NYSDEC. These mapped wetlands are also ranked into environmental sensitivity and protection classes based on the functions and values they provide according to the NYSDEC. The higher the wetland classification, the greater the benefit that wetland provides. Lower class wetlands within the NYSDEC rating system also provide important benefits, but typically are not as important for resource protection purposes as are the higher rated wetlands.
- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) maps: NWI mapped wetlands are classified in accordance with the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). Wetlands encountered along the Land Route include palustrine emergent wetlands (PEM) and palustrine scrub-shrub wetlands (PSS). Freshwater NWI mapped wetlands are generally jurisdictional under Section 404 of the Federal Clean Water Act and are regulated by the U.S. Army Corps of Engineers (USACE).

4.3.1.1 Tidal Wetlands

Tidal wetlands are found in areas that are subject to tidal influence and are typically vegetated with plant species that are adapted to the cyclical flooding and ebbing of the tide. Tidal wetlands are located along much of the Hudson River estuary from the mouth of the river in New York City up to the Troy Dam in Troy, New York, approximately 160 miles upriver. Salinities within the tidally influenced portions of the Hudson River will vary depending on the location upriver with salinity decreasing the further upriver from New York Harbor’s Upper Bay. Tidal wetlands serve important wildlife and fisheries habitat within the Hudson River estuary. Tidal wetland systems along the Hudson River estuary are state-regulated wetlands under the New York State Freshwater Wetlands Act (Environmental Conservation Law, Article 24) and the New York Tidal Wetlands Act (Environmental Conservation Law, §§ 1-0101, 3-0301, 25-0302). This type of wetland also falls under the jurisdiction of the USACE pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 under the Clean Water Act.

The locations of tidal wetlands of the Hudson River estuary were recently updated and mapped along the upper portions of the Hudson River by the Cornell Institute for Resource Information Sciences (IRIS) using 2007 photo-imagery. Tidal wetlands were mapped and classified into the following categories.

- **Lower intertidal mix:** Areas of vegetated lower intertidal wetland that may include *Scirpus pungens,* Sweetflag *(Acorus calamus)*/mix, and *Polygonum* sp.
- **Upper intertidal mix**: Areas of upper intertidal wetland mix that may include purple loosestrife/mix, Bulrush (*Scirpus* sp), Sweetflag/mix, and *Polygonum* sp.
- ***Phragmites australis***: Areas dominated by the non-indigenous common reed (*Phragmites australis*).
- **Scrub/Shrub**: Areas of scrub/shrub wetland vegetation.

- **Submerged Aquatic Vegetation (SAV)**: Beds of submerged aquatic vegetation.
- ***Trapa Natans***: Beds dominated by the non-indigenous water chestnut (*Trapa natans*).
- ***Typha angustifolia***: Emergent wetland areas dominated by narrowleaf cattail.
- **Unvegetated flats**: Areas of unvegetated mud flats.
- **Wooded Swamp**: Areas of forested wetland.

Tidal wetlands based on the Cornell IRIS mapping are displayed in Figure 4.3-1.

Tidal wetland maps indicate that tidal wetlands do not occur at either proposed Landfall location (Figure 4.3-1, Sheets 1 and 6).

Tidal wetlands do occur along the In-River Transmission Cable Route within the middle to lower sections of the Hudson River estuary. The most extensive area of mapped tidal wetlands occurs between river mile (RM) 107 and RM 118 (Figure 4.3-1, Sheet 1). Most of the tidal wetlands in this reach of the Hudson River consist of wooded swamps and lower intertidal emergent wetlands. Extensive beds of the non-indigenous and invasive species water chestnut occur in the coves in this area of the river. Stands of common reed, another non-indigenous species, also occur at scattered locations in backwater channels and coves, while stands of the native narrowleaf cattail occur along the immediate shorelines of the river in this area. Large named tidal wetlands along the Project Route include the Esopus Estuary, Tivoli Bays, Constitution Marsh, and Iona Island. The Esopus Estuary is located at the mouth of the Esopus Creek on the west side of the river in the town of Saugerties at RM 101 (Figure 4.3-1, Sheet 2). This tidal wetland complex consists of the lower 1.3 miles of Esopus Creek and includes shallow water, intertidal mudflats, tidal marsh, and tidal swamp both north and south of the creek mouth.

Tivoli Bays are a relatively large area of tidal wetlands that occur just south of the Esopus Estuary on the eastern side of the River between RM 97 and RM 101 (Figure 4.3-1, Sheet 2). Tivoli Bays habitats include freshwater intertidal marsh, open waters, riparian areas (lands along the Hudson River shoreline), subtidal shallows, mudflats, tidal swamp and mixed forest uplands (NYSDEC 2013). These wetlands include a mix of wooded swamps and stands of cattails that border areas of SAV.

Constitution Marsh, a tidal wetland comprised of extensive stands of cattails and lower intertidal, emergent wetland vegetation, borders the Hudson River on its east side between RM 52 and RM 54 (Figure 4.3-1, Sheet 5).

Iona Island, another tidal wetland is located between RM 45 and RM 46 (Figure 4.3-1, Sheet 6). Iona Island is comprised of brackish intertidal mudflats, brackish tidal marsh, freshwater tidal marsh, and deciduous forested uplands (NYSDEC 2013). The Cornell mapping also indicates that stands of common reed occur at Iona Island.

4.3.1.2 Freshwater Wetlands

The NWI wetlands maps were initially used to identify freshwater wetland crossings along the Land portions of the Proposed Route. Wetlands were subsequently field-delineated at the Northern and Southern Converter Stations and along portions of the Land Transmission Cable Routes in April 2013. A section of the Northern Land Route from the Northern Landfall to 2nd Street will be evaluated for wetlands in the field at a future date.

Southern Land Transmission Cable Route—Westchester County

The NWI wetlands maps indicate that the Southern Land Transmission Cable Route in Westchester County does not cross any NWI–designated wetlands (Figure 4.3-2). The proposed Southern Converter Station location and Southern Land Route were inspected for any jurisdictional wetland resource areas that may not have been included in the NWI maps. The following wetlands were field verified and delineated during the site reconnaissance and are displayed in Figure 4.3-2.

Wetland 2 – Wetland 2 is a very small, isolated emergent wetland (Cowardin classification: PEM5C) vegetated entirely by the non-indigenous species common reed. This wetland is located at the Southern Converter Station and appears to have been created as a result of historic earth moving and excavation activities at this heavily disturbed site. The primary hydrologic input to Wetland 2 is surface runoff from the adjacent slope. This wetland is not a NYSDEC mapped wetland and is therefore not jurisdictional under the New York State Freshwater Wetlands Act. It is isolated and presumed non-jurisdictional under Section 404 of the federal Clean Water Act. The final jurisdictional status of this wetland will be determined by the USACE during their review of the Project.

Wetland 3 – Wetland 3 is a scrub-shrub and emergent wetland (Cowardin classification: PSS1C/PEM2C) located adjacent to Broadway along the Southern Land Route. This wetland is located at the base of a steep slope that begins just off the shoulder of a roadway. Wetland 3 is vegetated with spicebush (*Lindera benzoin*), common reed, and skunk cabbage (*Symplocarpus foetidus*). The soils within the wetland have a mucky mineral layer over a fine sandy loam. Wetland 3 is not a NYSDEC mapped wetland and is therefore only jurisdictional under the federal Clean Water Act.

Northern Land Transmission Cable Route—Greene County

The NWI mapping indicates that the Northern Land Transmission Cable Route in Greene County crosses a palustrine, emergent wetland (Cowardin classification: PEM1A/E) along Leeds Athens Road (Figure 4.3-3). The Land Cable Route passes adjacent to another mapped palustrine emergent wetland (PEM1A) in the section between the Leeds Substation and the Northern Converter Station (Figure 4.3-3). In addition, the existing Leeds Substation is bordered by a NYSDEC regulated wetland (HN-108) on three sides. HN-108 is designated a Class I wetland by the NYSDEC. The Northern Converter Station is located just to the east of this NYSDEC-designated wetland. The NYSDEC wetland also has an associated 100-foot adjacent area in accordance with New York State Freshwater Wetlands Act. The following wetlands were field delineated along the Northern Land Transmission Cable Route and Northern Converter Station in April 2013 and are shown on Figure 4.3-3.

Wetland 4 – Wetland 4 is a large wet meadow (Cowardin classification: PEM2E) at the base of a steep slope off Flats Road Extension at the proposed Northern Converter Station location. Several areas of scrub-shrub, wetland vegetation (Cowardin classification: PSS1E) occur in the northern portions of this wetland. The wetland is currently used as pasture for a variety of livestock and appears to be mowed for maintenance as a grass meadow. Saturated clay soils underlie most of the wet meadow areas. Wetland 4 is adjacent to the NYSDEC mapped wetland (HN-108). Wetland 4 is jurisdictional under Section 404 and likely jurisdictional under the New York State Freshwater Wetlands Act because of its proximity to a NYSDEC mapped wetland (HN-108).

Wetland 7 – Wetland 7 is a small roadside emergent wetland (Cowardin classification: PEM2E) and intermittent stream channel (Cowardin classification: R4) that is located in the shoulder on the north side of Leeds Athens Road. The intermittent stream channel runs under Leeds Athens Road via an existing culvert. This wetland is vegetated with the invasive species purple loosestrife (*Lythrum salicaria*) and broadleaf cattails (*Typha latifolia*). Wetland 7 is only jurisdictional under Section 404 of the Clean Water Act.

4.3.1.3 Floodplains

The existing Federal Emergency Management Agency (FEMA) flood maps that cover the Project Area were reviewed to determine whether any portions of the Land Cable are located within the 100-year flood plain. Despite the fact that the Land Cable system will be buried underground and not displace any of the route area's flood storage capacity, portions of the Southern and Northern Landfalls are located within the 100-year flood plain (Zone AE) of the Hudson River according to digital FEMA flood map data for the area (Figure 4.3-2 and Figure 4.3-3). The base flood elevation (BFE) of the Hudson River has been calculated by FEMA at the two preferred landfalls. The BFE is 11 feet (NAD29) at the Northern Landfall and 7 feet (NAD29) at the Southern Landfall. Both the landfall locations are located in previously developed areas.

The Southern Land Cable is located outside the 100-year floodplain (Figure 4.3-2). A section of the Northern Land Cable is located within the 100-year floodplain of the Hudson River according to the FEMA mapping (Figures 4.3-3).

4.3.1.4 Streams and Rivers

USGS maps were initially reviewed to determine whether any mapped perennial or intermittent streams occur within the Project Area. Stream locations were verified during field reconnaissance in April 2013.

There are no stream crossings or potential impact to streams along the Southern Land Route.

A perennial stream and pond are located just south of the existing Leeds Substation at the terminus of the Northern Land Cable Route (Figure 4.3-3). The Northern Land Transmission Cable Route crosses three mapped streams along Leeds Athens Road. The first is an intermittent stream that crosses the Land Route near the intersection with Howard Hall Road; the second is a perennial stream that crosses the Land Route east of Spoorenburg Road and the third crosses the Land Route just west of Second Street (Figure 4.3-3). All three streams have a C classification from NYSDEC, which indicates they support fisheries and are suitable for non-contact recreation. None of the streams support trout or trout spawning according to the NYSDEC database. In addition to the Hudson River, these three streams were delineated where they cross Leeds Athens Road and are described in more detail below. All of the following wetlands are jurisdictional under Section 404 of the Clean Water Act; the Hudson River is also jurisdictional under Section 10 of the Rivers and Harbors Act.

Wetland 1 and 1A – The ordinary high water mark of the Hudson River was determined in the field at the Southern Landfall location. It should be noted that the banks of the Hudson River at this location have been altered by bulkheads and are not vegetated. The Northern Landfall location will be delineated and investigated in the field at a future date.

Wetland 5 – Wetland 5 is a 2 to 3-foot wide intermittent stream (Cowardin classification: R4) that runs under Leeds Athens Road via a culvert. This upper intermittent stream is characterized by a relatively steep slope and is dominated by a cobble and shale substrate. Stream banks are vegetated with scrub-shrub vegetation.

Wetland 6 – Wetland 6 is an upper perennial stream (Cowardin classification: R3) that runs under Leeds Athens Road via a culvert. The banks are vegetated with scrub-shrub vegetation and trees. The stream is approximately 20 to 25 feet wide and has a cobble and boulder streambed. There is evidence of accelerated bank erosion along the downstream side near the road crossing, likely due to higher flows from large rain events.

Wetland 8 – Wetland 8 is an upper perennial stream (Cowardin classification: R3) that runs under Leeds Athens Road via a large culvert. The stream is approximately 20 to 25 feet wide and has a boulder, cobble, and silt stream bed. The banks of Wetland 8 are vegetated with scrub-shrub vegetation and trees.

4.3.1.5 Groundwater

Along the Land Transmission Cable Routes, local groundwater resources are typically found in unconsolidated glacial deposits (surficial geology), and/or in the underlying bedrock (see Section 4.2.1 for geologic setting). Where these surficial deposits and bedrock formations are capable of yielding economically sufficient quantities of groundwater, they are identified as an aquifer. Aquifers along the Land Transmission Cable Routes are recharged from precipitation, lateral seepage from adjacent streams, rivers, and lakes, by subsurface flow from adjacent uplands, and by seepage from bedrock.

The groundwater elevation within the Land Transmission Cable Routes is not known at this time, but based on locally observed conditions, it is anticipated that shallow groundwater will likely be encountered in the location of the underground Transition Vaults at each landfall location.

Groundwater in the vicinity of the Land Transmission Cable Routes is classified by the NYSDEC as GA, which is the general classification for all fresh groundwater in New York State (6 NYCRR, Chapter X, § 701.15). The best usage of Class GA waters is as a source of potable water supply. However, because all fresh groundwaters of the state are classified as GA, this classification is not an indicator of site-specific groundwater quality at the landfall locations. Due to the likelihood of brackish or saline conditions within the Hudson River, it is unlikely that the natural groundwater proximal to the river and landfall locations could be used for potable purposes without desalinization or pre-treatment along the southern portion of the route south of approximately Poughkeepsie.

The New York State Department of Health (NYSDOH) has identified 18 Primary Water Supply Aquifers (also referred as Primary Aquifers). These are defined as "highly productive aquifers presently utilized as sources of water supply by major municipal water supply systems". No primary water supply aquifers were identified along either the Northern or Southern Land Transmission Cable Routes or their respective landfall locations (NYSDEC 2013)

The Northern and Southern Land Transmission Cable Routes were evaluated to determine the presence, if any, of sole-source aquifers. As defined by USEPA, a sole-source aquifer is that which supplies at least fifty percent (50%) of the drinking water consumed in the area overlying the aquifer. These areas can have no alternative drinking water source(s) which could physically, legally, and economically supply all those who depend upon the aquifer for drinking water. No sole source aquifers were identified along either the Northern or the Southern Land Transmission Cable Routes or their respective landfall locations (EPA 2013).

4.3.2 Environmental Impacts and Mitigation

The construction and operation of the Project will lead to temporary and localized permanent impacts to wetlands, floodplains, streams, and groundwater. The majority of the impacts are controllable by use of best practices in construction of the Project where such temporary impacts are expected to occur. Aside from some displacement of wetlands by the Converter Stations, there will be no impacts to these resources after construction and restoration are complete. Impacts during construction will be minimized through the use of prudent and effective mitigation measures that are described in the following sections.

4.3.2.1 Potential Construction Impacts and Mitigation

Construction impacts will include both direct and indirect impacts to wetlands and waterbodies in the Project Area. Direct impacts are characterized by trenching, vegetation clearing and placing of clean backfill within the resource area itself, while indirect impacts are associated with the potential for increased stormwater runoff, changes in hydrology, or changes in sun exposure as a result of land alteration and vegetation clearing.

The direct and indirect impacts associated with the Project and mitigation that will be provided to minimize these impacts is provided for each resource area in the following sections.

Freshwater Wetland Impacts and Mitigation

At the Southern Converter Station, Wetland 2, a 700-square foot isolated wetland with low function and values will be impacted. Wetland 2 is comprised almost entirely of Phragmites and provides little to no value to typical wetland functions such as wildlife habitat, groundwater recharge or nutrient cycling. Wetland 2 is not jurisdictional under the New York State Freshwater Wetlands Act and is presumed to be non-jurisdictional under Section 404 of the Clean Water Act.

WPP has sited and designed the Northern Converter Station to avoid or minimize wetland resource area impacts to the maximum extent possible. An alternatives analysis for the Northern Converter Station is presented in Section 3.4. Each of the alternative sites has mapped hydric soils and Flats Road and New Athens Generating Parcel have mapped NYSDEC wetlands. Flats Road and 389 Leeds-Athens Road have rare species associated with them. Ultimately 165 Flats Road Extension, the preferred location, was the only parcel identified that met the design criteria. The Northern Converter Station footprint has been sited to maximize use of forested upland area (approximately 1.4 acres) surrounded by the wet meadow. However, the size and scale of the new HVDC Converter Station will require the unavoidable loss of approximately 3.4 acres of Wetland 4 (the wet meadow) in order to provide adequate land base area for construction of the new electric Converter Station. The wetland is currently used as pasture for a variety of livestock and appears to be mowed for maintenance as a grass meadow. Wetland 4, at the Northern Converter Station site, likely provides sediment retention as well as nutrient removal, retention and transformation from the surrounding watershed.

The underground installation of the AC Transmission Cable between Leeds Substation and the Northern Converter Station, and the construction of the DC Transmission Cable near its interconnection point with the Northern Converter Station will also result in temporary and localized impacts to the surrounding wetland areas. Impacts to wetlands will be minimized by utilizing narrow trenching and compact work areas. The Northern Land Route will cross approximately 1,600 linear feet of Wetland 4 in this area. The AC Transmission Cable from the Substation to the Converter Station however, will be installed through the use of HDD, which will greatly minimize impacts. The DC Transmission Cable will be installed using open trench cutting and direct burial/backfill methods.

WPP will develop a wetland mitigation plan to compensate for the loss of form or function of a portion of the freshwater wetlands at the Northern Converter Station site. The wetland mitigation plan will be designed to mitigate the loss of wetland values and benefits. The wetland impact mitigation plan will be developed in consultation with state and federal agencies.

The use of HDD installation will minimize impacts to Wetland 4 to the maximum extent possible as it is an underground conduit installation method which avoids direct disturbance of surface wetlands, soils, and water. HDD will minimize soil disturbance in wetlands by avoiding the need to clear cut surface vegetation and construct a trench for the cable. The HDD operation will instead install the cable below the ground surface for a distance of approximately 2,500 feet, thus avoiding wetland impacts. The final locations of the entry and exit boreholes will be developed during the EM&CP stage of the project. However, the anticipated set-up involves a drill rig staging area approximately 65 feet long by 8.5 feet wide. This staging area will include an HDD/bentonite pit (approximately 8 feet wide by 12 feet long), for operating the mud system and drilling operation.

The HDD construction process will involve the use of bentonite drilling fluids in a mineral water slurry in order to transport drill cuttings to the surface for recycling, aid in stabilization of the in situ sediment drilling formations, and provide lubrication for the HDD drill string and down-hole assemblies. There is a potential for the bentonite drilling fluid to be inadvertently released to the surface. A release of drilling muds from the borehole could result in a temporary direct impact to wetlands. To avoid or minimize the potential impacts from a drill mud release, the drilling operation will be closely monitored. In addition, WPP will develop and implement a fluid loss response plan in the event that a fluid loss occurs. These response plans include drill stem adjustments, injection of loss circulation additives such as Benseal® that can be mixed in with drilling fluids at the mud tanks, and other mitigation measures as appropriate. The bentonite drilling fluid would be removed from the wetland should a loss of fluid occur.

The DC cable near the Northern Converter Station will be installed using standard utility trenching and installation techniques. The site will first be prepared by removing vegetation within the construction corridor. This will lead to the temporary loss of wetland vegetation and the potential transport of sediment to adjacent wetland areas outside the construction corridor. Vegetation clearing in adjacent upland areas also has the potential to impact wetlands through sedimentation from runoff. Wetlands may be indirectly impacted as a result of vegetation clearing in uplands through localized alteration of existing hydrology and changes in shading levels within adjacent wetlands.

After vegetation clearing is completed, the trench will be excavated, with soils temporarily stockpiled adjacent to the trench. Excavation will be performed with standard earthmoving equipment, including excavators and backhoes, and will be performed in accordance with applicable health and safety standards. After the cables are installed, the trenches will be backfilled using excavated soil and/or in combination with clean thermal backfill.

Erosion control measures will be utilized and installed prior to the start of construction for both HDD and standard trenching operations. The erosion control measures will reduce the potential for sedimentation in wetlands from stormwater runoff and will also be used to define the work areas. Trenches will be backfilled with existing native soil and any excess soil will be removed offsite for proper disposal. Temporarily disturbed wetland areas will be regraded to match existing conditions and seeded with a native wetlands seed mix to stabilize soils and establish native vegetation.

Tidal Wetland Impacts and Mitigation

The In-River Transmission Cable does not cross any NYSDEC-designated Hudson River tidal wetlands. Therefore, these wetland systems will not be adversely impacted or directly disturbed by the Project.

Some tidal wetlands may be indirectly impacted by increased turbidity of riverbed sediments during jet plow embedment of the In-River Cable below the river bed. However, these temporary levels of jet-plow induced turbidity in the river-estuary system are well within the range of natural variation these wetlands experience during any hydrologic year. SSFATE, a 2-dimensional analytical model was used to model the anticipated suspended sediment dispersion (as Total Suspended Solids or TSS) resulting from jet plow embedment of the In-River Cable. SSFATE predicts that increases in TSS concentrations will be limited to the near-bottom portion of the water column. The portion of the temporary turbidity plume at concentrations >200 mg/L is predicted to remain in the bottom 3-4 meters (10-13 feet) of the adjacent water column, with concentrations decreasing to approximately 10 mg/L or less 5-8 m (16-26 feet) above the bottom into the middle and upper water column. TSS concentrations are similarly expected to decrease rapidly with horizontal or lateral distance from operations; concentrations at or above 200 mg/L are expected to remain within 95 m (312 feet) of the operating jet plow. Increased TSS concentrations were predicted to be short-term, with concentrations greater than 200 mg/L not expected to exceed two hours in duration, returning to ambient levels within 24 hours of jet plow passage. Therefore, as described in Section 4.5, increases in TSS will be temporary and localized; no permanent impacts to tidal wetlands will result from In-River Cable installation.

Temporary wake generation from the crew and construction service vessels may result in some indirect displacement of individual plants or breakage of leaves of plants within tidal wetlands. However, the Hudson River is a very active commercial waterway with significant vessel traffic that frequently generates large wakes and results in wave action along the shoreline. Additionally, vessels associated with the In-River Transmission Cable installation are likely to move at relatively low speeds for safety purposes. Therefore, waves generated by In-River Transmission Cable installation will not result in additional adverse impacts to fringing shoreline tidal wetland vegetation.

Floodplain Impacts and Mitigation

There will be no permanent impact to floodplain storage capacity as a result of the Project. Mapped FEMA floodplains are located only at the Northern and Southern Landfall locations near the Hudson River. The use of HDD and underground installation methods may temporarily alter the grade at these locations for the construction of the boreholes and drill pits. Any temporary change in grade at these locations by trench excavation or backfilling will be restored to existing conditions after these activities are complete. There will be no permanent additional fill placed in the mapped floodplain resulting in no change in floodplain elevation as a result of the Project. Accordingly, there is no flood storage capacity loss expected as a result of the Project.

Appropriate erosion control measures will be utilized and installed prior to construction to minimize the potential for sedimentation in the floodplain during HDD operations. The erosion controls will also define the limit of work.

Stream Impacts and Mitigation

The Southern Land Route does not cross any streams; therefore, there will be no stream impacts associated with the Project at its southern end. The Northern Land Route crosses three streams (Wetland 5, 6 and 8) along Leeds Athens Road. The Land Cable will be installed in the edge of the roadway ROW and the streams will not be directly impacted by construction.

Trenches will be excavated in roadway edges or within shoulders using standard utility trenching and installation techniques and equipment, with spoils being temporarily stockpiled adjacent to the trench. The three streams currently pass under the road via culverts; therefore, the trench will be installed either above or below the existing culvert and there is no impact to stream flow anticipated. The trench will be backfilled after the Transmission Cable is installed. The surface disturbance associated with the trenching work has the potential to indirectly impact streams as a result of stormwater runoff and sedimentation. Sedimentation can lead to increased turbidity levels and reduced dissolved oxygen levels within adjacent streams. Contaminants associated with construction, such as oils, greases, fuel, chemicals and/or other hazardous material may also impact streams as a result of stormwater runoff. West Point Partners will develop a Stormwater Pollution and Prevention Plan to minimize the potential for water quality degradation of streams along the Northern Land Route and to be in compliance with the State Pollution Discharge Elimination System.

Erosion control measures will be utilized and installed prior to the start of construction for the trenching and cable installation operations. The erosion control measures will reduce the potential for sedimentation in streams from stormwater runoff and will also be used to define the work areas. Any temporarily disturbed areas along the edge of the roadway will be graded to existing conditions and seeded with a native seed mix to stabilize the site and allow for vegetation re-establishment.

Groundwater Impacts and Mitigation

There are no state designated aquifer zones or other sensitive groundwater resources identified within the Project Area. Therefore, the installation and operation of the Land Cable will not have any impacts on groundwater.

During construction, dewatering may be necessary to control surface or subsurface water to allow for the necessary construction activities to be performed.

Dewatering may be required during standard trenching in low-lying areas and also may be required during the installation of the Transition Vaults, proximal to the Hudson River at both landfalls. Dewatering will be performed using standard construction practices including the installation of temporary sumps and/or gravel backfill to allow for the operation of dewatering pumps and to allow dewatering to the target depth or elevation.

Pump intakes will be positioned and screened to minimize the intake of sediment, to the extent practical. Sediment content of pumped water will also be controlled using typical construction techniques, such as portable sediment tanks or sediment filter bags. If it is not possible to use either portable sediment tanks or filter bags, an energy dissipation device, such as a haybale basin, will be used to reduce the energy of the pumped water to avoid erosion and to reduce the sediment load by allowing the sediment to settle out within the haybale basin. This may be the preferable option during the installation of the Transition Vaults proximal to the Hudson River. The haybale basin is typically underlain by polyethylene sheeting or geotextile fabric to minimize erosion within the basin. The polyethylene sheeting or geotextile fabric can also be extended downgradient of the haybale basin to minimize the potential for erosion at the point of discharge from the basin. All equipment used during the dewatering process will be removed from the site as soon as possible after the construction activities have been completed.

Sediment collected within any of the sediment control devices (e.g., portable sediment tank, filter bags, haybale basin) will be utilized at the construction location to the extent possible, at an acceptable distance from any wetlands or water bodies. Any excess soil or sediment will be managed off-site in a state-approved solid waste disposal facility.

If any contaminated groundwater is encountered in any of the construction areas potentially requiring dewatering, WPP will consult with DPS and DEC to address discharge or off-site management of the pumped water.

4.3.2.2 Potential Operational Impacts and Mitigation

Operational impacts associated with the Project will be minimal. Only in unusual circumstances would temporary and localized re-trenching be required, similar to a standard underground electric cable in roadway edges. Should these activities require work near wetlands or streams, the erosion control measures utilized during construction will be implemented to further minimize the risk of environmental impacts.

Potential impacts to wetlands as a result of the Northern Converter Station operation include incidental spills or releases, stormwater runoff control and building shading effects. The Converter Station building will be a low profile building sized to house the voltage converter systems. It will be operated in accordance with federal and state operating requirements and maintain spill prevention and containment equipment and measures to contain or clean-up any releases that may occur on-site.

WPP will develop a Spill Prevention, Control, and Countermeasure Plan for both Converter Station sites similar to those prepared in past projects that will be utilized in the event of a spill. Stormwater will be managed in accordance with the Stormwater Pollution Prevention Plan that will be developed for the Project.

4.4 Lower Hudson River Physical Characteristics

This section describes the physical characteristics of the riverbed and sediments present in the In-River Project Area to identify and assess potential impacts during Project construction, operation, and maintenance activities. The following information is based on existing published information, literature review, site specific field survey, and correspondence with regulatory agencies.

4.4.1 Existing Conditions

This section describes physical conditions present within this portion of the Hudson River-Estuary, covering a 200-foot wide in-river study corridor approximately 75 miles long between Athens and Cortlandt, New York. The results of a comprehensive project-specific geophysical field program conducted in August/September 2012 and other published studies regarding geophysical and geotechnical conditions in the area of the study corridor are summarized in the sections below. The results of the field program were used to assist In-River Cable routing and constructability assessments. The data were also used to model and assess potential impacts associated with In-River Cable installation and operation.

4.4.1.1 Tides and Currents

The hydrodynamics in the Lower Hudson River are mostly driven by tides and tidal currents and estuarine circulation resulting from horizontal and vertical salinity gradients (NOAA, 2013). Other factors that play a smaller role are wind-driven currents and freshwater flow.

- **Tidal Currents:** The strong tidal currents in the Project Area are responsible for near-surface and near-bottom turbulence that results in high levels of total suspended solids (particularly during spring freshets) and naturally maintained deep water channels. Freshwater flows contribute to the currents in the Project Area, particularly during spring high flow events where freshwater discharge displaces the typical bi-directional estuarine flow patterns.

- **Estuarine Circulation:** The flow patterns of the Lower Hudson River along the In-River Cable Route also are well documented to have bi-directional flow type estuarine circulation due to seasonal horizontal and vertical variations in bottom salinity profiles in the estuary. The estuarine circulation pattern (net outflow of near-surface waters and net inflow of near-bottom waters) is driven by these fluctuating horizontal salinity gradients. The vertical salinity gradient (known as stratification) augments the estuarine circulation by reducing mixing between the near-surface and near-bottom waters, and is influenced by freshwater inflow and spring-neap tidal variations.

Tides in the Hudson River are semi-diurnal (i.e., two tidal cycles per day). These tides are primarily affected by freshets, winds, and droughts. Freshets occur during the spring when tidal oscillations diminish and times of high and low waters are delayed. The National Oceanographic and Atmospheric Administration (NOAA) monitors tidal conditions at two stations in the area of the In-River Cable Route. NOAA tide station No. 8518924, located in Haverstraw Bay, New York, is approximately 7 miles south of the Southern Landfall. At this station, the mean tide elevation is 1.78 feet mean lower low water (MLLW) and the tidal range from mean high water (MHW) to mean low water (MLW) is 3.23 feet. NOAA tide station No. 1551, located near Albany, New York, is approximately 30 miles north of the Northern Landfall. At this station, the mean tide is 2.71 feet MLLW and the tidal range from MHW to MLW is 4.98 feet.

Because of the variability in the natural tidal fluctuations over the approximately 75 miles of river within the Project Area, the standard vertical datum NAVD88 will generally be used for describing tidal elevations in this document.

At the Haverstraw Bay tide station, MLLW is 1.64 feet below NAVD88, and at Albany MLLW is 1.80 feet below NAVD88. To make conversions between MLLW and NAVD88 for the Project, it has been assumed that 0 feet NAVD88 equals -1.64 feet MLLW between RM 38 and RM 91, and that 0 feet NAVD88 equals -1.80 feet MLLW between RM 91 and RM 145.

Currents in the Hudson River in the In-River Project Area are primarily influenced by tides with secondary influence from freshwater flows and wind forcing. These currents are primarily fair, except near wharves and bends, and durations of flood and ebb are subject to extensive changes (NOAA 2013). The NOAA current station most proximal to the Northern Landfall is at Hudson, NY, where tidal currents are ebb-dominated with an average predicted maximum speed of 2.0 knots. Moving southerly, the NOAA current station at Saugerties is ebb-dominated with an average predicted maximum speed of 1.9 knots. The NOAA current station at Poughkeepsie, NY is ebb-dominated with an average predicted maximum speed of 1.2 knots. The NOAA current station at West Point, NY is ebb-dominated with an average predicted maximum current of 1.1 knots. The NOAA current station in the vicinity of the Southern Landfall at Haverstraw Bay (approximately 1.7 miles south of the landfall) is ebb-dominated with an average, predicted maximum speed of 1.2 knots. The average predicted maximum flood current at Hudson, NY and Haverstraw are 1.6 knots and 0.8 knots, respectively (Nobeltec Tides and Currents, version 3.5.107).

4.4.1.2 Federal Channels and Dredging

The following information regarding the dredge history of Federal Navigation Projects within the In-River Project Area was obtained through email correspondence with Mr. Robert Berrian of the United States Army Corps of Engineers (USACE) New York District Inland Waterways Division (Albany Field Office) in February of 2012. Information was requested for the following Federal Channel maintenance dredging activities, which are in the vicinity of the In-River Cable Route: North Germantown Reach, Malden Reach, Tivoli Reach, Barrytown Reach, and Kingston Point.

For all of the Federal Channels listed above, the authorized project depth is 32 feet below mean low water (MLW) [33.58 feet below NAVD88]. During previous dredge events on these navigation channels, the USACE allowed for a one (1) foot over-dredge.

The recent history of dredging activity for each of the Federal Channels in the In-River Project Area is presented below:

North Germantown Reach (RM 107-110): Maintenance dredging was performed in 1979, 1986, 1995, 2001, and January 2013. A contract to dredge approximately 186,000 cubic yards (CY) of maintenance material from the Hudson River at North Germantown was awarded on August 7, 2012 to Dutra Dredging Company. Work in the dredged material placement site commenced on September 10, 2012 and in-water work commenced on October 06, 2012 (USACE, 2013). In-water work was completed in January of 2013. Sediment composition within the maintenance dredge area is described in the USACE contract documents as being 0.0% gravel, 76.2% sand, 17.2%silt, and 6.6% clay.

Malden Reach (RM 104-105): Maintenance dredging was performed in 1993 and 2003. Condition surveys are performed annually to prioritize maintenance dredging requirements. Subject to available funding and prioritization, maintenance dredging of this reach may be scheduled within a five year time frame (2012-2017).

Tivoli Reach (RM 100-101): No maintenance dredging has been performed since the last deepening project (to 32 feet below MLW / 33.58 feet below NAVD88) during the 1960s.

Barrytown Reach (RM 96-97): No maintenance dredging has been performed since the last deepening project (to 32 feet below MLW / 33.58 feet below NAVD88) during the 1960s.

Kingston Point (RM 92-93): Maintenance dredging was last performed in 2007. Condition surveys are performed annually to prioritize maintenance dredging requirements. Based on the latest condition surveys and funding limitations, the USACE does not anticipate performing maintenance dredging of this reach within the next five years (2012-2017).

The dredged material from these maintenance activities are brought to a single, federally owned upland site on Houghtaling Island, which is north of the In-River Project Area, for disposal.

<u>4.4.1.4 Technical Studies Completed</u>

This section describes project-specific technical studies that were performed to characterize the hydrography and riverbed conditions along the In-River Cable Route.

<u>Geophysical Studies</u>

A site-specific geophysical survey of the conditions along the In-River Cable Route was conducted for WPP in August 2012 (Alpine, 2013). The purpose was to collect geophysical data to be used for general assessment of the planned route.

The goal of the survey was to:

1. Determine water depths within a 200-foot wide corridor between Athens, NY and Cortlandt, NY using multibeam echo sounder (MBE).
2. Map riverbed features along the route using side scan sonar.
3. Determine depths to major sedimentary layers using subbottom profiling.
4. Map significant magnetic anomaly targets, such as cables and pipelines located across the route, using a magnetometer.

The data were collected utilizing the R/V *Henry Hudson*, a 45-foot survey vessel. The geophysical survey was conducted along a 200 foot wide and approximately 75-mile long corridor. Survey lines were acquired along the centerline of the corridor with wing lines surveyed at 50 feet and 100 feet to either side of the centerline. Two sections for a potential alternate route were also completed from Esopus Creek to Cementon (a deviation around Green Flats) and from the Rip Van Winkle Bridge to the northern end of the survey corridor. In these areas, survey data were acquired along lines at 50 feet on either side of the centerline to achieve a 100-foot wide corridor. Additionally, cross lines were run every 1,500 feet perpendicular to the route as a quality control check. In addition to the planned alternate survey lines described above, when obstructive targets were located, supplementary lines were run to seek out potential cable re-route options to avoid the obstructions. The survey report (Alpine, 2013) contains additional technical details and specific equipment used for the survey.

Because of the variability in tidal elevations over the approximately 75 miles of river within the In-River Project Area, the vertical datum NAVD88 was used for the survey work to provide a consistent point of reference throughout the survey.

The results of the survey described in this section were used to develop the final proposed In-River Cable Route, as shown in Exhibit 2. The section below addresses only the final proposed route. Side scan sonar targets and magnetic anomalies are also described in the context of Cultural Resources (Section 4.11).

Geotechnical Studies

A geotechnical study involving sediment sampling, thermal resistivity measurements, and benthic grab sampling was conducted along the survey corridor established during the geophysical survey.

Sediment cores were collected from 56 vibracore stations, at variable spacing (see Figure 4.4-1), along the proposed In-River Cable Route with a total of 60 sediment samples analyzed. A pneumatic vibracore sampler was utilized to collect cores between 5 and 15 feet long, with a few greater than 15 feet but none more than 19 feet in length. Vibracore sampling locations were selected based on the geophysical data in order to ground truth bottom types and verify the riverbed mapping available through the NYSDEC Hudson River Estuary Program (see Figure 4.4-1). Fifty (50) cores were collected along the proposed jet-plow embedment area of the route (VC-01 through VC-50), three cores were collected from a proposed northern temporary cofferdam/dredge landfall location (VC-L1, VC-L2, VC-L3)[1], and three cores were collected from a proposed southern temporary cofferdam/dredge landfall location (VC-L4, VC-L5, VC-L6). The target penetration depth was approximately 10 feet below the sediment-water interface. At each of the 56 sampling sites, ESS also conducted a benthic grab sample. At sites VC-L2, VC-18, and VC-50, additional samples were obtained to determine thermal resistivity and thermal dry out characterization at 5, 10, and 15 feet below the sediment-water interface.

Each vibracore was logged, photographed, and characterized prior to sampling. Sediment samples from the vibracores were analyzed for the following physical characteristics:

- ASTM Classification based on Particle Size Analysis (ASTM D422)
- Moisture, Ash, & Total Organic Matter Content (ASTM D2974)
- Specific Gravity (ASTM D854)
- Atterberg Limits (ASTM D4318)

Analytical results for the physical characteristic laboratory analyses are provided in Appendix 4B and described briefly in Section 4.4.1.6 below.

Each sediment sample was also analyzed for the following bulk chemical parameters:

- Total Organic Carbon (TOC) – EPA Method 9060.

[1] The sampling was performed at what has become an alternate landfall location. Since the time when the sampling was completed, the ability to use this location for the Project has become less likely. Sampling at the Northern Landfall location presented in this Article VII will be completed in the summer of 2013 and the results will be submitted under separate cover.

- Metals – Samples were analyzed for arsenic, cadmium, copper, and lead (As, Cd, Cu, and Pb) using EPA Method 6020A and for mercury (Hg), using EPA Method 7474.
- Polycyclic Aromatic Hydrocarbons (PAHs) – EPA Method 8270.
- Volatile Organic Compounds (VOCs) – Samples were analyzed for benzene, toluene, ethylbenzene, and xylenes using EPA Method 8260C.
- Pesticides – EPA Method 8081B.
- Polychlorinated Biphenyl (PCB) Aroclors – EPA Method 8082A.
- PCB Congeners – The six (6) samples with the greatest PCB aroclor concentrations were analyzed for PCB congeners using EPA Method 8270D-SIM/NOAA-M.
- Dioxins/Furans – The six (6) samples with the greatest PCB aroclor concentrations were analyzed for dioxins/furans using EPA Method 1613B.

Analytical results for the bulk chemical parameters are provided in Appendix 4B and discussed in the context of Sediment Quality (Section 4.5).

4.4.1.5 Geophysical Characteristic Results

This section summarizes the findings of the geophysical survey. Due to variability in riverbed characteristics and features throughout the survey route, the survey result summary has been divided into the following sections.

1. Athens to Cementon - RM 116 - RM 107
2. Cementon to Ulster Landing - RM 107 - RM 98
3. Ulster Landing to Esopus Meadows Point - RM 98 - RM 87
4. Esopus Meadows Point to Highland - RM 87 - RM 77
5. Highland to Cedar Cliff - RM 77 - RM 67
6. Cedar Cliff to Cornwall-on-Hudson - RM 67 - RM 57
7. Cornwall-on-Hudson to Ft. Montgomery - RM 57 - RM 48
8. Ft. Montgomery to Verplanck Landing - RM 48 - RM 42

For the purpose of this section, the term reflectivity refers to acoustic reflectivity measured using the side scan sonar. High values for acoustic reflectivity typically correspond to hard substrate (e.g. rock, gravel, coarse sand) and low reflectivity typically corresponds to soft substrate (e.g. organic material, mud, soft clay). Also, the term reflector refers to an acoustic reflector identified using the subbottom profiler system, which often corresponds to sediment layer boundaries in the subsurface geology.

Athens to Cementon (RM 116 - RM 107)

Water depths along this section of the River range from approximately 8-feet to 61-feet (below NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

Small to large sand ripples and waves are evident in the multibeam and side scan data along the majority of this section. The base of the sand ripples and waves was often observed on the subbottom profiler data, at depths ranging from 1.6 feet up to 7.3 feet, but acoustic penetration appears to be limited below that depth. It is possible that this represents a mobile sand layer overlying glacial sediments or silty clay material. Occasionally the sand waves were interrupted by flat lying areas of riverbed with limited penetration which may represent the underlying sediments.

There is an area of high reflectivity scouring from approximately RM 110 to 109.5 and additional scouring around two possible wrecks near RM 110, approximately 37 feet west of the proposed centerline.

Cementon to Ulster Landing (RM 107 - RM 98)

Water depths along this section of the River range from approximately 13-feet to 85-feet (below NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

The proposed In-River Cable Route runs along a narrow channel on the eastern side of the river that breaks from the main channel around RM 107 and continues to RM 102. The narrow channel is bounded to the west by the Upper Flats at the northern end and Green Flats on the southern end, according to NOAA chart 12347.

Throughout this section, there is a relatively smooth riverbed with occasional areas of sand ripples/waves ranging from medium to high reflectivity. The sand ripples/waves generally encroach on the In-River Cable Route from the western side of the corridor. There are seven (7) outcrops from RM 104 to 103.5 that have a higher reflectivity and appear gravely. They average 198 feet long by 80 feet wide. The survey area from RM 101.5 to 101 appears to be potentially rocky or have a harder substrate (higher reflectivity).

Subbottom data yielded a depth range to the base of the sand waves and ripples in this section of approximately 1.2-feet to 7.3-feet. Areas with no reflectors are likely flat-lying silts and clays containing biogenetic gas, and the shallow reflector may be reflecting a gravelly layer within a silt or clay matrix.

Ulster Landing to Esopus Meadows Point (RM 98 - RM 87)

Water depths along this section of the River range from approximately 13-feet to 83-feet (below NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

Between RM 97.5 and 91.0 the riverbed appears relatively smooth with only small intermittent fields of sand ripple/waves. From RM 91 to 90, the geophysical data indicates that sediments have been disturbed as evidenced by circular outcrops of medium reflectivity riverbed on the side scan sonar. RM 90 to 87 is a relatively flat area with a striated appearance from scouring of small debris/gravel. There are two small rock outcrops in this section at RM 87.5 and RM 87 that are 115 feet west and 163 feet east respectively from the proposed centerline. In the vicinity of RM 87 the riverbed exhibits varied reflectivity and disturbed looking surface.

The base of the sand ripples is not easily discernible in this section, but crest to trough heights are observed to range from 0.8 to 1.6 feet.

No subbottom reflectors are observed in this section, which may indicate the presence of biogenetic gas within the sediments. Sediments are likely flat-lying silts and clays, which are overlain by mobile sands in the sand ripple areas.

Esopus Meadows Point to Highland (RM 87 - RM 77)

Water depths along this section of the River range from approximately 15.5 feet to 143 feet (below NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

From RM 86.5 to 85 the riverbed appears to be smooth with low to medium reflectivity. Between RM 85 and 84.5 the riverbed appears mottled, which may be an indication of a disturbed bottom. From RM 84.5 to 83, the riverbed is generally smooth with medium to high reflectivity and potential areas of exposed rock along the eastern side of the corridor in the vicinity of Bard Rock. Between RM 83 and 80 the riverbed exhibits a smooth medium to high reflective surface with a rockier surface and rock outcrops along the western edge of the corridor. From RM 80 to 79.5 the riverbed is mottled or disturbed with medium to high reflectivity and a possible rock outcrop at RM 80. From RM 79.5 to 77 the riverbed returns to a relatively smooth bottom with medium reflectivity and a rock outcrop at RM 79.5 (152 feet east of centerline).

Very few subbottom reflectors are observed below the riverbed in this section, which may be due to masking by biogenic gas within the sediments. Only a single reflector near RM 80 was observed, reaching a maximum depth of 7.7 feet below the riverbed.

Highland to Cedar Cliff (RM 77 - RM 67)

Water depths along this section of the River range from approximately 28 feet to 118 feet (below NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

Between RM 77 and 76.5, the riverbed is smooth with medium reflectivity which transitions into a mottled riverbed around RM 76.5. From RM 76.5 to 73.5 the riverbed appears mottled with intermittent sand ripples with medium to high reflectivity. The riverbed is smooth with medium reflectivity from RM 73.5 to 70.5. Within this section, however, there is a large rock outcrop at RM 73.5 on the east side of the corridor with a deep scour that encroaches on the centerline. There are also rock outcrops on the west side of the corridor from RM 71.5 to 71. The mottled looking bottom reappears from RM 70.5 to 69. RM 69 to 68.5 exhibits a smooth bottom with medium reflectivity followed by another mottled area to RM 67.5 where it returns to being smooth. From RM 67.5 to 67 there are multiple rock outcrops within the route and on the western edge of the corridor.

Diamond Reef is a shallow rocky reef located at RM 67. The In-River Cable has been routed to the western side of the reef where the riverbed appears to be scoured but absent of rock. A possible ridge runs south from the Reef and is possibly comprised of gravel.

The subbottom data in this section of the route is characterized by intermittent areas with no observed reflectors and areas where a shallow horizon is visible below the riverbed. Areas with no reflectors are possibly areas of flat-lying silts and clays containing some biogenic gas.

Cedar Cliff to Cornwall-on-Hudson (RM 67 - RM 57)

Water depths along this section of the River range from approximately 15 feet to 145 feet (below NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

From RM 67 to 66 the riverbed has spotted high reflectivity (possibly gravel) on a smooth medium reflective riverbed. The riverbed returns to a smooth medium reflectivity from RM 66 to 65.5 but has circular highly reflective features that may correspond to gravel areas. From RM 65.5 to 62.5 the riverbed exhibits a speckled look with small scouring and sedimentation buildup around small debris or gravel, which transitions to a mottled looking bottom with medium to high reflectivity. From RM 62.5 to 59 the riverbed is smooth with a medium reflectivity with intermittent higher reflectivity mottling. The mottled riverbed returns from RM 58.5 to 58 then transitions into speckled (possibly gravelly) bottom from RM 58 to 57.

The subbottom data in this section of the route is characterized by an intermittent shallow reflector between areas with no observed horizons. The character of the seismic data where the reflectors are visible also appears to change where the magnitude of the riverbed and multiple return signals are relatively reduced. This change in character may be due to the presence of biogenic gas within the sediments where no reflectors are observed. The shallow reflector could be indicating a gravelly layer within a silt or clay matrix.

Cornwall-on-Hudson to Ft. Montgomery (RM 57 - RM 48)

Water depths along this section of the River range from approximately 17 feet to 179 feet (relative to the NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

The riverbed is smooth from RM 57 to RM 56, at which point the riverbed exhibits evidence of scouring until RM 55. From RM 55 to-53.5 there are transitions from mottled or disturbed riverbed with high reflectivity to smoother with medium reflectivity. From RM 54 to-53.5 the high reflectivity is observed, which indicates a rocky or hard substrate. Directly south of Constitution Island, the riverbed is rocky until RM 52. Three potential rock outcrops/debris piles exist between RM 53.5 and 52.5.

From RM 52 to 48 subbottom data shows a relatively smooth riverbed with low to medium reflectivity. There are some rock outcroppings along the east side of the survey corridor from RM 51 to-49.5 and a possible cable near RM 51. From RM 49.5 to 48 the riverbed is slightly more reflective but still smooth with the exception of a highly reflective linear riverbed feature with relief surrounded by small, highly reflective debris or rocks at RM 49.5. From RM 48 to 47.5 there are rock outcrops that jut out from the west into the route but on the eastern side of the corridor, the riverbed appears smoother with medium to high reflectivity.

Ft. Montgomery to Verplanck Landing (RM 48 - RM 42)

Water depths along this section of the River range from approximately 5 feet to 174 feet (below NAVD88) due to the proximity of the route to naturally occurring nearshore shallow water and to the center of the deep water channel at various locations along the route segment.

From RM 47.5 to 46.5 the riverbed is smooth with low reflectivity and rock outcrops along the western edge of the survey corridor. RM 46.5 to 46 is a highly reflective mottled area that could potentially be rocky. From RM 46 to 44 the bottom returns to being smooth with medium to low reflectivity excluding the rock outcrops to the far west of the survey corridor. RM 44 to 43.5 exhibits a medium to high reflective mottled bottom with a few small sand ripples transitioning back into a smooth riverbed with some striating and scouring from small debris or gravel until RM 42.5. From RM 42.5 to 42 the riverbed becomes mottled again with a medium to high reflectivity through a mapped pipeline area. In the vicinity of RM 42 the riverbed appears to be smooth with medium to high reflectivity.

The subbottom data along this section of the route shows a discontinuous shallow horizon between areas with no visible seismic reflectors. This horizon may reflect a layer of gravel within a silt or clay matrix. The areas with no reflectors may be the result of masking by biogenic gas within the sediments, which are expected to comprise flat-lying silts and clays. A small rock outcrop is also evident near RM 47.

4.4.1.6 Geotechnical Characteristic Results

Physical Characteristics Results

Physical characteristic results from sediment samples taken along the In-River Cable Route are included in Table 1 of Appendix 4B and summarized below. Figure 4.4-1 shows the sample locations, overlain on existing Hudson River sediment mapping data obtained from the NYSDEC Hudson River Estuary Program. In general, the site-specific sediment data corresponds well with the bottom type characterizations provided by the NYSDEC.

On the basis of grain size analysis, the northern portion of the route (VC-L1 through VC-17) is classified as sand, including SM (silty sand, 15 of 20 samples) and SP-SM (poorly graded sand with silt, 3 of 20 samples). The remainder of the route (VC-18 through VC-L6) is classified predominately as silt and clay, including CH (fat clay, 26 of 40 samples), ML (silt with sand, 6 of 40 samples), MH (elastic silt, 4 of 40 samples), and CL (sandy lean clay, 1 of 40 samples).

Ash Content is a measure of the nonvolatile inorganic matter in a soil. Ash Content values range from 92.5 milligrams per kilogram (mg/kg) (VC-16-S1) to 99.5 mg/kg (VC-02-S1). The majority of the samples had Ash Content above 95 mg/kg.

Organic matter is a measure of the carbon-based matter within a soil. Organic Matter values range from 0.5 mg/kg (VC-02-S1) to 7.5 mg/kg (VC-16-S1). All samples had organic matter values below 5 mg/kg except VC-16-S1, VC-26-S2 (5.4 mg/kg), VC-27-S1 (5.4 mg/kg), VC-28-S1 (5.5 mg/kg), VC-32-S1 (6.4 mg/kg), VC-42-S1 (5.1 mg/kg), VC-L4-S1 (5.3 mg/kg), VC-L5-S1 (6.1 mg/kg), and VC-L6-S1 (6.4 mg/kg).

Liquid Limit is a descriptive soil property that indicates the moisture content at which a soil sample would behave as either a plastic (moisture content below Liquid Limit) or a liquid (moisture content above Liquid Limit). Liquid Limit values range from 30 (VC-20-S1) to 94 (VC-46-S1).

Plastic Limit is a descriptive soil property that indicates the moisture content at which a soil sample would behave as either a semi-solid (moisture content below Plastic Limit) or a plastic solid (moisture content above Plastic Limit). Plastic Limit values range from 23 (VC-09-S1 and VC-20-S1) to 36 (VC-49-S1).

Moisture Content values range from 22% (VC-14-S1) to 120% (VC-46-S1). Cohesive sediment samples with moisture content between the Liquid Limit and Plastic Limit will behave like a plastic. Thirty-three of the 40 cohesive sediment samples (with the exception of VC-03-S1, VC-19-S1, VC-27-S1, VC-31-S1, VC-36-S1, VC-43-S1, and VC-47-S1) have moisture contents greater than their respective Liquid Limits. The moisture content of the exceptions listed above is greater than the Plastic Limit. Twenty of the 60 samples were non-cohesive sandy sediments.

Plasticity Index values range from 10 (VC-CB07-S2) to 97 (VC-CB50-S1). Plasticity index is the difference between Liquid Limit and Plastic Limit, which provides information about the range of water contents over which a soil exhibits plastic properties.

4.4.2 Environmental Impacts and Mitigation

4.4.2.1 Potential Construction Impacts and Mitigation

This section provides a characterization of potential impacts to water depths, currents, and riverbed sediment in the Hudson River. Descriptions of potential impacts to water quality from sediment disturbance are provided in Section 4.5.2.

The aspects of the Project that could result in potential impacts to the in-river physical characteristics are associated with installation of the In-River Transmission Cable. These construction activities are primarily the jet plow embedment of the cable and dredging within the temporary cofferdams at the two landfall locations. The use of low-impact jet plow embedment technologies and HDD environmental drilling methods for In-River Transmission Cable installation combined with the short-term duration of these activities and adherence to agreed upon in-water work windows will serve as appropriate mitigation and avoidance of potential Project-related impacts.

Jet Plow Embedment

The method of installation for the In-River Transmission Cable is the jet plow embedment process. Jet plow equipment uses pressurized river water to fluidize the *in situ* sediment column along a predetermined cable route such that the In-River Transmission Cable settles into the trench under its own weight to the planned depth of burial. Exhibit E-3 provides a detailed description of the jet plow embedment process that will be used for the Project.

The jet plow embedment process is specifically designed to "fluidize" *in situ* sediments within the limits of the trench so that the cable can naturally settle by gravitational forces to the designed burial depth after being laid near the bottom of the trench by the jet plow. The hydrodynamic processes resulting from the fluidization of the sediment result in a volume displacement of consolidated sediment that exceeds the volume capacity of *in situ* sediment conditions within the limits of the trench prior to fluidization by the jet plow. Accordingly, the jet plow operation is not intended to "blow out" the sediment from the trench; instead, the fluidization process creates excess porosity that displaces consolidated *in situ* sediment volume outside the limits of the trench. The percentage of the *in situ* sediment volume displaced out of the trench and into the water column is dependent upon *in situ* sediment geotechnical conditions (grain size, moisture content, consolidation, etc.), the geometric dimensions of the trench, and the hydraulic forces imposed on the sediment by the jet plow to fluidize the sediment column in the trench.

Since the actual fluidization of *in situ* sediments by the jet plow device is primarily a function of the geotechnical characteristics of the actual sediment column to be disturbed, the equipment to be used in the jet plow process, and the operating characteristics of the jet plow device, the relative amount of *in situ* volume to be displaced outside the limits of the trench is route specific.

The jet plow will be configured to fluidize sediment to a depth between 9.5 and 16.5 feet below the present riverbed, depending on whether the cable is located outside or within the federal channel. The depths are 1.5 feet deeper than the minimum design burial depth of 8 feet and 15 feet below present bottom to account for the diameter of the cables and to allow for burial to the required depth. The vertical trench cross section will be approximately 14.25 to 24.75 square feet.

Based on a review of expected sediment conditions along the In-River Transmission Cable Route and on the planned depth of burial, the selected installer is planning for an average rate of jet plow advancement of 98 feet per hour. This rate of advancement has been used to assess potential impacts. The jet plow embedment process for cable installation is expected to take approximately 48 days, based on the above rate of advancement.

Based on the relevant information, combined with direct experience of the installer with similar equipment in similar types of sediments and the knowledge, experience and judgment of the scientific team evaluating the issues for similar projects, it is estimated that of the volume of *in situ* sediment within the jetted trench, approximately 25% of this volume will exit the trench and be subject to transport and deposition by ambient tidal currents and circulation. The remaining

75% of that volume will remain inside the incised trench below the level of the surrounding riverbed and settle within the trench.

This level of volume displacement/retention partitioning within the jetted trench has been previously studied and documented in other underwater transmission cable projects using similar equipment in similar sediments. Similar volume partitioning ratios have been critically reviewed, evaluated and accepted by state regulatory agencies for similar underwater transmission cable installation projects such as the Hudson Transmission Project, the Bayonne Energy Center Project, and the Long Island Replacement Cable Project.

The model predicts that a cumulative suspended sediment deposition greater than 2 mm (0.08 in) will generally occur along the path of the operating jet plow and extend up to 300 feet from the centerline, covering an area of approximately 227 acres of adjacent river bed surface area. Based on this area and the length of the In-River Transmission Cable Route between the landfalls, the average total lateral extent of the sediment deposition that is greater than 2 mm is approximately 600 feet, centered on the route (i.e., 300 feet to either side of the route). Deposition thicknesses greater than 2 mm generally fall along the path of the operating jet plow and will provide sediment cover for the installed cable.

The results of the sediment dispersion modeling indicate that jetting of the In-River Transmission Cable will only result in localized and short-term increases in the amount of sediment in the water column available for transport by tidal currents. In addition, the modeling indicates that sediment suspended by the jetting operation will generally be confined to the near bottom portion of the water column and return to ambient conditions within approximately 24 hours after jetting has occurred. Therefore, the Project is not expected to result in significant increases in sediment transport in the Project Area and the amount of sediment suspended by the jetting operation is within the range of natural variability that is to be expected in the Project Area. Section 4.5.2 describes potential impacts from jet plow induced increased suspended sediment concentrations in the water column.

Horizontal Directional Drilling

The use of HDD technology will avoid negative impacts to nearshore bottom conditions by drilling under the riverbed rather than excavating a trench that could change water depths along the alignment. There will be no adverse impacts to the marine physical characteristics of the Hudson River resulting from the use of HDD at the landfalls.

Temporary Cofferdams

The installation of temporary cofferdams and the dredging of sediment within the temporary cofferdams will result in changes to bottom contours while the temporary cofferdams are in place. After cable installation is complete, the temporary cofferdams will be removed and the dredged areas will be backfilled with clean fill material to restore pre-construction bottom contours.

Water Depths/Hydrographic Data

The jet plow embedment of the In-River Transmission Cable will result in the direct disturbance and displacement of sediments along the cable alignment. Slight depressions, estimated to be 2 feet deep or less, are anticipated to result from installation of the In-River Transmission Cable. Slight depressions may also be left on the riverbed by the two skids of the jet plow as it is towed along the In-River Transmission Cable Route. These depressions are expected to fill in naturally with time as a result of the natural sediment deposition and repositioning that occurs as a result of tidal currents, episodic storm events, and passage of vessels.

Based on the above analysis, potential impacts to water depths are expected to be localized and temporary.

Tidal Conditions

Installation of the In-River Transmission Cable will not result in any effects on tidal conditions in the Hudson River.

Riverbed Sediment Type

Installation of the In-River Transmission Cable will not result in changes to the types of sediments found along the In-River Transmission Cable Route. Sediments will be suspended by the jet plow embedment process, and as a result, the distribution of sediment types (fine-grained versus course grained) may be altered where sediment is suspended and then deposited on the riverbed. As described above, approximately 75% of the sediment is expected to remain within the trench and sediment suspended by the jet plow is expected to settle into areas near the cable trench. Therefore, the impacts to sediment type are expected to be minimal.

4.4.2.2 Potential Operational Impacts and Mitigation

Operation of the In-River Transmission Cable will have no adverse impacts on water depths, tidal conditions or types of sediments found along the In-River Transmission Cable Route. The In-River Transmission Cable will be buried a minimum of 8 feet below present river bottom (15 feet below authorized depth within the Federal Navigation Channel) along the majority of the route or armored by low profile (< 1 foot) concrete mattresses at select crossings coinciding with chartered cables/pipelines. Once installed, the concrete mattresses will settle under their own weight into the riverbed and sediment will be naturally deposited over the mattresses. Following installation of the cable, there will be no impacts to the physical characteristics of the sediment from Project operation.

In the unlikely event that repair of the In-River Cable is required at a certain location; the sediment above the cable in the area needing repair will be removed to expose the cable. This may be accomplished either with a jetting device or mechanical dredging. This work would temporarily affect water depths in that a depression may exist where the cable is removed. As appropriate, and in accordance with the Project's permits, the riverbed in such an area may be restored to pre-repair contours with the placement of clean sand backfill material.

4.5 Lower Hudson River Sediment and Water Quality

This section describes Hudson River sediment and water quality conditions present within the affected Project Area and the potential impacts associated with Project construction, operation, and maintenance. Section 4.5.1 presents the existing sediment and water quality conditions present within the Hudson River, extending from Athens (RM 116) to Cortlandt (RM 42), New York. Potential impacts associated with project activities are identified in Section 4.5.2. The following information is based on field surveys, existing published information, literature review, and correspondence with regulatory agencies.

4.5.1 Existing Conditions

The results of a comprehensive field program and other published studies on sediment and water quality conditions along the In-River Cable Route are summarized in the sections below.

4.5.1.1 Sediment Quality

The Hudson River has a long history of direct disposal of industrial chemical waste into the river. Elevated levels of polychlorinated biphenyl (PCB) contamination were first discovered in the sediments and fish of the Hudson River in the 1970's and by 1977 the production of PCBs was banned in the United States. Although the majority of PCB contamination was isolated to areas immediately downstream from the sources, the contamination has spread down to New York Bay; a distance of over 140 miles (Farley et al. 2006).

To assess the relative quality of sediment affected by the proposed Project, a comprehensive field program, including a sediment coring and sampling survey, was conducted along the In-River Transmission Cable Route. The sampling program was conducted in accordance with an In-River Geotechnical Sediment Sampling and Analysis Plan ("SAP"), approved by the NYSDEC and NYS DPS (see Appendix 4B). Detailed descriptions of the field surveys, including field observations and analytical results are presented in the "In-River Cable Route Field Evaluations Report" provided in Appendix 4B and summarized below.

The sediment chemistry analytical results from this program were compared to the sediment threshold values for in-water/riparian placement of dredged material specified in NYSDEC TOGS 5.1.9. Based on the concentration of contaminants identified during the chemical analysis, sediment in the Project Area is classified as Class A, B, or C, as presented in Table 2 of TOGS 5.1.9. The following are the definitions of the three Classes of sediment quality thresholds under the NYSDEC TOGS:

- Class A - No Appreciable Contamination (No Toxicity to aquatic life). - If sediment chemistry is found to be at or below the chemical concentrations, which define this class, dredging and in-water or riparian placement, at approved locations, can generally proceed.
- Class B - Moderate Contamination (Chronic Toxicity to aquatic life). Dredging and riparian placement may be conducted with several restrictions. These restrictions may be applied based upon site-specific concerns and knowledge coupled with sediment evaluation.
- Class C - High Contamination (Acute Toxicity to aquatic life). Class C dredged material is expected to be acutely toxic to aquatic biota and therefore, dredging and disposal requirements may be stringent.

Threshold concentration values for in-water/riparian placement of dredged material, specified in TOGS 5.1.9, were used for the entire Project. It should be noted that the Project does not include the placement of dredged material at in-water/riparian locations. The Project will include upland disposal of dredged material from the temporary cofferdams at both landfall locations that will be authorized by NYSDEC, and jet plow embedment of the In-River Transmission Cable. Jet plowing is not considered "dredging" since there is no offsite disposal of sediments disturbed by the jet plow activity; instead, the sediments disturbed by jet plowing remain in the aquatic system. In jet plowing, water jetting temporarily fluidizes a narrow portion of sediment to a desired depth, allowing the cable to sink by its own weight to the bottom of the fluidized trench. For the purpose of this Article VII application, all sediment samples collected along the entire In-River Transmission Cable Route (including both jet plowed portions where sediment stays in the aquatic system and dredged portions to be disposed of at an upland facility) have been assessed below as if they were being dredged and placed at in-water locations.

<u>Summary of Survey Results</u>

Sediment cores were collected from 56 vibracore locations along the proposed In-River Transmission Cable Route with a total of 60 sediment samples analyzed. Fifty (50) cores were collected along the proposed jet-plow embedment area of the route (VC-01 through VC-50), three cores were collected from the proposed northern cofferdam/dredge landfall location (VC-L1, VC-L2, VC-L3), and three cores were collected from the proposed southern cofferdam/dredge landfall location (VC-L4, VC-L5, VC-L6). The target penetration depth was 10 feet below the sediment-water interface, but actual core lengths ranged from 5 to 15 feet. Cores collected along the northern portion of the route (VC-L1 through VC-17 [RM 116 through RM 96]) were composed primarily of sand, while the remainder of the cores collected along the southern portion of the route (VC-18 through VC-L6 [RM 96 through RM 41]) were composed predominately of silt and clay. The bulk physical characteristics of the sediment are further summarized in Section 4.4.

Sediment samples were analyzed for the following bulk chemical parameters:

- Total Organic Carbon (TOC) using EPA Method 9060.
- Metals – arsenic, cadmium, copper, and lead (As, Cd, Cu, and Pb) using EPA Method 6020A; and mercury (Hg) using EPA Method 7474.
- Polycyclic Aromatic Hydrocarbons (PAHs) using EPA Method 8270.
- Volatile Organic Compounds (VOCs) – benzene, toluene, ethylbenzene, and xylenes using EPA Method 8260C.
- Pesticides using EPA Method 8081B.
- Polychlorinated Biphenyl (PCB) Aroclors using EPA Method 8082A.
- PCB Congeners – The six (6) samples with the greatest PCB aroclor concentrations were analyzed for PCB congeners using EPA Method 8270D-SIM/NOAA-M.
- Dioxins/Furans – The six (6) samples with the greatest PCB aroclor concentrations were analyzed for dioxins/furans using EPA Method 1613B.

Bulk chemical analytical results from sediment samples, as well as comparisons of the results to the TOGS 5.1.9 guidelines, are summarized below and in Table 4.5-1 and detailed in Appendix 4B.

PCBs

Concentrations of one or more PCB aroclors (specifically 1242, 1254, and/or 1260) were detected above laboratory method reporting limits in 23 of the 60 samples collected. Seven samples yielded Total PCB aroclor values greater than the NYSDEC sediment quality threshold value of >1,000 µg/kg for Class C PCB contamination. The highest PCB aroclor concentrations were found in samples VC-28 (2955 µg/kg) and VC-33 (2260 µg/kg). Ten samples contained sediments with contaminant concentrations representative of Class B sediment (100-1,000 µg/kg). Of those ten samples, three were located near the proposed southern cofferdam/dredge landfall location. Lower PCB values, representative of Class A sediments, were generally found in samples collected along the northern portion of the proposed route and near the proposed northern cofferdam/dredge landfall location.

The six samples with the greatest PCB aroclor concentrations (i.e., VC-11, VC-17, VC-23, VC-28, VC-33 and VC-49) were analyzed for PCB congeners. Total PCB congener concentrations ranged from 15.51 to 2955 µg/kg. Three samples contained sediments with congener concentrations that exceeded the Class C threshold (> 1,000 µg/kg) while three samples had PCB congener concentrations representative of Class B sediment.

Metals

Twenty-one samples contained sediments classified as Class B for one or more metals. All 21 samples were classified as Class B for mercury. The only contaminant to exceed the Class C contamination threshold (> 218 mg/kg) was lead, which measured 235 mg/kg at VC-48. Lower metals concentrations, representative of Class A sediments, were generally found in samples collected along the northern portion of the proposed route and near the proposed northern cofferdam/dredge landfall location.

PAHs

Concentrations of one or more PAHs were detected above laboratory reporting limits in 38 of 60 samples. Fifty-seven (57) of 60 samples contained sediments classified as Class A for total detected PAH concentrations (< 4,000 µg/kg). Three locations (VC-11, VC-17 and VC-50) had total detected PAH concentrations within the Class B range (4,000 – 45,000 µg/kg); and no samples contain total PAH concentrations above the Class C threshold (> 45,000 µg/kg).

VOCs

VOCs were not detected above the method reporting limit in any samples and all samples are within the Class A Sediment Quality Threshold Values for these compounds.

Pesticides

Concentrations of one or more pesticide compounds (specifically 4,4-DDD, 4,4-DDE, 4,4-DDT, dieldrin, and mirex) were detected above laboratory method reporting limits in 29 of 60 samples. Thirteen (13) samples contained sediments with detected contaminant concentrations representative of Class B sediments. The remaining 47 samples did not have pesticides detected above Class A range and no samples were within Class C range for pesticides. Although chlordane was not detected above the laboratory method reporting limit in any samples, the reporting limit exceeded the threshold value of 3 µg/kg for Class A sediments.

Dioxins/Furans

The six samples with the greatest PCB aroclor concentrations (i.e., VC-11, VC-17, VC-23, VC-28, VC-33 and VC-49) were analyzed for dioxins/furans. Total TEQ for dioxins ranged from 9 pg/g to 43 pg/g. All six samples contained sediments with total detected dioxin/furans TEQ concentrations representative of Class B sediments (> 50 pg/g).

Table 4.5-1: Summary of Sediment Chemistry Concentrations

TOGS 5.1.9 Classification	Number (%) of Samples					
	PCBs	Metals	PAHs	VOCs	Pesticides	Dioxins/Furans*
Class A – No Appreciable Contamination	43 (72%)	38 (63%)	58 (97%)	60 (100%)	47 (78%)	0 (0%)
Class B – Moderate Contamination	10 (17%)	21 (35%)**	2 (3%)	0 (0%)	13 (22%)	6 (100%)
Class C – High Contamination	7 (12%)	1 (2%)***	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Note: Percentages may not add up to 100 due to rounding
* Only six samples (VC-11, VC-17, VC-23, VC-28, VC-33 and VC-49) were analyzed for dioxins/furans.
** Classification based on mercury concentration
***Classification based on lead concentration

4.5.1.2 Sediment Transport

Sediment transport patterns in the Hudson River generally respond to the seasonal variability of its natural hydrodynamic forces (tide, wind, freshwater high flow events). This portion of the Hudson River typically exhibits bi-directional estuarine flow patterns influenced by seasonal variability in freshwater and tidal conditions. The sediments originate from glacial deposits carried to the Hudson River via its tributary system and in the Lower Estuary are supplemented by marine- borne suspended sediments imported from the sea (Bokuniewicz 2006). Reversing tidal currents carry sediment usually near the estuary floor up and down the river depending on tide and freshwater discharge conditions.

Geochemical processes within the suspended sediment-water matrix in the estuary exist as the circulation of denser saline water wedges beneath less dense freshwater creating a cycle of fine-grained sediments being deposited, re-suspended, and re-deposited many times before being permanently buried in sediment deposits or exported to the sea (Bokuniewicz 2006). The location of the saline wedge, or salt front, is dynamic and seasonal, primarily being dictated by freshwater input (Abood 1974).

The area within the Lower Hudson River Estuary where the salt wedge meets the seaward flowing freshwater discharge creates a zone of maximum suspended sediment throughout the river's water column (Geyer et al. 2000). This is called the "Estuarine Turbidity Maximum (ETM) Zone". TSS concentrations in the ETM zone dynamically fluctuate with season and tide. TSS water column concentrations in the ETM zone have been measured at over 3,000 mg/L. The In-River Transmission Cable Route is located well north of the ETM zone; however, the reaches of the Upper Estuary where the Project is located may experience high levels of TSS water column concentrations during spring high freshwater discharge conditions and large storm events (i.e. hurricanes).

Suspended Sediment Concentrations

Suspended sediment concentrations within the Hudson are constantly fluctuating due to changing tides and watershed runoff. Concentrations can range seasonally from summer lows of <10 mg/L to winter highs around 100 mg/L (Wall et al. 2008). Daily fluctuations due to sediment resuspension range from 20 mg/L during summer months to 40 mg/L in winter months (Wall et al. 2008). These data concur with data published in 1982 which yielded an average concentration of 35 mg/L with seasonal variation from 17 to 45 mg/L in the upper reaches and 23 to 26 mg/L in the lower reaches (Arnold 1982). Annual sediment accumulation rates in the Hudson River Estuary vary by location but are reported to range from no accumulation to more than 8 mm/yr (Nitsche et al. 2010).

Four (4) separate project-specific TSS field sampling events were conducted between June and October 2012 to aid in the characterization of sediment transport within the Hudson River along the In-River Transmission Cable Route. Total suspended sediment (TSS) and turbidity data were collected at the surface, middle, and bottom of the water column along transects located in the northern (Tivoli Transect), middle (Poughkeepsie Transect), and southern (Cold Spring Transect) portions of the In-River Cable Route (Figure 4.5-1). Additionally, point measurements of TSS and turbidity were obtained near RM108 (Duck Cove), RM102 (Germantown Flats), RM91 (Esopus Creek confluence), and RM55 during a synoptic sampling event conducted on September 20, 2012. At each station, a stainless steel Kemmerer bottle sampler was used to collect samples at depth for turbidity and TSS analysis. Turbidity was measured in the field using a portable turbidity meter. TSS samples were analyzed by a New York State-certified analytical laboratory. TSS concentrations of samples collected over the four sampling dates ranged from 1 to 220 mg/L. The corresponding turbidity measurements from these samples ranged from 2 to 330 NTU.

Field measurements from this project-specific TSS survey were compared to historical turbidity data collected by Riverkeeper and the Hudson River Environmental Conditions Observing System (HRECOS) dating back to 2007. Turbidity data compiled from Riverkeeper (May-October, 2007-2012) for twenty sites located along the Hudson River within the Project Area, generally ranged between 3 and 284 NTU (Riverkeeper 2012). There was a single occurrence of turbidity measuring 894 NTU in May 2010. Overall, turbidity averaged 58.2 NTU across all years and locations and was highest in September. Data compiled from the HRECOS historical dataset (July 2008 - Dec 2010) at Norrie Point (RM 85) showed a range of turbidity values between 0 and 286.5 NTU (HRECOS 2012). Periods of turbidity greater than 200 NTU occurred during July and August of 2009 and 2010. A comparison of average turbidity along the river reach from north to south showed no spatial relationship, indicating that levels are consistent along the river reach with temporary localized spikes, having minimal effects on the average.

4.5.1.3 Water Quality

The Hudson River is a tidal estuary from its confluence with Upper New York Bay to the Federal Dam at Troy (RM 153). The entire length of the Project lies within the tidally influenced portion of the Hudson River.

New York State Water Quality Standards promulgated under 6 NYCRR Part 703 set the required water quality criteria that must be met to support the best use indicated. The In-River Cable Route traverses three NYSDEC water body classes including Class A, Class B, and Class SB waters (Table 4.5-2) The northern portion of the In-River Cable Route is classified as Class A (freshwater), suitable as a drinking water source, for primary and secondary contact recreation, fishing, and fish, shellfish, and wildlife propagation. The middle and lower portions of the In-River Cable Route are classified as Class B (fresh surface water) and Class SB (saline surface water) respectively, suitable for primary and secondary contact recreation, fishing, and fish, shellfish, and wildlife propagation (6 NYCRR §701).

Waterbodies that do not meet the criteria associated with their use classification are considered to be impaired. NYSDEC maintains the Waterbody Inventory and Priority Waterbodies List (WI/PWL), a database that contains information on water quality, the ability of waters to support their use classifications, and known or suspected sources of contamination. All portions of the Hudson River within this area are listed as impaired for fish consumption due to PCBs, heavy metals (cadmium), and other contaminants (sourced from sediments). The contamination is considered to be the result of past industrial discharges, particularly PCB discharges in the Upper Hudson River (NYSDEC 2013).

Table 4.5-2: Summary of Water Body Classes Crossed by the In-River Cable Route

In-River Transmission Cable Route Segment	NYSDEC Classification	Best Usage (per 6 NYCRR §701)	Impairments
Northern Landfall to River Mile 65	A (fresh surface water)	• Drinking Water Source • Primary and Secondary Contact Recreation • Fishing • Fish, Shellfish, and Wildlife Propagation and Survival	Fish consumption

In-River Transmission Cable Route Segment	NYSDEC Classification	Best Usage (per 6 NYCRR §701)	Impairments
River Mile 65 to River Mile 47	B (fresh surface water)	• Primary and Secondary Contact Recreation • Fishing • Fish, Shellfish, and Wildlife Propagation and Survival	Fish consumption
River Mile 47 to Southern Landfall	SB (saline surface water)	• Primary and Secondary Contact Recreation • Fishing • Fish, Shellfish, and Wildlife Propagation and Survival	Fish consumption

Freshwater flow is probably the single most important factor in determining physical, chemical, and biological processes within the Hudson River estuary. The majority of freshwater flow enters the Hudson River estuary at its head in Troy. The seasonal variability of freshwater in-flow to the estuary can have a dominating effect on sediment transport, dilution, mixing, and consequently water quality conditions. For example, under low freshwater flow conditions, saline waters and associated marine species can reach far upstream, while under high freshwater flow conditions, freshwater and freshwater organisms are found much further downstream. The intensity and location of this mixing and transport varies throughout the course of the seasons. The distinctive estuarine salt front of saline bottom water is known to recede as far south as the George Washington Bridge (RM 11) during high spring freshwater flows, and brackish water (slightly saline) is known to extend as far north as Poughkeepsie (RM 75) during summer low freshwater water flows (USFWS 1997).

Semi-diurnal tide characteristics of the Hudson River Estuary also impact ambient water quality and flow regimes within this portion of the Hudson River. The mean tidal range is 1.37 meters at the Battery, 0.80 meters at West Point, and 1.56 meters at Albany (Cooper et al. 1988). The tidal flow generally ranges from about 200,000 to 300,000 cubic feet per second (cfs) but may be as much as 494,000 cfs (Busby 1966). Consequently, freshwater flows can be masked by the much larger tidal oscillations, particularly during low freshwater flow conditions.

The Hudson River Estuary can be divided into four salinity zones: polyhaline (18 to 30 parts per thousand [ppt]), mesohaline (5 to 18 ppt), oligohaline (0.5 to 5 ppt), and freshwater tidal (<0.5 ppt). The salinity levels of the estuary are primarily governed by daily tides and the volume of fresh water flowing into the estuary. Under high-flow conditions, freshwater overrides the salt layer and salinity differences of up to 20 percent can be established (Busby and Darmer 1970). Average salinities collected at Iona Island Marsh and Piermont Marsh in the winter and spring were approximately one-fourth that of summer and fall (NERRS 2009). Under normal seasonal tide and inflow conditions, the salt front and associated transition zone ranges from below Hastings-on-Hudson (RM 21.5) during high-flow periods in spring to New Hamburg (RM 67.7) during low-flow periods in late-summer, a distance of about 50 miles (de Vries and Weiss 2001). Along the proposed In-River Transmission Cable Route measured salinities ranged from 0.1 ppt to 5.40 ppt in data compiled from HRECOS, USGS, and Riverkeeper.

Adequate dissolved oxygen levels are critical to the survival of fish and other aquatic organisms. Dissolved oxygen (DO) concentrations are determined by several factors, including the degree of tidal mixing, photosynthesis rates, temperature, microbial decomposition of organic matter, and organism respiration levels. Photosynthesis, a high degree of tidal mixing, and relatively low temperatures generally result in an increase in dissolved oxygen concentrations, while higher organism respiration rates, microbial decomposition of organic material, chemical oxidation, and high air and water temperatures generally depress dissolved oxygen levels. According to NYSDEC Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations (6 NYCRR Part 703.3), dissolved oxygen for Class SB waters shall not be less than a daily average of 4.8 mg/l. However, there are times when dissolved oxygen can be less than 4.8 mg/l, but it shall not fall below 3.0 mg/l. For Class A and B waters, depending on the suitability of trout habitat, the DO concentration shall not be less than 4.0 mg/L.

In the Hudson River, between Catskill and Albany, dissolved oxygen levels range from 10.0 - 12.0 parts per million (ppm) in the spring to 7.0 - 8.0 ppm in the summer (Dynegy 2006). Isolated declines in oxygen levels may be attributed to the species invasion of zebra mussels (*Dreissena polymorpha*). During pre-zebra mussel periods (1986-1991), DO averaged 95% saturation during summer months (June-September). After 1992, DO averaged 85% saturation, thus the degree of undersaturation increased nearly 3-fold (Caraco et al. 2000). On average, dissolved oxygen levels are highest in the upper river reaches of the estuary and decline in the downstream direction as the solubility of oxygen decreases with increasing salinity levels.

In the late summer of 2000 and 2001, NYSDEC conducted the Hudson River Biocriteria Project to develop indicators of biological conditions for the Hudson River Estuary. The goal of the project was to develop one or more biological indicators that could be used to assess the ecological condition of the estuary through long-term monitoring. Water samples were collected for nutrient analysis and TSS and *in situ* water column profiles were performed at each station to measure the basic water quality parameters of dissolved oxygen, salinity, conductivity, temperature, and turbidity. Water clarity was also measured with a Secchi disk (Llansó et al. 2003). Sampling sites in the Hudson River (Troy to The Battery) had mean bottom dissolved oxygen levels of 8.6 to 8.8 mg/l and temperatures of 19.4 to 21.7°C, typical of late summer conditions of well-mixed temperate systems. Vertical stratification of the water column was insignificant, as tidal flow keeps the water column well mixed vertically (Strayer and Smith 2001); and therefore low dissolved oxygen is not typically a problem (Llansó et al. 2003).

Nutrients, such as phosphorous and nitrogen, can exist as organic pollutants in water systems when found in excess as they act as fertilizers and promote the growth of algae and aquatic plants; which can result in algal blooms and promote invasive species growth. Average phosphate levels along the river reach range from about 0.05 to 0.12 mg/L (NERRS 2009). However, there are isolated spikes near Tivoli due to effluent discharge from a municipal sewage treatment plant. According to the Cary Institute (CI 2012), the Hudson River has phosphate concentrations that average about 0.06 mg/L and total phosphorus (TP) concentrations of about 0.1 mg/L.

Nitrogen sources along the river reach include rain water, sewage treatment plants, septic systems, and agricultural run-off. Average nitrate concentrations range from 1.9 mg/L to 2.5 mg/L with isolated spikes near Tivoli due to the municipal sewage treatment plant (NERRS 2009). According to the Cary Institute (CI 2012), concentrations average about 2.2 mg/L of NO_3 or 0.5 mg/L of NO_3 – N in the freshwater part of the Hudson River. The nitrogen concentrations in the Hudson are affected by stream flow and seasonal growth of biota. During summer growing periods an increase in biological activity causes higher nitrate uptake and therefore lower overall concentrations, conversely, during the winter a decrease in biological activity warrants less nitrate uptake and higher overall concentrations in the Hudson River.

Chlorophyll *a* is the primary pigment responsible for facilitating photosynthesis and therefore growth in most plants and algae. The concentration of chlorophyll *a* present in the water column system is an indicator of the primary productivity of a waterbody and high levels of this pigment may suggest excessive nutrient loading. Currently, there are no water quality standards established for chlorophyll *a*, although values greater than 10 micrograms per liter (ug/l) are usually indicative of a eutrophic (nutrient-rich) system (Wetzel 2001). According to data collected at Norrie Point by HRECOS between 2009 and 2010 chlorophyll *a* concentrations ranged from 0.0 to 379.3 ug/L and averaged about 4.8 ug/L (HRECOS 2012). From 1988 to 2002, mean growing season chlorophyll *a* concentrations in the tidal freshwater portion of the Hudson River varied from 1.5 to 27 ug/L; however, a significant decline in mean chlorophyll *a* levels was observed following invasion by the exotic, filter-feeding zebra mussel in 1992 (Caraco et al. 2006).

Bacteria found in the Hudson River typically originates from combined sewer overflows, improper boat waste disposal, animal and wildlife waste, and stormwater runoff. Enterococci are bacteria found in the stomachs of warm-blooded animals and are monitored as a marker to detect the presence of harmful pathogens and raw sewage in water bodies. USEPA enterococci standards for recreational use of fresh waters are 130 colony forming units (cfu)/100 mL for a single sample and 35 cfu/100 mL for the geometric mean of five samples (USEPA 2012). Enterococci counts within the Hudson River ranged from 1 cfu/100 mL to 4,352 cfu/100 mL and averaged 84.93 cfu/100 mL during summer months between 2008 and 2012 (Riverkeeper 2012).

4.5.2 Environmental Impacts and Mitigation

4.5.2.1 Potential Construction Impacts and Mitigation

In-River Cable installation activities, including the pre-lay grapnel run, jet plow embedment, and cofferdam dredging, will directly disturb bottom sediments. However, these areas of disturbance are in very narrow or localized areas of the river bed compared to the overall expanse of the riverbed along the 75 mile route. These activities have the potential to temporarily impact Hudson River sediment dispersion and water quality resulting from jet plow induced turbidity and water column dispersion. Only 25-30% of the subsurface riverbed sediments fluidized by the jet plow cable trenching activities will be introduced to the vertical water column above the trench cut surface. Most of the fluidized sediments (up to 75% by volume) remain within the vertical limits of the jet plow trench and are not introduced into the water column. These sediments quickly settle out by gravity and mass flow within the trench which then serves to “bury” the cable system at its target burial depth. Installation of the in-river cable system will require approximately 3-4 months, depending on weather and river conditions, so its time duration is relatively short.

In order to estimate the relative magnitude of potential impact from the jet plow embedment process to natural estuarine sediment suspension and transport, a suspended sediment transport model (SSFATE) was employed to predict the concentration and subsequent cumulative riverbed deposition of suspended sediment introduced into the water column during cable jetting operations. This model has been used extensively in the past for similar projects in the Hudson River and has proven to conservatively predict TSS concentrations produced by the jet plow. A summary of the model predictions is included in the sections presented below, and the complete technical report may be found in Appendix 4C.

Sediment Quality

Jet Plow Embedment

Metals, PAHs, pesticides, PCBs, and dioxins/furans are present at Class B or Class C concentrations at various locations along the In-River Cable Route. During installation of the In-

River Transmission Cable, mobilization and deposition of these contaminated sediments could have an indirect impact on the quality of surficial sediments in adjacent areas.

SSFATE modeling results show that sediments suspended by jet plow activities will generally fall along the path of the operating jet plow with most resultant sediment deposition confined to a narrow band of influence extending between 200 and 500 feet on either side of the jet plow. Thinner deposition layers (less than 0.5 mm [0.02 in]) are predicted to extend further on either side along the route, but at a negligible thickness compared to ambient conditions and natural variability in the Project Area. Deposition thicknesses greater than 2 mm (0.08 in) may potentially cover an area of 227 acres and deposits thicker than 5 mm are predicted to cover no more than 0.37 acres for the entire route of 75 miles. These predicted deposition thicknesses are within the range of annual deposition rates reported by Nitsche et al. (2010).

Overall, impacts on sediment quality from the jet plow embedment of the In-River Transmission Cable are expected to be temporary, localized, and minor when compared to the surrounding natural sediment quality conditions along the preferred route.

Dredging within Temporary Cofferdams at the Northern and Southern Landfalls

Dredging of approximately 6,500 cubic yards of river sediment from the interior section of the Temporary Cofferdams will be accomplished using mechanical methods. Results from chemical analysis of sediment samples collected nearest the planned Northern and Southern Landfall locations indicate potential contamination concerns with the material to be removed. Sediment samples collected closest to the planned location of the Northern Landfall suggest that the pesticide Chlordane may exceed Class B concentrations. Site-specific sediment samples collected near the Southern Landfall indicate that Class B contamination levels are potentially present for metals, pesticides, and PCBs. Disposal of the dredged material from within the Temporary Cofferdams will be arranged with landfills licensed for the type of material involved. Removing the material from within the cofferdams will prevent the spread of sediments and will have a beneficial effect on sediment quality.

The cofferdam side walls will contain the dredging operation and, combined with the use of proper dredging equipment, will minimize the release of dredged sediments suspended during dredging. Therefore, impacts on sediment quality from installation of the temporary cofferdams and dredging of the enclosed areas are also expected to be minor.

Landfall HDD Operations

Surface sediments in the vicinity of the Landfall locations could be affected by localized release of HDD drilling fluids from deeper subsurface borehole drilling if drilling fluids are released and not properly contained. In this unlikely event sediment composition may be impacted. However, HDD drilling fluids (bentonite, clay and water) are biologically inert and would not result in water quality deterioration. The HDD operation will include a drilling fluid fracture or overburden breakout monitoring program during borehole drilling operations to minimize environmental effects which at worst would be temporary and very localized. The details of this program will be provided in the EM&CP. The bentonite contained in the drilling fluid will gel or coagulate upon contact with saline or brackish water. In the event of a fluid release, the bentonite fluid density and composition will cause it to remain as a cohesive mass, which can be quickly cleaned up and removed by diver-operated vacuum equipment. Given the small area covered and short-term duration of HDD operations, impacts to sediment quality are expected to be minor.

Sediment Transport

Jet Plow Embedment

Installation of the In-River Transmission Cable will temporarily influence the normal localized patterns of sediment transport and deposition during jet plow embedment operations and impacts are expected to be minor.

Dredging within Temporary Cofferdams at the Northern and Southern Landfalls

The temporary cofferdams installed at the Northern and Southern Landfalls will confine most sediment suspended due to dredging within each cofferdam structure. Given the temporary and localized nature of this increase in suspended sediments, the overall impacts of dredging on sediment transport are expected to be minor.

Water Quality

Jet Plow Embedment

During installation of the In-River Transmission Cable, the primary source of potential impact on ambient water quality will be the localized and temporary increased suspended sediment concentrations resulting from the jet plow embedment of the cable. The extent and intensity of expected Project-related impacts to ambient suspended sediment conditions was modeled along the entire In-River Cable Route using SSFATE. The model results were presented as both a snapshot in time (illustrating the instantaneous sediment plume predicted to exist during cable jetting) and as a maximum concentration predicted to occur during jet plow embedment at any time and location along the entire In-River Cable Route. The maximum model-predicted concentrations are a composite in both space and time and are not predicted to occur at any one location or time during the In-River Transmission Cable installation period due to the movement of the jet plow and variation of current speeds and directions. Therefore, these maximum predicted results are inherently conservative and serve as an upper predictive concentration limit.

Jet plow-induced suspended sediment concentrations are predicted to decrease rapidly with both lateral and vertical distance from the operating jet plow. Suspended sediment concentrations exceeding 50 mg/L are predicted to extend a maximum lateral distance of 1,470 feet (448 meters) from the jet plow, while concentrations greater than 200 mg/L are expected to be confined within 312 feet (95 m) of the jet plow. These levels are within the NYSDEC typically imposed compliance criteria of jet-plow only induced suspended sediment concentrations no greater than 200 mg/L above the up-current background station at a distance of 500 feet down current of the jet plow device. This compliance criteria was required for the Bayonne Energy Center submarine cable installation in Upper New York Bay and the Hudson Transmission Project, a submarine cable project at the mouth of the Hudson River. TSS monitoring conducted during installation of the Bayonne and Hudson projects did not exceed the established threshold.

At a distance of 500 feet from the jet plow, the SSFATE model for the Project’s in-river cable installation predicts an average suspended sediment concentration of 28.1 mg/L with a maximum below 160 mg/L. Under all conditions modeled, the vertical extent of suspended sediment concentrations greater than 200 mg/L is predicted to remain in the bottom 10 to 13 feet (3 to 4 meters) of the water column, decreasing rapidly to approximately 10 mg/L or less approximately 16 to 26 feet (5 to 8 meters) above the riverbed.

The model also predicts that suspended sediment concentrations in the water column decrease rapidly with time as the jet plow passes beyond a fixed measuring point. Concentrations greater than 200 mg/L above ambient are not predicted to exceed 2 hours in duration at any single location. After 3 hours, the suspended sediment concentration level above ambient is predicted to be below 50 mg/L and the concentration drops to less than 10 mg/L above ambient after 12 hours. This residence time for jet-plow induced TSS concentrations in the water column is minimal and is within the range of ambient conditions and the wide range of natural variability in TSS that the river already experiences.

Under all modeled conditions, suspended sediment concentrations subside to ambient conditions within 24 hours of passage of the jet plow. These estimates are considered conservative and likely to be most applicable to the southern portions of the In-River Cable Route (RM 94 to RM 42), which are predominately silt and clay (fine-grained material). Return to ambient conditions is anticipated to be more rapid in the northern portion of the In-River Cable Route (RM 116 to RM 94). This is mainly due to the coarser grained sediments (silty sands and poorly graded sands with silt) expected in this area.

The use of jet plow embedment will greatly reduce the amount of sediment to be disturbed, as well as the potential for more far-field effects of resultant sediment suspension, transport, and deposition. Jet plow embedment will not have a measurable impact on water quality parameters such as salinity, chlorophyll *a*, pathogens, or nutrients. The portion of the Hudson where the In-River Cable will be installed is a very active section of the river for maritime transport activities, barge traffic, recreational boating traffic and other commercial and recreational uses that likely have suspended sediment effects on the river almost every day. The impacts to water quality generated by the jet plow will be comparable to impacts associated with these activities and will be similarly localized and of short-term duration.

Overall, given the brief period of time and limited area associated with the jet plow embedment, impacts on water quality are anticipated to be localized, temporary and minor.

Dredging within Temporary Cofferdams at the Northern and Southern Landfalls

Installation of and dredging within the temporary cofferdams at the northern and southern landfalls is not anticipated to have a measurable impact on local water quality conditions. The temporary cofferdams installed at the Northern and Southern Landfalls will confine most sediment suspended and, combined with the use of environmental dredging equipment, will limit dispersion within each cofferdam structure.

Given the temporary and localized nature of dredging within the temporary cofferdam areas, overall impacts on water quality are expected to be minor.

Accidental Releases by Vessel Operations

An SPCC plan will be developed and employed throughout the life of the Project and spill procedures will be implemented in the case of a spill, to limit the impacts to surrounding water quality and sediments. With proper training and implementation, the likelihood of a spill is small, and the impact would be minor.

HDD - Possible Bentonite Release

Water quality in the vicinity of the Landfall locations could be affected by localized release of HDD drilling fluids from deeper subsurface borehole drilling, if drilling fluids are released and not properly contained. However, HDD drilling fluids (bentonite, clay and water) are biologically inert and would not cause appreciable poor water quality conditions. The bentonite contained in the drilling fluid will gel or coagulate upon contact with saline or brackish water. In the event of a fluid release, the bentonite fluid density and composition will cause it to remain as a cohesive mass on the seabed, which can be quickly cleaned up and removed by diver-operated vacuum equipment. The HDD operation will include a drilling fluid fracture or overburden breakout monitoring program during borehole drilling operations to minimize environmental effects which at worst will be temporary and very localized. The details of this program will be provided in the EM&CP. Given the small area covered and short-term duration of HDD operations, impacts to water quality are expected to be minor.

4.5.2.2 Potential Operational Impacts and Mitigation

The In-River Transmission Cable consists of a solid di-electric solid core HVDC cable that does not contain cooling or insulating fluids. Therefore, fluid leakage from the In-River Transmission Cable is not possible and adverse impacts on sediment or water quality in the Hudson River are not expected.

The In-River Transmission Cable will generate a limited amount of heat that will dissipate into the sediment surrounding the cable. The sediment temperature at 10 cm (4 inches) below the river bottom is expected to increase less than 1° Celsius during operation of the In-River Transmission Cable. The temperatures of the sediment at the river bottom (sediment-water interface) and within the water column above the river bottom are expected to remain unchanged by the operation of the In-River Transmission Cable.

Therefore, potential impacts to sediment or water quality from thermal emissions during operation of the In-River Transmission Cable are expected to be negligible as a result of rapid heat dissipation in the waters of the Hudson River through advective and convective processes.

4.6 Finfish

This section describes the finfish species that may be present in the vicinity of the Project Area and identifies and assesses potential impacts to those species and their habitats during Project construction, operation, and maintenance activities. The following information is based on existing published information, literature review, and correspondence with regulatory agencies.

4.6.1 Existing Conditions

4.6.1.1 Description of the Project Area

The proposed In-River Transmission Cable Route extends from Athens, New York (RM 118) at the northernmost extent to Cortlandt, New York in the south (RM 42). The entire In-River Cable Route is within the Hudson River Estuary, which stretches for 153 miles between Troy, NY and New York Harbor (NYSDEC 2012).

Varying concentrations of seawater mixed with freshwater inflow influences the distribution and function of both plants and animals within the Hudson River Estuary. The Hudson River Estuary can be divided into four salinity zones: polyhaline (18 to 30 parts per thousand [ppt]) from Manhattan north to Yonkers (RM 0 to RM 18), mesohaline (5 to 18 ppt) from Yonkers north to Stony Point (RM 18 to RM 40), oligohaline (0.5 to 5 ppt) from Stony Point (RM 41) north to about Wappinger Falls (RM 68), and freshwater tidal (<0.5 ppt) from Wappinger Falls north to the Troy Dam. These salinity zones vary greatly with the season and are primarily governed by daily tides and the volume of fresh water flowing into the estuary. Although tidal flows tend to dominate, ranging from 10 to 100 times the total freshwater inflows, freshwater flows can have a significant effect on transport, dilution, mixing, and water quality. Under low freshwater flow conditions, saline water and associated marine species can reach far upstream, while under high freshwater flow conditions, freshwater organisms are found further downstream. The distinctive estuarine salt front of saline bottom water is known to recede as far south as the George Washington Bridge (RM 11) during high spring freshwater flows, and brackish water (slightly saline) is known to extend as far north as Poughkeepsie (RM 75) during summer low freshwater water flows (USFWS 1997).

The Project Area extends from RM 42 to RM 118; therefore it is located in the oligohaline and tidal freshwater zones. Given the broad range of seasonal salinities found within the river-estuary system, the Project Area is typically populated or traversed by a variety of marine, estuarine, freshwater, anadromous, and catadromous fish species (USFWS 1997).

4.6.1.2 Significant Coastal Fish and Wildlife Habitat

Significant Coastal Fish and Wildlife Habitats (SCFWH) exhibit unique or higher quality wildlife habitat values compared to other river habitat areas, and may also help support populations of rare, threatened, and endangered species; commercially and recreationally important fish species; and various human activities such as hunting, fishing, boating, and wildlife viewing. The proposed In-River Transmission Cable Route passes through seven (7) Significant Coastal Fish and Wildlife Habitats (SCFWH) designated by The New York State Department of State-Division of Coastal Resources (NYSDOS DCR). Additionally, nine SCFWHs are located adjacent to (within 0.1 miles of) the In-River Cable Route (NYSDOS 2013). There are 40 SCFWHs located within and along the Hudson River and encroachment by in-water activities including daily vessel traffic, is sometimes unavoidable and unlikely to negatively impact the habitat.

From north to south, the Project crosses the following SCFWHs: Vosburgh Swamp and Middle Ground Flats, Catskill Deepwater, Germantown-Clermont Flats, Esopus Estuary, the Flats, Kingston-Poughkeepsie Deepwater, and Hudson Highlands. Details regarding the SCFWH areas that may be affected by Project activities are provided in Section 4.9.

4.6.1.3 Finfish Species Identified in the Project Area

Daniels et al. (2005) identified 129 species of finfish within the main channel of the Hudson River south of the Troy dam. An additional 81 species are found north of the Troy dam, within the Mohawk River, or within smaller tributaries of the Lower Hudson (Daniels et al. 2005). Of the 129 species of finfish which have been identified within the main channel of the tidal reaches of the Hudson Estuary, 49 are primarily marine species and the remaining 80 species are either diadromous or freshwater species (Table 4.6-1)(Daniels et al. 2005).

Common marine fish species known to occur in the Hudson River include spotted hake (*Urophycis regia*), bluefish (*Pomatomus saltatrix*), naked goby (*Gobiosoma bosc*), seaboard goby (*G. ginsburgi*), striped killifish (*Fundulus majalis*), northern pipefish (*Syngnathus fuscus*) summer flounder (*Paralichthys dentatus*), and winter flounder (*Pseudopleuronectes americanus*). Crevalle jack (*Caranx hippos*), weakfish (*Cynoscion regalis*), spot (*Leiostomus xanthursus*), and Atlantic menhaden (*Brevoortia tyrannus*) are episodically common (Daniels et al. 2005).

Common estuarine fish species inhabiting the Hudson River include bay anchovy (*Anchoa mitchilli*), mummichog (*Fundulus heteroclitus*), white perch (*Morone americana*) and hogchoker (*Trinectes maculatus*) (Daniels et al. 2005).

Freshwater species found to be common in the lower Hudson River, according to Daniels et al. (2005), include gizzard shad (*Dorosoma cepedianum*), spotfin shiner (*Cyprinella spiloptera*), common carp (*Cyprinus carpio*), cutlip minnow (*Exoglossum maxillingua*), eastern silvery minnow (*Hybognathus regius*), common shiner (*Luxilus cornutus*), golden shiner (*Notemigonus crysoleucas*), emerald shiner (*Notropis atherinoides*), spottail shiner (*N. hudsonius*), rosyface shiner (*N. rubellus*), bluntnose minnow (*Pimephales notatus*), fathead minnow (*P. promelas*), blacknose dace (*Rhinichthys atratulus*), longnose dace (*R. cataractae*), creek chub (*Semotilus atromaculatus*), fallfish (*S. corporalis*), white sucker (*Catastomus commersonii*), white catfish (*Ameiurus catus*), brown bullhead (*A. nebulosus*), redfin pickerel (*Esox americanus*), chain pickerel (*E. niger*), central mudminnow (*Umbra limi*), eastern mudminnow (*U. pygmaea*), brown trout (*Salmo trutta*), banded killifish (*Fundulus diaphanous*), brook silverside (*Labidesthes *sicculus*), rock bass (*Ambloplites rupestris*), redbreast sunfish (*Lepomis auritus*), pumpkinseed (*L. gibbosus*), bluegill (*L. macrochirus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*M. salmoides*), black crappie (*Pomoxis nigromaculatus*), tessellated darter (*Etheostoma olmsteadi*), yellow perch (*Perca flavescens*), log perch (*Percina caprodes*), and walleye (*Sander vitreus*). Goldfish (*Carassius auratus*) were once common, and appear to be increasing in abundance (Daniels et al. 2005).

Table 4.6-1: List of common and abundant fish species found within the lower tidal Hudson River (Troy to the Battery) from 1970-2003 (Daniels et al. 2005)

Common Name	Scientific Name	Distribution	Abundance Status
Sea lamprey	*Petromyzon marinus*	anadromous	common
Shortnose sturgeon	*Acipenser brevirostrum*	anadromous	common
American eel	*Anguilla rostrata*	catadromous	common
Blueback herring	*Alosa aestivalis*	anadromous	abundant
Alewife	*Alosa pseudoharengus*	anadromous	common
American shad	*Alosa sapidissima*	anadromous	common
Atlantic menhaden	*Brevoortia tyrannus*	marine	episodically common
Gizzard shad	*Dorosoma cepedianum*	freshwater	common, increasing
Bay anchovy	*Anchoa mitchilli*	estuarine	abundant
Goldfish	*Carassius auratus*	freshwater	once common, increasing
Spotfin shiner	*Cyprinella spiloptera*	freshwater	common
Common carp	*Cyprinus carpio*	freshwater	common
Cutlip minnow	*Exoglossum maxillingua*	freshwater	common
Eastern silvery minnow	*Hybognathus regius*	freshwater	common
Common shiner	*Luxilus cornutus*	freshwater	abundant
Golden shiner	*Notemigonus crysoleucas*	freshwater	common
Emerald shiner	*Notropis atherinoides*	freshwater	common
Spottail shiner	*Notropis hudsonius*	freshwater	abundant
Rosyface shiner	*Notropis rubellus*	freshwater	common
Bluntnose minnow	*Pimephales notatus*	freshwater	abundant
Fathead minnow	*Pimephales promelas*	freshwater	abundant, increasing
Blacknose dace	*Rhinichthys atratulus*	freshwater	abundant
Longnose dace	*Rhinichthys cataractae*	freshwater	abundant
Creek chub	*Semotilus atromaculatus*	freshwater	abundant
Fallfish	*Semotilus corporalis*	freshwater	common
White sucker	*Catastomus commersonii*	freshwater	abundant
White catfish	*Ameiurus catus*	freshwater	common
Brown bullhead	*Ameiurus nebulosus*	freshwater	abundant
Redfin pickerel	*Esox americanus*	freshwater	common
Chain pickerel	*Esox niger*	freshwater	common
Central mudminnow	*Umbra limi*	freshwater	common
Eastern mudminnow	*Umbra pygmaea*	freshwater	common
Brown trout	*Salmo trutta*	freshwater	common
Atlantic tomcod	*Microgadus tomcod*	anadromous	common, declining
Spotted hake	*Urophycis regia*	marine	common
Atlantic needlefish	*Strongylura marina*	anadromous	common
Banded killifish	*Fundulus diaphanous*	freshwater	common
Mummichog	*Fundulus heteroclitus*	estuarine	common
Striped killifish	*Fundulus majalis*	marine	common
Brook silverside	*Labidesthes sicculus*	freshwater	common, increasing
Northern pipefish	*Syngnathus fuscus*	marine	common

Common Name	Scientific Name	Distribution	Abundance Status
White perch	*Morone americana*	estuarine	abundant
Striped bass	*Morone saxatilis*	anadromous	common, increasing
Rock bass	*Ambloplites rupestris*	freshwater	common
Redbreast sunfish	*Lepomis auritus*	freshwater	common
Pumpkinseed	*Lepomis gibbosus*	freshwater	abundant
Bluegill	*Lepomis macrochirus*	freshwater	common
Smallmouth bass	*Micropterus dolomieu*	freshwater	common
Largemouth bass	*Micropterus salmoides*	freshwater	common
Black crappie	*Pomoxis nigromaculatus*	freshwater	common
Tessellated darter	*Etheostoma olmsteadi*	freshwater	abundant
Yellow perch	*Perca flavescens*	freshwater	common
Log perch	*Percina caprodes*	freshwater	common
Walleye	*Sander vitreus*	freshwater	common
Bluefish	*Pomatomus saltatrix*	marine	common
Cravalle jack	*Caranx hippos*	marine	episodically common
Weakfish	*Cynoscion regalis*	marine	episodically abundant
Spot	*Leiostomus xanthurus*	marine	episodically abundant
Naked goby	*Gobiosoma bosc*	marine	common
Seaboard goby	*Gobiosoma ginsburgi*	marine	common
Summer flounder	*Paralichthys dentatus*	marine	common
Winter flounder	*Pseudopleuronectes americanus*	marine	common
Hogchoker	*Trinectes maculatus*	estuarine	common

Anadromous and Catadromous Fish Species

In the spring, many anadromous fish migrate north from the Atlantic Ocean through Upper New York Bay to brackish and freshwater upstream spawning areas within the Lower Hudson River Estuary. In the late summer and fall, juveniles migrate south to a more estuarine and marine environment (Woodhead 1993). Alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), striped bass (*M. saxatilis*), Atlantic tomcod (*Microgadus tomcod*), rainbow smelt (*Osmerus mordax*), Atlantic sturgeon (*Acipenser oxyrhynchus*), hickory shad (*Alosa mediocris*), Atlantic needlefish (*Strongylura marina*), threespine stickleback (*Gasterosteus aculeatus*), ninespine stickleback (*Pungitius pungitius*), sea lamprey (*Petromyzon marinus*) and shortnose sturgeon (*Acipenser brevirostrum*) are among the anadromous species known to migrate though this area (USFWS 1997). Of these anadromous species, striped bass and Atlantic tomcod are considered resident species (Woodhead 1993). Additionally, American eel is a catadromous species that is found in the Lower Hudson River (USFWS 1997, Daniels et al. 2005). American eels spawn at sea and the juveniles migrate into estuaries during the spring. The shortnose sturgeon and Atlantic sturgeon are federally listed endangered species and are described in more detail in Section 4.9.

Fish and Wildlife Coordination Act – Representative Species

The life histories for twelve species representative of the fish that NOAA Fisheries and the USFWS manage under the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e) that are not already covered under the EFH Assessment (Appendix 4D) or the Threatened and Endangered Species section (Section 4.9) are described below. These fish represent species known to occur in the vicinity of the In-River Cable Route and were selected based on consultations with staff from NOAA Fisheries.

Alewife (*Alosa pseudoharengus*)

The alewife is an anadromous species, which as an adult is typically found in coastal Atlantic waters between Newfoundland and South Carolina (Pisces 2008). Alewife migrate through Upper New York Bay in the early spring and into the freshwater tributaries of the Hudson River to spawn (Everly and Boreman 1999). It is believed that alewife return to their natal river to spawn (Everly and Boreman 1999, Bigelow and Schroeder 2002). Larvae and juveniles remain in the freshwater tributaries of the Hudson River until June, when the species begins to migrate out of the nursery areas and downstream to the lower Hudson River, through Upper New York Bay, and out to the Atlantic Ocean (Everly and Boreman 1999).

Alewife have been recorded in the Hudson River during various scientific sampling efforts along the shoals during the spring months, between April and June; and within the Federal Channels during the summer (July through September) and fall months (October through December) (Everly and Boreman 1999). Alewife feed primarily on amphipods, mysid shrimp, copepods, fish eggs, and small fish such as herring, eels, lance, cunner, as well as their own species (Everly and Boreman 1999, Bigelow and Schroeder 2002).

American Eel (*Anguilla rostrata*)

The American eel is a catadromous fish species, spending most of its life in freshwater or estuarine environments, and then returning to the ocean to reproduce. Typically, American eels are found buried within the benthic substrate; however, the species is known to inhabit rocky and sandy habitats. Their diet is diverse and generally includes nearly all types of aquatic fauna that occupy the same habitats (Woodhead 1991, Heimbuch et al. 1994, Bigelow and Schroeder 2002).

Spawning occurs solely in the Sargasso Sea during the winter and the early spring, from February to April and possibly beyond (Bigelow and Schroeder 2002). Considering that the larvae themselves spend at least a year at sea before migrating inshore (Able and Fahay 1998), it is highly unlikely that American eel eggs would be found in the Hudson River. As the larvae of the American eel are carried by surface currents towards the shoreline of the United States, they develop into the classic “eel form” and are called glass eels. Once the glass eels have migrated into coastal estuaries and rivers the eels take on their adult coloring and are known as elvers. In general, eels are predators and scavengers and will eat almost anything they can swallow. While in freshwater, eels typically feed on insects, worms, crayfish and other crustaceans, frogs, and fish. Larger crustaceans, polychaetes and other fishes are also known prey items for larger American eels (Bigelow and Schroeder 2002).

American eels migrate into the Hudson River estuary in early spring (mid-March to April) and then disperse throughout the river and its tributaries. Eels are known to move upstream past the Federal Dam, as far as Saratoga Lake and the Adirondack lakes. Eels may reside in the Hudson River for upwards of 30 years before migrating out of the river to the spawning grounds in the Sargasso Sea (Levinton and Waldman 2006). The commercial fishery for eels in the Hudson River has been closed since 1976 due to PCB contamination; however U.S. landings of American eels have indicated a substantial decline since 1979. American eel are especially susceptible to the accumulation of toxic compounds because of their long residence in aquatic habitats and their accumulation of lipids prior to migration. New York State has imposed a minimum length limit for harvest of American eels in marine waters of 15 cm (ASMFC 2000).

American Shad (*Alosa sapidissima*)

The American shad is a highly migratory, anadromous species that spends most of its life in the Atlantic Ocean between Newfoundland and Florida, but returns to its natal, freshwater river to spawn (Everly and Boreman 1999, Pisces 2008, ASMFC 2012a, HRVI 2012). In March and April, adults migrate from the Atlantic, through Upper New York Bay, and into the Hudson River to spawn (Everly and Boreman 1999). Spawning occurs primarily between sunset and midnight (HRVI 2012) in areas where there is shallow water with moderate current, and on various substrates including sand, silt, muck, gravel, or boulders (Everly and Boreman 1999, ASMFC 2012a). After spawning, adults return to the sea and migrate northward to their summer feeding grounds in the Gulf of Maine/Bay of Fundy, where they primarily feed on zooplankton and small fishes (ASMFC 2009). Adults overwinter in the deep water of the Atlantic and Gulf of Maine (Everly and Boreman 1999).

Fertilized eggs are carried by river currents and hatch within 2-17 days depending on water temperatures. Larvae drift with the current until they mature into juveniles, which tend to remain in nursery areas during the summer and early fall (ASMFC 1999, Everly and Boreman 1999). American shad are most active in the Hudson River in the spring; however individuals that hatch in June represent the majority of population recruitment (Levinton and Waldman 2006). Most juveniles complete their migration from the freshwater and into the Atlantic by late fall or early winter (Everly and Boreman 1999, ASMFC 1999). Juveniles feed on copepods, other crustaceans, zooplankton, chironomid larvae, and aquatic and terrestrial insects. Immature shad will remain in the ocean for three to six years before returning to spawn (ASMFC 1999).

The American shad population in the Hudson River, similar to other East Coast River, has been declining for many years because of overfishing, pollution and anthropomorphic effects (Pisces 2008). Commercial landings have also been declining (Levinton and Waldman 2006). Despite the declining levels, recruitment has been high and inriver fishing mortality rates have fallen, indicating that abiotic or biotic factors (i.e. predation) rather than overfishing, may be causing the population decline (Levinton and Waldman 2006). As a result, NYSDEC closed the commercial and recreational shad fisheries in 2010 and implemented a long-term restoration plan.

Hickory Shad (*Alosa mediocris*)

Hickory shad are known to occur in inshore waters in the New York Bight and Long Island Sound but little is known of hickory shad in the Hudson River. Fishing records exist indicating that hickory shad are caught near the mouth of the Hudson River between September and November and have been recorded as far upriver as Indian Point. There is no evidence that hickory shad reproduce in the Hudson River. Similar to trends noted in Connecticut and the Chesapeake Bay, it is believed that hickory shad abundance has been increasing (Levinton and Waldman 2006).

Gizzard Shad (*Dorosoma cepedianum*)

Gizzard shad are a predominately freshwater species; however they are able to tolerate brackish waters. Gizzard shad are relatively new inhabitants of the Hudson River, having first been reported in the lower Hudson River between 1969 and 1971 (O'Leary and Smith 1987). Gizzard shad are becoming more abundant in the tidal Hudson River and common in many tributaries in the spring and summer. Gizzard shad are reported to be spawning in the river with larvae concentrating in the estuary near Albany (Daniels et al. 2005).

Atlantic Tomcod (*Microgadus tomcod*)

Atlantic tomcod are a nearshore shallow water species known to occur along the Atlantic coast through Virginia. The species is common within the Hudson River Estuary, where it is considered a resident species, and therefore, found throughout the year; however, the Hudson River system likely represents the southern limit of their range (Woodhead 1991, Everly and Boreman 1999).

Adult Atlantic tomcod are omnivorous, feeding on crustaceans, small invertebrates, and larvae of fishes such as menhaden, alewife, and other common estuarine fishes. Tomcod also search out amphipods and polychaetes within benthic sediment utilizing its chin barbel and pectoral fins (Bigelow and Schroeder 2002).

The Hudson River population of tomcod reaches maturity faster than more northerly populations; generally spawning males and females are one year old (Bigelow and Schroeder 2002) and spawning occurs between November and February (USFWS 1997). Spawning occurs primarily between Tappan Zee and Poughkeepsie (Levinton and Waldman 2006), which is within the proposed Project Area. Once released by the female, the eggs of the Atlantic tomcod sink to the bottom and stick to the benthos until hatching occurs.

After hatching, tomcod larvae tend to congregate near the bottom of a waterbody, and in the Hudson River, tend to stay in the northern freshwater systems. As the fish grow, they continue to remain along the bottom of the river and gradually migrate into the brackish lower river. Juveniles are most abundant in the Tappan Zee and West Point regions from April to November, but tend to move north with the salt front to the Indian Point area during the summer. After reaching full sexual maturity in late fall at approximately 11 months of age, Atlantic tomcod migrate upriver to their spawning grounds (Woodhead 1991, Everly and Boreman 1999, Levinton and Waldman 2006).

The Atlantic tomcod spawning cohort of a given year is comprised almost entirely (92-99%) of individuals that hatched the previous winter. Due to their short life span and abundance in estuarine systems, as well as sensitivity to environmental stresses, the Atlantic tomcod stock is an excellent measure of environmental health (USFWS 1997). Environmental factors that affect the recruitment success of Atlantic tomcod in one year will have a direct impact on population size the following year (Levinton and Waldman 2006).

<u>Blueback Herring (*Alosa aestivalis*)</u>

Blueback herring range from Florida to Newfoundland, but are most abundant from warmer waters of the Chesapeake Bay southward (ASMFC 1999). Blueback herring are an anadromous species, which as adults, spend most of their lives at sea following a seasonal migration pattern along the Atlantic coast. It is believed that blueback herring return to their natal, fresh tidal river to spawn (ASMFC 2012b), but adults quickly return downstream once spawning is complete. In the northern end of the range, spawning typically occurs between June and August in areas of rivers where there is gravel or clean sand substrates (ASMFC 1999).

Juveniles spend three to nine months in their natal rivers feeding on zooplankton before moving to the ocean as water temperatures decline in the fall (ASMFC 1999, 2012b). Beginning in late summer juveniles are generally found in the lower ends of freshwater tributaries and rivers, where many spend their first winter (ASMFC 2012b).

The Hudson River provides spawning habitat for blueback herring (Everly and Boreman 1999), and tidal rivers to the New York Harbor Estuary reportedly provide nursery habitat for juveniles (USFWS 1997). Studies in the Hudson River suggest that blueback herring spawn primarily in the main channel of the estuary; the single peak, typically observed in late May, in the temporal distribution of “river herring” eggs in the main channel, is believed to represent eggs of blueback herring. Hudson-spawned blueback juveniles remain in the river until July, when they begin to migrate downriver (Everly and Boreman 1999) and migrate through Upper New York Bay on their way back to sea. Blueback herring feed primarily on a variety of plankton, copepods, pelagic shrimp, and early life stages of small fishes (Everly and Boreman 1999).

Rainbow Smelt (*Osmerus mordax*)

Rainbow smelt are anadromous fish that migrate through Upper New York Bay in early spring to the spawning areas in the Hudson River and its tributaries (USFWS 1997, Daniels et al. 2005). Typically, rainbow smelt are found in the northern part of the western Atlantic and in many naturally land-locked populations (Pisces 2008), which include lakes and ponds of New Hampshire and Maine, Lake Champlain, and various Canadian lakes (Bigelow and Schroeder 2002). The Hudson River population of rainbow smelt is at the southern extreme of their reproductive range, although historically that range occurred farther south to New Jersey and Virginia (Pisces 2008). Rainbow smelt consume crustaceans, amphipods, nereidid worms, oligochaetes, fish, and insect larvae (Levinton and Waldman 2006).

Historically, larval and juvenile rainbow smelt were found from mid-June to August in the middle and lower Hudson Estuary; however, juvenile rainbow smelt have since begun to decline (Daniels et al. 2005, Pisces 2008). This may to be due to a change in their distribution, possibly related to the invasion of zebra mussels, which began in 1992 (Pisces 2008). It is also possible that the species has declined because of global warming and the steadily increasing water temperatures of the Hudson River (Daniels et al. 2005, Pisces 2008). Rainbow smelt runs in the nearby coastal streams of western Connecticut have also drastically declined or disappeared simultaneously with the decline in the Hudson River population (Daniels et al. 2005).

Striped Bass (*Morone saxatilis*)

Striped bass are anadromous fish, living the majority of their life in coastal and estuarine waters, and migrating to freshwater systems to spawn (Bigelow and Schroeder 2002). The species ranges from the St. Lawrence River in Canada to Florida (Pisces 2008). Striped bass spawn in the tidal reaches of the Hudson River, from Troy to New York City, between April and mid-June. The fish then migrate downriver prior to the low winter temperatures.

The eggs of striped bass are semi-buoyant and non-adhesive and are typically carried downstream by the ambient current, but can sink to the bottom of the waterway in periods of low flows (Bigelow and Schroeder 2002). The Hudson River is one of two primary spawning locations for striped bass on the Atlantic coast, and significantly contributes to the adult summer population in coastal New England waters (USFWS 1997). Striped bass populations have reportedly been steadily increasing since the early 1990's. This is thought to be a result of several factors including a reduction in fishing pressure, and improvement of water quality in the vicinity of New York Harbor and Long Island Sound, which increases the available nursery habitat (Pisces 2008).

Striped bass typically feed on smaller fishes inducing alewife, anchovy, croakers, channel bass, eels, flounders, herring, menhaden, mummichogs, mullet, rock eels, launce, sculpins, shad, silver hake, silversides, smelt, tomcod, weakfish, and white perch; and a wide variety of invertebrates including lobsters, crabs, shrimps, isopods, gammarid crustaceans, various worms, squid, soft clams, and small mussels (Bigelow and Schroeder 2002).

White Perch (*Morone americana*)

White perch are a euryhaline species, living primarily in estuarine waters and migrating upstream to freshwater to spawn. The species occurs in estuarine and coastal rivers along the Atlantic coast from Canada to the Carolinas (Pisces 2008). White perch are widely distributed throughout the brackish to freshwater portions of the Hudson River. Adults spawn in protected habitats between April and June, with peak egg deposition occurring from mid-May to early June.

The eggs of white perch are extremely adhesive and usually sink and stick to the benthos. In areas with high flow, eggs may stick to each other and drift downstream, resulting in semi-pelagic incubation (Stanley and Danie 1983). Shortly after hatching, post yolk-sac larvae disperse downriver, alternately swimming up into the water column and sinking. Juveniles move into the shore zone by the end of the summer and move into deeper water by late fall (Everly and Boreman 1999). Adult white perch generally prefer shallow water (<5 m depth), where they form pelagic schools in the water column, feeding on small squid and other invertebrates, fish eggs, and small fish fry (Bigelow and Schroeder 2002). Populations of white perch in the Hudson River have generally been in decline since the 1980s, with highly variable recruitment year to year (Pisces 2008).

Largemouth Bass (*Micropterus salmoides*)

Largemouth bass is a cosmopolitan freshwater-oligohaline species, having been introduced as a game fish throughout the world. The species prefers warm vegetated lakes, ponds, and pools of slow-moving creeks and rivers, including the freshwater and oligohaline reaches of the Hudson (Fishbase 2013, UMMZ 2013b). They seek shelter in dense vegetation or near submerged structural elements, including boulders and logs (NYSDEC 2013c). Largemouth bass generally prefer shallow water, no deeper than 2.5 m (UMMZ 2013b), however they move into deeper waters to overwinter (FLMNH 2013).

Adult largemouth bass spawn during the spring, when water temperatures have reached approximately 60°F, typically between May and early July (Everly and Boreman 1999, NYSDEC 2013c, UMMZ 2013b). The male excavates a crude nest in a protected cove or bay in which a female will lay eggs. The male then guards the eggs until they hatch and for an additional month as larvae and developing juveniles (UMMZ 2013b). Juvenile largemouth bass feed primarily on crustaceans, insects, and small fishes, whereas adults feed on fishes, crayfish, and frogs, and occasionally conspecifics (Fishbase 2013).

Smallmouth Bass (*Micropterus dolomieu*)

Smallmouth bass is a freshwater species native to the Great Lakes and the St. Lawrence seaway drainages from southern Canada and New Hampshire west to North Dakota, as well as parts of the Mississippi River drainage. It has become established in a much wider range due to introduction as a game fish around the world. This species inhabits cool, sandy or rocky bottomed lakes and ponds as well as flowing streams and rivers (UMMZ 2013a). They are typically found seeking shelter near submerged rocks or large logs (NYSDEC 2013c).

Adult smallmouth bass typically spawn between late May and early July, when males form shallow nests in the gravelly substrate. Females release their eggs in these nests, where the eggs and larvae are guarded by the male for up to 2 weeks (UMMZ 2013a). Larvae and juveniles of this species typically feed on zooplankton and insect larvae, whereas the adult diet is more opportunistic and includes crayfish, amphibians, insects, fish, and conspecific young of other parents (NYSDEC 2013c).

Ichthyoplankton

The Hudson River Estuary provides important nursery and spawning grounds for a wide variety of fish species including freshwater, estuarine, and diadromous species. Annual, seasonal and life-cycle changes in the abundance, distribution, or life history of these species have the greatest effect on the overall assemblage of fish in the Hudson River.

Many fish species generally exhibit a seasonal onshore and offshore migration pattern, i.e., moving upstream and toward shore during the spring and summer, and downstream to deeper waters during the fall and winter (USFWS 1997). Species, such as the striped bass, also exhibit diel vertical migration, moving from deep waters during the day to mid-depth and surface waters at night (NYU 2013). Most fish species begin spawning in late spring and continue throughout the summer (Table 4.6-2). Notable exceptions are Atlantic tomcod, in which eggs and larvae are most commonly found in the Hudson River Estuary between November and April (USFWS 1997) and winter flounder, in which spawning occurs in more saline water, but larvae are commonly found in the Hudson River Estuary from November to June (Stone et al., 1994). The eggs of many of the species are demersal or bottom nesting.

The reproductive behavior of many species is controlled by environmental cues, such as water temperature, salinity, light, and tidal and river flow; as a result, spawning typically occurs during confined periods of time and space, resulting in patchy distribution of early life history stages (NYU 2013). Other factors that affect the ichthyoplankton assemblage include habitat modification (including dredging and filling) and the effects of urbanization. A negative correlation has been identified between the number of alewife larvae exiting Hudson River tributaries and the degree of watershed urbanization (Limburg and Schmidt 1990). There has also been a noted decline in abundance of early life stages of rainbow smelt and Atlantic tomcod, possibly due to global warming, because the Hudson River is at the southern extreme of their geographic ranges. Alternatively, global warming may lead to an increase in the number of marine strays entering the estuary (Daniels et al. 2005).

The Indian Point Power Plant is located near the Southern Landfall point and ichthyoplankton studies have been conducted here as part of their entrainment monitoring since 1971. The eggs and larvae of striped bass and the larvae of white perch, bay anchovy and several transient marine species are common in the vicinity of Indian Point (NYU 2013). Peak densities of eggs typically occur in June and July and are primarily dominated by bay anchovy. It is important to note that eggs are underrepresented in the entrainment samples due to their small size and the inability of standard plankton nets to effectively capture them. Peak yolk-sac larvae densities are noted in May, consisting of striped bass and white perch; *Alosa* sp., bay anchovy, and hogchoker tend to peak later in June and July. Post-yolk sac larvae peak in late July and consist primarily of bay anchovy. High densities of striped bass and white perch larvae were also noted in late May and June (ConEd 1984).

Table 4.6-2: Life History Characteristics of Key Fish Species Found in the Hudson River Estuary

	Early Life Stages		Older Life Stages		Designation/ Importance
	Eggs	Larvae	Juveniles	Adults	
Benthic Species					
Hickory Shad	May - June[f]	n/a			Diadromous
Gizzard shad	April - June	n/a			Resident
American eel	n/a		Year-round		Diadromous
Atlantic Sturgeon	May - August		Year-round	May – Sept.[a]	Threatened/ Endangered Species
Atlantic tomcod	November - April		Year-round; peak April – Nov.	Year-round; peak Nov. – Feb.	Diadromous
Rainbow smelt	March – May	n/a			Diadromous
Shortnose Sturgeon	April - June		Year-round		Threatened/ Endangered Species
Striped bass	April – June[b]				Diadromous
Winter flounder	n/a	Nov. – June[c]	Year-round	n/a	EFH

	Early Life Stages		Older Life Stages		Designation/ Importance
	Eggs	Larvae	Juveniles	Adults	
Windowpane flounder	n/a			Year-round; peak May and Sept.	EFH
White perch	April – June[d]	April – July[e]	Year-round		Resident/semi-diadramous
Largemouth bass	May - July	May - August	Year-round		Resident
Smallmouth bass	May - July	May - August	Year-round		Resident
Pelagic Species					
Alewife	March – June			March - June; Also recorded July – Dec.	Diadromous
American shad	March - June		June – Sept	March - June	Diadromous
Hickory shad	May - June[f]	May - June	June – September	May - August	Diadromous
Gizzard shad	n/a	April - July	Year-round		Resident
Atlantic butterfish	n/a	June - August	April - November		EFH
Blueback herring	May - June		May - July		Diadromous
Bluefish	n/a		May - October		EFH
Rainbow smelt	n/a	April - June	June - August	March - May	Diadromous
Red hake	n/a	May – Dec.; peak Sept. – Oct.	n/a		EFH
Striped bass	April – June[b]	n/a			Diadromous
Winter flounder	n/a	Nov – June[c]	n/a		EFH
Windowpane flounder	February - November; peak May and October		n/a		EFH
White perch	April – June[d]	April – July[e]	n/a		Resident/semi-diadramous

[a] Atlantic sturgeon adult females leave the river 4-6 weeks after spawning, however males may remain until fall.
[b] Eggs are semi-buoyant (may float or sink) and non-adhesive.
[c] Larvae are initially planktonic but become increasingly bottom-oriented as metamorphosis approaches.
[d] Eggs are extremely adhesive and in strong currents may stick to each other and drift, resulting in semi-pelagic incubation.
[e] Larvae are semi-pelagic, becoming more benthically-oriented as they develop.
[f] Eggs tend to be demersal, but are only mildly adhesive and thus are easily dislodged and carried by currents.

4.6.1.4 Essential Fish Habitat Species

The Magnuson-Stevens Fishery Conservation and Management Act and the 1996 Sustainable Fisheries Act mandate that NOAA identify and protect important marine and anadromous fish habitat (essential fish habitat [EFH]). EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity” (16 U.S.C.1802 § 3). The Magnuson Stevens Act requires consultation with NOAA National Marine Fisheries Service (NOAA Fisheries) for proposed activities that may “adversely effect” EFH. An “adverse effect” is defined as any impact which reduces quality and/or quantity of EFH, including direct, indirect, individual, cumulative or synergistic impacts.

NOAA Fisheries designates EFH for most species in association with a grid of 10 x 10 minute squares, which covers all marine habitats along the United States coastline. NOAA Fisheries also designates EFH for estuarine waters (including estuaries, bays and rivers). EFH within the Project Area would most closely fall under the EFH designations for the square covering the Atlantic Ocean within the Hudson River estuary (Grid 40407350), as well as in the Hudson River/Raritan/Sandy Hook Bays Estuary in New York waters. Although the In-River Transmission Cable Route is located north (up-river) of the Hudson River estuary 10 x 10 minute grid square and the area defined by the Hudson River/Raritan/Sandy Hook Bay Estuary, it may contain habitat that is essential to certain EFH species.

A list of species with EFH designated within the Project Area is provided in Table 4.6-3. Of these 20 species, five (scup, Atlantic mackerel, and three skate species) have been designated only within the seawater salinity zone, and seven (king mackerel, Spanish mackerel, cobia, pollock, and three shark species) have been identified with no salinity zone specifications, although their life history descriptions indicates that they prefer high-salinity waters. The remaining eight species are either listed as occurring within the mixing water/brackish/seawater or freshwater zones. Further analysis of Project-specific habitat conditions may indicate that EFH does not exist for some of these species or lifestages in the Project Area. A detailed EFH Assessment is contained in Appendix 4D.

Table 4.6-3: Summary of EFH Designations for the Project Area[1]

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Red hake (*Urophycis chuss*)		M,S	M,S*	M,S*	
Winter flounder (*Pseudopleuronectes americanus*)	M,S*	M,S	M,S	M,S*	M,S*
Windowpane flounder (*Scophthalmus aquosus*)	M,S	M,S	M,S*	M,S*	M,S
Bluefish (*Pomatomus saltatrix*)			M,S	M,S	
Atlantic butterfish (*Peprilus triacanthus*)		M	M,S	M,S	
Summer flounder (*Paralichthys dentatus*)		F,M,S*	M,S*	M,S*	
Pollock (*Pollachius virens*)			X*	X*	
Atlantic herring (*Clupea harengus*)		M,S*	M,S*	M,S*	
Atlantic mackerel (*Scomber scombrus*)			S*	S*	
Scup (*Stenotomus chrysops*)	S*	S*	S*	S*	S*
Black sea bass (*Centropristis striata*)			M,S*	M,S*	
King mackerel (*Scomberomorus cavalla*)	X*	X*	X*	X*	
Spanish mackerel (*Scomberomorus maculatus*)	X*	X*	X*	X*	
Cobia (*Rachycentron canadum*)	X*	X*	X*	X*	
Clearnose skate (*Raja eglanteria*)			S*	S*	
Little skate (*Leucoraja erinacea*)			S*	S*	
Winter skate (*Leucoraja ocellata*)			S*	S*	

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Sand tiger shark (*Carcharias taurus*)		X*			
Dusky shark (*Carcharhinus obscurus*)		X*			
Sandbar shark (*Carcharhinus plumbeus*)		X*			X*

[1]The In-River Transmission Cable Route is located north (up-river) of the 10 x 10 minute grid square defined by NMFS as well as the area defined by the Hudson River/Raritan/Sandy Hook Bay Estuary; but may contain habitat that is essential to certain EFH species.
S = Includes the seawater salinity zone (>25 ppt)
M = Includes the mixing water/ brackish salinity zone (0.5 ppt to 25 ppt)
F = Includes tidal freshwater salinity zone (0.0 ppt to 0.5 ppt)
X = Designated EFH but no salinity specified.
* = Unlikely to be found in project area due to salinity conditions.

4.6.1.5 Commercial and Recreational Fisheries

The fisheries of the Hudson River have provided an important source of food to the local human population since pre-Colonial times. Since the 19th century, when fishing pressure began to significantly increase, many species have undergone a cycle of overfishing, population crash, reduction in fishing effort, and population rebound. Because of these population stressors, today, commercial harvest of several species is prohibited on the Hudson River, and recreational harvest of certain species is restricted as well.

Due to bioaccumulation of mercury in some fish species, women and children are advised not to consume yellow perch, northern pike, pickerel, walleye, or black bass from any Adirondack or Catskill region waters. Additionally, due to certain areas of PCB contamination in the river, the following advisories apply to all consumers: between the Troy Dam and the bridge at Catskill, all fish species except river herring, rock bass, and yellow perch should be avoided entirely. South of the bridge at Catskill, channel catfish, white catfish, and gizzard shad should be avoided entirely; Atlantic needlefish, bluefish, brown bullhead, carp, goldfish, black bass, rainbow smelt, striped bass, walleye, and white perch should not be consumed in quantities greater than 0.5 lbs per month; all other fish species should not be consumed in quantities greater than 2 lbs per months (NYSDEC 2012).

Recreational Fishing

The NYSDOH conducted an angler survey in 1996, which included 172 miles of the Hudson River from Hudson Falls to the Tappan Zee Bridge at Tarrytown. The most important finfish species caught by anglers were white perch, striped bass, white catfish, and American eel. Finfish species kept by anglers were white perch, white catfish, striped bass, carp, largemouth and smallmouth bass, bluefish, and American eel (NYSDOH 1996).

In 2005, river herring (alewife and blueback herring) comprised approximately 83% of the recreational fish harvest in the Hudson River. Striped bass represented approximately 8% of the recreational harvest, and the remaining 9% was comprised primarily of white perch, catfish, and American eel (Normandeau 2007). The river herring recreational fishing season is open from mid-March to mid-June from Waterford, NY to the George Washington Bridge, and in the tributaries and embayments of the Hudson River (NYSDEC 2012). White perch and catfish are caught year-round, with the largest catches realized in the spring (Stanley and Danie 1983). American eels are also available for harvest year-round and without catch limits; however, the species may only be used for bait (NYSDEC 2012).

Striped bass appears to be the most widely sought-after fish among recreational anglers, with 81% of all spring fishing trips targeting that species. Eleven striped bass fishing tournaments were held in the spring of 2005, the largest of which, in Tarrytown, attracted over 700 entrants (Normandeau 2007). Striped bass season is open from mid-March to late November throughout the Hudson River north of the George Washington Bridge (NYSDEC 2012). Striped bass landings reached a peak in the 1890s, which was followed by drastic declines throughout the early to mid-1900s. Following the adoption of regulations regarding season, size limits, and gear restrictions in the 1980s, the fishery began to recover (Levinton and Waldman 2006).

Black bass (largemouth and smallmouth bass) also provide a popular recreational fishery in the Hudson River. These species primarily occur in the oligohaline and freshwater reaches of the Hudson River. The black bass recreational fishing season is open from late June to late November, in the Hudson River south of the Troy Dam and throughout all tributaries to the first impassable barrier to fish (NYSDEC 2012).

Commercial Fishing

River herring are currently the only finfish species legally harvestable on a commercial scale for human consumption in the Hudson River from the Troy Dam to the George Washington Bridge. The river herring commercial fishing season is open from March 15 to June 15, and there are no size limits in place (NYSDEC 2012).

Historically, American shad landings have experienced several peaks followed quickly by drastic declines since the turn of the 20th century. During the mid-1900s, American shad was an important food fish, but the stock collapsed in the 1950s. Following a resurgence and subsequent decline in the 1980s, regulations were adopted by ASMFC and the State of New York to limit American shad harvest (NYSDEC 2009). In 2010, NYSDEC prohibited all commercial and recreational American shad fishing in an effort to help restore the population to sustainable levels (NYSDEC 2010).

Atlantic sturgeon were heavily harvested during the 19th and 20th centuries for their meat and caviar, which were considered delicacies. As other fisheries collapsed, commercial fishing effort became more focused on Atlantic sturgeon. By the end of the 20th century, the population had faced steep declines; however, a small commercial fishery still existed. In 1998, the ASMFC adopted regulations prohibiting all harvest of Atlantic sturgeon for 40 years, closing the fishery (Levinton and Waldman 2006). In 2012, NOAA upgraded the status of Atlantic sturgeon from Candidate to Endangered, reaffirming the closure of the fishery and providing further protection for the species (NOAA 2012).

4.6.1.6 Protected Fish Species

This section will briefly describe the life histories of two protected fish species, shortnose sturgeon and Atlantic sturgeon. For further information regarding these species, please refer to Section 4.9.

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is a federally and New York State listed endangered species. The geographic range of this species is restricted to the large rivers and estuaries along the Atlantic seaboard in North America (NOAA 2013b). In New York State, shortnose sturgeon are limited to the lower portion of the Hudson River, from RM 0 to Troy Dam at RM 152 (Stegemann 1994). The summer range of adult Hudson River shortnose sturgeon is relatively broad, stretching from approximately from New York Harbor to Catskill (RM 24 to RM 109). During the winter months, adults tend to concentrate in a few overwintering areas, the largest occurring south of Kingston, New York, near Esopus Meadows (RM 86-94), and Haverstraw Bay (RM 33-38). Between late March and early April adults migrate from these brackish downstream overwintering sites upstream to freshwater spawning grounds north of Coeymans, New York and well north of the In-River Cable Route (RM 132) (Dovel et al. 1992). Spawning generally occurs from late April through May, after which the adults disperse quickly downstream. Juvenile shortnose sturgeon are distributed throughout the river during the summer, and move to the Haverstraw Bay region (South of the In-River Cable Route - RM 33-38) during the fall (NOAA 2013c).

Atlantic Sturgeon (*Acipenser oxyrinchus*)

Atlantic sturgeon are listed federally as endangered species and are protected by the state of New York. Atlantic sturgeon are anadromous and range throughout the Atlantic coast from Labrador to Florida (Bigelow and Schroeder 2002). The spawning population of Atlantic sturgeon in the Hudson River represents a distinct population segment (DPS) of this species, also known as the New York Bight DPS. Spawning typically begins between April and May at several well-known spawning areas within the Hudson River, primarily near Hyde Park (RM 83) and Clinton Point (RM 69). Following spawning, adult sturgeon migrate out of the Hudson River and return to the marine environment in late spring and early summer (NOAA 2013c). After hatching, Atlantic sturgeon larvae remain upstream of the salt front before moving downstream toward more brackish waters as juveniles. Juvenile Atlantic sturgeon remain in the river for approximately three years and are known to concentrate in Newburgh (RM 61) and Haverstraw Bay (RM 36) during the summer (Sweka et al. 2007) and move downstream (RM 12 to RM 46) during the winter (NOAA 2013c).

4.6.2 Environmental Impacts and Mitigation

4.6.2.1 Potential Construction Impacts and Mitigation

Potential impacts to finfish and finfish habitat from installation of the In-River Transmission Cable will be localized and temporary, resulting primarily from direct and indirect riverbed sediment disturbance from the narrow jet plow embedment corridor along the proposed route. Sediment disturbance will be limited to the extent practicable through the use of low-impact jet plow embedment. Horizontal directional drilling (HDD) and installation of a temporary cofferdam that will contain sediment disturbed during dredging at both the southern and northern landfalls will also minimize suspended sediment and turbidity effects. These methods minimize disturbance to the benthic environment when compared with other installation techniques such as mechanical dredging or trenching, reducing impact to finfish life stages that utilize the area as habitat and a source of benthic invertebrate prey.

Notwithstanding the deployment of low impact underwater cable installation techniques, which minimize direct bottom disturbance, the Project will employ a series of additional mitigation measures, most notably respecting fishery time of year restrictions to avoid or minimize potential project impacts to fisheries in the Project Area during installation activities.

Summary of In-River Construction Timeline Mitigation

In-River construction is anticipated to begin August 2015, with the installation of temporary cofferdams at the Northern and Southern Landfall locations, route clearance, and jet plow embedment of the in-river cable. The In-River Transmission Cable Route will enter the Hudson River at the Northern Landfall in Athens, NY via HDD. The HDD will terminate at a temporary cofferdam to be installed near RM 118. Similar to the Northern Landfall, the In-River Transmission Cable Route will enter the Hudson River at the Southern Landfall in Cortlandt, NY via HDD. The HDD terminates at a temporary cofferdam to be installed at a location just south of the Indian Point Power Plant near RM 42. The temporary cofferdams will remain in place until jet plow embedment installation of the Transmission Cable is complete. The cofferdams will serve to contain the suspended sediment associated with dredging and subsequent jet plow embedment operations. Dredging within the cofferdam will begin after the temporary cofferdam has been installed. Each temporary cofferdam is expected to be 300 feet long, by 70 feet wide, by 10 feet deep, with an estimated dredged volume of approximately 6,500 cubic yards each. HDD operations will begin once the temporary cofferdam installation and associated dredging is complete. The installation of the In-River Transmission Cable via jet plow embedment is anticipated to take approximately 4 months to complete. The In-River work is expected to be completed between August and November to minimize potential direct and indirect impacts to fish species.

Direct Impacts to Benthic Habitat

Impacts to the benthic habitat will be temporary and limited in spatial extent. HDD activities will be conducted within temporary cofferdams at each landfall location, thereby containing sediments that may be suspended during dredge and drilling activities and generally providing a barrier between the open river habitat and construction. Benthic invertebrate species with limited mobility that inhabit the sediments within the temporary cofferdams will experience mortality as the sediment is dredged. However, mobile fish and invertebrate species are expected to exhibit avoidance behavior and retreat to similar habitat nearby, thus avoiding major impact from construction activities. After installation of the In-River Transmission Cable is complete, the temporary cofferdams at both landfalls will be removed and the dredged area within will be backfilled with imported clean backfill material to restore the riverbed to preconstruction grade. As benthic invertebrates rapidly recolonize the backfilled material, fish are expected to return to utilize the habitat (Van Dolah et al. 1984, Tuck et al. 2000).

The In-River Transmission cable will be installed by jet plow embedment, which fluidizes the sediments within the embedment trench, thereby allowing the cable to settle under its own weight. Compared to traditional dredging, jet plow embedment reduces the direct impact to the riverbed, the temporary increase in suspended sediments from construction, and the subsequent deposition of sediments outside the immediate cable trench. As the jet plow is towed along the riverbed, the plow's skids and the stinger blade will directly disturb the sediments. The width of direct disturbance to benthic communities due to jet plow embedment is expected to be 18-24 inches. The cable will either be buried a minimum of 8 feet below present river bottom (15 feet below authorized depth within the Federal Navigation Channel) along the majority of the route or armored by low profile (< 1 foot) concrete mattresses at select crossings coinciding with chartered cables/pipelines. The concrete mattresses are typically 8 feet wide and approximately 9 inches thick. Once installed, the concrete mattresses will settle under their own weight into the riverbed and sediment will be naturally deposited over the mattresses. As a result, the potential impacts to benthic habitat from the In-River Transmission Cable installation activities will be localized and temporary.

While direct mortality or injury to benthic organisms in the immediate path of the jet plow and dredging activities is unavoidable, many benthic invertebrate species (prey for finfish) are capable of opportunistically recolonizing surrounding benthic sediments during such disturbances. Apart from the direct mortality of benthic organisms in the immediate path of the jet plow and within the cofferdam locations, the temporarily elevated levels of TSS water column concentrations and rapid rates of sediment deposition experienced by benthic organisms in the area immediately adjacent to the jetted trench may be similar to conditions that routinely occur within this part of the Hudson River, particularly during spring high freshwater discharge conditions and large storm events. Recovery of the benthic community in areas directly impacted by the jet plow is expected to be rapid, given the narrow width of the impacted area compared to the large area of adjacent unimpacted habitat that will serve as a recruitment source for recolonization (Van Dolah et al. 1984, McCabe et al. 1998, Guerra-Garcia et al. 2003, Schaffner 2010)

Direct Impacts to Finfish

Juvenile and adult finfish are likely to temporarily relocate to adjacent areas of the waterway during cable system installation as a natural avoidance response, but are expected to return to the area as soon as the construction activity ceases. Juvenile and adult finfish species are also not expected to become buried or suffocated by elevated suspended sediment in the vicinity of mobile jet plow operations given the slow rate at which the jet plow advances and their own mobility and the limited nature of the sediment disturbance and deposition associated with jetting activities. Of the species listed above under Section 4.6.1.3 (Finfish Species Identified in the Project Area), Section 4.6.1.4 (EFH species), and Section 4.6.1.6 (Protected Fish Species) those with juvenile and adult life stages that could be present in the Project Area from August through November include hickory shad, gizzard shad, alewife, American eel, American shad, Atlantic tomcod, winter flounder, windowpane, butterfish, bluefish, rainbow smelt, white perch, largemouth bass, smallmouth bass, shortnose sturgeon, and Atlantic sturgeon. Many of these species are pelagic; however, even the demersal species are highly mobile and have the ability to avoid the temporary area of disturbance during construction. The narrow area of sediment disturbance assures that fish will not have to relocate very far. Therefore, direct mortality resulting from Project construction activities will be minimal.

Egg and larval stages of fish species present in the Project Area during in-water construction are more likely to be impacted because they lack motility. Of the species listed above under Section 4.6.1.3 (Finfish Species Identified in the Project Area), Section 4.6.1.4 (EFH species), and Section 4.6.1.6 (Protected Fish Species), the only species that may have demersal eggs and/or larvae present in the Project Area during the planned In-River Cable installation window (August to November) are winter flounder, Atlantic tomcod, Atlantic sturgeon, largemouth bass, and smallmouth bass. Winter flounder eggs are not expected to be present in the Project Area because the salinity in this area is lower than their preferred range for spawning; however, winter flounder larvae could be present during the latter part of construction in November. Winter flounder larvae are initially pelagic and become bottom oriented as metamorphosis approaches. They are found in the river from November to June and may be present during the cable installation period (August - November). Atlantic tomcod eggs are released between November and February and stick to the bottom until hatching; therefore eggs and larvae could be present during the latter part of in-water construction in November. Atlantic sturgeon are known to spawn along the In-River Cable Route near RM 69 and RM 83 in April and May. Young of the year individuals typically remain upstream of the salt wedge, because of their low salinity tolerance; before moving downstream as juveniles in the fall. Therefore, Atlantic sturgeon larvae may be present in the Project Area at the very start of construction, but will move downstream of the project area in the fall. Largemouth and smallmouth bass spawn between May and July in shallow nests. The nests are guarded until the eggs hatch and the larvae remain in the nest for an additional 2-4 weeks. Therefore, largemouth and smallmouth bass larvae could be present in the early part of in-water construction in August.

If these few species of demersal eggs and larvae are present within the direct footprint of the In-River Transmission Cable or temporary cofferdam dredging area during in-water installation, they are expected to experience some level of unavoidable mortality. However, the area to be impacted along the In-River Cable Route and within the temporary cofferdam is relatively small and the expected timeline is anticipated to be of such short duration that any impact is expected to be minor.

Fish species with pelagic eggs and larvae will be less affected by temporary benthic disturbance since they are not as closely associated with the bottom; however, those in the immediate area of construction could experience some level of unavoidable injury or mortality. The planned in-river construction period of August to November would avoid the sensitive periods of most anadromous fish spawning migrations and peak biological activity within the Hudson River.

Pelagic larvae of the following species: red hake, butterfish, winter flounder and windowpane flounder could be present during the proposed August to November construction timeframe; however, these larvae should not be directly affected by the jet plow embedment since they will occur in the water column above the direct influence of the installation activities. Indirect impacts that could occur to these species and life stages are discussed below. In addition, although windowpane flounder eggs could occur in the Project Area during the construction period, they would be rare as they are documented to prefer higher saline waters than found in the Project Area (see EFH Assessment, Appendix 4D).

Due to the low number of species that may spawn or have eggs within the Project Area during the in-river construction period (August to November), no direct impacts to finfish populations as a whole are expected. Therefore, construction and installation of the In-River Transmission Cable via jet plow embedment will in no way hinder the successful growth and development of younger fish. Due to the limited and contained nature of the HDD installation and dredging activities within the temporary cofferdam at the Southern and Northern Landfall locations, no substantial impacts to finfish or the benthic habitat that supports these species are expected from those activities.

Indirect Impacts – Temporary Increase in Total Suspended Sediments

In-River construction activities that are expected to contribute to localized sediment resuspension include dredging, jet-plowing, vessel movements, and cofferdam construction. These activities will result in a temporary and localized increase in suspended sediment concentrations in the water column above ambient conditions in the areas surrounding construction activities. HDD will be used within cofferdams constructed at the two Landfall locations in order to minimize impacts at the shoreline and nearshore areas to the best extent practicable. In order to estimate the extent of potential impacts from sediment suspension generated by jet plow activities, numerical modeling using SSFATE (as previously discussed) was conducted to predict jet-plow induced suspended sediment transport and deposition associated with in-water jetting activities. A summary of the model results is presented in Section 4.4 and Section 4.5. The complete modeling report is provided in Appendix 4C.

The model results show that the highest concentrations of jet-plow induced suspended sediment and deposition occur on the riverbed directly at the jetting heads of the jet plow device, Concentrations and deposition thicknesses are predicted to decrease rapidly with distance from the jet plow as well as in time as the plow advances along the In-River Cable Route. In terms of vertical distribution, suspended sediment concentrations > 200 mg/L are predicted to remain within the bottom 10 to 13 feet of the water column, and decrease rapidly to approximately 10 mg/L or less approximately 16 to 26 feet above the bottom (see Appendix 4C). In addition, the modeling indicates that the suspended sediment will settle out quickly and suspended sediment concentrations will return to ambient conditions within 24 hours after passage of the jet plow. Such increases in water column solids loads would be within the normal variation occurring in the Hudson River (see Section 4.5 for characterization of ambient sediment conditions).

Resuspension of sediments can have a range of impacts to fish depending on the magnitude and duration of the event, its spatial and temporal distribution, and species and life stages being considered. Potentially lethal levels of sustained TSS concentrations vary widely among different species. Lethal effects of exposure to TSS in the Delaware River were demonstrated between concentrations of 580 to 700,000 mg/L depending on species, (580 mg/L for sensitive species and 1,000 as more typical) (Burton 1993). Common non-lethal impacts to finfish are the abrasion of gill membranes and respiration impairment, impairment of feeding, reduction in dissolved oxygen, inhibition of migratory movements, and mortality to early life stages. A study conducted by NOAA concluded that TSS concentrations as low as 350 mg/L could block upstream migrations of various species (NOAA 2001). Fish, however, are mobile and generally able to avoid unsuitable environments, such as large increases in suspended sediment and noise (Clarke and Wilber 2000). Based on the results of the SSFATE model, increased suspended sediment concentrations (greater than 200 mg/l) are predicted to extend a maximum of 312 feet from the jet plow and occur for a duration of less than two hours. After 12 hours, the suspended sediment concentration above ambient is predicted to be below 10 mg/L. These TSS characteristics are well within established NYSDEC requirements for jet plow embedment methods in the Hudson River.

No significant adverse impacts to juvenile or adult life stages are expected from jet plow installation or limited cofferdam dredging since these life stages are highly mobile and would have the ability to avoid the temporary area of disturbance during construction. Of the species listed above under Section 4.6.1.3 (Finfish Species Identified in the Project Area), Section 4.6.1.4 (EFH species), and Section 4.6.1.6 (Protected Fish Species), those with juvenile and adult life stages that could be present in the Project Area during the construction period (August to November) include alewife, American eel, American shad, Atlantic tomcod, rainbow smelt, winter flounder, windowpane, butterfish, bluefish, hickory shad, gizzard shad, white perch, largemouth bass, smallmouth bass, shortnose sturgeon, and Atlantic sturgeon. The narrow area of sediment disturbance limits the distance the fish need to relocate. Therefore, indirect disturbance from temporary elevated suspended sediment concentrations to these older life stages will be minimal.

Egg and larval stage fish are more likely to be affected by low-level increases in suspended sediment; however, they also exhibit a wide suspended sediment tolerance range. Hatching was delayed for striped bass and white perch eggs at concentrations of 100 mg/l over a 24 hour exposure period; however, egg development was not impaired by suspended concentrations of 300 and 500 mg/L for Atlantic herring (Kiorboe et al. 1981). Clarke and Wilber (2000) also reported that burial of fish eggs (i.e. Atlantic herring) by sediment deposition had more significant effects than exposure to suspended sediment concentrations as high as 7,000 mg/L for short periods (<24 hours). However, mortality increased at lower suspended sediment concentrations that were sustained for longer periods of time. Striped bass, American shad, yellow perch and white perch exhibited increased mortality at suspended sediment concentrations less than 500 mg/L for 3 or 4 days (Auld and Schubel 1978).

Of the species listed above under Section 4.6.1.3 (Finfish Species Identified in the Project Area), Section 4.6.1.4 (EFH species), and Section 4.6.1.6 (Protected Fish Species), demersal larvae of Atlantic tomcod, Atlantic sturgeon, winter flounder, largemouth bass, and smallmouth bass and demersal eggs of Atlantic tomcod could be present between August and November and could be affected by temporary elevated levels of suspended sediment generated during jet plow embedment activities. Other larval fish species described above that are pelagic in nature and may be present from August through November include red hake, winter flounder, windowpane, and butterfish. These species could have pelagic larvae present during jet plow embedment. If any of these few species with demersal eggs and larvae or pelagic larvae are present during in-water installation, they may experience indirect impacts from temporary elevated TSS concentrations. However, model results predict that the highest suspended sediment concentrations (greater than 200 mg/L) remain in the bottom 10 to 13 feet of the water column under all tide conditions and concentrations are predicted to decrease rapidly to approximately 10 mg/L or less approximately 16 to 26 feet above the bottom under all tide conditions. Therefore, many of the pelagic larvae that may be present in the water column along the In-River Cable Route would be expected to be above the indirect influence of the elevated suspended sediment concentrations. Any larvae that are affected may be temporarily displaced in the water column as a result of the limited disturbance associated with the jet plow. However, the overall area of habitat disturbed is likely insignificant in comparison to surrounding areas of larval habitat in the Hudson River. Further, NMFS has indicated that TSS concentrations below 100 mg/L are not likely to affect eggs and larvae – at least over short durations (AKRF 2012).

Predatory fish species, which may feed on the larvae, may also be temporarily displaced from the area as a result of the same short term disturbance during construction activities. Limited motility in the latter stages of larval development may actually help facilitate disturbance avoidance, and thus allow these individuals to remove themselves from areas of disturbance.

Given the tolerance of the finfish species with the potential to occur in the Project Area to high concentrations of suspended sediments, the natural variation of suspended sediments in the Hudson River under ambient conditions, and the limited area over which suspended sediment would be increased, the resuspension of bottom sediment that would result from construction of the Project would not result in adverse impacts to finfish species.

Indirect Impacts – Sediment Deposition Resulting from Jet Plow Embedment and Cofferdam Dredging

Deposition of the sediment suspended in the water column during jet plow embedment and cofferdam dredging occurs over time as the sediment particles settle through the water column to the riverbed. The SSFATE model was used to predict the cumulative suspended sediment deposition thickness resulting from jetting of the In-River Cable as described in Section 4.4. The model predicts that a cumulative suspended sediment deposition greater 2mm (0.08 in) thick on the riverbed resulting from jetting of the In-River Cable extends up to 300 feet to either side of the centerline of the In-River Transmission Cable Route and covers an area of approximately 227 acres. Deposition thicknesses greater than 2 mm generally fall along the path of the operating jet plow and will provide sediment cover for the installed cable.

Resettling sediments during construction activities can potentially bury any demersal eggs or larvae that are within the zone of deposition in the Project Area. However, as previously stated, of the species listed above, Atlantic tomcod, Atlantic sturgeon (larvae only), winter flounder (larvae only), and largemouth and smallmouth bass (larvae only) are the only species that have the potential for demersal eggs and/or larvae to occur in the Project Area at the time of jet plow embedment activities (August – November). Any demersal eggs or larvae in the immediate vicinity of the jet plow or cofferdam dredging area would experience mortality and others may experience localized increases in physical abrasion, burial or mortality. However, the area affected by jet plow embedment and cofferdam dredging is small when compared to the surrounding habitat of the Hudson River. Therefore, the Project will not result in population-level effects. Burial of older life stages of demersal fish is not expected because the amount of sediment displaced is minimized by the jet plow technology and also because construction activity will facilitate avoidance behavior in fish before sediments are settled.

Indirect Impacts – Effect of Sediment Contaminants

The use of jet plow technology will greatly limit the amount of sediment and contaminants introduced into the water column. The sediments disturbed by jet plow embedment of the cable contain various chemical constituents, in most cases, at concentrations comparable to existing surface sediment. The suspended sediment plumes generated by the jetting process are predicted to dissipate rapidly after embedment activities cease and potential impacts to surface water will likely be indistinguishable from that potentially resulting from existing surface sediment.

In order to minimize impacts to sediment quality at the shoreline and nearshore areas to the best extent practicable, HDD will be used at the two landfall locations. Further, sediments from within the temporary cofferdams established at the two landfall locations will be removed by mechanical dredging and disposed of at an upland facility.

Indirect Impacts – Effect of Accidental Spill

During the installation of the cables, several vessels, including tugs, barges, cranes, and workboats, will be employed. Each of these vessels contains fuels, hydraulic fluid, oil, and potentially other hazardous materials that could be accidentally released to the water. A SPCC plan will be developed and employed throughout the life of the Project and spill procedures will be implemented in the case of a spill, to limit the impacts. With proper training and implementation, the likelihood of a spill is small, and the impact would be minor.

Indirect Impacts – HDD – Possible Bentonite Release

A possible indirect impact to fish resources during HDD operations could occur if bentonite (drilling fluid) is released and not contained during construction. To address a possible bentonite release, the HDD operation will be designed to include a drilling fluid fracture or overburden breakout monitoring program to minimize the potential of drilling fluid breakout into the waters of the Hudson River. The details of this program will be provided post-certification in the EM&CP. The Project will use bentonite drilling fluids that will gel or coagulate upon contact with saline or brackish water to minimize potential impacts. In the unlikely event of a fluid release, the bentonite fluid density and composition will cause it to remain as a cohesive mass on the riverbed, which can be quickly cleaned up and removed by diver-operated vacuum equipment, further minimizing any long-term impacts to finfish habitat.

Indirect Impacts - Acoustics

Underwater sound of certain levels and frequencies are known to affect fish behavior but specific effects vary with fish species and the existing hydroacoustic environment. The hearing frequency of the majority of fish ranges from 20 to 1,000 Hz, with best hearing sensitivity from 100-400 Hz (Popper et al. 2003, Bass and Ladich 2008, Popper and Schilt 2008). Overall there is a decreasing range of effects at greater distances from the source. For those very close to the source, effects may range from mortality to behavioral changes. As the distance to the source increases, mortality becomes less likely, but physiological and behavioral effects may still exist. Aside from distance from the source, the nature of effects will depend on factors such as fish hearing sensitivity, sound level, rise time of the signal, duration of the signal, signal intensity, and the motivation level of the fish (Richardson et al. 1995).

The level of a sound in water is typically expressed in terms of decibels (dB relative to 1 micro-Pascal [μPa]). Interim criteria have been established for the acoustic levels at which there could be potential onset of physiological effects to fish (Stadler and Woodbury 2009). Studies suggest that there is not likely to be any adverse behavioral response from any fish species at sound levels as low as 150 dB re 1 µPa. Further, NMFS employs a 150 dB re 1µPa rms criterion for assessing the effects of pile driving at several West Coast projects (CADOT 2009).

Underwater noise generated during construction activities has the potential to cause physical damage and displace/disrupt foraging and migratory activities of adult and juvenile fish within the study area. The installation of the In-River Transmission Cable as well as cofferdam construction and dredging will result in a certain level of noise from limited pile driving (cofferdam installation), service vessels and equipment that may temporarily result in fish species avoiding the construction area; however, underwater noise from construction activities will be short-term and impacts to finfish will be minimal. Aside from the limited pile driving, these noise levels are similar to noise levels from existing vessel traffic to which fish are routinely exposed.

Indirect Impacts – Lighting

The In-River Cable Installation will occur on a continuous basis, which will require nighttime lighting on the construction vessels. Some species of fish are attracted to light at night, while other species avoid illuminated areas. Fish that are attracted to the vessels may be exposed to areas of increased suspended sediment concentrations resulting from the jetting if they move towards the illuminated area around the vessels. Adverse effects due to this behavior will be minimized by the separation distance between the water jetting device on the bottom and the lighting at the surface. In addition, most fish will avoid areas around the water jetting device and vessels due to elevated noise levels, which may partly compensate for any attraction behaviors exhibited by fish. The use of nighttime lighting will be of short duration and impacts to finfish will be minimal.

4.6.2.2 Potential Operational Impacts and Mitigation

The In-River Transmission Cable will be buried a minimum of 8 feet below present bottom and will not create a physical barrier that could interfere with fish migration or use of existing habitats or nursery areas. Therefore, finfish and their habitat would not be directly impacted during the normal operation of the In-River Transmission Cable. There will also be no adverse impacts to invertebrate or plankton prey species of fish (indirect impact) during the normal operation of the In-River Transmission Cable.

Operation of the In-River Transmission Cable will generate both magnetic and electric field emissions. The intensity of the electromagnetic field created by the cable is a direct function of voltage, although separation between the cables and burial depth also influences field strength. In industry standard High Voltage DC (HVDC) cables, the materials are sufficient to contain the directly emitted electric field, but the magnetic field cannot be fully shielded (Gill and Bartlett 2010). The predicted magnetic field for these cables is strongest directly over the cables and decreases rapidly with vertical and horizontal distance from the cables (Normandeau et al. 2011). Fish may use the Earth's magnetic field to support orientation, homing, and navigation to assist with long or short-range migrations or movements. Functions supported by an electric sense in fish may include the detection of prey, predators, or conspecifics to assist with feeding, predator avoidance, and social or reproductive behaviors. A risk of interference with these functions exists in areas surrounding cables where sensory capabilities overlap with cable EMF levels detectable by the organism. Species that travel near the riverbed and species that feed on or near the bottom would have greater exposure to the field than those swimming or feeding higher in the water column. Diadromous fishes are also more likely to encounter EMFs from subsea cables either during the adult movement phases of life or their early life stages during migration within shallow, coastal waters adjacent to natal rivers (Gill et al. 2012). While there is evidence that many fish species, particularly benthic elasmobranchs, are able to sense the magnetic field generated by the cables, the response is not predictable and does not appear detrimental (Gill et al. 2009).

The In-River Transmission Cable will generate a limited amount of heat that will dissipate into the sediment surrounding the cable. The sediment temperature at 10 cm (4 inches) below the river bottom is expected to increase less than 1° Celsius during operation of the In-River Transmission Cable. The temperatures of the sediment at the river bottom (sediment-water interface) and within the water column above the river bottom are expected to remain unchanged by the operation of the In-River Transmission Cable.

Hence, potential impacts to fish species from electromagnetic/thermal emissions during the normal operation of the In-River Transmission Cable are expected to be negligible as a result of the pelagic lifestyle of most species and the 8 foot burial depth of the cable.

4.6.2.3 Summary of Potential Impacts to Finfish

As described above, potential impacts to finfish and finfish habitat from installation of the In-River Transmission Cable will be localized and temporary, and will primarily result from direct and indirect sediment disturbance. There will be little to no adverse impact to finfish resulting from operation of the In-River Transmission Cable. Table 4.6-4 summarizes the potential impact from the Project to finfish depending on their life stage and habitat preference in the water column. A more detailed version is provided in Attachment A of Appendix 4D for EFH designated species.

Table 4.6-4: Summary of Potential Impacts to Finfish

Potential Impact	Level of Potential Impact*			
	Near-bottom Egg/Larvae	Pelagic Egg/Larvae	Near-bottom Juvenile/ Adults	Pelagic Juvenile/ Adults
Temporary finfish/benthic habitat loss (jet plow embedment of cables and vessel positioning activities)	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE
Temporary finfish/benthic habitat loss (nearshore HDD installation, cofferdam installation, and minor dredging within cofferdam)	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE
Mortality/Injury/Displacement	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE
Elevated TSS levels (jet plow embedment of cables and limited dredging in temporary cofferdam).	MINOR	MINOR	NEGLIGIBLE	NEGLIGIBLE
Water Quality Impacts from suspension of contaminants and accidental spill	MINOR	MINOR	MINOR	MINOR
Bentonite Release	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE
Acoustic	NEGLIGIBLE	NEGLIGIBLE	MINOR	MINOR
EMF	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

*Level of Impact Definitions
Negligible - No measurable impacts
Minor - Most impacts to the affected resource could be avoided with proper mitigation; if impacts occur, the affected resource will recover completely without any mitigation once the impacting agent is eliminated.
Moderate - Impacts to the affected resource are unavoidable; the viability of the affected resource is not threatened although some impacts may be irreversible, OR; the affected resource would recover completely if proper mitigation is applied during the life of the project or proper remedial action is taken once the impacting agent is eliminated.

4.7 Benthos and Shellfish

This section describes the benthic macroinvertebrate and shellfish communities found to be present in the Project Area and identifies and assesses potential impacts to those species and their habitats during Project construction, operation, and maintenance activities. The following information is based on existing published information and route-specific field studies conducted to support the evaluation of the Project.

4.7.1 Existing Conditions

The Project Area lies within the tidal estuary of the Hudson River where freshwater flowing from the north mixes with seawater from the Atlantic Ocean. During times of average precipitation and river flow, the oceanic salt-front extends upriver to the Tappan Zee Bridge or further north to Newburgh; however, during droughts the salt front may reach as far north as Poughkeepsie. The greatest mixing between freshwater inputs and seawater occurs in the oligohaline zone from Stony Point north to Wappinger Falls. North of this point is the lower freshwater zone, where the water is fresh, but currents and water levels are largely controlled by the daily tidal cycle. The lower freshwater zone of the Hudson River stretches from Troy Dam south to about Wappinger Falls, and is characterized by tidally influenced benthic habitats (USFWS 1997, NYSDEC 2013a). The variable nature of salinities throughout this portion of the Hudson River has implications for the benthic invertebrate community, as many species are restricted in range by their salinity tolerance levels. Within the lower freshwater zone, species are typical of freshwater river habitats. In contrast, benthic species in the oligohaline zone include both freshwater and marine species tolerant of salinity ranges from 0.5 ppt to over 5.0 ppt (USFWS 1997, Strayer 2006). The importance of the freshwater/saline boundary in understanding the ecology and health of the Hudson River is also reflected in the New York State water quality standards, which vary depending on salinity classes of each portion of the river (see Exhibit 4.5).

4.7.1.1 Benthos

Oligohaline Zone

Salinity within the oligohaline zone of the Hudson River varies seasonally and with the daily tidal cycle, ranging between about 0.5 and 5.0 ppt. Local conditions, including bottom depth and wind regime, also influence variation in salinity levels on a small spatial scale (USFWS 1997, NYSDEC 2013a). The range in salinity throughout this zone leads to a diverse benthic macroinvertebrate community, which includes estuarine as well as freshwater species of mollusks, annelid worms, crustaceans, and insects (Strayer 2006).

Mollusks in the oligohaline zone of the river are represented by several small bivalve species, hydrobiid snails, and the softshell clam, *Mya arenaria*. A recent river-wide survey for the Hudson River Estuary Biocriteria project (Llansó et al. 2003) identified the exotic Atlantic rangia clam, *Rangia cuneata*, as the most abundant species within this zone of the river. This species now ranges as far north as Newburgh (Strayer 2012). Atlantic rangia is native to the Gulf of Mexico but has become established in the Hudson, primarily inhabiting muddy bottomed, turbid waters (GISD 2005). Another exotic species, the zebra mussel *Dreissena polymorpha*, is present in the low-salinity regions of this zone, though in much lower densities than in freshwater zones (Llansó et al. 2003).

Annelid worms in the oligohaline zone include oligochaete and polychaete taxa. While oligochaetes worms are also common in the lower freshwater zone, polychaetes are mainly restricted to more estuarine and marine habitats. At least nine species of polychaete worms are represented in the oligohaline zone of the Hudson River, compared to a single species occurring in the freshwater upstream (Strayer 2006, Llansó et al. 2003). The most common taxa are spionids, a family of deposit and suspension feeding worms that typically live in tubes and burrows in soft-sediment habitats. Additional polychaete families in the oligohaline zone include Ampharetidae, Capitellidae, Neriedidae, and Sabellidae (Llansó et al. 2003).

Crustaceans in the oligohaline zone include sideswimmers or scuds (amphipoda), isopods, and cumaceans. Grass shrimp (*Palaeomontes* spp.) and mud crabs also occur in this zone, as well as the larger and commercially-important blue crab (*Callinectes sapidus*) (Strayer 2006).

Insect larvae in this zone are represented by several species of non-biting midges (Chironomidae). At least 12 genera were identified in the survey by Llansó et al. (2003), though many additional species are known to occur upstream in the lower freshwater zone (Strayer 2006).

Lower Freshwater Zone

Annelid worms, mollusks, crustaceans, and insects are the primary benthic macroinvertebrate organisms of the lower freshwater zone in the Hudson River (Strayer 2006).

Annelids are represented by oligochaetes, leeches (Hirudinea), and polychaetes. Oligochaete worms are the most common of the annelids in the tidal freshwater portions of the Hudson River and are represented by as many as 30 species. A number of leech species are also present but are usually found at much lower densities than oligochaete worms. Polychaete worms are represented by just one species in the lower freshwater zone, *Manayunkia speciosa*, and are much less common as a group in this part of the Hudson than in oligohaline and mesohaline habitats downstream (Strayer 2006).

Freshwater crustaceans are primarily sideswimmers or scuds (Amphipoda), isopods, and crayfish (Astacoidea). However, blue crab is occasionally reported as far upstream as Troy (Strayer 2006).

Insects in this zone are dominated by lentic (lake-dwelling) and large river species. Non-biting midges (Chironomidae) are represented by more than 70 species and the benthic larvae are by far the most abundant insect in the Hudson River, typically exceeding 1,000/m^2 (Strayer 2006).

Mollusks are also common and 14 aquatic species were documented by Coote and Strayer (2009) in the freshwater portion of the river from Albany to Poughkeepsie, where two snails, mud Amnicola (*Amnicola limosa*) and henscomb hydrobe (*Littoridinops tenuipes*) dominated sub-tidal habitats. The invasive faucet snail (*Bithynia tentaculata*) was also documented but appears to be declining.

In addition to the faucet snail, exotic zebra mussels are currently established in the Hudson River (Benson et al. 2013a, Kipp et al. 2013). Asian clam (*Corbicula fluminea*), another invasive exotic species, was recently confirmed in the lower freshwater zone of the Hudson River (NYIS 2013). Quagga mussel (*Dreissena bugensis*) has yet to be confirmed from the Hudson River but is known from the Mohawk River, a primary tributary (Benson et al. 2013b), and has clear potential to spread into the Hudson.

Of these species, zebra mussels currently appear to have had the greatest impact on the benthic community of the Hudson River. The rapid invasion by zebra mussels in the early 1990s resulted in decreased availability of phytoplankton and small zooplankton to other filter-feeders and increased benthic biomass and respiration rates (Strayer 2006). In the early stages of zebra mussel colonization, the species was restricted to rocky bottom habitats. However, as shell hash from zebra mussel beds was transported and deposited on top of softer substrates, these habitats became more accessible to zebra mussel colonization (Strayer et al. 1998). The impacts of the invasion were particularly devastating to native unionid mussel populations, which witnessed a decline in abundance of more than 50% after zebra mussels became established in the Hudson River (Yozzo et al. 2005). This decline was due primarily to competition for food resources (phytoplankton), although substrate modification and smothering by zebra mussels that settle on top of native mussels may also have played a role.

Recent invasions of exotic aquatic plants, including water chestnut (*Trapa natans*) and Eurasian milfoil (*Myriophyllum spicatum*), have also altered available habitats for benthic macroinvertebrates in the lower freshwater zone of the Hudson River. Dense growths of these species sometimes encourage anoxic or hypoxic (low dissolved oxygen) conditions, which can place detrimental metabolic stresses on many macroinvertebrate species. However, as documented by Kornijów et al. (2010), the presence of extensive water chestnut beds does not necessarily preclude development of a species-rich macroinvertebrate community.

4.7.1.2 Shellfish

The Preferred In-River Cable Route runs through freshwater and oligohaline portions of the Hudson River that, with the exception of blue crab, are not supportive of the growth or reproduction of commercially harvested shellfish. No shellfish beds are mapped within the Project Area.

Blue crab inhabits the Hudson River at densities high enough to support a small fishery. Anecdotal evidence extends the range of Hudson River blue crab as far north as Albany, although a recent tagging study only observed tagged crabs up to Poughkeepsie (NYSDEC 2013b). The Hudson River blue crab season is open year-round, with minimum size limits to protect younger, developing crabs (NYSDEC 2013c). Although some winter dredge harvesting does occur elsewhere in the state, there is not generally an active winter crab fishery within the Hudson (Normandeau 2004).

Blue crab is omnivorous and will take both live prey and fresh carrion. It is also one of the few organisms known to feed on zebra mussel in the Hudson River (Kinney 2002). However, less is known about the Hudson River blue crab population than those occupying more southerly waters, such as Chesapeake Bay. The annual movements of blue crab in the Hudson River appear to broadly mimic those of other populations. In general blue crab spawning occurs in summer and fall in the lower Hudson River. Currents carry the hatched eggs (zoea) out to more saline waters for a short period of time, where they grow as planktonic larvae. As the zoea mature, currents carry them back into nearshore zones where they settle out and begin to move back up into the Hudson River as juveniles. At this time, SAV beds appear to offer an important refuge where predatory pressures are reduced during critical molts (Stein 1991). They continue to grow until the cooler waters of fall cause them to burrow into river muds, where they pass the winter. Young-of-the-year male blue crabs appear to make up the majority of the Hudson River overwintering population. Older crabs, particularly females, move out of the Hudson River entirely as winter approaches. Blue crabs typically do not return to the lower portions of the Hudson River until March or April, gradually making their way back to areas from River Mile 65 north in May. Recruitment of blue crabs into the Hudson River fishery is highly variable from year to year. Additionally, winter mortality likely plays a significant role in Hudson River blue crab abundance (Normandeau 2004).

4.7.1.3 Technical Studies Completed

To obtain route-specific information on the benthic community, fifty-one benthic samples were collected along the In-River Cable Route from Athens to Cortlandt, NY, in September, 2012 (Figure 4.7-1). Of these, 33 samples were collected within the lower freshwater zone and eighteen within the oligohaline zone of the river. Benthic samples were collected using a 0.1 m^2

Young modified Van Veen grab, deployed from the vibracore vessel prior to vibracore activities at each site to minimize disturbance to the benthic community being sampled. After collection, contents of each grab sample were sieved through a 0.5 mm mesh in the field, and the retained material and organisms were preserved in 70% ethanol. Most samples that were processed yielded a substantial volume of organic or sandy/gravel debris remaining on the sieve (due to limited amounts of fine-grained material available to pass through the mesh), therefore, several samples were split in the field with half of the volume retained for quantitative lab analysis.

Preserved benthic samples were returned to the lab where the organisms were sorted from residual debris. Due to the high volume of debris in the samples, the material was first split into 16 equal fractions using a gridded tray. Randomly selected fractions were sub-sampled and sorted until a target of 200 organisms was retained or a sufficient sub-sample had been examined, as determined by best professional judgment. Several sparse samples with very little debris and very few organisms were sorted in their entirety. The unsorted and sorted fractions of each sample were retained separately, preserved in 70% ethanol.

For quality assurance and control (QA/QC) purposes, a second qualified staff member (quality assurance officer) resorted 10% of the samples analyzed by each sorter to ensure organisms were being adequately retained. If the original sorter achieve less than a 90% sorting efficiency (i.e., removed less than 90% of the organisms in the sample), an additional sample sorted by that analyst was re-examined by the quality assurance officer. In samples where organisms were very sparse (i.e., fewer than 25 organisms in the sorted fraction), the QA/QC criteria were adjusted to no more than 20 organisms remaining in the sorted residue. None of the samples analyzed failed to meet QA/QC sorting efficiency criteria.

Organisms sorted from each sample were enumerated and identified by qualified macroinvertebrate taxonomists to the lowest practicable taxonomic level using readily available regional keys and species lists (Pettibone 1963, Gosner 1971, Bousfield 1973, Cook and Brinkhurst 1973, Peckarsky et al. 1990, Abbott and Morris 1995, Weiss 1995, Merritt and Cummins 1996). Most taxonomic determinations were made using a dissecting microscope; however, oligochaete worms and chironomid midge larvae were slide-mounted for examination under a compound microscope. Prior to data summary, all species counts were converted to number of individuals per square meter, taking into account sample-splitting in the field as well as subsampling at the lab.

Oligohaline Zone

The density of macroinvertebrates among the 18 samples collected in the oligohaline portion of the Hudson River ranged from $10/m^2$ to $11,840/m^2$ (Table 4.7-1) with an average density of $2,105/m^2$ (Table 4.7-2). Taxonomic richness was also variable. A single taxon (hydrobiid snails) was identified in samples BG-41 and BG-44, whereas other samples contained up to 15 taxa. Average taxonomic richness across the oligohaline zone was 6 taxa per sample. Overall, the taxa identified were typical of soft-substrate estuarine habitats and included both native and exotic species.

Mollusks represented the most abundant taxonomic group of macroinvertebrates in oligohaline zone samples, contributing 64% of the total individuals collected (Table 4.7-2). Common gastropods included hydrobiid snails and turbonille pyramid snails (*Turbonilla* sp). Bivalve mollusks included juvenile fingernail clams, the exotic invasive Asian clam and the dwarf surfclam *Mulinia lateralis*. Another invasive, the zebra mussel was identified in sample BG-35. Zebra mussels are known to be abundant in the tidal freshwater zone of the Hudson but can tolerate low levels of salinity within the northern reaches of the oligohaline zone. Several additional samples from within the oligohaline zone also contained empty zebra mussel shells, though living individuals were not collected.

Table 4.7-2: Summary of Key Statistics from Route-specific Survey

Statistic	Tidal Freshwater	Oligohaline
Number of Stations	33	18
Mean Abundance (±1 SD)	2,417 ± 3,442	2,105 ± 2,792
Mean Taxa Richness (±1 SD)	6 ± 4.0	6 ± 3.7
Percent of Total Abundance		
Mollusks	18%	64%
Oligochaetes and Leeches	31%	8%
Polychaetes	0%	4%
Crustaceans	35%	9%
Insects	11%	7%
Other	6%	8%

Crustaceans were abundant among samples collected in the oligohaline zone, and included copepods, ostracods, amphipods, isopods, and xanthid mud crabs. Other groups identified in this zone included oligochaete worms, nematode worms, insect larvae, and polychaete worms. Polychaetes are abundant in the marine and estuarine environment, less so in freshwater. In the present study they were only identified in samples collected from the most southerly portion of the survey area. For example, the spionid mud worms *Marenzelleria viridis* and *Polydora* sp, as well as a nereidid clam worm *Neanthes succinea*, were identified in sample BG-45. Bristle worms from the family Ampharetidae were also identified in this sample, as well as BG-48 and BG-50 further south.

Lower Freshwater Zone

The density of macroinvertebrates among the 18 samples collected in the lower freshwater portion of the Hudson River ranged from 0/m^2 to 15,360/m^2 (Table 4.7-1). Macroinvertebrate density averaged 2,417/m^2 among the 33 samples collected (Table 4.7-2). Sample BG-16 contained the highest density of organisms (15,360/m^2); in contrast, sorters did not find a single organism in sample BG-4. Taxonomic richness ranged from 1 to 14 taxa per sample among tidal freshwater sites. Samples BG-1 and BG-26 each contained a single taxon, the chironomid midge *Polypedilum* and tubificid oligochaete worms, respectively. Average taxonomic richness for the lower freshwater zone was 6 taxa per sample.

While the density and taxonomic richness values were similar between lower freshwater and oligohaline zone samples, the dominant taxonomic groups differed between the regions (Table 4.7-2). Unlike the oligohaline zone, where mollusks were the most abundant group, crustaceans and aquatic oligochaete earthworms dominated the samples from the lower freshwater portion of the river. Crustaceans represented 35% of the individuals collected in this zone and included amphipods of the genus *Gammarus*, cyclopoid copepods, and two isopod species. Oligochaetes represented 31% of the individuals collected. Tubificid oligochaetes were the most common of this group, and included the species *Limnodrilus hoffmeisteri* and *L. udekimianus*. Oligochaetes from a second family, Naididae, were also identified in one sample, BG-3.

Mollusks were also common in samples from the lower freshwater zone, and included several snail and bivalve taxa. The invasive zebra mussels and Asian clams were identified in most of these samples.

Chironomid midge larvae were also abundant in this zone, particularly the genera *Coelotanypus*, *Cryptochironomus*, and *Polypedilum*. Other taxa identified in these samples included caddisfly larvae, nematode and nemertean worms, planarian flatworms, and hydrachnid water mites.

4.7.2 Environmental Impacts and Mitigation

Sediment disturbance will be limited to the extent practicable through the use of low impact jet plow cable embedment. Horizontal directional drilling (HDD) and installation of temporary cofferdams that will contain sediment disturbed during dredging at the landfall locations will also minimize in-river suspended sediment impacts. The use of jet plow embedment and HDD will minimize impacts to the benthic community. Direct impacts, including displacement or mortality due to abrasion, entrainment, or removal from the in-river environment, will be limited to areas of active cable installation and temporary cofferdam work. Indirect impacts through resuspension and subsequent deposition of sediments may extend beyond the immediate area of active construction but will be temporary and limited in extent.

4.7.2.1 Potential Construction Impacts and Mitigation

Impacts to the benthic community in the Project Area during construction will be minimized by the use of HDD at the northern and southern landfall locations and jet plow embedment for the In-River Cable. These methods of cable installation will minimize construction disturbance to the river bottom and the associated benthic habitats.

Although the use of HDD eliminates impacts to the benthic community near the shore, there will be temporary and localized impacts to the benthic community from the construction of the cofferdam in the deeper, albeit less diverse, area of the river. The primary impacts to the benthic community from the HDD process will be localized at the temporary cofferdam locations at the northern and southern landfalls. Temporary cofferdam installation and removal will directly impact the benthic community through anchoring (spuds) of the construction barge, installation of the sheet piles into the river bottom, dredging of river sediments within the cofferdam, and removal of the cofferdam structure. Each temporary cofferdam is expected to be 300 feet long, by 70 feet wide. Dredging will remove approximately 10 feet of sediments from the area within each temporary cofferdam.

Jet plow embedment of the In-River Transmission Cable will be a simultaneous lay and burial operation. The jet plow process involves using high pressure jets of water to fluidize the sediments within the cable embedment trench. This process allows the cable to settle to the bottom of the trench under its own weight and be buried by settling of the fluidized sediments on top of the cable once the jet plow has advanced. The jet plow will be towed behind a cable lay barge equipped with a dynamic positioning system. This will allow the cable lay operation to avoid direct disturbance of benthic habitats adjacent to the cable trench that might otherwise be impacted through anchor drop and anchor line sweep.

Installation of the In-River Transmission Cable will be preceded by a grapnel run along the centerline of the In-River Cable Route. The intent of the grapnel run is to clear the area of debris prior to installation. This event is not anticipated to increase the area of direct impact because it will occur in the same area as the eventual installation of the In-River Transmission Cable.

Table 4.7-3 Summary of Construction Impacts to Benthic Macroinvertebrate Taxa*

Taxon	Common Name	Estimated Tolerance			Notes
		Physical Disturbance	Smothering	Suspended Sediment	
Mollusca					
Hydrobiidae	Hydrobiid snails	Intolerant	Somewhat intolerant	Somewhat intolerant	Shell is fragile
Laevapex fuscus	Limpet	Intolerant	Somewhat intolerant	Somewhat intolerant	Shell is fragile
Planorbidae	Ram's horn snails	Somewhat intolerant	Somewhat intolerant	Somewhat tolerant	
Turbonilla sp	Turbonille	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Corbicula fluminea	Asian clam	Somewhat tolerant	Somewhat intolerant	Somewhat intolerant	Exotic invasive species
Dreissena polymorpha	Zebra mussel	Somewhat tolerant	Intolerant	Somewhat tolerant	Exotic invasive species
Mulinia lateralis	Dwarf surfclam	Somewhat tolerant	Somewhat tolerant	Somewhat tolerant	
Pisidiidae and Sphaeriidae	Fingernail clams	Somewhat intolerant	Somewhat intolerant	Somewhat intolerant	
Crustacea					
Gammaridea	Scuds	Somewhat tolerant	Somewhat tolerant	Somewhat tolerant	
Cyclopoida	Cyclopoid copepods	Somewhat tolerant	Somewhat tolerant	Somewhat tolerant	
Harpacticoida	Harpacticoid copepods	Somewhat tolerant	Tolerant	Tolerant	
Rhithropanopeus harrisii	Mud crab	Somewhat tolerant	Tolerant	Somewhat tolerant	
Xanthidae	Xanthid pea crabs	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Chiridotea almyra	Chaetiliid isopod	Somewhat tolerant	Somewhat tolerant	Somewhat tolerant	
Cyathura polita	Anthurid isopod	Somewhat tolerant	Somewhat tolerant	Somewhat tolerant	
Ostracoda	Seed shrimp	Somewhat tolerant	Somewhat intolerant	Somewhat intolerant	
Polychaeta					
Ampharetidae	Ampharetid worms	Intolerant	Somewhat intolerant	Tolerant	
Marenzelleria viridis	Mud worm	Somewhat intolerant	Somewhat tolerant	Tolerant	
Neanthes succinea	Clam worm	Somewhat tolerant	Somewhat tolerant	Tolerant	Highly motile
Polydora sp.	Mud worm	Somewhat tolerant	Somewhat tolerant	Tolerant	

Table 4.7-3 Summary of Construction Impacts to Benthic Macroinvertebrate Taxa*

Taxon	Common Name	Estimated Tolerance			Notes
		Physical Disturbance	Smothering	Suspended Sediment	
Oligochaeta	Aquatic earthworms	Tolerant	Tolerant	Tolerant	
Nematoda	Roundworms	Somewhat tolerant	Somewhat tolerant	Somewhat tolerant	Motile but ecology varies with species. Some species are commensal.
Nemertea	Ribbon worms	Somewhat tolerant	Somewhat tolerant	Somewhat tolerant	
Planaria	Flatworms	Somewhat tolerant	Somewhat tolerant	Somewhat Tolerant	
Insecta					
Axarus sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	Tube dweller in clay or wood
Coelotanypus sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	Major predator of oligochaete worms
Cryptochironomus sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	Predatory on other midges and oligochaete worms
Harnischia sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	Associated with SAV beds
Parametriocnemus sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Polypedilum sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Probezzia sp	Biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Procladius sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	tolerant	Predatory on other midges and oligochaete worms
Stempellina sp	Non-biting midge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Plecoptera	Stoneflies	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Limnephilidae	Northern caddisflies	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	
Oecetis sp	Long-horn sedge	Somewhat intolerant	Somewhat tolerant	Somewhat tolerant	

*Includes taxa that were documented by the 2012 route-specific survey.
Sources: Weiss 1995, Merritt and Cummins 1996, Gallagher and Keay 1998, Tuck et al 2000, Hinchey et al. 2006, Schaffner 2010, Jones et al. 2012

Direct Impacts to Benthos and Shellfish

Temporary Cofferdam Installation and Dredging

Direct disturbance to the riverbed from temporary cofferdam installation and dredging will include the footprint of each cofferdam at the northern and southern landfalls. Additional direct disturbance to the riverbed associated with spudding of the construction barge will occur in the area adjacent to each temporary cofferdam. The total area of direct disturbance from temporary cofferdam installation, dredging within each cofferdam, and spudding of the construction barge will be approximately 1.0 acres. Mortality, injury, or displacement of infaunal and epifaunal benthic organisms is expected in the area directly impacted by temporary cofferdam installation and dredging.

Direct impacts to benthic and shellfish from temporary cofferdam installation and dredging activities will be localized and temporary. The area that will be directly disturbed by the cable installation is minimal compared to the surrounding habitat in the Hudson River. Consequently the disturbance to the benthic community will be short-term because benthic macroinvertebrates are capable of opportunistically recolonizing habitats after such disturbances (e.g. Rhoads et al. 1978, Schaffner 2010). The small area of direct impact compared to the large source area of nearby unimpacted habitat is expected to result in rapid recolonization within the footprint of the temporary cofferdams and in areas impacted by barge spudding following construction.

Given these factors, the overall direct impact to benthic resources from temporary cofferdam installation and dredging will be minor and temporary and will quickly recover to pre-construction conditions resulting in no permanent impact to benthic resources.

Blue crab is the only exploited shellfish species with potential to occur near the temporary cofferdams. Due to the season and locations proposed for installation of the temporary cofferdams, individuals of this species are not anticipated to be buried (a behavior associated with overwintering) in river sediments. Rather, any blue crabs in the area would likely be above the sediment-water interface and able to move freely. As highly motile organisms, blue crabs present in the cofferdam areas during construction will likely leave the immediate area once activity is underway. Once the temporary cofferdams are completed, it will be very difficult for blue crabs to enter the area targeted for dredging. Therefore, direct impacts to shellfish resources from this portion of the project will be negligible.

Jet Plow Embedment of the In-River Transmission Cable

Direct disturbance to the riverbed from the jet plow will be primarily limited to the width of the In-River Transmission Cable trench and the skids on either side. The trench is expected to measure 18-24 inches along the entire In-River Cable Route. Mortality, injury, or displacement of benthic organisms in the path of the In-River Transmission Cable trench and skids is likely.

Prior to installation of the In-River Cable, a grapnel hook will be towed along the cable centerline to clear potential obstructions to installation of the In-River Transmission Cable. After obstructions have been cleared, jet plow equipment will be used to install the cable along the same route. Therefore, the grapnel tow will not increase the area of direct disturbance above that of resulting from jet plow embedment.

Potential direct impacts to benthic and shellfish from In-River Transmission Cable installation activities will be localized and temporary. The area that will be directly disturbed by the cable installation is minimal compared to the surrounding habitat in the Hudson River. Benthic community disturbance will be short-term because benthic macroinvertebrates, like those in the Project Area, will opportunistically recolonize habitats after such disturbances (e.g. Rhoads et al. 1978, Schaffner 2010). The small area of direct impact compared to the large source area of nearby unimpacted habitat is expected to result in rapid recolonization following construction.

Given these factors, the overall direct impact to the benthic community from jet plow installation of the In-River Transmission Cable will be minor and will quickly recover to pre-construction conditions resulting in no permanent impact.

Concrete Mattresses

The Project will require the placement of concrete mattresses where the In-River Cable crosses other previously installed utilities in the Hudson River and where the field-joints are installed in the In-River Cable. Concrete mattresses will be required at approximately 48 utility crossing locations and two cable field-joint locations. At each utility crossing, approximately 250 feet of mattresses will be installed. At each field-joint location, approximately 490 feet of mattresses will be installed. Concrete mattresses are typically 8 feet wide and approximately 9 inches thick. This would result in an estimated total bottom impact from placement of the mattresses in the Hudson River of approximately 2.3 acres, which represents less than 0.01% of the approximately 35,000 acres of bottom habitat in the Hudson River between RM 42 and RM 118. The exact locations and dimensions of the concrete mattresses required for the Project will be described in the EM&CP. Once installed, the concrete mattresses will settle under their own weight into the riverbed and sediment will be naturally deposited over the mattresses.

Given the limited spatial extent of these impacts, organisms from the surrounding undisturbed habitat are expected to recolonize the area relatively quickly, resulting in negligible long-term impact to the benthos (Rhoads et al. 1978, Van Dolah et al. 1984, Howes et al. 1997, Guerra-García et al. 2003).

Indirect Impacts to Benthos and Shellfish

Jet Plow Embedment of the In-River Transmission Cable

Suspension and subsequent deposition of sediments from the jet plow cable embedment will cause indirect impacts to benthic and shellfish populations. An SSFATE numerical model run to estimate the extent of the jet-plow induced sediment plume along the project route predicted that the highest concentrations of TSS and rates of deposition occur at the immediate location of jet plow activities. Suspended sediment concentrations and deposition thicknesses are predicted to decrease rapidly with distance from the jet plow as it advances along the In-River Cable Route. The maximum distance from the jet plow that a suspended sediment concentration of 50 mg/L is predicted to occur is 1,470 feet while concentrations at or above 200 mg/L extend a maximum of 312 feet from the jet plow. In addition, the modeling predicts that sediments suspended by the jet plow will settle quickly, returning suspended sediment concentrations to ambient conditions within 24 hours of passage of the jet plow. In-river monitoring performed during construction of similar projects in the Hudson River shows these maximum modeled predictions to be conservative. A report providing the detailed results of the SSFATE modeling can be found in Appendix 4C.

Sediments suspended by jet plow activities are predicted to fall along the path of the operating jet plow with most deposition confined to a narrow band extending between 200 and 500 feet from the jet plow. Thinner deposition layers up to 0.5 mm are predicted to cover more than 2,750 acres. However, the area covered decreases rapidly with deposition thickness. Deposition thicknesses greater than 2 mm may potentially cover an area of 227 acres. Deposits thicker than 5 mm are predicted to cover no more than 0.37 acres.

The benthic community will not be significantly disturbed by either the suspended sediments or sediment deposition associated with cable installation. Benthic fauna in the project area are regularly exposed to temporary natural occurrences of increased TSS and deposition, and many of the taxa observed in the benthic assessment are well adapted or tolerant to burial or smothering (Table 4.7-3). Many species, including certain burrowing polychaetes, oligochaetes, insects, and amphipods, are able to burrow upward to the surface through relatively shallow layers of deposited sediments. Some tube-dwelling polychaetes, such as *Polydora* spp., may be able to survive burial by extending their tubes or constructing new tubes at the surface (Hill 2007). Taxa that are unable to relocate or tolerate these impacts may experience mortality; however, given the limited spatial extent of these impacts, organisms and propagules from the surrounding undisturbed habitat are expected to recolonize the area relatively quickly, resulting in negligible long-term impact to the benthos (Rhoads et al. 1978, Van Dolah et al. 1984, Howes et al. 1997, Guerra-García et al. 2003).

HDD – Possible Bentonite Release

A possible indirect impact to the benthos during HDD operations could occur if bentonite (drilling fluid) is released and not contained during construction. To address this possibility, the HDD operation will include a drilling fluid fracture or overburden breakout monitoring program to minimize the potential extent of drilling fluid breakout into the waters of the Hudson River. The details of this program will be provided in the EM&CP. The Project will also use bentonite drilling fluids that will gel or coagulate upon contact with saline or brackish water. In the unlikely event of a fluid release, the bentonite fluid density and composition will cause it to remain as a cohesive mass on the riverbed, which can be quickly cleaned up and removed by diver-operated vacuum equipment, further minimizing any long-term impacts to the benthos.

Accidental Spill

During the installation of the cables, many vessels, including tugs, barges, cranes, and workboats, will be employed, each of which contains fuels, hydraulic fluid, oil, and potentially other hazardous materials that could be accidentally released to the water. An SPCC plan will be developed and employed throughout the life of the Project and spill procedures will be implemented in the case of a spill, to limit the impacts to surrounding benthic habitat. With proper training and implementation, the likelihood of a spill is small, and the impact would be minor.

Potential Construction Impacts Involving Exotic Invasive Benthic Species

Exotic invasive species are usually characterized by the ability to rapidly invade an area and outcompete other species for food, space, light, or other essential resources following disturbance. Therefore, disturbance from construction activities associated with the In-River Transmission Cable may allow invasive species already present in the area to gain a foothold in previously uncolonized habitats.

Zebra mussel is a firmly established exotic invasive benthic species along freshwater portions of the In-River Cable Route. This species requires coarse substrate for proper attachment and growth after larvae settle to the riverbed. Due to the sediment fluidizing action that characterizes jet plow installation, median grain size of benthic substrates along the installation trench and in areas where deposition of mobilized sediments occurs are expected to generally be the same as pre-installation. This implies that these habitats will not be any more attractive for zebra mussel colonization than prior to installation.

Asian clam and Atlantic rangia are invasive species that do not require attachment to hard-bottom substrates and may settle in sand or silt as larvae (Sundberg and Kennedy 1993, Wittman et al. 2008). Therefore, these species could potentially colonize habitats directly and indirectly impacted by the jet plow installation. However, given the fact that the Hudson River is a highly trafficked waterway with a navigational channel subject to maintenance dredging, soft-bottom benthic habitats along the In-River Cable Route are already likely to be disturbed.

4.7.2.2 Potential Operational Impacts and Mitigation

Operation of the In-River Transmission Cable will have negligible to minor impacts on shellfish and benthic resources (Table 4.7-4). The In-River Cable will utilize a solid HVDC cable without the need for pressurized dielectric fluid. As such, it does not pose a risk for fluid releases that could impact benthic communities.

The In-River Transmission Cable will generate a limited amount of heat that will dissipate into the sediment surrounding the cable. The sediment temperature at 10 cm (4 inches) below the river bottom is expected to increase less than 1° Celsius during operation of the In-River Transmission Cable. The temperatures of the sediment at the river bottom (sediment-water interface) and within the water column above the river bottom will remain unchanged by the operation of the In-River Transmission Cable. As a result, epifaunal organisms (i.e., those living on the riverbed) will not experience any detectable thermal impacts from operation of the In-River Cable. However, infaunal organisms, which reside within the thin biological active layer (5.0 cm [2.0 inches]) (NYSDEC 2000) near the sediment–water interface will experience a small change in temperature (less than 1° Celsius), which is well within the typical seasonal fluctuation of water and surface sediment temperatures in the Hudson River, which can vary by 25° Celsius between summer and winter (Ashizawa and Cole 1994). Additionally, any detectable change in sediment temperature would be highly localized. As a result, the impact to benthic macroinvertebrates from potential sediment temperature increases will be negligible to minor.

Table 4.7-4: Summary of Potential Impacts to Benthos and Shellfish

Potential Impact	Level of Potential Impact to Benthos and Shellfish*	
	Epifauna	Infauna
Construction Impacts		
Direct mortality/injury/displacement	MINOR	MINOR
Temporary benthic habitat loss (jet plow embedment of cable, temporary cofferdam installation/dredging)	MINOR	MINOR
Temporary increase in TSS and contaminant levels (jet plow embedment of cable, temporary cofferdam installation/dredging)	MINOR	MINOR
Burial by deposited sediments (jet plow embedment of cable, temporary cofferdam installation/dredging)	MINOR	MINOR
Operational Impacts		
Thermal	NEGLIGIBLE	MINOR

***Definitions of impact categories:**
Negligible - No measurable impacts
Minor - Most impacts to the affected resource could be avoided with proper mitigation OR if impacts occur, the affected resource will recover completely without any mitigation once the impacting agent is eliminated.

4.8 Vegetation and Wildlife

This section describes the vegetation and wildlife that are or may be present in the Project Area and identifies and assesses potential impacts to those species and their habitats during Project construction, operation, and maintenance activities. The following information is based on existing published information, literature review, selected field observations, correspondence with regulatory agencies, and field reconnaissance. State and federally-listed rare species are discussed in Section 4.9 (Protected Habitats and Threatened and Endangered Species). Freshwater and tidal wetland vegetation are described in Section 4.3.

4.8.1 Existing Conditions

Information on existing terrestrial vegetation and wildlife in the Project Area was compiled from field observations of natural communities and desktop data sources, including the U.S. Fish and Wildlife National Wetlands Inventory (NWI) maps; New York Natural Heritage Program (NYNHP) Environmental Resource Mapper and Draft Ecological Communities of New York State (Edinger et al. 2002); Cornell University IRIS maps; Checklist of Amphibians, Reptiles, Birds and Mammals of New York; 2000-2005 New York State Breeding Bird Atlas; and NYSDEC Herp Atlas Project.

4.8.1.1 Vegetation

Terrestrial Vegetation

The natural terrestrial vegetation within the Project Area has been historically altered by human disturbance and previously developed for over 300 years. For example, much of the natural forests in the Hudson River Valley were cleared during the 18th and 19th centuries for heating, construction of homes and buildings, or was converted to agricultural land. Much of this converted agricultural land has been abandoned in the last century, and is now reverting back to successional forest through natural processes. The natural vegetation in other areas has been converted into urban and suburban residential and commercial development with associated roadway and cultivated landscapes.

Starting at the Northern Landfall, the Northern Land Cable Route follows existing public roadways though the Town of Athens, NY for approximately 3.0 miles, then follows a proposed private site access road for approximately 0.30 miles leading to the Northern Converter Station location. This proposed site access road will pass through a small forested upland area and pastureland and wet meadow. The small forested area is a mixed stand of hardwoods and conifers typical of this region, and is surrounded by residential properties and pastureland. From the Northern Converter Station, the Land Cable will be installed using HDD technology for approximately 0.50 miles before reaching the existing Leeds Substation.

Based on field observations of the proposed Land Cable Route in 2012 and 2013 and use of the Ecological Communities of New York (Edinger et al. 2002) publication as a reference, seven *(7)* ecological communities were identified along the Northern Land Cable Route, and three (3) ecological communities were identified at the Northern Converter Station location.

The seven (7) ecological communities identified along the Northern Land Cable Route are: successional old field, successional shrubland, successional red cedar woodland, successional southern hardwoods, pastureland, mowed roadside/pathway, and mowed lawn.

At the Northern Converter Station location, the following three (3) ecological communities were identified: wet meadow, pastureland, and successional red cedar woodland.

Moving inland from the Southern Landfall, the Southern Land Cable Route is approximately 1.65 miles in length. Approximately 1.20 miles of this route follows existing roadways through the Town of Cortlandt and Village of Buchanan. Approximately 0.30 miles of this route will be the proposed new site access road leading to the Southern Converter Station. Direct trenching and cable burial methods will be used to install the portion of the Southern Land Transmission Cable along the new site access road from the Southern Converter Station to the existing public roadway entrance. The portion of the Land Cable that will be installed using direct burial methods passes through a small area of mixed hardwood and conifers. This small forested area is adjacent to the Hudson River border at this location where there are existing surrounding residential properties, and other roadways located in the Town of Cortlandt.

Based on field observations conducted in 2012 and 2013, three (3) ecological communities were identified along the Southern Land Cable Route, and three (3) ecological communities were identified at the Southern Converter Station.

The ecological communities identified along the Southern Land Cable Route are the following: mowed roadside/pathway, mowed lawn, and successional old field. At the Southern Converter Station, the following ecological communities were identified: successional old field, successional shrubland, and successional southern hardwoods.

A summary of definitions for each of the eight (8) ecological communities that were identified along the Land Cable Route and at the Northern and Southern Converter Station sites is provided below.

Successional Old Field

Successional old field habitat is essentially abandoned farmland, characterized by a meadow dominated by grasses and forbs. Typical species of successional old fields include goldenrods (*Solidago* sp.), bluegrasses (*Poa* sp.), timothy (*Phleum pretense*), orchard grass (*Dactylis glomerata*), evening primrose (*Oenothera biennis*), asters (*Aster* sp.), ragweed (*Ambrosia artemisiifolia*), and dandelion (*Taraxacum* sp.).

Successional Shrubland

Successional shrubland is similar to successional old field, but in a later stage of plant succession. Shrubs cover over 50% of the available land. Species characteristic of this habitat are dogwood (*Cornus* sp.), eastern red cedar (*Juniperus virginiana*), sumac (*Rhus* sp.), arrowwood (*Viburnum* sp.), and multiflora rose (*Rosa multiflora*).

Successional Red Cedar Woodlands

Successional red cedar woodlands also commonly exist in areas that were formerly used for agriculture, and were subsequently abandoned. Eastern red cedar is the dominant species in this habitat type, although birches (*Betula* sp.), hawthorn (*Crataegus* sp.), and buckthorn (*Rhamnus* sp.) may also be present. Understory vegetation is similar to that found in successional old fields and successional shrublands.

Successional Southern Hardwoods

Successional southern hardwoods are a hardwood or mixed hardwood-conifer forest that occurs in areas that have been previously disturbed. This habitat type exists in a later stage of plant succession than successional red cedar woodland. Several species of tree may be found in successional southern hardwoods, including elms (*Ulmus* sp.), white ash (*Fraxinus americana*), maples (*Acer* sp.), sassafras (*Sassafras albidum*), birches, hawthorn, eastern red cedar, and choke-cherry (*Prunus virginiana*).

Pastureland

Pastureland is habitat that is currently or was recently used for agriculture, specifically as a grazing area for livestock.

Mowed Roadsides and Pathways

Mowed roadsides or pathways are strips of vegetation adjacent to roads that is maintained by humans through mowing. It may also include mowed paths through other habitat types, such as fields or forests. Typically, the vegetation in these areas is dominated by grasses and other herbaceous plants that can survive periodic mowing.

Mowed Lawns

Mowed lawns are found in residential or commercial areas such as recreational fields, business parks, or unpaved airport runways. The habitat is dominated by mowed grasses, but may also feature ornamental or native shrubs.

Wet Meadow

Wet meadows are communities characterized by organic soils that are permanently saturated with water. This habitat is dominated by forbs and grasses that form tussocks; however, sparse small shrubs may be present. Species typical of wet meadows include tussock-sedge (*Carex stricta*), bluejoint grass (*Calamagrostris canadensis*), spike rushes (*Eleocharis* sp.), bulrushes (*Scirpus* sp.), other sedges (*Carex* sp.), marsh cinquefoil (*Potentilla palustris*), sensitive fern (*Onoclea sensibilis*), meadowsweet (*Spiraea* sp.), and sweet gale (*Myrica gale*).

Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) beds exist throughout the shallow-water portions of the Hudson River along the proposed In-River Cable Route. The type and extent of SAV beds in the Hudson River reportedly varies from year to year (Findlay et al. 2006), but physiological controls (e.g., hydrodynamics, availability of light with depth of water, water turbidity, etc.) generally limit the location of SAV beds in the river to waters less than 10 feet (3 meters) deep, hence they occur more along shoreline and shoal oriented (warmer, quieter, photic zone) and not in deeper waters of channels and channel slopes.

Recent mapping obtained from Cornell University IRIS (2007) suggests that SAV beds along the In-River Cable Route are most extensive in the north, generally from RM 116 to RM 86 (Figure 4.8-1) as a result of the shallower depths throughout this area of the route, but particularly along the margins of the river. From approximately RM 86 to RM 69, mapped SAV resources become more restricted to narrow beds on either side of the river, on more shallow flanking shoals and shorelines likely restricted to these areas due to the river's significantly deeper depths within the mid-channel area. From RM 69 to the Southern Landfall location, this mapping shows SAV beds in these areas tend to form larger contiguous masses but their distribution is more scattered than along the northern portion of the In-River Cable Route. This may be due to local variations in riverbed substrate conditions, water depths, current velocity influences, or other water quality factors.

Water celery (*Vallisneria americana*) is reported to be the dominant plant species found within the mapped SAV areas. This species also happens to be well-adapted to waters with lower available incident light, and consequently may grow as deep as 16 feet (5 meters) below the mean water surface elevation where water clarity is good (Korschgen et al. 1988), but likely much less deep in waters such as the Hudson River where water clarity is generally not good. This species reproduces both sexually through seed set and asexually through winter buds (turions). Reproductive success through seeds can vary substantially from one location to another and between years. Turions emerge in spring to produce creeping stolons that may generate as many as 20 individual plants during the growing season. The adaptation to lower light and its formation of turions allows water celery to grow in turbid waters and rapidly regenerate or recolonize areas following burial with sediment or after disturbance. These characteristics are likely to explain why this plant is so common throughout the Hudson River, which is relatively turbid and routinely receives additional sediment load from its watershed following storm events.

Exotic curly-leaf pondweed (*Potamogeton crispus*), Eurasian water-milfoil (*Myriophyllum spicatum*) and native slender naiad (*Najas flexilis*) also contribute to the mapped SAV beds. Exotic water chestnut (*Trapa natans*) forms extensive beds within the Hudson River and may have displaced the native water celery in many parts of the river. Although water chestnut does produce some submerged vegetative growth, most of its biomass goes into production of floating leaves, and is therefore, not typically considered SAV (Findlay et al. 2006). In general, water celery is dominant in deeper beds with water chestnut and the other exotic species more common to shallower habitats.

Tidal Wetland Vegetation

Tidal wetlands are located along the Hudson River estuary from the mouth of the river in New York City up to the Troy Dam in Troy, New York, approximately 160 miles upriver. Tidal wetlands along the Project Route are described in Section 4.3.

4.8.1.2 Wildlife

Terrestrial Wildlife

Terrestrial wildlife within the Project Area refers to and includes typical species that are found in human-altered landscapes of the Hudson River Valley. Many of these species have adapted to and become tolerant of decades of habitat alteration and disturbance from human activities along the river shorelines and backlands. It is reported that mammals such as white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*), Virginia opossum (*Didelphis virginiana*), northern raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), and white-footed deermouse (*Peromyscus leucopus*) are likely to be present (NYSDEC 2010).

Avifauna

Terrestrial bird taxa typical of the habitat types found along the Hudson River Valley in the vicinity of the Land Cable Route and Converter Station sites include diurnal raptors, owls, game birds, woodpeckers, and songbirds. The most common diurnal raptor in the region is the red-tailed hawk (*Buteo jamaicensis*); other species likely present include northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), and sharp-shinned hawk (*Accipiter striatus*). Owl species that may be present in the terrestrial portions of the Project Area include great horned owl (*Bubo virginianus*), barred owl (*Strix varia*), barn owl (*Tyto alba*), eastern screech-owl (*Megascops asio*), and northern saw-whet owl (*Aegolius acadicus*). A common game bird of the northeastern United States is the wild turkey (*Meleagris gallopavo*); ruffed grouse (*Bonasa umbellus*) and American woodcock (*Scolopax minor*) may also be present in the vicinity of the Project Area.

Several species of woodpecker inhabit mixed forests in the region. They include pileated woodpecker (*Dryocopus pileatus*), northern flicker (*Colaptes auratus*), yellow-bellied sapsucker (*Sphyrapicus varius*), red-bellied woodpecker (*Melanerpes carolinus*), and downy woodpecker (*Picoides pubescens*). Dozens of species of songbirds may use the proposed Project area for breeding, feeding, migratory, and/or overwintering habitat. Some common species are eastern phoebe (*Sayornis phoebe*), great crested flycatcher (*Myiarchus crinitus*), tree swallow (*Tachycineta bicolor*), black-capped chickadee (*Poecile atricapillus*), tufted titmouse (*Baeolophus bicolor*), white-breasted nuthatch (*carolinensis*), brown creeper (*Certhia americana*), Carolina wren (*Thryothorus ludovicianus*), northern cardinal (*Cardinalis cardinalis*), eastern towhee (*Pipilo erythrophthalmus*), song sparrow (*Melospiza melodia*), savannah sparrow (*Passerculus sandwichensis*), dark-eyed junco (*Junco hyemalis*), eastern bluebird (*Sialia sialis*), American robin (*Turdus migratorius*), wood thrush (*Hylocichla mustelina*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), house finch (*Haemorhous mexicanus*), eastern meadowlark (*Sturnella magna*), Baltimore oriole (*Icterus galbula*), blue jay (*Cyanocitta cristata*), and American crow (*Corvus brachyrhynchos*) (NYSDEC 2010).

Herpetofauna

Common reptile and amphibian species typical of the habitat types found along the Land Cable Route include eastern garter snake (*Thamnophis sirtalis*), black rat snake (*Pantherophis obsoletus*), eastern box turtle (*Terrapene carolina carolina*), spotted turtle (*Clemmys guttata*), American toad (*Bufo americanus*), wood frog (*Rana sylvatica*), and red-backed salamander (*Plethodon cinereus*) (NYSDEC 2010).

Coastal and Aquatic Wildlife

The Hudson River Valley provides habitat for many species of water birds representing several different taxonomic orders, including waterfowl, waders, raptors, shorebirds, rails, coots, grebes, and songbirds. Breeding waterfowl on the Hudson River include Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), and the non-native mute swan (*Cygnus olor*). American black ducks (*Anas rubripes*), scaup (*Aythya* sp.), bufflehead (*Bucephala albeola*), and mergansers (*Mergus* sp.) are common on the Hudson River during spring and fall migrations, and many individuals also overwinter on the river. Diving ducks such as scaup and bufflehead may form large rafts on ice-free portions of the river during the winter (Stane et al. 2005). These species can occur anywhere on the river, but are likely to avoid the federal channel where boat traffic affects use of the habitat.

In addition to waterfowl, wading birds such as the great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), least bittern (*Ixobrychus exilis*), and green heron (*Butorides virescens*) are found in the wetlands along the Hudson River and may cross the Project Area. These species feed upon fish, amphibians, and large invertebrates captured using their dagger-like bills. Breeding colonies of some species exist along tributaries of the Hudson (Stane et al. 2005).

Diurnal raptors such as the bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and peregrine falcon (*Falco peregrinus*) are found along the Hudson River throughout all or part of the year. Bald eagles and osprey feed primarily on fish caught from the river, while peregrine falcons typically hunt birds in flight or small mammals. Bald eagles and peregrine falcons nest along the Hudson River, while osprey are not known to breed in this region (Stane et al. 2005).

Other species such as pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), Virginia rail (*Rallus limicola*), spotted sandpiper (*Actitis macularia*), belted kingfisher (*Ceryle alcyon*), and marsh wren (*Cistothorus palustris*) breed in the wetlands along the fringes of Hudson River (Stane et al. 2005) outside of the In-River Cable Route.

A few mammal species in the Hudson River Valley are obligate wetland animals, and inhabit the marshes or open water portions of the Hudson River within the Project Area. Muskrats (*Ondatra zibethica*) are common in the wetlands of the Hudson River Valley, where they create lodges of vegetation and mud. Muskrats are active year-round and feed primarily on wetland plants, especially cattails (*Typha* sp.). Muskrats are not anticipated to occur in deeper waters where the In-River Cable is located. Mink (*Mustela vison*) and northern river otter (*Lutra canadensis*) are also obligate wetland mammal species. Both mink and river otter create dens in the muddy banks of the river, are primarily nocturnal, and feed largely on fish or aquatic invertebrates. These two related species are somewhat uncommon on the Hudson River (Stane et al. 2005). Mink and river otter are also likely to stay closer to shorelines and avoid the location of the In-River Cable Route.

The reptile and amphibian community in the wetlands and aquatic portions of the Hudson River is markedly different from that of the terrestrial portions of the Project Area. Surprisingly, reptiles and amphibians are relatively uncommon within and along the banks of the Hudson River itself, including the flanking shorelines of the Project Area. This is likely due to the relatively high flow river and tidal currents as well as salinity conditions. This may also be caused by the high degree of variation in temperature in tidal wetlands and the presence of several riverine species which prey upon reptiles and amphibians. In shallow wetlands along the banks of the Hudson River and its tributaries, species such as green frog (*Rana clamitans*), spring peeper (*Pseudacris crucifer*), mudpuppy (*Necturus maculosus*), snapping turtle (*Chelyda serpentina*), painted turtle (*Chrysemys picta*), diamondback terrapin (*Malaclemys terrapin*), and northern water snake (*Nerodia sipedon*) may be found (Stane et al. 2005). Some of these reptile and amphibian species may be present within the nearshore portions of the Northern and Southern Landfall Transition zones that are to be crossed by the project using HDD technology at both ends of the In-River Cable Route.

4.8.1.3 Non-Indigenous and Invasive Species

Non-Indigenous Invasive Flora

In general, the presence of non-indigenous invasive flora reduces the ecological value of the habitats in which they occur and the more prevalent that these species become within a habitat, the less valuable the habitats become to fish, birds and other wildlife. The Project Area, including both the Northern and Southern Converter Station sites and the In-River Cable Route, has an abundance of these non-indigenous plant species which have been mapped previously or documented directly through field observations in 2012 and 2013 as detailed below.

Water Chestnut

Water chestnut (*Trapa natans*) is an annual aquatic herbaceous plant that grows as a rosette of floating leaves with air bladders. A slender cord-like stem attaches the floating rosette to the large barbed seed, which is typically buried in the sediment. The plant can form dense floating mats of leaves, which reduce light penetration into the water column, thereby shading out native SAV (Yozzo et al. 2005; Kiviat and Hummel 2004).

A native of Africa and Eurasia, water chestnut was planted in Collins Lake in Scotia, New York in 1884 (Kiviat and Hummel 2004). The species was transported to the Mohawk River after flooding of the New York Barge Canal raised water levels in the area. By 1920, water chestnut was firmly established in the Mohawk River, and had spread to the Hudson River at Cohoes by the late 1930s. It soon became widespread throughout the tidal freshwater portions of the Hudson River Estuary (Yozzo et al. 2005), and today is well established in nearly all sheltered shallow portions of the tidal freshwater reaches of the Hudson River, from Saratoga County to Putnam and Orange Counties (Kiviat and Hummel 2004; Lamont and Fitzgerald 2001).

Proliferation of water chestnut can alter the physical, chemical, and biological characteristics of shallow subtidal habitats. Dense infestation of water chestnut can cause an increase in the biochemical oxygen demand and localized hypoxic conditions (Yozzo et al. 2005). Fish communities, especially larval and juvenile life stages, associated with native submerged aquatic plants may be negatively impacted by water chestnut, due to changes in the physical structure of the underwater habitat and in the availability and composition of invertebrate prey (Schmidt and Kiviat 1988).

Water chestnut is prolific in the shallow, near shore, areas of the Hudson River and although widespread within the river, dislodging it during in-water work activities during the summer period of seed formation could contribute to its further spread. Within the Project Area, water chestnut is essentially confined to areas within the nearshore portions of the Northern and Southern Landfall Transition zones that are to be crossed by the project using HDD technology at both ends of the In-River Cable Route. Other portions of the In-River Cable Route are too deep or fast moving to provide suitable habitat for this exotic plant.

Common Reed

Common reed (*Phragmites australis*) has the potential to spread rapidly within brackish and intertidal freshwater wetlands along the Hudson River, especially in the mid to upper-intertidal zone, where it outcompetes native species such as narrow leaved cattail (*Typha angustifolia*), spotted jewelweed (*Impatiens capensis*), and Olney three square (*Scirpus americanus*) (Yozzo et al. 2005). Common reed is also present within the footprint of the Southern Converter Station, based on site-specific observations. Common reed expanded its range in many parts of North America, invading fresh and brackish wetlands in the 1900s (Saltonstall 2002). The recent spread of common reed is believed to be in part due to the proliferation of a more aggressive European genotype in North America (Saltonstall 2002). Human disturbances, sedimentation, and eutrophication of marsh and wetland areas also contribute to common reed expansion. A new native subspecies (*Phragmites australis* subsp. *americanus*) is now recognized as genetically distinct from both the European genotypes and the North American Gulf Coast lineages (Saltonstall et al., 2004).

Common reed, which is known to occur within the proposed footprint of the Southern Converter Station site, provides limited or no habitat value to most species common to the Project Area since this species offers limited cover or foraging value with its dense mono-typic stands of growth. Common reed is present along the Northern and Southern Land Cable Routes. The Landfall Transition zones that are to be crossed by the project using HDD technology at both ends of the In-River Cable Route are not anticipated to cross common reed habitat.

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) is present in bordering wetlands along the tidal portion of the Hudson River, from the federal dam at Troy to Piermont Marsh (Yozzo et al. 2005). Based on site-specific observations, it occurs near stream crossings along the Northern Land Cable Route and within the footprint of the Northern Converter Station. Purple loosestrife was first discovered in the Hudson River Valley around 1800, and by 1900 it had become widespread in the region. This species is common in freshwater wetlands and wet meadows throughout the United States, especially in the northeastern United States and southern Canada (Yozzo et al. 2005). The presence of purple loosestrife in a wetland reduces habitat suitability for specialized wetland bird species such as black terns (*Chlidonias niger*), least bitterns (*Ixobrychus exilis*), pied-billed grebes (*Podilymbus podiceps*), and marsh wrens (*Cistothorus palustris*) (Blossey et al. 2001). Most breeding marsh birds will not nest in purple loosestrife, except certain generalist songbirds such as red-winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscula*), swamp sparrow (*Melospiza georgiana*), and song sparrow (*Melospiza melodia*). Purple loosestrife changes rates of decomposition of organic detritus and changes rates of nutrient recycling, and causes a reduction in wetland plant diversity, including the native *Lythrum alatum*.

Exotic Bush Honeysuckles

Tatarian honeysuckle (*Lonicera tartarica*), Morrow’s honeysuckle (*L. morrowii*), and their hybrid Bell’s honeysuckle (*Lonicera x bella*) form a group of closely related Eurasian bush honeysuckle species that have invaded areas of New York State in and adjacent to the Hudson River Valley (USDA 2013). These species produce berries that are attractive to songbirds, which serve as the primary vector for dispersion. The primary ecological impact of exotic bush honeysuckles is their ability to quickly colonize forest edges and outcompete native species (USFS 2005). Site-specific presence of exotic bush honeysuckle was documented at the location of the Southern Converter Station.

Eurasian Water Milfoil

Eurasian water milfoil (*Myriophyllum spicatum*) is a submerged aquatic plant native to Europe, Asia, and North Africa. The plant grows upright in the water column, and leaves are arranged around the central stem in whorls of four (WSDE 2013). As an invasive species in North America, Eurasian water milfoil grows in dense stands in fresh water and replaces native plants that provide a more suitable food source and habitat structure for waterfowl, fish, and other aquatic organisms (Stanne et al. 2005). Transport of Eurasian water milfoil is primarily through angling activity, as small fragments of the plant can become attached to boats, motors, or angling gear. Chemical effects to water bodies with dense Eurasian water milfoil infestations include increased rate of phosphorus loading, increased pH, decreased light penetration, decreased dissolved oxygen, and increased temperatures. These conditions result in decreased habitat suitability for fish and other aquatic organisms (WSDE 2013).

Curly-leaf Pondweed

Curly-leaf pondweed (*Potamogeton crispus*) is native to Eurasia, Africa, and Australia but has established populations in most of the contiguous United States (Capers et al. 2005). This species is present in the tidal freshwater zone of the Hudson River (Findlay et al. 2006). Curly-leaf pondweed is a submerged aquatic plant that grows quickly into the water column in spring. During this period, it can form dense single-species beds. After setting seed in late spring or early summer, the plants typically die back. Seed may be responsible for some reproduction but the primary reproductive mechanism is vegetative in the form of dormant buds (Wehrmeister 1978).

Non-indigenous Invasive Fauna

Multiple invasive aquatic faunal species are present or likely to be present at or near the In-River Cable Route. These include benthic species such as zebra mussel (*Dreissena polymorpha*), Atlantic rangia (*Rangia cuneata*), Asian clam (*Corbicula fluminea*), and faucet snail (*Bithynia tentaculata*). For more detailed information on these species, refer to Section 4.7 Benthos and Shellfish.

4.8.2 Environmental Impacts and Mitigation

4.8.2.1 Potential Construction Impacts and Mitigation

Terrestrial Vegetation

Construction activities associated with direct trenching and underground burial of the Land Cable along the planned Northern and Southern Land Cable Routes will occur primarily in or immediately adjacent to existing roadways and public rights-of-way using standard underground utility installation methods. Installation of the Land Cable Route along the edge of existing roadways will directly impact native vegetation within approximately three feet immediately adjacent to the roadway.

Construction of new site access driveways to the Northern and Southern Converter Stations will require a new permanent access corridor, approximately 20 to 30 feet wide through existing vegetation. Vegetation types in these areas are typical species for this region and include mixed hardwood forest and pasture. The AC Transmission Cable from the Northern Converter Station to the existing Leeds Substation will be installed using HDD underground conduit, which will avoid direct and indirect environmental impacts to terrestrial vegetation for this portion of the Route. A temporary 12-foot wide construction corridor will be needed for installation of the Land Cable from the Southern Converter Station to existing public roadways using direct trenching and underground burial methods. Construction of the Northern Converter Station will directly impact approximately 5 acres of pastureland, wet meadow, and successional red cedar woodland.

Construction of the Southern Converter Station will be constructed entirely on upland areas and will also impact approximately 5 acres of successional old field, successional shrubland, and successional southern hardwoods.

An erosion and sediment control plan consistent with the New York Standard and Specifications for Erosion and Sediment Control (August 2005) will be developed as part of the EM&CP and will detail specific techniques to minimize impacts to vegetation.

Submerged Aquatic Vegetation

The In-River Cable Route was aligned to avoid or minimize impacts to SAV and does not cross any mapped SAV beds. Additionally, there are no mapped SAV beds at either of the preferred locations for the Northern or Southern Landfalls. Therefore, direct impacts to these beds from in-river cable installation activities will not occur as a result of the Project.

Indirect impacts to SAV from the In-River Transmission Cable installation will be minimal during jet plow operations.

SSFATE modeling of anticipated sediment dispersion from jet plow embedment operations predicts that increases in TSS concentrations will be limited to the near-bottom location in the water column. TSS concentrations are similarly expected to decrease rapidly with horizontal or lateral distance from operations; concentrations at or above 200 mg/L are expected to remain within 95 m (312 feet) of the operating jet plow. Increased TSS concentrations were predicted to be short-term, with concentrations greater than 200 mg/L not expected to exceed 2 hours in duration, returning to ambient levels within 24 hours of suspension by jet plow passage (see Section 4.5).

Subsequent deposition of jet-plow induced suspended sediments was predicted by the SSFATE model to be mostly limited to a narrow band extending 200 to 500 feet from the centerline of the jet plow trench. Deposition thicknesses greater than 2 mm (0.08 in) are not expected to extend more than 91 m (300 feet) from the centerline, covering a total area of 227 acres along the entire in-river route. Deposition thicknesses of 5 mm (0.2 in) are expected to cover no more than 0.31 acres in total.

Water celery, the main native species within mapped SAV beds, regenerates from budlike structures called turions. These turions can tolerate substantial sediment burial (Carter et al. 1985) and will emerge and grow when covered by as much as 15 cm of sediment (much more than predicted by the SSFATE model). Therefore, indirect impacts to SAV from sediment deposition will be minimal.

Temporary cofferdams to be constructed in the river near the Northern and Southern Landfall locations are designed to contain sediments suspended during dredging. Increases in TSS concentrations outside the limits of the temporary cofferdams are expected to be minimal and are not anticipated to reach mapped SAV beds. Therefore, indirect impacts on SAV from installation and dredging at the Northern and Southern Temporary Cofferdams will be negligible.

Wave action from the construction vessels may result in some indirect displacement of individual plants or breakage of leaves of aquatic plants. However, the Hudson River is a navigable waterway of the United States and significant daily vessel traffic results in frequent wakes and wave action along the shoreline. Given the existing vessel use of the Hudson River, no additional impacts to SAV beds are expected from passage of the In-River Cable installation vessels and equipment.

Overall indirect impacts to SAV beds are expected to be minor and negligible given the temporary and localized nature of projected increases in TSS concentrations and the minimal thickness of sediment deposition anticipated from jet plow embedment of the In-River Transmission Cable. Given the natural ability of the dominant SAV species, water celery, to recover from these types of impacts due to its adaptation to this type of environment, it is reasonable to expect no permanent indirect impacts to any SAV beds as a result of the Project.

Wildlife

Construction activities associated with the Land Cable Route will occur primarily in or adjacent to existing roadways. Direct impacts to wildlife from construction-related activities in these areas will be minor and temporary. Some wildlife will exhibit avoidance behavior around active construction areas and some localized disturbance of wildlife, primarily birds and terrestrial mammals, may occur due to operation of construction-related equipment. The construction of the Land Cable Route and the Converter Stations may also cause indirect impacts through an initial reduction in the amount of habitat available to local wildlife for breeding, foraging, or resting. However, this reduction will be minor compared to the amount of nearby habitat that will not be impacted by the Project. The linear nature of the Land Cable Route will leave sufficient undisturbed habitat for use by wildlife in the vicinity of construction activities. Additionally, terrestrial construction activities will be short-term and limited in scope, and therefore will not cause significant disturbance or measurable impacts to local wildlife.

Operation of construction equipment during installation of the In-River Cable may result in minor to negligible impacts to some wildlife species. Wildlife that use the Hudson River or adjacent terrestrial habitats for foraging, commuting, or breeding may temporarily avoid active cable installation areas due to noise. Additionally, some wildlife, such as foraging bats or migrating birds, may be directly or indirectly attracted to the active cable installation area by nighttime lighting. However, these impacts will be temporary and localized.

4.8.2.2 Potential Operational Impacts and Mitigation

Terrestrial Vegetation

Vegetation impact mitigation measures will be employed for construction activities along affected roadways and site access roads in order to maintain rights-of-way associated with the Northern and Southern Land Cable Routes as well as the Northern and Southern Converter Stations.

Although impacts to terrestrial vegetation from operation of the Land Transmission Cable and Converter Stations are anticipated to be ongoing over the operational life of the Project, the total area impacted will be comparatively minor compared to the available habitat around the area. An invasive species control plan will also be developed and presented in the EM&CP to avoid establishment of invasive species.

Submerged Aquatic Vegetation

The need to extract a portion of the installed In-River Transmission Cable for repair is a remote possibility. In the unlikely event that this were to become necessary, repair activities would be localized and temporary. Additionally, given the alignment of the In-River Cable Route outside of mapped SAV beds, any repair or maintenance activities will not have a measurable impact on SAV.

Wildlife

The discrete areas where the Northern and Southern Converter Stations will be constructed (approximately 5 acres each) are unlikely to function as valuable wildlife habitat. However, areas adjacent to building footprints may support low vegetation and therefore, supplement or complement surrounding habitats, including successional wet meadow, pastureland, and red cedar woodland near the Northern Converter Station site and successional old field, shrubland and southern hardwoods at the Southern Converter Station site.

The Northern and Southern Converter Stations will each permanently displace approximately 5 acres of terrestrial and wetland habitats to allow for construction and operation of the Converter Station buildings and electrical transformer yard areas. However, the permanent but localized displacement of these resource areas and their habitat value is minimal compared to the expansive matrix of similar habitats surrounding the Converter Station site areas.

Operational impacts associated with the respective Land Cable Routes are similarly expected to be negligible. Underground burial of the Land Transmission Cable will occur primarily in existing paved roadway or adjacent shoulder areas, minimizing the amount of vegetation management that may be required during cable operation. However, the permanent but localized displacement of these resource areas and their habitat value is minimal compared to the expansive matrix of similar habitats surrounding the Land Cable Routes.

Impacts to wildlife associated with the operation of the In-River Cable will not occur since the In-River Cable will be buried well below the zone where wildlife activity occurs.

4.9 Important Habitats and Threatened and Endangered Species

4.9.1 Existing Conditions

4.9.1.1 Important Habitats

This section describes existing special management areas along and within the coastal margins of the Hudson River Valley that may be affected by the Project. These areas include Wildlife Management Areas (WMAs), Important Bird Areas (IBAs), Significant Coastal Fish and Wildlife Habitats (SCFWHs), and any other designated lands that are protected primarily for the conservation of fish or wildlife habitat.

Unique, Sensitive or Protected Plant Communities

Based on a review of the available data from NYNHP (2013a) and USFWS (2013), no sensitive or protected plant communities have been identified along the Land Cable Routes or Converter Station sites (Appendix 4A). Therefore sensitive or protected plant communities are not expected to be impacted by the land-based components of the Project.

A discussion of rare, threatened, and endangered plant species occurring along the In-River Cable Route can be found in Section 4.9.1.2 below.

Important Habitats and Conservation Land

Important Bird Areas

The Important Bird Area (IBA) Program is a worldwide initiative to identify and conserve areas deemed to be important habitat for birds and other wildlife. The IBA Program was started in Europe by BirdLife International in the 1980s, and the program has since grown to include over 8,000 IBAs globally. Since 1995, the National Audubon Society has administered the IBA Program in the United States, where over 2,600 IBAs have been designated, encompassing nearly 370 million acres (National Audubon Society 2013).

There are five (5) IBAs located along the proposed In-River Cable Route in this area of the Hudson River Valley, as presented in Figure 4.9-1. From north to south, they are: Stockport Flats, Tivoli Bays, Constitution Marsh Sanctuary, Doodletown and Iona Islands, and Lower Hudson River (National Audubon Society 2013). Summaries of each IBA are presented below.

Stockport Flats IBA

The Stockport Flats IBA is comprised of an expansive area of approximately 1,600 acres on the eastern bank of the Hudson River in Columbia County (RM 117-125). Habitats in the IBA are primarily emergent herbaceous vegetation, deciduous forest, and open water typical of this area of the river. The IBA provides habitat for several waterfowl species, especially in the spring months, and bald eagles are relatively common there year-round (National Audubon Society 2013).

Tivoli Bays IBA

The Tivoli Bays IBA encompasses another expansive area of approximately 1,600 acres on the eastern shore of the Hudson River in Dutchess County (RM 97-101). This IBA is also primarily comprised of emergent herbaceous vegetation, deciduous forest, and open water habitats typical of this area of the river. Tivoli Bays IBA provides habitat for many waterfowl and waterbird species, especially during spring migration. It also provides habitat for a high diversity of songbird species, as well as several species of diurnal raptors, including bald eagles (National Audubon Society 2013).

Constitution Marsh Sanctuary IBA

Constitution Marsh Sanctuary comprises approximately 600 acres on the eastern shore of the Hudson River in Putnam County (RM 52-54). Habitats in this IBA are primarily emergent herbaceous wetlands and deciduous forest. The Constitution Marsh Sanctuary provides habitat for waterfowl, especially Canada goose, wood duck, American black duck, and mallard, as well as diurnal raptors including bald eagles, and songbirds (National Audubon Society 2013).

Doodletown and Iona Islands IBA

The Doodletown and Iona Islands IBA encompasses nearly 2,500 acres on the western shore of the Hudson River in Rockland County (RM 44-46). This IBA is composed primarily of deciduous forest, but also contains some emergent herbaceous wetlands and other habitats. Habitats in this IBA provide for an especially high diversity of breeding songbirds, including approximately 30 species of wood-warblers (Parulidae) (National Audubon Society 2013).

Lower Hudson River IBA

The Lower Hudson River IBA encompasses over 27,000 acres of the oligohaline portion of the Hudson River, from the Ulster-Orange County line south to and including portions of Haverstraw Bay (RM 32-68). This IBA is over 90% open water; other habitat types included in the IBA are emergent herbaceous wetlands and deciduous forest. The Lower Hudson River IBA provides habitat for several species of migratory and wintering waterfowl, other waterbirds, diurnal raptors, and songbirds. Bald eagles are relatively common in this IBA and peregrine falcons are also present (National Audubon Society 2013).

National Estuarine Research Reserve

The National Estuarine Research Reserve System (NERRS) was created by the Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management (CZM) Program. The reserve system is a network of protected areas established to promote informed management of the Nation’s estuaries and coastal habitats. The reserve system currently consists of 27 reserves in 22 states and territories, protecting over one million acres of estuarine lands and waters.

The Hudson River Reserve, designated in 1982, is a network of four coastal wetlands, encompassing 4,838 acres, located along 100 miles of the Hudson River Estuary in New York State. From north to south the sites include: Stockport Flats in Columbia County, Tivoli Bays in Dutchess County, and Piermont Marsh and Iona Island in Rockland County (NOAA 2013a).

Stockport Flats is located just north of the Northern Landfall and Piermont Marsh is located south of the Southern Landfall. The In-River Transmission Cable Route passes adjacent to the Tivoli Bays and Iona Island sites, which are shown in Figure 4.9-1 and described below.

Tivoli Bays

The Tivoli Bays component of the Hudson River Reserve extends for two miles along the east shore of the Hudson River between the villages of Tivoli and Barrytown (RM 98-100). Tivoli Bays comprise two large coves on the east shore of the Hudson River including Tivoli North Bay, a large intertidal marsh, and Tivoli South Bay, a large, shallow cove with mudflats exposed at low tide. The site also includes an extensive upland buffer area bordering North Tivoli Bay, sections of upland shoreline along Tivoli South Bay, Cruger Island and Magdalene Island, two bedrock islands, extensive subtidal shallows, and the mouths of two tributary streams, the Stony Creek and the Saw Kill. Habitats include freshwater intertidal marsh, open waters, riparian areas, subtidal shallows, mudflats, tidal swamp, and mixed forest uplands (NOAA 2013a).

The In-River Cable Route does not pass directly through this site, but passes adjacent to the Tivoli Bays.

Iona Island

Iona Island is located along the western shore of the Hudson River, in the Town of Stony Point (RM 44-46), six miles south of West Point. Iona Island is a bedrock island in the midst of the Hudson Highlands, bordered to the west and the southwest by Salisbury and Ring Meadows, two large tidal marshes, the mouth of Doodletown Bight, and an expanse of shallows and mudflats. A separate island, Round Island, is also included in this site. The site encompasses 556 acres and is comprised of brackish intertidal mudflats, brackish tidal marsh, freshwater tidal marsh and deciduous forested uplands. In addition to being part of the Hudson River NERR, Iona Island and its associated tidal wetlands have been designated a National Natural Landmark by the National Park Service (NOAA 2013a).

The In-River Cable Route does not pass directly through the site, but passes adjacent to the Iona Island site.

Significant Tidal River Habitats

NYSDOS Division of Coastal Resources and Waterfront Revitalization in conjunction with the Nature Conservancy, have identified areas of special environmental importance located along and within the tidal section of the Hudson River in certain locations along the proposed In-River Cable Route. Detailed information on these tidal river areas is presented in the Hudson River Significant Tidal Habitats: A Guide to the Functions, Values, and Protection of the Rivers Natural Resources (NYSDOS and TNC 1990). All of the Significant Tidal Areas crossed by the project are also Significant Coastal Fish and Wildlife Habitats and are described below.

Significant Coastal Fish and Wildlife Habitats (SCFWH)

There are 40 SCFWHs identified by the NYSDOS Division of Coastal Resources within the overall Hudson River Estuary system. Under the SCFWH program, a site is considered significant if it serves one or more of the following functions:

- Is essential to the survival of a large portion of a particular fish or wildlife population

- Supports populations of species which are endangered, threatened or of special concern
- Supports populations having significant commercial, recreational, or educational value
- Exemplifies a habitat type which is not commonly found in the State or in a coastal region
- Would be difficult or impossible to replace.

A ranking system was developed in order to evaluate fish and wildlife habitats, using the following five criteria: Ecosystem Rarity, (ER), Species Vulnerability (SV), Human Use (HU) and Population Level (PL), and Replaceability (R). Scores were assigned to the criteria for each Habitat and combined to determine the Significance of a particular habitat. A significance of 15.5 was chosen as the threshold for designation of a particular habitat as SCFWH.

The In-River Cable Route crosses or passes adjacent (within 0.1 miles) to 16 SCFWHs, with significance rankings ranging from 24 to 188.26. At the current configuration, the In-River Cable has been positioned to minimize adverse affects to SCFWHs by being placed in the deeper water areas that are less productive and do not support the diversity of fish, wildlife and avifauna compared to the shallow water areas of these habitats. Of these 16 SCFWHs, the In-River Cable Route unavoidably passes directly through only seven (significance rankings 114.6-151.5), since they are primarily located in-water and stretch bank to bank. The Route also runs adjacent to (within 0.1 miles of) nine SCFWHs that are predominantly shoreline or nearshore tidal flat areas adjacent to the main course of the river channel. These special habitat areas are almost ubiquitous along the Hudson River and have maintained their ecological value for decades despite frequent and prolonged commercial and navigational use.

The seven SCFWHs that will be intersected by the proposed In-River Cable Route, including Vosburgh Swamp and Middle Ground Flats, Catskill Deepwater, Germantown-Clermont Flats, Esopus Estuary, The Flats, Kingston-Poughkeepsie Deepwater, and Hudson Highlands, are presented in Figure 4.9-1 and described in Table 4.9-1. A detailed description of each SCFWH and potential project impacts, if any, to these areas is provided in Appendix 4E.

Table 4.9-1: Description of Significant Coastal Fish and Wildlife Habitats Crossed by the In-River Cable

Name	River Miles	Significance Score	Length of Route Crossed (mi)	Habitat Types			Associated Species of Interest	Other Designations
				Deep-water	Shallow Water	Emergent Wetland		
Vosburgh Swamp and Middle Ground Flats	116.75 - 121.5	119.86	1.14		X	X	**Plants:** American waterwort (E), golden club (T), heartleaf plantain (T), spongy arrowhead (T), smooth bur-marigold (T), Delmarva beggar-ticks (R) **Non-fish Wildlife:** least bittern (T), northern harrier (T), bald eagle (T), pied-billed grebe (T), American bittern (SC) **Fish:** shortnose sturgeon (E), Atlantic sturgeon (C-Fed), American shad, white perch, alewife, American eel, blueback herring, striped bass	Waterfowl hunting area; recreational fishing area; NYSDEC boat launch
Catskill Deepwater	110.25 - 114	121.2	2.68	X			**Fish:** shortnose sturgeon (E), Atlantic sturgeon (C-Fed), American shad, striped bass, alewife, blueback herring, white perch	Critical habitat for most estuarine-dependent fisheries originating from the Hudson River; recreational fishing area
Germantown-Clermont Flats	102.75 - 107.5	139.2	3.73		X	X	**Fish:** American shad, striped bass, white perch	Significant recreational fishing area

Name	River Miles	Significance Score	Length of Route Crossed (mi)	Habitat Types			Associated Species of Interest	Other Designations
				Deep-water	Shallow Water	Emergent Wetland		
Esopus Estuary	99.75 - 103.5	114.6	1.03	X	X	X	**Plants:** spongy arrowhead (T), heartleaf plantain (T) **Non-fish Wildlife:** least bittern (T), bald eagle (T), northern harrier (T), osprey (SC), American bittern (SC) **Fish:** shortnose sturgeon (E), Atlantic sturgeon (C-Fed), American shad, white perch, alewife, blueback herring, rainbow smelt, largemouth bass, smallmouth bass, striped bass, American eel	Significant recreational fishing area; waterfowl hunting area; kayak and canoe use; birdwatching area
The Flats	92.5 - 96.5	150	3.28	X	X		**Fish:** shortnose sturgeon (E), Atlantic sturgeon (C-Fed), American shad, striped bass, white perch	Recreational fishing area; waterfowl hunting area

Name	River Miles	Significance Score	Length of Route Crossed (mi)	Habitat Types			Associated Species of Interest	Other Designations
				Deep-water	Shallow Water	Emergent Wetland		
Kingston-Poughkeepsie Deepwater	66 - 91.75	151.2	23.03	X			**Fish:** shortnose sturgeon (E), Atlantic sturgeon (C-Fed), American shad, striped bass, fourspine stickleback, threespine stickleback, white perch, bluegill, brown bullhead, common carp, golden shiner, largemouth bass, pumpkinseed, smallmouth bass, spottail shiner, white catfish, yellow perch, alewife, American eel, blueback herring	Critical year-round to both sturgeon
Hudson Highlands	40.75 - 59.75	151.5	17.95	X			**Non-fish Wildlife:** bald eagle (T) **Fish:** shortnose sturgeon (E), Atlantic sturgeon (C-Fed), striped bass, bluefish, anchovy, silversides	Critical habitat for most estuarine-dependent fisheries originating from the Hudson River; eagle sanctuary; recreational fishing area; biological study area

Vosburgh Swamp and Middle Ground Flats

The Vosburgh Swamp and Middle Ground Flats SCFWH is a 1,300-acre area located along the western shoreline of the Hudson River, from RM 116.8 to RM 121.4. The Northern Landfall is located within the southern tip of this SCFWH. The proposed In-River Cable Route also passes through this SCFWH for 1.14 miles (NYSDOS 2012).

The Vosburgh Swamp and Middle Ground Flats SCFWH comprises mudflats and shallows, open-water areas, hardwood swamp and freshwater impoundment, freshwater tidal marsh, spoil bank islands, and a portion of Murderers Creek. SAV beds in the shallows are dominated by water celery (*Vallisneria americana*). Additional plant species in the area include the threatened or endangered American waterwort (*Elatine americana*), golden club (*Orontium aquaticum*), heartleaf plantain (*Plantago cordata*), spongy arrowhead (*Sagittaria calycina* var. *spongiosa*), smooth bur-marigold (*Bidens laevis*) and Delmarva beggar ticks (*Bidens bidentoides*) as well as the invasive common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*) and water chestnut (*Trapa natans*). This submerged and emergent vegetation provides food and refuge for fish and invertebrates, as well as food for waterfowl. In addition, common map turtles (*Graptemys geographica*) also utilize the shoreline and wetland habitats.

The shoreline tidal flats and shallows within this SCFWH support relatively high concentrations of American shad (*Alosa sapidissima*), which use the area for spawning between March and June. The deeper waters of the SCFWH are also utilized by alewife (*Alosa pseudoharengus*), American eel (*Anguilla rostrata*), blueback herring (*Alosa aestivalis*), striped bass (*Morone saxatilis*), white perch (*Morone americana*), shortnose sturgeon (*Acipenser brevirostrum*), and Atlantic sturgeon (*Acipenser oxyrhynchus*). Several of these species also utilize Murderers Creek as spawning, nursery, and feeding grounds. Spawning timeframes for all of these species occur largely outside of the planned August to November jet plow embedment timeframe for this Project.

Waterfowl utilize the Vosburgh Swamp and Middle Ground Flats SCFWH for feeding and resting areas, primarily during the fall and spring migrations, and during the winter when open water is available. Subsequently, the area is a popular hunting location for the region.

Bird species occurring in this SCFWH include green heron (*Butorides virescens*), American black duck (*Anas rubripes*), mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), Virginia rail (*Rallus limicola*), common moorhen (*Gallinula chloropus*) and marsh wren (*Cistothorus palustris*). Several threatened or special concern species of birds also utilize this area as nesting grounds in the spring, including American bittern (*Botaurus lentiginosus*), least bittern (*Ixobrychus exilis*), pied-billed grebe (*Podilymbus podiceps)*, northern harrier (*Circus cyaneus*), and bald eagle (*Haliaeetus leucocephalus*).

Catskill Deepwater

The Catskill Deepwater SCFWH comprises an approximately four mile stretch of deepwater habitat within the Hudson River from RM 110.25 to RM 114.0. Water depths within this special area range from 30 to 50 feet. The In-River Cable Route runs through this SCFWH for 2.68 non-contiguous miles.

The Catskill Deepwater SCFWH provides critical habitat for estuarine fishes, including alewife, blueback herring, and white perch. In addition, it serves as spawning habitat for American shad, striped bass, and Atlantic sturgeon, as well as overwintering habitat for juvenile and adult shortnose sturgeon (NYSDOS 2012). However, according to a letter from NOAA Protected Resources specific to this Project (NOAA 2013d), the Catskill SCFWH was not identified as a spawning habitat for either of these species.

Germantown-Clermont Flats

The Germantown-Clermont Flats SCFWH is a 988-acre area of shallow freshwater and intertidal mudflats located within and along the eastern shoreline of the Hudson River from RM 102.75 to RM 107.5. The In-River Cable Route passes through this SCFWH for 3.73 miles.

The shallow tidal flats and open-river habitat within this SCFWH are utilized by large concentrations of waterfowl, including greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), common goldeneye (*Bucephala clangula)*, hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), mallard, American black duck, blue-winged teal (*Anas discors*), green-winged teal (*Anas crecca*), common loon (*Gavia immer*), and additional species of grebes, gulls, wading, and shorebirds. In addition to providing feeding and resting areas for these species, this SCFWH also serves as refuge from hunting pressures along the shoreline.

Submerged and emergent vegetation within this SCFWH are dominated by wild celery and spatterdock (*Nuphar advena*), respectively, which provide food and refuge for fish and invertebrates. Shallow, freshwater tidal flats such as the Germantown-Clermont Flats SCFWH also serve as feeding and nursery areas for many fish species, including striped bass and white perch between April and July. Large concentrations of American shad also utilize the Germantown-Clermont Flats SCFWH as spawning and nursery grounds from March to June. The spawning and nursery timeframes for all of these species occur outside of the planned August to November jet plow embedment timeframe for this Project. The large concentrations of fish in the SCFWH support a recreational fishery, primarily for striped bass, attracting anglers from the surrounding region.

Additional species that utilize the Germantown-Clermont Flats SCFWH include painted turtle (*Chrysemys picta*), common map turtle, water snake (*Nerodia s. sipedon*), red-spotted newt (*Notophthalmus v. viridescens*), redback salamander (*Plethodon cinereus*), American toad (*Bufo americanus*), gray treefrog (*Hyla versicolor*), spring peeper (*Pseudoacris crucifer*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*) and wood frog (*Rana sylvatica*) (NYSDOS 2012).

Esopus Estuary

The Esopus Estuary SCFWH is a 970-acre area located within and along the western shoreline of the Hudson River, from RM 99.75 to RM 103.5. It comprises the lower portion of Esopus Creek, a tributary to the Hudson River, including submerged vegetation beds, surrounding freshwater tidal wetlands and tidal swamp forest, mudflats, shallows, and littoral zone areas, as well as a deepwater portion of the Hudson River. The In-River Cable Route passes through this SCFWH for 1.03 miles.

The diversity of habitat types within the Esopus Estuary SCFWH supports a wide range of plant and animal species. Submerged vegetation in the estuarine areas is dominated by water celery, which provides food and refuge for fishes and invertebrates, as well as food for waterfowl. Vegetation in intertidal areas includes spongy arrowhead and heartleaf plantain. Surrounding marsh and swamp vegetation provide habitat for common map turtles, spring peeper, gray treefrog, green frog, and wood frog.

Esopus Creek and adjacent shallow areas of this part of the Hudson River shoreline serve as habitat for migratory coastal fish species as well as resident freshwater species. Fish that utilize this SCFWH for feeding, spawning, and nursery grounds include striped bass, white perch, American shad, alewife, blueback herring, rainbow smelt (*Osmerus mordax*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*) and American eel. Spawning and nursery timeframes for all of these species occur largely outside of the planned August to November jet plow embedment timeframe for this Project. Largemouth and smallmouth bass also utilize the tidal portions of Esopus Creek as overwintering habitat. The deepwater habitat and areas north and south (including Esopus Meadows) of the Esopus Creek mouth also serve as winter habitat for Atlantic and shortnose sturgeon. However, according to a letter from NOAA Protected Resources specific to this Project (NOAA 2013d), this area serves as overwintering habitat for shortnose sturgeon only.

Several mammal species are also reported to utilize the Esopus Estuary SCFWH, including bats, muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*). The tidal marshes and shallows also serve as resting and feeding grounds for American black duck, mallard, and other migratory waterfowl. These marshes also serve as nesting areas for American bittern and least bittern. Osprey (*Pandion haliaetus*) forage in the shallows near the mouth of Esopus Creek, primarily during spring migration (April through May); bald eagles and northern harriers have also been observed in the habitat area.

The fishery and wildlife resources within Esopus Estuary SCFWH support recreational use by kayakers, canoeists, birdwatchers, and waterfowl hunters. The area also supports a striped bass recreational fishery and several popular annual bass fishing tournaments (NYSDOS 2012).

The Flats

The Flats SCFWH is a 1,400-acre area of the Hudson River that extends from the east bank across most of the width of the river from RM 92.5 to RM 96.5; therefore, passage through this habitat can't be reasonably avoided. The proposed Project route passes through this SCFWH for 3.28 miles.

The Flats SCFWH comprises an area of shallow freshwater tidal flats as well as deepwater channel habitat. The shoals of this SCFWH support SAV beds dominated by water celery, which serve as feeding areas for waterfowl. Species that occur within this SCFWH include greater scaup, lesser scaup, common goldeneye, common merganser, hooded merganser, American black duck, mallard, and blue-winged teal.

The shallow flats, shoals, and sandbars within The Flats SCFWH serve as spawning grounds for American shad between March and June. The Flats also serve as spawning, nursery, and feeding habitat for striped bass and white perch between April and July. The fishery and waterfowl resources that occur in this SCFWH attract recreational use of the area by hunters and anglers from throughout the region (NYSDOS 2012).

Kingston-Poughkeepsie Deepwater

The Kingston-Poughkeepsie Deepwater SCFWH is a 6,350-acre section of deepwater habitat within the Hudson River from RM 66.0 to RM 91.75. Depths within this area generally range from 20 to 50 feet, with a small area that exceeds 125 feet. The proposed In-River Cable Route passes through this SCFWH for 23.03 non-contiguous miles, exiting and re-entering the habitat at different locations along the in-river route.

The Kingston-Poughkeepsie Deepwater SCFWH provides spawning and nursery habitat for Atlantic sturgeon between May and June, as well as overwintering habitat for shortnose sturgeon. This area is also part of the broad summer range occupied by juvenile and adult shortnose sturgeon. This deepwater section of the Hudson River also provides habitat for fourspine stickleback (*Apeltes quadracus*), hogchoker (*Trinectes maculatus*), killifish (*Fundulus diaphanous*), threespine stickleback (*Gasterosteus aculeatus*), white perch, bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), common carp (*Cyprinus carpio*), golden shiner (*Notemigonus crysoleucas*), largemouth bass, pumpkinseed (*Lepomis gibbosus*), smallmouth bass, spottail shiner (*Notropis hudsonius*), white catfish (*Ameiurus catus*), yellow perch (*Perca flavescens*), alewife, American eel, American shad, blueback herring, and striped bass, which in turn supports in-river and regional commercial and recreational fisheries throughout the North Atlantic.

In addition to fish habitat, the Kingston Poughkeepsie Deepwater SCFWH supports a diverse assemblage of waterfowl. These species include American black duck, mallard, blue-winged teal, green-winged teal, gadwall (*Anas strepera*), northern pintail (*Anas acuta*), common goldeneye, common merganser, red-breasted merganser (*Mergus serrator*), hooded merganser, greater scaup, lesser scaup, and wood duck. Blue crab (*Callinectes sapidus*) are also found in this habitat (NYSDOS 2012).

Hudson Highlands

The Hudson Highlands SCFWH is a 6,700-acre area of the main channel of the Hudson River from RM 44.0 to RM 55.75. Shallow areas within this SCFWH are host to SAV beds, dominated by water celery. It also includes the narrowest and deepest sections of the Hudson River, with depths of up to 200 feet, strong currents, and areas of rocky substrate. The southern landfall of the proposed Project route, as well as the proposed cofferdam construction location is located within this SCFWH. The proposed In-River Cable Route passes through this SCFWH for 17.95 miles.

The strong currents, rocky substrate, and location of this SCFWH within the transition zone of salty oceanic water mixing with freshwater runoff from the north creates favorable conditions as a spawning area for coastal migratory fishes, especially striped bass. The deepwater habitat also serves as migration routes for Atlantic sturgeon and shortnose sturgeon. Con Hook lies adjacent to this SCFWH and is also noted as an important area for Atlantic sturgeon (pers. comm. D. Rusanowsky (NOAA) and S. Herz (ESS)). Shortnose sturgeon juveniles and post-spawn adults also utilize the habitat as summering areas. In addition, several marine species including bluefish (*Pomatomus saltatrix*), anchovy, silversides, and blue crabs may move up through this area as the salt front moves north through the Hudson Highlands SCFWH.

As spawning ground and habitat for these fish species, the Hudson Highlands SCFWH helps support recreational fisheries throughout the Hudson River as well as commercial and recreational fishing off the coast of New York. A substantial wintering population of bald eagles utilizes this river area of abundant fishery resources as a food source from December through March (NYSDOS 2012).

Terrestrial Wildlife Management Areas and other Conservation Lands

According to available data and information, there are no other special Wildlife Management Areas or other significant conservation land holdings/special protection areas within the proposed project area established by the federal government, state or local governments, or private or non-profit entities exist along or in the vicinity of the Land Cable Route or Converter Stations.

Anadromous Fish Concentration Areas

Correspondence from the New York Natural Heritage Program dated April 15, 2013 (Appendix 4A) indicates that several Anadromous Fish Concentration Areas are present in the Hudson River along the In-River Cable Route. These areas are located in several portions of the Hudson River, including RM 44 to RM 56, Roeliff Jansen Kill (Columbia County), Stockport Creek (Columbia County), Rogers Island (Columbia and Greene Counties), Germantown Clermont Flats (Columbia, Greene, and Ulster Counties), Fishkill Creek Mouth (Dutchess County), Tivoli Bays (Dutchess County), Vanderburgh Cove (Dutchess County), Wappingers Creek Mouth (Dutchess County), Esopus Estuary (Dutchess and Ulster Counties), The Flats (Dutchess and Ulster

Counties), Moodna Creek Mouth (Orange County), Constitution Marsh (Orange County), Esopus Meadows (Ulster County), and Rondout Creek Mouth (Ulster County).

4.9.1.2 Threatened and Endangered Species

The United Stated Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), a bureau within the National Oceanic and Atmospheric Administration (NOAA), jointly administer the Endangered Species Act (ESA). The federal ESA protects species designated as federally threatened or endangered in the United States. USFWS administers the ESA with regard to terrestrial and freshwater species, while NOAA has primary responsibility for anadromous and marine fish/mammal species. The NYSDEC administers the New York State Endangered Species Act. Threatened, Endangered and Species of Concern are listed under 6 NYCRR Part 182.5. NYSDEC identifies rare, threatened, and endangered plant species under 6 NYCRR Part 193.3.

This section describes rare, threatened, and species of special concern that may occur in terrestrial or aquatic habitats along the Project route in this area of the Hudson River Valley. The potential presence of threatened, endangered, candidate and special concern species and/or habitats for these species were initially determined through a review of available publications and databases maintained by the NYSDEC and the USFWS. More detailed information was requested from the USFWS, NMFS, and NYSDEC for the presence of protected species and habitats along the Project route. Table 4.9-2 lists the endangered, threatened, and species of concern potentially occurring in or near the Project Area, based on agency correspondence. The table illustrates that the listed species are largely plants that potentially occur along and within Project area shorelines and shoal flats; and that in water fauna species are limited to the two sturgeon species.

The New York Natural Heritage Program (NYNHP) indicated in a letter dated April 15, 2013 (Appendix 4A) that seven listed animal species and 14 listed plant species have the potential to occur in or near the Project Area. A USFWS species list dated May 10, 2013 (Appendix 4A) indicated that four additional animal species and two additional plant species have the potential to occur in or near the Project Area (USFWS 2013). The NOAA NMFS Northeast Region Office identified two federally listed fish species (shortnose sturgeon and Atlantic sturgeon) likely to be present in or near the Project Area in a letter dated April 15, 2013 (Appendix 4A) (NOAA 2013d). Descriptions of the species identified through correspondence with these agencies as potentially occurring in or near the Project Area are provided in the following sections.

Table 4.9-2: Summary of Listed Species potentially occurring in or near the Project Area*

Common Name	Scientific Name	Federal Status	State Status
Fish			
Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered	Endangered
Atlantic Sturgeon	*A. oxyrinchus*	Endangered (New York Bight Distinct Population Segment)	No Open Season
Birds			
Least Bittern (Breeding)	*Ixobrychus exilis*	Unlisted	Threatened
Pied-billed Grebe (Breeding)	*Podilymbus podiceps*	Unlisted	Threatened
King Rail (Breeding)	*Rallus elegans*	Unlisted	Threatened

Common Name	Scientific Name	Federal Status	State Status
Bald Eagle (Breeding and non-breeding)	*Haliaeetus leucocephalus*	Unlisted	Threatened
Peregrine Falcon (Breeding)	*Falco peregrinus*	Unlisted	Endangered
Mammals			
Indiana Bat	*Myotis sodalis*	Endangered	Endangered
New England Cottontail	*Sylvilagus transitionalis*	Candidate	Special Concern
Other Aquatic Species			
Bog Turtle	*Clemmys* [=*Glyptemys*] *muhlenbergii*	Threatened	Endangered
Dwarf Wedgemussel	*Alasmidonta heterodon*	Endangered	Endangered
Plants			
Spongy Arrowhead	*Sagittaria montevidensis* var. *spongiosa*	Unlisted	Threatened
Heartleaf Plantain	*Plantago cordata*	Unlisted	Rare
Golden Club	*Orontium aquaticum*	Unlisted	Threatened
Delmarva Beggar-ticks	*Bidens bidentoides*	Unlisted	Rare
Smooth Bur-marigold	*Bidens laevis*	Unlisted	Threatened
Northern Estuary Beggar-ticks	*Bidens hyperborea* var. *hyperborea*	Unlisted	Endangered
Long's Bittercress	*Cardamine longii*	Unlisted	Threatened
Narrow-leaved Sedge	*Carex amphibola*	Unlisted	Endangered
Davis' Sedge	*Carex davisii*	Unlisted	Threatened
Southern Dodder	*Cuscuta obtusiflora* var. *glandulosa*	Unlisted	Endangered
Water Pigmyweed	*Crassula aquatic*	Unlisted	Endangered
Gypsy-wort	*Lycopus rubellus*	Unlisted	Endangered
Terrestrial Starwort	*Callitriche terrestris*	Unlisted	Threatened
Saltmarsh Aster	*Symphiotrichum subulatum* var. *subulatum*	Unlisted	Threatened
Northern Wild Monkshood	*Aconitum noveboracense*	Threatened	Endangered
Small Whorled Pogonia	*Isotria medeoloides*	Threatened	Endangered

*Based on Project-specific correspondence with NYSDEC, NOAA, and USFWS

Fish Species

Shortnose Sturgeon (Acipenser brevirostrum)

The shortnose sturgeon is a federally and New York State-listed endangered species. The geographic range of this species is restricted to the large rivers and estuaries along the Atlantic seaboard in North America (NOAA 2013b). In New York State, the presence of shortnose sturgeon is limited to the lower portion of the Hudson River from RM 0 to the Troy Dam at RM 152, which is more heavily influenced by tidal flow and estuarine circulation (Stegemann 1994). During the winter months, adults tend to concentrate in a few deepwater overwintering areas, the largest occurring south of Kingston, New York (RM 86-94), near Esopus Meadows. Shortnose sturgeon overwintering near Esopus Meadows are primarily spawning adults, whereas prespawning adults tend to overwinter in sites further downstream in the Croton-Haverstraw Bay area (RM 33-38). Movement during the overwintering period is localized and fairly sedentary. Between late March and early April adults migrate from these brackish downstream overwintering sites upstream to freshwater spawning grounds north of Coeymans, New York (RM 132) (Dovel et al. 1992).

Shortnose sturgeon spawning generally occurs between late April and May, from Coeymans, New York to the Troy Dam (RM 131 to 152), which is well north of the In-River Cable Route. After spawning, the adults disperse quickly downstream into their summer range. The summer range of adult Hudson River shortnose sturgeon is relatively broad, stretching from approximately RM 24 to RM 109 and containing the majority of the Cable Route. Shortnose sturgeon males spawn every other year, while females spawn every third year. The eggs and larvae are demersal and adhesive, and generally remain in the vicinity of the spawning grounds for up to four weeks post spawning. By mid-June the eggs have hatched and developing larvae and juveniles drift downriver as they grow (Stegemann 1994, NOAA 2013b). Juveniles have a broad summer range, similar to adults, and tend to concentrate south of the Project Area in the Haverstraw Bay region (RM 33 to 38) from the late fall through winter (Geoghehan et al. 1992). Seasonal presence of this species in the Hudson River Estuary is summarized by life stage in Table 4.9-3.

Several factors have led to the decline and consequent listing of shortnose sturgeon populations as an endangered species under the ESA. Habitat loss due to construction of dams has limited the shortnose sturgeon's access to suitable spawning grounds within the Hudson River, and habitat degradation through the dumping of pollutants generated by coastal land users in and around the river has also contributed to their decline. In addition, eggs and larvae of the shortnose sturgeon have been reported to be caught in electrical power generation plant cooling systems along the river, or disturbed from time to time by navigation channel maintenance dredging by the federal government, all contributing to reducing the reproductive success of the species. Prior to federal protection of the species in 1967, shortnose sturgeon were overexploited as a commercial fishery for their highly prized eggs (caviar) and flesh. Recent studies suggest the Hudson River population of this species has largely recovered from its population decline (Bain et al. 2007); however, federal and state protections still remain in place.

Atlantic Sturgeon (*Acipenser oxyrinchus*)

Atlantic sturgeon is a federally listed endangered species, but has not been listed in the state of New York. They are the largest sized sturgeon species occurring in New York waters, occasionally reported to reach up to six to eight feet in length and over 200 pounds in weight in the Hudson River. The spawning population of Atlantic sturgeon in the Hudson River represents the New York Bight distinct population segment (DPS), which is the smallest division of a species permitted to be protected under the ESA. In addition to the spawning individuals from the New York DPS, adult and subadult Atlantic sturgeon from other DPSs are known to utilize the lower portions of the Hudson River, where the salinity is greater than 0.5 ppt (RM 0 to RM 67), which overlaps with approximately 25 miles of the In-River Cable Route.

Atlantic sturgeon are anadromous fish, that migrate from oceanic, coastal, or estuarine overwintering areas upstream into freshwater rivers to spawn. Atlantic sturgeon adults are likely to migrate through the Project area in the spring as they move from oceanic overwintering grounds to spawning sites, and then migrate back through the area as they move to lower reaches of the estuary in the late spring and early summer. In general, Atlantic sturgeon adults are most likely to occur in the project area from May – September (NOAA 2013c).

In the Hudson River, spawning typically begins between April and May. There are several well-known Atlantic sturgeon spawning areas within the Hudson River, typically in deepwater habitat where the cold, clean water likely supports healthy larval development (NOAA 2013c). Two particular areas along the In-River Cable Route have been identified as spawning sites, the areas around Hyde Park (RM 83) and Clinton Point (RM 69) (Bain et al. 2000). This spawning time of year sensitivity has been taken into consideration in scheduling Project in-water activities in order to minimize and avoid potential project impacts to this protected species.

Post-spawning adult females typically return to the open ocean within four to six weeks after spawning, whereas post-spawn adult males may remain in downstream brackish portions of the river until fall. Atlantic sturgeon larvae have a low salinity tolerance and remain in more freshwater before moving downstream toward more brackish waters as juveniles. Immature sturgeon (age 1+) are known to concentrate in Newburgh (RM 61) and Haverstraw Bay (RM 36) (Sweka et al. 2007). More generally, they tend to occupy clay, sand, and silt-bottomed habitat between RM 37 and RM 66 during the summer, moving downstream between RM 12 and RM 46 in winter. After approximately three years, juvenile Atlantic sturgeon exceeding 70 cm total length begin migrating out of the river into the coastal habitat (Bain et al. 2000, NOAA 2013c). Seasonal presence of this species in the Hudson River Estuary is summarized by life stage in Table 4.9-3.

Atlantic sturgeon populations within the Hudson River have declined from historical numbers mainly due to habitat loss from dam construction and other river modifications as well as over-harvesting. Since the closing of the fishery in the mid-1990s, there have been few comprehensive surveys to assess the recovery of the stocks in the Hudson (NOAA 2013c).

Table 4.9-3: Seasonality of Listed Sturgeon Species Life Stages that Occur in the Hudson River Estuary

	Early Life Stages		Older Life Stages	
	Eggs	Larvae	Juveniles	Adults
Atlantic sturgeon	May – August		Year-round	May – September[a]
Shortnose sturgeon	April – June		Year-round	

All life stages for these species are benthic
[a] Atlantic sturgeon adult females leave the river 4-6 weeks after spawning, however males may remain until fall.

Wildlife

Avifauna

Least Bittern (*Ixobrychus exilis*)

Least bitterns, a small species of wading bird, potentially occur in all of the eight counties along the proposed Project route, and are present in the state of New York from early April to late October (NYNHP 2011). Breeding sites for this species along the proposed Project Route are known to occur at Brandow Point (Greene County) and Inbocht Bay (Greene County) (NYSDEC 2013a). The breeding period is from early May to late July. Breeding habitat includes shallow or deep emergent marshes and freshwater tidal marshes, with cattails, bulrush, bur-reed, sedges, and/or common reed. Cattail marshes with some open pools, slow-moving channels, and some woody vegetation are preferred. Open habitats, such as mats of emergent vegetation, typically provide poor habitat for least bitterns. Ecological communities associated with this species include: brackish tidal marsh, deep emergent marsh, freshwater tidal marsh, and shallow emergent marsh. This species is listed as threatened by the State of New York (NYNHP 2011).

Pied-billed Grebe (*Podilymbus podiceps*)

Pied-billed grebes are a small waterbird species that can be found state-wide during the breeding season (NYNHP 2011). Breeding areas for this species along the proposed route are known to occur at Denning Point Cove (Dutchess County) (NYSDEC 2013a). Habitat types include quiet marshes, marshy shorelines of ponds, and marshy bays. Areas with a nearly even mixture of open water and emergent vegetation are ideal. Pied-billed grebes are rarely found in areas with dense emergent vegetation, or in brackish marshes. Ecological communities associated with pied-billed grebes are: backwater slough, deep emergent marsh, impounded marsh, marsh headwater stream, shallow emergent marsh, and shrub swamp. This species is listed as threatened by the State of New York (NYNHP 2011).

King Rail (*Rallus elegans*)

King rails, a secretive marsh bird, are present in the state year-round (NYNHP 2011). Along the proposed Project Route, this species is known to breed at Tivoli Bays (Dutchess County) (NYSDEC 2013a). Breeding season habitat includes fairly shallow (0-25 cm) fresh and brackish marshes with well-developed areas of emergent vegetation. Winter habitat includes coastal salt marshes in the lower Hudson River valley and around Long Island. Ecological communities associated with king rails are: freshwater intertidal mudflats, freshwater intertidal shore, freshwater tidal marsh, freshwater tidal swamp, inland salt marsh, shallow emergent marsh, and tidal river. This species is listed as threatened by the State of New York (NYNHP 2011).

Bald Eagle (*Haliaeetus leucocephalus*)

Bald eagles are a large bird of prey that ranges throughout North America and can primarily be found in undisturbed areas near large bodies of waters. Their primary food is fish, which are taken from lakes, rivers, and marshes. Nest sites are typically located along large water bodies, and are re-used annually. Bald eagles can be found in New York State year-round, and may congregate at hydro-electric plants during the winter (Nye 2010). The breeding season can begin with nest-building as early as early December, and ends with fledging of chicks as late as late August (USFWS 2007a). The species was once nearly extirpated from the state due to interactions with pesticides and heavy metals. Re-introduction and captive-rearing programs have re-established bald eagles in New York, and their population is now growing (NYSDEC 2012).

Bald eagles occur in all of the eight counties along the proposed Project route: Greene, Colombia, Ulster, Dutchess, Orange, Putnam, Rockland, and Westchester Counties (USFWS 2012a). The Second New York State Breeding Bird Atlas confirmed bald eagle nests along the proposed route in the Hudson River (NYSDEC 2012). Along the proposed Project Route, bald eagle breeding habitat exists at Stewart Island (Columbia and Greene Counties) and Tivoli Bays Cruger Island (Dutchess County), while non-breeding habitat exists at Fishkill Creek Mouth (Dutchess County), Moodna Creek Mouth (Orange County), Cedar Cliff (Orange and Ulster Counties), Constitution Island (Putnam County), and Iona Island (Rockland and Westchester Counties) (NYSDEC 2013a). Bald eagles are not anticipated to occur along the Land Cable Route or Converter Stations. While no longer federally listed under the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), bald eagles are federally protected under the Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. 668-668c) and the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712). These laws prohibit the “take” of bald eagles, their parts, nests, or eggs, wherein “take” is defined as any action that may cause disturbance or harm (USFWS 2007a). This species is also listed as threatened by the State of New York (NYSDEC 2013).

Peregrine Falcon (*Falco peregrinus*)

Peregrine falcons are a medium-sized bird of prey that are present along the proposed Project route year-round (NYNHP 2011). Breeding habitat for peregrine falcons along the Transmission Cable System is known to occur at the Mid-Hudson Bridge (Dutchess County), the Newburgh-Beacon Bridge (Dutchess County), the Rip Van Winkle Bridge (Greene County), and the Bear Mountain Bridge (Rockland and Westchester Counties) (NYSDEC 2013a), This species nests on ledges and rocky cliffs, as well as on manmade structures such as bridges, buildings, and towers. The breeding period is from early March to mid-July. This species is listed as endangered by the State of New York (NYNHP 2011).

Mammals

Indiana Bat (*Myotis sodalis*)

The range of the Indiana bat (*Myotis sodalis*) extends throughout eastern New York State, where nursing sites occur along forested streams and lakes. During the summer months, Indiana bats occur in all of the eight counties along the proposed Project route: Greene, Columbia, Ulster, Dutchess, Orange, Putnam, Rockland, and Westchester Counties (USFWS 2012b). Additionally, four of the ten known Indiana bat hibernacula in New York are located in Ulster County (NYNHP 2011).

In late summer, Indiana bats congregate at caves and mines to breed. These same locations may serve as hibernacula during the winter, where Indiana bats may form very dense colonies. The spring range can extend beyond the hibernacula by hundreds of miles. Indiana bats prefer to forage for insects along streams, floodplains, and over ponds and reservoirs. They will also forage over forests, early successional areas, and pastures (USFWS 2010). This species is listed as endangered by the federal government and the State of New York (NYSDEC 2012c, USFWS 2012a).

Indiana bats are sensitive to habitat loss, including loss of summer roosting habitat, which is characterized by trees or snags with loose bark, cracks, and crevices (USFWS 2012b), loss of maternity habitat, or loss of swarming habitat (USFWS 2011). This species is most susceptible to disturbance during winter hibernation, and is especially sensitive due to the spread of white-nose syndrome, a highly infectious condition which is causing steep declines in bat populations throughout the northeastern United States (NYSDEC 2012d).

However, Indiana bats are not known to occur in the towns of Athens or Cortlandt where the Land Cable and Converter Stations are proposed (NYSDEC 2012a, NYSDEC 2012b, NYSDEC 2013a).

New England Cottontail (*Sylvilagus transitionalis*)

The range of the New England cottontail rabbit in New York extends along the east bank of the Hudson River in the southeastern part of the state (NYSDEC 2012e). New England cottontails occur in the four counties along the east bank of the Hudson River along the proposed Project route: Columbia, Dutchess, Putnam, and Westchester Counties (USFWS 2012a).

New England cottontails are not known to occur in the Towns of Athens or Cortlandt (NYSDEC 2012a, NYSDEC 2012b, NYSDEC 2013a), the locations of the Land Cable Routes and the Converter Stations.

Other Freshwater Aquatic Species

Bog Turtle (*Clemmys [=Glyptemys] muhlenbergii*)

In New York, bog turtles are found in the southeastern portion of the state, as well as along Lake Erie. Bog turtles emerge from hibernation in the spring to breed, and nests of up to four eggs are laid in June. Eggs hatch in September, and hatchlings often over-winter in the nest, while adults return to an over-wintering location, commonly an abandoned muskrat lodge, by October. Bog turtles are semi-aquatic and prefer cool, shallow-water habitats such as wet meadows and bogs dominated by sedges (*Carex* sp.) or *Sphagnum* moss. This species is highly secretive and is typically seen while basking in early spring. Bog turtles are listed as threatened by the federal government and as endangered by the State of New York (NYSDEC 2012f).

Bog turtles occur in seven counties along the proposed Project route: Columbia, Ulster, Dutchess, Orange, Putnam, Rockland, and Westchester Counties (USFWS 2012a). Most of the proposed Project Route runs through the State-defined focus area of the USFWS Hudson/Housatonic Bog Turtle Recovery Unit (NYSDEC 2012g). Habitat potentially suitable for bog turtles may exist in the wetlands along the Northern and Southern Land Transmission Cable Routes.

Bog turtles are not known to occur in the Towns of Athens or Cortlandt (NYSDEC 2012a, NYSDEC 2012b, NYSDEC 2013a).

Dwarf Wedgemussel (*Alasmidonta heterodon*)

The dwarf wedgemussel is a small, freshwater mussel that grows up to 1.5 inches in length. This species may be found in any fresh running water body, including large rivers. Preferred bottom substrates are silt, sand, and gravel, though even small patches of these substrate types, interspersed among cobble or boulders, are sufficient. Water with low levels of calcium are preferred, or at least tolerated. The largest population in the State of New York is in the lower Neversink River, in Orange County (NYSDEC 2012h).

Dwarf wedgemussels occur in two counties along the proposed Project route: Dutchess and Orange Counties (USFWS 2012a). This species is listed as endangered by both the federal government and the State of New York. Within Dutchess and Orange Counties, this species inhabits the Delaware River watershed, in the Delaware River and the Neversink River (NYNHP 2011).

This species is not known to occur within the Hudson River, and therefore its range does not coincide with the In-River Cable Route (NYSDEC 2013a).

Plants

Spongy Arrowhead (*Sagittaria montevidensis var. spongiosa*)

Spongy arrowhead is known to occur along the Cable Route at Iona Island (Rockland County See Figure 4-9-1). Spongy arrowhead can be found growing in freshwater and brackish intertidal mudflats, and may also occur in freshwater and brackish tidal marshes. Ecological communities associated with spongy arrowhead are: brackish intertidal mudflats, brackish tidal marsh, freshwater intertidal mudflats, and freshwater tidal marsh. There are approximately twenty known extant populations of this species in the state of New York, seven of which have 100 or fewer individuals. The flowering period of spongy arrowhead is from mid-August to late September, and the fruiting period is from early to late September. This species is listed as threatened by the State of New York (NYNHP 2011).

Heartleaf Plantain (*Plantago cordata*)

Heartleaf plantain is known to occur along the Cable Route at Rogers Island (Columbia County), Tivoli Bays Cruger Island (Dutchess County), Brandow Point (Greene County), Inbocht Bay (Greene County), Middle Ground Flats (Greene County), Murder's Creek Mouth (Greene County), Smith's Landing Cementon (Greene County), Ulster Landing (Ulster County), Saugerties Marsh (Ulster County), Roeliff Jansen Kill (Columbia County), and Greendale (Columbia County) (NYSDEC 2013a). In the Hudson River valley, heartleaf plantain grows along the edges of freshwater intertidal mudflats, sandy or rocky shorelines of tidal creeks, edges of freshwater tidal marshes, and gravelly shores along the freshwater tidal portions of the Hudson River. Ecological communities associated with heartleaf plantain are: freshwater intertidal mudflats, freshwater intertidal shore, freshwater intertidal creek, freshwater intertidal marsh, marsh headwater stream, and red maple – hardwood swamp. While historical records confirm that heartleaf plantain once ranged south to New York City, there are likely no extant populations south of the mouth of Rondout Creek, Ulster County. There are approximately 30 known extant populations of heartleaf plantain along the Hudson River. Many of these populations are comprised of less than forty individuals, however at least three populations contain over 1,000 individuals. The flowering period of heartleaf plantain is from early April to mid-June. The fruiting period is from early June to mid-October. Surveys are most likely to be successful from mid-May to early October. This species is listed as rare by the State of New York (NYNHP 2011).

Golden Club (*Orontium aquaticum*)

Golden club is known to occur along the Cable Route at Tivoli Bays (Dutchess County), Roeliff Jansen Kill (Columbia County), Rogers Island (Columbia County), Greene Point (Greene County) (NYSDEC 2013a). This species inhabits freshwater tidal marshes, shores, and mudflats, as well as *Sphagnum* bogs, poor fens, and coastal plain ponds. Ecological communities associated with golden club are: coastal plain pond, freshwater intertidal mudflats, freshwater intertidal shore, freshwater tidal creek, freshwater tidal marsh, and inland poor fen. There are approximately 13 known populations in the state of New York. The flowering period of golden club is from mid-April to late June, and the fruiting period is from early July to mid-October. This species is listed as threatened by the State of New York (NYNHP 2011).

Delmarva Beggar-ticks (*Bidens bidentoides*)

Delmarva beggar-ticks is an annual herb found in freshwater intertidal mudflats and freshwater tidal marshes along the Hudson River in New York State. This plant often grows near the boundary between tidal marshes and mudflats. Delmarva beggar-ticks are known to be present in approximately two dozen sites along the shoreline of the Hudson River, and many historical populations continue to persist. The overall population of the species in the state appears to be relatively stable, with several new populations discovered in the past three decades (NYNHP 2013). Populations of this plant along the Cable Route are known from Rogers Island (Columbia County), Tivoli Bays Cruger Island (Dutchess County), Brandow Point (Greene County), Catskill Marsh (Greene County), Inbocht Bay (Greene County), Middle Ground Flats (Greene County), Murderers Creek Mouth (Greene County), Bristol Beach (Ulster County), and Rondout Creek Mouth (Ulster County) (NYSDEC 2013a). The flowering period of Delmarva beggar-ticks is from late August to mid-October, and the fruiting period is from late September to mid-October. In New York State this species is listed as rare (NYNHP 2011).

Smooth Bur-Marigold (*Bidens laevis*)

Smooth bur-marigold is known to occur along the Cable Route at Rogers Island (Columbia County) and Middle Ground Flats (Greene County) (NYSDEC 2013a). Smooth bur-marigold typically grows in freshwater and brackish tidal mudflats and tidal marshes. Ecological communities associated with smooth bur-marigold are: brackish intertidal mudflats, brackish intertidal shore, brackish tidal marsh, freshwater intertidal marsh, freshwater tidal marsh, and shallow emergent marsh. There are approximately ten known extant populations of this species along the Hudson River. The flowering period of smooth bur-marigold is from mid-August to late September. The fruiting period is from mid-September to mid-October. This species is listed as threatened by the State of New York (NYNHP 2011).

Northern Estuary Beggar-ticks (*Bidens hyperborea* var*. hyperborea*)

Northern estuary beggar-ticks is known to occur along the Cable Route at Tivoli Bays Cruger Island (Dutchess County) (NYSDEC 2013a). This species grows in tidal shores and mudflats. Ecological communities associated with northern estuary beggar-ticks are: freshwater intertidal mudflats and freshwater tidal marsh. There are approximately three known extant populations of northern estuary beggar-ticks in the State of New York. One of these was a re-discovered historical population, and the other two are new populations discovered since 1985. The flowering period of northern estuary beggar-ticks is from early to late September, and the fruiting period is from mid-September to mid-October. This species is listed as endangered by the State of New York (NYNHP 2011).

Long's Bittercress (*Cardamine longii*)

Long's bittercress is known to occur along the Cable Route at Greendale (Columbia County), Rogers Island (Columbia County), Hudson River Athens (Greene County), Inbocht Bay (Greene County), Constitution Island (Putnam County), and Iona Island (Rockland County) (NYSDEC 2013a). This species inhabits shaded areas of tidal swamps, mudflats, and muddy banks along tidal creeks. Ecological communities associated with Long's bittercress are: brackish intertidal mudflats, brackish intertidal shore, brackish tidal marsh, freshwater intertidal mudflats, freshwater intertidal shore, freshwater tidal marsh, freshwater tidal swamp, red maple – hardwood swamp, and saltwater tidal creek. There are approximately nine known populations along the Hudson River. The flowering period of Long's bittercress is from mid-May to late June, and the fruiting period is from early June to mid-October. This species is listed as threatened by the State of New York (NYNHP 2011).

Narrow-leaved Sedge (*Carex amphibola*)

Narrow-leaved sedge, a state-listed endangered species, is an herbaceous plant species that occupies a wide range of habitat types in New York State. This plant is primarily found in upland habitats such as mesic deciduous forests; slopes above streams, tidal marshes, or mudflats; and meadows. It may also be found in wetland habitats such as swales or floodplain forests (NYNHP 2011). Narrow-leaved sedge is known to occur along the Cable Route at Astor Point (Dutchess County) (NYSDEC 2013a). There are two known populations of this species in New York and 10 historical records, although historical records of this species may be inaccurate due to confusion with similar species. The fruiting period is from early June to mid-July (NYNHP 2011).

Davis' Sedge (*Carex davisii*)

Davis' sedge is known to occur along the Cable Route at Astor Point (Dutchess County) and Denning Point (Dutchess County) (NYSDEC 2013a). Habitat types include open gravel bars of large rivers, wet meadows and forests, stream sides, ditches, rich deciduous forests, and disturbed areas. Ecological communities associated with Davis' sedge are floodplain forest, limestone woodland, maple-basswood rich mesic forest, shallow emergent marsh, and unpaved road/path. This species is known to occur at Rogers Island, Columbia County. There are approximately 12 known extant populations of Davis' sedge in the state of New York, most of which occur along the Hudson River. This species is listed as threatened by the State of New York (NYNHP 2011).

Southern Dodder (Cuscuta *obtusiflora var. glandulosa*)

Southern dodder is known to occur along the Cable Route at Inbocht Bay (Greene County) (NYSDEC 2013a). Southern dodder can be found swamps and marshes. The ecological community associated with southern dodder is: freshwater tidal marsh. This species was discovered in New York State in 1996, and there are currently five known populations in the state. This species is listed as endangered by the State of New York (NYNHP 2011).

Water Pigmyweed (*Crassula aquatica*)

Water pigmyweed is known to occur along the Cable Route at Constitution Island (Putnam County) (NYSDEC 2013a). Habitat types associated with water pigmyweed include freshwater intertidal mudflats, freshwater intertidal shore, freshwater tidal marsh, and riverine submerged structure. There are approximately three known populations in the State of New York. This species is listed as endangered by the State of New York (NYNHP 2011).

Gypsy-wort (*Lycopus rubellus*)

Gypsy-wort is known to occur along the Cable Route at Constitution Island (Putnam County). Habitat types of gypsy-wort include shallow emergent marshes, medium fens, and riprap/artificial shores. There are approximately five known populations in the state of New York. Gypsy-wort is listed as endangered by the State of New York (NYNHP 2011).

Terrestrial Starwort (*Callitriche terrestris*)

Terrestrial starwort is known to occur along the Cable Route at Dunderberg Mountain Base (Rockland County) (NYSDEC 2013a). Habitat types associated with terrestrial starwort include brackish tidal marshes, freshwater intertidal mudflats, and red maple swamps. There are approximately ten known populations of terrestrial starwort in the State of New York. This species is listed as threatened by the State of New York (NYNHP 2011).

Saltmarsh Aster (*Symphiotrichum subulatum var. subulatum*)

Saltmarsh aster is an annual herb that occurs in salt-influenced habitats such as salt to brackish marshes, tidal channels, and edges of salt ponds. In the Project Area, saltmarsh aster is known to occur at Iona Island (Rockland County) (NYSDEC 2013a). Currently, 13 populations are known to exist in New York. Habitat loss and competition with non-native *Phragmites* are considered the primary threats to the species. This plant is listed as a threatened species by the State of New York (NYNHP 2011).

Northern Wild Monkshood (*Aconitum noveboracense*)

Northern wild monkshood is a perennial, herbaceous, flowering plant found on shaded cliffs and cool stream sides with cool soil conditions, cold air drainage, or cold groundwater flowage (NYSDEC 2012i, USFWS 2007b). In New York, northern wild monkshood is found in the southern part of the state to the west of the Hudson River, and in the counties that border New Jersey and northeastern Pennsylvania (USDA 2012). Northern wild monkshood occurs in one county along the proposed route: Ulster County (USFWS 2012a). This species is listed as threatened by both the federal government and the State of New York (USDA 2012). Northern wild monkshood is not known to occur in the Project Area in Greene or Westchester Counties (NYSDEC 2013a, USFWS 2012a).

Small Whorled Pogonia (*Isotria medeoloides*)

Small whorled pogonia, a member of the orchid family, is an herbaceous, perennial, flowering plant that grows to between 10 and 14 inches in height. The habitat of this species is comprised of old-growth hardwood forests with little understory and acidic soils (USFWS 2008). In New York, small whorled pogonia exists only in a few, mainly non-contiguous, counties throughout the state. Small whorled pogonia occurs in three counties along the proposed Project area: Ulster, Orange, and Rockland Counties (USFWS 2012a). This species is listed as threatened by the federal government and as endangered by the State of New York (USDA 2012). Small whorled pogonia is not known to occur in the Project Area in Greene or Westchester Counties (NYSDEC 2013a, USFWS 2012a).

4.9.2 Environmental Impacts and Mitigation

4.9.2.1 Important Habitats

Important Bird Areas

The In-River Cable Route does not pass through the Stockport Flats IBA, and is located on the opposite bank of the Hudson River. The In-River Cable Route is also separated from the Stockport Flats IBA by the Middle Ground Flats, a forested island located in the middle of the river. Therefore, any work activities associated with the installation of the In-River Cable are not anticipated to result in adverse effects to this IBA.

The In-River Cable Route passes through or adjacent to the Tivoli Bays, Constitution Marsh Sanctuary, Doodletown and Iona Island, and Lower Hudson River IBAs. Where IBAs are crossed, the benthic habitat of the River will be very locally and temporarily impacted by the jet plow methods used to install the In-River Cable. The In-River Cable Route has been aligned to avoid crossing any mapped SAV beds in these IBAs, therefore impacts, if any, to this habitat are not expected. (For a more detailed discussion of potential Project impacts to SAV, see Section 4.8.2.1). Similarly, continuous operation of the cables once installed beneath the riverbed and energized is not expected to have any impact on adjacent IBAs.

National Estuarine Research Reserves

The In-River Cable Route does not pass directly through any portion of the Hudson River NERR, though it runs adjacent to the Tivoli Bays and Iona Island NERR areas. Construction-related impacts to these wetland and aquatic habitat areas will be negligible, if any. The jet plow embedment technique used for cable installation will create a localized and temporary increase in suspended sediments within a very narrow zone on the riverbed which is not expected to have any adverse impacts on adjacent NERR coastal habitat areas. Similarly, continuous operation of the cables once installed beneath the riverbed and energized is not expected to have any impact on adjacent NERR areas.

Significant Coastal Fish and Wildlife Habitats

The In-River Transmission Cable Route passes through seven regions designated as SCFWH. These areas, from north to south, are the Vosburgh Swamp and Middle Ground Flats, Catskill Deepwater, Germantown-Clermont Flats, Esopus Estuary, The Flats, Kingston-Poughkeepsie Deepwater, and Hudson Highlands. The NYS Coastal Policies state that proposed actions occurring within or adjacent to designated SCFWHs shall not be undertaken if such actions destroy or significantly impair the viability of an area as a habitat. When an action has the potential to impair the viability of a designated habitat, that action would only be permitted when the following criteria have been met:

- No reasonable alternative exists;
- The action taken will minimize all adverse effects to the maximum extent practicable;
- The action will advance one or more of the coastal policies; and
- The action will result in an overriding regional or statewide public benefit.

Potential impacts to SCFWH areas include: a) temporary disturbance-related impacts associated with the installation of the cables, including increased turbidity, re-suspension of sediment, and direct physical disturbance to bottom substrates, and b) operational impacts associated with ongoing use and maintenance of the transmission system including thermal and magnetic fields surrounding the cables. The preferred In-River Cable Route minimizes adverse affects to SCFWHs by being placed in the deeper water areas that are less productive and do not support the diversity of fish, wildlife and avifauna compared to the shallow water areas of these habitats. Additionally, mitigating measures have been incorporated into the design to minimize or eliminate impacts to SCFWHs including the use of HDD at the transitions from land to in-river configurations to minimize disturbance to shoreline and nearshore coastal fish and wildlife habitats; and the use of construction/installation windows to avoid particularly sensitive times of year for species of concern that utilize the SCFWHs. Potential project-specific impacts to these areas are summarized below and described in detail in Appendix 4F.

Disturbance to the benthic habitat will be localized within the footprint of the jet plow and pre-installation grapnel run, which will occur along the same linear route. Sediment suspension and subsequent sediment deposition in the surrounding near-field of the jetting operations will be temporary and negligible compared to natural sediment transport and deposition in this section of the river-estuary at certain times of the year. Based on past experience in the river for similar projects, very little if any fish mortality has been observed or documented as a result of jet plowing activities simply because of their apparent natural avoidance of the jetting operation. Hence, most mobile fish species that are in the area during construction will avoid the work zone area, and either move up- or downriver from the activity or move to other nearby habitat or foraging areas. The avoidance behavior likely exhibited by fish during the construction period will be similar to the behavior exhibited when large ships pass, which occurs on a regular basis in the Hudson River.

Benthic resources (bottom dwelling invertebrate worms, SAV, etc.) as described in Section 4.7 are relatively sedentary in location and do not move as rapidly or as expansively as more motile fish or shellfish. These benthic resources, typically more abundant on the river-estuary's flanking shoals adjacent to the deeper channels, may be directly impacted by jet plow operations in the near field of the trench cut. Those benthos that are in the direct path of the jet plow incision in the riverbed will likely not survive. Those benthos that are immediately adjacent to the trench cut, within approximately 200 feet, will experience rapid sedimentation of the jetted sediments, which may temporarily inhibit their growth or availability as a food source to fish, but are expected to survive and recolonize as this is the nature of this river-estuary that they have adapted to. Multiple studies, as well as post installation monitoring of benthos recovery after jet plow operations, have shown that these benthic invertebrate communities are capable of rapid recolonization after such disturbances, resulting in limited impact to the benthos and benthic prey for fishes (Van Dolah et al. 1984, McCabe et al. 1998, Guerra-Garcia et al. 2003, Schaffner 2010).

Jet plow and support vessel related noise, some nighttime shipboard operations lighting, and the periodic movement of support vessels and equipment may result in a very temporary impact (avoidance) on the usual behavior of some fish near this moving work area. However, there has not been any documented fish mortality during nighttime jetting operations where fish may be attracted to surface lights to some degree, because noise and near-field turbidity likely kept them from investigating the light sources. Waterfowl and other wildlife utilizing these SCFWH areas, either at or above the surface of the river, will also naturally avoid the vicinity of the work zone, in a manner similar to a vessel moving up or down the river which happens every day. These effects on habitat utilization and food source are temporary in any certain area and any disturbed species have been found to return to their local habitat once construction has completed.

Both the Northern and Southern Landfalls are located in areas designated as SCFWH; the Northern Landfall is located within the Vosburgh Swamp and Middle Ground Flats SCFWH, while the Southern Landfall is located within the Hudson Highlands SCFWH. Construction-related impacts to these SCFWH will include very limited impacts from the temporary cofferdam construction, dredging, and HDD activities; by design these methods have been incorporated into the Project's work plan due to their low impact characteristics which have been well proven in similar projects on the Hudson River and Upper New York Bay. Upon completion of the HDD and jet plow embedment of the In-River Cable, the temporary cofferdams will be removed from the riverbed, and the bottom sediments will be backfilled with clean sand to match pre-construction depth contours and elevations.

Potential post-installation impacts from the daily operation of the In-River Transmission Cable, once energized, will be minimal due to the fact that the cable system will be armored and buried beneath the riverbed. Because the cable will either be buried a minimum of 8 feet below present bottom along the majority of the route or armored by low profile (< 1 foot) concrete mattresses at select crossings coinciding with chartered cables/pipelines, the presence of the cable will not create a physical riverbed surface or water column barrier that could interfere with natural tidal circulation, sedimentation, fish migration, or the use of existing habitats or spawning areas.

The operating cable system will not impose any appreciable thermal impacts on the riverbed due to its burial depth. There will also be no adverse impacts to invertebrate or fish from operation of the cable. The In-River Transmission Cable will generate a limited amount of heat that will dissipate into the sediment surrounding the cable. The sediment temperature at 10 cm (4 inches) below the river bottom is expected to increase less than 1° Celsius during operation of the In-River Transmission Cable. The temperatures of the sediment at the river bottom (sediment-water interface) and within the water column above the river bottom are expected to remain unchanged by the operation of the In-River Transmission Cable.

Operation of the In-River Transmission Cable will generate an electromagnetic field (EMF). The electric field will be eliminated by the placement of a metal sheath around the cable. The magnetic field can't be eliminated, but can be minimized via burial of the cable. The magnetic field will be strongest directly over the cable and decreases rapidly with vertical and horizontal distance. The maximum calculated magnetic field on the river bottom, resulting from operation of the in-river portion of the cable, will be 88 mG, while the field calculated at the surface of the water column will be 7.2 mG, both of which are very minor compared to the Earth's geomagnetic field, which ranges from 300 to 700 mG. Species of fish or invertebrates that live, feed, or travel near the riverbed would have greater exposure to EMF than those fish or wildlife species swimming or feeding higher in the water column or on the surface; however, no adverse effect due to exposure to very low levels of EMF is expected.

Several SCFWH areas are also significant recreational use areas for fishing, waterfowl hunting, canoeing, kayaking, and birdwatching. Construction-related impacts to these recreational uses will be temporary and limited in spatial extent as the construction activities pass. The daily operation of the in-river cable will not cause any long-term disruption of recreational use of these areas.

In summary, the installation and operation of the In-River Transmission Cable is not expected to “destroy or significantly impair the viability” of any of the designated habitats.

4.9.2.2 Threatened and Endangered Species

Sturgeon

The following sections will discuss potential impacts and mitigation measures with regard to shortnose and Atlantic sturgeon in the Hudson River during the construction and operational phases of the proposed Project.

Potential Construction Impacts

Potential impacts to sturgeon present in the Project Area during construction will be minimized by timing the construction activities to avoid spawning periods as well as using low impact construction methods to reduce impact to sensitive life stages that utilize the Project Area as habitat and a food source. Shortnose sturgeon are reported to spawn north of the project area between late April and May with the benthic egg and larval stages remaining in the vicinity of the spawning grounds through June. Atlantic sturgeon are reported to spawn along the In-River Cable Route near RM 69 and RM 83 in April and May with the benthic egg and larval stages of remaining in the freshwater portion of the River through the summer. As a result, Atlantic sturgeon larvae may be present in the Project Area at the very start of construction, and experience some level of unavoidable mortality, but will move downstream of the project area in the fall. Likewise, indirect effects of egg or larval burial by sediments suspended by construction activities will be minimized by scheduling construction outside of the peak spawning period in areas of identified significance. Since these life stages are not typically present during the planned in-water construction period (August - November) impacts to sturgeon reproductive success and survival of early life stages, as a result of construction and operation of the Project, will be minimized.

Impacts to juvenile (young) and adult sturgeon resulting from in-water construction activities are expected to be minimal given the inherent mobility of these life stages and the limited and localized nature of the jet plow riverbed disturbance zone. Although sturgeon make seasonal movements up and down the River, primarily in the spring and fall, the use and timing of low impact methods, such as HDD and jet plow embedment, will minimize the extent of sediment disturbance and suspension compared with other more traditional installation methods (dredging, plowing, etc.) and no blockage of sturgeon passage is expected. It is expected that these life stages will temporarily relocate to nearby habitat areas akin to when a large ship passes through the river, a daily occurrence. Underwater noise during the installation of the In-River Transmission Cable has the potential to interrupt behavior in sturgeon. This noise disturbance will be short-term and is expected to stimulate avoidance behavior, effectively allowing the fish to temporarily avoid the in-water construction area, similar to when large vessels pass. Nighttime lighting is also expected to have little to no impact on the behavior and movement of sturgeon due to the accompaniment of noise and in-water operations; sturgeon are likely to simply avoid the work area or find sufficient unaffected areas of the river to inhabit and forage in.

Potential Operational Impacts

The In-River Transmission Cable will be buried a minimum of 8 feet below present bottom and will not create a physical barrier that could interfere with sturgeon migration or use of benthic habitats or nursery areas.

Operation of the In-River Transmission Cable will generate an electromagnetic field that has the potential to affect benthic communities, migratory fish movement and fish egg and larval development. Exposure to the electric field will be controlled by using a metal sheathing cover around the transmission cable; as a result there will be no adverse impact due to exposure to the electrical field during operation of the cable. Exposure to the magnetic field will be minimized by burying the cable a minimum of 8 feet below the sediment within the river. Species, such as sturgeon, that travel near the riverbed or that feed on or near the bottom, may be exposed to a very minor magnetic field (< 88 mG). However this level is extremely low compared to levels associated with the Earth's geomagnetic field, which varies from 300 - 700 mG, and will not impact the sturgeon.

The In-River Transmission Cable will generate a limited amount of heat that will dissipate into the sediment surrounding the cable. The sediment temperature at 10 cm (4 inches) below the river bottom is expected to increase less than 1° Celsius during operation of the In-River Transmission Cable. The temperatures of the sediment at the river bottom (sediment-water interface) and within the water column above the river bottom are expected to remain unchanged by the operation of the In-River Transmission Cable.

Therefore, sturgeon would not be directly impacted during operation of the In-River Transmission Cable. There will also be no adverse impacts to benthic prey species during the operation of the In-River Transmission Cable.

Wildlife

In addition to shortnose and Atlantic sturgeon, nine rare, threatened, or endangered wildlife species were identified to occur in the Project Area according to recent communications with NYSDEC and USFWS (Appendix 4A). They are peregrine falcon, bald eagle, least bittern, pied-billed grebe, king rail, Indiana bat, New England cottontail, bog turtle, and dwarf wedgemussel. The following sections will discuss potential impacts and mitigation measures with regard to these species during the construction and operational phases of the Project.

Potential Construction Impacts

Terrestrial

The terrestrial portion of the construction phase of the Project will involve installation of the Land Transmission Cables interconnecting the landfall transition vault near the shoreline to the existing inland substations and construction of the Northern and Southern Converter Stations. The Land Transmission Cable routes mostly follow existing paved or graded roadways and pass through previously altered habitats such as fallow pastures and mixed woodlands. The Converter Station locations are located in similar areas and require approximately 5 acres of land each for footprint and yard area construction.

The wildlife habitat in and along the terrestrial portion of the proposed Project Area Land Cables and Converter Stations is unsuitable for least bittern, pied-billed grebe, and king rail, which use shallow-water emergent wetland habitat (NYNHP 2011) along of the river. Upland habitat is also unsuitable for dwarf wedgemussel, which occurs in the benthic habitat of fresh streams and rivers (NYSDEC 2012h). Bog turtles are found in cool, shallow-water wetlands such as wet meadows or bogs, but are not known occur along the Land Cable Route or Converter Stations (NYSDEC 2013a).

Additionally, neither New England cottontails nor Indiana bats have been documented in the Towns of Athens (NYSDEC 2012a) (northern terrestrial portion of the Project) or Cortlandt (NYSDEC 2012b) (southern terrestrial portion of the Project). Therefore these species are not anticipated to be impacted by the Land Cable or Converter Station construction. Indiana bats occur along the Hudson River, but do not typically forage over large water bodies (USFWS 2010) and are not anticipated to be impacted by In-River Cable installation.

The Northern Converter Station is partially located in existing pasture land that is part of a larger patchwork of surrounding agricultural land. This area may provide hunting habitat for peregrine falcons, which prefer to hunt prey in open areas such as fields and coastlines (NYNHP 2011). However, given the large patchwork of similar habitat surrounding the Northern Converter Station location, plentiful foraging habitat will be available to any peregrine falcons in the area during and operation. Therefore impacts to peregrine falcon from the Project are not expected.

Bald eagles in the Project Area feed primarily on fish caught from the Hudson River (NYSDEC 2012), so foraging habitat of this species is not expected to be impacted by terrestrial construction activities. Interaction with bald eagle nesting is unlikely for two primary reasons. First, there are a relatively small number of bald eagle nests along the Hudson River (NYSDEC 2012), and it is unlikely that a bald eagle nest exists in the terrestrial portion of the Project Area. Since bald eagle nests are reused from year to year (USFWS 2007a), it is unlikely that any tree removal associated with construction of the Northern or Southern Converter Stations will impact potential future bald eagle nesting habitat.

Bald eagles are known to congregate around the Indian Point Nuclear Plant in the winter to take advantage of the open water areas created by the large and continuous volumes of warm water discharge from the plant’s cooling system and the abundance of easily caught fish that have been impinged by water intake ducts (Nye 2010). It is unlikely that bald eagles use the immediate vicinity of the Project Area for roosting habitat given that it is near medium-density residential properties, roadways, and a baseball field. Therefore, construction activities at the Southern Converter Station and along the Southern Land Transmission Cable Route are not expected to impact habitat used by bald eagles.

In-river

The In-River Cable Route has been configured to avoid shallow-water areas and remain in the deeper portions of the river to the greatest extent possible. This will avoid impacts to emergent wetland areas along the shorelines of the river which provide habitat to least bittern, pied-billed grebe, and king rail (NYNHP 2011). The cable installation will use jet-plow technology, which results in a lesser degree of suspended sediments than other riverbed cable installation methods. This will result in fewer indirect impacts to listed plant species that may be present due to increased sedimentation. Only small portions of the In-River Route will be affected by the installation of the In-River Transmission Cable at any one time. The installation of the In-River Transmission Cable will not have more than minor impact on bald eagle or peregrine falcon habitat or behavior. Bald eagles feed primarily on fish caught from the Hudson River (NYSDEC 2012) and the Project will only have minor impacts on this food source (*see* Section 4.6 for details on impacts to finfish). Peregrine falcons do not directly use the aquatic habitat of the Hudson River. The timing of in-river construction (August to November) will be outside the breeding period of peregrine falcons and bald eagles in this region (NYNHP 2011, USFWS 2007a).

Foraging habitat of Indiana bats includes fields, forests, and small water bodies (USFWS 2010). Indiana bats are not known to forage over the Hudson River in large numbers. Indiana bats that do forage over the Hudson River are unlikely to encounter In-River construction-related activities, since the vast majority of the Project Area will be free of active construction at any given time. The habitats of the Hudson River are outside the requirements of New England cottontail (USFWS 2006) and bog turtle (NYSDEC 2012f). Dwarf wedgemussel is not known to occur in the

Hudson River, and occurs only in the Neversink River in the Counties of Dutchess and Orange (NYNHP 2011).

Potential Operational Impacts

Terrestrial

The terrestrial portion of the proposed Project includes the Northern and Southern Land Cable Routes and the Northern and Southern Converter Stations. The Land Cable Routes will primarily follow existing roadways. The operation of the Converter Stations and Land Cables will not involve significant alterations to rare species habitat.

The operation of the Land Cables and the Converter Stations will not result in any impacts to the listed species discussed in this section.

In-river

The operational phase of the In-River Transmission Cable is not expected to impact the habitat of the protected animal species discussed in this section. Dwarf wedgemussel is not known to occur in the Hudson River, and occurs only in the Neversink River in the Counties of Dutchess and Orange (NYNHP 2011), therefore no impacts are anticipated Least bittern, pied-billed grebe, and king rail all use emergent wetland habitat found along the banks of the Hudson River for foraging, shelter, and breeding. These species feed primarily on invertebrates and plants found in these shallow-water wetland habitats (NYNHP 2011). Indiana bats exist along the Hudson River, but do not typically forage over large water bodies (USFWS 2010). Bald eagles nest in trees along the banks of the Hudson River, and their diet is mostly comprised of fish caught from the river (NYSDEC 2012). Peregrine falcons nest on the bridges that span the Hudson River and prey upon small birds and mammals (NYNHP 2011).

The normal operation of the In-river Transmission Cable will not result in any impacts to listed wildlife in the area. The Transmission Cable will be buried a minimum of 8 feet below present bottom, which is not a habitat used by any of the species discussed in this section.

Plants

Fourteen (14) rare plant species were identified in consultation with NYSDEC as potentially occurring within or in the vicinity of the proposed Project Area. An additional two species, northern wild monkshood and small whorled pogonia, were identified as potentially occurring in or near the Project Area. The habitat requirements of twelve of these species are freshwater or brackish intertidal marshes or mudflats. This habitat type is typical of shorelines of the Hudson River throughout the proposed Project Area. The remaining four species, narrow-leaved sedge, Davis' sedge, northern wild monkshood, and small whorled pogonia, occur in terrestrial habitats such as deciduous forests, shaded cliffs, flooded meadows, or disturbed areas.

Potential Construction Impacts

Terrestrial

Terrestrial construction activities, including installation of the Land Transmission Cables and the Northern and Southern Converter Stations, will not impact the 12 plant species which occur only in intertidal marshes and mudflats. These habitat types do not occur along the Land Transmission Cable Routes or at the Converter Station locations. Two plant species which can grow in upland habitats, narrow-leaved sedge and Davis' sedge, could potentially occur within or in the vicinity of the proposed Project Area. According to the NYSDEC correspondence dated April 15, 2013, narrow-leaved sedge and Davis' sedge occur in the Project Area only at Astor Point and Denning Point, in Dutchess County. These locations are far from the terrestrial portions of the proposed

Project Area, and therefore there will be no impacts to these two species are expected from construction activities related to the Land Transmission Cables or the Converter Stations. Similarly, neither northern wild monkshood nor small whorled pogonia are known to occur in Greene or Westchester Counties (USFWS 2012a). Impacts to these species from terrestrial construction activities will not occur.

In-river

Twelve of the listed plant species identified in consultation with NYSDEC are found in freshwater or brackish intertidal marshes and mudflats, areas that exist along the shorelines of the Hudson River throughout the in-river portion of the Project Area. The In-River Transmission Cable Route avoids passing near the shoreline of the Hudson River to the greatest extent possible; however in some cases this is unavoidable. Installation of the In-River Cable Route will involve work in the Vosburgh Swamp and Middle Ground Flats SCFWH for 1.19 miles, the Germantown-Clermont Flats SCFWH for 3.72 miles, Esopus Estuary SCFWH for 1.03 miles, and The Flats SCFWH for 3.27 miles. These locations may contain populations of listed plant species. Although the In-River Cable Route passes through these SCFWHs, it will avoid shallow waters within these areas that may provide habitat for listed plants and will not directly impact intertidal marshes or mudflats of the Hudson River that may contain populations of listed plants.

The cable installation will use jet-plow technology, which results in a lesser degree of suspended sediments than other cable installation methods. This will result in fewer indirect impacts to listed plant species that may be present due to increased sedimentation. SSFATE modeling of the anticipated sediment suspended from jet plow embedment predicts that increases in total suspended solids (TSS) concentrations will be limited to the near-bottom location in the water column. The area where suspended sediment concentrations exceed 200 mg/L is predicted to remain in the bottom 3-4 meters (10-13 feet), with concentrations decreasing to approximately 10 mg/L or less 5-8 m (16-26 feet) above the bottom. TSS concentrations are similarly expected to decrease rapidly with horizontal or lateral distance from operations; concentrations at or above 200 mg/L are expected to remain within 95 m (312 feet) of the operating jet plow. Increased TSS concentrations were predicted to be short-term, with concentrations > 200 mg/L not expected to exceed 2 hours in duration, returning to ambient levels within 24 hours of suspension by jet plow passage.

Subsequent deposition of jet-plow induced suspended sediments was predicted by the SSFATE model to be mostly limited to a narrow band extending 200-500 feet from the centerline of the jet plow trench. Deposition thicknesses greater than 2 mm (0.08 in) are expected to extend at the most up to 91 m (300 feet) from the centerline, covering a total area of 227 acres along the entire in-river route. Deposition thicknesses of 5 mm (0.2 in) are expected to cover no more than 0.31 acres.

Due to the short-term nature of in-river construction activities, any indirect impacts to wetland areas along the shoreline of the Hudson River will be temporary and minor.

Potential Operational Impacts

Terrestrial

None of the listed plant species are known to occur in the vicinity of the terrestrial portions of the proposed Project Area, which includes the Land Transmission Cable Route and the Northern and Southern Converter Stations. Twelve of the listed species occur strictly in freshwater or brackish intertidal marshes or mudflats. The remaining four species, which may occur in terrestrial habitats, are not known to exist in the vicinity of the northern or southern portions of the terrestrial

Project Area, based on consultation with NYSDEC and USFWS (Appendix 4A). Therefore, there will be no operational impacts to listed terrestrial plant species.

In-river

The In-River Transmission Cable will be buried at a minimum depth of 8 feet below the bottom of the Hudson River, which is not a habitat used by any of the listed plant species. Magnetic emissions from the buried cable will be absorbed and dissipated by the surrounding sediment, and the Project will not result in any change to habitats used by the listed plant species.

4.10 Land Use

This section describes the land uses within and surrounding the Converter Stations, Land Transmission Route, and Landfalls in the Towns of Athens and Cortlandt, and the Villages of Athens and Buchanan, New York. The current and future land use of the Land Cable Route and Converter Stations has been characterized using real property parcel-based land use information, aerial photographs, and municipal zoning maps. Potential impacts to land uses that may occur from construction, operation and maintenance of the Project are identified and assessed. In addition, the Project's consistency with the requirements of local ordinances, local comprehensive plans, coastal policies, and provisions contained in Local Waterfront Revitalization Programs (LWRPs) is reviewed.

4.10.1 Existing Conditions

Northern Land Cable Route and Converter Station

The Northern Land Cable Route begins at the Leeds Substation, in the Town of Athens, crosses an existing transmission right-of-way to the east before turning north through fields and woodlots to connect to the Northern Converter Station. The area immediately surrounding the Northern Converter Station site is characterized by a patchwork of small to medium agricultural operations, low -density residential land, and woodlots. The CSX River Line Railroad right-of-way runs roughly north-south to the west of the site, and just to its west, is a 1,080-MW combined cycle natural gas generation facility (Athens Generating Plant), the associated switchyard and substation, and multiple transmission rights-of-way.

From the Northern Converter Station the Northern Land Cable runs east, then south to Leeds Athens Road, then east towards the Hudson River following existing local and county roads bordered by open fields, woodlots and residential properties. Once in the Village of Athens, the route passes the Athens Elementary School before turning southeast onto Second Street, which consists of closely situated homes, sidewalks and street amenities typical in a village setting. At Vernon Street, the route proceeds northeast, bounded by residential properties, woodlots, and agricultural fields, then through similar land uses to the southeast on Union Street. At Washington Street (State Route 385), the route turns northeast and is bounded by mixed residential, waterfront, and industrial properties. The Northern Landfall is located at an industrial fuel storage and distribution facility, which is bordered to the East by the Hudson River, to the west by Washington Street, and to the north by the state-owned Athens boat launch.

Uniform land use codes (per the New York State Office of Real Property Services) within 200 feet of the Northern Land Cable Route or 1,500 feet of the Northern Converter Station consist of the following:

- 105 - Agricultural Vacant Land (Productive)
- 120 - Field Crops
- 210 - One Family Year-Round Residence

- 220 – Two Family Year-Round Residence
- 230 - Three Family Year-Round Residence
- 240 - Rural Residence with Acreage (10 acres or more)
- 270 - Mobile Home
- 311 - Residential Vacant Land
- 312 - Residential Land Including a Small Improvement (not used for living accommodations)
- 314 - Rural Vacant Lots of 10 Acres or Less
- 380 - Public Utility Vacant Land
- 441 - Fuel Storage and Distribution Facilities
- 471 - Funeral Homes
- 612 – Schools
- 872 - Electric Substation Electric Power Generation Facilities
- 961 – State-Owned Public Parks, Recreation Areas, and Other Multiple Uses

The location of the Northern Land Cable Route and Northern Converter Station and land uses in this part of the Project Area are presented in Figure 4.10-1.

<u>Southern Land Cable Route and Converter Station</u>

The Southern Landfall in the Town of Cortlandt is on Con Edison Property near a former limestone quarry and south of the Indian Point Energy Center. From the Southern Landfall, the Southern Land Cable proceeds southeast on 9th Street, which is bordered by a small residential area. The route then proceeds north on Highland Avenue and returns to Con Edison property where it enters the Southern Converter Station. This property consists of access roads, fields, and wooded areas with an existing electric transmission right-of-way passing just to the north of the Southern Converter Station. From the Southern Converter Station, the route exits the Con Edison property and proceeds southeast along 11th Street, where a residential area borders the road to the south. After a short distance, the route turns northeast to proceed along Broadway. A baseball field occupies the northern corner of this intersection. However, the remainder of the Land Cable Route along Broadway is bordered on the west by the Con Edison property and a patchwork of wooded, residential, mining, and industrial areas. The eastern side of this portion of the Land Cable Route is initially bounded by residential areas and the St. Patrick's Cemetery, before proceeding past a wooded area to the Buchanan Substation.

Uniform land use codes (per the New York State Office of Real Property Services) within 200 feet of the Southern Land Cable Route or 1,500 feet of the Southern Converter Station consist of the following:

- 190 – Fish, Game and Wildlife Preserves
- 210 – One Family Year-Round Residence
- 220 – Two Family Year-Round Residence
- 280 – Residential - Multi-Purpose/Multi-Structure
- 311 – Residential Vacant Land

- 323 – Other Rural Vacant Lands
- 340 – Vacant Land Located in Industrial Areas
- 440 – Storage, Warehouse and Distribution Facilities
- 441 – Fuel Storage and Distribution Facilities
- 484 – One Story Small Structure
- 534 – Social Organizations
- 620 – Religious
- 662 – Police and Fire Protection, Electrical Signal
- 681 – Cultural Facilities
- 692 – Roads, Streets, Highways and Parkways, Express or Otherwise
- 695 – Cemeteries
- 861 – Electric and Gas
- 876 – Electric Power Generation Facility - Nuclear
- 880 – Electric and Gas Transmission and Distribution
- 963 – City/Town/Village Public Parks and Recreation Areas

The location of the Southern Land Cable Route and Southern Converter Station and land uses in this part of the Project Area are presented in Figure 4.10-2.

4.10.1.1 Zoning

Zoning maps were obtained for the Town of Athens, Village of Athens, Town of Cortlandt, and Village of Buchanan. These maps depict permitted uses under current zoning ordinances and provide an indication of the type of potential future land uses that would be expected along the Land Cable Routes and near the Converter Stations.

Town of Athens

The Athens Town Code establishes zoning designations for Open Space/Conservation (OS), Agriculture (AG), Recreational Residential (Rr), Rural Residential (Ru, Ru-1, or Ru-385), Light Industrial (LI-1 and LI-2), Mixed Use Commercial (MUC), Hamlet (H) and several watershed overlay districts. The Northern Converter Station is located on Ru and OS designated land. Zoning along the Northern Land Cable Route and near the Northern Converter Station in the Town of Athens consists of Ru, AG, OS, LI-1, and MUC designations. A map of zoning along the Northern Land Cable Route and Northern Converter Station in the Town of Athens is presented in Figure 4.10-3.

Under the Athens Town Code, any use not listed in the "Schedule of Uses" is deemed prohibited. Utilities and utility infrastructure are not listed specifically in the Schedule of Uses. Therefore, the Northern Land Cable Route and Northern Converter Station would be considered a prohibited use."

Village of Athens

The Village of Athens is in the final stages of a multi-year Zoning Law Review Process, which will result in numerous changes to the existing Local Zoning law, originally adopted in or about 1982

(Current law). A final draft of the Amended Zoning Law was presented at public hearing on January 9, 2013, and is awaiting adoption by the village board (Proposed Law).

The Proposed Law establishes eight (8) zoning designations, including Open Space/Conservation (OS/C), Mixed Use Waterfront (MU/W), Waterfront (W), Commercial (C), Commercial Residential (CR), Medium-Density Residential (RM), Low-Density Residential (RL), and Recreational Residential (RR) and Historic (H) and Special Flood Hazard (F) districts that may overlay any zoning designation.

The Northern Landfall is located in a MU/W and OS/C district that also falls within the Special Flood Hazard district overlay. Zoning adjacent to the Northern Land Cable Route in the Village of Athens consists of MU/W, C, RL, RM, and OS/C. The portion of the Land Cable Route along 2^{nd} Street is also located in a Historic District overlay.

A map of zoning along the Northern Land Cable Route in the Village of Athens is presented in Figure 4.10-3.

Development in MU/W districts must be consistent with the LWRP, which seeks to preserve and develop public access to the waterfront. Installation of utilities or utility infrastructure is not specifically authorized in any district and therefore considered a prohibited use.

Town of Cortlandt

The Cortlandt Town Code establishes multiple zoning designations, including Single-Family Residential (R-160, R-80, R-40, R-20, R-15, R-10), Single- and Two-Family Residential Districts (R-40A), General Residential (RG), Commercial (HC, CC, and CD); Industrial (MD and M-1), Park, Recreation and Open Space (PROS), Conservation, Recreation and Open Space (CROS), and Aquifer Protection. Cortlandt has also adopted the Westchester County Greenway Compact Plan “as a statement of policies, principles, and guides to supplement other established land use policies in the Town.”

The Southern Landfall and Land Cable Route are expected to pass through or adjacent to districts zoned as MD, RG, and R-15 in the Town of Cortlandt.

A map of zoning along the Southern Land Cable Route in the Town of Cortlandt is presented in Figure 4.10-4.

Public utility facilities are permitted in any zone except for PROS or CROS. A special use permit is required for public utility facilities other than those containing a volume of less than 300 cubic feet, for local distribution of utility services or buildings approved in connection with, and on the same site as, a Planning Board-approved subdivision. The Cortlandt Town Code provides specific regulations for public utility facilities. All public utility facilities must be placed on a lot with a minimum lot size of one acre and maximum building coverage of 25%. All surrounding yards must be at least 30 feet from the structure or a distance equal to the height of the structure, whichever is greater. Fencing or landscaping is required to shield the structure from the surrounding property.

Village of Buchanan

The Buchanan Village Code establishes multiple zoning designations, including residential (R-7.5, R-10, R-15, R-20, and R-40), commercial (C-1 and C-2), and industrial (M-1 and M-2). Uses not specifically listed in the Schedule of Use Regulations are prohibited.

A map of zoning along the Southern Land Cable Route and Southern Converter Station in the Village of Buchanan is presented in Figure 4.10-4.

Zoning along the Southern Land Cable Route and near the Southern Converter Station in the Village of Buchanan consists of M-2 and R-40. Buildings and structures for public utilities are expressly permitted by Special Use Permit in all residential districts, including R-40. Because utilities are not specifically listed as a permitted use in the M-2 district, a variance is required. However, underground utilities are compatible with uses permitted by right in M-2 Districts, which include gasoline stations with retail, auto repair, gypsum board manufacturing, and peaceful use of atomic energy. Uses permitted by Special Permit include industries such as sheet metal shops, lumberyards, masonry supply, warehouses, fabricated metal products, welding, plumbing and heating, air conditioning supply, and dewatering facilities.

4.10.1.2 Parks and Recreational Resources

The transition from Northern Land Transmission Cable to In-River Transmission Cable will occur on a property that is currently developed for fuel storage and distribution use. One park, the state-owned Athens boat launch abuts this property to the north. The Athens Nature Park/Bunker Hill Dog Park is located more than 0.5 miles from the Northern Land Cable Route. No other parks are located in the vicinity of the Northern Converter Station or along the Northern Land Cable Route.

Village Park abuts the parcel containing the termination point of the Southern Land Cable Route at the Buchanan Substation. The park is located less than 0.05 miles southeast of the Buchanan Substation and approximately 0.6 miles northeast of the converter station.

4.10.2 Environmental Impacts and Mitigation

4.10.2.1 Potential Construction Impacts and Mitigation

Construction impacts on land use will be temporary and localized in nature and of the sort typically associated with construction activities—noise and traffic disruption, which will be controlled by using good construction practices detailed in the EM&CP. Construction at the Northern Landfall will not prevent access to the Hudson River from the adjacent Athens state boat launch.

4.10.2.2 Potential Operational Impacts and Mitigation

With the exception of the Converter Stations, the Project will be entirely underground. As a result operation of the Land Transmission Cable will have no greater impact on land use than the impact associated with the presence of underground utilities. The Project will be registered with the Protection of Underground Utilities program. Impacts will be further minimized by burying much of the Land Transmission Cable under or adjacent to existing roads, where rights-of-way are already maintained. Where the Land Cable Route passes through areas not currently maintained as rights-of-way, certain types of development or use may be restricted.

Operation of the Project will have no impact on the use of the Northern and Southern Landfalls, beyond those restrictions normally associated with the presence of underground utilities.

The Converter Stations may have a moderate impact on land use in their immediate vicinity in the Town of Athens and Town of Cortlandt. These stations will be built above-ground and may be visible from certain locations in the surrounding landscape. Additionally, once the Converter Stations are built, the areas occupied by these stations will be unavailable for most other types of development or use. However, impacts have been minimized by locating the Converter Stations close to existing electric generation and transmission infrastructure.

4.10.3 Consistency with NYS Coastal Zone Management Policies and LWRP

In accordance with the Federal Coastal Zone Management Act of 1972, the State of New York adopted in 1981 a Coastal Zone Management Program via the Waterfront Revitalization and Coastal

Resources Act (NYS Executive Law Article 42). The Coastal Zone Management Program is administered by the New York State Department of State (NYSDOS). Representative portions of the declared policy of New York State concerning waterfront revitalization include:

- To achieve a balance between economic development and preservation that will permit the beneficial use of coastal and inland waterway resources while preventing the loss of living marine resources and wildlife, diminution of open space areas or public access to the waterfront, shoreline erosion, impairment of scenic beauty, or permanent adverse changes to ecological systems.
- To encourage and facilitate public access for recreational purposes.
- To encourage local governments to enter into regional agreements to protect their shared environment and improve their region's economic strategy.
- To encourage state agencies to provide technical and financial assistance for implementation of local waterfront revitalization programs.
- To encourage local governments and state agencies to celebrate, protect and enhance the special places that made waterfronts distinct ecological systems and preferred locations for people to live, work, and recreate.

The Northern Converter Station and most of the Northern Land Route will be outside of the Coastal Zone. Project Landfalls and the In-River Cable will be within the Coastal Zone. Therefore, consistency with NYS Coastal Zone Management Policies and LWRPs is required. The Project is consistent with NYS Coastal Zone Management Policies in that it does not preclude the uses promoted by these policies. A detailed consitency assessment is presented in Appendix 4E.

LWRPs and Harbor Management Plans

The Village of Athens has adopted a LWRP, pursuant to the Coastal Resources Act. The LWRP defines the village policies regarding waterfront development and recreational usage. The Village of Athens's LWRP was approved by NYSDOS on September 20, 2001. To be considered consistent, a project or action must be found to not conflict with the goals and policies of any LWRPs or the state's Coastal Zone Management Program.

The Towns of Athens and Cortlandt and the Village of Buchanan do not currently have a state-approved LWRP. Therefore, no separate consistency review is required for portions of the Land Cable Route within these municipalities.

Along the In-River Cable Route, a number of municipalities have state-approved LWRPs in place. Harbor Management Plans, which have been a required component of LWRPs since July 1994 (NYSDOS 2013) have also been prepared for some municipalities. The area covered by these plans typically extends to the municipal boundary in the Hudson River. Municipalities with LWRPs and/or Harbor Management Plans along the In-River Cable Route are summarized in Table 4.10-1.

Table 4.10-1: List of Completed LWRPs and Harbor Management Plans in Municipalities Located along West Point Transmission Project

Municipality	State-approved LWRP	Harbor Management Plan
Village of Athens	✓	
City of Hudson		✓
Village of Saugerties	✓	
City of Kingston	✓	

Municipality	State-approved LWRP	Harbor Management Plan
Town of Esopus	✓	
Town of Lloyd	✓	
Town of Red Hook	✓	
Village of Tivoli	✓	
Town of Rhinebeck	✓	
Town of Poughkeepsie	✓	
City of Beacon	✓	✓
City of Newburgh	✓	✓
Town of Stony Point	✓	
City of Peekskill	✓	

4.10.4 Consistency with NYS and Local Land Use Policies and Plans

Actions within the coastal zone must be consistent with the New York State Coastal Management Program (CMP) State Policies and all State approved Local Waterfront Revitalization Programs (LWRP). LWRPs augment the State Policies in a manner that address specific concerns of the affected municipality. .

To support both a Federal and State consistency finding, the Project was evaluated for consistency with the State Policies. The Coastal Zone Consistency Review is provided in Appendix 4E. For the following communities with approved LWRPs, the Project was further evaluated against specific local policies:

- The Town and Village of Athens
- Village of Saugerties
- Town of Red Hook
- Village of Rhinebeck
- City of Kingston
- Town of Esopus
- Town of Lloyd
- City of Poughkeepsie
- City of Newburgh
- City of Beacon
- City of Peekskill
- Town of Stony Point

Electric transmission facilities are not explicitly permitted in the Town or Village of Athens zoning laws. However, the Project has been designed to minimize most land use impacts by routing much of the Transmission Route within the Hudson River. Land use impacts from the Land Cable Route have been minimized by burying the Land Transmission Cable and routing under or along existing roads, where possible. Additionally, the Northern and Southern Landfalls are located where existing land use is compatible with the installation and operation of electric transmission cable and future likely land use will not be precluded by the Project. Land use impacts from the Converter Stations have been minimized by placing these close to existing electric transmission infrastructure. In addition, local laws prohibiting utility infrastructure or requiring a variance are overly restrictive in light of existing technology, factors of cost, and the needs of consumers and can be overridden as provided for in Section 126 of the Public Service Law (see Exhibit 7). The Project has been designed to be compatible with State and local land use policies, including consistency with State and local Coastal Zone Management policies.

4.11 Cultural Resources

This section describes the studies conducted to determine the presence or absence of cultural and historic resources within the Project's Area of Potential Effect (APE) in New York. Information included in this section is based on the following technical reports prepared for the Project by qualified cultural resource management (CRM) professionals.

- The land portions of the Project Area were assessed by John Milner Associates, Inc. (JMA) in reports entitled *Phase 1A Cultural Resources Survey – West Point Transmission Project Northern Converter Station and Associated Land Components* (see Appendix 4F-1) and *Phase 1A Cultural Resources Survey – West Point Transmission Project Southern Converter Station and Associated Land Components* (see Appendix 4F-3).
- The in-river portion of the Project Area was assessed by Dolan Research, Inc. in its report entitled *Submerged Cultural Resources Review of Background Research and Geophysical Data for West Point Project* and supporting documentation, prepared by Dolan Research, Inc. (see Appendix 4F-2).

The purposes of the studies were to identify previously recorded archeological or historic sites that may be affected by proposed construction or development of the Project, evaluate the potential for previously unrecorded archeological resources to be located within the Project's APE, and assess potential impacts to cultural and historic resources that may occur from construction, operation, and maintenance of the Project.

The studies were conducted to comply with Section 106 of the National Historic Preservation Act of 1969, as amended (NHPA). All technical research and report preparation were conducted in accordance with the New York Archaeological Council's *Standards for Cultural Resources Investigations and the Curation of Archaeological Collections* (NYAC 1994), recommended for use by the New York State Office of Parks, Recreation and Historic Preservation (OPRHP).

4.11.1 Existing Conditions

Existing conditions are summarized below from the three technical CRM reports prepared for the land and in-river portions of the Project Area in New York, and their cited sources and references.

4.11.1.1 Northern Land Portions of Project Area

The upland Phase 1A reconnaissance survey included a walkover of the Project Area in April 2013; background research of the geology, soils, and history of the Project vicinity; and review of previously recorded cultural resources within the Project Area and vicinity. This information was used to develop an archeological sensitivity assessment for potential prehistoric (pre-European Contact Period) and historic archeological resources to be present within the Project's APE for ground disturbance.

Area of Potential Effect

As required by the NYS Office of Parks, Recreation and Historic Preservation (OPRHP) State Historic Preservation Office (SHPO), the Study Area for archaeological resources (the Archaeological Study Area or Project APE) consists of the area within 0.25 miles of the 11.3-acre portion of land identified for construction of the Northern Converter Station in the Town of Athens. The APE also includes approximately 3.1 linear miles of underground (direct buried) DC electric transmission cable from the Northern Landfall at the Hudson River shoreline (Village of Athens) to the inland location of the Northern Converter Station. In addition, this survey includes the approximately 0.5 linear miles of underground AC cable connecting the Northern Converter Station to the Leeds Substation (Appendix 4F-1, Figures 2 and 3). The 11.3-acre area studied for the Converter Station is much larger than the proposed site footprint (4.8 acres), which provides a degree of flexibility in the final location of the facility within this defined study area.

The Viewshed Study Area for above-ground historic properties is a 3.0-mile radius centered on the Northern Converter Station area location. The Viewshed Study Area includes portions of the Towns of Athens, Coxsackie, and Catskill in Greene County (west side of the Hudson River), and a portion of the Town of Greenport and City of Hudson in Columbia County (east side of the Hudson River).

To determine whether previously recorded cultural and historic resources are located on or near the on-land archaeological APE, and to research the history of the site to assess the potential for previously unrecorded resources, several information sources were reviewed including Sanborn Fire Maps, USGS, Soil Survey, National Register of Historic Places, OPRHP, and several others (refer to Appendix 4F-1).

Previously Recorded Cultural Resources - Northern Converter Station

Available and reviewed historic resource information indicates there are no previously-recorded archeological sites within the footprint of the Project Area.

Seventy-two (72) previously-recorded archeological sites were identified within one mile of the Project Area, seven of which are listed on (or have been determined eligible for listing on) the S/NRHP (Table 2, Appendix 4F-1). Of these 72 sites, at least 57 are recorded as Pre-Contact (prior to indigenous peoples contact with an outside culture) only or contain Pre-Contact evidence. Seventeen (17) of the 72 resources fall within the one-quarter mile of the Project APE, one of which is listed (or is eligible for listing) on the S/NRHP.

Background History of Land Uses - Northern Converter Location

The history of land uses in the area surrounding the proposed location for the Northern Converter station was developed to assist in evaluating the potential for previously unrecorded resources to be present within the archaeological APE.

A detailed history of the area surrounding the Northern Converter Station is provided in Appendix 4F-1. This review is primarily based upon chronological review of historic "Sanborn Maps" and historic aerial photographs obtained to develop the site history.

The aerials and Sanborn maps indicate the potential existence of unidentified archaeological deposits due to the intact nature of soils found in the APE and density of Pre-Contact archaeological sites in the vicinity.

Archaeological Resources

JMA's opinion is that the Northern Converter Station location possesses a high probability for the presence of intact Pre-Contact Period Native American archeological deposits due to its proximity to high-quality and plentiful chert sources, high density of recorded Pre-Contact archeological sites in the Study Area, and the intact nature of the soils observed in the area of the proposed Northern Converter Station. The area of the Northern Converter Station possesses a low probability for the presence of Historic Period archeological deposits due to consistent agricultural usage since settlement and a lack of structural, foundation, or shaft feature evidence.

Within the remaining portions of the Archeological Study Area, including the route of the AC Land Cable, Flats Extension Road, Leeds-Athens Road, Second Street, North Vernon Street, Union Street, North Washington Street, and the Northern Landfall, it is JMA's opinion that there is a moderate sensitivity for Pre-Contact Period archeological deposits to be found along any of these routes. There is a moderate to high sensitivity for Historic Period archeological deposits to be found along any of these routes. However, intensive ground disturbance and redevelopment along streets within the Village of Athens since the nineteenth century reduces the likelihood that such archeological deposits remain intact, except along the route of the AC Land Cable and the portion of the route of the DC Land Cable along the predominantly-rural Flats Road Extension and Leeds-Athens Road.

Due to the intact nature of the soils found within the proposed location of the Northern Converter Station and the density of Pre-Contact archeological sites in its vicinity, JMA opined that Phase 1B archeological testing is warranted within the area of the converter station to evaluate the presence of previously unrecorded archeological deposits.

Because of the proximity of previously recorded archeological resources and the lack of documentable prior ground disturbance, JMA further recommends Phase 1B archeological testing along the portion of the proposed route of the DC Land Cable that follows the predominantly rural Flats Road Extension and Leeds-Athens Roads (previously undisturbed areas within the construction footprint only), and at the horizontal directional drill entry/exit points for the proposed AC Land Cable between the existing Leeds substation and the converter station location.

Additionally, JMA recommends additional field reconnaissance, background research, and non-invasive testing (e.g., ground penetrating radar) to evaluate the potential for the presence of unmarked graves along the portion of the buried DC Land Cable route where it passes in close proximity to the areas denoted as cemeteries.

Architectural Resources

In order to determine the potential visibility within three miles of the proposed above ground facilities associated with the Northern Converter Station, a viewshed analysis map was prepared (see Section 4.12). JMA reviewed the State and National Registers of Historic Places (S/NRHP) for properties within the Viewshed Study Area, including above-ground properties within the three mile viewshed. JMA also reviewed the OPRHP Building-Structure Inventory to identify properties that have not been listed on the S/NRHP, but which have been determined eligible for listing by OPRHP and/or are in the process of being nominated to the S/NRHP. One property was identified that is listed in the S/NRHP, and ten that are not listed but have been determined by the SHPO to be eligible for listing in the S/NRHP. In addition to these 11 structures falling within the viewshed, the proposed route of the DC Land Cable passes through the Second Street area of the Athens Lower Village Historic District along Leeds-Athens Road and Second and North Vernon Streets.

No additional architectural survey to identify previously unrecorded or unevaluated properties is recommended by JMA. JMA does recommend additional evaluation of the 11 above-ground historic properties discussed in this report to determine if they are in the true Project viewshed, or if they will be screened by intervening structures and/or vegetation.

4.11.1.2 In-River Cable Route

The goal of the submerged cultural resources review was to determine the presence or absence of remotely sensed (via acoustic shipboard survey) targets that might be associated with significant cultural resources and might be affected by the Project. A brief maritime historic context was developed to identify potential submerged cultural resource types in the Hudson River. Additionally, available historic documentation on local shipwrecks was reviewed, and the Automated Wreck and Obstruction Information System (AWOIS) was consulted for listings within the overall Hudson River study area. Sources reviewed are listed in the report (Appendix 4F-2).

Previously Recorded Submerged Cultural Resources

Historic maritime activity in the Hudson Valley region dates to the sixteenth century when the first European explorers surveyed the mouth of New York Bay. The Hudson River has historically been a main commerce and transportation highway. Historical sources reviewed and cited in Appendix 4F-2 indicate numerous vessels from a wide range of historical eras over the last 400 years have transited, and been sunk, or scuttled in the Hudson River. Overboard dumping of ballast, metal, tools, etc. from these vessels transiting the river from New York to Albany over hundreds of years, common to major river systems such as the Hudson River, has also occurred during this period. As a result, the Hudson River and New York Harbor have likely become repositories for a wide range of submerged cultural resources.

An inspection of submerged archeological state site files at the New York Office of Parks, Recreation and Historic Preservation confirmed the presence of 28 shipwreck sites in the Hudson River along the Project Area. The Automated Wreck and Obstruction Information System (AWOIS) list of wrecks and obstructions indicated two wrecks in the Project Area. In addition, secondary sources suggest that numerous other vessels from a wide range of historical eras have been deposited in the river within the Project Area. With the exception of the dredged portions of the federal navigational channel, much of this section of the Hudson River could likely contain National Register eligible submerged cultural resources. To be eligible for the NRHP, a vessel must have significance in one or more "Areas of Significance" that are listed in National Register Bulletin 16.

Given the level of maritime activity on the Hudson River, the extent of vessel losses (see Appendix 4F-2), and degree of preservation found at shipwreck sites in other similar environmental settings, well-preserved shipwreck sites may exist in certain portions of the Hudson River (e.g., locations outside of the dredged areas, or naturally deep areas). However, the comprehensive navigational dredging of the river has undoubtedly removed or disturbed any of the potential submerged cultural resources located within the federal channel.

Methodology of the Submerged Marine Cultural Resource Surveys

A shipboard remote sensing survey, including collection of sidescan sonar and magnetometer (ferrous object identification) data, was conducted for the Project in the Hudson River. Remote sensing survey investigations were performed along five tracklines spaced approximately 50 feet from each other and centered on the proposed In-River Cable Route in accordance with NYS SHPO survey guidelines. Additional tracklines were surveyed in two sections, from Esopus Creek to Cementon and from the Rip Van Winkle Bridge to the Northern Landfall site, for alternate route considerations. After completion of the pre-planned tracklines, additional tracklines were surveyed to determine areas where the cable could potentially be re-routed to avoid potential obstructions identified during the survey.

Side-scan sonar data were acquired at a 123 foot range, which allowed for good data quality as well as greater than 100% overlapping coverage within the survey corridor. The data were recorded at both high and low frequencies in XTF files, with the high frequency (500 kHz) being used for the final mosaic and target report. Data was processed using Chesapeake SonarWiz software (Appendix 4B).

Magnetometer data were acquired simultaneously with the side-scan sonar by "piggybacking" the magnetometer behind the sonar towfish. The magnetometer was “flown” at a distance of less than six meters off the bottom.

The acoustic and magnetometer data set was reviewed by a marine archeologist, to assess the possible presence and location of submerged archeological resources within the survey corridor, and develop recommendations for further investigation of remote-sensing targets that might be associated with submerged cultural resources. Magnetic and/or acoustic targets generating remote sensing signatures suggestive of cultural resources were, to the extent possible, to be identified and evaluated.

Analysis of remote sensing signatures identified during the survey was based on several criteria. Magnetometer targets were analyzed according to: magnetic intensity (total distortion of the magnetic background measured in gammas); pulse duration (detectable signature duration); signature characteristics (negative monopolar, positive monopolar, dipolar, or multi-component); and spatial extent (total area of disturbance). Acoustic targets were analyzed according to their spatial extent (total area of disturbance), signature characteristics (shape, relief above the bottom, strength of return, and contrast with the background) and environmental context.

Summary of Findings of the Submerged Lands Cultural Resource Surveys

Comprehensive listings of bottom features and magnetic anomalies found during the acoustic remote sensing surveys were compiled as part of the data processing. Excluding geologic features identified in the survey, 422 sonar features on the river bottom were identified that appeared to be related to man-made activities. In addition, there were 1,641 magnetic anomalies identified.

Of all these targets, thirty-three (33) sites generated remote sensing signatures that were suggestive of submerged cultural resources that might be associated with a shipwreck episode. Seventeen of the 33 targets had associated magnetic signatures indicating some level of ferrous content. Most of these sites have distinctive geometric forms and intersecting lines that are suggestive of a shipwreck site. The other sites appear to contain debris piles that may be associated with a ship or boat. Many of these targets when further investigated clearly appear to be the remains of barges, scows, canal boats and/or steam boats that have used the river course for centuries.

Of these 33 targets, only 16 are located within 200 feet of the In-River Cable Route (the SHPO imposed “sensitivity of impact” area). Thirteen (13) of the 33 targets are located greater than 200 feet (outside the sensitivity zone) from all routing alignments surveyed and four of the targets are located within 200 feet of one but not all of the alternative alignments.

4.11.1.3 Southern Land Route

The upland Phase 1A reconnaissance survey included a walkover of the Project Area in April 2013; background research of the geology, soils, and history of the Project vicinity; and review of previously recorded cultural resources within the Project Area and vicinity. This information was used to develop an archeological sensitivity assessment for potential prehistoric (pre-European Contact Period) and historic archeological resources to be present within the Project’s APE for ground disturbance.

Area of Potential Effect

The Study Area for archaeological resources for the Southern Land Cable Route (Archaeological Study Area or Project APE) consists of a short linear route area within 0.25 miles of the proposed land based installations beginning at the landfall transition vault, the buried AC and DC Cable Routes and the Southern Converter Station in the Town of Cortlandt, NY. This land route segment includes the approximately 0.6 miles of underground direct buried DC cable between the Southern Landfall and the converter station, and the approximately 1.1 miles of direct buried AC cable between the converter station and the existing Buchanan Substation. It should be noted that the northern segment of this route is located within the Village of Buchanan (Appendix 4F-3, Figures 2 and 3).

The land area surveyed for this cultural assessment is larger than the footprint of the proposed converter station, allowing a degree of flexibility in the final placement of the facility.

The Viewshed Study Area for above-ground historic properties consists of the three-mile viewshed associated with the Southern Converter Station location. This viewshed radius includes portions of the City of Peekskill, Village of Buchanan, and Town of Cortlandt in Westchester County, NY, and portions of the Towns of Stony Point and Haverstraw in Rockland County, NY.

To determine whether previously recorded cultural and historic resources are located on or near the upland archaeological APE's, and to research the history of the route and Converter Station site to assess the potential for previously unrecorded resources, several information sources were reviewed for this analysis including Sanborn Fire Maps, USGS, Soil Survey, National Register of Historic Places, New York State Parks Recreation and Historic Preservation, and several others. Please see Appendix 4F-3 for the full listing of references.

Previously Recorded Cultural Resources –Southern Converter Station

The review and analysis of available information described above show there are no previously-recorded archeological sites within the planned footprint areas of the Southern Converter Station or its linear interconnection route from the landfall transition vault. This review identified five previously-recorded archeological sites within one mile (a distance of 1-mile was used to determine the presence and density of previously recorded archeological sites) of the Project Area (1-mile surrounding the Southern Converter Station and Land Cable Routes) and a total of 32 historic properties, including portions of two historic districts, within the three-mile viewshed Study Area (3-miles surrounding the Southern Converter Station).

History of Southern Converter Location

A history of the area that will contain the Southern Converter station was compiled to assist in evaluating the potential for previously unrecorded to be present within the archaeological APE.

A detailed history of the area surrounding the Southern Converter Station is provided in Appendix 4F-3, based upon chronological review of the Sanborn maps and historic aerial photographs obtained to develop the site history.

The aerials and Sanborn maps indicate that the potential for unidentified archaeological deposits is low in the area of the Converter Station due to previous soil disturbing activities in the APE.

Archaeological Resources

JMA's opinion is that there has been extensive prior ground disturbance in the area north of 11th Street, and that there is no potential for intact Pre-Contact Period Native American archeological deposits or intact Historic Period archeological deposits. Within the remaining portions of the Archeological Study Area, along 9th Street, Highland Avenue, 11th Street, and Broadway, it is

JMA's opinion that there is a moderate sensitivity for Pre-Contact Period archeological deposits and some potential for the presence of Historic Period archeological deposits, but prior ground disturbance along these roadways during the Historic Period reduces the likelihood of intact archeological deposits.

JMA's opinion is that Phase 1B archeological testing is not necessary in the portion of the Archeological Study Area north of 11th Street in the hamlet of Verplanck. This includes the area of the proposed Southern Converter Station, and segments of proposed routes of the DC Land Cable and the AC Land Cable.

Because of the proximity of previously recorded archeological resources and the lack of documentable prior ground disturbance, JMA recommends Phase 1B archeological testing along the proposed route of the DC Land Cable on 9th Street and Highland Avenue (previously undisturbed areas within the construction footprint only), and along the route of the proposed AC Land Cable on 11th Street and on Broadway between 16th Street and the Buchanan Substation.

Architectural Resources

In order to determine the potential visibility within three miles of the proposed above ground facilities associated with the Northern Converter Station, a viewshed analysis map was prepared (see Section 4.12). JMA reviewed the State and National Registers of Historic Places (S/NRHP) for properties within the Viewshed Study Area, including above-ground properties within the three mile viewshed. JMA also reviewed the OPRHP Building-Structure Inventory to identify properties that have not been listed on the S/NRHP, but which have been determined eligible for listing by OPRHP and/or are in the process of being nominated to the S/NRHP. Of the 157 individual properties that are identified as contributing to the significance of the Peekskill Downtown S/NRHP Historic District, 17 are located within the three-mile Viewshed Study Area. Of the 199 individual properties that are identified as contributing to the significance of the Nelson Avenue/Fort Hill S/NRHP Historic District, 56 are located within the three-mile Viewshed Study Area. It is probable that if the viewshed were redrawn to take into account the effects of intervening structures and vegetation a majority of the properties within the theoretical worst-case viewshed would no longer be included.

JMA also recommends that an historic architectural resources survey be performed to determine if previously unidentified or unevaluated above ground historic properties that could be visually affected by the Project exist with the three-mile Project viewshed. The architectural survey should include ground-truthing of the 32 above-ground historic properties discussed in this report to determine if they are in the true viewshed, or if they will be screened by intervening structures and/or vegetation.

4.11.2 Environmental Impacts and Mitigation

4.11.2.1 Northern Converter Station Land and Linear Interconnection Route

Given the JMA's findings as described above, there is potential for impact to archaeological resources if they exist in areas to be disturbed as part of the Project. Phase 1B archeological testing may be considered once the location of the Northern Converter Station and the Northern Land Cable Route have been confirmed as acceptable from a land use and environmental perspective. Additional research to determine the potential for the presence of unmarked graves along the portion of the buried DC cable route where it passes in close proximity to the areas denoted as cemeteries may also be required. Due to the inherent inaccuracies found in the historic maps, the distance from the DC cable to the cemetery or grave site(s) is unknown. The need for additional investigations will be determined by the outcome of NYS SHPO review of this component of the Project.

The 11 above-ground historic properties identified in the study area have been evaluated to determine if they are in the true Project viewshed, or if they will be screened by intervening structures and/or vegetation and of the 11 above-ground historic properties, only two have potential project visibility based on vegetation and topography. Further site evaluations suggest that hedge rows, not considered in the vegetated viewshed analysis, may prevent open views from the two remaining architectural resources which are 0.9 and 1.9 miles away from the proposed Converter Station. Minimal visual effect to these two resources, if any will result from the proposed project. This is largely due to the distance of the resources from the Proposed Converter Station and the very narrow profile of lightning masts sampled in the viewshed analysis. Additional information on visibility and potential visual effects can be found in Section 4.12.

4.11.2.2 In-River Cable Route

The 33 submerged targets that generated signatures that were suggestive of submerged cultural resources were recommended for avoidance by the marine archeologist. Sixteen are located within 200-feet of the In-River Cable Route. The marine archaeologist further recommended establishing an avoidance buffer of at least 40 m (131 feet) around each of the 33 targets. Based on this recommendation, the In-River Cable Route was adjusted to avoid these targets and their associated buffers to the maximum extent practical. For those targets that cannot be avoided, additional underwater archeological investigations to positively identify the source of the remote sensing signatures would be conducted after the OPRHP review of the marine archaeologist's report and recommendations.

4.11.2.3 Southern Converter Station and Linear Interconnection Route

Given the JMA's findings as described above, there is little potential for impact to archaeological resources since they are not likely to exist in areas to be disturbed as part of the Project. Therefore, Phase 1B archeological testing is not necessary in the portion of the archeological Study Area that includes the Southern Converter Station, and along most of the Southern Land Cable Route. The need for additional investigations will be determined by the outcome of NYS SHPO review of this component of the Project.

The architectural survey of the APE conducted in the southern end of the Project Area identified 31 above-ground historic properties that required evaluation. These have been evaluated to determine if they are in the true Project viewshed, or if they will be screened by intervening structures and/or vegetation. Two of the 31 structures do not exist in the OPRHP records and therefore additional research will be necessary to determine their locations. Of the remaining 29 structures, 19 have potential project visibility. Fourteen of the visible structures occur in the City of Peekskill. Since the vegetated viewshed analysis does not consider the screening effects of structures, in reality, visibility of the Proposed Converter Station from within the city would be very unlikely. A more detailed account of visibility from historic resources can be found in Section 4.12.

The Phase 1A evaluation detailed in Appendix 4F will be submitted to SHPO for a review and concurrence. If, at that time additional historic architectural resources surveys are required, WPP would conduct these evaluations, as directed. Protocols for these evaluations would be developed and presented in the EM&CP.

4.12 Visual and Aesthetic Resources

In accordance with PSL §122(1)(c) and 16 NYCRR §86.5(b)(2)(i) -(ii), and (8), this section includes a study of the visual and aesthetic impacts resulting from construction and operation of the Project. Since the majority of the Project is underground or in the riverbed, this study examines the visual qualities and above-ground existing visual resources within a three (3) mile radius of the Northern and Southern

Converter Stations (the Viewshed Study area). This work was done to determine whether the siting of the proposed Converter Stations employed reasonable efforts to “avoid scenic, recreational, and historic areas” and whether the Converter Stations have been located, “to minimize [their] visibility from areas of public view.”

Additionally, this section will address potential temporary visual effects associated with the construction of the Land Cable, horizontal directional drilling, and the marine vessels and construction equipment required for installation of the In-River Cable.

To address the Project’s only above ground components, the Viewshed Study Area is separated into the Northern Converter Station Visual Study Area (Northern Study Area) and the Southern Converter Station Visual Study Area (Southern Study area). These discrete study areas are in excess of 70 miles apart and are considered visually unique and independent settings, and are therefore treated separately when describing visual setting and potential visual impact.

4.12.1 Existing Conditions

4.12.1.1 Northern Study Area

The Northern Converter Station will be located in the Town of Athens in Greene County, on the west side of the Hudson River at the lower elevations near the river within this area’s ridge and valley topography. The proposed site is located on an approximately 11-acre private land parcel just north of Leeds Substation and Leeds- Athens Road. The site is east of Interstate Route 87 and 9W and west of the Hudson River. The parcel consists of partially wooded pasture land, wet meadow, and agricultural land characterized by a low lying valley, commonly known as the Athens Flats.

The Northern Study Area encompasses small portions of Greene County and Columbia County, including the riverfront Towns of Athens, Catskill, Coxsackie, and Greenport as well as the Village of Athens and the City of Hudson. In addition, the study area encompasses a 4.9-mile length of the nearby Hudson River.

The topography ranges from the mean elevation of the Hudson River’s water surface, up to 670 feet above NGVD. The Hudson River valley rises steeply to the east and more gradually on the western side where there is a series of undulating high ridges and ridgelines aligned north-south.

Land cover within the study can be best characterized as rural in natural and altered context. The area includes predominantly (40 percent) deciduous, evergreen, or mixed forest and wet meadows with open fields. Open water, open space, wetlands and agricultural land uses evenly and cumulatively make up approximately 53 percent of this study area. Developed areas cover about 6% of the total study area. These developed areas include Village of Athens and the City of Hudson. The Village of Athens, to the east of the project site, consists of a mixture of commercial, light industrial, and residential development clustered along gridded roads and nearby major highways. Directly across the river from Athens, the study area encompasses a portion of the City of Hudson, which is situated on a plateau on the east side of the Hudson River. Hudson consists of high density residential and commercial development. Its suburban context transitions to rural community away from the downtown area.

Existing energy infrastructure facilities in this area of Athens include multiple high voltage transmission line corridors, the 345 kV Leeds Substation, natural gas pipelines, and the utility-scale natural gas combined cycle generating facility (Athens Generating Plant). This area is sometimes referred to as Power Valley as it is a central junction point for the generation and transfer of upstate power resources to downstate load centers such as Westchester County and New York City.

The Northern Converter Station is approximately 1,620 feet northeast of the existing Leeds Substation (which will be one of the Project's power grid interconnect locations) and approximately 1,200 feet east of the Athens Generating Station.

The Northern Converter Station is situated in a low elevation area between ridgelines west of the river, with 100 to 150 foot high ridges rising to the east and west sides of the proposed location which minimize potential impacts to the surrounding land uses (mostly residential, light industrial, pasture and agricultural land) and as importantly Hudson River viewscapes, if any, from the site area to the river and vice versa.

4.12.1.2 Southern Study Area

The Southern Converter station will be located in the town of Cortlandt in Westchester County, on an existing private parcel. This area of Cortlandt is also rich in existing utility infrastructure facilities where, like Leeds to the North, it is a main junction point for high voltage overhead electric transmission lines coming from the north and leading into New York City, and electric generating stations (Indian Point Energy Center). The area is light industrial in context surrounded by nearby suburban residential and commercial land uses. The site area also contains an abandoned stone quarry to the west and a gypsum processing plant to the north.

The study area for the Southern Converter Station includes portions of Westchester and Rockland Counties and the Towns of Cortlandt, Stony Point, and the northern tip of Haverstraw and the City of Peekskill and the Village of Buchanan. A seven-mile portion of the Hudson River also bisects the 3-Mile study area.

The topography ranges from river water level up to 1,117 feet in elevation. Topography is highly variable throughout the study area. From the river valley, the topography climbs steeply on the west side of the river becoming mountainous wooded terrain interceded by steep river valleys. On the east side, of the Hudson, the elevation gain is more gradual allowing for more dense development. The proposed southern converter station is situated in a small ridge at an elevation of approximately 100 feet above mean sea level (AMSL). The topography gradually slopes down to the west where it meets the low lying wetlands and tidal flats of the Hudson River.

Land cover within the study area includes approximately 37 percent deciduous, evergreen, or mixed forest and approximately 28 percent is open water. The remaining area is largely developed land. The Hamlet of Verplanck, to the south, is a medium to high density residential community, which continues east along the south side of Route 9 to the study area limit. North of Route 9, development density drops off, giving way to steeper, forested terrain. The Village of Buchanan is located to the north of the Southern Converter Station site and consists of large industrial developments along the Hudson River and medium to high density residential and commercial developments east of Broadway Street. The City of Peekskill is at the northern extent of the study area and contains a mix of commercial, residential and industrial development, extending south down State Route 9 toward the Southern Converter Station site.

4.12.1.3 Project Description

Permanent above ground components include two Voltage Source Conversion-High Voltage Direct Current (VSC-HVDC) Converter Stations, which will require approximately 5 acres each. The Converter Station footprint will be approximately 322 feet by 636 feet and will be enclosed by a security fence or walls. The largest component of the Converter Station is the converter hall, which is a standard enclosed structure measuring approximately 106 feet by 370 feet and 49 feet tall. The control building is also an enclosed structure measuring 47 feet by 156 feet and 26 feet tall. The switchyard components are generally located at ground level and interconnect with the Converter Station components in a low profile manner. The Converter Stations will also include numerous lightning masts that will be narrow poles approximately 80 feet tall. Figure 4.12.3 shows a plan view schematic of the proposed Converter Station facilities.

The Project's proposed HVDC Cable facilities are described in Exhibit 2. From a visual perspective, once construction is complete, all Project components, with the exception of the converter stations will be underground and not visible.

4.12.1.4 Inventory of Aesthetic Resources

The first step taken in the visual assessment of the Project was to inventory significant scenic and aesthetic resources within the visual study area that are identified in NYSDEC's Program Policy DEP-00-2 entitled Assessing and Mitigating Visual Impacts (NYSDEC, 2000). The policy states that the State's interest with respect to aesthetic resources is to protect those resources whose scenic character has been recognized through national or state designations. The policy addresses thirteen categories of aesthetic resources of statewide significance. These are listed below in Table 4.12-1. Figure 4.12-1, sheets 1 through 4 show the mapped locations of these visual resources keyed to the Table below.

Table 4.12-1 Three Mile Study Area Scenic Resources

Map ID	Resource Name	City/Town	County	Distance (Miles)	Potential Visibility	
					Bare Earth	Vegetated
Northern Converter Station						
National Register of Historic Places, National Register Eligible						
1	**Athens Lower Village Historic District (NRHP)**	Athens	Greene	1.4	○	○
2	**Brandan, William, House (NRHP)**	Athens	Greene	1.3	○	○
3	**Brick Row Historic District (NRHP)**	Athens	Greene	2.3	○	○
4	**Haxton-Griffin Farm (NRHP)**	Athens	Greene	0.8	●	●
5	**Hudson Historic District (NRHP)**	Hudson	Columbia	2.5	○	○
6	**Hudson/Athens Lighthouse (NRHP)**	Hudson	Columbia	2.1	○	○
7	**Stranahan-DelVecchio House (NRHP)**	Athens	Greene	2.0	○	○
8	**Susquehannah Turnpike (NRHP)**	Catskill	Greene	2.7	○	○
9	**Van Loon, Albertus, House (NRHP)**	Athens	Greene	1.9	○	○
10	**Wiswall, Oliver, House (NRHP)**	Hudson	Columbia	2.3	○	○
11	**Zion Lutheran Church (NRHP)**	Athens	Greene	1.9	○	○
12	**Front Street-Parade Hill- Lower Warren Street Historic District (NRHP)**	Hudson	Columbia	2.7	○	○
13	**Dennis Residence - Structure 52 (NRHP)**	Athens	Green	1.9	●	●
14	Rushmore Residence - Structure 7	Athens	Green	1.0	●	●
15	Structure 12	Athens	Green	0.7	○	○
16	Structure 13	Athens	Green	1.0	●	○
17	Structure 49	Athens	Green	1.5	●	○
18	Structure 77	Athens	Green	2.3	●	○
19	Structure 78	Greenport	Columbia	2.8	●	○
20	Structure 79	Greenport	Columbia	2.6	●	○
21	Moore-Howland Estate	Catskill	Green	2.7	●	○
State Parks, Recreation						
None						

Table 4.12-1 Three Mile Study Area Scenic Resources

Map ID	Resource Name	City/Town	County	Distance (Miles)	Potential Visibility	
					Bare Earth	Vegetated
Other Parks/Recreation						
22	Greene County Environmental Education Center	Athens	Greene	1.5	●	○
23	Athens Nature Park	Village of Athens	Greene	1.3	○	○
25	Athens State Boat Launch	Village of Athens	Greene	2.1	○	○
26	Brandow Point Unique Area	Athens	Greene	1.2	○	○
27	Hudson State Boat Launch	Hudson	Columbia	2.5	○	○
28	Middle Ground Flats Unique Area	Village of Athens	Greene	2.1	○	○
29	Rogers Island Wildlife Management Area	Greenport	Columbia	2.8	○	○
Urban Cultural Parks						
None						
State Forest Preserves						
33	State Forest Preserve	Greenport	Columbia	2.9	○	○
National Wildlife Refuges						
None						
National Natural Landmarks						
None						
National Park System, Recreation Areas, Seashores, Forests						
None						
Rivers Designated as National or State Wild, Scenic or Recreational						
None						
Scenic Sites, Area, Lake, Reservoir, or Highway						
None						
Scenic Areas of Statewide Significance						
35	Columbia - Greene North	Athens/ Greenport	Green/ Columbia	2.4	○	○
36	Catskill - Olana	Greenport	Columbia	2.6	●	○
Palisades Park						
None						
State and Federal Trails						
None						

Notes:
● - Potentially Visible
○ - Not Visible

Table 4.12-1 Three Mile Study Area Scenic Resources (Continued)

Map ID	Resource Name	City/Town	County	Distance (Miles)	Potential Visibility	
					Bare Earth	Vegetated
Southern Converter Station						
Historic Properties (National Register, State Register, and Register Eligible)						
1	**Peekskill Freight Depot (NRHP)**	Peekskill	Westchester	2.4	○	○
2	**Standard House (NRHP)**	Peekskill	Westchester	2.3	○	○
3	**US Post Office—Peekskill (NRHP)**	Peekskill	Westchester	2.7	○	○
4	**Bear Mountain Bridge Rd. (NRHP)**	Cortlandt	Westchester	2.9	●	○
5	Augustowski Residence	Peekskill	Westchester	1.7	●	○
6	Commercial Funeral Home	Peekskill	Westchester	2.4	●	●
7	Commercial/Residence	Peekskill	Westchester	2.4	○	○
8	**Drum Hill High School (NRHP)**	Peekskill	Westchester	2.7	●	●
9	**Ford Administration Building (NRHP)**	Peekskill	Westchester	2.8	●	●
10	Former Townsend Estate - Mt. Saint Francis	Peekskill	Westchester	2.1	●	○
11	**Fort Hill-Nelson Avenue Historic District (NRHP)**	Peekskill	Westchester	2.9	●	●
12	Lutheran Church	Peekskill	Westchester	2.5	●	●
13	**M/V Commander (NRHP)**	Stony Point	Rockland	2.0	●	●
14	Mabie Residence	Peekskill	Westchester	2.7	●	●
15	McKinnley School No. 3	Peekskill	Westchester	1.5	●	○
16	Peekskill Armory	Peekskill	Westchester	1.7	●	●
17	**Peekskill Downtown Historic District (NRHP)**	Peekskill	Westchester	2.7	●	●
18	**Peekskill Presbyterian Church (NRHP)**	Peekskill	Westchester	2.7	●	●
19	Purdy Residence	Peekskill	Westchester	2.3	●	●
20	Robillard Residence	Peekskill	Westchester	2.9	●	●
21	**Saint Mary's Episcopal Complex (NRHP)**	Peekskill	Westchester	2.6	●	●
22	St. Patrick's Church	Cortlandt	Westchester	0.1	●	○
23	**Stony Point Battlefield (NRHP)**	Stony Point	Rockland	1.2	●	●
24	**Stony Point Lighthouse (NRHP)**	Stony Point	Rockland	1.3	●	○
25	Strang Residence	Peekskill	Westchester	2.9	●	●
26	Suarez residence	Peekskill	Westchester	2.4	●	●
27	Tomassio Residence	Peekskill	Westchester	1.9	●	●
28	Tomkins Cove Library	Stony Point	Rockland	1.3	●	●
29	Town Hall, former High School	Stony Point	Rockland	2.4	●	○
30	Veterans Administration Medical Center	Cortlandt	Westchester	1.7	●	●
31	**William H. Rose House (NRHP)**	Stony Point	Rockland	2.1	●	○
32	Wohlstein Residence	Peekskill	Westchester	2.3	●	●
State Parks, Recreation						
33	Harriman State Park	Stony Point	Rockland	1.4	●	○
34	Hudson Highlands State Park	Cortlandt	Westchester	2.8	●	○
35	Bear Mountain State Park	Stony Point	Rockland	1.2	●	●
Other Parks/Recreation						
36	Georges Island County Park	Cortlandt	Westchester	1.1	●	●
37	Oscawana County Park (undeveloped)	Cortlandt	Westchester	2.4	●	○
38	Blue Mountain Reservation (County Park)	Cortlandt/ Peekskill	Westchester	1.6	●	●

Table 4.12-1 Three Mile Study Area Scenic Resources (Continued)

Map ID	Resource Name	City/Town	County	Distance (Miles)	Potential Visibility	
					Bare Earth	Vegetated
39	Depew Park	Peekskill	Westchester	2.2	●	●
40	Sunset Park	Cortlandt	Westchester	1.1	●	●
41	Minisceongo State Tidal Wetlands	Stony Point	Rockland	2.4	●	●
Urban Cultural Parks						
None						
State Forest Preserves						
42	Montrose Point State Forest	Cortlandt	Westchester	0.7	●	●
National Wildlife Refuges						
None						
National Natural Landmarks						
43	Iona Island Marsh	Stony Point	Rockland	2.6	○	○
National Park System, Recreation Areas, Seashores, Forests						
None						
Rivers Designated as National or State Wild, Scenic or Recreational						
None						
Scenic Sites, Area, Lake, Reservoir, or Highway						
44	Bear Mountain Bridge Road	Cortlandt	Westchester	2.8	●	●
45	Bear Mountain State Park Road	Stony Point	Rockland	1.5	●	●
Scenic Areas of Statewide Significance						
46	Hudson Highlands	Peekskill, Stony Point, Buchanan Village	Westchester, Rockland	0.9	●	●
Palisades Park						
23	Stony Point Battlefield State Historic Site	Stony Point	Rockland	1.2	●	●
35	Bear Mountain State Park	Stony Point	Rockland	1.2	●	●
33	Harriman State Park	Stony Point	Rockland	1.4	●	○
State and Federal Trails						
47	Through Trail	Cortlandt	Westchester	0.8	●	○
48	Through Trail	Cortlandt	Westchester	0.9	●	○
49	Through Trail	Cortlandt	Westchester	0.8	●	○
50	Through Trail	Cortlandt	Westchester	0.9	●	○
51	Spur Trail To Brick Beach	Cortlandt	Westchester	0.9	●	●
52	Spur Trail To Brick Beach	Cortlandt	Westchester	0.9	●	○
53	Through Trail Boardwalk	Cortlandt	Westchester	1.0	●	○
54	Spur Trail To Scenic Overlook	Cortlandt	Westchester	0.9	●	○
55	Through Trail ,Right-Of-Way Across Kolping Society	Cortlandt	Westchester	1.0	●	○
56	Through Trail	Cortlandt	Westchester	0.7	●	○
57	Bypass Trail	Cortlandt	Westchester	0.8	●	●
58	Spur Trail To Brick Bridge And Osage Orange	Cortlandt	Westchester	0.9	●	○
59	Bypass Trail	Cortlandt	Westchester	0.9	●	○
60	Spur Trail	Cortlandt	Westchester	0.9	○	○

Notes:
● - Potentially Visible
○ - Not Visible

4.12.1.5 Visibility Analysis

A visibility analysis was completed to determine the areas of potential visibility within the Study area through the use of a GIS desktop analysis and field verification. These tools are useful in narrowing the area of potential effect and removing those locations which will not have project visibility from further analysis. Additionally, visual simulations were produced to demonstrate how the completed Converter Stations will appear once complete and in operation.

Viewshed Analysis

The purpose of the viewshed analysis is to determine the geographic areas within which there is a reasonable probability of Project visibility. The viewshed analysis considers the highest point of the proposed converter station structures, the lightning masts at a height of 80 feet. The masts have a very narrow profile and most of the facilities' more substantial structures are below this elevation (for example, the converter hall structure is approximately 49 feet tall). It is assumed that 80 feet constitutes the worst case visibility scenario.

Additionally, physical limitations regarding the angular resolution of the human eye limit the distance at which a narrow object can be seen. Typically, the resolution of the human eye is approximately 1.0 to 1.2 arcseconds. Assuming 1.2 arcseconds, it is unlikely that an object 8 to 12 inches in diameter would be distinguishable beyond 0.5 miles. It should be noted that glare on steel objects, under certain conditions, could extend the range of visibility of narrow objects. A second viewshed analysis control point was run at 49 feet (Control Building height) to represent a more accurate visibility scenario.

To create the viewshed analysis, 10-Meter USGS Digital Elevation Models (DEM's) are imported into a Geographic Information Systems (GIS) workspace for the three-mile study area. The center of the proposed Converter Station sites is used as a control point, set at 80 feet above ground level and 49 feet above ground level, depending on the scenario being modeled. The GIS software then scans each of the 10-meter cells within the 3-mile study area. The scan assumes a 5.1-foot receiver elevation to simulate the viewer eye height to determine whether an uninterrupted line of sight to the converter station is available. If the cell is determined to have potential visibility, each of those cells is coded as visible. The resulting data layer includes a combination of those cells with project visibility. This result represents the geographic area in which the project would be visible under bare earth conditions. The bare earth viewshed result is considered the worst case visibility for a project and is inherently conservative since bare earth conditions do not exist in the Project Area and it does not consider screening by buildings.

An additional viewshed analysis was created to account for the screen effects of surrounding vegetation. The vegetation data is extracted from the 2006 National Landcover Data Set, which analyses cover type in 30 meter square blocks. The vegetation data is then combined with the DEM and assigned a height of 40 feet. The viewshed model was rerun and the areas of vegetation excluded from the visible areas. This scenario is also conservative since screening by buildings is not considered, and developed areas exist around each Converter Station.

Field Verification

A field visibility assessment was conducted on April 2, 2013 during a high visibility, clear weather day. A professional visual analyst visited several locations within both the North and South Study Areas to verify the desktop viewshed analysis results and to further define the existing visual character of the surrounding area. Photographs and GPS geo-reference points were obtained from several viewpoint locations during the field visit for use in the creation of the visual simulations. A Nikon D7000 with a 50 mm equivalent lens was used to collect the photographs. This is a standard for the creation of distortion free simulations.

Visual Simulations

Visual simulations were produced from a representative viewpoint for both the Northern and Southern Converter Stations. Simulations make it possible to demonstrate how the proposed action will appear in the view once complete.

Simulations were created by using the photographs obtained during the field visit. A three dimensional virtual camera is created in a 3D application. This virtual camera matches the location, height, and focal length of the original photograph. Additionally, the output dimensions are set to precisely match the photograph. These settings allow duplication of the original photograph's size, perspective, and zoom level.

The Converter Stations are also modeled with the necessary degree of detail in the 3D software. In order to ensure correct position and scale of the objects, all data is georeferenced in an appropriate coordinate system and datum (State Plane North American Datum 1983). A terrain model, derived from USGS 7.5 Digital elevation data and LiDAR survey, is converted to a mesh for use in the 3D software. Next, the camera is aligned and adjusted to match the original photograph. To align the camera, the virtual target is adjusted until contextual information in the model matches the corresponding elements in the base photograph. Once the 3D camera has been aligned, a virtual sunlight system is placed in the model. This system computes exact lighting parameters based on the project location, time of day, day of year, and atmospheric conditions observed in the field. The 3D model is then rendered for final production and post-processing. Post processing includes the process of placing the model into the photograph in the appropriate zone (e.g. existing foreground vegetation is placed in front of the object).

4.12.2 Environmental Impacts and Mitigation

The Project will have minimal and insignificant visual impacts to visual resources within the Study Area. The above ground components are consistent with other adjacent uses in the Northern and Southern Converter Station sites and visibility will be minimal due to existing topography, vegetation, structures, and the relatively low profile of the facility.

4.12.2.1 Potential Visual Effects – Northern Converter Station

Visual impacts associated with the Northern Converter station will be minimal due to the lack of significant visibility resulting from the linear broad valley in which the Converter Station will be situated and dense vegetation throughout the three mile North Study Area. Additionally, the existing utilities located on the project site such as the Athens Generating Plant, Leeds Substation, and associated overhead utility lines tend to draw focus from the proposed converter station as demonstrated Figure 4.12-2 Sheet 2).

As shown in the viewshed analysis (Figure 4.12-1 Sheet 2) using a bare earth scenario and sampling the tallest structure within the Converter Station (the narrow profile lightning masts), approximately 20 percent of the three mile study area will have potential visibility of the Northern Converter Station. As demonstrated in Table 4.12-1, one of the two Scenic Areas of Statewide Significance, and 2 of the 14 National register Historic Sites may have potential visibility of the Northern Converter Station. These results are considered very conservative since the lightning masts, in fact, will only be visible over short distances. When considering the control building as the tallest visible component, 17 percent of the Study Area, will have potential views of the Converter Station. Additionally, the converter station will not be visible from the Hudson River.

The viewshed analysis that incorporates the screening effect of vegetation (Figure 4.12-1 Sheet 1) suggests that only two percent of the study area will have visibility. As demonstrated in Table 4.12-1, the two Scenic Areas of Statewide Significance and 12 of the 14 National register Historic

Sites will have no open unobstructed views of the Northern Converter Station. These results are considered very conservative since the lightning masts will only be visible over short distances. When considering the control building as the tallest visible component, only 1.4 percent of the Study Area will have potential views of the Converter Station.

The visual simulations in Figure 4.12-2 Sheets 2 and 3 show both a standard 50 mm frame and an expanded panorama view. While the Northern Converter Station is a new built element in the view, the color, texture and form of the view is minimally interrupted. The viewpoint location is on Leeds-Athens Road, approximately 0.54 miles south of the Converter Station, and the lightning masts are the only elements within the Converter Station that protrude above the visual horizon. The lightning masts already have a very narrow profile, and at this viewing distance, do not create a strong vertical interruption. The lower profile of the remaining structures tends to blend with the background vegetation. However, seasonal color contrasts may make the structures more apparent. The expanded panorama view of the Northern Converter Station shows the Project in context with the existing utility lines and the Athens Generating Plant. The Converter Station adds minimal additional visual clutter due to its scale relative to the existing power plant and transmission lines.

4.12.2.2 Potential Visual Effects – Southern Converter Station

Visual impacts associated with the Southern Converter station will be minimal due to the dense vegetation and developed nature of the three mile South Study Area. The Southern Converter Station will be visible from scenic and historic resources on both sides of the Hudson River (including the Hudson itself). However, high voltage overhead powerlines, substations, and a large energy generating station already in operation in this area are much larger and more visible and will draw the viewers' attention away from the Converter Station, if not completely screen views from many vantage points.

As shown in the viewshed analysis (Figure 4.12-1 Sheet 4) using a bare earth scenario and sampling the tallest structure within the Converter Station (the narrow profile lightning masts), approximately 51 percent of the three mile study area will have potential visibility of the Southern Converter Station. As demonstrated in Table 4.12-1, the Hudson Highlands Scenic Area of Statewide Significance may have potential views of the Proposed Southern Converter Station. However, this Scenic Area is nearly one mile north of the Converter Station, thus visibility will be minimal, if not screened, from many locations. Three of the 14 National Register Historic Sites will have no open views of the Southern Converter Station. These results are considered very conservative since the lightning masts will only be visible over short distances. When considering the control building as the tallest visible component, 46 percent of the Study Area will have potential views of the Southern Converter Station.

The viewshed analysis that incorporates the screening effect of vegetation (Figure 4.12-1 Sheet 3) suggests that 27 percent of the study area will have visibility. As demonstrated in Table 4.12-1, six of the 14 National register Historic Sites will have no open views of the Northern Converter Station. These results are considered very conservative since the lightning masts will only be visible over short distances. When considering the control building as the tallest visible component, only 19 percent of the Study Area has potential project visibility.

The Southern Converter Station will be visible from scenic and historic resources on both sides of the Hudson River (including the Hudson itself).

The visual simulation (Figure 4.12-2 Sheet 5) of the Southern Converter Station is taken from a recreation field directly adjacent to the proposed site on the corner of Broadway and 11th Street in the Town of Cortlandt, approximately 500 feet southeast of the Converter Station. The existing view includes a portion of the ball field and an early successional wooded lot behind it. The simulation demonstrates that the Converter Station is relatively well screened by the remaining vegetation between the site and the ball field. During the summer months it is likely that the majority of the Converter Station will be obscured from view, with the exception of the access road opening. This is one view for which offsite mitigation could be considered to create a planting buffer between the ball field and the Converter Station.

Some resources directly adjacent to the Converter Station, such as the recreation field, may experience minor visual impacts resulting from tree clearing and the operation of the facility. Siting considerations such as facility layout and distance from these resources have been implemented and will reduce the potential for impact. Additional mitigation measures, such as vegetative screening should be considered where practicable.

4.12.2.3 Potential Visual Effects During Construction

There will also be minor temporary visual impacts associated with the construction of the Converter Stations and installation of the Cables, but these will be insignificant and of relatively short duration. The planned underground burial of the cable in the vicinity of potential sensitive visual receptors will be similar or less in scale than typical road resurfacing or underground utility maintenance operations that can occur at any time in the area. During construction of the underground Land Cables, installation of the Transition Vaults, HDD operations, and the interconnection of the Cable System to the Leeds and Buchannan North Substations, temporary construction equipment will be visible at some point along the entire Land and In-River Cable Route. Due to the generally low elevation of the landfall sites and existing vegetation, construction activities will not be visible from many of the visual and aesthetic resources in the study area.

Potential visual impacts of Project construction at those visual and aesthetic resources in the study area with open views of the Landfalls and along the In-River Cable Route will be minimal, localized, and temporary. Any visual impacts will be mitigated by the temporary nature of the activity, the nature of their immediate context (existing industrialized areas), and the existence of vegetation and screening structures.

4.12.2.4 Potential Visual Effects During Operation

Once construction is complete, the Land Cable will be located below ground except for approximately 20 to 25 feet of cable and accessory structures located at the point of interconnection within the Leeds and Buchannan Substations. The In-River Cable will obviously not be visible from land. The Transition Vaults will be installed underground with a manhole cover at grade to allow access for maintenance purposes. The Converter Stations will be the only other visible components of the Project.

4.13 Noise

This section describes noise, or sound level concepts, existing ambient noise levels in the areas where the proposed Project will be constructed and operated, applicable noise guidelines and community standards, and the anticipated potential construction and operational noise impacts on noise sensitive areas as well as the proposed mitigation measures to reduce projected impacts.

A detailed Noise Level Evaluation of the Project was completed in 2013 that identifies the study areas and the testing methodology, provides summaries of the measurements taken of existing ambient noise levels for the identified noise sensitive areas, and provides the results of the modeling of noise impacts on noise sensitive areas for both construction and operation of the Project is provided in Appendix 4G.

The results of the Noise Level Evaluation demonstrate that the predicted noise levels resulting from the construction of the Project will be temporary and will vary depending on the particular phase of construction and the proximity of the construction activity to noise sensitive areas. It also predicts that the noise levels resulting from the operation of the Project will conform to applicable NYSDEC and community standards.

4.13.1 Existing Conditions

4.13.1.1 Sound Level Concepts

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that interferes or disrupts normal activities. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. The reaction of individuals to similar noise events is diverse and influenced by numerous factors, such as the type of noise, its perceived importance, the time of day during which the noise occurs, its duration, frequency, level, etc.

Noise is measured using a standardized instrument called a ”sound level meter”. All sound level meters are equipped with small microphones that detect minute changes in atmospheric pressure caused by the mechanical vibration of air molecules. Healthy human hearing can detect pressures as low as 0.00002 Pascals (threshold of hearing) to more than 100 Pascals (threshold of pain).[2] Since this dynamic range is enormous (greater than one million to one), sound pressures are reported using a logarithmic scale, which compresses the numbers to keep them more manageable. Once converted, they are referred to as sound pressure levels, followed by decibels (abbreviated dB) as the unit of measure. On a logarithmic scale, the threshold of hearing and the threshold of pain are 0 and approximately 130 decibels, respectively.

Noise is generally characterized by amplitude (level) and by frequency (pitch). Amplitude can be reported using various human-perception scales, similar to reporting temperature in terms of wind chill or humidity in terms of dew point. The latter are better indicators of perceived cold or dampness, respectively. Similarly, sound level measurements are often reported using the 'A-weighting' scale of a sound level meter. A-weighting slightly boosts high frequency sound, while reducing low frequency components (similar to the way stereo bass and treble controls work) providing a better indicator of perceived loudness at relatively modest volumes. These measures are called A-weighted levels, (abbreviated dBA). Table 4.13-1 provides A-weighted noise levels of familiar noise sources and activities.

[2] - A Pascal is a unit of pressure (one Pascal is equivalent to about 0.02 lbs/ft^2). A single Pascal of pressure will produce a sound pressure level of 94 dB.

Table 4.13-1: Common Sound Levels/Sources and Subjective Human Responses

Thresholds/Noise Sources	Noise Level (dBA)	Subjective Evaluations
Human Threshold of Pain Carrier Jet Takeoff (50 feet)	140	
Siren (100 feet) Loud Rock Band	130	
Jet Takeoff (200 feet) Auto Horn (3 feet)	120	Deafening
Chain Saw Noisy Snowmobile	110	
Lawn Mower (3 feet) Noisy Motorcycle (50 feet)	100	
Heavy Truck (50 feet)	90	Very Loud
Pneumatic Drill (50 feet) Busy Urban Street, Daytime	80	
Normal Automobile at 50 mph Vacuum Cleaner (3 feet)	70	Loud
Large Air Conditioning Unit (20 feet) Conversation (3 feet)	60	
Quiet Residential Area Light Auto Traffic (100 feet)	50	Moderate
Library Quiet Home	40	
Soft Whisper	30	Faint
Slight Rustling of Leaves	20	
Broadcasting Studio	10	Very Faint
Threshold of Human Hearing	0	

The ability of an individual to perceive changes in noise levels is well documented and summarized in Table 4.13-2. Generally, changes less than 3 dBA are barely perceptible to most listeners outside laboratory conditions, whereas a 10 decibel change is normally perceived as a doubling (or halving) of loudness.

Table 4.13-2: Average Ability to Perceive Changes in Noise Levels

Change in Sound Level (dBA)	Human Perception of Sound
2–3	Barely perceptible
5	Readily noticeable
10	A doubling or halving of the loudness of sound
20	A “dramatic change”
40	Difference between a faintly audible sound and a very loud sound
Source: BBN 1973	

Environmental noise levels constantly change over time and at any given moment are often combinations of natural sounds from birds, insects or tree rustle; noise from local or distant traffic; and/or from industrial, commercial and residential activities. In order to separate low-level constant noise sources (the din of distant traffic, for example) from louder, short-duration events (such as aircraft flyovers or vehicle pass-bys) percentile or ”exceedance” measurements are often used. These measures help describe the ”average” noise level as well as the range of highs to lows for any given measurement period.

L_{10} (L-Ten) is the level exceeded 10% of the time, that is, levels are higher than this value only 10% of the measurement time. The L_{10} typically represents the loudest and shortest noise events occurring in the environment, such as car and truck pass-bys or aircraft flyovers.

L_{50} (L-Fifty) is the sound level exceeded 50% of the time. Levels will be above and below this value exactly one-half of the measurement time, and therefore the L_{50} is sometimes referred to as the 'median' sound level.

L_{90} (L-Ninety) is the sound level exceeded 90% of the time and is often called the 'background' sound level. Measured levels are higher than this value most of the measurement time, so the L_{90} represents the relatively low-level, constant noise present in the environment, discernible only when temporary or varying noises such as bird calls, car pass-bys or aircraft flyovers cease.

Noise levels may also be reported in terms of "equivalent energy levels" or L_{EQ}. An L_{EQ} is a single, calculated value that is equal in energy to the actual fluctuating noise for any given measurement period.

Day-Night Levels or L_{DN}, are determined from hourly L_{EQ} measurements and represent a 24-hour assessment of noise within a community. The L_{DN} is calculated by adding a 10-decibel ‘penalty’ to hourly L_{EQ} measurements collected between 10 p.m. and 7 a.m. to account for the potential of increased annoyance when people are resting, relaxing or sleeping.

Sound power level (PWL) is a single number that ranks how much sound energy is produced by a piece of equipment, independent of the surroundings or environment, and allows one piece of equipment to be directly compared with another. Sound power levels for each major piece of equipment were used in a computer-generated acoustical model of the Project to predict off-site noise levels.

4.13.1.2 Baseline Sound Level Measurements

An ambient sound level survey was conducted for the proposed Project which included surveys for the proposed sites for the Northern Converter Station, the Northern Landfall, the Northern Land Transmission Cable Route in the Town of Athens and the Southern Converter Station, the Southern Landfall and the Southern Land Transmission Cable Route in the Town of Cortland.

The goals of the noise surveys were to determine the location of Noise Sensitive Areas (NSAs) near the sites proposed for the Project, to determine the baseline sound levels in these areas, and to determine the sources of existing sound levels. A reconnaissance of each of the sites associated with the Project was performed to identify NSAs such as residential and other land uses that could potentially be impacted by noise from the Project. The nearest NSAs to the proposed sites for the Project were found to be all residential properties.

A total of eight measurement locations were selected as being representative of these NSAs, four in the areas involved with the Project near the Northern Converter Station and four in the areas involved with the Project near the Southern Converter Station. A description of each location is provided in Tables 4.13-3 and 4.13-4, below. All distance references are from the center of the proposed Converter Station parcels.

Northern Site Noise Sensitive Areas. At the proposed Northern Converter Station site near the Town of Athens, the closest residences are located approximately 650 feet to the east along Flats Road Extension. There are residences located along most of Flats Road Extension, as well as along Schoharie Turnpike to the north and Howard Hall Road to the northeast. Directional drilling to support the installation of the transmission cable landfall will take place at the edge of the Hudson River just north of the Village of Athens. The closest residences to this location are approximately 750 feet to the west along Highway 385 (Washington Street).

Table 4.13-3: Nearest Noise-Sensitive Receivers - Northern Site

Receiver	Location	Description
N1	Flats Road Extension	• Representative of nearest residential properties located along Flats Road Extension • Nearest residence located ~650 feet east of proposed Station • Open field and trees in-between • Residences located ~100 feet higher in elevation than Station
N2	Howard Hall Road	• Representative of residences located along Howard Halls Road and Schoharie Turnpike • Residences located at least 4,000 feet from proposed Station • Mainly trees in-between • Residences located ~100 feet higher in elevation than Station
N3	Highway 9W	• Representative of residences and motels located along Highway 9W • Residences located at least 3,800 feet from proposed Station • Mix of open field and trees in-between • Similar elevation with proposed Station
N4	Highway 385 near Cable Landfall	• Representative of residences located near landfall area • Nearest residences located approximately 700 feet west of landfall area • Highway 385 in-between • Residences located approximately 25 to 50 feet above elevation of landfall
N4A	Village of Athens	• Representative of residences within Village of Athens

The major and constant sources of the background sound levels at the proposed Northern Converter Station site include long and frequent (daily) freight train transit, the Leeds Substation, the Athens Generating Station, distant traffic, birds and insects, and traffic on local roads. Occasionally audible were dogs, overhead planes, and distant industrial blowers. The measured L_{EQ} sound levels at the closest residence to the proposed site ranged from approximately 40 to 45 dBA during the nighttime hours to 45 to 55 dBA during the daytime hours. The louder levels during the daytime are attributable to traffic, winds, birds, and the activities of residents. Noise levels were lowest along Flats Road Extension, and loudest along Highway 9W.

The ambient measured L_{EQ} sound levels from the short-term measurements taken at the proposed Northern Converter Station site and the proposed Northern Landfall area are provided in Table 4.13-4, as are descriptions of the audible sources during daytime and nighttime periods at each site. In general, ambient sound levels in the vicinity of the proposed Northern Converter Station are dominated by the existing Leeds Substation, the 1,080 megawatt combined-cycle Athens Generating Plant, freight trains, and local area highway traffic. At night, the Leeds substation is a continuous source of noise, while noise from trains fluctuates depending on the frequency of train cars passing through the area. Noise from the Athens Generating Plant fluctuated during the measurements, and does so seasonally as its gas turbine engines ramp up and down to meet dispatched and local electricity demands. During the daytime, noise levels were more directly influenced by surrounding local highway traffic. Very little local traffic was experienced on Flats Road Extension as it is more of a cut through connector, a moderate amount was experienced on Howard Hall Road, and significant levels of traffic were experienced on Highways 385 and 9W.

The sound levels measured by the continuous monitor at N1 generally range from 40 to 55 dBA (L_{EQ}). At night, the sound levels generally ranged from 40 to 45 dBA, with an average of 41 dBA (L_{EQ}) during the quietest four hour period (6 p.m. to 10 p.m. on April 22nd). The higher measured sound levels are presumed to be the result of noise from trains, traffic, wind, and activities at the residence where the monitor was placed.

At the proposed Northern Landfall area, daytime noise levels were approximately 50 dBA, and controlled primarily by traffic on Highway 385.

Table 4.13-4: Short-Term Ambient (L_{EQ}) Community Noise Levels - Northern Site

Location	Description	Daytime L_{EQ} Range (dBA)	Nighttime L_{EQ} Range (dBA)	Audible Sources
N1	Flats Road Extension	44	31 – 32[1]	Daytime: Leeds transformer station, trains, distant traffic, Athens Generating Plant
				Nighttime: Leeds transformer station, trains, distant traffic, breeze in pines
N2	Howard Hall Road	50 – 58	30 – 32[1]	Daytime: Distant and local traffic, breeze in pines, industry to north
				Nighttime: Distant traffic, crickets, mechanical 'hum' to north
N3	Highway 9W	65 – 68	53 – 55	Daytime: Traffic on 9W, distant traffic, birds
				Nighttime: Leeds transformer station, occasional 9W traffic, trains
N4	Landfall Area	49 – 50	---	Daytime: Traffic on Highway 385, distant traffic, distant pumps, birds
N4a	Village of Athens	---	36 – 38	Nighttime: Trains across river, distant traffic, chimes on houses

***Southern Site Noise Sensitive Areas*.** At the Southern Converter Station in Buchanan, NY, some 75 miles downriver from the Leeds Substation, the closest residences are located approximately 650 feet to the southeast along 11th Street. There are residences located all along the south side of 11th Street, as well as along the eastern side of Broadway. Directional drilling to support the installation of the Southern Landfall will take place at the edge of the Hudson River at the end of 9th Street. The closest residences to this location are approximately 650 feet to the southeast along 9th Street.

Table 4.13-5: Nearest Noise-Sensitive Receivers - Southern Site

Receiver	Location	Description
S1	Broadway and 16^{th} Street	• Representative of residences located east of the Converter Station and near Broadway • Nearest residences located ~800 feet east of proposed Station • Wooded land in-between • Residences located at approximately the same elevation as Station
S2	Broadway and 11^{th} Street	• Representative of residences located southeast of Station along Broadway and 11^{th} Street • Residences located approximately 800 feet from proposed Station • Mainly trees in-between • Residences located ~50 feet lower in elevation than Station
S3	11^{th} Street and Highland Avenue	• Representative of nearest residences to Station • Residences located ~550 feet from proposed Station • Mix of open field and trees in-between • Similar elevation with proposed Station
S4	9^{th} Street	• Representative of residences located near landfall area • Nearest residences located approximately 800 feet east of landfall area • Mainly trees in-between • Residences located approximately 25 to 50 feet above elevation of landfall

The main sources of the background sound levels at the proposed Southern Converter Station site include the drywall plant located to the north, freight trains, distant traffic, birds and insects, and traffic on local roads. Occasionally audible were dogs and overhead planes. The measured L_{EQ} sound levels at the closest residence to the proposed site ranged from approximately 40 to 50 dBA during both nighttime and daytime hours. The consistency in the levels from night to day is due to the fact that the drywall plant was operating 24 hours per day during the study and was the dominant noise source. Noise levels were lowest in the residential neighborhood adjacent to the proposed station, and loudest along Broadway.

The measured L_{EQ} sound levels from the short-term measurements conducted at the proposed Southern Converter Station and Southern Landfall area are provided in Table 4.13-6, as are descriptions of the audible sources during daytime and nighttime periods at each site. In general, ambient sound levels in the vicinity of the Southern Converter Station were controlled by the drywall plant, trains, and local and distant traffic. At night, the drywall plant was a continuous source of noise, while noise from trains fluctuated. During the daytime, noise levels were more a function of local traffic volumes. A moderate amount of traffic was experienced on Broadway, with relatively little local traffic on all other roads.

The sound levels measured by the continuous monitor at S3 generally ranged from 40 to 50 dBA (L_{EQ}). At night, the measured sound levels generally ranged from 40 to 45 dBA, with an average of 40 dBA (L_{EQ}) during the quietest four hour period (9 p.m. to 1 a.m. on April 22^{nd}). The higher sound levels measured are presumed to be the result of noise from trains, traffic, wind, and activities at the residence where the monitor was placed.

Table 4.13-6: Short-Term Ambient (L_{EQ}) Community Noise Levels – Southern Site

Location	Description	Daytime L_{EQ} Range (dBA)	Nighttime L_{EQ} Range (dBA)	Audible Sources
S1	Broadway and 16th Street	56 – 62	47 – 49	Daytime: Drywall plant, birds, traffic on Broadway
				Nighttime: Drywall plant
S2	Broadway and 11th Street	48 – 54	46 – 47	Daytime: Drywall plant, birds, local traffic
				Nighttime: Drywall plant
S3	11th Street and Highland Ave	40 – 50	40 – 45	Daytime: Drywall plant, birds, local traffic
				Nighttime: drywall plant
S4	Landfall Area at end of 9th Street	48 – 50	43	Daytime: Birds, distant traffic, drywall plant (faint)
				Nighttime: Drywall plant

4.13.1.3 Applicable Noise Regulations

This section describes laws, ordinances, regulations, and standards (LORS) for the control of noise applicable to the Project and/or considered for this evaluation. Applicable regulations and land use guidelines are summarized in Table 4.13-8.

Federal LORS for Noise Control. Although no noise-related federal LORS affect this project, guidelines promulgated at the federal level address a broad range of noise impact issues. Specifically, as a result of the Noise Control Act of 1972, the U.S. Environmental Protection Agency (EPA) identified noise levels affecting residential land use, which are mostly stated in terms of Day-Night levels, and are summarized on Table 4.13-7. The EPA concluded that exposure to outdoor noise levels at or below an L_{DN} of 55 dBA or to indoor noise levels at or below an L_{DN} of 45 dBA, is satisfactory to “protect the public health and welfare” since such exposure would not normally result in adverse community reaction, complaint, or annoyance in average communities that have moderate levels of background noise.

Table 4.13-7: EPA Noise Levels Identified to Protect Public Health and Welfare

Effect	Level	Area
Hearing loss	$L_{EQ}(24) \leq 70$ dB	All areas
Outdoor activity interference	$L_{DN} \leq 55$ dB	Outdoors in residential areas and farms, other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use
	$L_{EQ}(24) \leq 55$ dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, parks, etc.
Indoor activity interference and annoyance	$L_{DN} \leq 45$ dB	Indoor residential areas
	$L_{EQ}(24) \leq 45$ dB	Other indoor areas with human activities, such as schools

Source: EPA

New York State Department of Environmental Conservation. The New York State Department of Environmental Conservation (NYSDEC) noise guidelines are defined in their publication, “Assessing and Mitigating Noise Impacts” (see Appendix 4G NYSDEC Guidelines). This document states that sound pressure level (SPL) increases from 0 to 3 decibels should have no appreciable effect on receivers; increases of 3 to 6 decibels may have the potential for adverse impact only in cases where the most sensitive of receptors are present; and increases of more than 6 decibels may require a closer analysis of impact potential depending on existing noise levels and the character of surrounding land uses. The guideline further states that, in terms of threshold values, the addition of any noise source should not raise ambient levels above 65 dBA in non-industrial settings or above approximately 79 dBA for industrial environments. NYSDEC recommends that projects exceeding these threshold levels should explore the feasibility of implementing mitigation.

New York State Public Service Commission. The New York State Public Service Commission (NYSPSC) has not established noise criteria for Article 7 submittals, such as the Project. However, NYSPSC siting guidelines for Article 10 submittals requires the reporting of existing noise environments and projections of future noise levels by which new-source noise impacts at residential receptors may be evaluated (see Appendix 4G, NYSPSC Siting Guidelines). Although this report attempts to satisfy the general intent of these guidelines, the NYSPSC, at its discretion, may require specific reporting or assessment beyond what is addressed herein.

Greene and Westchester Counties. Neither Greene County nor Westchester County has established LORS that would specifically limit noise from the Project.

Town of Athens. The Town of Athens has established acceptable thresholds for ambient noise that should not be exceeded due to the addition of new noise sources. Specifically, new sources should not increase ambient levels above 65 dBA in nonindustrial settings, or above 79 dBA in industrial or commercial areas (see Appendix 4G, Town of Athens Administrative Legislation).

Village of Athens. The Village of Athens and Town of Athens abide by the same local ordinances and as such the above ambient noise thresholds identified under the Town of Athens apply as well to the Village of Athens.

Town of Cortlandt. The Town of Cortlandt limits noise emissions at the property line on which such noise is generated or perceived (as appropriate) to 65 dBA from 8 a.m. to 6 p.m. and to 55 dBA from 6 p.m. to 8 a.m. within residential zones, and to 65 dBA at any time within commercial zones. (*see* Appendix 4G – Town of Cortland Noise Control Law)

Village of Buchanan. The Village of Buchanan has not established LORS that would specifically limit noise from the Project.

Table 4.13-8: Summary of Noise Control Evaluation Standards Considered

Entity	Agency	Document	Standard or Guideline	
Federal	EPA	Levels Requisite to Protect Public Health & Welfare	$L_{DN} \leq 55$ dB	
State of New York	Department of Environmental Conservation	Assessing & Mitigating Noise Impacts	Increases to Ambient Noise at Sensitive Receivers Ideally Not More Than 3 dBA	Future Ambient Noise Limited to 65 dBA in Non-Industrial areas

Table 4.13-8: Summary of Noise Control Evaluation Standards Considered

Entity	Agency	Document	Standard or Guideline
State of New York	Public Service Commission	Siting Guidelines	Reporting of Existing Noise Environment and Projected Future Noise Environment
Town of Athens		Administrative Legislation	Future Ambient Noise Limited to 65 dBA in Non-Industrial Areas
Town of Cortlandt		Noise Control Law	Noise Emissions at Residential Receivers Limited to 65 dBA (Daytime) and 55 dBA (Nighttime)

4.13.2 Environmental Impacts and Mitigation

The construction and operation of the Project's proposed Converter Stations and Land Transmission Cables have the potential to subject sensitive land uses (such as residences) to noise. The following sections describe the potential construction and operation of the proposed Project.

4.13.2.1 Potential Construction Impacts and Mitigation

The construction of the proposed Northern and Southern Converter stations is expected to be similar to the construction of small-capacity power projects or large substations in terms of schedule and the equipment used. The sound levels from construction activities will vary depending upon the construction phase. Construction activities can generally be divided into five phases that use different types of equipment. These include: (1) site preparation and excavation; (2) concrete pouring; (3) steel erection; (4) mechanical equipment installation; and (5) clean-up.

The Project will also utilize HDD to install subterranean transmission cables at various locations in order to minimize impacts to environmentally sensitive areas such as the landfalls along the Hudson River and wetland areas near the existing Leeds substation. A total of three HDD installations are planned. One HDD drilling site is proposed near the northeastern side of the existing Leeds substation to aid installation of transmission cables between the existing Leeds substation and the proposed Northern Site Converter Station site. A second HDD drilling site is proposed near the Northern Landfall, just north of the intersection of Washington Street and Union Street. A third HDD drilling site is proposed near the Southern Landfall, at the western end of 9th Street.

The balance of the Land Transmission Cable will be installed in cable duct banks that will be installed either in open land or in existing streets using standard utility trenching and installation techniques, depending on the location. Excavation will be performed with standard earthmoving machinery, including excavators and backhoes, and will be performed in accordance with applicable industry standards. Once the duct banks are installed trenches will be backfilled using excavated soil and/or clean fill. Excess soil or soil unsuitable for use as backfill will be removed off-site as needed and in accordance with applicable regulations.

Construction of the Land Transmission Cable in existing roads will result in some short term construction activities occurring near residences located along the roads where the cable duct banks will be installed. The duct banks to be installed in the roadways are simply pipes installed in the ground through which the transmission cables will eventually be pulled. The open excavation construction activity will move past any one residence relatively quickly and will be similar to typical in-road utility construction that occurs in many communities every day. The in-road construction for the cable duct banks will occur during the daylight hours. During this construction activity a focus will be on keeping traffic flowing on these roadways to avoid impacts to the residences located in these areas. As a result, the in-road construction of the Land Transmission Cables will result in short term noise impacts to the residences along these roads. More detailed information on the Land Transmission Cable installation techniques will be provided in the EM&CP.

Project construction is expected to be completed over a 24-month period, with the heaviest construction activity occurring during the first three months. The three planned HDD activities will likely not all occur at the same time, but when HDD installation methods are employed they are expected to occur over a 1-month period for each of the three planned HDD installations.

Construction would likely take place over the course of daytime shifts, although it is possible that extensions of the basic workday, or moderate amounts of evening or weekend work would occur. However, construction activities that may be associated with higher increases in ambient noise levels would typically be scheduled only during weekday, daytime hours.

Appendix 4G ("Noise Level Evaluation for the West Point Transmission Project") provides a detailed analysis of the methods used to model the potential noise impacts from the construction of the Project. The methods used to estimate potential noise impacts rely on EPA Office of Noise Abatement and Control and the Empire State Electric Energy Research Corporation references for individual pieces of construction equipment as well as from power plant construction sites.

The following provides a summary of the noise modeling results for the projected construction activities planned for the Project. Since the planned construction activities primarily occur either at the location of the proposed site for the Northern Converter Station and the Northern Landfall or at the proposed site for the Southern Converter Station or the Southern Landfall, the potential construction noise impacts are presented in the following two tables.

Noise Modeling Results - Northern Converter Station and Landfall. Table 4.13-9 identifies the worst-case modeled construction noise levels (L_{EQ}) for the various construction activities at each of the identified sensitive receptor locations. The noise levels are predicted to range from a low of 12 dBA to a high of 75 dBA at nearby residences with the specific impacts being highly dependent on the specific site of the on-going construction activity and the distance of any specific residence to that construction activity.

Table 4.13-9: Projected Northern Site Construction Noise Levels—(L_{EQ})

Position	Construction Phase or Activity					
	Horizontal Drilling	Grading and Excavation	Concrete Pouring	Steel Erection	Equipment Installation	Finishing
Project East Property Boundary (Nearest Residence on Flats Road Extension)	53	75	71	75	70	65
Additional Residence on Flats Road Extension (Monitor N1)	57	53	49	53	48	43
Residences on Schoharie Turnpike (Monitor N2)	34	42	38	42	37	32
Residences on Route 9W (Monitor N3)	36	43	39	43	38	33
Residences on Washington Street (Monitor N4)	66	22	18	22	17	12

Noise Modeling Results - Southern Converter Station and Landfall. Table 4.13-10 identifies that worst-case construction noise levels (LEQ) are predicted to range from a low of 41 dBA to a high of 63 dBA at nearby residences with the specific impacts being highly dependent on the specific site of the on-going construction activity and the distance of any specific residence to that construction activity.

Table 4.13-10: Projected Southern Site Construction Noise Levels—(L_{EQ})

Position	Construction Phase or Activity					
	Horizontal Drilling	Grading and Excavation	Concrete Pouring	Steel Erection	Equipment Installation	Finishing
Residences on Broadway (Monitor S1)	41	63	59	63	58	53
Residences on Broadway (Monitor S2)	41	63	59	63	58	53
Residences on 11th Street (Monitor S3)	49	63	59	63	58	53
Residences on 9th Street (Monitor S4)	55	57	53	57	52	47

In general, it is anticipated that construction noise levels will be noticeably above current ambient noise levels (LEQ) at the residences nearest to HDD and converter station construction activity. Note these noise emissions represent outdoor levels and that a building or home would provide significant attenuation (i.e., reduction of noise by the building structure). Specifically, noise levels within a building would be up to 27 dBA lower assuming closed windows. Even with open windows, indoor levels would be up to 17 dBA lower than levels observed outside. Moreover, these projected levels are expected to be temporary and transitory in nature. The average individual is likely to accept noise associated with construction given its temporary nature and that the majority of construction will take place during daytime hours (i.e., when acceptance towards noise is higher and the risk of sleep disturbance and interference with relaxation activities is lower). Any nighttime or weekend construction activities will likely be similar to the "finishing phase" of construction, which is typically 10 decibels quieter than for other phases. Also, the size of a nighttime work force would be significantly smaller than during typical daytime weekday hours, thereby further reducing noise levels. As such, only a temporary impact resulting from construction is expected. Mitigation of construction related noise then will be accomplished primarily by limiting the majority of construction to daylight hours.

4.13.2.2 Potential Operational Impacts and Mitigation

Operation of the proposed Project has the potential to subject sensitive land uses to stress and/or interference from noise. Once constructed, transmission cable systems do not produce noticeable noise emissions. Potential noise impacts associated with the operation of the proposed Project will primarily reflect noise emissions from the converter stations, which will operate continuously 24-hours per day. An operational noise analysis of each converter station was therefore conducted to evaluate this potential.

Appendix 4G ("Noise Level Evaluation for the West Point Transmission Project") provides a detailed analysis of the methods used to model the potential noise impacts from the future operation of both the Northern and Southern Converter Stations which are the only permanent potential noise sources for the Project. Expected noise levels for the two converter stations were based on the converter stations layouts and expected noise levels for the converter station equipment as provided by the Project's converter station equipment supplier (Siemens).

Tables 4.13-11 and 4.13-12 below provide a summary of the operational noise modeling results for the two converter stations.

Noise Modeling Results - Northern Converter Station. As summarized in Table 4.13-11 the worst-case operation noise levels (LEQ) are predicted to range from a low of 19 dBA to a high of 50 dBA at nearby residences.

Table 4.13-11: Projected Northern Site Operation Noise Levels—(L_{EQ})

Location	Project Noise Level (dBA)
Project East Property Boundary (Nearest Residence on Flats Road Extension)	50
Additional Residence on Flats Road Extension (Monitor N1)	32
Residences on Schoharie Turnpike (Monitor N2)	19
Residences on Highway 9W (Monitor N3)	24

Noise Modeling Results - Southern Converter Station. As summarized in Table 4.13-12 the worst-case operation noise levels (LEQ) are predicted to range from a low of 34 dBA to a high of 45 dBA at nearby residences.

Table 4.13-12: Projected Southern Site Operation Noise Levels—(L_{EQ})

Location	Project Noise Level (dBA)
Residences on Broadway (Monitor S1)	34
Residences on Broadway (Monitor S2)	37
Residences on 11th St (Monitor S3)	45
Residences on 9th St (Monitor S4)	38

4.13.2.3 Operational Noise Level Evaluation

This section provides an analysis of the modeled operational noise levels at the nearest Noise Sensitive Areas (NSAs) and compares these noise levels to the applicable regulations and land use guidelines previously identified in Table 4.13-8.

Federal. Although the Project does not require any specific permits and/or approvals from the U.S. EPA, it is useful to note that the EPA has concluded that exposure to outdoor noise levels at or below LDN = 55 dB is satisfactory to "protect the public health and welfare" since such exposure would not normally result in adverse community reaction, complaint, or annoyance in average communities with moderate background noise. For constant sources of noise such as the Project's converter stations, the Day-Night level is readily calculated by adding approximately 7 decibels to the projected LEQ values provided in Tables 4.13-11 and 4.13-12 above. As shown in Table 4.13-13, LDN values range from 26 dBA to 57 dBA at the nearest noise-sensitive areas and therefore are generally consistent with EPA recommended guidelines for noise control.

Table 4.13-13: Day-Night (L_{DN}) Noise Levels

Position	Description	Operational Noise Level (L_{EQ})	Day-Night Level (L_{DN})
North	Project East Property Boundary (Nearest Residence on Flats Road Extension)	50	57
North	Additional Residence on Flats Road Extension (Monitor N1)	32	39
North	Residences on Schoharie Turnpike (Monitor N2)	19	26
North	Residences on Highway 9W (Monitor N3)	24	31
South	Residences on Broadway (Monitor S1)	34	41
South	Residences on Broadway (Monitor S2)	37	44
South	Residences on 11th St (Monitor S3)	45	52
South	Residences on 9th St (Monitor S4)	38	45

New York State Department of Environmental Conservation. The New York State Department of Environmental Conservation (NYSDEC) indicates that sound pressure level increases from 0 to 3 decibels should have no appreciable effect on receivers and that the addition of any noise source in a non-industrial setting should not raise ambient noise above 65 dBA.

As summarized in Table 4.13-14, no significant increase (less than 3 decibels) in existing ambient noise levels is expected at most residences. Ambient increases that may have the potential for adverse impact (3 to 6 decibels) are expected at some receivers near the north and south converter stations. The residence nearest to the northern converter station may experience increases to ambient noise greater than 6 decibels. Additionally, future noise levels are not expected to exceed 65 dBA at any residential location.

Table 4.13-14: Current Ambient Noise Levels versus Future Ambient Noise Levels (dBA)

Site Location	Description	Current Ambient Noise Level (L_{EQ})	Predicted Project Noise Level (L_{EQ})	Future Ambient Noise Level (L_{EQ})	Change in Noise Level
North	Project East Property Boundary (Nearest Residence on Flats Road Extension)	41[3]	50	51	+10
North	Additional Residence on Flats Road Extension (Monitor N1)	41	32	42	+1

[3] - Arithmetic average of four quietest consecutive hours.

Table 4.13-14: Current Ambient Noise Levels versus Future Ambient Noise Levels (dBA)

Site Location	Description	Current Ambient Noise Level (L_{EQ})	Predicted Project Noise Level (L_{EQ})	Future Ambient Noise Level (L_{EQ})	Change in Noise Level
North	Residences on Schoharie Turnpike (Monitor N2)	30	19	30	+0
North	Residences on Highway 9W (Monitor N3)	53	24	53	+0
South	Residences on Broadway (Monitor S1)	47	34	47	+0
South	Residences on Broadway (Monitor S2)	46	37	47	+1
South	Residences on 11th St (Monitor S3)	40	45	46	+6
South	Residences on 9th St (Monitor S4)	43	38	44	+1

Town of Athens. The Town of Athens restricts the addition of new noise sources from increasing ambient noise levels above a maximum of 65 dBA within non-industrial settings. As summarized in Table 4.13-15 below, predicted ambient noise levels during Project operation are expected to range from approximately 30 dBA up to 51 dBA, and are therefore well below Town of Athens requirements.

Table 4.13-15: Town of Athens Compliance Evaluation (dBA)

Location	Existing Ambient Noise Level (L_{EQ})	Predicted Project Noise Level (L_{EQ})	Future Ambient Noise Level (L_{EQ})	Noise Limit for Non-Industrial Zones	Complies?
Project East Property Boundary (Nearest Residence on Flats Road Extension)	41[4]	50	51	65	Yes
Additional Residence on Flats Road Extension (Monitor N1)	41	32	42	65	Yes
Residences on Schoharie Turnpike (Monitor N2)	30	19	30	65	Yes
Residences on Highway 9W (Monitor N3)	53	24	53	65	Yes

[4] - Arithmetic average of four quietest consecutive hours.

Town of Cortlandt. The Town of Cortlandt limits Project noise emissions within residential areas to no more than 65 dBA during daytime hours (8 a.m. to 6 p.m.) and no more than 55 dBA during nighttime hours (6 p.m. to 8 a.m.). As summarized in Table 4.13-16 below, operational noise levels at nearby residences are expected to range from approximately 34 dBA up to 45 dBA, well below the nighttime noise level limits.

Table 4.13-16: Town of Cortlandt Compliance Evaluation (dBA)

Location	Predicted Operational Noise Level	Nighttime Residential Noise Limit	Complies?
Residences on Broadway (Monitor S1)	34	55	Yes
Residences on Broadway (Monitor S2)	37	55	Yes
Residences on 11th St (Monitor S3)	45	55	Yes
Residences on 9th St (Monitor S4)	38	55	Yes

Noise due to construction of the proposed Project's converter stations and transmission system will vary depending on the specific construction phase and proximity to construction activity. Construction is likely to increase ambient noise levels noticeably, but is expected to be accepted given its temporary nature. In general, operational noise levels at nearby residences are expected to be consistent with Federal guidelines (EPA), New York State guidelines (NYSDEC, NYSPSC), and local legislation for noise control (Town of Athens, Town of Cortlandt). Increases to existing ambient noise levels are predicted to be negligible at most nearby residences, but residences closest to the converter stations may experience more significant increases to ambient noise.

4.14 Electric and Magnetic Fields

This section includes an assessment of the electric and magnetic fields (referred to as EMF) associated with the operation of the proposed AC and DC transmission cables installed in the land based duct banks and the bundled DC transmission cables installed beneath the bottom of the Hudson River. The evaluation considers the general effects of the proposed Project and discusses measures proposed for assuring compliance with the New York State Interim Policy on EMF standards established to identify acceptable public exposure to EMF.

Analysis of electric and magnetic fields from the transmission cable installations demonstrates that the impacts will:

- Be well below human health-based guidelines (Ecological Impacts are addressed in Sections 4.6 and 4.7)
- Be well below the relevant New York State Interim Policy on EMF standards

4.14.1 Existing Conditions

The electric and magnetic fields (EMF) conditions present in the Project Area(s) are the result of existing natural phenomena and man-made electrical facilities at and along the proposed In-River and Land Transmission Cable Route.

Everyone experiences a variety of natural and man-made electric and magnetic fields. Electric fields arise naturally during electrical storms from the separation of charges and from voltages applied to conductors. These fields are typically measured in volts per meter. Most objects including fences, buildings and other conductive structures reflect or attenuate electric fields. For underground electric lines, conductive wrapping on the cable as well as the ground or water will shield the electric field.

Magnetic fields are produced by the flow of electric current and are typically measured as the flux density in milligauss (mG). These fields are common in everyday life in household appliances, building wiring or other items that use electricity. The earth's core itself creates a static magnetic field that can be easily demonstrated with a compass needle. The size of the earth's magnetic field, in the Northern United States, is about 570 mG. Knowing the strength of the earth's magnetic field provides a perspective on the low magnetic field measurements experienced near most electric transmission lines.

Table 4.14-1 shows guidelines suggested by various national and international health organizations for both electric and magnetic fields. Table 4.14-2 lists guidelines that have been adopted by various states in the U.S. The first table provides EMF levels which were developed to be protective against adverse health effects, but which should not be viewed as representing EMF levels that have been proven as safe versus un-safe; the values shown are simply guidelines based on current knowledge.

The second table shows guidelines that have been adopted by a number of U.S. states to establish EMF design guidance for future transmission line right of ways that are equivalent to that currently measured within or at the edge of existing transmission rights of way for similarly configured transmission-lines; these EMF state guidelines are not health-based standards but simply guidelines to maintain EMF values for new transmission lines at EMF measurements experienced for existing similarly configured transmission lines.

Table 4.14-1: 60-Hz EMF Guidelines Established by Health & Safety Organizations

Organization	Magnetic Field	Electric Field
American Conference of Governmental and Industrial Hygienists (ACGIH) (occupational)	10,000 mG [a] 1,000 mG [b]	25 kV/m [a] 1 kV/m [b]
International Commission on Non-Ionizing Radiation Protection (ICNIRP) (general public, continuous exposure)	2,000 mG	4.2 kV/m
Non-Ionizing Radiation (NIR) Committee of the American Industrial Hygiene Assoc. (AIHA) endorsed (in 2003) ICNIRP's occupational EMF levels for workers	4,170 mG	8.3 kV/m
Institute of Electrical and Electronics Engineers (IEEE) Standard C95.6 (general public, continuous exposure)	9,040 mG	5.0 kV/m
U.K., National Radiological Protection Board (NRPB) [now Health Protection Agency (HPA)]	2,000 mG	4.2 kV/m
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Draft Standard, Dec. 2006 [c]	3,000 mG	4.2 kV/m
*Comparison to **steady** (DC) EMF, encountered as EMF outside the 60-Hz frequency range:*		
Earth's magnetic field and atmospheric electric fields, steady levels, typical of environmental exposure [d]	[550 mG]	[0.2 kV/m up to > 12 kV/m]
Magnetic Resonance Imaging Scan, static magnetic field intensity [d]	[20,000,000 mG]	---

Notes:
[a] ACGIH guidelines for the general worker.
[b] ACGIH guideline for workers with cardiac pacemakers.
[c] http://www.arpansa.gov.au/pubs/comment/dr_elfstd.pdf; and http://www.arpansa.gov.au/News/events/elf.cfm
[d] These EMF are steady fields, and do not vary in time at the characteristic 60-cycles-per-second that power-line fields do. However, if a person moves in the presence of these fields, the body experiences a time-varying field.

Table 4.14-2: State EMF Standards and Guidelines for Transmission Lines

State / Line Voltage	Electric Field		Magnetic Field	
	On ROW	Edge ROW	On ROW	Edge ROW
Florida [c] 69 – 230 kV	8.0 kV/m	2.0 kV/m [f]		150 mG
230 kV and <= 500 kV	10.0 kV/m	2.0 kV/m [f]		200 mG,
>500 kV	15.0 kV/m	5.50 kV/m		250 mG [e]
Minnesota	8.0 kV/m			
Montana	7.0 kV/m [a]	1.0 kV/m [b]		
New Jersey		3.0 kV/m		
New York [c]	11.8 kV/m 11.0 kV/m [d] 7.0 kV/m [a]	1.6 kV/m		200 mG
Oregon	9.0 kV/m			

Key: ROW = right of way; mG = milliGauss; kV/m = kilovolts per meter
Notes:
[a] Maximum for highway crossings
[b] May be waived by the landowner
[c] Magnetic fields for winter-normal, maximum line-current capacity
[d] Maximum for private road crossings
[e] 500 kV double-circuit lines built on existing ROW's
[f] Includes the property boundary of a substation
Sources:"Questions and Answers About EMF." National Institute of Environmental Health Sciences and U.S. Department of Energy, 2002. http://www.niehs.nih.gov/health/topics/agents/emf/index.cfm
Florida, see: http://www.dep.state.fl.us/siting/files/rules_statutes/62_814_emf.pdf

4.14.2 Environmental Impacts and Mitigation

The following sections address potential EMF impacts during the construction and operation of the proposed Project.

4.14.2.1 Potential Construction Impacts and Mitigation

There are no potential EMF impacts from the proposed transmission lines during the construction of the Project given that none of the electrical equipment and transmission cables will be energized until the overall Project is placed into operation after extensive inspection and testing have been completed.

4.14.2.2 Potential Operational Impacts and Mitigation

The following assesses EMF associated with the operation of the proposed transmission Project.

Electric Fields

Electric fields are generated around all power lines when they are in operation or energized. The resulting strength of the electric field formed is dependent on the voltage of the power line and decreases with distance from the power line. Electric fields can easily be controlled by a wide range of materials that are effective in screening exposure to the fields or simply by increasing the distance from the source of the electric field. Any material that is even slightly conductive (materials that allows electric charges to flow within the material like wire or metal) can be used to screen out electric fields. Conductive materials that are electrically grounded are the most effective since these materials continually remove any electric charges that buildup within the material to ground, thus reducing the electric field.

Electric fields from modern transmission cables used in underground or submarine applications are controlled by a layer of metal sheathing incorporated into the design of the cables. The metal sheathing is grounded at both ends of the transmission cable to ensure that it continually drains away any electric field generated by the transmission cable. As a result, modern transmission cables do not generate electric fields in the vicinity of the cable. The ground or water beneath which the cable is buried will also shield the electric field.

Figures E-1.1 through E-1.3 provide a cross section drawing of typical modern AC and DC cables showing the (i) many layers of materials incorporated into the cable to meet the cable's requirements for long life and provide the needed electrical transmission capacity of the cable, (ii) materials to insulate the cable from the environment and (iii) a metal sheathing layer to eliminate electric fields being generated by these cables. The metal sheathing layer or shielding layer is identified in Figure E-1.1 through E-1.3. This cable design feature will be incorporated into all of the AC and DC transmission cables used in the Project; as a result there will be no electrical fields generated by the Project's transmission cables in the local environment around the transmission cables.

Magnetic Fields

Magnetic fields are another type of field produced by the flow of electricity or current in a conductor, where electric field strength is a function of the voltage. The strength of a magnetic field also decreases quickly with distance from the conductor which is one of the most frequently applied methods of controlling exposure to magnetic fields from transmission lines and cables.

Since the flow of electricity or load on a transmission cable varies with time of day based on the need for electric power in the region, the magnetic field associated with electric transmission lines also varies throughout the day and with seasonal changes in electric demand. In addition magnetic fields associated with DC cables will be static while the fields associated with AC cables will be time variable due to the 60 hz power line frequency.

Above ground transmission lines are typically located in transmission corridors or rights-of-way with the conductors suspended from towers or poles while transmission cables are typically installed below ground either by direct burial of the cable or in structures (duct banks) built to protect the cable and to aid in the installation of the cable.

All of the Project's transmission cables will either be installed in below ground structures called duct banks, as is the case for the land based AC and DC transmission cables, or as bundled DC cables to be installed below the bottom of the Hudson River.

As identified above, the land based AC and DC cables will be installed in buried underground duct banks which are simply structures consisting of conduits or pipes through which the transmission cables are pulled to complete the cable installation. Using a conduit protects the cable and speeds installation of the cable at a later time by providing a smooth pathway for the cable in the below ground duct bank. If more than one conduit is included, the overall arrangement of the conduits is referred as a "duct bank" (which is simply a series of underground pipes or conduits run in parallel through which transmission cables can be installed). Duct banks are often used when cables are installed in roadways to protect the cable from heavy traffic and to speed installation of the transmission cables thus reducing the overall construction time in these roadways.

Figure 4.14-1 and Figure 4.14-2 provide a cross section of the planned design for the duct banks for the Project's land based AC and DC cable installations showing the planned burial depth and concrete covering for these transmission cables. Figure 4.14-3 shows a cross section of the DC cable bundle typical of that which will be installed in the bottom of the Hudson River. The bundling of the DC cables aids in the installation of the transmission cables from ships used to install cables by jet plowing the cable bundle into the bottom of a river by allowing a single jet plow operation rather than installing the individual cables requiring more than one jet plow operation. A bundled DC transmission cable is simply a number of DC transmission cables bundled together in such a way that it aids in handling of the cables during installation. Figure 4.14-3 also shows the planed burial depth of the bundled DC transmission cables in the bottom of the Hudson River and the expected minimum depth of water over the DC bundled transmission cables.

As a result of the flow of electricity in the transmission cables, magnetic fields will be formed in the vicinity of each cable. Magnetic fields cannot be controlled by shielding or by simple burial of the transmission cables in the ground or river bottom. Appendix 4H provides the results of the EMF Analysis for magnetic fields for the Project's proposed transmission cable configurations. Magnetic field levels were calculated for three planned cable configurations as identified in Figures 4.14-1, Figure 4.14-2 and Figure 4.14-3. These three figures illustrate the cable burial configurations for the land based AC and DC cables and the bundled DC cables to be installed in the river bottom.

The maximum magnetic field that could be generated by each of the three transmission cable configurations were calculated at the maximum power rating expected for the Project, although the transmission cables may actually operate at a power rating that is less than the full design rating of these cables.

The calculated magnetic fields for each cable configuration are based on design information for of the transmission cables, such as the line voltage, current, conductor diameter, transmission line configuration, and depth of burial depth of the installed cables.

Tables 4.14-3, 4.14-4 and 4.14-5 provide the calculated results of the magnetic field levels (see Appendix 4H) for the AC and DC land based cable duct bank configurations and the bundled DC cables to be installed in the Hudson River bottom.

The calculated AC magnetic field identified in Table 4.14-3 for the underground AC cables is below the 200 mG level specified in the Statement of Interim Policy on Magnetic Fields of Major Electric Transmission Facilities (NYSPSC, September 11, 1990) above the AC circuits for separations of 2, 4, 6, and 8 feet and at ±75 feet from the centerline.

Although the Statement of Interim Policy on Magnetic Fields of Major Electric Transmission Facilities (NYSPSC, September 11, 1990) was not designed to address magnetic fields from DC transmission lines, Tables 4.14-4 and 4.14-5 provide the calculated peak DC magnetic field levels for the DC land based duct bank configuration and the bundled DC cables to be installed in the Hudson River bottom at various distances from the cables.

Table 4.14-4 identifies the DC magnetic field calculated at the river bottom for the DC cable bundle installed in the river as shown in Figure 4.14-3. The DC magnetic field directly above the DC cable bundle will have a peak of 88 mG with the field quickly decreasing to approximately 2 mG 50 feet to either side of the cable installation. At the surface of the Hudson River, the magnetic field from the DC cable bundle installed in the river bottom is only 8.7 mG at its peak location directly over the DC cable bundle and quickly decreases to 1.9 mG 50 feet away.

Table 4.14-5 identifies the DC magnetic field calculated at 1 meter above the land based DC cable installations as shown in Figure 4.14-2. The DC magnetic field 1 meter directly above the land based DC cable installations will have a peak of 187 mG with the field quickly decreasing to approximately 1 mG 100 feet to either side of the cable installation.

Both tables 4.14-4 and 4.14-5 show the peak magnetic fields for either the DC bundled cables installed in the river bottom or the land based DC cables will all be below the 200 mG standard identified in the Statement of Interim Policy on Magnetic Fields of Major transmission Facilities[2].

As with other recently approved electric transmission facilities, WPP will submit certification by a New York licensed professional engineer that the all of the transmission cable installations comply with New York State Interim Policy on EMF standards, as constructed in accordance with final design plans, with the EM&CP.

Table 4.14-3: Major axis AC magnetic field levels (mG) 1 meter above ground for the Land Based AC circuits

	AC magnetic-field level (mG)								
Separation between Duct Banks	**-100’**	**-50’**	**-25’**	**-10’**	**Peak**	**10’**	**25’**	**50’**	**100’**
2 feet between duct banks (4.5 feet from circuit CL-CL)	0.64	2.6	9.7	44	92	44	9.7	2.6	0.64
4 feet between duct banks (6.5 feet from circuit CL-CL)	0.64	2.6	9.9	45	73	45	9.9	2.6	0.64
6 feet between duct banks (8.5 feet from circuit CL-CL)	0.64	2.6	11	47	64	47	11	2.6	0.64
8 feet between duct banks (10.5 feet circuit CL-CL)	0.64	2.6	11	49	60	49	11	2.6	0.64

Table 4.14-4: DC magnetic field levels (mG) for the river-based portion of the DC lines

	DC Magnetic Field Level (mG)								
Location	**-100’**	**-50’**	**-25’**	**-10’**	**Peak**	**+10**	**+25**	**+50’**	**+100’**
On the river bottom (DC cable buried 8 feet under the river bed)	0.60	2.4	8.7	36	88	36	8.7	2.4	0.60
On the surface of the river (DC cable 26 feet below the river surface)	0.57	1.9	4.6	7.6	8.7	7.6	4.6	1.9	0.57

Table 4.14-5: DC magnetic field levels (mG) 1 meter above ground for the Land Based DC lines

	DC Magnetic Field Level (mG)								
Location	**-100’**	**-50’**	**-25’**	**-10’**	**Peak**	**+10’**	**+25’**	**+50’**	**+100’**
At 1 meter above ground (DC cable buried ~ 4 feet)	1.0	4.0	15	67	187	67	15	4.0	1.0

4.15 Summary of Impacts

The West Point Transmission Project (the Project) has been sited and designed to avoid impacts to environmental resources within the Project area and along the Project route. Where impacts may be unavoidable, the Project has been designed to minimize them to the greatest extent possible. A summary of the potential environmental impacts associated with the installation and operation of the Project is provided below and described in more detail in the previous sections.

Table 4.15-1: Summary of Potential Environmental Impacts

Resource	Potential Impact	Overall Significance
Land		
Topography	Minor	• Most of the Land Cable and the Transition Vaults will be installed within existing paved roads and other previously disturbed areas. Once the cable is buried, there will be no visible above ground components. • Operation of the cable will have no adverse impact on topography
Wetlands	Minor	• Construction of the Converter Stations will result in temporary and permanent impacts to wetlands and vegetation. A wetland mitigation plan will be developed and implemented that will create, restore, enhance and/or preserve wetlands with equal functions to those that will be lost permanently. • Temporary impacts to wetlands could include temporary loss of wetland vegetation and potential transport of sediment to adjacent wetland areas. Installation of soil erosion and sediment control devices prior to construction activities and implementation of a SWPPP will reduce the potential for sedimentation or stormwater runoff in wetlands or streams. • There is a slight potential for temporary impacts to wetlands from an unanticipated bentonite release during HDD operations; however, mitigation measures will be implemented to minimize the likelihood of a release and to manage a release if one should occur. • Operation of the cable will have no adverse impact on wetlands
Wildlife	Minor	• Limited localized disturbance of wildlife may occur due to noise or presence of equipment associated with cable duct banks, HDD drilling, and converter station construction • Construction of the Land Cable Route and the Converter Stations will cause a small reduction in the amount of habitat available to local wildlife for breeding, foraging, or resting • Operation of the cable will have no adverse impact on wildlife

Table 4.15-1: Summary of Potential Environmental Impacts

Resource	Potential Impact	Overall Significance
Visual Resources	Minor	• There is a potential for minor and temporary visual impacts during construction of the Converter Stations and Land Cables. The burial of the cable in the vicinity of sensitive receptors will be similar or smaller in scale to road resurfacing or major underground utility maintenance, and will be a moving operation. • Once the cable is buried, there will be no visible above ground components, and therefore no visual impacts. • Visual impacts associated with the Northern Converter Station will be minimal due to the lack of significant visibility as a result of the linear broad valley in which the converter station is situated, its distance from sensitive receptors, and the dense vegetation that exists throughout the three mile study area. Additionally, the existing utilities infrastructure located on the project site such as the Athens Generating Plant, Leeds Substation, and associated overhead utility lines would tend to draw focus away from the proposed converter station. • Some resources directly adjacent to the Southern Converter Station may experience minor visual impacts resulting from tree clearing and the operation of the facility. Siting considerations such as orientation and distance from these resources have been considered and will reduce the potential for impact; additional mitigation measures, such as vegetative screening, will be considered where practicable and necessary. • There are some local scenic and historic resources on both sides of the Hudson River that will likely have visibility of the proposed Southern Converter Station, but the Indian Point Power facility is a much larger and visible facility which will draw the viewer's eye away from the converter station from most vantage points.
Cultural and Historic Resources	Minor	• Phase 1A cultural reviews have been performed at the Northern and Southern Converter Station sites as well as along the Land Cable Routes. Where necessary, additional cultural resource surveys will be performed to confirm the presence or absence of cultural resources in these areas.
EMF	Minor	• EMF values will be within recognized and acceptable standards [see Table 4.14-5]
In-River		
Topography	Minor	• Localized disturbance to the riverbed in a narrow swath resulting from movement of the jetting sled along the In-River Cable Route and at discreet points from the use of anchors • Slight depressions in the riverbed sediment, estimated to be 2 feet deep or less, will result from jet plow embedment of the cable. These depressions are expected to fill in with time as a result of the natural sediment deposition and repositioning that occurs as a result of tidal currents, episodic storm events, and passage of vessels. • Operation of the cable will have no adverse impact on topography

Table 4.15-1: Summary of Potential Environmental Impacts

Resource	Potential Impact	Overall Significance
Navigation	Minor	• The In-River Cable Route has been designed to minimize impacts to navigation in the Hudson River by placing the cable outside of the navigational fairway to the greatest extent possible and through review of the proposed route with local river interests such as the River Pilots that work in this area of the Hudson. • Temporary impacts to navigation around ongoing in-river construction activities could occur. • Once installed, operation of the cable will have no adverse impact on navigation. GPS navigation units are not affected by the magnetic fields that are emitted by the cable. Compass deflection directly over the operating cable is expected to be very slight (< 0.5°) based on the proposed burial depth and the water depths along the route.
Sediments	Minor	• Contaminated sediments or nutrients may be mobilized from jet plow embedment and limited dredging in the temporary cofferdams, which could have an indirect impact on sediment quality in adjacent areas and short-term impacts on aquatic life. Deposits of potentially contaminated sediments are expected to generally fall along the path of the operating jet plow. Given the brief period of time and limited affected area, impacts on water quality from jet plow embedment will be minor. • The sediment temperature at 10 cm (4 inches) below the river bottom is expected to increase less than 1° Celsius during operation of the In-River Transmission Cable. The temperature of the sediment at the river bottom (sediment-water interface) will remain unchanged by the operation of the In-River Transmission Cable.
Water Quality	Minor	• Temporary and localized increases in suspended sediment concentrations will occur in the areas surrounding jet plow embedment and limited dredging in the temporary cofferdams. Results from the sediment dispersion modeling indicate that increased suspended sediment concentrations from jet plowing will be short in duration, concentrated toward the near-bottom portion of the water column, and will return to ambient conditions within approximately 24 hours after jetting has occurred. • The heat generated by operation of the cable will be rapidly dissipated through the water column and there will be no measurable water temperature changes. Operation of the cable will have no adverse impact on water quality

Table 4.15-1: Summary of Potential Environmental Impacts

Resource	Potential Impact	Overall Significance
Finfish/Benthic Resources	Minor	• Temporary finfish/benthic habitat loss from jet plow embedment, vessel positioning activities, nearshore HDD installation, and minor dredging within temporary cofferdams could occur. These habitats are expected to recover quickly after disturbance given the natural reworking of the river bottom that occurs as a result of tidal currents. • Some finfish, benthos and shellfish mortality, injury and/or displacement in the direct vicinity of jet plow embedment activities and cofferdam dredging activities could occur for those organisms that are not able to move out of the way of construction activities. • Temporary impacts to finfish, benthos and shellfish from elevated suspended sediment levels and potential suspension of contaminated sediments during jet plow embedment and limited dredging in cofferdam could occur, but project-induced suspended sediment levels are not expected to be greater than the natural range of variability in the suspended sediment levels in the river. • Potential temporary impacts from unanticipated bentonite release during HDD operations could occur; however, mitigation measures will be implemented to minimize the likelihood of a release and to manage a release if one occurs. • Predicted sediment temperature changes associated with operation of the cable are low (less than 1° C at 10 cm (4 inches) below the river bottom). This increase will have no adverse impact on finfish or benthic resources.
Protected Species / Sensitive Habitats	Minor	• Localized and temporary impacts within designated SCFWHs in the Hudson River may occur. • Impacts to sturgeon reproduction and early life stages will be minimized by scheduling construction outside of the peak spawning period. • Impacts to juvenile and adult sturgeon resulting from construction activities will be minimal given the mobility of these life stages and the limited nature of the benthic disturbance. • The cable will be buried a minimum of 8 feet below present bottom and will not create a physical barrier that could interfere with fish migration or use of existing habitats or nursery areas.
Cultural and Historic Resources	Minor	• The Project's submerged cultural resource study determined that approximately 30 to 35 targets identified during the marine survey could have cultural significance as potential shipwrecks. Appropriately sized construction buffer zones will be established around these targets. Additional investigations may be performed if other constraints in the River require that construction take place within these buffer zones. • Operation of the cable will have no adverse impact on cultural or historic resources

Table 4.15-1: Summary of Potential Environmental Impacts

Resource	Potential Impact	Overall Significance
Visual Resources	Minor	• During installation of the In-River Cable, construction vessels will be visible along the Hudson River during the short construction period. Any visual impacts to receptors will be temporary, localized and minor • The operation of the In-River Cable will result in no visual impacts since the transmission line will be underwater.
EMF/Thermal	Minor	• Negligible impacts are expected to Hudson River resources from EMF or thermal emissions from operation of the In-River Transmission Cable.

4.16 Cumulative Impacts

The Project has been sited and designed to avoid impacts to environmental resources within the Project Area and along the Transmission Cable Route. Where impacts may be unavoidable, the Project has been designed to minimize them to the greatest extent possible.

The cumulative impact analysis for this Project is based on the assumption that one additional HVDC electric transmission cable, such as the proposed CHPE Project, would be constructed in the same portions of the Hudson River as the West Point Transmission Project, because that project is the only known proposal intending to use the bed of the Hudson River in this area. WPP has met with stakeholders and no other plans, projects, or proposals have been identified that would require inclusion in a cumulative impacts analysis. This cumulative impact analysis does not consider cumulative impacts involving the land-based construction, since the West Point converter station sites, land cable routes, and landfall sites are unique to West Point, and there are no known development proposals to be sited in proximity to these land-based sites and routes.

WPP has considered feasible In-River Cable routing alternatives that assume coexistence with the CHPE project, which vary slightly depending on which project is constructed first in time. These alternatives are presented in Exhibits 2 and 3. WPP's preferred route, described in Exhibit 2, assumes that no other project will occupy the riverbed in this area. To date, the CHPE project is undergoing environmental review by the U.S. Department of Energy.

As demonstrated in Exhibit 4, the potential for adverse impacts of installing an HVDC line in the bed of the Hudson River are limited to impacts occurring during construction. Those impacts are temporary and localized, as confirmed by the Public Service Commission in its April 18, 2013 "Order Granting Certificate of Environmental Compatibility and Public Need" for the CHPE Project (Case No. 10-T-0139). Accordingly, cumulative impacts would primarily be effects resulting from the construction of two projects occurring at the same time or in close enough succession that the impacts from one had not attenuated to background levels prior to the second installation occurring. A worst case would result if either both projects were installed simultaneously or they were installed in quick succession. That possibility can be avoided by scheduling the construction of both projects so as to maintain an appropriate time period to pass between the two installations. WPP believes that such scheduling could be established during the EM&CP approval process for the two projects, if they were both to proceed simultaneously.

A residual source of cumulative impact that will be permanent, though minor in its effect, involves the placement of concrete mattresses at the places where the WPP and CHPE cables must cross each other. Both projects will require the placement of concrete mattresses where they cross other previously installed utilities in the Hudson River (mattresses planned at approximately 48 utility crossing locations and 2 cable field-joint locations in the case of the West Point Transmission Project), which results in project-specific impact as described in Exhibit 4 of this Application and in the CHPE Project's application. Installation of both the West Point Transmission Project and the CHPE Project, would require concrete mattresses at 16 more locations for the West Point Transmission Project (refer to Alternative R1B in Exhibit 3).

The placement of the additional 16 mattresses for the West Point Transmission Project would result in cumulative impact in the form of additional potential loss of benthic habitat at the places where one of the two lines must cross the other in the Hudson River. This would result in the total bottom impact from placement of the mattresses in the Hudson River increasing from approximately 2.3 acres (refer to Section 4.7.2) to approximately 3.0 acres, which is negligible when compared to the approximately 34,613 acres of bottom habitat in the Hudson River between RM 42 and RM 118. Once installed, the concrete mattresses will settle under their own weight into the riverbed and sediment will be naturally deposited over the mattresses, which would mitigate the cumulative impact. Given the limited spatial extent of the effects from the mattresses, the expected sediment deposition that would cover the mattresses and the ability of benthic organisms to recolonize the area relatively quickly, no long-term cumulative impacts to the riverbed or the benthos in the Hudson River would occur.

The other project-specific impacts associated with either the West Point Transmission Project, as previously described in Sections 4.1 through 4.15, or the CHPE Project would not be increased or lead to cumulative impacts if both projects are installed in the Hudson River with an appropriate time period between the two installations.

4.17 References

Section 4.2 - Geology, Topography and Soils

Geologic Map of New York - Lower Hudson Sheet, NYS Museum and Science Service, 1970, re-printed 1995, scale 1:250,000.

Surficial Geologic Map of New York - Lower Hudson Sheet, NYS Museum-Geological Survey, 1989, scale 1:250,000.

Soil Survey of Greene County, New York – USDA_SCS, February 1993

Soil Survey of Putnam and Westchester Counties, New York – USDA-SCS, September 1994

USGS 2008, Open File Report 2008-1123, Flow-Log Analysis for Hydraulic Characterization of Selected Test Wells at the Indian Point Energy Center, Buchanan, New York, John. H. Williams.

Section 4.3 - Wetlands and Water Resources

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Washington, D.C.: U. S. Department of the Interior, Fish and Wildlife Service.

EPA. 2013. Designated Sole Source Aquifers in EPA Region 2, http://www.epa.gov/safewater/sourcewater/pubs/qrg_ssamap_reg2.pdf. Accessed on June 20, 2013.

NYSDEC, Division of Water Regulations, Part 701 (Classifications-Surface Water and Groundwater) and Part 703 (Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations).

NYSDEC. 2013. Map of Primary Aquifers in New York State, http://www.dec.ny.gov/lands/36164.html. Accessed on June 20, 2013.

NYSDEC, 2013. Hudson River National Estuarine Reserve. Accessed online May 2013. \http://www.dec.ny.gov/lands/4915.html#NSTivoli.

Section 4.4 - Lower Hudson River Sediment and Water Quality

Alpine Ocean Seismic Survey, Inc. 2013. Geophysical and Geotechnical Route Survey for the West Point Transmission Project. Hudson River, NY. Prepared for ESS Group, Inc.

[NOAA] National Oceanographic and Atmospheric Administration. 2013. United States Coast Pilot 2 – Atlantic Coast: Cape Cod, MA to Sandy Hook, NJ. 42nd Edition. Available Online: http://www.nauticalcharts.noaa.gov/nsd/coastpilot_w.php?book=2

[USACE] U.S. Army Corps of Engineers. 2013. Hudson River, NYC to Waterford, NY Maintenance Dredging: Maintenance Dredging – North Germantown Reach. Albany, NY: USACE Fact Sheets

Section 4.5 - Lower Hudson River Sediment and Water Quality

Abood, K.A. 1974. Circulation in the Hudson Estuary. *Annals of the New York Academy of Sciences* 250: 39-111.

Arnold, C.A. 1982. “Modes of Fine-grained Suspended Sediment Occurrences in the Hudson River Estuary.” Marine Sciences Research Center, State University of New York at Stony Brook, Stony Brook, NY. Master’s Thesis: 102 pp.

Bokuniewicz, H. 2006. Sedimentary Processes in the Hudson River Estuary. Chapter 4 in The Hudson River Estuary, J. S. Levinton and J. R. Waldman, eds. New York: Cambridge University Press.

Busby, M. W. and K. I. Darmer. 1970. A look at the Hudson River Estuary. Water Resources Bulletin 6:802-812.

Busby, W. 1966. Flow, quality and salinity in the Hudson River estuary. In: Hudson River Ecology. Albany, NY: Hudson River Valley Commission, p. 135-145.

Caraco, N.F., J.J. Cole, S.E.G. Findlay, D.T. Fischer, G.G. Lampman, M.L. Pace, and D.L. Strayer. 2000. Dissolved oxygen declines in the Hudson River associated with the invasion of the zebra mussel (*Dreissena polymorpha*). Environmental Science and Technology 34:1204-1210.

Caraco, N.F., J.J. Cole, and D.L. Strayer. 2006. Top-down control from the bottom: Regulation of eutrophication in a larger river by benthic grazing. Limnology and Oceanography, 51(1, part 2): 664-670.

[CI] Cary Institute of Ecosystem Studies. 2012. Changing Hudson Project. Accessed 21 March 2013. http://www.caryinstitute.org

Cooper, J.C., F.R. Cantelmo, and C.E. Newton. 1988. Overview of the Hudson River estuary. American Fisheries Society Monograph. 4:11-24.

de Vries, M.P. and L.A. Weiss. 2001. Salt-Front Movement in the Hudson River Estuary, New York – Simulations by One-Dimensional Flow and Solute-Transport Models. Troy, New York: USGS. Water-Resources Investigations Report 99-4024.

[Dynegy] Dynegy Roseton, LLC. 2006. Year Class Report for the Hudson River Estuary Monitoring Program. Prepared for the Hudson River Utilities.

Farley, K.J., J. R. Wands, D. R. Damiani and T. F. Cooney III. 2006. Transport, Fate and Bioaccumulation of PCBs in the Lower Hudson River. Chapter 25 in The Hudson River Estuary, J. S. Levinton and J. R. Waldman, eds. New York: Cambridge University Press.

Geyer, W. R., J. T. Trowbridge, and M. M. Bowen. 2000. The dynamics of a partially mixed estuary. Journal of Physical Oceanography, 30:2035–2048.

Hudson River Environmental Conditions Observing System (HRECOS). 2012. Hudson River Environmental Conditions Observing System: River Conditions. Accessed on December 20, 2012. http://www.hrecos.org/joomla/

Llansó, R. J., M.T. Barbour, J. Gerritsen, 2003. Hudson River estuary biocriteria: Final report. Albany, N.Y.: New York State Dept. of Environmental Conservation.

Nitsche, F.O., T.C. Kenna, and M. Haberman. 2010. Quantifying 20th century deposition in complex estuarine environment: an example from the Hudson River. Estuarine, Coastal and Shelf Science, 89(2): 163-174.

[NERRS] National Estuarine Research Reserve System. 2009. Hudson River National Estuarine Research Reserve: Revised Management Plan 2009-2014. Silver Spring, MD. NOAA Nation Ocean Service, Estuarine Reserves Division.

[NYSDEC] New York State Department of Environmental Conservation. 2013. Lower Hudson Watershed. Accessed April 11, 2013. http://www.dec.ny.gov/lands/48367.html

Riverkeeper. 2012. Hudson River Water Quality. Accessed December 20, 2012. http://www.riverkeeper.org/water-quality/hudson/

Strayer D. L. and L. C. Smith. 2001. The zoobenthos of the freshwater tidal Hudson River and its response to the zebra mussel (*Dreissena polymorpha*) invasion. Archiv fur Hydrobiologie Supplement, 139:1–52.

[USEPA] U.S. Environmental Protection Agency. 2012. EPA's Recreational Water Quality Criteria - 2012. U.S. Environmental Protection Agency, Office of Water: Washington, DC. 820-F-12-058

[USFWS] United States Fish and Wildlife Service. 1997. Significant Habitats and Habitat Complexes of the New York Bight Watershed. Southern New England – New York Bight Coastal Ecosystems Program. Accessed March 2013. http://library.fws.gov/pubs5/web_link/text/toc.htm.

Wall, G. R, E.A. Nystrom, and S. Litten. 2008. Suspended sediment transport in the freshwater reach of the Hudson River Estuary in Eastern New York. Estuaries and Coasts, 31: 542-553.

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. San Diego, CA: Academic Press.

Section 4.6 - Finfish

Able, K. W. and M. P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. New Brunswick, NJ: Rutgers University Press.

[AKRF] AKRF, Inc. 2012. Essential Fish Habitat Assessment For the Tappan Zee Hudson River Crossing Project. Prepared for U.S. Department of Transportation Federal Highway Administration.

[ASMFC] Atlantic States Marine Fisheries Commission. 1999. Fishery Management Report No. 35: Amendment 1 to the Interstate Fishery Management Plan for Shad & River Herring.

Washington DC: Atlantic States Marine Fisheries Commission, Apr. 1999. Nos. NA87 FGO 025 and NA97 FGO 0034.

[ASMFC] Atlantic States Marine Fisheries Commission. 2000. Interstate fishery management plan for American eel. Fishery Management Report 36.

[ASMFC] Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring. Washington DC: Atlantic States Marine Fisheries Commission, May 2009.

[ASMFC] Atlantic States Marine Fisheries Commission. 2012a. American Shad (*Alosa sapidissima*): Life History and Habitat Needs. ASMFC Managed Species. Atlantic States Marine Fisheries Consortium. Accessed on December 2012. http://www.asmfc.org/.

[ASMFC] Atlantic States Marine Fisheries Commission. 2012b. "Blueback Herring (Alosa aestivalis): Life History and Habitat Needs." ASMFC Managed Species. Atlantic States Marine Fisheries Consortium. Accessed December 2012. http://www.asmfc.org/.

Auld, A. H. and J. R. Schubel. 1978. Effects of suspended sediment or fish eggs and larvae: A laboratory assessment. Estuarine and Coastal Marine Science 6:153-164.

Bass, A. H., and F. Ladich. 2008. Vocal-acoustic communication: From neurons to brain. In: Fish Bioacoustics, J. F. Webb, R. R. Fay, and A. N. Popper, eds. New York: Springer Science + Business Media, LLC.

Bigelow, H. B. and W. C. Schroeder. 2002. Fishes of the Gulf of Maine: 3rd Edition, B. Collette and G. Klein-MacPhee, eds. Washington DC: The Smithsonian Institute.

Burton, W. H. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Versar, Inc.

[CADOT] California Department of Transportation 2009. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Prepared by ICF Jones & Stokes and Illingworth and Rodkin, Inc.

Clarke, D. G. and D. H. Wilber. 2000. Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection (ERDC TN-DOERE9), US Army Engineer Research and Development Center, Vicksburg, MS.

[ConEd] Consolidated Edison Company of New York. 1984. Hudson River Ecological Study in the area of Indian Point. 1981 Annual Report.

Daniels, R. A., K. E. Limburg, R. E. Schmidt, D. D. Strayer, and R. C. Chambers. 2005. Changes in Fish Assemblages in the Tidal Hudson River, New York. American Fisheries Society Symposium. 45:471-503.

Dovel, W. L., A. W. Pekovitch, and T. J. Berggren. 1992. Biology of the shortnose sturgeon (*Acipenser brevirostrum* Lesueur, 1818) in the Hudson River estuary, New York. In: Estuarine Research in the 1980s, C. L. Smith, ed. Albany, New York: State University of New York Press.

Everly, A. W. and J. Boreman. 1999. Habitat Use and Requirements of Important Fish Species Inhabiting the Hudson River Estuary: Availability of Information. NOAA Technical Memorandum NMFS-NE-121.

Fishbase. 2013. Micropterus salmoides (Lacepède, 1802), Largemouth black bass. Accessed online on May 28, 2013 at: http://www.fishbase.org/summary/3385

[FLMNH] Florida Museum of Natural History. 2013. Biological Profiles: Largemouth Bass. Accessed online on May 29, 2013 at: http://www.flmnh.ufl.edu/fish/Gallery/Descript/LargemouthBass/LargemouthBass.html

Gill A. B., Bartlett M., Thomsen F. 2012. Potential interactions between diadromous fishes of U.K. conservation importance and the electromagnetic fields and subsea noise from marine renewable energy developments. Journal of Fish Biology. 81(2):664-695.

Gill, A. B. and M. Bartlett. 2010. Literature review on the potential effects of electromagnetic fields and subsea noise from marine renewable energy developments on Atlantic salmon, sea trout and European eel. Scottish Natural Heritage Commissioned Report No.401

Gill, A. B., Y Huang, I. Gloyne-Philips, J. Metcalfe, V, Quayle, J. Spencer, and V. Wearmouth. 2009. COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2: EMF-sensitive fish response to EM emissions from sub-sea electricity cables of the type used by the offshore renewable energy industry. Commissioned by COWRIE Ltd (project reference COWRIE-EMF-1-06).

Guerra-García, J.M., J. Corzo and J.C. García-Gómez. 2003. Short-term benthic recolonization after dredging in the harbour of Ceuta, North Africa. Marine Ecology 24(3): 217-229.

Heimbuch, D., S. Cairns, D. Logan, S. Janicki, J. Seibel, D. Wade, M. Langan, and N. Mehrotra. 1994. Distribution Patterns of Eight Key Species of Hudson River Fish. Prepared for the Hudson River Foundation, New York, NY. Linthicum, MD: Coastal Environmental Services, Inc.

[HRVI] Hudson River Valley Institute. 2012 American Shad (*Alosa sapidissima*) of the Hudson River. Accessed online December 2012. http://www.hudsonrivervalley.org/themes/shad.html

Kiorboe, T., E. Frantsen, C. Jensen, and O. Nohr. 1981. Effects of suspended-sediment on development and hatching of herring (*Clupea harengus*) eggs. Estuarine, Coastal and Shelf Science 13:107-111.

Levinton, J. S. and J. R. Waldman, eds. 2006. The Hudson River Estuary. New York: Cambridge University Press.

Limburg, K. E., and R. E. Schmidt. 1990. Patterns of fish spawning in Hudson River tributaries: response to an urban gradient? Ecology 71:1238-1245.

McCabe, G.T., S. A. Hinton, and R. L. Emmett. 1998. Benthic invertebrates and sediment characteristics in a shallow navigation channel of the lower Columbia River, before and after dredging Northwest Science 72(2):116-126.

[NOAA] National Oceanic and Atmospheric Administration. 2001. Letter regarding NMFS's biological opinion regarding FERC's issuance of a permit for Millennium pipeline. United States Department of Commerce. National Marine Fisheries Service, Northeast Region. September 4, 2001.

[NOAA] National Oceanic and Atmospheric Administration. 2012. Final Listing Rule for Gulf of Maine, New York Bight, and Chesapeake Bay Distinct Population Segments of Atlantic Sturgeon in the Northeast Region. 77 FR 5880.

[NOAA] National Oceanic and Atmospheric Administration. 2013b. NOAA Fisheries, Office of Protected Resources. Shortnose Sturgeon (*Acipenser brevirostrum*). Accessed online March 27, 2013 at: http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm

[NOAA] National Oceanic and Atmospheric Administration. 2013c. NOAA Fisheries, Office of Protected Resources. Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*). Accessed online March 27, 2013 at: http://www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon.htm

[NYSDEC] New York State Department of Environmental Conservation. 2009. Status of American Shad in the Hudson River, New York. http://www.dec.ny.gov/docs/fish_marine_pdf/hrshadstatus.pdf

[NYSDEC] New York State Department of Environmental Conservation. 2010. Hudson River American Shad: An Ecosystem-Based Plan for Recovery, Hudson River Estuary Action Plan. http://www.dec.ny.gov/docs/remediation_hudson_pdf/shadrecoveryplan.pdf.

[NYSDEC] New York State Department of Environmental Conservation. 2012. The Hudson Estuary: A River that Flows Two Ways. Accessed January 2012. http://www.dec.ny.gov/lands/4923.html.

[NYSDEC] New York State Department of Environmental Conservation. 2013a. Shortnose Sturgeon Fact Sheet. . Accessed March 2013. http://www.dec.ny.gov/animals/26012.html.

[NYSDEC] New York State Department of Environmental Conservation. 2013b. New York's Sturgeon. Accessed March 2013. http://www.dec.ny.gov/animals/7025.html.

[NYSDEC] New York State Department of Environmental Conservation. 2013c. The Sunfish Of New York. Accessed May 2013. http://www.dec.ny.gov/animals/7022.html

[NYSDOH] New York State Department of Health. 1996. Health Consultation: 1996 Survey of Hudson River Anglers. NYSDOH, Center for Environmental Health.

[NYSDOS] New York State Department of State. 2013. Significant Coastal Fish & Wildlife Habitats. Accessed March 2013. http://www.dos.ny.gov/communitieswaterfronts/consistency/scfwhabitats.html.

[NYU] New York University. 2013. Hudson River Ecosystem Studies: Effects of Entrainment by the Indian Point Power Plant on Biota in the Hudson River Estuary. New York University Medical Center. Institute of Environmental Medicine. New York. UNT Digital Library. Accessed April 5, 2013. http://digital.library.unt.edu/ark:/67531/metadc29387/.

[Normandeau] Normandeau Associates, Inc. 2007. Assessment of Spring 2005 Hudson River Recreational Fisheries. Prepared for NYSDEC. Contract Number C005100.

[Normandeau] Normandeau Associates, Inc., Exponent, T. Tricas, and A. Gill. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

O'Leary,J. and D.G. Smith. 1987. Occurrence of the first freshwater migration of the Gizzard Shad *Dorosoma cepedianum*, in the Connecticut River, Massachusetts. Fishery Bulletin 85(2).

[Pisces] Pisces Conservation Ltd. 2008. The Status of Fish Population and the Ecology of the Hudson. Lymington, United Kingdom: Pisces.

Popper, A. N. and C. R. Schilt. 2008. Hearing and acoustic behavior (basic and applied). In: J. F. Webb, R. R. Fay, and A. N. Popper (eds.) Fish Bioacoustics, pp. 17-48. New York: Springer Science + Business Media, LLC.

Popper, A. N., R. R. Fay, C. Platt, and O. Sand. 2003. Sound detection mechanisms and capabilities of teleost fishes. In: Sensory Processing in Aquatic Environments, S. P. Collin and N. J. Marshall, eds. New York: Springer-Verlag.

Richardson, W. J., C. R. Greene, Jr., C. I. Malme, and D. H. Thomson. 1995. Marine Mammals and Noise. New York: Academic Press.

Schaffner, L. C. 2010. Patterns and rates of recovery of macrobenthic communities in a polyhaline temperate estuary following sediment disturbance: Effects of disturbance severity and potential importance of non-local processes. Estuaries and Coasts 33:1300-1313.

Stadler, J. H., and D. P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. Inter-Noise 2009, Ottawa, Ontario, Canada.

Stanley, J. G., and D. S. Danie. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic) – white perch. U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS-82/11.7. U.S. Army Corps of Engineers, TR EL-82-4.

Stegemann, E.C. 1994. Sturgeon – the King of Freshwater Fishes, Freshwater Fishes of New York. Accessed March 27, 2013. http://www.dec.ny.gov/animals/7025.html.

Stone, S. L., T. A. Lowery, J. D. Field, C. D. Williams, D. M. Nelson, S. H. Jury, M. E. Monaco, and L. Andreasen. 1994. Distribution and abundance of fishes and invertebrates in Mid-Atlantic estuaries. Silver Spring, MD: NOAA/NOS Strategic Environmental Assessments Division. ELMR Report No. 12.

Strayer, D. L. 2006. The Benthic Animal Communities of the Tidal-Freshwater Hudson River Estuary. Chapter 19 in The Hudson River Estuary, J. S. Levinton and J. R. Waldman, eds. New York: Cambridge University Press.

Sweka, J. A., J. Mohler, M. J. Millard, T. Kehler, A. Kahnle, K. Hattala, G. Kenney, and A. Higgs. 2007. Juvenile Atlantic sturgeon habitat use in Newburgh and Haverstraw bays of the Hudson River: implications for population monitoring. North American Journal of Fisheries Management 27:1058-1067.

Tuck, I. D., N. Bailey, M. Harding, G. Sangster, T. Howell, N. Graham, and M. Breen. 2000. The impact of water jet dredging for razor clams, *Ensis* spp., in a shallow sandy subtidal environment. Journal of Sea Research 43:65-81.

[USFWS] United States Fish and Wildlife Service. 1997. Significant Habitats and Habitat Complexes of the New York Bight Watershed. Southern New England – New York Bight Coastal Ecosystems Program. Accessed March 2013. http://library.fws.gov/pubs5/web_link/text/toc.htm.

[UMMZ] University of Michigan Museum of Zoology. 2013a. Micropterus dolomieu, Bass. Animal Diversity Web. Accessed online on May 28, 2013 at: http://animaldiversity.ummz.umich.edu/accounts/Micropterus_dolomieu/

[UMMZ] University of Michigan Museum of Zoology. 2013b. Micropterus salmoides, Bass. Animal Diversity Web. Accessed online on May 28, 2013 at: http://animaldiversity.ummz.umich.edu/accounts/Micropterus_salmoides/

Van Dolah, R. F., D. R. Calder, and D. M. Knott. 1984. Effects of dredging and open-water disposal on benthic macroinvertebrates in a South Carolina estuary. Estuaries 7(1):28-37.

Woodhead, P. M. J. 1991. Inventory and characterizations of habitat and fish resources, and assessment of information on toxic effects in the New York-New Jersey Harbor Estuary. Report in U.S. E.P.A., Harbor Estuary Program (Tasks 3.2, 5.1 and 5.3). New York: Region II.

Woodhead, P. M. J. 1993. The fish community of New York Harbor: Spatial and temporal distributions of major species. Proceedings of the Conference on the Impacts of New York Harbor Development on Aquatic Resources, W. Wise, ed. New York, NY: The Hudson River Foundation for Science. 103-122.

Section 4.7 - Benthos and Shellfish

Abbot, R. T. and P. A. Morris. 1995. A field guide to shells of the Atlantic and gulf coasts and the West Indies. Peterson Field Guide Series. New York: Houghton Mifflin.

Ashizawa, D. and J.J. Cole. 1994. Long-term temperature trends of the Hudson River: A study of historical data. Estuaries 17:155-171.

Benson, A. J., M. M. Richerson, E. Maynard, J. Larson, and A. Fusaro. 2013a. *Dreissena bugensis*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. Accessed January 18, 2013. http://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=95

Benson, A. J., D. Raikow, J. Larson, and A. Fusaro. 2013b. *Dreissena polymorpha*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. Accessed January 18, 2013. http://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=5

Bousfield, E. L. 1973. Shallow-water Gammaridean Amphipoda of New England. Ithaca, NY: Comstock Publishing Associates.

Cook, D. G. and R. O. Brinkhurst. 1973. Marine flora and fauna of the northeastern United States. Annelida: Oligochaeta. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NOAA Technical Report NMFS CIRC-374.

Coote, T.W. and D. Strayer. 2009. Gastropods of the Hudson River Shoreline: Subtidal, Intertidal, and Upland Communities. Section IV in Final Reports of the Tibor T. Polgar Fellowship Program, 2008, S.H. Fernald, D. Yozzo, and H. Andreyko, eds. Hudson River Foundation.

Gallagher, E.D. and K.E. Keay. 1998. Organism-sediment-contaminant Interactions in Boston Harbor. In Contaminated Sediments in Boston Harbor, K. Stolzenbach and E. Adams, eds. MIT Sea Grant Publication 98-1.

[GISD] Global Invasive Species Database. 2005. *Rangia cuneata* (mollusc). Accessed January 18, 2013.
http://www.issg.org/database/species/ecology.asp?si=1156&fr=1&sts

Gosner, K. L. 1971. Guide to identification of marine and estuarine invertebrates: Cape Hatteras to the Bay of Fundy. New York: John Wiley & Sons, Inc.

Guerra-García, J.M., J. Corzo and J.C. García-Gómez. 2003. Short-term benthic recolonization after dredging in the harbour of Ceuta, North Africa. Marine Ecology 24(3): 217-229.

Hill, J.M. 2007. *Polydora ciliata*. A bristleworm. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme. Plymouth: Marine Biological Association of the United Kingdom. Accessed April 23, 2013 http://www.marlin.ac.uk/speciesfullreview.php?speciesID=4165.

Hinchey, E. K., L. C. Schaffner, C. C. Hoar, B. W. Vogt, and L. P. Batte. 2006. Responses of estuarine benthic invertebrates to sediment burial: the importance of mobility and adaptation. Hydrobiologia 556:85-98.

Howes, B.L., D.R. Schlezinger, J.A. Blake, and D.C. Rhoads. 1997. Infaunal “Recovery” as a Control of Sediment Organic Matter Remineralization and the Fate of Regenerated Nutrients in Boston Harbor. Abstracts from the 14th Biennial Estuarine Research Federation (ERF) International Conference - The State of Our Estuaries. Providence, RI.

Jones, J. I., J. F. Murphy, A. L. Collins, D. A. Sear, P. S. Naden, and P. D. Armitage. 2012. The impact of fine sediment on macro-invertebrates. River Research and Applications 28:1055-1071.

Kinney, G. 2002. Annual Report on the Commercial Monitoring of the Hudson River Blue Crab Fishery. Prepared for the New York State Department of Environmental Conservation.

Kipp, R. M., A. J. Benson, J. Larson, and A. Fusaro. 2013. *Bithynia tentaculata*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. Accessed January 18, 2013. http://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=987

Kornijów, R., D. L. Strayer, and N. F. Caraco. 2010. Macroinvertebrate communities of hypoxic habitats created by an invasive plant (*Trapa natans*) in the freshwater tidal Hudson River. Fundamental and Applied Limnology, Archiv für Hydrobiologie, 176(3):199-207.

Llansó R., M. Sutherland, J. Volstad, D. Stebel, G. Mercurio, M. Barbour and J. Gerritsen. 2003. Hudson River Estuary Biocriteria Final Report. Submitted to New York State Department of Environmental Conservation.

Merritt, R. W. and K. W. Cummins, eds. 1996. Aquatic insects of North America, 3rd edition. Dubuque, Iowa: Kendall/Hunt Publishing Company.

[NYIS] New York Invasive Species Clearinghouse. 2013. Asian clam (*Corbicula fluminea*) profile. Accessed January 18, 2013. http://www.nyis.info/index.php?action=invasive_detail&id=52

[NYSDEC] New York State Department of Environmental Conservation. 2013a. The Hudson Estuary: A river that flows two ways. Accessed April 2, 2013. http://www.dec.ny.gov/lands/4923.html

[NYSDEC] New York State Department of Environmental Conservation. 2013b. Blue Crabs of the Hudson River: Blue Crab Tagging Study. Accessed January 16, 2013. http://www.dec.ny.gov/animals/37185.html

[NYSDEC] New York State Department of Environmental Conservation. 2013c. Regulations Chapter 1: Fish and Wildlife, Part 1: Lobsters and Crab. Accessed April 2, 2013. http://www.dec.ny.gov/regs/4011.html

[NYSDEC] New York State Department of Environmental Conservation. 2000. Hudson River Estuary Sediment Profile Imagery (SPI) [dataset].

[Normandeau] Normandeau Associates, Inc. 2004. Abundance and Distribution of Blue Crab (*Callinectes sapidus*) Overwintering in the Hudson River Estuary. Prepared for New York State Department of Environmental Conservation Hudson River Fisheries Unit.

Peckarsky, B. L., P. R. Fraissinet, M. A. Penton, and D. J. Conklin, Jr. 1990. Freshwater macroinvertebrates of northeastern North America. Ithaca, NY: Cornell University Press.

Pettibone, M. H. 1963. Marine polychaete worms of the New England Region: I. Families Aphroditidae through Trochochaetidae. Smithsonian Institution, Washington DC.

Rhoads, D.C., P.L. McCall, and J.Y. Yingst. 1978. The ecology of seafloor disturbance. American Scientist 66: 577-586.

Schaffner, L. C. 2010. Patterns and rates of recovery of macrobenthic communities in a polyhaline temperate estuary following sediment disturbance: Effects of disturbance severity and potential importance of non-local processes. Estuaries and Coasts 33:1300-1313.

Stein, J. J. 1991. Blue Crab (*Callinectes sapidus*) Distribution and Habitat Utilization in the Lower Hudson River and Tributaries. A Report of the 1991 Polgar Fellowship Program. New Britain, CT: Central Connecticut State University.

Strayer, D.L., L.C. Smith, and D.C. Hunter. 1998. Effects of the zebra mussel (*Dreissena polymorpha*) invasion on the macrobenthos of the freshwater tidal Hudson River. Canadian Journal of Zoology 76:419-425.

Strayer, D. L. 2006. The Benthic Animal Communities of the Tidal-Freshwater Hudson River Estuary. Chapter 19 in The Hudson River Estuary, J. S. Levinton and J. R. Waldman, eds. New York: Cambridge University Press.

Strayer, D. L. 2012. The Hudson Primer: The Ecology of an Iconic River. Berkeley, CA: University of California Press.

Sundberg, K. and V.S. Kennedy. 1993. Larval settlement of the Atlantic rangia, *Rangia cuneata* (Bivalvia: Mactridae). Estuaries 16(2): 223-228.

Tuck, I. D., N. Bailey, M. Harding, G. Sangster, T. Howell, N. Graham, and M. Breen. 2000. The impact of water jet dredging for razor clams, *Ensis* spp., in a shallow sandy subtidal environment. Journal of Sea Research 43:65-81.

[USFWS] U.S. Fish and Wildlife Service. 1997. Lower Hudson River Estuary Complex #21. In Significant Habitats and Habitat Complexes of the New York Bight Watershed. Charlestown, RI: Southern New England – New York Bight Coastal Ecosystems Program.

Van Dolah, R. F., D. R. Calder, and D. M. Knott. 1984. Effects of dredging and open-water disposal on benthic macroinvertebrates in a South Carolina estuary. Estuaries 7(1):28-37.

Weiss, H. M. 1995. Marine animals of southern New England and New York: Identification keys to common nearshore and shallow water macrofauna. State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, Hartford, CT.

Wittman, M., J. Reuter, G. Schadlow, S. Hackley, B. Allen, S. Chandra, and A. Caires. 2008. Asian clam (Corbicula fluminea) of Lake Tahoe: Preliminary Scientific Findings in Support of a Management Plan.

Yozzo, D. L., J. L. Andersen, M. M. Cianciola, W. C. Nieder, D. E. Miller, S. Ciparis, and J. McAvoy. 2005. Ecological Profile of the Hudson River National Estuarine Research Reserve. Prepared by

Barry A. Vittor and Associates for the New York State Department of Environmental Conservation.

Section 4.8 - Vegetation and Wildlife

Blossey, B., V. A. Nuzzo, H. L. Hinz, and E. Gerber. 2001. Garlic Mustard. In: Van Driesche, ed. Biological Control of Invasive Plants in the Eastern United States. USDA Forest Service Publication FHTET-2002-04, 413 p.

Capers, R. S., G. J. Bugbee, R. Selsky, and J. C. White. 2005. A Guide to Invasive Aquatic Plants of Connecticut. New Haven, CT: The Connecticut Agricultural Experiment Station. Bulletin No. 997.

Carter, V., I. J. Paschal, Jr., and N. Bartow. 1985. Distribution and Abundance of Submersed Aquatic Vegetation in the Tidal Potomac River and Estuary, Maryland and Virginia, May 1978 to November 1981: A Water Quality Study of the Tidal Potomac River and Estuary. U.S. Geological Survey, Water Supply Paper 2234-A.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero, eds. 2002. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. (Draft for review). Albany, NY: New York Natural Heritage Program, New York State Department of Environmental Conservation.

Findlay, S. D. Strayer, M. Bain, and W. C. Nieder. 2006. Ecology of Hudson River Submerged Aquatic Vegetation: Final Report to State Department of Environmental Conservation.

Korschgen, C. E. and W. L. Green. 1988. American Wildcelery (*Vallisneria americana*): Ecological Considerations for Restoration. U.S. Fish and Wildlife Service, Fish and Wildlife Technical Report 19. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/plants/wildcel/index.htm

Kiviat, E. and M. Hummel. 2004. Review of world literature on water chestnut with implications for management in North America. Journal of Aquatic Plant Management 42:17-28.

Lamont, E. E. and J. M. Fitzgerald. 2001. Noteworthy plants reported from the Torrey range—2000. Journal of the Torrey Botanical Society 128(4):409-414.

[NYSDEC] New York State Department of Environmental Conservation. 2010. Checklist of Amphibians, Reptiles, Birds and Mammals of New York State, Including Their Legal Status (Revised September 2007). Albany NY: NYSDEC.

Saltonstall, K. 2002. Cryptic invasion by a non-native genotype of the common reed, *Phragmites australis*, into North America. Proceedings of the National Academy of Science 99:2445-2449.

Saltonstall, K., P. M. Peterson, and R. J. Soreng. 2004. Recognition of *Phragmites australis* subsp. *americanus* (Poaceae: Arundinoideae) in North America: Evidence from Morphological and Genetic Analyses. SIDA 21(2):683-692.

Schmidt, R. E., and E. Kiviat. 1988. Communities of Larval and Juvenile Fish Associated with Water-chestnut and Water-celery in the Tivoli Bays of the Hudson River: A Report to the Hudson River Foundation. Annandale, NY: Hudsonia Ltd., Bard College Field Station.

Stanne, S. P., R. G. Panetta, and B. E. Florist. 2005. The Hudson, An Illustrated Guide to the Living River. 2nd ed. New Brunswick, NJ: Rivergate Books.

[USDA] U.S. Department of Agriculture. 2013. PLANTS Database. Accessed April 18, 2013. http://plants.usda.gov/java/

[USFS] U.S. Forest Service. 2005. Weed of the Week: Exotic Bush Honeysuckles. Newtown Square, PA: USFS Northeastern Area Forest Health Protection Program.

[WSDE] Washington State Department of Ecology. 2013. *Myriophyllum spicatum* (Eurasian Watermilfoil) Technical Factsheet. Accessed April 11, 2013. http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua004.html

Wehrmeister, J. R. 1978. An Ecological Life History of the Pondweed *Potamogeton crispus* L. in North America. Columbus, OH: The Ohio State University Center for Lake Erie Area Research. Technical Report No. 99.

Yozzo, D. J., J. L. Anderson, M. M. Cianciola, W. C. Niede, D. E. Miller, S. Ciparis, and J. McAvoy. 2005. Ecological Profile of Hudson River National Estuarine Research Reserve. NYSDEC Contract No. C004646.

Section 4.9 - Important Habitats and Threatened and Endangered Species

Bain, M. B., N. Haley, D. Peterson, J. R. Waldman, and K. Arend. 2000. Harvest and habitats of Atlantic sturgeon *Acipenser oxyrinchus* Mitchill, 1815, in the Hudson River Estuary: lessons for sturgeon conservation. Instituto Espanol de Oceanografia. Boletin 16:43-53.

Bain, M. B., N. Haley, D. L. Peterson, K. K. Arend, K. E. Mills, and P. J. Sullivan. 2007. Recovery of a US Endangered Fish. PLoS ONE 2(1):e168. doi:10.1371/journal.pone.0000168.

Dovel, W. L., A. W. Pekovitch, and T. J. Berggren. 1992. Biology of the shortnose sturgeon (*Acipenser brevirostrum* Lesueur, 1818) in the Hudson River estuary, New York. In: Estuarine Research in the 1980s, C. L. Smith, ed. Albany, New York: State University of New York Press.

Geoghegan, P., M. T. Mattson, and R. G. Keppel. 1992. Distribution of shortnose sturgeon in the Hudson River, 1984-1988. In: Estuarine Research in the 1980s, C. L. Smith, ed. Albany, New York: State University of New York Press.

Guerra-García, J.M., J. Corzo and J.C. García-Gómez. 2003. Short-term benthic recolonization after dredging in the harbour of Ceuta, North Africa. Marine Ecology 24(3): 217-229.

McCabe, G.T., S. A. Hinton, and R. L. Emmett. 1998. Benthic invertebrates and sediment characteristics in a shallow navigation channel of the lower Columbia River, before and after dredging Northwest Science 72(2):116-126.

National Audubon Society. 2013. National Map of Important Bird Areas. Accessed online April 10, 2013 at: http://www.mapsportal.org/audubon_national_iba/

[NOAA] National Oceanic and Atmospheric Administration. 2013a. National Estuarine Research Reserve System. http://nerrs.noaa.gov/Reserve.aspx?ResID=HUD

[NOAA] National Oceanic and Atmospheric Administration. 2013b. NOAA Fisheries, Office of Protected Resources. Shortnose Sturgeon (*Acipenser brevirostrum*). Accessed online March 27, 2013 at: http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm

[NOAA] National Oceanic and Atmospheric Administration. 2013c. NOAA Fisheries, Office of Protected Resources. Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*). Accessed online March 27, 2013 at: http://www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon.htm

[NOAA] National Oceanic and Atmospheric Administration. 2013d. NOAA Fisheries, Office of Protected Resources. Response to ESS Group, Inc. re: Presence of Protected Species, Which Occur or May Occur in or in the Immediate Vicinity of the West Point Transmission Project Area.

[NYNHP] New York Natural Heritage Program. 2011. Online Conservation Guide. Accessed May 25, 2012. http://www.acris.nynhp.org/

[NYNHP] New York Natural Heritage Program. 2013. Delmarva Beggar-Ticks Fact Sheet. Accessed April 30, 2013. http://www.acris.nynhp.org/report.php?id=8750.

[NYNHP] New York Natural Heritage Program. 2013a. Report to ESS Group, Inc. on Rare Animals, Rare Plants and Significant Natural Communities, Which Occur or May Occur in or in the Immediate Vicinity of the West Point Transmission Project Area. April 15, 2013.

[NYSDOS] New York State Department of State, Office of Communities and Waterfronts. 2012. Significant Coastal Fish and Wildlife Habitat Descriptions. Accessed June 8, 2012. http://www.dos.ny.gov/communitieswaterfronts/consistency/scfwhabitats.html#hudson

[NYSDOS and TNC] New York State Department of State Division of Coastal Resources and Waterfront Revitalization and the Nature Conservancy. 1990. Hudson River Significant Tidal Habitat: A Guide to the Functions, Values, and Protection of the River's Natural Resources.

[NYSDEC] New York State Department of Environmental Conservation. 2012. Bald Eagle Fact Sheet. Accessed May 24, 2012. http://www.dec.ny.gov/animals/74052.html

[NYSDEC] New York State Department of Environmental Conservation. 2012a. New York Nature Explorer Town Results Report: Athens. Accessed March 27, 2012. http://www.dec.ny.gov/natureexplorer/app/

[NYSDEC] New York State Department of Environmental Conservation. 2012b. New York Nature Explorer Town Results Report: Cortlandt. Accessed March 27, 2012. http://www.dec.ny.gov/natureexplorer/app/

[NYSDEC] New York State Department of Environmental Conservation. 2012c. Indiana Bat Fact Sheet. Accessed May 24, 2012. http://www.dec.ny.gov/animals/6972.html

[NYSDEC] New York State Department of Environmental Conservation. 2012d. White Nose Syndrome Threatens New York's Bats. Accessed May 24, 2012. http://www.dec.ny.gov/animals/45088.html

[NYSDEC] New York State Department of Environmental Conservation. 2012e. New England Cottontail Survey. Accessed May 24, 2012. http://www.dec.ny.gov/animals/67017.html

[NYSDEC] New York State Department of Environmental Conservation. 2012f. Bog Turtle Fact Sheet. Accessed May 24, 2012. http://www.dec.ny.gov/animals/7164.html

[NYSDEC] New York State Department of Environmental Conservation. 2012g. Protecting Bog Turtles on Private Land. Accessed May 24, 2012. http://www.dec.ny.gov/pubs/48707.html

[NYSDEC] New York State Department of Environmental Conservation. 2012h. Dwarf Wedge Mussel Fact Sheet. Accessed May 24, 2012. http://www.dec.ny.gov/animals/42253.html

[NYSDEC] New York State Department of Environmental Conservation. 2012i. Federally Protected Plants. Accessed May 24, 2012. http://www.dec.ny.gov/animals/7133.html

[NYSDEC] New York State Department of Environmental Conservation. 2013. List of Endangered, Threatened and Special Concern Fish and Wildlife Species of New York State. Accessed April 23, 2013. http://www.dec.ny.gov/animals/7494.html

[NYSDEC] New York State Department of Environmental Conservation. 2013a. Report to ESS Group, Inc. re: Rare or State-Listed Animals and Plants, and Significant Natural Communities, Which Occur or May Occur in or in the Immediate Vicinity of the West Point Transmission Project Area.

Nye, P. 2010. New York State Bald Eagle Report, 2010. Prepared for NYSDEC. http://www.dec.ny.gov/docs/wildlife_pdf/baea2010.pdf

Schaffner, L. C. 2010. Patterns and rates of recovery of macrobenthic communities in a polyhaline temperate estuary following sediment disturbance: Effects of disturbance severity and potential importance of non-local processes. Estuaries and Coasts 33:1300-1313.

Stegemann, E.C. 1994. Sturgeon – the King of Freshwater Fishes, Freshwater Fishes of New York. Accessed March 27, 2013. http://www.dec.ny.gov/animals/7025.html

Sweka, J. A., J. Mohler, M. J. Millard, T. Kehler, A. Kahnle, K. Hattala, G. Kenney, and A. Higgs. 2007. Juvenile Atlantic sturgeon habitat use in Newburgh and Haverstraw bays of the Hudson River: implications for population monitoring. North American Journal of Fisheries Management 27:1058-1067.

[USDA] United States Department of Agriculture. 2012. PLANTS Database. Accessed May 25, 2012. http://plants.usda.gov/java/

[USFWS] United States Fish and Wildlife Service. 2013. Response to ESS Group, Inc. on List of threatened and endangered species that may occur in the West Point Transmission Project Area, and/or may be affected by the West Point Transmission Project. May 10, 2013.

[USFWS] United States Fish and Wildlife Service. 2006. New England Cottontail Fact Sheet. http://www.fws.gov/northeast/pdf/necotton.fs.pdf

[USFWS] United States Fish and Wildlife Service. 2007a. National Bald Eagle Management Guidelines. Accessed May 8, 2013. http://www.fws.gov/MississippiES/pdf/Eagle%20Guidelines.pdf

[USFWS] United States Fish and Wildlife Service. 2007b. Northern Wild Monkshood Fact Sheet. http://www.fws.gov/midwest/endangered/plants/monkshoo.html

[USFWS] United States Fish and Wildlife Service. 2008. Small Whorled Pogonia Fact Sheet. http://www.fws.gov/midwest/endangered/plants/smallwhorledpogoniafs.html

[USFWS] United States Fish and Wildlife Service. 2010. Indiana Bat Summer Habitat Report. http://www.fws.gov/northeast/njfieldoffice/pdf/IbatSummerHab.pdf

[USFWS] United States Fish and Wildlife Service. 2011. Revised Indiana Bat Mitigation Guidance for the Commonwealth of Kentucky. http://www.fws.gov/frankfort/pdf/Jan2011%20Indiana%20bat%20Mitigation%20Guidance.pdf

[USFWS] United States Fish and Wildlife Service. 2012a. Endangered Species Search Engine. Accessed March 2012. http://www.fws.gov/endangered/

[USFWS] United States Fish and Wildlife Service. 2012b. Indiana Bat Fact Sheet. Last updated February 13, 2012. http://www.fws.gov/northeast/nyfo/es/ibat.htm

Van Dolah, R. F., D. R. Calder, and D. M. Knott. 1984. Effects of dredging and open-water disposal on benthic macroinvertebrates in a South Carolina estuary. Estuaries 7(1):28-37.

Section 4.10 - Land Use

[NYSDOS] New York State Department of State. 2013. Guidelines for the Preparation of Harbor Management Plans. Accessed April 22. http://www.dos.ny.gov/communitieswaterfronts/pdfs/hmpguide.pdf

Section 4.12 - Visual and Aesthetic Resources

NYSDEC Policy System. Assessing and Mitigating Visual Impacts, 2000, accessed on 14 May 2013 at http://www.dec.ny.gov/docs/permits_ej_operations_pdf/visual2000.pdf

Tables

www.essgroup.com

Table 4.7-1: Taxa Collected during Site-specific Benthic Sampling Program, August 2012

	Density (individuals/m^2)																			
	TIDAL FRESHWATER ZONE																			
Taxon	**BGL2**	**BG01**	**BG02**	**BG03**	**BG04**	**BG05**	**BG06**	**BG07**	**BG09**	**BG10**	**BG11**	**BG12**	**BG13**	**BG14**	**BG15**	**BG16**	**BG17**	**BG18**	**BG19**	**BG20**
Hydrobiidae																				
Laevapex fuscus				120																
Planorbidae								20												
Turbonilla sp	53																60			
Bivalvia	53							20				107		20			20			
Corbicula fluminea	107		160	120		20	160	260	200	320	40	747	300	460	640		520	80		80
Dreissena polymorpha				4440		20		20	120		10	1600								80
Juvenile Fingernail Clam	107																20	160		
Mulinia lateralis																				
Axarus sp																				
Chironomidae								20		53						1920				
Chironominae									40				20							
Chironomini														40						
Coelotanypus sp											10			20						
Cryptochironomus sp							80		80			107		40			20			
Harnischia sp																				
Orthocladiinae																				
Parametriocnemus sp																				
Polypedilum sp		160	160	160			120		120		10	427	160	80			60			80
Probezzia sp																				
Procladius sp																				
Stempellina sp									40								940			
Tanypodinae				80																
Plecoptera																				
Limnephilidae																		80		
Oecetis sp				160								320								
Gammaridea				240		20		100						40						
Gammarus daiberi			107	2080		20	40	60	40											
Gammarus sp	213		53	2840		760	440	1280	960	800	130	5867	40	540		1280	240			800
Copepoda																				
Cyclopoida			53	40		20	160	60	40		60	427		20			1340	80	80	
Harpacticoida																				
Rhithropanopeus harrisii																				
Xanthidae																				
Chiridotea almyra													40							240
Cyathura polita				120		20		20	160			213	20	20						
Idoteidae																				
Ostracoda																				
Hirudinea																				
Oligochaeta			53																	
Enchytraidae																				
Naididae				80																
Tubificidae																				

Table 4.7-1: Taxa Collected during Site-specific Benthic Sampling Program, August 2012

	Density (individuals/m^2)																			
	TIDAL FRESHWATER ZONE																			
Taxon	**BGL2**	**BG01**	**BG02**	**BG03**	**BG04**	**BG05**	**BG06**	**BG07**	**BG09**	**BG10**	**BG11**	**BG12**	**BG13**	**BG14**	**BG15**	**BG16**	**BG17**	**BG18**	**BG19**	**BG20**
(imm. w/ hair chetae)																				
Tubificidae (imm. w/o hair chetae)	107			40		220	1080	240	560	107	330	427		280	640	10,880	880			160
Limnodrilus hoffmeisteri								120	40					60		1280	60			
Limnodrilus udekemianus						20	80	100		53		107					20			
Ampharetidae																				
Neanthes succinea																				
Marenzelleria viridis																				
Polydora sp																				
Nematoda								20	40											
Nemertea																				
Planaria												213					20			
Total Density	**640**	**160**	**587**	**10,520**	**0**	**1,120**	**2,160**	**2,340**	**2,440**	**1,333**	**590**	**10,560**	**580**	**1,620**	**1,280**	**15,360**	**4,200**	**400**	**80**	**1,440**
Number of Taxa	**6**	**1**	**6**	**13**	**0**	**9**	**8**	**14**	**13**	**5**	**7**	**12**	**6**	**12**	**2**	**4**	**13**	**4**	**1**	**6**

Table 4.7-1: Taxa Collected during Site-specific Benthic Sampling Program, August 2012

	TIDAL FRESHWATER ZONE														OLIGOHALINE ZONE				
	Density (Individuals/m^2)														Density (Individuals/m^2)				
Taxon	**BG22**	**BG23**	**BG24**	**BG25**	**BG26**	**BG27**	**BG28**	**BG29**	**BG30**	**BG31**	**BG32**	**BG33**	**Mean Density**	**Percent of Stations Reporting Taxon**	**BG34**	**BG35**	**BG36**	**BG37**	**BG38**
Hydrobiidae							200				160	80	147	9.1	640	140		320	7360
Laevapex fuscus													120	3.0					
Planorbidae													20	3.0					
Turbonilla sp							40						51	9.1	160				320
Bivalvia			640	160									146	21.2					
Corbicula fluminea				160							30		245	54.5	960	440	53	640	2240
Dreissena polymorpha													899	21.2		40			
Juvenile Fingernail Clam			960	160			120						254	18.2	160				1280
Mulinia lateralis													0	0					
Axarus sp													0	0		100			
Chironomidae													664	9.1		20			
Chironominae													30	6.1					
Chironomini													40	3.0					
Coelotanypus sp				320		40	120	320	1280		50	80	249	27.3	320	100	53	640	320
Cryptochironomus sp									160		10		71	21.2			27		
Harnischia sp													0	0		20			
Orthocladiinae													0	0		20			
Parametriocnemus sp			320										320	3.0					
Polypedilum sp													140	33.3				320	
Probezzia sp									160				160	3.0			27		
Procladius sp													0	0					
Stempellina sp													490	6.1					
Tanypodinae													80	3.0					
Plecoptera													0	0					
Limnophilidae													80	3.0					
Oecetis sp											10		163	9.1	160	60			
Gammaridea													100	12.1					
Gammarus daiberi													391	18.2					
Gammarus sp			320	160					160				938	54.5		20			
Copepoda	160												160	3.0					
Cyclopoida		480	320	480		320	320		480	160	80	80	243	63.6	160			320	
Harpacticoida													0	0	480		160		320
Rhithropanopeus harrisii													0	0					
Xanthidae													0	0					
Chiridotea almyra													140	6.1					
Cyathura polita											30		75	24.2		120			
Idoteidae													0	0					
Ostracoda							40						40	3.0	160	20		320	

Table 4.7-1: Taxa Collected during Site-specific Benthic Sampling Program, August 2012

Taxon	TIDAL FRESHWATER ZONE														OLIGOHALINE ZONE				
	Density (Individuals/m^2)														Density (Individuals/m^2)				
	BG22	**BG23**	**BG24**	**BG25**	**BG26**	**BG27**	**BG28**	**BG29**	**BG30**	**BG31**	**BG32**	**BG33**	**Mean Density**	**Percent of Stations Reporting Taxon**	**BG34**	**BG35**	**BG36**	**BG37**	**BG38**
Hirudinea	0												0	3.0					
Oligochaeta	320												187	6.1					
Enchytraidae													0	0					
Naididae													80	3.0					
Tubificidae (imm. w/ hair chetae)		160	320										240	6.1					
Tubificidae (imm. w/o hair chetae)	160	1280	960		80	20	1320	640		320	40	80	869	72.7		280	213		
Limnodrilus hoffmeisteri							80				10		236	21.2		20		320	
Limnodrilus udekemianus													63	18.2					
Ampharetidae													0	0					
Neanthes succinea													0	0					
Marenzelleria viridis													0	0					
Polydora sp													0	0					
Nematoda			320			60		320	1280		10	160	276	24.2	1440	200	107		
Nemertea									320				320	3.0					
Planaria													117	6.1					
Total Density	**640**	**1,920**	**4,160**	**1,440**	**80**	**440**	**2,240**	**1,280**	**3,840**	**480**	**430**	**480**			**4,640**	**1,600**	**640**	**2,880**	**11,840**
Number of Taxa	**4**	**3**	**8**	**6**	**1**	**4**	**8**	**3**	**7**	**2**	**10**	**5**			**10**	**15**	**7**	**7**	**6**

Table 4.7-1: Taxa Collected during Site-specific Benthic Sampling Program, August 2012

	OLIGOHALINE ZONE														
	Density (individuals/m^2)														
Taxon	BG39	BG40	BG41	BG42	BG43	BG44	BG45	BG46	BG47	BG48	BG49	BG50	BGL6	Mean Density	Percent of Stations Reporting Taxon
Hydrobiidae	640	2080	10	1880	140	3040	740	60	320	120	40	160		1,106	88.9
Laevapex fuscus														0	0
Planorbidae														0	0
Turbonilla sp					10		40							133	22.2
Bivalvia														0	0
Corbicula fluminea														867	27.8
Dreissena polymorpha														40	5.6
Juvenile Fingernail Clam														720	11.1
Mulinia lateralis							20			80			27	42	16.7
Axarus sp														100	5.6
Chironomidae														20	5.6
Chironominae														0	0
Chironomini														0	0
Coelotanypus sp	160			20	10			60		60	40	160	27	152	72.2
Cryptochironomus sp				40	10			20						24	22.2
Harnischia sp														20	5.6
Orthocladiinae														20	5.6
Parametriocnemus sp														0	0
Polypedilum sp														320	5.6
Probezzia sp														27	5.6
Procladius sp								20						20	5.6
Stempellina sp														0	0
Tanypodinae														0	0
Plecoptera										20				20	5.6
Limnophilidae														0	0
Oecetis sp														110	11.1
Gammaridea														0	0
Gammarus daiberi														0	0
Gammarus sp														20	5.6
Copepoda	240													240	5.6
Cyclopoida		80								180				185	22.2
Harpacticoida							40							250	22.2
Rhithropanopeus harrisii							80				20			50	11.1
Xanthidae									160					160	5.6
Chiridotea almyra														0	0
Cyathura polita							140				20			93	16.7
Idoteidae												160		160	5.6
Ostracoda	80									20				120	27.8
Hirudinea													27	27	5.6

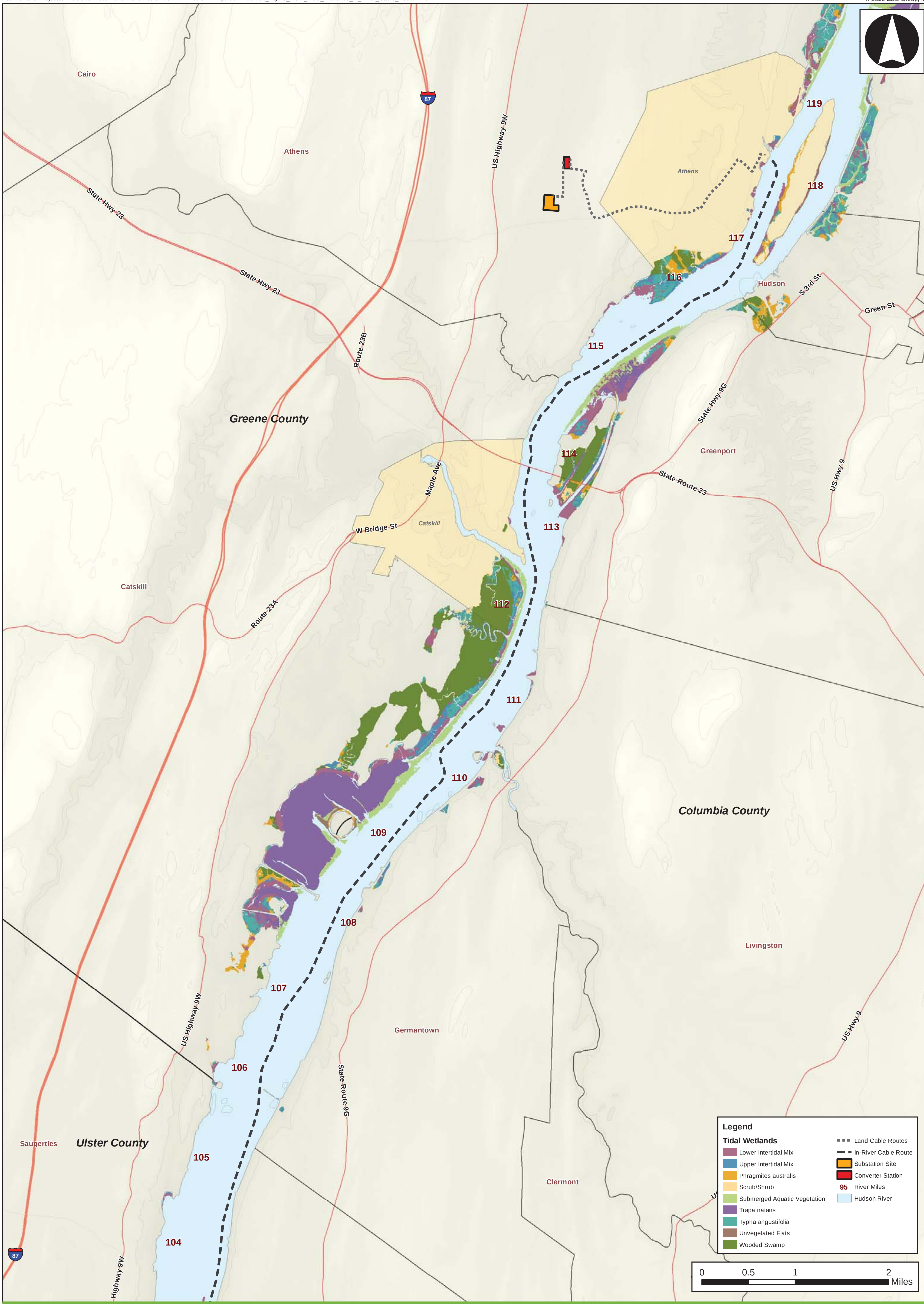
Table 4.7-1: Taxa Collected during Site-specific Benthic Sampling Program, August 2012

Taxon	OLIGOHALINE ZONE Density (individuals/m^2)														
	BG39	**BG40**	**BG41**	**BG42**	**BG43**	**BG44**	**BG45**	**BG46**	**BG47**	**BG48**	**BG49**	**BG50**	**BGL6**	**Mean Density**	**Percent of Stations Reporting Taxon**
Oligochaeta								20						20	5.6
Enchytraidae										20				20	5.6
Naididae														0	0
Tubificidae (imm. w/ hair chetae)														0	0
Tubificidae (imm. w/o hair chetae)	160	1120		420			20			40		160	27	271	50.0
Limnodrilus hoffmeisteri	160			20										130	22.2
Limnodrilus udekemianus														0	0
Ampharetidae							20			20		160		67	16.7
Neanthes succinea							20							20	5.6
Marenzelleria viridis							20							20	5.6
Polydora sp							1440							1,440	5.6
Nematoda	560	160												493	27.8
Nemertea							40		240	20				100	16.7
Planaria														0	0
Total Density	**2,000**	**3,440**	**10**	**2,380**	**170**	**3,040**	**2,620**	**180**	**720**	**580**	**120**	**800**	**107**		
Number of Taxa	**7**	**4**	**1**	**5**	**4**	**1**	**12**	**5**	**3**	**10**	**4**	**5**	**4**		

Figures

www.essgroup.com

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.3-1_Tidal_Wetlands_In_River_Cable_Route.mxd



environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 5,000 feet

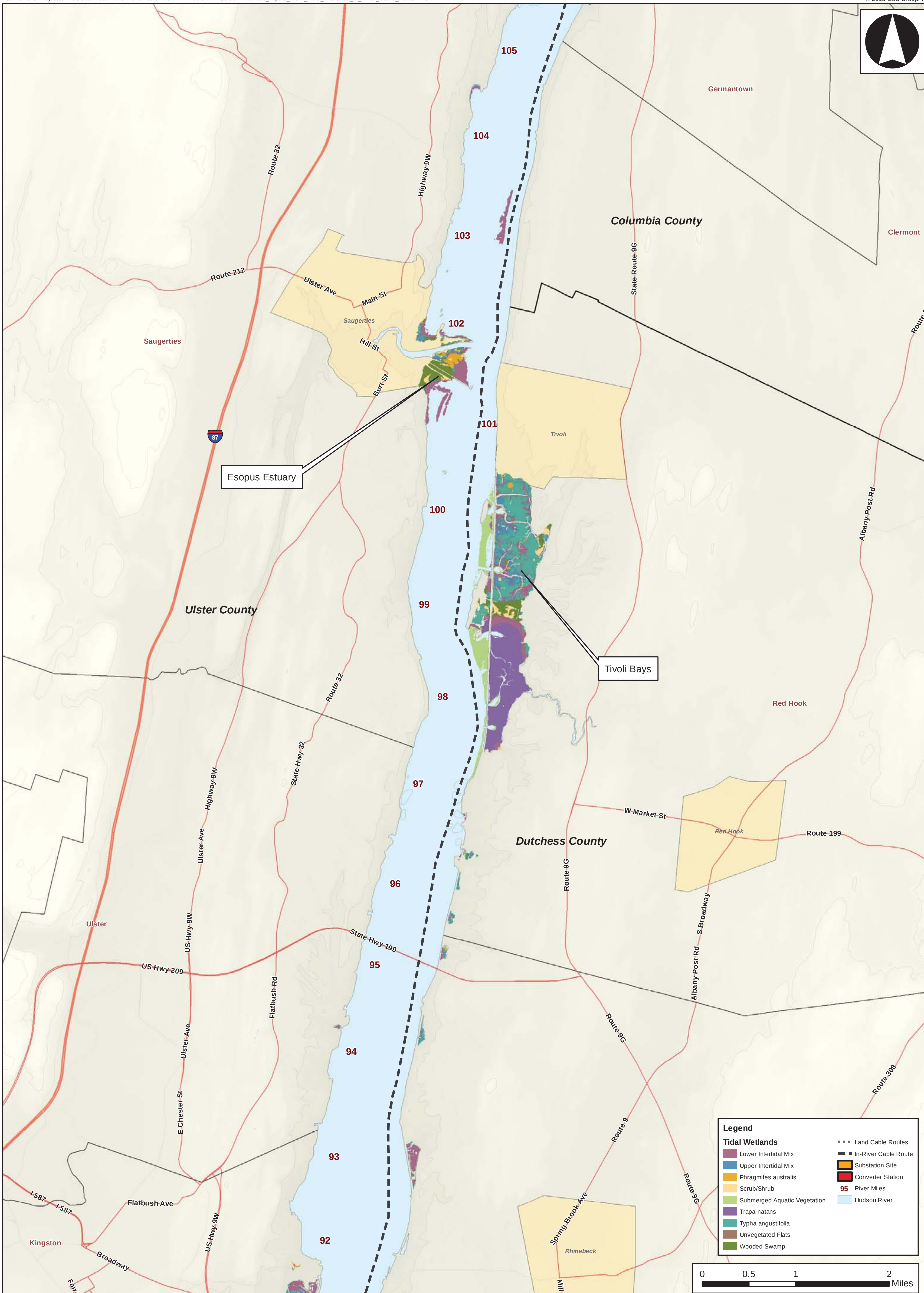
Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Tidal Wetlands, 2007

Tidal Wetlands Along In-River Cable Route

Figure 4.3-1

Sheet 1 of 6

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.3-1_Tidal_Wetlands_In_River_Cable_Route.mxd



West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

1 inch = 5,000 feet

environmental consulting & engineering services

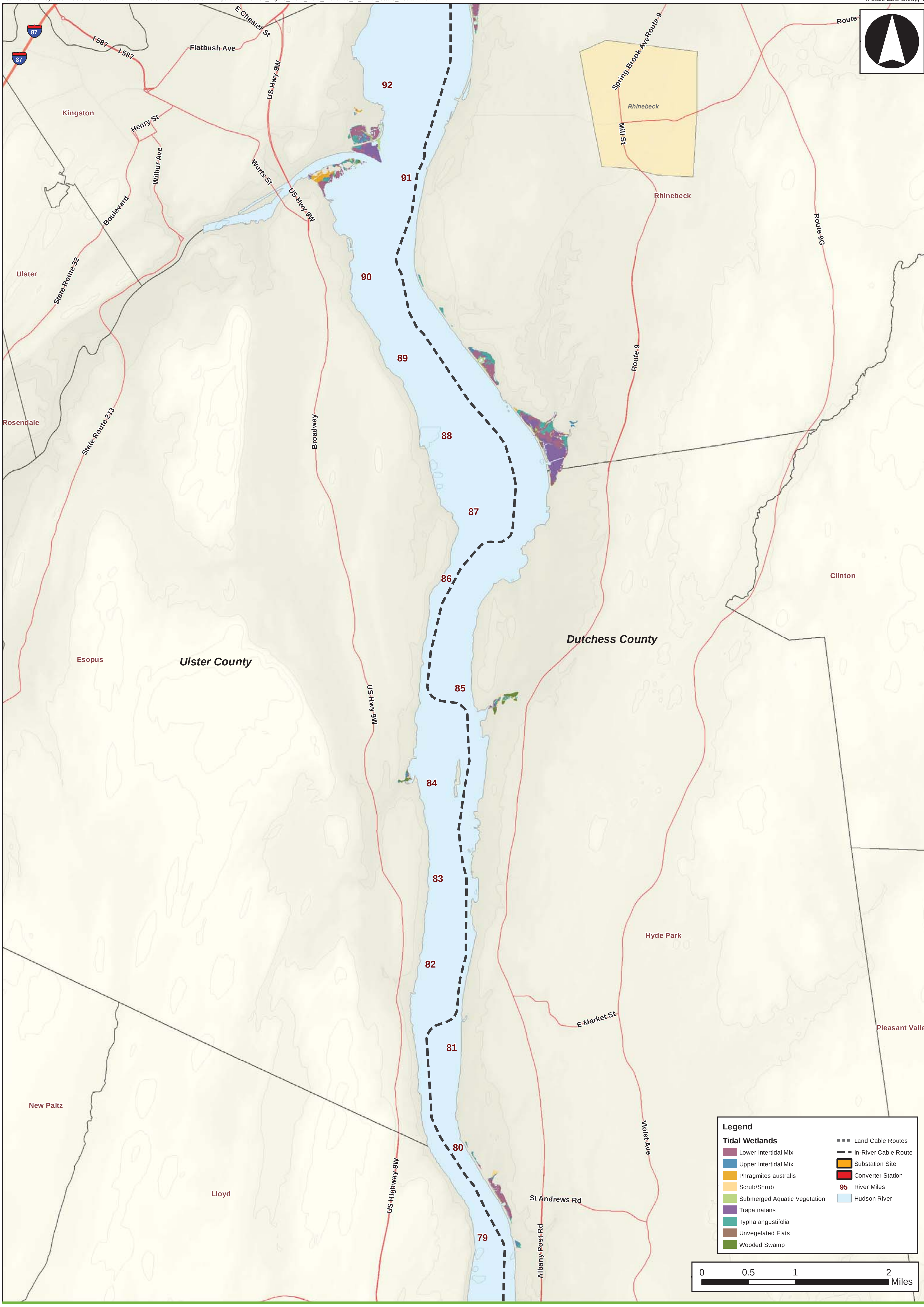
Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Tidal Wetlands, 2007

Tidal Wetlands Along In-River Cable Route

Figure 4.3-1

Sheet 2 of 6

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.3-1_Tidal_Wetlands_In_River_Cable_Route.mxd



environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 5,000 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Tidal Wetlands, 2007

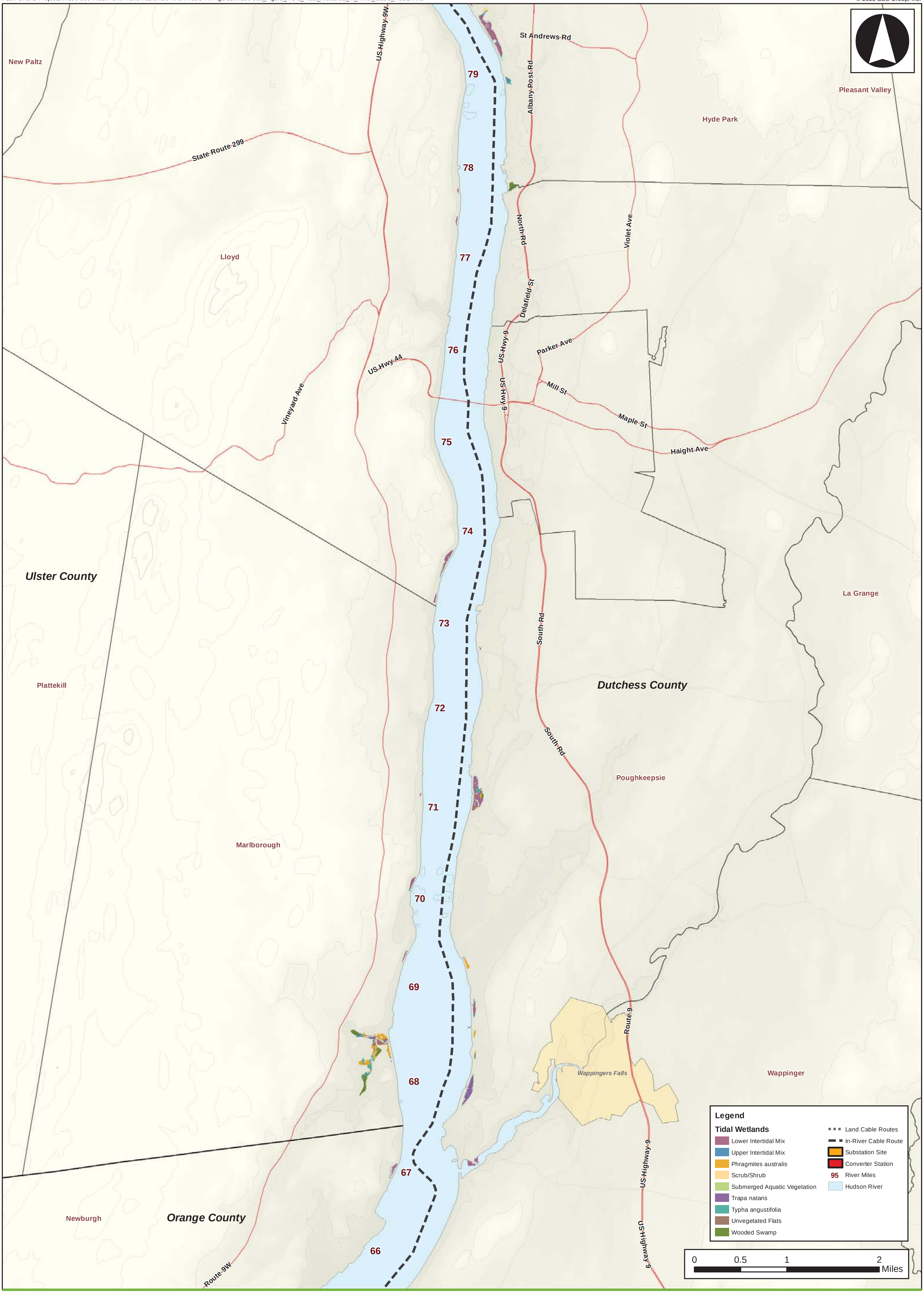
Tidal Wetlands Along In-River Cable Route

Figure 4.3-1

Sheet 3 of 6

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.3-1_Tidal_Wetlands_In_River_Cable_Route.mxd

© 2013 ESS Group, Inc.



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 5,000 feet

Tidal Wetlands Along In-River Cable Route

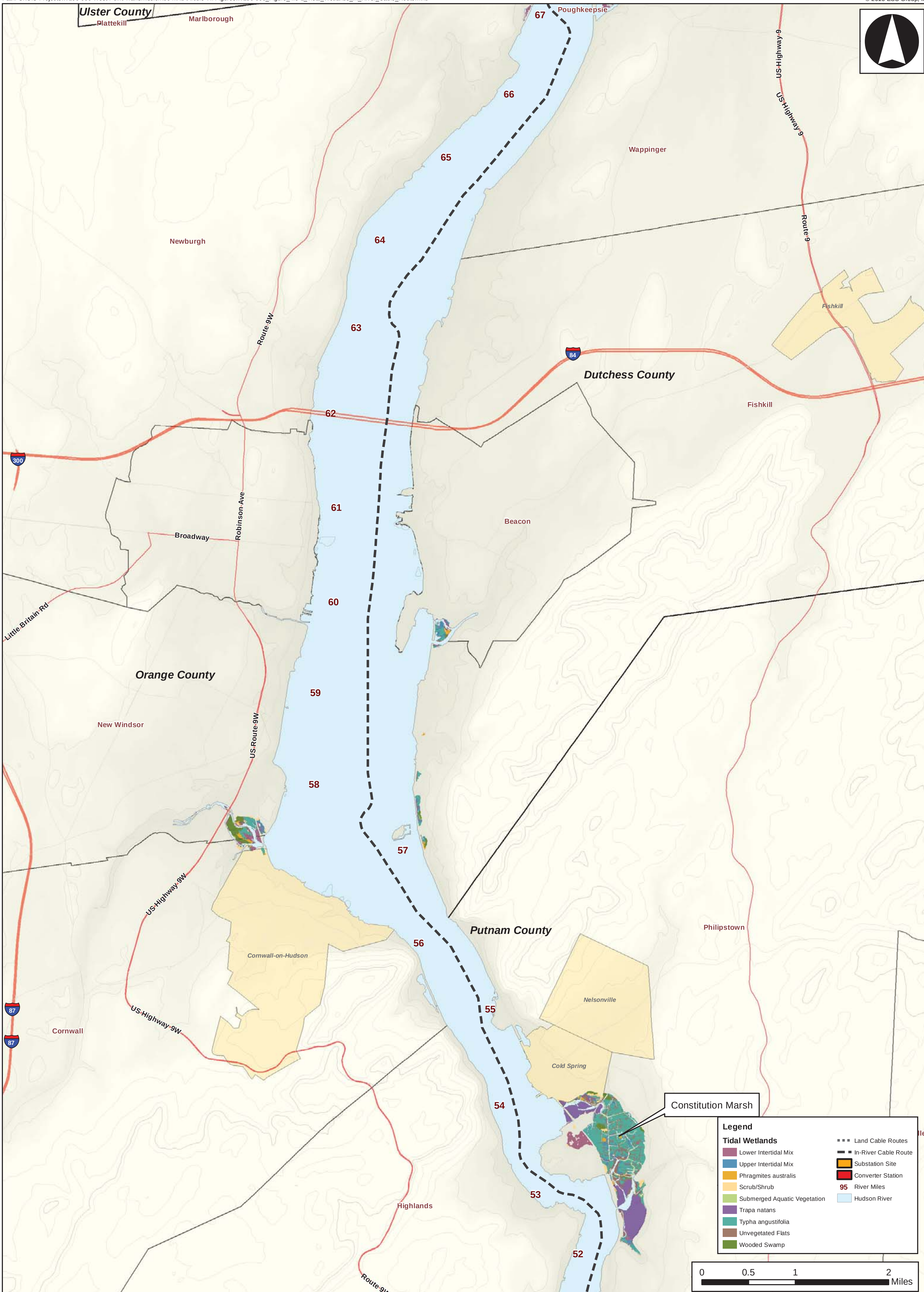
Figure 4.3-1

Sheet 4 of 6

ess group

environmental consulting & engineering services

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Tidal Wetlands, 2007



West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 5,000 feet

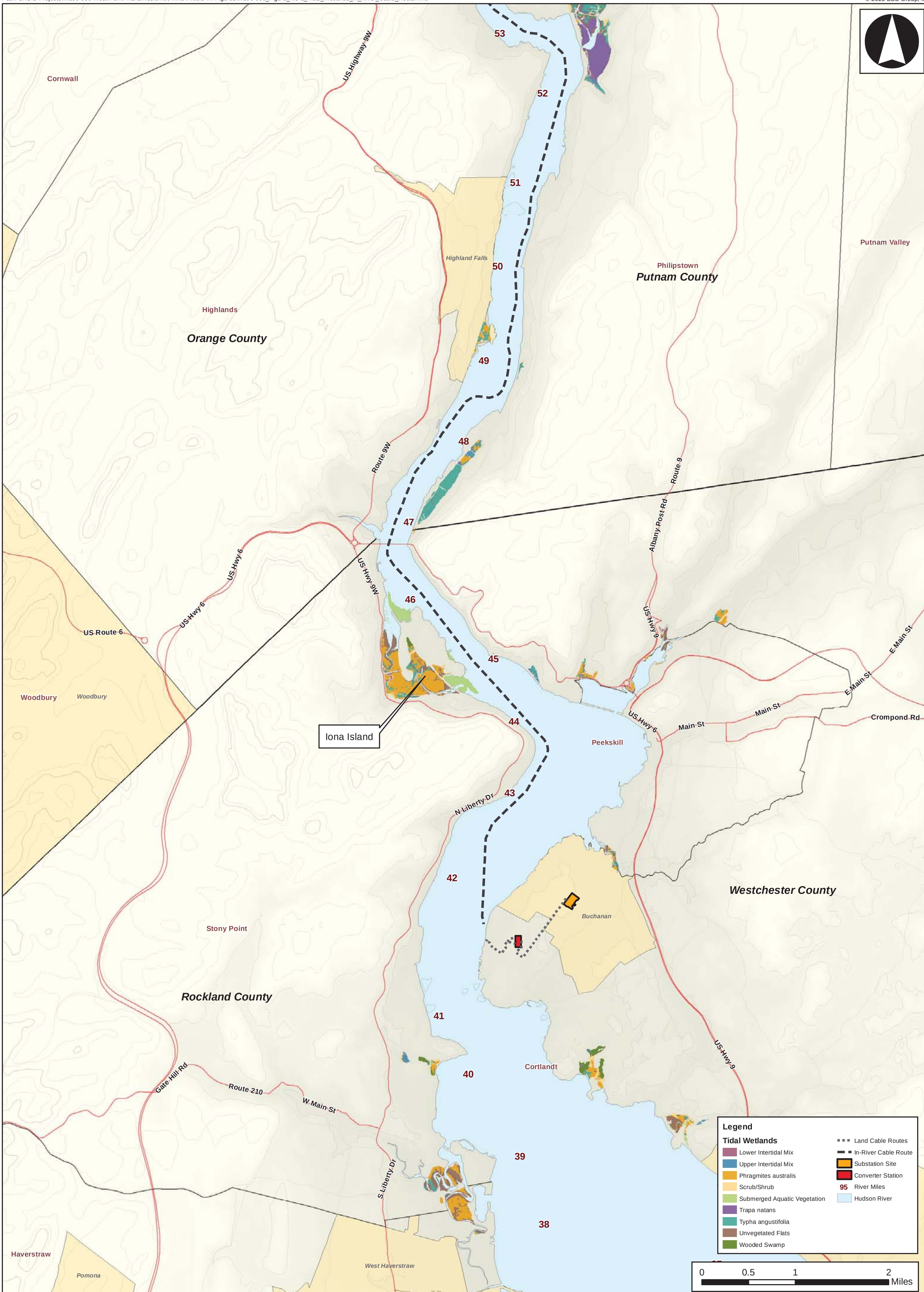
Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Tidal Wetlands, 2007

environmental consulting
& engineering services

Tidal Wetlands Along In-River Cable Route

Figure 4.3-1

Sheet 5 of 6



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 5,000 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Tidal Wetlands, 2007

ess group

environmental consulting
& engineering services

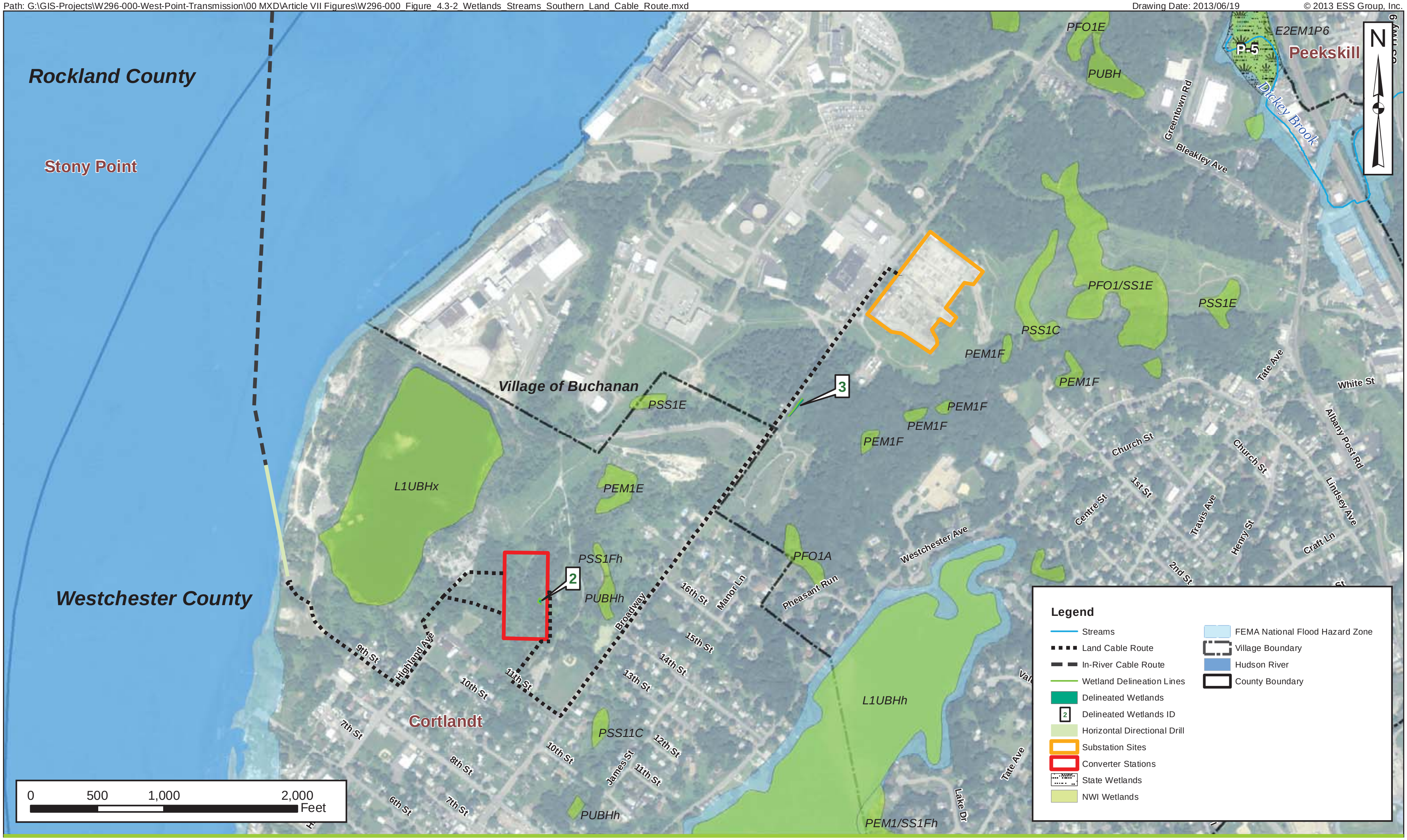
Tidal Wetlands Along In-River Cable Route

Figure 4.3-1

Sheet 6 of 6

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.3-2_Wetlands_Streams_Southern_Land_Cable_Route.mxd

Drawing Date: 2013/06/19



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 1,000 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) NAIP Imagery 4) NYS GIS Clearinghouse, Civil Boundaries, 2009 5) FEMA, NFLH Floodplain, 2012
6) NWI, Wetlands, 2011 7) NYSDEC, State Wetlands, 2004 8) NHD, Flowline Data, 2012

ess group
environmental consulting & engineering services

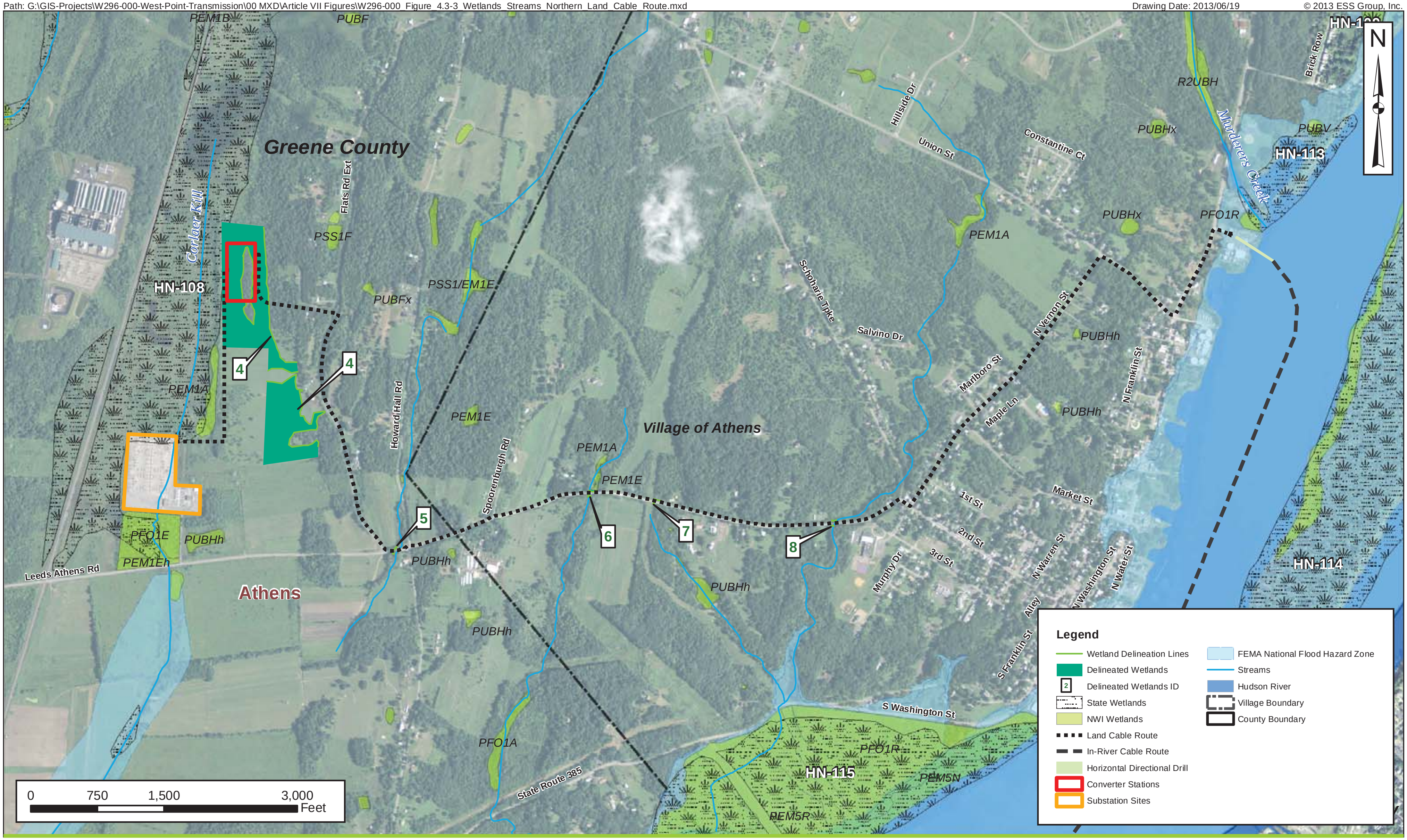
Wetlands and Streams

Southern Land Cable Route and Southern Converter Station

Figure 4.3-2

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.3-3_Wetlands_Streams_Northern_Land_Cable_Route.mxd

Drawing Date: 2013/06/19



ess group environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

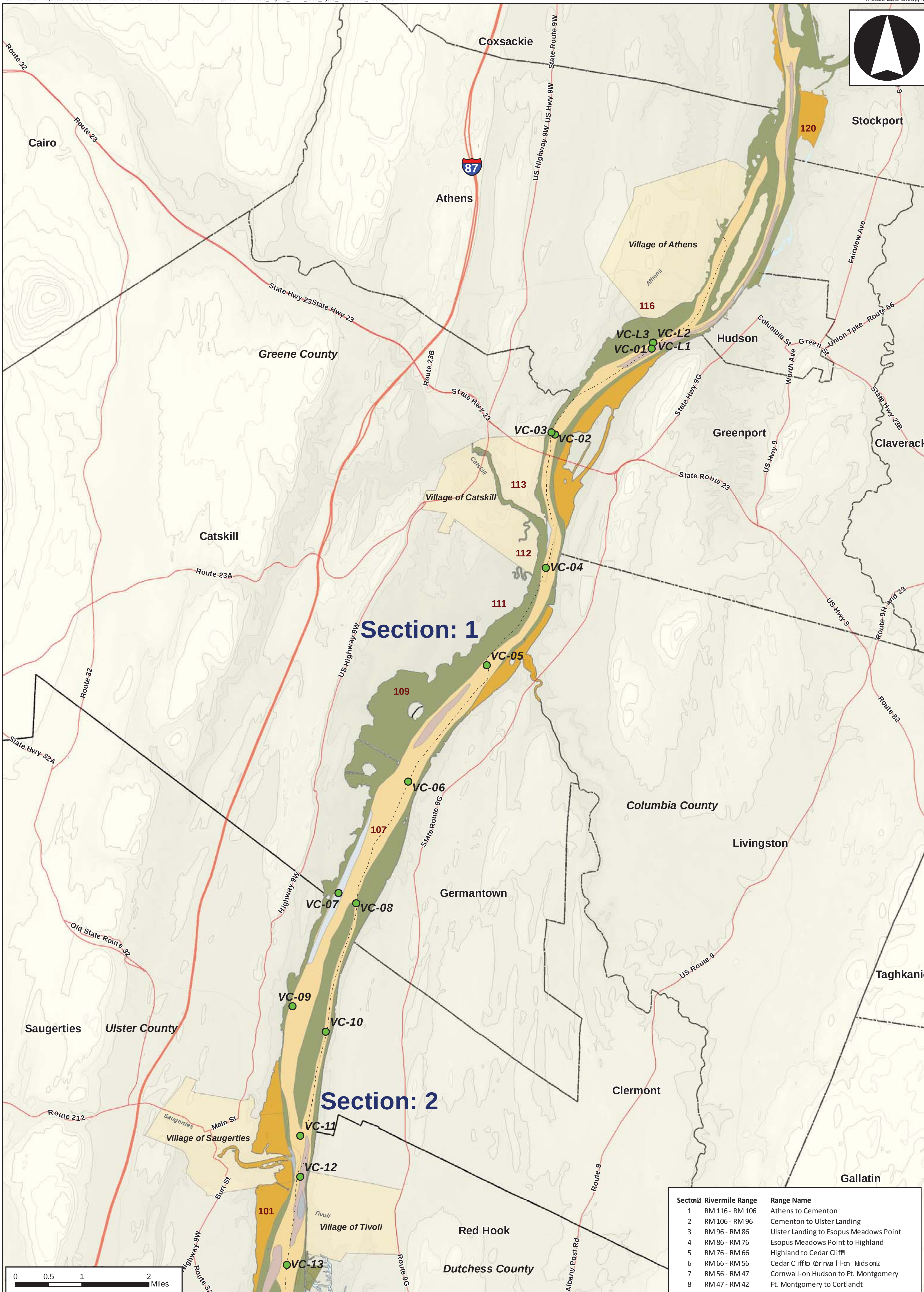
1 inch = 1,500 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) NAIP Imagery 4) NYS GIS Clearinghouse, Civil Boundaries, 2009 5) FEMA, NFLH Floodplain, 2012
6) NWI, Wetlands, 2011 7) NYSDEC, State Wetlands, 2011 8) NHD, Flowline Data, 2012

Wetlands and Streams

Northern Land Cable Route and Northern Converter Station

Figure 4.3-3



Secton	Rivermile Range	Range Name
1	RM 116 - RM 106	Athens to Cementon
2	RM 106 - RM 96	Cementon to Ulster Landing
3	RM 96 - RM 86	Ulster Landing to Esopus Meadows Point
4	RM 86 - RM 76	Esopus Meadows Point to Highland
5	RM 76 - RM 66	Highland to Cedar Cliff
6	RM 66 - RM 56	Cedar Cliff to Cornwall-on Hudson
7	RM 56 - RM 47	Cornwall-on Hudson to Ft. Montgomery
8	RM 47 - RM 42	Ft. Montgomery to Cortlandt

ess group
environmental consulting & engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

1 inch = 7,000 feet

Source: 1) ESS Vibracore Locations, 2012 2) NYS GIS Clearinghouse, Civil Boundaries, 2009
3) New York State Office of Cyber Security, NYS Streets, 2012
4) USGS, National Elevation Dataset Topography, 2006,2007,2008

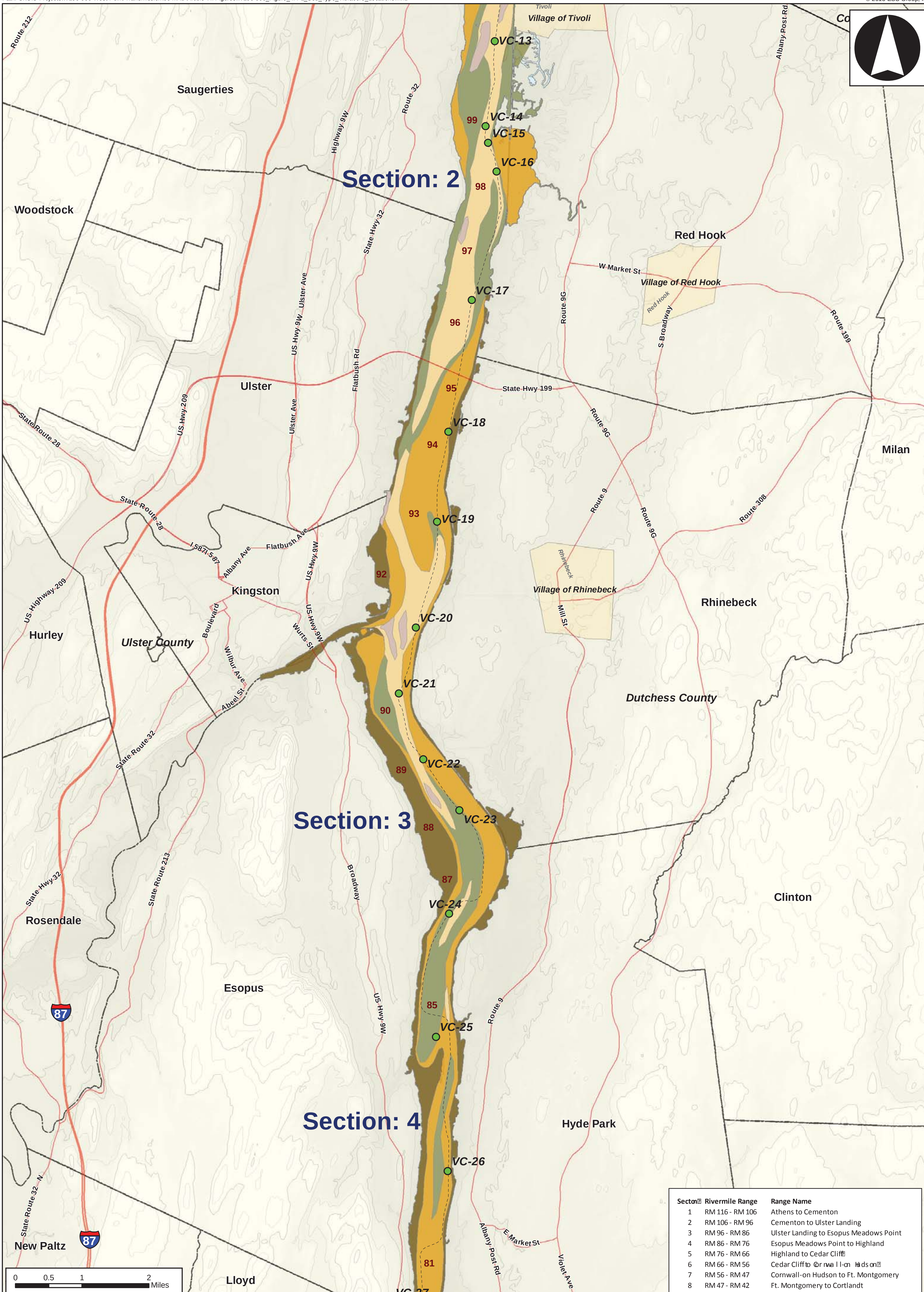
Legend

Hudson River Sediment Type
New York State DEC
- Gravel
- Gravelly Sand
- Gravelly Mud
- Sandy Gravel
- Sand
- Sandy Mud
- Muddy Gravel
- Muddy Sand
- Mud
- Vibracore Locations
- 95 River Miles
- S:1 Hudson Rivermile Sections
- In-River Cable Route

Sediment Type Vibracore Locations

Figure 4.4-1

Sheet 1 of 4



Secton	Rivermile Range	Range Name
1	RM 116 - RM 106	Athens to Cementon
2	RM 106 - RM 96	Cementon to Ulster Landing
3	RM 96 - RM 86	Ulster Landing to Esopus Meadows Point
4	RM 86 - RM 76	Esopus Meadows Point to Highland
5	RM 76 - RM 66	Highland to Cedar Cliff
6	RM 66 - RM 56	Cedar Cliff to Cornwall-on Hudson
7	RM 56 - RM 47	Cornwall-on Hudson to Ft. Montgomery
8	RM 47 - RM 42	Ft. Montgomery to Cortlandt

ess group
environmental consulting
& engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

1 inch = 7,000 feet

Source: 1) ESS Vibracore Locations, 2012 2) NYS GIS Clearinghouse, Civil Boundaries, 2009
3) New York State Office of Cyber Security, NYS Streets, 2012
4) USGS, National Elevation Dataset Topography, 2006,2007,2008

Legend

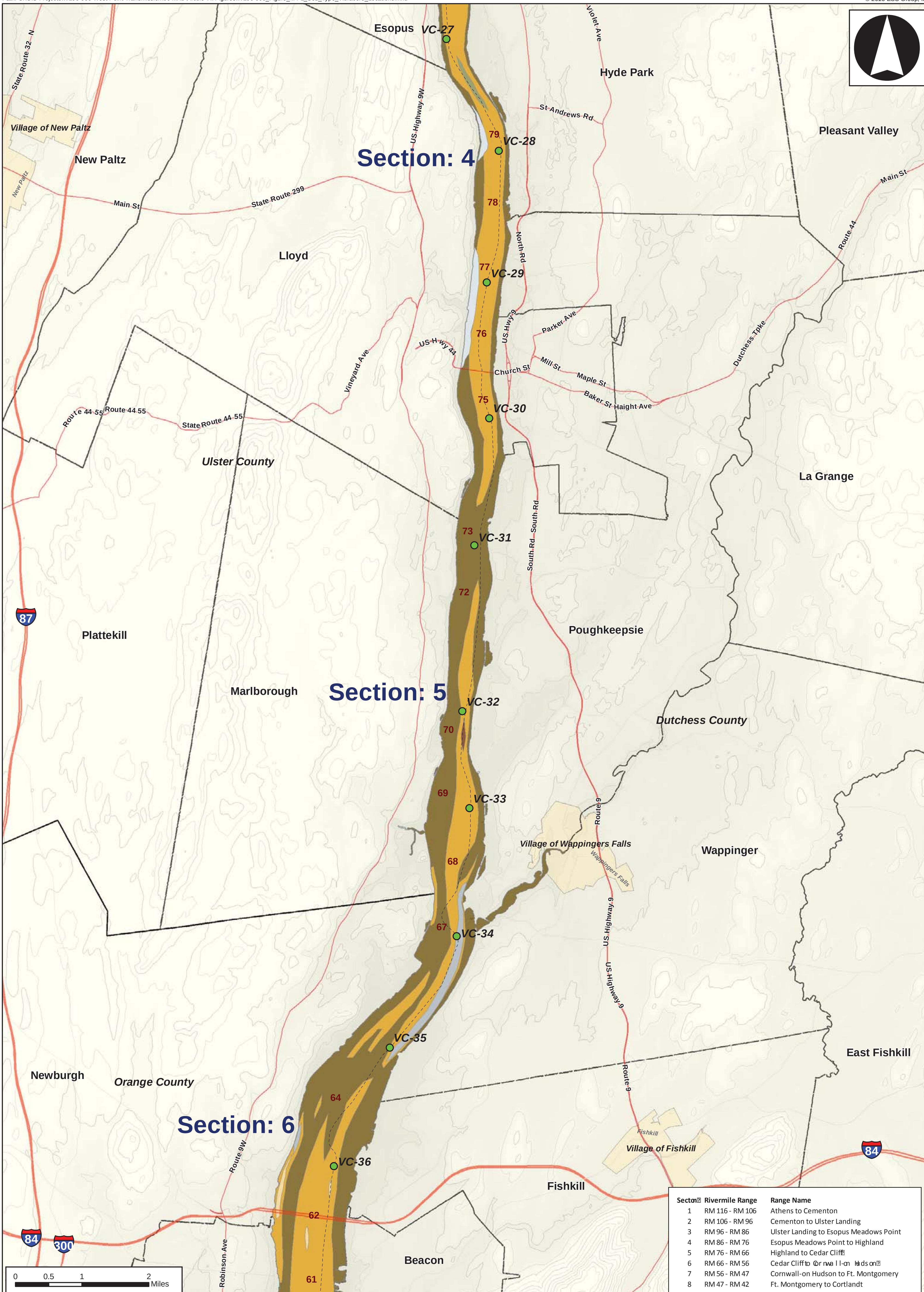
Hudson River Sediment Type
New York State DEC

- Gravel
- Gravelly Sand
- Gravelly Mud
- Sandy Gravel
- Sand
- Sandy Mud
- Muddy Gravel
- Muddy Sand
- Mud
- Vibracore Locations
- 95 River Miles
- S:1 Hudson Rivermile Sections
- In-River Cable Route

Sediment Type Vibracore Locations

Figure 4.4-1

Sheet 2 of 4



ess group
environmental consulting & engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

1 inch = 7,000 feet

Source: 1) ESS Vibracore Locations, 2012 2) NYS GIS Clearinghouse, Civil Boundaries, 2009
3) New York State Office of Cyber Security, NYS Streets, 2012
4) USGS, National Elevation Dataset Topography, 2006,2007,2008

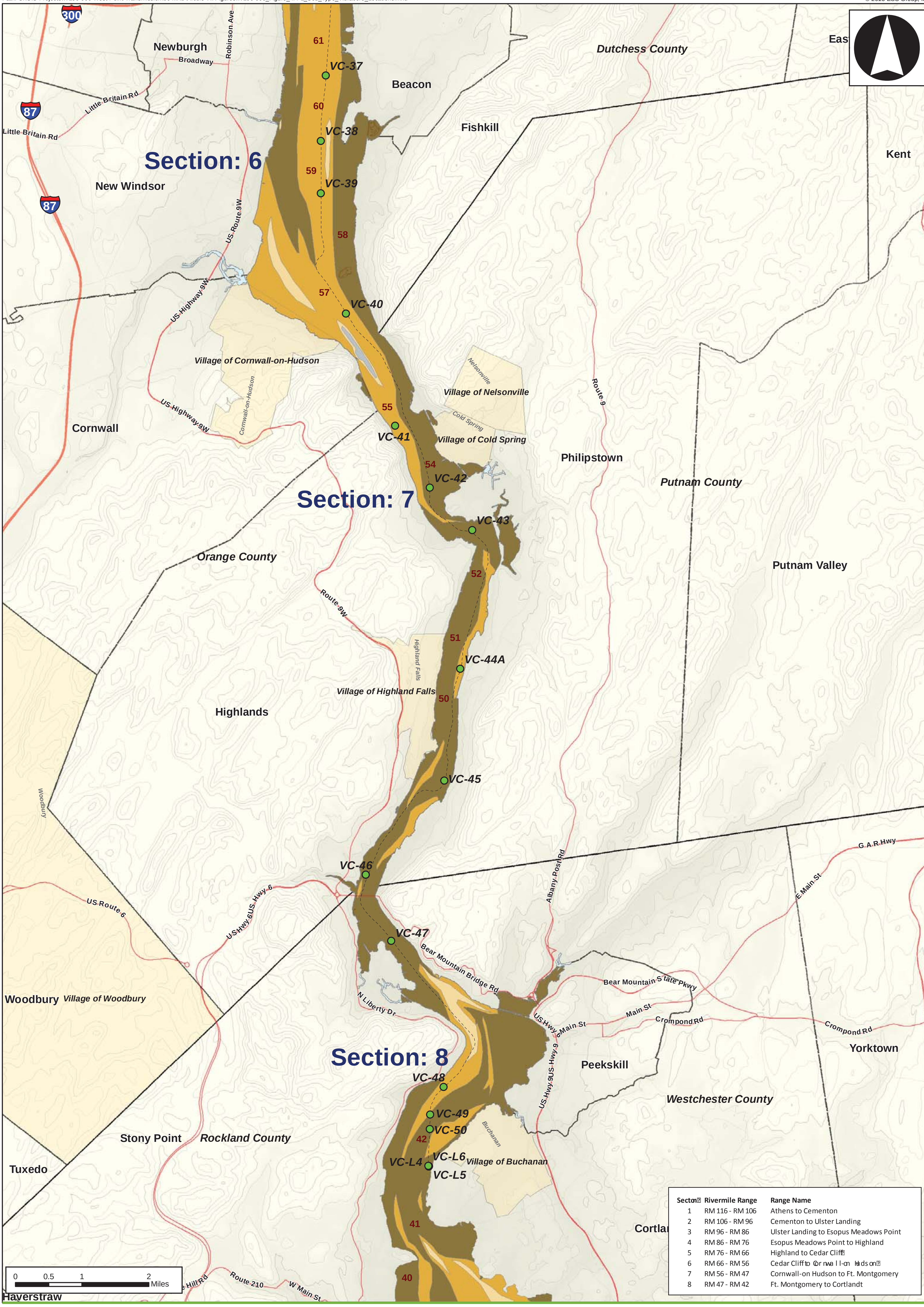
Legend

Hudson River Sediment Type
New York State DEC
- Gravel
- Gravelly Sand
- Gravelly Mud
- Sandy Gravel
- Sand
- Sandy Mud
- Muddy Gravel
- Muddy Sand
- Mud
- Vibracore Locations
- 95 River Miles
- S:1 Hudson Rivermile Sections
- In-River Cable Route

Sediment Type Vibracore Locations

Figure 4.4-1

Sheet 3 of 4



Secton	Rivermile Range	Range Name
1	RM 116 - RM 106	Athens to Cementon
2	RM 106 - RM 96	Cementon to Ulster Landing
3	RM 96 - RM 86	Ulster Landing to Esopus Meadows Point
4	RM 86 - RM 76	Esopus Meadows Point to Highland
5	RM 76 - RM 66	Highland to Cedar Cliff
6	RM 66 - RM 56	Cedar Cliff to Cornwall-on Hudson
7	RM 56 - RM 47	Cornwall-on Hudson to Ft. Montgomery
8	RM 47 - RM 42	Ft. Montgomery to Cortlandt

ess group
environmental consulting & engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

1 inch = 7,000 feet

Source: 1) ESS Vibracore Locations, 2012 2) NYS GIS Clearinghouse, Civil Boundaries, 2009
3) New York State Office of Cyber Security, NYS Streets, 2012
4) USGS, National Elevation Dataset Topography, 2006,2007,2008

Legend

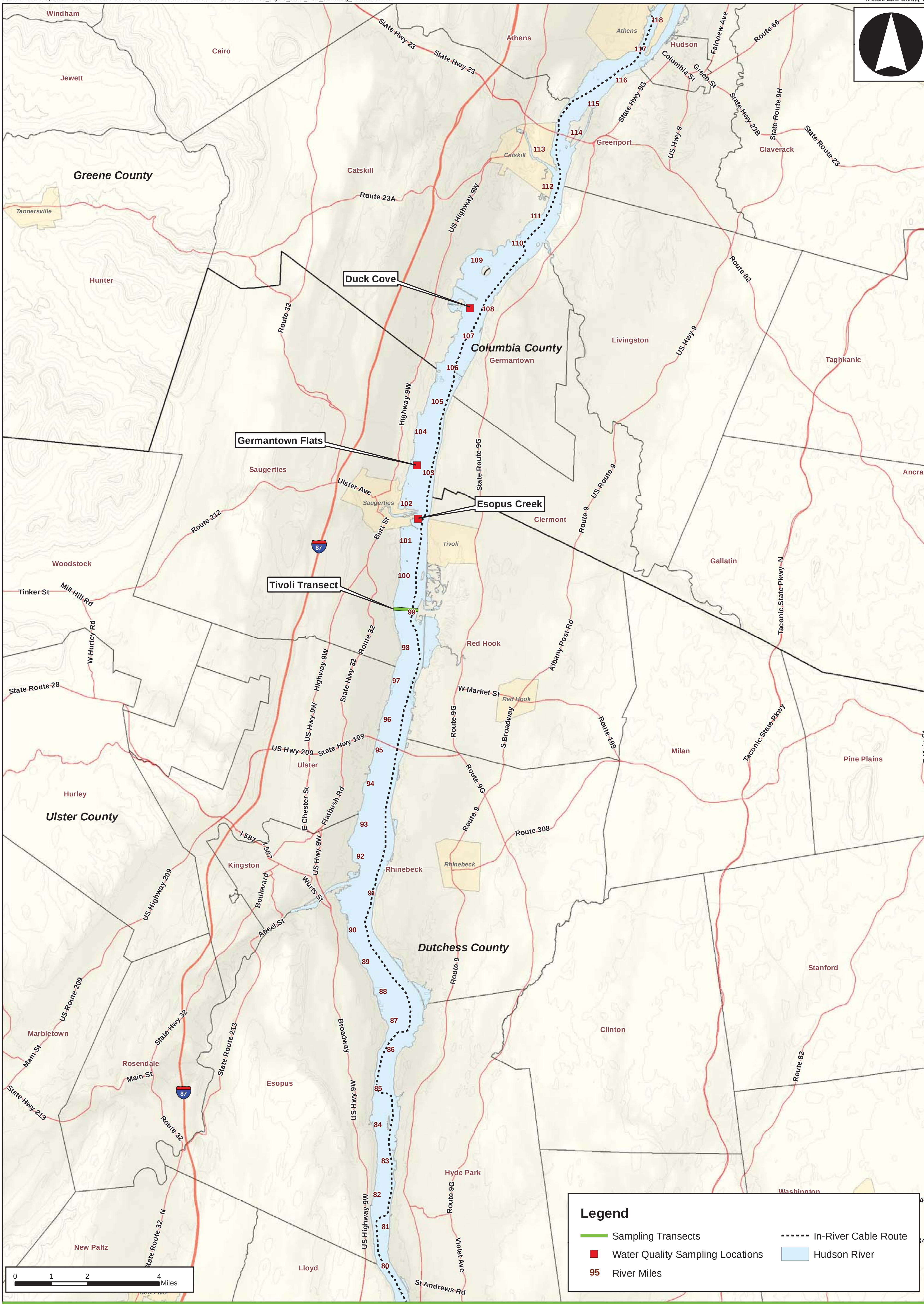
Hudson River Sediment Type
New York State DEC
- Gravel
- Gravelly Sand
- Gravelly Mud
- Sandy Gravel
- Sand
- Sandy Mud
- Muddy Gravel
- Muddy Sand
- Mud
- Vibracore Locations
- 95 River Miles
- S:1 Hudson Rivermile Sections
- In-River Cable Route

Sediment Type Vibracore Locations

Figure 4.4-1

Sheet 4 of 4

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.5-1_TSS_Sampling_Locations.mxd



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 13,000 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) NOAA Rivermiles, 2005
3) New York State Office of Cyber Security, NYS Streets, 2012 4) USGS, National Elevation Dataset Topography, 2006,2007,2008
5) NYS GIS Clearinghouse, Civil Boundaries, 2009

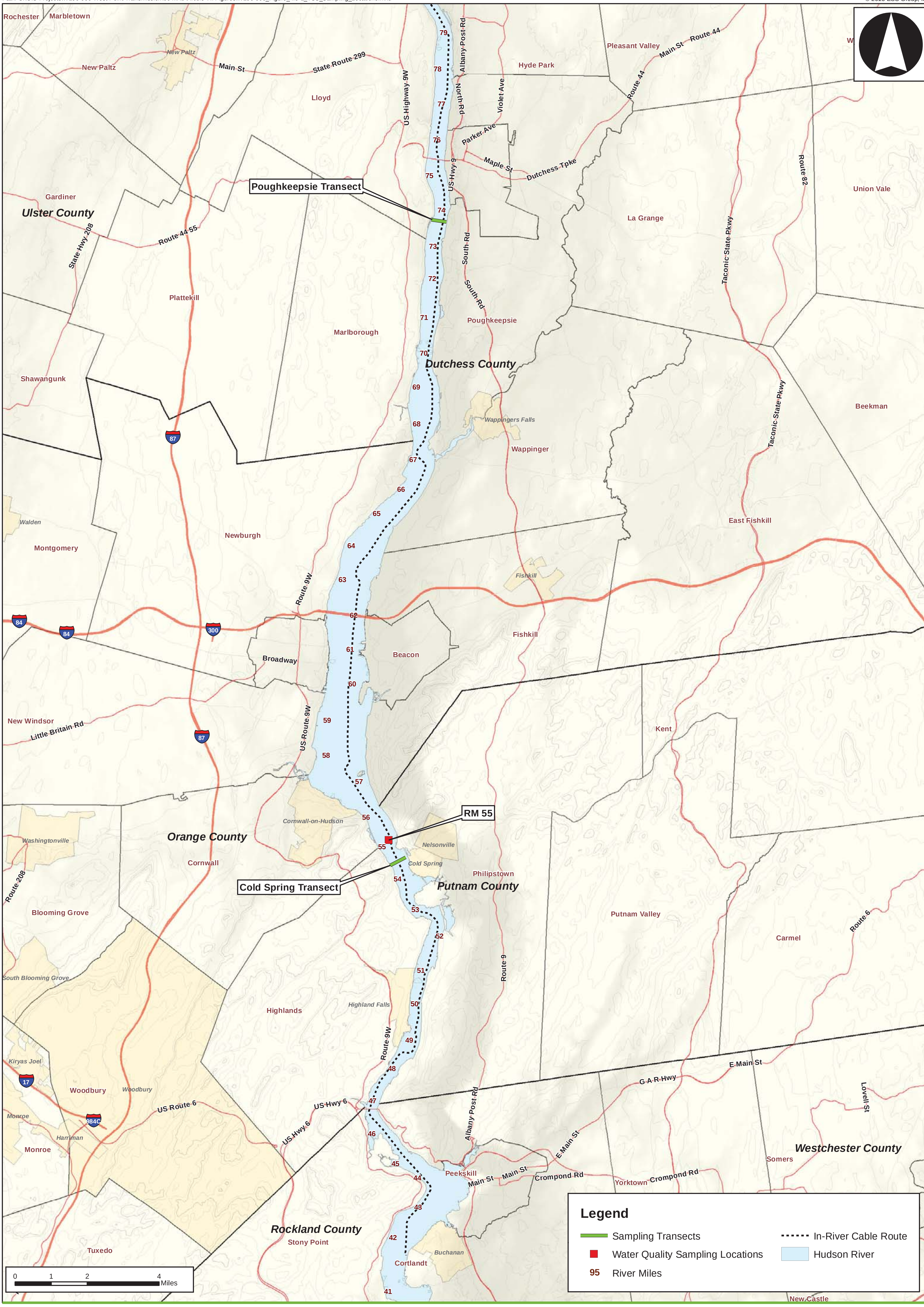
ess group
environmental consulting & engineering services

TSS Sampling Locations

Figure 4.5-1

Sheet 1 of 2

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.5-1_TSS_Sampling_Locations.mxd



ess group
environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 13,000 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) NOAA Rivermiles, 2005
3) New York State Office of Cyber Security, NYS Streets, 2012 4) USGS, National Elevation Dataset Topography, 2006,2007,2008
5) NYS GIS Clearinghouse, Civil Boundaries, 2009

TSS Sampling Locations

Figure 4.5-1

Sheet 2 of 2

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.7-1_Biological_Sampling_Locations.mxd

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 2 miles

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) NOAA Rivermiles, 2005
3) New York State Office of Cyber Security, NYS Streets, 2012 4) USGS, National Elevation Dataset Topography, 2006,2007,2008
5) NYS GIS Clearinghouse, Civil Boundaries, 2009

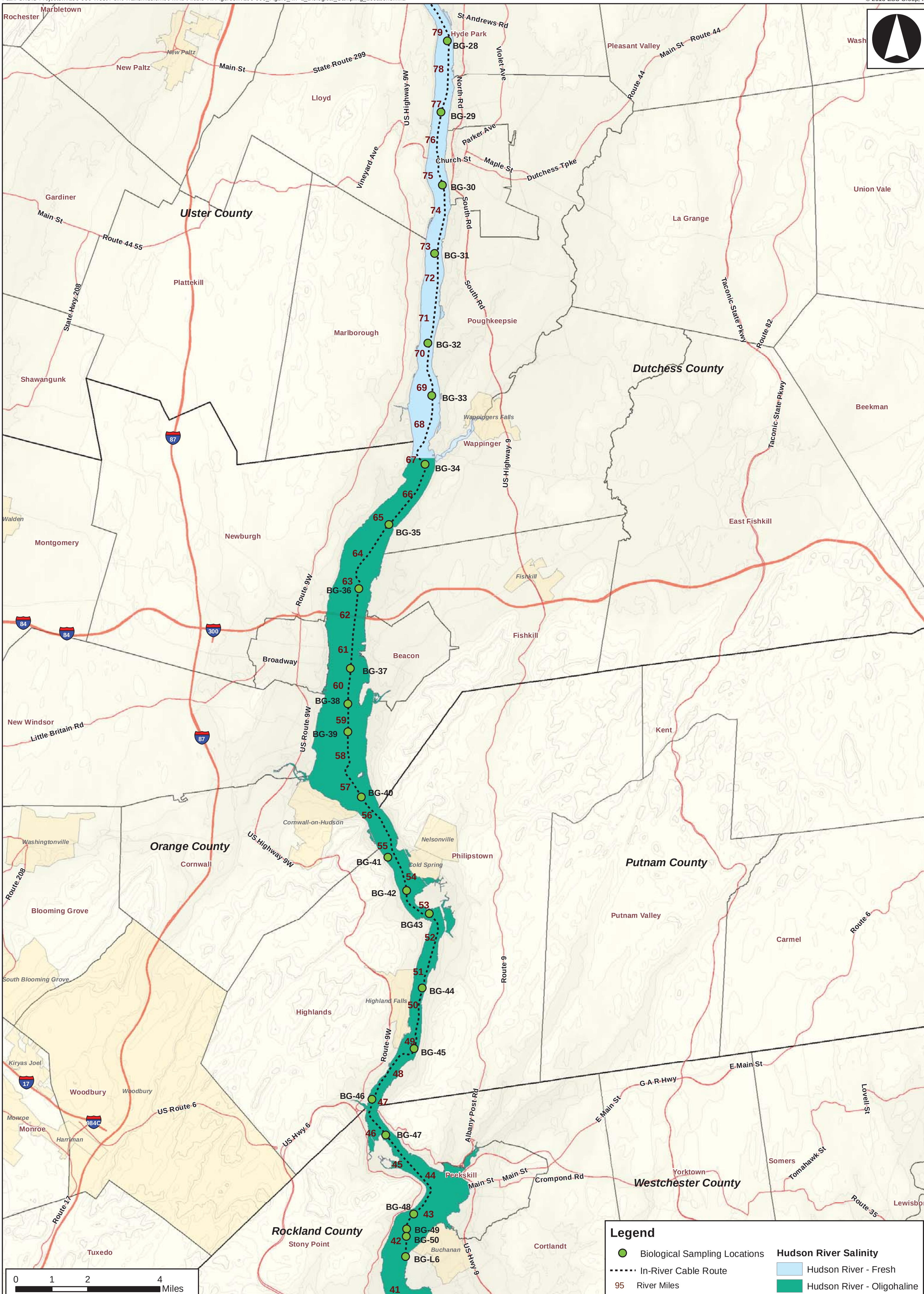
environmental consulting & engineering services

Biological Sampling Locations

Figure 4.7-1

Sheet 1 of 2

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.7-1_Biological_Sampling_Locations.mxd



West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 2 miles

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) NOAA Rivermiles, 2005
3) New York State Office of Cyber Security, NYS Streets, 2012 4) USGS, National Elevation Dataset Topography, 2006,2007,2008
5) NYS GIS Clearinghouse, Civil Boundaries, 2009

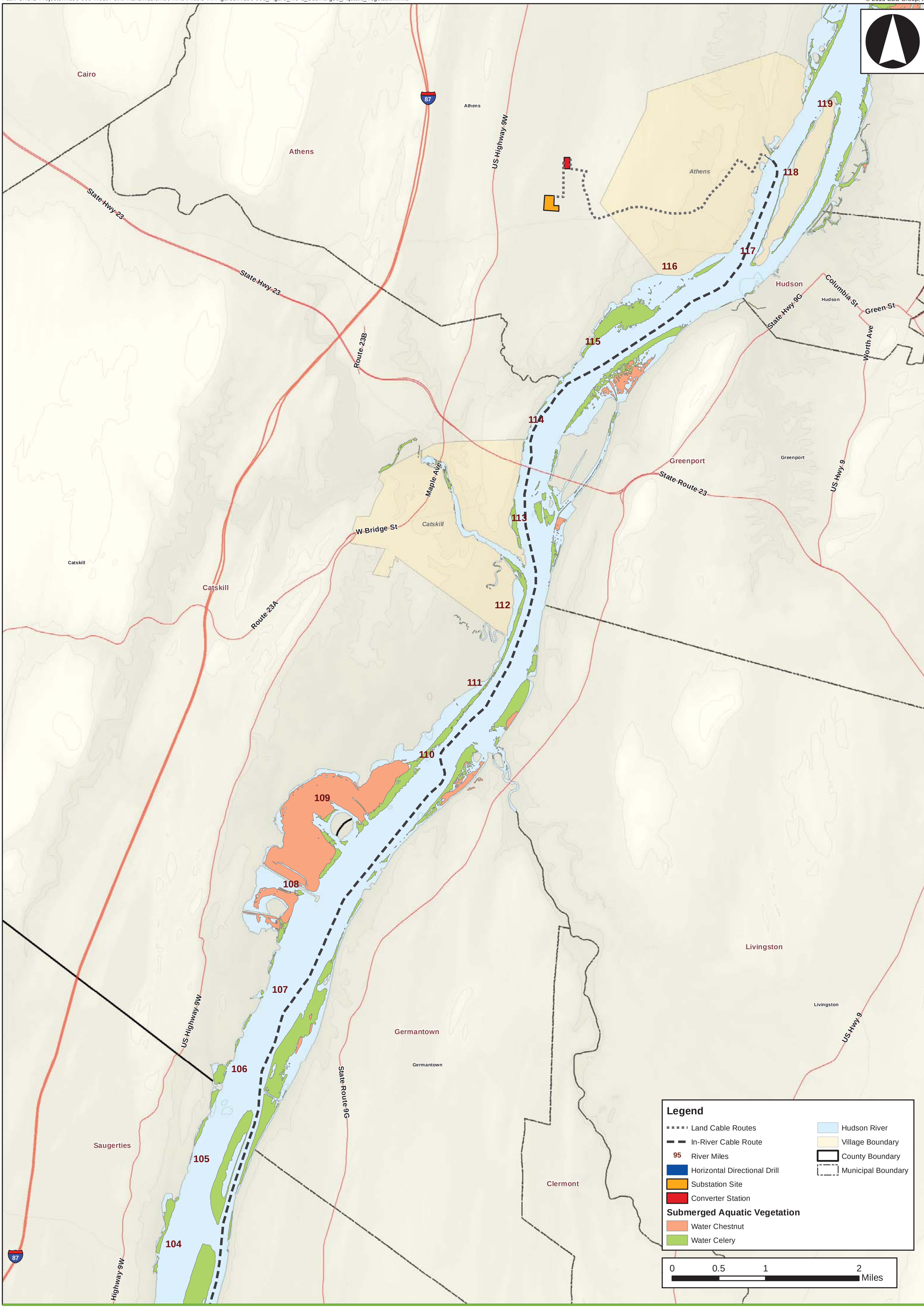
ess group
environmental consulting
& engineering services

Biological Sampling Locations

Figure 4.7-1

Sheet 2 of 2

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.8-1_Submerged_Aquatic_Vegetation.mxd



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 5,000 feet

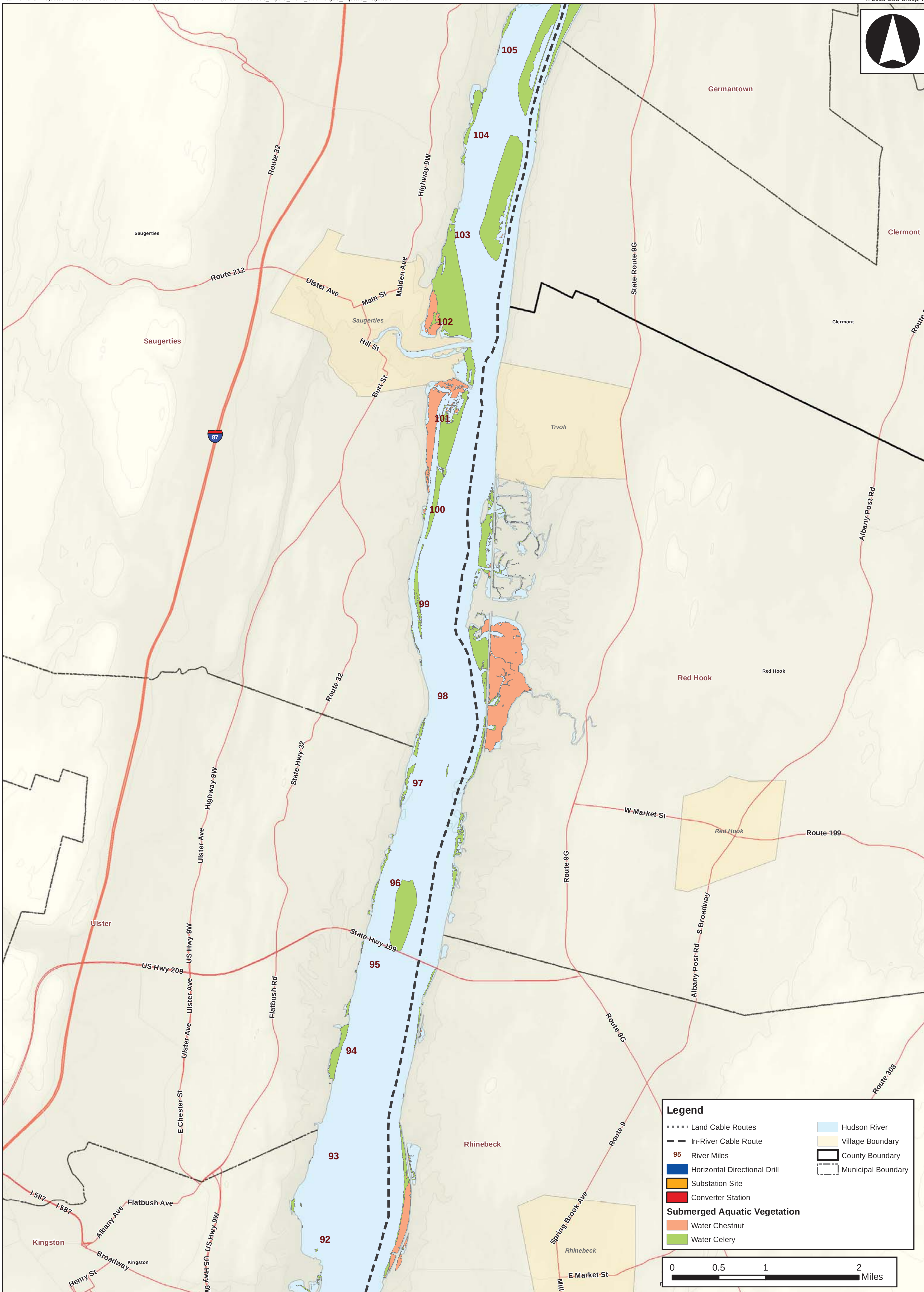
Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Submerged Aquatic Vegetation, 1997, 2002, 2007

ess group
environmental consulting
& engineering services

Submerged Aquatic Vegetation

Figure 4.8-1

Sheet 1 of 6



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 5,000 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Submerged Aquatic Vegetation, 1997, 2002, 2007

ess group

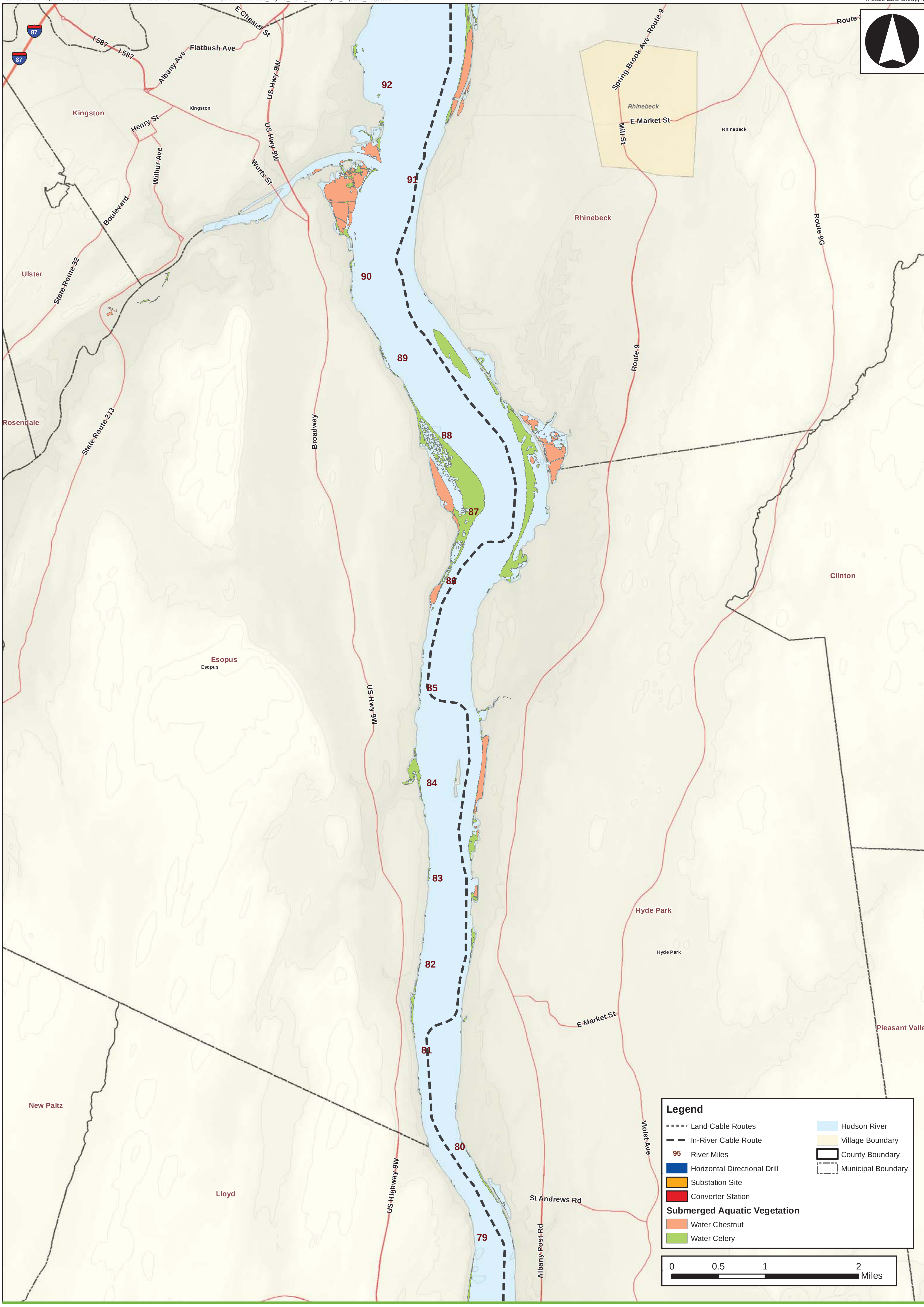
environmental consulting & engineering services

Submerged Aquatic Vegetation

Figure 4.8-1

Sheet 2 of 6

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.8-1_Submerged_Aquatic_Vegetation.mxd



environmental consulting
& engineering services

West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 5,000 feet

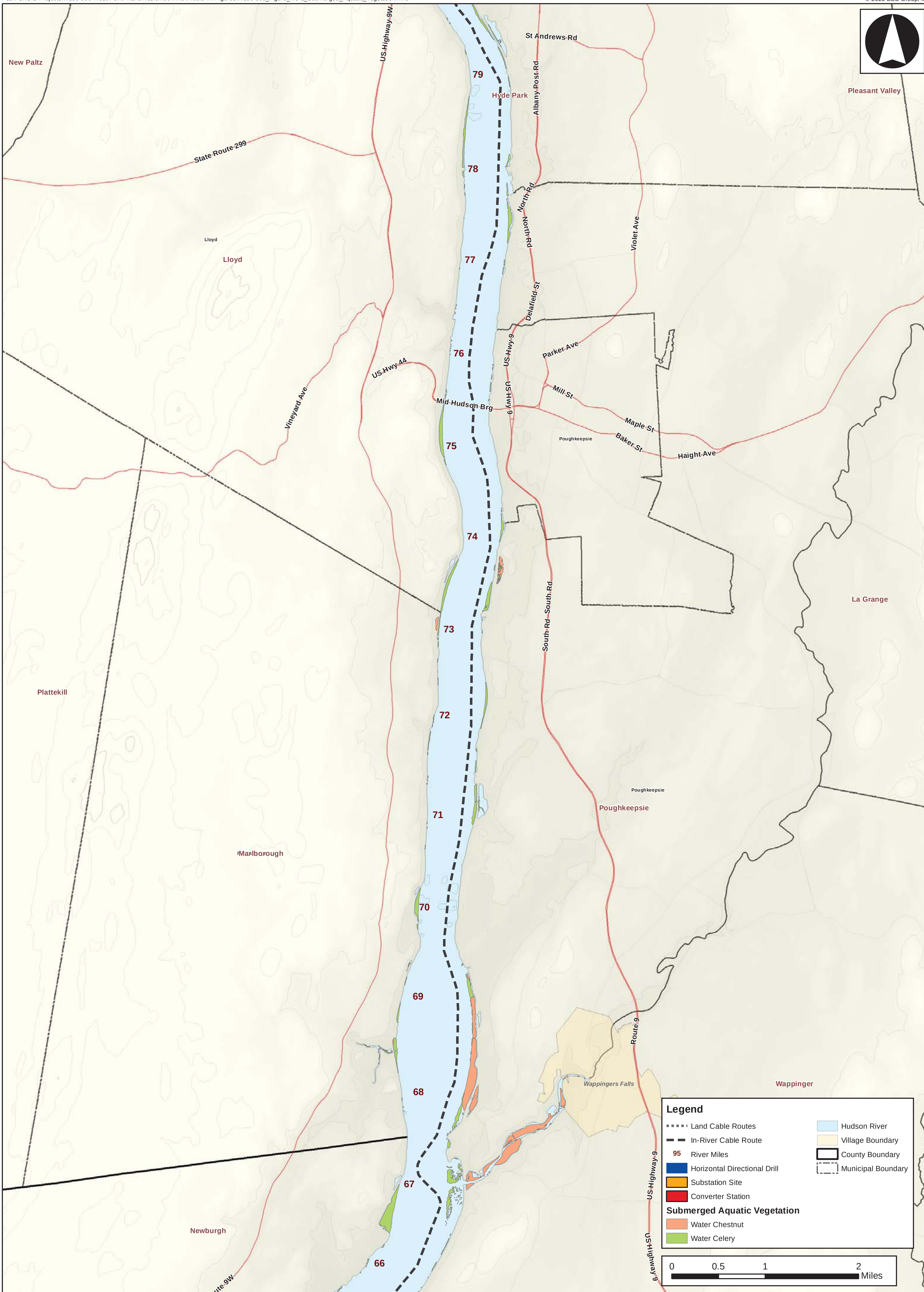
Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Submerged Aquatic Vegetation, 1997, 2002, 2007

Submerged Aquatic Vegetation

Figure 4.8-1

Sheet 3 of 6

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.8-1_Submerged_Aquatic_Vegetation.mxd



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 5,000 feet

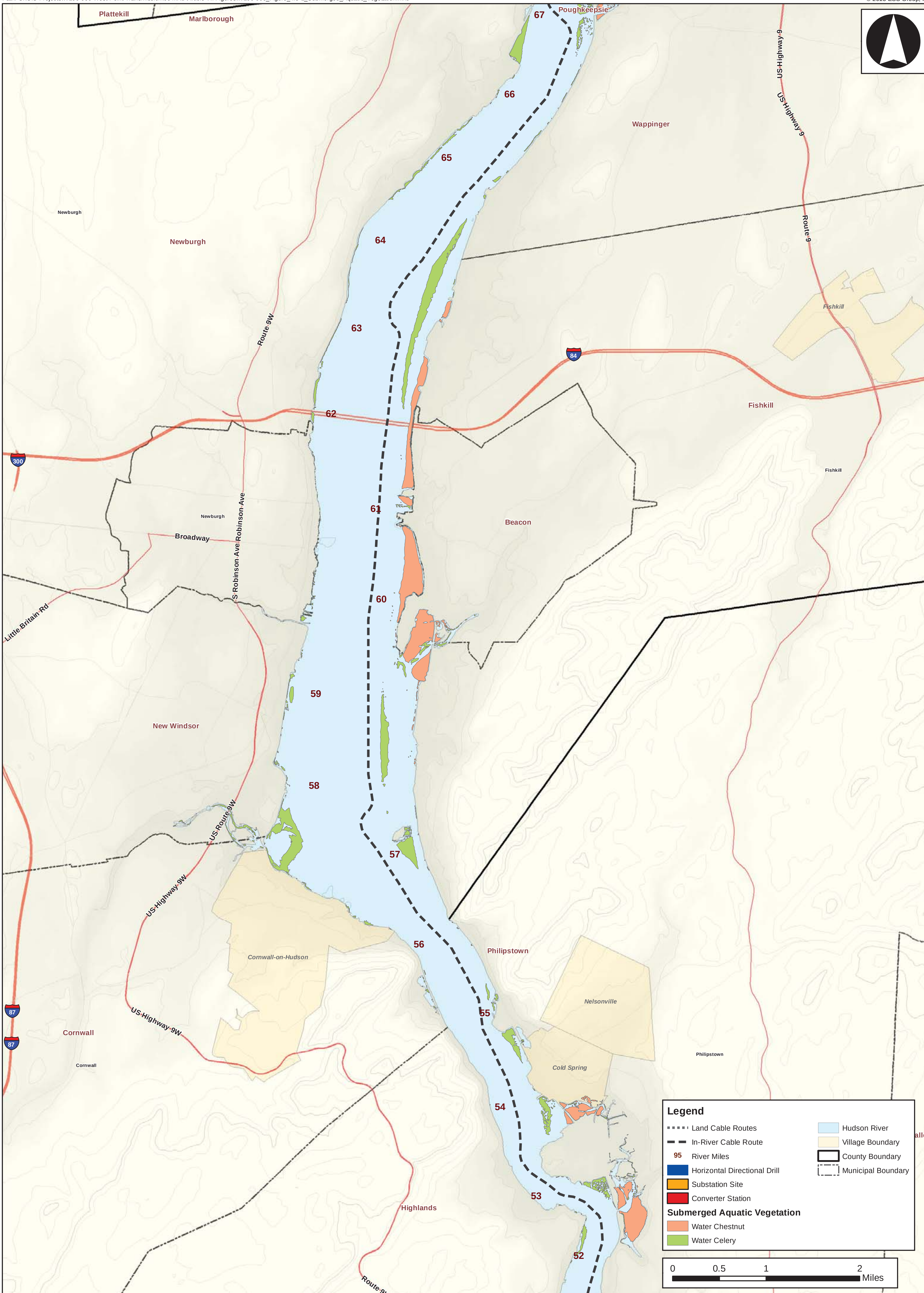
Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Submerged Aquatic Vegetation, 1997, 2002, 2007

ess group
environmental consulting
& engineering services

Submerged Aquatic Vegetation

Figure 4.8-1

Sheet 4 of 6



environmental consulting
& engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

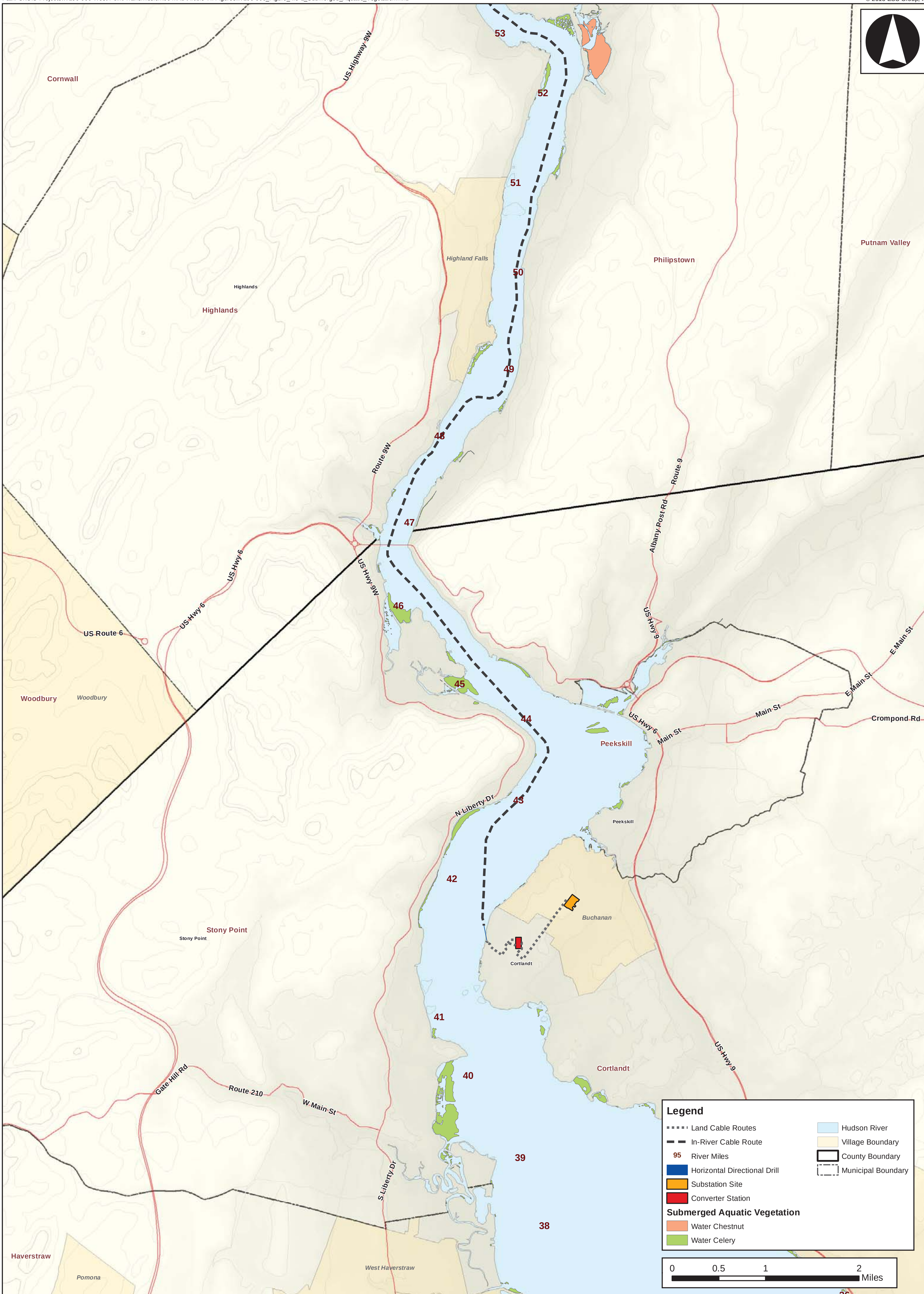
1 inch = 5,000 feet

Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Submerged Aquatic Vegetation, 1997, 2002, 2007

Submerged Aquatic Vegetation

Figure 4.8-1

Sheet 5 of 6



ess group
environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 5,000 feet

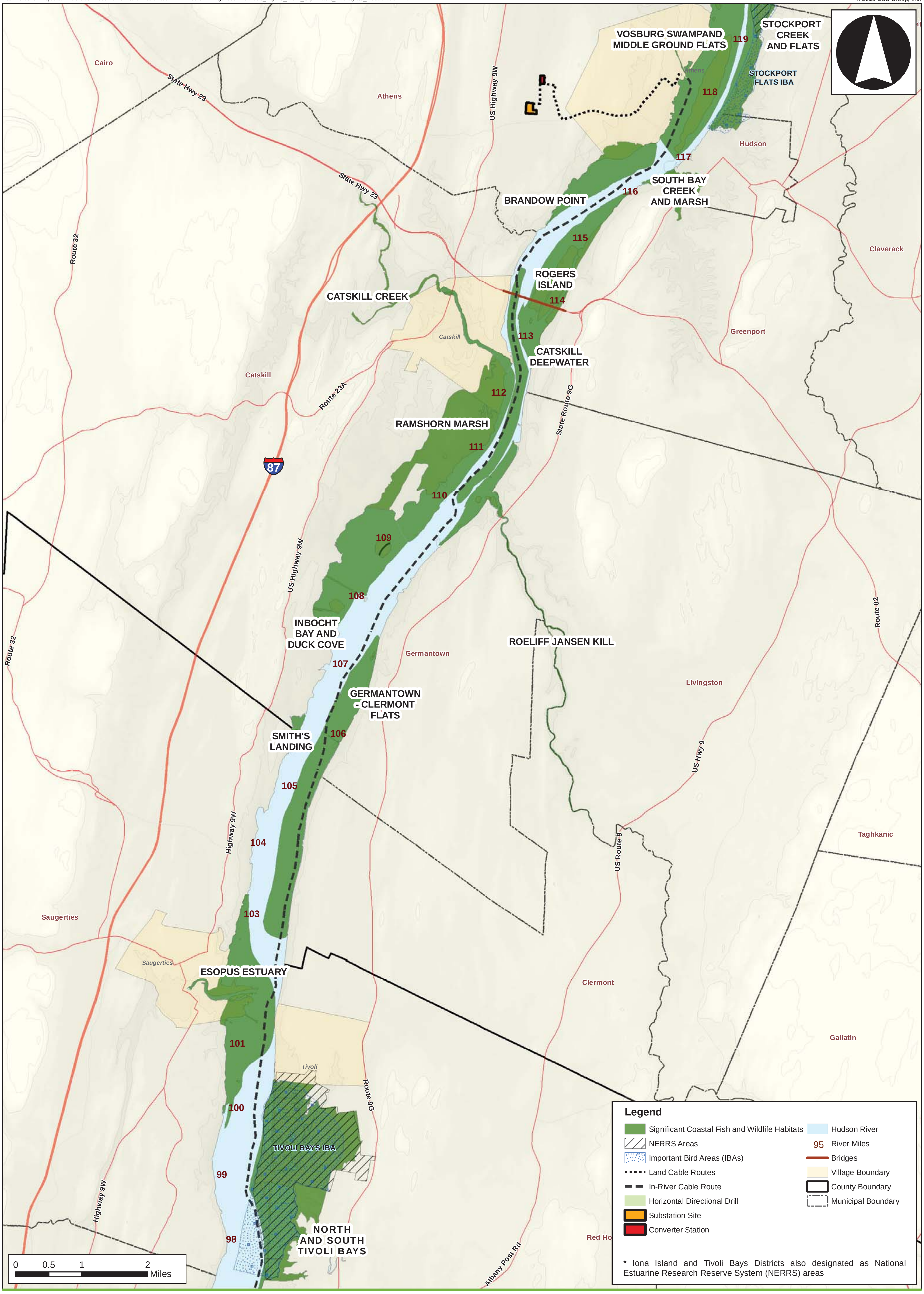
Source: 1) NYS BLM, Hudson River shoreline, 2001 2) New York State Office of Cyber Security, NYS Streets, 2012
3) USGS, National Elevation Dataset Topography, 2006,2007,2008 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NOAA Rivermiles, 2005 6) Cornell IRIS, Submerged Aquatic Vegetation, 1997, 2002, 2007

Submerged Aquatic Vegetation

Figure 4.8-1

Sheet 6 of 6

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.9-1_Significant_Ecological_Resources.mxd



ess group
environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

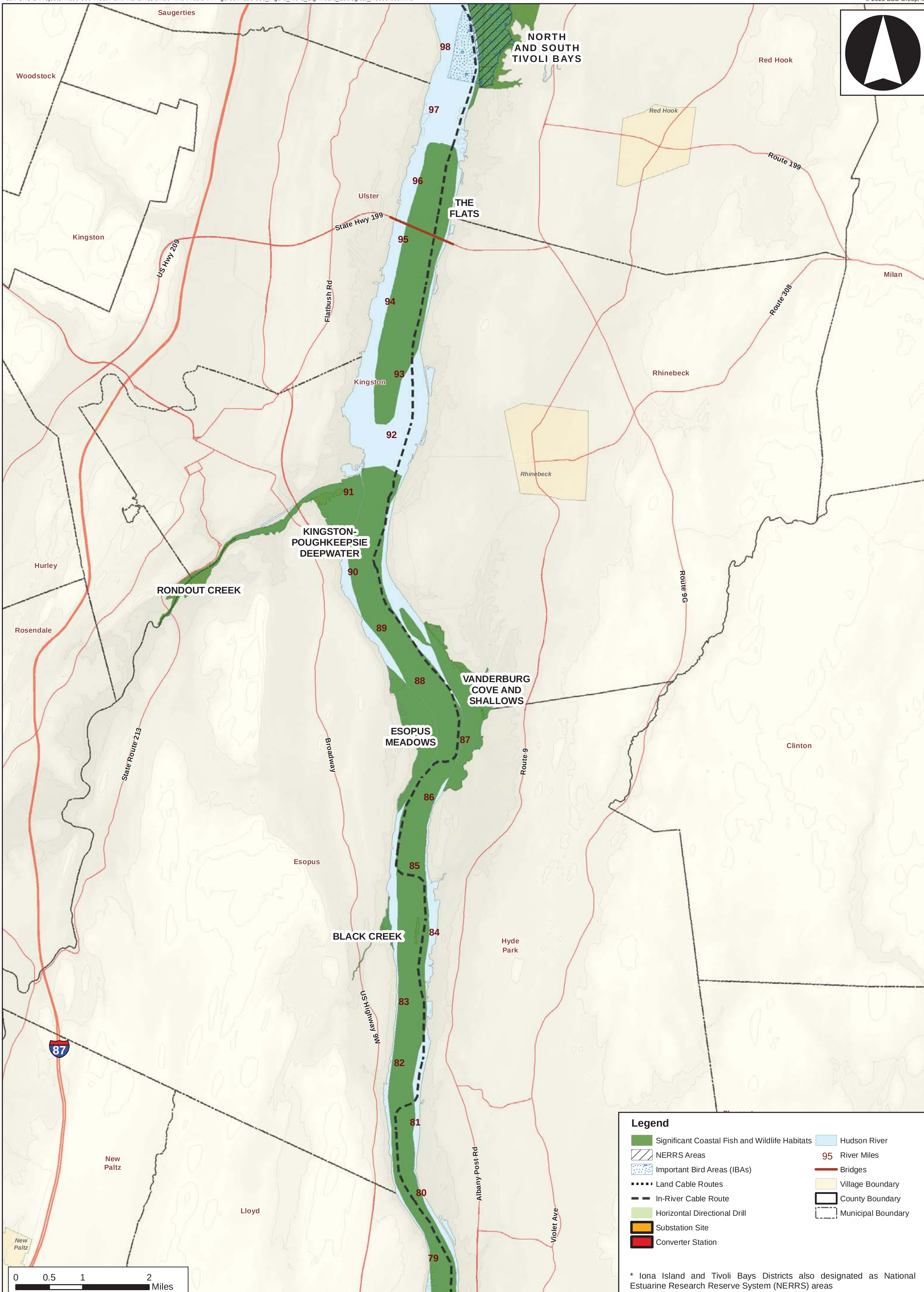
1 inch = 1 miles

Source: 1) New York State Office of Cyber Security, NYS Streets, 2012, 2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NYS GIS Clearinghouse, Civil Boundaries, 2009, 4) NYSDEC List of Rare, Threatened, and Endangered Species, 2013
5) National Estuarine Research Reserve System, NERRS Boundary data, 1998 6) Audubon, Digitized IBA data, 2012

Significant Ecological Resources

Figure 4.9-1

Sheet 1 of 4



environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 1 miles

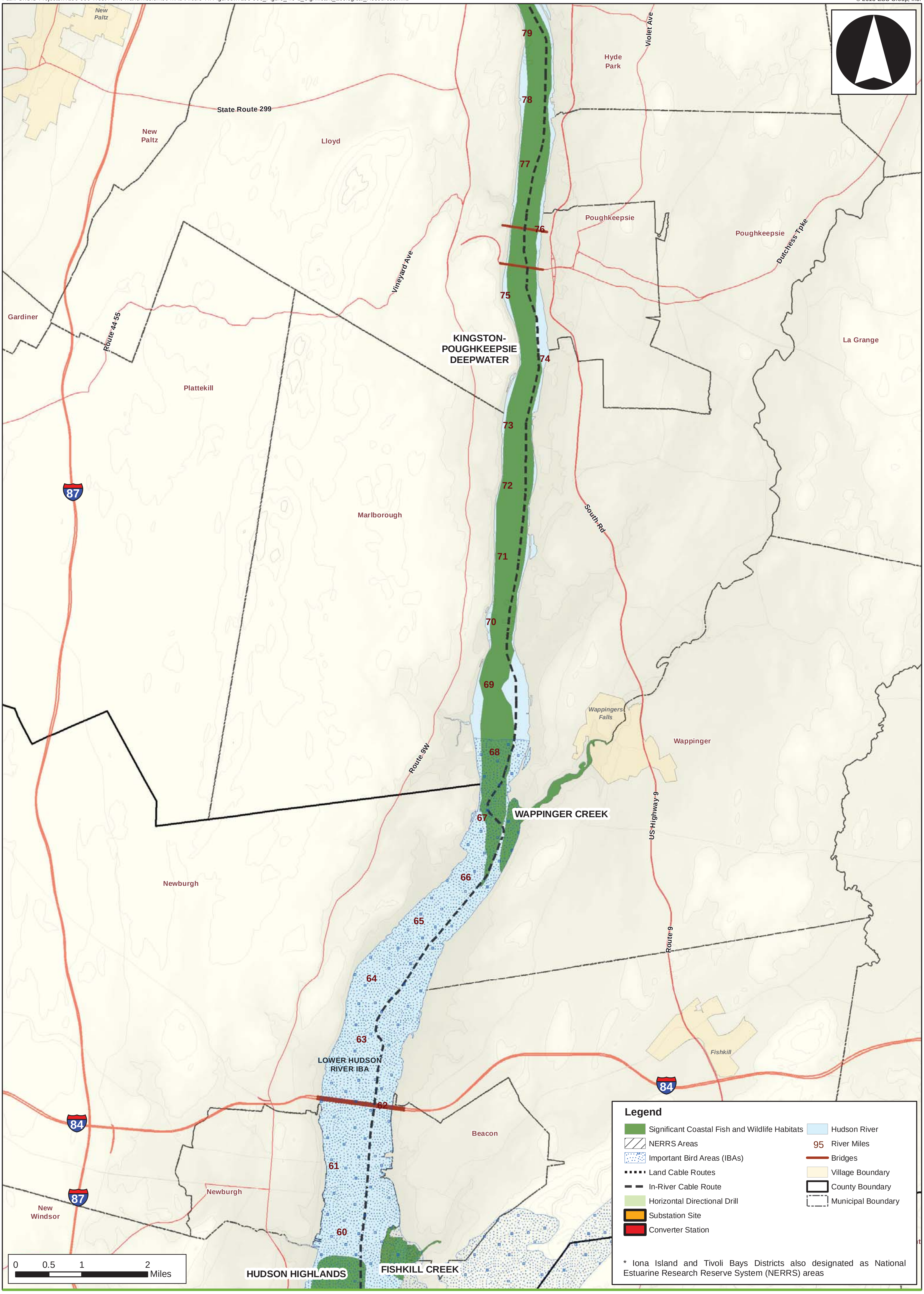
Source: 1) New York State Office of Cyber Security, NYS Streets, 2012, 2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NYS GIS Clearinghouse, Civil Boundaries, 2009, 4) NYSDEC List of Rare, Threatened, and Endangered Species, 2013
5) National Estuarine Research Reserve System, NERRS Boundary data, 1998 6) Audubon, Digitized IBA data, 2012

Significant Ecological Resources

Figure 4.9-1

Sheet 2 of 4

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.9-1_Significant_Ecological_Resources.mxd



ess group
environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 1 miles

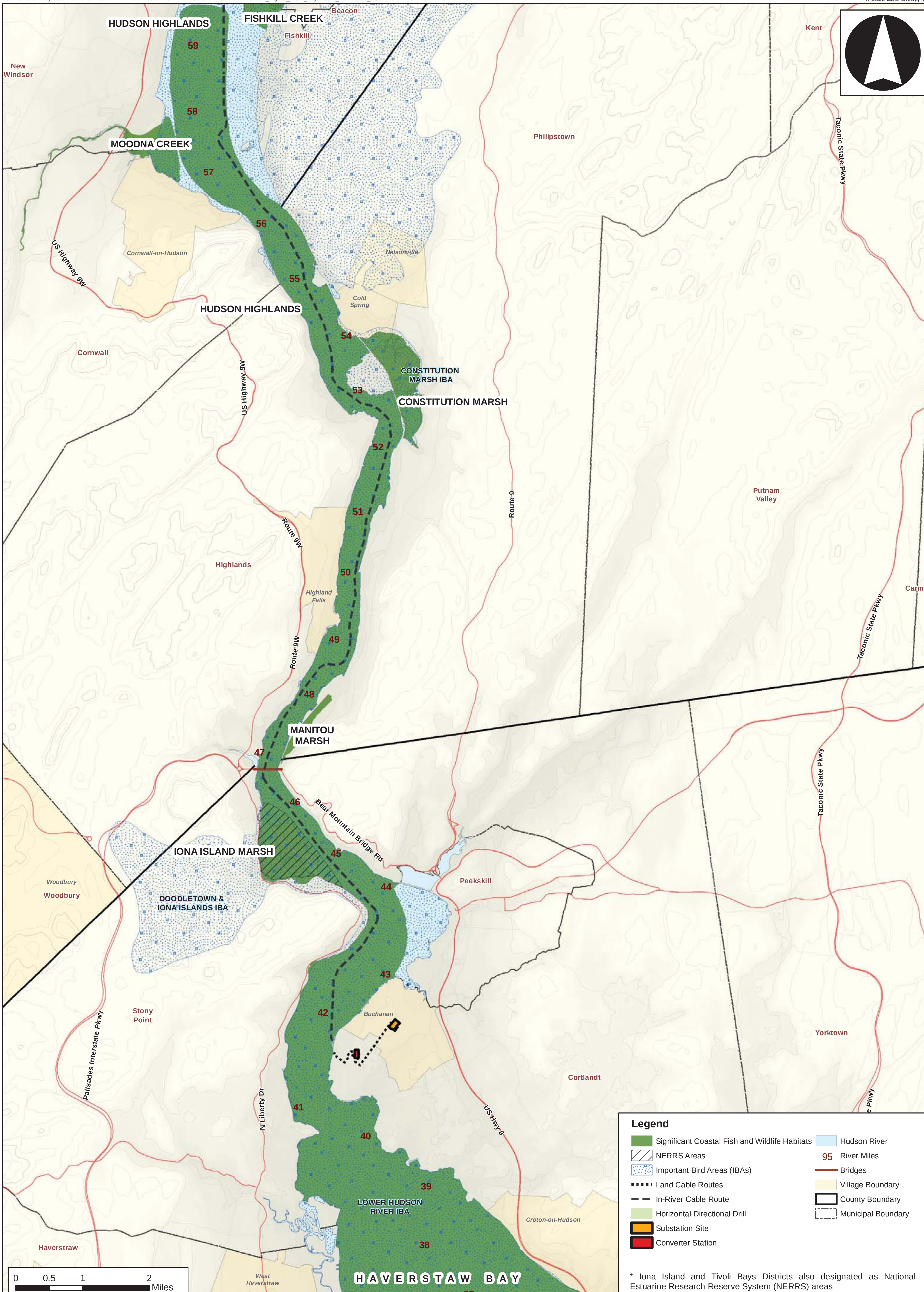
Source: 1) New York State Office of Cyber Security, NYS Streets, 2012, 2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NYS GIS Clearinghouse, Civil Boundaries, 2009, 4) NYSDEC List of Rare, Threatened, and Endangered Species, 2013
5) National Estuarine Research Reserve System, NERRS Boundary data, 1998 6) Audubon, Digitized IBA data, 2012

Significant Ecological Resources

Figure 4.9-1

Sheet 3 of 4

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.9-1_Significant_Ecological_Resources.mxd



ess group
environmental consulting & engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

1 inch = 1 miles

Source: 1) New York State Office of Cyber Security, NYS Streets, 2012, 2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NYS GIS Clearinghouse, Civil Boundaries, 2009, 4) NYSDEC List of Rare, Threatened, and Endangered Species, 2013
5) National Estuarine Research Reserve System, NERRS Boundary data, 1998 6) Audubon, Digitized IBA data, 2012

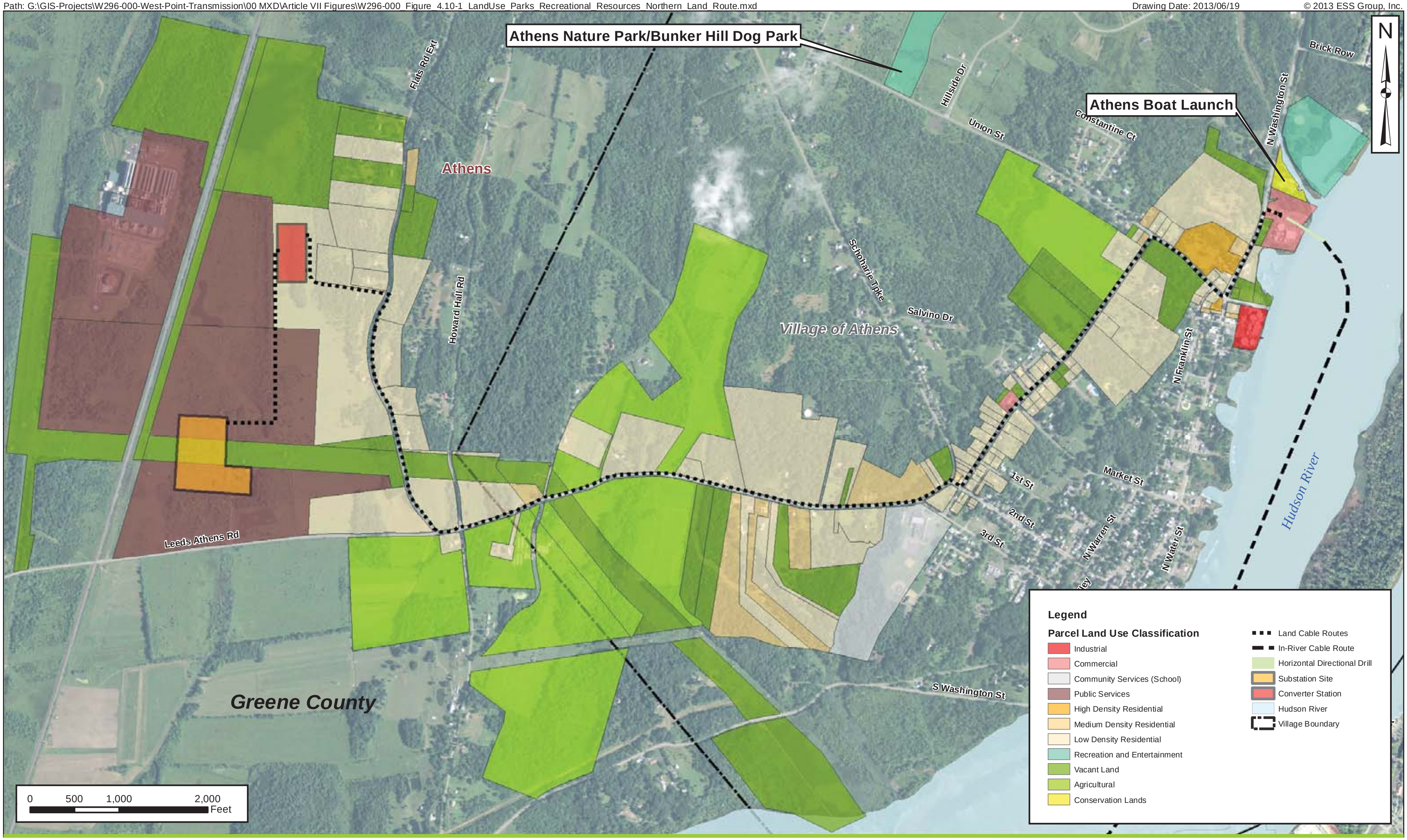
Significant Ecological Resources

Figure 4.9-1

Sheet 4 of 4

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.10-1_LandUse_Parks_Recreational_Resources_Northern_Land_Route.mxd

Drawing Date: 2013/06/19



West Point Partners, LLC

West Point Transmission Project

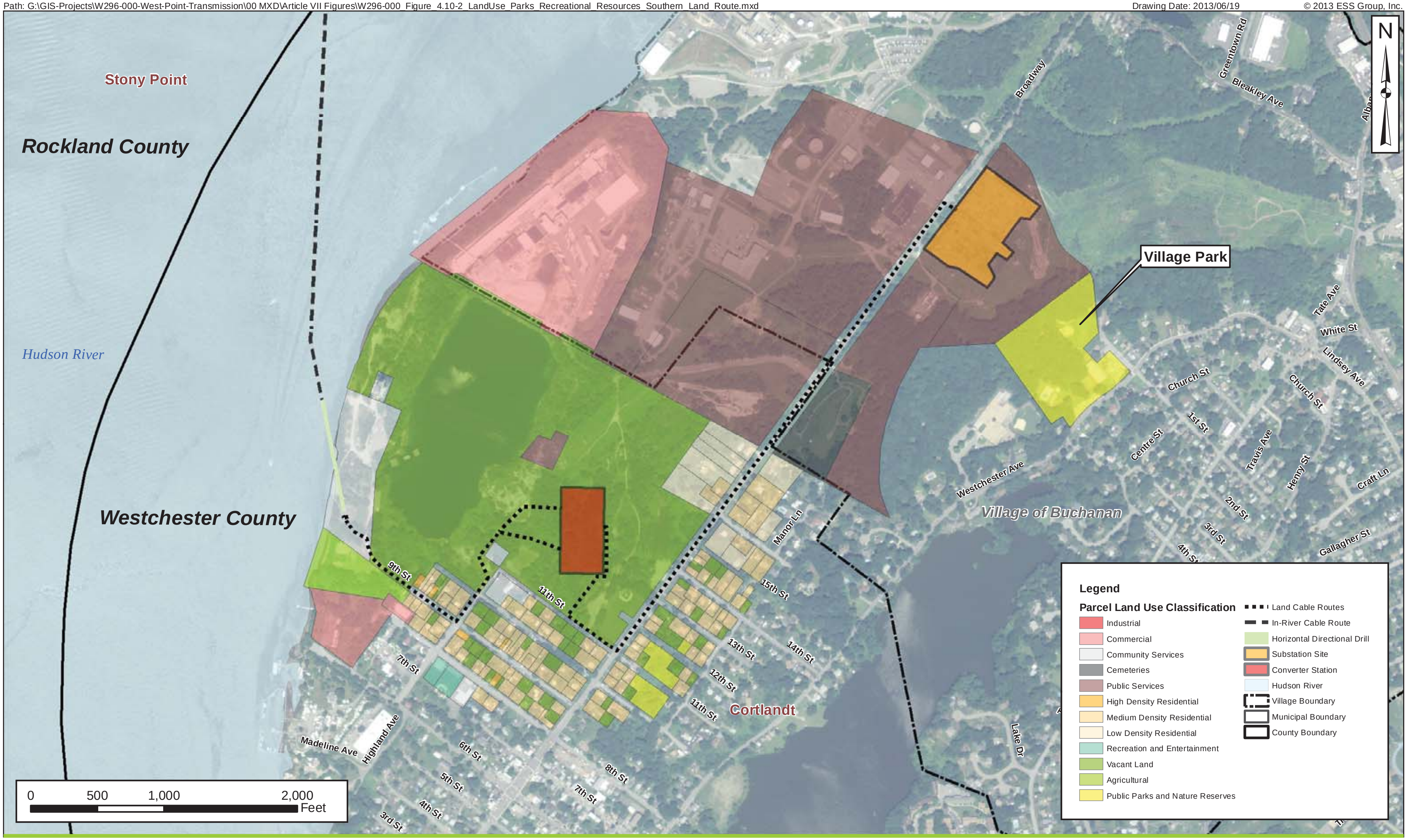
Athens to Buchanan, New York

1 inch = 1,500 feet

Source: 1) NYSGIS, Parcel data, Parks data 2) NYS BLM, Hudson River Shoreline, 2001
3) New York State Office of Cyber Security, NYS Streets, 2012 4) USGS, National Elevation Dataset Topography, 2006,2007,2008
5) NYS GIS Clearinghouse, Civil Boundaries, 2009 6) NAIP Imagery

Land Use, Parks, and Recreational Resources
Northern Land Cable Route and Northern Converter Station

Figure 4.10-1



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 1,000 feet

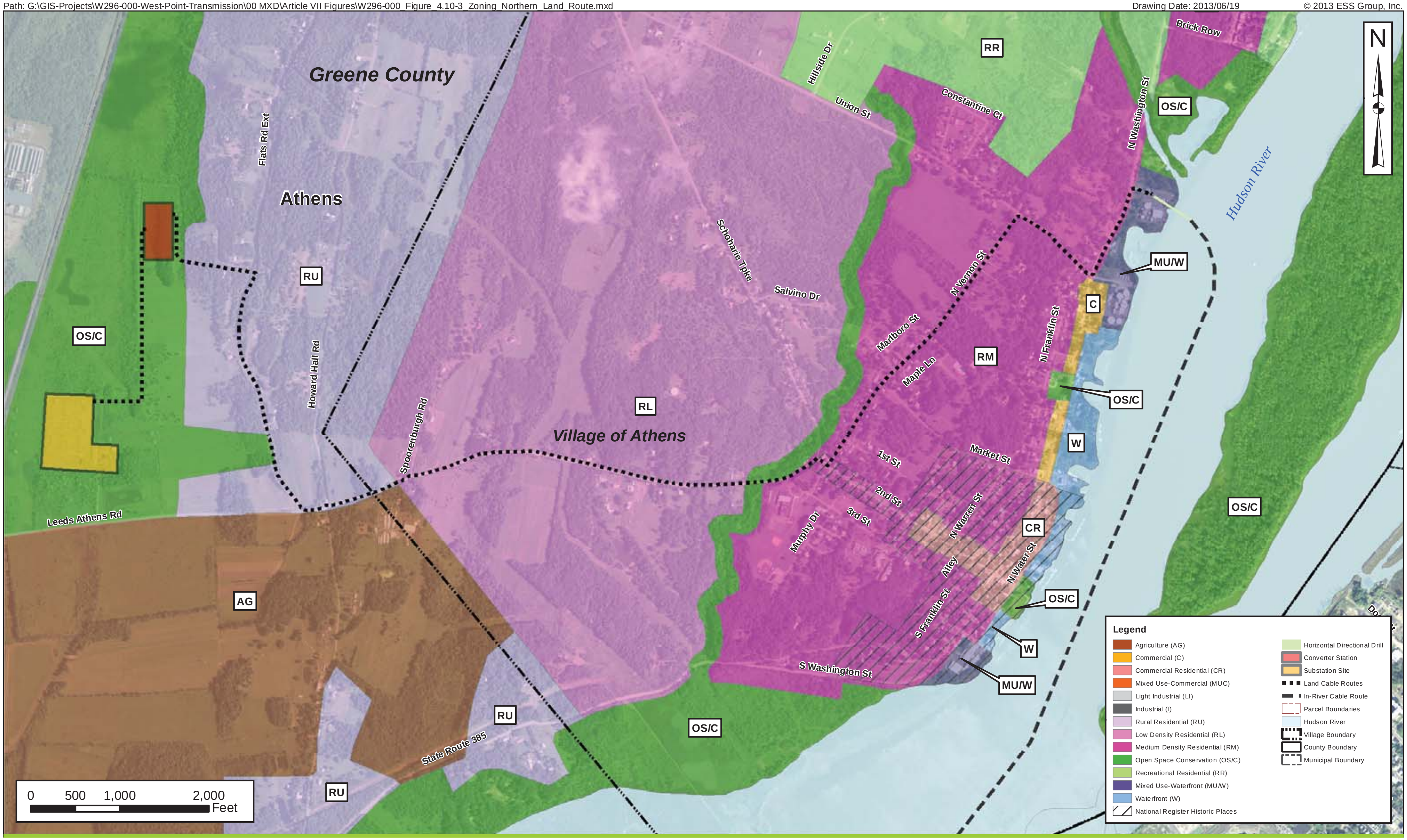
Source: 1) NYSGIS, Parcel data, Parks data 2) NYS BLM, Hudson River Shoreline, 2001
3) New York State Office of Cyber Security, NYS Streets, 2012 4) USGS, National Elevation Dataset Topography, 2006,2007,2008
5) NYS GIS Clearinghouse, Civil Boundaries, 2009 6) NAIP Imagery

Land Use, Parks, and Recreational Resources
Southern Land Cable Route and Southern Converter Station

Figure 4.10-2

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.10-3_Zoning_Northern_Land_Route.mxd

Drawing Date: 2013/06/19



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 1,500 feet

Source: 1) Town of Athens Zoning, Village of Athens Zoning, 2011, 2010 2) NYSGIS, Parcel data
3) NYS BLM, Hudson River Shoreline, 2001 4) New York State Office of Cyber Security, NYS Streets, 2012
5) NYS GIS Clearinghouse, Civil Boundaries, 2009 6) NAIP Imagery

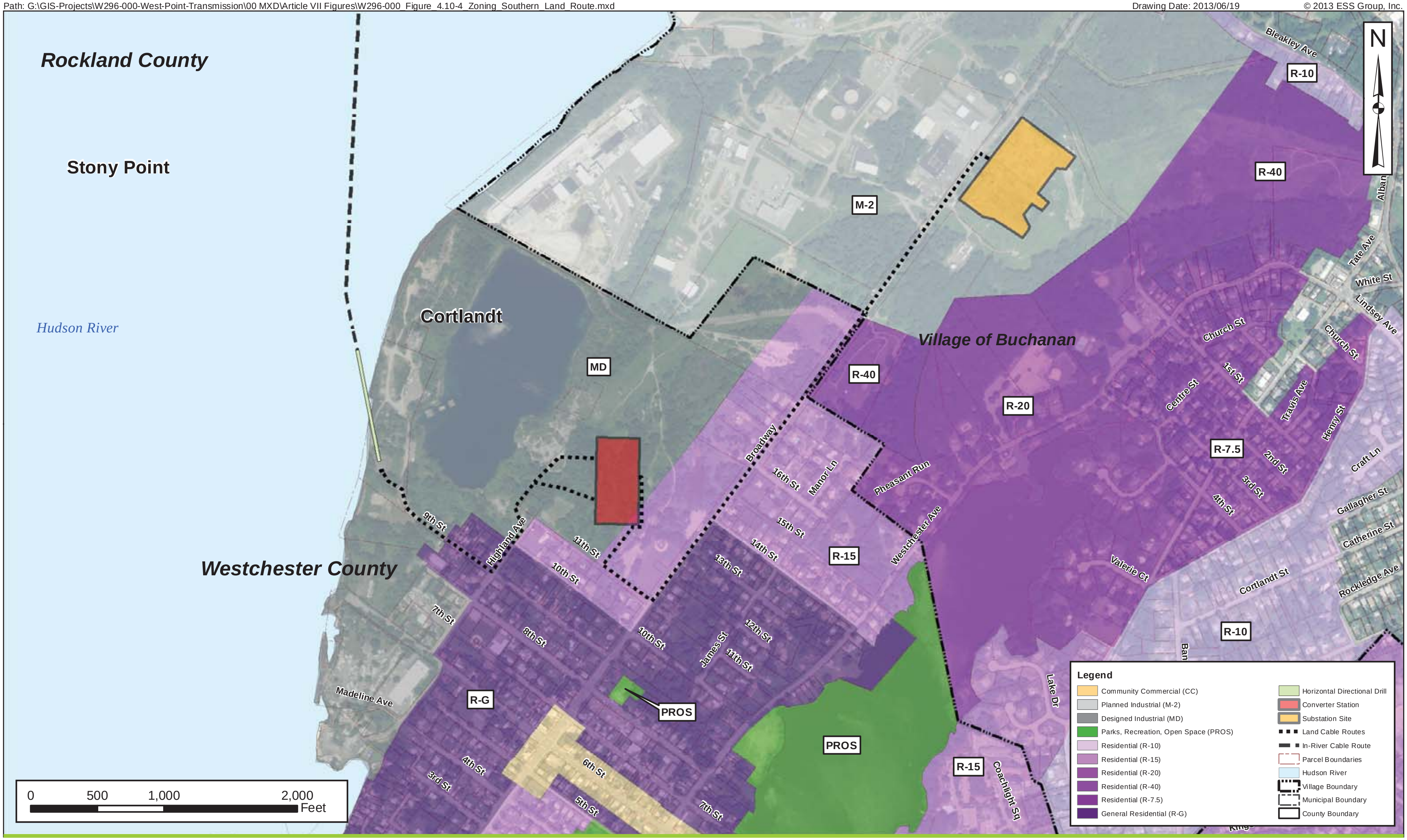
ess group
environmental consulting & engineering services

Zoning - Northern Land Cable Route and Northern Converter Station

Figure 4.10-3

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.10-4_Zoning_Southern_Land_Route.mxd

Drawing Date: 2013/06/19



West Point Partners, LLC

West Point Transmission Project

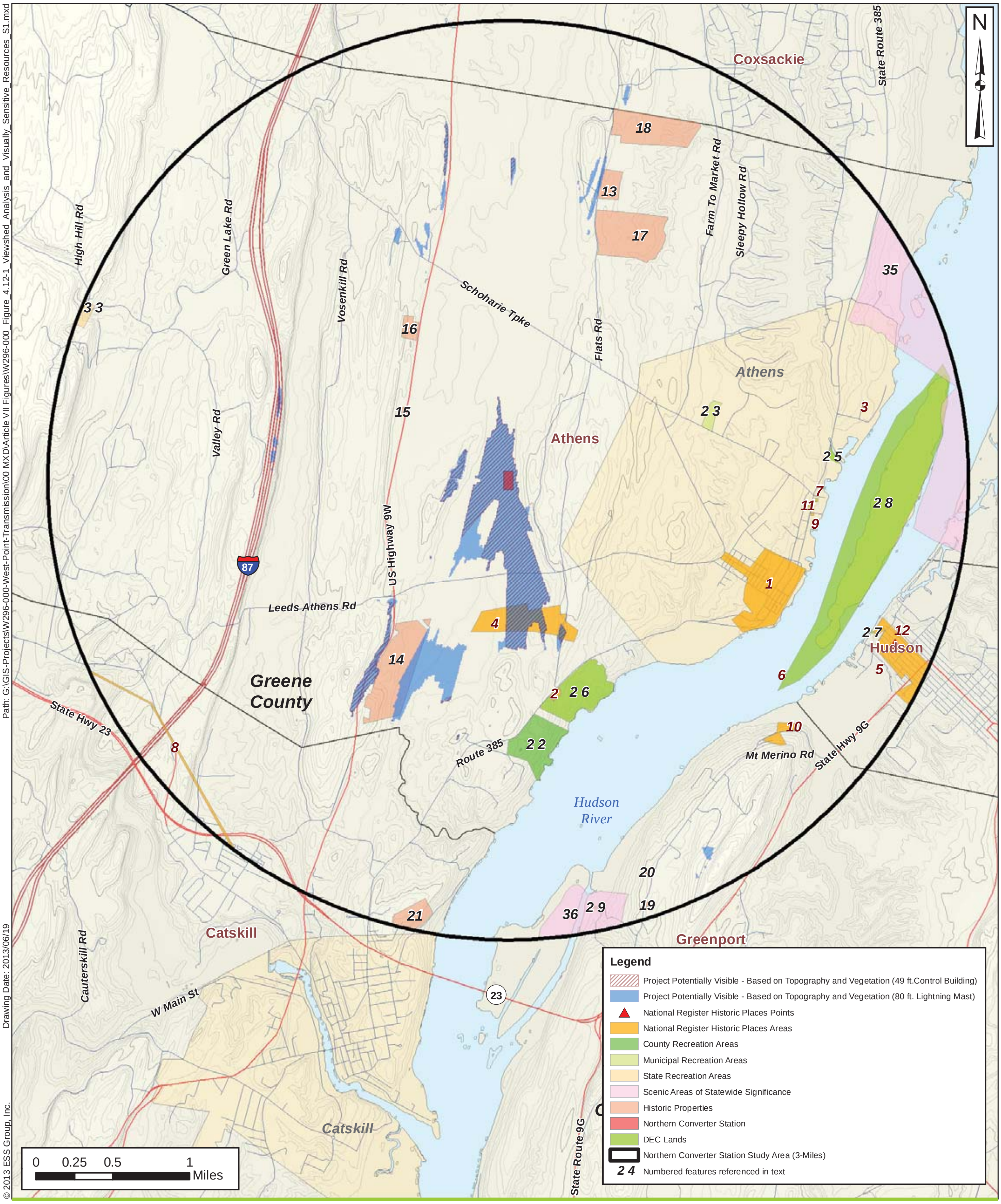
Athens to Buchanan, New York

1 inch = 1,000 feet

Source: 1) Westchester County Parcels, Zoning, 2010, 2006 2) NYS BLM, Hudson River Shoreline, 2001
3) New York State Office of Cyber Security, NYS Streets, 2012 4) NYS GIS Clearinghouse, Civil Boundaries, 2009
5) NAIP Imagery

Zoning - Southern Land Cable Route and Southern Converter Station

Figure 4.10-4



Drawing Date: 2013/06/19
Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.12-1_Viewshed_Analysis_and_Visually_Sensitive_Resources_S1.mxd

ESS group
environmental consulting & engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York
1 inch = 4,500 feet

Source: 1) NYS GIS Clearinghouse, Resource Layers, 2013
2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NPS, NRHP Points and Areas, 2007 4) JMA, Historic Properties, 2013

Viewshed Analysis and Visually Sensitive Resources
Northern Converter Station - Vegetated Visibility Results

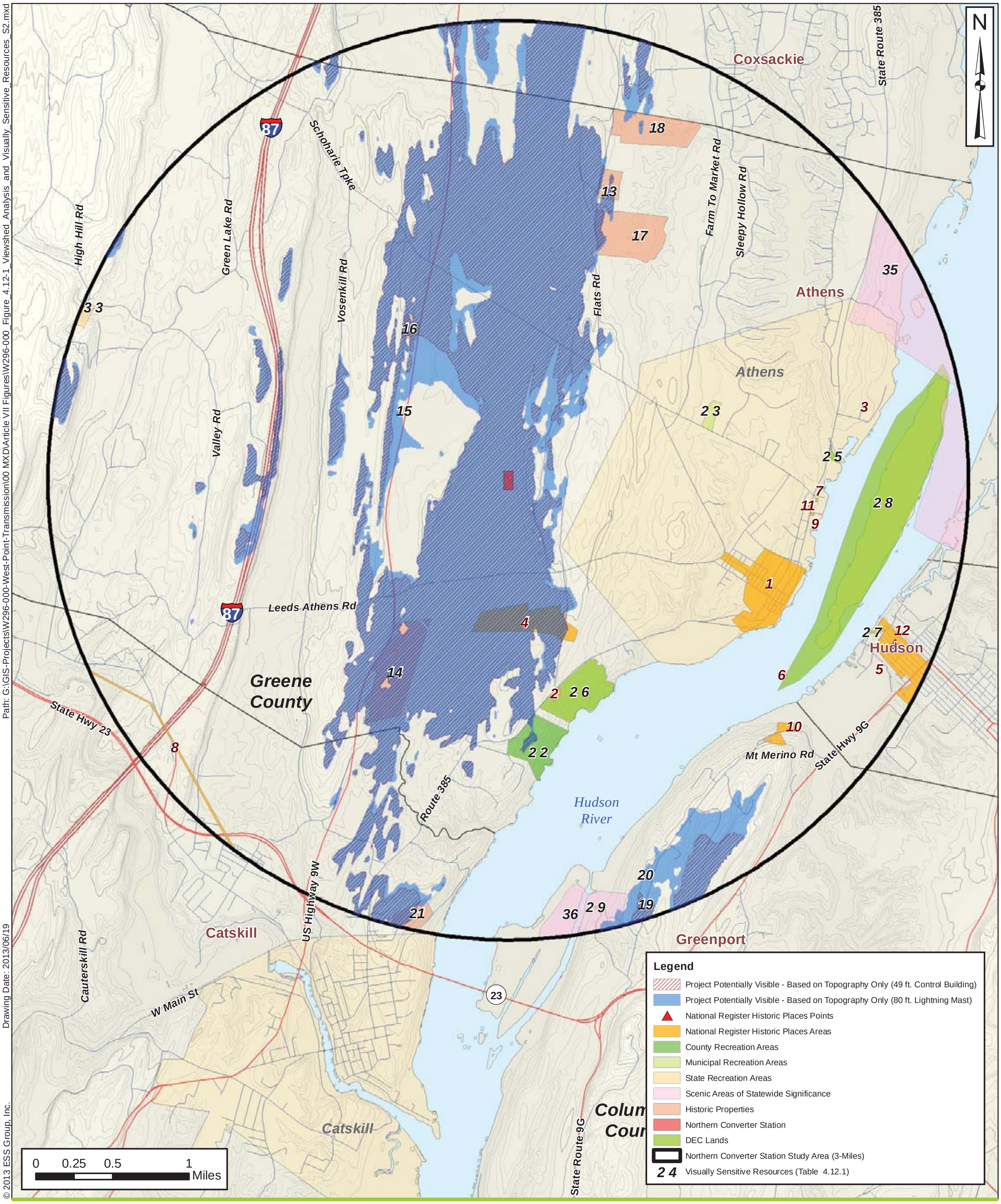
This Viewshed Analysis Assumes a Tree Height of 40 Feet and Does Not Consider The Screening Effect of Structures.

Figure 4.12-1

Sheet 1 of 4

Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.12-1_Viewshed_Analysis_and_Visually_Sensitive_Resources_S2.mxd

Drawing Date: 2013/06/19



West Point Partners, LLC

West Point Transmission Project

Athens to Buchanan, New York

1 inch = 4,500 feet

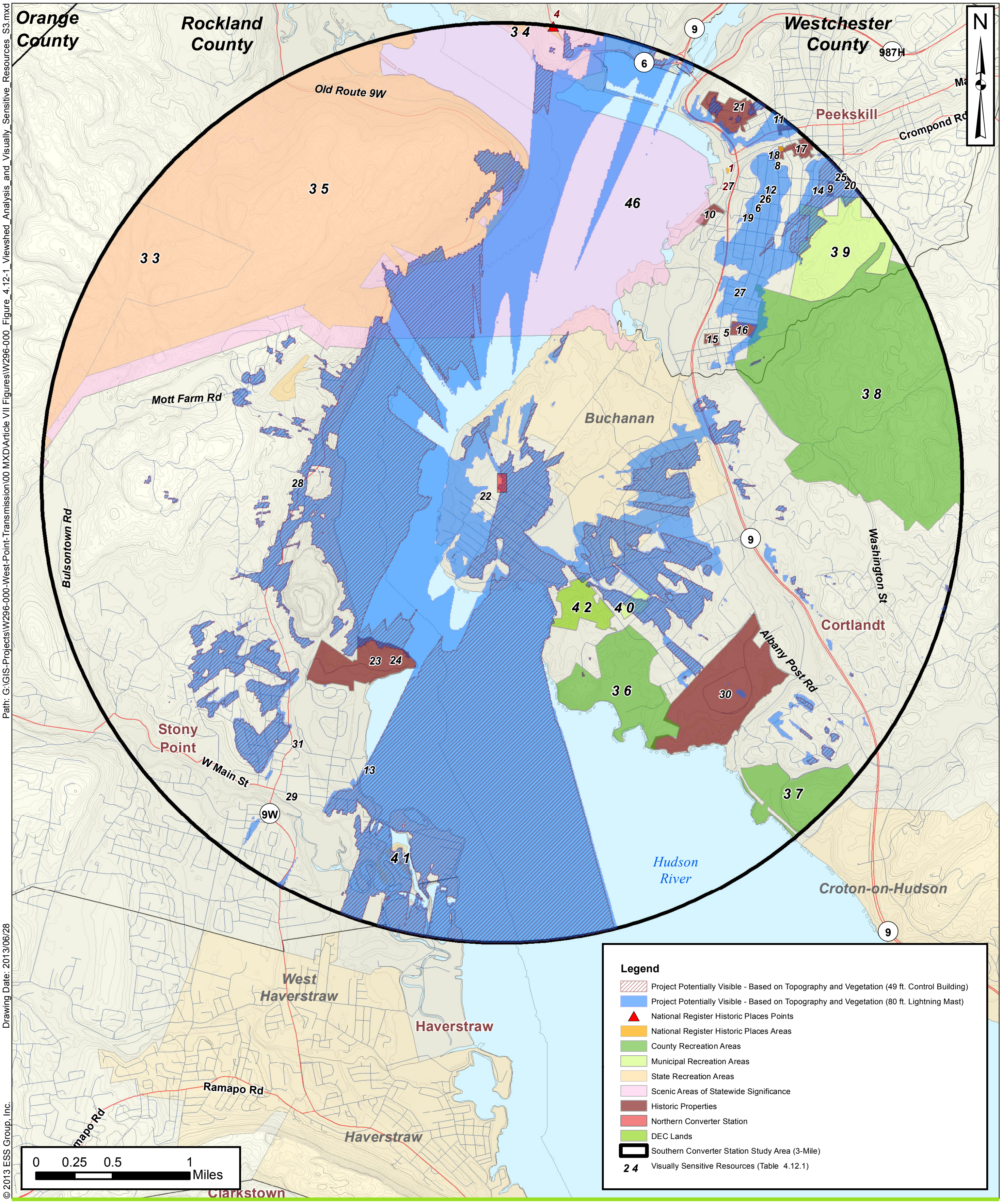
Source: 1) NYS GIS Clearinghouse, Resource Layers, 2013
2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NPS, NRHP Points and Areas, 2007 4) JMA, Historic Properties, 2013

Viewshed Analysis and Visually Sensitive Resources
Northern Converter Station - Bare Earth Visibility Results

This Viewshed Analysis Does Not Consider The Screening Effect of Vegetation or Structures.

Figure 4.12-1

Sheet 2 of 4



Legend

- Project Potentially Visible - Based on Topography and Vegetation (49 ft. Control Building)
- Project Potentially Visible - Based on Topography and Vegetation (80 ft. Lightning Mast)
- National Register Historic Places Points
- National Register Historic Places Areas
- County Recreation Areas
- Municipal Recreation Areas
- State Recreation Areas
- Scenic Areas of Statewide Significance
- Historic Properties
- Northern Converter Station
- DEC Lands
- Southern Converter Station Study Area (3-Mile)
- 2 4 Visually Sensitive Resources (Table 4.12.1)

ESS group
environmental consulting & engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York
1 inch = 4,500 feet

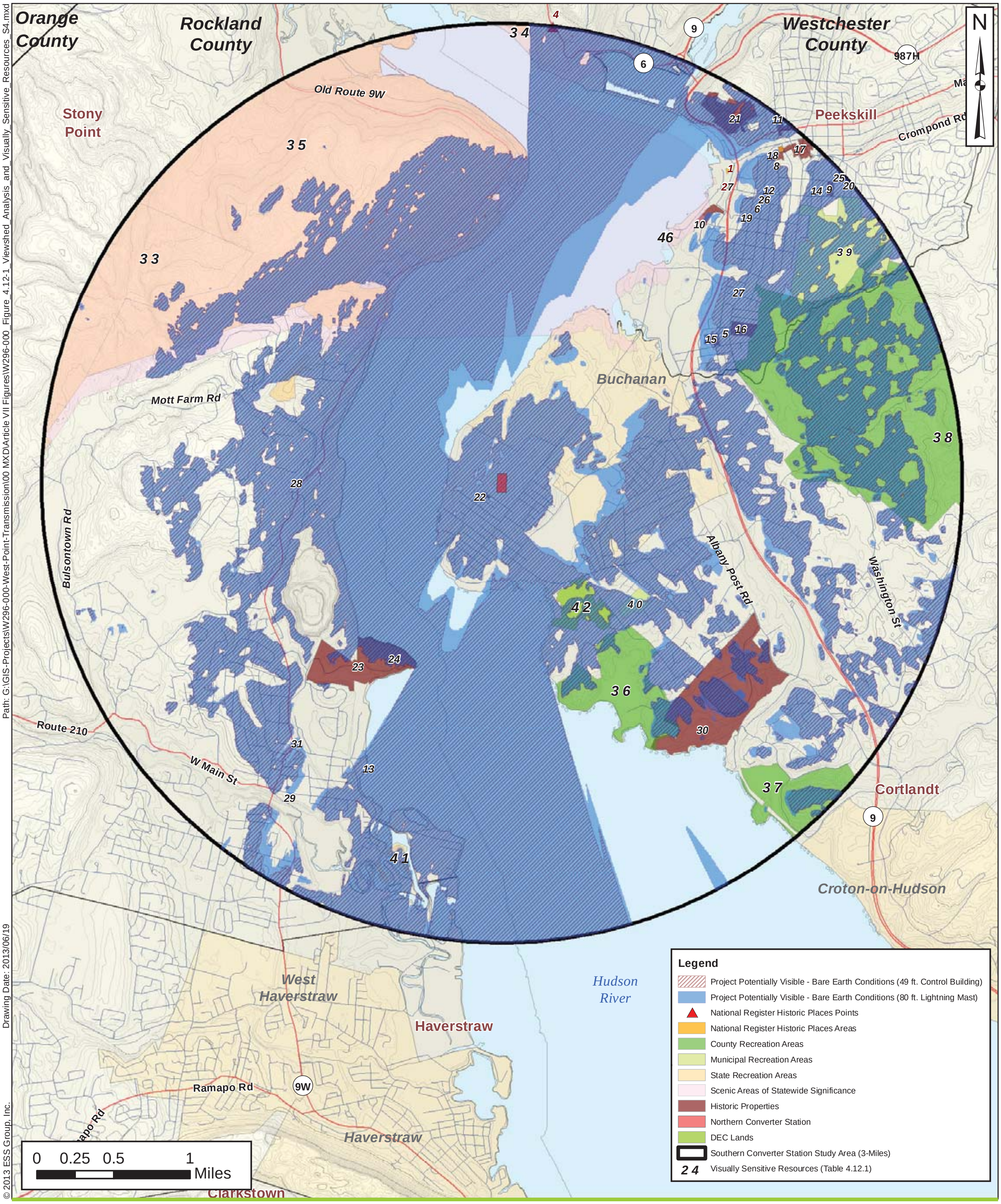
Source: 1) NYS GIS Clearinghouse, Resource Layers, 2013
2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NPS, NRHP Points and Areas, 2007 4) JMA, Historic Properties, 2013

Viewshed Analysis and Visually Sensitive Resources
Southern Converter Station - Vegetated Visibility Results

This Viewshed Analysis Assumes a Tree Height of 40 Feet and Does Not Consider The Screening Effect of Structures.

Figure 4.12-1
Sheet 3 of 4

Drawing Date: 2013/06/19
Path: G:\GIS-Projects\W296-000-West-Point-Transmission\00 MXD\Article VII Figures\W296-000_Figure_4.12-1_Viewshed_Analysis_and_Visually_Sensitive_Resources_S4.mxd



West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York
1 inch = 4,500 feet

Source: 1) NYS GIS Clearinghouse, Resource Layers, 2013
2) USGS, National Elevation Dataset Topography, 2006,2007,2008
3) NPS, NRHP Points and Areas, 2007 4) JMA, Historic Properties, 2013

Viewshed Analysis and Visually Sensitive Resources
Southern Converter Station - Bare Earth Visibility Results
This Viewshed Analysis Does Not Consider The Screening Effect of Vegetation or Structures.

Figure 4.12-1
Sheet 4 of 4

environmental consulting
& engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

Visual Simulations
Northern Converter Station Existing View

Figure 4.12-2

environmental consulting
& engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

Visual Simulations
Northern Converter Station Proposed View

Figure 4.12-2

environmental consulting
& engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

Visual Simulations
Northern Converter Station Proposed View

Figure 4.12-2

environmental consulting
& engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

Visual Simulations
Southern Converter Station Existing View

Figure 4.12-2

Sheet 4 of 5

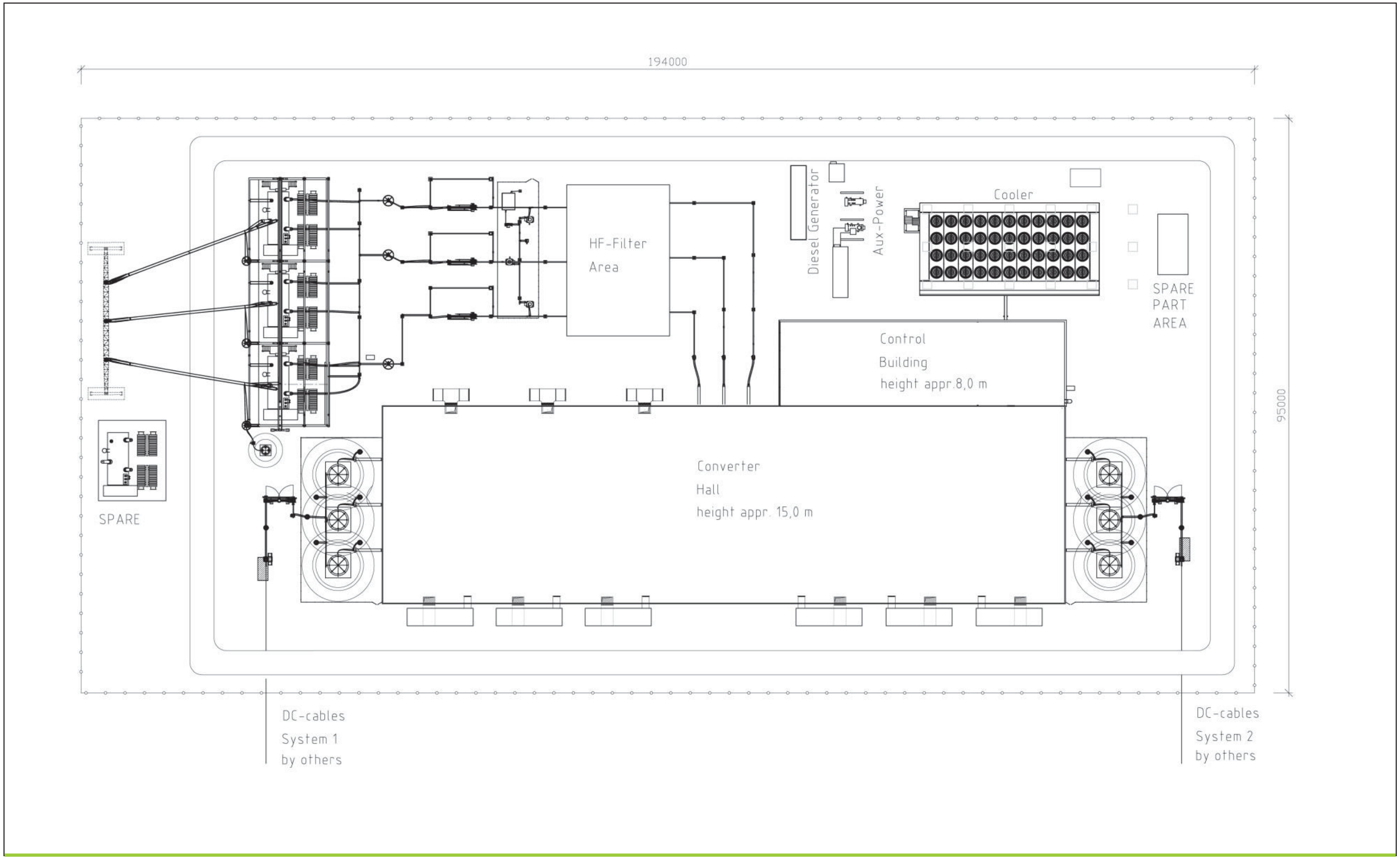
environmental consulting
& engineering services

West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

Visual Simulations
Southern Converter Station Proposed View

Figure 4.12-2



environmental consulting
& engineering services

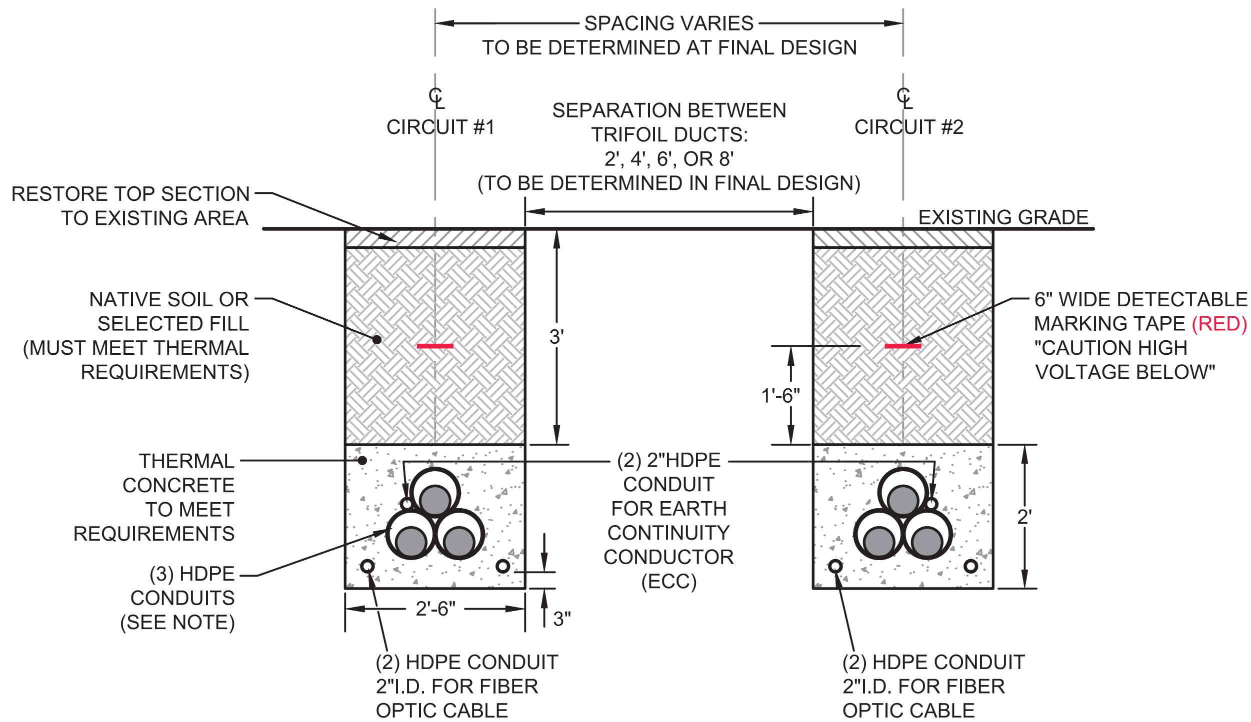
West Point Partners, LLC

West Point Transmission Project
Athens to Buchanan, New York

Source: Siemens Engineering, 2013

Converter Station Layout

Figure 4.12-3



NOTE:

AC DUCT BANK SPECIFICATIONS:

Cable diameter: 5"
Duct diameter: 8"
Full rating: 1,000 MW, or 500 MW per 3 phase duct
Cable ampacity per phase: 840 A
Depth of burial: 4ft to centerline of Trifoil cable bundle

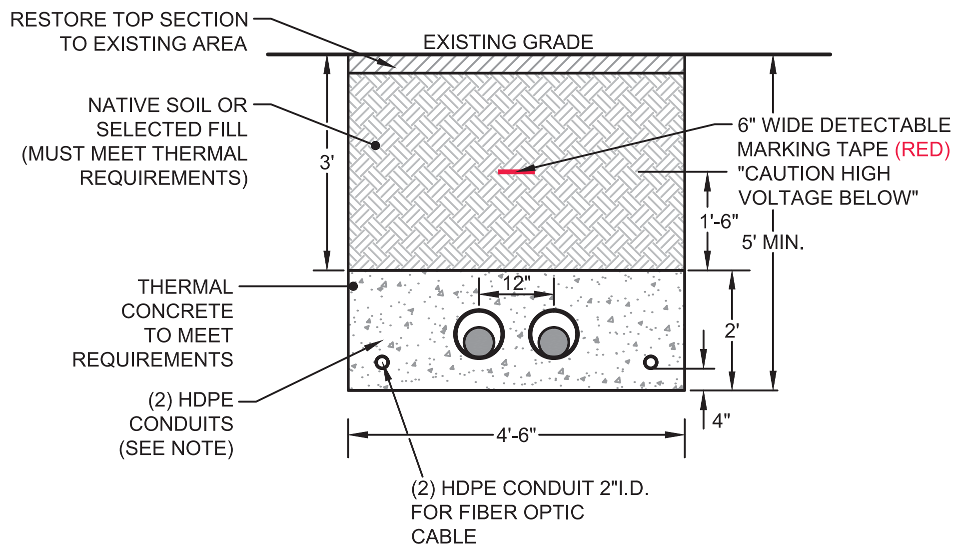
DATE: Jun 19, 2013 - 1:28PM
FILENAME: H:\W296-001 West Point\06 Article VII\W296_Figure_4.14-1_AC Land Cable Trench Detail.dwg

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

Typical Trench Detail
345kV AC Land Cable (Dual Circuit)

Figure
4.14-1

DATE: Jun 19, 2013 - 1:30PM
FILENAME: H:\W296-001 West Point\06 Article VII\W296_Figure_4.14-2_DC Land Cable Trench Detail.dwg



NOTE:

DC DUCT BANK SPECIFICATIONS:

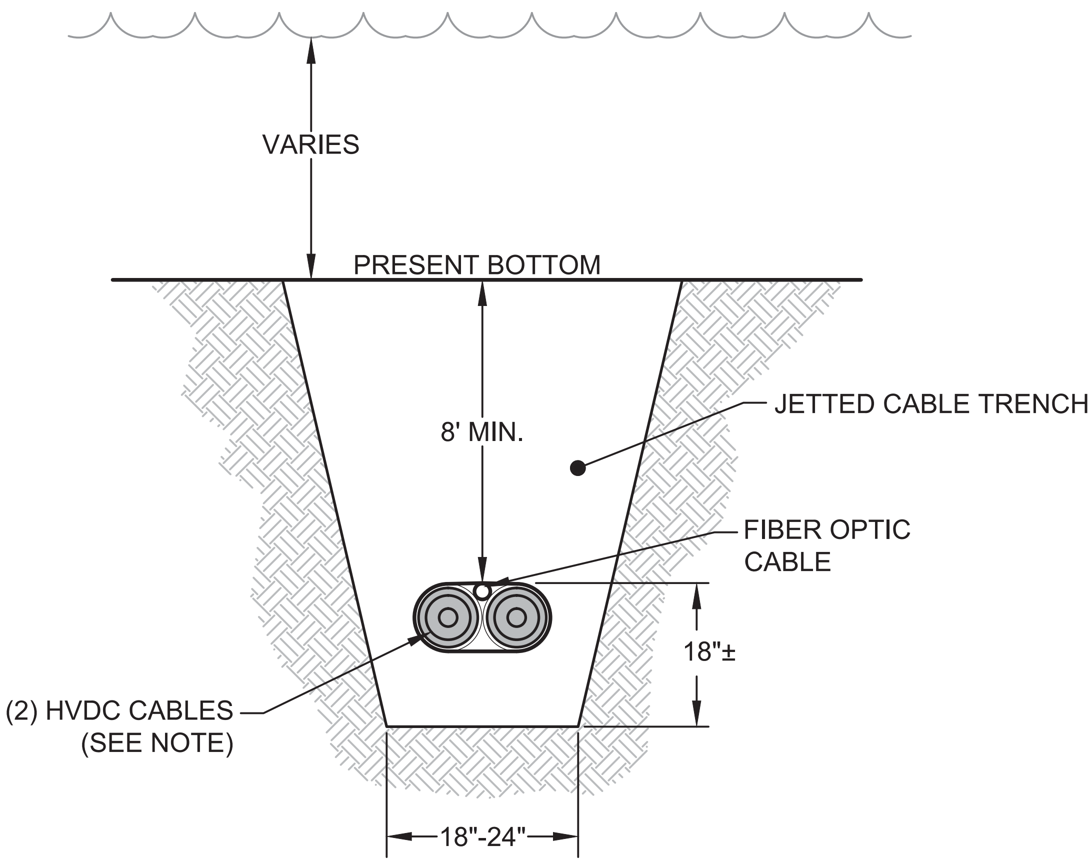
Cable diameter: 5"
Duct diameter: 8"
Duct separation: 4" clear
Duct burial: 4' to centerline of cables
Voltage: +/- 320kV
Current in each cable: +1,570A and -1,570A (simultaneous)

ess group
environmental consulting & engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

Typical Trench Detail
HVDC Land Cable

Figure
4.14-2



NOTE:

DC BUNDLED CABLE (IN-RIVER) SPECIFICATIONS:

Cable diameter: 7"
Voltage: +/- 320kV
Current in each cable: +1,570A and -1,570A (simultaneous)

DATE: Jun 19, 2013 – 1:31PM
FILENAME: H:\W296-001 West Point\06 Article VII\W296_Figure_4.14-3_DC In-River Cabel Bundle.dwg

ess group
environmental consulting & engineering services

West Point Partners, LLC
West Point Transmission Project
Athens to Buchanan, New York

Typical Trench Detail
HVDC In-River Cable

Figure
4.14-3