APPENDIX B

CWA Section 404 Permit Application
Alternatives Analysis Report

CHAMPLAIN HUDSON POWER EXPRESS

HVDC TRANSMISSION PROJECT

UPDATED LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE EVALUATION

CHAMPLAIN HUDSON POWER EXPRESS, INC.

Albany, New York

USACE Application 2009-01089-EYA

July 3, 2013

CHAMPLAIN HUDSON POWER EXPRESS
HVDC TRANSMISSION PROJECT
UPDATED LEAST ENVIRONMENTALLY DAMAGING PRACTICAL ALTERNATIVE EVALUATION

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List of Acronyms

AC	Alternating current
Article VII	Article VII of New York State Public Service Law
Astoria-Rainey Cable	Proposed set of HVAC cables from the Astoria Annex substation, which would be located within the streets of New York City for approximately three miles to Con Edison's Rainey Substation
BMP	Best Management Practices Manual
Certificate	Article VII Certificate of Environmental Compatibility and Public Need
CHPEI	Champlain Hudson Power Express, Inc.
CO_2	Carbon dioxide
Con Edison	Consolidated Edison Company of New York, Inc.
Corps or USACE	U.S. Army Corps of Engineers
CP	Canadian Pacific Railway
CSX	CSX Transportation, Inc.
CWA	Clean Water Act
D&H	Delaware and Hudson Railway
DC	Direct current
DOE	U.S. Department of Energy
Dredging Project	Upper Hudson River PDB Dredging Project
EM&CP	Environmental Management and Construction Plan
EMF	Electromagnetic fields
EPC	Engineering, Procurement and Construction
EPC	Engineering, Procurement and Construction
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration

GHG .... Greenhouse gas

Guidelines .... Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230)

HDD .... Horizontal directional drilling

HDPE .... High density polyethylene

HVAC .... High-voltage alternating current

HVDC .... High-voltage direct current

J&B .... Jack and Bore

kPA .... Kilopascals

kV .... Kilovolt

LEDPA .... Least environmentally damaging practicable alternative

LEI .... London Economics International, LLC

MNCR .... Metro-North Commuter Railroad Co.

MP .... Milepost

MTA .... Metropolitan Transit Authority

MW .... Megawatt

NAAQS .... National ambient air quality standards

NE-ISO .... New England Independent System Operator

NIETC .... Mid-Atlantic Area National Interest Electric Transmission Corridor

NYISO .... New York Independent System Operator

NYPA .... New York Power Authority

NYPSC .... New York Public Service Commission

NYRI .... New York Regional Interconnect Project

NYSCC .... New York State Canal Corporation

NYSDEC..New York State Department of Environmental Conservation

NYSDOS..New York State Department of State

NYSDOT ....New York State Department of Transportation

NYSDPS ....State of New York Department of Public Service

PAAA...New York State Public Accountability Act of 2005

PCBs ....Polychlorinated biphenyls

PM...Particulate matter

Project ....Champlain Hudson Power Express Project

RAP...Realistic achievable potential

RGGI...Regional Greenhouse Gas Initiative

RNA ....Reliability Needs Assessment

ROV ....Remotely-Operated Vehicle

ROW ....Right-of-way

RSU Route ....Uninterrupted submarine route between the Hertel substation located near Quebec and potential converter station locations within the NIETC and the vicinity of New York City

RWS..Gestion RSW, Inc.

SCFWH...Significant Coastal Fish and Wildlife Habitat

SPCC...Spill Prevention, Countermeasure, and Control Plan

TIGER...U.S. Census Bureau’s Topologically Integrated Geographic Encoding and Referencing data files

USACE or Corps................................U.S. Army Corps of Engineers

USEPA..U.S. Environmental Protection Agency

VOCs...Volatile organic compounds

West Point..West Point Military Academy

XLPE...Cross-link polyethylene

Executive Summary

The U.S. Environmental Protection Agency ("USEPA") developed Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230) ("Guidelines") to implement Section 404(b)(1) of the Clean Water Act.[1] Pursuant to § 230.10 of the Guidelines, an applicant for a U.S. Army Corps of Engineers ("USACE") permit under Section 404 of the Clean Water Act must demonstrate that the proposed action is the least environmentally damaging practicable alternative ("LEDPA").

Specifically, applicants must demonstrate that there is no "practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem" and which "does not have other significant adverse environmental consequences" (40 C.F.R. § 230.10(a)). The Guidelines consider an alternative practicable "if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (40 C.F.R. § 230.10(a)(2)). In accordance with the Guidelines, Champlain Hudson Power Express, Inc. evaluated several alternatives to the Champlain Hudson Power Express Project ("Project").

Consistent with the Guidelines, the following alternatives analysis incorporates the extensive alternatives analysis undertaken as part of the New York State siting and permitting process.[2] As part of that proceeding, Settlement Parties undertook an intensive review of Project routing, with a specific focus on locating the cables out of the water to the extent practical and feasible. The Applicants also completed an alternatives analysis for the New York State Department of State as part of its review of the consistency certification for the Project in accordance with the Coastal Zone Management Act.[3] Based on consultation prior to the state proceeding, the State's alternatives analysis, and the ensuing settlement discussions and resultant Joint Proposal settlement, the Project incorporated a number of design and route changes.

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1 33 U.S.C. § 1344. See http://www.law.cornell.edu/uscode/text/33/1344.

2 230.10(a)(5). (Stating, in part, "[t]o the extent that practicable alternatives have been identified and evaluated under a Coastal Zone Management program, a § 208 program, or other planning process, such evaluation shall be considered by the permitting authority as part of the consideration of alternatives under the Guidelines."). See http://www.wetlands.com/epa/epa230pb.htm.

3 New York State Department of State, *Champlain Hudson Power Express Conditional Concurrence with Consistency Certificate* (June 8, 2011). See http://www.chpexpress.com/docs/regulatory/F-2010-1162%20CondCCR.PDF.

While these changes resulted in significant cost increases to the Project, the changes also ensured that the Project route was the least environmentally damaging practicable alternative consistent with the Project purpose (*i.e.*, the delivery of clean sources of generation from Canada into New York City in an economically efficient manner). As noted by the settlement parties in the state proceeding:

> *The preferred route as presented in this [settlement] was determined to be the best suited for the Facility, since it provides an appropriate balance among the various state interests, and it represents the minimum adverse environmental impact, considering the state of available technology, the nature and economics of the studied alternatives and other pertinent considerations.*

The New York State Public Service Commission issued an order granting Certificate of Environmental Compatibility and Public Need for the Project on April 18, 2013.[4]

As part of its LEDPA analysis, the Applicants reviewed three routes provided by the New York State Department of Public Service as part of the Article VII proceedings and three additional routes requested by the USACE. One of these alternatives, the Hell Gate Bypass, was accepted by the Applicants during the Article VII proceedings while segments of the Hudson River Western Rail Line Route were also incorporated into the Project. Each of the remaining alternatives was assessed for their overall practicability based on existing technology, logistics and costs. As summarized in the table below, when evaluated in terms of logistics and costs, the alternatives presented various logistical hurdles including engineering complexity, site access, and adverse affects to existing development, as well the potential for political and public opposition. All of the alternatives had projected costs, when coupled with the additional costs associated with the route designs accepted during the Article VII process, which would result in substantially greater costs than are normally associated with the particular type of project.

4 Order Granting Certificate of Environmental Compatibility and Public Need at 256, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Apr. 18, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A71423C8-B489-4996-9C5A-016C9F334FFC}.

Evaluation of Practicality of Alternatives to Project

	Logistics	Cost
Hudson River Western Rail Line Route	• Long HDD installations • Narrow work spaces • Installation in close proximity to residences/ businesses • Access restrictions • Increased construction duration • Four tunnel segments • Potential for public and political opposition	Increase in Project costs of ~$620 million or 42% over Article VII baseline route.
Harlem River Rail Route	• Busy passenger and rail usage • Geotechnical challenges • Access restrictions on rail trestle by NYSDOT and MTA • Increased risk of cable damage • Increased construction duration • High uncertainty as to engineering feasibility	Increase in costs from ~$81 million (305% of segment cost, 6% of Project cost) to $189 million (15%) over Article VII baseline route.
Existing ROW – West of Adirondack Park	• Difficult HDD installations • Narrow work spaces • Installation in close proximity to residences/ businesses • Density of aboveground utilities and other features • Underground utility avoidance • Increased construction duration • Potential for public and political opposition	Increase in project costs of ~$512 million or 35% over Article VII baseline route.
Existing ROW – East of Hudson River	• Long HDD installations • Narrow work spaces • Installation in close proximity to residences/ businesses • Density of aboveground utilities and other features • Underground utility avoidance • Increased construction duration • Potential for public and political opposition	Increase in project costs of ~$508 million or 35% over Article VII baseline route.
Overland Using New Power Line Route	• Potential long and difficult HDD installations • Increased construction duration • Potential for public and political opposition	Increase in project costs of ~$1.14 billion or 79% over Article VII baseline route.

As part of the Article VII proceeding and consistency review under the Coastal Zone Management Act, the Applicants have accepted a number of Project routing changes aimed at locating the cables out of the water to the extent practical and feasible. While these changes resulted in significant cost increases to the Project, the changes also ensured that the Project route was the least environmentally damaging practicable alternative consistent with the Project purpose (*i.e.*, to deliver clean sources of generation from Canada into New York City in an economically efficient manner). The further analysis undertaken here, pursuant to the Guidelines, confirms that the Project — when evaluated against other alternatives based on logistics, existing technology, and costs — is the least environmentally damaging practicable alternative.

Section 1
Introduction

The U.S. Environmental Protection Agency ("USEPA") developed Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230) ("Guidelines") to implement Section 404(b)(1) of the Clean Water Act.[5] Pursuant to § 230.10 of the Guidelines, an applicant for a U.S. Army Corps of Engineers ("USACE") permit under Section 404 of the Clean Water Act must demonstrate that the proposed action is the least environmentally damaging practicable alternative ("LEDPA").

In accordance with the Guidelines, Champlain Hudson Power Express, Inc. ("CHPEI", and, together with its wholly owned subsidiary, CHPE Properties, Inc., the "Applicants") has developed this alternatives analysis to evaluate several alternatives considered for the Champlain Hudson Power Express Project ("Project"). This document provides an overview of the proposed Project and describes the alternatives considered in the Project's design process. As summarized in this analysis, the Applicants evaluated several alternatives in relation to the Project's purpose, need, and geographic requirements, as well as the practicability and environmental consequences of each alternative.

Consistent with the Guidelines, this analysis incorporates the extensive alternatives analysis undertaken as part of the New York State siting and permitting process.[6] As a consequence of that process, many alternatives were evaluated and the Project has been revised significantly since it was originally proposed. Thus, as demonstrated below, the Project – as currently proposed – is the least environmentally damaging practicable alternative.

1.1 Project Background

The discussion below provides an overview of the development of the Project and identifies the various environmental, regulatory, cost, and political factors that informed the routing of the Project.

5 33 U.S.C. § 1344. See http://www.law.cornell.edu/uscode/text/33/1344.

6 230.10(a)(5). (Stating, in part, "[t]o the extent that practicable alternatives have been identified and evaluated under a Coastal Zone Management program, a § 208 program, or other planning process, such evaluation shall be considered by the permitting authority as part of the consideration of alternatives under the Guidelines."). See http://www.wetlands.com/epa/epa230pb.htm.

1.1.1 Original Project

In 2008, the Applicants commissioned Gestion RSW, Inc. ("RSW") to conduct feasibility studies of possible HVDC submarine transmission cable projects that would deliver power to the Mid-Atlantic Area National Interest Electric Transmission Corridor ("NIETC"). RSW developed an uninterrupted submarine route between the international border and potential converter station locations within the NIETC and the vicinity of New York City (the "RSW Route").[7] The RSW Route utilized the Richelieu River, Lake Champlain (within New York State), the Champlain Canal, the Hudson River, and other parts of the waters in and around New York City.

As a result of Applicants' consultation prior to filing a state siting permit with New York State, the New York State Canal Corporation ("NYSCC") staff raised concerns over its legal authority to enter into a long-term agreement providing the Applicants with the right to locate cables within the Champlain Canal. Among other state constitutional and statutory obstacles, the NYSCC is subject to certain restrictions under the New York State Public Authorities Accountability Act of 2005 with regard to the transfer of real property rights.[8] Additionally, after consultation with state and federal regulatory agencies (including the USEPA), it became evident that the HVDC submarine cables should not be installed within the Upper Hudson River before completion of the dredging activities associated with the Upper Hudson River PCB Dredging Project ("Dredging Project"), which was estimated to continue through 2016.[9] Therefore, the Applicants identified a terrestrial bypass route to circumvent the Dredging Project area to ensure the Project would not exacerbate existing water quality issues or otherwise interfere with the Dredging Project.[10]

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[7] *Attachment Q: Supplemental Alternatives Analysis at 2 -3, Application of Champlain Hudson Power Express, Inc. and CHPE Properties, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the Public Service Law for the Construction, Operation and Maintenance of a High-Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. July 22, 2010) http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={D6AC823D-402A-4E1F-A621-8E7FF1906D7D}.

[8] New York State Public Authorities Law Section 2897. See http://codes.lp.findlaw.com/nycode/PBA/9/5-A/2897.

[9] General Electric. 2008. Phase 2 Intermediate Design Report, Hudson River PCBs Superfund Site. Accessed on-line on April 28, 2013 at: http://www.epa.gov/hudson/pdf/2008_5_13_phase_2_intermediate_design_report_text.pdf.

[10] The northern portion of the Upper Hudson River PCB Dredging Project begins near the former Fort Edward Dam at Lock C7 and moves south to Troy Dam.

1.1.2 New York Regional Interconnection

In designing the Project to incorporate the overland bypasses described above, the Applicants attempted to maximize the use of existing rights-of-way ("ROW") and bury the transmission cables as a consequence of the failed New York Regional Interconnect ("NYRI") project. NYRI was a New York company that attempted to obtain authorization from New York State to construct a 1,200 MW, HVDC transmission line from the Edic substation in Marcy, New York to the Rock Tavern substation in New Windsor, New York.[11] The NYRI project, as proposed, would have been completely overhead with no burial.[12] NYRI's sponsors argued that the line would reduce congestion and help meet state goals regarding renewable energy, fuel and locational supply diversity, and greenhouse gas reduction.[13]

Citizen groups organized against the project (*e.g.*, STOPNYRI, Communities Against Regional Interconnect, Upstate New York Citizen's Alliance)[14] due to the use of overhead lines and the potential for NYRI to use eminent domain to take homes within its proposed project area.[15] Over 2,000 people attended thirteen (13) public hearings held by the New York Public Service Commission ("NYPSC") and more than 2,600 letters and e-mails from the public were received by the NYPSC.[16] Various hearings regarding the project drew over-capacity crowds and, in the

11 *Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor,* Case No. 06-T-0650, http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=06-T-0650.

12 Comments of NYSDEC Regarding the Application at 3, *Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor,* Case No. 06-T-0650 (N.Y. P.S.C. July 18, 2006), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={DC7B9711-93BB-450F-8166-6A4D09D16169}.

13 Rebuttal Testimony of Jonathan A. Lesser and J. Nícholas Puga on Behalf of New York Regional Interconnect, Inc. at 15-16, *Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor,* Case No. 06-T-0650 (N.Y. P.S.C. Mar. 2, 2009), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={5EDB6D60-3CD7-4F6E-9504-E706A6B3D07A}.

14 Fritz Mayer, *The Year of the Power Line Battles*, The River Reporter (Dec. 28, 2006), http://www.riverreporter.com/issues/06-12-28/news-power.html.

15 New York Transportation Corporation Law (N.Y. Transp. Corp. L. § 11(3-a) (McKinney 1996)) generally allows an electric corporation to take private property if needed for a public purpose.

16 Press Release, New York State Public Service Commission, *Commission Officially Dismisses NYRI, New Application Must Be Filed if Company Wants to Pursue Project* (Apr. 21, 2009),

later stages, required police presence to maintain order.[17] Reports indicated that approximately $2,397,000 was spent in opposition to the project.[18]

Community opponents argued that the line would traverse historic areas, raise upstate electricity prices, increase the risk of childhood cancers as a result of electromagnetic fields (EMF), and reduce property values in a part of the state already struggling economically. The seven (7) counties which would be occupied by the proposed NYRI transmission system organized against the project.[19] Local media coverage of the project was intense and hostile. In addition to local community concerns, the project was opposed by upstate business, utilities, and state agencies.[20]

Attempts to stop the project occurred in several venues. Market opponents attempted to frustrate the project during interconnection proceedings before the New York Independent System Operator ("NYISO").[21] In addition, NYRI became a high-visibility issue for the New York State Legislature. The first legislative response was a proposal to fund opposition to the project.[22] As opposition grew, however, opponents demanded that the legislature do more to definitively terminate the project. As a result, Governor George Pataki enacted legislation limiting the use of

http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={6F0413CF-6EB1-4695-A65B-82AC65D682D3}.

17 Brendan Scott, *High-voltage Line Ignites Crowd's Ire*, The Herald-Record (Apr. 28, 2006), http://www.recordonline.com/apps/pbcs.dll/article?AID=/20060428/NEWS/304289999&cid=sitesearch.

18 Elizabeth Cooper, *NYRI Quits; Power Line Project Dead*, Utica Observer-Dispatch (Apr. 4, 2009), http://www.uticaod.com/news/x1525913735/NYRI-Quits-power-line-project-dead?zc_p=1.

19 Melissa deCordova, *County Leaders Strategize Against NYRI*, The Evening Sun (June 13, 2006), http://www.evesun.com/news/stories/2006-06-13/99/County-leaders-strategize-against-NYRI/.

20 Comments and testimony in opposition to the NYRI project either wholly or in part as proposed were provided by, among others, the New York Chapter of the National Federation of Independent Business, Con Edison, the New York Power Authority, New York State Department of Environmental Conservation, New York State Attorney General, New York State Department of Public Service and New York State Department of Agriculture and Markets, *See Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor*, Case No. 06-T-0650, http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=06-T-0650.

21 Companies expressing concerns were Con Edison, Orange and Rockland Utilities, Central Hudson, and Long Island Power Authority. *See Power Line near Delaware Hits Snag*, Pocono News (June 2, 2008), http://www.pocononews.net/news/June08/02/02Jun08-5.html.

22 Jeff Genung, *Libous Announces $1M to Fight NYRI*, The Evening Sun (Aug. 30, 2006), http://www.evesun.com/news/stories/2006-08-30/461/Libous-announces-1M-to-fight-NYRI/.

eminent domain to acquire rights-of-way generally, making it "virtually impossible" for NYRI to build the power line.[23]

After several unfavorable NYISO, court, and Federal Energy Regulatory Commission ("FERC") decisions, NYRI filed a letter with the NYPSC on April 6, 2009 (as clarified on April 8, 2009) withdrawing its petition for a certificate to construct the power line.[24] On April 21, 2009, the NYPSC granted the withdrawal "with prejudice," indicating that, if NYRI decided to resurrect the project, it would need to file a new application and begin the process anew.[25] The magnitude of public and political opposition that NYRI faced, and which ultimately killed the NYRI project, substantially informed Applicants' approach to the design and route of the Project. More specifically, Applicants avoided, to the extent practicable, proposing a Project route that would locate the line near homes and business or otherwise rely significantly on eminent domain to achieve its routing.

In the ensuing analysis, when the Applicants state that public or political opposition is likely, this characterization is directly based on NYRI's experience and its failed outcome.

1.1.3 New York State Article VII Settlement Process

In addition to the Project route configurations resulting from pre-filing consultation and the lessons learned from the failed NYRI project, the current Project route was shaped significantly by the New York State permitting process. Specifically, the alternatives analysis set forth herein includes and incorporates information and analysis undertaken pursuant to Article VII of the

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23 Fritz Mayer, *Citizen Groups Still Fighting NYRI*, The River Reporter (Nov. 9, 2006), http://www.riverreporter.com/issues/06-11-09/head2-nyri.html.

24 NYRI Submits Notification that it is Suspending its Application filed under Article VII of the Public Service Law, *Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor*, Case No. 06-T-0650 (N.Y. P.S.C. Apr. 6, 2009), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={7241B9D8-8B9C-4A92-B19E-4446DF4D0F9D}.

25 Letter from Jaclyn A. Brilling, New York State Public Service Commission, to Leonard H. Singer, Esq., Couch White LLP, Regarding a Certificate of Environmental Compatibility and Public Need, *Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor*, Case No. 06-T-0650 (N.Y. P.S.C. Apr. 21, 2009), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={26743727-8726-4A5D-9DB6-64ABD60BA7CB}.

New York State Public Service Law ("Article VII").[26] Through the Article VII process, the Applicants, along with a number of state regulatory agencies and non-governmental public interest organizations ("Settlement Parties"),[27] conducted an intensive and thorough review of the Project's proposed routing, with a specific focus on locating the cables out of the water to the extent practical and feasible. After consideration of various alternative routes, the Settlement Parties established a route that "represents the minimum adverse environmental impact, considering the state of available technology, the nature and economics of the studied alternatives and other pertinent considerations."[28] The Settlement Parties' findings were recently affirmed by the NYPSC when an Article VII Certificate of Environmental Compatibility and Public Good was issued to the Applicants on April 18, 2013.[29]

Concurrently with the Article VII process, the New York State Department of State (NYSDOS) completed its review of the consistency certification for the Project in accordance with the Coastal Zone Management Act.[30] As part of this process, the NYSDOS requested that the Applicants provide an analysis of alternative routes considered.[31] In its decision, the NYSDOS

26 N.Y. Pub. Serv. Law §§ 120-130. In New York State, Article VII governs the state siting and environmental review process for transmission facilities. See http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+&QUERYDATA=@SLPBS0A7+&LIST=LAW+&BROWSER=EXPLORER+&TOKEN=27396543+&TARGET=VIEW.

27 Settlement endorsing the Joint Proposal for all purposes include: the Applicants, New York State Department of Public Service; New York State Department of Environmental Conservation; New York State Department of State; Adirondack Park Agency; New York State Office of Parks, Recreation and Historic Preservation, Riverkeeper, Inc.; Scenic Hudson, Inc.; and New York State Council of Trout Unlimited. The New York State Department of Transportation and Vermont Electric Power Company signed the JP for the limited purposes of participating in the sections of importance to them.

28 Joint Proposal at 46, *Application of Champlain Hudson Power Express, Inc. and CHPE Properties, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the Public Service Law for the Construction, Operation and Maintenance of a High-Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012) ("Joint Proposal" or "Joint Proposal of Settlement"), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C5F63E41-5ED5-46A2-99A5-F1C5FC522D36}.

29 Order Granting Certificate of Environmental Compatibility and Public Need, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Apr. 18, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A71423C8-B489-4996-9C5A-016C9F334FFC}.

30 New York State Department of State, *Champlain Hudson Power Express Conditional Concurrence with Consistency Certificate* (June 8, 2011). See http://www.chpexpress.com/docs/regulatory/F-2010-1162%20CondCCR.PDF.

31 Article VII Updated Alternatives Analysis, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border*

note that "while the project does not itself constitute a "water dependent" use, several conditions ensures that the transmission cables will be sited and installed in a manner that facilitates water dependent economic uses and avoids interference with other important water dependent uses such as navigation and fishing."[32] The conditions imposed by the NYSDOS, which in general address burial depth, utilization of horizontal directional drilling, routing and construction windows, have all be incorporated into the Applicants' Project as confirmed in a letter sent to the USACE on July 7, 2011.

1.1.4 Impacts of Revised Routing on Costs

As a result of changes to the Project route that occurred during the Article VII process, the cost of the Project has already increased significantly as compared to the original Project design. Thus, in assessing the cost of the various alternatives discussed below, it is important to note that the baseline cost of the Project as currently proposed includes significant additional costs to account for the various alternatives that have already been incorporated into the Project through both pre-application consultation and the New York State siting process. These incorporated alternatives – all designed to ensure the Project is both able to be permitted and the least environmentally damaging – have increased the original cost of the Project substantially.

As a result, the true magnitude of cost increase that could result from the alternatives discussed below is often masked because the Project baseline cost already accounts for substantial cost increases that resulted from the New York State siting process. As CHPE already has absorbed significant cost increases associated with incorporating various alternatives routes, even relatively small incremental additional costs may have a disproportionate impact on the Project. Therefore, in the context of this Project, which has already incorporated a significant number of alternatives to date as a result of the state siting process, the cost of the alternative as compared to the overall Project cost is not necessarily an accurate measure of whether an alternative is practical. Rather, the LEDPA analysis must account for the significantly increased costs that have already been imposed on the Applicants to revise the Project route, and the impact that

to New York City, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012) ("Article VII Updated Alternatives Analysis"), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={1376106E-8A60-4BC8-B601-EA7C43ECC0BB}.

32 New York State Department of State, *Champlain Hudson Power Express Conditional Concurrence with Consistency Certificate* at 5 (June 8, 2011). See http://www.chpexpress.com/docs/regulatory/F-2010-1162%20CondCCR.PDF.

additional costs will have on the Applicants' ability to effect the Project purpose. As the EPA has noted, "[w]e consider it to be implicit that, to be practicable, an alternative must be capable of achieving the basic purposes of the proposed activity."[33]

1.2 Project Purpose

The purpose of the Project is as follows:

> The Project will deliver clean, renewable power[34] generated from the Canadian province of Quebec into New York City through a new 1,000 MW HVDC underground/underwater transmission line that is economically efficient.

1.3 Project Need

The Project is consistent with state and municipal energy policies, which call for the increased use of energy from renewable/sustainable resources.

1.3.1 State Energy Policy

In his 2012 State of the State Address, Governor Andrew Cuomo announced a plan to build a private sector funded $2 billion "Energy Highway" system, specifically referring to an "energy expressway down from Quebec."[35] The goal of the Energy Highway is to ensure that a "cost-efficient, reliable and environmentally sustainable supply of power is available to fuel the state's economic growth and to meet the needs of its residents."[36] The Energy Highway Task force issued a Request for Information that solicited information related to "sustainable and environmentally responsible" projects and requested that respondents provide details on how their project would "help to reduce the carbon footprint of electricity consumed in New York,

[33] Preamble to Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 45 Fed. Reg. 85,336, 85,343 (Dec. 24, 1980) as referenced in U.S. Envtl. Prot. Agency & U.S. Army Corps of Engineers, *Memorandum: Appropriate Level of Analysis Required for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternatives Requirements* § 3.b. (Aug. 23, 1993) ("Section 404(b)(1) Compliance Memorandum"), http://water.epa.gov/lawsregs/guidance/wetlands/flexible.cfm.

[34] See Certificate, Pg. 54

[35] Press Release, N.Y. State Governor's Office, *Governor Cuomo Outlines Plan to Continue Building a New York by Growing the Economy, Reinventing State Government, and Advancing New York as a Progressive Leader* (Jan. 4, 2012), http://184.106.78.18/press/sos2012.

[36] Press Release, N.Y. State Governor's Office, *Governor Cuomo's Energy Highway Task Force Holds Summit* (Apr. 4, 2012), http://184.106.78.18/press/04042012Energy-Highway.

regardless of where electricity is produced."[37] Additionally, New York State developed an Energy Plan with the goal of "Increasing Reliance on Renewables," including "expanding the State's purchases of hydropower."[38] The Energy Plan noted that "the prospect of securing hydro power from Canada increases the likelihood that we will be able to reduce [Greenhouse Gas] emissions 80 percent by 2050."[39]

The City of New York also recognized the importance of increasing the amount of renewable electricity available to consumers in New York City. In its "PlaNYC" update, the City calls for diversifying the City's supply portfolio through, among other options, "harnessing cleaner resources outside the city." [40]

1.3.2 Greenhouse Gases

The Project supports established state and federal goals to reduce Green House Gas ("GHG") emissions and other air emissions associated with electric generation. On August 6, 2009, then-New York Governor David Paterson issued Executive Order No. 24 setting a goal of reducing the state's greenhouse gas emissions 80 percent from 1990 levels by 2050.[41] The New York State Energy Plan calls for an increase in renewable energy to reduce the emissions of GHGs, nitrous oxides, sulfur dioxide, particulate matter ("PM"), and volatile organic compounds ("VOCs") associated with traditional fossil-fuel-fired power plants.[42] The New York State Department of Environmental Conservation ("NYSDEC"), as a settlement party in the Project's Article VII process, represents the State on the Regional Greenhouse Gas Initiative, which is a cooperative effort to cap and reduce GHG air emissions associated with the production of electricity.[43]

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37 N.Y. Energy Highway, *Request for Information* at 13 (Apr. 19, 2012), http://www.nyenergyhighway.com/Content/pdf/EH_RFI_Brochure_2012.pdf.

38 N.Y. State Energy Planning Board, *2009 State Energy Plan*, Vol. I at 93 (Dec. 2009), http://www.nysenergyplan.com/final/New_York_State_Energy_Plan_VolumeI.pdf ("State Energy Plan").

39 *Id.* at xvii.

40 City of New York, *PlaNYC: A Greener, Greater New York* at 112 (Apr. 2011), http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_planyc_full_report.pdf.

41 N.Y. State Dep't of Envtl. Conservation, *Executive Order No. 24 (2009): Establishing a Goal to Reduce Greenhouse Gas Emissions Eighty Percent by Year 2050 and Preparing a Climate Action Plan*, http://www.dec.ny.gov/energy/71394.html (last visited Apr. 22, 2013).

42 *See* State Energy Plan at xiii, 3-5.

43 N.Y. State Dep't of Envtl. Conservation, *The Regional Greenhouse Gas Initiative (RGGI): Carbon Dioxide Budget Trading Program*, http://www.dec.ny.gov/energy/rggi.html (last visited Apr. 22, 2013).

The 2009 New York State Energy Plan indicates that infrastructure investments are necessary to support the state's transition to a clean energy system with very low GHG emissions.[44] The Plan goes on to state that hydroelectric power from Canada could increase the likelihood of achieving an 80% reduction of GHG gases by 2050.[45]

The Clean Air Act also requires states, at a minimum, to meet national ambient air quality standards ("NAAQS").[46] When a state is in nonattainment of one or more of the NAAQS, such as New York, it must have a plan to come into attainment. The New York City metropolitan area is currently considered to be in nonattainment of the ground level ozone NAAQS and in nonattainment of the PM_{10}[47] and $PM_{2.5}$[48] NAAQS. Ground level ozone is created by emissions of nitrous oxides and VOCs, which are emitted by all fossil-fuel-fired electric generating facilities. PM_{10}, $PM_{2.5}$, and sulfur dioxide are also emitted by fossil-fuel-fired electric generating facilities.

London Economics International, LLC ("LEI") conducted an analysis for the Project and concluded that in 2018 the electricity produced via the type of generation to be transmitted by the Project into New York City would reduce emissions of CO_2 by 2.5 to 2.9 million tons, sulfur dioxide (SO_2) by 454 to 571 tons, and oxides of nitrogen ("NOx") by 952 to 1,114 tons, with no offsetting emissions at the point of generation.[49] A separate analysis completed by the State of New York Department of Public Service ("NYSDPS") estimated reductions of 1.5 to 2.2 million tons of CO_2, 499 to 828 tons of SO_2, and 748 to 1,432 tons of NOx.[50]

1.3.3 Transmission Congestion

The 2009 National Electric Transmission Congestion Study conducted by the U.S. Department of Energy ("DOE") identified the metropolitan areas of New York southward through Northern

44 State Energy Plan at 4.
45 *Id.* at xvii.
46 U.S. Envtl. Protection Agency, *National Ambient Air Quality Standards (NAAQS)* (Dec. 14, 2012), http://www.epa.gov/air/criteria.html, .
47 U.S. Envtl. Protection Agency, *Particulate Matter (PM-10) Nonattainment State/Area/County Report* (Dec. 14, 2012), http://www.epa.gov/oar/oaqps/greenbk/pncs.html (New York).
48 U.S. Envtl. Protection Agency, *Particulate Matter (PM-2.5) 2006 Nonattainment State/Area/County Report* (Dec. 14, 2012), http://www.epa.gov/oar/oaqps/greenbk/rncs.html (New York).
49 London Economics International LLC, *Results of the 2018 Test Year Modeling Analysis* (Jan. 18, 2010), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={E7E08BDC-E247-4C08-9922-3E9A90A05015}.
50 Joint Proposal of Settlement at 59-60 & Fig. 2.

Virginia (the Mid-Atlantic Coastal area) as a Critical Congestion Area.[51] This is an area in which the DOE determined that it is critically important to remedy existing or growing transmission congestion problems because the current and/or projected effects of transmission congestion in terms of economic cost and reliability are severe. The report noted that while there are many projects in the NYISO generation interconnection queues, "new generation is slow to come on-line and is often offset by retirement of older generation capacity."[52]

As noted in the New York State Energy Plan.[53]

> Because New York's electric infrastructure is old, significant capital investments will need to be made in the utilities' electric transmission and distribution system to meet future electric demand and allow them to continue to provide reliable service. Replacement and improvement of existing aging infrastructure are critical, as system failures not only raise safety and reliability concerns, but can also lead to increased system congestion and therefore higher emissions and costs.

The document further notes that the construction of new infrastructure may be required regardless of economic and reliability benefits, to achieve New York State's clean energy policy goals.[54]

Additionally, New York State's Energy Highway Plan Request for Information noted:

> Most of New York State's transmission lines were built more than 50 years ago. It is estimated that about 25 percent of the State's transmission system will have to be replaced within the next 10 years and nearly 50 percent will require replacement in the next 30 years. The utilities that own the transmission lines continue to invest in them, and the system can still be operated with utmost reliability. However, physical limitations and congestion on the grid at times prevent excess power supplies from upstate and Canada from reaching the downstate region, where demand is greatest. These transmission bottlenecks have a number of actual and potential consequences in terms of economics, the reliability of the power supply, the environment and public health:
>
> - Many higher-cost downstate power plants must run even when cheaper plants are available because power from the cheaper plants cannot be delivered. This can result in higher costs for consumers and cost-effective solutions need to be sought.

51 U.S. Dep't of Energy, *National Electric Transmission Congestion Study* § 4.4 (Dec. 2009), http://energy.gov/sites/prod/files/Congestion_Study_2009.pdf
52 *Id.* at 51.
53 State Energy Plan at 65.
54 *Id.* at 66.

- The downstate area lacks diversity in its power supply and relies mostly on natural gas-fired generation to meet its needs.
- Older plants in urban areas must run at peak hours, increasing air pollution and health risks in the summer months when these effects are most pronounced.
- At times, bottlenecks limit downstate access to renewable power.

> In addition to addressing these concerns, investments in new and upgraded transmission lines will provide substantial economic benefits. For example, a recent national report concluded that every $1 billion of transmission investments "supports approximately 13,000 full-time-equivalent years of employment and $2.4 billion in total economic activity.[55]

The Project enables distant generators to serve a portion of the regional load while bypassing locations where the transmission system experiences congestion. It avoids the challenges associated with building new generation capacity within the NYC load pocket, which include air quality restrictions, high real estate values, fuel supply problems, and local opposition to power plants. Energy efficiency, demand response, and other demand-side measures can reduce loads and improve the balance between supply and demand, but those measures must be pursued over extended periods (often with uncertain results) in order for their impacts to grow to transmission or power-plant-equivalent quantities.[56]

1.4 Geographic Requirements

The Project is intended to connect clean generation sources with the New York City load center. The majority of New York's existing generation portfolio is composed of gas- and/or oil-fueled facilities, which accounts for approximately 61 percent of the total installed capacity in the state.[57] The vast majority of these gas and oil facilities tend to be older; about 65 percent of them were built before 1980, and therefore are relatively inefficient.[58]

55 New York Energy Highway: Request for information, pgs 7-8 ((2012).

56 U.S. Dep't of Energy, *National Electric Transmission Congestion Study* at 43 (Aug. 2006) ("2006 Transmission Congestion Study"), http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/Congestion_Study_2006-9MB.pdf.

57 *See* N.Y. Independent Sys. Operator, 2012 Load and Capacity Data "Gold Book" at Table III-2 (Apr. 2012) ("2012 Gold Book"), http://www.nyiso.com/public/webdocs/media_room/publications_presentations/Planning_Reports/Planning_Reports/2012_GoldBook_V3.pdf.

58 *Id.*

There are currently no proposed renewable energy projects in the interconnection queue in the vicinity of New York City – in fact, over 3,500 MW has been withdrawn from the queue since 2007.[59] Therefore, other new generation sources in the New York City region are not anticipated to provide a significant increase in energy supply capacity and a resultant enhancement in system reliability comparable to the Project[60] and sources from locations outside of New York City must be identified. Hydropower projects in Canada currently generate excess electrical capacity, thereby making clean sources of generation in Canada the most practical choice for providing the additional capacity needed to help fulfill regional demands, while increasing the stability and security of the grid.[61]

The current and/or projected effects of transmission congestion in New York are complex and will be difficult to resolve.[62] The Project enables generators in Canada to serve a portion of the regional load without further increasing transmission congestion in the region. To do so effectively requires interconnection to the grid at locations within the load pocket. This design allows electricity generated outside of the region to be delivered without the need to rely significantly on the existing transmission facilities that are already suffering congestion.

In analyzing the potential solutions to congestion in the New York City region, the DOE's National Electric Transmission Congestion Study concluded that construction of major new transmission lines from north of the city would significantly increase the options available to the city for power.[63] Such transmission lines would deliver relatively inexpensive electricity from Canadian hydroelectric power plants and other renewable sources to load centers in major metropolitan areas.[64]

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59 *Id*.
60 Joint Proposal of Settlement at 14.
61 U.S. Dep't of Energy, *National Electric Transmission Congestion Study* at 43 (Aug. 2006) ("2006 Transmission Congestion Study"), http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/Congestion_Study_2006-9MB.pdf
62 *Id.*
63 *Id.*
64 *Id.*

Section 2
Proposed Project

The Project consists of a 1,000 MW underwater/underground HVDC electric transmission system extending from the international border between Canada and the United States to Queens, New York City, New York. The Applicants propose to develop the Project to deliver clean sources of power to New York City.

2.1 Proposed Project Route

As discussed earlier, the Project as currently configured, represents the alternatives incorporated as part of the New York Sate siting and permitting process.

The Project originates at the international border between the United States and Canada and continues south within Lake Champlain for approximately 101.5 miles in waters of the state of New York. The cables will be located to the east of Rouses Point, Point au Fer, Chazy Landing, Point Au Roche and Cumberland Head, east of Valcour Island and the Four Brothers islands, and then would continue towards the New York – Vermont border near the middle of the lake. From Split Rock Point south, the cables will be located closer to the New York shoreline. Proceeding southward from Crown Point, the waters of the lake become shallower, and the cable route would be closer to the New York-Vermont border near the middle of the narrow water body.

At milepost ("MP") 101.5, in the town of Dresden, Washington County, New York, the transmission cables would transition from the waters of Lake Champlain to the land on the western shore via a horizontal directional drill ("HDD"). The cables would then transition from under Lake Champlain to land owned by the Delaware and Hudson Railway ("D&H")[65] and other property owners, and then enter the ROW of New York State Route 22. The cables would continue south within the Route 22 ROW until MP 111.9, except for a crossing of South Bay at MP 109.7. The cable route would continue within the Route 22 ROW into the Village of Whitehall and then would enter the Canadian-Pacific Railway ("CP") ROW on lands owned by the D&H within the Village of Whitehall. The cables would remain primarily within the CP ROW and lands owned by the D&H for approximately 65.1 miles, crossing the Washington

[65] The D&H was acquired some years ago by the Canadian Pacific Railway Company, but it still operates for many purposes under the D&H name.

County municipalities of Whitehall, Fort Ann, Hartford, Kingsbury, Fort Edward Town and Village; the Saratoga County municipalities of Moreau, Northumberland, Wilton, Greenfield, City of Saratoga Springs, Malta, Milton, Ballston, and Clifton Park; the Schenectady County municipalities of Glenville, Rotterdam and the City of Schenectady. Along this portion of the overland route, the cable route would have relatively minor deviations out of the CP ROW onto private and public lands for various engineering constraints, such as a narrow section of ROW, buildings, railroad developments, and sensitive habitat areas. In Schenectady, the proposed route would leave the CP ROW at MP 173 to be installed within Erie Boulevard so as to bypass a section of railroad bridges. The cables would re-enter the CP ROW around MP 173.6, but would exit again at MP 173.7 to utilize largely vacant land to pass beneath Interstate I-890. The cables re-enter the CP ROW at MP 174.3 and would continue to the Town of Rotterdam.

Around MP 177 in Rotterdam, the cables would transfer from the CP ROW to the CSX Transportation Railroad ("CSX") ROW. The cables would be located within the CSX ROW southeasterly for approximately 22 miles through the Albany County municipalities of Guilderland, New Scotland, Voorheesville, Bethlehem and Coeymans. From MP 199, the cables would continue along a CSX ROW that runs south parallel to the Hudson River within the Town of Coeymans and the Village of Ravena, and the Greene County municipalities of New Baltimore, Town and Village of Coxsackie, Town of Athens, and the Town and Village of Catskill. There are relatively minor deviations from the CSX ROW due to engineering constraints such as bridges, roadway crossings, and areas where the existing ROW is too narrow to permit cable installation while meeting established railroad clearance criteria.

In the Town of Catskill north of the hamlet of Cementon, the cable route would exit the CSX ROW at MP 227.5 and turn easterly to follow Alpha Road, which terminates at a landing area at MP 228.2. At this point the cables would transition into the Hudson River via an HDD. The cables would be located within the Hudson River south from Cementon for approximately 67 miles. The cable route has been sited to avoid known sensitive habitat, potential cultural resources, contamination zones and navigation hazards to the extent practicable.

At MP 295.7, the cables would transition from the Hudson River via an HDD and enter a CSX ROW in the Rockland County Town of Stony Point. The cables subsequently would follow the CSX route and a public road (Route 9W) ROW for a 7.7-mile overland bypass of Haverstraw

Bay, which has been identified as one of the most sensitive significant coastal habitats within the Hudson River. The cable route then would travel through the Town of Haverstraw, Village of West Haverstraw and Village of Haverstraw primarily within the CSX ROW, although there are deviations to avoid engineering constraints such as bridges and roadway crossings. At MP 300.8, the CSX ROW is bordered on the east and then on both sides by Haverstraw Beach State Park; therefore, starting at MP 301.4, an HDD would be established to install the cables under Rockland Lake State Park and Hook Mountain State Park (comprising portions of Palisades Interstate Park) to enter the ROW of NYS Route 9W in the Town of Clarkstown. From MP 301.8 to 302.4, the cables would be located within the Route 9W ROW. At this point, another HDD would install the cables beneath the two parks and transition the cables into Hudson River.

From MP 302.8 south of Haverstraw Bay, the cables would be located within the New York State section of the Hudson River for approximately 20.7 miles. As with the other in-water segments, the routing has been designed so as to avoid sensitive resources. At MP 324, the cable would turn easterly and enter Spuyten Duyvill Creek and the Harlem River within the borough of Manhattan in New York City. The cable route would be located within the Harlem River for 6.58 miles, and then transition to land via an HDD to enter a CSX ROW in the borough of the Bronx. The cable route along the CSX ROW would cross lands owned by the New York State Department of Transportation, cross beneath the Robert F. Kennedy Bridge and the Hell Gate railroad bridge and then transition via an HDD to cross beneath and into the East River. After a short jet plow installation, the cable route would transition to land via another HDD in the borough of Queens in New York City, and would continue easterly to the Luyster Creek converter station site in Astoria, north of 20th Avenue on lands of Consolidated Edison Company of New York, Inc. (“Con Edison”).

The converter station would be a “compact type” with a total footprint (i.e., building and associated equipment and related areas) of approximately five (5) acres. Gas insulated HVAC cables would connect the converter station to the New York Power Authority (NYPA) Astoria Annex 345 kilovolt (“kV”) substation. In addition, the NYISO may require the Applicants to construct a four-breaker gas-insulated ring bus in a building to be located on the same parcel as the converter station, unless a preferable location for this ring bus can be found closer to the Astoria Annex.

From the Astoria Annex substation, another set of HVAC cables would be located within the streets of New York City for approximately three miles to Con Edison's Rainey Substation ("Astoria-Rainey Cable"). The cable would run north parallel along 20th Avenue before crossing 20th Avenue southwesterly onto 29th Street. The cable route would continue within 29th Street for one city block before turning northwest onto 21st Avenue and continuing within 21st Avenue until 23rd Street. The cable route would turn onto 23rd Street and continue southerly, including crossing under the Triborough Bridge, until 30th Drive. The cable route would then turn westerly on to 30th Drive and then southerly within 14th Street. The cable route would turn to the west onto 31st Drive for one city block before turning to the south onto 12th Street. The cable route would turn west onto 35th Avenue and continue to the Rainey Substation.

The proposed Project route is shown in Figure 2-1.

FIGURE 2-1
PROPOSED PROJECT ROUTE

2.2 Proposed Project Construction Techniques

Given the length of the route from the Canadian border to New York City (approximately 333.3 miles from the international border to the converter station plus the Astoria-Rainey Cable which is approximately 3.5 miles) and the diversity of landforms and water areas that are crossed by the cable route, a variety of construction methods and equipment will be employed. As part of Settlement Parties' Joint Proposal filed in the Article VII proceeding, the Applicants developed a Best Management Practices ("BMP") Manual, which details BMPs to be utilized during Project construction. The BMP Manual was included as Attachment O to Applicants' Supplemental Application.[66]

2.2.1 Underwater Installation Methods

The two HVDC underwater cables associated with the Project would be bundled and laid together within the same trench. The cables would be initially placed in a vertical position (one on top of the other) in the trench, although sediment conditions may allow for slumping into a horizontal position (side-by-side) relative to each other. Cable burial would generally be performed at the same time the cable is laid or at a later date, as deemed appropriate or necessary due to subsurface conditions. The cables would be laid by specialized cable-laying vessels or a specially outfitted laybarge, depending on navigation constraints along the Project route.

The cables would be transported from the manufacturer by a special cable transport vessel and transferred onto the cable installation vessel. The linear cable machines onboard the installation vessel would pull the cables from coils on the transport vessel onto the installation vessel and into prefabricated tubs. After the cable has been transferred, the installation vessel would travel to the construction commencement location. This process would be repeated as necessary to deliver and install the cable along the length of the various waterways.

Based on the sediment data collected during the spring 2010 Marine Route Survey,[67] it is not anticipated that a backfill plow would be needed. As the cables would be simultaneously laid

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[66] Attachment O: Best Management Practices, Champlain Hudson Power Express Inc., Supplement to U.S. Army Corps of Engineers Application, No. 2009-1089-EHA (Feb. 10, 2012) ("CHP Supplemental Application"), http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20O%2020120229.pdf.

[67] *See* Attachment E: Marine Route Survey Summary Report, Champlain Hudson Power Express Inc., U.S. Army Corps of Engineers Application, No. 2009-1089-EHA (Dec. 6, 2010),

and buried, the majority of displaced sediments would refill the trench. In addition, due to the natural dynamic processes in the lakes, rivers and estuaries, sediments would be naturally deposited within the trench. Post-installation bathymetric and sediment surveys would be conducted to monitor benthic habitats and sediment conditions.

2.2.1.1 Jet Plow/Water Jetting

The proposed method for laying and burial of the majority of the underwater cable is the jet plow/water jetting embedment process. These methods involve the use of a positioned cable vessel and a hydraulically powered water jetting device that simultaneously lays and embeds the cables in one continuous trench. At this time, the primary proposed installation vessel would be dynamically positioned, using thrusters and the vessel propulsion system. Deeper draft vessels equipped with dynamic positioning thrusters are proposed for deeper water locations. Dynamically positioned cable installation vessels do not contact or impact the bottom. However, there may be limited circumstances such as in relatively shallow water depths (typically less than 15 feet) where shallow draft vessels/barges using anchors for positioning may be used for installation. An anchor-positioned vessel would propel itself along the Project route with forward winches while letting out on aft winches with other lateral anchors holding the side-to-side alignment during the installation. In the event that an anchor-positioned vessel is needed, it is assumed that a 4-to-8 point anchor mooring system would be used in this process and requires an anchor-handling tug to move anchors while the installation and burial proceeds uninterrupted on a 24-hour basis.

The jet plow/water jetting embedment methods for underwater cable installations are considered to be the most effective and least environmentally damaging when compared to traditional mechanical dredging and trenching operations.[68] This method of laying and burying the cables simultaneously ensures the placement of the underwater cable system at the target burial depth with minimum bottom disturbance, with much of the fluidized sediment settling back into the trench. For these reasons, it is the installation methodology that appears to be preferred by state

http://www.chpexpress.com/docs/regulatory/USACE/CHPE_USACE_Application_E.pdf. Sediment data can be found on pages 20 to 27 of this report.

[68] Bureau of Ocean Energy Management, *Cape Wind Final Environmental Impact Statement* at 2-11 (Jan. 2009), http://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/Studies/Cape%20Wind%20Energy%20Project%20FEIS.pdf.

and federal regulatory agencies based on review of past underwater cable projects[69] and the Settlement Parties concluded that "no permanent or long-term impacts to water quality from cable installation are expected."[70]

Jet Plow/water jetting equipment uses pressurized water (taken from ambient waterbodies) from water pump systems onboard the cable vessel to fluidize sediment. The water jetting device is typically fitted with hydraulic pressure nozzles located down the length of "swords" that are inserted into the sediment on either side of the cable and which create a direct downward and backward "swept flow" force inside the trench. This provides a down and back flow of re-suspended sediments within the trench, thereby "fluidizing" the *in situ* sediment column as the equipment progresses along the cable route such that the underwater cable settles into the trench under its own weight to the planned depth of burial. The water jetting device's hydrodynamic forces do not work to produce an upward movement of sediment into the water column, since the objective of this method is to maximize settling of re-suspended sediments within the trench to bury or "embed" the cable system. The pre-determined deployment depth of the jetting swords controls the cable burial depth using adjustable hydraulics on the water jetting device.

The cable system location and burial depth would be recorded during installation for use in the preparation of as-built location plans. The water jetting device is equipped with horizontal and vertical positioning equipment that records the laying and burial conditions, position, and burial depth. This information is monitored continually on the installation vessel. This information

[69] *See, e.g.*, Order Granting Certificate of Environmental Compatibility and Public Need, *Application of Hudson Transmission Partners, LLC for a Certificate of Environmental Compatibility and Public Need for a 345 Kilovolt Submarine/Underground Electric Transmission Line Between Manhattan and New Jersey*, Case No. 08-T-0034 (N.Y. P.S.C. Sept. 15, 2010), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={CAFAD145-3C87-4E33-ACDF-45D87B7A76C6}; Order Adopting the Terms of a Joint Proposal and Granting Certificate of Environmental Compatibility and Public Need, With Conditions and Clean Water Act §401 Water Quality Certification, *Application of Bayonne Energy Center, LLC for a Certificate of Environmental Compatibility and Public Need for the Construction of the New York State Portion (Kings County) of a 6.6 Mile, 345 kV AC, 3 Phase Circuit Submarine Electric Transmission Facility Pursuant to Article VII of the PSL*, Case No. 08-T-1245 (N.Y. P.S.C. Nov. 12, 2009), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={8BF803F7-E587-439E-AB32-83C01BB41401}.

[70] Joint Proposal at 21, *Application of Champlain Hudson Power Express, Inc. and CHPE Properties, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the Public Service Law for the Construction, Operation and Maintenance of a High-Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C5F63E41-5ED5-46A2-99A5-F1C5FC522D36}.

would be forwarded to appropriate agencies and organizations as required for inclusion on future navigation charts.

Burial can be performed by either a towed or self-propelled burial machine. In this instance, the self-propelled water jetting device moves forward by the reaction of the backward thrust of the hydraulic jetting power that is fluidizing the soil and keeping the created trench open for the cable to sink into. The forward rate of progress is regulated by the varying types of sediment and the water pressure applied through the jets.

A skid/pontoon-mounted jet plow/water jetting device or wheeled, frame-mounted water jetting device, deployed and operated in conjunction with the cable-laying vessel, is proposed for the underwater installation operations. For burial, the cable vessel is used as the platform to operate the water burial device at a safe distance as the laying/burial operation progresses. The cable system is deployed from the vessel to the funnel of the water jetting device. The water jetting swords are lowered onto the bottom, pump systems are initiated, and the jet trencher progresses along the cable route with the simultaneous lay and burial operation. The pontoons can be made buoyant to serve different installation needs.

Temporarily resuspended in-situ sediments are largely contained within the limits of the trench wall, although a small percentage of the re-suspended sediments are transported outside of the trench. Any resuspended sediments that leave the trench generally tend to settle out quickly in areas immediately flanking the trench. However, the amount of sediment transported out of the trench, the residence time of sediment suspension, and the distance suspended sediments are transported are dependent upon multiple factors, including sediment grain-size, composition, hydrodynamic forces, trench depth, and the hydraulic jetting pressures imposed on the sediment column necessary to achieve desired burial depths. Water quality modeling specific to the conditions in Lake Champlain and the Hudson, Harlem, and East Rivers is provided in Attachment M of the Supplemental Application.[71]

As the jetting device progresses along the route, the water pressure at the device nozzles would be adjusted as sediment types or densities change to achieve the required water quality

[71] Attachment M: Water Quality Modeling, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20M%2020120229.pdf.

standards.[72] A test trench may be preformed to ensure proper depth of burial. In the unlikely event that the minimum burial depth is not met during water jetting embedment, additional passes with the water jetting device or the use of diver-assisted water jet probes would be utilized to achieve the required installation target depth.

Jet water pressure varies with different bottom sediment materials, with typical pressures including:

Material	Estimated Jet Water Pressure
Sand and Silt	400-600 psi
Soft Clay	600-800 psi
Hard Clay	800-1,000 psi

Some types of water jetting devices also employ an ejector system to assist in the trenching operation in certain sediment types that do not fluidize well. The ejector system employs an airlift system to create a suction force within the ejector pipes that entrains sediment and releases it at the end of the ejector pipes to either side of the water jetting device. This addition to the water jetting methodology would only be employed to assist in burial if monitoring of the installation reveals difficulty in obtaining the required burial depth due to lack of adequate fluidization of sediments.

In addition to continuous closed circuit video monitoring, divers would make regularly scheduled dives in order to monitor the cable installation operation and inspect the condition of the cable trench and jet sled. Occasionally, the jet sled may require maintenance during cable burial operations due to nozzle wear or loss. During these maintenance periods, the jet leg roller load cells, suction piping, and hose connections are checked, and hydraulic fluid is replenished as required. As necessary, a Spill Prevention, Countermeasure, and Control ("SPCC") Plan or its

[72] New York State Public Service Commission 401 Water Quality Certification, Application of Champlain Hudson Power Express, Inc. and CHPE Properties, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the Public Service Law for the Construction, Operation and Maintenance of a High-Voltage Direct Current Circuit from the Canadian Border to New York City, Case No. 10-T-0139 (N.Y. P.S.C. Jan. 1, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={E992FA4C-1906-44EB-9B92-8567F410F660}

equivalent would be developed pursuant to federal and/or state regulations and would be followed during construction equipment maintenance and repair activities.

In certain small areas, typically transition areas between shoreline HDDs and underwater cable trenches, a diver-operated hand jet or Remotely-Operated Vehicle ("ROV") may be used to bury the cable. In this process, a support vessel provides pressurized water through a hose with a nozzle that is maneuvered by a diver or ROV. The jet of water works the sediment under the cable to create a trench into which the cable settles. This method would be employed for short distances only, typically less than one hundred (100) feet.

2.2.1.2 Plowing

For the plowing technique, a trench is made for the cables by towing a plow, and the cables are simultaneously fed into the trench as it is created by the plow. The plow is not self-propelled, but is instead tethered to a surface support vessel, which supplies the pulling power. Usually, the bottom sediment is allowed to naturally backfill the trench over the cable by slumping of the trench walls, wave action, or bed load transport of sediments.

Shear plows can potentially reduce sediment disturbance as they do not fluidize the sediment and generally require less force to create a narrower trench in the riverbed or lakebed to bury underwater cables than other types of cable installation equipment. Some issues that affect the suitability of shear plows for underwater cable installation and burial are sediment cohesiveness and burial depth. Use of the shear plow is typically limited to sediments that have shear strengths less than 20 Kilopascals ("kPa"). Also, shear plows are typically used with shallower burial depths (less than four (4) feet), which generally reduces the overall amount (i.e., volume) of sediment disturbed during installation.

2.2.1.3 Conventional Dredging

While it is intended that the use of conventional underwater trench excavation methods would be avoided or minimized, there would be some locations where conventional dredging would be used to meet required installation depths, or to install cofferdams associated with shoreline HDD installations. These circumstances may include instances where the cable route crosses an existing Federal navigation channel. In these locations, either a clam-shell dredge or a barge-mounted excavator would be used to pre-dredge a trench into which the cable would be laid. Dredge material would be brought to the surface to be placed on barges for approved disposal and would not be used for backfill. This work would most likely occur from spud barges, although anchor-moored or jack-up barges may also be employed, depending upon equipment availability and site conditions. A typical spud dredge barge would be equipped with two or more legs, with one spud being a walk-away spud. The barge would have a crane, typically outfitted with a 6 to 9 cubic yard clamshell bucket. Alternatively, the barge may have a track hoe excavator working off the deck of the barge, possibly with an extended boom for areas of deeper water. Once a segment of trench is excavated, cable would be laid, and the clam-shell dredge or excavator would place clean backfill sediment back into the trench.

2.2.1.4 Infrastructure Crossing

A preliminary review of the underwater cable route identified areas where cable installation activities would occur in the vicinity of or cross existing infrastructure (e.g., electric cables, gas pipelines, ferry cables, etc.). There are several different installation techniques that can be utilized when crossing existing infrastructure based on the type, burial depth, and existing protective coverings of the infrastructure. The design of utility crossings would follow industry standards.

When crossing utilities that are owned by a third party, the design of the protection at existing cables and pipelines would require formal consultations with the owners and/or operators of this collocated infrastructure. Detailed discussions on coordination, design and installation methodologies and safety issues would be conducted with the owners of these infrastructures, as specified in the Article VII Certificate Conditions.[73] The detailed designs for each crossing would be provided as part of the Environmental Management and Construction Plan (“EM&CP”), which will be filed with the NYS Public Service Commission for approval.

[73] Order Granting Certificate of Environmental Compatibility and Public Need at 86, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Apr. 18, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A71423C8-B489-4996-9C5A-016C9F334FFC}.

Crossing of Fiber Optic and Telecommunication Cables

Wherever possible, the HVDC cables would cross existing fiber optic and telecommunication cables at right angles, extending approximately one hundred fifty (150) to three hundred (300) feet in length. The method of embedding and protection would be determined by the burial depth of the existing cables. The details of these crossings would be coordinated with the owners and/or operators of the existing facilities as well as the USACE.

Crossing of Gas or Oil Pipelines and Power Cables

Where the cables cross existing pipelines or power cables, the cables would cross the existing infrastructure as close as possible to right-angles, extending up to three hundred (300) feet on each side of the crossing point. The method of cable embedding and protection would be determined by the burial depth of the existing infrastructure. The details of these crossings would be coordinated with the owners and/or operators of the existing facilities as well as the USACE.

Crossings of Other Infrastructure Types

A "chain-ferry" operates across the proposed underwater cable route within Lake Champlain. The chain ferry utilizes ferry cables laid on the bottom of Lake Champlain. The normal penetration of the ferry cables into the lakebed would be assessed, and if deemed necessary, additional protection in the form of deeper cable burial at the crossing point or the use of an outer protection sleeve to guard against abrasion would be installed. The ferry cables would be temporarily removed to facilitate the installation of the underwater cables. The ferry cables would then be replaced over the top of the transmission cables. The ferry operator reports that its cables are replaced every four years; therefore, there may be an opportunity to coordinate the HVDC cable installation schedule with the ferry cable replacement schedule. Detailed coordination and discussions with the ferry operator on methodologies and scheduling will occur.

The underwater HVDC cables would also be routed beneath overhead infrastructures, including road bridges and electrical transmission lines. These would not be of concern for the cable systems once in operation, but the superstructure on the cable-laying vessels would be designed to take account of any height restrictions

2.2.2 Terrestrial Installation Methods

For the overland portions of the cable route, the cables will be buried via excavated trenches or trenchless technology (HDD or Jack and Bore ("J&B")) methods. The majority of the overland portion of the cable route is located within or immediately adjacent to the existing CP, CSX, and NYS Routes 22 and 9W ROWs. Standard and typical diagrams, which include details representing various methods and equipment to be used during Project construction, were provided as Attachment H to Applicants' Supplemental Application.[74]

A minimum separation distance is required from the rails to the cables by each railroad; CP requires a minimum separation of ten (10) feet from the centerline of the outermost track to the cable trench, and CSX requires a minimum separation of twenty-five (25) feet from the centerline of the outermost track. The typical and preferred layout is to have the bipole (two cables) installed on one (same) side of the railroad tracks. With this layout, the limits of anticipated construction activity extend forty (40) feet beyond the required minimum setback of the railroads. This 40-foot area would include the area needed for excavation of the trench (approximately four (4) feet wide), installation of erosion and sediment control measures, and stockpiling of excavated material.[75] There are areas that would require different configurations and pose additional engineering challenges, such as steep slopes, environmentally sensitive areas, and existing structures. These areas would be identified and site-specific engineering solutions would be developed as part of the Environmental Management and Construction Plan ("EM&CP"). The EM&CP, which represents the final design phase of the Project, will be filed with the NYS Public Service Commission for approval. A minimum construction corridor of 25 feet would be required along the edge of Routes 22 and 9W for installation of the two HVDC cables, although a wider width may be employed to allow for more efficient construction and quicker completion of the work in these areas.[76]

Each of the two (2) overland cables would require a number of joints and a temporary flat pad would be installed underneath each joint for splicing activities.[77] The number of joints would be

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74 Attachment H – Revised Attachment H: Cross Section Diagrams, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20H%2020120229.pdf.

75 *Id.* at 13, 16.

76 *Id.* at 19.

77 *Id.* at 12.

kept to a minimum and would be determined either by the maximum length of cable that can be transported in a single piece or by the maximum length of cable that can be pulled, whichever is less, as well as the number of HDD and J&B locations. For land installation, the expected maximum segment lengths between splices would be approximately one-half mile. The jointing for both cables would be performed in a single jointing pit, with typical pit dimensions being 30 feet long, 12 feet wide, and four (4) feet deep.[78] Subsequent to completion of cable jointing, the jointing pit would be backfilled primarily with native soils to the original contours/conditions. As further described in Section 5 and shown in the diagrams included in Attachment H of the Supplemental Application,[79] thermal resistivity sand and a protective covering may be used around the immediate vicinity of the buried cables.

The following sections identify the general construction sequence for routine cable installation along the overland portion of the cable route:

- Initial clearing operations and storm water and erosion control installation;
- Trench excavation;
- Cable installation;
- Backfilling; and
- Restoration and revegetation.

2.2.2.1 Initial Clearing Operations & Stormwater and Erosion Controls

Initial clearing operations would include the removal of vegetation within the cable trench area and within any temporary additional construction workspace (e.g., HDD workspace, cable joint pits, access roads and staging areas) either by mechanical or hand cutting. Vegetation would be cut at ground level, leaving existing root systems intact except for the immediate trench area, and the aboveground vegetation removed for chipping or disposal. Tree stumps and rootstock would be left undisturbed in the temporary workspace wherever possible to encourage natural revegetation. Brush and tree limbs would be chipped and spread in approved locations or hauled

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78 *Id.*
79 *Id.* at 11.

off-site for disposal. Timber would be removed from the ROW for salvage or to approved locations.

The cleared width within the ROW and temporary construction workspace would be kept to the minimum that would allow for spoil storage, staging, assembly of materials, construction vehicle passage, and all other activities required to safely install the cables and associated equipment.

Prior to or closely following initial disturbance of the soil, erosion controls would be properly installed as required. Representational drawings of erosion control methods are included in Attachment H of the Supplemental Application (see "Silt Fence," Figure 176764-UM-21[80] and "Straw Bale Dike," Figure 176764-UM-22).[81] Design of the stormwater and erosion controls would be completed as part of the development of the EM&CP and would include measures such as silt fences, hay bales, temporary mulching, etc.

2.2.2.2 Trench Excavation

The typical cable trench along the overland portion of the route would be four (4) feet wide at the bottom and approximately four (4) to five (5) feet deep to allow for the proper depth required for the burial of the cables (see "Typical Trench Cross Section," Figure 176764-UM-08).[82] The cables would generally be installed side-by-side; although in some situations there may be up to three (3) feet of spacing between the cables within the four-foot-wide trench.

In normal terrain where the soil conditions range from organic loam, sand, gravel or other unconsolidated material and sufficient clearances exist, traditional excavation equipment would be used. The mixing of topsoil with subsoil would be minimized by using topsoil segregation construction methods in agricultural lands and wetlands (except when standing water or saturated soils are present). Topsoil would be stripped from the trench and placed on one side of the trench. The subsoil stockpile area (trench plus spoil side method) would be placed on the other side of the trench or otherwise segregated. Representative drawings of stockpile placement and management are included in Attachment H of the Supplemental Application (see "ROW Top

[80] Attachment H – Revised Attachment H: Cross Section Diagrams at 32, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20H%2020120229.pdf.
[81] *Id.* at 33.
[82] *Id.* at 11.

Soil Segregation Techniques").[83] Should it become necessary to remove water from the trench, it would be pumped to a stable, vegetated upland area (where practical) or filtered through a filter bag or siltation barrier.

Based on review of soils and geologic maps of the routing area, shallow bedrock has the potential to be encountered along some portions of the overland segment of the Project route. The technique selected to remove bedrock encountered during cable installation activities is dependent on relative hardness, fracture susceptibility, and expected volume of the material. Techniques include the following:

- Conventional excavation with a backhoe;
- Hammering with a pointed backhoe attachment followed by backhoe excavation;
- Rock saw/trencher; or
- Blasting followed by backhoe excavation.

All blasting activity would be performed by licensed professionals according to strict guidelines designed to control energy release. Proper safeguards will be taken to protect personnel and property in the area. Charges would be kept to the minimum required to break up the rock. Where appropriate, mats made of heavy steel mesh or other comparable material or trench spoil would be utilized to prevent the scattering of rock and debris. These activities would strictly adhere to all industry standards that apply to controlled blasting and blast vibration limits with regard to structures and underground utilities. Blasting in the vicinity of nearby utilities and railroads would be coordinated with the owner, as necessary. Blasted rock would be hauled off-site and disposed of in an appropriate manner. Details of blasting controls and safety procedures would be specified in the EM&CP filing.

2.2.2.3 Cable Installation

For the overland sections of the Project route, the two (2) power cables would typically be laid side-by-side in a trench approximately four (4) feet wide and four (4) to five (5) feet deep.[84] Once a pre-selected length of trench is excavated to the necessary depth and the base prepared,

[83] *Id.* at 23.
[84] *Id.* at 11.

rollers would be placed in the bottom of the trench (or along the upper rim of the excavation) to facilitate pulling the cable into the trench. A cable attached to a winch at the opposite end of the trench from the cable spool would be attached to the cable and reeled in, pulling the cable down the length of the trench on the rollers. Depending upon the soil conditions on the bottom of the trench, the bottom of the trench may require padding fill (i.e., clean sand) before pulling the cable into the trench. Once the cable segment is pulled down the length of the trench, it is moved off the rollers and the rollers are re-used at a different location. Given the need to schedule work with the railroads and the overall construction schedule, it is anticipated that cable installation activities would occur twenty four (24) hours per day/seven (7) days per week in most areas, with nighttime shutdowns occurring in select sensitive receptor areas.[85]

During cable installation along railroad corridors, it is anticipated that the railroads would be used to transport heavy equipment such as cable drums to centralized stockpiling areas. Final transport of the cable spools, construction equipment, and supplies would be transported on roadways and so it would be necessary for vehicles to arrive and depart from work areas via local roadways. Workers may arrive at contractor yards or the right-of-way in pickup trucks, supplies may be delivered directly to the site, and equipment such as dewatering pumps, generators, or excavators may also need to access the site via local roads. Along the NYS Routes 22 and 9W corridors, all equipment and supplies would be delivered via the roadways. Within New York City, equipment and supplies would be delivered by roadway, rail, or water transport. Procedures for traffic management would be included in the EM&CP and may include items such as detours, police details, and signage.

2.2.2.4 Backfilling

Subsequent to laying the cables, the trench would be backfilled with a layer of soil exhibiting the required low thermal resistivity properties needed to surround the cables, which may include non-native material if the native materials do not exhibit the required low thermal resistivity properties. Because the operation of the cables results in the generation of heat, and heat reduces

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[85] Environmental Impacts Associated with Routing Proposed in Joint Proposal at 5, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={4CC6BFC1-1945-401B-8EF9-D67CB3C263FB}.

the electrical conductivity of the cables, it is important to backfill with soil having a low thermal resistivity. The soil's ability to conduct heat to the atmosphere would limit the temperature build-up in the soil around the cable and prevent heat from one cable affecting the nearby cable. There would be a protective concrete or high density polyethylene ("HDPE") cover plate directly above the low thermal resistive backfill material, which is anticipated to be one to two feet above the bottom of the trench. A safety marker tape would be placed approximately two (2) feet below the ground surface and directly above the cables. The top of the trench may be slightly crowned to compensate for settling. Excess clean spoil material from trench excavation would be disposed of by spoiling on site where approved, or properly disposed of off site at an approved location. Contaminated spoils would be disposed of as required by federal and/or state regulation.

2.2.2.5 Restoration and Re-vegetation

Cleanup crews would complete the restoration and revegetation of the ROW and temporary construction workspace. In conjunction with backfilling operations, any remnant woody material and construction debris would be removed from the rights-of-way or as allowed by state and federal regulators. The construction area would be seeded with an approved seed mix for the temporary work area and allowed to further revegetate naturally. Paved areas would be restored to match existing conditions in accordance with NYSDOT requirements.

2.2.2.6 Wetland Crossings

As part of the Joint Proposal, the Applicants agreed to a condition which required that they "minimize disruption to regulated wetlands during the construction, operation, and maintenance activities of the Facility."[86] This condition further requires that any activities that may affect regulated wetlands shall be designed and controlled to minimize adverse impacts, giving due consideration to the environmental values and functions of the regulated wetlands and the adjacent area. The Applicants are also required "to the maximum extent practicable, avoid direct

[86] Order Granting Certificate of Environmental Compatibility and Public Need at 256, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Apr. 18, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A71423C8-B489-4996-9C5A-016C9F334FFC}.

impacts to regulated wetlands and construct access roads outside regulated wetlands and adjacent areas."[87] Pursuant to another condition, the Applicants will establish and implement a program to monitor the success of wetland and stream restoration upon completion of construction and restoration activities.[88]

Routing construction equipment working along the overland portions of the route will operate primarily from the railroad bed, railroad access roads, embankments, along the road shoulder, or other upland areas. If any construction equipment needs to operate within wetlands that are likely to be impacted by soil compaction or rutting, based on conditions at the time of construction, the Applicants will use equipment mats or low-ground-pressure tracked vehicles to avoid and/or minimize impacts to wetland soils.[89] Clearing of existing vegetation within wetlands and/or in or near waterbodies will be limited to the area necessary to allow for completion of construction activities and to allow for reasonable access for long term maintenance.[90]

To avoid increases in erosion and sedimentation into waterbodies and wetlands from land disturbance in nearby construction areas, the Applicants will install temporary and permanent erosion control measures along the construction corridor and adjacent to soil stockpiles, as needed, and will manage construction stormwater in accordance with a Storm Water Pollution Prevention Plan ("SWPPP") for the Project.[91] If dewatering is required within the excavated trench, water will be discharged to a well-vegetated upland area, a properly constructed dewatering structure, or thorough a filter bag.[92]

In addition to the requirements of the Certificate Conditions, the Applicants have also agreed to implement Best Management Practices ("BMPs"), which establish basic procedures to be followed during construction, operation and maintenance of the Project[93]. Topics covered in the BMPS include stormwater pollution prevention, protection of streams and wetlands, and the

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87 *Id.*
88 *Id.* at 264.
89 *Id.*
90 *Id.* at 260.
91 *Id.* at 262.
92 *Id.*
93 *Id.* at 368.

cleanup and restoration of disturbed lands. The complete document was provided to the USACE in Appendix O of the Supplemental Application.[94]

2.2.2.7 Overland Infrastructure/Waterway Crossings

The Project route would result in multiple river, stream, road, and other crossings by the cables and construction equipment. Cable installation options for the infrastructure and/or waterway crossings include trenching, HDD (see Section 2.2.2 below), or attachment to existing structures such as bridges or railroad trestles. The specific design for each crossing would address the conditions at the particular location, owner/operator design requirements and the preferences of the Engineering, Procurement and Construction ("EPC") contractor, or the Conditions of the Article VII Certificate of Environmental Compatibility and Public Need ("Certificate") and would be detailed in EM&CP.

2.2.3 Horizontal Directional Drilling Installation Methods

HDD is a common technique used to install transmission cable projects to avoid or minimize environmental impacts as well as to address engineering or infrastructure constraints associated with traditional trench installation (e.g., major highway crossings). HDD is a trenchless method for installing pipelines and conduit beneath other facilities or resources of concern, including habitats, archeological sites, waterbodies, or existing infrastructure. HDD is a multi-stage process[95] composed of the five steps listed below:

- Pre-site planning;
- Drilling a pilot hole;
- Expanding the pilot hole by reaming if necessary;
- Pull back of drill string with simultaneous installation of conduit; and
- Cable pull through the conduit.

[94] Attachment O: Best Management Practices, Champlain Hudson Power Express Inc., Supplement to U.S. Army Corps of Engineers Application, No. 2009-1089-EHA (Feb. 10, 2012) ("CHP Supplemental Application"), http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20O%2020120229.pdf.

[95] Attachment H – Revised Attachment H: Cross Section Diagrams at 26, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20H%2020120229.pdf.

For each proposed HDD location, two separate drills would be required, one for each cable. Each cable would be installed within a 10-inch-diameter, or larger, HDPE casing. To maintain appropriate separation between the two cables, a minimum of six (6) feet would be required between each drill path. HDD would be employed in a number of situations during construction, including both overland sections of the Project route and at shoreline land/water transition locations. HDD locations along the Project route would have both the entry and exit holes staged on land. The HDD locations are shown on the Terrestrial Route Plan View Map provided in Attachment E of the Supplemental Application.[96] All HDD locations would be engineered on a site-specific basis during development of the final design phase for inclusion in the EM&CP.

At the seven (7) locations along the Project route where the cables transition from water to land (and vice versa), installation would be accomplished through the use of HDD methodology in order to avoid or minimize disturbance to the banks and near-shore areas. The HDD would be staged at the onshore landfall area and would involve the drilling of the boreholes from land toward the offshore entry/exit point. Two (2) conduits (one for each cable) would then be installed through the length of the boreholes and the transmission cable would be pulled through the conduit from the submarine end toward the land. A transition manhole or transmission cable-splicing vault would be installed using conventional excavation equipment (backhoe) at the onshore transition point where the underwater and overland transmission cables would be connected (see "Typical Terrestrial Transition" Figure 176764-UM-41[97] and "Typical Splice Vault" Figure 176674-UM-35[98] in Attachment H of the Supplemental Application).

A drill rig would be set up onshore behind a bentonite pit, where a drill pipe with a pilot-hole drill bit would be set in place to begin the horizontal drilling. Drilling fluid would then be pumped into the hole as the cutting head is advanced into the soil. The HDD construction process would involve the use of drilling fluid in order to transport drill cuttings to the surface for recycling, aid in stabilization of the in situ soil/sediment to keep the hole open, and to provide lubrication for the HDD drill string and down-hole assemblies. This drilling fluid is composed of a carrier fluid and solids. The selected carrier fluid for this drilled crossing would consist of

96 Attachment E – Revised Attachment D: Plan View Maps – Overland Route, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20E%2020120229.pdf.

97 Attachment H – Revised Attachment H: Cross Section Diagrams at 10.

98 *Id.* at 12.

water (approximately 95 percent) and inorganic bentonite clay (approximately 5 percent). The bentonite clay is a naturally occurring hydrated aluminosilicate composed of sodium, calcium, magnesium, and iron that is environmentally benign.

After each section of drilling, an additional length of drill pipe is added until the final drill length is achieved. To avoid or minimize the release of the bentonite drilling fluid into the water, freshwater may be used as a drilling fluid to the extent practicable for the final section of drilling, just prior to the drill bit emerging in the pre-excavated pit. This would be accomplished by pumping the drilling fluid out of the drill stem and replacing it with freshwater as the drill bit nears the pre-excavated pit. When the drill bit emerges in the pre-excavated pit, the bit is replaced with a hole-opening tool called a reamer to widen the borehole. It is anticipated that a single reaming pass would be necessary to allow installation of the conduit. Once the desired hole diameter is achieved, a pulling head is attached to the end of the drill pipe and the drill pipe is used to pull back the HDPE conduit pipe into the bored hole. As with the pilot hole drilling process, freshwater would be utilized, if practicable, as the reaming tool nears the pre-excavated pit. Once the HDPE conduits are in place, the underwater cables would be pulled through the conduit, which would be permanently sealed at each end to complete the installation process.

A temporary cofferdam would be constructed at the offshore entry/exit hole location for HDD cable installation at major land-water transitions. The cofferdam would be rectangular in shape and approximately sixteen (16) feet by thirty (30) feet. The cofferdam would generally be constructed using steel sheet piles driven from a barge-mounted crane. The cofferdam is intended to help reduce turbidity associated with the dredging and HDD operations as well as to help maintain the exit pit (see “Typical Terrestrial Transition, Figure 176764-UM-41,[99] in Attachment H of the Supplemental Application). The area inside the cofferdam would be dredged to create an entry/exit pit typically six (6) feet deep. The dredged material would be temporarily placed on a barge for storage and ultimate disposal at an upland permitted facility. Upon completion, the exit pit would be backfilled with clean sand to restore the bottom to preconstruction grade.

After the HDD conduit is installed, the ends of the conduit would be sealed with plastic caps until the subsequent installation of the HVDC transmission cables. After the cables have been

[99] *Id.* at 10.

installed, it is anticipated that the excess annular space with the HDD installed conduit and the installed cable would be backfilled with a thermal grout to help dissipate excess heat generated by the cable. The requirements for the backfill material would be determined in the final design, which would be included in the EM&CP.

The drilling fluid system would recycle drilling fluids (made up of a combination of water, bentonite, and the material being excavated) and contain and process drilling returns for offsite disposal. Although considered environmentally benign, the discharge or release of drilling fluids to the water would be minimized by implementing appropriate techniques and controls to be specified in a drilling fluid overburden breakout monitoring and response plan. It is likely that some residual volume of drilling fluid would be released into the pre-excavated exit pit when the pilot hole and reaming cutting heads come to the surface. The depth of the pit and the temporary cofferdam are expected to contain much of the drilling fluid. The drilling fluid will be removed from the cofferdam prior to removal of the cofferdam.

It is expected that the HDD conduit systems would be drilled through sediment overburden at the landfall location. However, it is anticipated that drilling depths in the overburden would be sufficiently deep to avoid pressure-induced breakout of drilling fluid through the sediments along most of the length of the drill path. Nevertheless, a visual and operational monitoring program will be implemented during the HDD operation to detect a fluid loss as part of the Best Management Practices program.[100] This monitoring includes:

- Visual monitoring of surface waters along the drill path and in the vicinity of the exit hole on a daily basis to observe potential drilling fluid breakout points.
- Drilling fluid volume monitoring by technicians throughout the drilling and reaming operations for each HDD conduit system.
- Implementation of a fluid loss response plan and protocol by the drill operator in the event that a fluid loss occurs. The response plan could include 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.

[100] Attachment O: Best Management Practices at 8-7, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20O%2020120229.pdf.

Section 3
Alternatives Analysis Methodology

3.1 USACE Requirements for LEDPA Analysis

Projects subject to the individual permitting process by the USACE under the Clean Water Act ("CWA") must comply with Section 404(b)(1) guidelines (40 CFR Part 230) for discharge of dredge and/or fill material into waters of the U.S. The Guidelines generally require applicants to demonstrate there is no "practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem" and which "does not have other significant adverse environmental consequences" (40 C.F.R. § 230.10(a)). The Guidelines consider an alternative practicable "if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (40 C.F.R. § 230.10(a)(2)).

The "404(b)(1) Alternatives Analysis" assesses alternatives from which the "least environmentally damaging practicable alternative" is determined. The list of alternatives from which the LEDPA is selected is created after the overall purpose of the project is identified, as only those alternatives which meet the project's overall purpose are considered. The geographic scope of the alternatives considered are determined by the project purpose and would include locations typically considered in similar projects. The level of review required under a LEDPA analysis depends on the nature and severity of the project's impact on the environment.[101] Many of this Project's impacts have been already eliminated or mitigated as a result of the New York State Article VII permitting process.[102]

Once the alternatives have been identified, the practicability of each alternative is evaluated using specific criteria. Any alternative which does not meet the screening criteria is eliminated from further consideration.

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[101] *See* U.S. Envtl. Prot. Agency & U.S. Army Corps of Engineers, *Memorandum: Appropriate Level of Analysis Required for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternatives Requirements* (Aug. 23, 1993) ("Section 404(b)(1) Compliance Memorandum"), http://water.epa.gov/lawsregs/guidance/wetlands/flexible.cfm.

[102] Order Granting Certificate of Environmental Compatibility and Public Need at 2, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case 10-T-0139 (N.Y. P.S.C. Apr. 18, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A71423C8-B489-4996-9C5A-016C9F334FFC}.

3.2 Alternatives Analysis Evaluation Criteria

The purpose and need for the proposed Project as described in Section 1, as well as the practicability criteria laid out in 40 C.F.R. 230.10(a)(2), were formulated as criteria against which each alternative would be evaluated, as shown in Table 3-1. Each individual criterion is described below.

TABLE 3-1
ALTERNATIVE ANALYSIS CRITERIA

Evaluation Category		Basis for Criterion
Purpose	Must meet Project purpose	An alternative must achieve Project purpose.
Existing Technology	Must use proven technology.	An alternative's technological methods for transmission must be tested and proven to minimize the risk of failing.
Logistics	Must not require extraordinary technical effort to overcome site conditions or pose difficult-to-overcome constructability issues.	Must not require complex or significant additional means to overcome difficult access or site conditions or require engineering solutions that may not accommodate long-term performance.
	Must be located outside areas having incompatible land use plans or existing incompatible land uses that could pose a risk to the transmission system.	Displacing or adversely affecting existing or planned development is likely to encounter significant regulatory hurdles, as well as political and public opposition.
	Must be located entirely within the State of New York	The proposed Project is delivering power to the New York Control Area; as the benefits of this power will accrue to New York State, regulatory approvals sought in other regions (i.e. New England) would likely face significant regulatory hurdles, as well as public and political opposition.
Cost	Must not be unreasonably expensive to the Applicant, based on costs of similar merchant or participant-funded transmission projects.	The cost of each alternative must be reasonable in the terms of not being substantially higher that the costs of similar merchant or participant-funded projects. As a *merchant* transmission line, Applicants are without captive wholesale customers and guaranteed rate recovery.

3.2.1 Evaluation of Cost

An alternative is not practicable when it is unreasonably expensive to the applicant.[103] The evaluation of cost is not based on the financial standing of the applicant, but rather on what are reasonable costs for the proposed Project. According to the USACE and EPA, "[t]he determination of what constitutes an unreasonable expense should generally consider whether the projected cost is substantially greater than the costs normally associated with the particular type of project".[104]

Unlike traditional utilities – which recover their cost-of-service from captive wholesale customers – the Applicants' Project is a merchant transmission line that assumes the full risk of market development; the Project must therefore be competitively-priced in order to attract transmission customers and provide a rate of return sufficient to retain and attract equity investors and secure debt financing. [105]. As is true for similarly-situated merchant developers, if the cost of the transmission line becomes unreasonably expensive then the proposed transmission line is not likely to be attractive to power generators because the transmission service is cost-prohibitive. CHPE has already absorbed significant cost increases associated with incorporating various alternatives routes, even relatively small incremental additional costs may have a disproportionate impact on the Project. Therefore, in the context of this merchant Project, which has already incorporated a significant number of alternatives to date as a result of the state siting process, the cost of the alternative as compared to the overall Project cost must account for the significantly increased costs that have already been imposed on the Applicants to revise the Project route, and the impact that additional costs will have on the Applicants' ability to effect the Project purpose. As the USACE Regulatory Guidance acknowledges: "It is important to emphasize, however, that it is not a particular Applicants' financial standing that is the primary

[103] Preamble to Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 45 Fed. Reg. 85,336, 85,343 (Dec. 24, 1980) as referenced in U.S. Envtl. Prot. Agency & U.S. Army Corps of Engineers, *Memorandum: Appropriate Level of Analysis Required for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternatives Requirements* § 3.b. (Aug. 23, 1993) ("Section 404(b)(1) Compliance Memorandum"), http://water.epa.gov/lawsregs/guidance/wetlands/flexible.cfm.

[104] *See* U.S. Envtl. Prot. Agency & U.S. Army Corps of Engineers, *Memorandum: Appropriate Level of Analysis Required for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternatives Requirements* § 3.b. (Aug. 23, 1993) http://water.epa.gov/lawsregs/guidance/wetlands/flexible.cfm.

[105] See Allocation of Capacity on New Merchant Transmission Projects and New Cost-Based, Participant-Funded Transmission Projects; Property Rights to New Participant Funded Transmission, 142 FERC ¶ 61,038 at P 1 (2013) at http://www.ferc.gov/whats-new/comm-meet/2013/011713/E-2.pdf

consideration for determining practicability, but rather the characteristics of the project and what constitutes a reasonable expense for these projects that are most relevant to practicability determinations."

In order to determine the costs normally associated with a transmission project of this type, four recent representative projects were selected. They are described as follows:

Juan de Fuca Project: The Juan de Fuca Project will be an approximately 31-mile-long, 550-megawatt (MW) submarine HVDC cable that extends beneath the Strait of Juan de Fuca to connect View Royal, British Columbia, with Port Angeles in the State of Washington. The expected construction cost of this project is $750 million.[106]

Trans Bay Cable Project: The Trans Bay Cable Project is a 57-mile-long, 400-MW[107] submarine HVDC transmission line located in San Francisco Bay and the Carquinez Straits, extending from a terminus in the City of Pittsburg in Contra Costa County to a terminus in the City of San Francisco in the vicinity of Potrero Point. Its construction costs are estimated to be $505 million.[108]

Neptune Regional Transmission System: The Neptune Regional Transmission System is a 65-mile-long submarine HVDC electric transmission line that connects Sayreville, New Jersey, to Long Island, New York. Construction costs for this project were approximately $600 million.[109]

Northern Pass: The Northern Pass Transmission Project proposes to bring 1,200 MW of energy from Canada to the Northeast region through a primarily overhead transmission system

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106 Stephan Burckhardt, *US-Canadian HVDC Transmission*, CleanTechies Blog (Feb. 7, 2012), http://blog.cleantechies.com/2012/02/07/us-canadian-hvdc-transmission/.

107 TD World. *Trans Bay Cable to Build Undersea Link to San Francisco.* October 15, 2007. Accessed on-line on April 28, 2013 at: http://tdworld.com/underground-tampd/trans-bay-cable-build-undersea-link-san-francisco

108 Chuck Bunton, *Cable Laying Ops Begin on Trans Bay Cable Project*, Maritime Professional Blog (Oct. 8, 2009 11:16 AM EST), http://www.maritimeprofessional.com/Blogs/Subsea/October-2009/Cable-Laying-Ops-Begin-on-Trans-Bay-Cable-Project.aspx.

109 *Neptune Underwater HVDC Project Saves LIPA $20 Million*, Transmission & Distribution World (Oct. 25, 2007), http://tdworld.com/projects_in_progress/announcements/neptune-hvdc-lipa/.

comprised of approximately 140 miles of HVDC and 40 miles of AC cables.[110] Construction costs in 2010 were estimated to be $1.1 billion.[111]

Table 3-2 below shows the costs of the Project as proposed against the three primarily submarine cable installation projects and one primarily overland cable installation project. The selected metric, cost per MW, is appropriate as it has a direct bearing on the costs which must be charged to transmission customers (and the attendant ability of those customers to deliver power at a competitive rate).

TABLE 3-2
CONSTRUCTION COSTS PER MW FOR PROJECT AND COMPARISONS

	CHPE Project	Neptune	Port Angeles - Juan de Fuca	Transbay	Northern Pass
Overall Cost	$ 1,999,800,000	$ 600,000,000	$ 750,000,000	$ 505,000,000	$ 1,100,000,000
MW	1,000	660	550	400	1,200
Cost Per MW	$ 1,999,800	$ 909,091	$ 1,363,636	$ 1,262,500	$ 916,667

As shown in Table 3-2, the Project's cost per MW of power is already significantly higher (47%) than the next closest project, the Port Angeles – Juan de Fuca transmission system. The source of this cost differential is the overland sections of the route which have been added to the Project since its inception through consultation and the Article VII process.

3.2.2 Evaluation of Logistics

For the purposes of this analysis, logistical factors may include the following: engineering constraints, utility and other public infrastructure, topography and geology, conformance to federal and state laws, social feasibility, regulatory hurdles, public and political opposition, and other consequences to the applicant and the public. The ability to utilize roadways as potential alternatives is limited by Federal Highway Law,[112] New York Highway Law,[113] New York State

110 Northern Pass FERC Transmission Service Agreement at 51.(Dec. 13, 2010),.http://www.northernpass.us/assets/permits-and-approvals/FERCTransmissionServiceAgreementFiling.pdf

111 *Id.* at 2..

112 23 U.S. Code §§ 101 et seq. http://www.ecfr.gov/cgi-bin/text-idx?&c=ecfr&tpl=/ecfrbrowse/Title23/23tab_02.tpl

113 New York State Highway Law §§ 10 and 52. See http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+&QUERYDATA=@LLHAY+&LIST=LAW+&BROWSER=EXPLORER+&TOKEN=40947028+&TARGET=VIEW

Transportation Regulations,[114] and the Accommodation Plan for Longitudinal Use of Freeway ROW by Utilities issued by the NYSDOT.[115] The NYSDOT, which signed the Joint Proposal for Settlement, has indicated that it would highly restrict the longitudinal use of limited access highway ROW by utilities (see Appendix A).[116] In a letter sent during the NYRI Article VII proceeding,[117] the NYSDOT stated that it has an agreement with, and an obligation to, the Federal Highway Administration ("FHWA") on how utility facilities are accommodated on controlled access highways in New York State.[118] Under the "Accommodation Plan for Longitudinal Use of Freeway Right-of-Way by Utilities" only communication facilities were currently permitted to longitudinally occupy New York State freeway rights-of-way with the control of access.[119] The NYSDOT further noted that any requests for non-highway use of controlled access highways must be submitted for approval by the FHWA and that "all alternatives must be exhausted before FHWA approval of an exception can be granted."[120] As of December of 2006, the NYSDOT stated only one exception had been granted by the FHWA.[121]

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114 New York State Department of Transportation Rules and Regulations, 17 NYCRR § 131 (2013). See http://government.westlaw.com/linkedslice/default.asp?SP=nycrr-1000

115 NYSDOT, *Accommodation Plan for Longitudinal Use of Freeway Right-of-Way by Utilities* (1995), https://www.dot.ny.gov/divisions/engineering/design/dqab/dqab-repository/accommod.pdf?nd=nysdot.

116 *See, e.g.,* Article VII Updated Alternatives Analysis at 8, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={1376106E-8A60-4BC8-B601-EA7C43ECC0BB}.

117 *See Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor*, Case No. 06-T-0650, http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=06-T-0650.

118 NYSDOT, *Accommodation Plan for Longitudinal Use of Freeway Right-of-Way by Utilities* (1995), https://www.dot.ny.gov/divisions/engineering/design/dqab/dqab-repository/accommod.pdf?nd=nysdot.

119 NYSDOT Letter Clarifying Its Position at 1, *Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor.* Case No. 06-T-0650 (N.Y. P.S.C. Dec. 18, 2006), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={7EEEDE23-E552-4741-A528-707F1FD866E7}.

120 *Id.* at 2

121 *Id.* at 2

The evaluation of logistics also considers whether an alternative is "available" to the applicant.[122] Legal restrictions that prohibit site development are also considered in determining whether an alternative site is available.

3.2.3 Evaluation of Existing Technology

Any technology found to be technically infeasible to construct and operate should be removed from consideration.[123] In terms of ensuring that the cable technology is tested and proven, only HVDC cable technology is considered in this analysis. HVDC has the ability to transmit large amounts of power over long distances with lower capital costs and with lower energy losses than HVAC.[124] HVDC can carry more power per conductor because, for a given power rating, the constant voltage in a HVDC line is lower than the peak voltage in an HVAC line.[125] HVAC transmission is limited by the amount of reactive power required to deliver active power through transmission lines, so that long distances are technically unreachable with HVAC lines due to limitations on how far reactive power will travel.[126]

In terms of environmental impacts, HVDC cables do not emit fluctuating electric and magnetic fields so they do not raise the health concerns as HVAC power lines.[127] The only field present is a low static magnetic field in close proximity to the cables which is similar to the background

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122 40 C.F.R. § 230.10(a)(2) (2012), See http://www.law.cornell.edu/uscode/text/33/1344.

123 U.S. Envtl. Protection Agency & U.S. Army Corps of Engineers, EPA842-B-92-008, *Evaluating Environmental Effects of Dredged Material Management Alternatives: A Technical Framework* at 21 (revised Mar. 2004), http://water.epa.gov/type/oceb/oceandumping/dredgedmaterial/evaluation.cfm.

124 Ex. 122: Report to Parties – XLPE at 9, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={42265426-A2D8-4BB4-9B0F-669847596CEB}.

125 *Id.* at 9.

126 *Importance of Reactive Power for System*, Electrical Notes & Articles (Mar. 21, 2011), http://electricalnotes.wordpress.com/2011/03/21/importance-of-reactive-power-for-system/.

127 Environmental Impacts Associated with Routing Proposed in Joint Proposal at 306, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={4CC6BFC1-1945-401B-8EF9-D67CB3C263FB}.

magnetic field of the Earth.[128] HVDC cables use a strong polymeric insulating material so they do not contain oils for cooling.[129]

Given there are no demonstrated environmental advantages to the use of HVAC cables and the costs are generally greater over longer distances, only HVDC cables will be considered in terms of the cable technology.

[128] Joint Proposal at 42, *Application of Champlain Hudson Power Express, Inc. and CHPE Properties, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the Public Service Law for the Construction, Operation and Maintenance of a High-Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C5F63E41-5ED5-46A2-99A5-F1C5FC522D36}.

[129] *Id.* at 44.

Section 4
New York State Department of Public Service Alternatives

As part of the review of the Project conducted pursuant to Article VII of the New York State Public Service Law, the New York State Public Service Commission Administrative Law Judges invited parties to the proceeding to submit alternative routes for the Project.[130] The NYSDPS submitted three alternative route segments which it considered to be "reasonable."[131] No other party to the proceeding provided an alternative for consideration.

The three NYSDPS alternatives – Hudson River Western Rail Line Route, Harlem River Rail Route, and the Hell Gate Bypass Route – and the outcome of their consideration, are discussed below.

4.1 Existing Technology

For each of the alternatives described in this section, the cable system would be buried. Buried overland installation of the cables is described in Section 2.2.2 above. The typical cable trench along the overland portion of the route would be four (4) feet wide at the bottom and approximately four (4) to five (5) feet deep to allow for the proper depth required for the burial of the cables. A minimum separation distance is required from railroad rails to the cables by each railroad; CP requires a minimum separation of ten (10) feet from the centerline of the outermost track to the cable trench, and CSX requires a minimum separation of twenty-five (25) feet from the centerline of the outermost track. The permanent ROW is anticipated to be thirteen (13) feet in the railroad

[130] Ruling on Schedule and Other Procedural Matters, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Oct. 4, 2010), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={F91C8DC4-973C-403F-B32C-F763D67B62F5}.

[131] NYSDPS Staff Submits Proposed Alternative Routes, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Oct. 27, 2010), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={421FD837-98B0-4E31-9B46-CCDA62591D73}.

ROW and seventeen (17) feet in other areas[132]. Based on typical construction configurations, the temporary construction zone is assumed to be thirty-one (31) to thirty-three (33) feet wide[133].

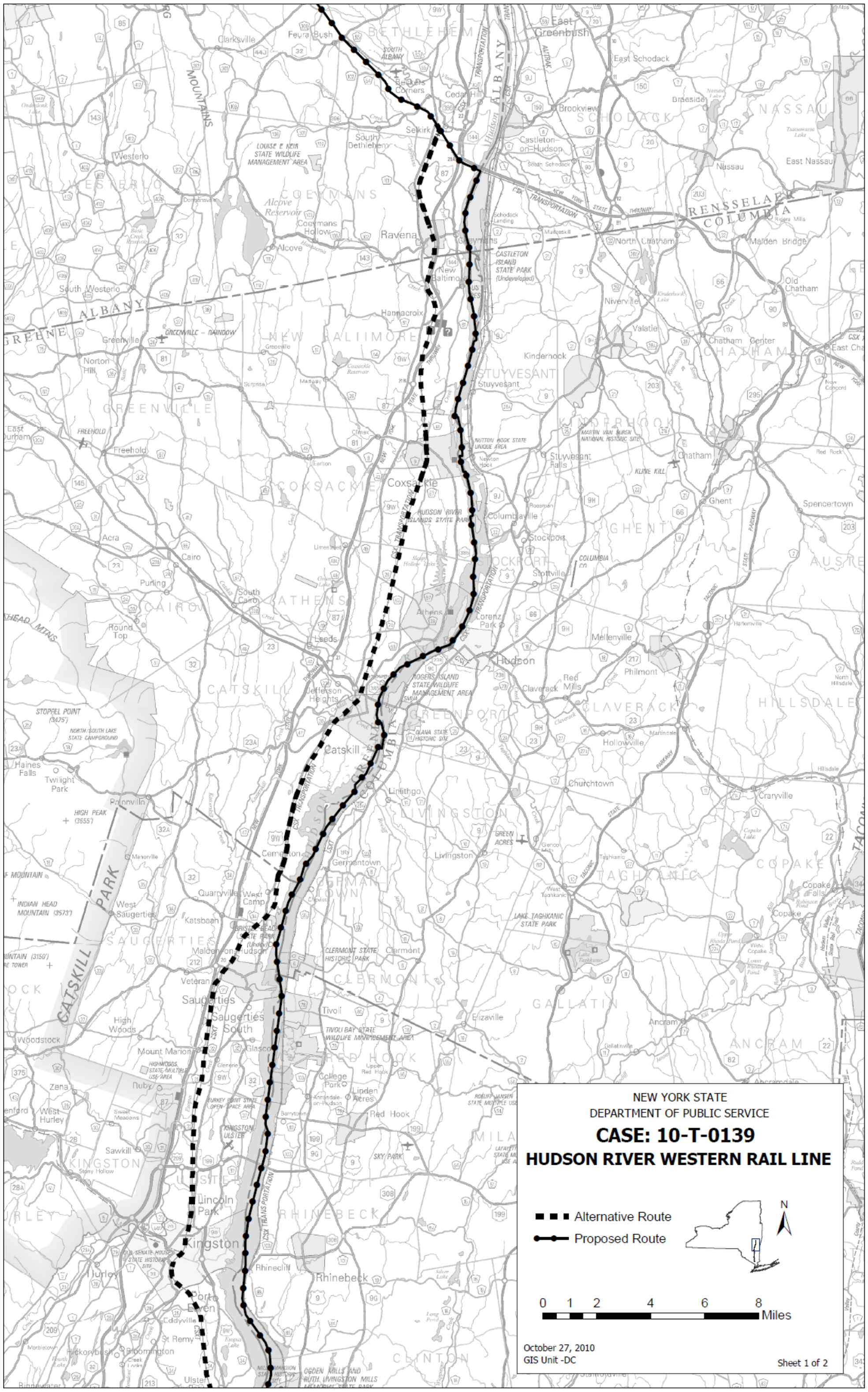
4.2 Hudson River Western Rail Line Route

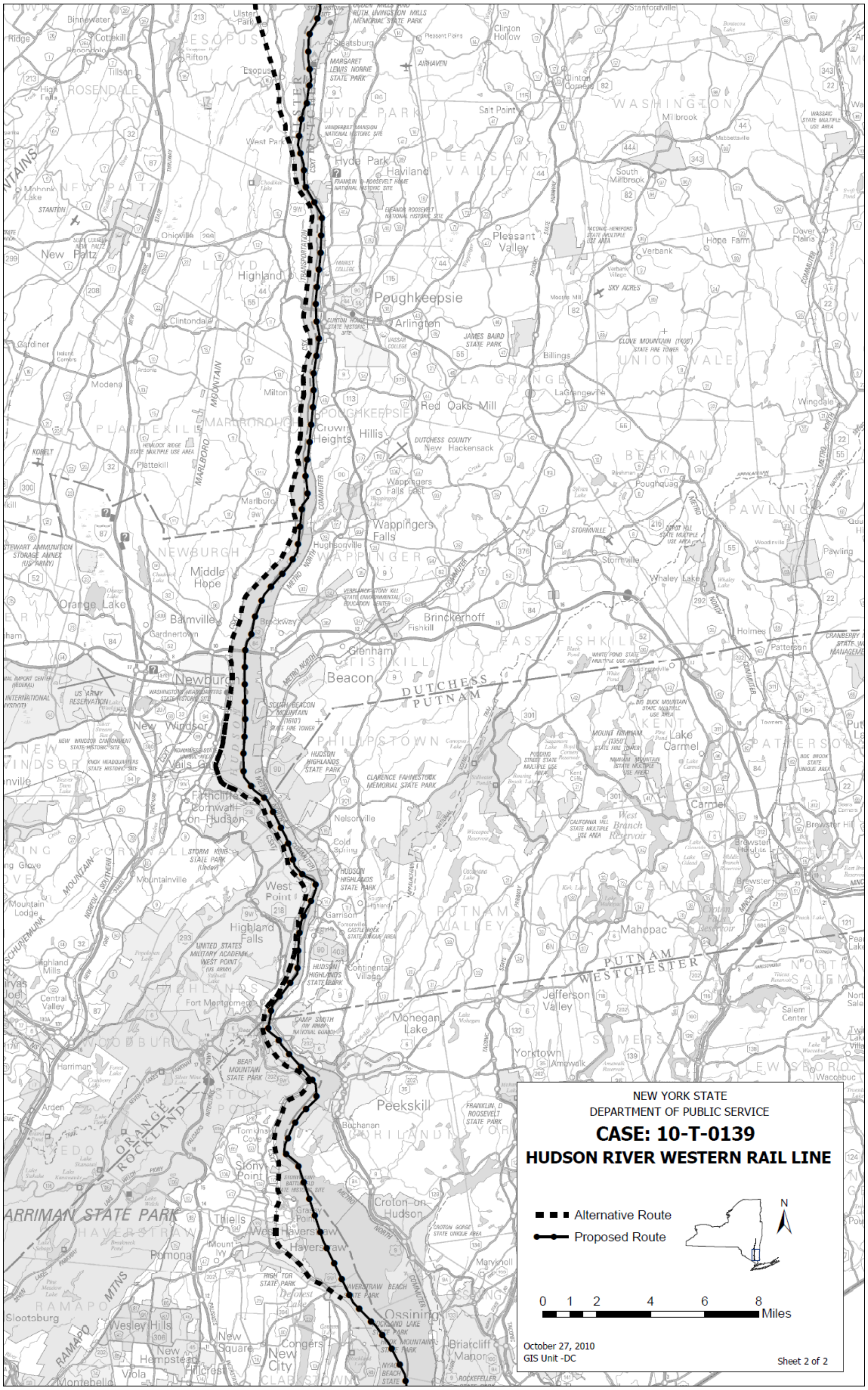
NYSDPS staff described the Hudson River Western Rail Line Route alternative as beginning in the Town of Bethlehem, Albany County and following with the CSX ROW to the west of the Hudson River. The proposed route would enter the Hudson River in the Town of Clarkstown, Rockland County. The route is shown on Figure 4-1.

[132] Order Granting Certificate of Environmental Compatibility and Public Need at 101, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Apr. 18, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A71423C8-B489-4996-9C5A-016C9F334FFC}.

[133] Attachment H – Revised Attachment H: Cross Section Diagrams, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20H%2020120229.pdf.

FIGURE 4-1
HUDSON RIVER WESTERN RAIL LINE




NEW YORK STATE
DEPARTMENT OF PUBLIC SERVICE
CASE: 10-T-0139
HUDSON RIVER WESTERN RAIL LINE
Alternative Route
Proposed Route
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October 27, 2010
GIS Unit -DC
Sheet 2 of 2

Practicable Alternatives

At the request of Settlement Parties and the NYSDOS, the Applicants conducted a detailed analysis of the routing constraints and available alternatives along the entirety of this route.[134] This analysis included a review of potential roadway ROWs which could be utilized in locations where the use of the railroad ROW was considered impractical. The following segments were determined to be practicable based on cost, available technology, and logistics.

Route Mile 202 to 223 (Coeymans to Catskill**)**

The Project route as originally proposed would have entered the Hudson River in Coeymans, New York, reaching that point by following the CSX ROW. The Applicants reviewed the CSX ROW from Selkirk south to north of Catskill and identified no significant engineering constraints. Therefore, this portion of the Hudson River Western Rail Line was accepted by the Settlement Parties as practicable.

Route Mile 296 to 303 (Haverstraw Bay – Stony Point to Clarkstown)

The Project route as originally proposed would traverse Haverstraw Bay by utilizing portions of the existing navigation channel. Haverstraw Bay, however, represents one of the most significant coastal habitats within the Hudson River; consequently, the Applicants worked collaboratively with Settlement Parties to develop a practicable bypass route of Haverstraw Bay, which roughly follows the southern portion of the Hudson River Western Rail Line Route.

Non-Practicable Alternatives

The Applicants' review of the portion of the Hudson River Western Rail Line Route between Catskill and Stony Point indicated that the route was not practicable based on logistics and costs. This analysis is provided below.

[134] Article VII Updated Alternatives Analysis, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012) ("Article VII Updated Alternatives Analysis"), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={1376106E-8A60-4BC8-B601-EA7C43ECC0BB}.

Logistics

The constraints based on access, topography and geology are presented below. For ease of review, the Hudson River Western Rail Line Route was divided into segments with reference to the route miles. The anticipated construction duration for the segments described below would exceed thirty-two months utilizing multiple crews, compared to the three months estimated by a contractor for in-water burial.

Route Mile 223 to 233 (Catskill to Malden-on-Hudson)

From Catskill to Malden-on-Hudson (north of Saugerties), Applicants identified CSX's Catskill Trestle, which crosses Catskill Creek and Route 9, as an engineering issue, as there is not a practicable alternative to bring the cables to the Hudson River. While the cables could be laid within the Route 34 right-of-way to connect to Riverside Road, the only parcel adjacent to the Hudson River with sufficient acreage for a HDD into the Hudson River was determined by the NYSDPS to be classified as a municipal park and therefore the rights to the land could not be transferred to a private party without state legislation.[135] Based on the logistics involved in obtaining access to this site, it was determined to be impractical.

Route Mile 233 to 245 (Malden-on-Hudson to Kingston)

Siting in this segment is logistically complicated due to the dense development within the Ulster / Kingston area. As the CSX railroad travels beneath Route 209 in Ulster, the railroad corridor is constrained by existing overhead transmission lines on both sides of the railroad ROW. It would not be possible to maintain a significant separation from these other facilities within the railroad ROW, so the cables would need to be located adjacent to John M. Clark Drive, which runs parallel to the tracks until they both intersect with Route 157, at which point the transmission lines no longer run on both sides of the railroad ROW. As a consequence, certain municipal approvals would be needed. After passing through the Kingston railyard and over Route 32/Flatbush Avenue, the railroad corridor traverses the middle of St. Mary's Cemetery with an overhead transmission line on the western side of the railroad corridor. There is insufficient room between the cemetery

[135] *See, e.g., Friends of Van Cortlandt Park v. City of New York*, 95 N.Y.2d 623, 631-32 (2001) ("[O]ur law is well settled: dedicated park areas in New York are impressed with a public trust for the benefit of the people of the State. Their use for other than park purposes, either for a period of years or permanently, requires the direct and specific approval of the State Legislature, plainly conferred.") (internal quotations omitted).

(actual gravestones) and the railroad tracks along the eastern side of the railroad corridor to install the Project's cables with traditional trenching methods; moreover, the extent of development would prevent the use of HDD. A roadway bypass would require utilizing the Route 32 ROW to access Farrelly Street to the east or Foxhall Avenue to the west. Utilizing either of these roadways would require traveling through residential neighborhoods where the houses are very close to each other and close to the roads, making installation extremely difficult; moreover, utilizing these roadways would likely generate significant local opposition from homeowners.

View (Looking East) of the Railroad Corridor
Extending through St. Mary's Cemetery in Kingston

Immediately south of the cemetery, the railroad corridor extends through a heavily developed urban area where large buildings are located immediately adjacent to the railroad corridor (within ~10 feet), resulting in insufficient horizontal clearance to install the Project cables within this section of ROW. This level of development is intermittent until the railroad crosses a small bridge over the Broadway roadway. As with the roads proximal to the cemetery, the roadways that might be utilized as an alternative to this segment (e.g. Foxhall Avenue, Cornell Street, Ten Broeck Avenue, and Grand Street) also have buildings immediately adjacent to the roadway as well as residential houses where construction would be disruptive. As with the above segment, there is likely to be public opposition to construction in close proximity to homes and businesses.

View of Large Buildings Immediately Adjacent to Railroad Corridor in Kingston

Roadway alternatives that would bypass the City of Kingston were also reviewed. Route 9W could be accessed by following Route 157 east at the terminus of John M. Clark Drive. While Route 9W has a low density of development north of Route 32, it becomes a limited access highway (controlled-access road) once it crosses Route 32. As discussed in Section 3.2.2, the NYSDOT has indicated that it would highly restrict the longitudinal use of limited access highway ROW by utilities (see Appendix A).[136]

Route 32 becomes Flatbush Road and Flatbush Avenue as it passes within the city center and experiences the same high level of development as other roadways within the city. Based on this analysis, the Applicants were unable to identify any practicable alternative that traversed the municipalities of Ulster and Kingston and therefore the cables would need to enter the water prior to this point.

In terms of roadway alternatives, the only road that travels in relatively close proximity to the Hudson River is Route 32 with a separation distance of approximately one-half mile. However, this roadway, as well as Route 9W, traverses the Esopus Creek Bridge to cross the Esopus Creek in

136 *See, e.g.,* Article VII Updated Alternatives Analysis at 8 and Appendix A of this document.

Saugerties. The NYSDOT has indicated that it would not permit hanging cables on structures owned and operated by the agency.[137] An HDD would be complicated by the depth of the gorge (approximately 75 feet), the gravity dam downstream of the bridge, and existing buildings at both ends of the bridge. There are no existing launch /exit sites that meet the necessary spacing criteria for a safe drill under these constraints. Therefore, routes 9W and 32 south of Esopus Creek are considered inaccessible to the northern portion of the cable route and therefore not a practical alternative.

<u>Route Mile 245 to 254 (Kingston to West Park)</u>

At the southern edge of Kingston, the railroad corridor enters a tunnel which leads onto a raised trestle bridge crossing the Rondout River. Cable burial within a tunnel is considered infeasible because adequate separation from the track is not possible; additionally, the cables would be susceptible to damage from the trains, which would pose a risk to the reliability of the cable system.

To access this portion of the alternative from the Hudson River, the cables would need to be installed within Rondout Creek. Rondout Creek been designated by the NYSDOS as a Significant Coastal Fish and Wildlife Habitat ("SCFWH"), as it is one of the largest freshwater tributaries of the Hudson River Estuary and the concentrations of anadromous and resident freshwater fish have been described by the NYSDOS as unusual in Ulster County.[138] Thus, it would have more significant environmental impacts than the proposed route. In addition, there is a former gasification plant at the mouth of the creek and soil remediation in the waterway is currently being conducted, which would severely limit the construction window.[139]

<u>Route Mile 254 to 261 (West Park to Highland)</u>

South of the intersection with Route 9W, the railroad ROW runs adjacent to the Hudson River and there are multiple instances where there is only a narrow strip of land between the edge of the Hudson River to the east and large rock outcroppings or very steep terrain to the west. Installation in these areas would require either blasting of the bedrock to create a sufficient degree of separation from the railroad or an expensive HDD installation (assuming that there is available space for this

[137] Article VII Updated Alternatives Analysis at 5.
[138] *Id.* at 6.
[139] *Id.*

technique).[140] Using on-line aerial photography, sixteen distinct outcrops with an estimated average length of 490 feet and a range of 230 to 1,020 feet were identified. This estimate of bedrock material should be considered conservative as the desktop analysis only accounts for exposed outcroppings. In Highland, Oakes Road runs immediately adjacent to the railroad ROW for approximately 3,200 feet, so there is insufficient room to install the cables for the majority of this stretch.[141]

View of Railroad Route on a Steep Embankment (opposite Hyde Park)

[140] *Id.* Blasting within a railroad ROW is a normally not permitted by railroads. If such work was approved, the cost would vary depending on rock hardness, location, quantity, size requirements, hauling rates, etc. A unit rate of $ 100 /cubic yard would not be unusual under typical railroad ROW conditions. Horizontal directional drills would also be costly, with unit costs in rock of near $1,000/ linear foot.

[141] Article VII Updated Alternatives Analysis at 6.

View of Railroad on a Steep Embankment (continued south of photo above)

The use of Route 9W was also considered, as this roadway initially travels through largely undeveloped countryside. Transmission poles border only one side of the road for less than two (2) miles until it intersects with Upper North Road in Highland. However, a short distance after the intersection with Upper North Road, Route 9W expands to four lanes. Over the next approximately four (4) miles, the transmission system switches sides eight times. In order to maintain the required separation, the cables would need to cross underneath the roadway. As Routes 44 and 55 overlap with Route 9W in Highland, the transmission system poles occupy both sides of the roadway. In addition, the density of businesses with access points on the roadway increases. Route 9W also crosses two bridges before it connects with Route 44/55 for which there are no readily identifiable bypasses. Overall this route would present severe logistical challenges in terms of identifying a constructible route. The intensity of development along Route 9W, particularly as it enters Highland, would result in insufficient room to install the cables for the majority of this stretch. Further, high traffic volume, as well as the presence of bridges, would further make utilization of Route 9W impracticable.

View of 9W at Intersection with Routes 55 and 44 in Highland

Route Mile 261 to 277 (Highland to Newburgh)

Immediately south of where the railroad ROW goes under the Route 44 bridge, a maintenance road or other limited roadway is located to the west of the tracks. The distance between this road and the ROW is insufficient to meet CSX's minimum separation distance from the tracks. Between the Route 44 bridge and U.S. Highway 84 bridge in Newburgh, eighteen rock outcrops were identified using aerial photography that would significantly complicate installation if the railroad companies allowed for the necessary construction activities. The average length of each outcrop is approximately 770 feet with a range of 160 feet to 2,950 feet. This segment also has seven instances where the railroad has water on both sides of the tracks for an average distance of 1,250 feet. As was noted earlier, the desktop analysis only accounts for visible bedrock and so the actual length of ROW where upland construction is essentially infeasible may be far longer. A short distance south of the U.S. Highway 84 bridge, the railroad occupies a raised berm. The cables would either need to be laid at the foot of the berm with HDDs for the road crossings or, in congested sections, the ROW of an alternate roadway such as Water Street would need to be accessed. Based on these geological and engineering logistical issues, installation in this section of railroad ROW is considered to be impractical.

View of Railroad and Culvert Located along Hudson River Southeast of Milton

In terms of roadway alternatives, Oakes Road passes under the Route 44 bridge but reaches a dead end within a mile. Other roadway route alternatives would need to be accessed through Highland and, as previously discussed, the intensity of development in the vicinity of the intersection of Routes 9W and 44 would result in insufficient room to install the cables for the majority of this stretch.

Following the Hudson River south from Highland, the first roadway to come in close proximity to the river is Old Indian Trail Road in Milton at approximately Route Mile 266. At its closest point, the road is adjacent to the railroad ROW and is less than a mile away from connecting to Route 9W. As Route 9W travels south, it traverses lightly to moderately developed areas. However, as was observed in a northern segment, the transmission poles cross the roadway multiple times which would require HDD drillings or open cut trenching at each location. The transmission line crossings are often necessary in order to avoid natural and anthropogenic obstacles,[142] thereby

[142] These natural and anthropogenic obstacles include street lights, isolated utility poles and rock outcrops,

making installation of the Project's cables more impractical since cables would not only need to avoid the transmission lines but also these features.

As the road approaches Marlboro, development becomes more pronounced with the hamlet buildings directly adjacent to the roadway. South of the hamlet's center, the road has transmission poles on one side and a cemetery on the other for approximately five hundred (500) feet. Bypassing this section would require utilizing residential roads for approximately one-half mile. Continuing south, Route 9W continues to travel through low to moderate density developments, with transmission poles that cross the highway at infrequent intervals. Based on the existing utility and development constraints, as well as the likely public opposition to construction in close proximity to homes and businesses, installation in this roadway alternative is considered to be impractical.

<u>Route Mile 277 to 280 (Newburgh to Cornwall on Hudson)</u>

South of Newburgh, where the railroad reaches Cornwall on Hudson where Shore Road is proximal to the railroad tracks, it would not be possible to meet minimum setbacks along much of this section.

Within a one-half mile distance of the Route 84 bridge, Route 9W experiences significant industrial development. In the center of Newburgh, the road is bordered by closely spaced packed residential houses as well as occasional park and recreational facilities. South of Newburgh proper, Route 9W becomes a divided four-lane highway for approximately two miles with transmission poles on the eastern side of the road. Once the divided highway ends, there is a bridge crossing of Moodna Creek which, based on NYSDOT's previously stated position about installation of transmission cables on agency bridges, would require that the Project utilize an HDD drill to cross under the creek.[143] As Route 9W crosses Route 107 in Cornwall, it transitions to a limited access highway and the collocation of transmission cables in the ROW of limited access highways is highly restricted and discouraged by NYSDOT.[144] Due to constraints in the Hamlet of Newburg and engineering constraints at Cornwall on Hudson, installation of the cables in this alternative section is impractical.

[143] Article VII Updated Alternatives Analysis at 8.
[144] *Id.*

Route Mile 280 to 284 (Cornwall on Hudson to West Point)

As the railroad reaches Cornwall on Hudson, Shore Road runs parallel to the tracks for approximately one mile and for more than half that distance the Hudson River lies along the eastern side. Five (5) rock outcroppings with an average length of 960 feet (range of 380 to 1,920 feet) were identified as well as a berm through a water way extending approximately 300 feet. In West Point, River Road and the Upton Road run parallel to the railroad tracks with the Hudson River to the east for approximately 4,060 feet before entering the tunnel beneath West Point Military Academy ("West Point").

As previously discussed, Route 9W becomes a limited access highway in Cornwall and NYSDOT has indicated that it would highly restrict the collocation in the ROW of limited access highways.[145] As an alternate route, Route 218 -- which intersects the highway prior to the transition to a limited access roadway -- was considered. However, this roadway travels through the center of Cornwall on Hudson through closely spaced residential houses and commercial districts. Trees line both sides of road through the town, so that any installation would either require their removal or risk damage as well as overcome any opposition from local residents and businesses. Outside the town proper, Route 218 enters Storm King State Park and climbs up Storm King Mountain along a steep and windy roadway. As the road crosses the front of the mountain, there is an approximately half-mile stretch where the road has been carved out of the cliff face. Based on the access and engineering constraints, this roadway is not considered to be a practical alternative.

Route Mile 284 to 285 (West Point)

The railroad tunnel beneath West Point extends for approximately 3,500 feet. As discussed earlier, the railroad company has specified safety setbacks which could not be met within this tunnel through burial installation. Rock cuts into the sides of the wall were considered, but railroad representatives indicated that they would not allow this approach as it would require work within the tunnel for months, significantly impacting railway use.[146] Installation of the cables within the tunnel ceiling would also require significant construction time and would present a serious liability should any type of failure occur. As the railroad tracks leave the tunnel, there is a short stretch

[145] *Id.*
[146] *Id.*

(approximately 500 feet) where an Academy parking lot lies to the east and Williams Road to the west. The parking lot would need to be excavated in order to install the cables or an HDD constructed. Installation in this section of railroad ROW is considered to be impractical.

There are no state roads in close proximity to either entrance to the tunnel. Both River Road and Upton Road are in close proximity to the water and connect into existing local roads. However, these roads are built perpendicular to the slope of the foothills of Storm King Mountain and the rights-of-way are narrow.

View of Railroad and Roads along Storm King State Park & Hudson Highlands State Park

<u>Route Mile 285 to 290 (West Point to Fort Montgomery)</u>

As with earlier segments, the railroad runs parallel to the Hudson River. Ten rock outcroppings with an average length of 720 feet (range of 265 to 1,606) were identified in addition to four water crossings with an average length of approximately 490 feet (range of 402 to 644). In addition, the ROW travels through the Bear Mountain tunnel, which extends for approximately 800 feet. Installation in this section of railroad ROW is considered to be impractical.

View of Railroad and Bridge Located South of West Point

View of Tunnel and Waterbody Crossing in Bear Mountain State Park

View of Railroad along Bear Mountain State Park

There are no state roads or local roads in close proximity to the water for this segment. Mine Dock Road in Fort Montgomery could be accessed if the cables came out of the water into the railroad ROW and were laid a short distance before entering the road. However, Mine Dock Road runs underneath Route 9W and private homes are located on either side of the bridge abutments, posing significant logistical concerns.

Route Mile 290 to 296 (Fort Montgomery to Stony Point)

Six rock outcroppings were identified with an average length of 490 feet (range of 190 to 860) and seven water crossings with an average length of 1,080 feet (range 391 to 2,373). In addition, north of Stony Point Lighthouse is an approximately 2,020-foot stretch of railroad where water is to the east and utility grade transmission lines are to the west. As the railroad curves around Dunderberg Mountain past Jones Point, River Road runs parallel to the tracks for approximately 1,400 feet. Further along the tracks, West Shore Drive in Tomkins Cove runs in close proximity to the railway for approximately 1,600 feet. Installation in this section of railroad ROW is considered to be impractical due to the constrained ROW.

A steep rock embankment lies beneath the bridge that connects Routes 6/202 into a round-about with 9W/202 and the Palisades Interstate Parkway, which is a limited access highway that terminates at this traffic circle. As there is a toll-collection area associated with the bridge to the east, consultation would need to occur with the NYSDOT as they have indicated that the use of the ROW of limited access highways would be highly restricted.[147] Moreover, the roadway travels south through Bear Mountain State Park and trees line both sides of the road, which is kept in a natural setting. The roadway passes a boat launch near Iona Island, whose bay is a SCFWH. Six rock outcroppings of an average length of 850 feet (range of 141 to 2,556 feet) were identified. Installation in this section of road is considered to be impractical due to the extent of clearing, blasting and/or other activities that would be required within a state park for a relatively short overland segment.

Cost

The Hudson River Western Rail Route entails an upland section from Catskill to Stony Point. These 96 miles include a number of challenging and costly installation measures including;

- Requirements for long horizontal directional drills;
- Accommodating extremely narrow work areas;
- Incorporating interim bypasses on roadways;
- Avoiding conflicts with existing utilities;
- Crossing of 11 waterways and 2 areas of Significant Coastal Fish and Wildlife Habitat;
- Construction through 61 areas with predominately rock conditions; and
- Passing through or around 4 tunnel sections.

Only for the purpose of preparing a cost estimate is it assumed that engineering solutions can be developed for all of the listed challenges; however, given the complexity of some of the challenges, engineering solutions or agency approvals may not, in fact, be attainable. The installation problems are more pronounced in the urban and industrial areas of Ulster, Kingston and Newburgh due to the existing developed landscape conditions. Engineering solutions will also require extensive

[147] Article VII Updated Alternatives Analysis at 8.

discussions with local municipalities, NYSDOT and with CSX to secure variances from conventional protocols for construction and installation in their busy freight rail corridor.

The estimated costs per mile for the additional 96 miles upland section ranges from$ 4.8M/mile to $9.0M/mile, as compared to the $3.5M/mile for the Article VII proposed marine route. Extending these estimated costs results in a net increase to the Project costs for installation of the cables from Catskill to Stony Point of approximately $620M or a 42% increase from the cost of the Article VII baseline cable installation estimate. The Hudson River Western Rail Route also represents a net additional twenty-four (24) miles of installation when compared to the baseline route.

Additional information on the comparative costs is shown in Table 4-1.

Analysis

NYSDPS staff described the Hudson River Western Rail Line Route alternative as beginning in the Town of Bethlehem, Albany County and following with the CSX ROW to the west of the Hudson River. During settlement negotiations, the Applicants agreed to the segment from Coeymans to Catskill (21 miles) and the bypass around Haverstraw Bay (7 miles).

However, the section from Catskill to Stony Point posed significant engineering issues, including insufficient room to install the cables around existing development and utility features, tunnel features, and the requirements for the long HDD installations that would be required in places. Access is also an issue for the alternative in areas where the land is restricted because of existing regulations and laws (e.g. limited access highways, municipal parks, federal land). The installation of the transmission cables in close proximity to homes and business will likely generate public opposition based on the experience of the NYRI project (particularly as the construction duration will be more than a ten-fold increase over in-water installation).

In addition to the logistical issues which would pose difficult issues as well as likely political and public opposition, the complete Hudson River Western Rail Route also has significant cost implications. Project costs would increase by approximately 43% from the current Project; at that cost, there would be no transmission customers that would take service on the transmission line. For these reasons, the Hudson River Western Rail Line Route is not a practical alternative.

TABLE 4-1
PROPOSED PROJECT AND HUDSON RIVER WESTERN RAIL ROUTE

Section	Upland or Marine	Distance (Miles)	Cost per mile ($million)	Project Cost ($million)	Hudson River Western Rail Cost ($million)
International Border to Dresden	Marine	101.5	2.9	$ 290.7	$ 290.7
Dresden to Catskill	Upland	126.8	5.3	$ 666.1	
	Upland	118.3	5.3		$ 621.5
Catskill to Stony Point	Marine	67.4	3.5	$ 237.4	
	Upland	100	9.0		$ 900.0
Stony Point to Clarkstown	Upland	7.9	12.7	$ 100.4	$ 100.4
Clarkstown to Bronx	Marine	27.6	4.4	$ 122.6	$ 122.6
Bronx to Astoria Converter site	Upland	2.3	15.0	$ 34.5	$ 34.5

	Project	Hudson River Western Rail
Marine Distance (miles)	196.5	129.1
Upland Distance (miles)	135.5	227.1
Total Distance (miles)	332.1	356.2
Total Cost ($millions)	$ 1,451.72	$ 2,069.6
Cost Variance from Project ($millions)		**$ 617.92**
Cost Variance from Project (%)		**42.6%**

Notes:

1. Baseline pricing based on estimate provided by reliable contractor in August 2012.
2. Distances based on segment lengths.
3. Marine costs/mile vary due to sub-bottom conditions, turbidity, installation methods, navigation and other considerations.
4. Estimate assumes that engineering solutions and CSX concurrence can be secured for challenging conditions.
5. Engineering solutions to some challenges may not be obtainable.

4.3 Harlem River Rail Route

This proposed alternative would begin in the Hudson River and make landfall at Spuyten Duyvill in the Bronx. The route would then proceed along the Metropolitan Transit Authority and New York State Department of Transportation railroad corridor along the northern and eastern banks of the Harlem River for approximately six miles to the rail yards west of Willis Avenue, where it would join the alignment of the Hell Gate Bypass Route described below. The route is shown in Figure 4-2.

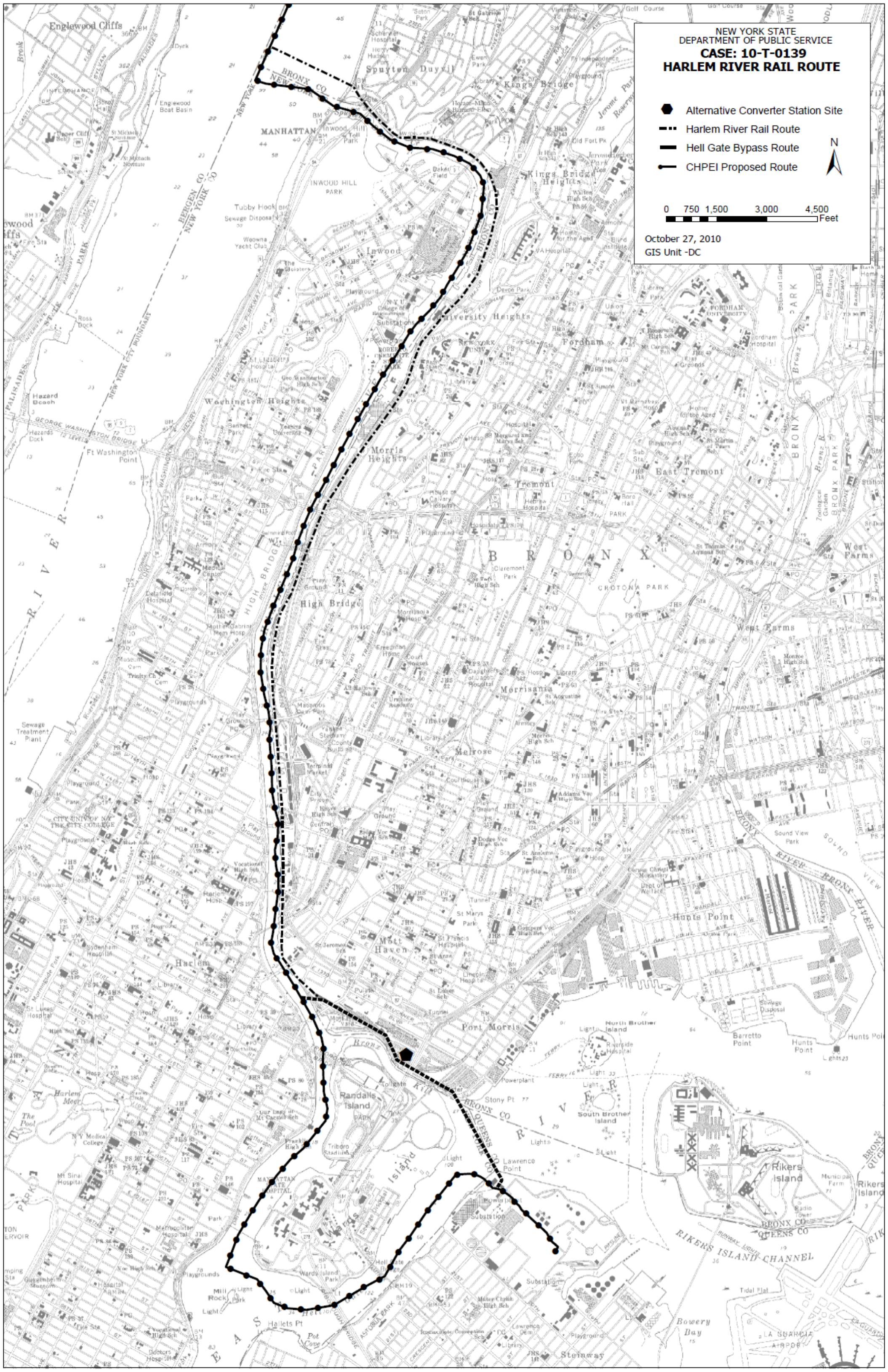
Logistics

The Harlem River Rail Route alternative entails a six mile upland section through the Bronx along rail corridors. The Harlem Rail Line along the river's edge on the Bronx side of the Harlem River provides a near direct upland course within a rail corridor, built in 1851, on trestles set in "rip-rap" foundations. In the northern portion, the route extends through the neighborhoods of the southwest

Bronx in challenging geotechnical conditions (e.g., Fordham gneiss and Inwood marble). The corridor is narrow and construction of a buried HVDC line will entail extended lengths of direct attachments of the cables to the supporting trestles which entail an increased risk of damage to the cables because the cables will be exposed in a high traffic area. Also, approval from the Metropolitan Transit Authority ("MTA") and NYSDOT would be required and it is not clear that such authorizations would be granted.[148] In the southern portion, the route follows a 1.9 mile section of the Oak Point Link which connects the Metro-North Railroad's Hudson Line ("MNCR") with the Harlem River Intermodal Yard and the CSX Transportation Oak Point Yard. Along the route, the cables would pass through three passenger stations and a rail maintenance facility. The Harlem River Rail Route passes under nine bridges and includes a six hundred (600) foot length segment between West Tremont Avenue and the Harlem River Park Bridge where it passes under a building.

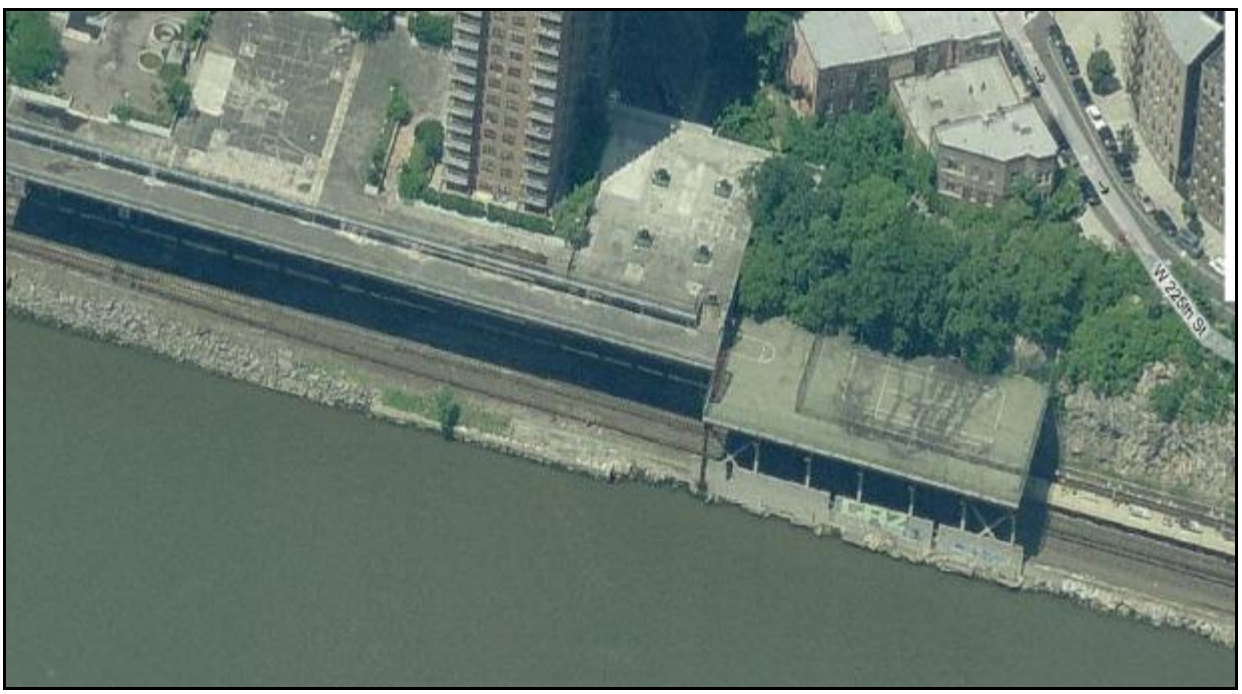
[148] For a discussion of NYSDOT's goals with regards to increasing the utilization of rail freight service in the New York City metropolitan area, see Comparison of Alternative Converter Station Sites Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={F78693D0-6E5B-4E71-BA6E-53D4A3445A15}.

FIGURE 4-2
HARLEM RIVER RAIL ROUTE



View of Railroad between Large Rock Outcropping along Harlem River

View of Building over Railroad along the Harlem River



View of Building Immediately adjacent to Railroad along Harlem River

Given the challenges of obtaining approvals to secure to the railroad trestle, an additional alternative was assessed; this alternative entails a landing on the west side of Manhattan and an upland route across the City and along a greenway on the western shore of the Harlem River. This route also would require the need for approvals from an assortment of City and State agencies. Working within the City of New York is replete with challenges (e.g. utility relocations, City-imposed work moratoriums) and production rates will likely range from 0 feet/day to 30 feet/day at the high end. Consequently, the overland through the City could disrupt City traffic for more than two years.

Cost

Only for the purpose of preparing this cost estimate is it assumed that engineering solutions can be developed for all of the listed challenges. Scheduling restraints will be most pronounced along the passenger lines. Engineering solutions also will require extensive discussions with the NYSDOT, MTA and with CSX to secure variances from conventional protocols for construction and installation in their busy passenger and freight rail corridor. Given the complexity of some of the challenges, engineering solutions and/or agency approvals may not be attainable.

The estimated cost per mile for the approximately 6 mile upland section ranges is $18M/mile, as compared to the $4.4M/mile for the Article VII proposed marine route, a four-fold increase. The Harlem River Route therefore represents a cost increase of approximately $81 million (305%) compared to in-water installation over the same segment. This results in an overall net increase to the Project costs of approximately 6% above the cost of the Article VII baseline cable installation estimate.

For the overland alternative across the City of New York, the estimated cost per mile for the approximately 6 miles upland section is $32.5 M/mile, as compared to the $4.4M/mile for the Article VII proposed marine route, almost an eight-fold increase. This results in a net increase to Project of approximately $189 M or a 15% increase from the cost of the Article VII baseline cable installation estimate.

Additional information on the comparative costs is shown in Table 4-2.

TABLE 4-2
PROPOSED PROJECT AND HARLEM RIVER RAIL ROUTE

Section	Upland or Marine	Distance (Miles)	Cost per mile ($million)	Project Cost ($million)	Harlem River Rail Cost ($million)	Harlem River (Manhattan)
International Border to Dresden	Marine	101.5	2.9	$ 290.7	$ 290.7	$ 290.7
Dresden to Catskill	Upland	126.8	5.3	$ 666.1	$ 666.1	$ 666.1
Catskill to Stony Point	Marine	67.4	3.5	$ 237.4	$ 237.4	$ 237.4
Stony Point to Clarkstown	Upland	7.9	12.7	$ 100.4	$ 100.4	$ 100.4
Clarkstown to Bronx	Marine	27.6	4.4	$ 122.6		
	Marine	21.6	4.4		$ 95.0	
Clarkstown to Manhattan	Marine	28.5	4.4			$126.60
Bronx (Inwood) to Bronx (HRY)	Upland	6	18		$ 108.0	
Manhattan (Landing to Launch)	Upland	6.5	32.5			$211.25
Bronx to Astoria Converter site	Upland	2.3	15.0	$ 34.5	$ 34.5	$34.5

	Project	Harlem River Rail	Harlem River (Manhattan)
Marine Distance (miles)	196.5	190.5	197.4
Upland Distance (miles)	135.5	141.6	142.1
Total Distance (miles)	332.1	332.3	339.5
Total Cost ($millions)	$ 1,451.72	$ 1,532.2	$1,666.97
Cost Variance from Project on Harlem River ($millions)		**$ 81.35**	**$188.59**
Cost Variance from Project on Harlem River (%)		**305.2%**	**707.6%**
Cost Variance from Overall Project ($millions)		**$ 80.44**	**$215.25**
Cost Variance from Overall Project (%)		**5.5%**	**14.8%**

Notes:

1. Baseline pricing based on estimate provided by reliable contractor in August 2012.
2. Distances based on segment lengths.
3. Marine costs/mile vary due to sub-bottom conditions, turbidity, installation methods, navigation and other considerations.
4. Estimate assumes that engineering solutions and CSX concurrence can be secured for challenging conditions.
5. Engineering solutions to some challenges may not be obtainable.

Analysis

The six-mile Harlem River Rail Route presents enormous logistical and engineering challenges on a busy passenger and freight rail corridor in the most densely populated city in the US. Engineering issues include: attaching the cables to the railway in such a manner that will both ensure the security of the transmission system and maintain existing railway use; installing the cables under buildings; and poor geotechnical conditions. Access to this corridor also would require substantial negotiations with the Metropolitan Transit Authority and NYSDOT; as has been discussed, the NYSDOT does not allow cables on their bridge structures. The construction costs for this segment of the route, even if achievable, are approximately 305% higher than the in-water installation. An alternative route buried in Manhattan would have a net increase to the Project costs of approximately $189 M or a 15% increase from the cost of the Article VII baseline cable installation estimate. Based on the higher construction costs as well as the extreme uncertainty as to whether it is feasible from an engineering perspective, this alternative is impractical.

4.4 Hell Gate Bypass Route

The Hell Gate Bypass Route alternative begins north of the Willis Avenue Bridge, and proceeds easterly to landfall at the NYSDOT railroad corridor and rail yards, following the rail corridor along the northerly side of the Bronx Kill to the East River. This route proceeds southeasterly across the East River to landfall at the power plant complex at Lawrence Point in Astoria, Queens. See Figure 4-3.

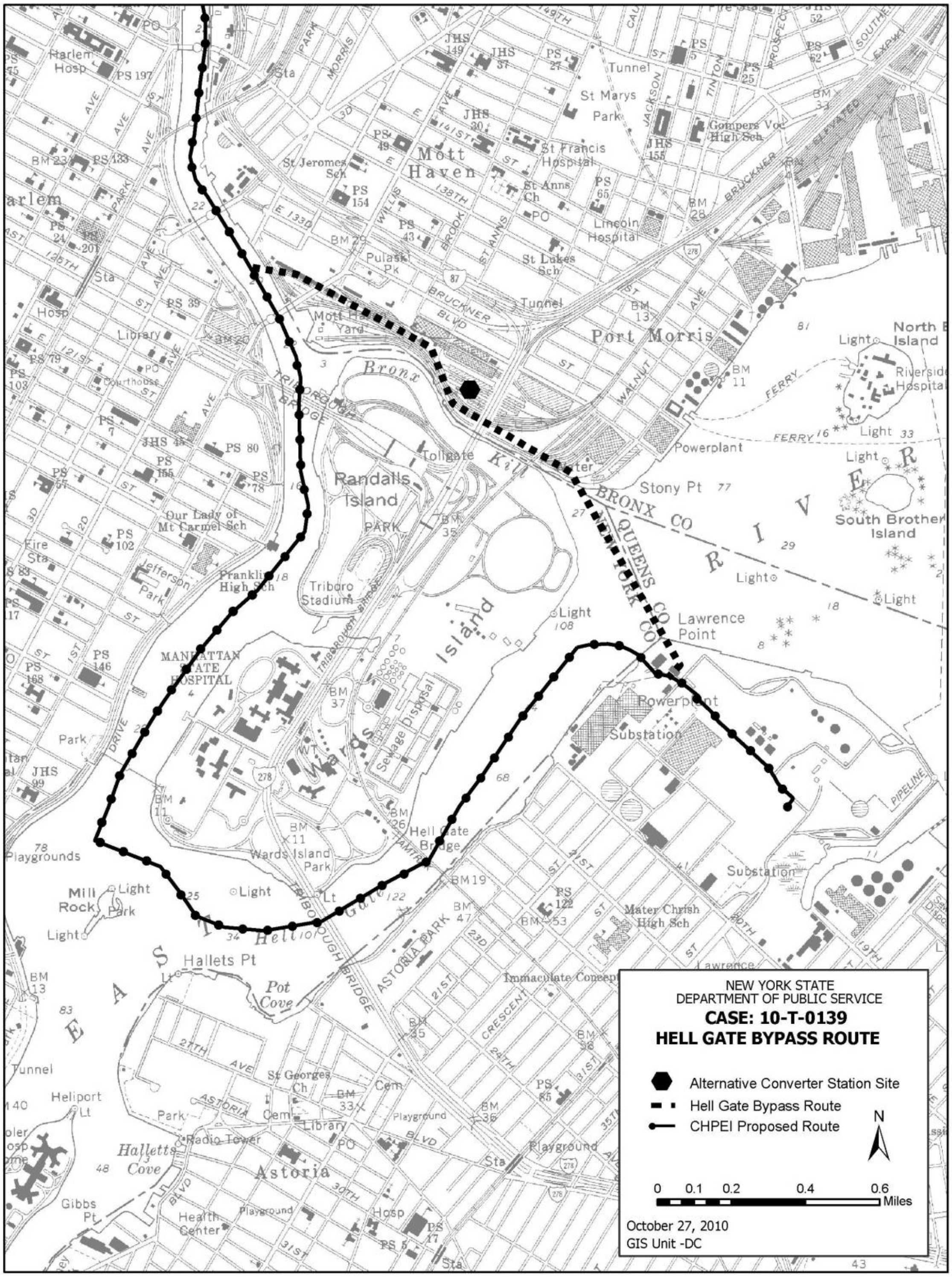
NYSDPS Staff noted that this alternative avoided installing the transmission cables in a longitudinal occupancy of the Hell Gate reach of the East River, where engineering constraints and environmental conditions may limit constructability.[149] Furthermore, this alternative minimized conflicts with proposed development of renewable hydrokinetic energy demonstration projects in the East River.[150]

Based on an analysis of this alternative as part of the Article VII proceeding, it was determined to be practical in terms of cost, available technology, and logistics and, therefore, was incorporated into the proposed Project.

[149] NYSDPS Staff Submits Proposed Alternative Routes at 3, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City,* Case No. 10-T-0139 (N.Y. P.S.C. Oct. 27, 2010), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={421FD837-98B0-4E31-9B46-CCDA62591D73}.

[150] New York East River Tidal Project, FERC Docket P-12665, and Roosevelt Island Tidal Project, FERC Docket P-12611. See http://web2.uconn.edu/seagrantnybight/documents/Energy%20Docs/6_Hydrokinetic.pdf

FIGURE 4-3
HELLGATE BYPASS ROUTE



Section 5
U.S. Army Corps of Engineers Alternatives

The USACE requested that the following alternatives be considered:[151]

a) A new overland power line route through a combination of road right-of-way (ROW), railroad ROW, and new power line ROW.

b) A new overland power line route through a new power line ROW.

Each of these alternatives is evaluated below.

5.1 Existing Technology

For each of the alternatives described in this section, the cable system would be buried. Buried overland installation of the cables is described in Section 2.2.2 above. The typical cable trench along the overland portion of the route would be four (4) feet wide at the bottom and approximately four (4) to five (5) feet deep to allow for the proper depth required for the burial of the cables. A minimum separation distance is required from railroad rails to the cables by each railroad; CP requires a minimum separation of ten (10) feet from the centerline of the outermost track to the cable trench, and CSX requires a minimum separation of twenty-five (25) feet from the centerline of the outermost track. The permanent ROW is anticipated to be thirteen (13) feet in the railroad ROW and seventeen (17) feet in other areas.[152] Based on typical construction configurations, the temporary construction zone is assumed to be thirty-one (31) to thirty-three (33) feet wide.[153]

5.2 Overland Using Existing Rights-of-Way

The proposed alternative using existing ROWs is presented in segments: 1) west of Adirondack Park; and 2) east of the Hudson River.

[151] U.S. Army Corps of Engineers. 2013 USACE File Number 2009-01089-WRY, Transmission Developers Inc., Champlain Hudson Power Express Transmission Line Project, OE Docket N.O. PP-362. USACE Comments on Preliminary Draft Environmental Impact Statement dated December 2012. Letter to Brian Mills, U.S. Department of Energy and Donald Jessome, TDI dated February 19, 2013.

[152] Order Granting Certificate of Environmental Compatibility and Public Need at 101, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Apr. 18, 2013), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A71423C8-B489-4996-9C5A-016C9F334FFC}.

[153] Attachment H – Revised Attachment H: Cross Section Diagrams, CHP Supplemental Application, http://www.chpexpress.com/docs/regulatory/permit-application/Attachment%20H%2020120229.pdf.

5.2.1 West of Adirondack Park

Based on the US National Transportation Atlas developed by the U.S. Department of Transportation's Research and Innovative Technology Administration, (see Figure 5-1), there are no major railroad routes which travel around the perimeter to the west of Adirondack Park.[154] CSX operates a railroad line that crosses the international border at Massena, New York, travels southwest to Syracuse, New York, then continues to the east to connect with the proposed Project route in Rotterdam, New York, for a total of 280 miles. As this routing would be approximately 100 miles more than the proposed routing for this section (of which approximately 40% is overland), a combination of railroad and roadway routing was selected for this alternative.

The alternative under consideration (see Figure 5-2) would follow the CSX railroad ROW from the U.S. – Canada border near Massena, New York and travel to the southwest for approximately 100.1 miles to the town of Evans Mills, New York. The route would enter the Route 46 ROW which, after a short distance, becomes Route 26. Route 26 would be utilized for approximately 27.1 miles past the municipalities of, among others, Great Bend, West Carthage, Sterlingville, Carthage, and Castorland before entering Lowville.

[154] U.S. Dep't of Transp. Research & Innovative Tech. Admin., *National Transportation Atlas Database* (2012), http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/2012/index.html.

FIGURE 5-1
EXISTING RAILROAD LINES

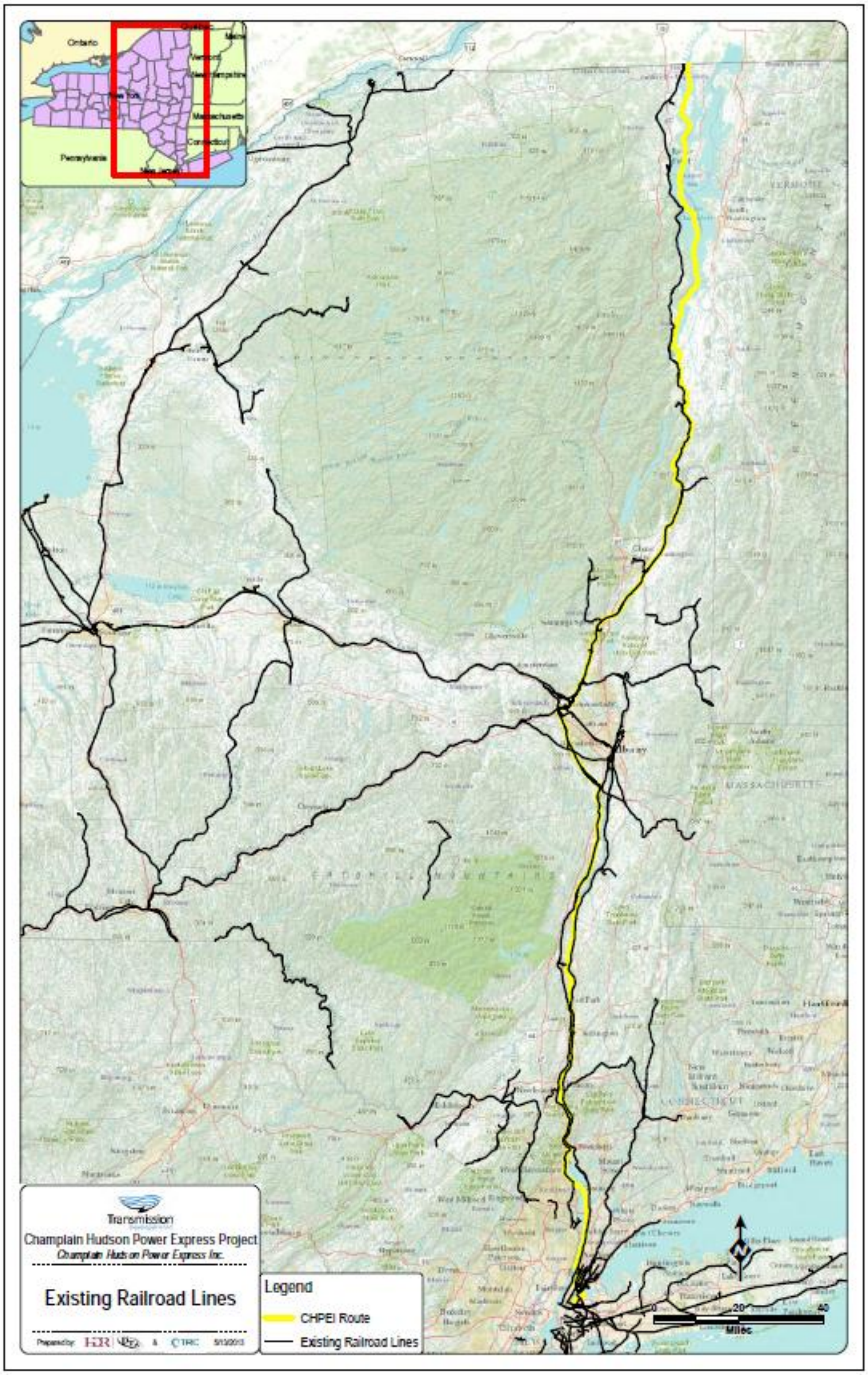
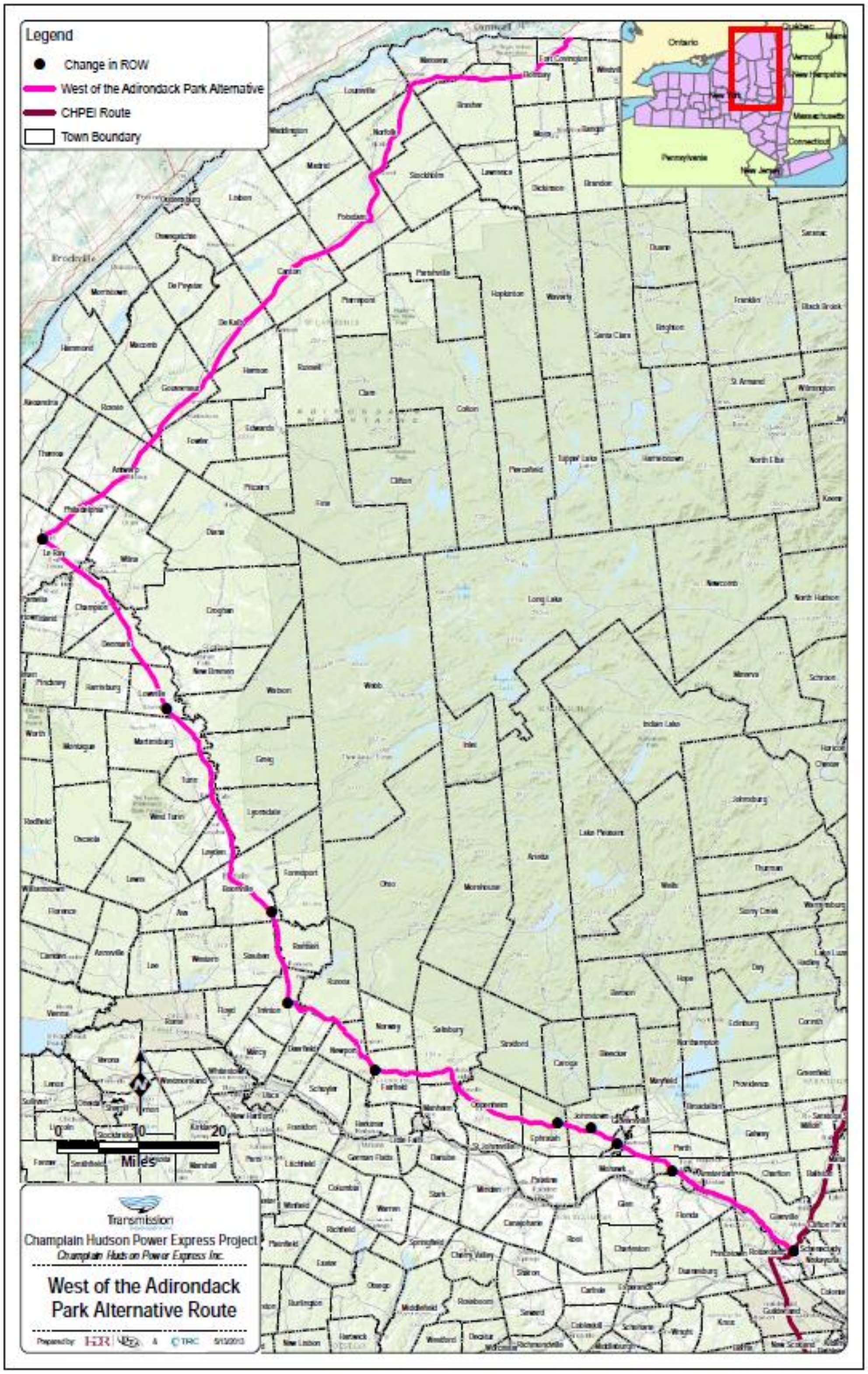


FIGURE 5-2
WEST OF ADIRONDACK PARK EXISTING RIGHTS-OF-WAY ALTERNATIVE



Leaving Lowville, the route would connect into the Route 12 ROW and proceed south for 30.8 miles along this roadway, crossing through, among others, Lewis, Port Levden, Glendale and Boonville. The alternative continues on Route 12 before intersecting with Route 28 in Alder Creek. These two roadways overlap for approximately 11.7 miles until diverging in Trenton.

The alternative would be installed in the Route 28 ROW to the east / southeast for approximately 15.6 miles before intersecting with Route 29 in Middleville.

The Route 29 ROW would be utilized for approximately 27.1 miles before entering Ephratah just after the intersection with Route 10, where Old State Road /Watershed Road and Red School House Road would provide a bypass of the section of Route 29 that enters the Adirondack Park (4.5 miles). Continuing along Route 29, the alternative would transfer from Route 29 to Route 67 in Johnstown after 4.0 miles. The alternative will follow Route 67 for 8.3 miles, overlapping with Route 5 from Fort Johnson to Amsterdam. After 18.6 miles, Route 5 connects to the proposed Project route in Schenectady. The total route length is approximately 247.8 miles.

Logistics

The route would enter the United States near Fort Covington, New York and travel along the railroad corridor primarily through rural areas. Along this route, there are eleven notable water crossings and a wetlands area near DeKalb. The line also passes through a G&W railroad yard. Passing through the towns of Norwood and Potsdam, there are houses in close proximity to the railroad ROW. The crossing of the Racquette River would be complicated by the limited available area on the southern side in which to establish an HDD operation and the presence of the Route 11 bridge abutments. In Canton, the railroad corridor narrows with existing development in close proximity, so that HDDs may be required. The crossing of the Grass River via HDD would be complicated by transmission lines on the northern side of the existing trestles. In Gouverner, towards the center of town, the tracks divide with Route 11 to the west/northwest and existing development to the east/southeast. There are on-going track improvement projects currently underway. The freight rail traffic on this alignment is anticipated to be moderate.

In Evans Mills, the alternative would shift from utilizing a railroad ROW to a series of roadway ROWs. Construction for the first approximately half-mile, as the route leaves the CSX railroad ROW to the Route 46 ROW, will cross through commercial and residential buildings on both sides of the road, resulting in disruption as the cables are installed in the roadway. Route 26 traverses primarily rural countryside with limited development. There are two notable water crossings at Champion and Denmark, which will require special measures. The crossing at Champion may not lend itself to a HDD and the NYSDOT has stated that it will not allow cables to be attached to their bridges. In Lowville, buildings are immediately adjacent to the Route 26 roadway and include residential houses where construction would be disruptive; as a consequence, there will likely be local opposition to this alternative route.

View of Route 26 in Lowville

As with Route 26, Route 12 primarily traverses rural areas with limited development (e.g. Lewis, Port Levden, Glendale). In Boonville, there is a half-mile section where the roadway is bordered on one site by buildings and water bodies on the other. The landscape remains roughly the same after the roadway intersects with Route 28 in Alder Creek and continues southbound, although the roadway widens to four lanes. As the roadway enters Trenton, existing development is located on both sides of the roadways, which is two-lane highway in this area, so that there is not a clear location in which to locate the transmission cables.

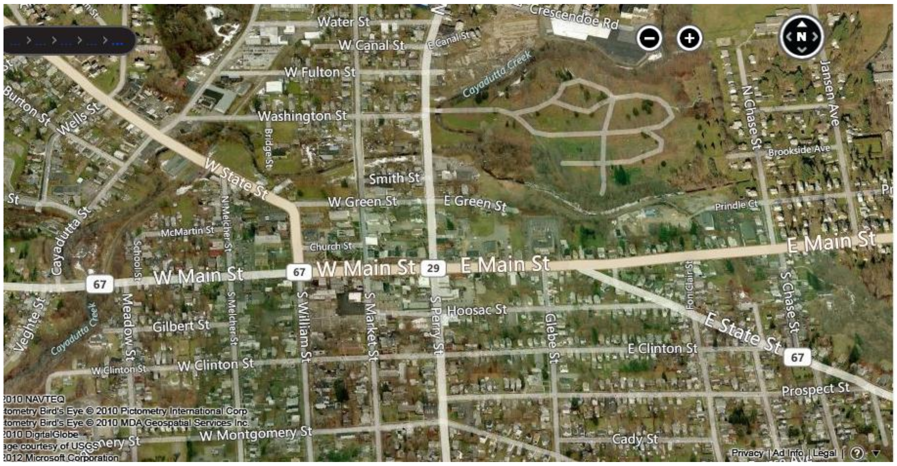
Route 28 primarily travels through rural areas. In centers of Poland, Newport, and Middleville, the roadway is bordered on each side by residential and limited commercial buildings, so that construction associated with installation would be disruptive and may encounter opposition. The construction corridor is particularly constrained in Newport due to the density of buildings adjacent to the roadway.

View of Route 28 in Newport

As with Route 28, residential properties are located on each side of the Route 29 ROW as it moves through the Middletown center. There are smaller communities along this length of this route (e.g. Fairfield, Salisbury Center) where construction will be disruptive to residential homes. More significantly, in Dolgeville, there are closely packed buildings immediately adjacent to the roadway as well as residential houses where construction would be disruptive. Crossing under the East Canada Creek will be severely complicated by the density of buildings on the west side of the waterway.

In Johnstown, the alternative will transfer from Route 29 to Route 67. There is an approximately one-mile segment where residential and commercial buildings are located close together on both sides of the roadway ROWs. There will likely be public opposition to construction in close proximity to homes and businesses, and construction would be further complicated by existing utilities.

View of Routes 29 / 67 in Johnstown



Outside of Johnstown, Route 67 continues the pattern of installation within rural land uses. After intersecting with Route 5, the alternative enters Amsterdam. Construction in this municipality would be severely complicated by the Amtrak railroad line along one side and commercial and residential buildings on the other. This situation is particularly pronounced where Routes 67 and 5 diverge as the existing road networks and buildings occupy all of the likely construction corridors.

Views of Sections of Routes 67 / 5 within Amsterdam

Outside of Amsterdam, installation within the Route 5 roadway would primarily need to be located along the northern side of the roadway due to the railroad to the south. A review of the route using available aerial photography indicates that rock outcrops will occur at sporadic locations along the roadway. In Glenville there are streetlights and transmission poles on both sides of the roadway for approximately a mile so that the cables would need to be installed beneath the state route. A similar situation occurs within Scotia and Schenectady, as utility poles and buildings on both sides of the road would require that installation of the cables occur within the road itself. The construction of the proposed upland alternative to the west of Adirondack Park would likely require, utilizing multiple crews, more than 70 months or 5 years, a more than three-fold increase.

Cost

Only for the purpose of preparing this cost estimate is it assumed that engineering solutions can be developed for all of the listed challenges. Engineering solutions, however, would require discussions with the NYSDOT, G&W, CSX and possibly other short-line owners to secure variances from conventional protocols for construction and installation in their freight rail right-of-way. The most notable engineering challenge appears to be a water crossing at Champion.

The estimated costs per mile for the approximately 240 miles upland section ranges from \$3M/mile to \$6M/mile, as compared to the Project route's 101 miles of marine burial at \$2.9M/mile and 71 miles of upland burial at \$5.3M/mile. The added cost of this alternate is approximately \$512M or 77% higher than the comparable costs for the corresponding Project segment. These estimated costs would result in a net increase to the Project costs of approximately \$512M or a 35% increase from the cost of the Article VII baseline cable installation estimate.

Additional information on the comparative costs is shown in Table 5-1.

Analysis

The proposed routing west of the Adirondack Park entails a 247.8 miles upland section from the Canadian border to Schenectady that passes west of the Adirondack Park along the existing DOT and rail rights-of-way in lieu of the Article VII proposed routing that is principally marine through Lake Champlain and the Champlain Channel. Elimination of the installation of approximately 101 miles of marine cable results in an additional 109 miles of upland cable installation when compared to the Article VII route.

Although the alternative utilizes existing ROWs, there are a number of engineering challenges that would need to be addressed. Specifically, there are a number of water crossings where long HDD installations would be required and, in some locations, there is limited available space to establish an HDD landing area (e.g. Racquette River, Grass River, and East Canada Creek). As the route moves south, it will cross through municipalities (e.g. Johnstown, Amsterdam) where construction would need to occur within close proximity to homes and businesses, which is likely to generate public concern. In certain communities such as Glenville, Scotia and Schenectady, the density of utility infrastructure such as transmission poles and streetlights present on both sides of the roadways will require complicated engineering solutions as well as extensive discussions with local municipalities and NYSDOT.

Moreover, the costs for this alternative represent a significant increase compared to the estimated Project costs. As with the Hudson River Western Rail Route, overland routing presents a number of challenging and costly installation measures including long HDD installations, accommodating narrow work areas, avoiding conflicts with existing utilities, and working in roadways. A buried overland route would represent an approximately 35% increase in the total costs of the Project, making it commercially infeasible. Therefore, this routing is not a practical alternative. As it represents one of the shortest potential routes around the Adirondack Park, all similarly situated routes would also be impractical.

TABLE 5-1
PROPOSED PROJECT AND WEST OF ADIRONDACK PARK OVERLAND ROUTE

Section	Upland or Marine	Distance (Miles)	Cost per mile ($million)	Project Cost ($million)	West of Adirondack Park Cost ($million)
International Border to Dresden	Marine	101.5	2.9	$ 290.7	
Dresden to Rotterdam	Upland	75.5	5.3	$ 396.62	
International Border to Rotterdam	Upland	280	5.0		$1,200.0
Rotterdam to Catskill	Upland	51.2	5.3	$ 268.95	$268.95
Catskill to Stony Point	Marine	67.4	3.5	$ 237.4	$ 237.4
Stony Point to Clarkstown	Upland	7.9	12.7	$ 100.4	$ 100.4
Clarkstown to Bronx	Marine	27.6	4.4	$ 122.6	$ 122.6
Bronx to Astoria Converter site	Upland	2.3	15.0	$ 34.5	$ 34.5

	Project	West of Adirondack Park
Marine Distance (miles)	196.5	95
Upland Distance (miles)	135.5	300
Total Distance (miles)	332.1	395.2
Total Cost ($millions)	$ 1,451.72	$ 1,963.84
Cost Variance from Project for Border to Rotterdam ($millions)		**$ 512.66**
Cost Variance from Project for Border to Rotterdam (%)		**77.2%**
Cost Variance from Project ($millions)		**$ 512.66**
Cost Variance from Project (%)		**35.3%**

Notes:

1. Baseline pricing based on estimate provided by reliable contractor in August 2012.
2. Distances based on segment lengths.
3. Marine costs/mile vary due to sub-bottom conditions, turbidity, installation methods, navigation and other considerations.
4. Estimate assumes that engineering solutions and CSX concurrence can be secured for challenging conditions.
5. Engineering solutions to some challenges may not be obtainable.

5.2.2 East of Hudson River

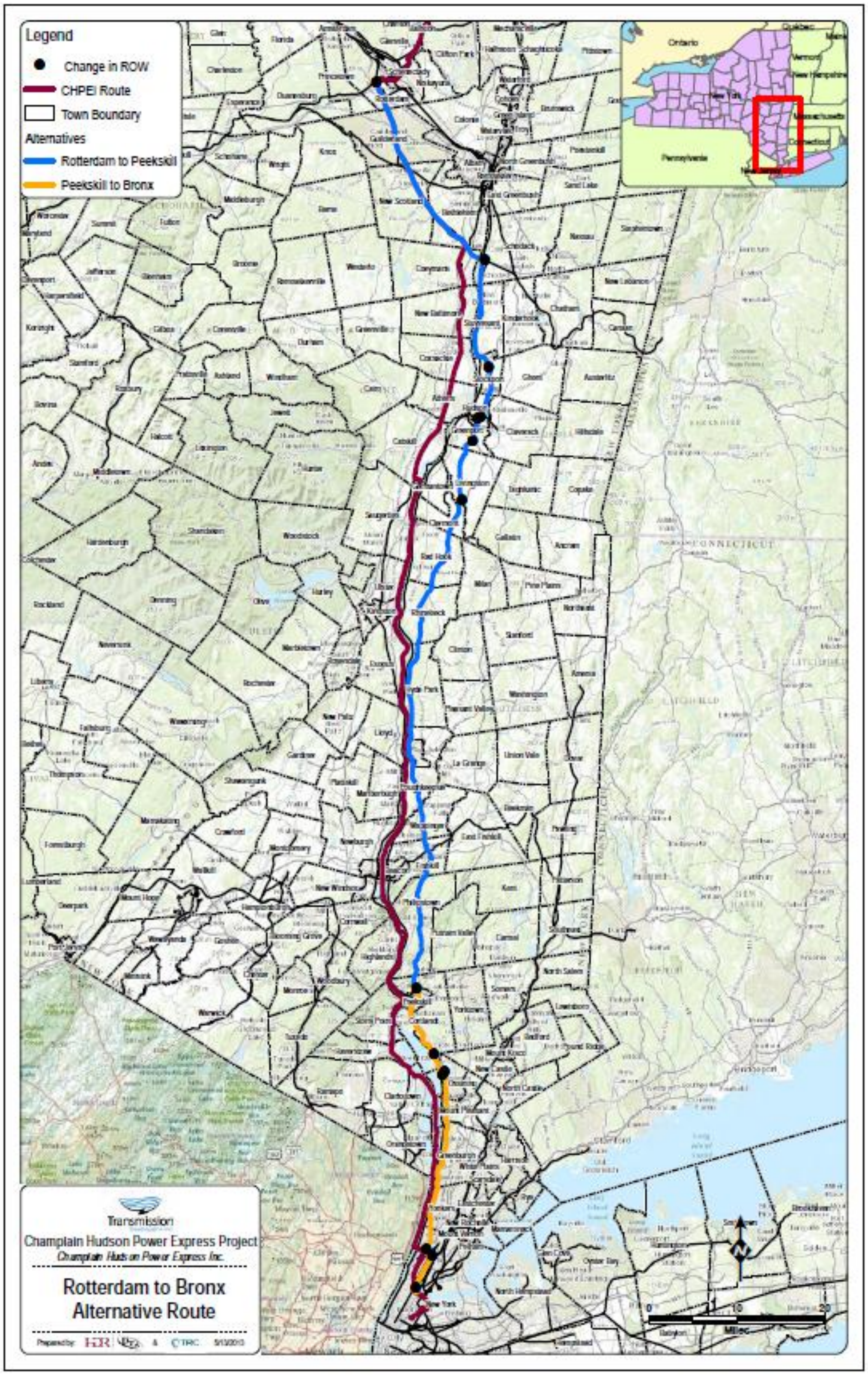
The East of Hudson River proposed alternative would follow the Project route along the CP railroad until it connects to the CSX railroad in Rotterdam and travels 24.7 miles southeast past Selkirk, where it crosses under the Hudson River. The alternative would enter the Route 9J ROW and travel south for 13.3 miles before intersecting with Route 9 in Stockport. Following Route 9 south for 6.1 miles to Greenport, the alternative would shift to Prospect Avenue (0.4 miles) and then back onto Route 9 south for 2.7 miles until reaching the intersection with Route 23. The alternative would be in the Route 31 South ROW for 7.5 miles before connecting again to Route 9 south in Blue Store. The route would be located in the Route 9 south for 60.1 miles, travelling through Nevis, Red Hook, Rhinebeck, Staatsburg, Hyde Park, Poughkeepsie, Wappingers Fall, North Highland and Graymoor. In Annsville, the alternative would follow the Old Albany Post Road into Peekskill as Route 9 becomes a parkway at the intersection with Routes 202 and 6.

In Peekskill, the alternative route would travel south along Highland Avenue, Route 63 / North Division Street, and South Street. South Street transitions to Lower South Street, which connects into Route 9A / Albany Post Road. The alternative would continue for 9.3 miles along Route 9A until Croton, where it would enter the Amtrak ROW for 2.7 miles utilizing Municipal Place and Half Moon Bay Drive before Route 9A shifts onto the Route 9 parkway. In Ossining, the route would connect to Route 9 via Snowden Avenue (0.6 miles).

Following Route 9 south for 21.3 miles the alternative would cross through Sleepy Hollow, Tarrytown, Irvington, Dobbs Ferry, and Yonkers. In Marble Hill to the north of the Harlem River, the alternative would travel south along Route 9 before crossing into Exterior Street, then it would travel east/southeast along West Kingsbridge Road for 1.2 miles to the Grand Concourse. Travelling south along the Grand Concourse, the alternative would be installed for 4.2 miles before intersecting with E 138th Street. Following E 138th to the east, the alternative would connect with Lincoln Avenue and, travelling south, connect to the current Project route (0.8 miles).

Figure 5-3 shows the proposed routing.

FIGURE 5-3
EAST OF HUDSON RIVER EXISTING RIGHTS-OF-WAY ALTERNATIVE



Logistics

The proposed east of the Hudson River route entails a routing similar to the Project route through Selkirk, where the line includes a challenging cross-Hudson River horizontal directional drill (HDD) of almost a mile in length. This HDD under these conditions may be a first of its kind and will have a notable price premium due to its inherent technical difficulty.

Route 9J is primarily located in a rural area with little development other than residential houses and the railroad line to the west. However, there are locations with municipalities such as Schodack and Stuyvesant where buildings are located immediately adjacent or in close proximity to the roadway where there is likely to be public opposition to construction in close proximity to homes and businesses. Route 9 is similarly predominantly set in an area with a low density of development. In Stottville center, transmission lines are located on the western side of the road and residential houses are located in close proximity to the roadway ROW. Within Greenport proper, there are significant stretches of ROW with utility poles on both sides of the roadway and development abutting the roadway, so that construction would need to occur in the roadway itself. Prospect Avenue also has utilities poles and buildings along both sides of its ROW before reconnecting with Route 9.

South of Greenport, the primary land use is rural and residential, but there is a continuous line of utility poles located on one side of the road with sporadic features (e.g. transmission poles, trees, buildings) along the other. A similar network of utility poles is found along Route 31, although the poles are on occasion located some distance from the road.

In Blue Store, the route transfers back to Route 9. As with earlier segments, there is a low density of development. Utility poles are located along the majority of the route with other features (e.g. houses, buildings, additional utility poles) periodically being located on the other side, thereby presenting routing concerns. In the center of municipalities such as Red Hook, Rhinebeck, and Hyde Park, houses are located more closely together in near proximity to the roadway so there may be public opposition to construction in close proximity to homes and businesses.

Views of Section of Route 9 within Red Hook

In Poughkeepsie, installation would be logistically demanding. The route passes through an urban area with a number of grade separations and water crossing (i.e., Sprout Brook) which will entail six to ten HDDs, as well as the other challenges of underground work in heavily trafficked roadways. The road becomes a two-way highway with development located adjacent to the ROW. The intersection of Routes 44 and 55 and Route 113 with Route 9 would pose significant challenges as construction will need to be sited so as to not affect the structural integrity of the extensive road and bridge network in this location. Further south, there is a one mile segment of road occupied by area businesses within and serving the South Hills Mall and Poughkeepsie Galleria. The high volume of traffic in this area would present safety concerns. This segment ends with a cloverleaf intersection of Routes 9 and 113, which poses the same concerns as the earlier intersection with Routes 44 and 55 in terms of siting so as to avoid impacts to the transportation structures.

Views of Section of Route 9 within Poughkeepsie

South of Poughkeepsie, the route traverses another forty-two (42) miles through suburban areas to Peekskill, through Tarrytown and Sleepy Hollow before its final section to New York City. Route 9 has a mix of open areas and commercial development, with utility poles largely eliminating half of the potential construction corridor. As the route enters into Peekskill, residential homes and some commercial buildings are densely packed and close to the road. This trend is found along Highland Avenue, North Division Street, and the upper portion of South Street. Development is still present but not as dense along Lower South Street and Route 9A.

In Croton, Route 9A is bordered by residential homes on the north/northeast and Route 9 to the south/southwest. Installation in this area would be complicated due to the presence of buildings and the roadway structures. Installation within the Municipal Place ROW would require consideration of the supporting structures for Route 9, which crosses over the roadway. The Amtrak facilities are located to the south of the intersection of the railroad ROW with Half Moon Bay Drive, thereby limiting installation to beneath a busy parking lot.

The cables would cross the Croton River, which will require another notably long HDD with limited work areas. After crossing the Croton River, the railroad ROW is closely bounded to the west by the Hudson River. Installation in this segment would be significantly slower as work would need to stop each time a train passed on one of the two sets of track. Snowden Avenue has a moderate level of residential development while Route 9 has a high density of homes and businesses as it extends through Ossining, as well as utility poles and other features on both sides of the roadway. With regard to construction in close proximity to homes and businesses, the NYRI experience suggests there may significant opposition to a disruption that is perceived to primarily benefit the City of New York.

South of Ossining, Route 9 primarily traverses residential and light commercial zones. Utility poles tend to be located along only one side although they can shift to service individual buildings or side roads. In a portion of Mount Pleasant, Rockefeller State Park borders the roadway to the east while a wall and transmission poles are located immediately to the west.

As the route transitions into first Sleepy Hollow and then Tarrytown, there is increased development on both sides of Route 9. There are also locations listed as public parks, where the Applicants would be unable to obtain access rights for a private venture.[155] Route 9 crosses the New York State Thruway (287/87) via a bridge. As the NYSDOT would not allow collocation on their bridges,[156] the Applicants would need to obtain authorization to cross under the federal interstate so as to not affect the integrity of the road system. Immediately south of the New York State Thruway intersection is a segment with parklands to the west and utility poles to the east of Route 9.

South of Tarrytown, Route 9 experiences a pattern of crossing through residential areas with utility poles occupying one side of the road with the occasional obstruction on the other, then a higher level of development density as it crosses through municipalities such as Dobbs Ferry and Hastings-On-Hudson. In these more urban areas installation would be complicated by close development and multiple situations where utility or traffic features are on both sides of the roadway. Public opposition to the Project would also be more likely to develop. Development within Yonkers is located particularly close to the road, so that it would be necessary to install beneath the pavement for most of this segment.

As the line approaches New York City, there are increasing engineering challenges. Due to existing structures, utilities, and heavy traffic a number of HDDs would be required. As Route 9 enters the Bronx, Van Cortlandt Park is located to the east and development borders the western side of the road, as well as the Henry Hudson Parkway crossing. At the intersection of Manhattan College

155 *See, e.g., Friends of Van Cortlandt Park v. City of New York*, 95 N.Y.2d 623, 631-32 (2001) ("[O]ur law is well settled: dedicated park areas in New York are impressed with a public trust for the benefit of the people of the State. Their use for other than park purposes, either for a period of years or permanently, requires the direct and specific approval of the State Legislature, plainly conferred.") (internal quotations omitted). See http://www.law.cornell.edu/nyctap/I01_0003.htm.

156 Article VII Updated Alternatives Analysis at 5.

Parkway and Route 9, a series of buildings occupy the area to the west of the road followed by the MTA rail tracks. As the road travels south, the MTA continues to occupy the area to the west.

View at intersection of Manhattan College Parkway and Route 9

As the alternative traverses Exterior Street, West Kingsbridge Road, and Grand Concourse, development continues to be densely packed. Further complicating installation is the City of New York's extensive utility network. To put this issue in perspective, for the three (3) mile connection between the Astoria Substation to the Rainey Substation, the City of New York identified only one routing alternative which would, in the City's opinion, accommodate its requirements in terms of the safety and reliability of their existing infrastructure.[157] It is unlikely that a similar pathway could be identified along or in close proximity to this proposed alternative. The alternative as presented would then follow E 138th Street to Lincoln Avenue before connecting into the current Project route. However, as with the earlier segment, the City of New York's utility network as well as the railroad and road infrastructure, may require that the final routing would need to follow a less direct pathway with a commensurate increase in the construction duration.

157 Alternatives Analysis for AR Cable, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City*, Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={4E927BAD-DD51-4E89-AA31-9B856BC95FA8}.

This alternative entails an additional estimated 25 miles to the overall route and an increase of the direct burial portion of approximately 120 miles; both increases contribute to a longer construction schedule than what had been anticipated for route described in the Article VII submission. The construction of the proposed upland alternative to the east of the Hudson River would likely require, utilizing multiple crews, more than 50 months or 4 years.

Cost

Notwithstanding the identified logistical issue that make this alternative impractical, the estimated costs per mile for the approximately one hundred fifty-five (155) miles upland section from Selkirk to the Bronx ranges from $4.9 to $19.2M/mile, as compared to Project route's ninety-five (95) miles of marine burial at $3.5 to 4.4M/mile and thirty-five (35) miles of upland burial at $5.3M/mile. For comparable sections from Selkirk to the Bronx, the East of the Hudson upland route represents an approximately 83% increase in costs compared to the baseline route. These estimated costs result in a net increase to the Project costs of approximately $508M or a 35% increase from the cost of the Project's installation estimate.

Additional information on the comparative costs is shown in Table 5-2.

TABLE 5-2
PROPOSED PROJECT AND EAST OF HUDSON RIVER ROUTE

Section	Upland or Marine	Distance (Miles)	Cost per mile ($million)	Project Cost ($million)	East of Hudson River Cost ($million)
International Border to Dresden	Marine	101.5	2.9	$ 290.7	$ 290.7
Dresden to Catskill	Upland	126.8	5.3	$ 666.12	
Dresden to Selkirk	Upland	98.5	5.3		$ 517.45
Selkirk to Castleton-on-the-Hudson (HDD)	HDD	0.95	12.0		$11.36
Castleton-on-the-Hudson to Poughkeepsie	Upland	72.2	4.9		$ 353.78
Catskill to Stony Point	Marine	67.4	3.5	$ 237.4	
Poughkeepsie to Peekskill	Upland	42.1	5.6		$ 235.76
Stony Point to Clarkstown	Upland	7.9	12.7	$ 100.4	
Clarkstown to Bronx	Marine	27.6	4.4	$ 122.6	
Peekskill to Yonkers	Upland	26	9.5		$247.0
Yonkers to Bronx	Upland	14	19.2		$ 268.8
Bronx to Astoria Converter site	Upland	2.3	15.0	$ 34.5	$ 34.5

	Project	East of Hudson River
Marine Distance (miles)	196.5	101.5
Upland Distance (miles)	135.5	255.65
Total Distance (miles)	332.1	357.15
Total Cost ($millions)	$ 1,451.72	$ 1,959.36
Cost Variance from Project for Selkirk to Bronx ($millions)		**$ 507.64**
Cost Variance from Project for Selkirk to Bronx (%)		**83.0%**
Cost Variance from Project ($millions)		**$ 507.64**
Cost Variance from Project (%)		**35.0%**

Notes:
1. Baseline pricing based on estimate provided by reliable contractor in August 2012.
2. Distances based on segment lengths.
3. Marine costs/mile vary due to sub-bottom conditions, turbidity, installation methods, navigation and other considerations.
4. Estimate assumes that engineering solutions and CSX concurrence can be secured for challenging conditions.
5. Engineering solutions to some challenges may not be obtainable.

Analysis

The logistical challenges posed by this approximately one hundred fifty-five (155) mile upland alternative would be similar to those of the previous alternatives but even more intensive in scope. Beginning with the HDD installation under the Hudson River, the routing would traverse several small communities where the construction would need to occupy their downtown areas. South of Greenport along Route 9, utility poles occupy one side of the roadway while the periodic presence of other features (e.g. houses, buildings, additional utility poles) on the opposite would limit installation options. The route crosses a number of municipalities such as Red Hook, Rhinebeck, Hyde Park, Poughkeepsie, Tarrytown, Sleepy Hollow and Croton where the density of development along the road will require construction in near proximity residences and businesses. The engineering challenges and likelihood of public opposition increase as the route approaches and enters the Bronx, as the complexity of land uses and existing utility networks will result in a protracted construction period. Resolving all of the engineering issues associated with this alternative would require discussions with an extensive number of state, local and private agencies.

Moreover, the complex engineering solutions necessitated by these concerns would significantly affect costs. The proposed route east of the Hudson River would increase overall Project costs by approximately 35% as the alternative would add an estimated $507.64 million to construction costs. Therefore, this routing is not a practical alternative as the costs would be unreasonably high, particularly for a merchant transmission line. Moreover, as it represents an almost directly southern route to the east of the Hudson River, it demonstrates that other routes of this type would be similarly impracticable.

5.3 Overland Using New Power Line Route

A new power line route was developed with extended 1) west of Adirondack Park; and 2) east of the Hudson River.

Logistics

In the State of New York, the development of new power line rights-of-way must be considered in the context of the recent NYRI project. Section 1.1.2 describes the opposition that arose from local groups, politicians, businesses and others. One of the key elements of this opposition was NYRI's proposal to utilize eminent domain to obtain required lands, as evidenced by legislation signed by Governor George Pataki limiting the use of eminent domain to acquire rights-of-way .[158]

Cost

To demonstrate the potential costs of an overland route utilizing a new power right-of-way, Figure 5-4 shows an alternative route which approximately represents the shortest reasonable overland route that connects into New York City. The routing was based on the following assumptions:

1. The route would be within the state of New York, so it would need to be installed to the west of Adirondack Park.

[158] Fritz Mayer, *Citizen Groups Still Fighting NYRI*, The River Reporter (Nov. 9, 2006), http://www.riverreporter.com/issues/06-11-09/head2-nyri.html.

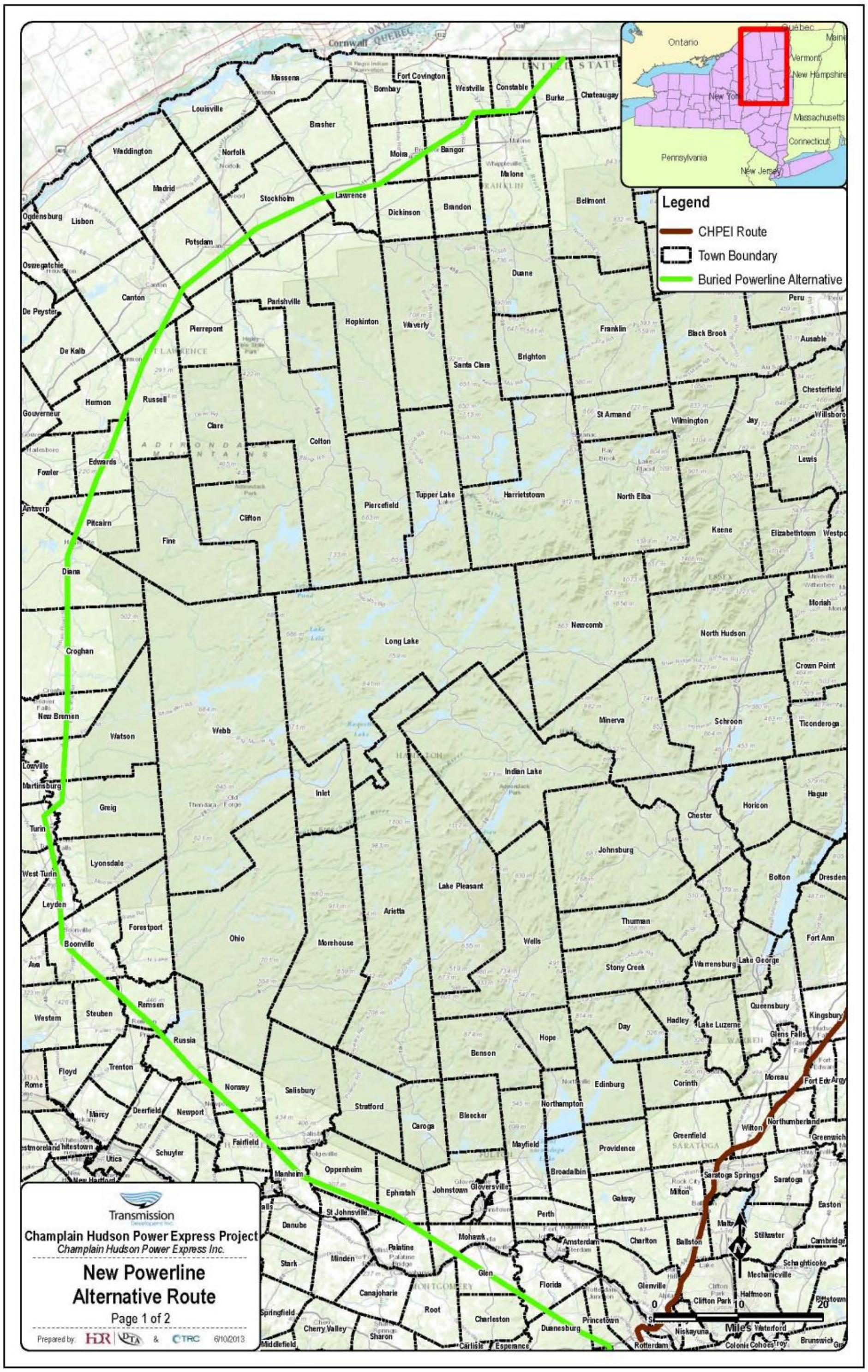
2. The overhead lines would not be acceptable within the close proximity to the Catskill Mountain region and could not cross into the Catskill Park.
3. The cable system would avoid developed areas such as village or town centers, due to the higher construction costs associated with burying the cables.

Costs for the buried routing include higher unit rates due the nature of the work, likelihood of HDDs for multiple water and street crossings, as well as the likelihood of rock excavation and difficult terrain. The estimated costs per mile for the approximately 385 miles of buried cable from the Canadian Border to the Bronx ranges from $5 to $15M/mile or an average of $6.4M/mile, as compared to the comparable aggregate cost of $4.4M/mile for the Project route. Extending these estimated costs results in a net increase to the Project costs by approximately $1.14B or a 79% increase from the cost of the Project's cable installation estimate.

This alternative entails an additional approximately 50 miles to the overall route and an increase of the direct burial portion which contributes to a longer construction schedule than what had been anticipated for route described in the Article VII submission. The construction of the proposed upland alternative to the west of Adirondack Park and east of the Hudson River would likely require, utilizing multiple crews, at least 67 months or more than 5 years.

Additional cost information for a new power line that is installed to west of the Adirondack Park and east of the Hudson River is shown in a Table 5-3.

FIGURE 5-4
ILLUSTRATIVE OVERLAND NEW POWER LINE ALTERNATIVE



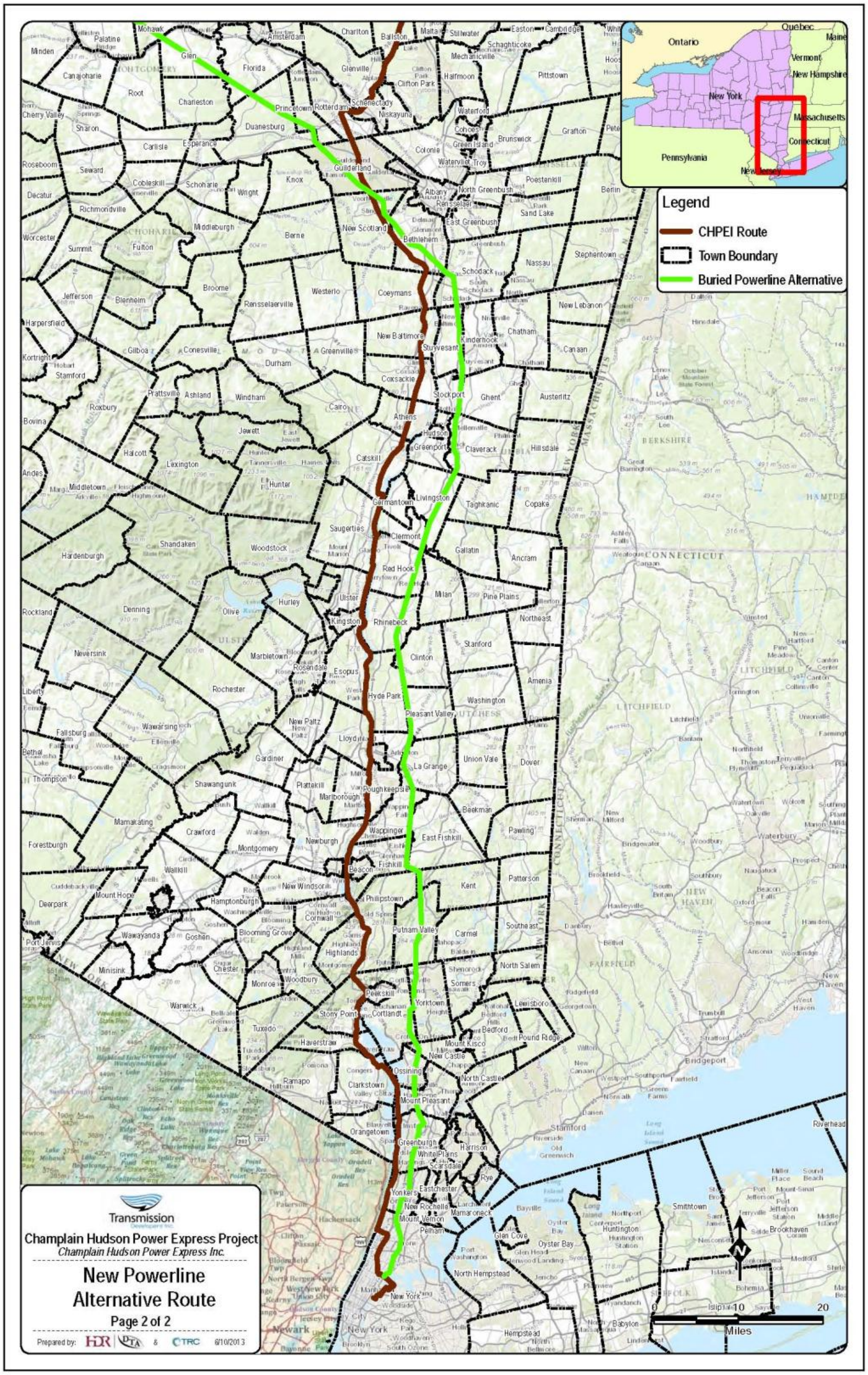

Legend
CHPEI Route
Town Boundary
Buried Powerline Alternative
Transmission
Champlain Hudson Power Express Project
Champlain Hudson Power Express Inc.
New Powerline
Alternative Route
Page 2 of 2
Prepared by:
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TABLE 5-3
PROPOSED PROJECT AND NEW POWER LINE TRANSMISSION ROUTE

Section	Upland or Marine	Distance (Miles)	Cost per mile ($million)	Project Cost ($million)	New Power Route Cost Buried ($million)
International Border to Dresden	Marine	101.5	2.9	$ 290.7	
International Border to Greenbush	Upland	256	5.0		$ 1,280
Greenbush to Poughkeepsie	Upland	64	5.2		$ 332.8
Dresden to Catskill	Upland	126.8	5.3	$ 666.12	
Catskill to Stony Point	Marine	67.4	3.5	$ 237.4	
Stony Point to Clarkstown	Upland	7.9	12.7	$ 100.4	
Clarkstown to Bronx	Marine	27.6	4.4	$ 122.6	
Poughkeepsie to Bronx	Upland	64	14.8		$ 947.2
Bronx to Astoria Converter site	Upland	2.3	15.0	$ 34.5	$ 34.5

	Project	New Power Route Cost Buried
Marine Distance (miles)	196.5	0
Upland Distance - Buried (miles)	135.5	385.8
Total Distance (miles)	332.1	385.8
Total Cost ($millions)	$ 1,451.72	$ 2,594.5
Cost Variance from Project ($millions)		**$ 1,142.8**
Cost Variance from Project (%)		**78.7%**

Notes:
1. Baseline pricing based on estimate provided by reliable contractor in August 2012.
2. Distances based on segment lengths.
3. Marine costs/mile vary due to sub-bottom conditions, turbidity, installation methods, navigation and other considerations.
4. Estimate assumes that engineering solutions and CSX concurrence can be secured for challenging conditions.
5. Engineering solutions to some challenges may not be obtainable.

Analysis

As this alternative was developed as a demonstration of the likely costs associated with a new power line, no assessment was completed as to the engineering challenges that would be encountered along the routing. However, this alternative likely would need to employ at least some long and difficult HDD installations similar to the routes west of Adirondack Park and east of the Hudson River. More importantly, this type of routing would require agreements with hundreds of landowners and/or condemnation through eminent domain along its entire length to develop the necessary easement corridor. The previously discussed NYRI project encountered significant public and political opposition to the use of eminent domain (even though the majority of the proposed route was in an existing ROW), which led to legislation curtailing NYRI's use of that power. If a similar level of opposition developed for this Project, even a small group of determined landowners could block the Project or require costly re-routings.

In addition, the proposed route west of Adirondack Park and east of the Hudson River would increase overall Project costs by approximately 79% as the alternative would add an estimated $1.14 billion to construction costs. This increase represents only construction costs and not the multiple landowner agreements that would need to be established. Therefore, this routing is not a practical alternative. Moreover, as it represents an almost directly southern route to the west of the Adirondack and the east of the Hudson River, it demonstrates that other routes of this type would be similarly impracticable.

Section 6
Other Alternatives Considered

The following alternatives were not requested by the USACE, but were considered as part of the extensive alternatives analysis undertaken as part of the New York State siting and permitting process and so, consistent with the Guidelines,[159] are presented as part of this assessment.

6.1 Overhead Alternative

6.1.1 Overhead Installation

The overhead transmission system alternatives considered in this analysis would all utilize a bipolar configuration, consisting of two conductors per pole (one positive and one negative) and a ground wire. In general, conductors would have a spacing of approximately 18 inches apart, and each conductor would have an overall diameter of approximately 1.75 inches. A metallic return conductor with a fiber optic core would be installed in the shield wire position above the electrical pole conductors to provide protection against lightning strikes. The return conductor would also provide a communication path between converter stations. A separate shield wire may be necessary on towers with a horizontal arrangement.

Several different transmission tower configurations may be utilized for overhead alternatives. In general, the potential transmission tower types can be defined as "lattice" or "monopole" designs. Lattice towers are constructed of galvanized steel and are assembled on site. These freestanding towers are widely used as transmission line support structures across the United States. Lattice towers have a relatively wide base, and their design requires greater clearance along rights-of-way. Their larger size and framework design make lattice towers suitable for areas where the visual/aesthetic impacts of tower installation are not a significant concern and for locations where adequate right-of-way easements can be acquired. The modular design of lattice towers makes them an economical choice for large-scale transmission lines linking distant endpoints.

[159] 230.10(a)(5). (Stating, in part, "[t]o the extent that practicable alternatives have been identified and evaluated under a Coastal Zone Management program, a § 208 program, or other planning process, such evaluation shall be considered by the permitting authority as part of the consideration of alternatives under the Guidelines.") See http://www.wetlands.com/epa/epa230pb.htm.

In contrast to the lattice design, monopole towers have a single-shaft, tubular structure. Because of their smaller footprint, monopole towers are well-suited to right-of-way locations where space is limited. Overall, monopole towers are less obtrusive and offer aesthetic benefits over conventional lattice tower designs. Notwithstanding these benefits, monopole towers tend to be more expensive;[160] one transmission study estimated that the total costs for monopole towers were 25% higher than for lattice towers.[161]

The specific height and design of each monopole or lattice tower would be determined by the angle of the conductor bundles, the span between towers, and the topography. In general, the lattice or monopole steel support structures for +/-320-kV would be expected to vary from approximately 65 to 135 feet in height, although some configurations require greater than 150 feet in height. Spans would range from 600 to 700 feet between monopole towers and 800 to 1,000 feet between lattice towers.

The width of the transmission line's permanent right-of-way is generally determined by the voltage of the system, to provide for adequate setbacks, maintenance and other concerns. A review of existing projects indicates that typical widths of existing 115-kV rights-of-way are approximately 90 to 130 feet wide. In comparison, +/- 320-kV rights-of-way (which would be the voltage of the Project) are typically about 150 feet wide. The transmission line clearing for construction purposes is dependent on the type of tower, topography, span, location, existing utility rights-of-way, and other factors. The precise rights-of-way would vary along sections of the lines. Vegetation-clearing activities along the rights-of-way may include cutting, grubbing, or other mechanized/hand-clearing techniques of shrubs and trees, as well as the removal of "danger trees" that could potentially damage the conductors. Vegetation management practices would continue after construction to ensure that the rights-of-way are maintained and that trees posing a threat of danger to the line are eliminated.

Access roads, lay-down areas, wire-pulling sites, and turnaround areas would also be required along the transmission line to facilitate construction equipment and vehicles. These areas would

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[160] Fabrimet, *Advantages of Lattice Towers*, http://www.fabrimet.com/advantages-lattice-towers.html (last visited Apr. 22, 2013).

[161] Joseph J. Seneca, Michael L. Lahr, James W. Hughes & Will Irving, *Economic Impacts on New Jersey of Upgrading PSE&G's Susquehanna-Roseland Transmission System* (May 2009), http://www.pseg.com/family/pseandg/powerline/pdf/rutgersjobreport.pdf.

need to be cleared of vegetation (i.e. shrubs and trees), and additional material may be deposited to ensure that access roads remain passable throughout construction. Trenching may also be necessary along the margins of access roads to avoid rutting.

Each transmission tower location would require a concrete foundation to ensure structural stability of the towers. The specific foundation requirements would be dependent on the geotechnical conditions at each tower location. Foundation size and depth would be decided based on the type of tower structure, load bearing capacity of soils, and other factors. For installation in areas of rock outcroppings, anchor bolts may be installed and a concrete pad poured over and around these anchors. At other locations, steel caissons may be necessary to create a dry work area that would allow concrete to be poured. Combinations of these techniques may be utilized to install foundations in areas where rock is encountered below grade.

6.1.2 Overland Using Existing Power Line Routes Alternatives

An alternative using existing power line ROWs was considered. Based on the U.S. Census Bureau's TIGER (Topologically Integrated Geographic Encoding and Referencing) data files (see Figure 6-1), there is an existing utility ROW network which circumvents the Adirondack Park to the west. From Montreal, an existing 765-kV transmission line travels southwest toward a substation in Massena, New York. The New York Power Authority (NYPA) owns a 765-kV transmission line corridor that extends from Massena to a substation in Marcy, New York. A 345-kV transmission corridor owned by National Grid continues toward the Pleasant Valley substation in Dutchess County, New York. South past the Pleasant Valley substation, a 345-kV transmission line owned by Con Edison connects into the greater Manhattan area. The total length of these connecting ROWs is approximately 430 miles from the Hertel substation near Montreal, Canada to Manhattan, New York and it is shown on Figure 6-2.

FIGURE 6-1
EXISTING TRANSMISSION LINES AS SHOWN ON TIGER FILES

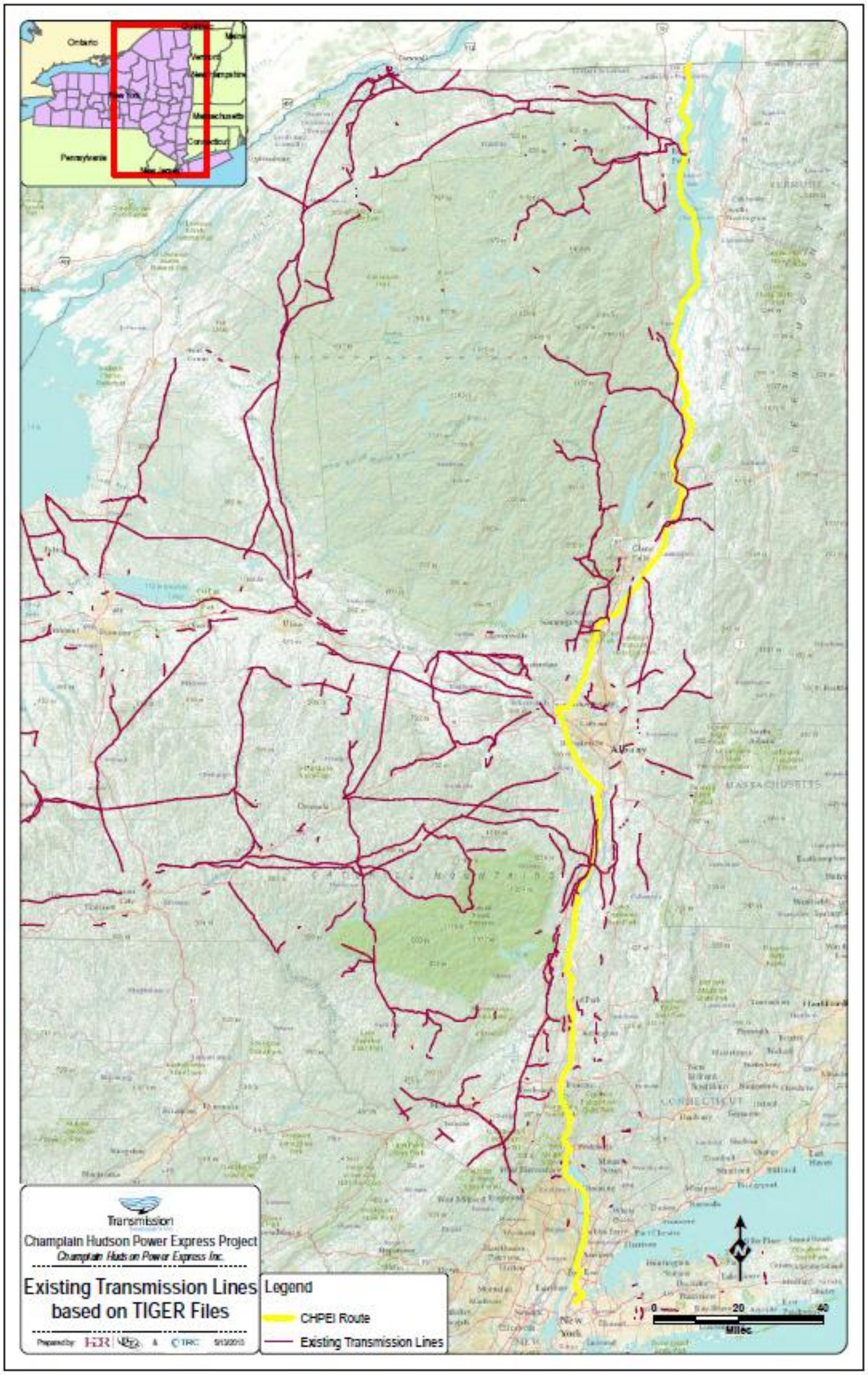
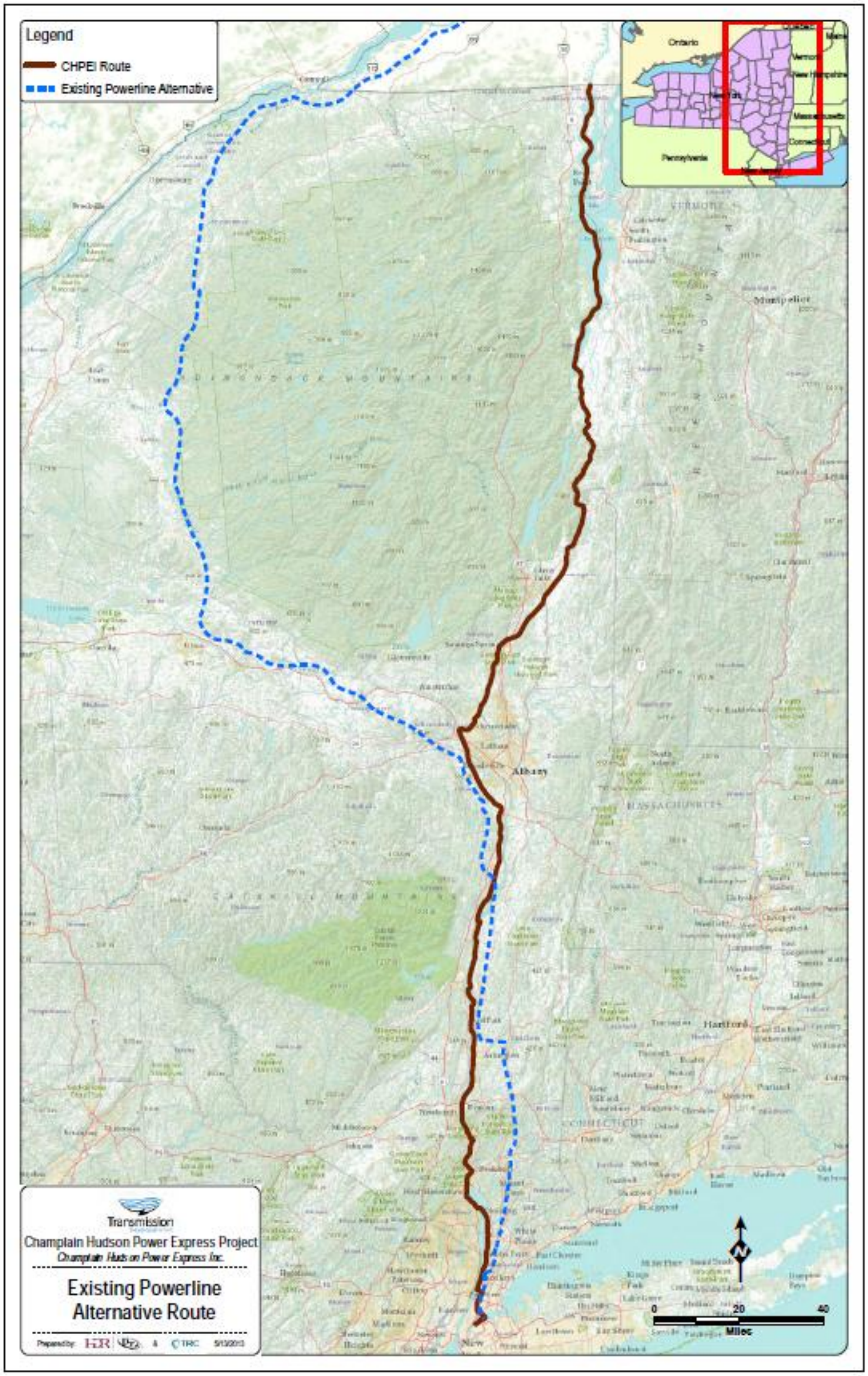


FIGURE 6-2
ALTERNATIVE USING EXISTING TRANSMISSION LINES



Logistics

As part of an alternatives analysis requested by the NYSDOS,[162] the Applicants spoke with the three utilities who own the ROWs under discussion. NYPA stated that it did not believe it would have the ability to grant the necessary long term land interests. Under the New York State Public Accountability Act of 2005 ("PAAA"), any public authority seeking to dispose of real property (i.e. transfer title or any other beneficial interest including a long-term lease) must conduct a public auction unless certain limited exceptions apply.[163] As part of the auction process, an explanatory statement detailing why the property is unneeded or unwanted must be transmitted to the State Comptroller, the Director of the Budget, the Commissioner of General Services, and the State Legislature not less than 90 days in advance of such disposal.[164] PAAA permits a private disposition if "the purpose of the transfer is within the purpose, mission, or governing statute" of the authority, if the Governor and the two houses of the legislature all sign off on the transfer, and if the private disposition is "otherwise authorized by law.".[165] Seeking approval of the Governor and the two houses of the legislature is impractical, and no party has attempted to utilize this exception since the PAAA was enacted.

In addition, in the NYRI proceeding a NYPA representative provided testimony that, "the Power Authority would not grant any permit or permission to conduct activities on its permanent easement that the Power Authority determined would or potentially could adversely impact the Power Authority's present facilities and operations or future development options on the Marcy South Line right-of-way."[166]

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162 *See* Article VII Updated Alternatives Analysis.

163 New York State Public Authorities Law Section 2897(3). See http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+&QUERYDATA=@LLPBA+&LIST=LAW+&BROWSER=EXPLORER+&TOKEN=50318073+&TARGET=VIEW.

164 New York Power Authority, Guidelines and Procedures for the Disposal of Real Property at § 5.4, 5.5 (Mar. 21, 2013), http://www.nypa.gov/doingbusiness/RealProperty2013/2013%20Disposal%20Guidelines%20-Clean.pdf.

165 New York State Public Authorities Law Sections 2897(7) (ii) and (iii) and 2896(6)(c)(vi). See http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+&QUERYDATA=@LLPBA+&LIST=LAW+&BROWSER=EXPLORER+&TOKEN=50318073+&TARGET=VIEW.

166 Direct Testimony of Witnesses for the Power Authority of the State of New York at 3, *Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII for a high voltage direct current electric transmission line running between National Grid's Edic Substation in the Town of Marcy, and Central Hudson Gas & Electric's Rock Tavern Substation located in the Town of New Windsor*, Case No. 06-T-0650 (N.Y. P.S.C. Jan. 9, 2009). Accessed on-line on April 18, 2013 at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={EF6A91DC-A71A-44F5-A1DC-B2855A9DDFE4}.

NYRI further testified that because the Power Authority's permanent easements for its Marcy South Line were taken by appropriation by the People of the State of New York, the Power Authority may be precluded from transferring or conveying any rights to its Marcy South right-of-way to a private party.[167] Presuming that the Power Authority had such a legal right, the representative stated, the Power Authority Trustees could not convey a real property interest that would adversely impact the Power Authority's ability to maximize the benefits of its transmission assets.[168]

National Grid also expressed concern regarding the impact the proposed Project would have on their system reliability and potential expansion of their own facilities within the ROW.[169] A representative of Con Edison stated that for safety and reliability reasons they would not want the cables installed in near proximity to their tower foundations.[170] In addition, Con Edison's transmission lines within Westchester County are buried and its representative did not believe Con Edison could grant the right to use their ROW to a separate private entity.[171]

Cost

While this assessment was not completed under the Article VII process, the Applicants did develop costing information for the purposes of understanding the cost differential between the Project route and an overhead transmission system. The New Power Line alternative discussed in Section 5.3 was modified to assume overhead installation, with concept-level estimated costs assuming routing where 80% of the line is overhead and 20% is buried within heavily developed areas. Lattice structural steel towers were assumed, as the costs for monopoles are typically 20-25% higher. The comparative costs are shown in Table 6-1.

[167] *Id.* at 4.
[168] *Id.*
[169] Article VII Updated Alternatives Analysis at 3, *Application of Champlain Hudson Power Express, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the PSL for the Construction, Operation and Maintenance of a High Voltage Direct Current Circuit from the Canadian Border to New York City,* Case No. 10-T-0139 (N.Y. P.S.C. Feb. 24, 2012), http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={1376106E-8A60-4BC8-B601-EA7C43ECC0BB}.
[170] *Id.*
[171] *Id.*

TABLE 6-1
PROPOSED PROJECT AND NEW POWER LINE TRANSMISSION ROUTE

Section	Upland or Marine	Distance (Miles)	Cost per mile ($million)	Project Cost ($million)	New Power Route Cost 80% Overhead/ 20% Buried ($million)
International Border to Dresden	Marine	101.5	2.9	$ 290.7	
International Border to Greenbush	Upland	256	3.2		$ 819.2
Greenbush to Poughkeepsie	Upland	64	4.2		$ 268.8
Dresden to Catskill	Upland	126.8	5.3	$ 666.12	
Catskill to Stony Point	Marine	67.4	3.5	$ 237.4	
Stony Point to Clarkstown	Upland	7.9	12.7	$ 100.4	
Clarkstown to Bronx	Marine	27.6	4.4	$ 122.6	
Poughkeepsie to Bronx	Upland	64	10.0		$ 640.0
Bronx to Astoria Converter site	Upland	2.3	15.0	$ 34.5	$ 35.5

	Project	New Power Route Cost Buried
Marine Distance (miles)	196.5	0
Upland Distance - Buried (miles)	135.5	385.8
Total Distance (miles)	332.1	385.8
Total Cost ($millions)	$ 1,451.72	$ 1,762.5
Cost Variance from Project ($millions)		**$ 310.77**
Cost Variance from Project (%)		**21.4%**

Notes:
1. Baseline pricing based on estimate provided by reliable contractor in August 2012.
2. Distances based on segment lengths.
3. Marine costs/mile vary due to sub-bottom conditions, turbidity, installation methods, navigation and other considerations.
4. Estimate assumes that engineering solutions and CSX concurrence can be secured for challenging conditions.
5. Engineering solutions to some challenges may not be obtainable.

Analysis

For the purpose of exploring an overhead option, the Applicants applied a route which was "efficient" in terms of the total distance and avoiding developed areas. The estimated costs of this conceptual alternative would raise the overall construction costs by an estimated 21%. However, as with the discussion of the buried construction line, the full increase in cost would also include establishing individual landowner agreements with the multiple property owners along the line. In addition, as discussed in the New Power Line alternative (Section 5.3) it is reasonable to assume that the engineering challenges will be similar to those associated with the alternatives west of Adirondack Park and east of the Hudson River. The NYRI experience suggests that the logistical issues would be considerable, particularly as this alternative represents an overhead installation that would require use of eminent domain and would likely generate significant opposition.. Therefore, this routing is not a practical alternative. Moreover, as it represents an almost directly southern route to the west of the Adirondack and the east of the Hudson River, it demonstrates that other routes of this type would be similarly impracticable.

6.2 Demand Side Management

With increased concern over greenhouse gas emissions, energy prices, and energy security, energy conservation has received increased attention. The federal government has enacted several pieces of legislation to promote more efficient use of energy, including the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and the American Recovery and Reinvestment Act of 2009.[172] The New York State Energy Plan's goal of "Increasing Reliance on Renewables" includes "expanding the State's purchases of hydropower."[173] New York City's PlaNYC 2030 targeted a 30% reduction of greenhouse gases by 2030.[174]

However, demand side management is not a practical alternative inasmuch as it is difficult to predict how its implementation would affect overall energy use. In its discussion of the aforementioned 15 percent goal of energy efficiency, the New York State Energy Plan notes that, even with the considerable achievements made to date in the state's end-user efficiency programs, meeting the 15 percent objective would require nearly a five-fold increase in annual energy savings by 2015.[175] An evaluation of energy efficiency potential conducted by Con Edison for its downstate markets of New York City and Westchester County concluded that the realistic achievable potential ("RAP") improvements in energy efficiency for electricity ranged from 8 to 10%.[176] The RAP savings for gas, steam, and fuel oil ranged from 3 to 7%.[177] Furthermore, in a report advising Governor Cuomo on how to bring New York's aging infrastructure into the future, none of the recommendations provided by the New York State

172 U.S. Department of Energy, *Alternatives Fuels Data Center: Key Federal Legislation* (May 2013), http://www.afdc.energy.gov/laws/key_legislation.

173 State Energy Plan at 93.

174 City of New York, *PlaNYC: A Greener, Greater New York* at 150 (Apr. 2011), http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_planyc_full_report.pdf.

175 State Energy Plan at 23.

176 Global Energy Partners, LLC, *Energy Efficiency Potential Study for Consolidated Edison Company of New York, Inc.* (June 2010), http://www.coned.com/documents/Volume_1_Executive_Summary.pdf.

177 *Id.* at 13.

Energy Highway Task Force addressed additional demand side management or energy efficiency as part of the plan to modernize New York's infrastructure.[178]

Demand side management would not meet the Project's overall goal of providing clean energy to New York, or state goals which call for an increase in clean energy in addition to energy efficiency.[179] In the Joint Proposal for Settlement, the Signatory Parties concluded that "conservation and distributed generation cannot be considered to be effective alternatives to the Facility"[180] and that the Project "should be viewed as a complement to the Commission's public policy objectives to promote renewable generation facilities, reduce environmental impacts, such as air pollution, and increase fuel diversity."[181] Therefore, this alternative was eliminated from further consideration.

6.3 Other New Generation Sources

From 2000 to 2013 in New York City and Long Island, approximately 4,800 MW of new capacity has been added, of which over 90% are natural gas-fired generating facilities.[182] During this same timeframe, nearly 1,900 MW of generation has been retired, therefore the incremental increase in capacity is about 2,900 MW.[183] Currently, all of the generation in New York City is fossil fuel fired (natural gas or oil).[184] In the NYISO interconnection queue, there is 2,300 MW of summer capacity to be added to New York City; other than the 660 MW Hudson Transmission Partners DC-based transmission line, all additions are also fired by fossil fuel[185] (and the HTP project is bringing energy into New York City from Eastern PJM, which has predominately fossil fuel fired generation).[186]

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178 New York Energy Highway Task Force, New York Energy Highway Blueprint, http://www.nyenergyhighway.com/PDFs/BluePrint/EHBPPT/ (last visited Apr. 22, 2013).

179 *See* Governor Andrew M. Cuomo, Building a New NY...With You, 2012 State of the State Address (2012), http://www.nyenergyhighway.com/Content/pdf/Building-a-New-New-York-Book.pdf.

180 Joint Proposal at 53.

181 *Id.*

182 Ventyx Velocity Suite. Generating Unit Capacity Dataset. Data Version 2013-03.

183 *Id.*

184 *See* 2012 Gold Book.

185 NYISO, NYISO Interconnection Queue, http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Interconnection_Studies/NYISO_Interconnection_Queue/NYISO_Interconnection_Queue.xls.

186 PJM, *Regional Transmission Expansion Plan – Book 2* (2012), http://www.pjm.com/sitecore%20modules/web/~/media/documents/reports/2012-rtep/2012-rtep-book-2.ashx.

In 2012, the NYISO identified resource adequacy gaps and reliability concerns as part of Reliability Needs Assessment ("RNA") for the NYC area. The "market solution" proposed in the NYISO's Comprehensive Reliability Plan is one that involves repowering of existing generation with gas fired generators.[187] Although the market solution would be more efficient than the steam turbines they would displace, they would still be CO_2, NOx, and SO_2 emitting resources. In the NYISO interconnection queue, currently there are 42 proposed renewable energy projects, representing nearly 2,600 MW of potential generation from wind, solar, hydro, pumped storage, wood, solid waste, methane, and energy storage (NYISO 2013).[188] However, many of the projects in the queues will likely be withdrawn, will not be constructed by the proposed timeline, or will change the proposed generating capacity, as evidenced by the 64 renewable energy projects, equaling over 13,000 MW, withdrawn from the NYISO queue since 2007 (NYISO 2013).[189]

There are currently no proposed renewable energy projects in the interconnection queue in the vicinity of southern New York City – in fact, over 3,500 MW has been withdrawn from the queue since 2007 (NYISO 2013).[190] Therefore, other new generation sources in the New York City region are not anticipated to provide the clean and renewable energy capacity, increased grid reliability, or transmission congestion solutions comparable to the Project. Accordingly, this set of alternatives is eliminated from further consideration.

6.4 No Build

Under the No Build Alternative, the Project would not be constructed. Therefore, to meet projected electricity needs in New York City, a) existing generation facilities would need to increase their power output, b) transmission facilities would need to be constructed or upgraded and/ or c) new generating facilities would need to be brought on line. This alternative would be inconsistent with the Project's purpose and need (see Section 1.2 and 1.3).

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187 NYISO, *2012 Comprehensive Reliability Plan – Final Report* (Mar. 19, 2013), http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Reliability_Planning_Studies/Reliability_Assessment_Documents/2012_Comprehensive_Reliability_Plan_Final_Report.pdf.

188 NYISO, NYISO Interconnection Queue, http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Interconnection_Studies/NYISO_Interconnection_Queue/NYISO_Interconnection_Queue.xls.

189 *Id.*

190 *Id.*

Moreover, in terms of existing generation, summer operating capacity in New York State totals 38,902 MW, with 9,466 MW of the generating capacity located in New York City. The majority of New York's existing generation portfolio is composed of gas- and/or oil-fueled facilities, which accounts for approximately 61% of the total installed capacity in the state.[191] The vast majority of these gas and oil facilities tend to be older; about 65% of them were built before 1980, and therefore are relatively inefficient[192] (NYISO 2012 Load and Capacity Data, 2012).

The No Build Alternative, which relies on increased generation from existing sources, would result in higher energy costs and higher GHG emissions and was therefore considered inconsistent with the Project's purpose and eliminated from further consideration.

[191] *See* 2012 Gold Book.
[192] *Id.*

Section 7
Conclusion

Prior to undertaking this LEDPA analysis, practical alternatives for the Project were comprehensively investigated and analyzed during the New York State Public Service Law Article VII proceeding. As part of that proceeding, Settlement Parties undertook an intensive review of Project routing, with a specific focus on locating the cables out of the water to the extent practical and feasible. Based on consultation prior to the state proceeding, the state alternatives analysis, and the ensuing settlement discussions and resultant Joint Proposal settlement, the Project incorporated a number of design and route changes. While these changes resulted in significant cost increases to the Project, the changes also ensured that the Project route was the least environmentally damaging practicable alternative consistent with the Project purpose (*i.e.*, to deliver clean sources of generation from Canada into New York City in an economically efficient manner).

As part of its LEDPA analysis, the Applicants reviewed three routes provided by the New York State Department of Public Service as part of the Article VII proceedings and three additional routes requested by the USACE. One of these alternatives, the Hell Gate Bypass, was accepted by the Applicants during the Article VII proceedings while segments of the Hudson River Western Rail Line Route were also incorporated into the Project. Each of the remaining alternatives were assessed for their overall practicability based on existing technology, logistics and costs. As summarized in the table below, when evaluated in terms of logistics and costs, the alternatives presented various logistical hurdles including engineering complexity, site access, and adverse affects to existing development, as well the potential for political and public opposition. All of the alternatives had projected costs, when coupled with the additional costs associated with the route designs accepted during the Article VII process, which would result in substantially greater costs than are normally associated with the particular type of project.

Evaluation of Practicality of Alternatives to Project

	Logistics	Cost
Hudson River Western Rail Line Route	• Long HDD installations • Narrow work spaces • Installation in close proximity to residences/ businesses • Access restrictions • Increased construction duration • Four tunnel segments • Potential for public and political opposition	Increase in Project costs of ~$620 million or 42% over Article VII baseline route.
Harlem River Rail Route	• Busy passenger and rail usage • Geotechnical challenges • Access restrictions on rail trestle by NYSDOT and MTA • Increased risk of cable damage • Increased construction duration • High uncertainty as to engineering feasibility	Increase in costs from ~$81 million (305% of segment cost, 6% of Project cost) to $189 million (15%) over Article VII baseline route.
Existing ROW – West of Adirondack Park	• Difficult HDD installations • Narrow work spaces • Installation in close proximity to residences/ businesses • Density of aboveground utilities and other features • Underground utility avoidance • Increased construction duration • Potential for public and political opposition	Increase in project costs of ~$512 million or 35% over Article VII baseline route.
Existing ROW – East of Hudson River	• Long HDD installations • Narrow work spaces • Installation in close proximity to residences/ businesses • Density of aboveground utilities and other features • Underground utility avoidance • Increased construction duration • Potential for public and political opposition	Increase in project costs of ~$508 million or 35% over Article VII baseline route.
Overland Using New Power Line Route	• Potential long and difficult HDD installations • Increased construction duration • Potential for public and political opposition	Increase in project costs of ~$1.14 billion or 79% over Article VII baseline route.

The further analysis undertaken here, pursuant to the Guidelines, confirms that the Project is the least environmentally damaging practicable alternative when other alternatives are considered based on factors of logistics, technology, and cost.

Appendices

Note: The appendices included in the Alternatives Analysis report are available in the full version of the report provided in the CHPE EIS website Document Library.
The library is accessible at the following link: http://www.chpexpresseis.org

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