Deficiency Response #3

Revised Exhibit 3

BEFORE THE
PUBLIC SERVICE COMMISSION
STATE OF NEW YORK

Application of New York Power Authority and Niagara Mohawk Power Company d/b/a National Grid for a Certificate of Environmental Compatibility and Public Need for the Rebuild of approximately 100 linear miles of existing 230 kV to either 230 kV or 345 kV along with associated substation construction and upgrades along the existing NYPA Moses-Willis 1&2, Willis-Patnode, Willis-Ryan, a portion of Ryan-Plattsburgh and National Grid's Adirondack-Porter 11, 12, and 13 in Clinton, Franklin, St. Lawrence, Lewis, and Oneida Counties, New York.	)))))))))))	Case No.: 21-T-XXXX

NEW YORK POWER AUTHORITY AND NIAGARA MOHAWK POWER

CORPORATION d/b/a NATIONAL GRID

SMART PATH CONNECT PROJECT

EXHIBIT 3

ALTERNATIVES

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EXHIBIT 3: ALTERNATIVES

16 NYCRR § 86.4 (a) The applicant shall submit a statement explaining what consideration, if any, was given to: (1) any alternative route; (2) the expansion of any existing right-of-way of the applicant or of another; (3) any alternate method which would fulfill the energy requirements with comparable costs. Such statement shall include the comparative advantages and disadvantages of any alternative considered. (b) The applicant shall, on New York State Department of Transportation maps, indicate any alternative route considered.

This section addresses the requirements of 16 NYCRR § 86.4.

3.1. Introduction and Project Purpose

The Power Authority of the State of New York doing business as New York Power Authority ("NYPA"), and Niagara Mohawk Power Corporation doing business as National Grid ("National Grid") (NYPA and National Grid, collectively, the "Applicant"), propose to construct and operate the Smart Path Connect Project (the "Project"). The Project consists of rebuilding approximately 100 linear miles of existing 230 kilovolt ("kV") transmission lines to either 230 kV or 345 kV along with associated substation construction and upgrades. The Project includes rebuilding all or parts of the following transmission lines primarily within existing rights-of-way ("ROW"): NYPA's Moses-Willis 1 & 2, NYPA's Willis-Patnode and NYPA's Willis-Ryan; and National Grid's Adirondack to Porter (Chases Lake-Porter Line 11, Adirondack-Porter Line 12, and Adirondack-Chases Lake Line 13), the extension of the existing 230 kV Rector Road to Chases Lake Line 10, as well as connecting to NYPA's Moses-Adirondack 1&2 (also known as "MA 1&2" or "Smart Path") ROW.

The Accelerated Renewable Energy Growth and Community Benefit Act (the "Act"),[1] signed into law by Governor Cuomo on April 3, 2020, provides for the "timely and cost effective construction of new, expanded, and upgraded distribution and transmission infrastructure as may be needed to access and deliver renewable energy resources"[1] to achieve clean energy and environmental targets established in the Climate Leadership and Community Protection Act ("CLCPA").[2] The CLCPA requires the Department of Environmental Conservation to establish a program to achieve a 40% reduction in greenhouse gas emissions from 1990 levels by 2030 and an 85% reduction by 2050, and requires the Public Service Commission ("Commission") to establish programs to achieve a renewable electric generation target of 70% by 2030; a 100% emissions-free electric demand system by 2040; and the procurement of at least 9 gigawatts ("GW") of offshore wind by 2035, 6 GW of photovoltaic solar generation by 2025, and 3 GW of energy storage resources by 2030 (referred to herein collectively as the "CLCPA Targets").[3]

Northern New York is already the site of significant renewable energy development, and the need for increased deliverability of existing renewable energy resources in Northern New York has been widely acknowledged since even before enactment of the CLCPA. According to NYISO data, curtailments of wind generation in the New York Control Area due to transmission constraints have been steadily increasing since 2010, with 70 GWh of wind energy curtailed in 2019 alone – the most to date.[4] The NYISO has also identified a series of renewable generation pockets

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[1] L 2020, ch 58, § 4 (Part JJJ) (effective April 3, 2020) (as codified at NY Executive Law § 94-c).
[2] L 2019, ch 106 (effective January 1, 2020).
[3] *See*, *supra*, note 2.
[4] *See* NYISO Power Trends 2020 at 16 (Figure 7), *available at* https://www.nyiso.com/documents/20142/2223020/2020-Power-Trends-Report.pdf/dd91ce25-11fe-a14f-52c8-f1a9bd9085c2; *see also id*. at 17 ("Additional transmission capability is necessary to alleviate constraints and maximize the potential contribution of the renewable resources to meeting electric demand and to achieving public policy goals.").

throughout the New York Control Area, particularly in upstate New York, where transmission constraints could prevent full utilization of existing and planned renewable generation without additional transmission expansion.[5] The failure to timely resolve these curtailments and expand transmission capacity in the area means the State's ratepayers have not received the full benefits of their investments in these generating resources, and has the potential to make CLCPA compliance difficult, if not impossible.

Additionally, the already rapid growth of renewable energy in the State is projected to further accelerate as a result of the Act, with a large slate of major renewable energy facilities likely to be approved as early as 2022. The majority of future renewable generation will be located in the western and northern regions of the State, which provide the necessary environs (e.g., wind and open space) for large renewable facilities. The CLCPA Targets can only be achieved if the renewable power from these new facilities can be delivered to load centers around the State, which in turn requires timely expansion of the State's existing transmission system.[6]

The Project is critical to realizing the full potential of renewables in the Northern New York area and meeting the CLCPA Targets and needs to be permitted and developed as rapidly as possible. As explained below, the Smart Path Connect Project squarely fits the statutory objectives of the Act. In its transmission planning studies, NYPA has found that the Smart Path Connect Project would accommodate an additional 1,000 MW of firm transfer capability for renewable energy generation in the region. Ordering Clause No. 1 of the Commission's October 15, 2020, Order on

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[5] *Id.* at 48-49.

[6] Additionally, many proposed major facilities may be delayed or cancelled if insufficient transmission exists to ensure that power from the facilities can be reliably delivered to load centers, because project developers need certainty about the availability of transmission to move forward with their substantial investments.

Priority Transmission Projects stated that: "The Northern New York Project [now known as Smart Path Connect Project] shall be referred to the New York Power Authority… for development pursuant to Section 7(5) of the Accelerated Renewable Energy Growth and Community Benefit Act."[7]

3.2. Alternative Routes *(16 NYCRR § 86.4(a)(1) and 16 NYCRR § 86.4(b))*

16 NYCRR § 86.4 (a) The applicant shall submit a statement explaining what consideration, if any, was given to: (1) any alternative route; . . . .

(b) The applicant shall, on New York State Department of Transportation maps, indicate any alternative route considered.

3.2.1. Introduction

In its Priority Transmission Order, the Commission noted that, in the Act, the NYS legislature had found and determined that NYPA "owns and operates backbone electric transmission assets in New York, has [ROWs] that can support in whole or in part bulk transmission investment projects, and has the financial stability, access to capital, technical expertise and experience to effectuate expeditious development of bulk transmission investments needed to help the state meet the CLCPA targets, and thus it is appropriate for [NYPA] . . . to develop those bulk transmission investments found by the Commission to be needed expeditiously to achieve CLCPA targets."[8]

[7] Case 20-E-0197, *Proceeding on Motion of the Commission to Implement Transmission Planning Pursuant to the Accelerated Renewable Energy Growth and Community Benefit Act ("Transmission Planning Proceeding")*, Order on Priority Transmission Projects at 30 (Issued and Effective October 15, 2020) (the "Priority Transmission Order").
[8] Priority Transmission Order at 14.

The Commission further noted that control of the ROWs needed for the Project, access to other Project real estate, and the availability of capital are all factors that NYPA can use to demonstrate how Project development will be expedited to meet its estimated in-service date.[9] The Commission found that NYPA "can use its existing ROWs for about 50 percent of the upgraded circuit miles included in the Project."[10] The Commission also found that "the Project could utilize substantial portions of National Grid's existing ROWs" and "access to existing ROW indicates that development can be pursued efficiently, particularly in a region of the State where obtaining new rights may be especially difficult."[11]

The Applicant's proposed Project, identified below and in Exhibit 2, has been developed to avoid the acquisition of new permanent transmission ROWs, except for *de minimis* acquisitions that cannot be avoided due to unique circumstances. The transfer or lease of existing transmission property, access rights or substation property from a current utility company owner is not considered an acquisition of new ROW given that such property has already been used or authorized to be used for electric utility purposes. A property transfer between NYPA and National Grid is proposed for the proposed Adirondack Substation. The Applicant is acquiring additional parcels adjacent to the existing transmission ROW to connect to new or expanded substations at Willis, Haverstock, Ryan, and Austin Road. Given the Commission's objectives of using existing ROW for priority transmission projects stated above, the Applicant did not consider any alternative routes that would require more than *de minimis* acquisition of new ROW.

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[9] *Id*. at 19.
[10] *Id*. at 23.
[11] *Id*. at 23-24.

3.2.2. Moses-Haverstock-Adirondack

Three 230 kV circuits (MH-1, MH-2 and MH-3) will connect the existing Moses Substation to the new Haverstock Substation. These circuits will be rerouted from their existing ROW onto a new segment of ROW to the Haverstock Substation. Any route to connect to the Haverstock Substation would require minimal new ROW; no alternative locations for this minimal new ROW were identified.

The new 345 kV lines identified as HA1&2 will originate at the Haverstock Substation and interface with the existing MA 1&2 ROW. The first interface in the north will proceed north westerly from Haverstock where they connect to the MA1&2 ROW. Minor additional ROW will be required for the connection. Alternative routes were not identified based on the minimal new ROW needed to bring these circuits out of the Haverstock Substation to the MA 1&2 ROW.

A second interface with the MA 1&2 ROW is proposed south of the Beaver River crossing and proceeds along a new ROW alignment bypassing the old Adirondack Substation to connect to the newly proposed Adirondack Substation. Minor additional ROW with limited tree clearing (approximately 500 feet) will be required for the bypass. Any alternative route would require additional tree clearing or several line crossings before entering the new Adirondack Substation. Adirondack Substation alternative siting analysis is described in Section 3.9.

3.2.3. Moses-Willis-Ryan/Patnode

The current MW 1&2 lines have occupied the existing 225-foot ROW since 1976. These lines are on a NYPA-maintained ROW for approximately 35.4 corridor miles. This corridor is located in a rural region of the State and has coexisted with the neighboring landowners. The proposed lines will be located within the same ROW originating and terminating at Haverstock and Willis Substations, respectively. Any alternative route would require the transmission lines to terminate at these same facilities but would require the purchase of land or the acquisition of easements for new ROW, adding a significant cost to the Project. In addition, any new ROW would have a significantly greater environmental impact than the proposed Project. New structures would have to be added in locations not currently containing transmission structures, thereby resulting in an adverse visual impact. Vegetation clearing, construction road access, and the potential need to acquire agricultural lands would have greater near-term and long-term environmental impacts and impacts to the local communities. For these reasons, the Applicant did not consider alternative routes that required substantial new ROW. Alternatives associated with the location of the Haverstock Substation are discussed in Section 3.9.

The Willis-Ryan/Patnode lines have occupied the existing 225-foot ROW for over 40 years. These lines are on a NYPA-maintained ROW for approximately 8.7 corridor miles. This corridor is located in a rural region of the State and has coexisted with the neighboring landowners. The new lines will be located within the same ROW originating at Willis and terminating at the existing Ryan and Patnode Substations, respectively, with the exception of a 0.5-acre section of new ROW needed just north of the Ryan Substation. Any alternative route will require the transmission lines to terminate at these same facilities but would require the purchase of land or the acquisition of easements for new ROW, adding significant cost to the Project. In addition, any new ROW will have a significantly greater environmental impact than the proposed Project. New structures would have to be added in locations not currently containing transmission structures, thereby resulting in an adverse visual impact. Vegetation clearing, construction road access, and the potential need to acquire agricultural lands would have greater near-term and long-term environmental impacts and impacts to the local communities. For these reasons, the Applicant did not identify alternative routes that required substantial new ROW.

3.2.4. Adirondack to Austin Road Corridor

The existing 230 kV Adirondack to Chases Lake 13 and Adirondack to Porter 12 transmission lines have occupied the existing ROW, which varies in width between 375 and 500 feet, since the 1950s. These lines are on a National Grid-owned ROW and are adjacent to other NYPA transmission facility ROWs. This corridor is located in a rural region of the State and has coexisted with the neighboring landowners. The new line identified as Adirondack - Austin Road Line 13 and Adirondack – Marcy Line 12 will originate at the proposed Adirondack Substation. The new Adirondack – Austin Road Line 13 will proceed south to a new Austin Road Substation just south of the existing Chases Lake Substation. The new Adirondack – Marcy Line 12 will be located within the ROW corridor and not connect to the new Austin Road Substation, but will proceed farther south to the Marcy Substation. No new ROW will be required for these transmission lines with the exception of adjacent to the proposed Austin Road Substation to connect the 345 kV Adirondack to Austin Road Line 13 and Austin Road to Edic Line 11 to the new substation and for the substation itself. No new ROW will be required for the new Rector Road to Austin Road Line 10, which is an extension of the existing 230 kV line currently terminating at Chases Lake Substation.

Any alternative route would require the transmission lines to connect at these same facilities but would require the purchase of land or the acquisition of easements for the new ROW and this would add a significant cost to the Project. An alternative parallel route was considered along the same ROW, but significant additional clearing would have been required having a greater environmental impact than the proposed alignment. For these reasons, alternative routes that required substantial new ROW or had more than a *de minimis* environmental impact were not found to be reasonable alternatives.

The MSU-1 765 kV transmission line ROW corridor runs adjacent to the National Grid ROW for a majority of the proposed length of the Adirondack-Porter portion of the Project. The MSU-1 corridor was found to not be a reasonable alternative for this segment of the Project because the corridor does not have sufficient width to accommodate the proposed new 345 kV transmission lines. New property rights would be required for all locations where the rebuilt lines would deviate from the existing ROW. Any deviation off of the existing ROW would have the impacts enumerated above; new vegetation clearing, new habitat disturbances, new construction roads, and potentially acquiring existing agricultural lands. For these reasons, routing the new 345 kV Adirondack – Marcy Line 12 and Adirondack – Austin Road Line 13 adjacent to the 765 kV MSU-1 line on the same ROW was not found to be a reasonable alternative.

3.2.5. Austin Road to Edic Corridor

The existing 230 kV Chases Lake – Porter Line 11 and Adirondack – Porter Line 12 have occupied the existing ROW, which varies in width between 375 and 500 feet, since the 1950s. These lines are on a National Grid-owned ROW and are adjacent to the MSU-1 corridor. This corridor is located in a rural region of the State and has coexisted with the neighboring landowners. The new line identified as Austin Road - Edic Line 11 will originate at the new Austin Road Substation (approximately 0.7 mile south of the existing Chases Lake Substation) and proceed south to the existing Edic Substation. This rebuilt line will run adjacent to the rebuilt Adirondack - Marcy Line 12 for the majority of its length. As with the Adirondack to Austin Road portion of the Project, no new ROW will be required for the transmission lines with the exception of an area adjacent to the proposed Austin Road Substation to connect the 345 kV Adirondack to Austin Road Line 13 and Austin Road to Edic Line 11 to the new substation and for the substation itself.

The MSU-1 ROW corridor runs adjacent to the existing 230 kV Chases Lake – Porter Line 11 and Adirondack – Porter Line 12 for a majority of the proposed length of the Project. Use of the MSU-1 corridor for the proposed 345 kV Adirondack – Marcy Line 12 and Austin Road – Edic Line 11 was not progressed past a screening-level analysis as an alternative location for this segment of the Project because the MSU-1 ROW corridor is not wide enough to accommodate the two new 345 kV transmission lines. New property rights would need to be required for all locations where the rebuilt lines would deviate from the existing ROW. Any deviation off of the existing ROW would have the impacts enumerated above: new vegetation clearing, new habitat disturbances, new construction roads, and potentially acquiring existing agricultural lands. For these reasons, routing the new 345 kV Adirondack – Marcy Line 12 and Austin Road – Edic Line 11 adjacent to the 765 kV MSU-1 line was not considered a reasonable alternative.

3.2.6. Underground Alternative

In assessing the viability of an underground transmission alternative, it is necessary to acknowledge both the implications of trenched construction, as well as the technical constraints of a long-distance underground transmission line. An underground alternative to each proposed transmission line would potentially involve multiple sets of cross-linked polyethylene ("XLPE") insulated 345 kV transmission cables, one fiber optic cable, and one ground continuity conductor per circuit installed using open cut methods in a concrete duct bank over the entire approximate 100 corridor miles of the proposed Project. The duct and manhole system would typically be constructed on roadways that loosely follow along the existing transmission route between the endpoints of the line. Where viable roadways do not exist, duct bank construction along the existing ROW might be considered, which is costly and proceeds slowly compared to roadway trench construction due to poor accessibility.

Generally, underground construction for the Project presents many disadvantages.

<u>Design Issues</u>

An underground transmission design is not preferred for the proposed new transmission lines due to several technical constraints of an underground alternative.

Cable Capacitance – Underground cables have significantly higher capacitance than overhead lines, meaning that it takes reactive power ("MVARs") to "charge up" the cable before the cable can transmit real power ("MWs"). Cable capacitance effects become greater as line length increases and as system voltages increase. On very long 345 kV underground lines a point is reached where charging current is equal to the rating of the cable circuit and no real power is transferred. This point is called the critical length. When considering the critical length and a viable amount of real power transfer, in general, the viability of a long-distance 345 kV underground transmission line becomes exceedingly worse at lengths above 20 miles. For this reason, a High Voltage Alternating Current ("HVAC") underground transmission alternative is technically nonviable, and a High Voltage Direct Current ("HVDC") alternative would need to be considered. An HVDC alternative would require direct current ("DC") to alternating current ("AC") transition stations required at the line endpoints. The alternative to an HVDC solution would be to sectionalize the lines into multiple shorter lines, requiring additional substations to be constructed.

Cable Reactance and Load Hogging – The underground cable would have a significantly lower series reactance than any overhead lines that would operate in parallel with the cable. This means that there would be an unequal split of the power flow between the underground 345 kV cables and other nearby parallel transmission lines, with the underground cable "hogging" the load. Under future loading conditions, the underground cable could be operating at its thermal limit, while the overhead line would be operating well below its limit. This could limit operating flexibility on the transmission system and might trigger the need for additional system reinforcements.

Cable Ratings – It is often difficult to match overhead line ratings with underground cables. Should line ratings need to be upgraded in the future, it is much more difficult to upgrade ratings on underground lines than it is to upgrade ratings on overhead lines.

Switching – Overvoltage situations due to switching in the network or transient overvoltage can also occur causing overvoltage relays to trip portions of the grid. If an HVAC alternative was pursued, the addition of long underground AC transmission lines can also create harmonic resonance issues; thus, additional harmonic filters or flexible alternating current transmission system ("FACTS") devices might be required at the stations to protect other grid equipment.

Construction Complications

Underground construction presents several issues and would not be preferred for the proposed transmission project.

Long Construction Duration – Underground cable installation typically proceeds more slowly than overhead transmission installation. Trench excavation involves excavators and other heavy machinery, which can have a high impact on communities due to significant traffic impacts on roadways, noise pollution, and visibility.

Special Construction & Environmental Impacts – Open cut trench construction has high impact potential to the environment. To avoid significantly higher impacts to streams, wetlands, agriculture, and other sensitive resources, the underground line must be re-routed (potentially adding length) or utilize complex trenchless construction methods, such as jack and bore, horizontal direction drilling, or in-air bridge crossings. In comparison, overhead transmission lines can typically span over sensitive resources without adding atypical cost or complexity. Geologic conditions (e.g., shallow rock) along the transmission route could present challenges with underground cable installation that would add cost and construction duration.

Community Impact – Numerous roadways would also be impacted by an underground alternative, resulting in impacts to traffic and/or increased costs and construction duration associated with trench construction and road restoration that can occur even after the transmission line is complete.

Cost – Due to the potential need for AC to DC conversion stations, the cost of an underground alternative could increase by upwards of $1,000,000,000 independent of the cable system and duct bank construction. Typical underground construction costs can vary based on terrain and could increase greatly due to the amount of rock encountered, level pad sites for the splice vaults, additional vaults to restrain cable in steeper terrain, and additional water body crossings. The cost of underground construction would be significantly higher than overhead construction, with estimated costs for constructing underground transmission lines generally ranging from 4 to 14 times more expensive than overhead lines of the same voltage and distance.

Acquisition of New ROW/Land Rights – The addition of underground to overhead transition stations, reactive compensation stations, and DC to AC transition stations would require the acquisition of significant areas of new ROW for station construction, conflicting with the Commission's goal for de minimis acquisition of new transmission line ROW. Duct bank construction would require significantly more ROWs on roadways to be acquired.

<u>Operational Issues</u>

Lengthy Outage Repair Times – When an overhead transmission line experiences an outage, it typically can be repaired within 24 to 48 hours. In the case of a failure of an underground transmission cable, repair times can be in the range of two weeks or more. The considerably greater outage times for underground cables expose the remainder of the transmission system to emergency loadings for longer periods of time. There is also increased exposure to loss of another transmission segment, with possible loss of load, during the extended underground outage.

Effect on Reclosing and Circuit Restoration – Many faults on overhead lines are temporary in nature. Often it is possible to “reclose” (re-energize) an overhead line after a temporary fault and return the line to service with only a brief interruption. Faults on underground transmission cables are almost never temporary and reclosing into a transmission cable fault can result in more extensive damage, thus extending already-long repair times. The cable must remain out of service until the problem is diagnosed and repairs are completed. In order to operate the overall underground alternative system efficiently, it would be necessary to install relaying equipment at transition stations to distinguish between faults on the underground system and the overhead system. This would also minimize the amount of cable testing required after a circuit breaker operation. Additionally, there may be customer substation upgrades required to eliminate fused connections to the underground cables.

Based on the many disadvantages of underground transmission, underground alternatives were not considered viable for the Project because of significant construction challenges, technical considerations and the challenges involved with long underground AC transmission lines.

3.3. Expansion of Existing Rights-of-Way *(16 NYCRR § 86.4(a)(2))*

16 NYCRR § 86.4 (a) The applicant shall submit a statement explaining what consideration, if any, was given to: (2) the expansion of any existing right-of-way of the applicant or of another;

The Project as proposed has been designed to maximize the use of the Applicants' existing ROW to the greatest extent possible. New transmission line ROW is limited to small segments for interfaces with the proposed Haverstock, Adirondack, and Austin Road Substations. In addition, because the Project is a rebuild of existing transmission lines located on existing ROWs, the only locations where the existing ROW rights need to be expanded are at Ryan Substation and one parcel to the north of the Moose River in Lyonsdale.

3.4. Alternative Methods to Fulfill Energy Requirements *(16 NYCRR § 86.4(a)(3))*

16 NYCRR § 86.4 (a) The applicant shall submit a statement explaining what consideration, if any, was given to: (3) any alternate method which would fulfill the energy requirements with comparable costs.

Applicant evaluated energy efficiency, demand-side management, and distributed generation as alternative methods to fulfill energy requirements. The Project is the reconstruction of the existing transmission infrastructure that currently transmits power from northern New York, including hydroelectric power from NYPA's St. Lawrence Project, and wind energy towards central New York. As stated above, the wind energy is curtailed. The 345 kV reconstruction is being proposed to alleviate reliability and energy delivery concerns with the 230 kV infrastructure. These alternative methods cannot eliminate the existing 230 kV systems function to transmit existing generation from northern New York to load.

3.5. No-action Alternative

The no-action alternative is not considered a viable option because the existing 230 kV transmission system is inadequate to deliver the required renewable energy. In addition, some facilities are nearing the end of their service life, requiring significant maintenance to ensure continued reliability. The Applicant did not identify any advantage to the "no-action alternative." Disadvantages to the "no-action alternative" are numerous. Selecting the no-action alternative would not address either the continued maintenance needed on these lines or the mandate of the Commission under the Order. With a no-action alternative, ongoing reliability concerns on some circuits would continue, and CLCPA goals would not be achieved.

In light of the Commission Order and the NYISO findings, the Applicant did not conduct any further analysis of non-transmission alternatives in developing the Project.

3.6. Alternative Technologies

The Project reviewed one possible alternative transmission technology: use of DC electric transmission facilities. To install new DC lines between the proposed terminal substations associated with the Project, the Applicants would need to build new power conversion facilities and interconnect the DC lines to the existing AC transmission system. In addition to the cost of the converter station facilities located at the terminal ends of the Project, there would be the need to interconnect the intermediate substations to the newly constructed DC system between Moses, Ryan, and Patnode Stations along with the stations between Adirondack, Marcy, and Edic.

The use of DC technology would limit the availability of renewable resources to connect to newly constructed system without creating the need for additional intermediate converter stations, which are more costly than a typical AC substation, or longer interconnecting AC transmission lines to extend to the terminal ends where converter facilities would be located.

DC technology was not further considered as an option for the Project due to the cost prohibitive nature associated with the construction of multiple AC/DC converter facilities and introduction of additional cost and complications associated with interconnecting renewable resources.

3.7. Alternative Overhead Configurations

The Project reviewed many different configurations prior to selecting 345 kV single circuit monopoles with delta phase configurations ("Proposed Configuration") for the transmission lines from Haverstock to Adirondack to Marcy and Edic. The Project also selected 230 kV double-circuit monopoles for the transmission lines from Willis to Ryan and Patnode, with single-circuit monopoles used for the Willis Patnode circuit between Ryan and Patnode.

Guyed structures are an alternative new structure configuration that were considered for potential cost savings at line angle locations and dead-ends. The use of guyed structures was ruled out for the Project in favor of self-supporting structures for the following reasons:

- Guyed structures consume additional ROW space and are not preferable in agriculturally cultivated lands
- Guyed structures have a greater risk due to additional modes of failure.
- Guyed structures are more susceptible to acts of vandalism and/or terrorism

The self-supporting structure configuration options given due consideration were:

- Single-circuit monopoles, delta phase configuration
- Single-circuit H-frames, horizontal phase configuration
- Double-circuit monopoles, vertical phase configuration

The Applicant selected double-circuit transmission structures as its preferred structure alternative for the new 230 kV lines between Willis to Ryan and Patnode and single-circuit delta structures as its preferred structure alternative for the new 345 kV lines. Table 3-1 presents the advantages and disadvantages of the various structure types considered for the Project.

Table 3-1: Structure Type Comparison

Structure Type	Advantages	Disadvantages
Lattice	Requires less steel and results in lower cost; may create lower visual impacts in some contexts	Complex structures with many potential points of failure; more effort and time to construct; typically, four foundations per structure, resulting in greater permanent surface disturbance and higher impacts to agriculture
H-Frame	May minimize structure height; faster installation time relative to lattice	Wider overall horizontal circuit phase spacing and wider horizontal base footprint, occupying more space in transmission corridor; two foundations per structure, resulting in greater permanent surface disturbance and higher impacts to agriculture
Monopole	Faster installation time relative to other structure types; one foundation per structure, resulting in less permanent surface disturbance and minimized impacts to agriculture; structures occupy less space in transmission corridor	May result in taller structures

Structure Type	Advantages	Disadvantages
Guyed Angle & Dead-end	Lighter structures and smaller foundations, resulting in cost savings at angle/deadend structures	Structures occupy more space in transmission corridor due to large footprint of guy wire system; additional points of potential structure failure; greater impacts to agriculture; more susceptible to vandalism

Considering the advantages and disadvantages of the various structure types, the Applicant selected monopole structures as the preferred structure alternative due to their faster installation time, smaller surface disturbance and agricultural impact footprint, and most efficient use of the transmission corridor.

The Applicant also considered vertical and delta configuration options for the monopole transmission structures (applicable to both the single-circuit and double-circuit structures). For the new single-circuit 345 kV lines between Haverstock and Willis, Haverstock and Adirondack, Adirondack and Austin Road and Austin Road to Edic, the delta configuration option was selected as the preferred configuration alternative since sufficient width exists within the corridor and the delta configuration can result in reduced structure heights. Additionally, the delta configuration generally results in reduced electric and magnetic field values at the edge of the ROW versus a vertical configuration.

For the new double-circuit structures between Willis and Ryan and Patnode, additional analysis was undertaken to determine the optimal configuration. To be consistent with the Order’s goal of maximizing the use of existing ROW, the Applicant was able to optimize ruling spans based on the double-circuit vertical configuration, which results in a combination of height minimization and optimized ruling spans (i.e., reduced number of structures).

As noted above, single-circuit H-frames were rejected, because the H-frame structures are wider at the conductor attachments therefore requiring more ROW space and would have a wider footprint at the base, and the combination of these would create more land use impact. Moreover, to ensure that the Project does not result in an exceedance over existing conditions regarding electric and magnetic field standards, either the H-frame structures would need to be taller than existing structures or the ROW would need to be widened.

Single-circuit H-frame structures place the phase conductors in a horizontal configuration at a lower elevation for all of the phases, this configuration yields a higher electric field level at the edge of ROW. Additionally, H-frame structures have twice the number of footings, and therefore pose more environmental impacts than do the monopole structure of the proposed configuration. The Applicant abandoned the H-frame structure configuration option in favor of the proposed configuration for all the 345 kV suspension structures.

Double-circuit monopoles were also rejected for use as 345 kV structures because they would be taller and would negatively impact the reliability of the bulk power system but were selected for the 230 kV built out from Willis as they meet the reliability goals for this segment as well as can be constructed within the ROW from Willis to Ryan and Patnode.

3.8. Alternative Conductors

The Project proposes the overhead conductor types shown in Table 3-2 based on system studies conducted by the Applicant.

Table 3-2: Conductor Types

Transmission Line Segment	Conductor type	Notes
Moses- Haverstock 230 kV Circuits 1,2,3	Single 795 kcmil ACSR	
Haverstock-Adirondack 345 kV Circuits 1&2	Twin 795 kcmil ACSR	To match Smart Path conductor
Haverstock-Willis 345 kV circuits 1&2	Twin 795 kcmil ACSS	
Willis-Patnode-Ryan 230 kV Circuits 1&2	Single 1,272 kcmil ACSS	
Adirondack – Austin Road Line 13	Twin 795 kcmil ACSS	
Austin Road – Edic Line 11	Twin 795 kcmil ACSS	
Adirondack to Marcy Line 12	Twin 795 kcmil ACSS	

The Project proposes aluminum conductor steel reinforced ("ACSR") conductor for the Haverstock to Adirondack transmission line because it matches the conductor installed for the Smart Path Project and is NYPA's standard conductor type. ACSR has generally been a standard of the electrical utility industry since the mid-1900s and is still the most common conductor type in use today.

A variant of ACSR is ACSR/TW, with "TW" standing for trapezoidal wire. In this conductor design, the aluminum outer strands have a cross section that is similar to a trapezoid, albeit a curved trapezoid. This strand shape provides more aluminum cross sectional area for the same given outside cable diameter. This increases the allowable ampacity; however, the additional aluminum increases the overall weight, structure loadings, and cost of the conductor. For the above reasons, the Applicant did not pursue this alternative conductor type.

The Applicant will also use aluminum conductor steel supported ("ACSS") conductor as an alternative to ACSR. ACSS conductor is very similar to ACSR with the difference that the aluminum strands are fully annealed (softened) by heat treatment. This results in a conductor in which all the cable tension is carried by the steel core strands. ACSS has the ability to run at temperatures up to 200°C, allowing for additional power flow. This softer aluminum outer strands require additional training for linemen who are not familiar working with ACSS so that the work is performed safely and results in the same quality installations as ACSS. From a line design standpoint, in comparison to the same size ACSR, a higher stress-level is imposed on the steel core during icing conditions and less wire strands are carrying the tension. The Applicant has experience utilizing both ACSR and ACSS in their systems. Both conductor types have proven to be reliable, with ACSS conductor providing increased capacity over the equivalent size ACSR conductor.

3.9. Alternative Substation Locations

The Project proposes to modify, expand, or construct 12 substation facilities as shown in Table 3-3 below.

Table 3-3: Proposed Substation Activities

Substation	Location	Proposed Alteration or Build
Moses Substation	Existing 230 kV substation	Modify station as necessary within existing footprint
Haverstock Substation	New 345 kV Substation	Construct new 345 kV substation in a new location

Substation	Location	Proposed Alteration or Build
Willis Substation	Existing 230 kV substation	Expand 345 kV/230 kV substation onto adjacent property
Ryan Substation	Existing 230 kV substation	Modify station as necessary within existing footprint.
Patnode Substation	Existing 230 kV substation	Modify station as necessary within existing footprint
Adirondack Substation	Existing 230/115 kV substation	Construct new 345/115 kV substation on adjacent property Decommission existing substation
Chases Lake Substation	Existing 230 kV substation	Partially decommission substation
Austin Road Substation	New 345 kV Substation	Construct new 345/230 kV substation on nearby property
Edic Substation	Existing 345 kV substation	Expand 345 kV substation on adjacent property
Marcy Substation	Existing 765/345 kV substation	Modify station as necessary within existing footprint
Massena Substation	Existing 765/230 kV substation	Modify station as necessary within existing footprint
Porter Substation	Existing 230/115 kV substation	Decommission 230 kV portion of substation

As shown in the table above, all substation project work except for Haverstock and Austin Road will be within existing substation boundaries or on nearby/adjacent land parcels. Where substation work will be on nearby or adjacent parcels, the Applicant has conducted or is in the process of conducting environmental due diligence and the results are discussed in Exhibit 4. A discussion of the alternatives considered for the new substation sites follows.

Haverstock

For the Haverstock Substation, the Applicant conducted the following alternative siting analysis. The alternatives considered are shown in Figure 3-1. The first option (Alternative 1) evaluated was at the existing Moses Substation. This site has a tight footprint with constraints from existing infrastructure, requiring a gas-insulated switchgear to be designed instead of a conventional air-insulated layout. This site would require rebuilding and upgrading two existing 230 kV circuits to 345 kV for 1.7 miles with additional ROW and tree clearing along the transmission corridor south of the Moses Substation. Another site (Alternative 2) was evaluated close to the Wiley Dondero Canal on federal property where NYPA currently does not have any land rights. While this site did have adequate space for siting the new station it would require rerouting several transmission circuits to the substation with additional ROW acquisition needed (with the potential for a NEPA review, associated tree clearing, and other resource impacts), so, therefore, this site was no longer considered. Another site (Alternative 3) consists of a new 345 kV substation constructed on a property identified along the Moses-Reynolds transmission corridor where NYPA currently does not have any land rights. While this site did have adequate space for siting the new station it would require rerouting several transmission circuits to the substation with additional ROW acquisition needed (with associated tree clearing and other resource impacts), so therefore, this site was no longer considered.

The currently proposed location of the Haverstock Substation (Alternative 4), located at the intersection of NYPA's existing north-south and east-west transmission ROW corridor, was then selected for the construction of a new 345 kV substation. This property is owned by NYPA and offers adequate space for the substation. This location is preferred as it is the natural point of interconnection for all of the Project's impacted transmission circuits and will result in the least amount of additional ROW acquisition. Power to the substation would utilize three existing 230 kV circuits within the transmission line corridor from Moses Substation eliminating the need to route transmission lines back to Moses. The rebuilt Moses Willis 1&2 345 kV circuits, in addition to the rebuilt MA 1&2 circuits would be connected to the 345 kV Haverstock Substation. It meets the Project's power delivery and reliability goals while also considering siting constraints and minimizing environmental impact.

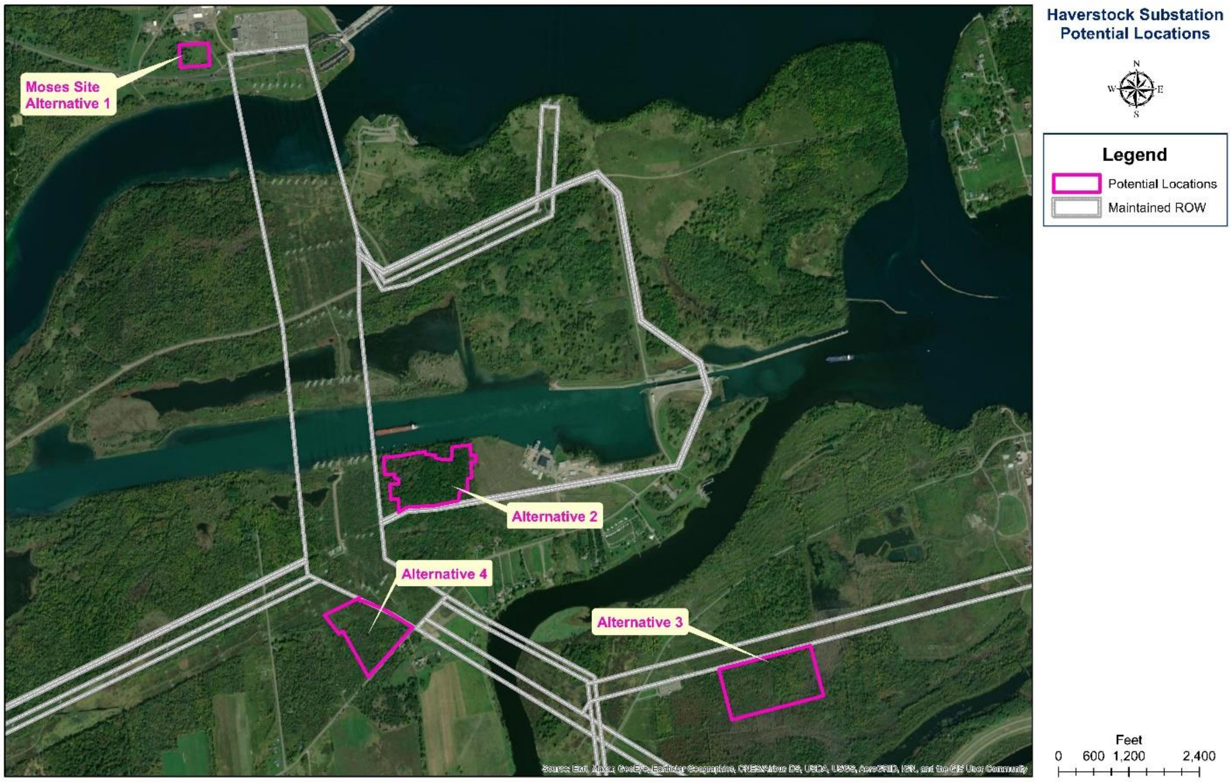

Figure 3-1: Alternative Haverstock Substation Locations

<u>Willis</u>

For the proposed Willis Substation expansion, the Applicant considered expanding to the west side of the existing substation (Alternative 1). The Applicant instead selected the proposed location to the north of the existing substation (Alternative 2) in order to avoid landowner agricultural impacts.

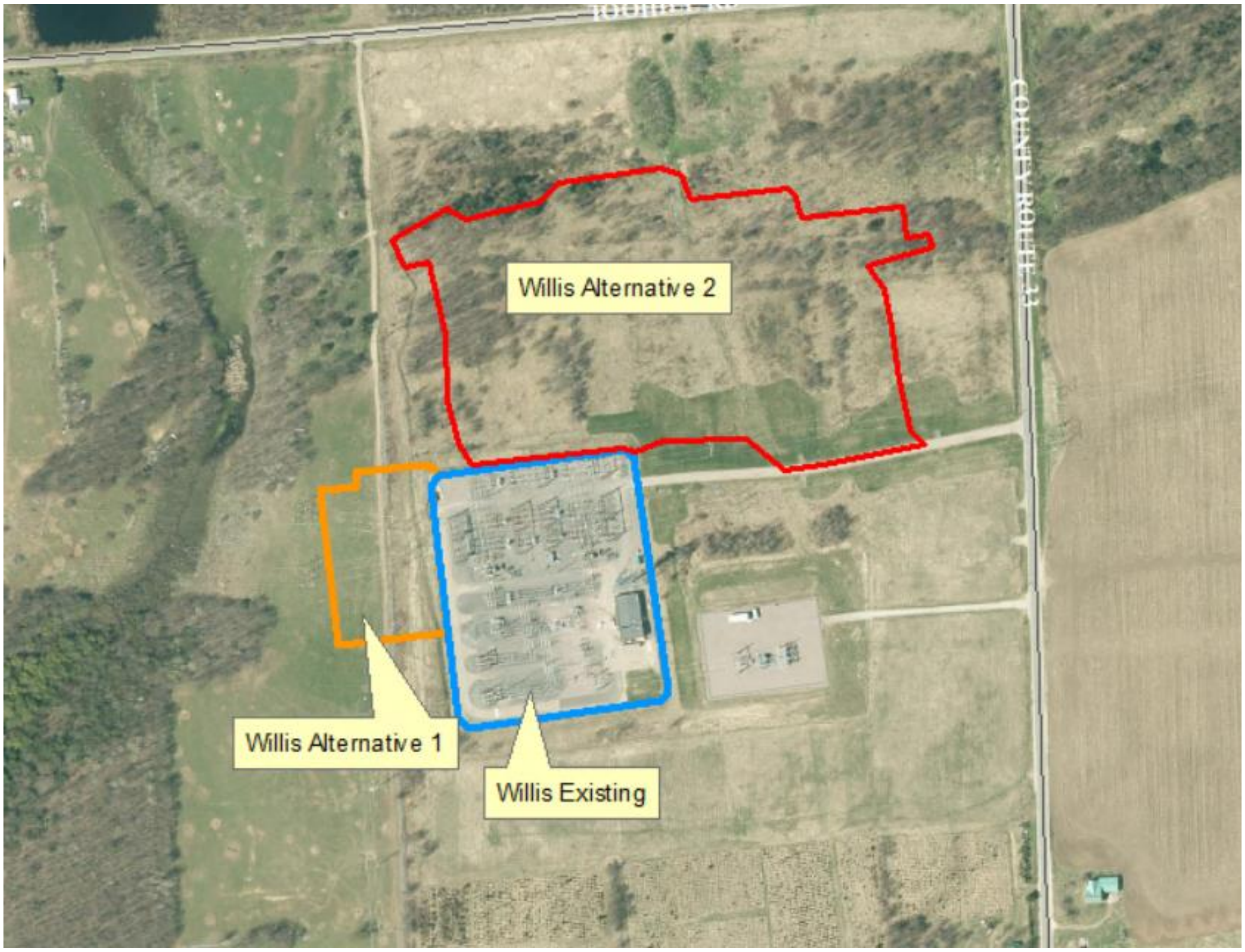

Figure 3-2: Alternative Willis Substation Locations

Adirondack

For the proposed Adirondack Substation, the Applicant conducted the following alternative siting analysis. The Applicant first looked at building at the existing site; however, there was not enough space to convert the station to 345 kV. Rebuilding on the existing site would also force long term outages on the 230 kV system and the 115 kV generator directly connected to the substation. Next, the Applicant looked at the option (Alternative 1) to construct a 345 kV station directly adjacent to the existing Adirondack Substation on property it currently owns; however, the parcel is small and also did not have enough space to accommodate the new substation. The proposed location of the new Adirondack Substation (Adirondack Proposed) just south of the existing site was then selected for the construction of a new 345 kV yard. This property is owned by National Grid and offers adequate space for the substation. The new substation location would support the required outage and transmission line sequencing required to convert the line to 230 kV to 345 kV.

Figure 3-3: Alternative Adirondack Substation Locations

Austin Road

For the proposed Austin Road Substation, the Applicant conducted the following alternative siting analysis. The first option evaluated was rebuilding at the existing Chases Lake Substation to a 345 kV, 3 breaker ring station. It was determined a three-breaker ring at 345 kV could be built in-situ (Alternative 1) however, it would use all the existing property. This would prevent any future expansion of the site without significant civil grading and additional property. Without the ability to expand the site, the opportunity for additional renewables to connect to the new corridor would be limited. The limited property size would also impact the ability to bring in maintenance equipment (i.e., cranes or bucket trucks) in the future, creating potential safety issues. Furthermore, building in-situ would force the station to be built in segments to limit outages on an existing wind farm and is anticipated to increase the overall schedule to meet transmission outage requirements. During the construction sequence, the wind farm would be limited to one transmission line, and if the transmission line outage for that line were required to be cancelled, the wind farm would have to be taken offline. Segmented construction would also create a condition where workers would need to work in close proximity of energized 230 kV equipment. Based on the impact on the overall schedule, potential impact on the wind farm generation, the inability for future expansion, limitations on future maintenance and potential safety concerns, this option was ruled out.

The Project then looked for a new location. The first location considered was east of the existing ROW and parallel with the existing Chases Lake Substation (Alternative 2). However, due to large changes in elevation, adjacent natural gas pipeline, and adjacent wetland complex, the site was deemed unviable. The Project team settled on a parcel of land approximately one mile south of existing Chases Lake that would be owned by National Grid (Austin Road Proposed). The new location afforded easy access for the adjacent public road and access to the ROW. Building at the new green field site will allow the station to be built in parallel with the transmission line, will support the project schedule and will have limited impact on existing wind farm generation. The site will also support expansion for additional renewable resources.

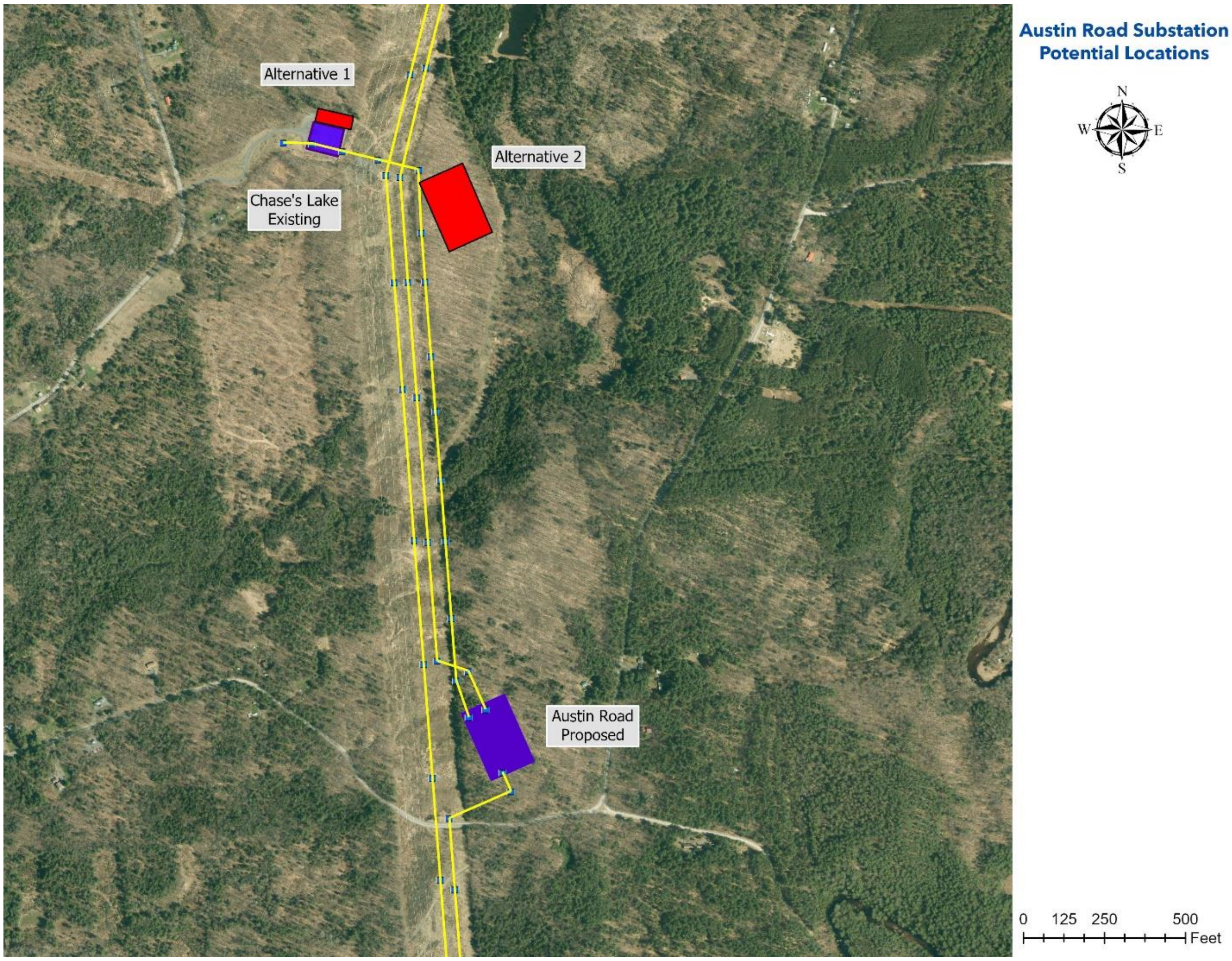

Figure 3-4: Alternative Austin Road Substation Locations

Edic Substation:

For the proposed Edic Substation modifications, the Applicant conducted the following alternative siting analysis. The initial option evaluated was building a new breaker and half bay to the north east of the existing station (Alternative 1). This option would require a large amount of civil work, grading, a large fence expansion and additional property acquisition to facilitate the build out and to avoid interference with other ongoing substation projects. This alternative also had the potential of impacting existing wetland to the northeast of the substation. It was determined that building a whole new breaker and half bay would be excessive for the requirements of this project, which combined with higher cost, ruled out the alternative. The second proposed option looked at using an existing spare position in the southern most breaker and half bay at the existing Edic Substation (Proposed Edic). To accommodate the capacitor bank, a small fence expansion, approximately 0.2 acres, would be required on existing National Grid fee-owned property. This proposed alternative was selected for this project as it would disturb the least amount of land, would meet all project requirements and would be the least cost option.

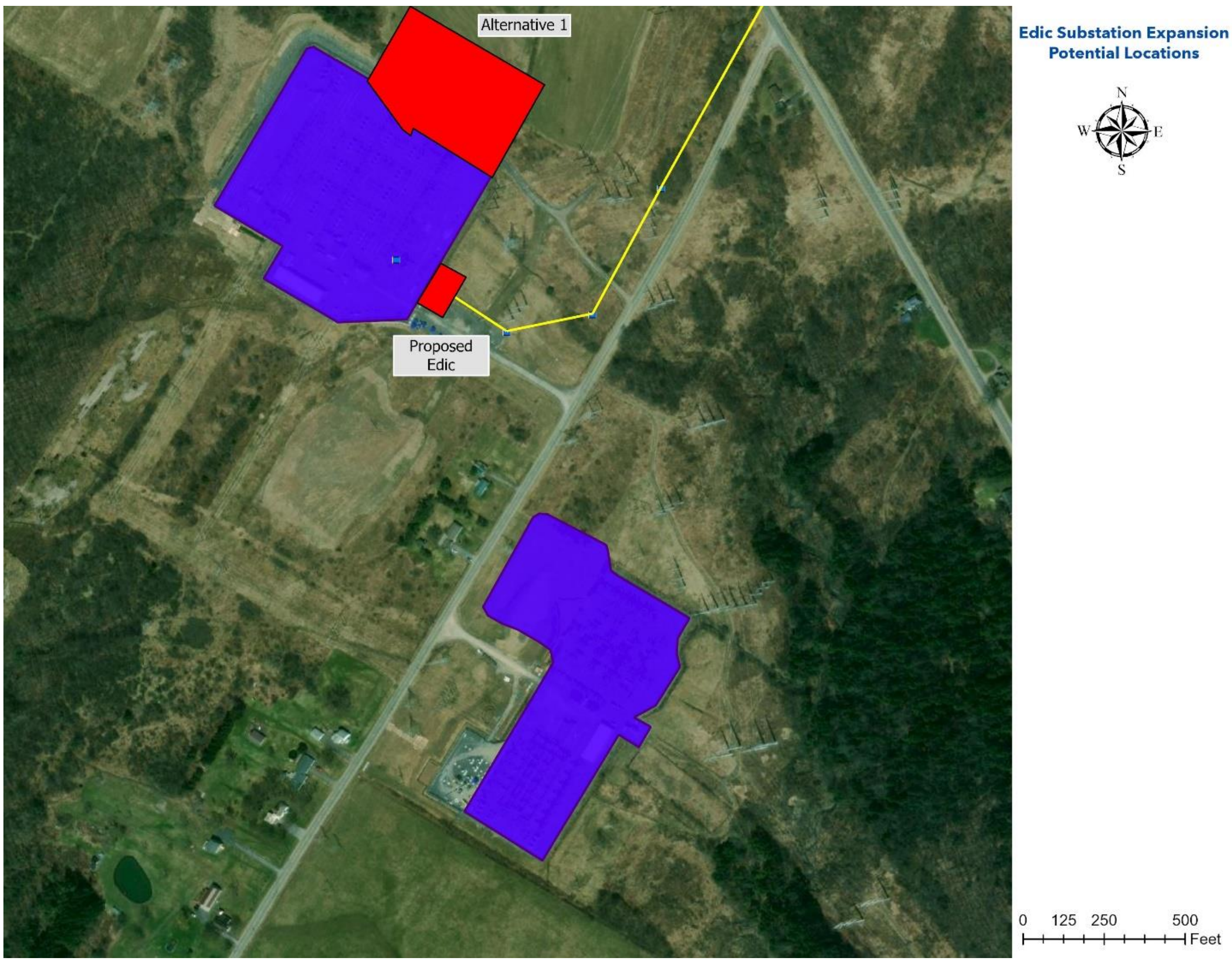

Figure 3-5: Alternative Edic Substation Locations