

Before the
Pennsylvania Public Utility Commission

**MARTINS CREEK – QUARRY #2
230 KV LINE RELOCATION**

ATTACHMENTS IN SUPPORT OF THE
Letter of Notification

Application Docket No. _____

Submitted by: PPL Electric Utilities Corporation



ATTACHMENT 1
MARTINS CREEK – QUARRY #2 230 KV LINE RELOCATION
NECESSITY STATEMENT

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ATTACHMENT 1
MARTINS CREEK – QUARRY #2 230 KV LINE RELOCATION
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric Utilities Corporation (“PPL Electric”) is requesting Pennsylvania Public Utility Commission (“PUC” or the “Commission”) approval to relocate and replace approximately 800 feet of the Martins Creek – Quarry #2 230 kV Transmission Line in order to allow for retermination of this line into a new 230 kV bay within the existing Quarry 230-69 kV Substation located in Freemansburg Borough and the City of Bethlehem, Northampton County, Pennsylvania (the “Quarry Substation Project” or the “Project”). As explained below, the Project is required to upgrade and expand the existing Quarry Substation to a more reliable electrical configuration and to comply with PJM Interconnection, LLC (“PJM”) Protection Standards.

The estimated cost to relocate the Martins Creek – Quarry #2 230 kV Line into the new bay position at Quarry 230-69 kV Substation is approximately \$945,000.¹ Subject to the Commission’s approval, construction is scheduled to begin in September 2016 to support an in-service date of June 2017.

B. SYSTEM PLANNING PROCESS AND GUIDELINES

1. System Planning

The nation’s interconnected transmission grid serves as the backbone for the safe and reliable delivery of large amounts of electricity from generating stations over substantial distances to customers served by transmission and local distribution systems. It is critically important that this interconnected transmission system (transmission grid) be planned and designed to be highly reliable so that reliable electric service can be provided under peak and all loading conditions and

¹ The estimated cost for the proposed Project is an order-of-magnitude estimate developed using averages of recent costs for similar projects and without an in-depth analysis of field investigation. The estimated cost is subject to change as the constructability of the Project, sequence of construction, and other factors that may affect cost are identified and analyzed as the Project progresses.

when certain elements of the system are out of service (system contingencies) due to planned or unplanned outages.

System Planning is the process that assures that the transmission system can supply electricity to all customer loads in a manner that is reliable and economical. This System Planning process assures that both the Bulk Electric System (BES)² and non-Bulk Electric System (non-BES)³ are planned and constructed so that:

- They are able to accommodate forecasted system flows during summer and winter peak load;
- They can adequately serve each customer's needs with regard to capacity, voltage and reliability for all load levels throughout the daily load cycle;
- They can sustain probable contingencies and disturbances with minimal customer service interruptions;
- They conform with NERC, PJM, and PPL Electric's transmission planning reliability principles, practices and standards (RP&P) for all normal and emergency operating conditions; and
- The age and/or operability of the electric system does not cause undue customer outages due to equipment failures and remains economically feasible and avoids excessive maintenance costs.

PJM is a Federal Energy Regulatory Commission (FERC) approved Regional Transmission Organization (RTO) charged with ensuring the reliability of the electric transmission system under its functional control (100 kV and above), and coordinating the movement of electricity in all or parts of thirteen states and the District of Columbia, including most of Pennsylvania. PPL Electric, as an owner of transmission facilities in Pennsylvania, is a member of PJM and actively participates in the PJM transmission planning process.

² Bulk Electric System (BES) - Includes transmission facilities operated at voltages of 100 kV or higher.

³ Non-Bulk Electrical System (non-BES) - Includes transmission facilities operated at voltages less than 100 kV.

PJM has also developed the PJM Protection Standards as set forth in the PJM Manual 07: PJM Protection Standards, (February 27, 2014) (“PJM Manual 07”). The PJM Protection Standards establish the minimum design standards and requirements for the protection systems associated with the bulk power facilities within PJM. The PJM Manual 07 is intended to provide design specification for new protection system installations. In accordance with the PJM Manual 07, all new projects approved after January 1, 2012 are required to conform to these design standards. As a transmission owner in the PJM service territory, PPL Electric is required to operate and design its transmission systems in compliance with the PJM Protection Standards.

2. The PPL Electric System Planning Process

The reliable and economical operation of PPL Electric’s transmission system requires upholding PPL Electric’s planning guidelines for system expansion. The principles upon which these planning guidelines are based recognize that:

- The system expansion should be coordinated to achieve the most economical balance of construction and operating expenditures.
- It should maintain a proper balance between the degree of risk, amount and type of load interrupted, and the cost of providing the needed expansion.
- System reliability should be maintained to prevent large scale, long term, or frequent service interruptions and to avoid adverse effects and hazards to the public.

These principles are incorporated in PPL Electric’s RP&P.

PPL Electric undertakes an independent analysis of both its BES transmission facilities, which include transmission facilities operated at voltages of 100 kV or higher and are under the functional control of PJM, and its non-BES transmission facilities. The PPL Electric planning criteria are outlined in the RP&P document, which was developed to ensure adequate and appropriate levels of electric service to its customers consistent with good utility practice. The PPL Electric RP&P for the BES is consistent with the limits and procedures established by the NERC and PJM reliability criteria.

In accordance with RP&P guidelines, PPL Electric’s transmission system is planned so that it can be operated at all projected load levels and during normal and scheduled outages to withstand

specific unscheduled contingencies without exceeding the equipment capability, causing system instability or cascade tripping, or exceeding voltage tolerances. The transmission system is required to have adequate capability so that it can be operated normally and can withstand the unscheduled contingencies and other system conditions.

Alternatives that can mitigate violations to the reliability criteria are then developed and analyzed to ensure that the PPL Electric transmission system meets the reliability criteria. Estimated costs and lead times to implement the reinforcements are prepared. PPL Electric then proposes solutions to PJM through an RTEP window. If the project is awarded to PPL Electric, it then becomes a baseline RTEP project. Projects that do not address a specific thermal, voltage or stability reliability criteria violation are presented to PJM stakeholders at either a TEAC or Sub-Regional RTEP meeting and are assigned a Supplemental project number in the RTEP.

PPL Electric has developed an Asset Optimization Strategy that has been incorporated into the planning process. A significant portion of the system infrastructure is either approaching the end of or has exceeded its expected or useful life. The Asset Optimization Strategy was developed to systematically identify and modernize these aging facilities. The measures used to identify and prioritize the equipment and lines that qualify for this work includes, but is not limited to: age, condition, operational issues, maintainability of the equipment, criticality of the equipment or line, line loading, and circuit performance. Once equipment has been identified and assessed under the above criteria, it will be put into the Capital Budget for replacement under the Asset Optimization Strategy. Asset Optimization Strategy projects are submitted to PJM as supplemental projects.

C. EXISTING SYSTEM

The Quarry 230-69 kV Substation is located in Freemansburg Borough and the City of Bethlehem, Northampton County, Pennsylvania. Approximately 33,688 customers in parts of Northampton County are presently served from the Quarry 230-69 kV substation. The existing Quarry 230-69 kV Substation is approximately 50 years old.

The Quarry 230-69 kV Substation currently utilizes four 230-69 kV transformers (three rated as 75 MVA and one rated as 85 MVA), four 230 kV transmission lines (Martins Creek – Quarry #2 230 kV, Quarry – Northwood 230 kV, and Steel City – Quarry #1 and #2 230 kV lines), two 138/69 kV transmission lines (Hosensack – Quarry #1 and #2 138/69 kV), and seven 69 kV transmission lines. The Quarry – Northwood 230 kV Transmission Line is owned by FirstEnergy and is located on the same set of structures as the PPL Electric-owned Martins Creek – Quarry #2 230 kV Transmission Line.

Two of the existing transformers tap into 230 kV buses while two transformers currently tap directly into 230 kV transmission lines. The Quarry 230-69 kV #1 transformer (85 MVA) taps directly into the Quarry West 230 kV bus, and the Quarry 230-69 kV #2 transformer (75 MVA) taps directly into the Quarry East 230 kV bus. The Quarry 230-69 kV #3 transformer (75 MVA) taps directly to the Martins Creek – Quarry #2 230 kV Transmission Line, and the Quarry 230-69 kV #4 transformer (75 MVA) taps directly into the Steel City – Quarry #2 230 kV Transmission Line.

A one-line diagram and map depicting the configuration of the existing facilities at the Quarry 230-69 kV Substation are provided as Figure 1-1 and Figure 1-2, respectively.

D. NEED FOR THE PROJECT

The existing Quarry 230-69 kV Substation serves more than 200 MW of load and at least 33,688 customers in parts of Northampton County, Pennsylvania. PPL Electric has determined that aging equipment within the existing Quarry 230-69 kV Substation has exceeded its useful life and cannot be relied upon to continue to provide reliable service into the future. Specifically, PPL Electric's Engineering Group has determined that the three of the four 230-69 kV transformers at the Quarry 230-69 kV Substation rated at 75 MVA have reached the end of their useful life and are at risk of failure based upon industry maintenance experience and engineering judgment. PPL Electric's Engineering Group also has determined that certain circuit breakers, protections systems, and battery systems at the Quarry 230-69 kV Substation have reached the end of their useful life and must be replaced. The existing control house has old electromechanical relays and non-standard

battery system. The new control house is required as the existing control house doesn't have enough space to accommodate the new relays and battery system. The Quarry 230-69 kV Substation is a vital substation to both the BES and non-BES transmission systems. As such, the substation cannot be decommissioned.

In addition, Section 8.2 of the PJM Manual 07 requires that there must be a protective device (fault-interrupting device) between a BES transmission line and the high side of a non-BES transformer. Currently, the Quarry 230-69 kV #3 transformer taps directly to the Martins Creek – Quarry #2 230 kV Transmission Line, and the Quarry 230-69 kV #4 transformer taps directly into the Steel City – Quarry #2 230 kV Transmission Line. Thus, the current configurations of these 230-69 kV transformer connections do not meet the requirements Section 8.2 of the PJM Manual 07.

For these reasons, PPL Electric proposes to replace the aging equipment at the Quarry 230-69 kV Substation and to reconfigure the substation into a more reliable electrical configuration.

E. PROPOSED SOLUTION

To address the issues explained above, PPL Electric proposes to upgrade and replace the aging electrical equipment and reconfigure Quarry 230-69 kV Substation into a more reliable electrical configuration. Specifically, PPL Electric proposes to expand the Quarry 230-69 kV Substation to add one additional 230 kV bay position and additional circuit breakers to reconfigure the Substation into a more reliable double bus, double breaker configuration.

The existing circuit breakers, protection systems, and battery systems that have reached the end of their useful lives will be replaced with modern equivalents. In addition, three of the existing 230-69 kV transformers will be upgraded from 75 MVA units to 230-69 kV 170 MVA rated transformer units. The 85 MVA transformer will remain onsite, but will not be connected to the Quarry 230-69 kV Substation. Instead, the transformer will serve as a backup transformer for PPL Electric to deploy if needed. The upgrade will increase the transformer capacity of the 69 kV

system at the Quarry 230-69 kV Substation by 200 MVA compared to the existing transformer capacity.

In addition, to meet the requirements of Section 8.2 of PJM Manual 07, the Quarry 230/69 kV #3 and #4 transformers will be rearranged to avoid directly tapping a BES transmission line. Specifically, the Quarry 230/69 kV #4 transformer will be rearranged into its own 230 kV bay position and will no longer be tapped from the Steel City – Quarry #2 230 kV Transmission Line. The Steel City – Quarry #2 230 kV Transmission Line will remain in place and continue to terminate into the current 230 kV bay. Similarly, the Quarry 230/69 kV Transformer #3 will be rearranged into the 230 kV west bus and will no longer be tapped from the Martins Creek – Quarry #2 230 kV Transmission Line. The Martins Creek – Quarry #2 230 kV Transmission Line will then be relocated and terminated into a newly installed 230 kV bay position. This proposed double breaker, double bus configuration will eliminate non-BES line tapped transformers and meet the requirements of Section 8.2 of the PJM Manual 07.

To interconnect the Martins Creek – Quarry #2 230 kV Transmission Line with the new 230 kV bay position, PPL Electric requests Commission approval to relocate and replace approximately 800 feet of the existing Martins Creek – Quarry #2 230 kV Transmission Line. For approximately 14 miles extending from the Quarry 230-69 kV Substation, the existing Martins Creek – Quarry #2 230 kV Transmission Line and Quarry – Northwood 230 kV Transmission Line are located on the same set of transmission structures, *i.e.*, one 230 kV circuit occupies one side of the structures while the other 230 kV circuit occupies the other side of the structures. The Quarry – Northwood 230 kV Transmission Line will remain on the existing structures. However, approximately 800 feet of the Martins Creek – Quarry #2 230 kV Transmission Line will be relocated and replaced to interconnect with the new 230 kV bay position. An engineering description of the relocated Martins Creek – Quarry #2 230 kV Transmission Line is provided in Attachment 2. A one-line diagram and map of the proposed Project are provided as Figures 1-3 and 1-4, respectively.

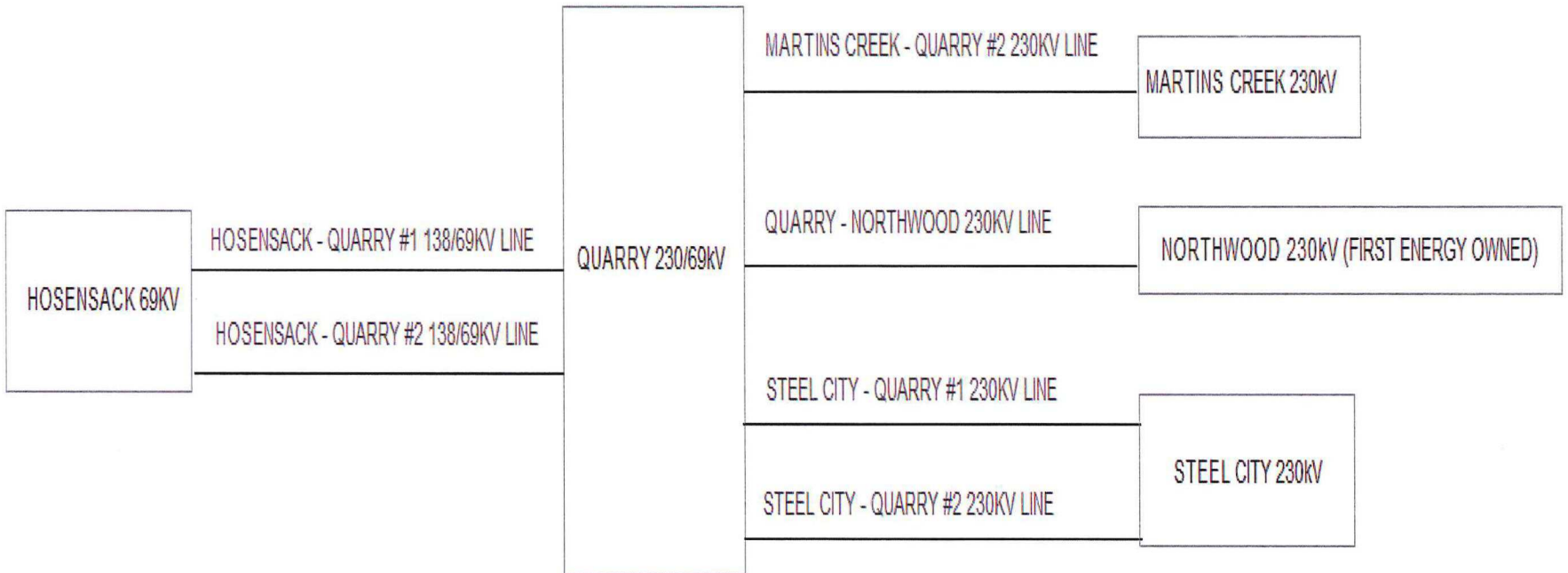
This Project is necessary to enable PPL Electric to continue to provide reliable service now and into the future, and therefore, PPL Electric requests approval of the Commission to complete this Project. The Project was presented before the PJM sub-regional Regional Transmission Expansion

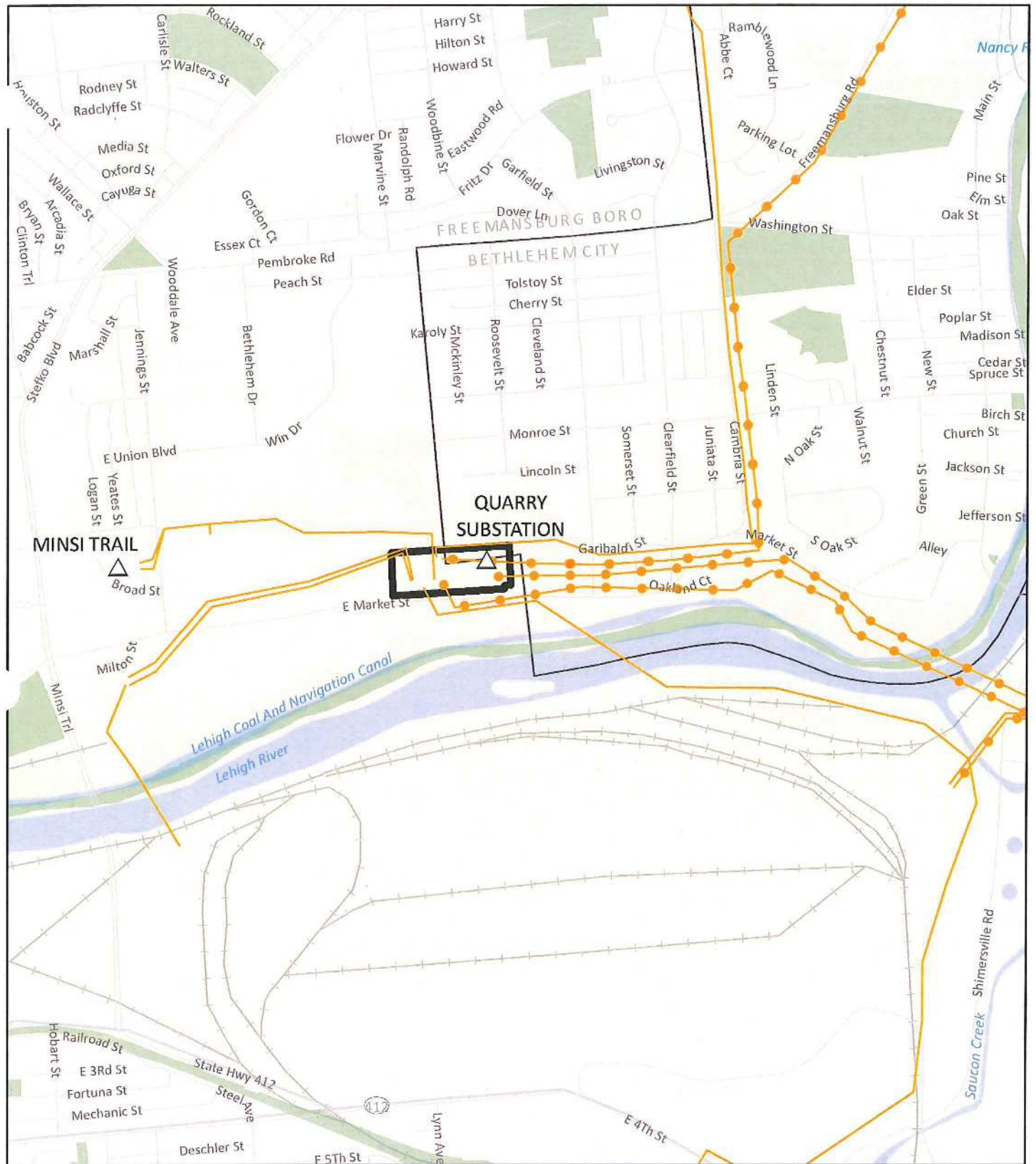
Plan (“RTEP”) committee for the mid-Atlantic zone on July 29, 2015.⁴ The Quarry Project was assigned supplemental project number s0957.1.

Subject to the Commission’s approval, construction is scheduled to begin in September 2016 to support an in-service date of June 2017. The scheduled in-service date is the date that the proposed facilities can reasonably be installed based on normal construction schedules.

⁴ PJM’s RTEP process is currently set forth in Schedule 6 of PJM’s Amended and Restated Operating Agreement (“Schedule 6”). Schedule 6 governs the process by which PJM’s members rely on PJM to prepare an annual regional plan for the enhancement and expansion of the transmission facilities to ensure long-term, reliable electric service consistent with established reliability criteria. In addition, Schedule 6 addresses the procedures used to develop the RTEP, the review and approval process for the RTEP, the obligation of transmission owners to build transmission upgrades included in the RTEP, and the process by which interregional transmission upgrades will be developed.

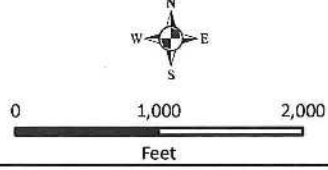
Figure 1-1. One-Line Diagram of Existing System





- Legend**
- Substation
 - Existing Substation Fenceline
 - Stream
 - Waterbody
 - Local Park
 - Railroad
 - Municipality Boundary
 - Existing Transmission**
 - 230 kV
 - 69 kV

**Martins Creek - Quarry #2
230 kV Line Relocation
Figure 1-2. Map of Existing Facilities**



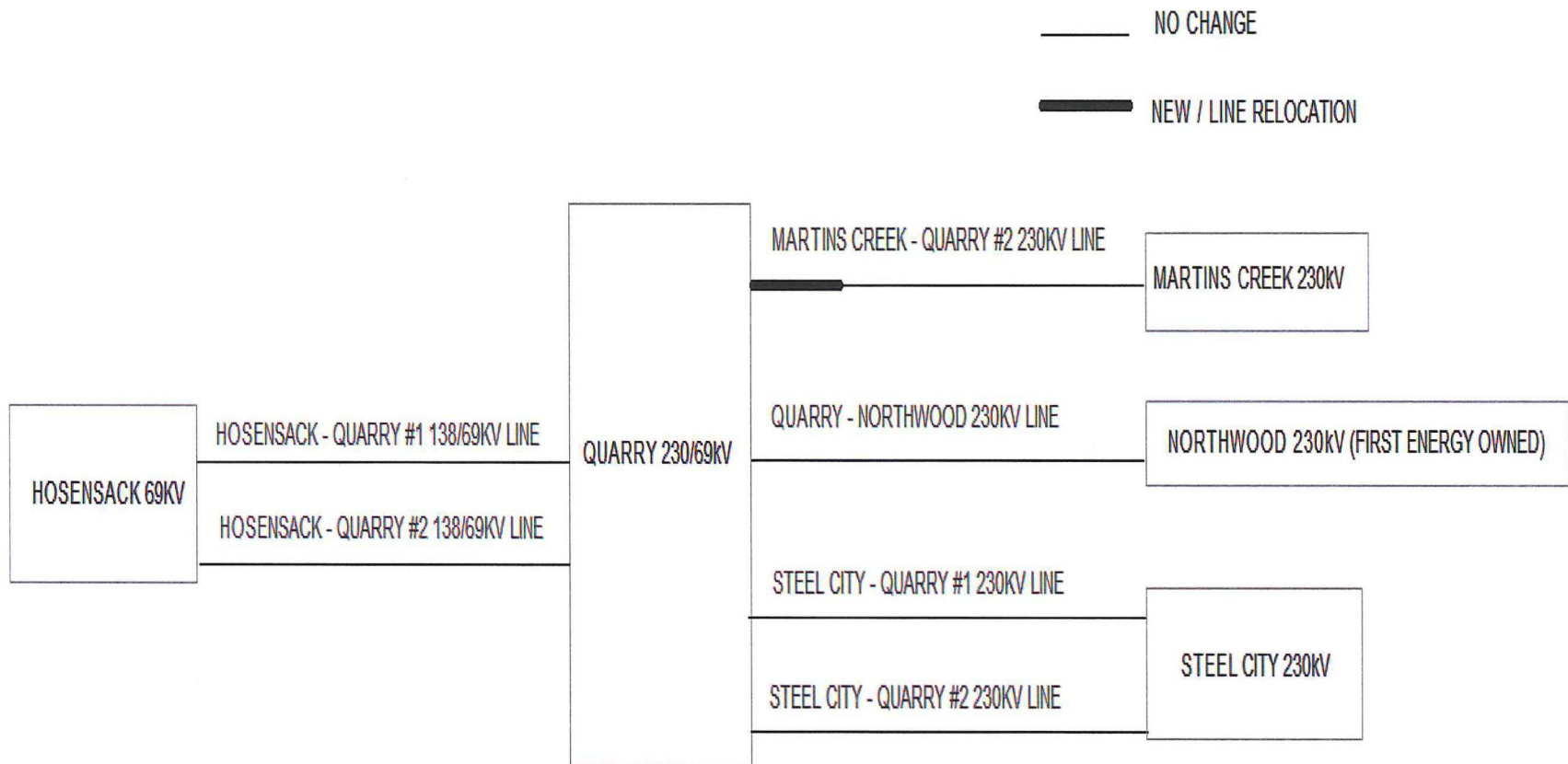
Sources: Pennsylvania Spatial Data Access (PASDA), Environmental Systems Research Institute (ESRI), United States Geological Survey (USGS)

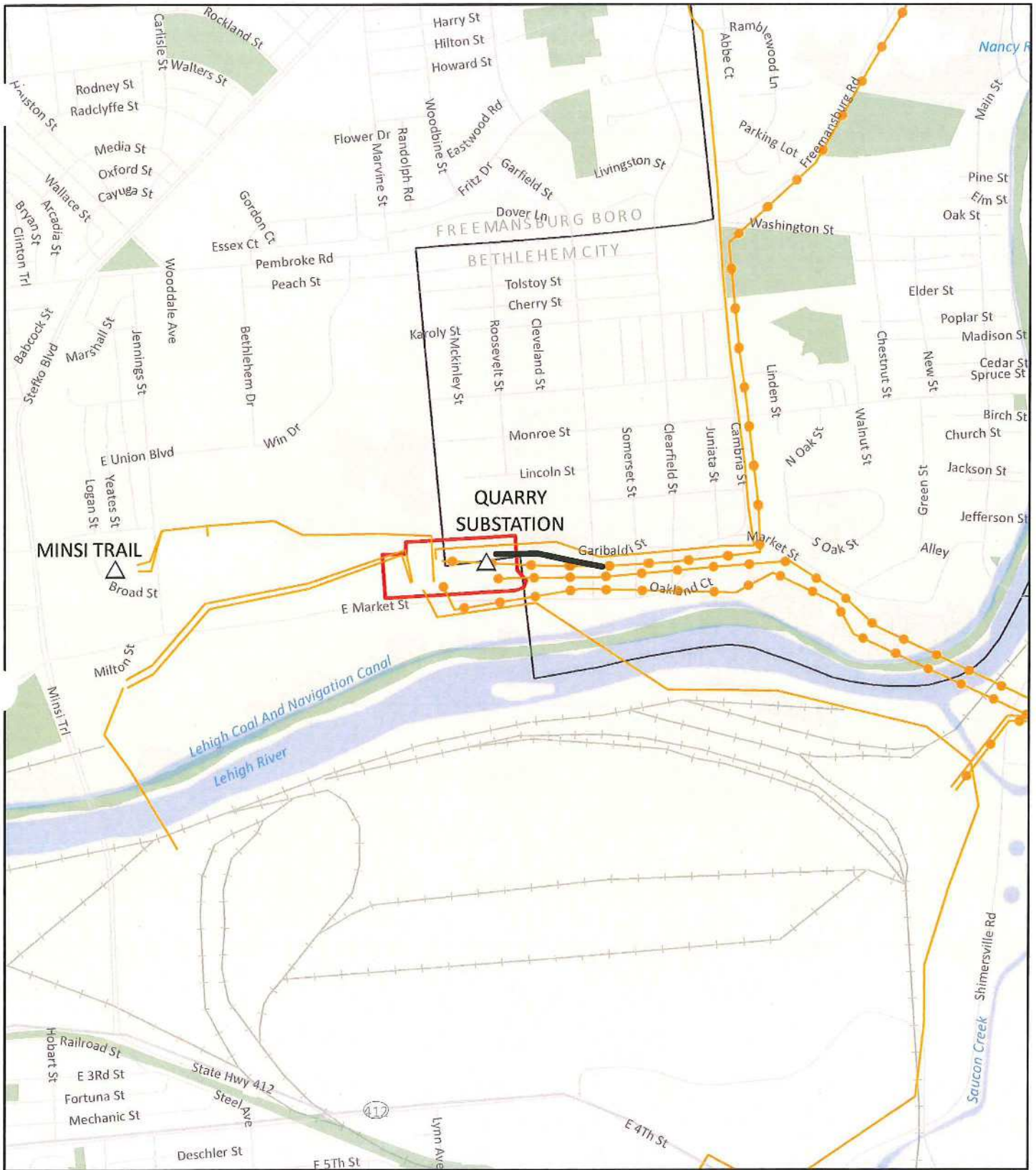
Louis Berger

Projected Coordinate System: PA State Plane, South.
Datum: North American Datum of 1983 (NAD83).
Projection: Lambert Conformal Conic.
Linear Unit: Feet.
Ellipsoid: Geodetic Reference System 80



Figure 1-3. One-Line Diagram of Proposed System





Legend

- Substation
- Proposed 230 kV Line
- Stream
- Railroad
- Existing Transmission 230 kV
- Existing Transmission 69 kV
- Waterbody
- Local Park
- Municipality Boundary
- Proposed Substation Fenceline

**Martins Creek - Quarry #2
230 kV Line Relocation**

Figure 1-4. Map of Proposed Facilities

0 1,000 2,000
Feet

Sources: Pennsylvania Spatial Data Access (PASDA), Environmental Systems Research Institute (ESRI), United States Geological Survey (USGS)

Projected Coordinate System: PA State Plane, South.
Datum: North American Datum of 1983 (NAD83).
Projection: Lambert Conformal Conic.
Linear Unit: Feet.
Ellipsoid: Geodetic Reference System 80.

ATTACHMENT 2
MARTINS CREEK – QUARRY #2 230 KV LINE RELOCATION
ENGINEERING DESCRIPTION

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ATTACHMENT 2
MARTINS CREEK – QUARRY #2 230 KV LINE RELOCATION
ENGINEERING DESCRIPTION

A. INTRODUCTION

PPL Electric Utilities Corporation (“PPL Electric”) proposes to upgrade and expand the Quarry 230-69 kV Substation located in Freemansburg Borough and the City of Bethlehem, Northampton County, Pennsylvania. As explained in Attachment 1, PPL Electric herein seeks approval from the Pennsylvania Public Utility Commission (“PUC” or the “Commission”) to relocate and replace approximately 800 feet of the existing Martins Creek – Quarry #2 230 kV Transmission Line into a new bay position within the expanded Quarry 230-69 kV Substation (the “Project”).

B. DESCRIPTION OF PROPOSED LINE

As explained in Attachment 1, PPL Electric proposes to upgrade and replace the aging electrical equipment and reconfigure Quarry 230-69 kV Substation into a more reliable electrical configuration. Specifically, PPL Electric proposes to expand the Quarry 230-69 kV Substation to add one additional 230 kV bay position and additional circuit breakers to reconfigure the Substation into a more reliable double bus, double breaker configuration.

As part of the Project, the Martins Creek – Quarry #2 230 kV Transmission Line will be re-terminated from the Quarry 230-69 kV #3 transformer into the new 230 kV bay position. Currently, the existing Martins Creek – Quarry #2 230 kV Transmission Line and Quarry – Northwood 230 kV Transmission Line are located on the same set of transmission structures as they interconnect with the Quarry 230-69 kV Substation. To interconnect the Martins Creek – Quarry #2 230 kV Transmission Line with the new 230 kV bay position, PPL Electric proposes to remove and replace the last two spans, or approximately 800 feet, of the existing Martins Creek – Quarry #2 230 kV Transmission Line from the existing structures and re-terminate the line into the new 230 bay position.

As explained in Attachment 3, approximately 720 feet of the relocated and replaced Martins Creek – Quarry #2 230 kV Transmission Line will be located on the PPL Electric-owned property for the Quarry 230-69 kV Substation. The remaining 80 feet of the relocated Martins Creek – Quarry #2 230 kV Transmission Line will be located entirely within PPL Electric’s existing right-of-way.

The relocated and replaced segment of the Martins Creek – Quarry #2 230 kV transmission line will require the installation of two new steel monopole structures on the Quarry 230-69 kV Substation site. Each new monopole structure will have an average height of approximately 110 feet. All new poles for the proposed Project will be self-supporting structures on drilled shaft, reinforced concrete foundations. A typical 230 kV monopole is shown in Figure 2-1.

The relocated segment of the Martins Creek – Quarry #2 230 kV Transmission Line will remove and replace the existing conductors with three new power conductors and one overhead ground wire. The power conductors will each be 1590 thousand circular mills (“kcmil”)¹, 45/7 stranding, aluminum conductor steel reinforced (ACSR). The overhead ground wire will be 0.5-inch diameter overhead ground wire (OHGW).

The proposed line will be designed to comply with National Electrical Safety Code (NESC) standards. The minimum conductor-to-ground clearance will be 32 feet, which occurs at a maximum conductor temperature of 125° C. Design specifications and safety rules practiced by PPL Electric are included in Attachment 4.

C. MAGNETIC FIELD MANAGEMENT

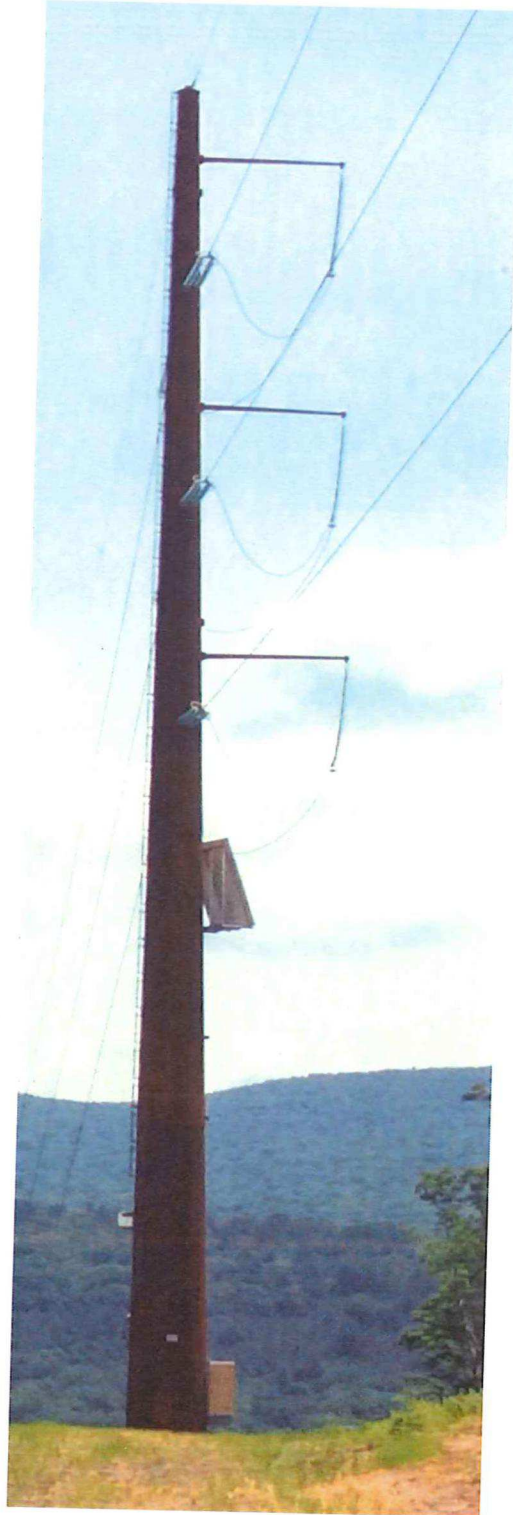
PPL Electric’s Magnetic Field Management Program is applied to new and reconstructed transmission line projects. The company does not believe that the current scientific evidence demonstrates that magnetic fields cause any adverse health effects or pose a health or safety danger to the public. Nevertheless, PPL Electric has determined, as a matter of policy, to design its new and rebuilt transmission lines to reduce magnetic fields when that can be done at low or no cost and consistent with functional requirements. PPL Electric’s Magnetic Field Management

¹ A kcmil wire size is the equivalent cross sectional area in thousands of circular mils. A circular mil is the area of a circle with a diameter of one thousandth (0.001) of an inch.

Program has been developed to implement that policy decision. To reduce magnetic field exposures, the program generally prescribes the use of a line design that provides five feet higher ground clearance than NESC standards and reverse phasing of new double-circuit lines where it is feasible to do so at low or no cost.

The relocated portion of the Martins Creek – Quarry #2 230 kV Transmission Line is single-circuit. Reverse phasing requires a double-circuit line. Therefore, reverse phasing will not be possible for the relocated transmission line. However, consistent with PPL Electric’s Magnetic Field Management Program, PPL Electric will construct the new 230 kV Transmission Line for ground clearances that are a minimum of five feet higher than NESC standards for 230 kV Transmission Lines to further mitigate the potential for exposure to magnetic fields.

FIGURE 2-1 - TYPICAL 230 kV STEEL MONOPOLE



ATTACHMENT 3
MARTINS CREEK – QUARRY #2 230 KV LINE RELOCATION
DESCRIPTION OF THE PROJECT AREA

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ATTACHMENT 3
MARTINS CREEK – QUARRY #2 230 KV LINE RELOCATION
DESCRIPTION OF THE PROJECT AREA

A. INTRODUCTION

PPL Electric Utilities Corporation (“PPL Electric”) proposes to upgrade and expand the aging Quarry 230-69 kV Substation located in Freemansburg Borough and the City of Bethlehem, Northampton County, Pennsylvania. As explained in Attachment 1, PPL Electric herein seeks approval from the Pennsylvania Public Utility Commission (“PUC” or the “Commission”) to relocate and replace approximately 800 feet of the existing Martins Creek – Quarry #2 230 kV Transmission Line into a new bay position within the expanded Quarry 230-69 kV Substation (the “Project”). The line relocation and replacement is necessary to accommodate the upgraded Quarry 230-69 kV Substation. The line relocation and replacement will occur entirely within Freemansburg Borough, Northampton County, Pennsylvania. PPL Electric has provided information about the proposed Project to Freemansburg Borough, the City of Bethlehem and Northampton County.

B. DESCRIPTION OF PROJECT AREA

As described in Attachment 1, PPL Electric proposes to upgrade and replace the aging electrical equipment and reconfigure Quarry 230-69 kV Substation into a more reliable electrical configuration. Specifically, PPL Electric proposes to expand the Quarry 230-69 kV Substation to add one additional 230 kV bay position and additional circuit breakers to reconfigure the Substation into a more reliable double bus, double breaker configuration as further explained in Attachment 1. As part of the upgrade, PPL Electric proposes to replace and re-terminate approximately 800 feet of the existing Martins Creek – Quarry #2 230 kV Transmission Line into the new 230 kV bay position as further explained in Attachment 2.

Approximately 720 feet of the replaced and relocated Martins Creek – Quarry #2 230 kV Transmission Line will be located within the PPL Electric-owned property for the Quarry 230 kV Substation. The remaining 80 feet will traverse within PPL Electric’s existing Martins Creek

– Quarry #2 230 kV right-of-way located in Freemansburg Borough. PPL Electric does not require any additional right-of-way to construct the Project. Figure 3-1 is an aerial map of the Project.

C. LAND USE AND NATURAL FEATURES

Impacts to land use are anticipated to be minimal because the majority of the Project will be constructed within the PPL Electric-owned Quarry Substation property, with a short distance extending to an existing structure located within an existing right-of-way. No additional property will be required to complete the proposed Project. PPL Electric will use and update previously established access roads for construction to further reduce interference with existing land uses.

No nearby communication towers, pipelines, or other utilities will be affected by the proposed Project. The closest airport is the Bethlehem Steel Plant Heliport, a privately owned facility, located approximately 0.7 mile south of the Martins Creek – Quarry #2 Transmission Line. PPL Electric does not anticipate any interference with airport operations because the Project is located in an area where there are existing electrical facilities and because the new facilities will be similar in height to the existing facilities. However, PPL Electric will file all required documentation with both the Federal Aviation Administration and the Pennsylvania Department of Transportation, Bureau of Aviation.

A National Area Inventory (NAI) has been prepared by The Nature Conservancy in association with the Pennsylvania Natural Heritage Program (PNHP) for Northampton County (2013). The NAI includes information on the location of rare, threatened, and endangered species and the highest quality natural areas located within the County. The Project is located approximately 0.2 mile northwest of the Lehigh River – Laubach Island NAI area. Lehigh River – Laubach Island is a floodplain of the Lehigh River and part of the old Lehigh Canal locks and dams system which provides habitat for three plant species of concern. No work will be conducted on the south side of Market Street which separates the Project from the Laubach Island NAI area. Therefore, no impacts on the Laubach Island NAI area are anticipated. See the Aerial Map provided as Figure 3-1 to this Attachment.

The Project is located approximately 0.5 mile northeast of the Bethlehem Steel Building NAI area. The Bethlehem Steel Building consists of manmade structures which serve as a cliff-like habitat for a breeding population of the Pennsylvania-endangered peregrine falcon. As described below, PPL Electric conducted an online review with the Pennsylvania Game Commission (PGC). No potential impacts to the peregrine falcon were identified. Further, due to the distance of the Project from this NAI area, no impacts are anticipated. The Project will not affect any other unique geological, scenic or designated natural areas. The Project will not affect any recreational areas or natural landmarks.

The 100-year floodplain borders the substation property to the south and slightly encroaches within the substation property on the south and west sides of the existing fenceline. The Martins Creek – Quarry #2 230 kV Transmission Line relocation will not cross the floodplain. The existing and upgraded substation is designed to be 3 feet above the 100-year floodplain; therefore, no additional flood protection measures are required.

PPL Electric retained a consultant to identify and delineate all wetlands and watercourses within the Project area. One small emergent wetland was delineated within the Quarry Substation property. However, this wetland will not be impacted by the construction of the 230 kV line or proposed substation upgrades. Based on preliminary design, the Project will not require any permits from the U.S. Army Corps of Engineers (USACE) or the Pennsylvania Department of Environmental Protection (PADEP). Should this change during detailed design, PPL Electric will obtain all required permits and will fully comply with any conditions on those permits. PPL Electric will also consult with the Northampton County Conservation District, prepare any required soil erosion and sedimentation control plans, and obtain National Pollutant Discharge Elimination System (NPDES) permits, if required, and comply with any conditions placed on those permits.

D. THREATENED AND ENDANGERED SPECIES

PPL Electric conducted an online Pennsylvania Natural Diversity Inventory (PNDI) database review on July 7, 2015¹. Based on this review, the PGC, Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Conservation and Natural Resources (DCNR), and the U.S. Fish and Wildlife Service (USFWS) reported that the proposed Project will not impact any threatened and endangered species, or special concern species and resources located within the Project area. Northampton County is located within the range of the federally threatened bog turtle (*Clemmys muhlenbergii*). However, because no Chapter 105 or general permits are needed from PADEP, a Phase I bog turtle survey is not required for this Project.

E. CULTURAL RESOURCES

PPL Electric conducted a review of the online Pennsylvania Historical and Museum Commission (PHMC) Bureau for Historic Preservation (BHP) Cultural Resources Geographic Information System (CRGIS) database to determine if National Register of Historic Places (NRHP) listed or eligible historic properties are located in the Project vicinity.

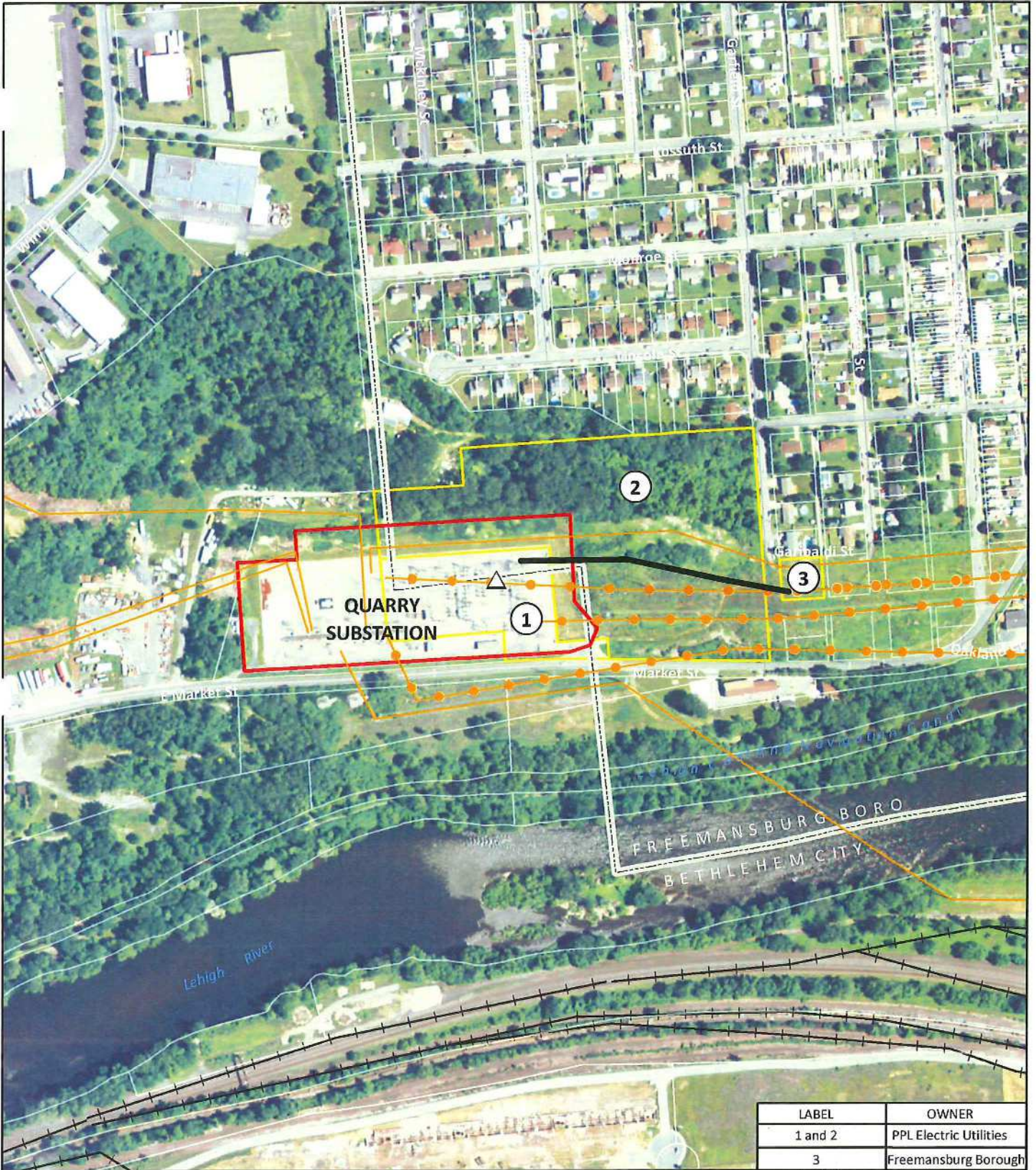
PPL Electric submitted a review letter to the PHMC on January 14, 2016. A response letter from PHMC dated February 18, 2016² indicated that the project will have no adverse effect on historic properties.

F. VEGETATION MANAGEMENT

The Project is being constructed in an area that previously has been cleared of vegetation. Minimal vegetation clearing may be necessary as part of the Martins Creek – Quarry #2 230 kV Transmission Line relocation. In areas where vegetation management is required to construct and maintain the Project, PPL Electric will apply its “Specifications for Initial Clearing and Control of Vegetation On or Adjacent to Electric Line Right-of-Way Through Use of Herbicides, Mechanical and Hand Clearing Techniques” to minimize any potential impacts.

¹ PNDI Receipt No. 20150702521200

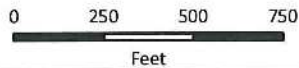
² ER No. 2016-0559-095-A



Legend

- Substation
- Proposed 230 kV Line
- Railroad
- Existing Transmission**
- 230 kV
- 69 kV
- Proposed Fenceline
- Municipality Boundary
- Parcels within Project Area
- Note, parcel boundaries displayed in white.

Martins Creek - Quarry #2
230 kV Line Relocation
Figure 3-1. Aerial Map



Sources: Pennsylvania Spatial Data Access (PASDA),
Environmental Systems Research Institute (ESRI),
United States Geological Survey (USGS)



Projected Coordinate System: PA State Plane, South.
Datum: North American Datum of 1983 (NAD83).
Projection: Lambert Conformal Conic.
Linear Unit: Feet.
Ellipsoid: Geodetic Reference System 80.



ATTACHMENT 4
MARTINS CREEK – QUARRY #2 230 KV LINE RELOCATION
PPL DESIGN CRITERIA AND SAFETY PRACTICES

The National Electrical Safety Code (NESC) is a set of rules to safeguard people during the installation, operation, and maintenance of electric power lines. The NESC contains the basic provisions considered necessary for the safety of employees and the public. Although it is not intended as a design specification, its provisions establish minimum design requirements. PPL Electric Utilities Corporation (PPL Electric) has developed design specifications and safety rules which meet or surpass all requirements specified by the NESC.

Engineering Design Criteria and Parameters

The NESC includes loading requirements and clearances for the design, construction, and operation of power lines. The “loads” on conductors and supporting structures are the mechanical forces that develop from the weight of the conductors, the weight of ice on the conductors, plus wind pressure on the conductors and supporting structures. Loading requirements are the loads on the conductors and structures that are anticipated assuming certain ice and wind conditions. Loading requirements always contain “safety factors” to allow for unknown or unanticipated contingencies. The clearances and loading requirements contained in the NESC were developed to ensure public safety and welfare.

PPL Electric transmission line design standards meet or surpass the NESC standards. For example, the relative order of grades of construction for conductors and supporting structures is B, C, and N; Grade B being the highest. According to the NESC standards, construction Grades B, C, or N may be used for transmission lines (except at crossings of railroad tracks and limited access highways where Grade B construction is specified). However, PPL Electric designs all of its transmission lines for Grade B construction. The use of Grade B design and construction specifies enhancements such as larger-minimum crossarm dimensions, larger-minimum conductor size, and increased safety factors.

Another example is the design parameters utilized to account for ice and wind loadings on the overhead ground wire (OHGW) and power conductors. The NESC standard ice and wind design magnitudes for the PPL territory are 0.5 inch thickness of radial ice combined with four pounds per square foot horizontal wind pressure (equivalent to 40-mile per hour wind velocity). The conductor sags and tensions used in line designs are the result of various ice and wind combinations, depending on the elevation at the line location and line design voltage. The conductor sags and tensions used in the design of all PPL transmission lines are at least 0.5-inch ice combined with eight pounds wind pressure (equivalent to 57 miles per hour wind velocity). This means that PPL Electric lines are designed to operate safely and reliably during inclement weather even more severe than assumed by the NESC. In addition, PPL Electric transmission lines are designed with more clearance to the ground than required by the NESC. The tables below compare PPL Electric and NESC ground clearances for lines of various voltages.

138 kV

Vertical Clearance to Ground

<u>Surface Underneath Conductors</u>	<u>NESC Standard</u>	<u>PPL Design</u>
Roads, streets, alleys	21 Ft.	30 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	21 Ft.	30 Ft.
Spaces accessible to pedestrians only	17 Ft.	30 Ft.
Railroad tracks	31 Ft.	35 Ft.

230 kV

<u>Vertical Clearance to Ground</u>		
<u>Surface Underneath Conductors</u>	<u>NESC Standard</u>	<u>PPL Design</u>
Roads, streets, alleys	23 Ft.	32 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	23 Ft.	32 Ft.
Spaces accessible to pedestrians only	19 Ft.	32 Ft.
Railroad tracks	31 Ft.	36 Ft.

500 kV

<u>Vertical Clearance to Ground</u>		
<u>Surface Underneath Conductors</u>	<u>NESC Standard</u>	<u>PPL Design</u>
Roads, streets, alleys	28 Ft.	53 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	28 Ft.	53 Ft.
Spaces accessible to pedestrians only	24 Ft.	53 Ft.
Railroad tracks	38 Ft.	53 Ft.

A relay protection system is used to protect the public safety and welfare as well as equipment and the transmission system. Relay protection is installed for all transmission lines to automatically de-energize the line in the unlikely event that the line or supporting structure fails and the line contacts the ground.

Periodic Maintenance Program on All Transmission Lines

To ensure continued public safety and integrity of service, a periodic maintenance and inspection program is implemented for every transmission line. The program is administered through the use of helicopter patrols, with supplemental foot and structure climbing patrols. A number of helicopter patrols are performed on all lines annually. The two-man helicopter crew flies parallel, to the left,

and above the line so that the observer can look for signs of line damage or deterioration and observe clearances between vegetation and conductors. The observations are included in a report that is forwarded to the appropriate department for corrective action.

Foot and structure climbing patrol programs for a transmission line begin approximately three to five years after the line is energized, unless a helicopter patrol reports a need for earlier action. The frequency of foot patrols varies from once every year to once every several years depending on line type and age.

An assigned foot patroller checks right-of-way conditions, including access roads, bridges, pole washouts, tower footers, vegetation height and clearance to conductors, pole and tower deterioration and, with the use of binoculars, insulators, and condition of hardware. Identified problems are included in a report that is forwarded to the appropriate department for corrective action.

A scheduled line outage is required to perform an overhead patrol because of “hands-on” inspection of hardware. Overhead patrols are conducted on a schedule determined by line age, operating record, and observed general condition. The necessary repairs are also done during the inspection outage.

Personnel Safety Rules

The following are a few of the PPL safety rules that demonstrate the Company’s concern for employee safety:

- Work procedures have been developed to allow work to be performed on energized facilities in a safe manner. When lines or apparatus are removed from service to be worked on, the Energy Control Process system is applied. This system provides that a red tag must be physically placed on the control handle of the de-energized equipment. The red tag may be removed only after proper authorization to energize the equipment. Various other tags are used for limited operations and informational purposes. Employees will not apply or remove a tag or change the status of tagged equipment unless authorized.

- Temporary safety grounds are used on de-energized facilities for employee safety during maintenance, construction, or reconstruction work. Safety grounds are wires connecting the de-energized facility to an electrical ground. If the facility should be energized, the safety grounds will divert the current directly to ground and reduce the likelihood of personal injury. The conductor size and attachment clamps of temporary safety grounds must be capable of conducting anticipated fault currents. Rubber gloves, rubber sleeves, and additional rubber protective equipment are used as required when applying or removing temporary safety grounds to or from the lines or apparatus to be grounded. An approved nonconductive working stick of sufficient length to allow workers to maintain the following required minimum clearances is used to test that the line has been de-energized and to apply temporary safety grounds:

<u>Voltage-kV</u>	<u>Minimum Clearance</u>
138	3'-7"
230	5'-3"
500	11'-3"

Before applying grounds, a test is done to confirm that the line is de-energized. The voltage test device is checked before and after use to assure reliability. When ground pins are used to establish proper ground points, they are driven to a depth of not less than four feet as near vertical as possible.

- Poles or structures are inspected and examined for structural integrity before climbing. If there is any reason to believe that a pole is unsafe, it is stabilized before work is performed. Appropriate safety gear in the form of body belts, safety straps, hard hats, gloves, etc., is worn by linemen during line work activity.