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## Constructability Analysis

Artificial Island-Red Lion 500kV Transmission Line

New Castle County, Delaware  
and Salem County, New Jersey

GAI Project Number: C110689.03

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Prepared for: PJM Interconnection, LLC  
955 Jefferson Avenue  
Valley Forge Corporate Center  
Norristown, Pennsylvania 19403

Prepared by: GAI Consultants, Inc.  
Pittsburgh Office  
385 East Waterfront Drive  
Homestead, Pennsylvania 15120-5005



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## 1.0 Executive Summary

In April 2013, PJM Interconnection, LLC (PJM) requested technical solutions for improving PJM operational performance in the Artificial Island area under a range of anticipated system conditions and to eliminate potential planning criteria violations. In response to the Artificial Island-Red Lion Window, PJM received conceptual design level proposals from five (5) developers for the design and construction of a 500kV transmission line between Public Service Electric and Gas Company's (PSE&G's) Salem and Hope Creek Substations, which are located at Artificial Island in Salem County, New Jersey (NJ), and Delmarva Power & Light's Red Lion Substation in New Castle County, Delaware (DE). The project is generally referred to as the Artificial Island-Red Lion 500kV Transmission Line.

GAI Consultants, Inc. (GAI) was retained by PJM to perform Conceptual Design level constructability analyses on the five (5) developers' proposals that were received. The purpose of these analyses was to verify overall constructability of the proposed projects within the cost and schedule provided and to identify significant risks and impediments to constructing the projects in the manner they are proposed. The assessment of these proposals with regard to their ability to address electrical system needs or reliability is not included in the scope of this study.

Based on our high-level review and analysis of the proposed projects it was determined that while construction of the proposed transmission line would most likely be feasible, the existence of several potential risks to constructing the project could affect both the costs and schedules that have been proposed. These risk factors include potential public opposition, construction difficulty, environmental constraints, property acquisition, and outage availability. Also, the landscape crossed by the line route introduces a number of construction challenges including: difficult access to structure locations, where the extensive use of swamp mats will be required; the use of crane helicopters for structure installation; and the installation of structures and foundations in the Delaware River.

Proposed expansions and/or modifications to Red Lion, Salem, and Hope Creek Substations, which vary considerably between the proposals, appear to be feasible based upon the preliminary designs submitted. However, difficulty in obtaining the outages that would be required to complete the construction of these proposed facilities could jeopardize completion of the project within the planned schedule and budget. Coordination with the incumbent substation owners would be necessary before a final design can be developed. Detailed descriptions of all proposed modifications are included in the Project Complexity section of this report.

GAI also evaluated the proposed schedules and cost estimates provided by each of the developers and provided an opinion as to whether or not each component was reasonable compared to industry standards, while also taking into account project-specific factors such as outage needs, permitting durations, and difficult access to certain areas of the proposed projects.

## 2.0 Project Overview

The proposed line routes for all five (5) projects run parallel to the existing Hope Creek-Red Lion 500kV transmission line for essentially their entire 17-mile lengths. The routes begin at Salem Substation in Salem County, NJ and extend approximately 12 miles to the north before turning west and continuing for approximately five (5) miles to Red Lion Substation. The latter segment includes a 2.5-mile long crossing of the Delaware River. Within the first 12 miles the line crosses approximately six (6) miles of coastal wetlands, and 2.5 miles of the line passes through the Supawna Meadows National Wildlife Refuge. Right-of-way (ROW) widths proposed by the developers ranged from 145 to 200 feet.

### 3.0 Detailed Scope Description

The scope of this constructability analysis for the proposed Artificial Island-Red Lion 500kV Transmission Line project was to identify potential risks and impediments to constructing the project in the manner proposed by the various developers. GAI evaluated each of the proposed conceptual designs to identify specific risks and constraints that could adversely affect the ability of the developer to construct the project within the proposed schedule and budget. We conducted a high-level environmental due diligence review of the proposed project to identify potential key compliance issues and identify potential regulatory risks, based on a desktop analysis of publicly available data. Permits that will be complex and require long lead times were identified. The timeframes proposed by the developers for key activities were reviewed to determine if the durations for ROW procurement, permit acquisition, regulatory approvals, material procurement, and construction were consistent with general industry durations. Finally, the proposed cost estimates were reviewed to determine if the proposed costs align with industry standards.

GAI also evaluated the constructability of the all proposed substation modifications at Red Lion, Salem, and Hope Creek substations, and assessed the degree to which outages would be required in order to complete the work.

### 4.0 Regulatory Risk

Our initial high-level desktop analysis was accomplished through a review of publicly available data as referenced below. No formal contact has been made with local, state, or federal agencies. Actual environmental scope, schedule, and costs would be subject to a broad range of variables. To allow for the appropriate use of the information in this report, supporting assumptions are provided, and the resources and approach used for specific analyses are discussed.

#### 4.1 Route Analysis Approach

The approach for regulatory analysis of the proposed Artificial Island-Red Lion 500kV route included three (3) primary tasks: 1) desktop review; 2) identification of key environmental permits and authorizations; and 3) assessment of potential risks. These three (3) tasks are further discussed in the sections that follow.

#### 4.2 Desktop Review

Using the redigitized and remapped centerline incorporating the existing Hope Creek-Red Lion 500kV route alignment shown in Figure 1, quantitative environmental feature information was derived from several government databases and collated by federal, state, and county. The databases included: United States Geological Survey (USGS) Land Use/Land Cover (LULC); USGS National Elevation Data; United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI); and Environmental Systems Research Institute (ESRI) Waterbodies.

Quantitative information (lengths, acreages, and/or number of crossings) derived from the above-listed databases pertained to the following features on the proposed centerline: state and federal land; wetlands and forested wetlands; prime farmland; forest land; agricultural land; residential areas; commercial areas; open water, perennial and intermittent waterbodies; railroad crossings; and road and highway crossings.

##### 4.2.1 Study Area

Based on information presented in five (5) developers' proposals received by PJM, the study area was defined as a 2,000-foot wide corridor centered on the proposed Artificial Island-Red Lion 500kV Transmission Line. The study area is intended to permit expansion of the existing Red Lion corridor and accommodate alignment adjustments as needed, regardless of which side of the existing 500kV line the new line would be constructed.

## **4.2.2 Environmental Features**

A quantitative analysis of the proposed Artificial Island-Red Lion 500kV Transmission Line route was performed to assist the identification of major environmental features and to provide a quantitative features base for the extrapolation and derivation of future construction, permitting, mitigation, and land costs studies for the overall project.

A summary of the quantitative environmental features information is presented by state in Table 1. The database source for each type of information is also listed. Those features that have a particularly significant direct or indirect bearing on the environmental aspects of project development are discussed further below.

### **4.2.2.1 Collocation with Existing ROW**

The proposed Artificial Island-Red Lion 500kV Transmission Line parallels the existing Red Lion-Hope Creek 500kV transmission line corridor for the entire 17.3 miles. Collocation of this extent has significant environmental advantages from an impact reduction and consequent permit acquisition standpoint. Additionally, paralleling the existing electric transmission ROW will limit the need to involve new landowners.

### **4.2.2.2 Public Lands**

Crossing of public lands, especially federal and state managed lands, invariably raises concerns regarding regulatory requirements, consultations, ROW approvals, and subsequent operation and maintenance activities. This concern is heightened by the environmental sensitivity attached to areas that support sensitive natural resources and/or recreational usage.

The proposed project study corridor crosses three (3) federally managed properties located within the NJ State boundaries: USFWS Supawna Meadows National Wildlife Refuge, USFWS Artificial Island and United States Army Corps of Engineers (USACE) Killcohook Coordination Area (formerly Killcohook Migratory Bird Refuge). On October 30, 1998, the USFWS jurisdiction over Killcohook Migratory Bird Refuge was revoked (Public Law 105-312, Sec. 203). Killcohook Coordination Area is used by the USACE to deposit dredged soil. The proposed transmission line crosses approximately 17,000 feet of federal land, which accounts for approximately 19 percent of the overall transmission line route.

The following publicly accessible state lands located in Salem County, NJ that are crossed by the proposed transmission line route were identified: Alloway Creek Restoration Site (total crossing length is approximately 10,900 feet), Abbotts Meadow Wildlife Management Area (WMA) Site (total crossing length is approximately 6,300 feet) and Mad Horse Creek WMA Site (total crossing length is approximately 8,600 feet). State land crossings total about 25,800 feet for approximately 28 percent of the overall transmission line route.

No crossings of local government land were identified. In total, federal and state land crossings account for approximately 47 percent of the overall transmission line length. Potential risks associated with the crossings of the above-referenced public lands are discussed in Section 4.4 of this constructability report.

### **4.2.2.3 Wetlands**

NWI data were gathered for the proposed route and organized by wetland type and acreage crossed for each state (See attached Table 1). In terms of the number of crossings, freshwater emergent wetlands (35), and freshwater-forested wetlands (27) are essentially equally represented; freshwater scrub-shrub wetlands (11) and freshwater ponds (11) are much less common along the project route. This pattern is also reflected in total crossing distance, where emergent and scrub-shrub wetlands are co-dominant (56,517 feet and 52,589 feet, respectively) while forested wetlands account for only 4,967 feet.

Along the Delaware River coastline, the approximate 35 estuarine and marine deepwater/wetlands crossed are characterized by an estuarine system comprised of deepwater tidal habitats and adjacent tidal wetlands that vary in salinity. Approximately 10 miles (58 percent) of the 17.3 mile transmission line route is dominated by estuarine and marine deepwater/wetlands. The attached Figure 1 reflects the wetland types inherent to the Delaware River coastline through which the proposed route crosses.

In addition to the need to adopt special construction techniques for specific wetland types and field conditions, the type of wetlands encountered has significant implications from a permitting and compensatory mitigation perspective. In general, forested wetlands tend to be considered a more sensitive, higher quality resource than other wetlands types because of their ecological diversity, comparative rarity, and long recovery time following clearing. Whereas ROW clearing of emergent and scrub-shrub wetlands for power line installation is usually (but not always) considered "temporary," clearing of forested wetlands is often regarded as "permanent," because of the short- and mid-term conversion to emergent or scrub-shrub form with only a long term transition back to forested status. From a regulatory perspective, clearing of forested wetlands can require on-site tree replanting and off-site compensatory mitigation involving restoration and/or creation of wetlands or purchase of credits in a wetlands mitigation bank. Typically, replacement acreages for forested wetlands are higher than those for emergent or scrub-shrub wetlands, with ratios as high as 4:1.

#### **4.2.2.4 Waterbodies**

The number of blue line waterbodies crossed by the proposed transmission line route through review of the USGS topographic route maps (1:24,000) is approximately 59. Table 1 lists, by State, the estimated number of waterbody crossings. Waterbodies crossed include Delaware River, Alloway Creek, Mill Creek, and multiple unnamed tributaries. However, the Delaware River is a major waterbody crossing that will require coordination with multiple agencies and will involve protracted regulatory reviews and attract public interest. Agencies likely to review design and construction plans specific to the Delaware River crossing include USACE, USFWS, National Marine Fisheries Service (NMFS), United States Coast Guard (USCG), and a host of state agencies. No National Wild and Scenic Rivers or 303(d) listed impaired waters are located within the project study area.

#### **4.2.2.5 Land Use**

LULC digital data from the USGS National LULC Database were overlain onto the route to identify and quantify land use types by footage and acreage. Land use types include forested, agricultural, urban, rangeland, barren and residential. The LULC information is summarized in Table 1. Mapped land cover types are depicted on the attached Figure 2.

The proposed transmission line route, which is collocated with the existing Hope Creek-Red Lion 500kV transmission line corridor, primarily crosses cultivated and herbaceous land cover. Agricultural and rangeland together characterize approximately 64 percent of the proposed route. The cultivated land is characterized by row crops such as corn and soybean. The rangeland is primarily used for cattle grazing. The remaining 36 percent is comprised of forested (9 percent), urban (12 percent), barren (1 percent) residential (5 percent), commercial (2 percent) and other (7 percent).

The proposed transmission line route crosses over one (1) historic property as shown on Figure 2. This property is discussed in Section 4.2.5.

#### **4.2.3 Rare, Threatened, and Endangered Species**

The assessment sought to identify federal and state-listed threatened, endangered, and special concern species that may occur within the proposed project study area. The review included



publicly available databases maintained by the USFWS, NJ Department of Environmental Protection (NJDEP)-Division of Fish and Wildlife (DFW), and DE Natural Resources and Environmental Control (DNREC-DFW). Although no agencies were formally consulted, database research concluded that four (4) federally-listed and 30 state-listed endangered, threatened, or candidate species could potentially occur in the vicinity of the proposed route. Of these 34 species, two (2) are both federally and state-listed. The attached Table 2 lists threatened and endangered species having potential to occur within the project study area by state. Note that no public information specific to New Castle County, DE was available.

The listed species numbers identified above for Salem County, NJ represent a “worst case” scenario, in so much as they are based on county-wide listings and are not necessarily indicative of the numbers of species frequenting the narrower locale represented by the proposed transmission line corridor. Some of these species could be eliminated from further consideration at an early stage in the consultation process based on known patterns of spatial distribution and habitat preferences. For those species that have a higher probability of occurring in the project area, USFWS and/or state wildlife agencies may require field surveys to confirm the presence or absence of suitable habitat and/or actual individuals. The federal-listed species are considered “higher probability” species that could possibly, but not necessarily, require surveys and/or additional consultations. Surveys may be required for both wildlife and plant species.

Although there are no critical habitats identified within the project study area, if a protected species or suitable habitat is identified during field surveys, specific mitigation measures may be required (e.g., timing restrictions, buffer zones). However, in the absence of project-specific agency consultation, the prediction of survey and mitigation requirements is uncertain.

#### **4.2.4 Timing Constraints**

Construction schedules can be influenced by agency-imposed timing constraints. Timing constraints are a form of mitigation that avoids or minimizes potential impacts to sensitive species by prohibiting or limiting the extent or nature of construction in specific areas during sensitive periods of the organism’s life cycle (e.g., during seasonal breeding, nesting, or spawning seasons). Depending on habitat preferences, the area of concern may be a wide region, such as a migratory zone, or a particular feature type, such as a coldwater stream or forested wetland. Different species have individual time windows during which construction can proceed, can proceed with limitations, or cannot proceed. Comparable time windows may vary slightly for the same species based on regional geography and/or differing agency interpretations and requirements. The USFWS and/or state wildlife agencies may apply timing constraints if federally or state-listed species are present in or near the project area and would be impacted by construction.

#### **4.2.5 Cultural Resources**

Desktop background research revealed the presence of five (5) National Register of Historic Places (NRHP) -listed properties mapped within an approximate half-mile radius of the proposed transmission line. These historic properties consist of the Finn’s Point National Cemetery/Fort Mott State Park, Finn’s Point Rear Range Lighthouse, Samuel Urion/Yerkes Farmstead, Benjamin Holmes House, and Samuel and Sarah Nicholson House. The proposed transmission line crosses one (1) NRHP-listed property boundary, the Samuel Urion/Yerkes Farmstead. In addition, review of USGS topographic quadrangle maps and aerial photography reveal the presence of potential historical resources (50 years old or older) proximal to the proposed transmission line. Additionally, known archaeological resources, as well as areas maintaining high potential for containing unrecorded archaeological sites, are located within or adjacent to the proposed undertaking. The NRHP properties and high probability areas are

depicted on the attached Figure 3. Given the presence of known historic properties, and the possibility of unrecorded historic properties, GAI recommends that consultation be conducted with the NJDEP-Historic Preservation Office and the DE Division of Historical and Cultural Affairs, under Section 106 of the National Historic Preservation Act. Given the cultural sensitivity, consultation may result in the need for investigations to assess the project's potential to impact significant cultural resources, including archaeological and historic architectural properties within the proposed project's Area of Potential Effect.

### **4.3 Federal, State, and Local Environmental Permits**

Table 3 (attached) lists the environmental permits, authorizations, clearances, and consultations that will be required for the Artificial Island-Red Lion 500kV Transmission Line Project. For each authorization, the table identifies the administering agency/authority, anticipated agency review timeframe, permit fees, and additional information to be considered.

Given the physical and jurisdictional extent of the Artificial Island-Red Lion 500kV Transmission Line Project, involving two (2) states and multiple federal, state, and local regulatory agencies, effective interagency coordination and scheduling will be an overriding factor for successfully securing the necessary governmental approvals.

#### **4.3.1 Federal Permits**

The proposed project would require several federal permits, authorizations, and consultations prior to construction. These include, but are not limited to: the USACE Section 404 permits for dredge and fill activities in wetlands and other waters of the United States, USACE Section 10 permits for construction and operation of facilities in federally navigable waters, USFWS consultations/authorizations under Section 7 of the Endangered Species Act, NMFS consultations under Magnuson-Stevens Fisheries Conservation and Management Act, and USCG aid to navigation private permit.

Regulations for implementing the procedural provisions of the National Environmental Policy Act (NEPA) allow for federal agencies to enter into interagency cooperative agreements for the purpose of documenting compliance with NEPA. These regulations provide guidelines for determining the lead federal agency. The guidelines include factors such as the agency's magnitude of involvement, project approval/disapproval authority, and expertise concerning the action's environmental effects (40 Code of Federal Regulations 1501.5). For this project, it is anticipated that the USACE would be the lead federal agency responsible for implementing NEPA.

##### **4.3.1.1 USACE Section 404 and Section 10 Permits**

The USACE is the agency delegated responsibility to implement Section 10 of the Rivers and Harbors Act of 1899 [33 United States Code (U.S.C.) 403] which prohibits the obstruction or alteration of navigable waters of the United States without a permit. Additionally, the USACE has responsibility for Section 404 of the Clean Water Act (33 U.S.C. 1344) which regulates the discharge of dredged or fill material into waters (including wetlands) of the United States. While the proposed project is located in two (2) states, it is wholly within the jurisdictional boundary of the Philadelphia District of the USACE.

USACE permits pertaining to electric transmission line construction fall into two (2) main categories: individual and nationwide. Nationwide permits (NWP) are "general" permits covering various commonly encountered activities. Electric transmission construction is often authorized under NWP No. 12 (NWP-12) for "Utility Line Backfill and Bedding." NWPs tend to be faster-track permits than individual permits based on less extensive review and public notice requirements. The USACE is required to permit a project using the least onerous permitting mechanism that can be legally applied to a proposed activity. An individual permit is

required where an activity does not meet an established threshold criterion (e.g., level of acreage impact) for NWP coverage.

Whether individual and/or NWP coverage is granted is probably immaterial in terms of schedule. The nationwide permitting avenue is ostensibly fast track, with a 45-day turnaround specified by regulation for a complete application, while an individual permit application requires a 30-day public notice and a more intensive review period of 90 to 120 days; however, for major electric transmission line projects, NWP approvals often take as long as individual permit approvals and the overall review and approval time frame may be nine (9) months or longer. More importantly, neither authorization is valid until state water quality certification is waived or granted and the most significant delays may be associated with the latter process.

To ensure that USACE permits are secured prior to construction start-up, early consultation with USACE-Philadelphia District is encouraged to better define the review process, interagency coordination and application requirements.

#### **4.3.1.2 USFWS Endangered Species Consultation and Clearance**

For federally funded or permitted projects, consultation with the USFWS is necessary to ensure that impacts to federally listed endangered or threatened species and critical habitat are appropriately addressed under Section 7 of the Endangered Species Act. Unlike the USACE, the regulatory boundary of the USFWS does not extend across state lines, and as a result will involve two (2) ecological services field offices: NJ and DE Bay Estuary.

Early consultation with each USFWS office will be of paramount importance. While publicly available data identify federally listed species on a county basis, more precise location information can be obtained only through formal agency consultation. Agency feedback, along with information acquired through preliminary field reconnaissance and detailed review of maps and aerial photographs, will be used to identify the scope of any subsequent species or habitat-specific field surveys that may be required. Given the limited seasonal time windows that exist for many such surveys, early planning is vital. Likewise, construction schedules can be impacted by agency-stipulated seasonal restrictions reflecting nesting, breeding, and other behavioral patterns. In the absence of project-specific agency consultation and a preliminary field assessment of habitat availability along the proposed project corridor, any species-related impacts on construction schedules cannot be ascertained.

If construction does not start within one (1) year of USFWS authorization, the protected species assessment must be revalidated through renewed consultation and, potentially, additional field surveys. No acute concerns relating to endangered and threatened listed species and associated schedule were identified.

#### **4.3.2 State Permits**

Each of the states affected by the proposed project would require similar environmental permits, consultations, clearances, and authorizations, including:

- + State Historic Preservation Office (SHPO) consultations and clearances;
- + National Pollutant Discharge Elimination System construction stormwater discharge permits;
- + Section 401 water quality certifications;
- + stream and wetland crossing permits;
- + erosion control permits; and
- + state-protected species consultations.

Of the above-listed permits and authorizations, those with most potential to impact schedule and cost are SHPO consultations and clearances, Section 401 water quality certification, and stream and wetland crossing permits. The other approvals are relatively straightforward in terms of application preparation and agency review schedules, with basic similarity in technical scope between the states.

The extent to which SHPO consultation and review can impact project cost and schedule is very much dependent on the number, location, and significance of any cultural resource sites that are encountered in the project area. The need to conduct Phase II and Phase III level surveys beyond initial Phase I reconnaissance surveys, along with ongoing consultation and reporting, can have a substantial impact on cost and schedule. Phase III data recovery can be a lengthy process, the need for which can be determined only after Phase I and Phase II surveys have been undertaken and the project is well-advanced.

State Section 401 water quality certification or a waiver of certification is required for all Section 404 dredge and fill activities permitted by the COE. Pre-approved Section 401 certification is available for certain Section 404 NWPs on a state-by-state basis. Often regional conditions or exceptions apply. Agency response timeframes for Section 404 certification vary from state-to-state and are not necessarily set by regulation. Protracted responses may occur, especially where the state works independently from the USACE in prescribing or advocating wetland/waterbody crossing techniques or other mitigation measures on a site-specific basis. In addition, state authorization of construction in non-federally regulated isolated wetlands may be achieved directly through, or in parallel with, the Section 401 certification process. This can add an extra layer of regulatory scrutiny to the approval process.

As indicated in Table 1 and depicted on Figure 2, the proposed project route would cross public lands managed by the States of NJ and DE. These include state wetland restoration sites, conservation areas, and WMAs. As with all properties on the proposed project route, the developer would need to seek access permission for pre-construction engineering and environmental surveys, as well as easement rights before the project goes to construction.

Obtaining survey permission for public land often involves a protracted bureaucratic application process and easement acquisition may not be possible if the proposed project conflicts with government-mandated use restrictions or environmental plans. Irrespective of the sensitive natural resources or recreational aspects often associated with these areas, early consultation and coordination is essential.

The DE River Basin Commission (DRBC) have regulatory mechanisms in place that drive an overall state-level environmental evaluation in a similar fashion to a NEPA review under Section 3.8 of the Delaware River Basin Compact. Additionally, NJ Board of Public Utilities Commission (NJBPU) and DE Public Service Commission (PSC) will coordinate with NJDEP and DNREC, respectively, through issuance of Certificate of Public Convenience and Necessity. The Artificial Island-Red Lion 500kV Transmission Line Project the permitting schedule should allow for sustained Commission participation throughout the state and federal permitting process.

#### **4.3.3 Local Permits/Authorizations**

Local environmental permits and authorizations are restricted to governmental entities within Salem County, NJ and New Castle County, DE where municipalities have adopted ordinances regulating land use. No specific schedule constraints are anticipated with respect to land use approvals.

## **4.4 Potential Risks**

Eight (8) critical constraints were identified for the proposed Artificial Island Red Lion 500-kV Transmission Line Project route. Of these, the most problematic is likely to be crossing of the

Supawna National Wildlife Refuge and the Delaware River because of the combination of technical and regulatory complexities associated with the combined 4.6 mile crossing of the river and the federally protected wildlife refuge, which contains unnamed tributaries to the Delaware River and extensive floodplains. The other critical constraints involve permitting of state lands and wetlands, cultural resources investigations, and demonstration of public need. Although these will bring regulatory and ROW acquisition challenges, they will not command the same level of attention from the public and regulatory agencies as the Supawna National Wildlife Refuge and the Delaware River crossing. The major potential risks are:

- The project requires coastal zone management approval from NJDEP and DNREC which may involve a lengthy review process depending on construction techniques and proposed pathways to access the ROW.
- The project crosses approximately 350 acres of forested wetlands that may require clearing. Compensatory mitigation involving the purchase of credits from a wetlands mitigation bank at ratios as high as 4:1 could potentially exceed \$7 million.
- Approval to cross the Delaware River would involve federal and state agencies coordination as well as public involvement. Additionally, the project will need to demonstrate that it will have minimal impact on the endangered Atlantic Sturgeon. If the project becomes controversial, the permitting process may extend well beyond the anticipated project schedule.
- A ROW Permit will need to be obtained from USFWS to cross Supawna National Wildlife Refuge. The process for obtaining easements on federally managed lands is typically lengthy and complex.
- Similarly, acquiring easements on state public lands (i.e., conservation easements, wetland restoration sites, and WMAs) typically involve multiple reviews and coordination between state environmental and real estate divisions.
- Historic and archaeological investigations (Phase II and Phase III) beyond initial Phase I reconnaissance surveys, along with ongoing consultation and reporting, can have a substantial impact on schedule and cost.
- Issuance of Certificate of Public Convenience and Necessity by NJBPU and DEPSC will likely occur concurrently with approvals from USACE, USFWS, and the state agencies.
- The Commissions will be hesitant to approve the project without assurance that it is being coordinated with NJDEP and DNREC.

The results of our research regarding the potential use of eminent domain in Delaware are inconclusive. While a recently promulgated bill allows the use of eminent domain for “utility purposes,” there is ambiguity as to what this term includes. However, since the Delaware portion of the proposed line is only 0.75-mile long, crosses only two (2) properties, and may be able to be constructed on existing ROW, this is not considered to be a substantial risk item.

## 5.0 Project Complexity

Each of the developers’ proposed projects was analyzed with regard to the complexity of their transmission line design from substation terminal to substation terminal. This analysis considered parameters such as crossings of existing transmission lines, the need for raising existing transmission line structures, proposed substation modifications, and any associated outage requirements. It should be noted that due to the fact that the developers’ proposals are conceptual in nature, the exact locations of any required crossings are not known at this time. It is assumed that during detailed design, these locations would be selected in such a manner as to minimize outage requirements to the greatest possible extent. Our observations with regard to project complexity are highlighted below.



- **Dominion**

Modifications at Red Lion Substation

Dominion has proposed modifications to Red Lion Substation that would involve major reconstruction of the station including the installation of a new terminal on the northern end of the substation to serve the proposed transmission line. More specifically, Dominion would install a new row of breakers north of the existing Hope Creek terminal and relocate the existing Red Lion-Hope Creek 5015 line to a new terminal position. A new backbone would be constructed to terminate the new 500kV line. Construction of these modifications would require multiple outages on the existing Red Lion-Hope Creek 5015 line, the durations of which would depend on the manner in which substation construction is phased.

Modifications at Hope Creek Substation

Dominion proposes to expand Hope Creek substation to the north to accommodate a third row of breakers as well as a new terminal location for the proposed 500kV line to Red Lion substation. A proposed new 500kV tie line to Salem substation would terminate on the current open position of the existing 500kV backbone. Although Dominion presented no details regarding the manner in which this tie line would be installed, it appears that it will need to cross the existing generator leads. These proposed substation modifications and additions would require significant outages.

Modifications at Salem Substation

Dominion proposes to terminate the new 500kV tie line from Hope Creek substation onto the open position on the existing 500kV backbone. One (1) 500kV breaker would be installed between the new line and the bus. Again, an outage would be required to perform this work.

Proposed Hope Creek-Red Lion 500kV line

The combination of proposed tie-in points to the respective substations requires that the new 500kV line cross the 5015 line at some point along its 17-mile length. The crossing location has not been defined by Dominion, and could require modifications to existing structures on the 5015 line, which would increase the cost and complexity of the project. Any outages required for construction of this crossing, would be of minimal duration and could be planned to coincide with the aforementioned outages required for the Red Lion Substation modifications.

- **PSE&G**

Modifications at Red Lion Substation

PSE&G's proposes to convert the existing ring bus at Red Lion Substation to a double breaker, double bus configuration. This modification would require an expansion of the northern end of the station and would include the installation of two (2) new breakers and a new line terminal. The existing Red Lion-Hope Creek 5015 line would be moved to the new terminal and the proposed new 500kV line would terminate at the vacated position. Construction of these modifications would require numerous sequential outages, including three (3) outages on the 5015 line totaling 40 days in duration. PSE&G's proposed modification to Red Lion substation would be the most impactful of any of the proposals.

Modifications at Hope Creek Substation

PSE&G proposes to expand Hope Creek substation by adding a new bay on the north end of the substation, which would include a new line termination for the proposed 500kV line to Red Lion. A new gas-insulated bus would tie this new bay to a new termination structure in the

middle of Salem substation, which could possibly interfere with the existing generator leads. Outages would be required for the expansion work and tie-ins at both substations.

#### Proposed Hope Creek-Red Lion 500kV line

The combination of proposed substation tie-in points selected by PSE&G at Red Lion and Hope Creek substations requires that the new 500kV line cross under the 5015 line just outside of Red Lion substation. Modifications to existing structures on the 5015 line may be required, and this would increase the cost and complexity of the project. Any outages required for construction of this crossing would be of minimal duration and could be planned to coincide with the aforementioned outages required for the Red Lion Substation modifications.

### ■ **LS Power**

#### Modifications at Red Lion Substation

LS Power has proposed the addition of a new 500kV line terminal and breaker in the northeast corner of the existing ring bus at Red Lion Substation. They would then move the existing Red Lion-Hope Creek 5015 line to this new terminal and use the existing terminal for the proposed 500kV line. Outages would be required for expansion of the bus and to transfer the 5015 line to the new terminal.

#### Modifications at Salem Substation

LS Power proposes to expand Salem substation by extending the 500kV main busses in the existing switchyard to the north to accommodate the proposed 500kV line to Red Lion substation. The low level of detail provided makes it difficult to determine whether or not there is sufficient room for the proposed expansion. A 500kV breaker-and-a-half configuration will service the Salem-Hope Creek bus tie while the existing bus tie terminal will provide service to the new Salem-Red Lion 500kV line. Outages will be required to expand the bus and to relocate the Hope Creek bus tie to the new terminal.

#### Proposed Salem-Red Lion 500kV line

The proposed Salem-Red Lion 500kV line would exit the substation at the current Hope Creek bus tie position; the existing lattice tower just outside of Salem substation would have to be replaced since the line angle will be significantly reduced. The new line would then cross both the Hope Creek-Red Lion 5015 line and the Hope Creek-New Freedom 5023 line. In order to meet required electrical clearances, both of these lines will likely need to be raised in this area, which would require outages on both lines.

### ■ **Transource**

Modifications at Red Lion Substation – Transource proposes to modify the existing ring bus to add a new 500kV line position at the northwest corner of an expanded yard. This modification of the bus will require an extended outage of the 5015 line.

Modifications at Salem Substation – A new line termination point will be created by tapping the 500kV west bus and installing a 500kV breaker. Once this work is complete, the Salem-New Freedom 5024 line would be relocated to this new line position and the Salem-Orchard 5021 line would be relocated to the former New Freedom position. This work would require sequential outages on each of these lines. After these changes are made, the existing Salem-Orchard 5021 line position would be used for the new Salem-Red Lion 500kV line.

Proposed Salem-Red Lion 500kV line – Transource plans to utilize of the first five (5) existing spans of the existing Salem-New Orchard line as part of the new Salem-Red Lion 500kV line. It is assumed that these spans would need to be reconducted to match the line rating of the

proposed line, possibly necessitating replacement of these structures due to increased loading. Just beyond these spans the new line will cross under the existing Hope Creek-New Freedom 5023 line before heading northward parallel to the existing Hope Creek-Salem 5015 line. In order to meet required electrical clearances, two (2) structures on the 5023 line may need to be raised, which would require an outage on the 5023 line.

- **PHI/Exelon**

Modifications at Red Lion Substation – PHI/Exelon proposes to expand the substation from a four position, four breaker ring bus arrangement to a six position, seven breaker arrangement. The existing fenced yard would be expanded by approximately 50 feet on the northwest and northeast sides, all of which would be on existing PHI property. The existing Red Lion-Hope Creek 5015 line would be moved to this line terminal, and the existing terminal would then be used for the new Red Lion-Salem 500kV line. This would necessitate the installation of at least one (1) new transmission structure on the 5015 line, and would require an extended outage.

Modifications at Salem Substation - PHI/Exelon proposes to expand the existing yard to the south for installation of a new line terminal position and breaker to serve the proposed Salem-Red Lion 500kV line. An outage will be required.

Proposed Salem-Red Lion 500kV line – After exiting Salem substation from the new terminal position, the proposed Salem-Red Lion 500kV line will then have to cross four (4) existing transmission lines: Salem-New Freedom 5024 line, Salem-Orchard 5021 line, Hope Creek-New Freedom 5023 line, and Hope Creek-Red Lion 5015 line. PHI/Exelon states in their proposal that all of these crossings would be constructed under the existing lines since the new circuit is being added to alleviate concerns during a second contingency outage. In order to meet required electrical clearances, two (2) structures each of the four (4) lines that are being crossed may need to be raised. This would require extended outages on each of these lines.

Additional complexities associated with all of the proposed projects include the difficulties associated with construction work in wetlands, which will require extensive swamp mat construction for access, as well as the usage of crane helicopters for construction in areas where land access is especially difficult.

The installation of approximately 2.5 miles of 500kV overhead transmission line across the Delaware River, while not unprecedented, poses significant construction challenges including the construction of underwater foundations near an active shipping channel. Installation of protective fenders and/or rubble mounds will be required to protect the structures from river traffic. Navigation and aviation lighting will also be required.

## 6.0 Schedule Analysis and Assessment

A high-level milestone schedule of all major tasks required to complete the transmission line project is presented in the attached Figure 4. Timeframes and project sequencing are based on GAI's experience on similar projects and are consistent with general industry durations. Our conceptual schedule is based on the following assumptions:

- Transmission line construction duration is based on an average construction rate of 0.75-mile per month.
- All modifications and expansions to existing substations will require shorter durations than the transmission line construction; therefore, these activities are not on the critical path.
- ROW acquisition would begin during the regulatory approval process, with Option Agreements being executed where possible.



- Long lead-time materials will not be ordered until regulatory approval is obtained, but will be ordered prior to obtaining all required permits.
- The permitting and regulatory approval activities (total anticipated duration of 30 months) includes all time required for any necessary public hearings.
- Construction activities would be scheduled to coincide with available outages that are necessary to complete that specific activity. Lack of outage availability will increase the total project length.

The conceptual project schedule developed by GAI indicates that the project will take approximately 66 months to complete, from project initiation to energization. There are four (4) major activities on the critical path: Siting and Route Evaluation, Preliminary Engineering for Permitting/Regulatory Approvals, Permit Reviews and Approvals, and Transmission Line Construction. Delays in completing any of these activities would jeopardize completion the project within the estimated 66 months.

ROW acquisition for some of the developers may take longer than the 36 months that is estimated, but this should not preclude starting construction in areas where right-of-way has already been secured, and will not become a critical path activity unless major difficulties are encountered in property negotiations.

Outage availability is a significant item of risk to completing this project on schedule, with the most risk being assigned to proposals requiring the most outages.

Estimates of total project durations that were received from four (4) of the five (5) developers ranged from 48 months to 66 months, all of which are within plus or minus 30 percent of our estimated total project duration. The sole outlier was Dominion with a total project duration of 111 months. Dominion's schedule includes a duration of 78 months for property acquisition and a duration of 81 months for regulatory approvals, both of which seem excessively long compared to the other proposals as well as our high-level milestone schedule.

The proposed schedules provided by the developers varied greatly in level of detail. Presented below are summaries of their estimated durations for the key tasks required to complete the project, along with appropriate clarification where required.

### **Routing and Preliminary Engineering**

GAI estimates that nine (9) months will be required to perform routing studies and preliminary engineering. The developers' proposed durations ranged from six (6) months (Transource) to twelve months (PHI/Exelon and LS Power). Dominion's proposed schedule did not address these tasks as a separate activity.

### **Regulatory and Permitting (Studies, Reviews and Approvals)**

GAI estimates that environmental studies, regulatory reviews, and permitting will require 30 months to complete, with all of these tasks running concurrently. However, it should be understood that the regulatory and permitting aspect of this project carries the most schedule-related risk of any of the required activities.

The developers' estimated durations for each of these activities are summarized below. It should be noted that several of the developers have assumed that construction of the line will begin prior to obtaining every required permit. This is considered to be a reasonable assumption given that obtaining permits for some portions of the 17-mile line will be less time-consuming than for others.

- Dominion estimated 23 months for regulatory approvals and 24.5 months for permitting and environmental studies. These activities are not overlapping. In their written description of anticipated permits, they state that the permitting will take up to 81 months before

construction can begin, but they do not reflect this in their schedule.

- LS Power estimated a total of 48 months, which includes 30 months for pre-construction permitting and 18 months for construction permitting.
- PHI/Exelon estimated 27 months for both regulatory and permitting approvals, with these activities running concurrently.
- PSE&G estimated 14 months for siting approvals and 40 months for permitting. Note that GAI estimates 18-24 months to obtain the permit for crossing the Supawna Meadows National Wildlife Refuge whereas PSE&G estimates 30 months and that GAI estimates 24 months for the Delaware River Crossing whereas PSE&G estimates 30 months.
- Transource estimated 21 months for siting applications and approvals and 27 months for permitting. Some environmental studies tasks are included with the siting application process as needed. All other environmental and permitting activities begin near the end of the siting approval process, and construction is slated to begin 18 months later.

### Right of Way (ROW) Acquisition

GAI estimates that up to 36 months could be required to obtain all right of way required for the project. We assumed that ROW acquisition would begin during the regulatory approval process with Option Agreements being executed, where possible, and that construction could start before all ROW was acquired if the ROW acquisition takes the full 36 months. Following is a summary of the developer' proposals with regard to ROW acquisition:

- Dominion proposes installation of the new 500kV line in a 150' wide right-of-way (ROW) on the west side of the existing 5015 line ROW. Dominion would need to acquire new ROW for the entire length of the line, and estimates an 81 month time frame.
- LS Power will need to procure all new ROW for the transmission line, and estimates an 18 month time frame to do so. They state that they will need to acquire easements on 15 private parcels in New Jersey.
- PHI/Exelon currently has ownership, easement rights, or joint ownership rights to all planned ROW for the project. PHI is part of the Lower Delaware Valley (LDV) Transmission Service Agreement.
- PSE&G owns or has property rights in some of the proposed ROW's. They estimate a time frame of 18 months will be required to obtain all required ROW. PSE&G is part of the LDV Transmission Service Agreement.
- Transource will need to procure new ROW for the entire length of the transmission line. They estimate that 15 months will be required to accomplish this task.

### Engineering and Material Procurement

GAI estimates a total of 15 months will be required for engineering and material procurement, with the nine (9) month material procurement activity starting upon receipt of regulatory approval. The developers' proposed durations for these activities vary between 19 months (PSE&G) to 57 months (LS Power). Dominion included a 13-month duration for engineering in their schedule but did not specify a material procurement duration.

## Construction

GAI estimates that physical construction of the 500kV transmission line project, including the Delaware River crossing, will take approximately 24 months. It should be noted that this timeframe could be shortened by assigning increased manpower to the project, but this would be dependent on the availability a sufficient workforce. The developers proposed construction durations vary from 12 months (LS Power) to 24 months (Dominion). Existing substation and transmission line modifications, to the extents proposed by each of the developers, should in all cases have durations that are significantly less than 24 months; therefore, the varying degrees of work proposed by all of the developers do not affect the critical path.

## Overall Schedule Summary

As stated earlier, four of the five developers' proposed timeframes for completing the project were within 30% of the total project duration estimated by GAI. We feel that this is a reasonable level of accuracy considering the many variables and risk factors that have been identified and discussed above. The critical path activity that has the most risk associated with it is Permit Reviews and Regulatory Approvals. It will be crucial to submit permit applications and regulatory filings as early as possible in order to help mitigate that risk. A significant amount of risk is also associated with the potential lack of outage availability.

## 7.0 Cost Analysis and Assessment

As part of this study, GAI performed a high-level assessment of the conceptual cost estimates that were included with the developers' proposals for this project. The purpose of our assessment was to determine if the proposed costs aligned with current industry standards. It should be noted that while we relied on our current and recent transmission line design experience in performing our assessment, GAI performed no design work for this project.

GAI's estimate of probable construction cost for the Artificial Island-Red Lion 500kV line is \$230 million. This figure is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with 500kV transmission line engineering and construction. Table 4 (attached) presents a summary of the probable conceptual costs associated with: line routing, siting, and permitting; environmental remediation; engineering; material procurement; construction of the Artificial Island-Red Lion 500kV line; expansion of Red Lion Substation; project management; and contingencies. It does not include Owner's overheads or Allowance for Funds Used During Construction (AFUDC).

Estimates of project cost received from the five (5) developers contained varying degrees of detail and in some cases included costs of facility upgrades that are not included in the scope of this study. These estimates, after being appropriately modified to reflect similar scopes of work, ranged from \$123 million to \$297 million. A summary of each developer's estimate along with appropriate comments is presented below.

- Dominion's total cost estimate is \$199 million. This figure includes \$186 million for the transmission line, \$11 million for modifications to Red Lion substation, and \$2 million for modifications to Salem substation. It does not appear that any contingency was included in this estimate.
- LS Power's total cost estimate is \$171 million. This cost is broken down into transmission line (\$118 million), switchyard modifications (\$11 million), owner costs (\$13 million), and contingency (\$29 million).

- PHI/Exelon's \$157 million cost estimate includes a \$100 million line item for the Delaware River Crossing (all inclusive) with no further breakdown provided.
- PSE&G's overall estimate of \$297 million includes overhead costs and a 25 percent contingency. PSE&G's estimate also includes a \$100 million line item for "major river crossings" including siting, land acquisition, engineering, procurement, and construction with no further breakdown of costs. This estimate is considered an outlier as it is 50 percent higher than the next highest estimate and approximately 70 percent higher than the average of all other developers' proposed costs.
- Transource provided an estimate ranging from \$123 million to \$156 million to complete the project. The range reflects the application of various percentages of the total project cost being added in for Project and Construction Management, Overheads, and Contingency. No costs are included for relocation of several spans of the Salem-Orchard 5021 line that are required as part of their proposed solution.

It is further noted that:

- Two (2) of the developers' cost estimates (PHI/Exelon and PSE&G) included a \$100 million line item for installing the Delaware River crossing, but no further cost breakdown was provided.
- None of the proposals included estimated costs associated with potential modifications to existing transmission lines or the replacement of existing transmission structures.

Land acquisition costs will be substantially lower for PHI/Exelon and PSE&G. These developers are both party to the Lower Delaware Valley agreement, while the other three (3) developers will need to purchase all new ROW.

The estimated cost for proposed substation expansions and modifications vary greatly because all five (5) developers have proposed significantly different scopes of work. Dominion's and PSE&G's proposed modifications at Red Lion substation are the most extensive and costly, while LS Power's and Transource's proposed modifications at Hope Creek/Salem are most impactful to the existing facilities.

## 8.0 Summary and Closing

Based on our constructability analysis of the conceptual designs proposed to PJM by five (5) developers, GAI has determined that construction of a 500kV transmission adjacent to the existing Hope Creek-Red Lion 500kV line is feasible, but will face considerable regulatory scrutiny and significant construction challenges. The total project duration, from project kickoff to line energization, is estimated at approximately 66 months, but could extend longer due to circumstances outside the control of the developers, such as regulatory approvals or outage availability.

Significant risks that have been identified that may adversely affect the developer's ability to construct the project within the proposed schedule and budget include possible difficulties in obtaining the following permits and approvals: Permit to cross Supawna National Wildlife Refuge; easements on public lands; approvals required for placing structures in the Delaware River; and obtaining Certificates of Public Convenience and Necessity from NJ and DE. Additional risks that may affect the project include the challenges associated with construction through environmentally sensitive areas and across the Delaware River, availability of any required transmission system outages, and Endangered Species Act compliance.

The above constructability analysis is based on the currently available documentation. If additional information becomes available, and as the project moves into final design, modifications to this document may be necessary.

Respectfully submitted,

**GAI Consultants, Inc.**

A handwritten signature in blue ink that reads "Michael T. Horn". The signature is fluid and cursive, with the first name "Michael" being the most prominent part.

Michael T. Horn, P.E.  
Engineering Manager  
Electrical Transmission Line Engineering

## TABLES

**Table 1**  
**Environmental Features Summary by State**

<b>Environmental Features</b>	<b>Unit</b>	<b>Total</b>	<b>NJ</b>	<b>DE</b>	<b>Data Source</b>
Length	miles	17.3	13.6	3.7	Earth Pro
Adjacent to Existing ROW	miles	17.3	13.6	3.7	Earth Pro
Federal Lands	acres	1022.0	897.4	124.6	United States Department of Agriculture (USDA)
State Lands	acres	1493.5	1493.5	0	USDA
Local Government Lands	acres	0	0	0	USDA
Total NWI-mapped Wetlands	acres	3191.6	2414.6	777.0	USFWS NWI
NWI-Mapped Forested Wetlands <sup>1</sup>	acres	355.4	324.6	30.8	USFWS NWI
NWI-Mapped Freshwater Wetland <sup>1</sup>	acres	416.3	347.0	69.3	USFWS NWI
NWI-Mapped Tidal Wetlands <sup>1</sup>	acres	2419.8	1743.0	676.8	USFWS NWI
Blue Line Streams <sup>2</sup>	count	59	58	1	ESRI – United States Waterbodies
National Wild and Scenic Rivers	count	0	0	0	ESRI – United States Waterbodies
Total Uplands	acres	809.1	692.3	116.8	USGS LULC
Forest Land	acres	81.0	47.1	33.9	USGS LULC
Agricultural Land	acres	549.7	533.7	16.0	USGS LULC
Urban Land	acres	103.5	103.5	0.00	USGS LULC
Rangeland	acres	14.2	0.00	14.2	USGS LULC
Barren Land	acres	8.0	8.0	0	USGS LULC
Residential	acres	46.6	46.6	0	Earth Pro
Commercial	acres	19.0	19.0	0	Earth Pro
Other Land	acres	52.7	0	52.7	USGS LULC
Residential	count	9	9	0	Earth Pro
Commercial	count	1	1	0	Earth Pro
Roads Crossed	count	13	13	0	USGS LULC

**Notes:**

- <sup>1</sup> NWI Forested Wetlands are a subset of NWI-mapped Wetlands.
- <sup>2</sup> Includes Waterbodies classified as “Intermediate” being between 10 and 100 feet in width and “Major” .being greater than 100 feet in width.

**Table 2**  
**Federally and State Listed Threatened and Endangered Species by State**

Species Name	Status	State (County)
<b>Federally-Listed</b>		
Sensitive Joint-vetch ( <i>Aeschymonene virginica</i> )	Threatened	NJ (Salem County)
Swamp Pink ( <i>Helonias bullata</i> )	Threatened	NJ (Salem County)
Bob Turtle ( <i>Clemmys muhlenbergii</i> )	Threatened	DE (New Castle)
Atlantic Sturgeon ( <i>Acipenser oxyrinchus oxyrinchus</i> ) <sup>1</sup>	Endangered	NJ/DE
<b>State-Listed</b>		
Woolly Three-awn Grass ( <i>Aristida Ianosa</i> )	Endangered	NJ (Salem County)
Low Rough Aster ( <i>Aster radula</i> )	Endangered	NJ (Salem County)
Erect Bindweed ( <i>Calystegia spithamea</i> )	Endangered	NJ (Salem County)
Chinquapin ( <i>Castanea pumila</i> )	Endangered	NJ (Salem County)
Coast Flat Sedge ( <i>Cyperus polystachyos</i> )	Endangered	NJ (Salem County)
Marsh Flat Sedge ( <i>Cyperus pseudovegetus</i> )	Endangered	NJ (Salem County)
Black-fruit Spike-rush ( <i>Eleocharis melanocarpa</i> )	Endangered	NJ (Salem County)
Carolina Elephant-foot ( <i>Elephantopus carolinianus</i> )	Endangered	NJ (Salem County)
Darlington's Glade Spurge ( <i>Euphorbia purpurea</i> )	Endangered	NJ (Salem County)
Bouquet Mud-plantain ( <i>Heteranthera multiflora</i> )	Endangered	NJ (Salem County)
Floating Marsh-pennywort ( <i>Hydrocotyle ranunculoides</i> )	Endangered	NJ (Salem County)
Barton's St. John's-wort ( <i>Hypericum adpressum</i> )	Endangered	NJ (Salem County)
Minute Duckweed ( <i>Lemna perpusilla</i> )	Endangered	NJ (Salem County)
Sandplain Flax ( <i>Linum intercursum</i> )	Endangered	NJ (Salem County)
Hairy Wood-rush ( <i>Luzula acuminata</i> )	Endangered	NJ (Salem County)
Virginia Bunchflower ( <i>Melanthium virginicum</i> )	Endangered	NJ (Salem County)
Cutleaf Water-milfoil ( <i>Myriophyllum pinnatum</i> )	Endangered	NJ (Salem County)
American Lotus ( <i>Nelumbo lutea</i> )	Endangered	NJ (Salem County)
Virginia False-gromwell ( <i>Onosmodium virginianum</i> )	Endangered	NJ (Salem County)
Southern Adder's-tongue ( <i>Ophioglossum vulgatum</i> var. <i>pycnostichum</i> )	Endangered	NJ (Salem County)
Greek-valerian ( <i>Polemonium reptans</i> )	Endangered	NJ (Salem County)
Chickasaw Plum ( <i>Prunus angustifolia</i> )	Endangered	NJ (Salem County)
Overcup Oak ( <i>Quercus lyrata</i> )	Endangered	NJ (Salem County)
Dwarf Azalea ( <i>Rhododendron atlanticum</i> )	Endangered	NJ (Salem County)
Coarse Grass-like Beaked-rush ( <i>Rhynchospora globularis</i> )	Endangered	NJ (Salem County)



**Table 2 (Continued)**

<b>Species Name</b>	<b>Status</b>	<b>State (County)</b>
Small Skullcap ( <i>Scutellaria leonardii</i> )	Endangered	NJ (Salem County)
Two-flower Bladderwort ( <i>Utricularia biflora</i> )	Endangered	NJ (Salem County)
Broad-leaf Ironweed ( <i>Vernonia glauca</i> )	Endangered	NJ (Salem County)
Squirrel-tail Six-weeks Grass ( <i>Vulpia elliottea</i> )	Endangered	NJ (Salem County)
Sword Bogmat ( <i>Wolffiella floridana</i> )	Endangered	NJ (Salem County)

Note:

- <sup>1</sup> Listed by NMFS as an endangered species in the Delaware River.

**Table 3**  
**Preliminary Permits, Authorizations, and Clearances**

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
<b>Federal</b>			
Section 404 Individual Permit Authorization	USACE - Philadelphia District	12 – 18 months	A NWP-12 for Utility Line Activities may be applicable if fill of wetlands is less than 0.5-acre. USACE review of NWP-12 Application is approximately 4 to 6 months.
Section 10, Rivers and Harbors Act Authorization			
Killcohook Coordination Area (formerly Killcohook Migratory Bird Refuge) Public Utility Easement		4 – 6 months	On October 30, 1998, the USFWS Service jurisdiction over Killcohook Migratory Bird Refuge was revoked (Public Law 105-312, Sec. 203). Killcohook Coordination Area is used by the USACE to deposit dredged soil.
Endangered Species Act of 1973 Consultation	USFWS – Northeast Region (5)	12 - 18 months	Preparation of an Environmental Assessment is likely to determine compatibility with the Refuge and to assess environmental impacts on and off federal land.
ROW permit for Crossing Supawna Meadows National Wildlife Refuge		18 – 30 months	
Aids to Navigation Private Permit	USCG	2 – 3 months	
Endangered Species Act of 1973, Marine Mammal Protection Act, and Magnuson-Stevens Fisheries Conservation and Management Act Consultation	NMFS	12 - 18 months	The Atlantic sturgeon in the Delaware River is listed as an endangered species by NMFS.
Regional Approval for Construction in Delaware River	DRBC	9 – 12 months	Requires the submission of an application to the DRBC for review and approval. Projects require approval at a commission public meeting. There are four commission meetings each year. The project will also require a hearing which can occur at the meeting or can be scheduled separately.
<b>State of New Jersey</b>			
Certificate of Public Convenience and Necessity	NJBPU	12 - 18 months	NJBPU reviews a project for need and land use practices.
Federal Coastal Zone Approval	NJDEP- Land Use Regulation Program (LURP)	12 - 18 months	
Coastal Area Facility Review Act Permit	NJDEP-LURP	6 - 9 months	

**Table 3 (Continued)**

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
<b>State of New Jersey (Continued)</b>			
Tidelands License	NJDEP-LURP	3-6 months	
Freshwater Wetland Permit, General Permit 21, Above Ground Utility Line	NJDEP-LURP	12 - 18 months	
Historic and Archaeological Resources Consultation	NJ Historic Trust	12 months	
Fish and Wildlife Review	NJDEP-DFW	12 - 18 months	
Soil Erosion and Sediment Control Plan - Construction Permit	Cumberland- Salem Conservation District	4 – 6 months	
Road Crossing Permit	NJ Department of Transportation	N/A	No state highways are crossed.
<b>State of Delaware</b>			
Certificate of Public Convenience and Necessity	DEPSC	6 months	The commission may enter an order extending this period for an additional 3 months
Coastal Zonal Act Permit	DNREC- Office of the Secretary	6 months	Public has 14 days to appeal once permit is issued
Subaqueous Lands and Tidal Wetlands (wetland and permit and subaqueous lands lease/easement)	DNREC, Division of Water Resources	4 months	
Federal Coastal Consistency Determination	DNREC, Division of Soil and Water Conservation (DSWC)	6 – 9 months	
Fish and Wildlife Review	DNREC-DFW	12 - 18 months	
Sediment and Storm water Management Plan	DNREC, DSWC	1 – 2 months	
Consultation Regarding Historic or Archaeological Resources	Department of State, Division of Historical and Cultural Resources	12 - 18 months	

**Table 3 (Continued)**

<b>Permit/Approval</b>	<b>Regulatory Agency</b>	<b>Agency Review Timeframe</b>	<b>Comments</b>
<b>Local</b>			
Land Use Approval	Pennsville Township (NJ)	2 months	
Land Use Approval	Elsinboro Township (NJ)	2 months	
Land Use Approval	Lower Alloways Creek Township (NJ)	2 months	
Land Use Approval	New Castle County, DE	1 month	

**Table 4**  
**Engineer's Estimate of Probable Construction Costs**

<b>Task</b>	<b>Qty.</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extended Price</b>
Transmission Line Routing and Permitting	1	Lump Sum	---	\$3,000,000
Environmental Remediation (Wetland Credits) <sup>a</sup>	350	Acre	\$20,000	\$7,000,000
Transmission Line Engineering	1	Lump Sum	---	\$3,000,000
Substation Engineering	1	Lump Sum	---	\$500,000
Right-of-Way Acquisition <sup>b</sup>	350	Acre	\$20,000	\$7,000,000
Access (Road Construction, Swamp Mats, Helicopter) (\$1 million per mile)	18	Mile	\$1,000	\$18,000,000
Delaware River Crossing Material & Construction <sup>c</sup>	2.5	Mile	\$22,000	\$55,000,000
Transmission Line Material & Construction (Other than river crossing)	15.5	Mile	\$4,000	\$62,000,000
Transmission Line Engineering	1	Lump Sum	---	\$3,000,000
Red Lion/Hope Creek/Salem Substation Expansions <sup>d</sup>	1	Lump Sum	---	\$10,000,000
Project Management (Approx. 10 percent)	1	Lump Sum	---	\$16,500,000
<b>Subtotal</b>				<b>\$185,000,000</b>
Contingency (Approx. 25 percent)				\$45,000,000
<b>Total</b>				<b>\$230,000,000</b>

Notes:

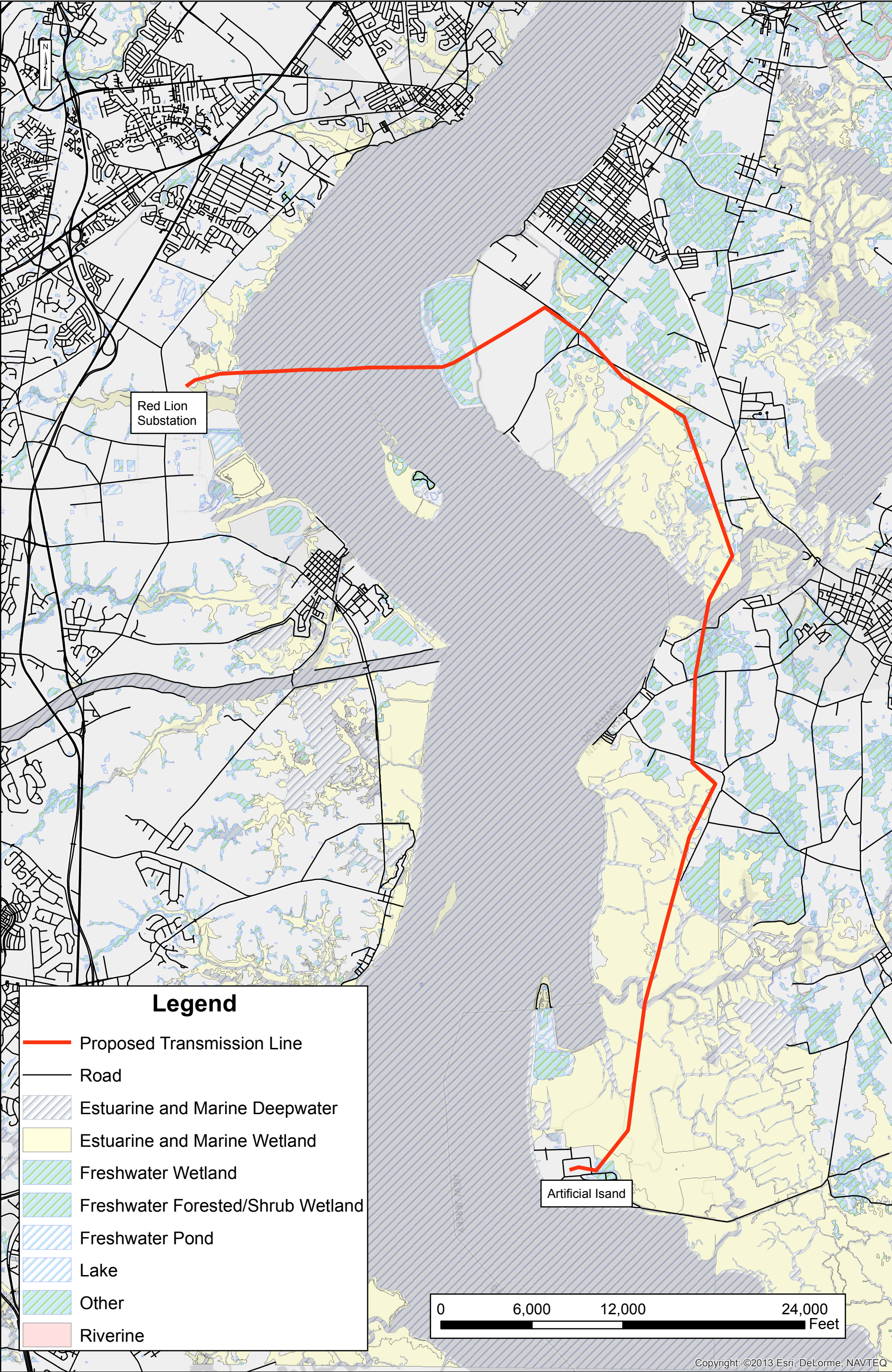
- The probable cost for environmental remediation is based on the project crossing approximately 350 acres of forested wetlands that may require clearing, with compensatory mitigation involving the purchase of credits from a wetlands mitigation bank at ratios as high as 4:1.
- The probable cost for right-of-way acquisition is based on acquiring all new right-of-way for the entire length of the line, at an average cost of \$20,000 per acre.
- The probable cost for the Delaware River crossing was determined by taking the approximate actual cost of installation of the existing crossing in 1976 (\$16,000,000) and escalating it to 2014 dollars (using an average escalation rate of 3 percent per year), plus an additional 10 percent to cover improved protection for structures installed in the river. We also considered the relative difference in complexity between the river crossing construction and the construction of the remainder of the line.
- Since the developers' scopes of work and cost estimates for substation modifications at Red Lion, Salem, and Hope Creek substations varied greatly, GAI used an approximate average cost in our opinion, solely for benchmarking purposes.

**Table 5**  
**Constructability Review Summary**

	<b>Dominion</b>	<b>LS Power</b>	<b>PHI/Exelon</b>	<b>PSE&amp;G</b>	<b>Transource</b>
<b>ROW Acquisition</b>	Dominion proposes installation of the new 500kV line in a 150' wide right-of-way (ROW) on the west side of the existing 5015 line ROW. Dominion would need to acquire ROW for the entire length of the line, and estimates an 81 month time frame.	LS Power will need to procure all new ROW for the transmission line, and estimates an 18 month time frame.	PHI/Exelon has ownership, easement rights, or joint ownership rights to all planned ROW for the project. PHI is part of the Lower Delaware Valley (LDV) Transmission Service Agreement.	PSE&G owns or has property rights in some of the proposed ROW's. They estimate a time frame of 18 months will be required to obtain all required ROW. PSE&G is part of the LDV Transmission Service Agreement.	Transource will need to procure all new ROW for the transmission line. They estimate that 15 months will be required to procure all required ROW.
<b>Land Acquisition</b>	Dominion would need to work with the existing owners of Red Lion and Salem Substations to execute any necessary agreements for property rights.	LS Power would need to work with the existing owners of Red Lion and Salem Substations to execute any necessary agreements for property rights.	PHI/Exelon owns all property required for the proposed expansion of Red Lion Substation. Expansion of Salem Substation would require the cooperation of the incumbent owner.	PSE&G owns all property required for the proposed modifications to Hope Creek and Salem Substations. Expansion of Red Lion SS would require the cooperation of the incumbent owner.	Transource would need to work with the existing owners of Red Lion and Salem Substations to execute any necessary agreements for property rights.
<b>Siting/Permitting</b>	The projects proposed by all five (5) developers will have similar siting and permitting risks since they all follow similar routes. The permits that are most complex and require the longest lead times are the Supawna National Wildlife Refuge crossing permit, the Delaware River crossing permit, and CPCNs in Delaware and New Jersey.				
<b>Project Complexity</b>	Dominion's design requires a crossing of the existing Red Lion-Hope Creek Line 5015 near Red Lion SS.	Proposed 500kV line will swap terminals with Line 5015. Salem Substation will be expanded, and the proposed 500kV line will swap terminals with the Hope Creek tie line; Proposed line will cross Lines 5015 and 5023.	At Salem SS, the existing Hope Creek tie line would be moved to a new terminal position; the proposed line would tie into the vacated position at Salem, and would have to cross Lines 5015, 5021, 5023 and 5024.	Proposed line would tie into Red Lion SS at new terminal location on north side of substation; this will require the new line to cross Line 5015.	The proposed 500kV line will cross Line 5015 near Red Lion Substation. At Salem Substation, the New Freedom and Orchard lines would be moved to new positions; the proposed line would use the current Orchard position, and would then need to cross Lines 5015 and 5023.
<b>Project Schedule</b>	111 months	66 months	60 months	51 months	48 months
<b>Estimated Project Cost</b>	\$199 million	\$171 million	\$157 million	\$297 million	\$123 - \$156 million

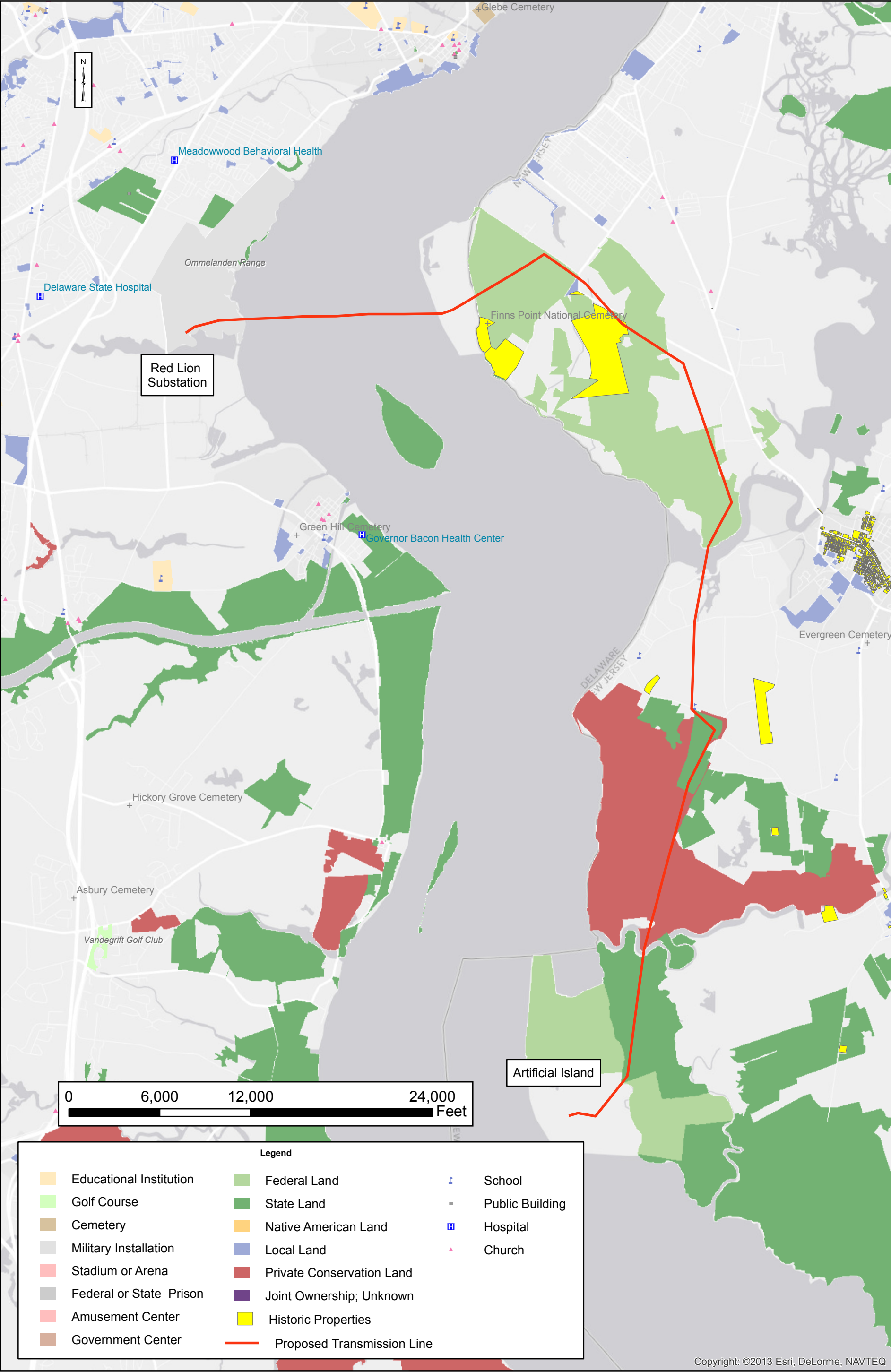
## FIGURES





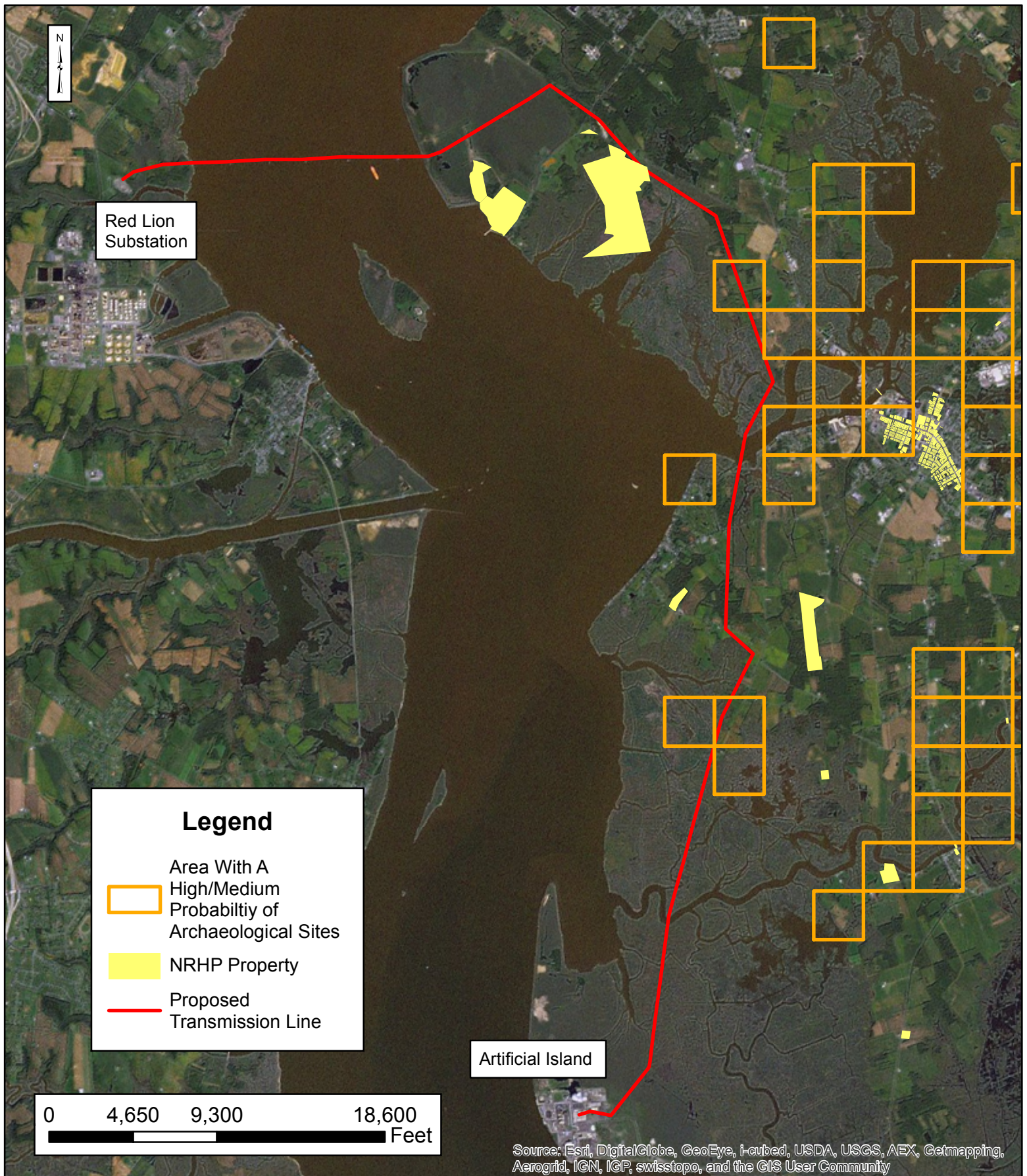
**FIGURE 1**  
**ENVIRONMENTAL FEATURES MAP**  
**ARTIFICIAL ISLAND-RED LION 500KV TRANSMISSION LINE**





**FIGURE 2**  
**LAND USE MAP**  
**ARTIFICIAL ISLAND-RED LION 500kV TRANSMISSION LINE**





**FIGURE 3**  
**NRHP PROPERTIES AND ARCHAEOLOGICAL SITES**  
**ARTIFICIAL ISLAND-RED LION 500kV TRANSMISSION LINE**

Figure 4  
Artificial Island - Red Lion 500kV Line  
Conceptual Project Schedule

