



**ALTERNATIVES  
ANALYSIS  
ADDENDUM II  
TO THE JUNE  
18, 2012 SOUTH  
JERSEY GAS –  
BL ENGLAND  
GAS ROUTE  
ANALYSIS  
REPORT**

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South Jersey Gas  
Company

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## **Addendum #2 to the June 18, 2012 Route Analysis Report**

In 2012 South Jersey Gas (SJG) retained Woodard & Curran (W&C) to evaluate potential routes for the installation of a new 24" diameter steel pipeline (the "Project") to supply natural gas to the existing Beesleys Point coal-fired electric generating plant located in Upper Township, Cape May County, commonly known as the B.L. England Generating Station (the "Facility") and to provide redundancy for the 142,000 natural gas customers in Cape May and Atlantic Counties. The Project is necessary to convert the Facility from a coal to natural gas fueled generating plant and to create a redundant pipeline feed (otherwise known as a "loop") into Cape May County, which currently is served by a single pipeline located in a flood-prone area. The new natural gas pipeline would originate from one of two possible existing pipelines either north or west of the facility. Since the only feasible method to supply natural gas to the Facility is via a pipeline, the Project is a necessary and essential component of the Facility repowering project and of the needed natural gas service redundancy in Cape May and Atlantic Counties.

In January 2013 an addendum to the June 2012 Route Analysis Report was prepared to provide more detailed assessments of the anticipated impacts associated with each of the original three alternatives. This second addendum has been prepared to provide updated information and detailed assessments of anticipated impacts associated with a "No Build" alternative plus four additional routes that were evaluated by the Pinelands Commission staff, including a route proposed by the Pinelands Preservation Alliance.

### **Location of Existing and Proposed Facilities**

The South Jersey Gas Transmission System that is capable of supplying the existing power plant located at Beesleys Point is located to the west and north of the plant. The gas volumes and pressures required for the plant will necessitate extending high-pressure gas pipeline to the plant. To meet the plant requirements, the proposed pipeline will be a 24" steel natural gas pipeline with a Maximum Allowable Operating Pressure (MAOP) of 700 psig. Potential routes for this pipeline would take it through the Pinelands and Coastal sections of New Jersey through residential, commercial, industrial, and utility properties. Seven routes have been identified including the three routes initially identified. The seven routes, identified as "A" through "G", are highlighted on Attachment #1.

SJG has several challenges meeting the need for reliable natural gas service in the coastal areas of Atlantic and Cape May Counties. First, the natural gas that serves these areas originates on the other side of the state, 70 miles away. Second, a single pipeline—the "Vineland to Mays Landing Pipeline"—carries the natural gas to these areas. Third, a significant portion of this pipeline is smaller than necessary to handle the BLE load and provide redundancy to SJG customers in the coastal area. Together, these factors pose a significant challenge to maintaining reliable service in the coastal regions of Atlantic and Cape May Counties and meeting the twin needs of repowering BLE and achieving redundancy while minimizing environmental impact.

All of the natural gas serving the coastal portions of Atlantic and Cape May originates at the two interstate pipelines that parallel Interstate 295 near Paulsboro (Transco Pipeline) and Swedesboro (Columbia Pipeline). The gas has to travel about 70 miles across the state, through the Pinelands Area, to reach the critical coastal areas in the SJG service territory. The Pinelands Area forms a continuous band from the extreme southern portion of Cape May County along and including the SR 47 right-of-way all the way north to Ocean County.

In order to transport natural gas 70 miles, SJG must maintain adequate pressure throughout the system, even when pressure is reduced because of demand for heat on the coldest days of the year. A 10-mile segment of the pipeline (discussed below) is only 20" in diameter, which constrains the ability to serve BLE and maintain adequate pressure to serve existing customers.

The Company's supply of natural gas to a significant portion of Atlantic County and all of Cape May County depends on two "single-feed" pipelines that currently lack redundancy. In the event either pipeline suffers damage due to a storm or accident, there is no secondary route to transport natural gas to serve these areas. This is the only significant portion of SJG's service territory that lacks secondary feed capability. The Company has been planning to add pipeline for years to address this reliability deficiency. Only recently has the Company had the ability to do so.

The first single-feed pipeline is the 20" diameter "Vineland to Mays Landing Pipeline", which runs west-east between Vineland and just south of Mays Landing at Rt. 50, and then continues at a 24" diameter to SJG's McKee City LNG facility just off Ocean Heights Avenue. This pipeline was constructed in 1986. The second pipeline, which is fed by the Vineland-Mays Landing Pipeline, is a 20-mile pipeline that runs north-south beneath Rt. 50 (the "Rte. 50 Pipeline"). This pipeline runs from Estell Manor along Rt. 50 in a 20" diameter pipe, which reduces to 16" just north of Corbin City. The Rt. 50 Pipeline was constructed in various segments between 1977 and 2005, and includes a critical crossing of the Tuckahoe River separating Atlantic & Cape May Counties that was installed in 1997.

Should a system interruption occur anywhere along the 10-mile segment of the Vineland-Mays Landing Pipeline between Union Road and NJ Route 50, approximately 142,000 customers in both Cape May and Atlantic Counties would be without natural gas service. Should a system interruption occur anywhere along the 20-mile Rt. 50 Pipeline, 60,000 residential and commercial customers of Cape May County would be without natural gas service.

Until 2010, SJG lacked the ability to address this risk of a single contingency failure of either the Vineland-Mays Landing Pipeline or the Rt. 50 Pipeline. In 2010, SJG completed construction of a 15 mile, 24" diameter pipeline loop from Malaga south to the Union Road Station at the Vineland-Mays Landing Pipeline ("Union Road Pipeline") to create an alternate feed down to the Vineland-Mays Landing Pipeline. This new pipeline fixed the single-feed deficiency between Vineland and Union Road. It is interconnected with the Vineland-Mays Landing Pipeline at Union Road and then joins with the existing 20" pipeline beneath Union Road. The Malaga to Union Road improvement provided SJG with another option to feed gas to the Vineland-Mays Landing Pipeline in the event that any portion of this pipeline west of Union Road is damaged. This improvement also provided SJG with an opportunity to extend the 20" Union Road pipeline (which currently ends at Rt. 49) across to the Rt. 50 Pipeline south of Corbin City, thus providing a secondary feed into Cape May. This 13-mile extension connecting the Union Road Pipeline to the Rt. 50 Pipeline, which would be constructed entirely beneath Rt. 49, would solve the single-feed deficiency in both the Vineland-Mays Landing Pipeline and the Rt. 50 Pipeline.

While it has been suggested that either the Vineland-Mays Landing Pipeline or the Union Road Pipeline could be extended to serve BLE, the facts demonstrate clearly that only the latter pipeline is capable of also providing redundancy to Atlantic and Cape May Counties. Only the Union Road Pipeline is capable of serving BLE *and* providing complete redundancy to reinforce both of the vulnerable supply lines, the Vineland-Mays Landing Pipeline and the Rt. 50 Pipeline. This is because any of the alternatives that would extend the vulnerable 20" Vineland-Mays Landing Pipeline would not create any redundancy. On the coldest winter days, a breakage anywhere along the 10 miles between Union Road and Rt. 50 would still take-out service to 142,000 customers east of Rt. 50 and south into Cape May County. Redundancy is achieved through what is known as a "loop." A "loop" is an alternative pathway to transport natural gas to an area. It is a fundamental concept in natural gas infrastructure reliability planning to loop infrastructure so that if one pathway is lost due to an accident or natural disaster, the other pathway is available to transport the gas.

In addition, recently completed SJG system gas flow modeling<sup>[1]</sup> indicates conclusively that any alternative extending the Vineland-Mays Landing Pipeline (Vineland-Mays Landing Segment) southward across the Great Egg Harbor Bay lacks the capacity to meet the demand of SJG's Atlantic County and Cape May County Customers and the BL England Facility. The 10 mile 20" diameter segment of the Vineland Mays Landing Pipeline between Union Road and Route 50 would need to be replaced with a larger 30" diameter pipeline to meet the demand on the system. This would require SJG to excavate about 7 miles of Pinelands Forest Area within Weymouth Township, which is not within existing roadways. The environmental impacts associated with installation of a new 30" pipeline between Union Road and Rt. 50 would be invasive to the Pinelands Forest Area.

In contrast, the Rt. 49 alternative would address both needs and would have no significant environmental impact. The Rt. 49 alternative solves the reliability problem with the single-feed on both the 10-mile segment of the Vineland-Mays Landing Pipeline between Union Rd and Rt. 50 and the entire 20-mile Rt. 50 Pipeline. In the event of a loss of the Vineland-Mays Landing Pipeline between Union Road and Rt. 50, natural gas could be fed along the proposed Rt. 49 Pipeline to feed both Atlantic County to the north (via a back feed up the Rte. 50 pipeline) and Cape May County to the south (via the normal gas flow down Rt. 50).

Furthermore, any alternatives involving an extension of the Vineland-Mays Landing Pipeline and crossing of the Great Egg Harbor Bay would be located within the Pinelands Area. Any extension of the Vineland-Mays Landing Pipeline would be located within a Regional Growth Area and/or Rural Development Area (depending on the alternative), and only would leave the Pinelands Area just north of the Great Egg Harbor Bay. Even though the waterways and adjacent lands of the Great Egg Harbor Bay are outside of the Pinelands Area, they still fall within the boundaries of the Pinelands National Reserve (PNR) and therefore are subject to New Jersey's Coastal Area Facilities Review Act (CAFRA). For any coastal construction permit applications within the PNR, the Commission serves as a reviewing agency. NJAC § 7:7E-3.44. NJDEP's Land Use Regulation Program and the Commission coordinate the permit review process through the procedure outlined in the February 8, 1988, Memorandum of Agreement between the two agencies. The 1988 MOA provides that NJDEP will implement the Pinelands CMP within the coastal zone to the extent of its statutory authority, will review comments submitted by the Commission on applications for development within the PNR, and will consider the Commission to be a reviewing agency for any CAFRA permit applications affecting the PNR. Because the Great Egg Harbor Bay alternatives are still within the PNR, and would still require a major upgrade of a 10 mile segment of the Vineland-Mays Landing Pipeline (7 miles of which is located within the Forest Area), for all intents and purposes, these alternatives are not "outside" the Pinelands.

### **Alternatives Evaluation Methodology**

This second addendum to the June 18, 2012 *South Jersey Gas – BL England Gas Route Analysis Report* (Report) has been prepared to provide more detailed assessments of the impacts associated with each alternative. Since the June 2012 report, as the project design and details have progressed, the project team has been able to better quantify impacts associated with each alternative.

### **June 18, 2012 Report Summary**

To determine the preferred alternative route for the gas pipeline, Woodard & Curran applied a utility-standard value rating system adapted from the Electric Power Research Institute (EPRI) to evaluate the alternative routes using specific environmental, community, cultural, constructability and maintenance criteria. Three possible routes were evaluated, **Route A**, which approaches the power station from the west and south; **Route B**, which approaches the power station from the west and north, and **Route C**, which approaches the power station from the west and south.

The evaluation was derived from publicly available information and preliminary field investigations including potential environmental impacts, community and neighborhood impacts, constructability issues, and operation and maintenance issues. Based on overall analysis of these factors, Route "A" was determined to be the preferred route. The Addendum to the June report provided additional details on the potential environmental impacts associated with the three original routes evaluated and confirmed that Route "A" was the preferred route.



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## **Alternatives Analysis**

Analysis of alternative routes for this linear project began by establishing the purpose and goals of the project, and progressed through the primary elements of each route to identify any significant issues or fatal flaws associated with a particular route. Potential fatal flaws that could eliminate a route from further consideration included significant environmental impacts; not meeting the goals of the project; significant time delays impacting the repowering; significant constructability risks; potential safety impacts; and right-of-way availability. For example, early in the process during a pre-application meeting in the spring of 2012, the Pinelands Commission staff identified a potential fatal flaw associated with route “C,” which would follow an abandoned railroad right-of-way (ROW). Pinelands staff indicated that if the abandoned railroad was overgrown or reforested, it would not be considered a viable alternative and should not be pursued further. Woodard & Curran’s investigation of route “C” ceased when field investigations revealed that in fact the ROW was overgrown for miles northwest of Woodbine and that the area included wetlands, stream corridors and threatened and endangered species habitat.

Based on engineering and constructability constraints and in accordance with required state and federal mandates of avoidance and minimization of natural resource impacts, each alternative was evaluated for its potential impacts to state and federally protected waters and wetlands, threatened and endangered species, engineering constraints, protected lands, and natural heritage sites. This alternatives analysis utilized existing state and federal databases from the New Jersey Department of Environmental Protection, the Pinelands Commission, the New Jersey Division of Fish and Wildlife, and the United States Fish and Wildlife Service. Alternatives were evaluated using geographical information system (GIS) data, design requirements/limitations, engineering/construction considerations, and field data gathered by the project design and permitting team.

Each alternative was evaluated consistently using the following assumptions:

- All stream and wetland crossings would be crossed using jack and bore (J&B) or horizontal directional drill (HDD) methods, resulting in no impacts to subject resources where ever possible
- Required cleared ROW in areas that are not cleared would be 30 feet wide
- HDD crossings would require a cleared pipe staging area at one end of 30 feet wide and the length of the HDD
- HDD crossings would require a pad at the other end 30 feet wide by 200 feet long. (See Attachment #2 “Horizontal Directional Drilling” for more detail)
- Clearing would not be required along any ROW with enough area to install the pipeline

Below is a description of each of the eight alternatives along with a discussion of potential impacts or affects to natural resources and an assessment of the routes meeting the goals of the project. Refer to Table 1 (Attachment #3) for totals of evaluated route data by resource area.

### **1. No Build Alternative**

The no build alternative does not meet the compelling public needs of the project, which are to provide a supply of natural gas to support the repowering of the BL England electric generating station, as well as to enhance the reliability of gas service for customers in Cape May and Atlantic counties. The impact of the pipeline not being constructed includes the following.

Reduced electric system reliability – A major purpose of the pipeline is to provide natural gas service to BLE to enable the plant to continue operating and thereby to supply cleaner, safer, and more reliable electricity to residents

and businesses in the Pinelands and surrounding areas of Atlantic and Cape May Counties. If the pipeline were not constructed to support the repowering of the plant, there would be multiple electric system reliability violations that would require significant electric system upgrades. The PJM Transmission Expansion Advisory Committee report dated April 10, 2014 and PJM's 2014 Regional Transmission Expansion Plan dated July 22, 2014 (Attachment 4) specifically identified improvements that would be required in the existing electric transmission system, should the BL England power plant not be repowered, as part of their "At Risk Generation Analysis" section of the report. The upgrades identified include:

1. Rebuild and reconfigure existing 138 kV line to establish a new Orchard – Cardiff 230 kV line (Cost Estimate: \$57M)
2. New Upper Pittsgrove – Lewis 138 kV line (Cost Estimate: \$28M)
3. New Cardiff – Lewis #2 138 kV line (Cost Estimate: \$3.5M)
4. Orchard substation work to accommodate new Orchard – Cardiff 230 kV line (Cost Estimate: \$3.6M)
5. Upper Pittsgrove substation work (Cost Estimate: \$0.05M)
6. Landis substation work to convert Landis to a ring bus and connect 3 lines to it (Cost Estimate: \$13.4M)
7. Dorothy Substation work – replace two switches with breakers (Cost Estimate: \$4M)
8. Cardiff substation work to accommodate new Orchard – Cardiff 230 kV line and new Cardiff – Lewis 138 kV line (Cost Estimate: \$16.4M)
9. Lewis substation work (Cost Estimate: \$0.1M)
10. Environmental (Cost Estimate: \$2M)

These transmission upgrades alone cannot replace the reliability and economic benefits of BLE's locally generated electricity. For example, during times of a natural disaster, like Hurricane Sandy, the reliability benefits of a local source of electricity are far superior to more distant electricity sources, such as those in Pennsylvania. Additionally, local generating sources provide a valuable source of reactive power, which is critical to maintaining grid stability, especially during peak air conditioning days. Moreover, in the event of a blackout, restoration of the grid often depends on the availability of local generation sources with "black start" capability – the ability of generating units to come on-line quickly after a blackout without the need for an electricity feed from a larger unit. BLE will have this black start capability.

Atlantic City Electric ("ACE") has advised that it intends to pursue some of these transmission upgrades whether or not BLE is repowered. However, in the event that BLE is repowered and ACE secures regulatory approval to construct their planned transmission upgrades, a repowered BLE will still result in the reduction of a significant portion of PJM's mandated transmission system improvement cost and will provide significant reliability, economic, and environmental benefits to the Pinelands that transmission upgrades will not.

- Increased electric cost for South Jersey customers – an analysis of the NJ electric system concluded that, following the closure of the Oyster Creek Nuclear Generating Station, 86% of the energy of the BLE plant would be consumed by residents and businesses within the Pinelands. In addition to the electric system improvement costs detailed above, South Jersey electric customers, primarily those in the Pinelands, will

bear increased electric costs resulting from the difference in price between locally generated electricity and electricity which is imported from Pennsylvania and other states through a very constrained electrical transmission network. This constrained network results in increased costs for imported power as opposed to power generated in-state.

- Increased air pollution – the repowering of BLE will result in significant reductions in the levels of carbon dioxide, nitrogen oxides, sulphur dioxide, mercury and fine particulates. If the plant did not repower and was forced to shut down, much of the replacement power would be purchased from nearby states, primarily Pennsylvania. Much of the air pollution generated from Pennsylvania’s coal-burning generating units directly impacts New Jersey and specifically the Pinelands. Prevailing west-east winds transport the fine particulates and sulfate air pollution from Pennsylvania’s power generation plants to the Pinelands, where they contribute to a number of human health problems.
- Continued risk of natural gas interruption for customers in Atlantic and Cape May counties – the inability to construct the pipeline as proposed will significantly impact plans for “hardening” the SJG system and enhancing reliability of natural gas service for customers in Atlantic and Cape May counties. As described earlier in this document, SJG’s existing infrastructure is dependent upon two segments of single natural gas transmission pipeline service as the “backbone” of the entire system serving Atlantic and Cape May counties. If a service interruption were to occur along this backbone, as many as 28,700 Pinelands customers in the Pinelands and 142,000 overall could be without gas service for several months. An interruption of this magnitude would put public safety and health at risk, especially during the winter months when natural gas usage peaks due to the need to heat homes, businesses and other critical facilities such as hospitals, schools, elder care facilities, etc.

For the reasons stated above, the No Build alternative clearly produces significant risks to the well-being of residents who live in South Jersey, many of whom reside in the Pinelands, and as a result should be eliminated from consideration.

## **2. Route “A”**

### **Route Description**

Route “A” begins in Maurice River Township, Cumberland County and ends at the BL England power plant in Upper Township, Cape May County. Route “A” is approximately 21.7 miles in length. Route “A” begins in Maurice River Township at Route 49 & Union Road (CR 671), at the location of an existing gas line. It then continues east on NJ Route 49 until it intersects Cedar Avenue; then south on Cedar Avenue to the intersection of CR 557; then east on CR 557 to NJ Route 50; then south on NJ Route 50 to the intersection of Mt. Pleasant – Tuckahoe Road (CR 664). The route then continues on what is being described as the Tuckahoe Road Segment, south on Mt. Pleasant – Tuckahoe Road to the intersection of Marshall Avenue; then east on Marshall Avenue to NJ Route 50; then south on NJ Route 50 to Tuckahoe Road; then east on Tuckahoe Road to the intersection with Oceanwoods Avenue. The route then proceeds north on Oceanwoods Avenue to the intersection with the Atlantic City Electric ROW, then proceeds east on the Atlantic City Electric ROW to the intersection with the BL England property and continues east to the power station. This route primarily follows existing cleared road and utility right-of-ways, minimizing potential impacts and limiting clearing required to install the gas pipeline.

SJG revised the project design to include 24 additional (30 total) horizontal directional drills (HDDs) which will reduce the surface area disturbance and therefore the potential adverse environmental impacts associated with roadside land disturbance both within the State Pinelands Area and in the Coastal area. The 24 additional HDDs total 22,034

linear feet (4.17 miles). This will reduce roadside disturbance by 16,904 linear feet within the State Pinelands area along the same route.

The following is a summary of the reduction in open cut pipe installation in each of the Pinelands Planning Areas:

**Open Cut Pipe Installation:**

Forest Planning:	reduced by = 63%
Pinelands Village:	reduced by = 59%
Rural Development:	reduced by = 35 %

This modification is projected to reduce the area of disturbance along the project route by 11.6 acres and to eliminate the need to excavate about 18,782 cubic yards of soil, roughly the equivalent of 1,000 dump trucks worth of soil. The enclosed plans clearly show the location of the additional HDDs and the relocation of the interconnect station.

Route "A" crosses through 10.17 miles of Pinelands Forest Planning Area. Route "A" is approximately 21.7 miles in length, provides service to the BL England Facility, and provides full reliability to SJG's customers.

**Results**

Route "A" was identified as the preferred route in early 2012 and as a result, detailed environmental investigations and engineering design have been completed over the past two years for this route. As a result, more details about potential environmental impacts and design are known about this route.

**Environmental**

Route "A" is 21.7 miles long with miles of **field delineated wetlands** adjacent to the route and 16 stream crossings. The wetlands were delineated in the field along the route and reviewed in the field by the Pinelands Commission and the NJDEP. Route "A" does not encroach on any wetlands throughout the project. Wetland buffer impacts are limited and are primarily temporary impacts associated with work on grass road shoulders. Our review of known threatened and endangered (T&E) species habitat along Route "A" identified numerous species and the NJDEP and Pinelands Commission provided specific requirements for field investigations to address plant and animal species of concern. The results of the T&E studies prepared by Trident Environmental Consultants (Trident) were submitted to the Pinelands Commission, the New Jersey Department of Environmental Protection, and the US Army Corps of Engineers so that their wildlife biologists could evaluate the conclusions of the investigations in conjunction with the project's design plans. The wildlife biologists at all three regulatory agencies agreed with Trident's conclusions that the project would not have a significant adverse impact on T&E species. Richard Grubb & Associates (Grubb) coordinated with the New Jersey Historic Preservation Office, the Pinelands Commission and the US Army Corps of Engineers archeologists prior to conducting field investigations for cultural and historic resources along the route and at material storage and staging areas. The archeologists at all three regulatory agencies agreed with Grubb's conclusions that the project would not have a significant adverse impact on historic or cultural resources.

The Manumuskin River is a designated Natural Heritage site and a designated Wild & Scenic River located on the south and north side of Route 49 at the western end of Route "A". The Egg Harbor River is a designated Wild & Scenic River and Route "A" crosses tributaries within the Wild & Scenic River designated area. Construction would be in the existing road ROW, no above ground structures will be located near the designated areas, and the National Park Service has completed its review of the design and confirmed there will be no significant adverse impact.

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## **Engineering and Construction Considerations**

Construction along this route includes HDDs of Tuckahoe River and Cedar Swamp Creek. Construction along numerous roadways and three crossings of overhead utility ROWs would be required. Adequate work area within the ROW is available for construction and HDD pipe staging without significant environmental impacts or road closures.

Construction for Route “A” incorporates HDDs and Jack & Bores under railroad ROWs, wetlands, streams and rivers to avoid adverse impacts on sensitive areas. The construction costs for Route “A” are driven up by the limited work space on the entire route. Under ideal conditions, the installation of a 24” gas pipeline requires a wider work zone, but the available work zone on larger roads such as Route 49, Route 50 and Tuckahoe Road is narrow. These narrow work zones avoid environmentally sensitive areas adjacent to the roadways, as well as permit compliance with the maintenance and protection of traffic requirements of the NJ Department of Transportation and the County Road Departments, which restrict lane closures to protect the driving public during construction.

## **Summary**

It was concluded that the pipeline could be designed along Route “A” to avoid significant adverse impacts while still achieving the goals of the project. The designs are complete, and have been submitted to the NJDEP to review for compliance with CAFRA, the Freshwater Wetlands Protection Act, the requirements of the Flood Hazard Area Protection Act, historic and cultural resources and T&E impacts. The NJDEP completed their review, concluded that the project complies with all applicable regulations, and issued permits for the project. The design was also submitted to the US Army Corps of Engineers to review for compliance with Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act of 1899, and Section 106 of the National Historic Preservation Act of 1966. The US Army Corps of Engineers completed their review, concluded that the project complies with all applicable regulations, and issued permits for the project. The New Jersey Department of Transportation has reviewed the design plans, maintenance, and protection of traffic plans and issued approvals for the project.

## **3. Route “B”**

Route “B” begins in Hamilton Township, Atlantic County and ends at the BL England power plant in Upper Township, Cape May County. To ensure the required level of reliability on this Route, an alternative segment was evaluated as part of this addendum. The original Route B begins in Hamilton Township Atlantic County on Route 559 / Ocean Heights Ave at the intersection with Harbor Avenue; then southeast on Ocean Heights Ave to the intersection of CR 575 / English Creek Avenue; then southwest on English Creek Avenue to the intersection of School House Road; then southeast on School House Road to the intersection of Somers Point / Mays Landing Road; then southeast on Somers Point / Mays Landing Road to the intersection of Jeffers Landing Road; then south on Jeffers Landing Road to Jobs Point/Morris Avenue and continues to the terminus of Jobs Point/Morris Avenue. The pipeline would then be extended by an HDD of approximately 7,000 linear feet across Great Egg Harbor Bay to the BL England Plant. The original Route “B” would be approximately 10.5 miles in length.

In addition to the original route, after further system modeling it was determined that Route “B” would also require the upgrade of the Vineland to Mays Landing Segment from a 20” diameter pipeline to a 30” diameter pipeline to meet the volume and capacity demands of SJG’s Atlantic County and Cape May County customers and the BL England Facility. This upgrade would operate at a Maximum Allowable Operating Pressure (MAOP) of 700 psig and begin in the City of Vineland, Cumberland County, just west of Union Road and just north of the intersection of Asher Road and Union Road at the existing South Jersey Gas Union Road Station facility and following the existing gas line easement right-of-way east, cross country, for approximately 10.2 miles to the intersection of Route 50. This upgrade crosses through 7.2 miles of Pinelands Forest Planning Area.

Route “B” with the upgrade of the Vineland to Mays Landing Pipeline is 20.7 miles in length but only satisfies one aspect of the project, the need to provide natural gas to the BL England Facility. In order to provide the required level of reliability to SJG’s customers in Atlantic County and Cape May County, an additional 8.4 miles of 24” diameter pipe would need to be installed from the BL England Facility to Tuckahoe where it would tie into SJG’s existing transmission facilities. This segment, known as the Tuckahoe Road Segment, would begin at the BL England Facility and travel south through the BL England property to the Atlantic City Electric ROW, then travel through the Atlantic City Electric ROW southwest to the intersection of Oceanwoods Ave. The alignment then would proceed south along Oceanwoods Ave. to Tuckahoe Road. Then the route would travel west along Tuckahoe Road to NJ Route 50 where it would proceed north to the intersection with Marshall Ave. The route then would travel west along Marshall Ave to Mount Pleasant Tuckahoe Road. From there, the route would travel north along Mount Pleasant Road to a SJG Interconnect Station and tie into SJG’s existing transmission facilities.

Route “B”, with the upgrade to the Vineland to Mays Landing Segment and the Tuckahoe Road Segment from BL England facility to Tuckahoe (29.1 miles in length), would provide limited reliability to SJG’s Customers by adding redundancy to the Route 50 Pipeline to SJG transmission system. This pipeline would provide security for SJG’s 60,000 Cape May County Customers if a service interruption were to occur on the Route 50 Pipeline. However, this route adds no redundancy to the Vineland and Mays Landing Pipeline and therefore provides no security to SJG’s 142,000 customers located within Atlantic County and Cape May County if a service interruption were to occur along the Vineland to Mays Landing Segment. Therefore, Route “B” would then be approximately 29.1 miles in length, provide service to the BL England Facility, but only provide limited reliability to SJG’s customers.

## Results

### Environmental

#### **Wetlands, Buffers, Streams, and Open Waters**

This route would cross 21 known streams on the entire route, including 6 streams on the cross-country segment of the route, 7 streams on the Tuckahoe Road Segment and 8 streams on the paved portion of the route north of Great Egg Harbor Bay. The 10+ mile Vineland to Mays Landing Segment includes approximately 8.5 acres of mapped wetlands within the 30 foot wide ROW. The project design would utilize HDDs where possible to avoid wetland, buffer, and stream impacts but it is anticipated that the route geometry and extent of wetlands would result in approximately **2.5 acres of wetland impacts** and additional wetland buffer impacts.

The HDD of Great Egg Harbor Bay would be approximately 7,000 linear feet. The Bay would be crossed with HDD; however, **approximately 5.2 acres of coastal wetlands would be impacted** by required pipe staging and installation along Morris Avenue, a 16 foot wide roadway, due to the narrow width of existing paving and fill. Additionally, significant area of wetland buffer would be impacted along Route “B” for construction and HDD staging. In addition, the wetland area that would be disturbed is mapped habitat for numerous threatened and endangered species, which would be impacted by the construction.

All other streams, wetlands, or open waters on the paved portion of the route would be crossed utilizing J&B or HDD with no additional anticipated significant adverse impacts. **Therefore, Route “B” would impact a total of approximately 7.7 acres of wetlands.**

### **Threatened and Endangered Species**

Northern pine snake, barred owl and red-headed woodpecker habitat is mapped within or in immediate vicinity of the cross-country portion of the ROW. No impacts to barred owl or red-headed woodpecker are anticipated as the ROW is absent of significant sized trees/snags to provide critical habitat for either of these birds. There are areas of exposed sandy soils that may provide habitat for northern pine snake. Open ROWs quite often host populations of Pinelands T/E plants; seasonal surveys (spring, summer, and fall) will likely need to be conducted to demonstrate compliance with the floral standards of the Pinelands CMP.

Eleven species of threatened or endangered species have habitat mapped along the paved portion of Route "B". Of these, bald eagle, black crowned night heron, black skimmer, cattle egret, and osprey are known to utilize estuarine wetlands and open waters within the Great Egg Harbor Bay and surrounding areas and have habitat mapped within the Route "B" corridor. Due to the wetland impacts required for the pipe installation on the narrow roadways and the HDD of the Bay, the above species may be adversely affected by construction of this alternative. Effects to bald eagle, black, skimmer, and osprey would likely consist of foraging disturbance only; however, black crowned night heron and cattle egret may be affected by habitat loss associated with the coastal wetland impacts.

### **Engineering and Construction Considerations**

The western section of this route, the Vineland to Mays Landing Segment, traverses cross country on existing gas ROW. The proposed installation would require clearing and disturbing at least 30ft wide in order to construct the pipeline. The proposed route traverses through long distances of heavily wooded/forested areas with limited construction access for installation of the pipeline. The western portion of this route would also pass through pockets of residential yards, and in close proximity to homes and commercial buildings.

There are also multiple waterway crossings throughout this area, and HDDs would not be feasible in some of these locations as the route has multiple curves and bends along the alignment. There would be no access for laying out the pipe or staging the pipe for the HDD installation without performing additional clearing of trees and potential wetland areas.

This route has several potential construction issues. There are numerous homes on School House Road that are less than fifteen (15') from the road, and the paving on the road leading from Jeffers Landing is only sixteen (16') wide which is the only access road to the homes located on the end of Jobs Point Rd. – Morris Ave. This route would require 2 major HDD's, one of which would be a technological challenge in the form of a long, difficult and complex water crossing posing difficult construction issues and risk. The 7,000 foot larger crossing of Great Egg Harbor requires 2 vertical and 1 horizontal curves in its design. During the preliminary route analysis, Woodard & Curran considered drilling from the plant side and from the end of Jobs Point Rd - Morris Ave., but either way presented issues. In the case of drilling from the plant side, it would require using Jobs Point Rd. - Morris Ave for a laydown area. Jobs Point Rd - Morris Ave is a very narrow, 16 foot wide paved area with year round homes located at the dead end. The terrain drops off quickly into marsh areas so construction would be very difficult with extremely tight working conditions. It would require the relocation of the residents during most of the construction period and especially during the final welding and pipe pullback. Drilling from the Jobs Point - Morris Ave side would require either locating the drill rig up on Jobs Point - Morris Ave., essentially shutting off traffic flow or if the rig could be staged at the very end of Jobs Point - Morris Ave., special permitting would be required due to the environmental considerations in that area.

In addition to the major HDD under Great Egg Harbor Bay, an additional shorter HDD would be required on Jeffers Landing Road just north of Jobs Point Rd. - Morris Ave. to circumvent a bridge and marsh area. This would require



drilling from the south and the laydown of the 24 inch steel pipe from the north. Again, the 24 foot wide pavement makes for a very limited work area and adds difficulty to the project due to the extremely close marsh areas along the perimeter of the pavement.

Finally, SJG engaged an engineering expert specializing in trenchless drilling technology, Dr. David Bennett, PE, to evaluate thoroughly whether an HDD beneath the GEHB is feasible. Dr. Bennett is the president of Bennett Trenchless Engineers, a specialty engineering consulting firm focusing entirely on trenchless pipeline design and construction. He served 28 years with the U.S. Army Corps of Engineers (“USACE”), where he directed the Waterways Experiment Station Soil and Rock Testing Laboratory. Dr. Bennett was responsible for the development and publication of the USACE’s trenchless construction guidelines and has authored more than 50 technical papers on trenchless technology, tunneling and geotechnical engineering. He is the co-author of “HDD Good Practices Guidelines”, published by the North American Society for Trenchless Technology, in which he serves as a Good Practice instructor. Based upon Dr. Bennett’s knowledge and experience, he concluded that an attempt to install the pipeline beneath the GEHB would pose several significant risks that could not be mitigated and that none of the alternatives involving an HDD beneath the GEHB are technically feasible. Specifically, Dr. Bennett evaluated 104 soil boring logs developed during three separate geotechnical investigations in the vicinity of the proposed HDD GEHB crossing. Based upon his review of the boring logs, Dr. Bennett concluded that there are extensive depths of highly unfavorable, low blow count, very soft to soft organic silt and clay, which would pose “extremely unfavorable, and likely insurmountable” challenges, including a high degree of risk of inadvertent returns of drilling fluid mud to the benthic zone of the GEHB. A copy of Dr. Bennett’s report is attached as Attachment 5. Dr. Bennett also evaluated the risks associated with the HDDs along the preferred route and concluded based upon the soil borings and site conditions that these HDDs were well within the technical limits of the technology and posed much less risk than attempting to drill the pipeline beneath the GEHB.

## **Summary**

Route “B” would be approximately 7 miles longer than Route “A”. Route “B” is not considered a viable alternative because of its overall environmental impacts, significant constructability issues, and the risk associated with the 7000 foot HDD beneath the Great Egg Harbor Bay, which would present several unacceptable risks to the sensitive ecosystem of the Bay in the event of a drilling fluid return to the surface or other difficulty completing the drill. Route “B” also would have significant community impacts because it would cause a major disturbance to homes along School House Road in Egg Harbor Township and would require temporary relocation of a dozen or so residents at the small community adjacent to the Great Egg Harbor Bay. The significant wetland and T&E impacts associated with the cross-country portion of this route, as well as the wetland and T&E impacts associated with the construction adjacent to Great Egg Harbor Bay are considered fatal flaws in this route.

## **4. Route “C”**

Route “C” begins in Maurice River Township, Cumberland County and ends at the BL England power plant in Upper Township, Cape May County. To ensure the required level of reliability on this Route an alternate segment was evaluated as part of this addendum. The original route begins at the same location as Route “A”, but deviates off of NJ Route 49 onto Port Elizabeth Road south to an abandoned Conrail railroad ROW; then southeast to the intersection of Route 9; then north on Route 9 for approximately 8.9 miles to the intersection of Clay Avenue; then west on Clay Avenue for approximately 0.3 miles to the BL England Power Plant in Upper Township, Cape May County. Route “C” crosses through 10.5 miles of Pinelands Forest Planning Area. Route “C” in the original Route Analysis is approximately 29 miles long and provides limited redundancy to SJG customers. This route is similar to Route B in that it only adds redundancy to the Route 50 Pipeline due to the limited capacity of SJG’s existing 16” diameter 250 psig pipeline that is located on Mount Pleasant Tuckahoe Road.

An alternate segment for Route “C” that would provide full redundancy, similarly to Route “A”, would also be approximately 29 miles long. This route would start at the same location as Route “A”, but deviates off of NJ Route 49 onto Port Elizabeth Road south to an abandoned Conrail Railroad ROW. The route then proceeds along the Conrail ROW cross country through the town of Woodbine to the intersection with Dennisville- Petersburg Road. The route then travels northeast along Dennisville-Petersburg Road to Mount Pleasant- Tuckahoe Road. Then it travels north into the town of Tuckahoe to the intersection with Marshal Avenue (Mt. Pleasant-Tuckahoe Road Segment). The route then follows the Tuckahoe Road Segment to the BL England Power Plant. This route would eliminate the bottleneck in the SJG system of the 16” diameter pipeline on Mount Pleasant Tuckahoe road that prevents the original Route “C” from providing full reliability. The alternate for Route “C” would then be approximately 29 miles in length, cross through 14.5 miles of Pinelands Forest Management Planning Area, provide service to the BL England Facility and provide full redundancy to SJG’s customers.

## Results

### Environmental

#### **Wetlands, Buffers, Streams, and Open Waters**

This alternative Route “C” would cross 10 known streams and many large wetland systems and require 11 HDDs. Due to succession and re-forestation along the Conrail ROW, this alternative would require approximately 5.9 miles of clearing the re-vegetated rail line ROW within the Pinelands. This clearing would result in **approximately 1.7 acres of direct wetland impact** associated with clearing enough width to construct the pipeline. In addition, significant area of wetland buffer would be impacted by clearing and construction of this alternative.

#### **Threatened and Endangered Species**

Nineteen threatened or endangered species have habitat mapped along Route “C”. Of these, barred owl, black crowned night heron, Cope’s gray tree frog, frosted elfin, northern pine snake, and swamp pink have mapped habitat within the approximately 5.9 mile length of rail ROW within the Pinelands that would require clearing for project construction. This area is listed as occupied habitat for northern pine snake. Clearing of this area for construction of Route “C” could result in significant adverse impact to the above species from habitat loss, edge creation, habitat fragmentation, disturbance, and in case of the known population of northern pine snake, potential take.

### Engineering Constraints and Construction Considerations

The approximately 5.9 miles of clearing required and improvements along the railroad ROW present significant constraints to engineering and construction. In addition, the 11 HDDs would require extensive design considerations.

The plan for this route was to follow the railroad ROW to avoid potential community impacts and crossing large waterways/tidal wetlands. During the field inspection of this route, the railroad ROW was found to be re-vegetated by understory and overstory species. There were also protected species identified in the reforested portions of the

railroad ROW. Single isolated sensitive areas could be circumvented by HDD, but field inspection of the route discovered that miles of the ROW have gone through natural succession to the point that this route would no longer be considered an improved ROW.

## **Summary**

This route would be approximately 7 miles longer than Route “A”. The reforestation of the railroad ROW and the impacts on wetlands and threatened and endangered species were considered fatal flaws on this route; therefore, this route is not a feasible alternative.

## **5. Route “D”**

Route “D” begins in Maurice River Township, Cumberland County and ends at the BL England power plant in Upper Township, Cape May County. To ensure the required level of reliability on this Route, an alternative segment was evaluated as part of this addendum. This route is similar to Routes B & C in that it only adds redundancy to the Route 50 Pipeline due to the limited capacity of SJG’s existing 16” diameter 250 psig pipeline that is located on Mount Pleasant-Tuckahoe Road. The original route begins in Maurice River Township, Cumberland County at the intersection of Route 49 and Union Road and continues east on Route 49 for approximately 0.5 miles to the intersection of Route 49 and County Route 646 (Port Elizabeth-Cumberland Road); then south on Route 646 for approximately 4.8 miles to the intersection of Route 47; then south on Route 47 for approximately 14.9 miles to the intersection of County Route 610 (Petersburg Road); then northeast on Route 610 for approximately 3.4 miles to the intersection of County Route 550 (Woodbine-Oceanview Road); then southeast on Route 550 for approximately 3.9 miles to the intersection of State Route 9; then north on Route 9 for approximately 8.9 miles to the intersection of Clay Avenue; then west on Clay Avenue for approximately 0.3 miles to the BL England Power Plant in Upper Township, Cape May County. This route primarily follows existing cleared road and utility right-of-ways, minimizing potential impacts and limiting clearing required to install the gas pipeline. Route “D” crosses through 8.6 miles of Pinelands Forest Planning Area. Route “D” is approximately 36.8 miles in length, provides service to the BL England Facility, but only provides limited reliability to SJG’s customers.

An alternate for Route “D” that would provide full reliability, similar to Route “A”, would also be approximately 36.8 miles long. This route would begin in Maurice River Township, Cumberland County at the intersection of Route 49 and Union Road and continue east on Route 49 for approximately 0.5 miles to the intersection of Route 49 and County Route 646 (Port Elizabeth-Cumberland Road); then south on Route 646 for approximately 4.8 miles to the intersection of Route 47; then south on Route 47 for approximately 14.9 miles to the intersection of County Route 610 (Petersburg Road); The route then travels northeast along County Route 610 (Petersburg Road) for approximately 5.0 miles to Mount Pleasant Tuckahoe Road; then north 3.3 miles into the town of Tuckahoe to the intersection with Marshal Avenue; then 0.2 miles east on Marshall Avenue to NJ Route 50 (Mt. Pleasant-Tuckahoe Road Segment); then 1.5 miles south on NJ Route 50 to Tuckahoe Road; then east on Tuckahoe Road for 4.2 miles to the intersection with Oceanwoods Avenue. The route then proceeds 0.4 miles north on Oceanwoods Avenue to the intersection with the Atlantic City Electric ROW, then proceeds 2.1 miles east cross country on the Atlantic City Electric ROW and the BL England property to the power station in Upper Township, Cape May County (Tuckahoe Road Segment). This route would eliminate the bottleneck in the SJG system of the 16” diameter pipeline on Mount Pleasant Tuckahoe Road that prevents the original Route “D” from providing full redundancy. The alternate for Route “D” would then be approximately 36.8 miles in length, cross through 12.6 miles of Pinelands Forest Planning Area, provide service to the BL England Facility and provide full redundancy to SJG’s customers.

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## Results

### Environmental

#### **Wetlands, Buffers, Streams, and Open Waters**

This alternative would cross 27 known streams and many large wetland systems and require numerous HDDs. The NJDEP Landscape mapping identified 12 areas of potential vernal habitat along this route.

#### **Threatened and Endangered Species**

The NJDEP Landscape mapping identified 2 threatened or endangered species habitat mapped along Route “D”. Swamp pink and Sensitive joint-vetch are both mapped along the subject route however, we would not expect significant adverse impacts on these species since the route will follow existing paved road ROW and design and construction techniques would be employed to avoid environmentally sensitive areas.

#### **Engineering and Construction Considerations**

The proposed Route “D” traverses through state and county roads. The route does provide access for constructability. However, since the majority of the route is in Pineland jurisdictional area, workspace may be reduced. Heavily populated areas along County Route 646 would limit work space resulting in potential exacerbation of traffic flow and control issues. There will be 19 HDDs to cross the many streams and waterways on the route.

The route is 36.8 miles long and much of its length is on Route 47, which would represent significant traffic and community impacts over the length of the construction period.

### **Summary**

Route “D” would be approximately 15 miles longer than Route “A”. While Route “D” does not have any identified fatal flaws, it does not avoid crossing through Pinelands Forest Planning Area, the single biggest reason it was included in the evaluation by the Pinelands Commission. In addition, when compared to Route “A” this route it would include increased traffic and community impacts, along with increased stream crossings and HDDs. Therefore, this route would not be more viable than Route “A”

## **6. Route “E”**

Route “E” begins in Estell Manor, Atlantic County and ends at the BL England power plant in Upper Township, Cape May County. The original route begins at SJG’s Esterville Station located on Route 50 in Estell Manor, Atlantic County, following Route 50 south for approximately 8.5 miles to the intersection of Tuckahoe Road; then east on Tuckahoe Road for 4.2 miles to the intersection with Oceanwoods Avenue; then 0.4 miles north on Oceanwoods Avenue to the intersection with the Atlantic City Electric ROW; then 2.1 miles east cross country on the Atlantic City Electric ROW and the BL England property to the power station in Upper Township, Cape May County.

Route “E” would also require the upgrade of the Vineland to Mays Landing Segment from a 20” diameter pipeline to a 30” diameter pipeline to meet the volume and capacity demands of SJG’s Atlantic County and Cape May County customers and the BL England Facility. This upgrade would operate at a Maximum Allowable Operating Pressure (MAOP) of 700 psig and begin in the City of Vineland, Cumberland County, just east of Union Road and just north of the intersection of Asher Road and Union Road at the existing South Jersey Gas Union Road Station facility and follow the existing gas line easement right-of-way east, cross country, for approximately 10.2 miles to the intersection of Route 50.

Placement of a new 24” pipeline directly adjacent to the existing 20” pipeline on Route 50 would not provide complete redundancy. First, this would not fix the single-feed configuration of the 10.2-mile Vineland to Mays Landing Pipeline. Approximately 142,000 Atlantic and Cape May County customers still would be vulnerable to a single contingency failure of the Vineland to Mays Landing Pipeline. Second, the new 24” pipeline would be vulnerable to the same exposures as the existing 20” pipeline. The co-location of critical “lifeline” infrastructure (i.e. those systems and facilities that deliver vital services and products to a community, including natural gas pipelines) increases system vulnerability because natural events like large storms, or man-made disasters like excavation accidents, can damage co-located infrastructure. See FEMA, “Collocation Impacts on the Vulnerability of Lifelines During Earthquakes with Applications to the Cajon Pass, California”, FEMA-221 (Oct. 1991); National Infrastructure Advisory Council, “A Framework for Establishing Critical Infrastructure Resilience Goals Final Report and Recommendations” (Oct. 2010). An event that would interrupt service along the 20” pipeline on Route 50 would have the potential also to interrupt service to a new 24” pipeline, thus exposing 60,000 customers in Cape May County to a loss of service. Full redundancy only can be achieved through what is known as a “loop”, an alternative pathway to transport natural gas to an area. It is a fundamental concept in utility infrastructure reliability planning to loop infrastructure so that if one pathway is lost due to an accident or natural disaster, the other pathway is available to provide service.

Route “E” crosses through 7.3 miles of Pinelands Forest Planning Area. Route “E” would be approximately 29.1 miles in length, provide service to the BL England Facility, and provide limited redundancy to SJG’s customers.

## Results

### Environmental

#### **Wetlands, Buffers, Streams, and Open Waters**

This route would cross 20 known streams on the entire route and 6 streams on the cross-country segment of the route. The 10+ mile cross-country segment includes approximately 8.5 acres of mapped wetlands within the 30 foot wide ROW. The project design would utilize HDDs where possible to avoid wetland, buffer, and stream impacts but it is anticipated that the route geometry and extent of wetlands would result in approximately **2.5 acres of wetland impacts** and additional wetland buffer impacts. Since the remaining portions of Route “E” are within existing cleared and maintained right-of-ways it is anticipated that wetlands and stream impacts could be avoided by utilizing HDDs and J&Bs. The NJDEP Landscape mapping also includes two vernal pool habitats within the cross-country portion of the route.

#### **Threatened and Endangered Species**

Northern pine snake, barred owl and red-headed woodpecker habitat is mapped within or in immediate vicinity of cross-country portion of the ROW. No impacts to barred owl or red-headed woodpecker are anticipated as the ROW is absent of trees/snags to provide critical habitat for either of these birds. There are areas of exposed sandy soils

that may provide habitat for northern pine snake. Open ROWs quite often host populations of Pinelands T/E plants; seasonal surveys (spring, summer, and fall) will likely need to be conducted to demonstrate compliance with the floral standards of the Pinelands CMP.

### **Engineering and Construction Considerations**

This alternative would approach BLE from the west and north via Route 50 and would involve installation of the pipeline crossing through the Pinelands Forest Area and in parallel with the existing Route 50 feeder line to Cape May County. This alternative would be invasive to the Pinelands Forest Area and would not achieve the same level of redundancy as Route "A" because it would not address the vulnerability of the Vineland-Mays Landing Pipeline. This alternative would still expose 142,000 SJG customers to single-contingency failure and a loss of natural gas service. In addition, because this alternative would require the new pipeline to be installed adjacent to the existing Rt. 50 Pipeline, it would be vulnerable to the same exposures as the existing pipeline and is therefore inadequate. The co-location of critical "lifeline" infrastructure (i.e. those systems and facilities that deliver vital services and products to a community, including natural gas pipelines) increases system vulnerability because natural events like earthquakes and large storms, or man-made disasters like excavation accidents, can damage co-located infrastructure. See FEMA, "Collocation Impacts on the Vulnerability of Lifelines During Earthquakes with Applications to the Cajon Pass, California", FEMA-221 (Oct. 1991); National Infrastructure Advisory Council, "A Framework for Establishing Critical Infrastructure Resilience Goals Final Report and Recommendations" (Oct. 2010).

The western section of this route, starting on Union Road, and extending to Route 50 (Vineland to Mays Landing Segment), traverses through an existing cross country gas ROW. The proposed installation would require clearing and disturbing at least a 30 ft. width in order to construct the pipeline. The proposed route traverses through long distances of heavily wooded/forested areas with limited construction access for installation of the pipeline. The western portion of this route would also pass through residential yards and in close proximity to homes and commercial buildings.

There are also multiple waterway crossings throughout this area, and HDDs may not be feasible in some of these locations as the route has multiple curves and bends along the alignment. There would be no access for laying out the pipe or staging the pipe for the HDD installation without performing additional clearing of trees and potential wetlands. Route "E" would be approximately 7.4 miles longer than Route "A" resulting in more overall disturbance.

### **Summary**

Route "E" would be approximately 7.4 miles longer than Route "A". System reliability is defined as "The reliability of an entire system, as opposed to the reliability of its components. The system reliability is defined by the reliability of the components as well as the way the components are arranged reliability-wise"<sup>1</sup>. Applying this definition and logic to the design of a natural gas system means there should be multiple independent gas supplies to serve customers. It is for this basic reason that installing a new gas main down Route 50 alongside other existing gas mains was discounted since it would not provide system supply options and redundancy.

The significant wetland and T&E impacts associated with the cross-country portion of this route as well as not providing the full redundancy element of the project are considered fatal flaws in this route. For all of these reasons, Alternative "E" was not considered a viable alternative.

## 7. Route “F”

Route “F” begins in Franklin Township, Gloucester County and ends at the BL England power plant in Upper Township, Cape May County. Beginning in Franklin Township, Gloucester County, at the South Jersey Gas Forest Grove Station, approximately 1900 feet west of the intersection of County Route 555 and Weymouth Road, adjacent to Weymouth Road and following the existing gas line easement right-of-way southeast, cross country, for approximately 15.5 miles to the intersection of Route 50; then south on Route 50 for approximately 13.5 miles to the intersection of Tuckahoe Road; then (Tuckahoe Road Segment) east on Tuckahoe Road for 4.2 miles to the intersection with Oceanwoods Avenue. The route then proceeds 0.4 miles north on Oceanwoods Avenue to the intersection with the Atlantic City Electric ROW, then proceeds 2.1 miles east on the Atlantic City Electric ROW and the BL England property to the power station in Upper Township, Cape May County.

Placement of a new 24” pipeline directly adjacent to the existing 20” pipeline on Route 50 would not provide complete reliability. First, this would not fix the single-feed configuration of the 10.2-mile Vineland to Mays Landing Pipeline. Approximately 142,000 Atlantic and Cape May County customers would remain vulnerable to a single contingency failure of the Vineland to Mays Landing Pipeline. Second, a new 24” pipeline still would be vulnerable to the same exposures as the existing 20” pipeline. The co-location of critical “lifeline” infrastructure (i.e. those systems and facilities that deliver vital services and products to a community, including natural gas pipelines) increases system vulnerability because natural events like large storms, or man-made disasters like excavation accidents, can damage co-located infrastructure. See FEMA, “Collocation Impacts on the Vulnerability of Lifelines During Earthquakes with Applications to the Cajon Pass, California”, FEMA-221 (Oct. 1991); National Infrastructure Advisory Council, “A Framework for Establishing Critical Infrastructure Resilience Goals Final Report and Recommendations” (Oct. 2010). An event that would interrupt service along the 20” pipeline on Route 50 would have the potential also to interrupt service to a new 24” pipeline, thus exposing 60,000 customers in Cape May County to a loss of service. Full redundancy only can be achieved through what is known as a “loop”, an alternative pathway to transport natural gas to an area. It is a fundamental concept in utility infrastructure reliability planning to loop infrastructure so that if one pathway is lost due to an accident or natural disaster, the other pathway is available to provide service. Route “F” crosses through 13 miles of Pinelands Forest Planning Area. Route “F” would be approximately 35.7 miles in length, provide service to the BL England Facility, and provide limited reliability to SJG’s customers.

## Results

### Environmental

#### **Wetlands, Buffers, Streams, and Open Waters**

This route would cross 18 known streams on the entire route and 6 streams on the cross-country segment of the route. The 15+ mile cross-country segment includes approximately 7.7 acres of mapped wetlands within the 30 foot wide ROW. The project design would utilize HDDs where possible to avoid wetland, buffer, and stream impacts but it is anticipated that the route geometry and extent of wetlands would result in approximately **3 acres of wetland impacts** and additional wetland buffer impacts.



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## **Threatened and Endangered Species**

On the northwestern segment of Route “F” where it travels cross country for 15+ miles, the NJDEP Landscape project mapping includes habitat for Barred Owl, Eastern Tiger Salamander, Pine Barrens Tree Frog, Bald Eagle, Osprey, Black Skimmer, Cattle Egret, and Least Tern, Black-crowned night-heron. Since there are anticipated impacts on 3 acres of wetlands on this segment of the route and significant clearing required during construction, we have to assume there will be impacts on some of the species habitat identified. On the section of this route where the pipeline would follow existing paved roadways Barred Owl, Cope’s Gray Tree Frog, Bald Eagle, Black Skimmer, Cattle Egret, Least Tern and Black-crowned night-heron habitat has been identified. We would not expect significant adverse impacts on these species since design and construction techniques would be employed to avoid environmentally sensitive areas.

## **Engineering and Construction Considerations**

The cross-country segment of Route “F” traverses through an existing SJG Easement, and the constraints would be that the proposed gas main expansion line would require at least a 30 ft. wide clearing in order to install the gas pipeline in this location. The existing easement traverses through heavily wooded/forested areas with a dirt access road approximately 6 to 10 feet wide, thus requiring additional clearing of up to 25 ft. for construction of the new pipeline for the majority of the route. For the majority of the route, there is limited access for construction vehicles/equipment to enter construction areas due to the location of the route. The rest of the route traverses through residential and commercial yards/properties, is in close proximity to schools, recreational camps and ball fields as well as apartment buildings. Proximity to schools, apartment buildings, and similar structures would require additional investigation so that suitable distance is maintained for public safety.

The pipeline easement runs through pockets of residential properties, front, and backyards, thus creating limited constructability within these areas.

There will be multiple HDDs and Jack & Bores required crossing major roadways (county roads), railroads, and waterways along the route.

This alternative would approach BL England facility from the west and north via Route 50 the same as Route “E” and would involve installation of the pipeline through the eastern portion of the Pinelands Forest Area in parallel with the existing Route 50 feeder line to Cape May County. This alternative would be invasive of Pinelands Forest Area and would not achieve the same level of redundancy because it would not address the vulnerability of the Vineland-Mays Landing Pipeline. This alternative would still expose 142,000 SJG customers to single-contingency failure and a loss of natural gas service. In addition, because this alternative would require the new pipeline to be installed adjacent to the existing Rt. 50 Pipeline, it would be vulnerable to the same exposures as the existing pipeline and is therefore inadequate. The co-location of critical “lifeline” infrastructure (i.e. those systems and facilities that deliver vital services and products to a community, including natural gas pipelines) increases system vulnerability because natural events like earthquakes and large storms, or man-made disasters like excavation accidents, can damage co-located infrastructure. See FEMA, “Collocation Impacts on the Vulnerability of Lifelines During Earthquakes with Applications to the Cajon Pass, California”, FEMA-221 (Oct. 1991); National Infrastructure Advisory Council, “A Framework for Establishing Critical Infrastructure Resilience Goals Final Report and Recommendations” (Oct. 2010).

## **Summary**

Route “F” would be approximately 14 miles longer than Route “A”. System reliability is defined as “The reliability of an entire system, as opposed to the reliability of its components. The system reliability is defined by the reliability of the

components as well as the way the components are arranged reliability-wise”<sup>2</sup>. Applying this definition and logic to the design of a natural gas system means there should be multiple independent gas supplies to serve customers. It is for this basic reason that installing a new gas main down Route 50 alongside other existing gas mains was discounted since it would not provide full system supply options and redundancy.

The significant wetland and T&E impacts associated with the cross-country portion of this route as well as not providing full redundancy are considered fatal flaws in this route. For all of these reasons, Alternative “E” was not considered a viable alternative.

## 8. Route “G”

Route “G” begins in Hamilton Township, Atlantic County and ends at the BL England power plant in Upper Township, Cape May County. Beginning in Hamilton Township Atlantic County on Route 559 / Ocean Heights Ave at the intersection with Harbor Avenue; then southeast approximately 6.1 miles to the intersection of the Garden State Parkway right-of-way (GSP ROW); then south on the GSP ROW for approximately 2.6 miles to a point just north of the Somers Point Toll Plaza on the GSP ROW; then directional drill approximately 8700 feet under the Great Egg Harbor Bay to a point on Route 9 just north of the intersection of Clay Avenue; then south on Route 9 for approximately 0.1 miles to the intersection of Clay Avenue; then west on Clay Avenue for approximately 0.3 miles to the BL England Power Plant in Upper Township, Cape May County. This route has been presented by Pinelands Preservation Alliance as a viable alternative route.

Route “G” would also require the upgrade of the Vineland to Mays Landing Segment from a 20” diameter pipeline to a 30” diameter pipeline to meet the volume and capacity demands of SJG’s Atlantic County and Cape May County customers and the BL England Facility. This upgrade would operate at a Maximum Allowable Operating Pressure (MAOP) of 700 psig and begin in the City of Vineland, Cumberland County, just east of Union Road and just north of the intersection of Asher Road and Union Road at the existing South Jersey Gas Union Road Station facility and following the existing gas line easement right-of-way east, cross country, for approximately 10.2 miles to the intersection of Route 50. This upgrade crosses through 7.2 miles of Pinelands Forest Planning Area.

Route “G,” with the required upgrade of the Vineland to Mays Landing Segment, is 33.7 miles in length but only satisfies one aspect of the project, the need to provide natural gas to the BL England Facility. In order to provide the required redundancy to SJG’s customers in Atlantic County and Cape May County, there are two alternatives. The first alternative would require an additional 8.4 miles of 24” diameter pipe to be installed from the BL England Facility to Tuckahoe (Tuckahoe Road Segment) where it would tie into SJG’s existing transmission facilities. This route would begin at the BL England Facility and travel south through the BL England property to the Atlantic City Electric ROW, then travel through the Atlantic City Electric ROW southwest to the intersection of Oceanwoods Ave. The alignment then would proceed south along Oceanwoods Ave. to Tuckahoe Road. Then the route would travel west along Tuckahoe Road to NJ Route 50 where it would proceed north to the intersection with Marshall Ave. The route then would travel west along Marshall Ave to Mount Pleasant Tuckahoe Road. From there, the route would travel north along Mount Pleasant Road to a SJG Interconnect Station and tie into SJG’s existing transmission facilities.

The second alternative would require approximately 12.8 miles of additional pipe starting at the intersection of Clay Avenue and Route 9 and traveling South along Route 9 for approximately 8.9 miles to the intersection of Route 550;

than northwest on Route 550 approximately 3.9 miles to the intersection with an existing South Jersey Gas pipeline which would provide the redundancy element of the project.

Route “G”, with the upgrade to the Vineland to Mays Landing Segment and either Reliability segment from BL England facility to SJG’s existing transmission facilities, would provide limited reliability to SJG’s Customers by adding redundancy to the Route 50 Pipeline to SJG transmission system. This pipeline would provide security for SJG’s 60,000 Cape May County Customers if a service interruption were to occur on the Route 50 Pipeline. This option adds no redundancy to the Vineland and Mays Landing Segment and therefore provides no security to SJG’s 142,000 customers located within Atlantic County and Cape May County if a service interruption were to occur on this segment. Route “G” would be at least 29.1 miles in length, and could be as much as 33.6 miles in length depending on the alternative chosen. The pipeline would provide service to the BL England Facility but only provide limited reliability to SJG’s customers.

## Results

### Environmental

#### **Wetlands, Buffers, Streams, and Open Waters**

This route would cross 18 known streams on the entire route and 6 streams on the cross-country segment of the route. The 10+ mile cross-country segment includes approximately 8.5 acres of mapped wetlands within the 30 foot wide ROW. The project design would utilize HDDs where possible to avoid wetland, buffer, and stream impacts but it is anticipated that the route geometry and extent of wetlands would result in approximately **2.5 acres of wetland impacts and additional wetland buffer impacts**. Since the remaining portions of Route “G” are within existing cleared and maintained right-of-ways it is anticipated that wetlands and stream impacts could be avoided by utilizing HDDs and J&Bs. The NJDEP Landscape mapping also includes two vernal pool habitats within the cross-country portion of the route.

#### **Threatened and Endangered Species**

Northern pine snake, barred owl and red-headed woodpecker habitat is mapped within or in immediate vicinity of cross-country portion of the ROW. No impacts to barred owl or red-headed woodpecker are anticipated as the ROW is absent of trees/snags to provide critical habitat for either of these birds. There are areas of exposed sandy soils that may provide habitat for northern pine snake. Open ROWs quite often host populations of Pinelands T/E plants; seasonal surveys (spring, summer, and fall) will likely need to be conducted to demonstrate compliance with the floral standards of the Pinelands CMP. The eastern segment of this route includes mapped habitat for swamp pink, black skimmer, osprey and least tern.

### Engineering and Construction Considerations

This alternative would approach BLE from the west and north via Route 50 and would involve installation of the pipeline crossing through the Pinelands Forest Area and in parallel with the existing Route 50 feeder line to Cape May County. This alternative would be invasive of the Pinelands Forest Area and would not achieve the same level of redundancy as Route “A” because it would not address the vulnerability of the Vineland-Mays Landing Pipeline. This alternative would still expose 142,000 SJG customers to the risk of a single-contingency failure and a loss of natural gas service.

The western section of this route, starting on Union Road and extending to Route 50, traverses through an existing gas ROW. The proposed installation would require clearing and disturbing at least a 30 ft. wide clearing in order to construct the pipeline. The proposed route traverses through long distances of heavily wooded/forested areas with limited construction access for installation of the pipeline. The western portion of this route would also pass through pockets of residential yards, and in close proximity to homes and commercial buildings.

There are also multiple waterway crossings throughout this area, and HDDs may not be feasible in some of these locations as the route has multiple curves and bends along the alignment. There would be no access for laying out the pipe or staging the pipe for the HDD installation without performing additional clearing of trees and potential wetlands.

The eastern segment of Route "G" includes construction on the Garden State Parkway ROW including HDDs under a tidal waterway and adjacent coastal wetland and an HDD approximately 8,700 feet long from the GSP Row north of the Great Egg Harbor Bay to the Route 9 ROW south of the Bay, which would present several unacceptable risks to the sensitive ecosystem of the Bay in the event of a drilling fluid return to the surface or other difficulty completing the drill. There would be significant traffic and community impacts associated with the pipe laydown area on Route 9 for a distance of approximately 4350 feet south of Clay Avenue.

### **Summary**

This route would be approximately 11.9 miles longer than Route "A". The significant wetland impacts and T&E impacts associated with the cross-country portion of this route, the prohibition to install a high pressure gas pipeline parallel to and within the Garden State Parkway ROW (NJ Turnpike Authority letter dated July 14, 2014 – Attachment 6) are considered fatal flaws in this route, therefore this route is not a feasible alternative.

### **Conclusion**

The "No Build" alternative is not considered a viable alternative because it would produce unacceptable risks for South Jersey residents and would not meet the needs and goals of this project.

Route "A" meets the goals of the project, would not have significant environmental or community impacts, but does cross through Pinelands Forest Management Planning Area.

Route "B" would not meet the goals of the project because it would only provide limited redundancy. There would be significant wetland and threatened & endangered species impacts, and significant engineering and environmental risks associated with the HDD under Great Egg Harbor Bay and based on Dr. Bennett's report an HDD under Great Egg Harbor is not feasible due to geotechnical limitations.

Route "C" meets the goals of the project but would have significant wetland and threatened & endangered species impacts. Large sections of the railroad ROW have overgrown so it is not considered an improved right-of-way or an acceptable route for the gas pipeline.

Route "D" meets the goals of the project but would have greater community and traffic impacts than Route "A". This route crosses through the Pinelands Forest Management Area and is 15 miles longer than Route "A".

Route "E" would not meet the goals of the project because it would only provide limited redundancy and there would be significant wetland and threatened & endangered species impacts.

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Route “F” would not meet the goals of the project because it would only provide limited redundancy and there would be significant wetland and threatened & endangered species impacts.

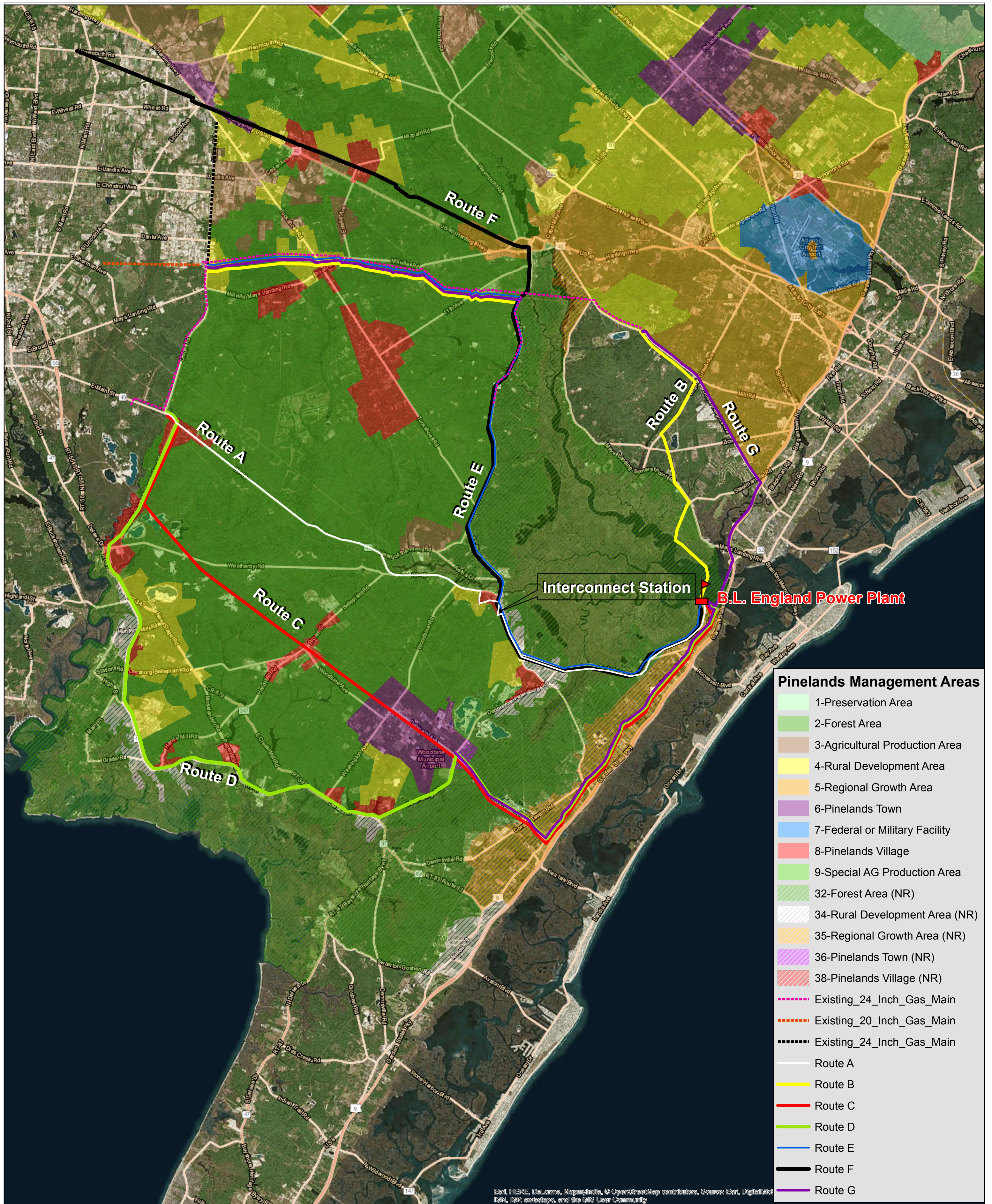
Route “G” would not meet the goals of the project because it would only provide limited redundancy. There would be significant wetland and threatened & endangered species impacts, and significant engineering and environmental risks associated with the HDD under Great Egg Harbor Bay.

The goals of the project are to provide natural gas to the BL England power plant and to provide redundancy to 142,000 customers in Cape May and Atlantic Counties. Only Routes “A”, “C” and “D” meet the goals of the project, and of these three alternatives, Route “C” has significant environmental impacts. All other routes also include significant adverse environmental impacts except “A” and “D”. None of the alternative routes, including the No Build Alternative, avoid construction in the Pinelands Forest Management Area. Route “A” is 15 miles shorter than Route “D” and would have less adverse community and traffic impacts. Route “D” does not avoid Pinelands Forest Planning Areas and includes increased stream and open water crossings. Therefore, Route “A” is the Preferred Route for implementation of the project.

ATTACHMENT 1

Alternative Routes Map





**South Jersey Gas  
Alternate Pipeline Routes  
Atlantic, Cape May and  
Cumberland Counties, New Jersey**



0 2 4 8 Miles

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, Source: Esri, DigitalGlobe, GeoEye, IGN, GeoEye, swisstopo, and the GIS User Community



## ATTACHMENT 2

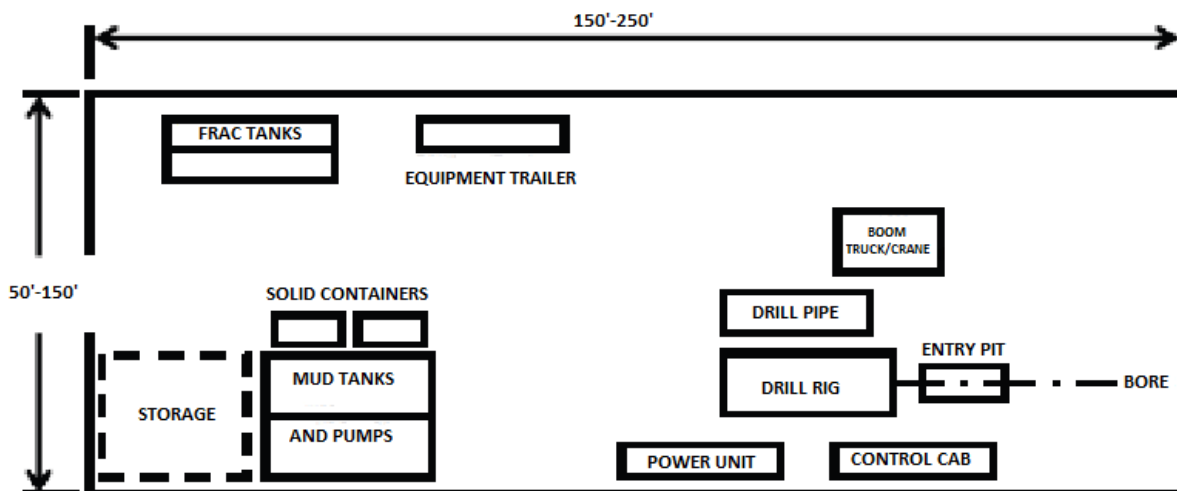
Operational Scope for Horizontal Directional Drilling

# Operational Scope for Horizontal Directional Drilling (HDD) 24 inch Pipe

Horizontal Directional Drilling (HDD) of 24" steel pipe is a monumental undertaking that requires a significant amount of open surface area for staging and operations. The operation is divided into two locations, each with its own requirements. On one side of the HDD, the entry pit and the equipment necessary for the drilling operation will be located in the staging area. The exit pit and the lay down area for the 24" pipe will be located at the opposite end of the HDD. This summary shall provide some perspective on the scope and logistics of the HDD operation in regards to the staging and lay down areas.

The project contains numerous drills varying in length from 800 to 5500 linear feet. No two drills are ever the same regardless if they are the same length. Each drill has its own hurdles that must be overcome but when planning for a drill there are guidelines that should be applied. The North American Society for Trenchless Technology (NASTT) has published *Horizontal Directional Drilling: Good Practices Guidelines* and is considered the industry standard when determining space requirements for a HDD pipeline. These guidelines will assist in providing a better understanding of the scope and operations associated with a HDD.

The guidelines recommend the staging area be 50 to 150 feet wide and 150 to 250 feet long for large diameter applications. This is due to the equipment necessary for the operation to be a success. The staging area will need space for the Drill Rig, the trailer containing the drill pipe, the power unit, the control cab, the boom truck, mud tanks and pumps, solids containers, water storage tanks, equipment trailers and storage trailers. The figure below illustrates the ideal placement of how the equipment should be staged at the entry point.



The following picture provides a more realistic view of how the equipment will be staged. The width of the staging for that drill is equivalent to 4 tractor trailers side by side in a parking lot (approximately 40 feet wide). The first trailer would be the control cab, the power unit, the mud tanks and pumps. The next trailer is the drilling rig itself. Then there is the trailer with the drill pipe and finally we have the excavator which is used to load and unload the drill pipe from the trailer to the drill rig. The remaining equipment needed for the operation does not need to be in the immediate vicinity of the drilling operation. The contractor will work within the constraints of the space provided.



This final picture depicts the lay down area for a large diameter HDD in an urban environment.



The guidelines recommend the lay down area be at least 40 feet wide and the length of the drill. The width is necessary to allow for the welding of the pipe and for the crane and sideboom equipment necessary to assist when the pipe is being pulled through the drilled hole. The guidelines recommend that the length of the lay down area be the entire length of the drill so that once the pullback of the pipe begins, the operator does not need to interrupt the pullback of the pipe to allow for segments to be welded together. Once the pullback begins, it is important to keep the interruptions to the process at an absolute minimum.

As the figure and pictures illustrate, the HDD process requires a significant amount of space and equipment. Despite the scale of the operation, the disturbance that is saved by using this construction technique is even greater. Despite the size of the operation necessary to use HDD technology, it is worth it to avoid trenching between the entry and exit points, which can be as much as a mile apart. Projects are able to move forward while still protecting environmentally sensitive areas through the use of this technology.

ATTACHMENT 3

Route Summary Table

**Table 1: South Jersey Gas - BL England Gas Pipeline Route Analysis Summary**

	Route A	Route B	Route C	Route D	Route E	Route F	Route G
Total Route Length (miles)	21.7	29.1	29	36.8	29.1	35.7	33.6
Width of pavement & maintained shoulder	30 to 50	0- 30	0-50	30-50	0-50	0-50	0-175
Construction & Engineering Considerations	roads, utility ROW, HDDs	Significant HDD 7000 ft under bay, 10.2 miles of cross country installation , narrow roads very limited work area	5.9 miles of cross country re-forested area within Pinelands; HDDs	Traffic and community impacts on Route 9 and Route 47	10.2 miles of cross country installation, traffic and community impacts from HDD in Tuckahoe, construction timing conflict with Route 50 road improvements	15.5 miles of cross country installation, traffic and community impacts from HDD in Tuckahoe , construction timing conflict with Route 50 improvements	Significant HDD approx 8,700 feet, 10.2 miles of cross country installation , Parkway ROW use not attainable, utility and traffic conflicts on 8.9 miles of Route 9, significant traffic and community impacts from pipe laydown on Route 9
Wetland Impacts (acres)	0.0 ac	7.7 ac	1.7 ac	0.0 ac	2.5 ac	3.0 ac	2.5 ac
Stream/open water crossings	16	21	10	27	20	18	18
HDD Sections	30	6	11	19	10	11	11
T&E Species Potentially Affected	bald eagle, barred owl, black crowned night heron, black skimmer, cattle egret, red headed woodpecker, osprey	bald eagle, black crowned night heron, black skimmer, cattle egret, osprey, northern pine snake, red-headed woodpecker, barred owl	northern pine snake, swamp pink, barred owl, Cope's gray treefrog, frosted elfin	swamp pink, sensitive joint-vetch	northern pine snake, barred owl and red-headed woodpecker	barred owl, eastern tiger salamander, pine barrens tree frog, bald eagle, osprey, black skimmer, cattle egret, least tern, black-crowned night-heron	northern pine snake, barred owl and red-headed woodpecker, swamp pink, black skimmer, osprey, least tern
Potential Adverse Effect on T&E	No; minor ROW edge temporary disturbance and minor tree clearing only	Yes; significant impacts to coastal wetland habitat, potential impact to Pine snake habitat	Yes; significant clearing (approx. 36 acres) of T&E habitat required	No; minor ROW edge temporary disturbance and minor tree clearing only	Yes, potential impact on Pine snake habitat	Yes, significant impact on freshwater wetlands habitat and ROW clearing	Yes, potential impact on Pine snake habitat
Length through PC Forest Planning Area	10.17 miles	7.2 miles	14.5 miles	12.6 miles	7.3 miles	13 miles	7.2 miles

ATTACHMENT 4

PJM Report dated April 10, 2014

&

PJM Report dated July 22, 2014





# Transmission Expansion Advisory Committee

April 10, 2014



# Interregional Planning Update

- Stakeholder WebEx March 25
- Stakeholder proposed scenarios
  - Winter stressed case (EIPC sample)
  - Spring stressed case (EIPC sample)
  - Severe drought (EISPC)
  - Update rollup case (NYISO PSC)
  - Indian Point and increased gas generation (NYISO PSC)
  - Increased gas generation (NYISO PSC)
  - High transmission build-out (NYISO PSC)
  - Nuclear shutdown (EISPC)

- NERC power flow compliance responsibility
- DOE congestion study data collection
- 2015/16 Work Plan possibilities
  - 10 year map
  - Rollup (add winter case), engage NERC process
  - Scenarios
  - Production Cost



# Interregional Planning Studies (not including JCM)

- **NCTPC**
  - Study requested by NCUC
  - Reliability and Economic impact of BRA resources
  - Scope under development
  - 2014 target completion
- **PJM/MISO Joint Planning Study**
  - Futures 1, 2, 3
  - No Future 1 projects pass yet
  - Futures 2 and 3 still being checked
  - Stakeholder comments still being evaluated

# Reliability Analysis Update



# Winter Peak Study Update

- Winter Study case
  - Same topology as 2019 Summer Peak case
  - External model using MMWG winter model
  - Winter Rating and Winter load profile submitted from TO
  - PJM Winter load forecast
  - Generation dispatch based on capacity factor during winter peak hours
  - Area interchange (Firm transfer Vs Historical metered data will be compared)
- Study Methodology
  - Deliverability test similar to light load test with different ramping level
  - CETO test (gas line contingency will be included)



# 2018 CETO/CETL Values

- Brattle recommendation for an annual “CETL forecast”
- 2013 RTEP Assumptions
  - Include transmission approved by the PJM Board through December 2013
- 2018 CETO/CETL values based on 2013 RTEP assumptions
- Limiting facilities identified



# Year 2018 RTEP Base Case CETO/CETL Values

2018 RTEP Base Case CETO & CETL Values					
Area	MW		CETO/CETL %	Limiting Facility	Violation Type
	CETO	CETL			
AE	1130	2322	205.5%	Voltage violation for the loss of Orchard - Cumberland 230 kV circuit	Voltage
AEP	1260	>4222	335.1%		
APS	3740	>7652	204.6%		
ATSI	4970	8470	170.4%	South Canton - Harmon 345 kV circuit	Thermal
BGE	4350	6217	142.9%	Pumphrey 230/115 kV	Thermal
CLEVELAND	3350	4940	147.5%	South Canton - Harmon 345 kV circuit	Thermal
COMED	2290	7020	306.6%	University Park – East Frankfort 345kV circuit	Thermal
DAYTON	970	>1455	150.0%		
DLCO	1520	>2280	150.0%		
DPL	980	>1470	150.0%		
DPL SOUTH	1440	1869	129.8%	Easton - Trappe Tap 69 kV circuit	Thermal
DEOK	3760	5065	134.7%	Pierce - Beckjord 138 kV circuit '1887'	Thermal
EKPC	250	>574	229.6%		
EMAAC	6140	9315	151.7%	Voltage collapse for the loss of the Keeney - Rock Springs 500 kV circuit	Voltage
JCPL	3370	>5055	150.0%		
MAAC	4420	7393	167.3%	Bristers - Ox 500 kV circuit	Thermal
METED	1290	2954	229.0%	Yorkana 230/115 kV transformer	Thermal
PECO	3260	>6172	189.3%		
PENELEC	600	>1083	180.5%		
PEPCO	3740	5359	143.3%	Voltage collapse for the loss of Burches Hill - Possum Point 500 kV circuit	Voltage
PJM WEST	8210	>12135	147.8%		
PLGRP	1310	4336	331.0%	Wescosville 500/138 kV transformer	Thermal
PSEG	6080	6700	110.2%	Roseland - Wilpipe 230 kV 230 kV circuit	Thermal
PSEG NORTH	2370	2795	117.9%	Roseland - Wilpipe 230 kV 230 kV circuit	Thermal
SWMAAC	5880	8053	137.0%	Voltage collapse for the loss of Burches Hill - Possum Point 500 kV circuit	Voltage
VAP	-540	>2089	386.9%		
WMAAC	-5010	>-1638	32.7%		

# 2020 Summer Peak Study Results

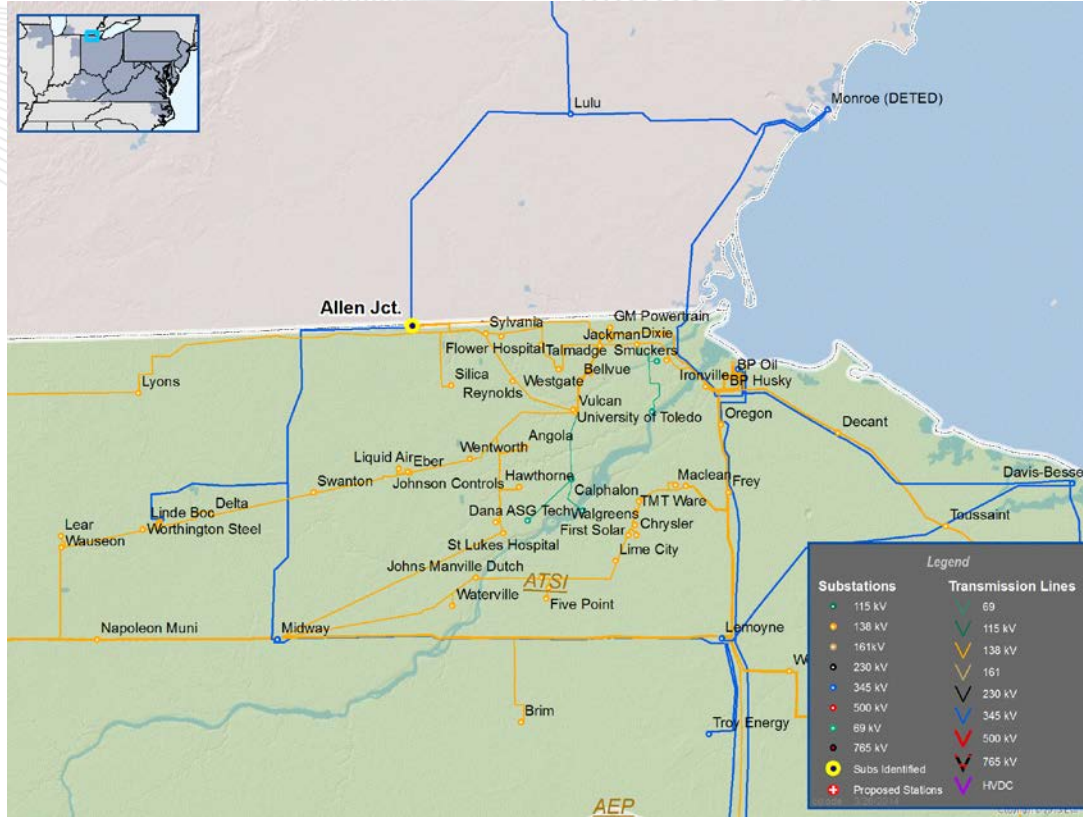
- 2020 (Year 8) summer peak case studied as part of the 2012 RTEP
- 2020 (Year 7) summer peak case studied as part of the 2013 RTEP
- Based on this study, no longer lead time system reinforcements recommended at this time
- 2022 (Year 8) summer peak base case will be created as part of the 2014 RTEP

Single Contingency Result							
Fr Bus	Fr Name	To Bus	To Name	CKT	KVs	Areas	100% Year
219110	GLOUCSTR_2	219753	CUTHBERT_2	1	230/230	PSEG	2020
219108	CUTHBERT	219125	CAMDEN	2	230/230	PSEG	2021
314074	6POSSUM	314096	6WOODBA	1	230/230	DOMINION	2028
214206	RICHMRE29	213922	RICHMOND	1	230/230	PECO	2026
314074	6POSSUM	314029	6DUMFRES	1	230/230	DOMINION	2024
232004	MILF_230	232001	COOLSPGS	1	230/230	DPL	2025
219754	CUTHBERT_3	219125	CAMDEN	1	230/230	PSEG	2020
219110	GLOUCSTR_2	219755	CUTHBERT_4	2	230/230	PSEG	2020
213519	CONOWG01	231006	COLOR_PE	1	230/230	PECO/DPL	2027
231004	RL_230	232002	CEDAR CK	1	230/230	DPL	2020
213520	CONOWG03	213844	NOTTINGHM	1	230/230	PECO	2026

Tower Contingency Result							
Fr Bus	Fr Name	To Bus	To Name	CKT	KVs	Areas	100% Year
217079	ESSEX	217061	KRNY_4-6	1	230/230	PSEG	2029
314094	6WOODBR	314067	6OCCOQUN	1	230/230	DOMINION	2026
314074	6POSSUM	314029	6DUMFRES	1	230/230	DOMINION	2024
314171	6BRAMBL	314006	6ASHBURA	1	230/230	DOMINION	2023
208040	MONT	208034	MILT	1	230/230	PPL	2025
905190	W4-021 TAP	206292	28FRENEAU	1	230/230	JCPL	2028
206314	28RED OAKA	206305	28RAR RVR	1	230/230	JCPL	2026

# Supplemental Projects

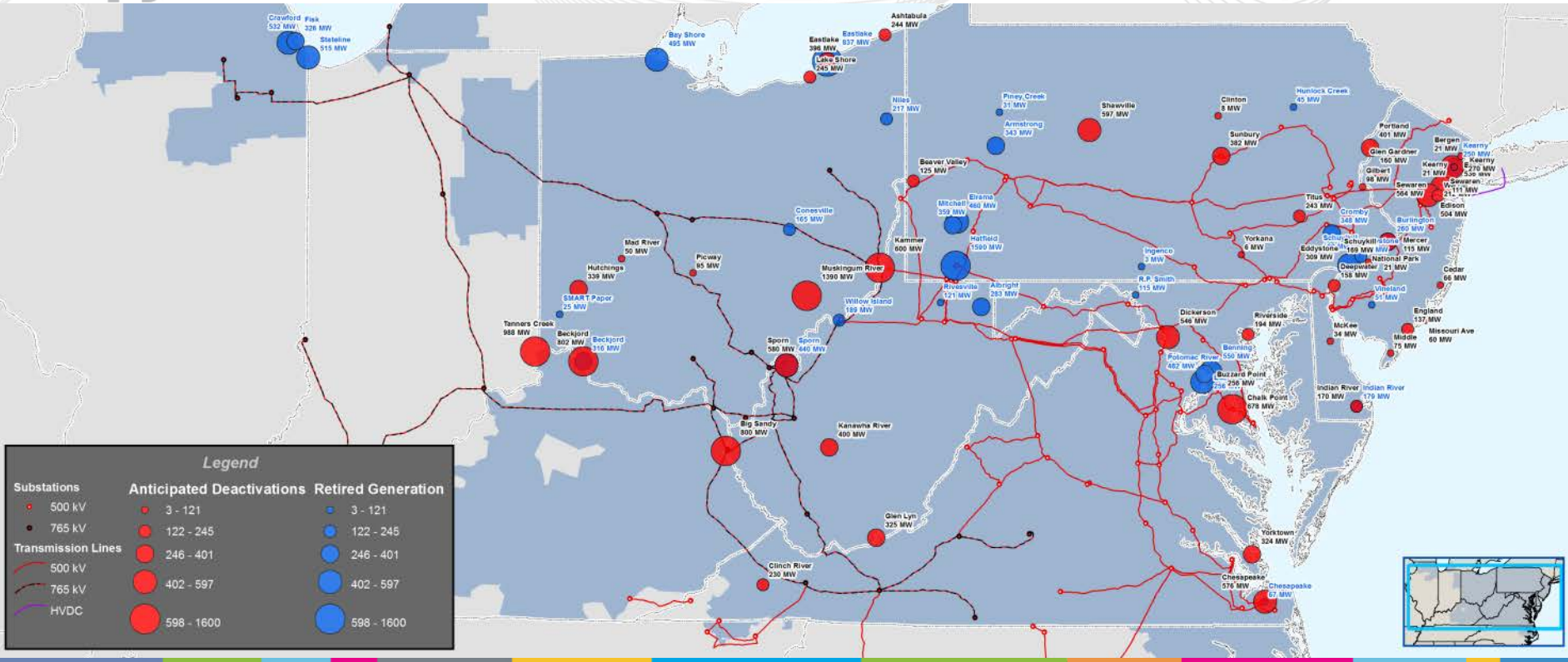
- Supplemental Project
- Associated work in the PJM ATSI transmission zone for MISO MTEP13 project
  - 4292: Allen Junction (FE) – Lenawee (ITC) 345kV Tie Line – MTEP13
  - ITC will be creating a new 345/138kV substation named Lenawee
  - The existing Beecher - Whiting 138kV, Beecher-Samaria 138kV, and the Allen Junction – Milan - Monroe 345kV lines will loop into the new substation.
  - The Milan/Monroe 345kV line exit at Allen Junction will be converted to the Lenawee 345kV line exit.
- PJM Supplemental: Upgrade the equipment on the existing Milan/Monroe 345kV line in order to become compatible with the new relaying & equipment at Lenawee (S0693)
- Projected IS Date: 4/1/2015





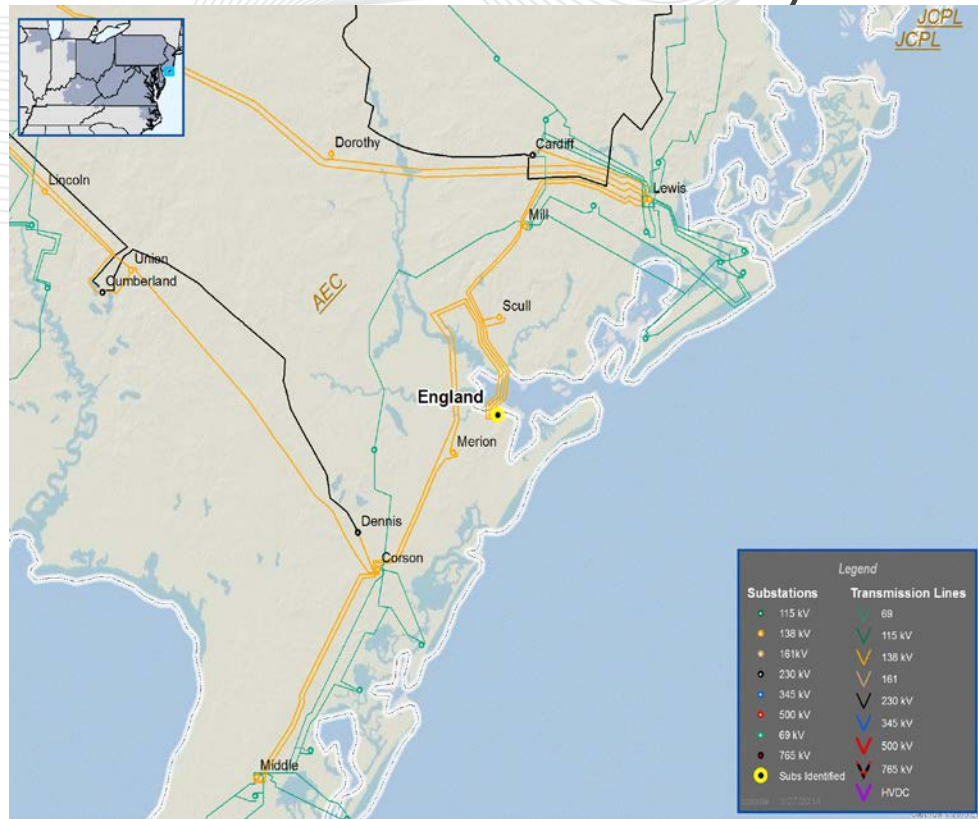
# Generation Deactivation Notification Update

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
McKee Units 1 & 2 (17MWs each)	DPL	5/31/2017	Reliability analysis complete. No impacts identified.
Dale Units 1-4 (193MWs total)	EKPC	4/16/2015	Reliability analysis underway



# At Risk Generation Analysis

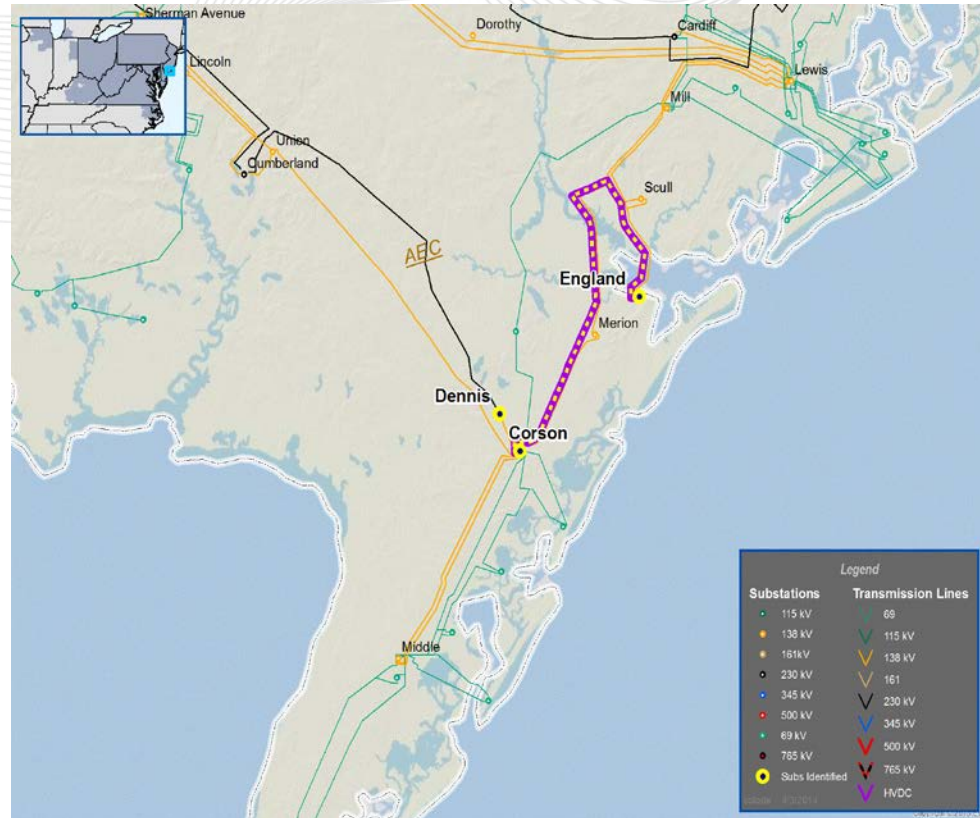
- BL England unit 2: 155MW
- BL England unit 3: 148.9MW
  - ACE Transmission Zone
  - 288 MW Total
  - Study Year: 2015
  
- BL England unit 1 & diesels were modeled offline in this study as it was already studied for deactivation



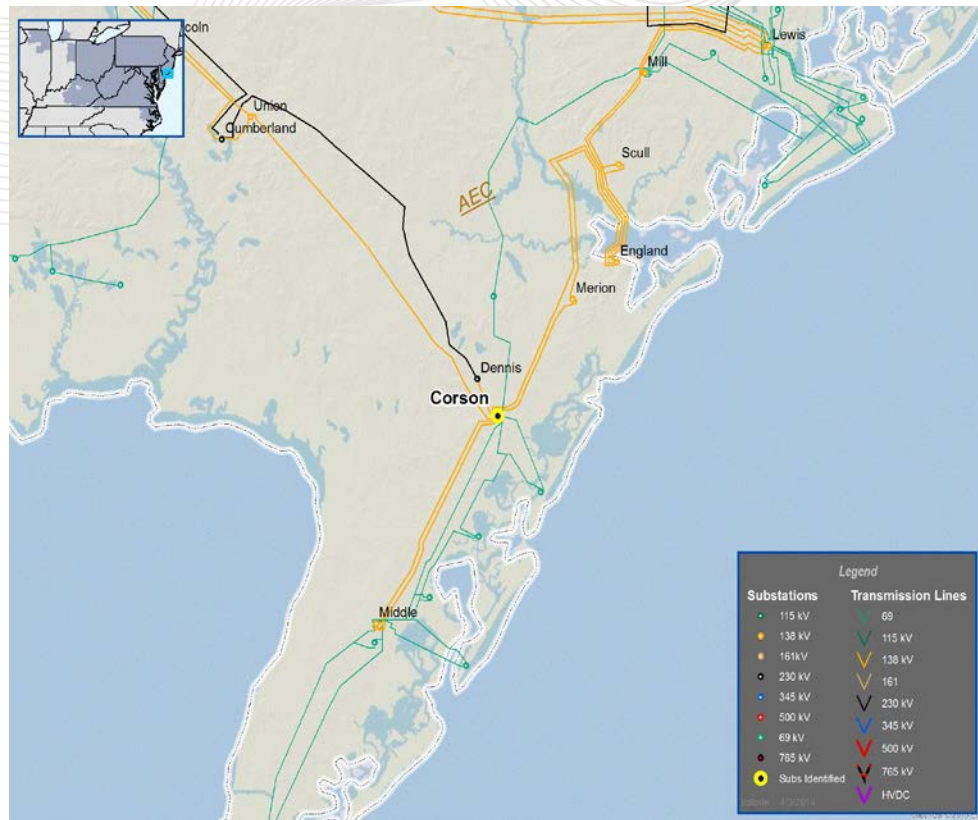


# ACE Transmission Zone

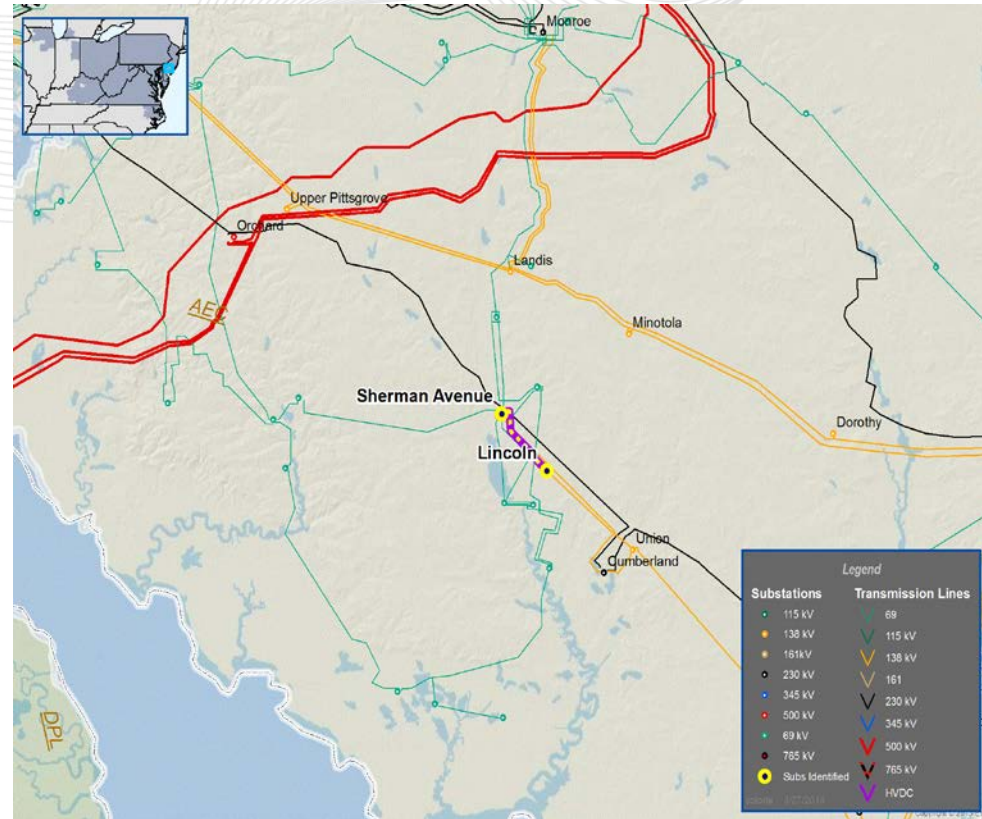
- N-1-1 Violation
- The DENNIS 230/138kV transformer is overloaded to 119.35% and DENNIS – CORSON 2 138kV line is overloaded to 114.37% for the loss of the New Freedom to Cardiff 230 kV line (CONTINGENCY 'NEWFDM-CARD') followed by the loss of Corson 3 – Union 138kV line (CONTINGENCY 'CORSON-UNION')
- *The MDLE TP – BLE 138kV line is overloaded to 102.81% for the loss of New Freedom – Cardiff 230 kV line followed by the loss of Oyster Creek – Cedar 230 kV line*
- Install new Dennis 230/69kV transformer
- Cost Estimate: \$15.2M
- Required IS Date: 6/1/2015
- Expected IS Date: 6/01/2016



- N-1-1 Violation
- The CORSON 2 - CORSON 1 138kV line is overloaded to 115.97% for the loss of the New Freedom to Cardiff 230 kV line (*CONTINGENCY 'NEWFDM-CARD'*) followed by the loss of Corson 2 – MDLE TP kV 138kV line (*'228107(CORSON 2)-228111(MDLE TP)\_1'*)
- The CORSON 2 - MDLE TP 138kV line is overloaded to 114.31% for the loss of New Freedom – Cardiff 230 kV line followed by the loss of Corson 1 – Corson 2 138kV line (*CONTINGENCY '228106(CORSON 1)-228107(CORSON 2)\_1'*)
- Upgrade 138kV and 69kV breakers at Corson substation
- Cost Estimate: \$0.8M
- Required IS Date: 6/1/2015
- Expected IS Date: 6/01/2016



- N-1-1 Violation
- The SHRMAN#3 - LINCOLN 138kV line is overloaded to 103.22% for the loss of the Dennis – Corson 2 138kV (CONTINGENCY 'DENN-COR') followed by the loss of Union – Cumberland 138kV line (CONTINGENCY '228210(UNION)-228262(CUMB)\_1')
- Reconductor 2.74 miles Sherman-Lincoln 138 kV line
- Sherman substation work
  - Cost Estimate: \$0.11M
- Lincoln substation work
  - Cost Estimate: \$0.11M
- Cost Estimate: \$4.0M
- Required IS Date: 6/1/2015
- Expected IS Date: 6/01/2016

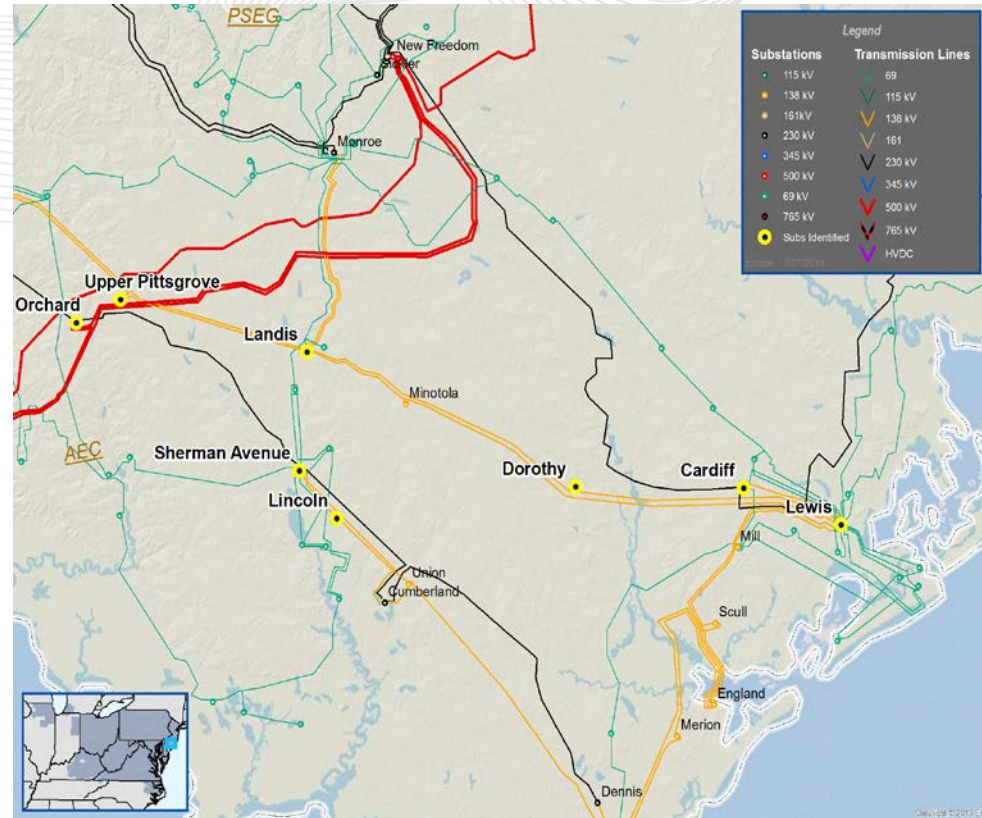




Multiple N-1-1 Thermal and N-1-1 Voltage magnitude and drop violations in ACE area are addressed by this set of upgrades

- IS Date 6/1/2015
- Expected IS Date: 6/01/2018-06/01/2019
- Rebuild and reconfigure existing 138 kV line to establish a new New Orchard – Cardiff 230kV line
  - Cost Estimate: \$57.0M
- New Upper Pittsgrove – Lewis 138kV line
  - Cost Estimate: \$28.0M
- New Cardiff – Lewis #2 138kV line
  - Cost Estimate: \$3.5M
- Orchard substation work to accommodate new Orchard – Cardiff 230kV line
  - Cost Estimate: \$3.6M
- Upper Pittsgrove substation work
  - Cost Estimate: \$0.05M

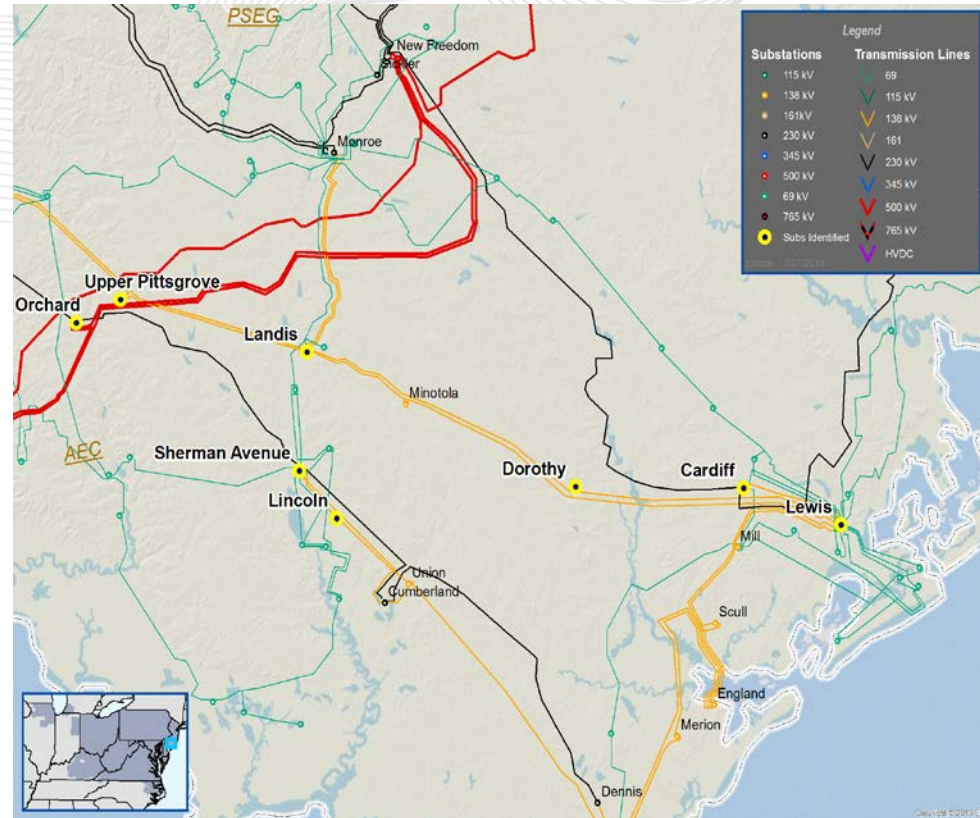
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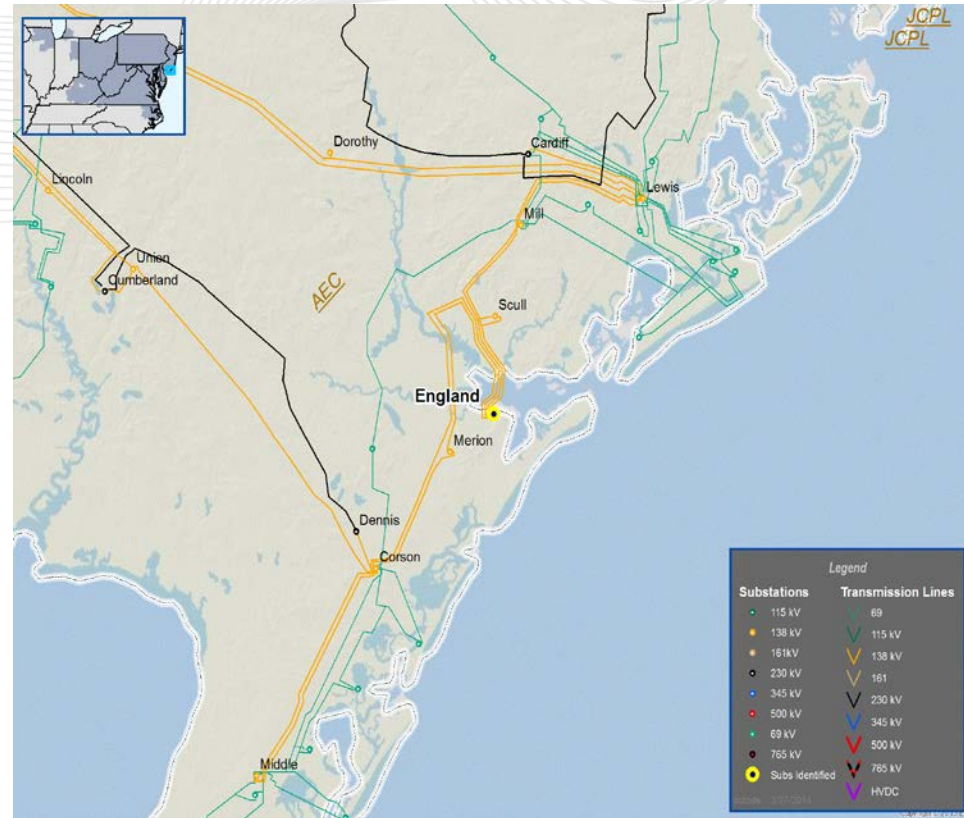
Continued from the previous slide:

- Landis substation work to convert Landis to a ring bus and connect 3 lines to it
  - Cost Estimate: \$13.4M
- Dorothy substation work – replace two switches with breakers
  - Cost Estimate: \$4.0M
- Cardiff substation work to accommodate new Orchard – Cardiff 230kV line and new Cardiff – Lewis 138kV line
  - Cost Estimate: \$16.4M
- Lewis substation work
  - Cost Estimate: \$0.1M
- Environmental
  - Cost Estimate: \$2M

Note: These upgrades will use existing ROW and will also address significant existing age and condition issue of 40 mile 138 kV double circuit tower line.

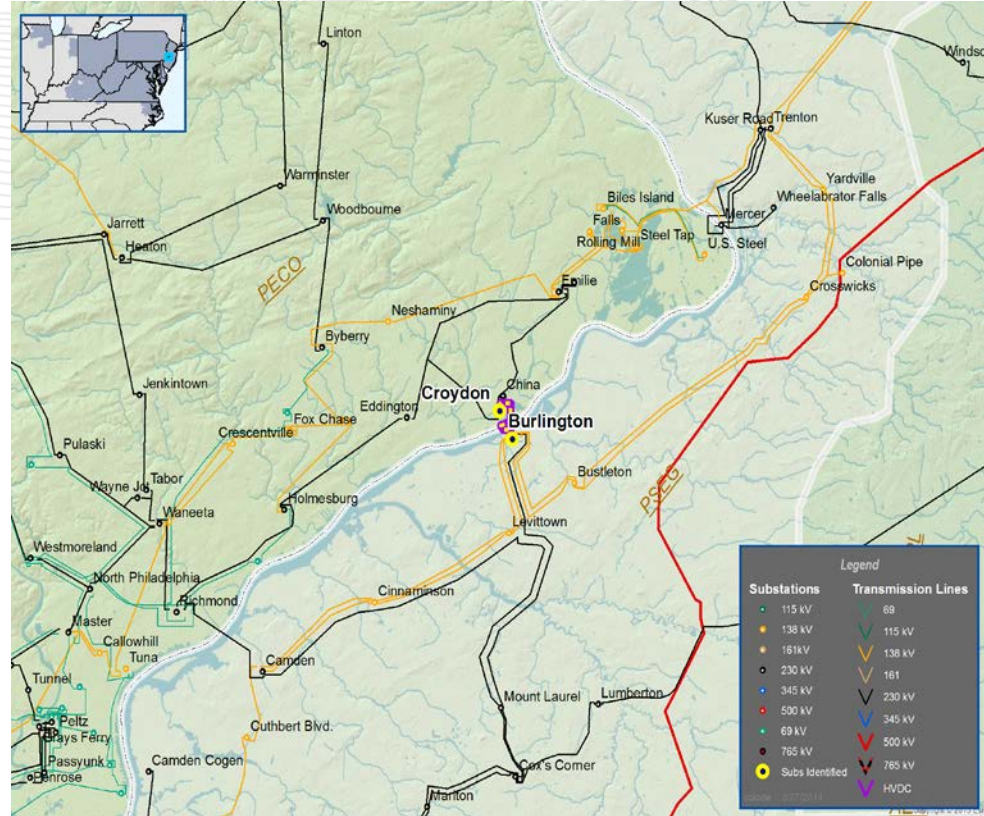


- Short term solution to multiple N-1-1 Voltage Violation in ACE area is to install a 100 MVar capacitor at BLE
- Cost Estimate: \$4.0M
- Required IS Date: 6/1/2015
- Expected IS Date: 6/1/2017





- **Generator Deliverability Violation**
- Croydon – Burlington 230kV line is overloaded to 107.61%% for the loss of Neshameny 138kV bus  
(CONTINGENCY '130-25/\* \$ BUCKS \$ 130-25 \$ L')
- *Existing baseline upgrades b1197 and b1197.1 – reconductor Croydon – Burlington 230kV line*
- Cost Estimate: \$8.6M
- Required IS Date: 6/1/2015
- Expected IS Date: 6/1/2015



- Evaluate the impact of the Oyster Creek deactivation along with BL England
  - Study conditions in 2017

# Artificial Island Update



# Artificial Island Stability Performance Comparison

1. Directional Carrier Blocking (DCB) Schemes
2. Performance of PSS/E version 32 vs. PSS/E version 29.
3. SVC performance during a fault and modeling of SVC
4. Performance of SVC on the Delaware Peninsula
5. Market Efficiency of various proposals

- Stakeholder concern: Should PJM reinforce the system as a result of the potential for a carrier blocking relay failure?
- Relay Subcommittee Discussion:
  - Directional Comparison Blocking (DCB) schemes are a widely used and valid communication method to help protect power system equipment. No simulation testing beyond normal criteria analysis is necessary unless there is a need to test beyond criteria (extreme or Type D) contingencies. If DCB schemes do fail they trip more equipment than is necessary in a conservative secure manner.

- Stakeholder concern: PSS/E v29 produces a different technical result as compared to PSS/E v32
- PJM Findings:
  - PJM consulted with Siemens (the software vendor)
    - Siemens described both the technical differences between v29 and v32 as well as the feedback from the global PSS/E user base
    - There is no technical driver for a benchmarking issue nor has any been reported by the user base, according to Siemens
  - PJM benchmarked PSS/E v29 versus v32 for several scenarios and observed comparable performance
  - Stability results from both versions are valid

## PSS/E ver. 29 case gives comparable results to ver. 32 case.

Current Operational AIOG Case (PSS/E ver. 29)

Group	Project ID	TO	SVC option	AI 500kV bus voltage	Maximum Angle Swing
7.1	P2013_1-5A-SVC	LS Power	Artificial Island	1.044	84
			Orchard	1.043	111
			New Freedom	1.043	115
7.1	P2013_1-2B-SVC	Transource (AEP)	Artificial Island	1.055	86
			Orchard	1.055	113
			New Freedom	1.055	117
7.1	P2013_1-2A-SVC	Transource (AEP)	Artificial Island	1.057	86
			Orchard	1.057	112
			New Freedom	1.057	116
7.1	P2013_1-1B-SVC	DVP	Artificial Island	1.053	83
			Orchard	1.053	110
			New Freedom	1.053	115

AI Order 1000 stability case (PSS/E ver. 32)

Group	Project ID	TO	SVC option	AI 500kV bus voltage	Maximum Angle Swing
7.1	P2013_1-5A-SVC	LS Power	Artificial Island	1.042	80
			Orchard	1.041	108
			New Freedom	1.041	112
7.1	P2013_1-2B-SVC	Transource (AEP)	Artificial Island	1.042	81
			Orchard	1.042	105
			New Freedom	1.042	109
7.1	P2013_1-2A-SVC	Transource (AEP)	Artificial Island	1.043	82
			Orchard	1.042	107
			New Freedom	1.042	112
7.1	P2013_1-1B-SVC	DVP	Artificial Island	1.042	85
			Orchard	1.041	106
			New Freedom	1.041	110

## 230kV+SVC options show stable result using the AIOG case in PSS/E ver. 29.

Group	Project ID	TO	Proposed Cost (\$)	SVC option	AI 500kV bus voltage	AI MVAR output	Critical Outage	Critical Contingency	Maximum Angle Swing
7.1	P2013_1-5A-SVC	LS Power	\$54+SVC	Artificial Island	1.044	636	5015	14b	84
				Orchard	1.043	641	5015	14b	111
				New Freedom	1.043	641	5015	14b	115
7.1	P2013_1-2B-SVC	Transource (AEP)	\$165 - \$208+SVC	Artificial Island	1.055	623	5015	14b	86
				Orchard	1.055	623	5015	14b	113
				New Freedom	1.055	623	5015	14b	117
7.1	P2013_1-2A-SVC	Transource (AEP)	\$213-\$269+SVC	Artificial Island	1.057	619	5015	14b	86
				Orchard	1.057	620	5015	14b	112
				New Freedom	1.057	620	5015	14b	116
7.1	P2013_1-1B-SVC	DVP	\$126+SVC	Artificial Island	1.053	621	5015	14b	83
				Orchard	1.053	621	5015	14b	110
				New Freedom	1.053	621	5015	14b	115

Note: The study results are obtained under the assumption of unity power factor at the high side of GSU.



- Stakeholder concern: Review PJM assumptions for modeling of SVC performance during a fault.
- PJM Findings:
  - PJM consulted industry experts at EPRI and a SVC hardware manufacturer
  - SVCs can support reactive power during the fault-on period
  - Response speed is fast enough to improve transient stability
  - PSS/E generic SVC models provide a reasonable representation of SVC performance in transient stability studies

- Stakeholder concern: PJM Should consider an SVC on the Delmarva Peninsula
- PJM Findings:
  - PJM simulated the sensitivity of an SVC on the Delmarva Peninsula and did not observe stable performance for the sensitivity cases.

# Artificial Island Constructability Update

- On-going discussion around SVCs and cable
  - Focus on application, budget level cost and sizing
    - SVC lead time tends to be 18 – 24 months



# Salem/Hope Creek Facility Owner Feedback

- Request to minimize outage and physical impacts to existing transmission facilities
- Station licensing documentation will need to be updated based on new configuration. Documentation will need to be submitted to the NRC for approval.
- Existing Hope Creek and Salem substations are within the Owner Controlled Area and subject to Nuclear Security screenings.
  - Increased schedule time and labor costs
- Licensing requirements
  - New lines would need to cross under any station Offsite Power Source.
  - An NRC review and acceptance of the SVC technology and application would be required for an SVC located at Artificial Island
- Detailed design items
  - Maintenance access for station service transformers
  - Limited available access to the Salem substation control house

- 5015 line outage challenges
  - 8 day outage in 2008 is the longest in the last 15 years
  - Numerous instances of curtailed or cancelled outages
- Generation islanding contingency
  - Pre-contingency 230kV overload
- Request to minimize impact to existing transmission facilities
  - RFP goal to reduce operational complexity
- Blackstart
  - 230kV connection provides additional benefit
- Avoid creating any additional NERC Category-D contingencies
  - 500kV line crossings
- Route Diversity



- PJM Scope Additions in Developing Cost Estimate
  - Submarine Cable
    - Added an installed spare cable
  - Auto-Transformer
    - Added a spare to proposals that included only one bank
  - 500kV Line Crossings
    - Added dead-end structures at 500kV line crossings

- Major components account for 70% - 90% of estimated material and construction costs
  - Submarine cable at \$5.3 million per mile
  - 500kV aerial at \$3.6 million per mile
  - Aerial Delaware river crossing at \$100 million
  - 500/230kV auto transformer at \$7.8 to \$10.5 million per phase



# Constructability Review – Cost Estimates

- Costs independently estimated in collaboration with PJM outside consultants
  - Engineering at 2.5%
  - Project management at 5%
  - Contingency range from 15% to 40%
- Estimate Sources
  - RTEP project cost estimates and actuals
  - Inputs from multiple outside consultants
  - Industry sources



# Cost Estimates – Southern Delaware Crossing Lines

	Dominion (VEPCO) Proposal 1B (overhead)	Transource Proposal 2A (submarine)	Transource Proposal 2B (submarine)	LS Power Proposal 5A (submarine)	LS Power Proposal 5A (overhead)
<b>Estimated Costs as Proposed (millions)</b>	• \$133	• \$213 - \$269	• \$165 - \$208	• \$148	• \$116
<b>PJM Estimated Costs (millions)</b>	<ul style="list-style-type: none"> <li>• \$233- \$283</li> <li>• Aerial Delaware river crossing</li> <li>• 3 miles 500kV</li> <li>• Six 500/230kV auto-transformers</li> </ul>	<ul style="list-style-type: none"> <li>• \$378 - \$461</li> <li>• 5.7 circuit miles of submarine cable (two cables per phase plus one spare cable)</li> <li>• Six 500/230kV auto-transformers</li> </ul>	<ul style="list-style-type: none"> <li>• \$264 - \$321</li> <li>• 3.6 circuit miles of submarine cable (two cables per phase plus one spare cable)</li> <li>• Six 500/230kV auto-transformers</li> </ul>	<ul style="list-style-type: none"> <li>• \$256 - \$311</li> <li>• 3.3 circuit miles of submarine cable (two cables per phase plus one spare cable)</li> <li>• Four 500/230kV auto-transformers</li> </ul>	<ul style="list-style-type: none"> <li>• \$211- \$257</li> <li>• Aerial Delaware river crossing</li> <li>• Four 500/230kV auto-transformers</li> </ul>



# Cost Estimates – Artificial Island to Red Lion Lines

	Dominion (VEPCO) Proposal 1C	PSE&G Proposal 7K	PHI / Exelon Proposal 4A	LS Power Proposal 5B	Transource Proposal 2C
<b>Estimated Costs as Proposed (millions)</b>	• \$199	• \$297	• \$181	• \$171	• \$123 - \$156
<b>PJM Estimated Costs (millions)</b>	<ul style="list-style-type: none"> <li>• \$242 - \$294</li> <li>• Aerial Delaware river crossing</li> <li>• 15.1 miles 500kV (includes aerial Salem-Hope Creek tie)</li> </ul>	<ul style="list-style-type: none"> <li>• \$249 - \$304</li> <li>• Aerial Delaware river crossing</li> <li>• 14.6 miles 500kV</li> </ul>	<ul style="list-style-type: none"> <li>• \$216 - \$263</li> <li>• Aerial Delaware river crossing</li> <li>• 14.6 miles 500kV</li> </ul>	<ul style="list-style-type: none"> <li>• \$221 - \$269</li> <li>• Aerial Delaware river crossing</li> <li>• 14.6 miles 500kV</li> </ul>	<ul style="list-style-type: none"> <li>• \$232 - \$282</li> <li>• Aerial Delaware river crossing</li> <li>• 14.6 miles 500kV</li> </ul>

Southern Delaware Line Crossing Projects		
	Submarine River Crossing	Overhead River Crossing
Schedule Risk Factors	<ul style="list-style-type: none"> <li>• Environmental permitting</li> <li>• (Transource) Relocation of 5024 line requires Salem expansion</li> <li>• Submarine cable lead time</li> </ul>	<ul style="list-style-type: none"> <li>• Public opposition / Permitting risk for the Delaware river crossing</li> <li>• (Dominion) - Salem interconnection coordination risk due to generator lead proximity</li> </ul>
Common Factors	<ul style="list-style-type: none"> <li>• Route cannot be finalized until permitting is complete</li> <li>• Salem expansion requires two bus outages for final tie-in</li> <li>• Crossing Delaware state route 9, which is a 'Scenic and Historic Highway' may impact permitting</li> <li>• Construction is approximately 2 years and does not appear to be a major schedule risk</li> </ul>	



	Dominion (VEPCO) Proposal 1C	PSE&G Proposal 7K	PHI / Exelon Proposal 4A	LS Power Proposal 5B	Transource Proposal 2C
<b>Common Factors</b>	<ul style="list-style-type: none"> <li>• Route parallels existing 5015 line               <ul style="list-style-type: none"> <li>• Permitting process</li> </ul> </li>   <li>• Delaware River Crossing</li>   <li>• Supawna Meadows National Wildlife Refuge</li>   <li>• All include an attachment into Salem and Red Lion substations</li>   <li>• Construction is approximately 2 years and does not appear to be a major schedule risk               <ul style="list-style-type: none"> <li>• All projects require at least one 500kV line crossing</li>   <li>• All projects require a 5015 line outage</li> </ul> </li> </ul>				

	Dominion (VEPCO) Proposal 1C	PSE&G Proposal 7K	PHI / Exelon Proposal 4A	LS Power Proposal 5B	Transource Proposal 2C
Schedule Risk Factors	<ul style="list-style-type: none"> <li>• Significant 5015 line outages required for Red Lion expansion and line crossing</li> <li>• Salem and Hope Creek tie coordination risk due to generator lead proximity</li> </ul>	<ul style="list-style-type: none"> <li>• Significant 5015 line outages required for Red Lion expansion and line crossing</li> <li>• 5037 relocation outage impact to Hope Creek substation</li> <li>• Salem and Hope Creek tie risk due to Salem generator lead proximity</li> </ul>	<ul style="list-style-type: none"> <li>• 5015 line outage required for Red Lion expansion and tie-in to new bay</li> <li>• Outages required to raise 5023, 5024, and 5021 lines to allow for crossing</li> </ul>	<ul style="list-style-type: none"> <li>• 5015 line outage required for Red Lion expansion and tie-in to new bay</li> <li>• Relocation of 5037 line requires Salem expansion</li> <li>• Outages required to raise 5023 and 5015 lines to allow for crossing</li> </ul>	<ul style="list-style-type: none"> <li>• 5015 line outage required for Red Lion expansion</li> <li>• Relocation of 5024 line requires Salem expansion</li> <li>• Relocation of 5021 line requires</li> <li>• Outage required to raise 5023 line to allow for crossing</li> </ul>

- SVC Locations:
  - New Freedom
  - Orchard
  
- Schedule Estimate 36 months
  - SVC lead time of 24 months
  - Permitting and land acquisition 6 months
  
- Cost Estimate \$80 million
  - SVC \$60 million



- Next Steps
- May 2014 – Artificial Island recommendation at PJM TEAC
- July 2014 – PJM staff to submit recommendation to the PJM Board

Questions?

Email: [RTEP@pjm.com](mailto:RTEP@pjm.com)



# Revision History

- 4/7/2014 v1
  - Original version distributed to PJM TEAC
- 4/9/2014
  - Updated expected in-service dates on slides 25 & 27





## PJM's 2014 Regional Transmission Expansion Plan

### Transmission Plan Proposed for Approval to Proceed with Construction Related to the 2014 Baseline Regional Transmission Expansion Plan

#### EXECUTIVE SUMMARY

On February 11, 2014 the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling over \$281.47 million, to resolve identified baseline reliability criteria violations and to incorporate network upgrades associated with new interconnection customers.

At the July PJM Board of Managers meeting PJM staff recommended a number of baseline upgrades to address violations that will occur for the anticipated deactivation of B. L. England generation in the Atlantic City Electric transmission zone. Although PJM has not been formally notified that the generation will deactivate, the units are considered to be at-risk. Baseline upgrades to address these issues are summarized below and were presented for the Board Reliability Committee's (BRC) consideration and for recommendation to the Board for approval. The projects described in this whitepaper were approved by the PJM Board of Managers. The total increase to the RTEP to include these baseline project additions and include these upgrades is \$143.6million. With these changes, the RTEP will include over \$29,308 million of transmission additions and upgrades since the first plan was approved by the Board in 2000.

In addition to the changes associated with the B. L. England units, PJM staff also reviewed the Artificial Island operational performance issue and proposed upgrades at the July board meetings. See the letter from Mr. Herling to the TEAC posted at the following link: <http://pjm.com/~media/committees-groups/committees/teac/20140807/20140807-teac-artificial-island-letter.ashx>

# Artificial Island

## Operational Performance Issue

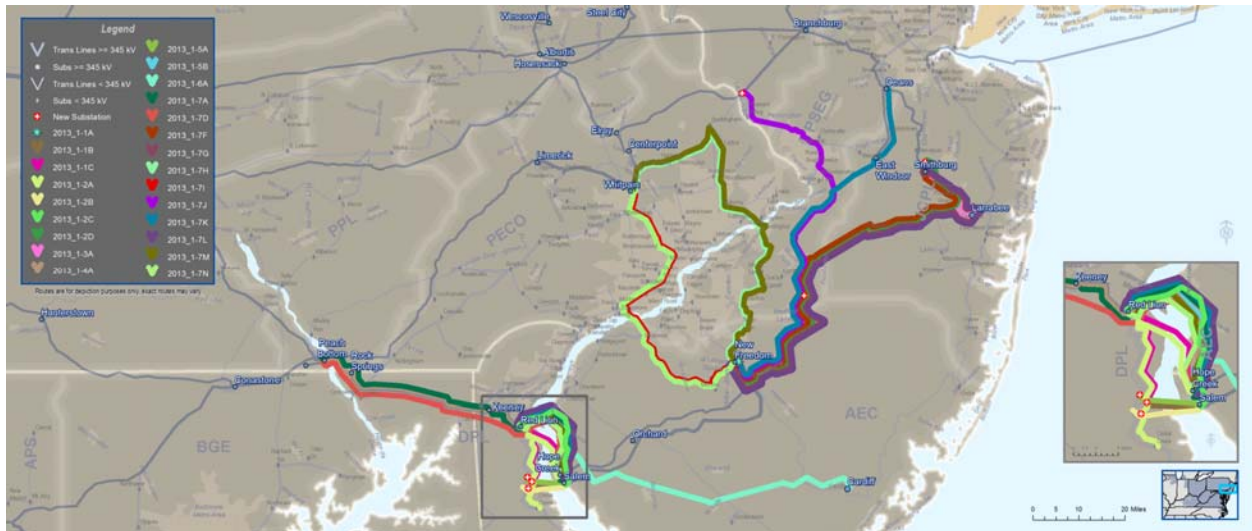
“Artificial Island” is the area in Southern New Jersey where the Salem and Hope Creek nuclear generation is located. The area has historically been stability constrained. Stability of the generation has been ensured through the use of operating procedures that require a minimum reactive output for each of the generators under various operating conditions. Higher generator reactive output generally results in higher local system voltages. Maintaining the minimum reactive output of each of the machines is becoming increasingly difficult while still respecting system high voltage limits. These issues are made even worse under transmission maintenance conditions since removing transmission typically requires maintaining higher reactive output from each of the generators.

## Proposal Window

In April of 2013 PJM opened a 60 day proposal window to solicit projects from stakeholders to address the operational performance issues around Artificial Island. PJM received 26 proposals from 7 different entities. The proposals, which are summarized in the table below, range in cost from just over \$100 million to over \$1,500 million and include FACTS devices, HVDC lines, new overhead and underground/underwater 230 kV lines and new overhead 500 kV lines. Additional information on each of the proposals is included in Appendix A – Artificial Island Proposal Descriptions.

Project ID	TO	Cost (\$)	Major Components	Supporting info
P2013_1-1A	Virginia Electric and Power Com	\$ 133	500 MVAR SVC near New Freedom	Two (2) Thyristor Controlled Series Compensation (TCSC) Devices near New Freedom
P2013_1-1B	Virginia Electric and Power Com	\$ 126	New 500 kV from Salem - a new station in Delaware	New 500/230 kV station in Delaware that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV
P2013_1-1C	Virginia Electric and Power Com	\$ 202	New 500 kV from Hope Creek - a new Station in Delaware	Install a new 500kV line from Hope Creek - Red Lion; New Salem - Hope Creek 500 kV line
P2013_1-2A	Transource	\$213 - \$269	Salem - Cedar Creek 230 kV	Two (2) 500/230 Transformers near Salem; Loop in Red Lion - Cartanza 230 to Cedar Creek
P2013_1-2B	Transource	\$165 - \$208	Salem - North Cedar Creek (new) 230 kV	Two (2) 500/230 transformers near Salem and loop in Red Lion - Cartanza 230 and Red Lion - Cedar Creek 230 kV
P2013_1-2C	Transource	\$123 - \$156	Salem - Red Lion 500 kV	
P2013_1-2D	Transource	\$788 - \$934	New Freedom - Lumberton - North Smithburg (New) 500 kV line	New Salem - Hope Creek 500 kV line and new 500/230 station east of Lumberton
P2013_1-3A	First Energy	\$410.7 (Only FirstEnergy portion)	New Freedom-Smithburg 500 kV line with a loop into Larrabee	Hope Creek - Red Lion 500 kV line
P2013_1-4A	PHI Elexon	\$ 475	Peach Bottom - Keeney - Red Lion - Salem 500 kV	Remove Keeney - Red Lion 230 kV; Reconfigure 230 around Hay Road; Reconductor Harmony-Chapel St 138 kV
P2013_1-5A	LS Power	\$116.3M - \$148.3M	Salem - Silver Run (new) 230 kV; Salem 500/230 kV Transformer	New 230 kV station that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV
P2013_1-5B	LS Power	\$ 170	Salem - Red Lion 500 kV	
P2013_1-6A	Atlantic Wind	\$ 1,012	320 kV HVDC Salem/Hope Creek - Cardiff	SVC at Salem/Hope Creek; New HVDC Stations at Cardiff and Salem
P2013_1-7A	PSE&G	\$ 1,371	Salem-Hope Creek to Peach Bottom 500 kV	Existing ROW
P2013_1-7B	PSE&G	\$ 1,372	Salem-Hope Creek to Peach Bottom 500 kV	Same as 7A with Loop into Keeney
P2013_1-7C	PSE&G	\$ 1,372	Salem-Hope Creek to Peach Bottom 500 kV	Same as 7A with Loop into Red Lion
P2013_1-7D	PSE&G	\$ 831	Salem-Hope Creek to Peach Bottom 500 kV	Same as 7A with New ROW
P2013_1-7E	PSE&G	\$ 692	New Freedom - Deans 500 & Salem - Hope Creek 500 kV lines	
P2013_1-7F	PSE&G	\$ 879	New Freedom - Smithburg and Salem-Hope Creek 500 kV lines	Existing ROW
P2013_1-7G	PSE&G	\$ 1,034	New Freedom - Smithburg and Salem-Hope Creek 500 kV lines	Same as 7F with a Loop into a new Larrabee 500 kV station
P2013_1-7H	PSE&G	\$ 1,177	New Freedom - Whitpain and Salem - Hope Creek 500 kV lines	Northern Route
P2013_1-7I	PSE&G	\$ 1,353	New Freedom - Whitpain and Salem - Hope Creek 500 kV lines	Same as 7H with the Southern Route
P2013_1-7J	PSE&G	\$ 915	New Freedom - New Station on Branchburg-Elroy 500 kV line ("5017 Junction") and Salem - Hope Creek 500 kV line	Existing ROW
P2013_1-7K	PSE&G	\$ 1,066	New Freedom - Deans & Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new);	Same as 7E with Hope Creek - Red Lion
P2013_1-7L	PSE&G	\$ 1,250	New Freedom - Smithburg & Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new);	Same as 7F with Hope Creek - Red Lion
P2013_1-7M	PSE&G	\$ 1,548	New Freedom - Whitpain (North) & Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new);	Same as 7H with Hope Creek - Red Lion
P2013_1-7N	PSE&G	\$ 1,289	New Freedom - a new Station on the Branchburg-Elroy 500 kV line ("5017 Junction") & Salem-Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new);	

The locations of the various proposals are shown on the following map.



## Proposal Evaluation

The proposals were evaluated from several different perspectives to identify the most efficient and effective solution. PJM staff completed extensive technical evaluations of each of the proposals that included stability, thermal, voltage and short circuit assessments. In addition, “constructability” reviews of the proposals were completed to review the overall feasibility and anticipated cost associated with the proposals. Staff met with the entities that proposed the projects as needed to get clarification on the proposals. In addition, staff met with PJM Operations, Artificial Island plant representatives and equipment manufacturers to solicit their feedback on the proposals.

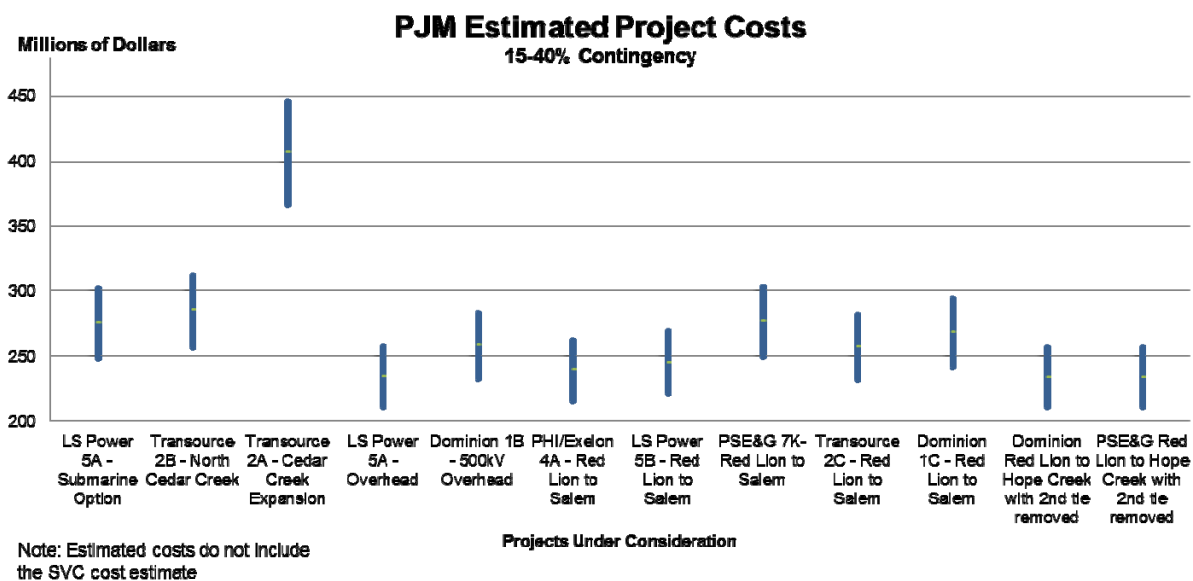
PJM staff performed an initial analytical screen of all of the proposals and found that only two of the projects as proposed satisfied PJM criteria. However, PJM staff determined that many of the proposals could be made more effective or efficient with some modification. The modifications included substation configuration changes, device changes such as increasing the size of a Static Var Compensator (SVC), and adding or removing substation components such as circuit breakers and SVCs. Considering the results of the analytical screening and the estimated cost of each of the proposals, PJM began to focus on a subset of proposals that included projects to build new lines from Artificial Island, across the Delaware River to transmission facilities in Delaware. The subset of proposals included both southern Delaware River crossings (both overhead and submarine) that terminated at the existing 230 kV system in Delaware and new 500 kV lines from either Hope Creek or Salem substations to the Red Lion 500 kV substation in Delaware.

The Delaware River crossing proposals were further evaluated for a number of factors including technical analysis. The technical analysis considered things such as generator rotor angle swing, voltage and thermal performance, short circuit, and NERC category D performance. All of the proposals with the PJM modifications noted above satisfied the required criteria. In addition, production cost simulations were done to determine the market efficiency benefits of the different proposals. These simulations showed that there were market efficiency benefits of the proposals however they were only on the order of several million

dollars per year and were far below the savings that would be required to satisfy the market efficiency criteria.

In addition to the evaluation of the technical performance of the Delaware River crossing proposals, projects were also evaluated for cost, schedule, operational factors, and factors or risks to cost and schedule. PJM engaged outside consultants to perform independent constructability reviews. These reports were factored into PJM's overall constructability evaluation.

The PJM estimated cost of the proposed projects ranged in cost from just over \$200 million to just over \$300 million with the exception of the Transource-2A proposal. The estimated costs are shown in the table below. Note that a range of cost for each proposal is shown below considering the risk and contingency variance for project components that ranged from 15% to 40%.



Cost estimates were driven by four major components:

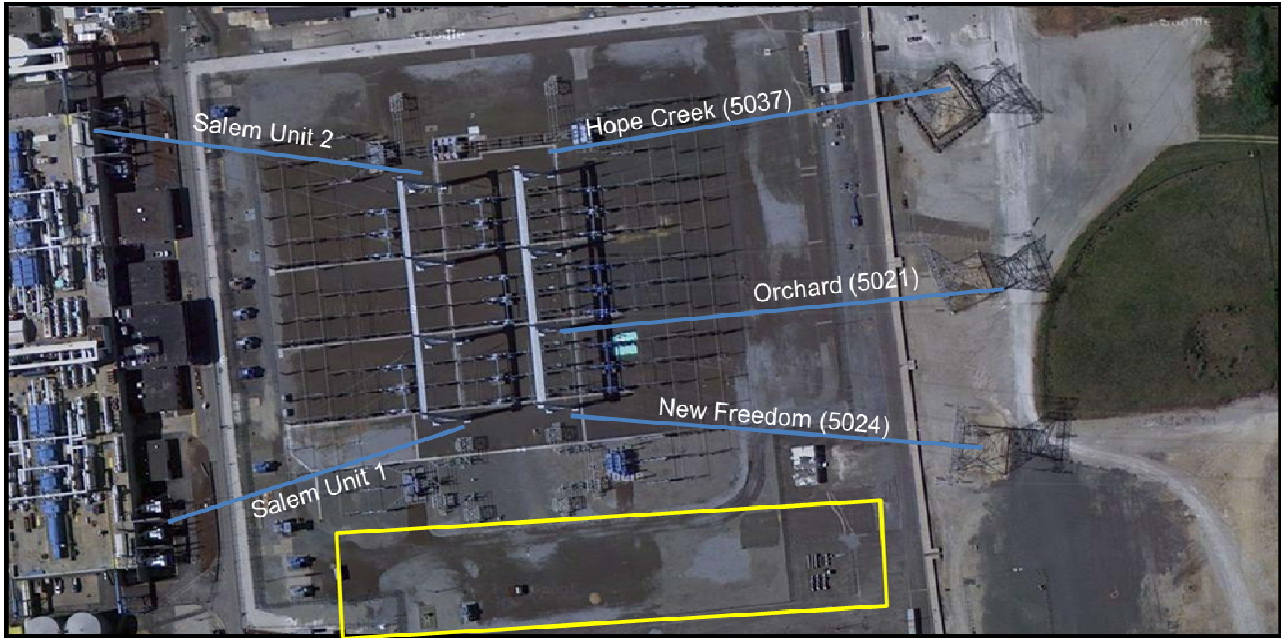
- Delaware River Crossing (aerial)
- Submarine Cable Installation
- 500 kV Transmission Line Installation
- 500/230 kV Auto-Transformers

Factors considered for project schedule included permitting, construction and long-lead time equipment. Multiple permits would be required for any of the proposals including CPCN or the equivalent from two states as well as permits from the Army Corp of Engineers. The construction schedule for any of the proposals would need to consider spawning and nesting seasons of endangered species however the southern crossing 230 kV submarine lines would also need to consider the time for obtaining or scheduling the specialized equipment required for installation of submarine cable. Materials can also impact overall project schedule. Long lead time materials for the southern crossing proposals include the 500/230 kV auto-transformers that would be required and the submarine cable and associated terminations that would be required for the submarine southern 230 kV crossings.

Risks to project cost and schedule were also considered in the evaluation of the proposals. Factors that could impact overall project cost and schedule include overall project complexity, right-of-way and land acquisition, and siting and permitting. All of the proposals will face challenges from a siting and permitting perspective and public opposition can be expected for all of the proposals. All of the projects would require a Delaware River crossing. All projects will require approval to cross coastal state lands and in addition, the Artificial Island to Red Lion 500 kV proposals will need approval to cross the Supawna Meadows National Wildlife Refuge. All of the projects are likely to impact wetlands which may require remediation and/or special construction methods to minimize impact. All of the projects will need to acquire land and right-of-way however there is existing right-of-way along the Hope Creek to Red Lion route that will need to be expanded in some locations to accommodate a second 500 kV line. Overall project complexity may also impact cost and schedule. All of the projects will require outages to interconnect to the existing system. The outages will need to be closely coordinated with Artificial Island operating personnel as well as with other required transmission system outages. Line crossings also add additional complexity to some of the proposals from the design, construction and operational perspectives. Projects with no line crossings are preferred. The extent to which proposals require modifications to the Artificial Island substations is also a factor related to project complexity. Projects that minimize the modifications required at the Artificial Island substations, and in particular the Salem substation, are viewed as more constructible due to the limited space for expansion and the complexity of installing new protection and control equipment in the secure area of the generating station at Salem.

The proposals were also evaluated from an operational impact perspective. Several operational impact factors were evaluated including on-going maintenance requirements, route diversity, blackstart benefits and Artificial Island facility requirements. The 230 kV projects are considered to have additional on-going maintenance needs primarily due to the new 500/230 kV transformers and associated equipment. In addition, projects that would utilize portions of the Salem substation would likely have additional maintenance needs from salt contamination due to the proximity to the river. Artificial Island facility requirements were also a consideration for operational impact. All of the projects will impact Artificial Island facilities to some degree however proposals that involve the Salem substation are considered to have a greater impact.

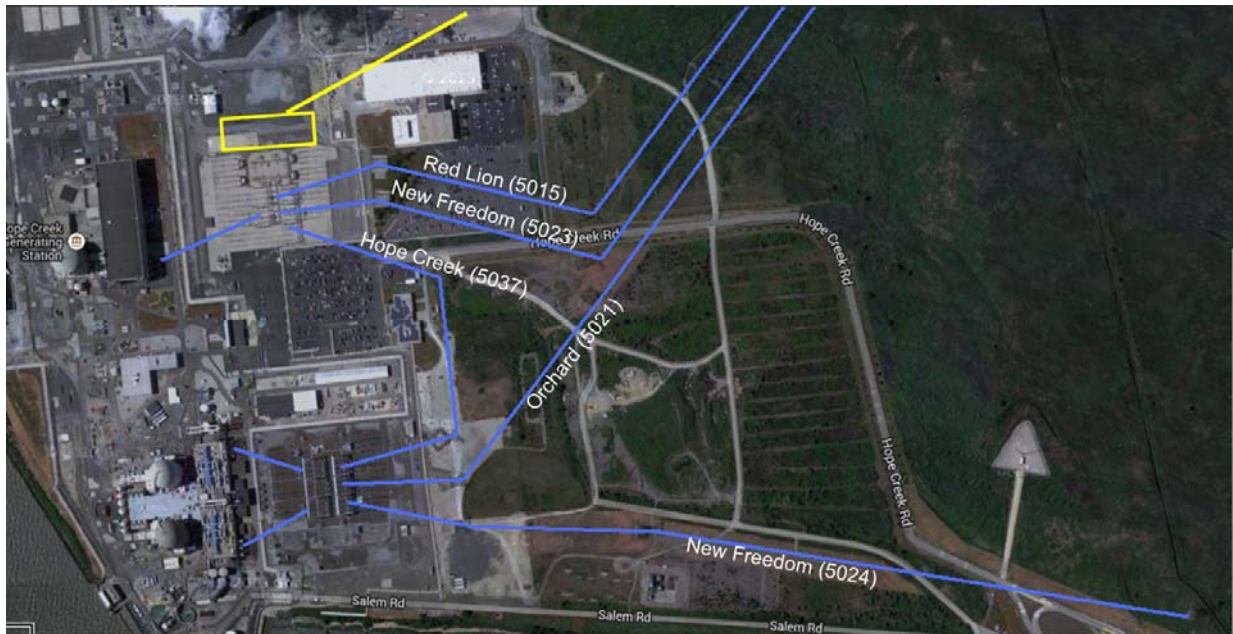




The picture above is an aerial view of the Salem Substation. Proposed space for expansion of the substation is highlighted by the yellow box. Most of the projects had proposed using this parcel of property to interconnect either a new 500 kV line bay for the proposals to add a new line to Red Lion, or to install equipment associated with a new 500/230 kV substation. Any additions to this section of the substation would need to be carefully designed given the proximity to the connections to the Salem 1 generator step-up leads. In addition, installing equipment in this section of the substation would impede access to station auxiliary transformers shown just above and to the left of the yellow box. In addition, the Salem to Red Lion 500 kV proposals would need to either relocate and/or cross existing lines. Finally, all of the controls for the Salem substation are located within the protected area of the generating station. There is currently limited spare conduit from the substation back into the plant that could be used for any of the control cable associated with the new substation facilities.

By way of comparison, the picture below provides an aerial view of the Artificial Island complex, including Hope Creek substation. Proposals to build a new line from Hope Creek to Red Lion would likely utilize the space in the yellow box. This space is believed to be of sufficient size for a new 500 kV line bay, and use of this space would not significantly impede access to station equipment as compared to the alternatives out of Salem. Controls for the equipment in the Hope Creek substation are located in a separate control building in the substation yard, eliminating the need to run new control cable into either Hope Creek or Salem protected areas. Finally, building a new 500 kV line from this part of the Hope Creek substation to Red Lion would not introduce any new 500 kV line crossings.





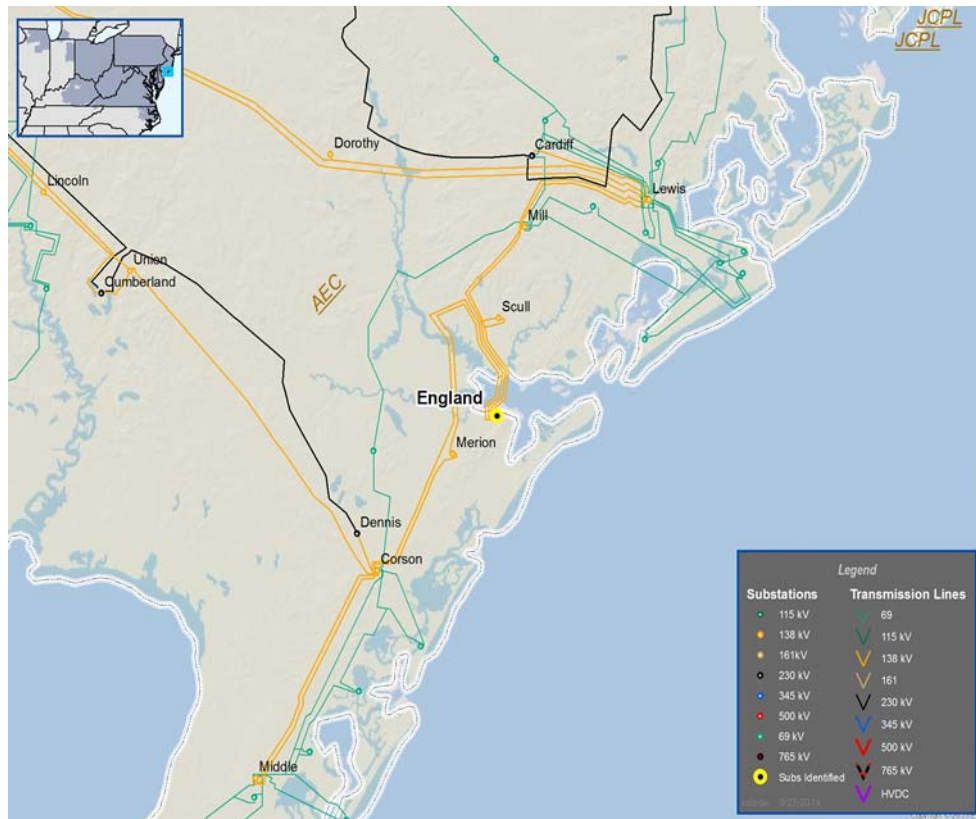
Considering all of these factors, proposals out of the Hope Creek substation that do not impact the Salem substation are preferred from an operational impact perspective.

The projects were also evaluated based on their impact to the thermal and voltage performance of the system. The southern river crossing proposals that were interconnecting with 230 kV facilities along the Delmarva Peninsula are expected to be very lightly loaded under normal conditions. The 500 kV path from Peach Bottom through Keeney and Red Lion to the Artificial Island is normally heavily loaded and is often a limiting contingency for transfers into the eastern part of PJM. Given that, the proposals between Red Lion and the Artificial Island will make the system more robust by providing additional transmission capability along a heavily loaded path and by eliminating a critical contingency improving overall reactive performance of the system.

#### PJM Staff Recommendation

In consideration of all of these factors, PJM staff prepared a recommendation to the PJM Board to build a new 500 kV line from Hope Creek to Red Lion be added to the RTEP to address the Artificial Island operational performance issues. In addition, PJM staff noted that stakeholders could comment on their recommendation. The PJM Board received a wide range of comments from interested stakeholders related to among other things, electrical performance, environmental impact and cost allocation. In addition LS Power, in its comments to the PJM Board modified their initial proposal to include a fixed cost cap on their proposal. The PJM Board deferred decision on the issue and asked PJM staff to take a number of additional steps. These additional actions are noted in the letter from Mr. Herling to the TEAC which is posted at the following link: <http://pjm.com/~media/committees-groups/committees/teac/20140807/20140807-teac-artificial-island-letter.ashx>

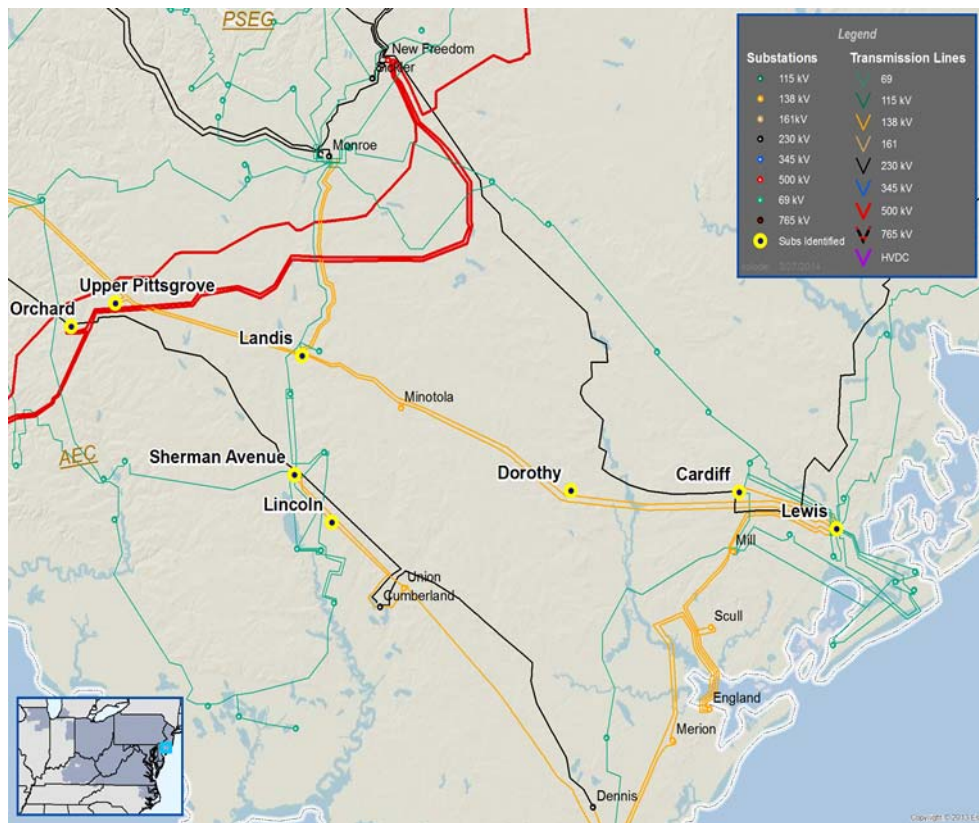
## B. L. England At-Risk Analysis



PJM staff completed a series of “at-risk” scenario studies related to the B. L. England units in the Atlantic City Electric transmission zone. These studies evaluated the impact to the system of the complete shutdown of all generation at the site by June of 2015. There are currently three steam units and four diesel units at the site. The B. L. England #1 unit is a 129 MW coal fired unit that retired in May of this year. In January of 2013 we were notified by the owners of the B. L. England diesels, which total 8 MW, of their intent to deactivate the units in the fall of 2015. The B. L. England #2 and #3 units are 155 MW oil fired steam units that had notified PJM back in 2004 of their intent to deactivate but withdrew that notice in 2007. In addition the #2 unit is under a consent order to shut down in 2017 due to environmental concerns. The owners of the B. L. England generators have entered an interconnection queue request (Y1-001) to build a new gas fired combustion turbine on site to replace the existing generation. The request is currently suspended. Earlier in 2014, a permit for the construction of a new gas pipeline to the B. L. England facility was rejected.

PJM staff evaluated the impact of the deactivation of all of the generation at B. L. England. Deactivation of all of the generation at B. L. England will have an adverse impact on the reliability of the transmission system. Specifically PJM staff identified a number of thermal and voltage reliability criteria violations primarily on the 138 kV and 69 kV systems in Atlantic City Electric. The following transmission upgrades were identified to address the potential thermal and voltage violations:

- Install new Dennis 230/69 kV transformer, environmental work –\$15.2 M
- Upgrade 138 kV and 69 kV breakers at Corson substation – \$0.8 M
- Reconductor 2.74 miles of Sherman - Lincoln 138 kV line and associated substation upgrades - \$4.22 M
- New Orchard - Cardiff 230 kV line (remove, rebuild and reconfigure existing 138 kV line) and associated substation upgrades - \$69.25 M
- New Upper Pittsgrove - Lewis 138 kV line and associated substation upgrades - \$7.23 M
- Relocate Monroe to Deepwater Tap 138 kV to Landis 138 kV and associated substation upgrade - \$0.57 M
- New Landis - Lewis 138 kV line and associated substation upgrades - \$31.03 M
- New Cardiff - Lewis #2 138 kV line and associated substation upgrades - \$11.26 M
- Install a 100 MVAR capacitor bank and B. L. England - \$4 M



It should be noted that a number of these upgrades will use existing right-of-way and will address an aging infrastructure issue for a roughly 40 mile 138 kV double circuit tower line.

Given the concerns that the existing generation at B. L. England will shut down due to environmental / economic concerns and the viability of the new generation given the permitting issues related to the new gas pipeline, PJM staff recommended the upgrades described above be added to the 2014 RTEP. If the status of the existing or proposed generation at B. L. England changes, staff will re-evaluate the need for the upgrades.

### **Review by the Transmission Expansion Advisory Committee (TEAC)**

The results of the evaluation summarized in this report were reviewed with the TEAC throughout the process. The most recent analyses, along with the recommended solutions, were reviewed at the June 16, 2014 TEAC meeting for the Artificial Island upgrades and June 5<sup>th</sup>, 2014 TEAC meeting for the B. L. England upgrades. Written comments were requested to be submitted to PJM communicating any concerns with the recommendations and any alternative transmission solutions for consideration. .

### **Cost Allocation**


Pursuant to FERC order, the allocations for the preliminary baseline reliability upgrades associated with the B. L. England “at-risk” studies that were recommended to the PJM Board were developed using the new “use based” allocation methodology. The preliminary cost allocations are attached at the end of this whitepaper.

### **Board Approval**


The PJM Board Reliability Committee was requested to endorse the new baseline reliability projects associated with the BL England at-risk analysis and associated cost allocations and recommend to the Board approval of the baseline upgrades to the 2014 RTEP.

On July 23<sup>rd</sup>, 2014, the PJM Board approved the changes to the RTEP associated with the BL England at-risk analysis as described within this document.




 Dominion Virginia Power (DVP) 1A


- New switching station cutting the 5023 and 5024 lines near New Freedom substation that includes
  - a 500kV SVC (+500 to -300 MVAR)
  - Two Thyristor Controlled Series Compensation (TCSC) devices
- Proposed Cost Estimate: \$130MM




PJM T&E - Artificial Island 06/16/2014 11 PJM2014

 Dominion Virginia Power (DVP) 1B

- Install a new 500kV line from Salem 500kV to a new station in Delaware
- Aerial crossing of the Delaware river
- New substation in Delaware that taps the existing Red Lion to Cartanza 230kV and Red Lion to Cedar Creek 230kV lines
- Proposed Cost Estimate: \$133MM




PJM T&E - Artificial Island 06/16/2014 12 PJM2014




- Expansion of Hope Creek substation
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Second Hope Creek to Salem tie line
- Reconfiguration of Red Lion substation into a breaker and a half scheme
- Proposed Cost Estimate: \$199MM

### Dominion Virginia Power (DVP) 1C




PJM T&E - Artificial Island 06/16/2014
13
PJM2014



- Expansion of the Salem substation
- New substation near Artificial Island with two 500/230 kV autotransformers
- Submarine line under the Delaware river
- Expand existing Cedar Creek substation to accept the new line and to loop in the Red Lion – Cartanza 230kV line
- Proposed Cost Estimate: \$213-\$269MM

### Transource (AEP) 2A




PJM T&E - Artificial Island 06/16/2014
14
PJM2014



**pjm**

## Transource (AEP) 2B

- Expansion of the Salem substation
- New substation near Artificial Island with two 500/230 kV autotransformers
- Submarine line under the Delaware river
- New substation in Delaware that taps the existing Red Lion to Cartanza 230 kV and Red Lion to Cedar Creek 230 kV lines
- Proposed Cost Estimate: \$165-\$208MM




PJM T&C - Artificial Island 06/16/2014 16 PJM2014


**pjm**

## Transource (AEP) 2C


- Expansion of Salem substation
- Move 5024 and 5021 line bays within Salem substation
- 17 mile 500kV line from Red Lion to Salem
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Reconfiguration of Red Lion substation into a breaker and a half scheme
- Proposed Cost Estimate: \$123-\$156MM




PJM T&C - Artificial Island 06/16/2014 1 PJM2014

 **Transource (AEP) 2D**


- Install a new 500kV line from New Freedom to Lumberton to North Smithburg
- New 500/230 substation east of Lumberton
- Second Hope Creek to Salem 500kV tie line
- Proposed Cost Estimate: \$788-\$994MM



PJM T&D - Artificial Island 06/16/2014 17 PJM2014


 **FirstEnergy 3A**

- Install a new, New Freedom to Smithburg 500kV line with a loop into Larrabee substation
- Install two new 500/230 auto-transformers at Larrabee
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Proposed Cost Estimate: \$452MM




PJM T&D - Artificial Island 06/16/2014 18 PJM2014






- Install a new Peach Bottom to Keeney to Red Lion to Salem 500kV line
- Remove existing Keeney to Red Lion 230 kV circuit
- Reconfigure the existing 230 kV line from Hay Road to Red Lion to terminate at Keeney instead of Red Lion
- Re-conductor the Harmony to Chapel Street 138 kV line
- Proposed Cost Estimate: \$475MM

## PHI / Exelon 4A

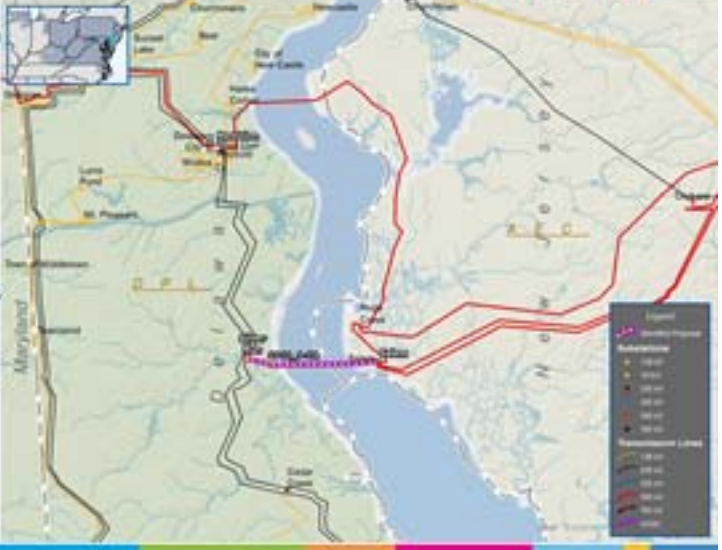


PJM T&E - Artificial Island 06/16/2014
19
PJM2014



- Expansion of the Salem substation to the south to include a new 500/230kV auto-transformer
- Submarine or aerial line over the Delaware
- New substation in Delaware that taps the existing Red Lion to Cartanza 230 kV and Red Lion to Cedar Creek 230 kV lines
- Proposed Cost Estimate: \$116 - \$148MM

## LS Power 5A




PJM T&E - Artificial Island 06/16/2014
20
PJM2014

**pjm**

### LS Power 5B

- Expansion of Salem substation
- 17 mile 500kV line from Red Lion to Salem
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Expansion of Red Lion substation ring-bus
- Proposed Cost Estimate: \$170MM




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**pjm**

### Atlantic Wind 6A

- Install a HVDC converter station near the Artificial Island
  - Install a SVC at the new Artificial Island HVDC station
- Install a HVDC converter station near the existing Cardiff 230 kV
- Install a 320kV HVDC line from the new Artificial Island HVDC station and the new HVDC station near Cardiff 230kV
- Proposed Cost Estimate : \$1,012MM



PJM T&C - Artificial Island 06/16/2014 22 PJM2014



**pjm**

### PSE&G 7A

- Second Salem to Hope Creek tie line
- Install a new Hope Creek to Peach Bottom 500 kV line on existing right of way
- Proposed Cost Estimate: \$1,371MM


PJM T&E - Artificial Island 06/16/2014 23 PJM2014

**pjm**

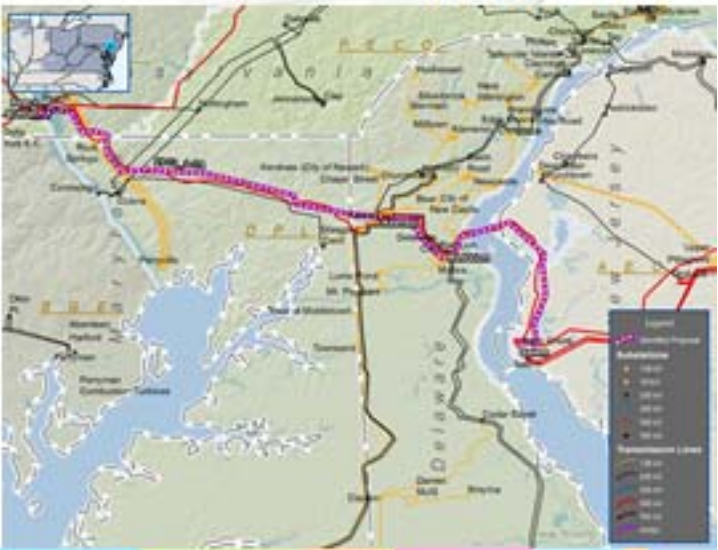
### PSE&G 7B

- Second Salem to Hope Creek tie line
- Install a new Hope Creek to Keeney to Peach Bottom 500 kV line on existing right of way
- Tie 5036 and 5025 lines together to open a bay position at Keeney substation
- Proposed Cost Estimate: \$1,372MM


PJM T&E - Artificial Island 06/16/2014 24 PJM2014

 **PSE&G 7C**

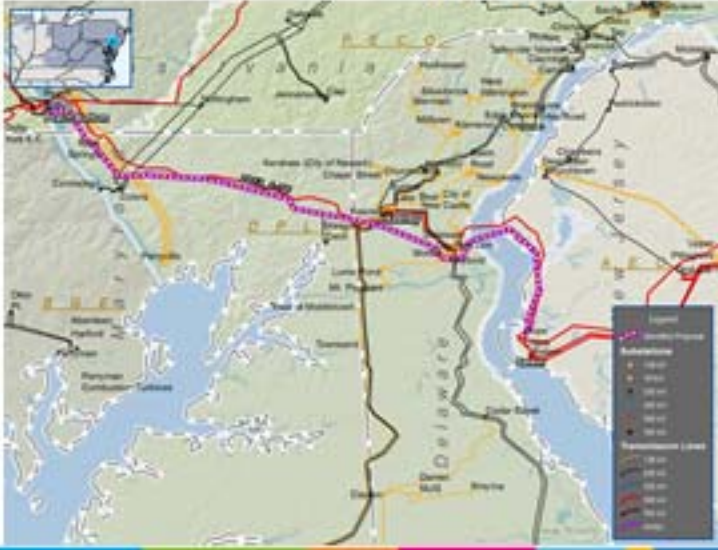
- Second Salem to Hope Creek tie line
- Install a new Hope Creek to Red Lion to Peach Bottom 500 kV line on existing right of way
- Tie 5036 and 5015 lines together to open a bay position at Red Lion substation
- Proposed Cost Estimate: \$1,372MM



PJM T&C - Artificial Island 06/16/2014 25 PJM2014


 **PSE&G 7D**

- Second Salem to Hope Creek tie line
- Install a new Hope Creek to Peach Bottom 500 kV line on new right of way
- Proposed Cost Estimate: \$831MM




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 PSE&G 7E


- Second Salem to Hope Creek tie line
- Install a new 500kV line Deans to New Freedom
- Proposed Cost Estimate: \$692MM



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 PSE&G 7F

- Second Salem to Hope Creek tie line
- Install a new Smithburg to New Freedom 500kV line
- Proposed Cost Estimate: \$879MM




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**pjm**

### PSE&G 7G

- Second Salem to Hope Creek tie line
- Install a new Smithburg to Larrabee to New Freedom 500kV line
- Expand Larrabee substation to accept the new 500kV connection
- Proposed Cost Estimate: \$1,034MM




PJM T&E - Artificial Island 06/16/2014 28 PJM2014

**pjm**

### PSE&G 7H

- Second Salem to Hope Creek tie line
- Install a new Whitpain to New Freedom 500kV line using a northern route
- Proposed Cost Estimate: \$1,177MM




PJM T&E - Artificial Island 06/16/2014 30 PJM2014




 **PSE&G 7I**


- Second Salem to Hope Creek tie line
- Install a new Whippain to New Freedom 500kV line using a southern route
- Proposed Cost Estimate: \$1,353MM



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 **PSE&G 7J**

- Second Salem to Hope Creek tie line
- New substation at the 5017 junction site cutting the 5017 Elroy to Branchburg line
- Install a new 5017 Junction to New Freedom 500kV line
- Proposed Cost Estimate: \$915MM



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**pjm**

**PSE&G 7K**

- Second Salem to Hope Creek tie line
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Install a new Deans to New Freedom 500kV line
- Proposed Cost Estimate: \$1,066MM




PJM T&C - Artificial Island 06/16/2014 33 PJM2014

**pjm**


**PSE&G 7L**

- Second Salem to Hope Creek tie line
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Install a new Smithburg to New Freedom 500kV line
- Proposed Cost Estimate: \$1,250MM




PJM T&C - Artificial Island 06/16/2014 34 PJM2014






- Second Salem to Hope Creek tie line
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Install a new Whitpain to New Freedom 500kV line using a northern route
- Proposed Cost Estimate: \$1,548MM

## PSE&G 7M




PJM T&C - Artificial Island 06/16/2014
36
PJM2014



- Second Salem to Hope Creek tie line
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- New substation at the 5017 junction site cutting the 5017 Elroy to Branchburg line
- Install a new 5017 Junction to New Freedom 500kV line
- Proposed Cost Estimate: \$1,289MM

## PSE&G 7N



PJM T&C - Artificial Island 06/16/2014
38
PJM2014

## Appendix B – RTEP Baseline Upgrade Cost Allocation

### Single Zone Allocations

Upgrade ID	Description	Cost Estimate (\$M)	Cost Allocation
b2476	Install new Dennis 230/69 kV transformer	\$15.29	AEC - 100%
b2477	Upgrade 138 kV and 69 kV breakers at Corson substation	\$0.80	AEC - 100%
b2478	Reconductor 2.74 miles of Sherman - Lincoln 138 kV line and associated substation upgrades	\$4.33	AEC - 100%
b2480.1	New Upper Pittsgrove - Lewis 138 kV line and associated substation upgrades	\$7.80	AEC - 100%
b2480.2	Relocate Monroe to Deepwater Tap 138 kV to Landis 138 kV and associated substation upgrades	\$0.57	AEC - 100%
b2480.3	New Landis - Lewis 138 kV line and associated substation upgrades	\$31.03	AEC - 100%
b2481	New Cardiff - Lewis #2 138 kV line and associated substation upgrades	\$11.54	AEC - 100%
b2489	Install a 100 MVAR capacitor at BL England	\$4.00	AEC - 100%

### Multiple Zone Allocations

Upgrade ID	Description	Cost Estimate (\$M)	Cost Allocation
b2479	New Orchard - Cardiff 230 kV line (remove, rebuild and reconfigure existing 138 kV line) and associated substation upgrades	\$69.81	AEC - 68.57%, JCPL - 31.43%



ATTACHMENT 5

Bennett Report

August 18, 2014

Mr. Richard Bethke, PE.  
Senior Engineer  
South Jersey Gas Company  
1 South Jersey Plaza, Route 54  
Folsom, NJ 08037

Subject: Expert Report: Technical feasibility and risk evaluation for HDD bore proposed by Pinelands Preservation Alliance (PPA) and alternative HDD alignments beneath Greater Egg Harbor Bay (GEHB)

Mr. Fontaine:

As requested, I have evaluated the technical feasibility and risks associated with a proposed long horizontal directional drilled (HDD) bore beneath Greater Egg Harbor Bay (GEHB) for installation of a 24-inch diameter steel gas pipeline for South Jersey Gas. The GEHB HDD bore was proposed by the Pinelands Preservation Alliance (PPA) as part of an alternative to the alignment recommended by South Jersey Gas's (SJC) design consultant, Woodard and Curran. The GEHB HDD bore proposed by PPA would be approximately 8,700 feet long, and would need to be approximately 36-inches in diameter to allow installation of a 24-inch diameter steel gas pipeline. Two other alternative GEHB HDD bore alignments were evaluated. In addition, I evaluated the relative risks and technical feasibility of the two longest proposed HDD bores along Alternative A Route.

I have relied on my extensive experience in geotechnical engineering, design and construction observations for long, large diameter HDD bores, my expertise in evaluating risks of inadvertent drilling fluid returns, sometimes referred to as hydrofractures, my expertise evaluating pipe stresses and pullback loads, and my extensive experience and knowledge of HDD design and construction good practices. I have reviewed documents provided to me, including available geotechnical data, aerial photographs, drawings, and engineering reports associated with the proposed gas pipeline. Figures referenced in the report are included at the end of the report. A list of documents I reviewed and/or relied upon is included in Appendix A.

My expert opinions are summarized below, followed by discussion of evidence supporting my opinions.

1. ***The anticipated ground conditions for the PPA proposed GEHB HDD crossing are extremely unfavorable.*** The ground conditions anticipated for the GEHB HDD crossing proposed by PPA, based on my review of available geotechnical boring logs and geotechnical reports, are extremely unfavorable, and likely insurmountable. I reviewed logs of 104 borings that were

drilled for 3 investigations in the near vicinity of the proposed HDD GEHB crossing. These borings were drilled over a period of 42 years by different geotechnical engineers. Almost without exception, the logs indicated extensive depths of highly unfavorable, low blow count, very soft to soft organic silt and clay. The logs of three borings drilled on land for the 1973 B. L. England Generating Station foundation investigation revealed extremely weak, soft soils (Harroun, 1973). Of 50 borings drilled for the 1970 Garden State Parkway (GSP) investigation, logs of 41 borings indicated intervals of low blow count, i.e. very soft to soft weak soils (Knoerle, Bender, Stone, and Associates, 1970). Fifty-one borings were drilled in 2011 for the New Jersey Turnpike Authority (NJTPA) GSP bridge replacement project investigation (Michael Baker, 2011). Every one of the 51 boring logs indicated very low blow count very soft to soft and weak soils, with some boring logs noting these unfavorable soils over extensive depth intervals. The logs and depth intervals where very soft to soft soils were noted on the 2011 boring logs are tabulated in Appendix B.

The available geotechnical information I reviewed indicates that very soft to soft organic silt and clay with low blow counts (weight of hammer or weight of rod were noted in many instances) were encountered in the vast majority (91%) of borings in the vicinity of the PPA proposed GEHB HDD bore, including numerous notations of these low blow count, weak, compressible materials at extensive depths. These extremely unfavorable soils would be anticipated along much or all of the proposed HDD bore alignment. Very soft to soft organic clay and silt deposits are unstable, will collapse around the HDD bore, will result in inadvertent drilling fluid returns, and will make it impossible to maintain circulation. These ground conditions will result in very poor steering response, inability to maintain design alignment and grade, and will make it impossible to install the pipe. Risks of adverse consequences to sensitive environmental features will be extremely high, as a result of the Contractor's inability to maintain circulation and avoid inadvertent drilling fluid returns.

2. ***Work areas and pipe layout areas are inadequate for PPA proposed GEHB HDD crossing.***

The pipe layout area for the PPA proposed HDD bore crossing of GEHB is inadequate for fabrication and staging of the pipeline in one continuous string for pullback. The 24-inch steel pipe cannot be bent around sharp curves. My review of the available drawings indicates that only approximately 2,500 feet of layout area is available near the south end of the PPA proposed GEHB crossing. The pipe fabrication and layout area would require use of an abandoned roadway that extends from North Shore Road near the intersection of Clay Avenue, southeast to Garden State Parkway. In order to take advantage of this area, the pipe would have to be deflected approximately 30°. Even if the pipe could be deflected by 30° within the layout area, the layout area is still inadequate to allow fabrication of a single continuous pipe string, and instead would have to be fabricated in at least four pipe segments. Very little work area exists at the northern end of the bore and would likely require clearing a significant amount of trees to accommodate the drilling equipment.

Fabrication and pullback of the pipeline in a continuous string reduces the risks of getting the pipeline stuck and being unable to complete the installation. When the pipeline must be staged in multiple shorter strings to accommodate the available layout area, long delays are incurred at each stopping point, to position, weld, inspect the weld, coat the welded joint,

inspect and test the coating, and resume pulling. Pullback forces increase after each stop, bore instability increases with time, and the bore would collapse. The very high pulling forces could exceed the rig pullback capacity.

3. ***The HDD intercept method and conductor casings would be required to attempt the PPA GEHB HDD Crossing.*** The work areas available to execute the PPA proposed GEHB HDD bore are highly constrained and inadequate. Very long HDD bores must be drilled using the intersect method, with a large HDD drill rig and separation plant (mud pump, mechanical shakers, and hydrocyclones) and other equipment at each end of the bore. Approximately  $\frac{3}{4}$  acre is required at each end for the equipment. Traffic and access to private property must be maintained. The intersect method can reduce risk of inadvertent drilling fluid returns, especially if conductor casing is installed at each end of the bore. The conductor casings and the use of two HDD rigs would help maintain circulation, reduce risk of settlement damage to existing utilities above the HDD bore, reduce the length of the drilling fluid flow path, and reduce drilling fluid pumping pressures. For the extensive very soft and soft organic soils anticipated along much or all of the PPA proposed GEHB HDD bore path, the conductor casings would have to be very long. Installation of the conductor casings would require use of a percussive hammer, which is very noisy. The fabrication and installation of the conductor casings would be disruptive to nearby residents and businesses. Conductor casing, if left in place, could pose high risks of corrosion to the gas pipeline. Removal of the conductor casings would introduce high risks of settlement damage to surface roads, utilities, and other features. The use of the intersect method and conductor casing would reduce risks for the GEHB HDD crossing, but would not render it feasible.
4. ***The PPA Proposed GEHB Crossing is Fatally Flawed and Beyond the State of the Industry.*** The PPA proposed HDD bore crossing of GEHB would be approximately 8,700 feet long, and would need to be approximately 36-inches in diameter to allow installation of 24-inch steel pipe. HDD bores up to 10,000 feet have been completed by highly skilled and experienced contractors in stable ground conditions, i.e. ground conditions which provide bore stability, allow circulation of drilling fluids to be maintained, reduce risks of inadvertent drilling fluid returns, and allow the product pipe to be pulled back without bore collapse. Favorable (stable) ground conditions include stiff to hard clay and cohesive silt, dense to very dense sand to clayey sand, and soft to medium strength competent rock. The soil conditions for the GEHB HDD crossing are anticipated to be very unfavorable, and therefore a long, large diameter HDD crossing is ill-advised. However, even if the ground conditions were favorable, an HDD bore of the required diameter and length needed to cross GEHB would be extremely challenging, even when attempted by highly skilled and experienced Contractors in favorable ground conditions.
5. ***The alternative alignments investigated for GEHB HDD crossing are also fatally flawed.*** In addition to the construction risks identified and discussed above, permitting risks must be identified and addressed. The proposed GEHB HDD crossing alignment is parallel and encroaches on the NJTPA GSP Right of Way (ROW). A permit would be required to construct the gas pipeline within the NJTPA GSP ROW. NJTPA's letter of July 14, 2014 indicates that there are no circumstances or exceptions under which such a permit for parallel occupancy

of the gas pipeline would be approved (NJTPA, 2014). Consequently, any GEHB crossing would have to be outside the GSP ROW.

I investigated two alternative alignments for an HDD crossing of GEHB outside the NJTPA GSP ROW. Specifically, I reviewed alternative GEHB alignments identified and described by Woodard and Curran, illustrated in Figure 1. Figure 1 shows alternative gas pipeline routes for portions of Alternatives A, B, and G, including three alternative GEHB crossing alignments, and the two longest HDD bores proposed along the Alternative A route. The PPA proposed alignment shown in purple on Figure 1 has been discussed previously. The other two alignments are shown in yellow and black. The yellow alignment represents an approximately 7,000-foot long HDD bore with a horizontal curve that makes a bend of approximately 68°, along Alternative Route B. The black alignment represents an approximately 12,700' long HDD bore with a horizontal curve that also makes a bend of approximately 68°.

The two alternative GEHB HDD bores are near the PPA proposed GEHB HDD bore alignment. Therefore, ground conditions along the yellow and black alternative GEHB crossing alignments would be expected to be very similar to the ground conditions anticipated and described previously for the PPA proposed crossing of GEHB, i.e. predominantly low blow count, weak, very soft to soft organic soils. No 36-inch diameter by 12,700' long HDD bore alignment with a 68° horizontal curve through weak, very soft to soft organic soils has ever been successfully completed. In fact, no 12,000-foot long HDD bore has ever been completed in *any* ground conditions. The extreme length, diameter, and severe horizontal curved geometry represent extremely risky uncharted territory, far outside the state of practice in the industry, and should not be attempted.

The 7,000-foot long bore has precedent within the HDD state of practice for length, but the 36-inch diameter, severe 68° horizontal curve, and weak, very soft to soft soils present extremely high risks that should be avoided. Neither of these alternative GEHB HDD bores has sufficient pipe layout area to accommodate the full pipe string length, necessitating one or more stops during pullback to position, weld, inspect the weld, and resume pullback. The interruptions significantly increase the risks of the pipe becoming stuck.

The severe horizontal curves in both alignments would substantially increase pipe pullback loads and bending stresses. Such severe horizontal curves cannot be achieved in very soft to soft organic soils, and very loose to loose sands because of the poor steering response. The end result of attempting either of these alignments would be certain failure and expensive Contractor claims for defective design. My evaluation led me to conclude that while possible to select an HDD bore alignment outside the GSP ROW, each of the risk factors identified previously related to extreme length, diameter, disruption to residents, inadequate pipe layout, highly constrained work areas, highly unfavorable soil conditions, and high risk of inadvertent drilling fluid returns would remain. In fact, any attempt to complete the 12,700 foot long alternative GEHB HDD bore would be certain to fail.

The cumulative effects of the identified risks for the Pinelands proposed HDD bore

alignment, and the two alternative GEHB HDD alignments evaluated renders any proposed GEHB HDD crossing not feasible. Any GEHB HDD crossing would violate good design practice in numerous ways and present extreme risks.

6. ***Alternative A alignments for Cedar Swamp Creek and Atlantic City Electric HDD bores are technically feasible and avoid or mitigate fatal flaws.*** Good HDD design practice dictates that risks be identified and avoided if possible. Risks that cannot be avoided must be mitigated, but risk avoidance always trumps mitigation. The PPA proposed GEHB HDD crossing and alternative GEHB crossings present very high risks that should be avoided. The identified risks can be avoided by selecting a route/alignment which reduces bore lengths, places the bore in more favorable anticipated ground conditions, provides adequate work area and pipe layout area, reduces risk of adverse environmental consequences, and reduces disruption to residents and businesses.

The South Jersey Gas design team has achieved substantial risk avoidance and reduction in its recommended route which avoids the excessively long and risky GEHB HDD crossing. I evaluated the two longest HDD bores along the recommended Alternative Route A. Specifically, I evaluated the Cedar Swamp Creek (CSC) bore and the Atlantic City Electric (ACE) bore. These bores are shown on Figure 1. The CSC HDD bore would be approximately 4,500 feet long. The ACE HDD bore would be approximately 5,330 feet long.

*Cedar Swamp Creek Crossing.* The CSC bore lies beneath Tuckahoe Road and would be approximately 70 feet deep along much of the bore alignment. This bore has a horizontal curve with a radius of approximately 2,600 feet and a deflection of approximately 20° along a portion of the HDD bore. Boring BS-04 was drilled approximately 1,000 feet from the proposed HDD bore exit point. The boring log is depicted in Figure 2 on the HDD bore profile. The log of BS-04 indicates very loose sand for the upper 15 feet of the bore, underlain by firm silt for the next 15 feet. Loose sands and loose silty sands were encountered for the next 25 feet, underlain by dense to very dense sand and silty sand to the bottom of the boring at approximately 94.5 foot depth. The HDD bore would be within the lower dense to very dense sands at this location. Boring BS-11 was drilled approximately 280 feet west of the CSC HDD bore entry along the alignment. Soils encountered in BS-11 at and near pipe elevation were very dense silty sand, with a thin lens or layer of very loose sand approximately 10 feet above the pipe, overlain by approximately 60 feet of medium dense to dense sand. Seven borings were drilled in 1964 for the reconstruction of Tuckahoe Road. These borings lie primarily within the horizontal curve portion of the proposed HDD bore. The logs of these 7 borings indicate that the soils at and near the HDD bore elevations are stiff to hard silt and medium dense to dense sand. Very loose to loose sands were encountered in the upper 14 to 20 feet below ground surface. These very loose to loose sands would be expected within the relatively short, straight tangent sections of the HDD bore near entry and exit, where neither vertical nor horizontal steering is required. My review of the available boring logs indicates that the majority of the proposed CSC HDD bore would be expected to be within the stiff to hard silt and dense to very dense sand, with excellent steering response. The stiff to hard silt and dense to very dense sand would provide excellent protection against inadvertent drilling fluid returns.



Layout area for the CSC HDD bore would be constrained, but the pipe could be accommodated in two strings. The proposed 4,500-foot long by 36-inch diameter HDD bore, while challenging, would have a high probability of success. The length and diameter are within the state of practice, successful precedent exists, and the soils encountered at and near HDD bore depth are predominantly stiff to hard silt and dense to very dense sand and silty sand, which are stable and represent favorable ground conditions for HDD construction. The proposed geometry, including the relatively gentle 20° horizontal bend presents low to moderate risks with successful precedent. The proposed 4,500-foot long CSC HDD bore presents far lower risks than any of the alternative GEHB HDD bores evaluated.

*Atlantic City Electric Crossing.* The proposed ACE HDD bore along Alternative Route A would be approximately 5,330 feet long by 36-inch diameter. The bore, as depicted, would include two horizontal curves, each with approximately 30° deflection. Adequate pipe layout area exists for at least 4,500 feet of the pipe string, and possibly for the entire 5,330-foot pipe string. The bore would be approximately 60 feet deep for the majority of its length. Boring BS-07 was drilled along the HDD bore alignment approximately 700 feet east of the HDD exit point, and is shown in Figure 3. Boring BS-08 was drilled approximately 1,150 feet west of the HDD entry and BS-09 was drilled within 200 feet of the entry. The soils encountered in BS-07 at and near the proposed HDD bore elevation were medium dense to dense sand, overlain by soft silt from approximately 5 feet above the bore to approximately 30 feet above the bore, with approximately 17 feet of firm silt above the soft silt. The upper 13 feet of surficial soils were soft silt and very loose sand. The medium dense to dense sand encountered at and near the proposed pipe elevation represent favorable soils for HDD construction, although the overlying soft silt presents risks for inadvertent drilling fluid returns. Since these soils would be expected near HDD entry and exit at shallow depth on land, these risks could be mitigated by mobilizing equipment to clean up any drilling fluid returns. The soils encountered in BS-08 at and near the proposed HDD bore elevation were medium dense to very dense sands, overlain by a thin layer of firm silt, and approximately 25 feet of medium dense to dense sand. Surficial soils to approximately 22 feet depth were very loose sands. The relatively thick medium dense to dense sands and firm silt represent favorable ground conditions from HDD bore elevation to approximately 40 feet above the bore. These soils would provide good protection against inadvertent drilling fluid returns and would provide reasonable stability against bore collapse and loss of circulation.

The soils encountered in BS-09 at and near HDD bore elevation were medium dense to dense sand and firm silt, overlain by approximately 10 feet of very soft silt and very loose sand, and approximately 10 feet of stiff silt. Surficial soils to approximately 30 feet depth were interbedded soft to firm silt. These three borings indicate favorable ground conditions at and near HDD bore elevation, overlain by relatively thin layers or lenses of soft or loose soils. The indicated soil conditions are generally favorable for HDD construction and far superior to the ground conditions indicated by borings within GEHB. The proposed ACE HDD bore presents far lower risks than any of the GEHB bores evaluated, due to its shorter length, much longer pipe layout areas, and much more favorable anticipated ground

conditions.

7. ***The two longest Alternative A HDD alignments present far lower risks than the GEHB bores.*** The two long HDD bores proposed by the South Jersey Gas design team along the Alternative A alignment present far lower risks than any of the potential GEHB HDD bores identified and evaluated. The Cedar Swamp Creek and ACE HDD bore lengths are well within the HDD industry state of practice. The lengths of all of the potential GEHB HDD bores are near the edge or beyond the state of practice in the industry. The soils encountered in borings drilled in the vicinity of the CSC and ACE HDD bores are generally favorable for HDD construction. The soils encountered in borings in the vicinity of the potential GEHB HDD crossings are extremely unfavorable for HDD construction. The GEHB crossings present very high risks of inadvertent drilling fluid returns, and present very high risks of bore collapse and loss of circulation. Steering response would be extremely poor for the potential GEHB crossings. The inadequate pipe layout area for the GEHB crossings, coupled with the extreme bore lengths and adverse soils conditions, present extremely high risk of failure to complete the bore. Adverse environmental consequences are far more likely for the potential GEHB bores, because of the long aqueous crossing. It would be impossible to mobilize and clean up the numerous inadvertent drilling fluid returns which would occur along the bottom of the GEHB. In summary, the potential GEHB HDD crossings are technically unsound, without successful precedent, fatally flawed, and should be avoided. The Alternative A alignment long HDD bores are within the state of practice of the HDD industry, have numerous successful precedents, are technically sound, and are far superior to the GEHB crossing alternatives.

I have reached my expert opinions with a high degree of scientific certainty, based on my review of available documents and my extensive experience and expertise in HDD design and construction oversight. I reserve the right to supplement or revise my opinions should additional evidence or facts become available which would warrant reconsideration.

Sincerely,

A handwritten signature in black ink that reads "David Bennett". The signature is written in a cursive, flowing style.

David Bennett PhD, PE (CA)

Figure 1. Depiction of portions of alternative routes A, B, and G, three alternative GEHB HDD crossings, and two longest HDD bores proposed along alternative A route.

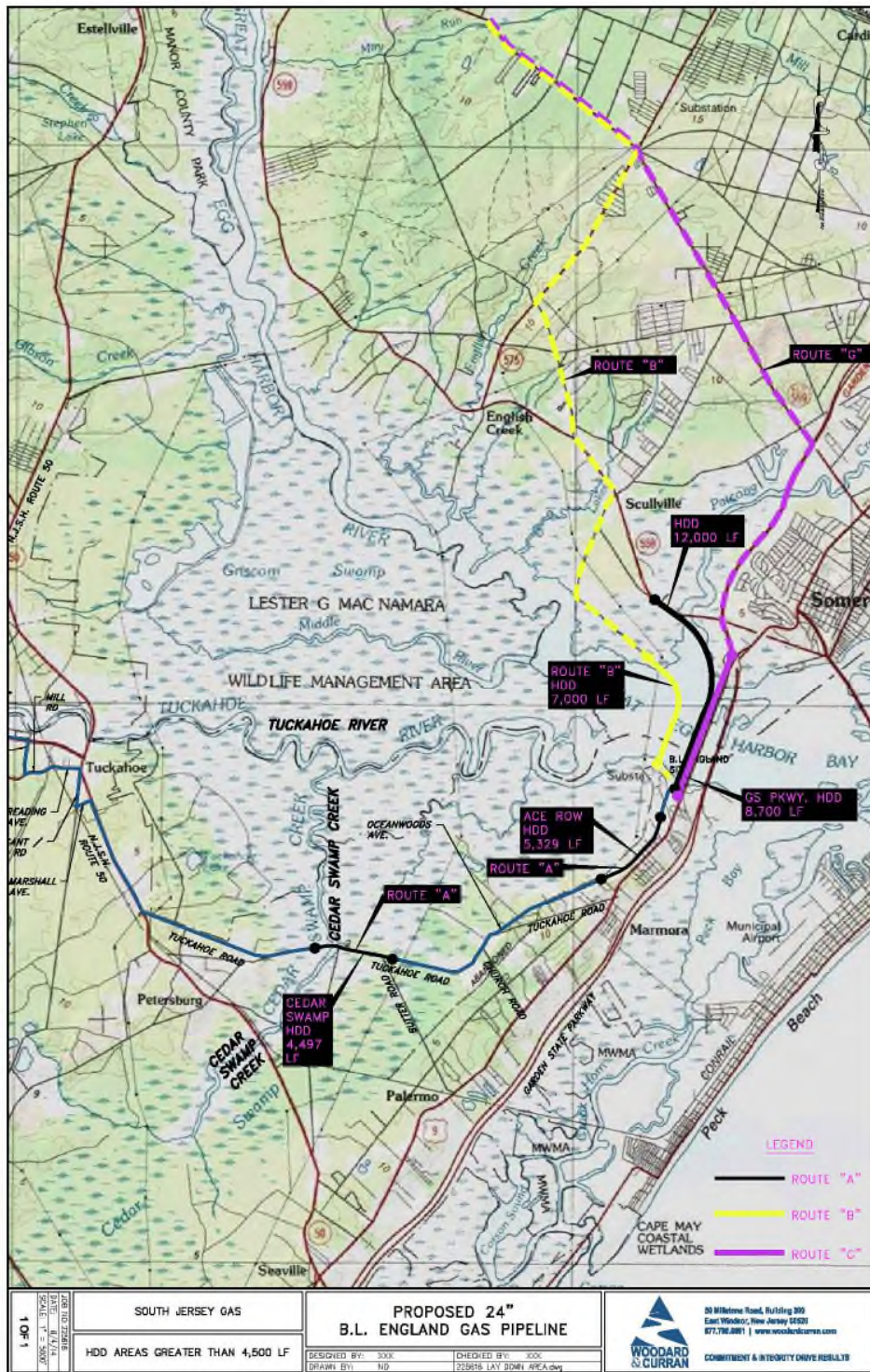


Figure 2. Profile of proposed Cedar Swamp Creek HDD crossing and BS-04 boring log.

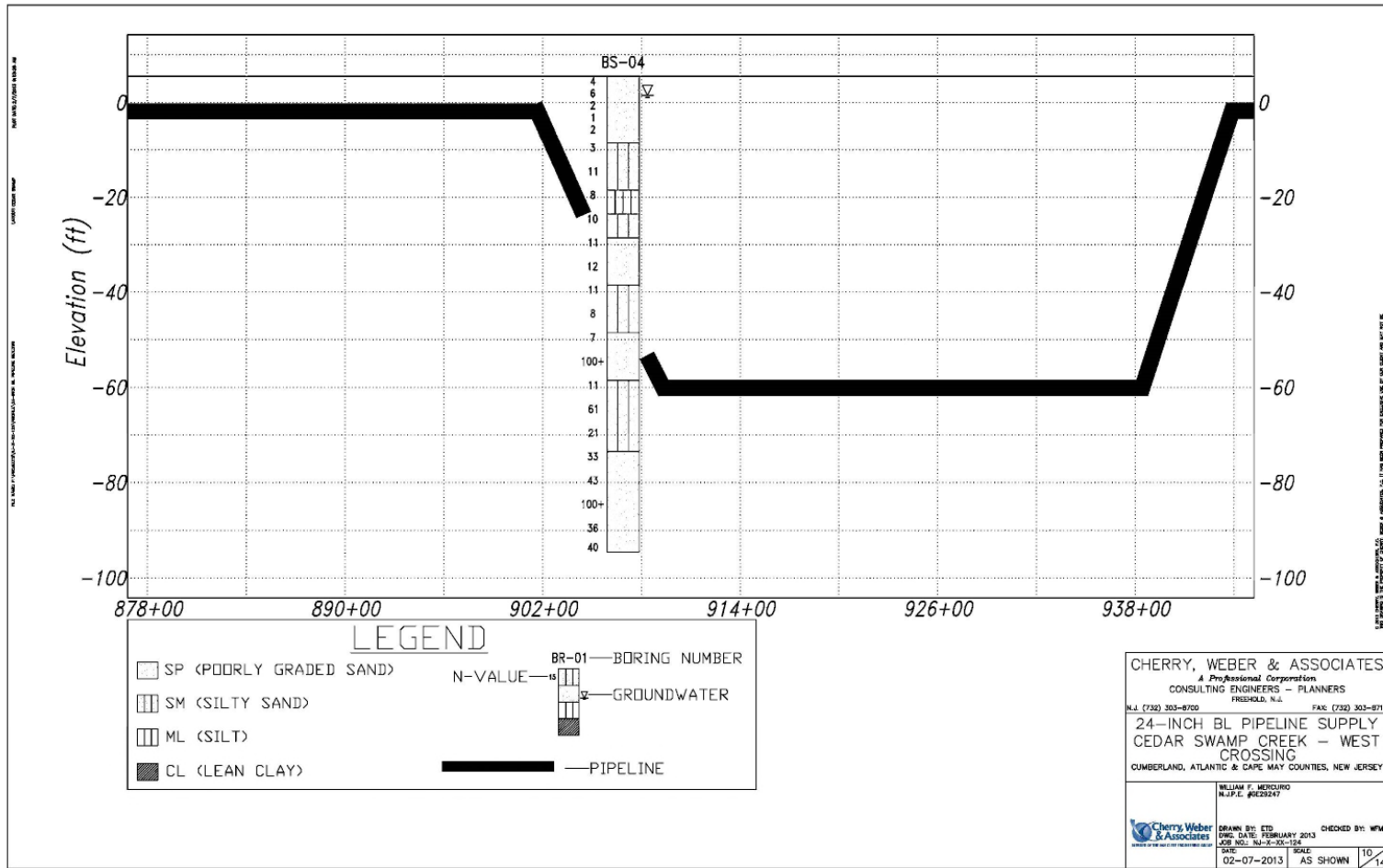
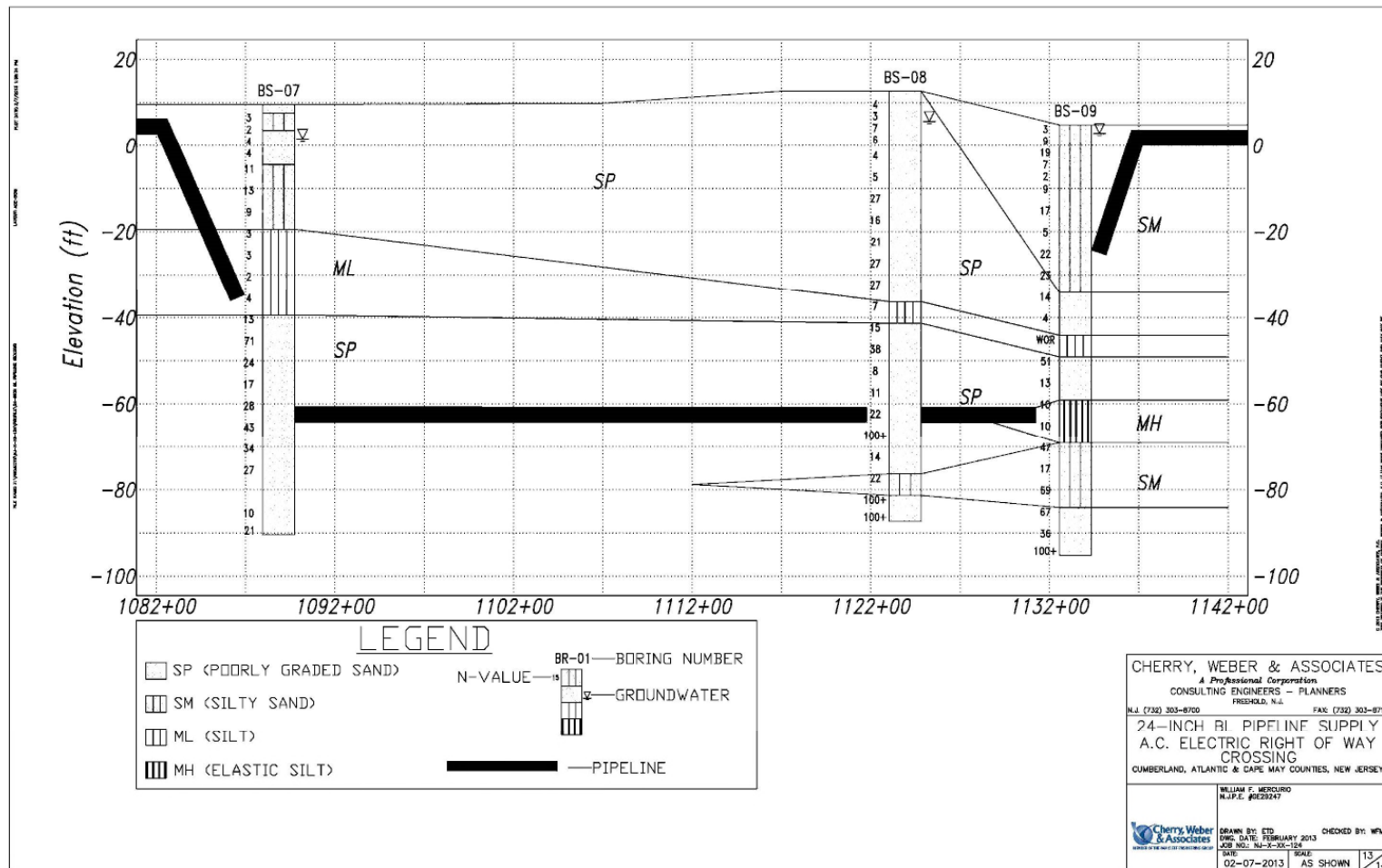


Figure 3. Profile of Atlantic City Electric proposed HDD crossing and BS-07, BS-08, and BS-09 boring logs.





## **Appendix A: List of Documents Reviewed and Relied Upon**

Bennett, David, and Ariaratnam, Samuel, 2008. "HDD Good Practices Guidelines", HDD Consortium, 3<sup>rd</sup> edition, copyright, North American Society for Trenchless Technology

Bennett, David, and Wallin, Kathryn, 2008. "Step-by-Step Method for Evaluation of Hydrofracture Risks on HDD Projects". Proceedings, No-Dig 2008, Dallas, TX

Cherry, Weber & Associates, 2013. "Geotechnical Engineering Report: 24-inch BL England Pipeline Supply Project", July 10, 2013.

Harroun Incorporated, 1973. "Engineering Soil and Foundation Analysis, BL England Generating Station, Unit No. 3 Natural Draft Cooling Tower ", prepared for United Engineers and Constructors, April, 1973.

Hyland Design Group, 2012. Drawing Sheet 1 of 1, BL England Generating Station Wetlands Conservation Area, August 21, 2012.

Hyland Design Group, 2008. Drawing Sheet 1 of 2 1, BL England Generating Station Plan of Freshwater Wetlands/Water Delineation, April 8, 2008.

Knoerle, Bender, Stone & Associates, 1970. " New Jersey Turnpike Authority, Garden State Parkway, Contract 77-526 Grading, Drainage, Paving, and Structures, Greater Egg Harbor Crossing Improvement", profiles of boring logs and boring location plan, August, 1970.

Michael Baker, 2011. Boring logs from 2011 New Jersey Turnpike Authority Garden State Parkway Bridge Replacement Project Geotechnical Investigation.

New Jersey Turnpike Authority, 2014. Letter with attachments to Mr. Steven Ewing, VP, Woodard and Curran: Subject-Proposed Gas Line Installation for BL England Power Plant, July 14, 2014.

Pinelands Preservation Alliance Staff, undated. "Review of Alternatives", printout of PowerPoint presentation, 20 pages.

Sprague and Henwood, 1964. "Profile of Boring Logs, Reconstruction of Tuckahoe Road Crossing at Cedar Swamp Creek", April 23, 1964

Woodard and Curran, 2013. "Alternatives Analysis Addendum to the June 18, 2012 South Jersey Gas-BL England Gas route Analysis Report", January 10, 2013.

Woodard and Curran, 2012. "South Jersey Gas-BL England Gas Route Analysis Report, June 18, 2012.

Woodard and Curran, 2014. "Proposed 24" BL England Gas Pipeline", Plan view map of Routes A, B, and G.

Woodard and Curran, 2013. "Cedar Swamp Creek – HDD", two drawings depicting plan and profile views of Atlantic City Electric HDD bore.

**Appendix B: Boring Logs and Depth Intervals with Very Soft to Soft Soils**

2011 NJTPA GSP Bridge Replacement Geotechnical Investigation (Michael Baker, 2011)

Boring Number	Very Soft to Soft Soils? (1 = yes)	Elevation of Very Soft Soils (3 blow counts or less)	Elevation of Soft Soils (4 to 7 blow counts)
B-1	1	1.4 to 0.4, -1.6 to -6.1, -22.1 to -26.1, -32.1	0.4 to -1.6, -33.1, -38.1
B-2	1	5.4 to -0.6, -10.6, -21.6 to -29.1	-1.6 to -4.6, -11.6
BL-3	1	3.3 to 0.3, -22.7	-0.7 to -1.7, -4.7 to -5.7, -23.7
BL-4	1	3.4 to -1.6, -3.6, -22.4	-2.6
B-4A	1	0.1, -20.4	-3.9
BL-7	1	-46.0, -50.2, -55.7	0.3, -4.7 to -9.7, -17.7, -30.2, -35.2, -47.0 to -49.2, -51.2, -56.7, -85.7
B-8	1	4.7, 2.7, 0.7, -1.3, -4.2 to -34.7, -41.7 to -51.2, -55.7 to -61.7, -66.7 to -68.7, -75.7, -85.7	3.7, 1.7, -0.3, -36.7
B-9	1	3.2 to 2.2, -5.8 to -35.3, -42.3, -57.8 to -62.8, -67.3 to -72.3, -77.3, -87.3	-1.8, -3.8, -47.3, -52.3
B-10	1	-1 to -36, -55.5	1 to 0, -60.5 to -66.5, -86
B-11	1	0.6 to -0.4, -4.2 to -20.7, -25.7 to -41.7	4.8 to 3.6, -1.4, -21.7
B-12	1	6, 2 to 1, -2 to -18.8, -23.8, -28.8	0 to -1, -33.8, -58.8, -73.8, -84.3
B-13	1	0.6 to -32.5, -40	
BL-16	1	-5 to -9, -31 to -42	7 to 5, -6, -10 to -28, -46.7, -76.7, -81.7
B-17	1	3.4 to 2.4, -4.6, -6.6, -12.6 to -37.1	1.4, -0.6, -5.6, -7.6
B-18	1	0.9, -13.6 to -39.1	-0.1 to -1.1, -5.1, -7.1 to -12.6, -40.1 to -44.1
B-19	1	-3.6 to -10.1, -35.6	0.4, -40.6
BL-20	1	3.4	5.4 to 4.4, 1.4, -7.2, -20.6
BL-20A	1	-36	
BL-21	1	-3.1 to -3.3, -25.2	1.7, -20.2 to -24.2, -34.6, -59.3
BL-22	1	-20, -24.5	1.9, -4, -15, -21, -25.5, -34.5 to -25.5, -49.5
BL-23	1	-35.5	-3.5, -20.5 to -25.5, -64.4
BL-24	1	0.9, -19.6, -35.9, -36.9	-1, -3.1 to -4.1, -20.6, -44.6, -59.6 to -60.6
WB-1	1	-16.1 to -25.1, -61.1	-5.6 to -6.6, -26.1, -51.1, -62.1, -82.2 to -83.2

WB-2	1	-3.3 to -9.6, -12.9 to -19.6, -23.8 to -24.8, -34.1 to -35.1, -83.1, -108.8	-58.5 to -63.6, -109.8
WB-3	1	-4.5 to -30, -35 to -48, -60	-31, -50, -75 to -76
WB-4	1	-5.5 to -51	-56 to -61
WB-5	1	-7.3 to -42.8	-47.8
WB-6	1	7.8 to -46.3, -113.3	-63.7, -114.3
WB-7	1	-11.9 to -41.4, -108.4 to -111.4	-42.4, -52.4 to -53.4, -72, -112.4
WB-8	1	-27.3 to -42.5, -52.5	-43.5, -53.5, -147
WB-9	1	-50.5 to -60, -71, -105, -117, -156, -158	-62, -116, -157
WB-10	1	-10.5 to -41	-62.2, -156.5
WB-11	1	-2 to -51.5, -102 to -105	-57.5 to -62.5
WB-12	1	-2.5 to -52, -58 to -62, -108	-53, -113.5 to -114.5
WB-13	1	-4.7 to -45.7, -56.2 to -60.7	
WB-14	1	-5.6 to -46.1, -118 to -120	-57.1 to -61.9, -76, -115
WB-15	1	-6 to -49.5, -119	-56, -61 to -64.5
WB-16	1	-5.4 to -46.4, -56.6, -70.6 to -71.6	-57.6, -65.9, -120
WB-17	1	-4.1 to -47.6, -69	-54, -59 to -60, -70, -104, -114
WB-18	1	-3.5 to -52, -69 to -70	-99.3, -109.2
WB-19	1	-3.3 to -49.3, -58, -68, -88.8, -94.3, -99.4	-59, -69, -89.8, -95.3, -118
WB-20	1	-2.3 to -49	-67, -77 to -87
WB-21	1	-1.4 to -36, -66, -81 to -83	-37, -72
WB-22	1	-6.1 to -36, -46.4	-37 to -41, -51, -56, -61 to -63, -76 to -79
WB-23	1	-11.3 to -37.7, -81	-38.7, -46, -51, -61
WB-24	1	-16.1 to -40, -81, -86	-41, -46, -82, -87, -96 to -98, -112
WB-25	1	-17.2 to -36.7, -77 to -79, -107	-37.7, -42, -47
WB-26	1	-18.9 to -38.4, -53, -73, -79 to -82, -94	-44, -48, -54 to -58, -74
WB-27	1	-15.1 to -38.6, -75, -80, -103 to -105	-45, -50, -55, -60, -95, -100
WB-28	1	-7.8 to -37	-42, -52, -72, -78 to -82, -94, -99
WB-29	1	0.8 to -37.7, -77 to -83	-51, -56, -76, -96

ATTACHMENT 6

New Jersey Turnpike Letter





# New Jersey Turnpike Authority

ADMINISTRATION BUILDING - 581 MAIN STREET  
P.O. BOX 5042 - WOODBRIDGE, NEW JERSEY 07095  
TELEPHONE (732) 750-5300

CHRIS CHRISTIE  
GOVERNOR

KIM GUADAGNO  
LIEUTENANT GOVERNOR

JAMES S. SIMPSON, *Chairman*  
RONALD GRAVINO, *Vice Chairman*  
MICHAEL R. DuPONT, *Treasurer*  
HAROLD L. HODES, *Commissioner*  
RAYMOND M. POCINO, *Commissioner*  
ULISES E. DIAZ, *Commissioner*  
DANIEL F. BECHT, *Commissioner*  
JAN WALDEN, *Commissioner*  
JOSEPH W. MROZEK, *Executive Director*

July 14, 2014

Mr. Steven R. Ewing  
Vice President  
Woodward & Curran  
50 Millstone Road  
Bldg. 300, Suite 115  
East Windsor, NJ 08520

**RE: Proposed Gas Line Installation for  
BL England Power Plant**

Dear Mr. Ewing:

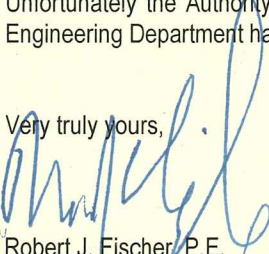
I am in receipt of your July 1, 2014 e-mail wherein feedback is requested regarding the Turnpike Authority's (Authority) position pertaining to the potential installation of a new 24-inch high pressure gas pipeline within the Garden State Parkway right-of-way.

The Authority has a Policy that establishes the requirements for the installation of third party utilities within the Authority's right-of-way. The Policy, which is outlined in Section 7 of the Authority's Procedures Manual (<http://www.state.nj.us/turnpike/documents/PM-Section-7-Utility-Installation-8-6-13.pdf>), states that such utilities "will not be allowed to be oriented parallel or diagonal to the Authority's right of way without the advance approval of the Authority's Engineering Department. To date, the Authority's Engineering Department has not granted any such approvals.

There are several reasons for not allowing parallel occupancy of third party utilities within the Authority's right of way. The most significant reason for this policy is that the Authority must be able to maintain, modify or expand its facilities as needed without being encumbered by third party infrastructure. The applicable types of activities that are commonly performed include roadway improvements, drainage improvements, the construction of new or modified bridge structures, the installation of wells for engineering or environmental purposes, construction staging areas, etc. Any such third party utility encumbrances would significantly complicate efforts associated with these types of activities. Unfortunately exceptions cannot be made to this policy because such exceptions would set a precedent such that the Authority would be in a position to justify specific denials to any such future requests. For that reason all such parallel occupancy is unacceptable to the Engineering Department.

Unfortunately the Authority cannot accommodate your request for parallel occupancy, however this is an issue for which the Engineering Department has no flexibility.

Very truly yours,

  
Robert J. Fischer, P.E.  
Chief Engineer

RJR/SMB/cr

cc: S. Buente  
File