



Reliability Analysis Update

Transmission Expansion Advisory
Committee

June 7, 2018



2018 RTEP Analysis Update

- Window 1
 - Standard 60 day window
 - Targeting opening window mid-June
 - Will include all analysis results excluding N-1-1 voltage
- Window 2
 - Abbreviated 30 day window
 - Targeting opening window in early July
 - Will only include N-1-1 voltage results



Proposal Window Exclusion Definitions

- The following definitions explain the basis for excluding flowgates and/or projects from the competitive planning process and designating projects to the incumbent Transmission Owner.
- Flowgates/projects excluded from competition will include the underlined language on the corresponding slide.
 - Immediate Need Exclusion: Due to the immediate need of the violation (3 years or less), the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity. - Operating Agreement, Schedule 6 § 1.5.8(m)
 - Below 200kV: Due to the lower voltage level of the identified violation(s), the driver(s) for this project are excluded from the competitive proposal window process. As a result, the local Transmission Owner will be the Designated Entity - Operating Agreement, Schedule 6 § 1.5.8(n)
 - FERC 715 (TO Criteria): Due to the violation need of this project resulting solely from FERC 715 TO Reliability Criteria, the driver(s) for this project are excluded from the competitive proposal window process. As a result, the local Transmission Owner will be the Designated Entity - Operating Agreement, Schedule 6 § 1.5.8(o)
 - Substation Equipment: Due to identification of the limiting element(s) as substation equipment, the driver(s) for this project are excluded from the competitive proposal window process. As a result, the local Transmission Owner will be the Designated Entity - Operating Agreement, Schedule 6 § 1.5.8(p)



Baseline RTEP Projects

Second Review



APS Transmission Zone: Baseline Flint Run 500/138 Substation

Problem Statement (Immediate Need):

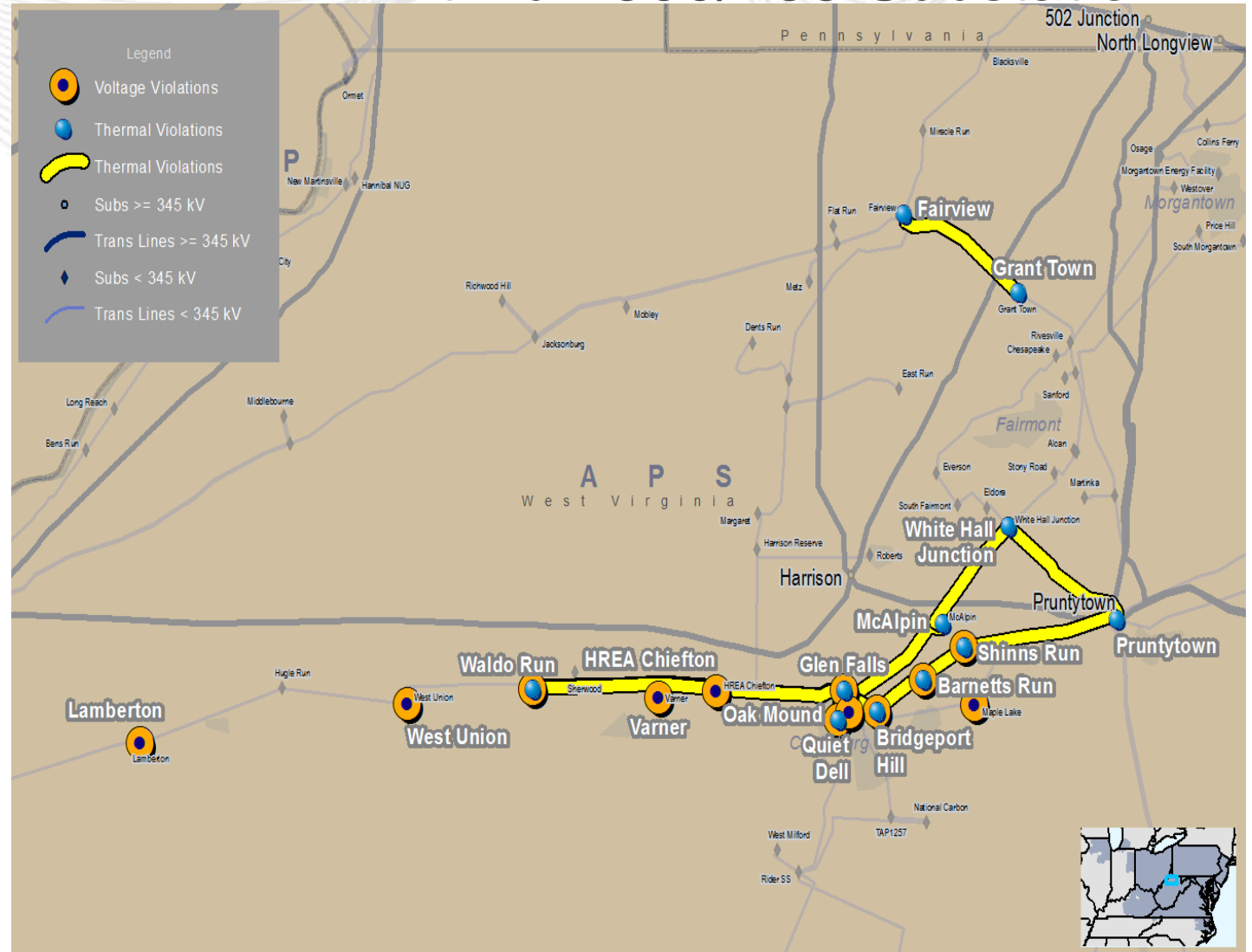
Increased customer load expectations connected to the Waldo Run 138 kV substation are causing the following thermal and low voltage violations.

Thermal Violations identified for the following facilities:

- Glen Falls - McAlpin 138 kV Ckt 1
- McAlpin - White Hall Junction 138 kV Ckt 1
- Pruntytown - White Hall Junction 138 kV Ckt 1
- Glen Falls - Oak Mound 138 kV Ckt 1
- Fairview - Grant Town 138 kV Ckt 1
- Oak Mound - Waldo Run 138 kV Ckt 1
- Oak Mound - Waldo Run 138 kV Ckt 2
- Glen Falls - Bridgeport Hill 138 kV Ckt 1
- Bridgeport Hill- Barnetts Run 138 kV Ckt 1
- Barnetts Run- Shinns Run 138 kV Ckt 1
- Shinns Run- Pruntytown 138 kV Ckt 1

Voltage Violations identified for the following facilities:

- Barnetts Run 138 kV
- Bridgeport Hill 138 kV
- Chiefton 138 kV
- Glen Falls 138 kV
- Lambertson 138 kV
- Maple Lake 138 kV
- Oak Mound 138 kV
- Quiet Dell 138 kV
- Shinns Run 138 kV
- Varner 138 kV
- West Union 138 kV
- Waldo Run 138 kV



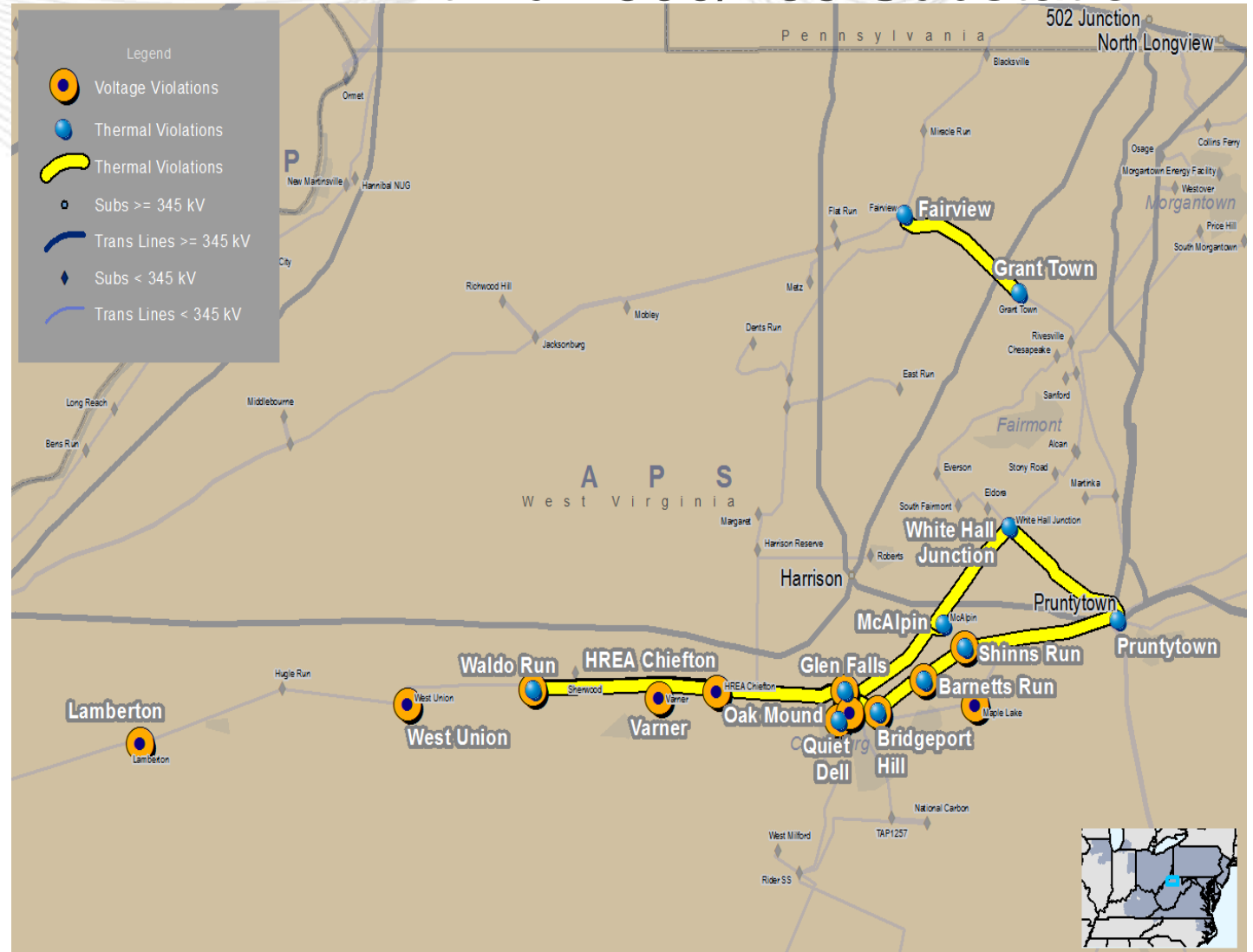


APS Transmission Zone: Baseline Flint Run 500/138 Substation

Alternatives considered:

1. Reconductor/rebuild overloaded 138 kV facilities with VAR support near the load – est. Cost >\$56M
2. Install new Pruntytown-Oak Mound 138 kV line with VAR support near the load – est. cost \$42.5M
3. Construct a new 500-138 kV substation to provide EHV source to the Marcellus shale load growth area – est. cost \$40.1M

By injecting the 500-138 kV source into the area expecting Marcellus shale load growth, we are designing the BES to withstand additional load requests in the area. The alternative solutions apply a temporary resolution at a higher cost to resolve expected load concerns, with no room for growth. The gas industry is greatly expanding in the Doddridge county area of WV, and the recommended solution allows for future support.





APS Transmission Zone: Baseline Flint Run 500/138 Substation

Recommended Solution:

Construct a new 500-138 kV substation as a 4-breaker ring bus with expansion plans for double-breaker-double-bus on the 500 kV bus and breaker-and-a-half on the 138 kV bus to provide EHV source to the Marcellus shale load growth area. Projected load growth of additional 160 MVA to current plan of 280 MVA, for a total load of 440 MVA served from Waldo Run substation.

Replace primary relaying and carrier sets on Belmont and Harrison 500 kV Remote End Substations

Construct additional 3-breaker string at Waldo Run 138 kV bus. Relocate the Sherwood #2 line terminal to the new string.

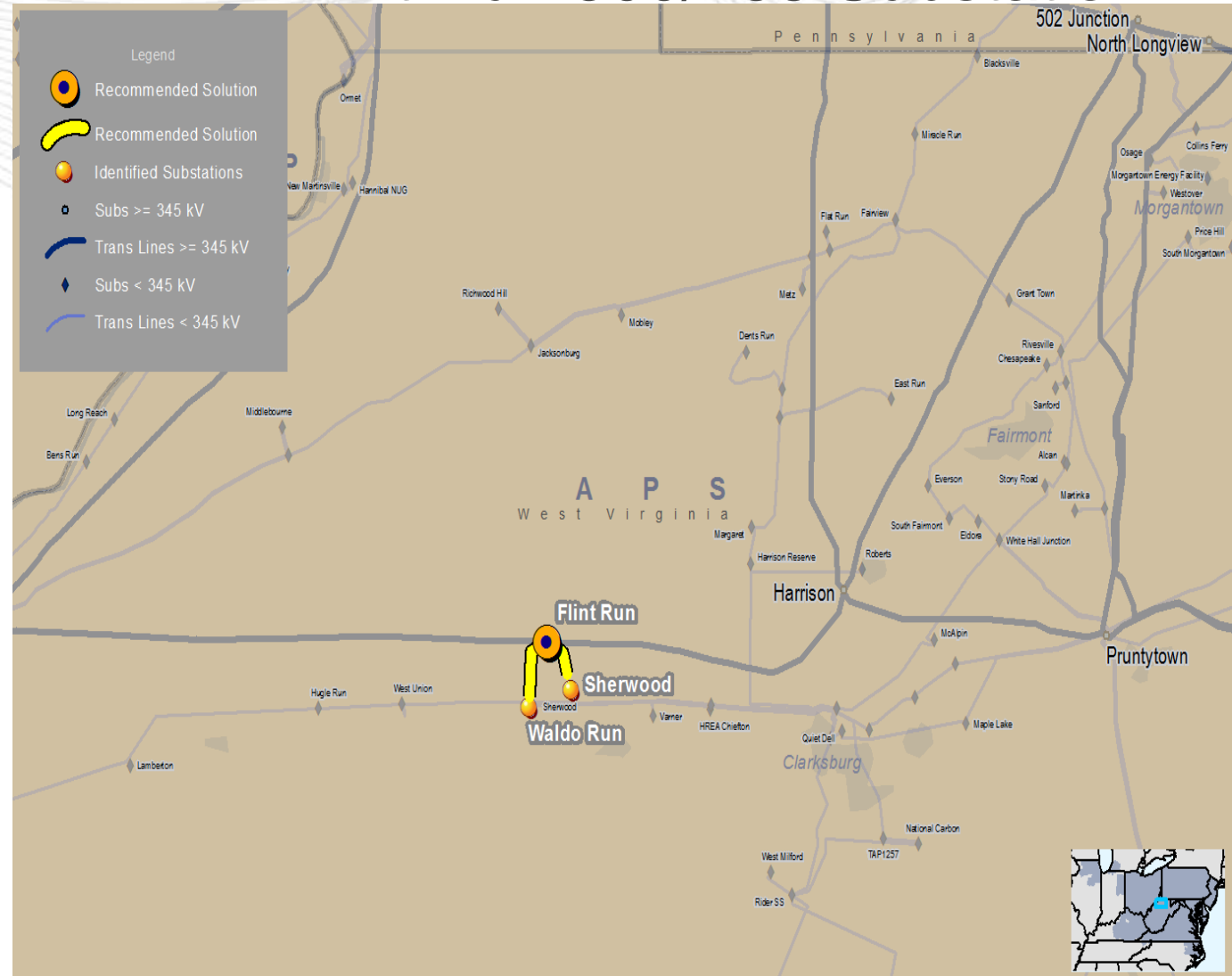
Construct two single circuit Flint Run - Waldo Run 138 kV lines using 795 ACSR (approximately 3 miles). After terminal relocation on new 3-breaker string at Waldo Run, terminate new Flint Run 138 kV lines onto the two open terminals.(b2996)

Estimated Cost: \$40.1M

Required IS Date: 12/31/2019

Projected IS Date: 12/31/2019

Project Status: Scoping



Previously discussed on 12/14/2017, 4/2018 and 5/3/2018 TEAC

Problem Statement (Immediate Need):

- High voltage in Powerton area (Katydid and Mole Creek 345kV buses) in real time: Powerton unit 6 is required to run to control 345kV voltages in Powerton area
- Significant Uplift Charges

Selected Solution:

Install a 120Mvar 345kV shunt inductor at Powerton (the 345kV yard already contains an empty bus position on the ring, so only a switching breaker for the inductor is needed) **(B2998)**

Estimated Cost: \$9M

Alternatives:

#1: Install shunt inductors at TSS 196 Katydid and TSS 908 Mole Creek (\$12M plus land purchase that may be required)

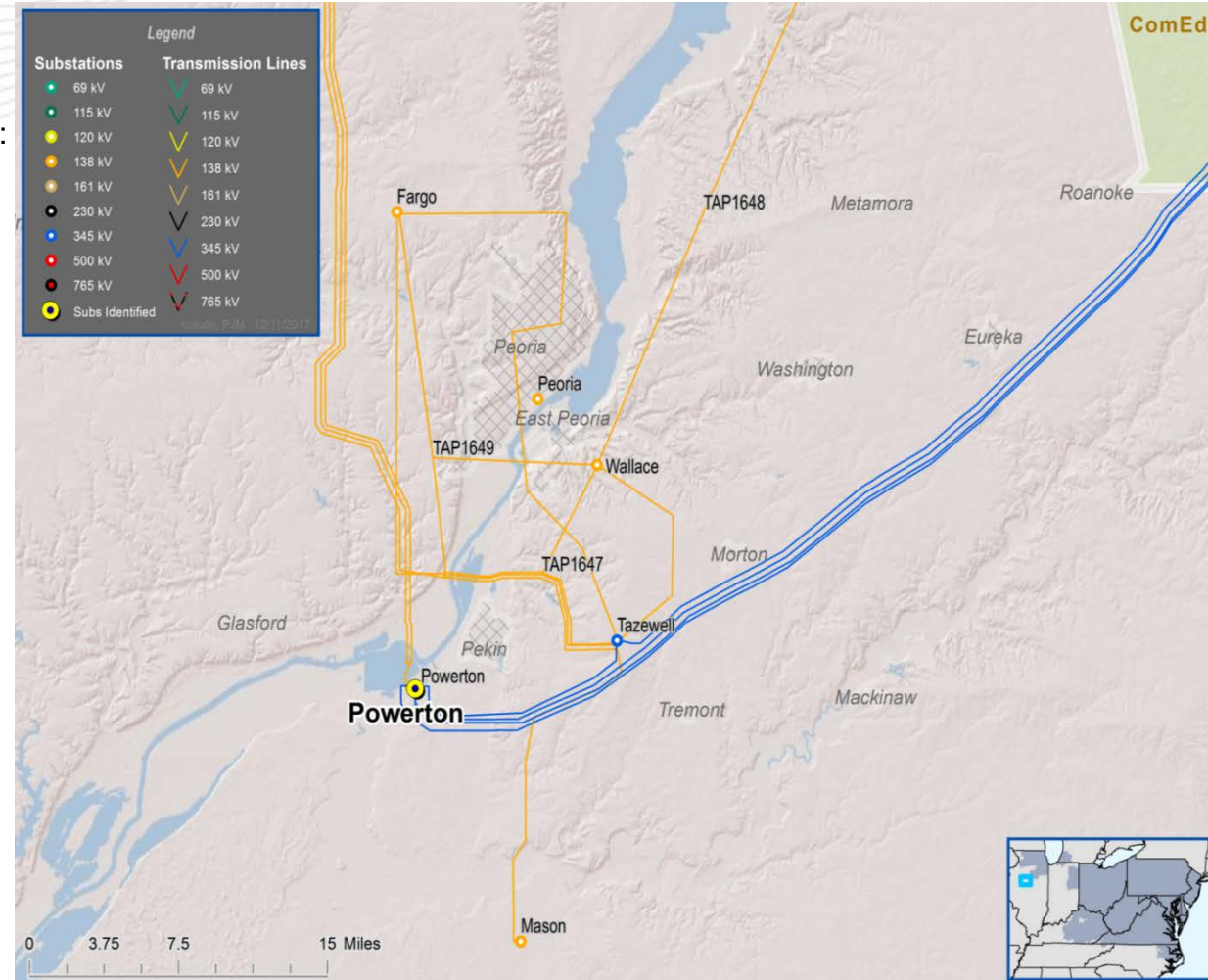
#2: At TSS 908 Mole Creek cut in three additional 345kV Powerton lines (Powerton – Katydid, Powerton - Goodings and Tazewell - Dresden)

- Would require purchasing additional property
- Potential thermal issues on Lasalle - Mazon 138kV line
- Breaker and a half layout
- Estimated cost: \$33M plus land purchase that may be required

Required IS Date: Immediate

Projected IS Date: 6/1/2021

Project Status: Planning



TO Criteria Baseline Projects

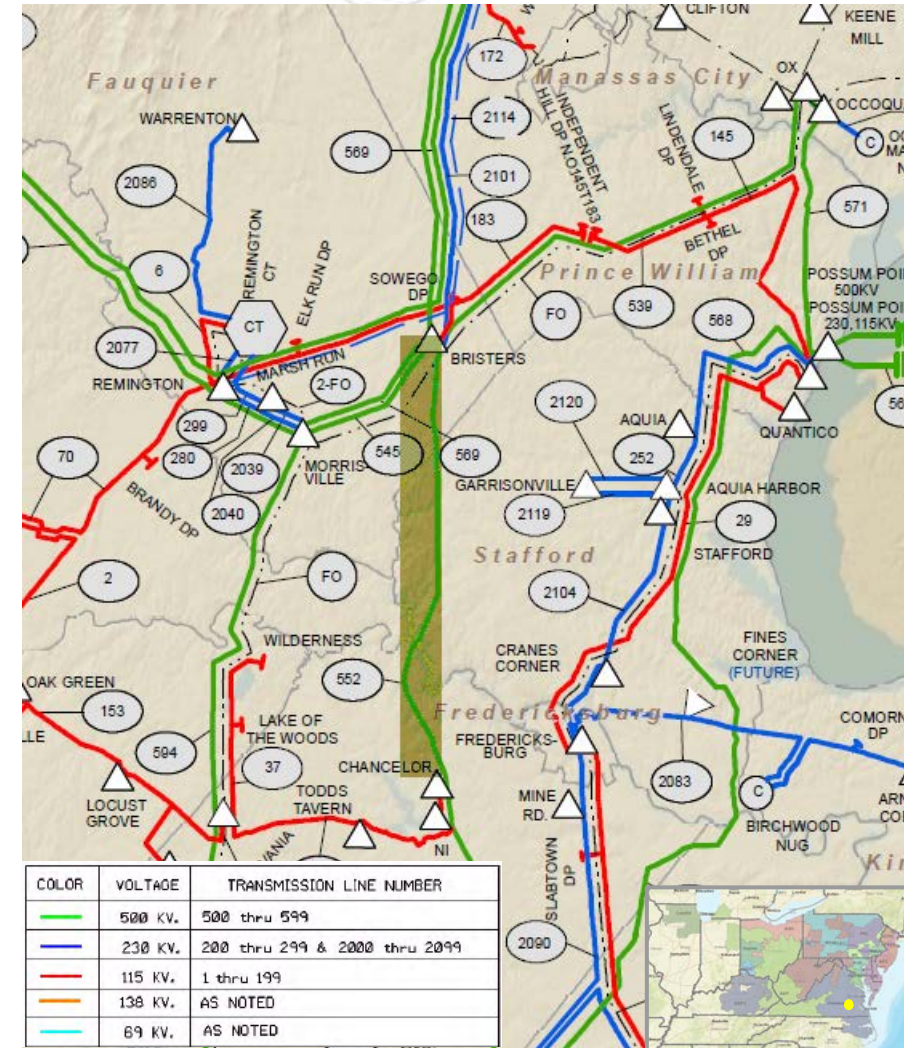
Dominion End of Life Criteria

Baseline Reliability: TO Criteria Violation

Problem Statement: Dominion “End of Life Criteria” (Immediate Need)

- Reliability assessments continue to demonstrate that the removal of Line #552 from service adversely impacts system reliability
 - Generation Interconnection Studies have identified this facility as a reliability deficiency
 - Previous generation additions in this area have been reduced in size due to system stability issues. Removal of Bristers-Chancellor 500 kV Line would only increase damping issues for existing generation in this area

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Recommended Solution:

- Rebuild the Bristers to Chancellor 500 kV line – 21.6 miles long (**b3019**)
- Conductor ampacity will increase from 3364 amps to 5000 amps
- Use standard single circuit 500 kV Tower Design

Alternatives:

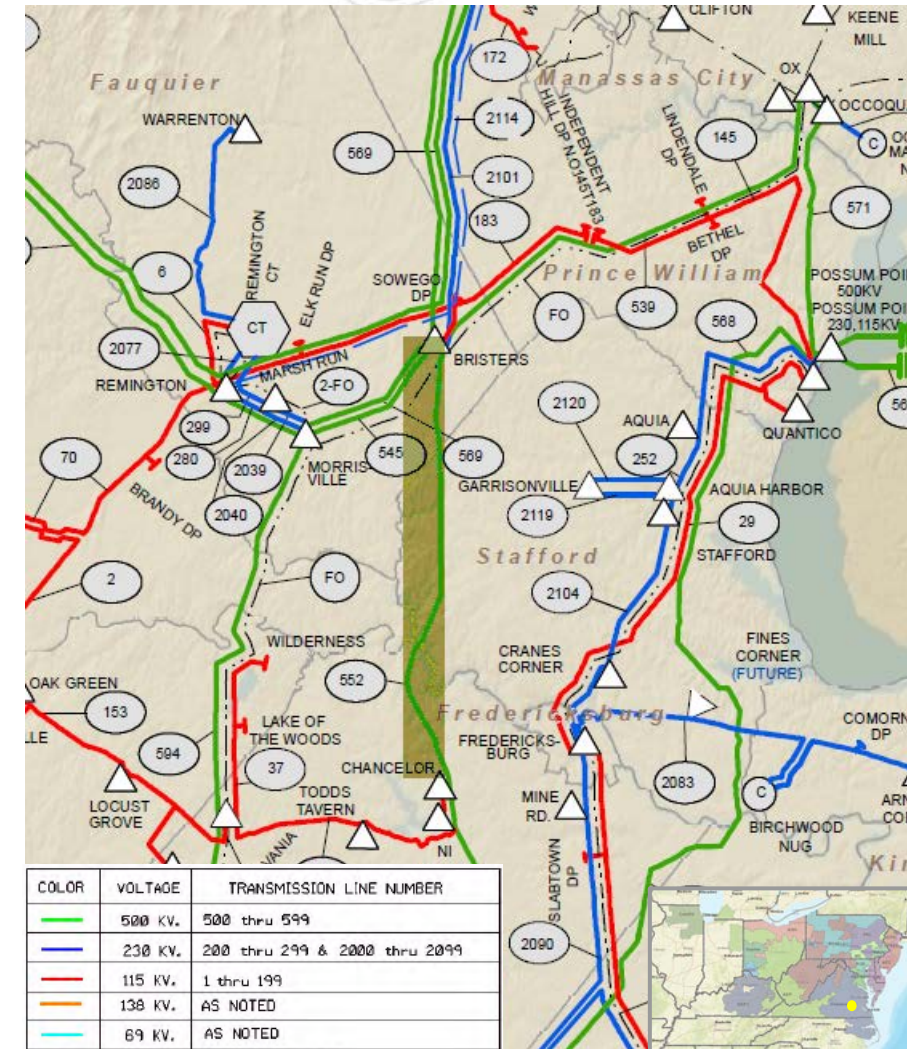
- No feasible alternatives

Estimated Project Cost: \$64.65 M

Required IS Date: Immediate

Projected IS Date: December 2023

Project Status: Conceptual

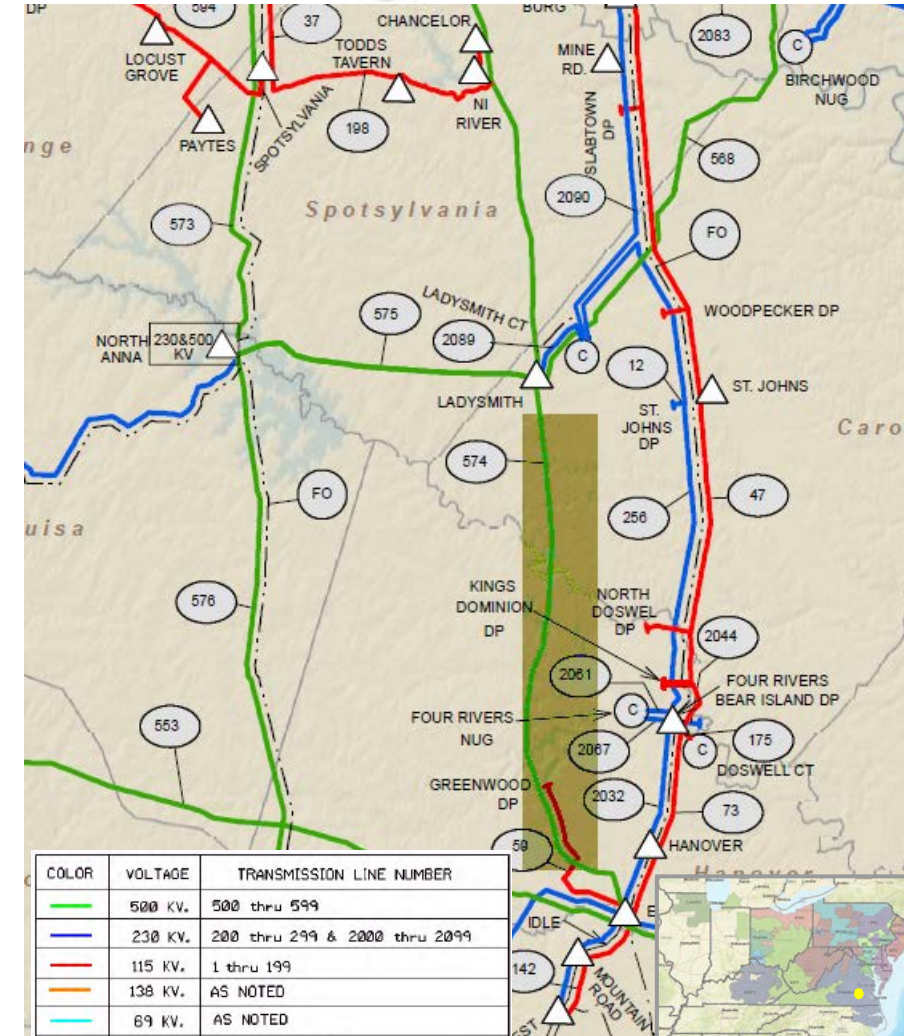


Baseline Reliability: TO Criteria Violation

Problem Statement: Dominion “End of Life Criteria” (Immediate Need)

- Reliability assessments continue to demonstrate that the removal of Line #574 from service adversely impacts system reliability
 - Generation Interconnection Studies have identified this facility as a reliability deficiency
 - Previous generation additions in this area have been reduced in size due to system stability issues. Removal of Ladysmith-Elmont 500 kV Line would only increase damping issues for existing generation in this area

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Recommended Solution:

- Rebuild the Ladysmith to Elmont 500 kV line – 26.2 miles long (**b3020**)
- Conductor ampacity will increase from 3364 amps to 5000 amps
- Use 5-2 Tower design for future 230 kV Line

Alternatives:

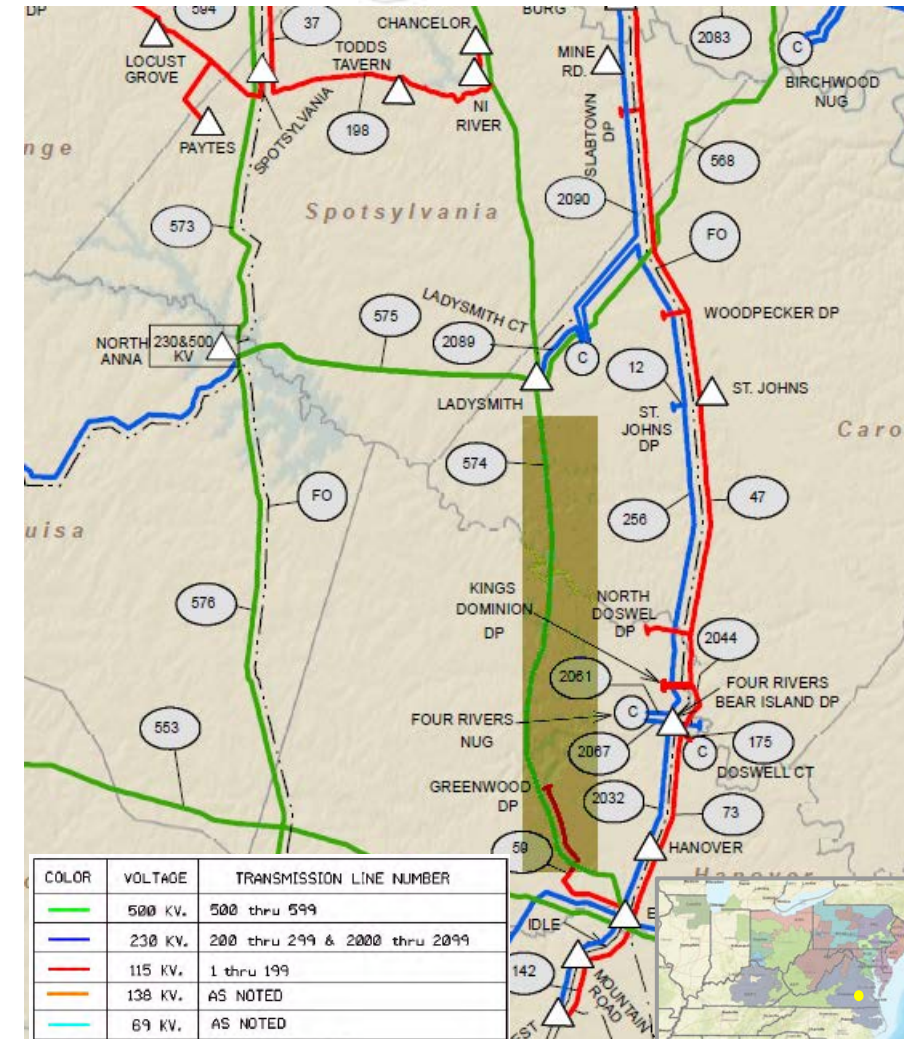
- No feasible alternatives

Estimated Project Cost: \$87.0 M

Required IS Date: Immediate

Projected IS Date: December 2022

Project Status: Conceptual

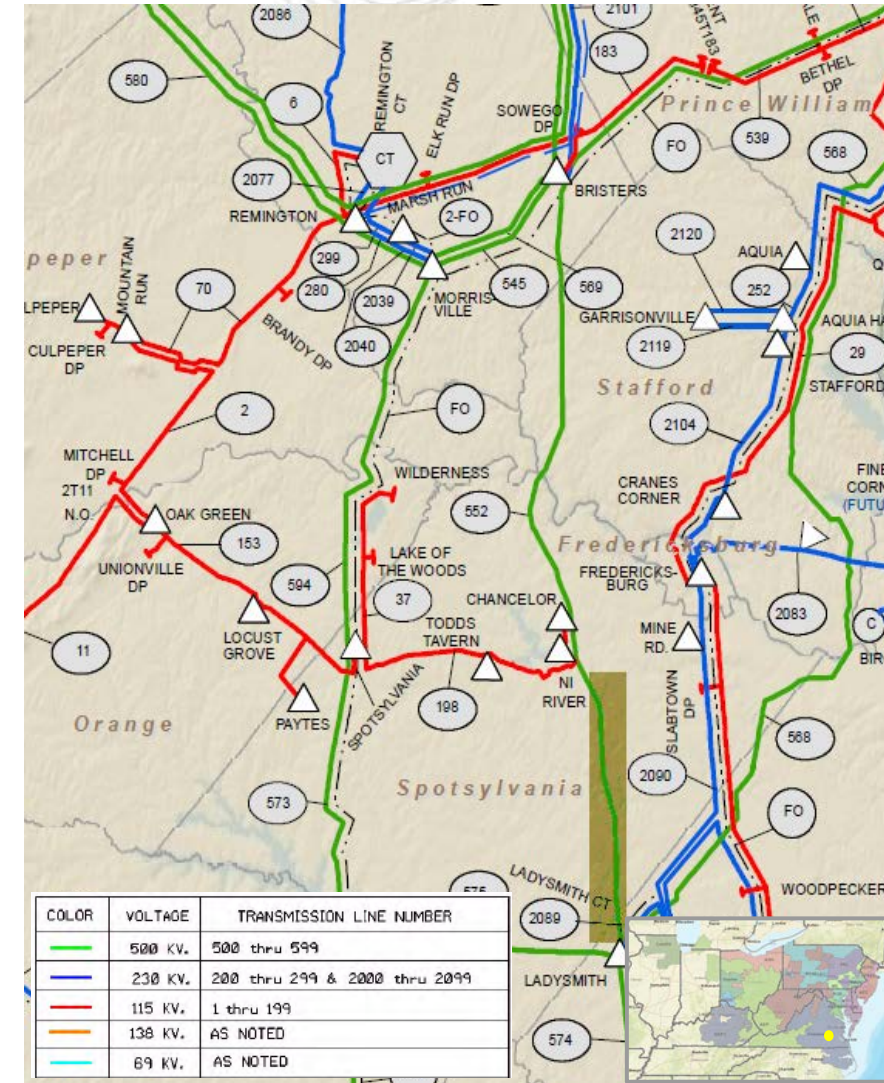


Baseline Reliability: TO Criteria Violation

Problem Statement: Dominion “End of Life Criteria” (Immediate Need)

- Reliability assessments continue to demonstrate that the removal of Line #581 from service adversely impacts system reliability
 - Generation Interconnection Studies have identified this facility as a reliability deficiency
 - Previous generation additions in this area have been reduced in size due to system stability issues. Removal of Ladysmith-Chancellor 500 kV Line would only increase damping issues for existing generation in this area

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Recommended Solution:

- Rebuild the Ladysmith to Chancellor 500 kV line – 15.2 miles long (**b3021**)
- Conductor ampacity will increase from 3364 amps to 5000 amps
- Use standard single circuit 500 kV Tower Design

Alternatives:

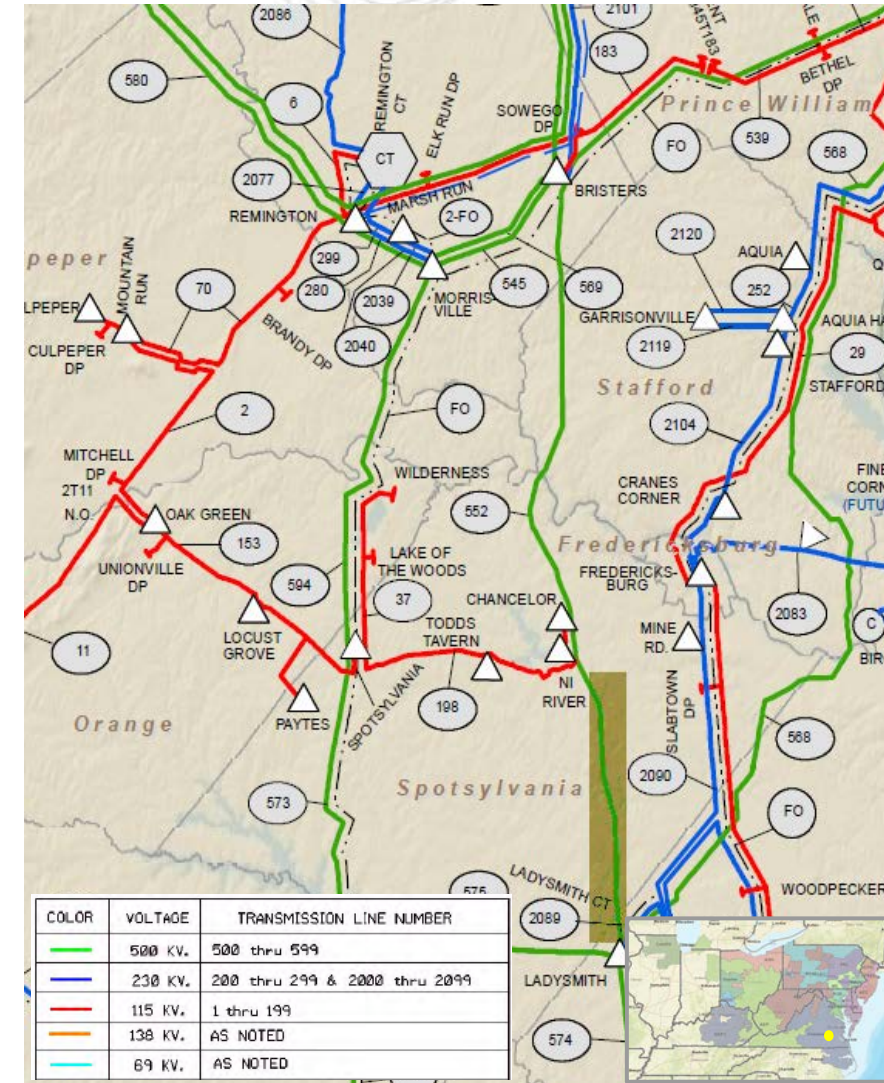
- No feasible alternatives

Estimated Project Cost: \$45.6 M

Required IS Date: Immediate

Projected IS Date: December 2023

Project Status: Conceptual



Supplemental Projects Second Review



PSE&G Transmission Zone: Supplemental Project Rebuild Circuit 5038 Highway Ramp Tower

Problem Statement:

- PSEG recently have performed LiDAR analysis and identified a conflict on 5038 causing a deration.
- Two spans of the existing New Freedom – East Windsor (5038) 500 kV circuit conductors are currently hanging above the right shoulder of a reconfigured on-ramp to a major highway and doesn't meet minimum NESC ground clearance without de-rating the circuit.

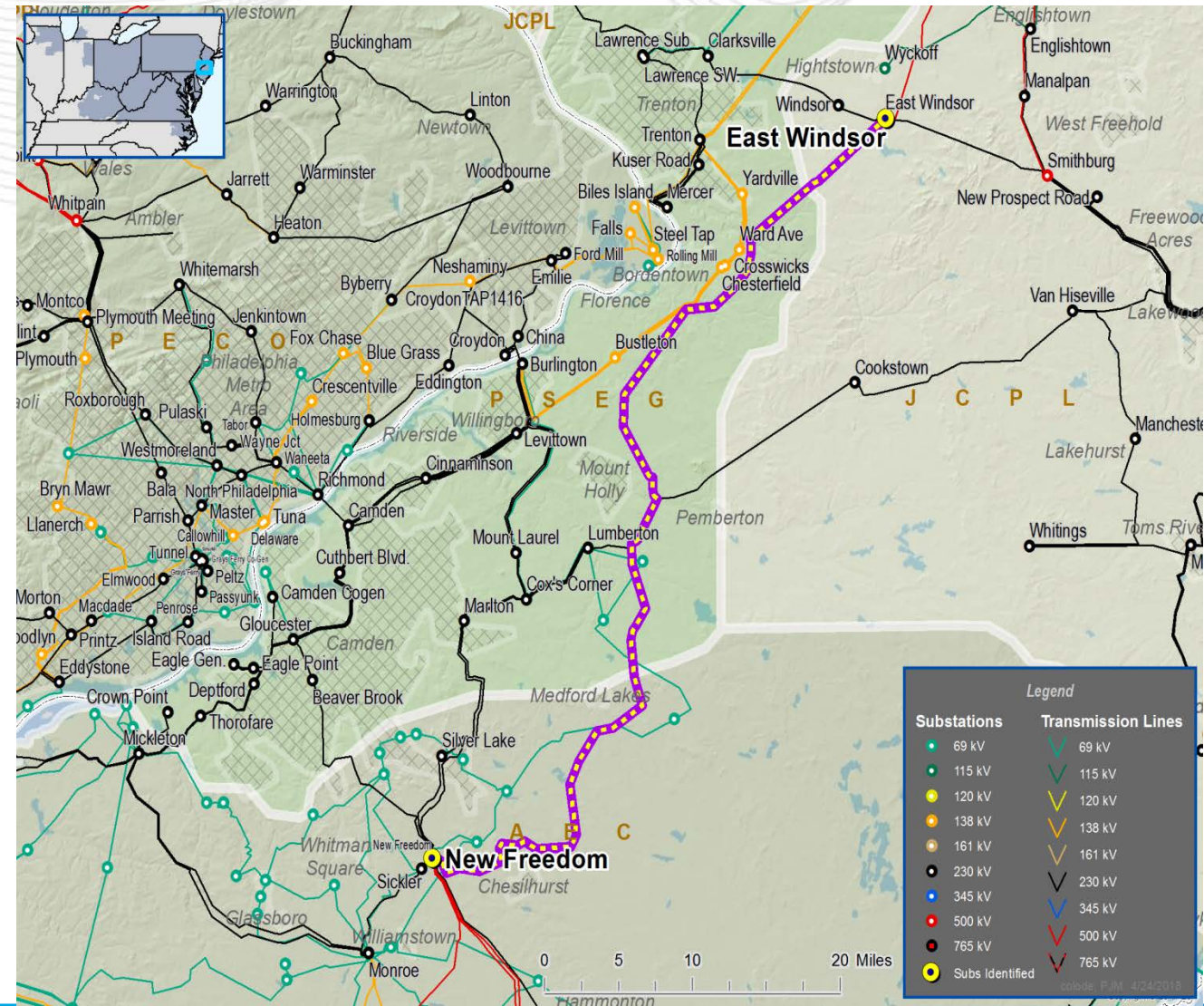
Selected Solutions:

- Rebuild/Replace Two spans of the exiting 5038 (New Freedom - East Windsor 500 kV) circuit. Replace the tower structure with an offset to the east of the ramp. This project will provide a clearance that meets NESC requirements along with PSE&G standards without derating the circuit. **(\$1655)**

Estimated Project Cost: \$3.9M

Projected IS date: 12/31/2018

Project Status: Engineering



Short Circuit Projects

Problem: Short Circuit

- The Beaumeade 230kV breaker "274T2081" is overdutied
- The NIVO 230kV breaker "2116T2130" is overdutied

Significant Driver:

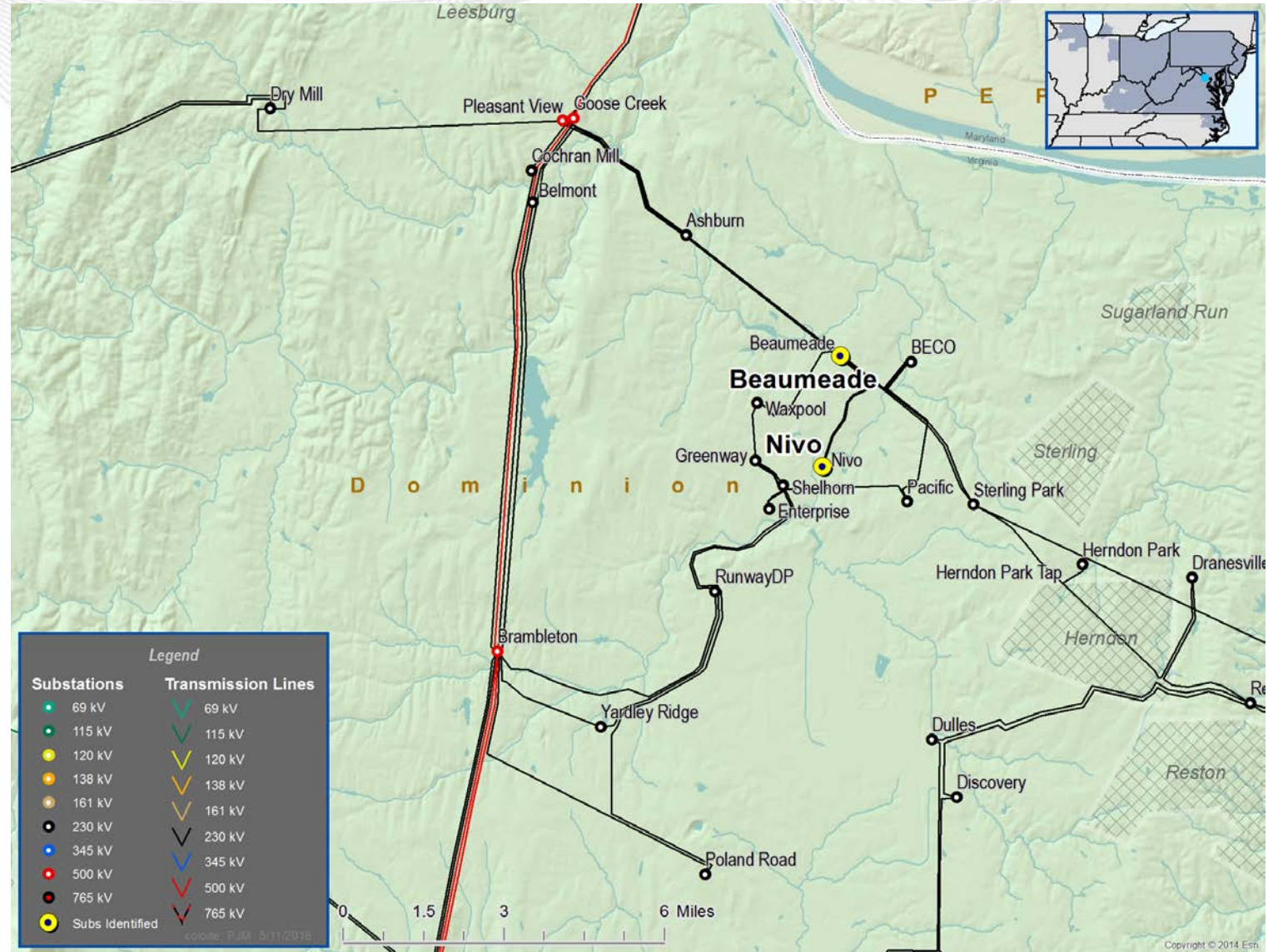
- B2962: Split Line #227 (Brambleton – Beaumeade 230 kV) and terminate into existing Belmont substation

Recommended Solution:

- Replace the Beaumeade 230kV breaker "274T2081" with 63kA breaker (B2962.1)
- Replace the NIVO 230kV breaker "2116T2130" with 63kA breaker (B2962.2)

Estimated Project Cost: \$0.6M

Required IS Date: June 1, 2022



2018 RTEP Next Steps

Home > Planning > Competitive Planning Process

Competitive Planning Process

The PJM competitive planning process implements FERC Order 1000. The process affords non-incumbent transmission developers an opportunity to participate in the regional planning and expansion of the PJM bulk electric system. By publishing a set of criteria violations and soliciting solutions from competing transmission developers, PJM and the FERC hope to encourage innovative, cost effective and timely solutions to the challenges of building and maintaining a highly reliable electric system.

PJM will announce in the [Transmission Expansion Advisory Committee \(TEAC\)](#) its intention to solicit competitive solutions to identified planning needs. The "windows" for submitting such solutions fit into three categories and follow the 18-month and 24-month planning cycles as described in Manual 14F: [Clean](#) [WEB](#) | [Clean](#) [PDF](#).

Planning Cycles	Standard Window Length	Required In-Service Date (Years)
Long Term - considers reliability criteria violations, economic constraints, system conditions and public policy requirements	120 days	> 5
Short Term - considers reliability criteria violations	60 days	3-5
Immediate-Need Reliability - considers reliability criteria violations	Shortened	< 3

While PJM endeavors to adhere to the standard length of the proposal windows, unique situations do arise. When adhering to the standard window length would be unnecessarily burdensome on the transmission developers, PJM may elect to modify the length of a proposal window. Any such changes will be made clear when the proposal window is announced.

Current Windows

Anticipated 2018 RTEP Proposal Window 1

OPEN

6.14.2018

CLOSED

8.13.2018

Window 1

[Preliminary Results & Analytical Files](#) [EXE](#) (13.1 MB) - requires CEI

Executable Files

The EXE files below are self-extracting, password-protected ZIP files and contain all of the files needed for the proposal window, including a description of the issue. The files can be downloaded and run with no special software. The password required to open the archive will be provided separately by PJM.

Completed Windows

- ▶ 2017

Planning Community

Training Video | User Guide [PDF](#)

Register for community

Window Registration

To gain access to a RTEP planning cycle window:

1. Submit the [Critical Energy Infrastructure Information request](#).
2. Complete the [Non-Disclosure Agreement](#).

Email List

Stakeholders are added to the competitive planning process email list upon receiving access to the windows.

Proposal Submissions

Submit a Proposal

Register for the 2018 RTEP window 1 at

<http://www.pjm.com/planning/competitive-planning-process.aspx>

Everyone must register to access the data regardless of prior participation in the PJM Competitive Process.



- PJM will retire the RTEP@pjm.com email address as of September 1, 2018. Stakeholders with questions about planning updates or planning windows should use the [Planning Community](#).
- PJM is enhancing the way we communicate to follow industry standards and maintain its standing as an industry leader.
- The [Planning Community](#) is a vital avenue for PJM members and staff to collaborate on planning updates, including RTEP windows, and get their questions answered.

2018

- TEAC meetings are the following Thursdays in 2018
- **1/11, 2/8, 3/8, 4/5, 5/3, 6/7, 7/12, 8/9, 9/13, 10/11, 11/8, 12/13**



Appendix: Previously Reviewed Baseline Upgrade Recommendations for the July 2018 PJM Board Review



Mid Atlantic Region

Previously Presented: 03/23/2018

Problem Statement:

FERC Form 715:

Maywood Substation is supplied by two underground 230kV cables. Maywood supplies more than 25,000 customers with load in excess of 130 MVA. An N-1-1 event would result in a complete loss of electric supply to the station for more than 24 hrs.

Recommended Solution:

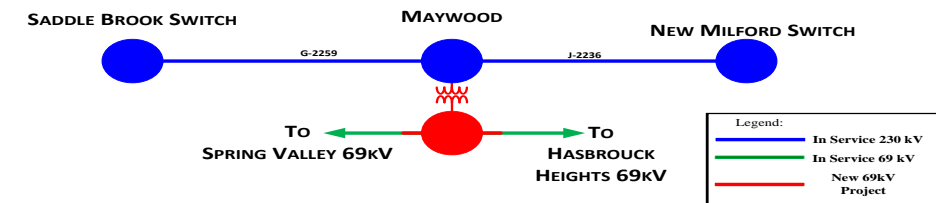
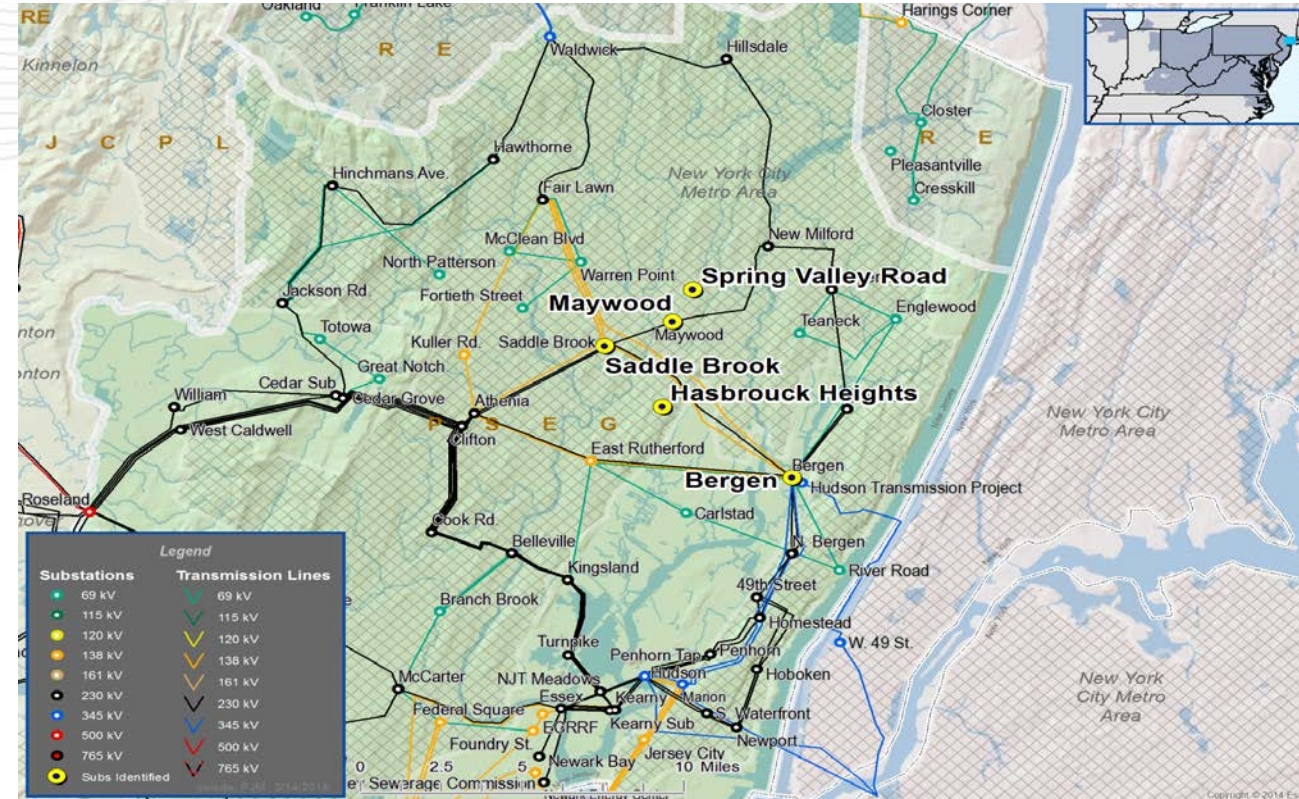
- Construct a 230/69kV station at Maywood. (B3003)
 - Purchase properties at Maywood to accommodate new construction.
 - Extend 230kV bus and install one (1) 230kV breaker.
 - Install one (1) 230/69kV transformer.
 - Install a 69kV ring bus.
 - Construct a 69kV network between Spring Valley Road, Hasbrouck Heights, and Maywood.
 - Estimated Project Cost: \$87M

Estimated Project Cost: \$87 M

Required IS date: 6/1/2018

Projected IS date: 12/31/2021

Status: Engineering





PSEG Transmission Zone: Baseline Project

South Trenton Network N-1-1 Reliability, Trenton Area Load Growth

Previously Presented: 03/23/2018

Problem Statement:

FERC Form 715:

The South Trenton 69kV network is supplied by a 230/69kV transformer at Trenton Switching Station and an underground 69kV circuit between Lawrence Switching Station and Ewing. The South Trenton 69kV network, which consists of Clinton Ave, Ewing, Hamilton, and Liberty St, supplies over 15,000 customers with load in excess of 40 MVA. An N-1-1 event would result in a complete loss of electric supply to the network for more than 24 hrs.

Load Growth:

Kuser Road currently supplies over 42,000 customers in the Trenton area. The load supplied exceeded 150 MVA during summer 2017 and is expected to grow in the local area. During the loss of a transformer at Kuser Road, there will be a ~9% overload on the remaining transformers.

Recommended Solution:

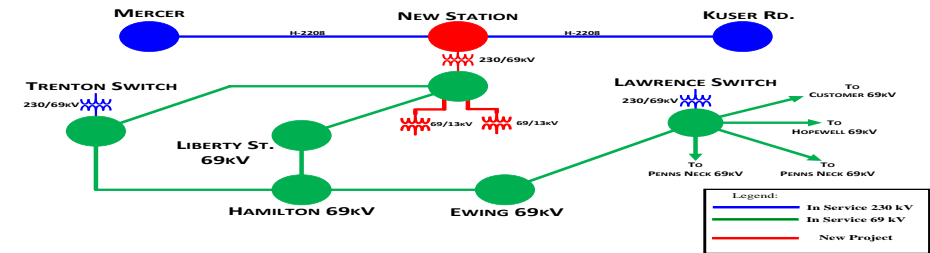
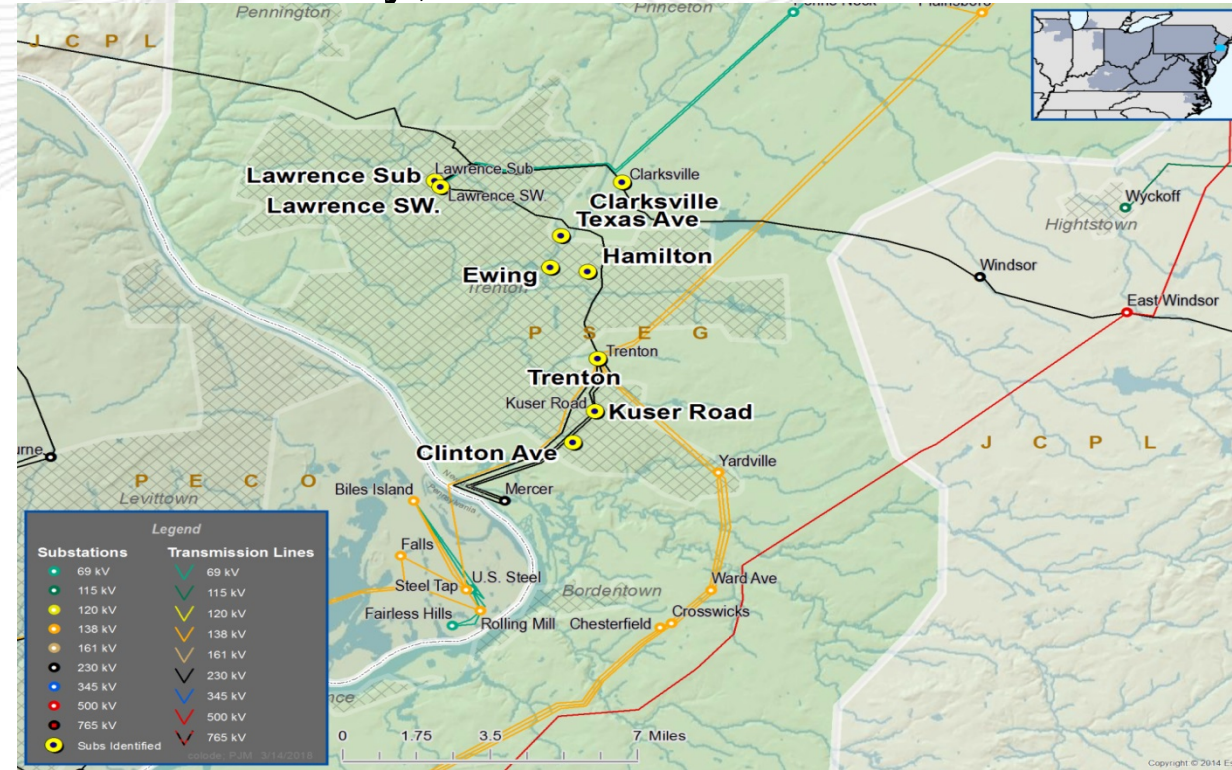
- Construct a 230/69/13kV station on existing 230kV ROW. **(B3004)**
 - Install 230kV ring bus with one (1) 230/69kV transformer at existing Clinton Ave location.
 - Expand existing 69kV ring bus at Clinton Ave with two (2) additional 69kV breakers.
 - Install two (2) 69/13kV transformers.
 - Install 18 MVAR capacitor bank.

Estimated Project Cost: \$62 M

Required IS date: 6/1/2018

Projected IS date: 12/31/2021

Status: Engineering





Western Region

B2831.2 Original Scope: Upgrade the Tanner Creek - Miami Fort 345 kV circuit (DEOK portion) to achieve new ratings of 2151 MVA Summer Normal and 2151 MVA Summer Emergency

Original Estimated Cost: \$7.81M

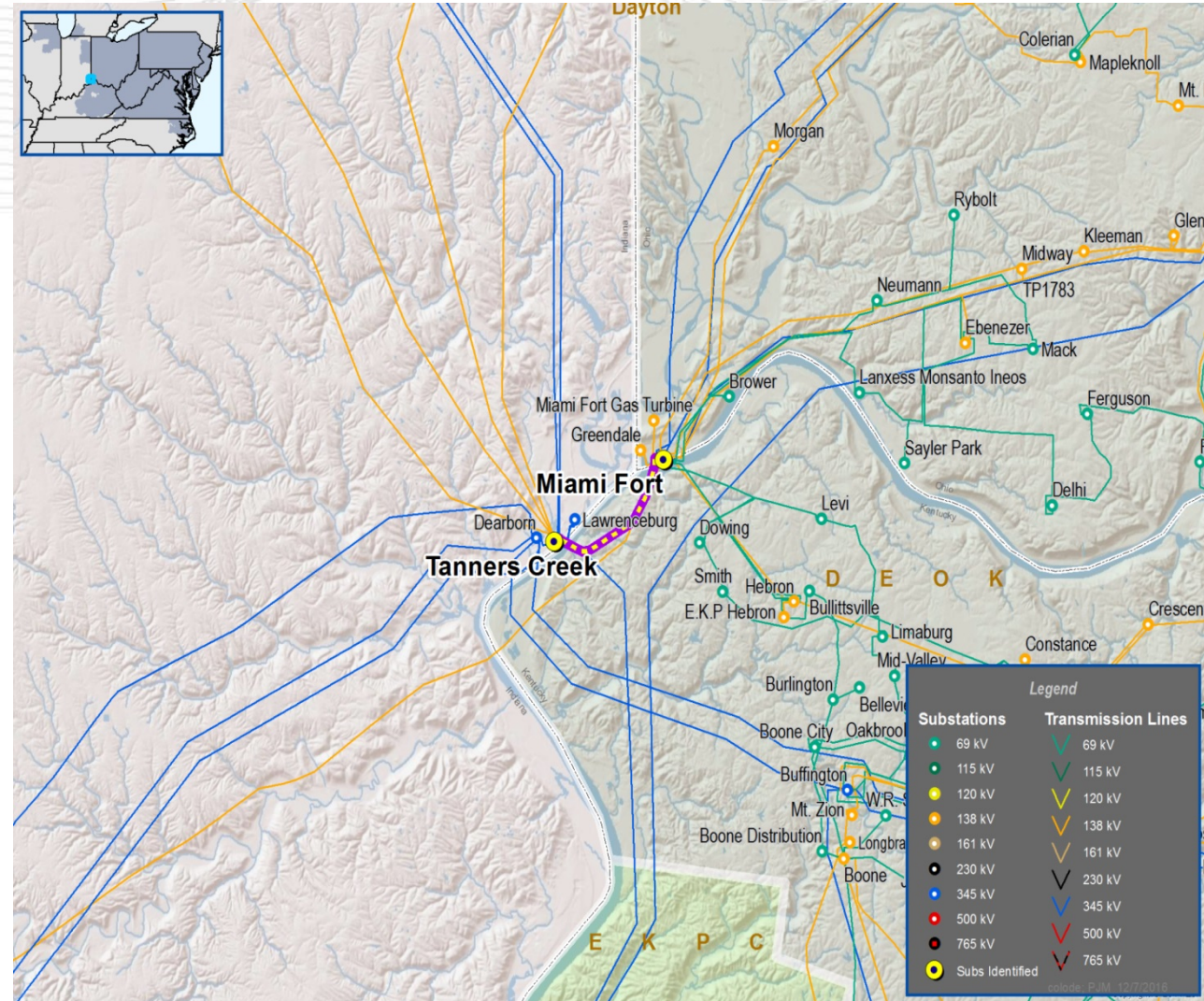
Original Required IS Date: 6/1/2018

New Scope: Rebuild the Tanner Creek – Miami Fort 345kV line (DEOK portion) to achieve a capacity of 2390 MVA.

New Estimated Cost: \$11.1M

New Required IS Date: 6/1/2018

Reason for the change: During preliminary engineering of the original scope of the project, it turns out that 5 structures need to be replaced. The rebuild would require the replacement of 6 structures. The loading is expected to incrementally increase on this circuit in the coming years. The rebuild will bring a 20% margin over the violation Vs. the 8% margin in the original scope. The incremental cost is \$3.29M, which includes the replacement of an additional structure and the general increase in cost for line work from 2016 to 2018.



Davis Creek SPS: Auto-closes a normally open 345kV bus tie at Davis Creek following loss of the specified line, which is described in ComEd System Planning Operating Guide (SPOG) 2-24 and PJM Manual 3. It is to prevent thermal overloads following loss of a 345kV line connected to TSS 86 Davis Creek.

Reasons for the removal:

B1841: Install the 3rd 345/138 kV transformer at TSS 86 Davis Creek; Already in service

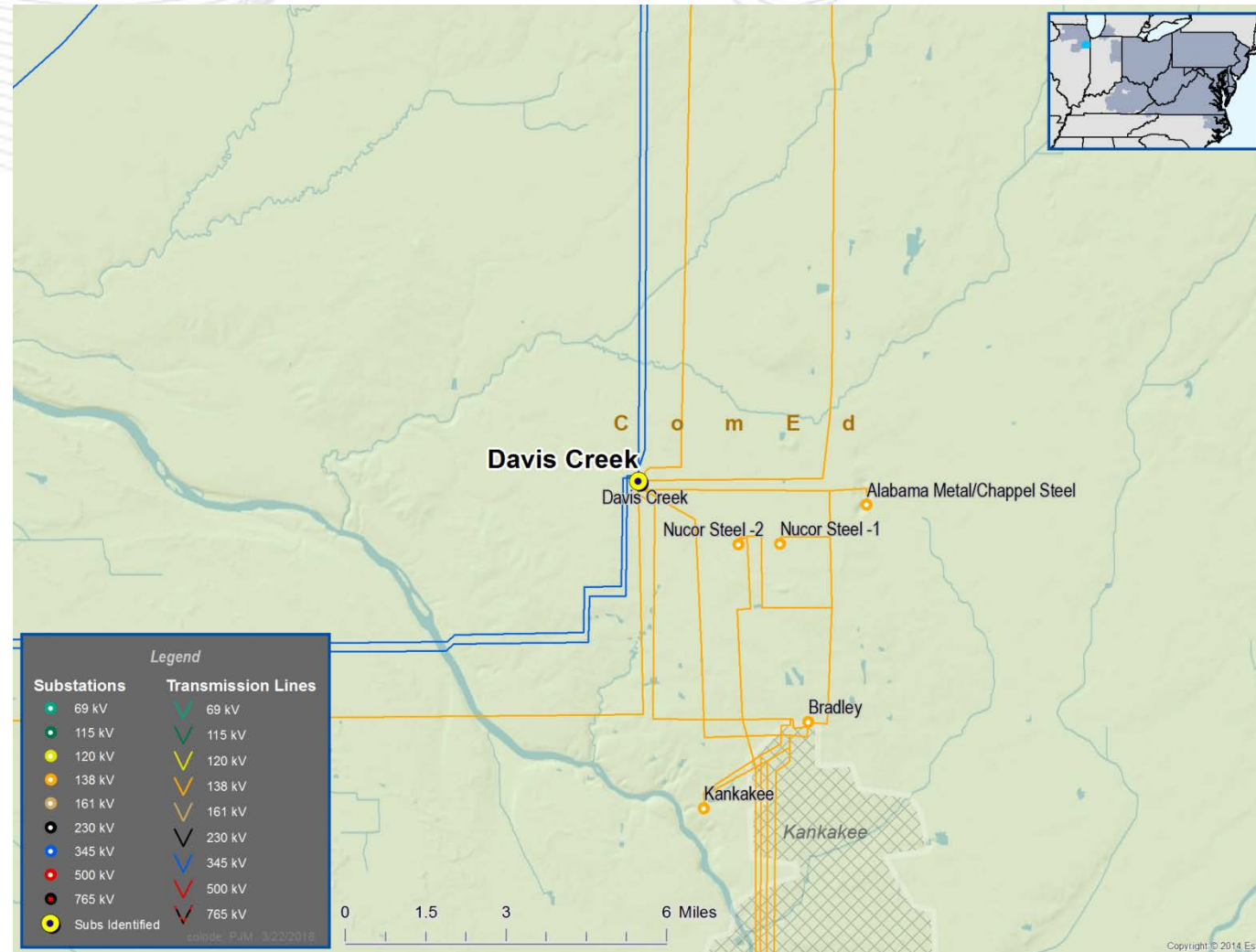
S1444: Expand Davis Creek 345kV straight busses to breaker and half; Projected IS date: 12/1/2018

With only B1841, there is currently no need for the RAS at Davis Creek. S1444 will further improve the performance around Davis Creek.

Recommended Solution: Remove Dave Creek RAS (B2995)

Estimated Cost: \$0M

Required IS Date: 12/31/2018



University Park North SPS: Trip generators at TSS 970 University Park North EC for specified delayed-clearing faults.

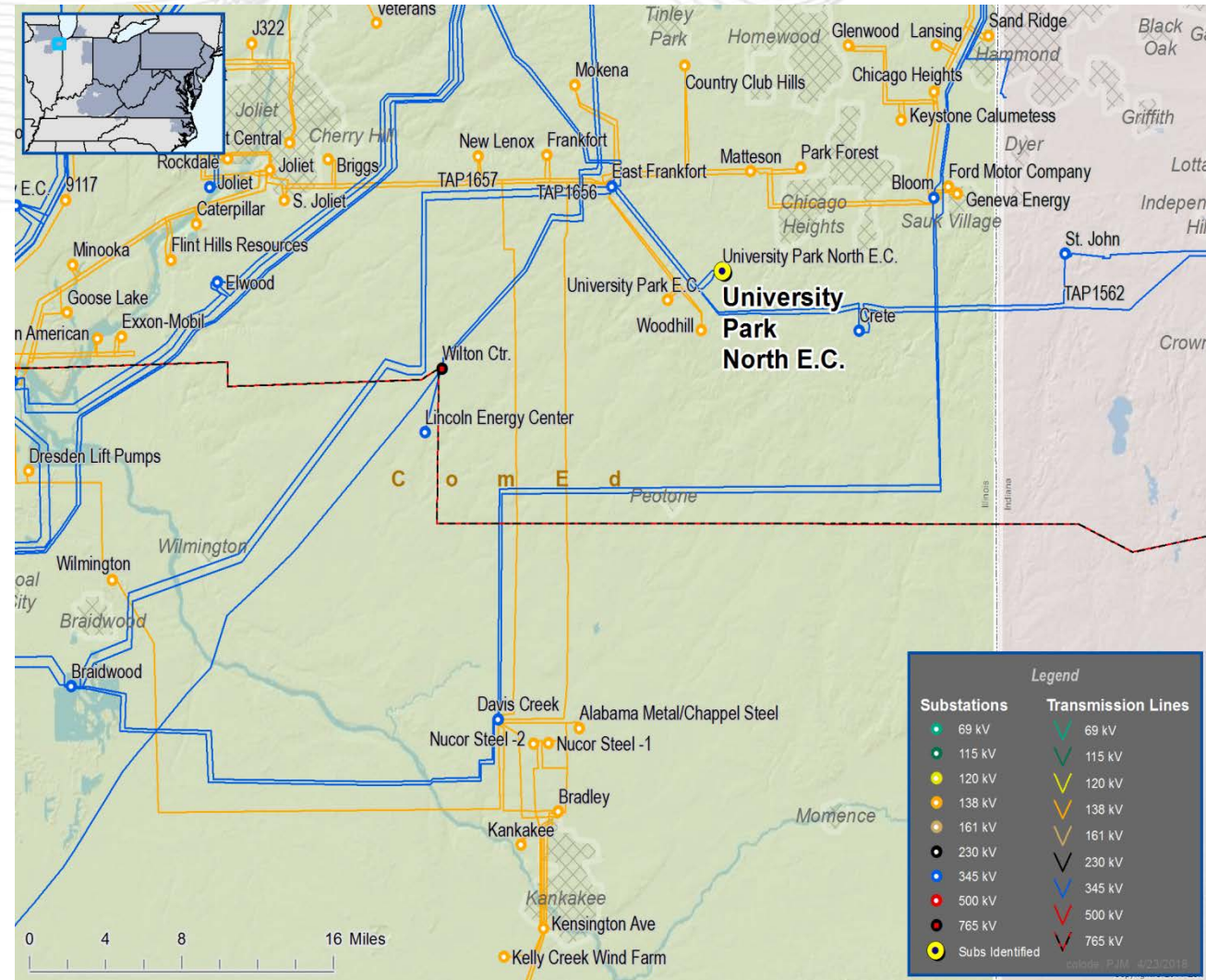
Reasons for the removal:

The periodic SPS evaluation study by both ComEd and PJM has determined that RAS is no longer needed to meet planning criteria.

Recommended Solution: Remove University Park North RAS (B2997)

Estimated Cost: \$0.1M

Required IS Date: 12/31/2018



Previously discussed on 12/14/2017 and 4//2018 TEAC

Problem Statement :

- High voltage in Powerton area (Katydid and Mole Creek 345kV buses) in real time: Powerton unit 6 is required to run to control 345kV voltages in Powerton area
- Significant Uplift Charges

Immediate Need:

Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity.

Potential Solution:

Install a 120Mvar 345kV shunt inductor at Powerton (the 345kV yard already contains an empty bus position on the ring we only need a switching breaker for the inductor) **(B2998)**

Estimated Cost: \$9M

Alternatives:

#1: Install shunt inductors at TSS 196 Katydid and TSS 908 Mole Creek (\$12M plus land purchase that may be required)

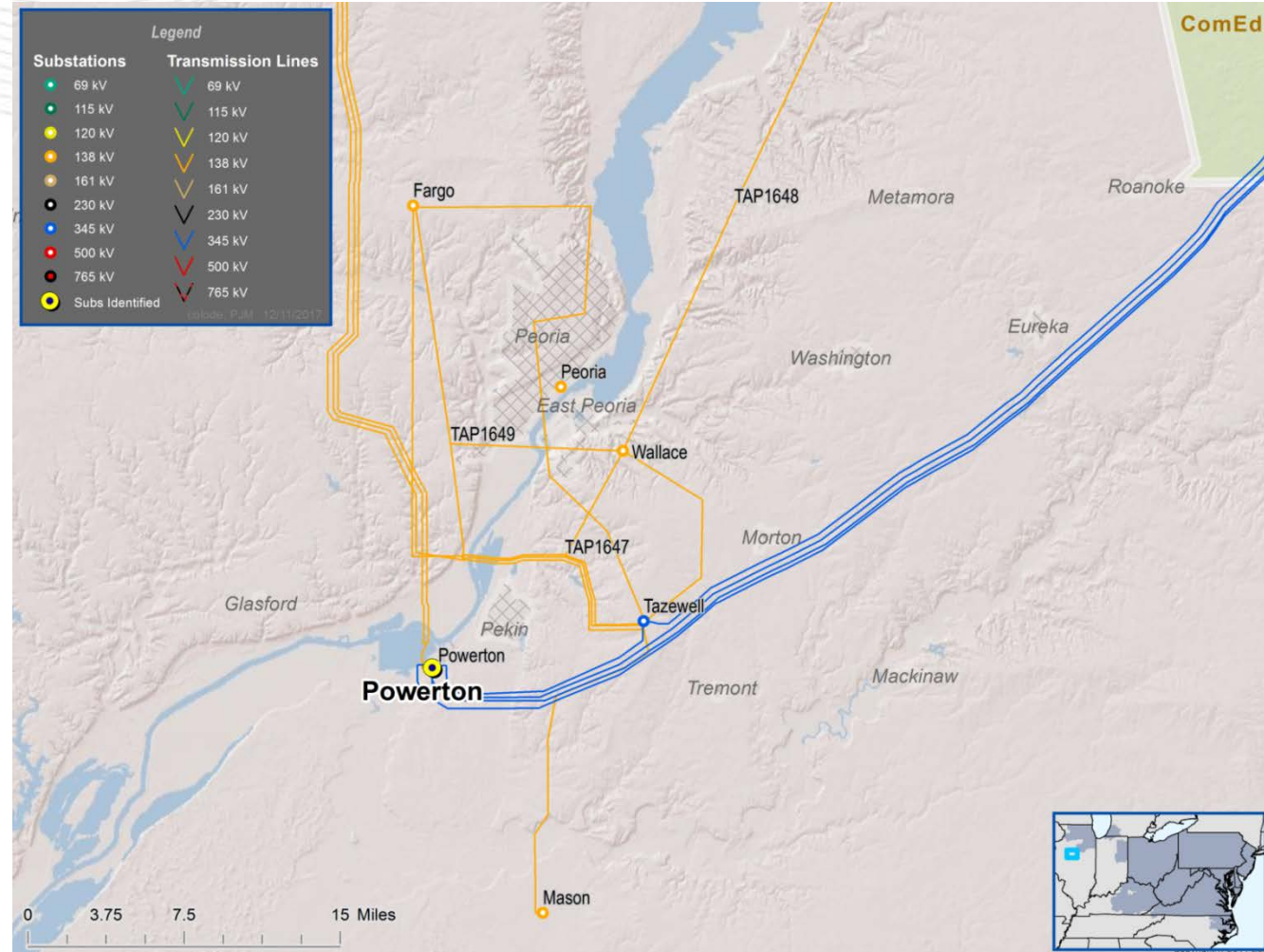
#2: At TSS 908 Mole Creek cut in three additional 345kV Powerton lines (Powerton – Katydid, Powerton - Goodings and Tazewell - Dresden)

- Would require purchasing additional property
- Potential thermal issues on Lasalle - Mazon 138kV line
- Breaker and a half layout
- Estimated cost: \$33M plus land purchase that may be required

Required IS Date: Now

Projected IS Date: 6/1/2021

Project Status: Planning



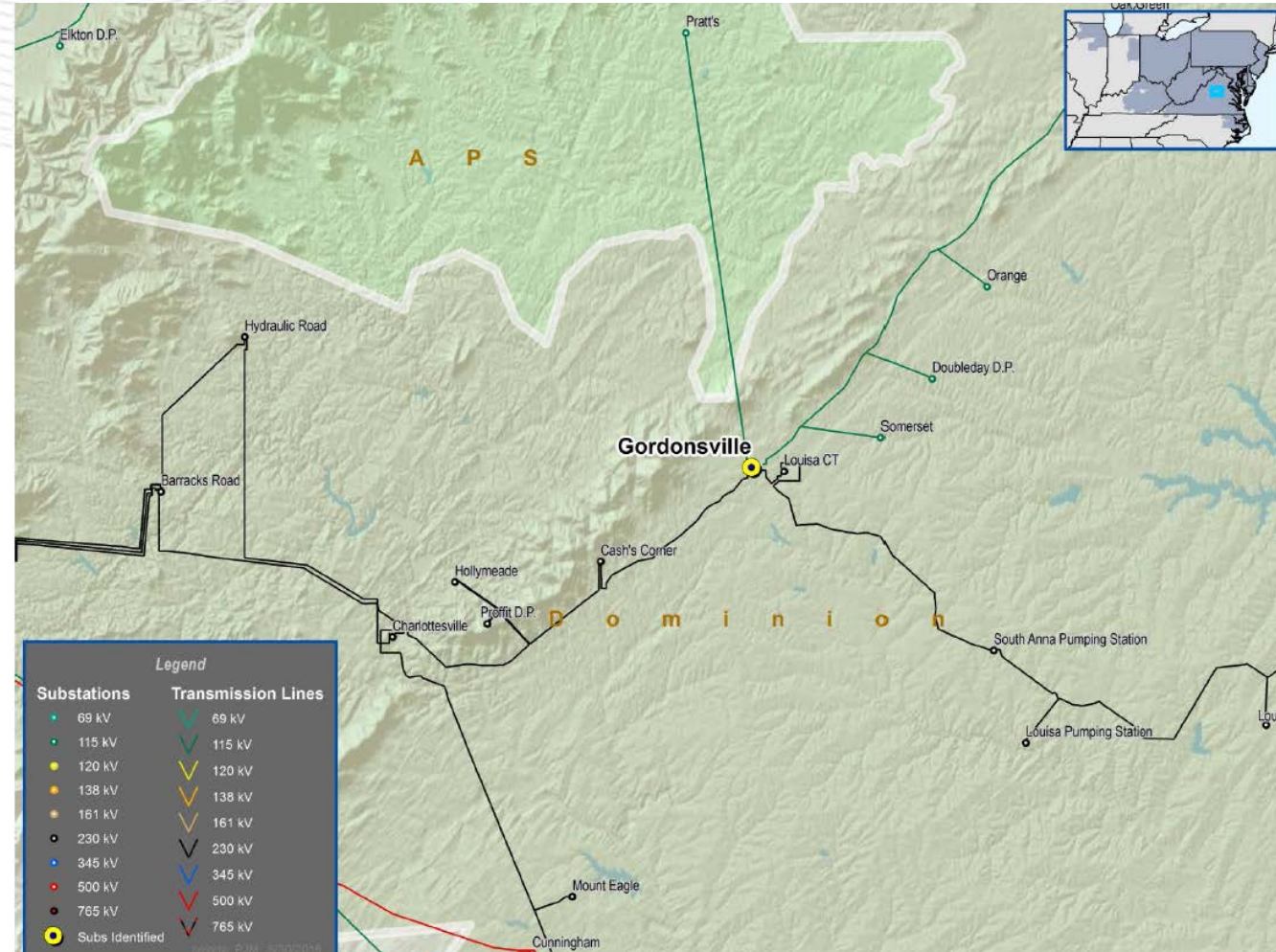
FE Scope for Dominion Baseline B2747

B2747: Install a Motor Operated Switch and SCADA control between Dominion's Gordonsville 115kV bus and FirstEnergy's 115kV line. (Presented in 7/26/2016 South SRTEP)

FE Scope: Relocate the FirstEnergy Pratts 138 kV terminal CVTs at Gordonsville substation to allow for the installation of a new motor operated switch being installed by Dominion. (B2747.1)

Estimated Cost: \$0.11M

Required In-service: 6/1/2018



Previously presented on 2/14/2018 SRRTEP
Baseline & Supplemental Project

Problem Statement:

Planning Criteria Violations (TO criteria violation):

For N-1 loss of the Reedurban 138-69kV transformer (or the South Canton-West Canton #2 138kV circuit), the following summer peak overloads are observed: Torrey-S. Gambrinus Switch 69kV (117% SE); S. Gambrinus Switch-Gambrinus Road 69kV (106% SE). The circuit sections are overloaded due to 4/0 Copper conductor (rated at 54 MVA SE).

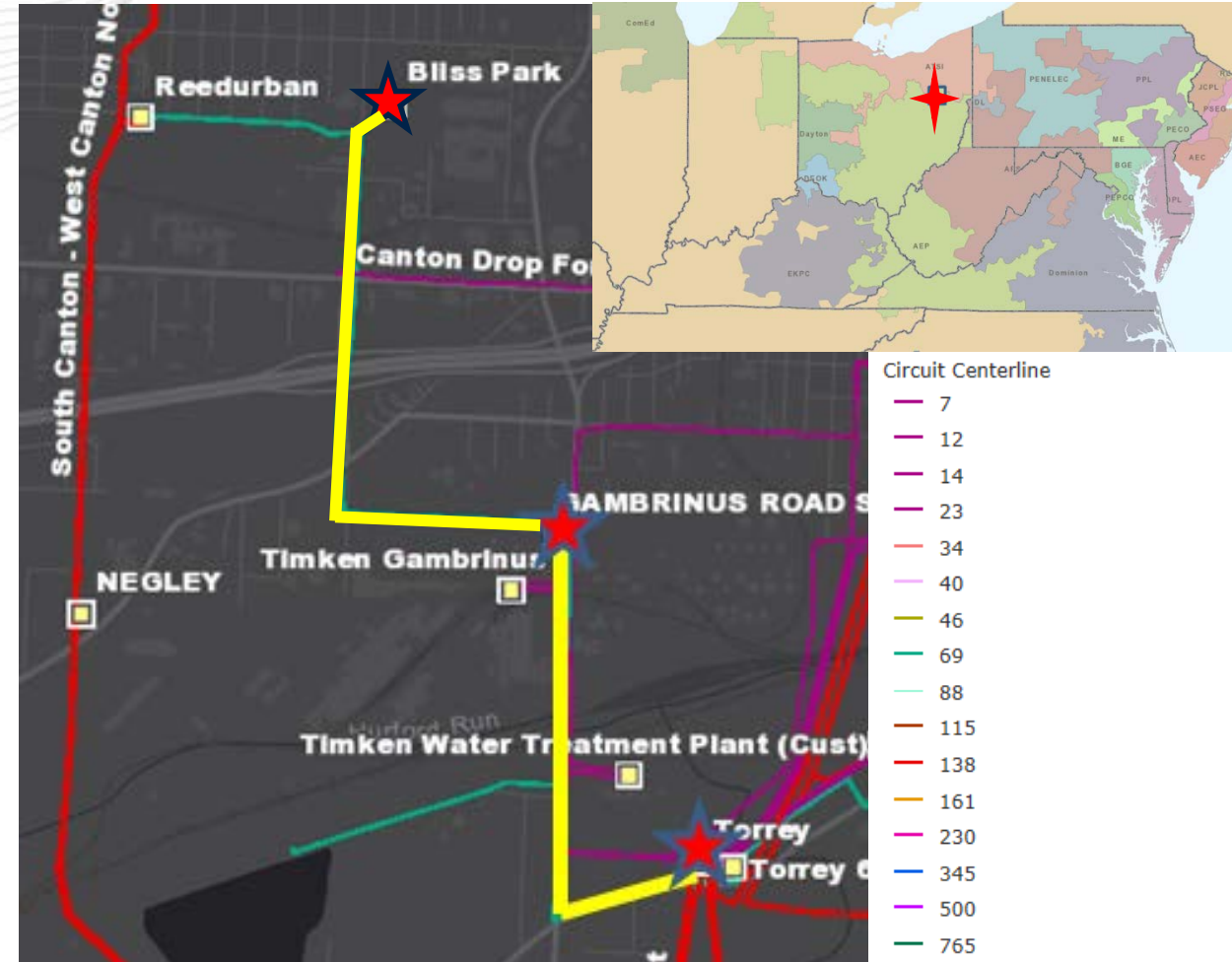
Equipment Material/Condition/Performance/Risk:

The existing 2.7 mile, 69 kV line section between Torrey and Bliss Park was originally constructed in 1922 using wood pole structures with 4/0 Copper conductor (54 MVA rating). The majority of the existing structures date to 1963 or earlier (55 years old), with the conductor dating to 1922. In addition, there is a 400 foot underground cable section that is in poor condition.

This 69kV line section has experienced 1.25 million minutes of customer interruption (CMI) in the past three years.

There are 17 open Category A conditions on this line section and 3 Category B items of concern. These issues include: rotted poles, damaged splices, and stolen ground-wire leads.

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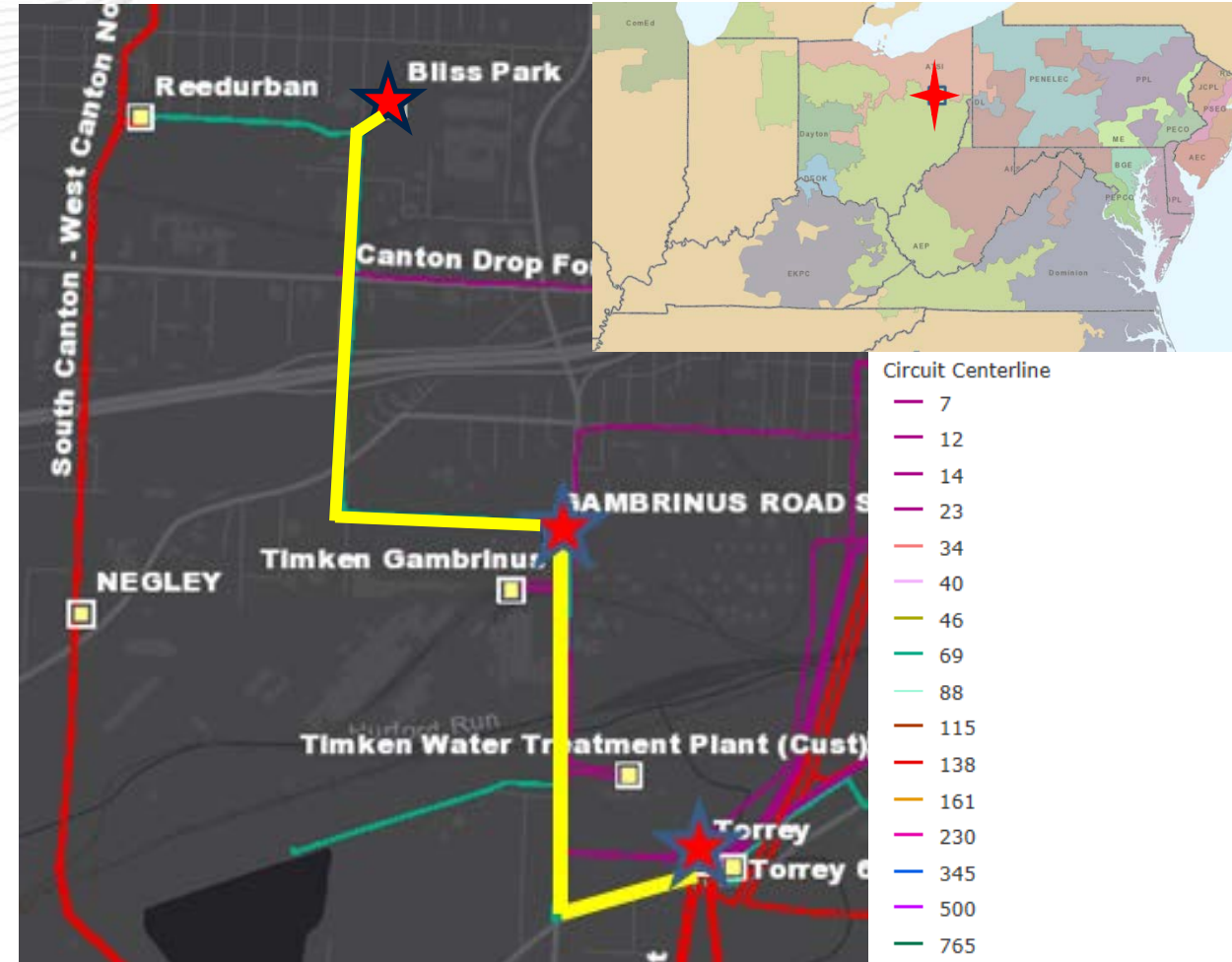
Operational Flexibility and Efficiency:

This 69kV line section provides service to a large oil refinery, which has sensitive electrical equipment. Proactively replacing this aging asset will ensure a high level of reliability for years to come. In addition, the existing capacity constraints hinder future customer expansion plans.

The circuit has experienced numerous local PCLLRW warnings in 2016-17, due to the real-time loads being above the N-1 capability of the circuit.

In addition, the Bliss Park-Gambrinus 69kV section loads to 51 MVA (94% of its 54 MVA SE rating), for an N-1 contingency of the Torrey 138-69kV transformer fault or a Torrey 69kV bus fault. The 3 MVA of margin on this line may be used up quickly due to the large industrial customers on the circuit (oil refinery and scrap metal yard).

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Selected Solution:

Baseline:

Rebuild the Torrey – South Gambrinus Switch – Gambrinus Road 69kV line section (1.3 miles) with 1033 ACSR ‘Curlew’ conductor and steel poles. (B2993)

Estimated Baseline Cost: \$2.8M

Required In-service: 6/01/2018

Projected In-service: 12/01/2018

Supplemental:

Rebuild the Gambrinus Road – Bliss Park 69kV line section (1.4 miles) with 1033 ACSR ‘Curlew’ conductor and steel poles. (S1558)

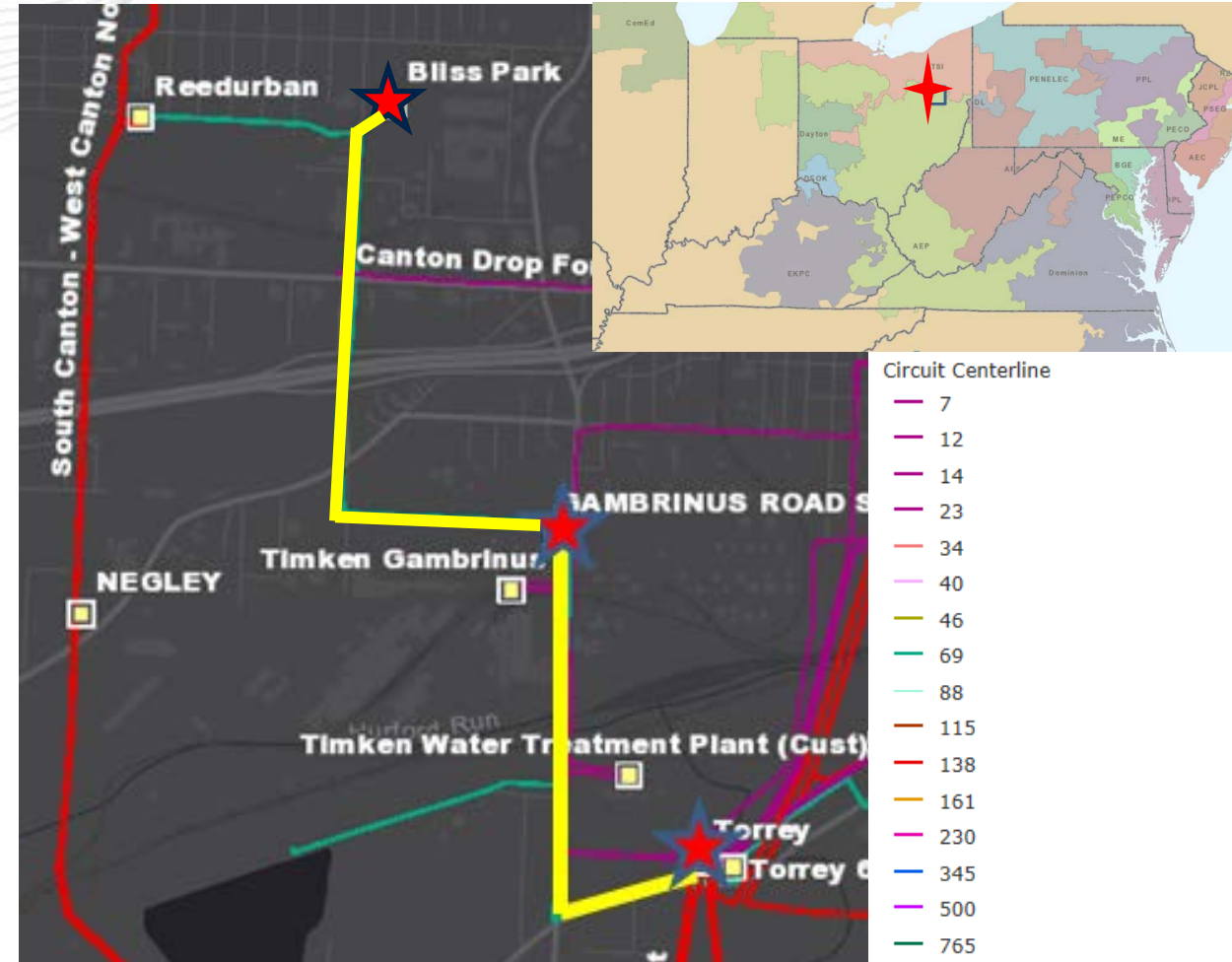
Estimated Supplemental Cost: \$3.0M

Total Estimated Cost: \$5.8M

[This conductor size was chosen due to the location of the major oil refinery that has discussed potential major load increases with AEP in recent years; in addition, this conductor is one of the most common in the Canton area, resulting in procurement/warehousing/spare-part cost savings.]

Projected In-service: 12/01/2018

Project Status: Engineering



- B2559(reconductor the existing Black River-Lorain substation and upgraded terminal equipment) was included in the RTEP to address Common Mode Outage violations resulting from 2014 RTEP Analysis.
- PJM included this project in subsequent RTEP analysis including 2015, 2016 and 2017 RTEP studies.



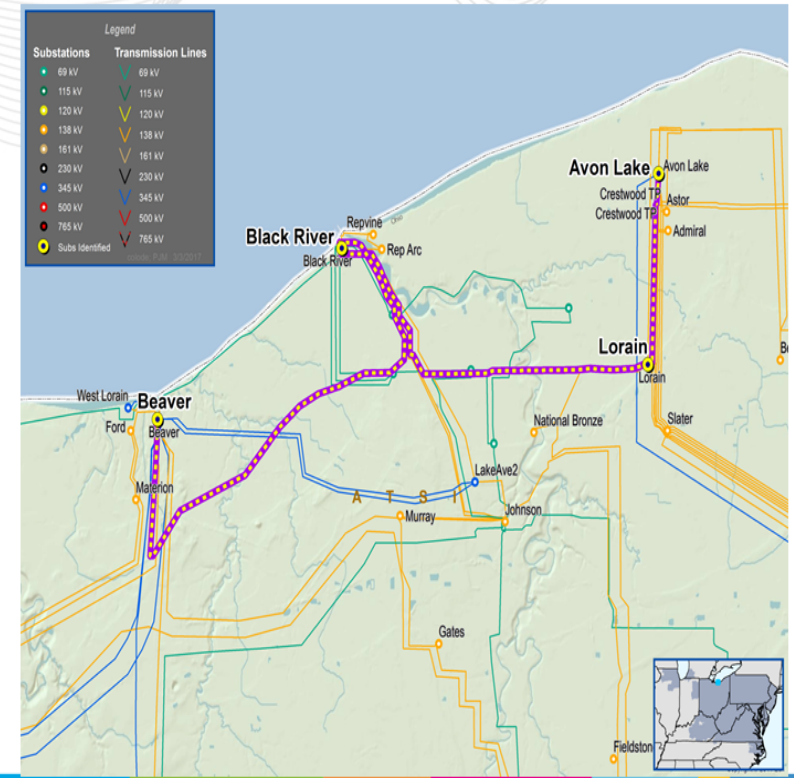
- **Baseline (FG# 99, 100, 101) and Common Mode Outage (FG# 754, 918, 919, 920, 921) Violation**
- **2014 RTEP Proposal Window #1 Violations**
- The Black River to Lorain 138 kV circuit is overloaded for multiple category C contingencies.
- Recommended Solution: Reconductor the Black River-Lorain 138kV line and upgrade Black River and Lorain substation terminal end equipment. (B2559) (P2014_1-9F)
- Estimated Project Cost: \$9.6M
- Required IS date: 6/1/2019

ATSI Transmission Zone

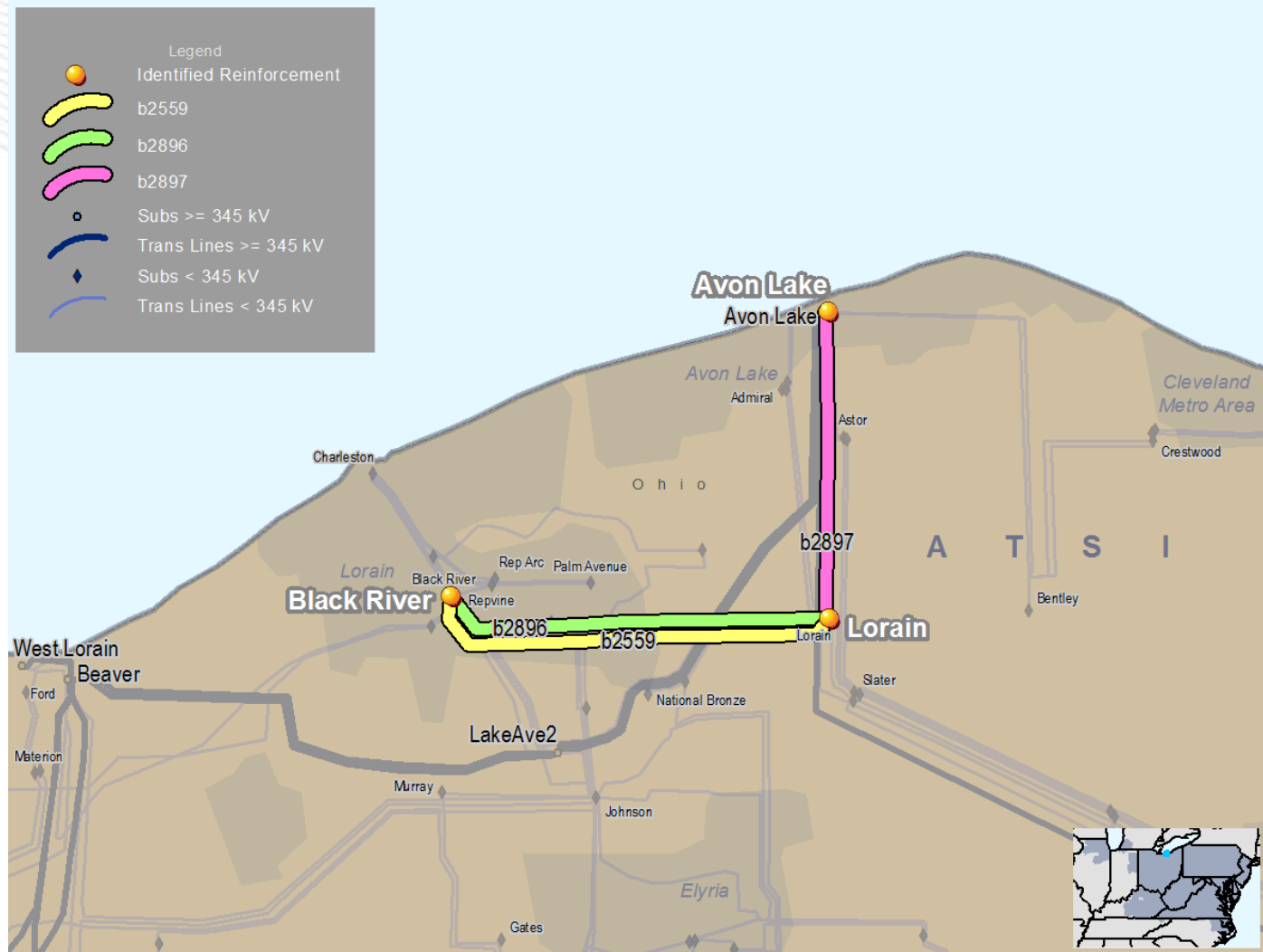


- 2016 RTEP Analysis, which included the b2559 project, identified additional violations on the Black river-Lorain-Avon circuit
- These 2016 RTEP violations were resolved with a group of upgrades including:
 - Rebuild/Reconductor the Black River – Lorain 138 kV circuit. (2016_3A-3B) → b2896
 - Reconductor the Avon – Lorain 138 kV section and upgrade line drop at Avon (2016_3A-3C) → b2897

- **Common Mode Outage (FG# 392, 393, 400, 407, 489, 490, 493 and 504) :**
- Black River – Lorain - Avon 138 kV circuit is overloaded for tower outage loss of Avon – Lake Ave 345 kV circuits and line fault stuck breaker contingency loss of the Avon – Lake Ave 345 kV circuits.
- **Common Mode Outage (Summer - FG# 915 and Winter – FG# 386) :**
- The Beaver to Black River 138 kV circuit is overloaded for tower line contingency loss of the Lake Ave – Beaver 345 kV circuits .



- Updated as-built data for b2559 included higher impedences and ratings than previously studied.
- As a result of the updated b2559 data, the drivers for b2896 and b2897 are no longer evident and these upgrades are being recommended for removal from the RTEP





Southern Region

- **Previously Presented:** 01/30/2018 SRRTEP

- **Problem Statement:**

- 115kV Line #130 (Carolina - Clubhouse) has a 4.0 mile long tap to Brink DP (MEC). The need to remove this long tap exposure was identified for reliability. Dominion Energy's Facility Interconnection Requirements (FIR) section 6.1.b states that transmission tap lines greater than a mile and less than 100MW should be protected by a 3 or 4 breaker ring.
- Line #130 is a 20 mile long 115kV network line with 5 tap connections. The number of tap connections on Line #130 exceeds the limit outlined in Dominion Energy's Planning Criteria (C.2.7) which limits tap connections to 4 per line.

- **Recommended Solution:**

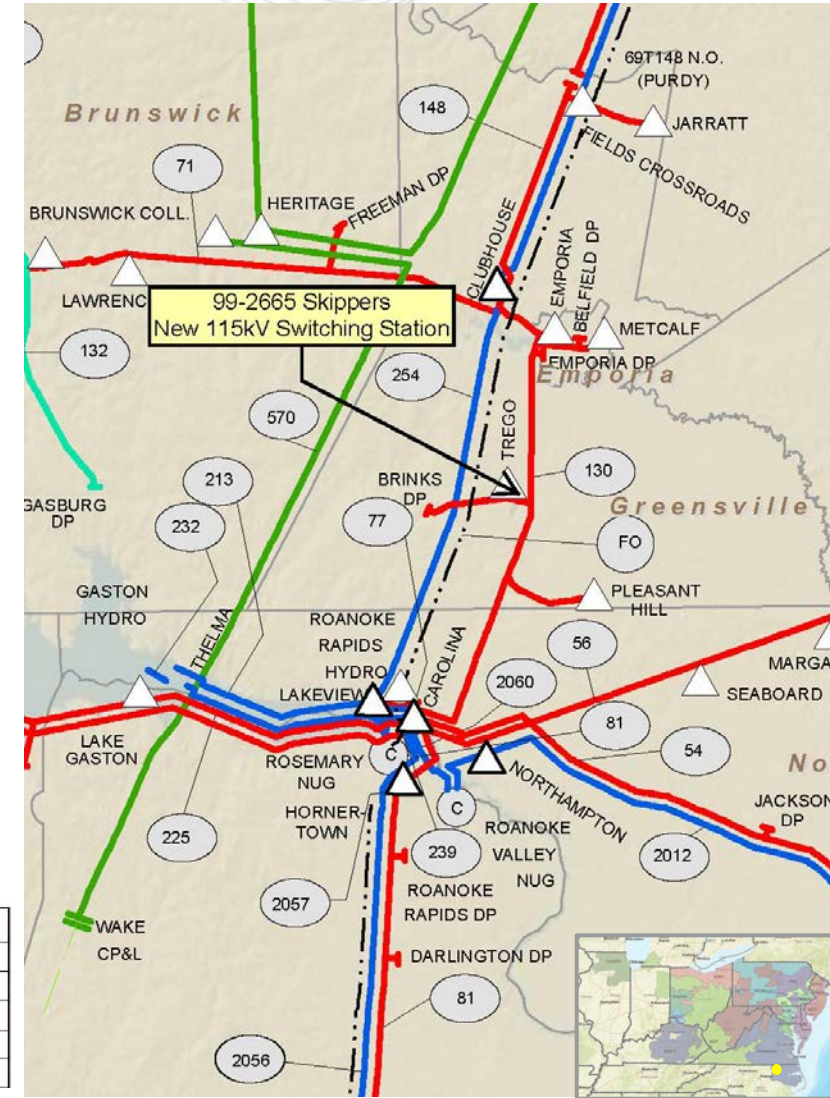
- Acquire land and build a new switching station (Skippers) at the tap serving Brink DP with a 115kV four breaker ring to split line #130 and terminate the end points. Terminate the Brink tap into the ring. This will reduce line exposure by splitting line #130 into 2 lines: Clubhouse to Brink Tap ~9 miles and Brink Tap – Carolina ~11 miles. This results in 1 tap connection between Carolina and the new station and 3 tap connections between the new station and Clubhouse. The fourth breaker in the ring prevents a breaker failure from taking out all customers (~7300) between Carolina and Clubhouse. **(b2994)**

- **Estimated Project Cost:** \$8.0 M

Projected In-service Date: 5/1/2020

Project Status: Conceptual

COLOR	VOLTAGE	TRANSMISSION LINE NUMBER
Green	500 KV.	500 thru 599
Blue	230 KV.	200 thru 299 & 2000 thru 2099
Red	115 KV.	1 thru 199
Orange	138 KV.	AS NOTED
Cyan	69 KV.	AS NOTED



Previously Presented: 04/05/2018 TEAC

Problem Statement: N-2 Voltage Outage

- Voltage magnitude and drop violations were identified in the vicinity of BreMO 138 kV substation for the simultaneous loss of the BreMO #9 230/138 kV transformer and several single contingencies.

Recommended Solution:

- Install a second 230 -115 kV Transformer(224 MVA) approximately 1 mile north of BreMO and tie 230 kV Line #2028(BreMO – Charlottesville) and 115 kV Line #91 (BreMO-Sherwood) together. A three breaker 230 kV ring bus will split Line #2028 into two lines and Line #91 will also be split into two lines with a new three breaker 115 kV ring bus. Install a temporary 230-115 kV transformer at BreMO substation for the interim until the new substation is complete. **(b2989)**

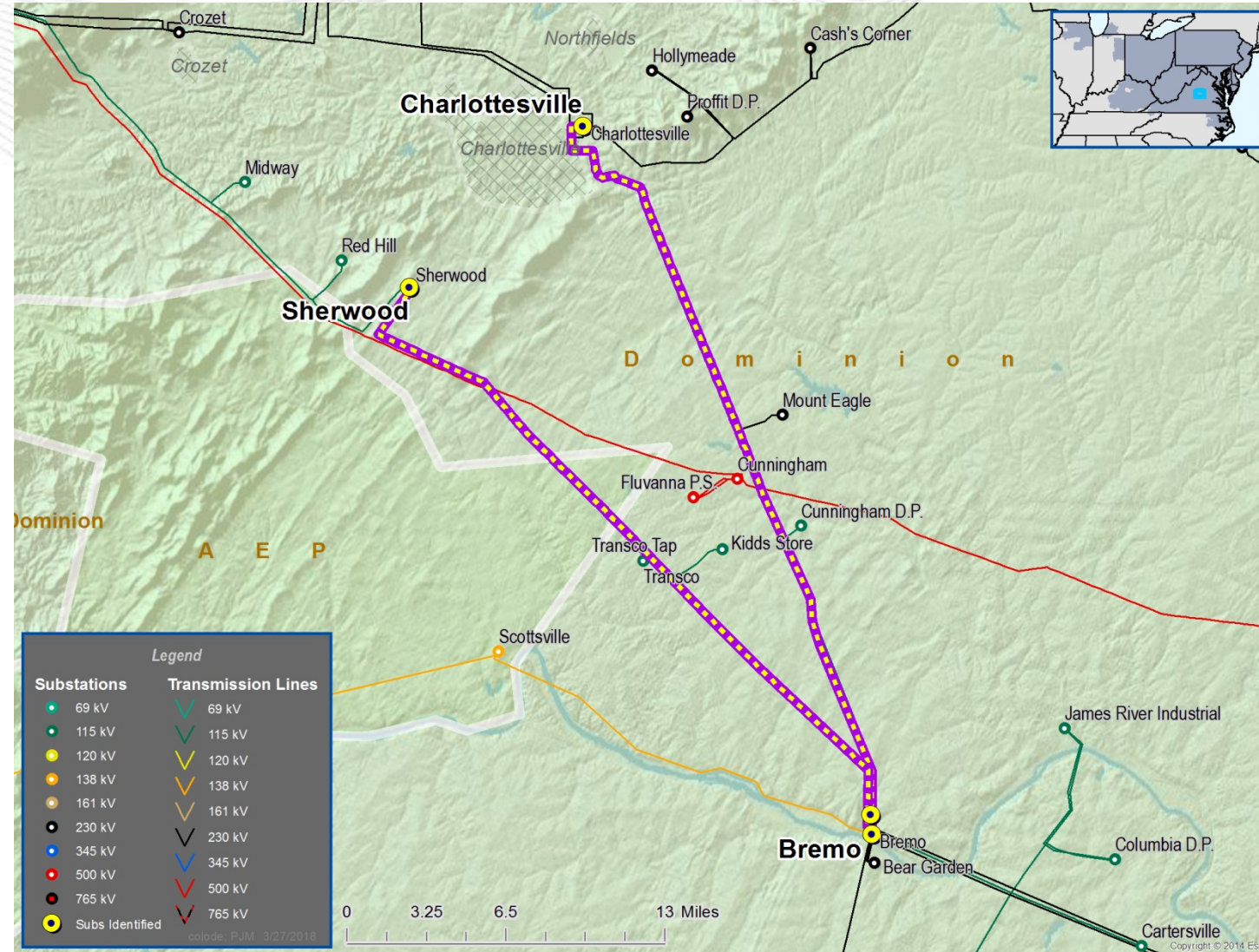
Estimated Project Cost: \$27M

Required IS Date: 06/01/2018

Projected IS Date: 06/01/2019

Project Status: Engineering

* Temporary transformer mitigates reliability impacts in the interim





Dominion Transmission Zone Deactivation Upgrades

Previously Presented: 04/05/2018 TEAC

Problem Statement: Generation Deliverability Outage

- Chesterfield to Basin 230 kV line is overloaded for the breaker failure contingency tripping the Carson to Septa 500 kV line and the Carson to Midlothian 500 kV line.

Recommended Solution:

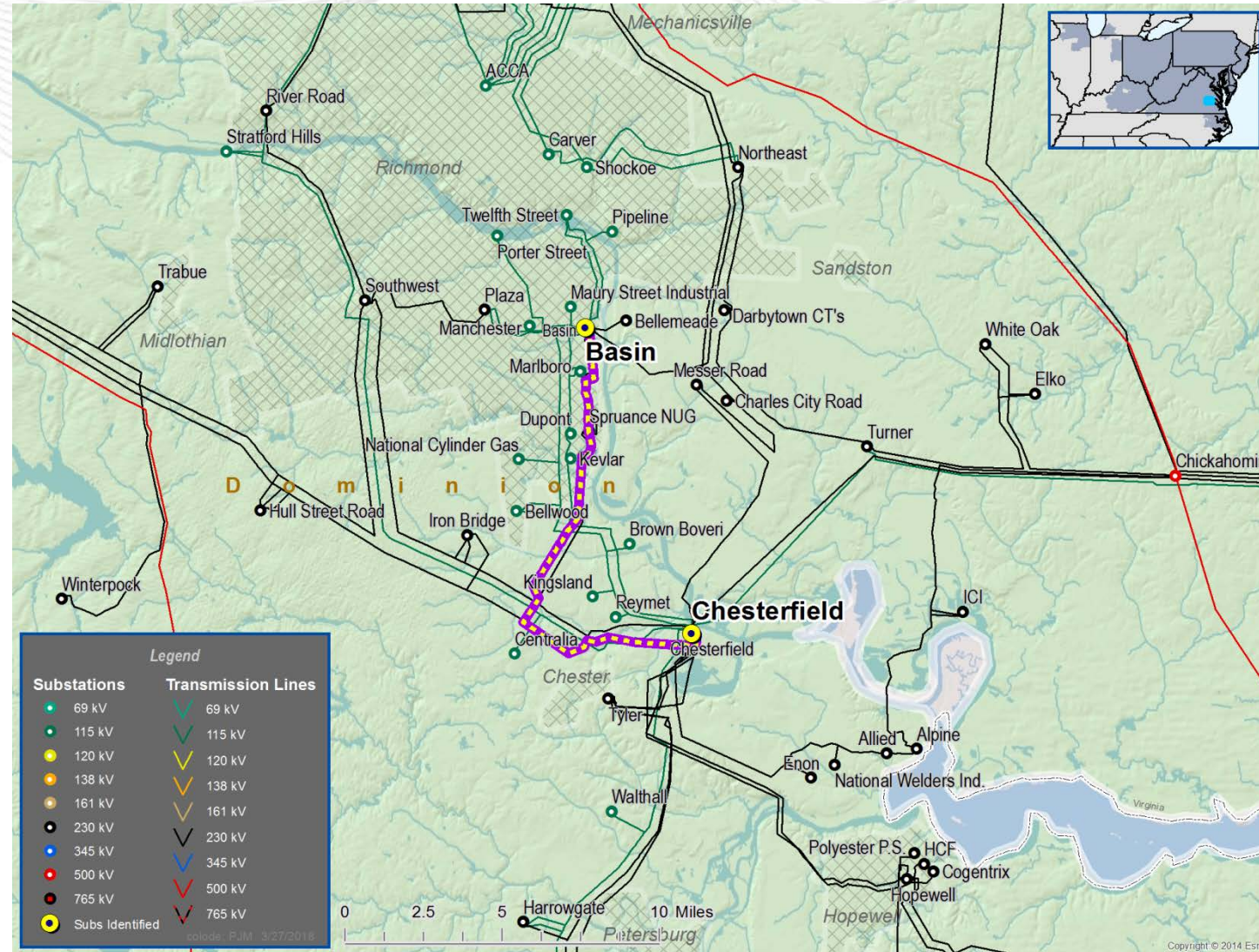
- Replace 0.14 miles of 1109 ACAR with a conductor which will increase the current line rating to approximately 706 MVA. **(b2990)**

Estimated Project Cost: \$0.35M

Required IS Date: 06/01/2018

Projected IS Date: 06/01/2018

Project Status: Engineering





Dominion Transmission Zone Deactivation Upgrades

Previously Presented: 04/05/2018 TEAC

Problem Statement: Generation Deliverability Outage

- Chaparral to Locks 230 kV line is overloaded for the breaker failure contingency tripping the Carson to Septa 500 kV line and the Carson to Midlothian 500 kV line.

Recommended Solution:

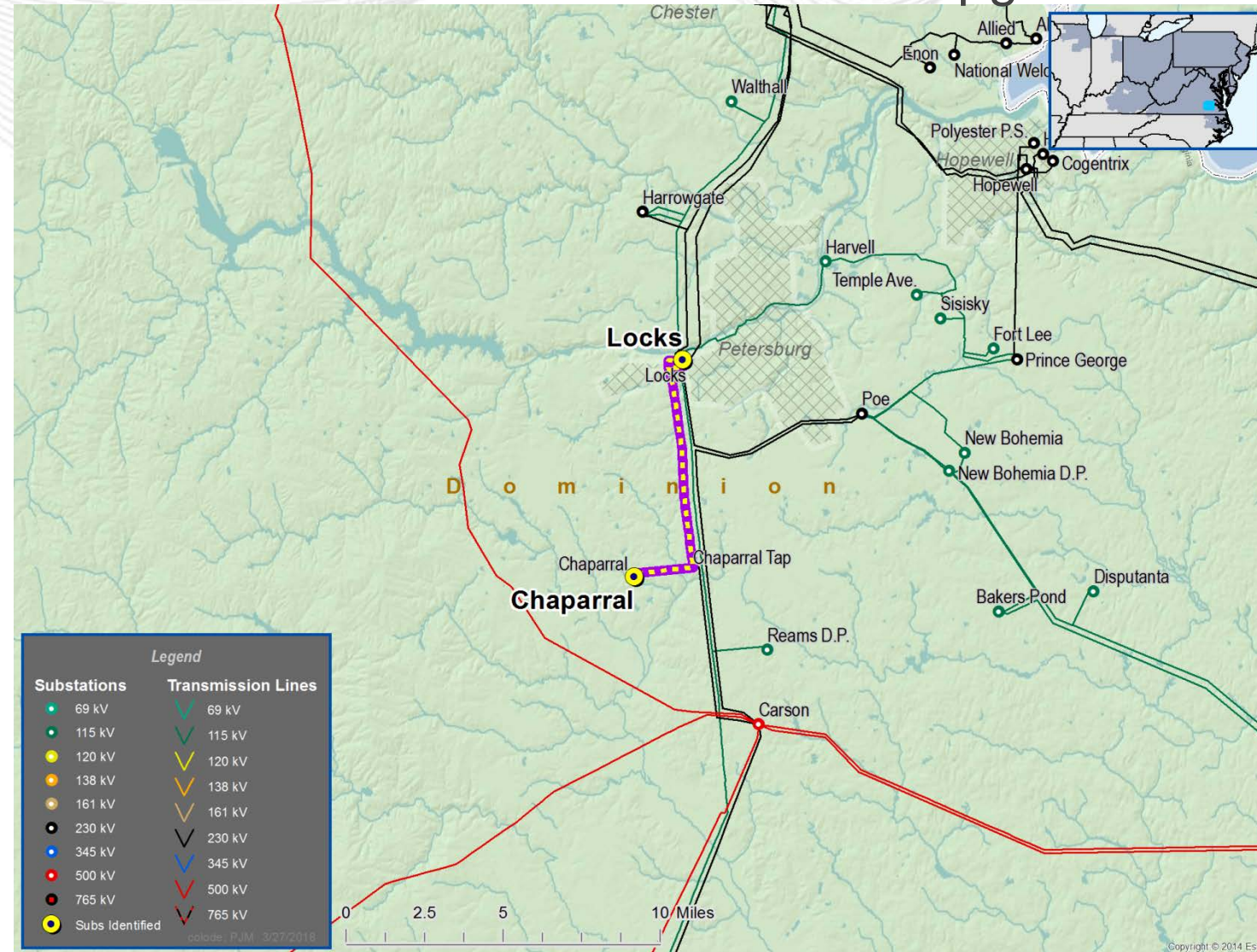
- Replace breaker lead (**b2991**)

Estimated Project Cost: \$0.1M

Required IS Date: 06/01/2018

Projected IS Date: 06/01/2018

Project Status: Engineering



- PJM anticipates that all recommended baseline solutions in today's presentation (including the Appendix) will be presented to the PJM Board in July and recommended for inclusion in the RTEP.

- V1 – 6/1/2018 – Original Slides Posted
- V2 – 6/4/2018 –
 - Corrected TO zone on slide 21 from AEP to Dominion.
 - Updated slides 44, 45 & 46 to reflect that the upgrades are driven by generation deactivations.