



Reliability Analysis Update

Transmission Expansion Advisory
Committee

May 3, 2018



2018 RTEP Analysis Update

- 2023 Base Case Development & Analysis Update
 - Summer
 - Posted preliminary 2023 summer peak RTEP base case and input files 3rd week of April
 - Targeting to post preliminary base case (N-1 thermal and voltage) and generator deliverability results 1st week of May
 - Load deliverability studies under way
 - N-1-1 thermal studies will start 1st week of May
 - Winter & Light Load
 - Cases completed and reviewed
 - Analysis will start 1st week of May

- Window 1
 - Standard 60 day window
 - Targeting opening window in early 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

Baseline RTEP Projects

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

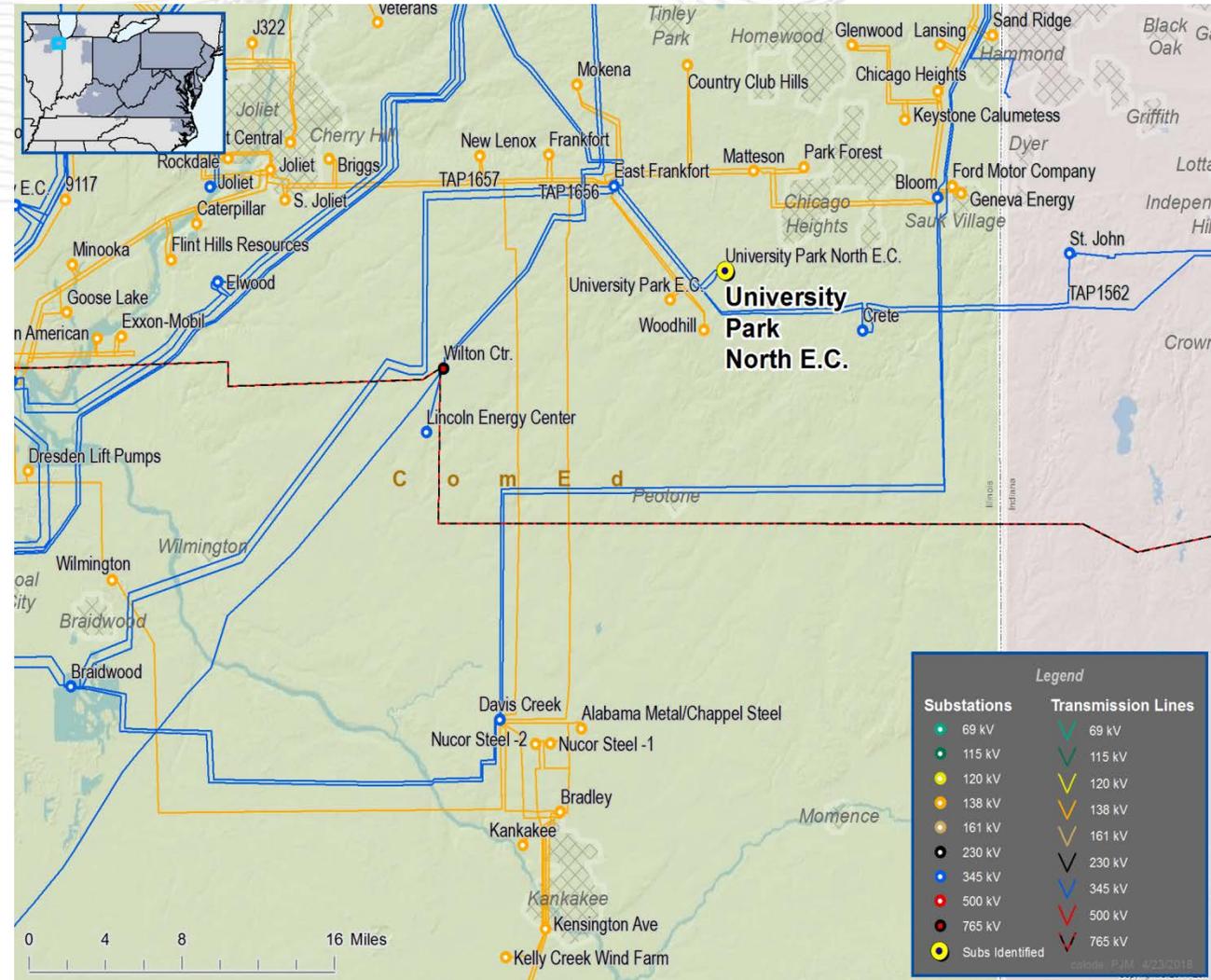
Reasons for the removal:

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





APS Transmission Zone: Baseline Flint Run 500/138 Substation

Problem Statement:

Increased customer load expectations connected to the Waldo Run 138 kV substation are causing several Gen Deliv, N-1 Thermal and N-1 low voltage violations in the vicinity of Waldo Run, Oak Mound, Pruntytown and Fairview.

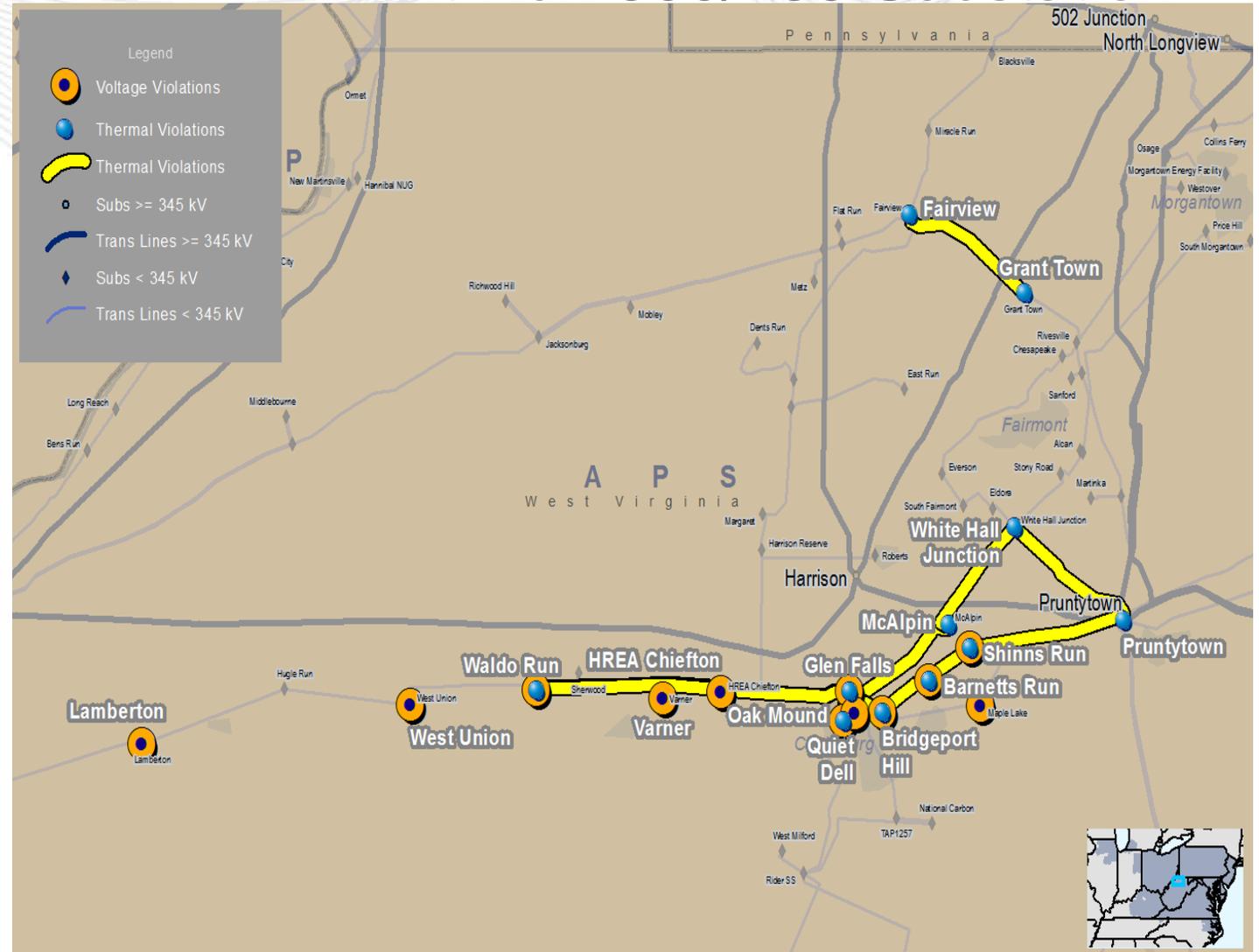
Immediate Need:

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.

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

Potential 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.

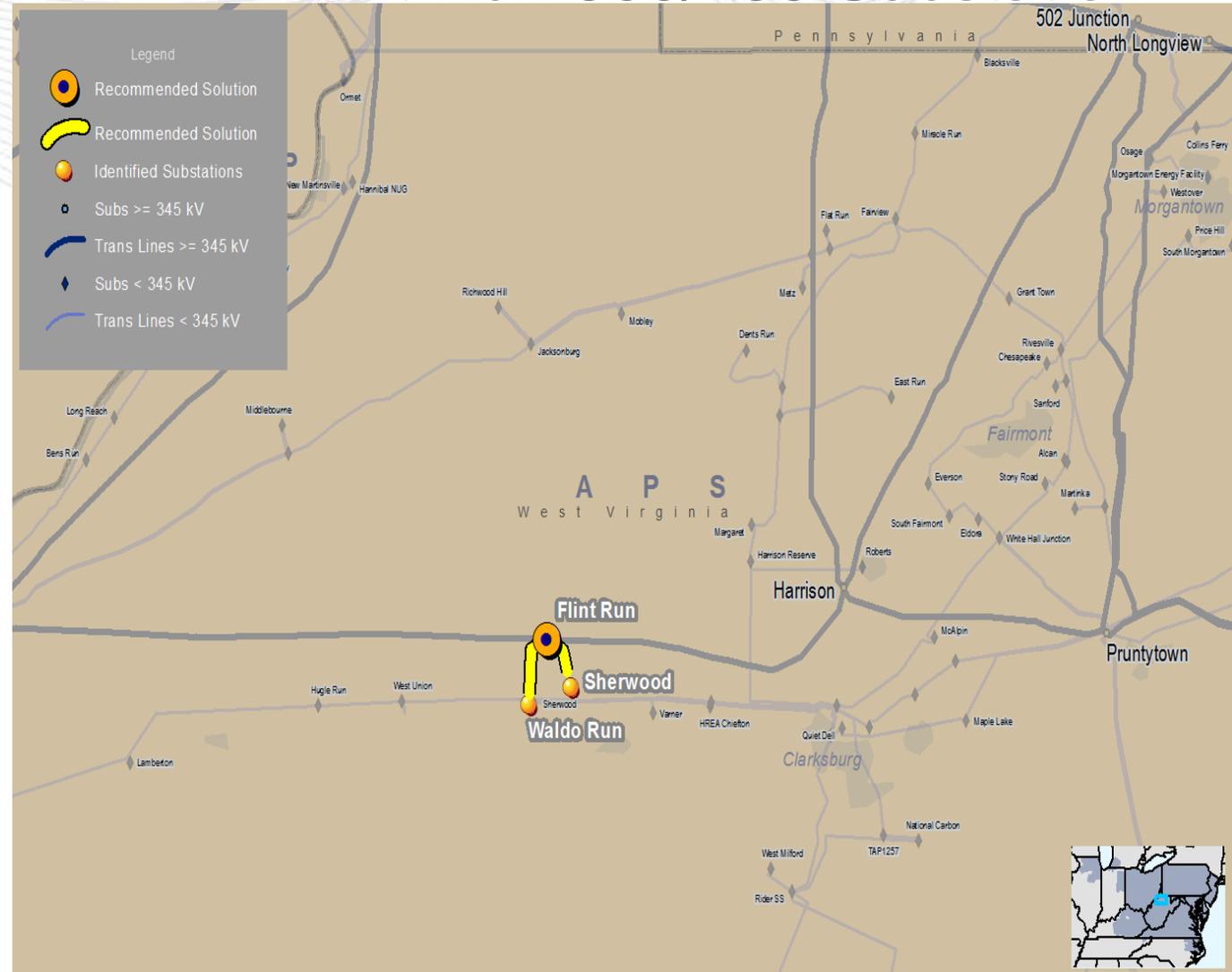
Construct two single circuit Flint Run - Waldo Run 138 kV lines using 795 ACSR (approximately 3 miles). After terminal relocation on new 3-breaker string at Waldo Run, terminate new Flint Run 138 kV lines onto the two open terminals.(b2996)

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 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)

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)

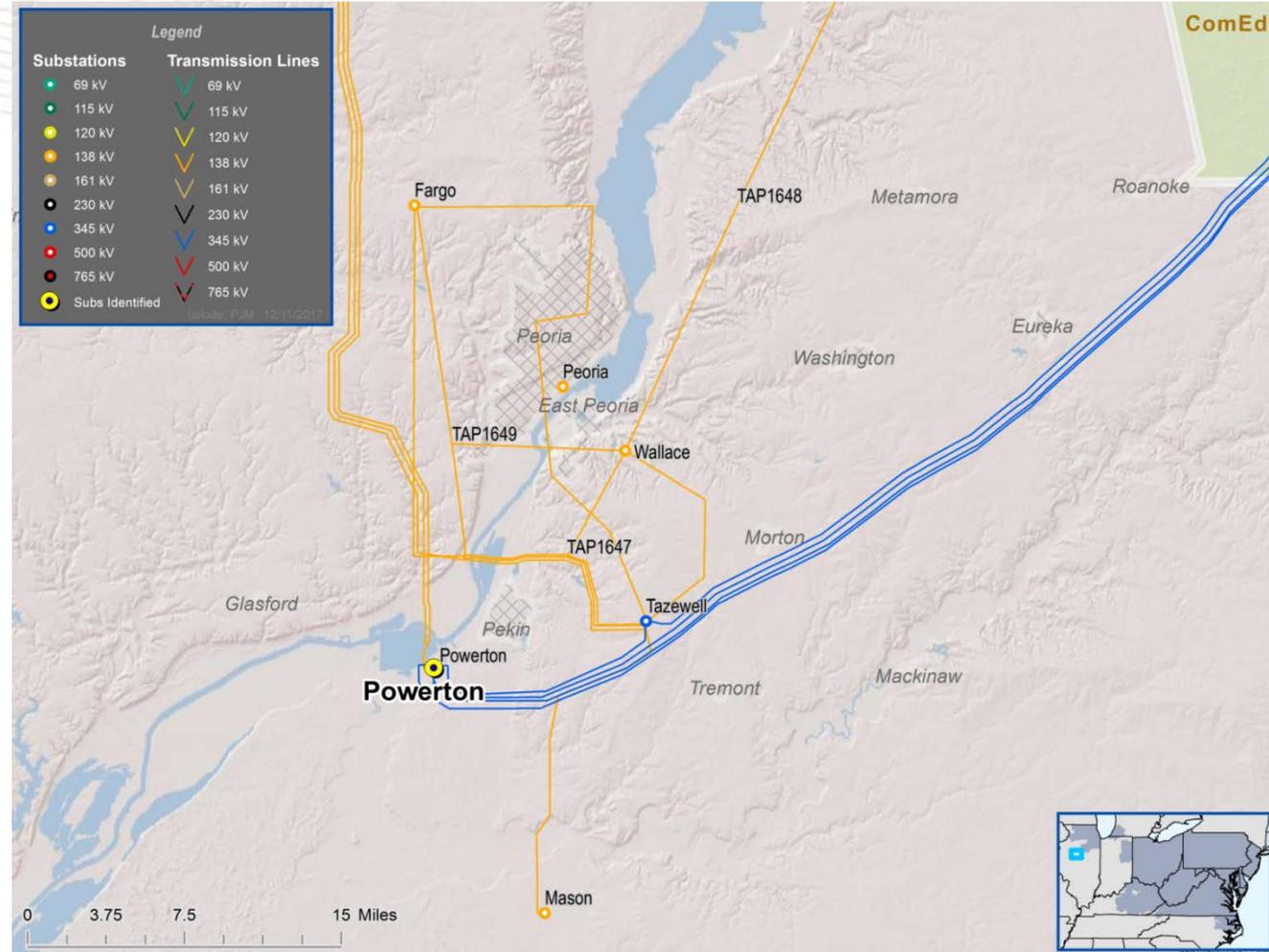
#2: At TSS 908 Mole Creek cut in three additional 345kV Powerton lines (Powerton – Katydid, Powerton - Goodings and Tazewell - Dresden)

- 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



Supplemental Projects First 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.

Alternative Solutions:

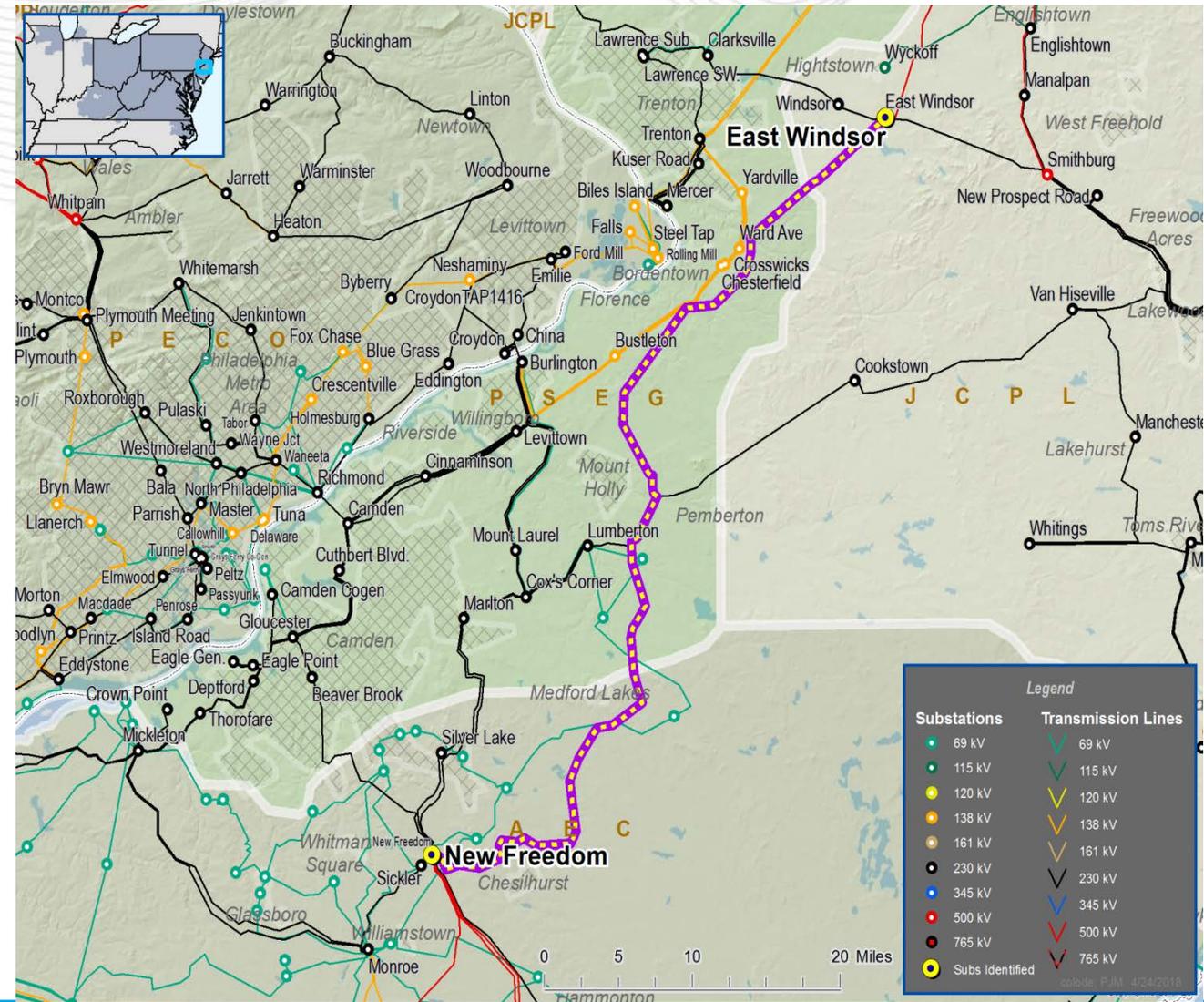
1. Replace the existing tower structure with an offset to the east of the ramp. This project will provide a clearance that meets NESC requirements along with PSE&G standards without derating the circuit.

Estimated Project Cost: \$3.9M

2. Do Nothing Alternative: Not installing the proposed structure and shifting circuit will create a constant cycle of de-rating during peak season. This has the potential to create summer capacity constraints.

Projected IS date: 12/31/2018

Project Status: Engineering



Supplemental Projects Second Review

Supplemental Project Previously Reviewed at 4/5/2018 TEAC

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The College Corner – Delaware 138kV circuit is a 1941 vintage line that has been responsible for 10 sustained outages in the last 10 years. The circuit has 12 open category A conditions and has a ~1 mile long underground section that has caused 2,000+ hours of outages. Due to past performance and conditions, this section of line will have to be addressed.

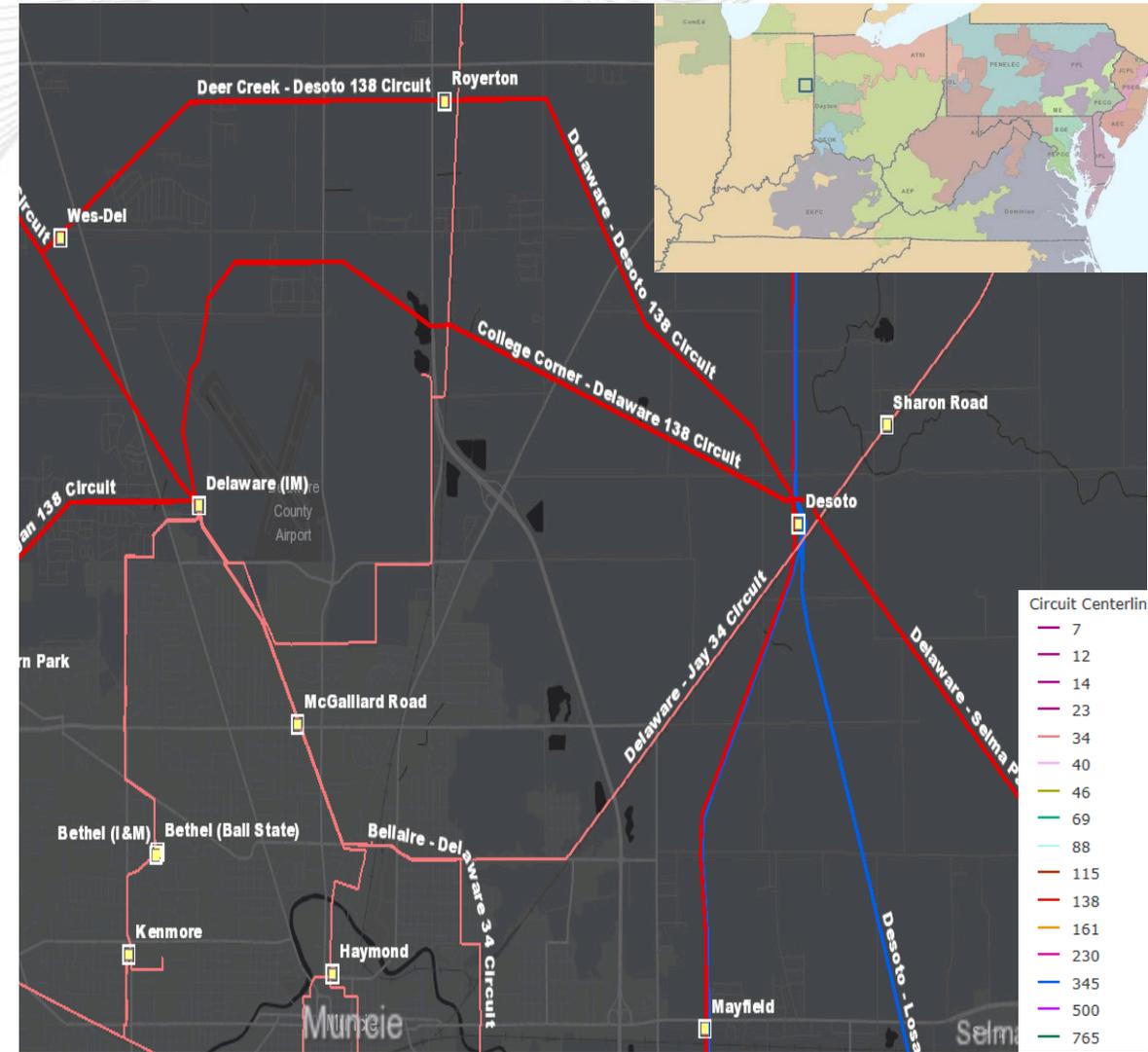
The Delaware – Deer Creek ~2 mile section being rebuilt is a 1927 vintage construction with 397 ACSR conductor (167 MVA rating) that has 46 open conditions across 11 structures. Rebuilding this portion is required if we retire the underground portion.

Operational Flexibility and Efficiency

The Tanners Creek 345kV line is hard tapped onto the Desoto 345kV bus 1. This means that any time this 48 mile line needs maintenance, AEP has to take a critical EHV bus outage. This is unacceptable from an operational standpoint and sectionalizing it with a breaker is required. Both transformers are tapped to the 345kV bus with MOAB's. Due to the high speed protections schemes associated with EHV systems and the challenges associated with keeping all three phases of the EHV MOAB's aligned, AEP standard is to install high side breaker protection on each transformer.

Desoto 138kV station is exposed to 12.55 miles of Desoto - Jay and 25.24 miles of Desoto – Madison 138kV lines. These lines were constructed in 1964 and 1928 respectively and have contributed to 12 momentary outages and 2 permanent outages in the last 10 years. Since Desoto station is a critical EHV source for the area, it is required to install a new breaker string to reduce the fault exposure seen by Desoto.

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Selected Solution

At Desoto station, install 4 345kV 5000A 63kA breakers in the 345kV yard with breaker B1 & B2 protecting the Tanners Creek #1 line, breaker D2 protecting transformer 1's high side and breaker D1 protecting transformer 2's high side. Install 5 138kV 3000A 63kA breakers; 3 to construct the new G string, 1 to finish the M string and 1 to protect the low side of transformer 2. (S1610.1)

Estimated Cost: \$9.9M

At Delaware station, retire exits toward College Corner and Selma Parker. Upgrade risers and busses on Deer Creek and Desoto exits. (S1610.2)

Estimated Cost: \$0.3M

Retire 7 miles of the Delaware-College Corner/Selma Parker double circuit 138 kV line and re-terminate it into Desoto station. (S1610.3)

Estimated Cost: \$4.7M

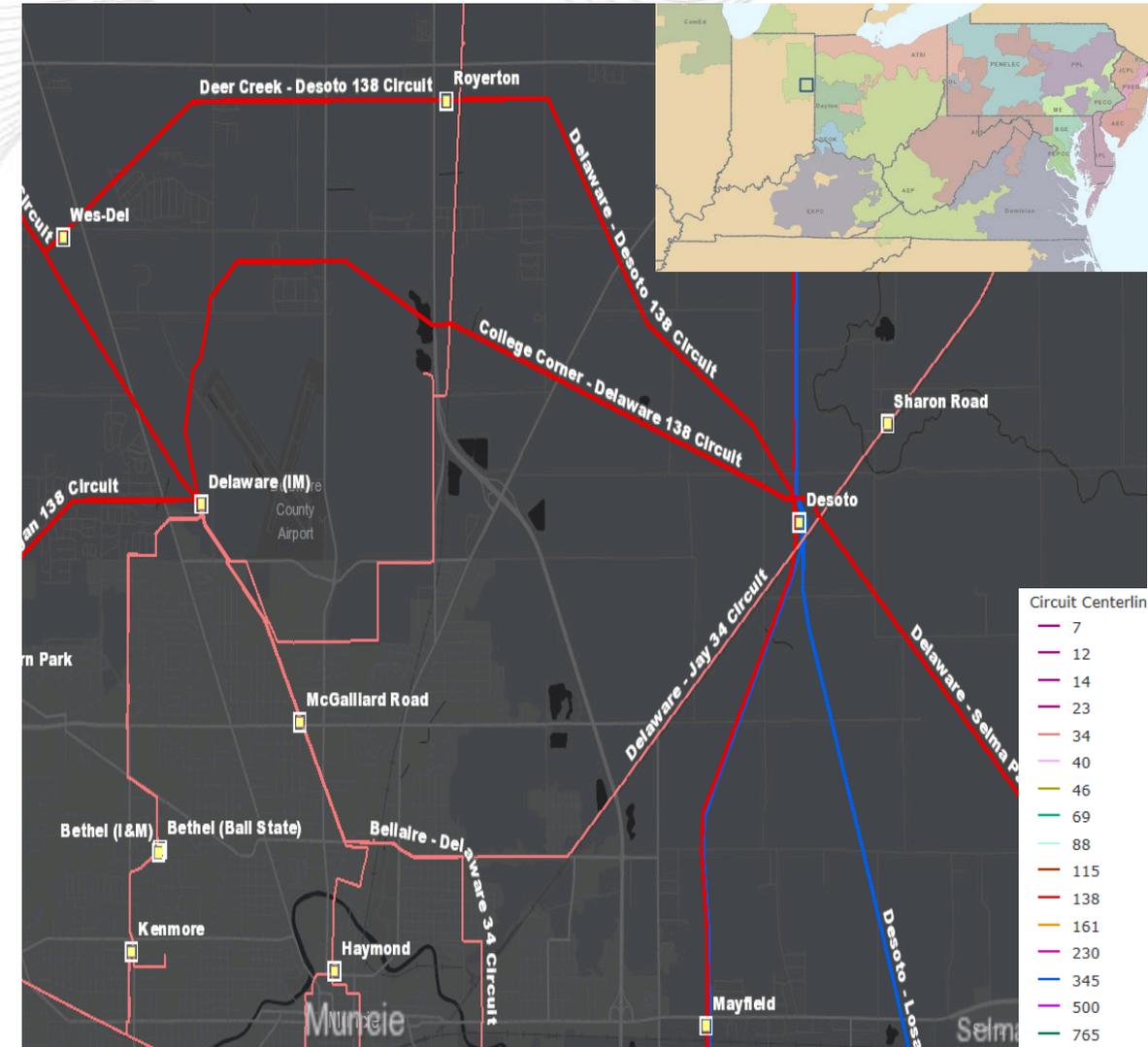
Rebuild roughly 2 miles of the Delaware-Deer Creek/Desoto line using 795 ACSR (257 MVA rating) (S1610.4)

Estimated Cost: \$6.2M

Total Estimated Transmission Cost: \$21.1M

Projected In-service: 04/29/2019

Project Status: Scoping



Supplemental Project Previously Reviewed at 4/5/2018 TEAC

Problem Statement:

Equipment Material/Condition/Performance/Risk:

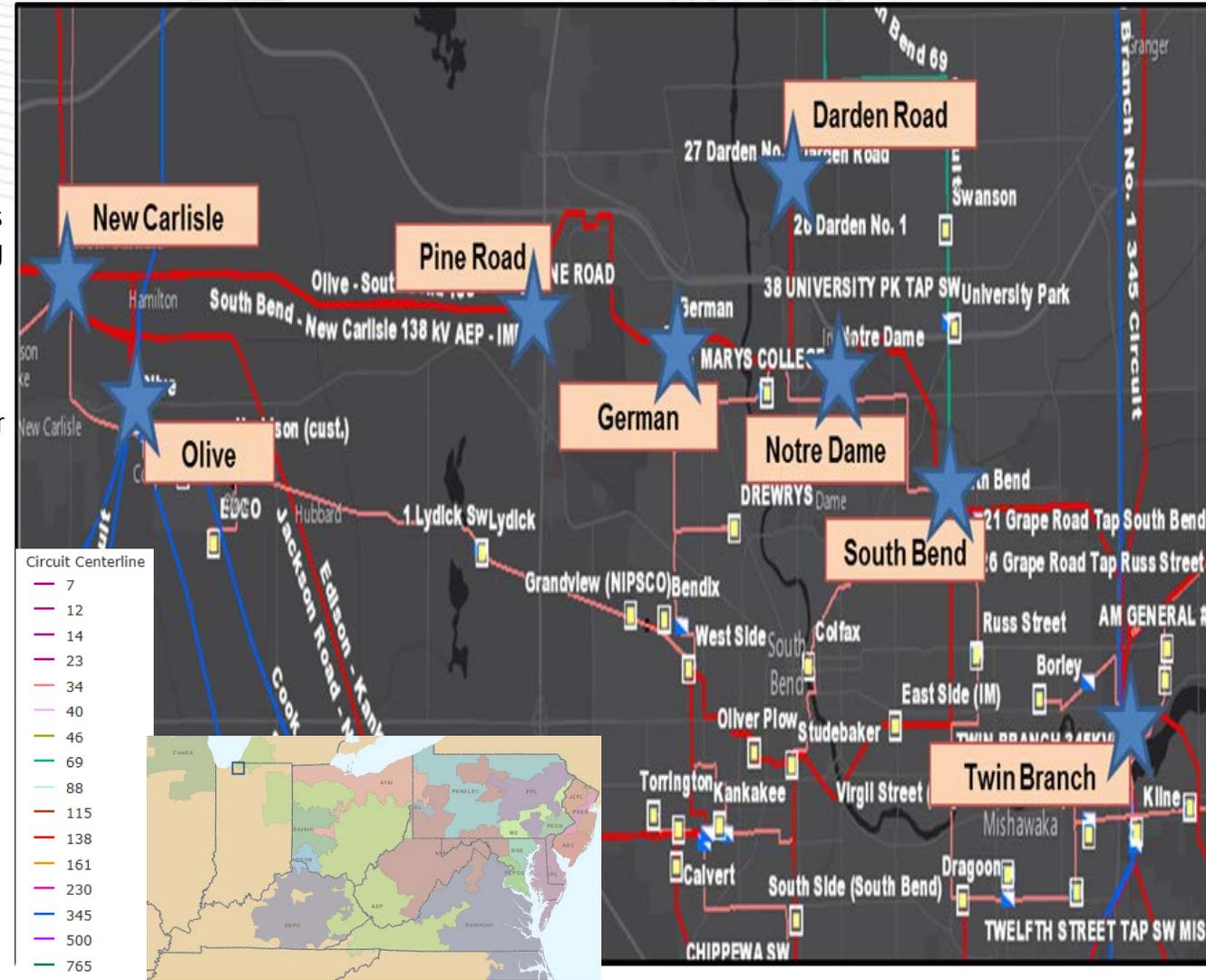
Approximately 75% of the 21.62 mile long South Bend – New Carlisle 138kV Line conductor is 1930's vintage built with 397 ACSR (167 MVA rating) and there are 128 open conditions along the entire line asset.

The Twin Branch – South Bend 138kV Line has 93% of the 4.86 miles constructed in 1925 with 397 ACSR (167 MVA rating) and there are 20 open conditions along the line asset. Multiple locations have ROW encroachment issues, several broken shield wires and conductor strands, woodpecker holes and broken aerial markers. This line also crosses a river and US route 31.

The 1966 vintage 69kV circuit breakers F at Olive Substation has operated through 8 fault operations. This oil 69kV CB is an FK model and has no oil containment. Without oil containment, environmental concerns are present. Recent inspections have also found this breaker to have issues with close operations. The velocity calculated has either been too fast or too slow. Probable causes may be a faulty damper or high pressure in the pneumatic storage tank.

Transformer #3 20 MVA 138/69kV at Olive Station was manufactured in 1950 and is showing high CO2 and Ethane measurements. It currently has failed pumps and fans, so it cannot reliably be loaded up to the name plate. The flow gauges on the pumps have also failed. It currently has oil leaks along the outlet valves. Finally the control cable for this transformer has a green substance that has been tested in other sites and is a sign of PCB contamination.

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Operational Flexibility and Efficiency

The 345/138 kV transformer at Olive is tapped directly off the bus and includes overlapping zones of protection. The 138/69 kV transformer at Olive is tapped directly off the 138 kV bus and includes overlapping zones of protection. These overlapping zones can lead to misoperations and relay coordination challenges.

There are currently four MOABs in series on this line, which is against current AEP standards. Breakers will be installed at German station to eliminate this potential source of misoperations.

Selected Solution

At German Station, install 3000A 40 kA 138kV line Breakers towards South Bend Station and Olive Stations. ~~(S1611.1) Estimated Cost: \$3.1M (Cancelled)~~

At South Bend Station, upgrade risers towards Olive and Twin Branch. (S1611.2) Estimated Cost: \$0.7M

At Twin Branch Station, upgrade risers towards South Bend. (S1611.3) Estimated Cost: \$0.5M

At Olive Station, install one 345kV CB, one 138kV CB, replace 69kV CB F and replace 138/69/34kV TR#3 with 60 MVA 138/69kV TR#3. (S1611.4) Estimated Cost: \$5.2M

Rebuild existing double circuit South Bend - New Carlisle 138 kV line asset with 795 ACSR (257 MVA rating), approximately 18.74 miles. (S1611.5) Estimated Cost: \$45.0M

Rebuild existing six wired Twin Branch – South Bend 138 kV line asset with single circuit line with 795 ACSR (257 MVA rating), approximately 4.8 miles. (S1611.6) Estimated Cost: \$9.9M

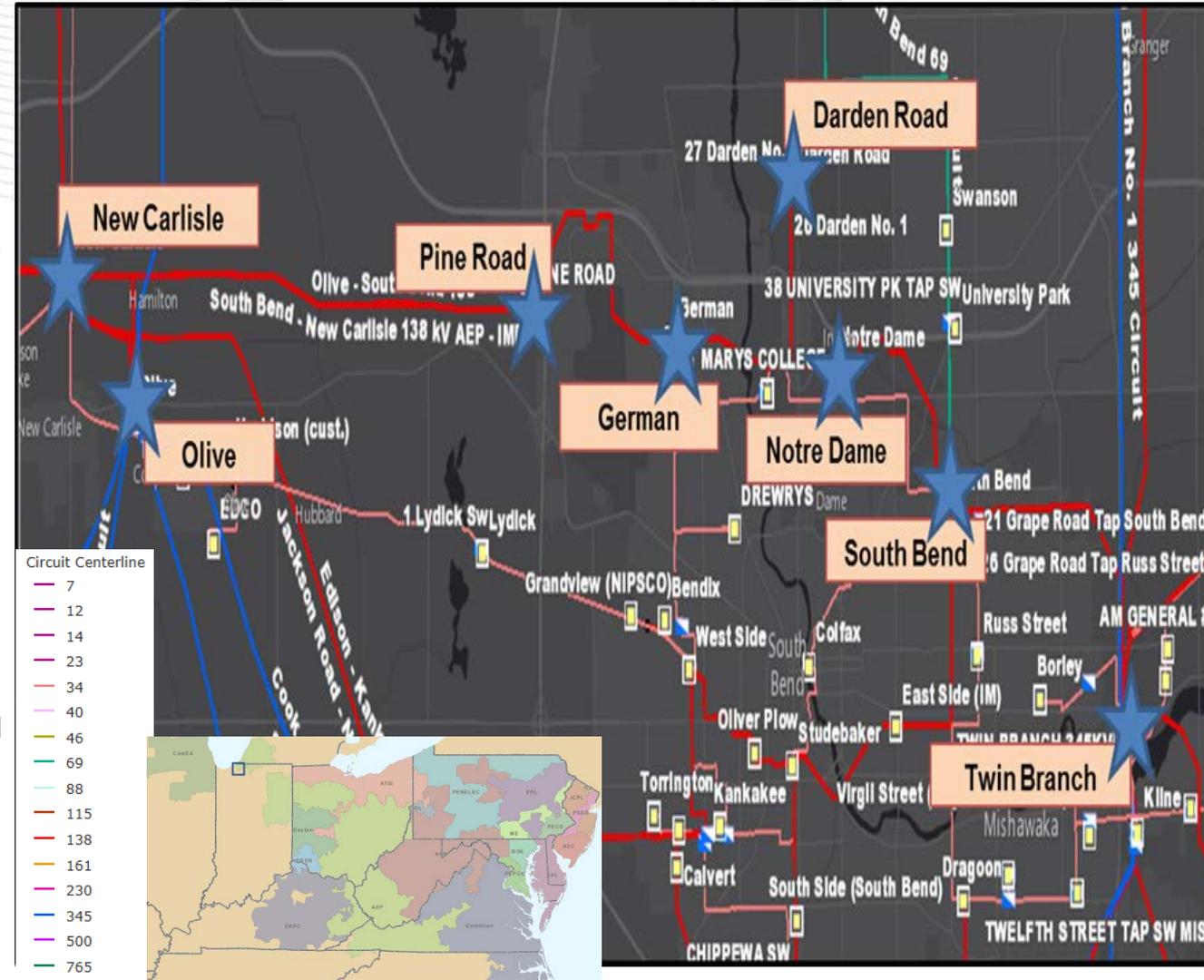
Rebuild existing double circuit Olive Entrance B 138kV Line asset with 795 ACSR (257 MVA rating), approximately 1 mile. (S1611.7) Estimated Cost: \$2.9M

Split the East Side - South Bend line off of the South Bend – Twin Branch shared pole. (S1611.8) Estimated Cost: \$0.2M

Total Estimated Transmission Cost: \$64.4M

Projected In-service: 06/30/2020

Project Status: Engineering



Scope Change Projects

Cancelled Projects

- 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.

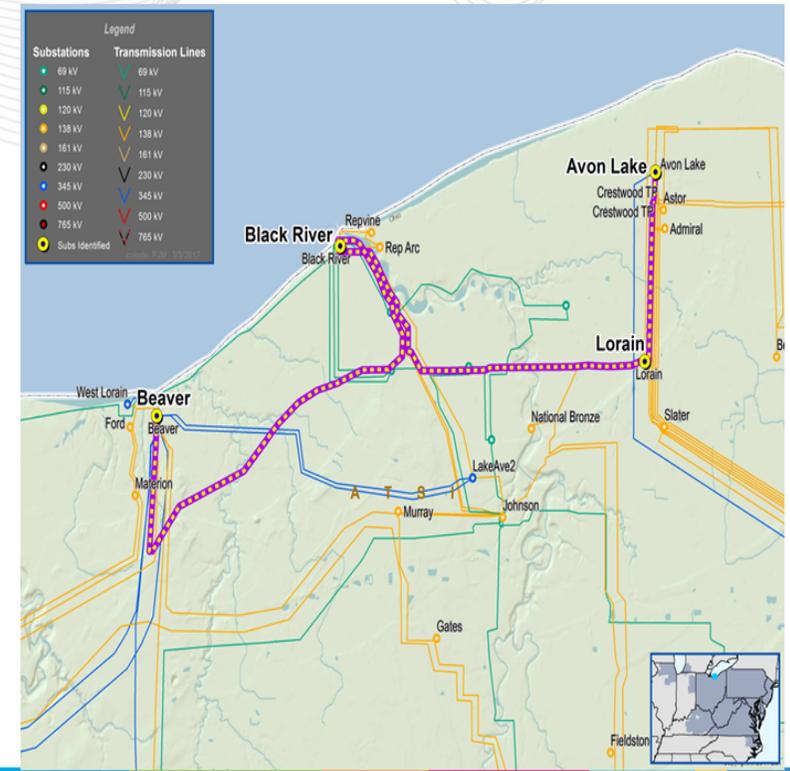
- **Baseline (FG# 99, 100, 101) and Common Mode Outage (FG# 754, 918, 919, 920, 921) Violation**
- **2014 RTEP Proposal Window #1 Violations**
- The Black River to Lorain 138 kV circuit is overloaded for multiple category C contingencies.
- Recommended Solution: Reconductor the Black River-Lorain 138kV 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

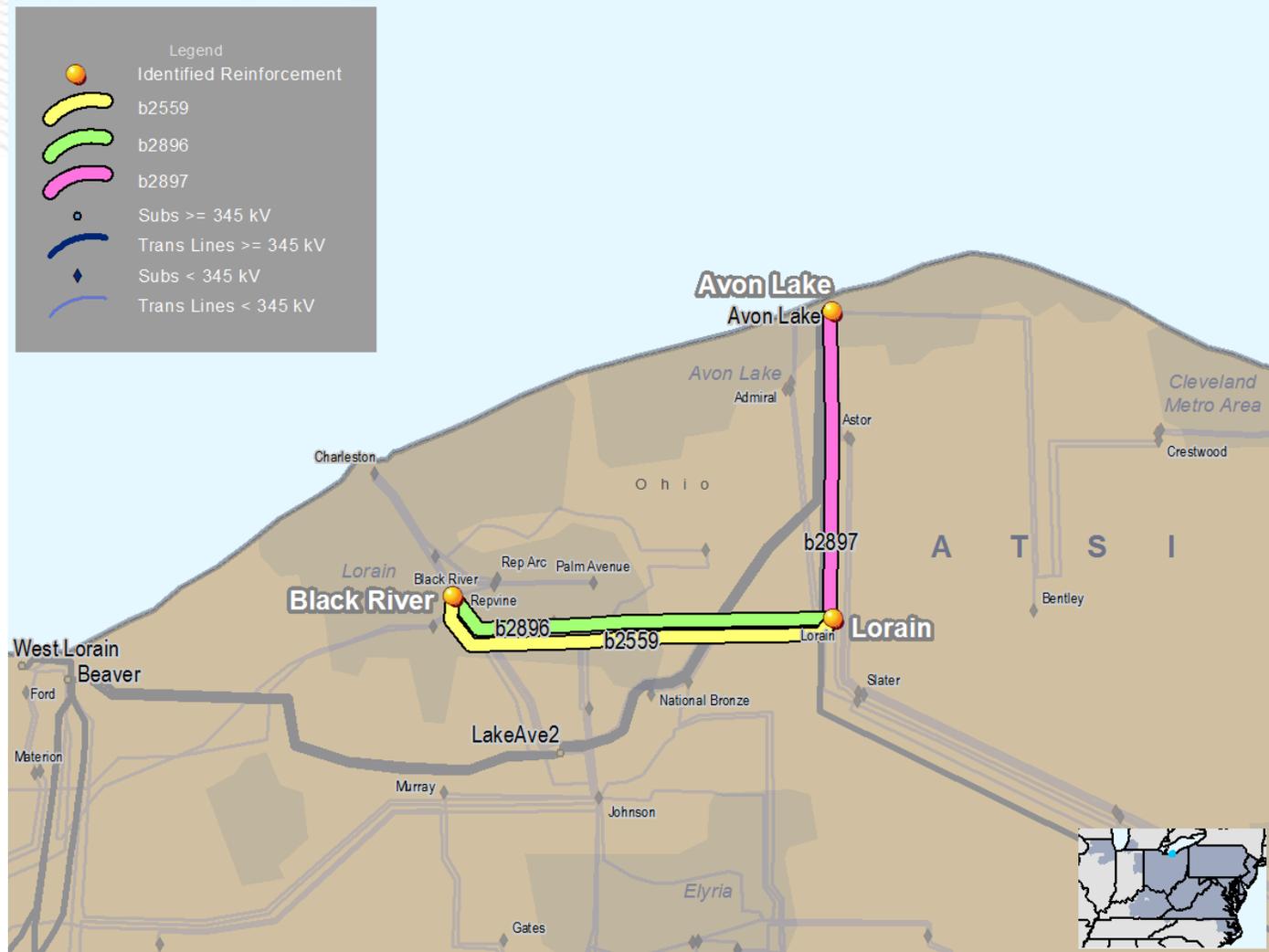


- 2016 RTEP Analysis, which included the b2559 project, identified additional violations on the Black river-Lorain-Avon circuit
- These 2016 RTEP violations were resolved with a group of upgrades including:
 - Rebuild/Reconductor the Black River – Lorain 138 kV circuit. (2016_3A-3B) → b2896
 - Reconductor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



Services & Requests

RTEP Upgrades & Status

RTEP Development

Resource Adequacy Planning

Planning Criteria

Design, Engineering & Construction

Interregional Planning

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](#).

	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 Window 1

OPEN 5.3.2018
 CLOSED 7.2.2018

ZIP 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.

Problem Statement
 With Analytical Files (EXE) - requires access approval for critical energy infrastructure information (CEII)
 Without Analytical Files (PDF)

TEAC White Papers
 May 2018 (PDF)



[Training Video](#) |
 [User Guide](#) [PDF](#)
[Register for community](#)

Window Registration

Submit a [CEII Request](#) to gain access to the appropriate RTEP Planning Cycle.

Email List

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

Proposal Submissions

[Pre-Qualification for Designated Entity Status](#)

[Submit a Proposal](#)

[Demonstration Video](#) [WEB](#)

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.

- RTEP@pjm.com will be retired effective September 1, 2018
- All Planning questions should be asked through the Planning Community
- As a reminder, the Planning Community is moderated and no confidential or CEII information will be posted publicly
- Registration for the Planning Community can be found on the Planning, Planning Committee, and TEAC pages of PJM.com



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**

- V1 – 4/26/2018 – Original Slides Posted
- V2 – 4/30/2018:
 - Slides 7,8 - Updated description of alternative analysis and potential solution.
 - Added slides 17 & 18 for Dominion’s Winter’s Branch project scope change.
- V3 – 5/1/2018:
 - Slides 6- Changed Davis Creek to University Park North.
- V4 – 5/7/2018:
 - Slide 6- Estimated Cost is 0.1M.
 - Slides 13,15 – Add Previously Reviewed TEAC Date
 - Slides 20,21,22 – Corrected Baseline Upgrade ID in header
- V5 – 5/30/2018
 - Slide 8 - Updated In Service date

- V6 – 6/8/2018
 - Slide 16 - Cancelled S1611.1 and updated cost for S1611.3 (from \$1.8M->\$0.5M) and the total project cost for South Bend Rebuild (from \$68.8 ->\$64.4M)