Sub Regional RTEP Committee
PJM West

February 14, 2018

Continue Dec. 18, 2017 SRRTEP slides (#115 - #147)

http://www.pjm.com/-/media/committees-groups/committees/srrtep-w/20171218/20171218-srrtep-w-reliability-analysis-update.ashx

First Review

Baseline Reliability and Supplemental Projects

ComEd Transmission Zone: Supplement
Glidden Hardening

Problem Statement:
Glidden substation does not comply with ComEd standards
Single breaker failure will trip the entire station.
Transformer failure trips two transformers.
Transformer maintenance requires de-energization of the 138kV bus and two transformers

Potential Solution:
Expand Glidden substation from a straight bus to a ring bus
Install seven 138kV breakers to create a ring bus
Install four transformer high side breakers

Estimated Cost: $21M

Alternatives:
- Upgrade to breaker and a half
- Do nothing

Projected In-service: 12/31/2020

Project Status: Engineering

ComEd Transmission Zone: Supplement
Lisle 345-138kV Transformer Tertiary Cap bank Replacement

Problem Statement:
Tertiary cap banks no longer installed on tertiary windings.
Tertiary cap bank failures stress the 345-138kV transformers and have caused transformer failures in the past.

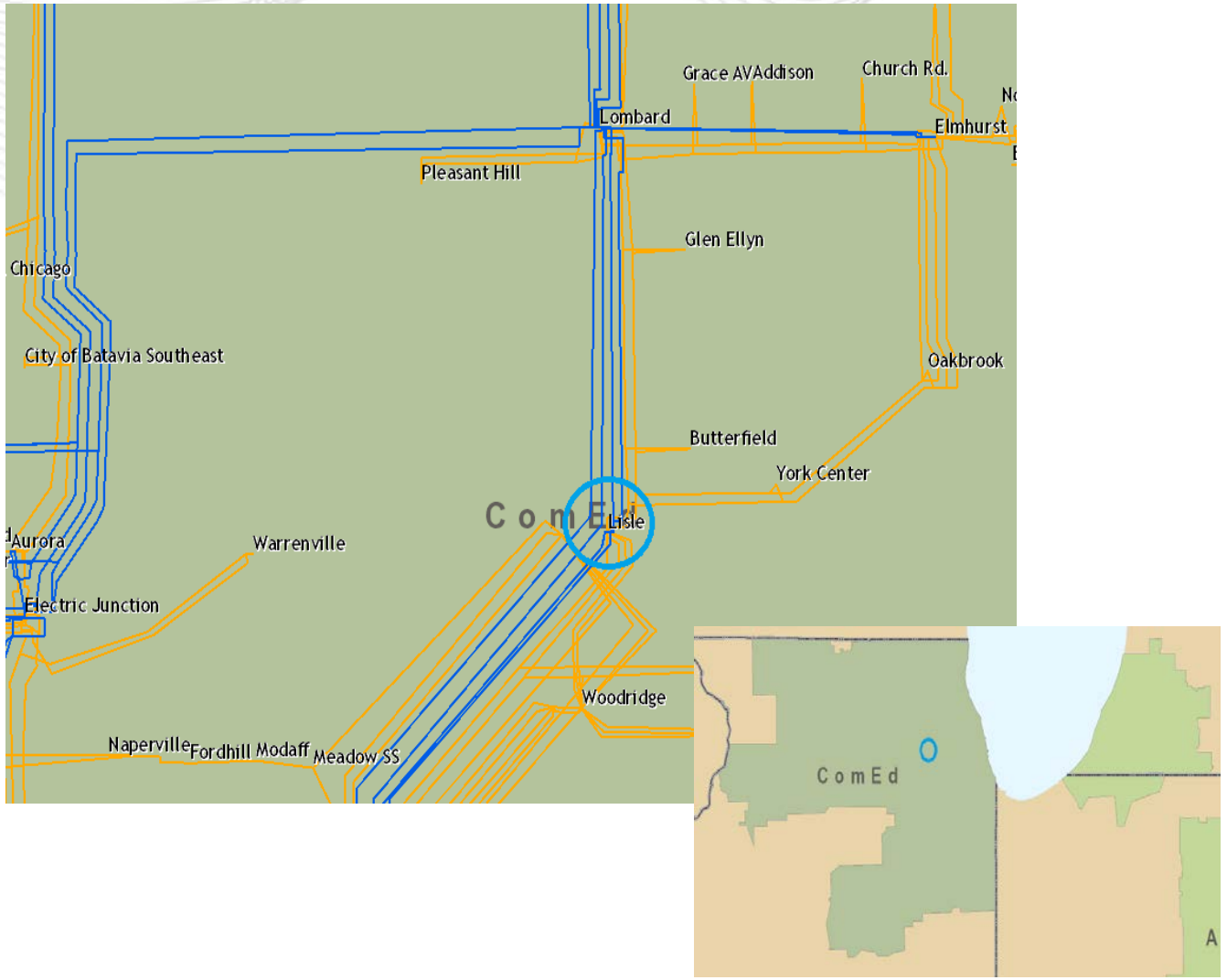
Potential Solution:
Remove tertiary capacitor banks and install 138 kV capacitor banks
Increase the thermal capability of the 345-138kV autotransformer

Estimated Cost: $6M

Alternatives:
- Do nothing

Projected In-service: 12/31/2018

Project Status: Engineering



ComEd Transmission Zone: Supplement
Ameren's Corbin Switching Station

Problem Statement:
Ameren (MISO) is retiring the Oglesby substation

- Oglesby is currently tapped off of 138kV line 7713
  - Line 7713 is a three terminal line

Potential Solution:
ComEd will cut 138kV line 7713 in and out of the new Ameren Oglesby substation

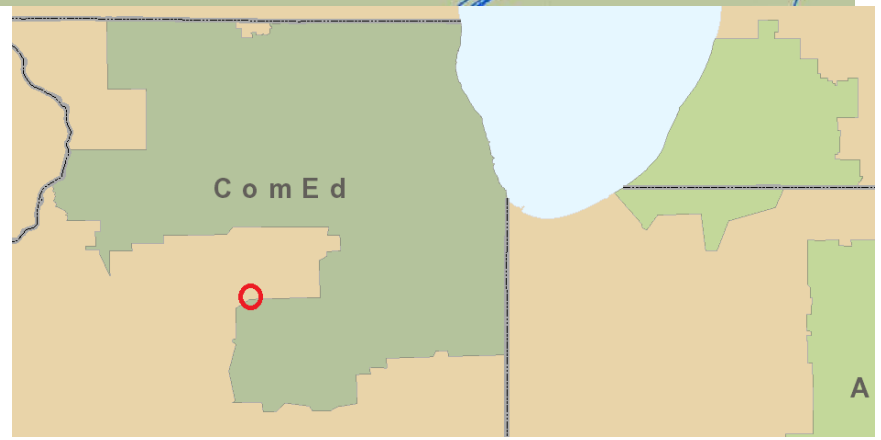
Requires additional structures to facilitate the installation of the new substation and the cutting in and out of the existing 138kV line 7713

Estimated Cost: $1M for ComEd

Alternatives:
Maintain 138kV line 7713 as a three terminal line.

Projected In-service: 12/31/2021

Project Status: Conceptual



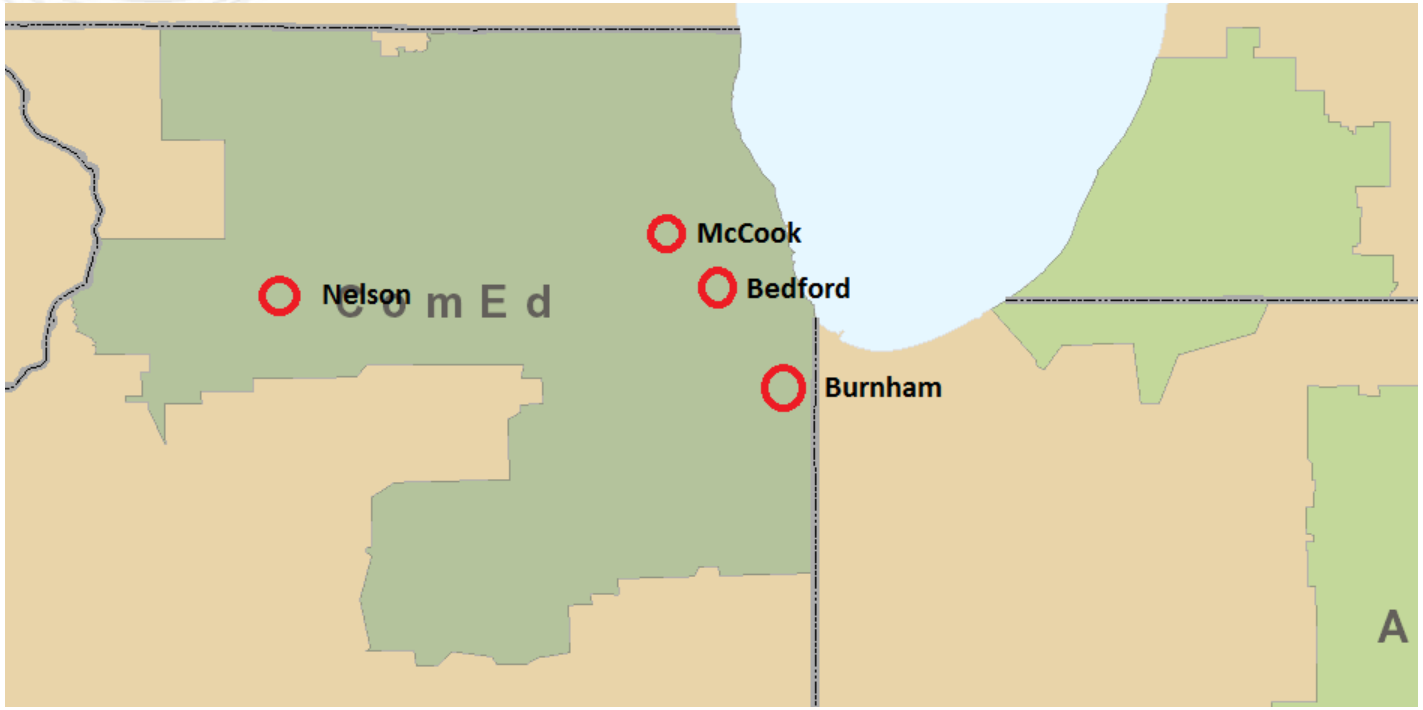
ComEd Transmission Zone: Supplement
Modernize 138kV Relays

Problem Statement:
Replacing obsolete electromechanical relays with microprocessor relays

- Improved performance
- Add SCADA connectivity
- Allow real time data gathering of Transmission events

Potential Solution:
Update relay packages at various location:

- 138kV line 15518 (Nelson-Rockfalls-Garden Plain) the upgrade is at Nelson and Rockfalls
- 138kV line 5104 (McCook-Bedford Park-Burr Ridge) the upgrade is at Bedford Park and Argonne
- 138kV line 7307 (Burnham-Chicago Heights) the upgrade is a Burnham and Chicago Heights



Estimated Cost: Transmission $320K per terminal

Alternatives:

- Do Nothing

Projected In-service: 12/31/2018

Project Status: Engineering

ComEd Transmission Zone: Supplement
138kV line 17712 Wave Trap Replacement

Problem Statement:
138kV line 17712 wave trap needs to be replaced due to material condition.

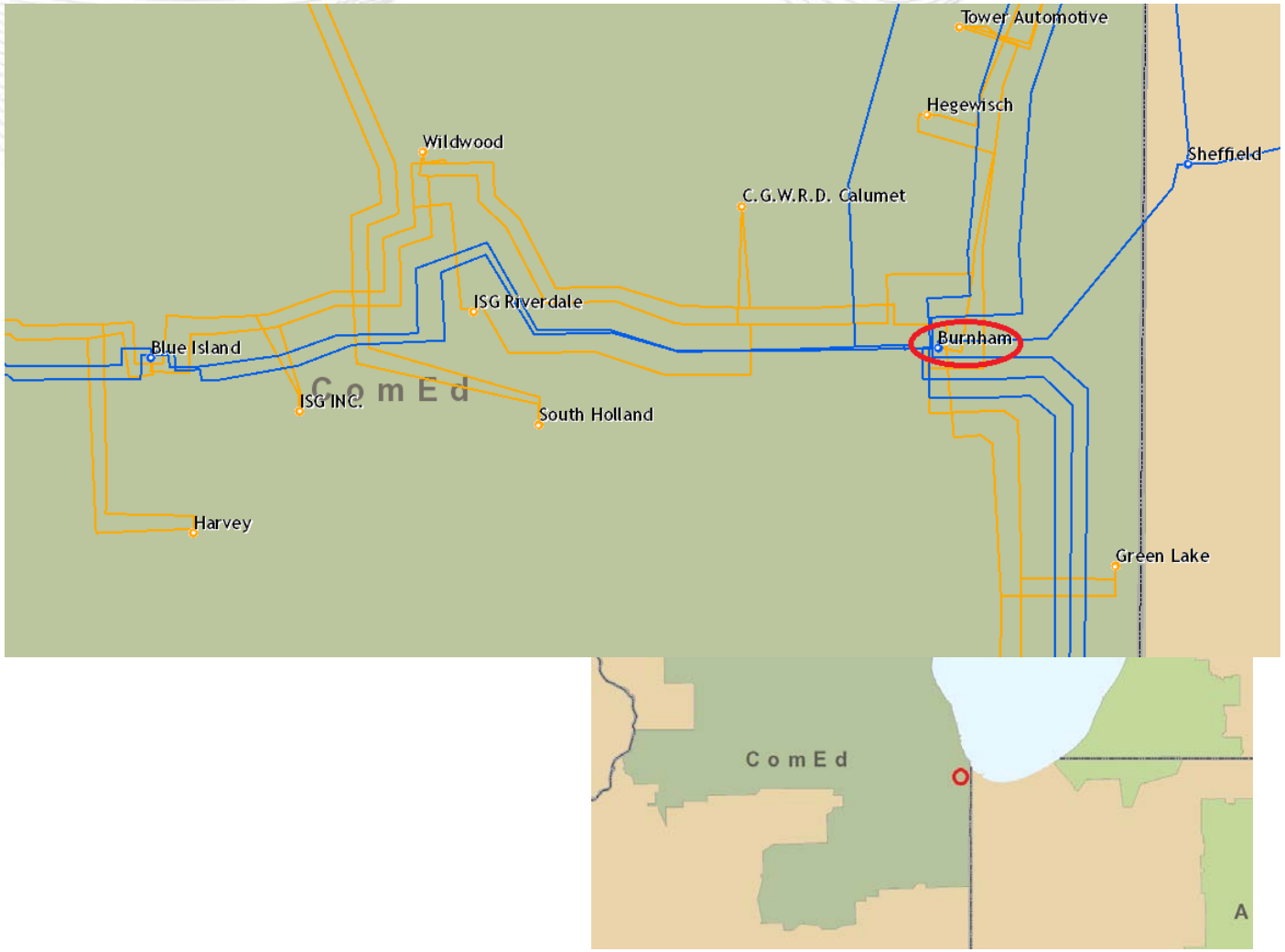
Potential Solution:
Replace the wave trap at the Burnham substation for 138kV line 17712

Estimated Cost: $50K

Alternatives:
- No alternatives – run to failure

Projected In-service: 12/31/2018

Project Status: Engineering



DUQ Transmission Zone: Supplemental Wilmerding Breaker Replacement

Problem Statement

The Wilmerding #86 and #88 138kV breakers were installed in 1968. The #88 breaker feeds a transmission customer and has the potential to remove this customer from service if not replaced. The lifespan of these breakers have been optimized and each are now at the end of their useful lives based on material condition and performance.

Drivers: Equipment Material Condition, Performance and Risk

Potential Solution:

Replace Wilmerding SS - #86 138kV Breaker (Present rating: 37.1kA, Future rating: 50kA).

Replace Wilmerding SS - #88 138kV Breaker(Present rating: 37.9kA, Future rating: 50kA).

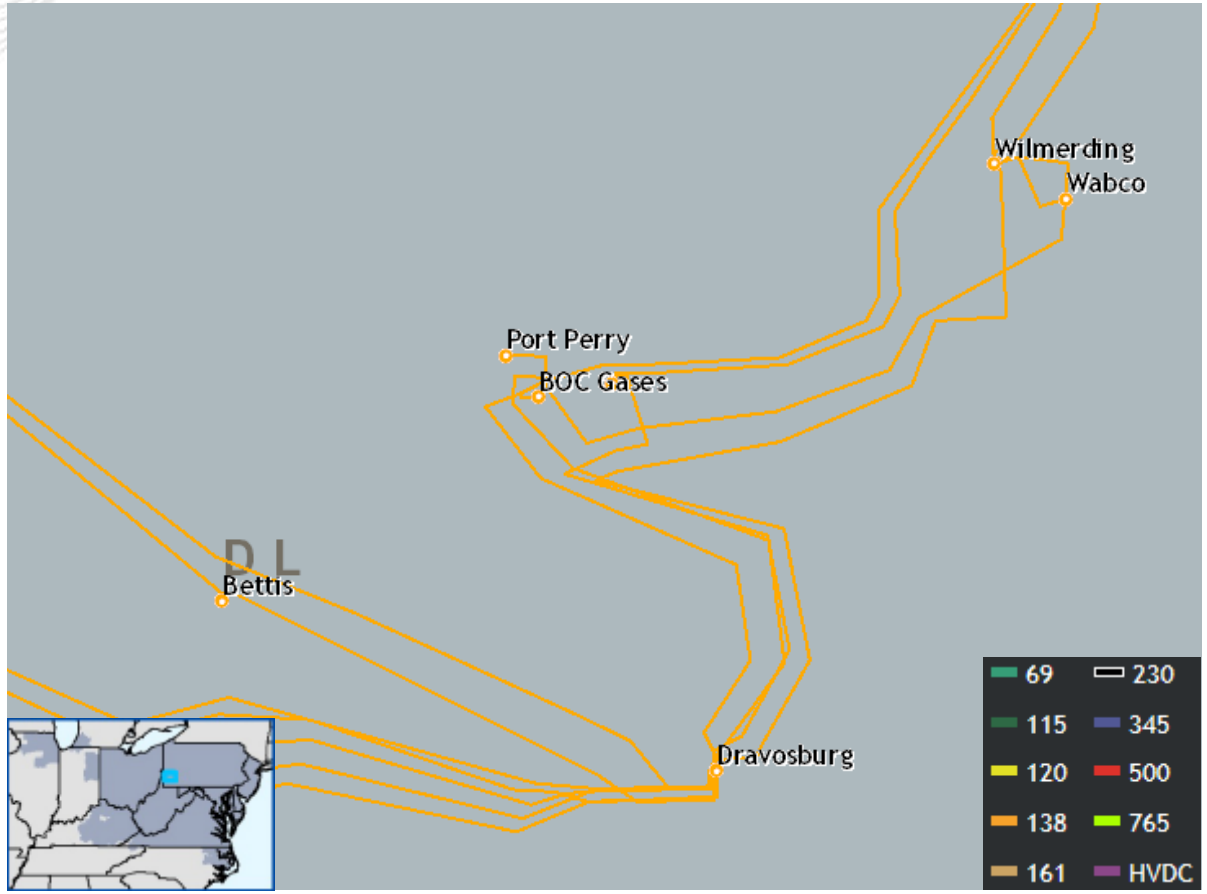
Alternatives Considered:

No cost effective alternatives.

Estimated Project Cost: $0.38M each

Projected IS Date (Expected IS Date): 9/30/2018

Status: Engineering



AEP Transmission Zone: Supplemental
Ambler Ridge Station

Problem Statement:

Operational Flexibility and Efficiency:

Currently AEP serves three critical customers from Thorofare Creek Switching Station. Due to physical limitations, AEP is unable to install circuit breakers at the Thorofare Creek Station. Therefore, by installing two 138 kV line breakers at Ambler Ridge Station, these critical customers will have line fault exposure reduced by 14 miles.

Customer Service:

Obligation to serve distribution customer request at a new station. Ambler Ridge station will serve approximately 6 MVA of load, transferred from Clendenin station.

Potential Solution

Construct a 138/34.5kV distribution station (Ambler Ridge). Install a new 138/34.5 kV 30 MVA transformer, two 3000 A 138 kV CB's and a 3000 A 40 kA 138 kV circuit switcher. **Estimated Cost: $1.5M**

Route the Thorofare – Chloe 138 kV in and out to Ambler Ridge Station.

Estimated Cost: $0.0M (funded by distribution)

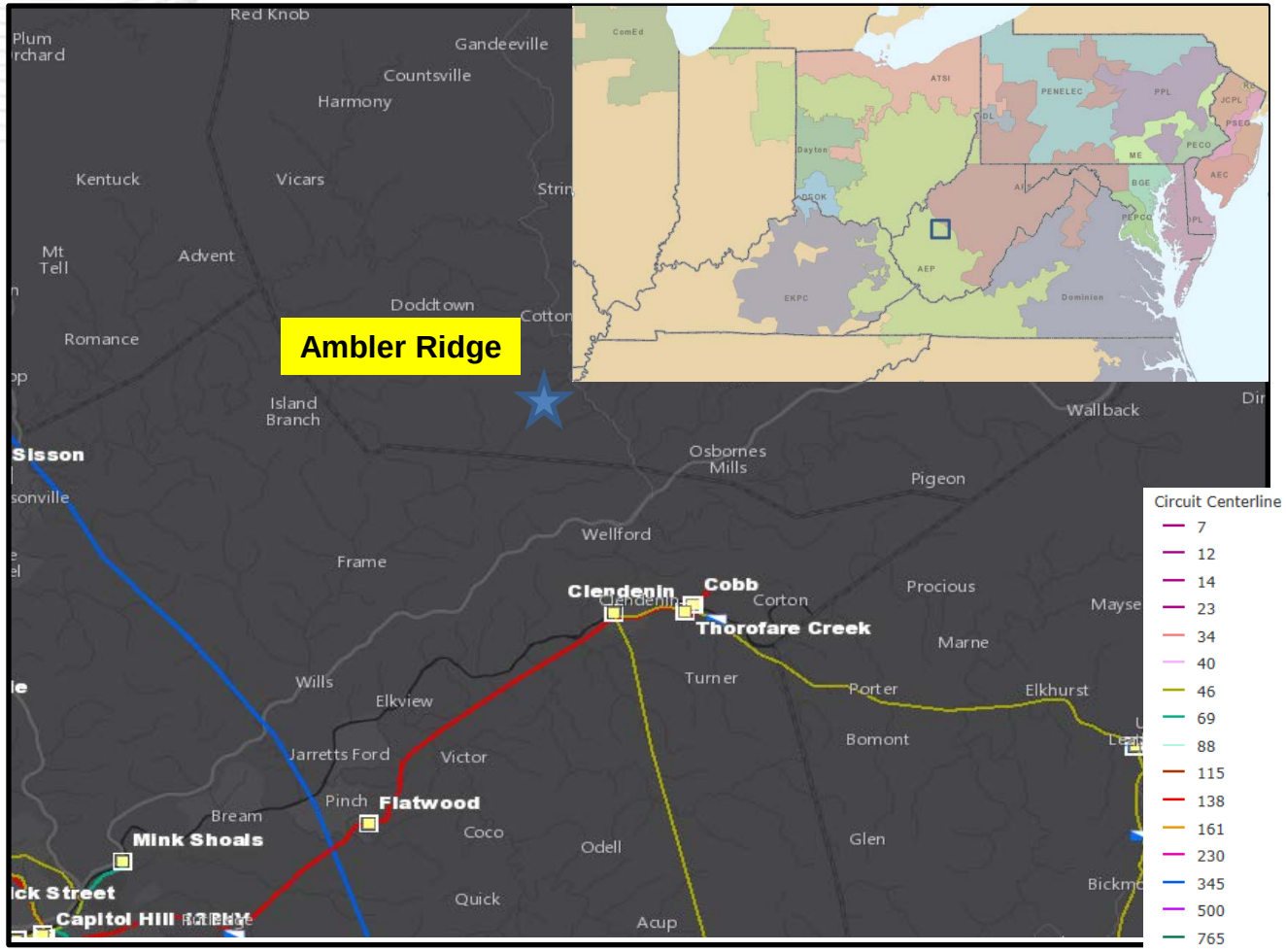
Total Estimated Transmission Cost: $1.5M

Alternatives:

No viable cost-effective alternatives could be identified.

Projected In-service: 6/1/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
West Huntington Station Rehab

Problem Statement:
138 kV circuit breaker 'D' at West Huntington has been identified by PJM as exceeding its rated interrupting capabilities due to supplemental project S1377.1 -.11, which was presented on 11/2/2017 and 12/18/2017 SRRTEP

Equipment Material/Condition/Performance/Risk:
138 kV circuit breakers "D" at West Huntington is FK type breaker that is over 67 years old. It is oil breakers that have become more difficult to maintain due to the required oil handling. There is an increased potential for oil spills during routine maintenance and failures with these types of breakers. Other drivers include PCB content, damage to bushings and number of fault operations exceeding the recommendations of the manufacturer. West Huntington breakers "D" & "E" have experienced 89 and 18 fault operations. The manufacturer's recommendation for this type of breaker is 10.

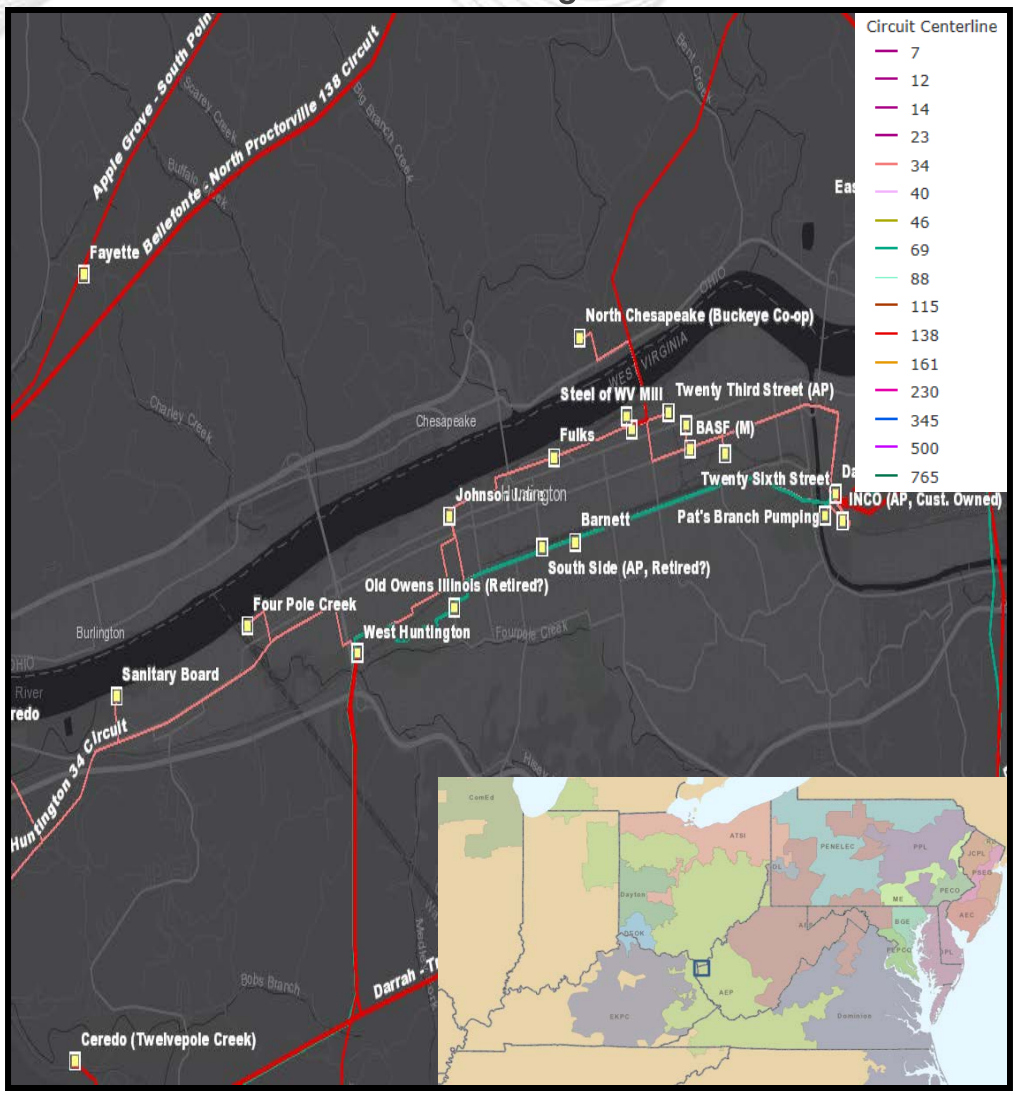
Potential Baseline Solution:
Replace the existing 1200A 20 kA 138 kV circuit breaker 'D' with a new 3000A 40 kV 138 kV circuit breaker at West Huntington station. (S1377.12)

Estimated Baseline Cost: $0.6M

Alternatives:
No viable cost-effective alternatives could be identified.

Projected In-service: 5/1/2018

Project Status: Under Construction



AEP Transmission Zone: Baseline and Supplemental
West Huntington Station Rehab

Problem Statement:

Equipment Material/Condition/Performance/Risk:

138 kV circuit breaker “E” at West Huntington is FK type breakers that are both over 67 years old. It is oil breaker that has become more difficult to maintain due to the required oil handling. There is an increased potential for oil spills during routine maintenance and failures with these types of breakers. Other drivers include PCB content, damage to bushings and number of fault operations exceeding the recommendations of the manufacturer. West Huntington breaker “E” have experienced 89 and 18 fault operations. The manufacturer’s recommendation for this type of breaker is 10.

69 kV circuit breaker “C” and 34.5 kV circuit breaker “J” at West Huntington are FK type oil breakers that are over 46 years and share the same concerns listed for the 138 kV breakers above. Circuit Breakers “C” & “J” have experienced 23 and 40 fault operations. The manufacturer’s recommendation for this type of breaker is 10.

Capacitor switcher “AA” at West Huntington is a VBM type switcher. Joslyn Varmaster VBM-34’s have a double stack interrupter design requiring simultaneous operation for rated current interruption; any delay between the two stacks would cause the full electrical stress of the operation to be placed on one stack. This could lead to capswitcher and/or cap bank failure. Like Mark V switchers, new control integration is difficult.

Operational Flexibility and Efficiency

138 kV circuit breakers will be added to the high side of the transformers at West Huntington to separate dissimilar zones of protection.

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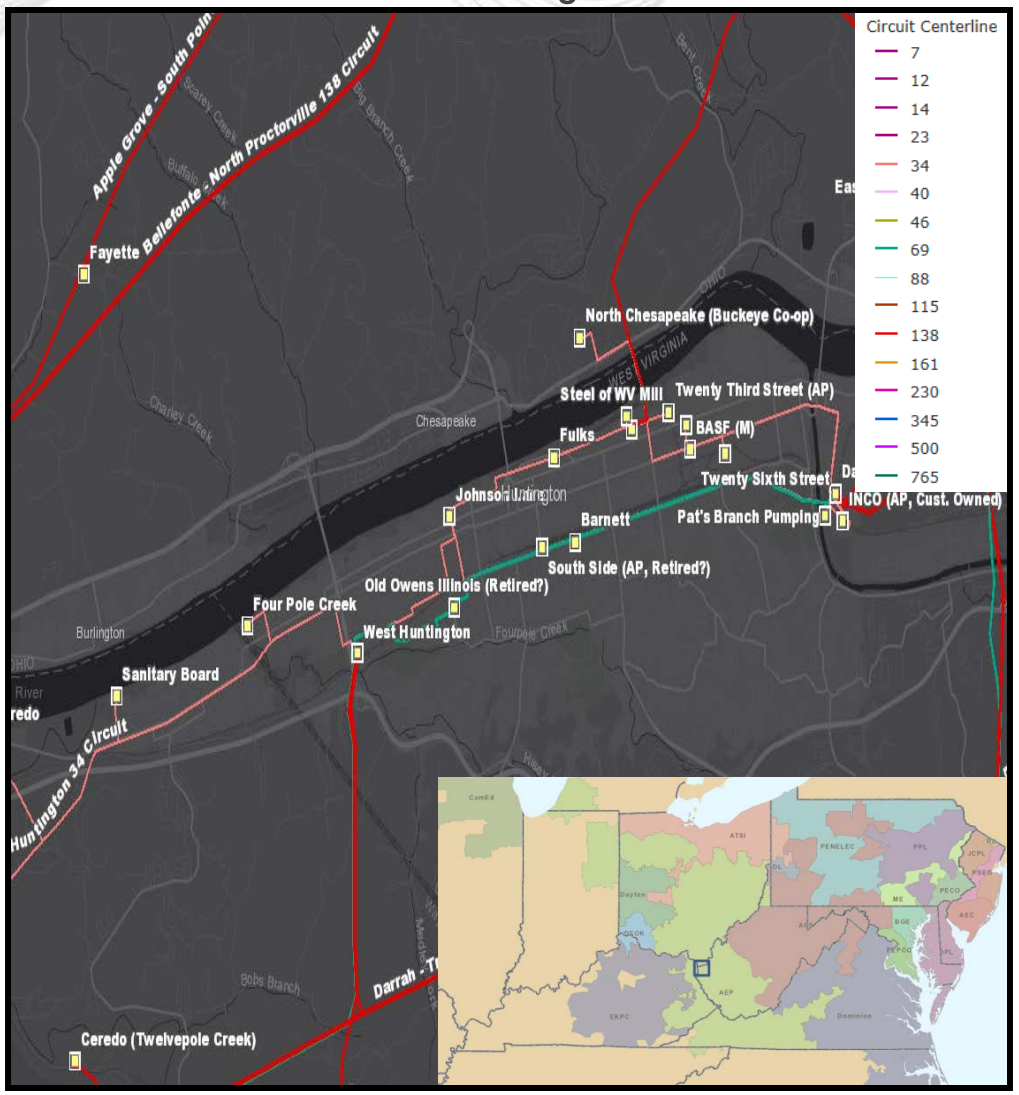

AEP Transmission Zone: Baseline and Supplemental
West Huntington Station Rehab

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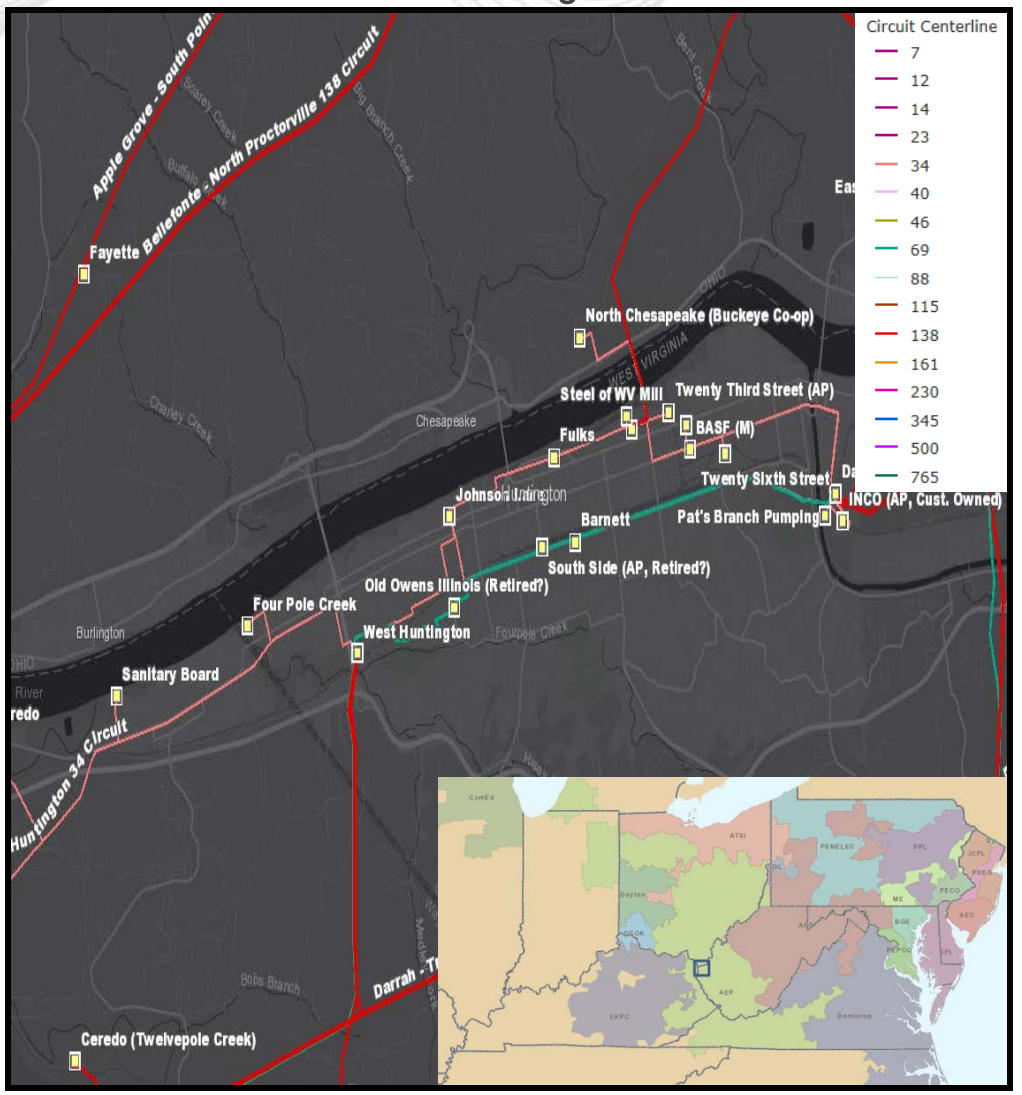
Potential Supplemental Solution:
Replace the existing 1200A 20 kA 138 kV circuit breaker 'E' with a new 3000A 40 kV 138 kV circuit breaker. Install three 138 kV 3000 A 40 kA circuit breakers on the high side of the three transformers at West Huntington. Replace the existing 1800A 27 kA 69 kV circuit breaker 'C' with a new 3000 A 40 kA 69 kV circuit breaker. Replace the existing 1800A 27 kA 34.5 kV circuit breaker 'J' with a new 3000A 40 kA 34.5 kV circuit breaker. Replace the existing capacitor switcher 'AA' with a new circuit switcher.
Estimated Cost: $3.9M

Alternatives:
No viable cost-effective alternatives could be identified.

Projected In-service: 5/1/2018

Project Status: Under Construction



AEP Transmission Zone: Supplemental Mount Vernon-Howard 69 kV Line Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Lexington – North Bellville – North Liberty Switch section of the Mount Vernon – Howard 69 kV line has conductor sizes of #1 Copper (31 MVA rating, originally built in 1917) and 1/0 ACSR (34 MVA rating, built in 1959). The line has 75 open conditions that pose risk of failure. Since 2013, the line has experienced over 2.9 M customer minutes of interruptions.

Potential Solution

Rebuild the North Liberty Sw – West Bellville Sw section (12 miles) of the Mount Vernon – Howard 69 kV line with the conductor size 959.6 ACSR/TW (141 MVA rating).

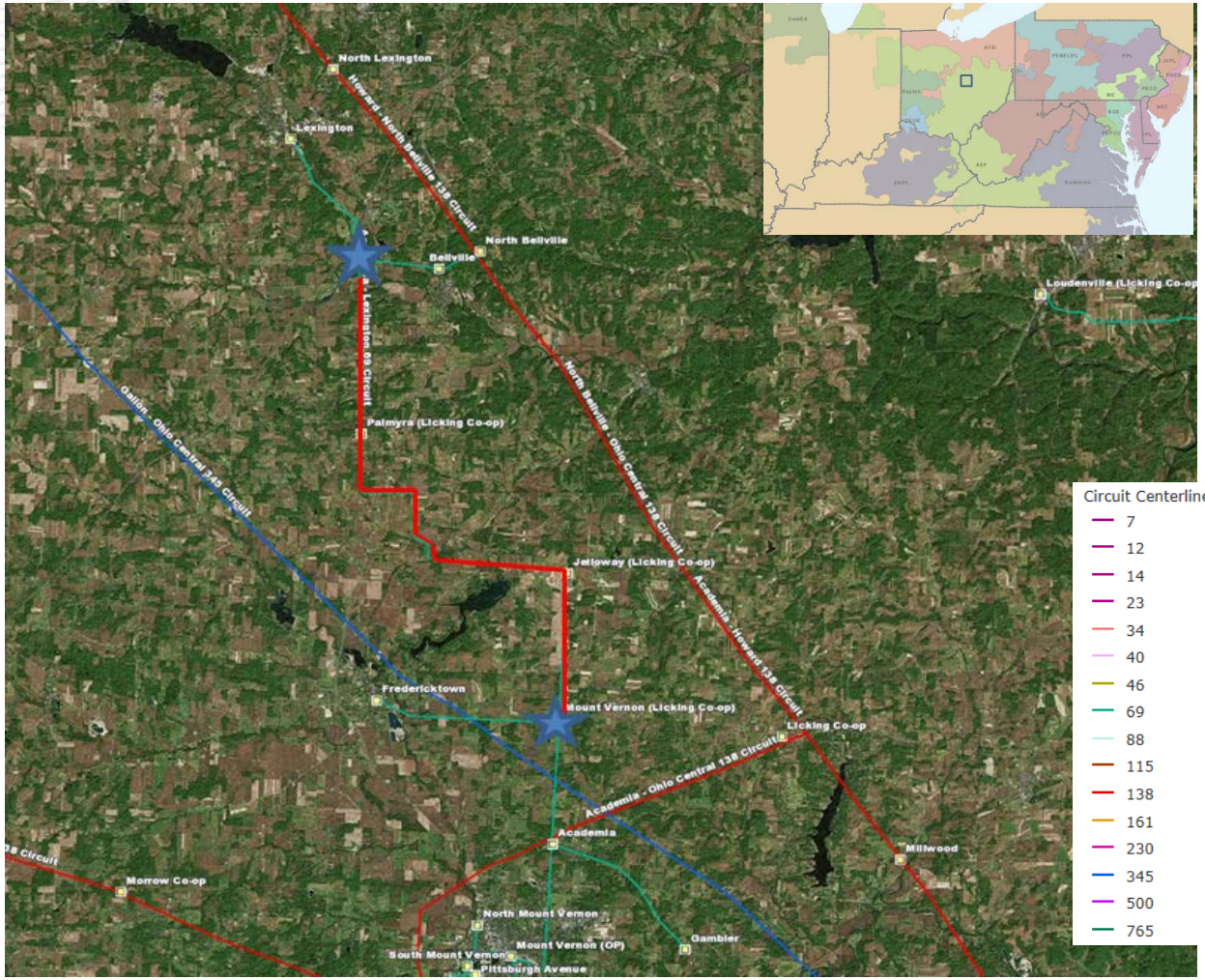
Estimated Cost: $8.5M

Alternatives:

No viable cost-effective alternatives could be identified. There are several Buckeye Coop delivery points served along the line.

Projected In-service: 6/1/2018

Project Status: Under Construction



AEP Transmission Zone: Baseline and Supplemental
Torrey-Bliss Park 69kV Line Rebuild

Problem Statement:

AEP Planning Criteria Violations:

Due to load model correction at Bliss Park, and Gambrinus Road area, 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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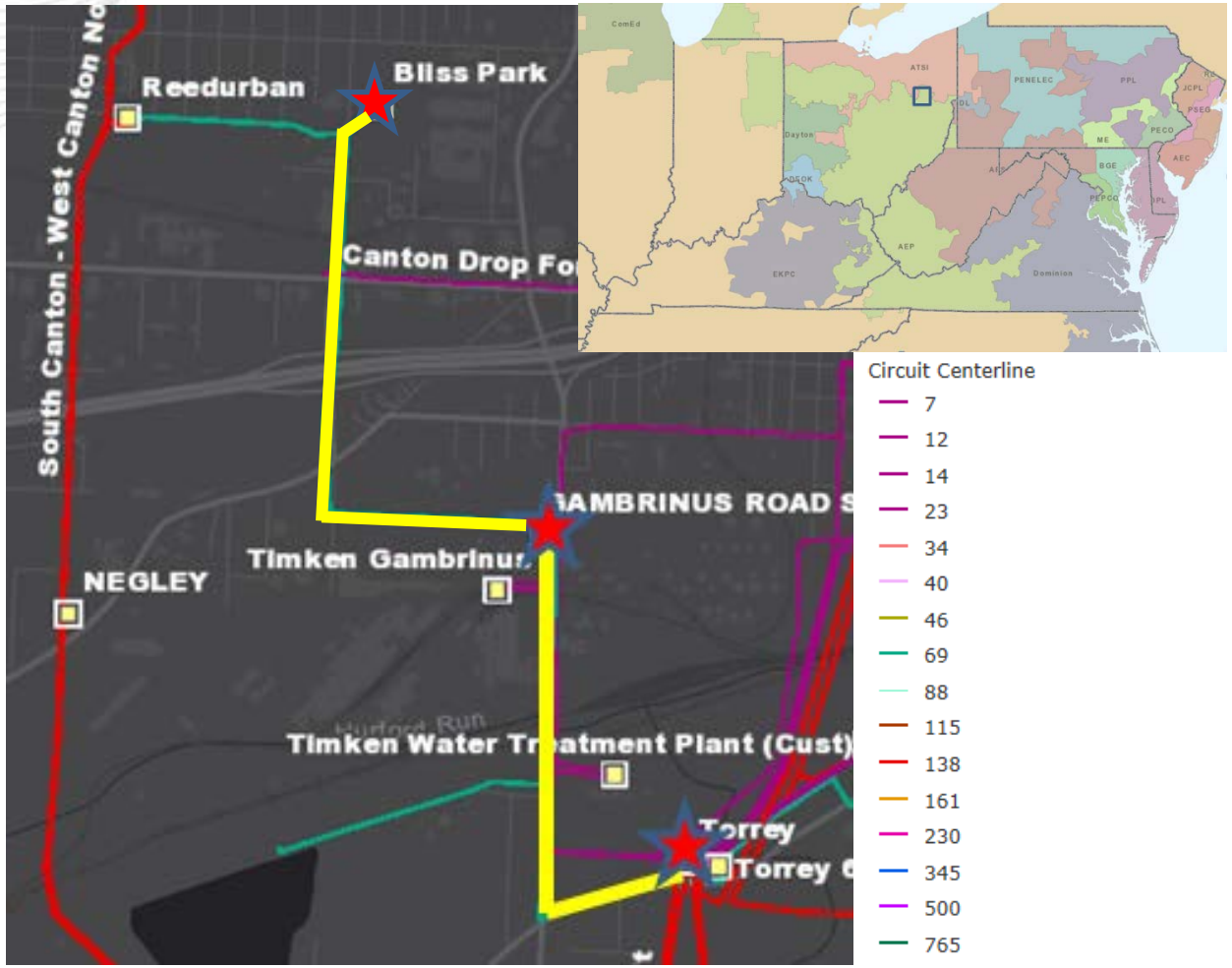

AEP Transmission Zone: Baseline and Supplemental
Torrey-Bliss Park 69kV Line Rebuild

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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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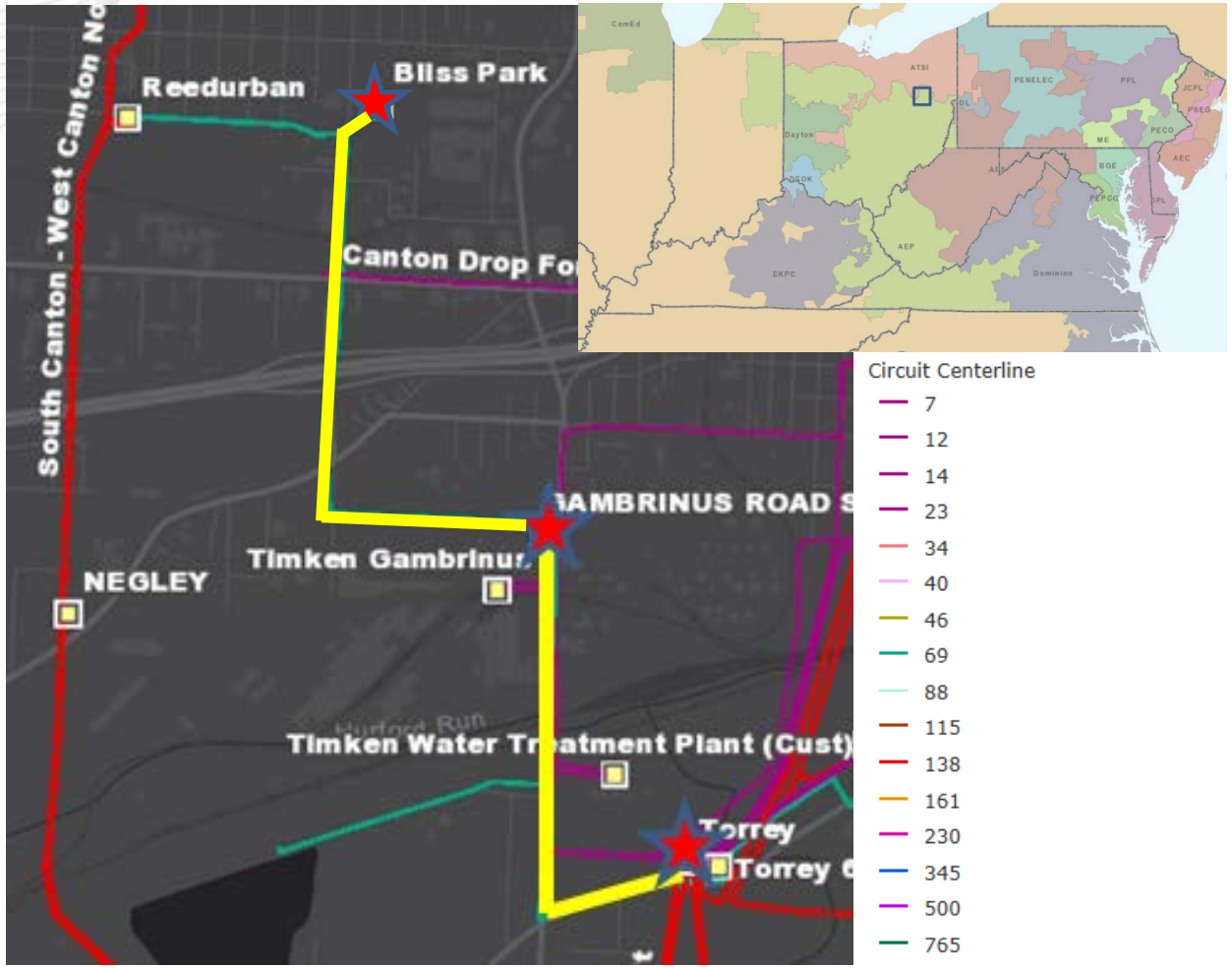

AEP Transmission Zone: Baseline and Supplemental
Torrey-Bliss Park 69kV Line Rebuild

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Potential Solution:

Baseline:

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

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.

Required IS Date: 6/1/2018

Estimated Baseline Cost: $2.8M

Supplemental:

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

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.]

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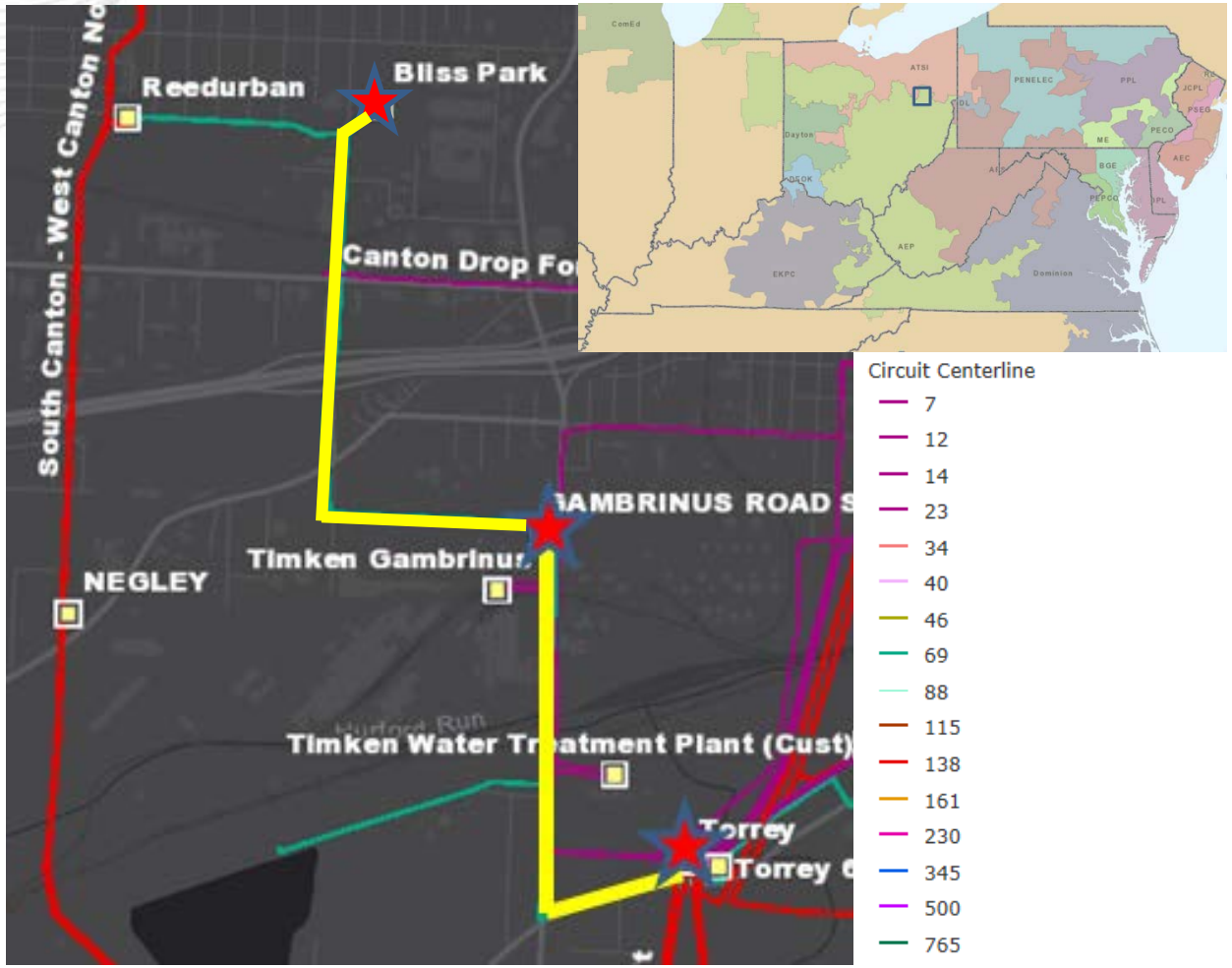

AEP Transmission Zone: Baseline and Supplemental
Torrey-Bliss Park 69kV Line Rebuild

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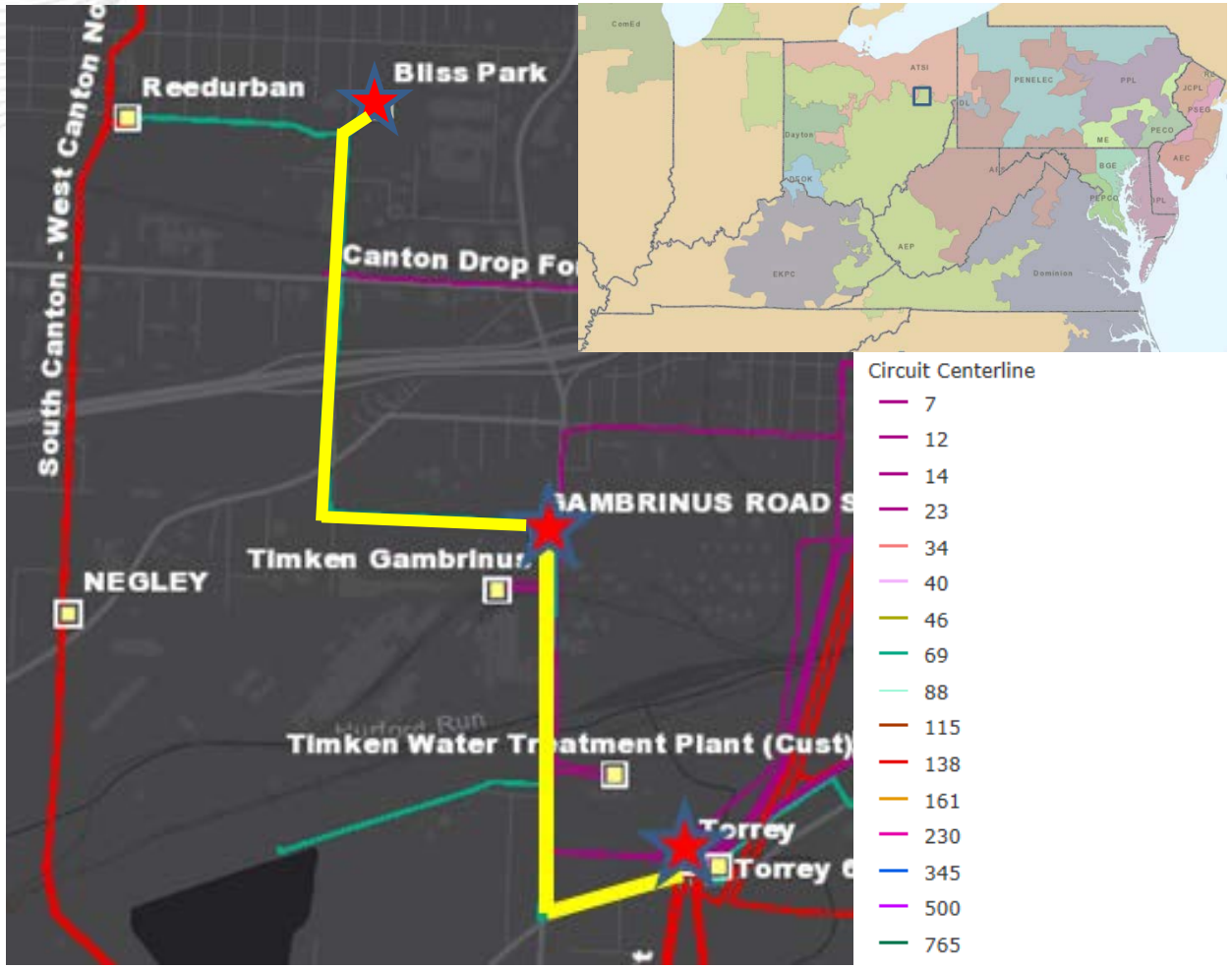
Alternatives:
No viable cost-effective transmission alternative was identified. Due to the 69kV circuit providing service to three separate delivery points (2- industrial retail customers and 1- AEP Ohio distribution station), the aging 69kV T-Line could not be realistically retired, without the need for an alternate 69kV or 138kV power source to be routed to the area. In particular, the large oil refinery served the 69kV is very sensitive to outages or power quality disturbances, so a low-impact transmission reinforcement was needed.

Projected In-service: 12/01/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental
Buckskin-Highland 69 kV Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Buckskin – Highland line was installed in 1926 with 4/0 ACSR conductor (50 MVA rating), with the majority of the line (96%) still from that vintage. There were 651 open conditions found during the most recent inspection of the Buckskin-Highland line, which was completed in 2015. Outages on this circuit are attributed to broken pole tops, floating phases, broken poles, and weather.

Petersburg Switch has been identified as a safety concern due to the terrain around the switch handles and the height at which the handles are installed. It has been recognized that when a switch person is switching, there is a tripping hazard due to the steep elevation change at the base of the pole where the GOAB handles are located: the switch handle is at head level at the high end of the terrain and is above the head when completely open. Switches on wood poles also have issues with the blades seating properly during switching, requiring additional outage and switching time from Transmission Dispatch. The existing wood pole switch will be replaced with a steel pole switch across the road from the existing location to allow for better footing, proper seating of the switch blades reducing outage and switching time, and safer operation of the switch. The FOI outage metric is 19.2, sufficient for the justification of MOAB switch installation.

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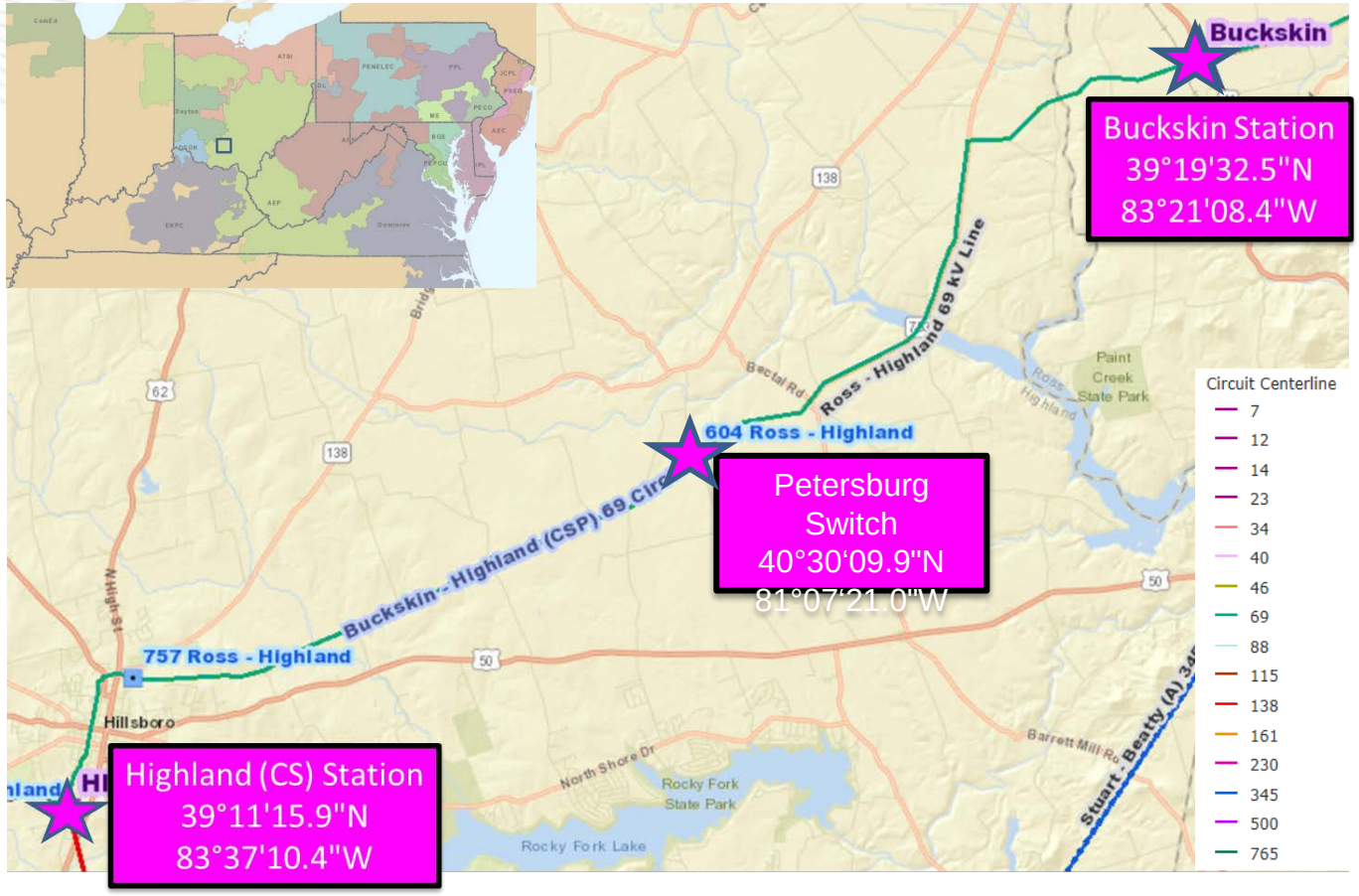

AEP Transmission Zone: Supplemental
Buckskin-Highland 69 kV Rebuild

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Potential Solution:
Rebuild ~18.7 miles of the Ross – Highland 69kV Line using 795 ACSR conductor (128 MVA rating) and 69kV Self Supporting steel with partial reroute around Hillsboro. Estimated Cost: $20.7M

Replace Petersburg Switch Estimated Cost: $0.3M

Total Estimated Transmission Cost: $21.0M

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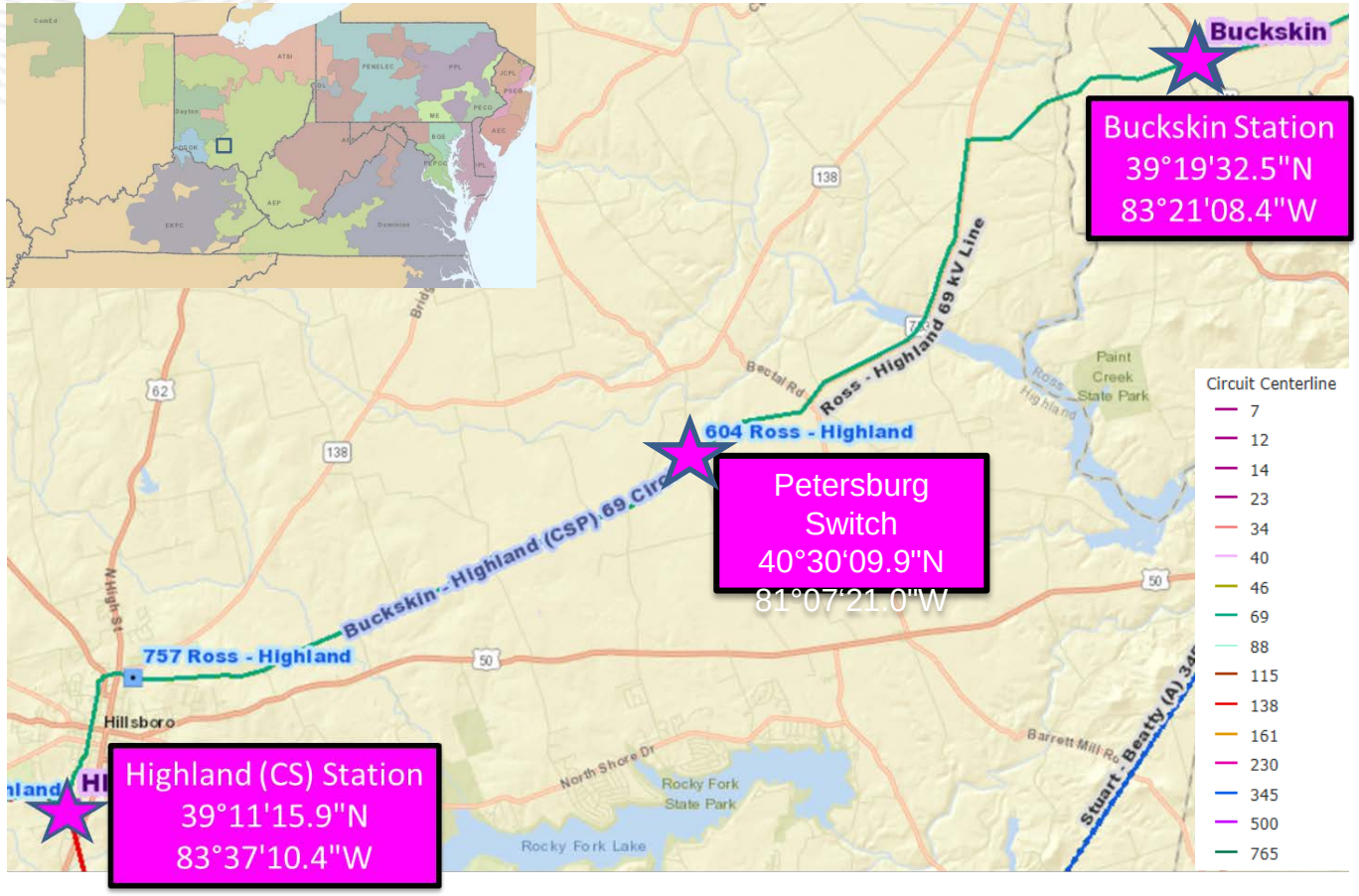

AEP Transmission Zone: Supplemental Buckskin-Highland 69 kV Rebuild

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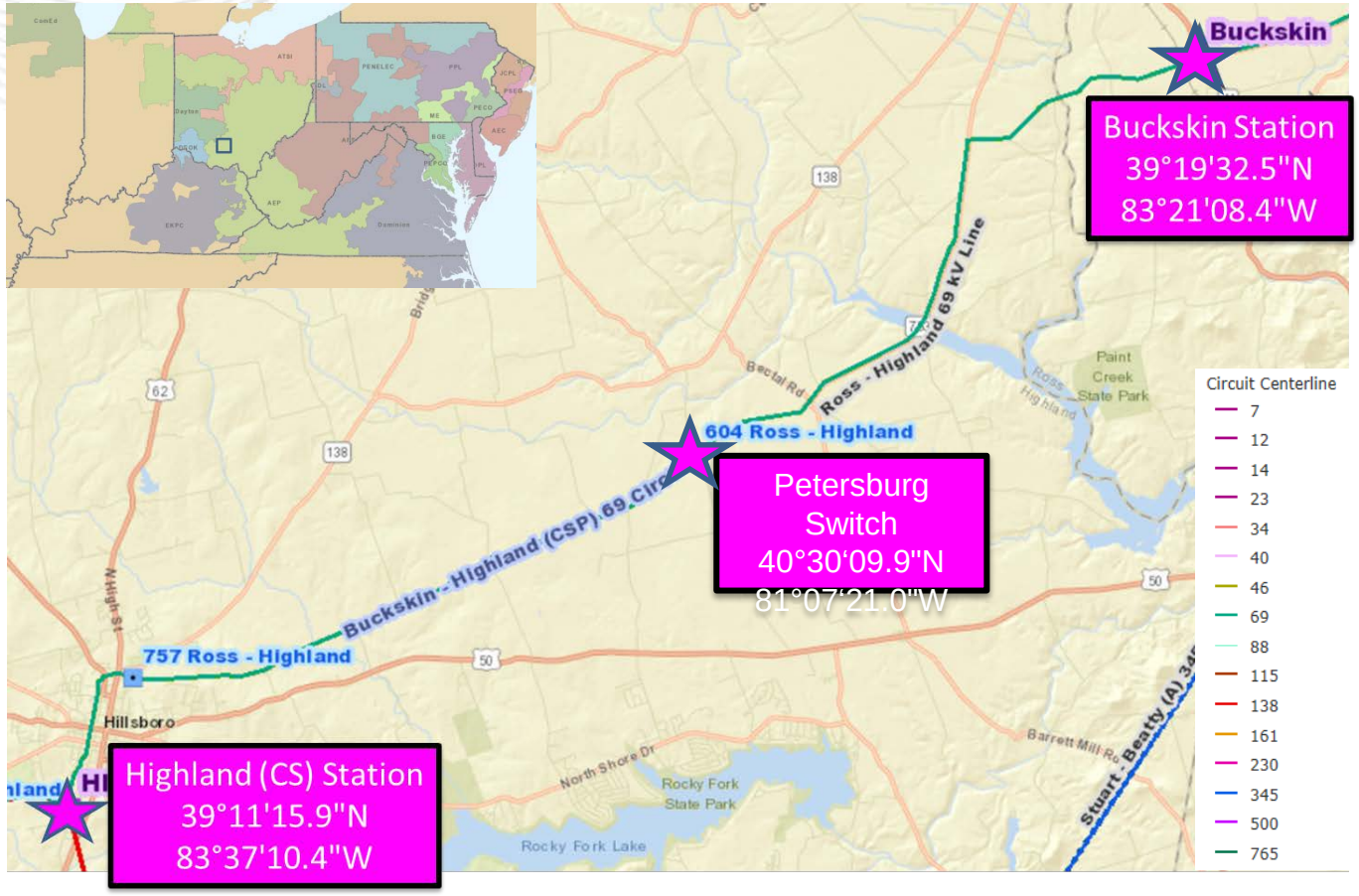
Alternatives:

Rebuild all of Ross-Highland on existing route through urban Hillsboro. If the portion through Hillsboro was rebuilt, a low rated conductor would have to be used for a portion of the line. Rebuilding this portion would require more outages and include more risk and difficulty in construction. With a line vintage of 1926 for the majority of the line, there are concerns regarding the necessary expansion of existing ROW and easements in the downtown area. Obtaining supplemental easements on the existing route is expected to be costly because of its urban location, whereas the proposed reroute passes through a rural area. Because of the more complex outage scheduling, the increased risk and difficulty of construction in an urban area, and the potential need for supplemental easements on the existing route, the cost for this alternate is estimated to be comparable to original solution. Estimated cost: $21M.

Projected In-service: 12/01/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental
Cabin Creek – Clendenin Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

From 2014-2016, the Cabin Creek – Clendenin 46 kV circuit (~ 26 miles) has experienced 8 permanent and 14 momentary outages resulting in approximately 750,000 customer minutes interrupted. The 17 mile Kelly Creek – Clendenin 46 kV line section that is to be rebuilt currently has 49 category A conditions along 114 structures of single circuit wood pole construction. These conditions include damaged/rotted poles and damaged guy wires, cross arms and contribute to the amount of momentary and permanent outages seen on the circuit. The majority of this circuit utilizes 1960s and 1970s wood structures as well as some 1910s lattice structures with a mix of 3/0 ACSR, 4/0 Copper and 3/0 Copper conductor (29 MVA rating).

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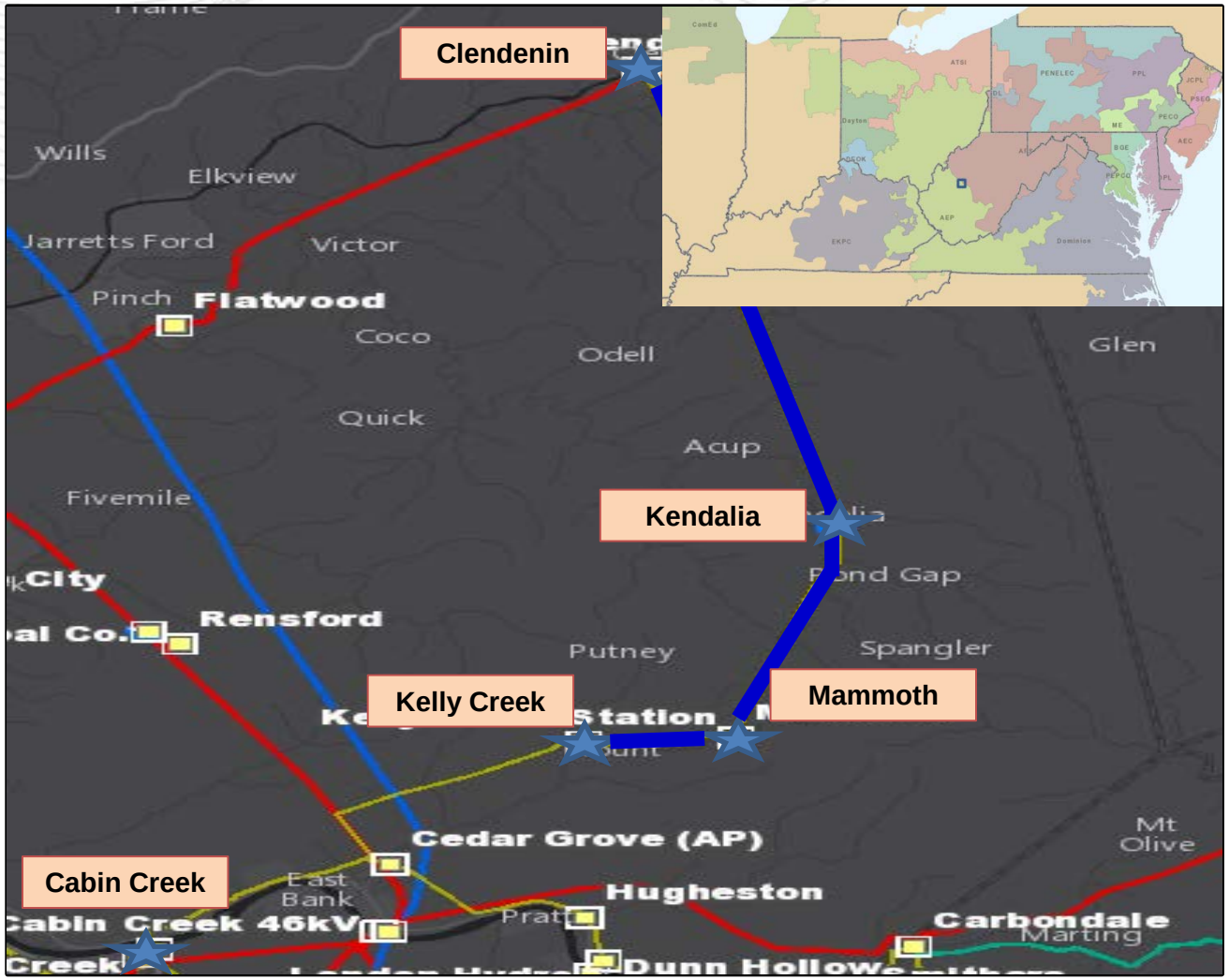

AEP Transmission Zone: Supplemental
Cabin Creek – Clendenin Rebuild

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Potential Solution:

Rebuild approximately 17.5 miles of the Clendenin –Kelly Creek 46kV line to 69kV standards (energized at 46kV) utilizing 556 ACSR (68 MVA rating). Retire Kendalia switch.

Estimated Cost: $29.3M

At Kelly Creek retire the switching structure and replace it with a 1200 A 3 way Phase Over Phase (POP) motorized switching structure.

Estimated Cost: $0.7M

At Mammoth station install a 1200 A 3 way POP motorized switching structure.

Estimated Cost: $0.7M

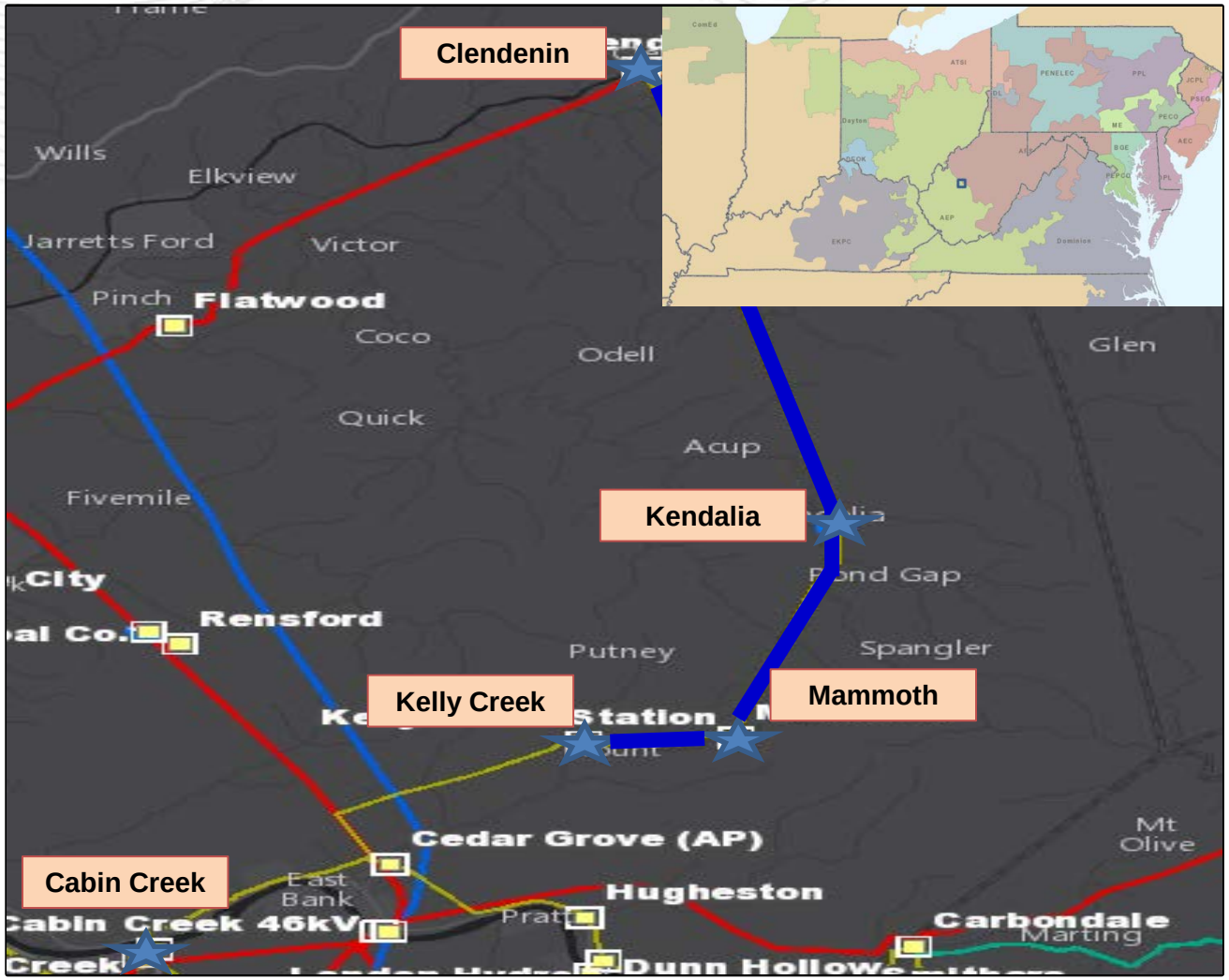
Total Estimated Transmission Cost: $30.7M

Alternatives:

No viable cost-effective alternatives could be identified

Projected In-service: 12/04/2020

Project Status: Engineering



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AEP Transmission Zone: Supplemental
Dorton Station Rehab

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Dorton's 138/46 kV Transformer #1 is 1956 vintage and is showing dielectric breakdown (insulation), accessory damage (bushings/windings) and short circuit breakdown (due to amount of through faults).

Operational Flexibility:

There are three overlapping zones of protection on the 46 kV bus – the transformer, bus, and line exits.

Potential Solution:

Replace the existing 138/46 kV 45 MVA transformer bank with a new 138/69/46 kV 90 MVA transformer bank. A low side 69 kV circuit breaker (operated at 46 kV) will be added to the transformer.

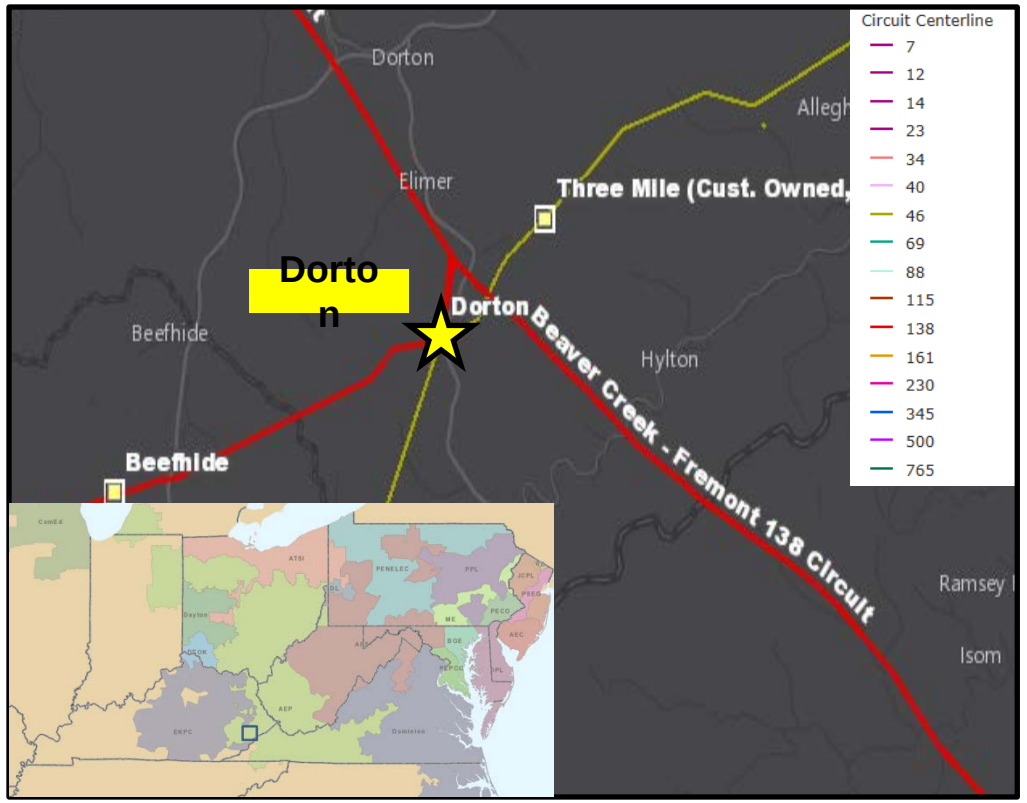
Total Estimated Transmission Cost: $2.5 M

Alternatives:

No viable cost-effective alternatives could be identified.

Projected In-service: 08/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
East Lima – Haviland 138kV

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The East Lima – Haviland 138kV line was originally constructed in 1925 with lattice towers and 397 ACSR conductor (167 MVA rating). The double circuit sections of the line being rebuilt is approximately 30 miles long on the path from Haviland – North Delphos – Rockhill. There are 99 total open conditions along the line. There are numerous issues with the conductor and conductor hardware on this line. Armor grip suspension assemblies were installed during routine maintenance periods in an attempt to restore the strength of the conductor. However, crews have found many cases of broken conductor strands under these armor grip assemblies. In addition, the conductors' steel core has been found to be deteriorated in sections due to corrosion, which is a cause for concern as the mechanical strength of the wire can be compromised. Many insulators have lost their outer glaze, allowing contaminant buildup, compromised electrical integrity and growing risk of electrical failure. As this line was originally built in 1925, its design standards do not meet modern standards for strength, resilience, galloping and horizontal and vertical clearances for safety. Also, the easement conditions present sections with undefined width and have several encroachments.

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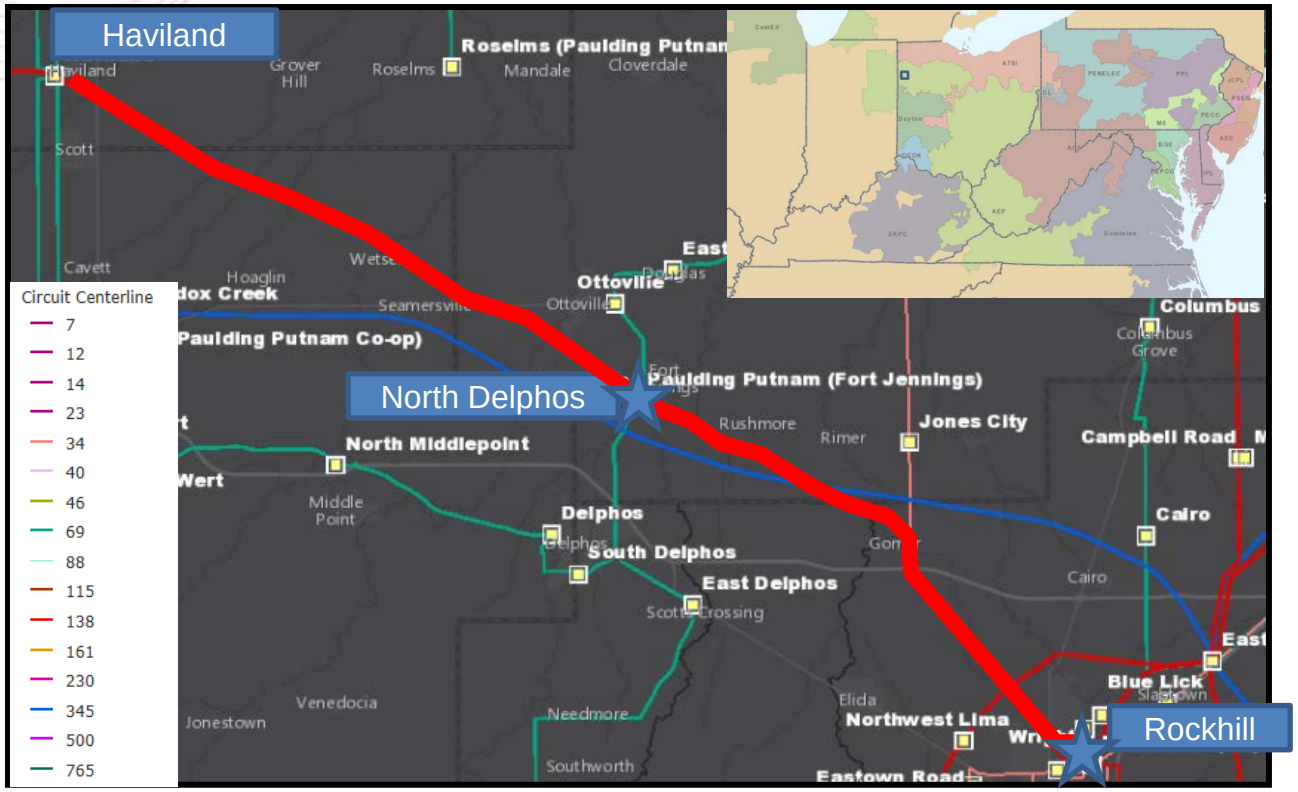

AEP Transmission Zone: Supplemental
East Lima – Haviland 138kV

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Potential Solution:
Haviland – North Delphos 138kV: Rebuild 15.6 miles of double circuit 138kV line utilizing 1033 ACSR conductor (296 MVA rating)
Estimated Cost: $24.3M

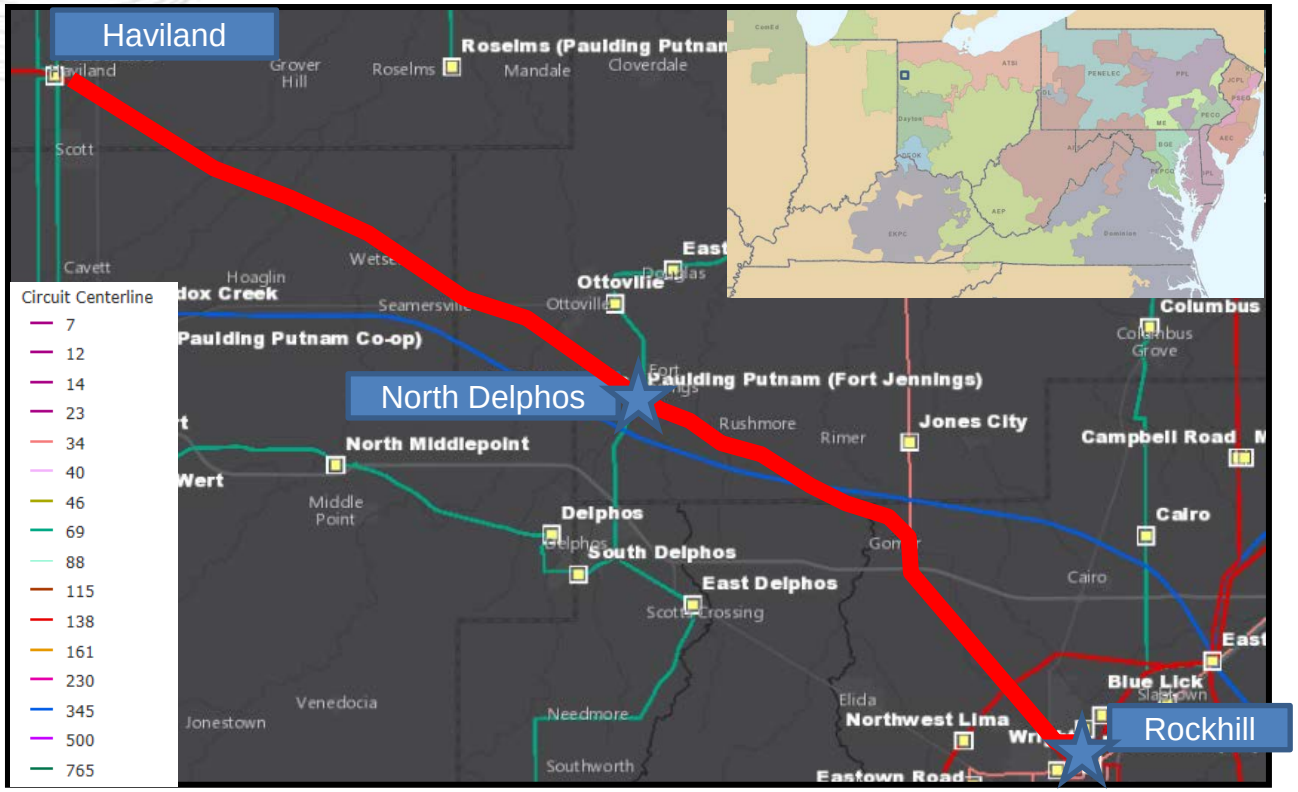
North Delphos – Rockhill 138kV: Rebuild 15.4 miles of double circuit 138kV line utilizing 1033 ACSR 1033 ACSR conductor (296 MVA rating)
Estimated Cost: $24.5M

Total Estimated Cost: $48.8M

Alternatives:
No viable cost-effective alternatives could be identified

Projected In-service: 12/18/2020

Project Status: Engineering



AEP Transmission Zone: Supplemental
Harpster – Waldo 69 kV Rehab

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Harpster – North Waldo 69 kV circuit was built between 1946 - 1969 and is almost entirely wood poles with 132 A and 214 B open conditions distributed along the entire circuit. Almost the entire line is cross arm construction with vertical post insulators (not a current AEP standard).These cross arms and braces typically fail to pass inspection. Maintenance has become increasingly difficult due to the in availability of material for repair as the existing line is primarily 1/0 copper (35 MVA rating). The existing wood pole structures have bay-o-nets supporting the shield wire, with poor grounding at every other structure (currently not to AEP standard) contributing to poor momentary outage performance. Much of the line has distribution underbuilt whose mechanical loads consume pole strength. Some of these underbuilt is owned by Ohio Edison (a First Energy subsidiary). Furthermore, the present easement rights for this vintage line is inadequate by present day AEP Transmission standards.

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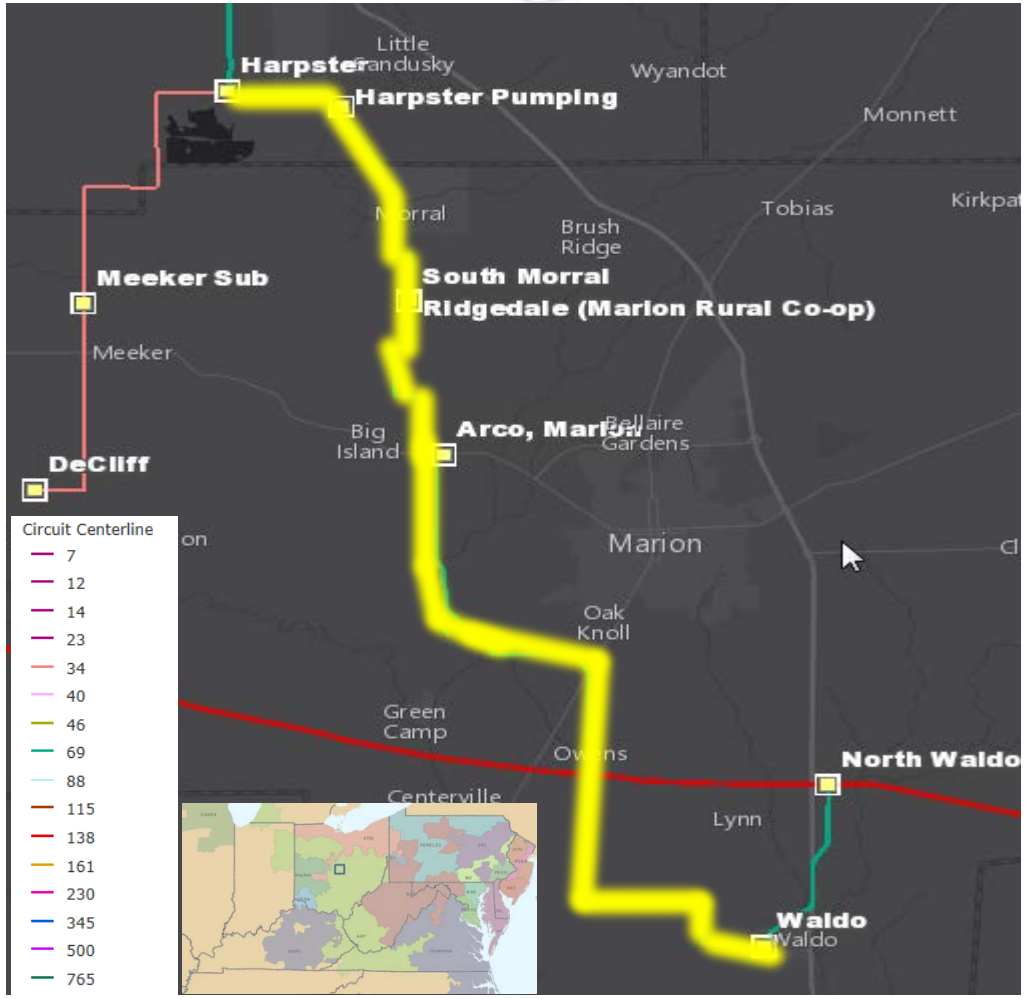

AEP Transmission Zone: Supplemental Harpster – Waldo 69 kV Rehab

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Potential Solution:
Rebuild ~27.7 miles from Harpster 69 kV Station to Waldo 69 kV Station utilizing 795 ACSR conductor (SN 129 MVA rating)
Estimated Trans Cost: $30.0M

Replace existing 600 A two way switch at Harpster Pump station with 1200 A three way switch.
Estimated Transmission Cost: $0.91M

Install a one way 1200 A phase over phase switch (Goodnow Road SW) just north of Ridgedale (Marion Rural Co-op)
Estimated Transmission Cost: $0.17M

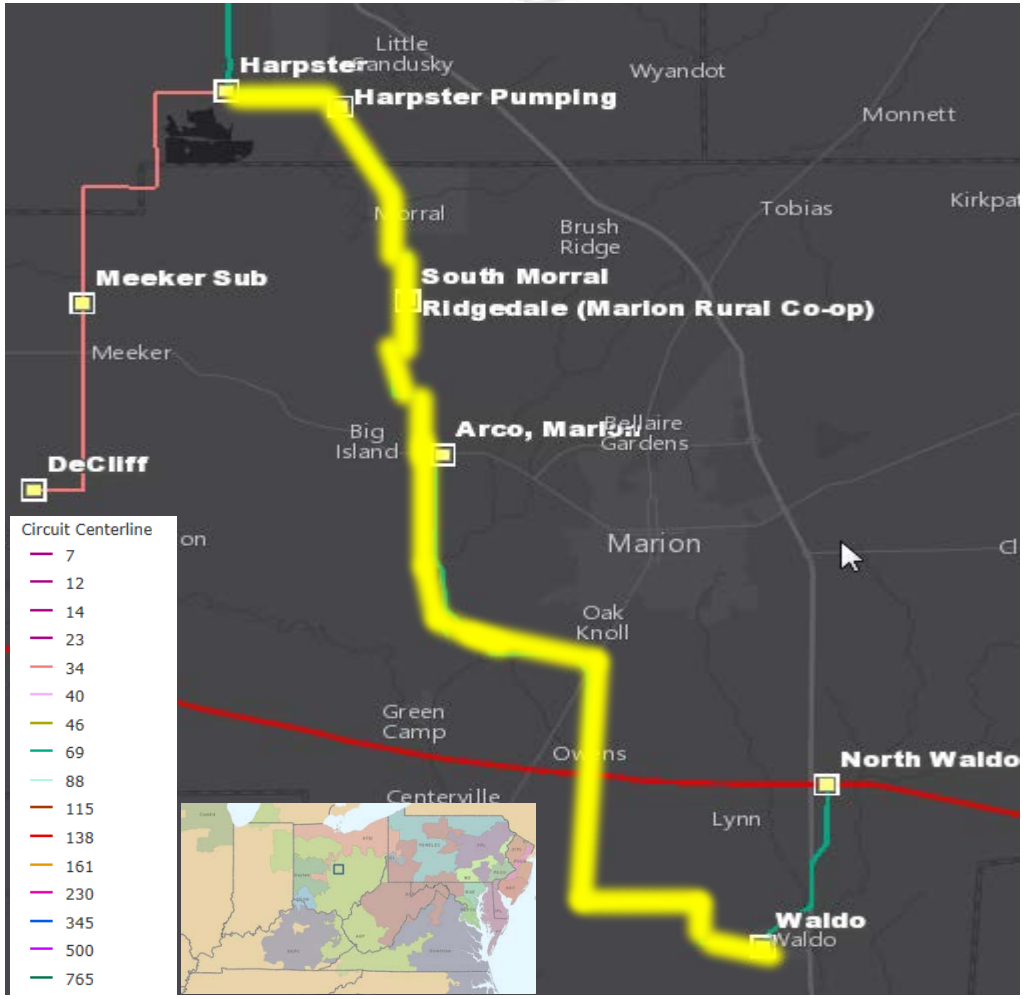
Remove station West Marion SW.
Estimated Transmission Cost: $0.08M

Total Estimated Transmission Cost: $31.2 M

Alternatives:
No viable cost-effective alternatives could be identified

Projected In-service: 06/04/2021

Project Status: Engineering



AEP Transmission Zone: Supplemental
Johns Creek Station Rehab

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Transformer Bank #1 (1980 vintage) has bad high side internal CTs which are not field replaceable. Given the faulty internal CT and the current maintenance issues, the bank is being replaced. Drivers for replacement include short circuit strength breakdown, bushing damage and dielectric strength breakdown (winding insulation). In order to move the 34.5 kV distribution load off the tertiary winding of the existing 138/69/34.5 kV transformer, a new 138/34.5 transformer is being installed along with the new 138/69/34.5 kV transformer.

Circuit Breaker 'A' is an oil breaker that is leaking oil. In addition the breaker has surpassed the manufacturer's recommended fault operations of 10 (135 fault operations).

Capacitor switcher 'AA' does not have pre-insertion inductor and has caused customer protection equipment in the area to trip off line due to voltage surges.

Capacitor switcher 'BB' is a Mark V model which no longer supports modern relaying packages. Mark V's have been historically prone to mechanism failures and are being replaced system wide where possible.

The MOAB/ground switch will be replaced. MOAB/ground switch combinations induce a fault on the system, tripping remote breakers for a transformer fault, reducing the life and increasing relay coordination complexity for the transformer protection.

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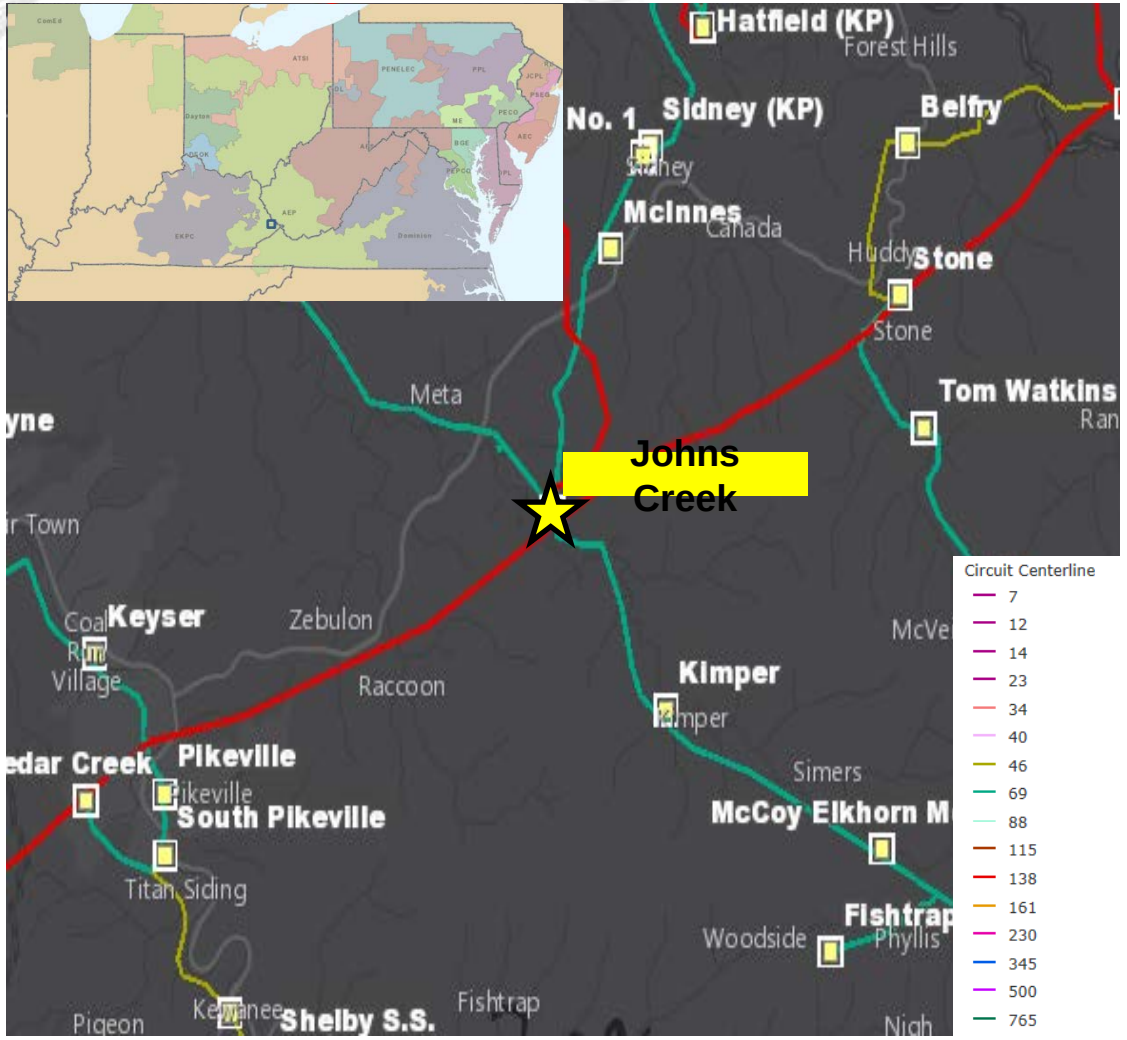

AEP Transmission Zone: Supplemental
Johns Creek Station Rehab

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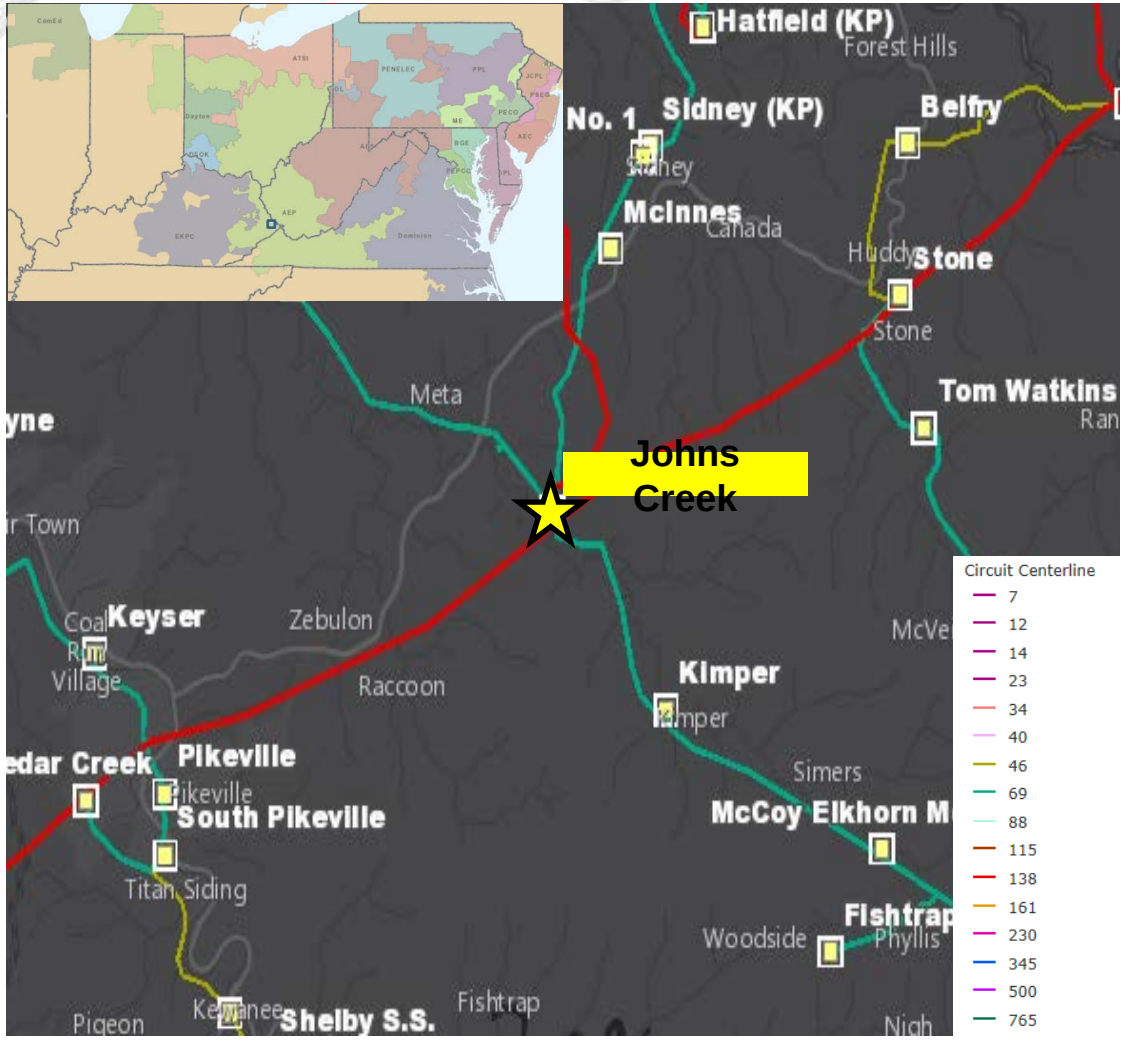
Potential Solution:
Replace existing 69 kV circuit breaker 'A' with a new 3000 A 40 kA circuit breaker. Replace the existing 138/69/34.5 kV 90 MVA transformer #1 with a new 90 MVA 138/69/34.5 kV transformer. Install a new 20 MVA 138/34.5 kV transformer to remove the distribution load from the tertiary of transformer #1. Install a new 2000 A 40 kA high side circuit switcher on the 138/34.5 kV Transformer. Replace existing capacitor switcher 'AA' with a new 3000 A 40 kA switcher and existing capacitor switcher 'BB' with new 3000 A 40 kA switcher.

Total Estimated Transmission Cost: $7.4 M

Alternatives:
No viable cost-effective alternatives could be identified

Projected In-service: 07/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
Layland – McClung Line Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

From 2013-2016 the Layland – McClung 69 kV line (~20 miles) has experienced 13 momentary and 14 permanent forced outages resulting in over 3.6M customer minutes of interruption. The line consists of 169 structures of single circuit 69 kV wood pole construction built in the 1930s. There are currently 45 structures with category A open conditions along the line. These conditions include damaged/rotted poles and cross arms. This line does not currently have shielding and is not designed to physically support a shield wire. The conductor for this line is 3/0 ACSR 6/1 Pigeon (16.5 miles) and 4/0 ACSR 6/1 Penguin (3.5 miles).

Potential Solution:

At Meadow Bridge station, replace the 600 A 2 way Phase over Phase Switch with 1200 A 2 way Phase over Phase Switch (motorized).

Estimated Cost: $0.6M

Rebuild approximately 20 miles of the Layland – McClung 69 kV line with 556.5 ACSR conductor.

Estimated Cost: $34.4M

Total Estimated Transmission Cost: $35 M

Alternatives:

No viable cost-effective alternatives could be identified. Retiring the line is not an option as it currently provides two way service to both McRoss and Meadowbridge stations. Retiring would leave both stations on 5+ mile radial lines.

Projected In-service: 12/04/2020

Project Status: Scoping

AEP Transmission Zone: Supplemental Newcomerstown Line Conversion and Transformer

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Newcomerstown 138/69/12 kV transformer #1 was installed in 1966. The transformer is showing signs of deterioration due to dielectric strength breakdown (winding insulation), accessory damage (bushings) and short circuit strength breakdown (due to the high number of through fault events).

Customer Service:

The Newcomerstown 138/69/12kV transformer overloaded for several contingencies when considering a large shale load increase in this area. The transformer is a 50 MVA unit with distribution load served off the tertiary winding. The transformer loaded to 101% of Summer Emergency (SE) for a breaker-failure contingency at West New Philadelphia and to 116% of SE for the single contingencies of Kammer – South Canton 765 kV and West New Philadelphia – Newcomerstown 138 kV circuit.

The Newcomerstown – Sugarcreek Terminal 34.5 kV line is already built to 69 kV standards. As part of this project, we are converting the line to operate at 69 kV in collaboration with customers presently served off the line. After the Newcomerstown – Sugarcreek Terminal circuit is converted to 69 kV, Sugarcreek Terminal – Belden 34.5 kV will be the only 34.5 kV connected to the Sugarcreek Terminal. There is not much 34.5 kV in the area or sources thus the N-1-1 outage of the Newcomerstown 69/34.5 kV transformer in conjunction with Sugarcreek Terminal 69/34.5 kV transformer would take out the Newcomerstown – Sugarcreek Terminal 34.5 kV and all its customers.

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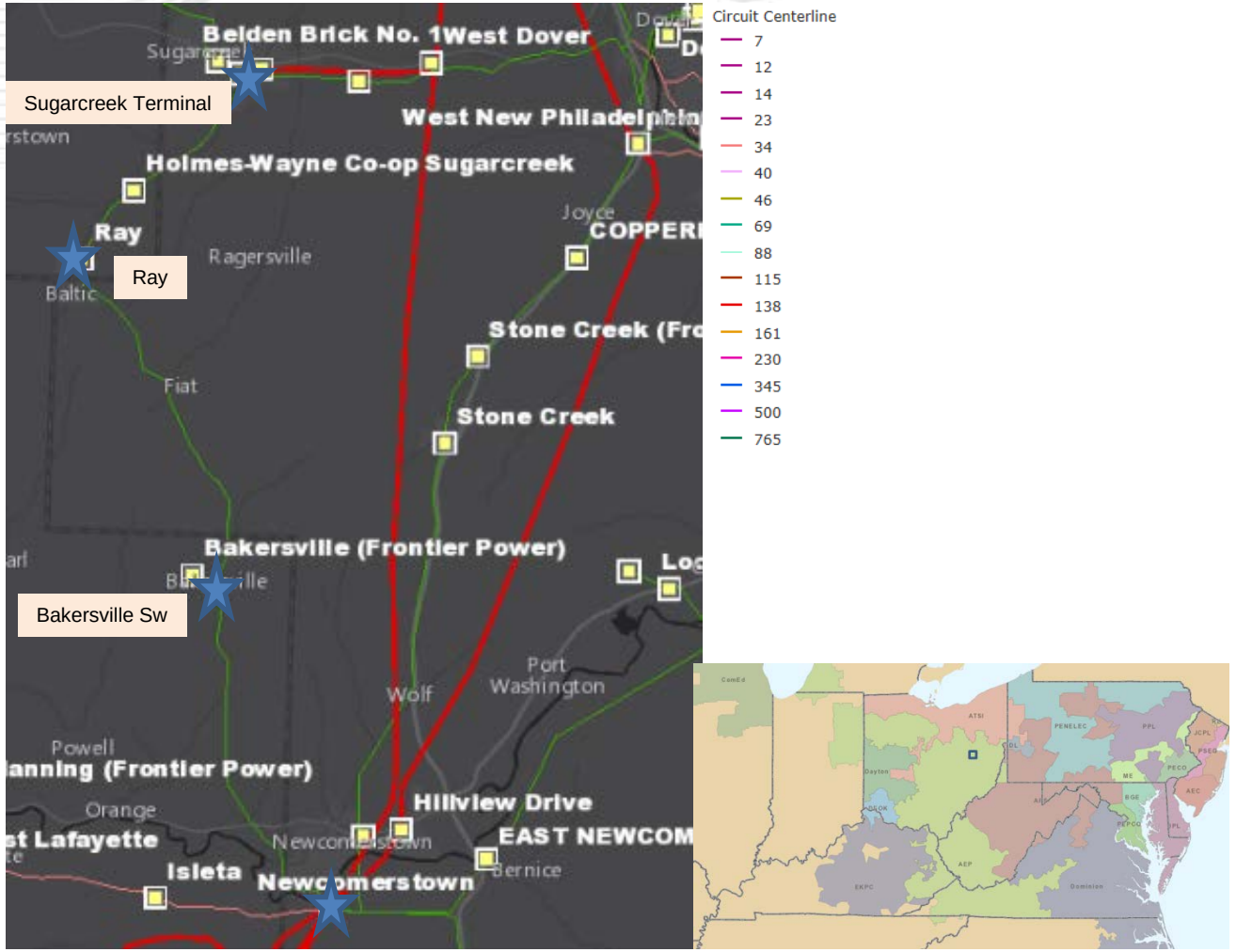

AEP Transmission Zone: Supplemental Newcomerstown Line Conversion and Transformer

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Potential Solution:

Relocate the Newcomerstown-Ray line to the 69 kV bay at Newcomerstown station.

Estimated Cost: $0.1M

At Newcomerstown station, install a new 69kV 3000 A 40 kA circuit breaker for the Sugarcreek Terminal line exit. Remove the 34.5 kV Circuit Breaker "I". Replace the 50 MVA transformer with a 90 MVA transformer and install a high side and low side circuit breaker.

Estimated Cost: $10.7M

At Ray station, install a 69 kV 3000 A 40 kA bus tie circuit breaker and transformer circuit switchers. Install a 69/34.5 kV transformer to serve the existing customers.

Estimated Cost: $0.7M

At Bakersville switch, remove existing and install new PTs due to the 34.5kV to 69kV conversion.

Estimated Cost: $0.3M

At Sugarcreek Terminal station, install a 69kV 3000 A 40 kA circuit breaker "F" for the Newcomerstown line exit. Remove 34.5 kV breaker "L."

Estimated Cost: $0.7M

Relocate Ray-Sugarcreek 69 kV line to 69 kV bay at Sugarcreek Terminal.

Estimated Cost $0.1M

Total Estimated Transmission Cost: $12.6M

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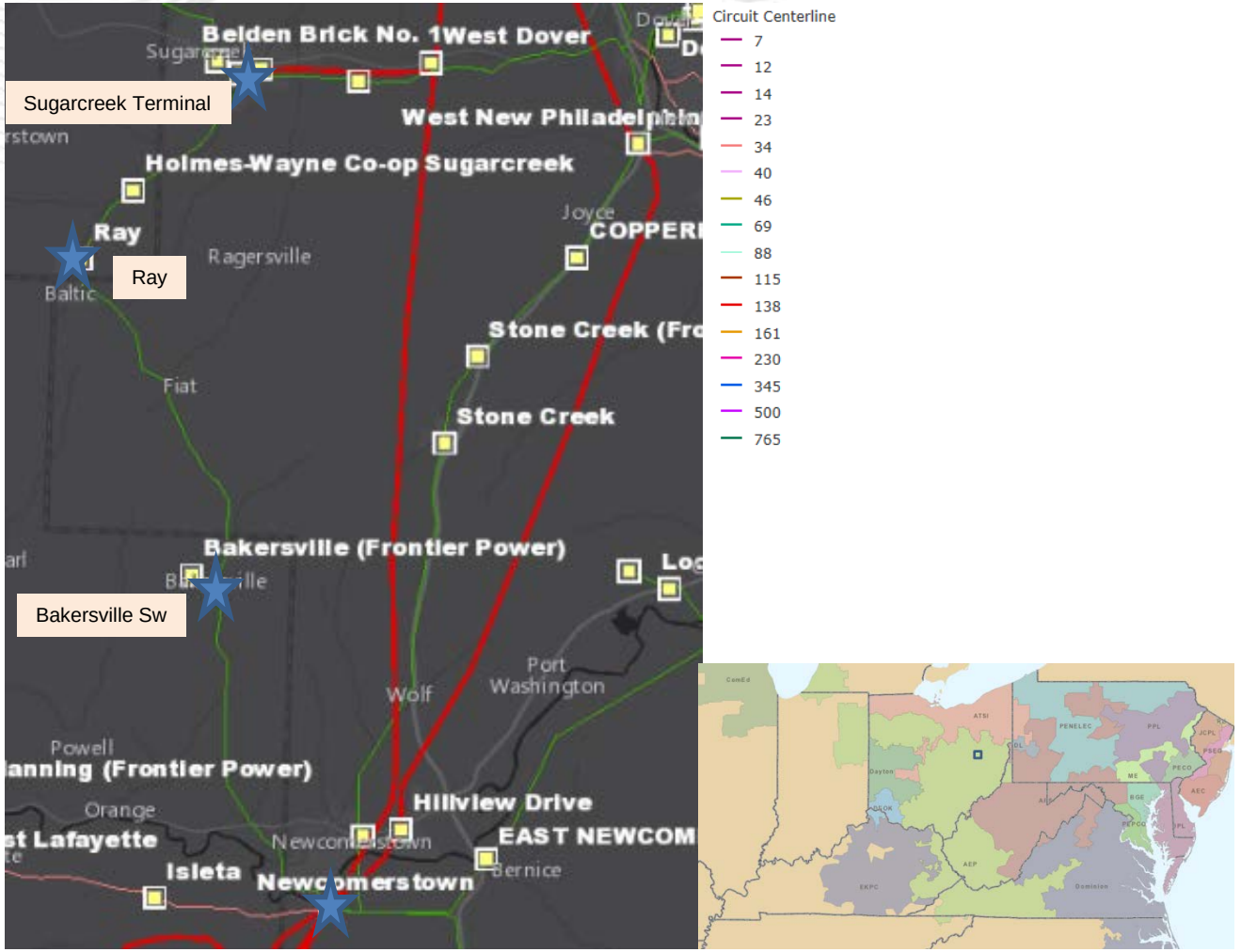

AEP Transmission Zone: Supplemental Newcomerstown Line Conversion and Transformer

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Alternatives:

Alternate for Newcomerstown – Sugarcreek 69 kV conversion:

Install a 138/34.5 kV transformer at Newcomerstown with a high side 138 kV circuit switcher and a low side 34.5 kV circuit breaker. This alternative is not viable since there is no space at Newcomerstown station therefore the cost was not fully evaluated.

Alternate for Newcomerstown 138/69 kV 90 MVA transformer:

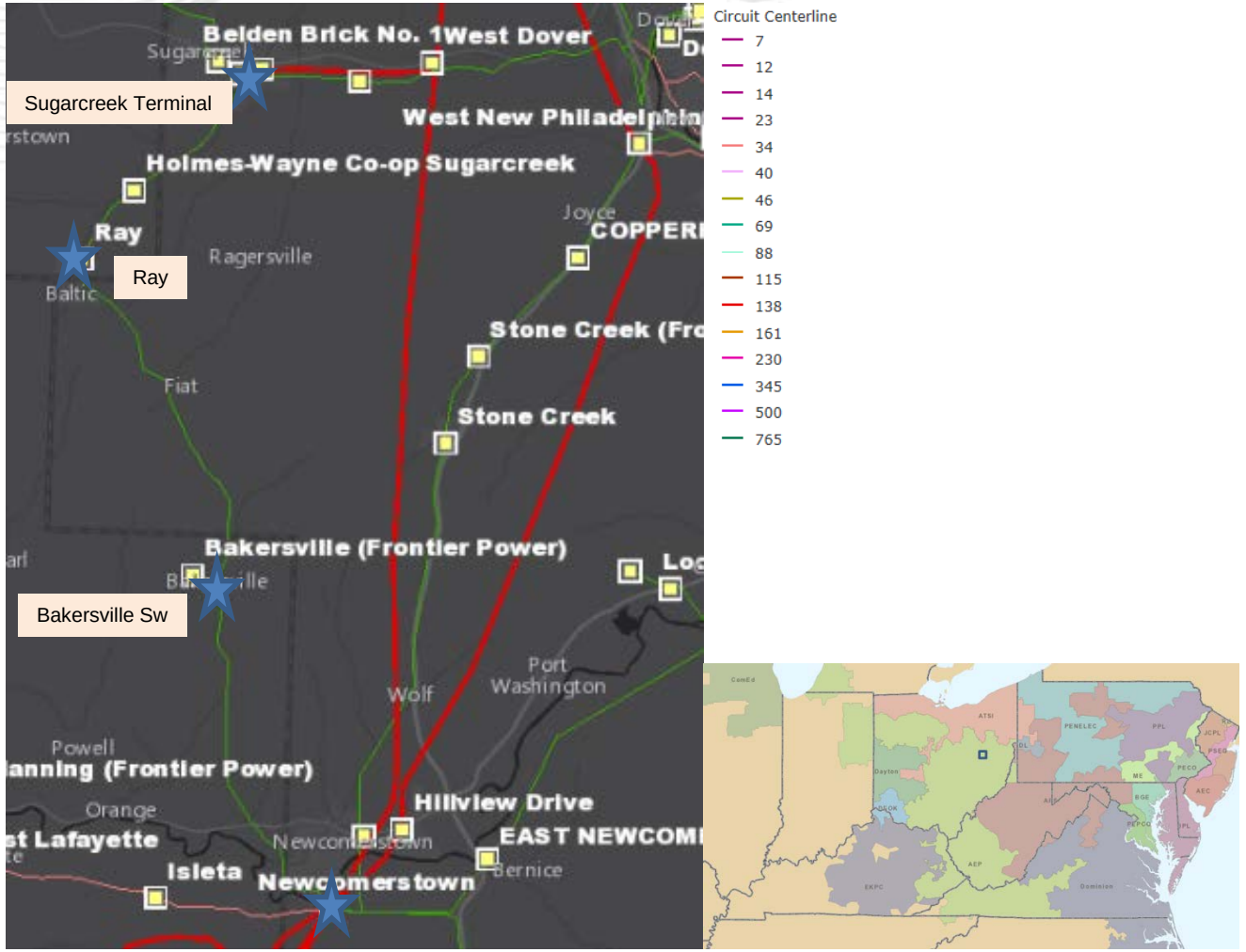
Install a new 138/69 kV station, in a three 69 kV circuit breaker ring bus arrangement, along the Philo – Canton 138 kV line and build a 2.2 miles 69 kV line from the new station to the Belden Switch on the Newcomerstown – Newport 69 kV circuit. Install two 138 V circuit breakers, 138 kV circuit switcher and low side 69 kV circuit breaker in the 138/69 kV station. Reconfigure Belden Switch into a four 69 kV circuit breaker ring bus arrangement. Estimated Cost: $20M.

Alternate for the Newcomerstown – Sugarcreek 69 kV conversion and the Newcomerstown 138/69 kV transformer replacement.:

Install a greenfield station in the intersection of the Philo Sw – South Canton 138 kV and the Newcomerstown – Sugarcreek 34.5 kV circuit. The station would consist of four 138 kV circuit breakers in a ring bus arrangement, a 138/69 kV 90 MVA transformer, a 138/34.5 kV 90 MVA transformer and a 0.6 mile 69 kV line. Estimated Cost: $27M.

Projected In-service: 12/16/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental
South Hicksville to Mark Center 69 kV Line

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Mark Center-South Hicksville line was originally constructed in 1957 with 336 ACSR conductor (73 MVA rating). There are 119 open conditions on this 8.8 mile long circuit. The existing line is almost entirely crossarm construction with suspension insulator assemblies, which is not the current AEP standard; the existing crossarms and braces are typical for distribution construction, not transmission construction. End splitting and failure is an elevated risk. Many arms fail periodic inspection; quantity failing inspection is abnormally high. Undersized braces are prone to end fittings becoming separated and arms rotating. Some existing wood pole structures have bay-o-nets supporting the shield wire. At least once in the last year the line experienced a cascading failure of multiple poles in a row. Existing grounding is only every other structure. The line is double-circuit construction for several spans near South Hicksville Station. Structure failures in the double-circuit section jeopardize system stability in the Hicksville, OH area, elevating the risk of an area-wide outage. Some of the line has distribution underbuild, which mechanically consumes pole strength. Legacy underlying easement rights for a line of this vintage are typically inadequate by present day AEP Transmission standards.

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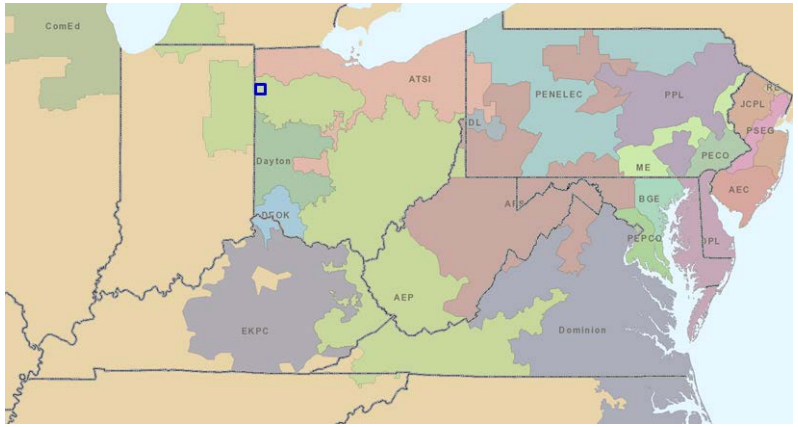
Existing Mark Center – South Hicksville 69 kV Line is highlighted in green;
Proposed rebuild is highlighted in red.



AEP Transmission Zone: Supplemental
South Hicksville to Mark Center 69 kV Line

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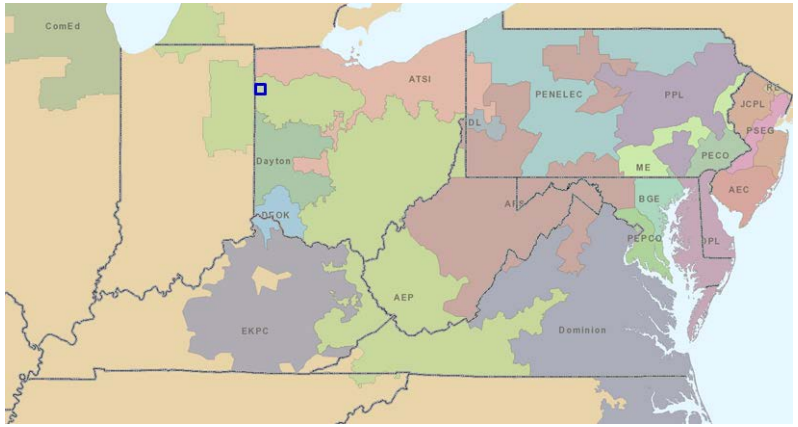
Potential Solution:
Rebuild existing South Hicksville – Mark Center Switch 69 kV line (~7.89 miles) with 795 ACSR (128 MVA rating), including a partial reroute to parallel the existing 138 kV line in the area.
Estimated Cost: $8.2 M

Alternatives:
Rebuild line without a line reroute.
Proposed reroute parallels existing 138 kV line which facilitates obtaining any supplemental easements and is ~1 mile shorter than existing route. Because of increased distance of this alternate and the predicted ease of obtaining parallel easements, the cost of this alternate is estimated to be within 3% of the cost of the proposed reroute, ~$8M.
Alternate routes that were considered were removed as options due to property owners and existing water springs.

Projected In-service: 5/31/2019

Project Status: Engineering

Existing Mark Center – South Hicksville 69 kV Line is highlighted in green;
Proposed rebuild is highlighted in red.



AEP Transmission Zone: Supplemental
Sunbright Station Rehab

Problem Statement:

Equipment Material/Condition/Performance/Risk:

34.5 kV circuit breakers “A” & “B” at Sunbright and “F” & “G” at Hill Stations are all FK type breakers (vintage 1950’s). These are oil breakers that have become more difficult to maintain due to the required oil handling. In general, oil spills occur often during routine maintenance and failures with these types of breakers. Other drivers include PCB content, damage to bushings and number of fault operations exceeding the recommendations of the manufacturer. Sunbright breakers “A” & “B” have experienced 25 and 26 fault operations respectively, which exceeds the manufactures recommended number of operations (10). Hill breakers “F” & “G” have experienced 74 and 35 fault operations respectively, which exceeds the manufactures recommended number of operations (10).

The 34.5/12 kV transformer at Sunbright is 61 years old and has experienced short circuit strength breakdown caused by a large amount of high temperature through fault events. This has led to minor gassing of the unit, and carbonization of the insulating paper. In addition, there is an upward trending of oil moisture content which will begin resulting in downward trending to the oil dielectric strength. Increasing moisture content is a resultant of water ingress through worn gaskets, leaks from the tank, or a breakdown of paper insulation of transformer windings.

Customer Service:

Obligation to serve distribution customer. The load on the Sunbright #1 transformer is projected to reach 124 % of its 8.5 MVA capability by winter 2017/18. The increase in loading is due to a 2 MVA addition to the Duffield Industrial Park in 2017. The Sunbright – Hill double circuit is already built to 69 kV standards.

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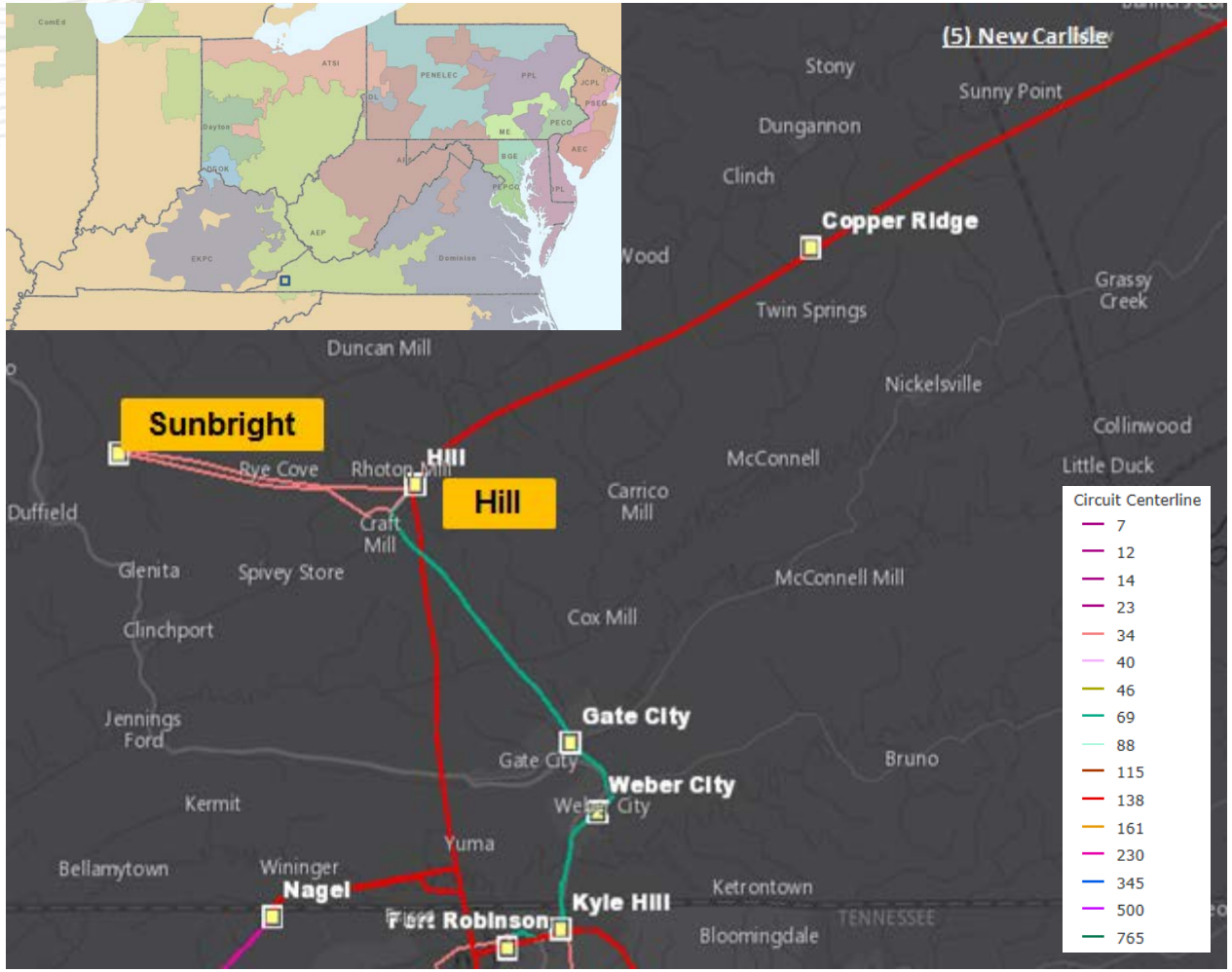

AEP Transmission Zone: Supplemental
Sunbright Station Rehab

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Potential Solution:
Convert Hill – Sunbright 34.5 kV circuits #1 and #2 to 69 kV. These lines were built to 69 kV standards. Estimated Cost: $0.0M

At Hill station, replace 34.5 kV circuit breakers "F" and "G" with new 3000 A 40 kA 69 kV circuit breakers to accommodate the conversion of the Hill – Sunbright circuit to 69 kV. A 69 kV circuit breaker will also be installed on the low side of the transformer 69 kV winding. Estimated Cost: $1.4M

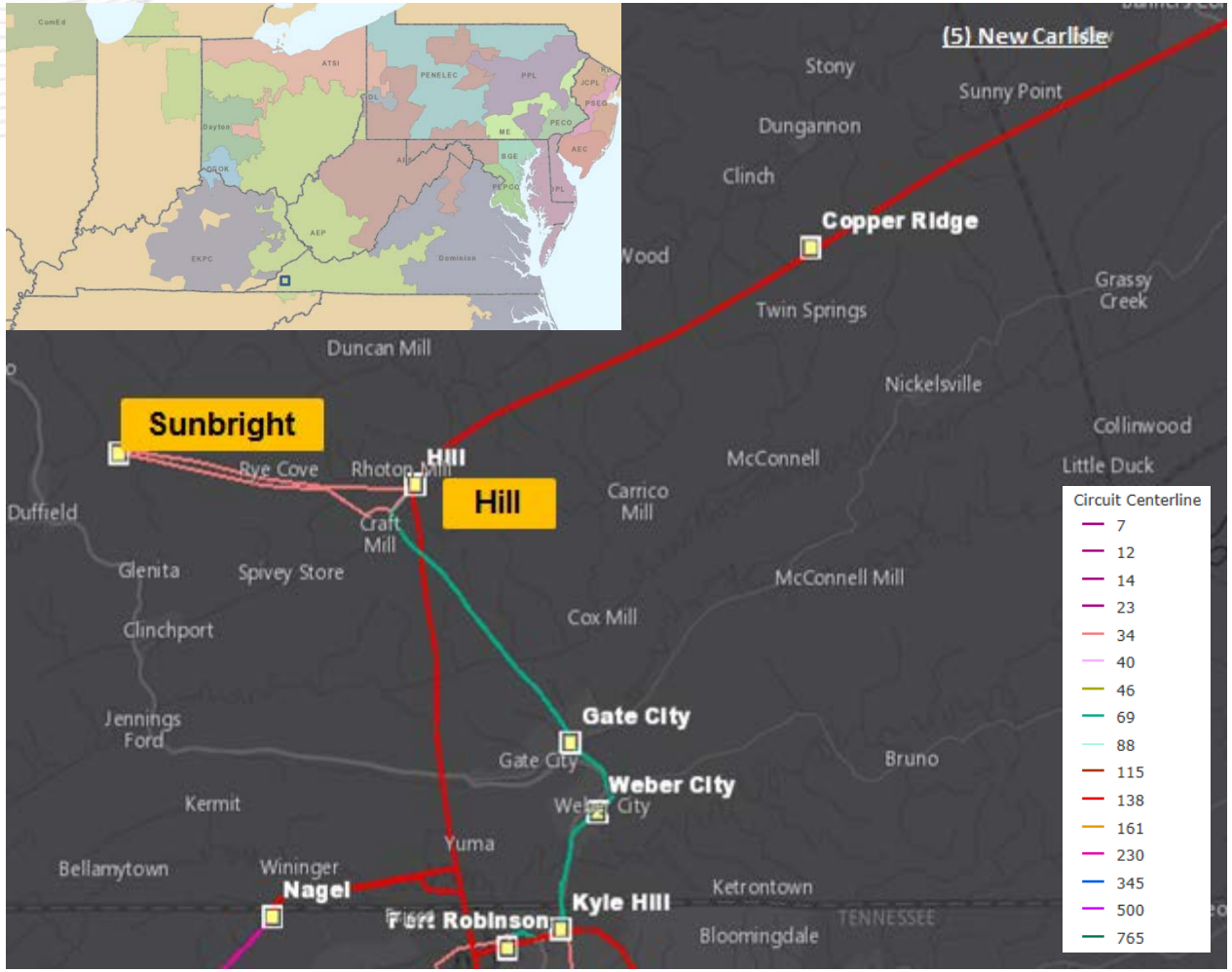
At Sunbright station, replace the existing 34/12 kV 5 MVA transformer with a new 69/12 kV 25 MVA transformer. Replace existing 34 kV 1200 A 17 kA circuit breakers with new 3000 A 40 kA 69 kV circuit breakers. Estimated Cost: $0.0M

Total Estimated Cost: $1.4 M

Alternatives:
Build a new 69 kV station near the city of Duffield. Construct approximately 2 miles of new 69 kV transmission line to serve the new Duffield Station. Upon completion, Sunbright 34.5 kV station would be retired. The Scott County Planning Commission requested that other station site options be pursued due to public opposition of the proposed Duffield site.

Projected In-service: 5/1/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental
Martinsville Station

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Martinsville 138 kV CB “C”, 69 kV CB “A” & “B” are oil type breakers without oil containment. These are oil breakers have become more difficult to maintain due to the required oil handling. In general, oil spills occur often during routine maintenance and failures with these types of breakers. Other drivers include PCB content and damage to bushings. CBs “A” & “B” are also legacy GE, oil-filled FK type breakers which have little to no access to replacement parts. CB “A” has experienced 27 fault operations, CB “B” has experiences 64 fault operations, and CB “C” has experienced 38 fault operations. The 138/34.5 kV transformer #1 has seen short circuit strength breakdown caused by excessive through fault events, some in excess of 700°C, which, has lead to an increased gassing of the unit. This transformer type (ME Co. auto banks) have frequent failures due to loose windings caused by thru faults. This transformer is needing a major overhaul to repair or replace safety and maintenance items (fans, pumps, paint, gasket, leaks). The 138/34.5 kV transformer #2B has an upward trending of oil moisture content resulting in decreasing oil dielectric strength. Increasing moisture content is a result of water ingress and/or break down of paper insulation of TF windings. The moisture content has since decreased without improvement to the dielectric strength. Short circuit strength breakdown caused by the amount of thermal through fault events, mostly in excess of 700°C, has lead to major gassing of the unit and carbonization of the insulating paper. The 138/34.5 kV transformer #2A is showing short circuit strength breakdown and high temperature health contributions due to the amount of thermal through fault events, with a majority in excess of 700°C . There are elevated levels of ethylene, methane, carbon monoxide, and carbon dioxide caused by these numerous through fault events. The CO/CO2 ratio has mostly been sustained at or above the warning level, and at times nearing the alert level. Carbonization of the insulating paper has begun which indicative of a transformer near the end of it useful life. 34.5 kV Martinsville – Morris Novelty #1 & #2 lines have pilot wire line relaying. Copper pilot wire is a relatively obsolete technology, and since the telephone companies almost never use it anymore, it is increasingly difficult to find suitable pilot wire cable and hardware. Consequently, we are avoiding like-kind replacement of pilot wire because the technology is increasingly difficult to maintain.

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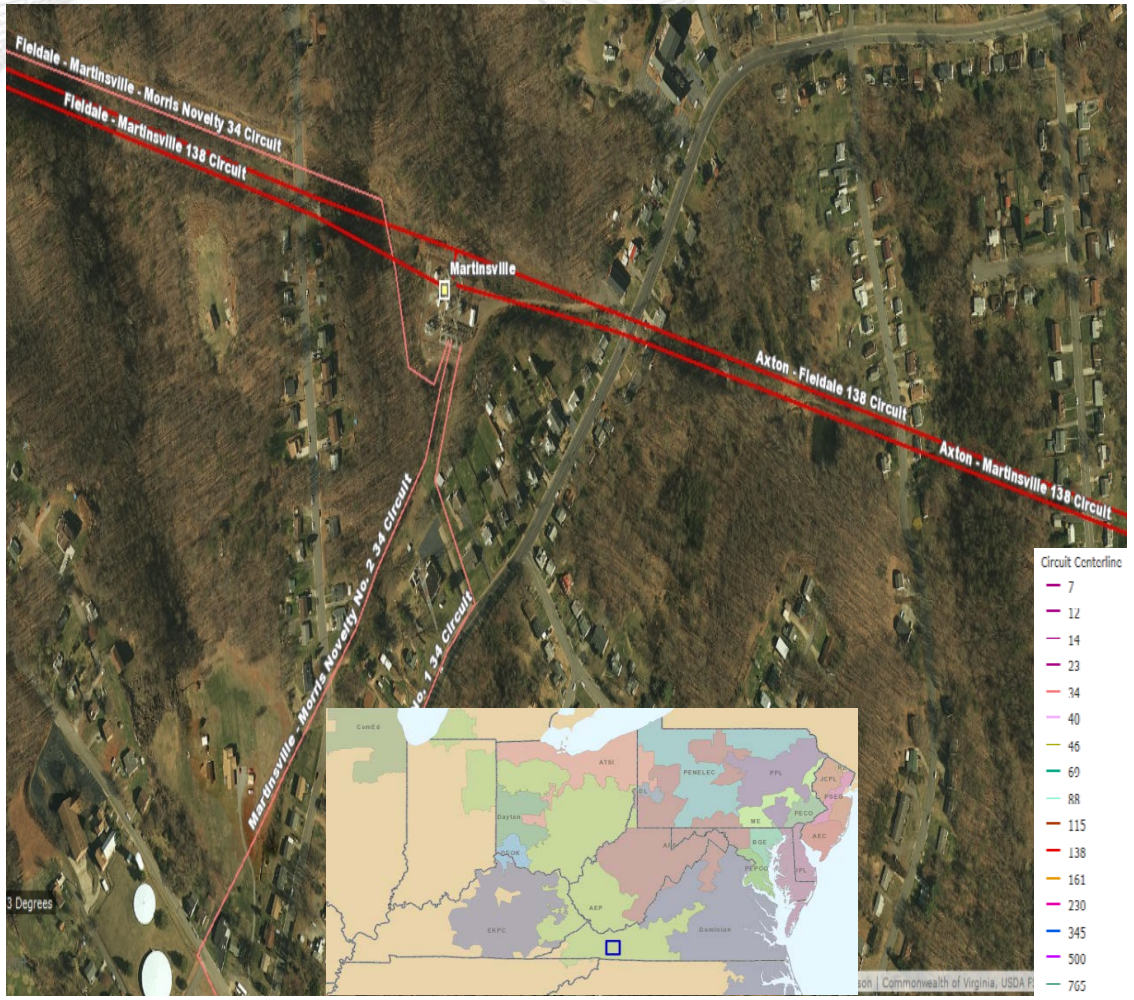

AEP Transmission Zone: Supplemental Martinsville Station

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Operational Flexibility and Efficiency:
The addition of Martinsville 138 kV line breaker (towards Fieldale) is going to break up three dissimilar zones of protection (line, bus and transformer) at Martinsville Station.

Infrastructure Resilience:
The existing control house at Martinsville Station has no room for additional relay panels. A new DCIM will be installed to accommodate new relay panels.

Customer Service:
The Martinsville substation is used as a back up to the Patriot Center Substation. The Patriot Center substation serves the largest industrial park in Henry county with over 25 business and the Patrick Henry Community College. With the current configuration both sources are going to experience outages with line or station faults. The breaker will isolate the sources during faults, allowing us to provide Patriot Centre with an increased reliability. Martinsville substation also serves all of the Southern Finishing accounts with is a large industrial customer with over 2.4 mw of load. This is a very power quality sensitive customer.

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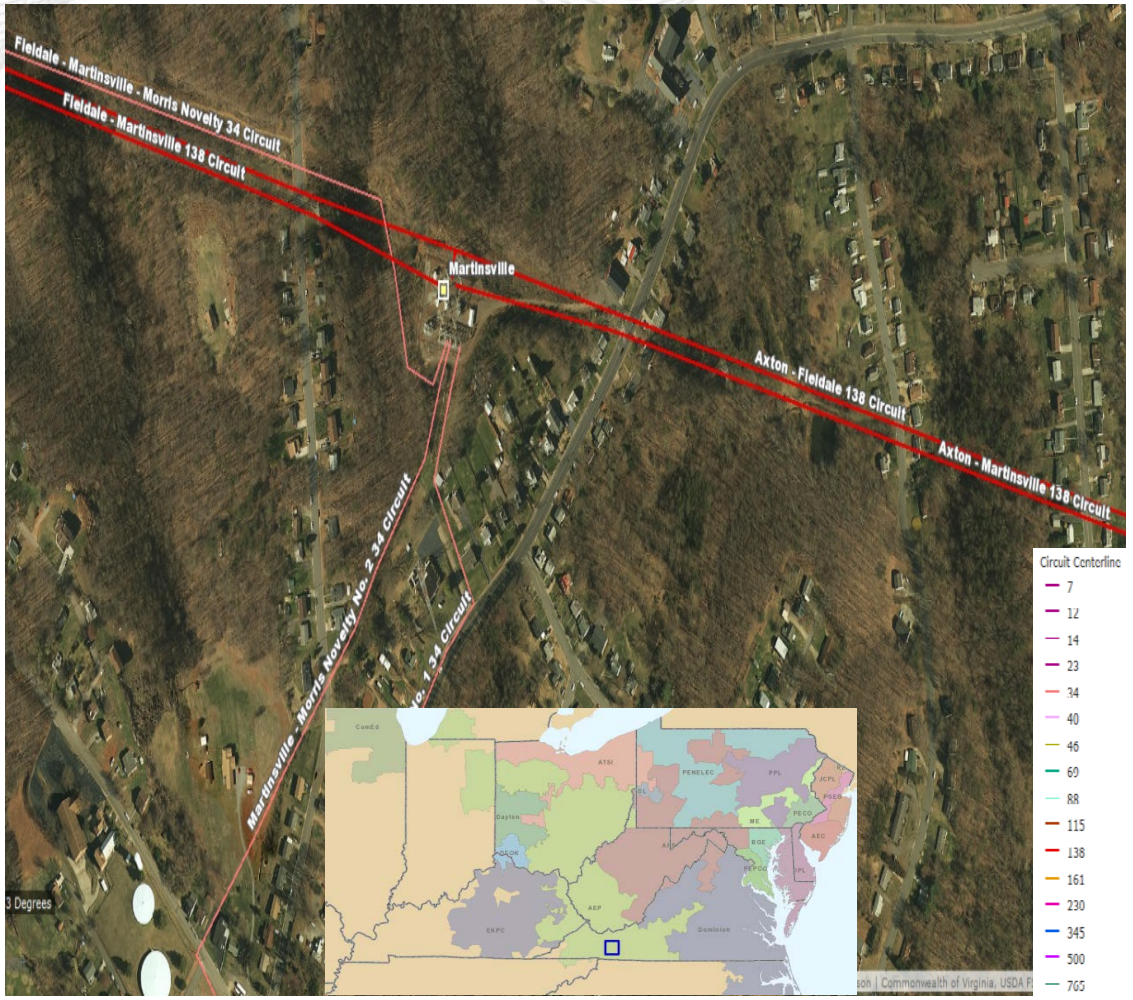

AEP Transmission Zone: Supplemental Martinsville Station

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Potential Solution

Replace the existing 138 kV/40 kA/3000A CB “C” and install new 138 kV/40 kA/3000A circuit breaker towards Fieldale. Relaying associated with the lines will be upgraded and new station equipment will be installed to support new relaying. Install a new Drop In Control Module (DICM). Replace 138/34 kV 30 MVA parallel transformers #2A and #2B with new 138/69/34 kV 90 MVA transformer. Install 138 kV/650 A/31.5 kA circuit switcher on both transformer #2 & #3. Retire 138/34 kV 128 MVA transformer #1. Retire 34 kV oil circuit breakers “A” and “B”. Replace pilot wire relays on Martinsville – Morris Novelty #1 & #2.

Estimated Cost: $2.8M

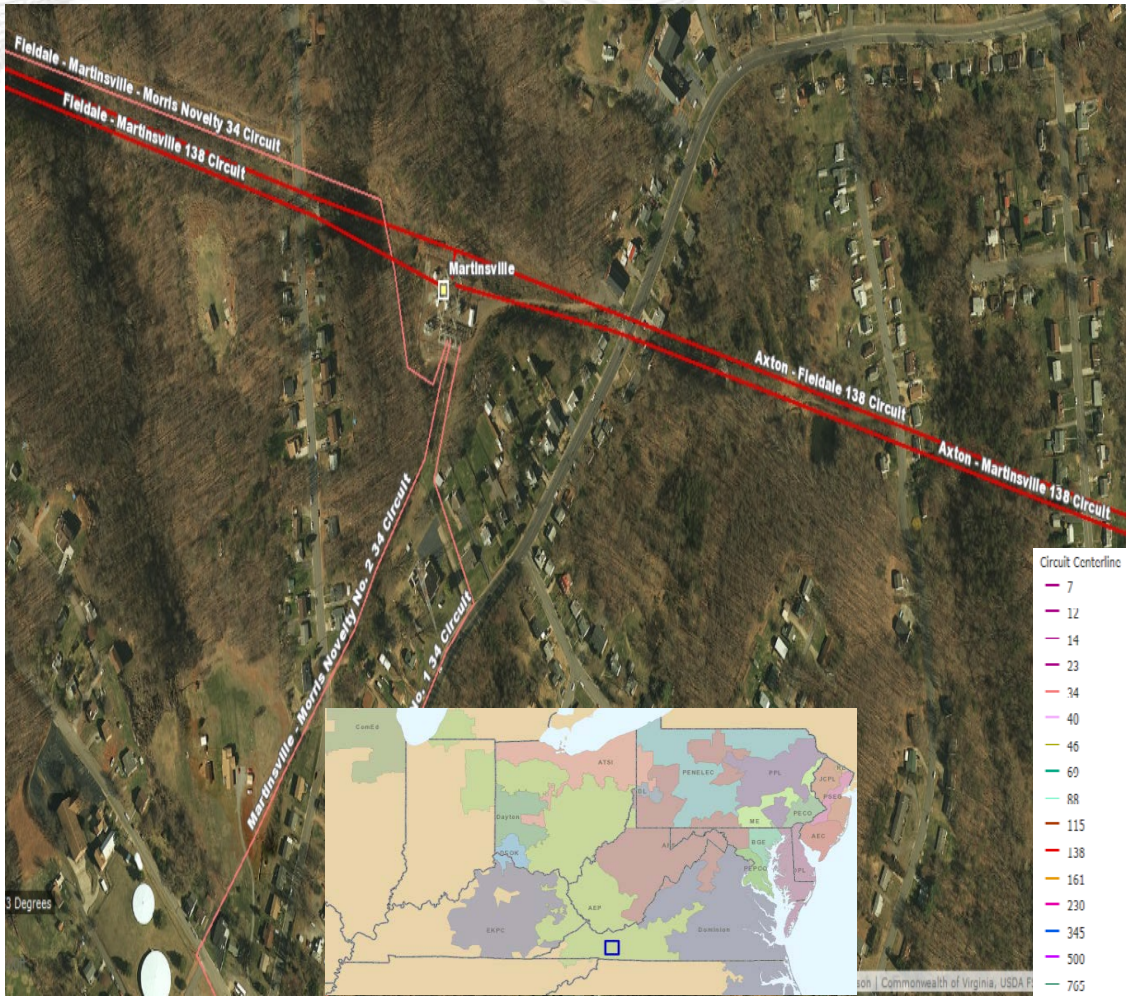
Alternatives:

Reconfiguration of the Martinsville Station to a ring bus arrangement. This would have required station expansion a major grading in the area for installation.

Estimated Cost: $8-10M

Projected In-service: 6/1/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental
West Carroll Station

Problem Statement:

Customer Service:

Obligation to serve distribution customer request at a new station. West Carroll station will serve approximately 17 MVA of load.

Potential Solution

Construct a new 138/34.5kV distribution station (West Carroll). Install a new 138/34.5 kV 30 MVA, two 3000 A 138 kV MOABs, and a 3000 A 40 kA 138 kV circuit switcher.

Estimated Cost: $0.0M

Tap the Huffman – Wythe 138kV circuit into West Carroll station.

Estimated Cost: $0.6M

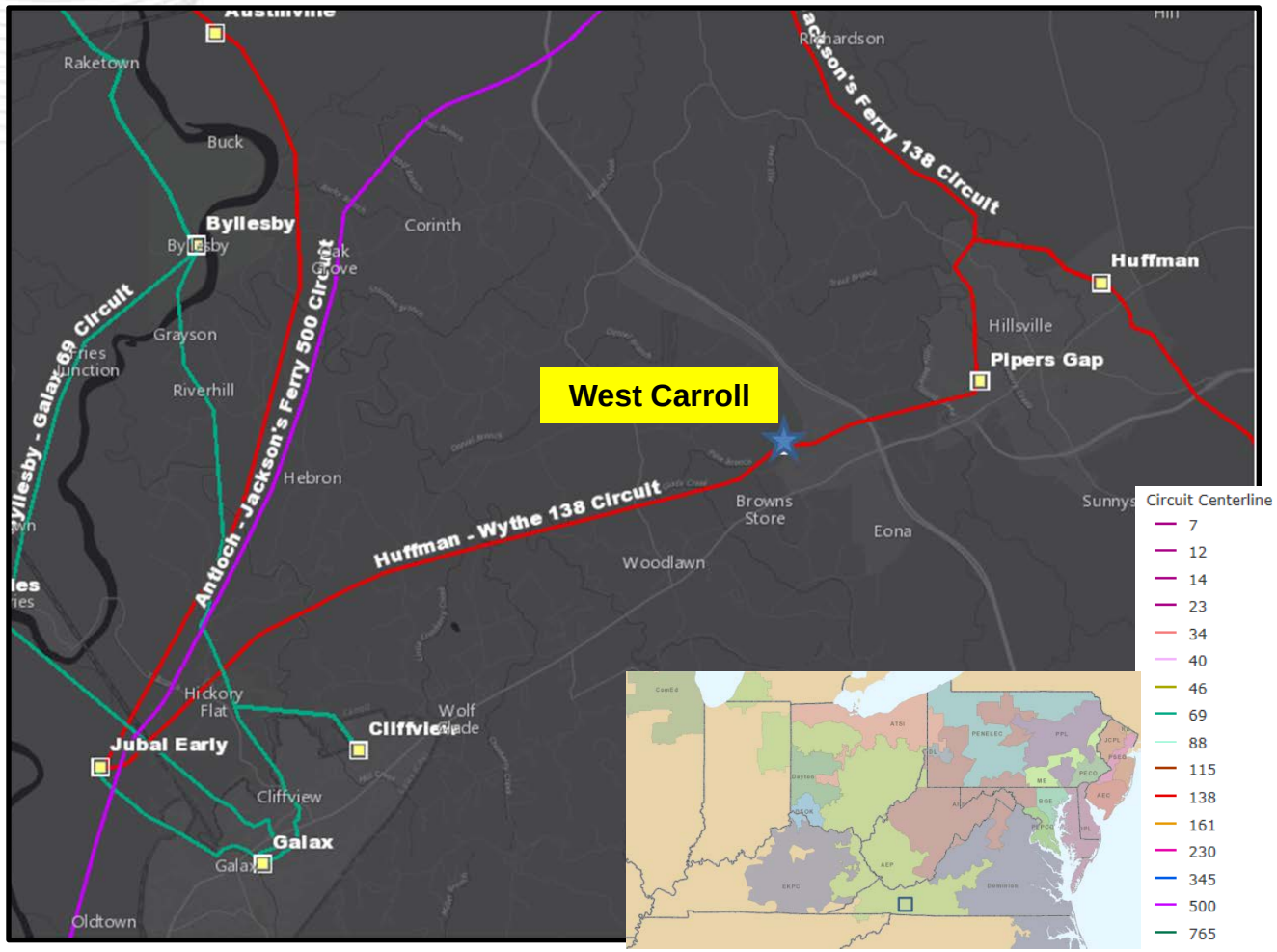
Total Estimated Transmission Cost: $0.6M

Alternatives:

No viable cost-effective alternatives could be identified.

Projected In-service: 12/1/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Stone Station

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 138/69/46 kV 50 MVA transformer at Stone station has failed beyond repair and requires replacement.

Circuit breaker “A” and “B” at Stone (vintage 1966) are 1200A, 21 kA CF-48 type breakers. These are oil breakers that have become more difficult to maintain due to the required oil handling. There is an increased potential for oil spills during routine maintenance and failures with these types of breakers. In addition, these breakers also have bushing damage, and they are experiencing mechanical breakdown associated with its contacts and resistors. Both breakers have exceeded the amount of fault operations recommended by the manufacturer of 10. Breaker “A” and “B” have experienced 84 and 101 fault operations respectively.

Potential Solution

Replace the failed 138/69/46 kV 50 MVA transformer bank with a new 138/69/46 kV 90 MVA transformer bank. Replace circuit breaker “A” with a new 69 kV 3000 A 40 kA circuit breaker. Replace circuit breaker “B” with a new 69 kV 3000 A 40 kA circuit breaker.

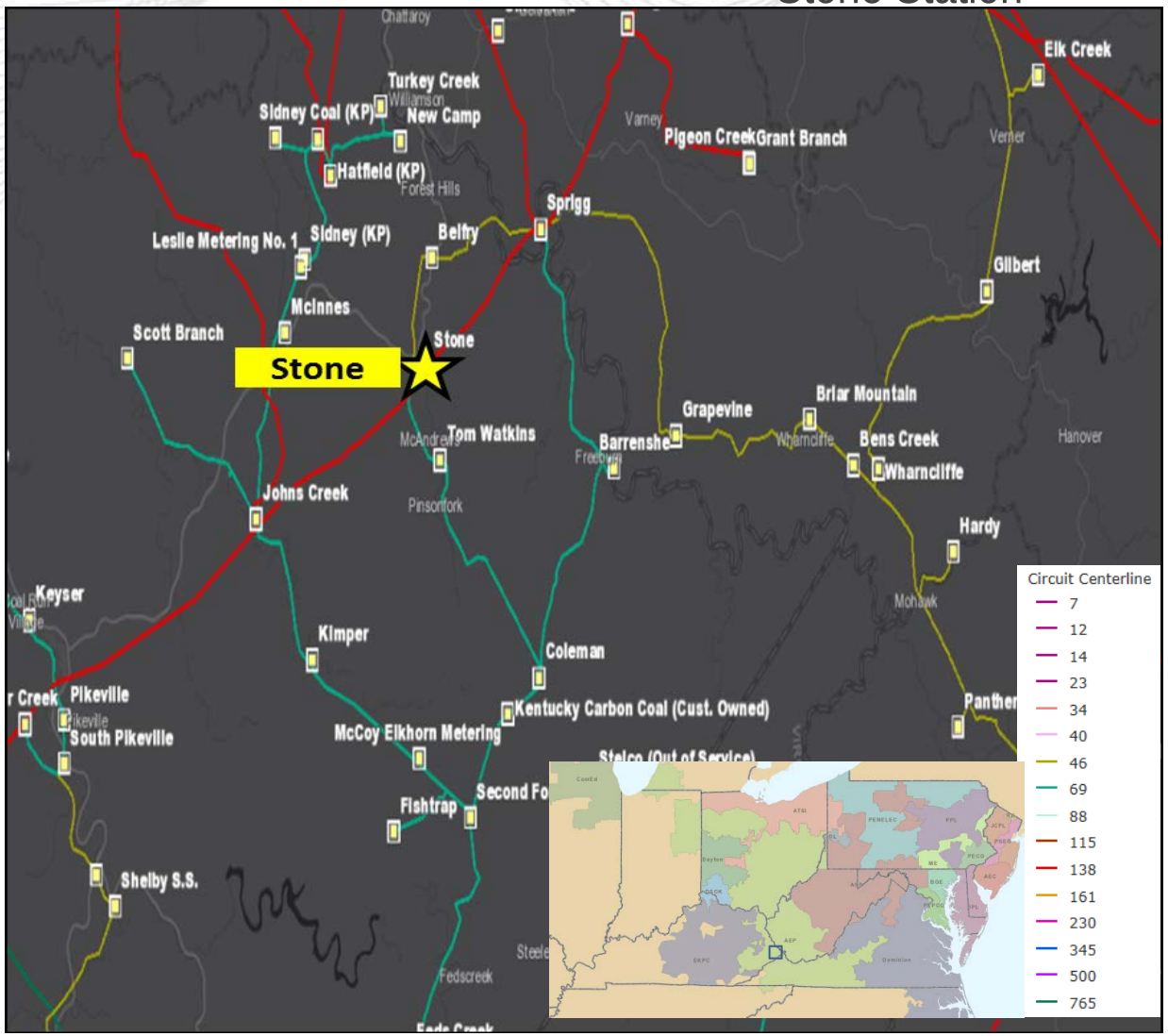
Total Estimated Transmission Cost: $3.3M

Alternatives:

No viable cost-effective alternatives could be identified.

Projected In-service: 12/1/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental Mink Station

Problem Statement:

Customer Service:

AEP Ohio has requested a new 138kV delivery point capable of serving 5-50MVA transformers. One transformer is to be installed now and a second will be install within 5 years as the load in the area increases.

AEP Ohio is also currently working with a large power prospect which would take two additional 138kV delivery points from Mink if this site is selected. There have been more than 10 large load requests that would connect directly to the new Mink Station, ranging from 50 MW to 1000 MW over the last several years. Many of the requests would like service in less than a year.

Equipment Material/Condition/Performance/Risk:

The 138 kV CBs 5 & 6 at East Broad Street Substation are oil filled, 2000A 40kA GE FK-Type breakers, manufactured in 1979 and are without oil containment. FK-Type oil filled breakers historically have poor performing operating mechanisms. The existing switches are mounted on cap and pin insulators. The steel is in poor condition and foundations are crumbling.

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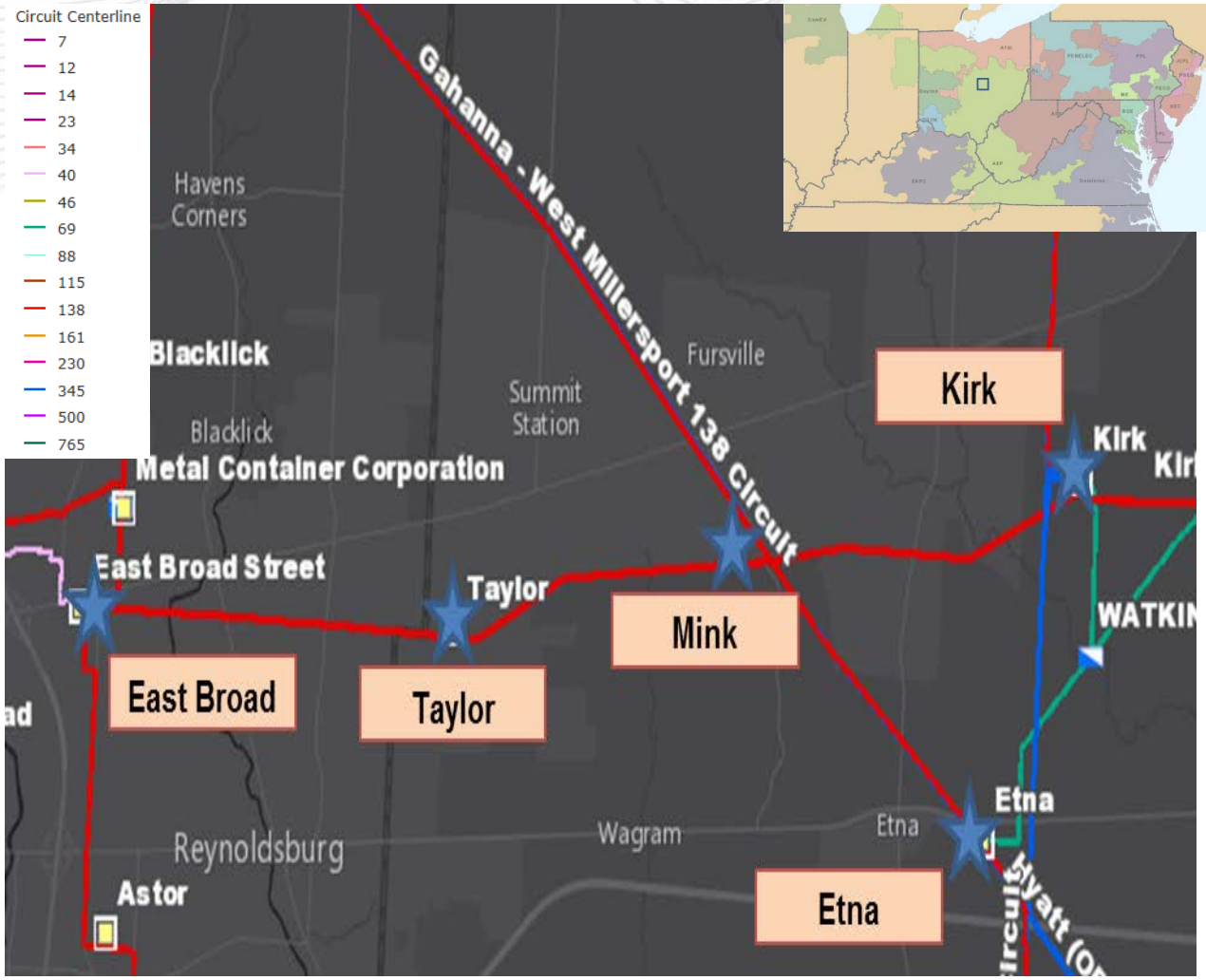

AEP Transmission Zone: Supplemental
Mink Station

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Potential Solution

Install 2 transmission line poles to cut the 138kV East Broad – Kirk #1 line into the Mink Station. Install 2-138kV line exits from the station to the new poles. Match conductors of existing line, which are 1272 ACSR (338 MVA rating).
Estimated Cost: $0.6M

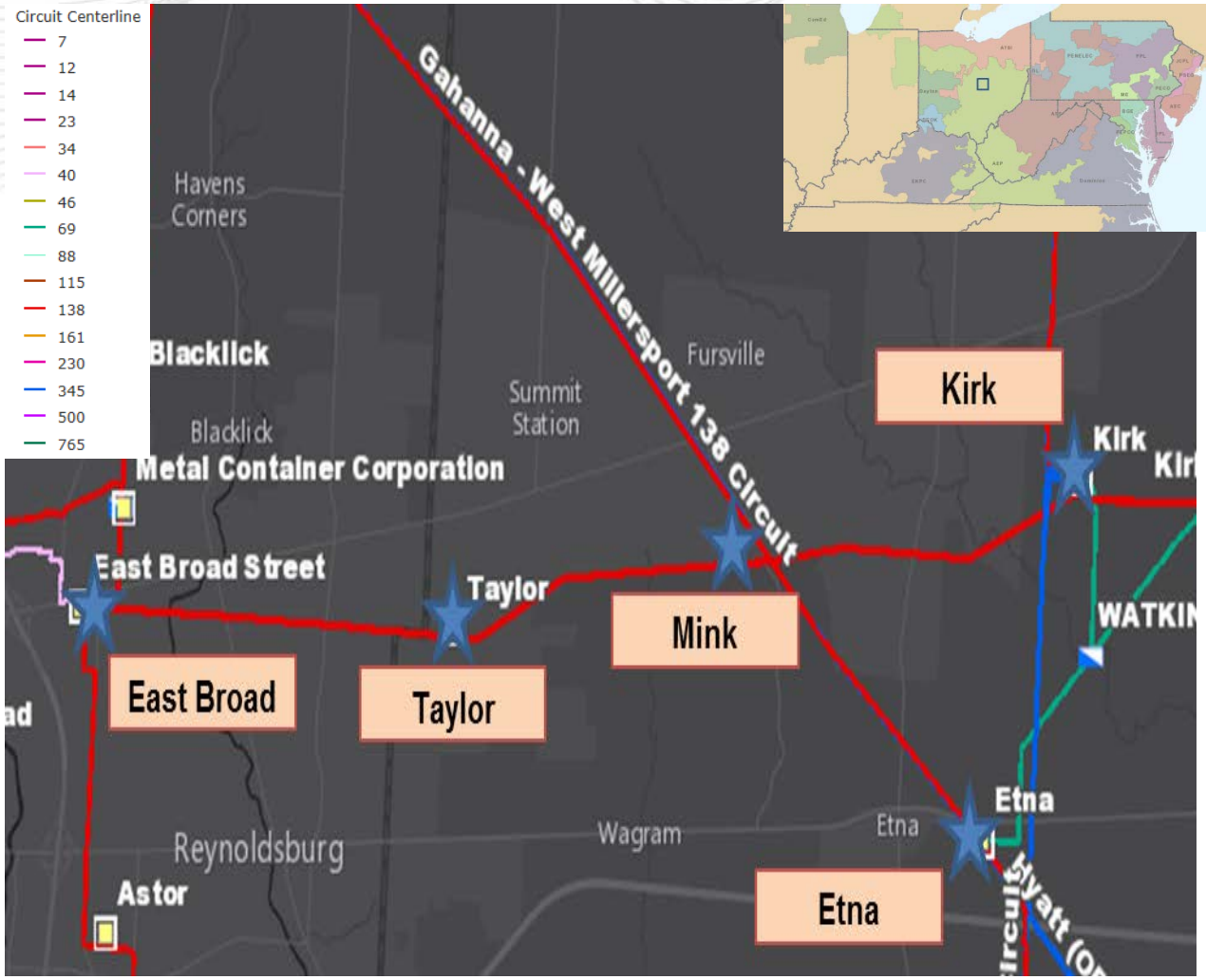
Mink Station: Install breaker and a half station with 6-138kV 3000A 63kA circuit breakers on five strings with two distribution transformers.
Estimated Cost: $5.1M

East Broad Station: Replace circuit breakers 5 and 6 and line relaying with 2-138kV 3000A 63kA circuit breakers.
Estimated Cost: $1.5M

Taylor Station: Remote end relaying.
Estimated Cost: $0.3M

Total Estimated Transmission Cost: $7.5M

Continued on next slide…



AEP Transmission Zone: Supplemental Mink Station

Continued from previous slide…

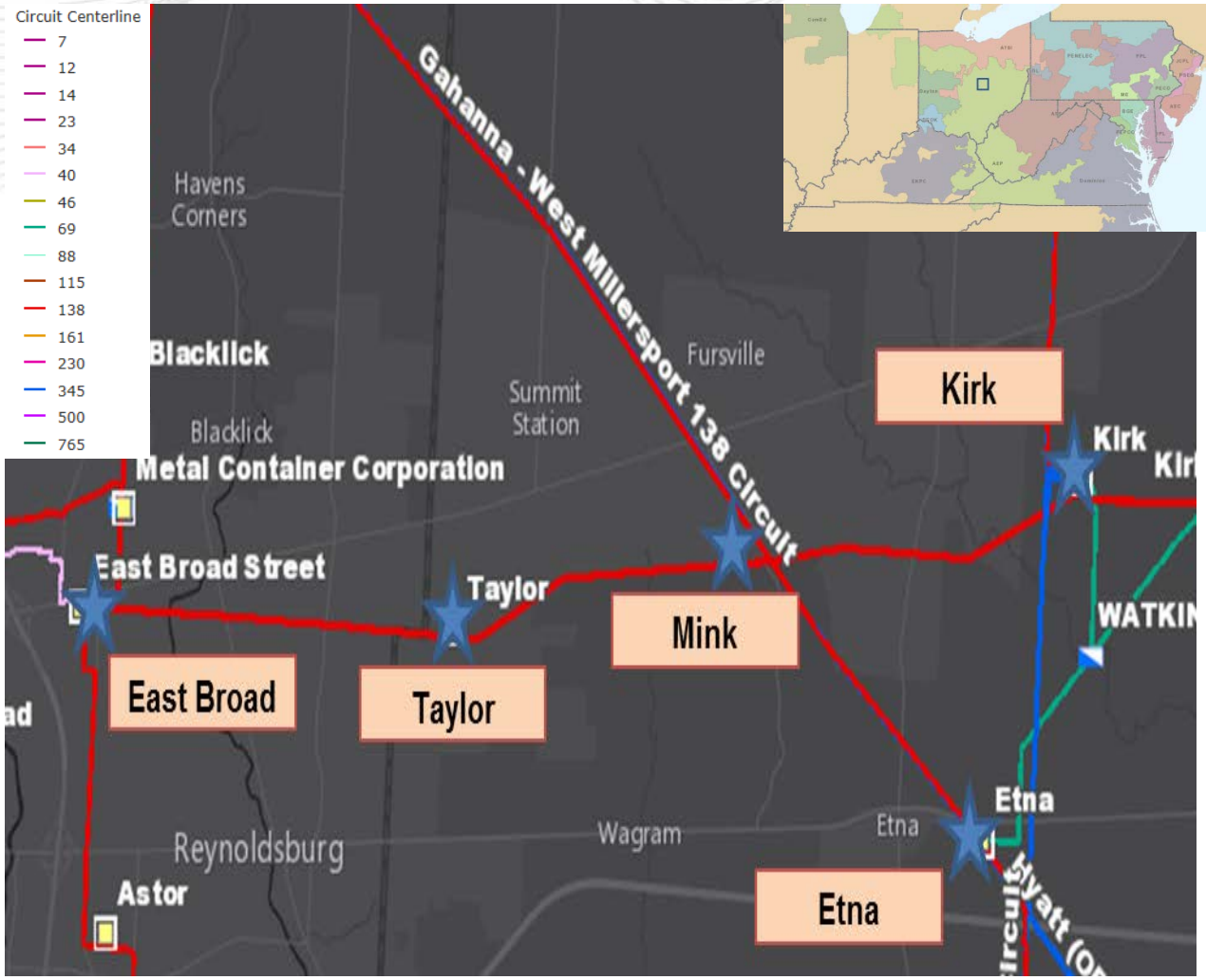
Alternatives:

Rebuild 69kV sourced Etna Station as a 138kV loop fed station. This station is approximately 3.5 miles from the load center. This project would require extensive outages and expense to convert from 69kV to 138kV. The station would need to be expanded on a new site purchase. Extensive distribution facilities would be required to reach the load center. Flexibility for future load growth would be limited. This would not be helpful in serving potential large load customers off the 138kV line in the industrial park. Estimated Cost: $13M

Construct third 34.5kV distribution feeder out of Kirk Station. This has several problems in that constructing a new overhead feeder through Pataskala would be very difficult. It would likely require triple circuiting for the majority of the route and obtaining ROW through the town would be difficult. This would only address the loading issues as they are now and would not allow for future loads. Kirk Station is approximately 7 miles from load center. Estimated Cost: $20M

Projected In-service: 6/29/2018

Project Status: Under Construction



Second Review

Baseline Reliability and Supplemental Projects

Previously presented on 1/8/2018 SRRTEP

Problem Statement :

Customer Service

- Illuminating Company Customer, Southerly Sewage, requires a new substation due to operating and maintenance concerns with the existing customer substation.
- No initial load increase.

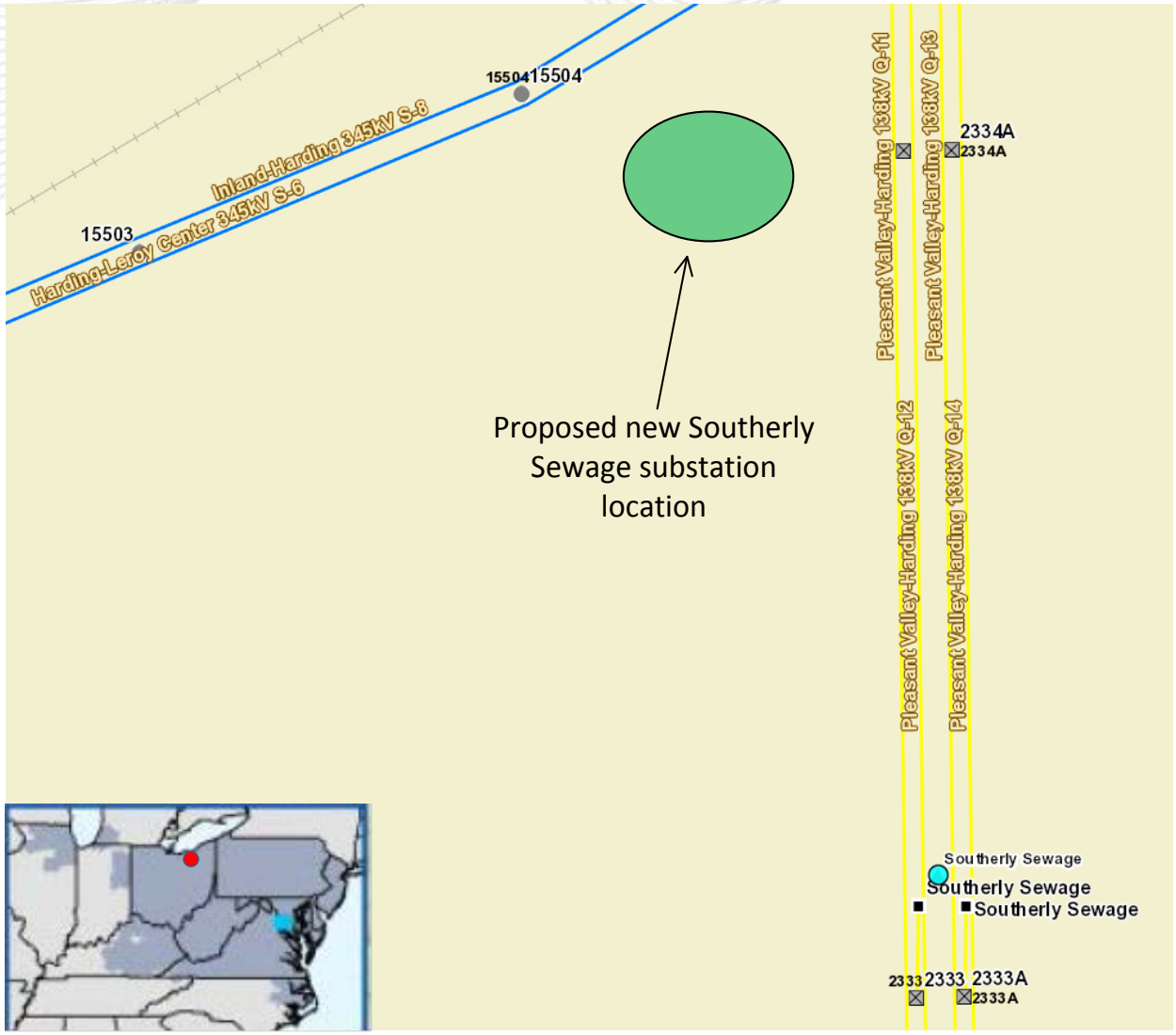
Selected Solution:

- Construct a new four (4) breaker 138kV ring bus substation (Southerly Sewage) that will connect to the Harding-Pleasant Valley Q11 138kV line and retire the existing customer substation. (S1465)

Estimated Project Cost: $9.3M (Reimbursable)

Projected IS Date: 06/15/2019

Status: Conceptual



ATSI Transmission Zone: Supplemental
First Solar New Substation - Customer

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Customer Service

- Support customer's load increase.

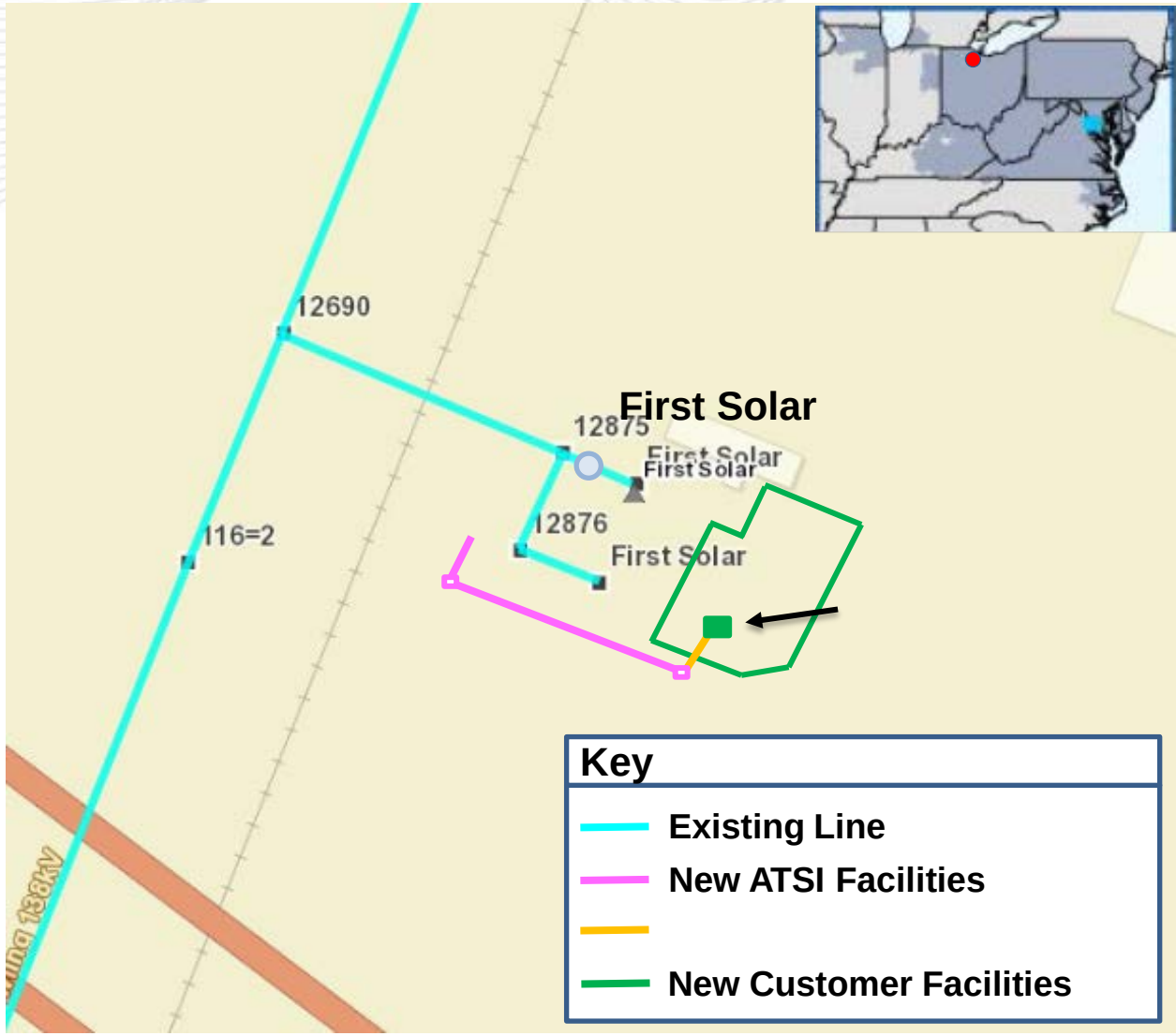
Selected Solution:

- Install new line tap on the Chrysler-Dowling 138kV circuit with 336 kcmil ACSR. (S1466)

Estimated Project Cost: $0.4M (Reimbursable)

Projected IS Date: 03/01/2018

Status: Engineering



ATSI Transmission Zone: Supplemental
Ford Brookpark Substation - Customer

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Customer Service

- Support customer's substation reconfiguration.
- Customer to retire in place two existing transformers.
- No increase in customer load.

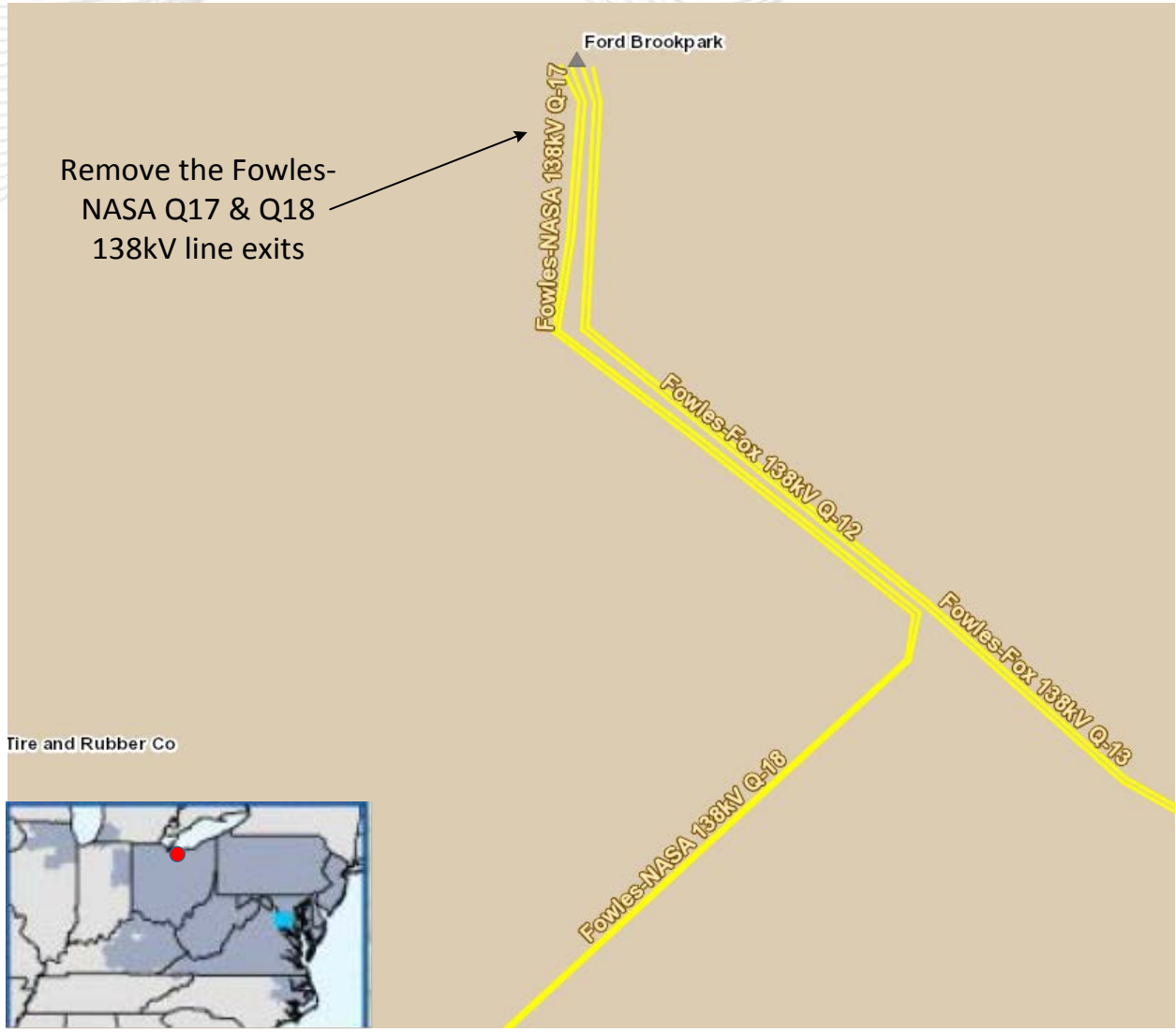
Selected Solution:

– Remove the Q17 & Q18 Fowles-NASA 138kV lines; by-pass existing customer Ford Brookpark substation. Maintain the Q13 & Q12 Fowles-Fox 138kV Lines for transmission service to customer substation. (S1467)

Estimated Project Cost: $0.4M (Reimbursable)

Projected IS Date: 05/31/2018

Status: Conceptual



Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):
Operational Flexibility and Efficiency

- Minimize significant local load loss for the common tower outage of Eastlake-Leroy Center Q15 and Q16 138kV lines.
- Improve operational flexibility during maintenance and restoration efforts.

Selected Solution:
Construct a four (4) breaker 138kV ring bus substation near the existing Nash substation. Loop and terminate the Eastlake-Leroy Center Q15 and Q16 138kV lines through the new ring bus. (S1468)

Estimated Project Cost: $8.6M

Projected IS Date: 06/01/2019

Status: Conceptual

ATSI Transmission Zone: Supplemental
Nathan Substation Connection Reconfiguration

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Minimize local load loss for the common tower outage of Eastlake-Leroy Center Q15 and Q16 138kV lines.

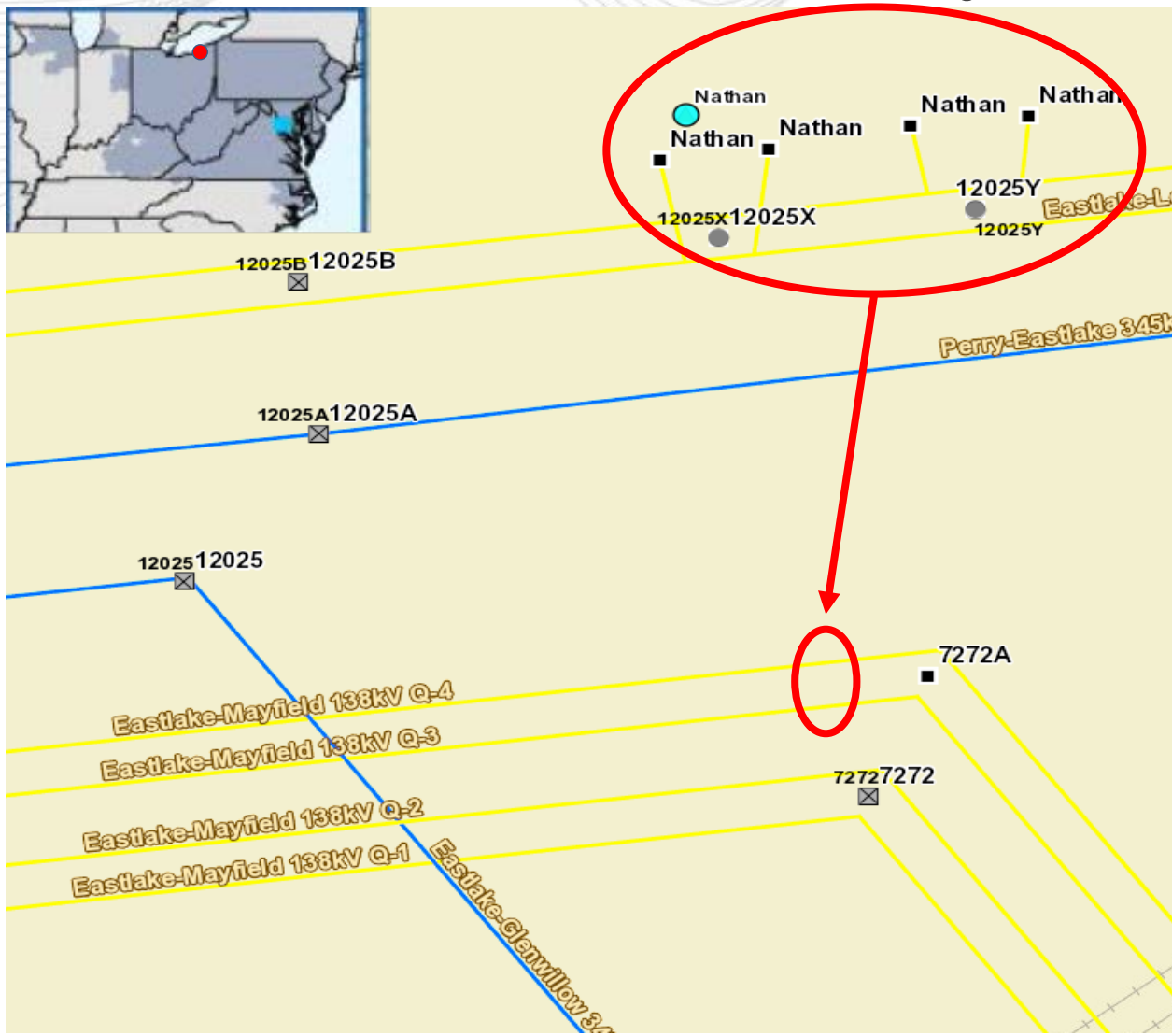
Selected Solution:

- Construct new line taps to Nathan substation from the Eastlake-Mayfield Q3 and Q4 138kV lines. Transfer Nathan substation from the Eastlake-Leroy Center Q15 and Q16 138kV Lines to the Eastlake-Mayfield Q3 and Q4 138kV lines. (S1469)

Estimated Project Cost: $2.3M

Projected IS Date: 12/31/2018

Status: Conceptual



ATSI Transmission Zone: Supplemental Stevens 69 kV Ring Bus

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.

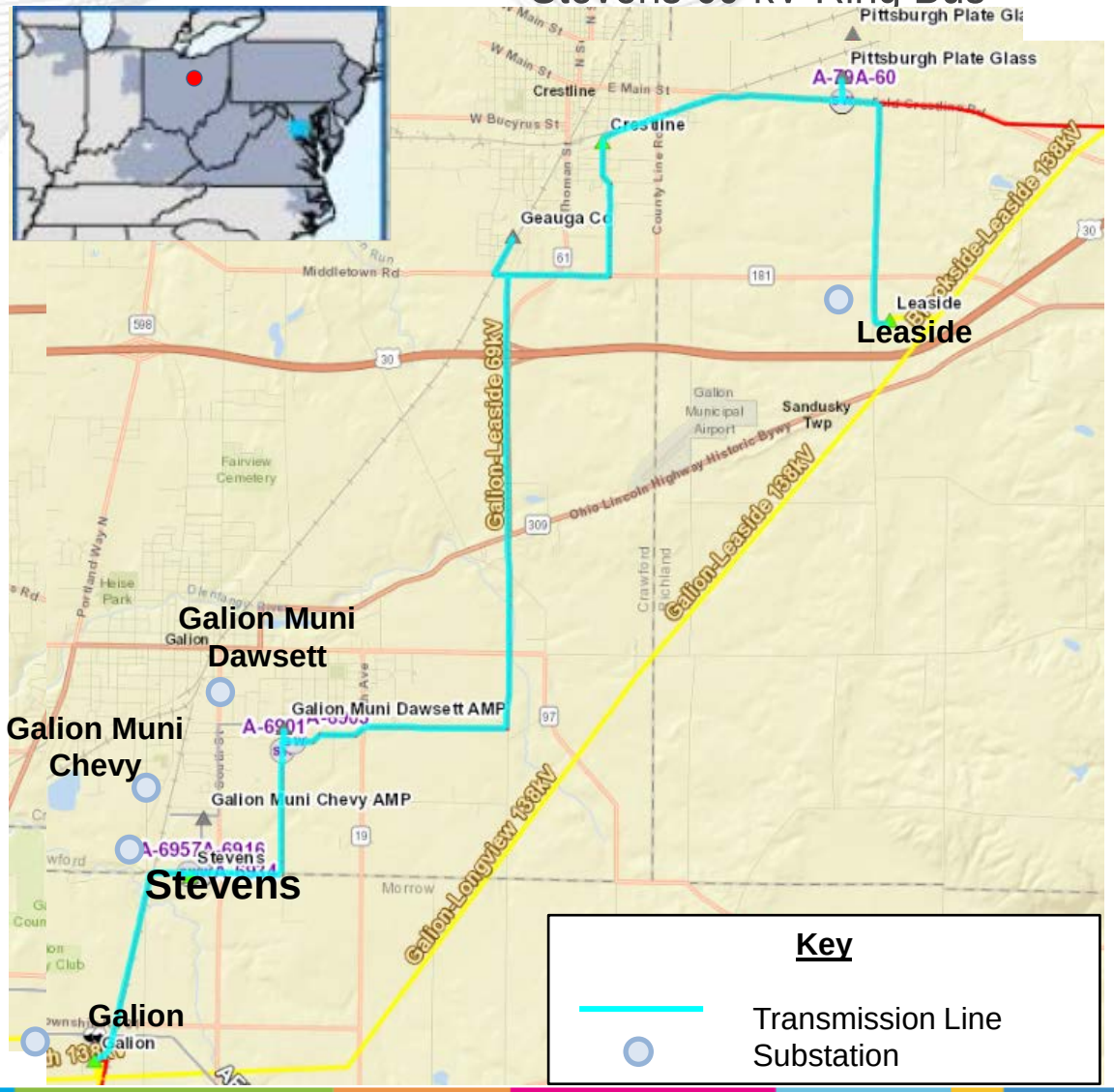
Selected Solution:

- Convert Stevens 69kV substation to a four (4) breaker ring bus. Reconfigure Stevens substation to include terminals for: Galion-Stevens 69 kV, Stevens-Leaside 69 kV, Stevens-Galion Muni (Chevy) 69 kV, and Stevens transformer to make the Station layout support line-load-line configuration. (S1470)

Estimated Project Cost: $5.6M

Projected IS Date: 12/31/2018

Status: Conceptual



ATSI Transmission Zone: Supplemental
Tyrrell – Ring Bus and Add 69 kV Cap Banks

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.

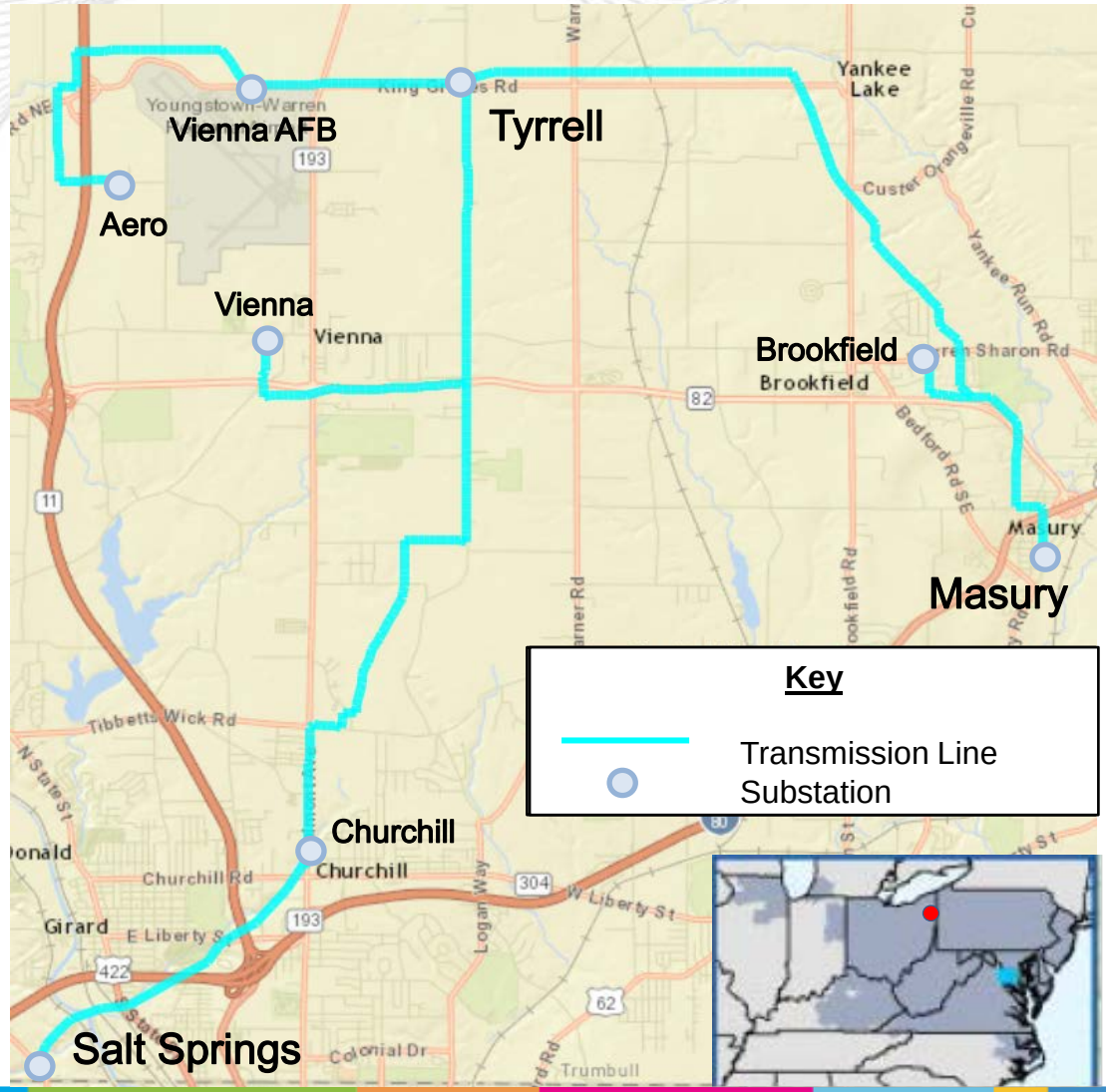
Selected Solution:

- Convert Tyrrell 69 kV substation into a four (4) breaker, future five (5), for future cap bank(s). (S1471.1)
- Incorporate the radial tap to Vienna Air Force Base and Aero sub into dedicated ring bus position (S1471.2)
- Reconfigure the line exits at Tyrell substation for Masury-Tyrrell 69kV line, Tyrrell-Salt Springs 69kV line, Tyrrell-Aero (radial), and Tyrrell transformer to make the substation layout support line-load-line configuration. (S1471.3)

Estimated Project Cost: $6.1M

Projected IS Date: 06/01/2019

Status: Conceptual



ATSI Transmission Zone: Supplemental
Ford Road 69 kV Ring Bus

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.

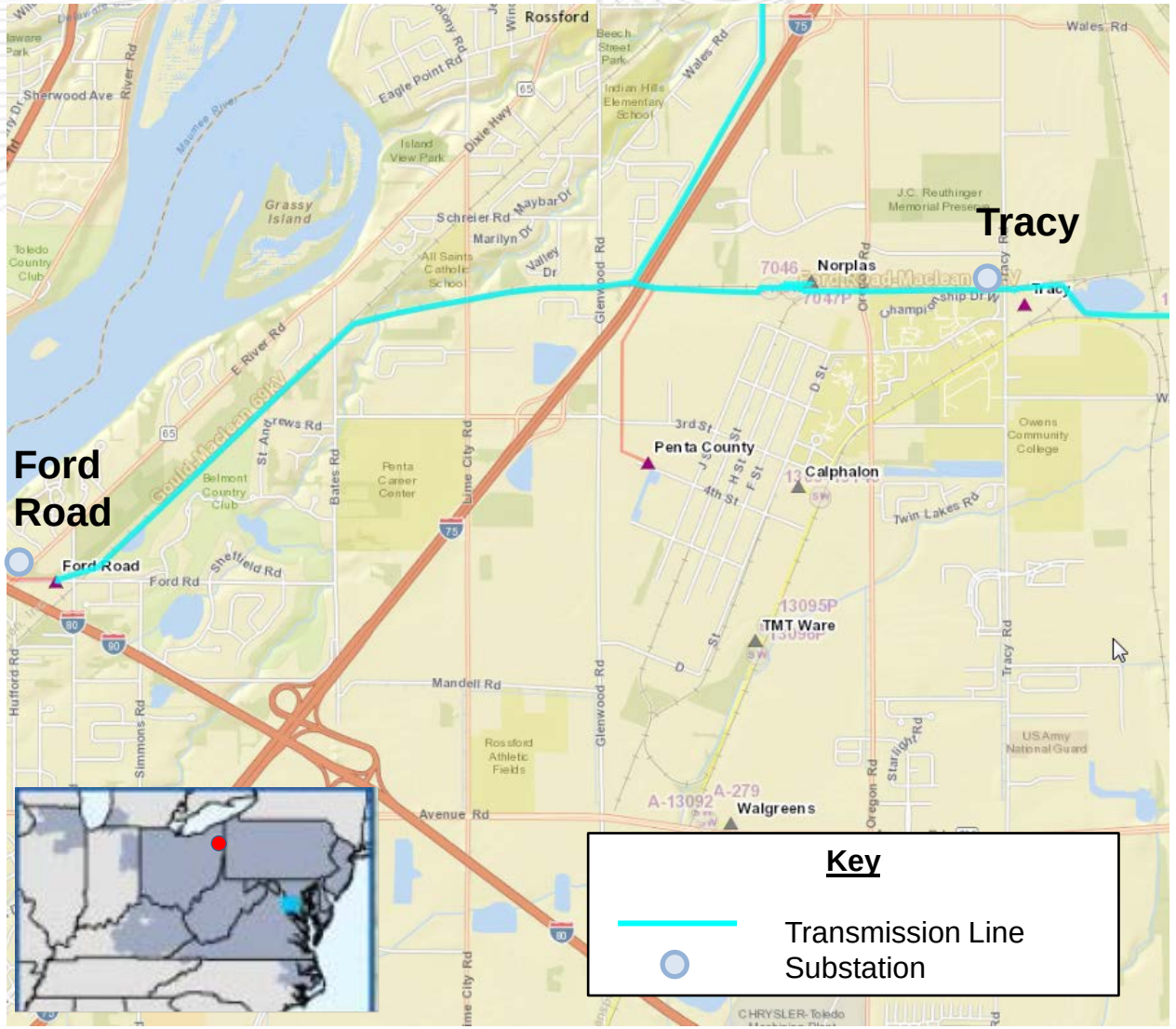
Selected Solution:

- Convert Ford Road substation to a four (4) breaker ring bus (S1472.1)
- Reconfigure the line exits at Ford Road substation for: Ford Road-Maclean 69 kV, Ford Road-Vulcan 69 kV, 69 kV capacitor bank, and Ford Road transformer to make the Substation layout support line-load-line configuration. (S1472.2)

Estimated Project Cost: $5.0M

Projected IS Date: 12/31/2018

Status: Conceptual



ATSI Transmission Zone: Supplemental
Vulcan - Add high-side breaker to transformer #10

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.
- Eliminate the simultaneous outages to three or more system elements.

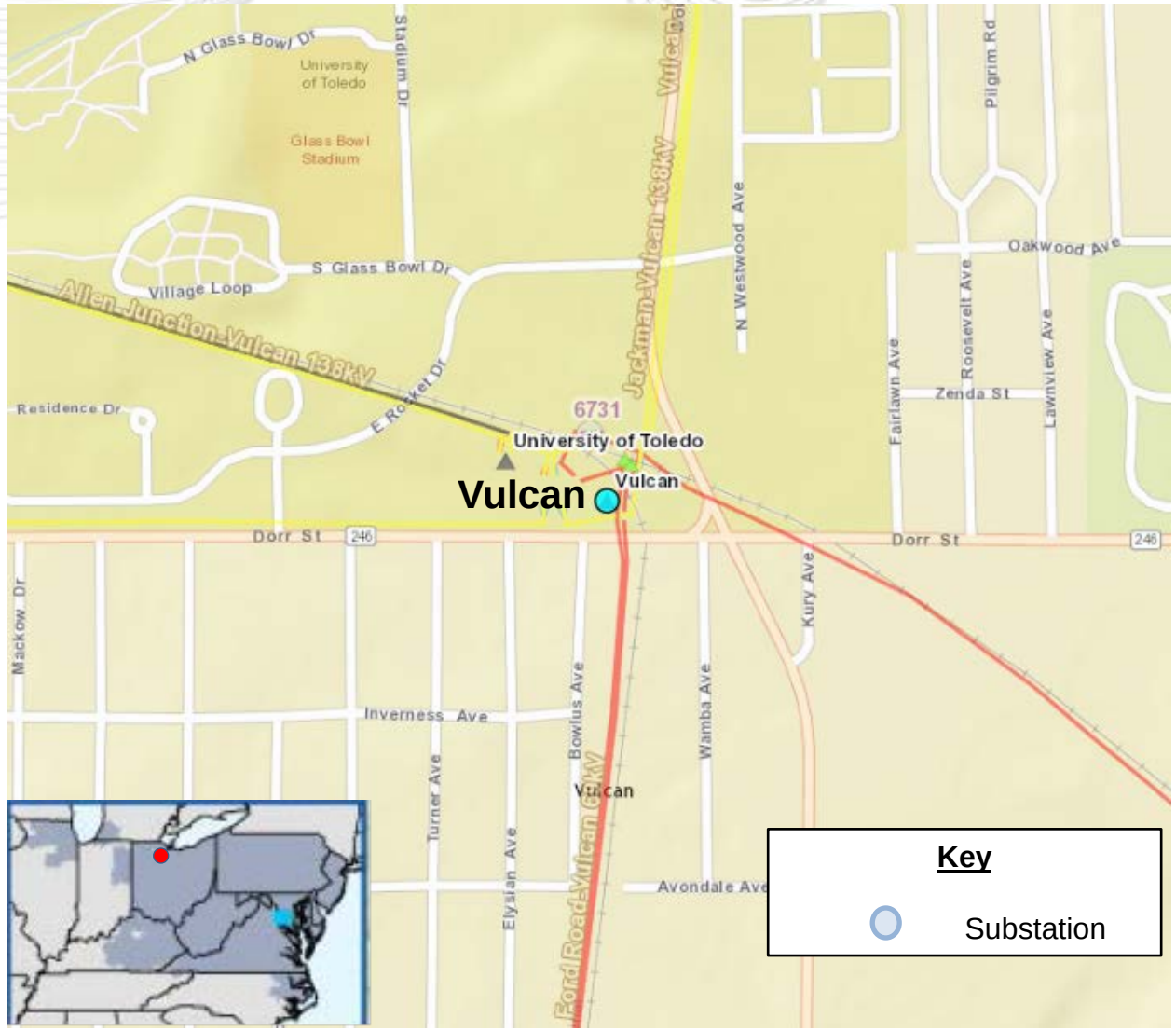
Selected Solution:

- Add new 138 kV breaker on high-side of the Vulcan #10 138/69 kV transformer. (S1473)

Estimated Project Cost: $0.6M

Projected IS Date: 5/1/2018

Status: Conceptual



ATSI Transmission Zone: Supplemental
Leffels Lane 69 kV Ring Bus

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.
- Eliminate the simultaneous outages to three or more system elements.

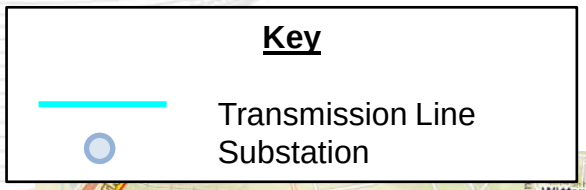
Selected Solution:

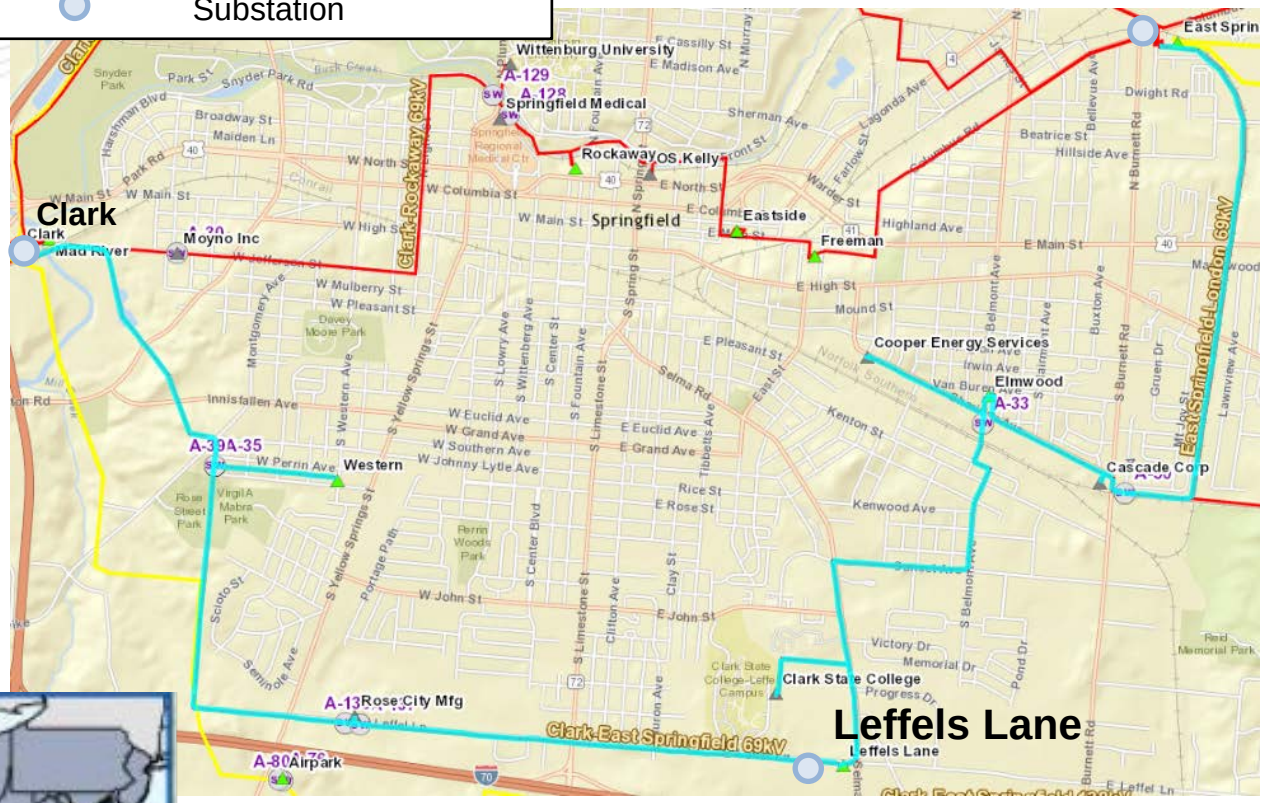
- Convert Leffels Lane substation to a four (4) breaker ring bus. (S1474.1)
- Reconfigure Leffels Lane substation to include terminals for: Clark-Leffels Lane 69kV, Leffels Lane-East Springfield 69kV, Leffels Lane transformer #1, and Leffels Lane transformer #2 to make the Substation layout support line-load-line configuration. (S1474.2)

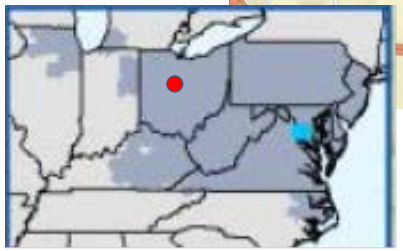
Estimated Project Cost: $4.5M

Projected IS Date: 05/01/2018

Status: Conceptual







ATSI Transmission Zone: Supplemental
Dilworth Garrettsville Area Upgrades

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.
- Eliminate the simultaneous outages to three or more system elements.

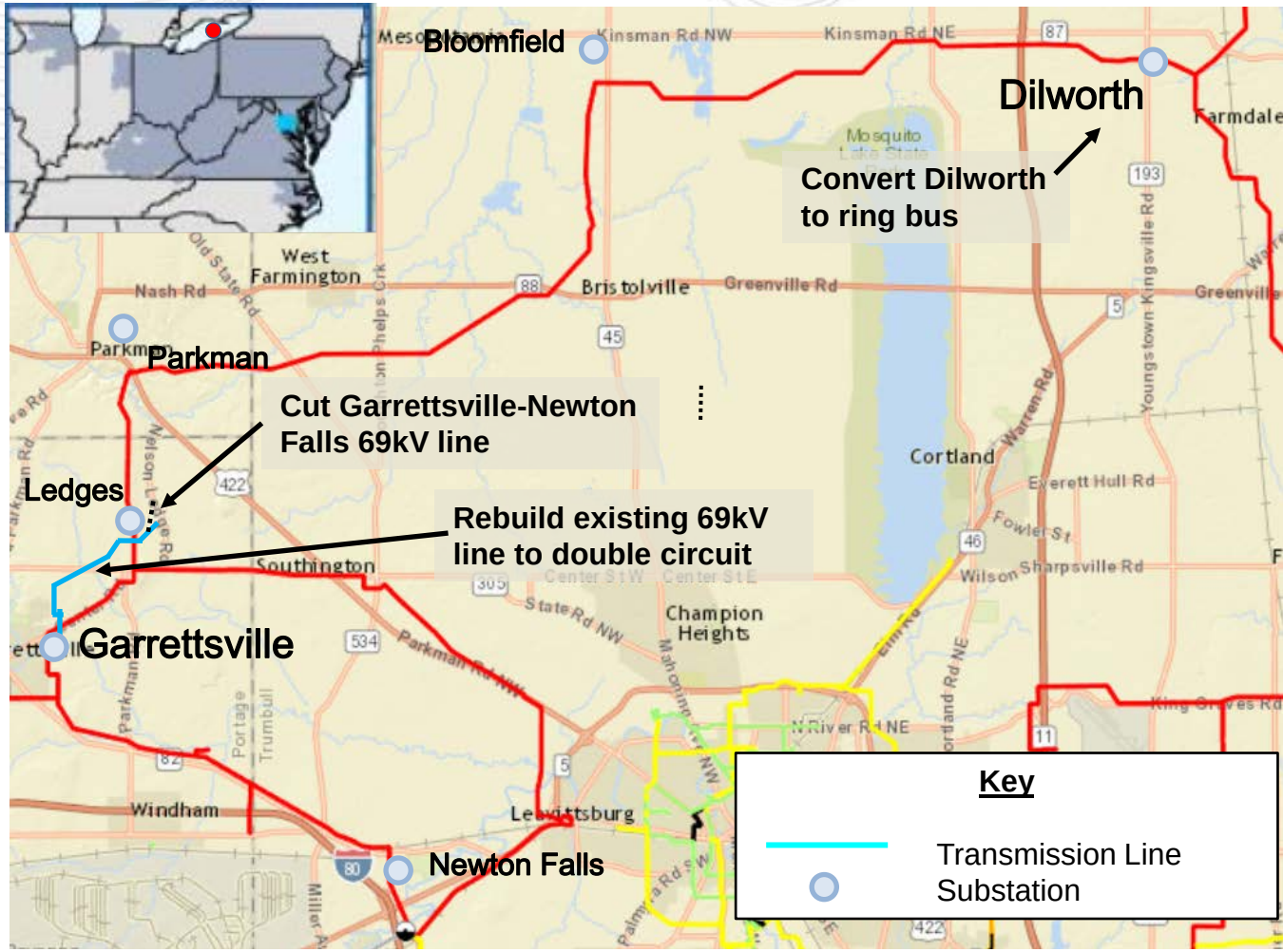
Selected Solution:

- Convert Dilworth substation to a five (5) breaker ring bus (S1475.1)
- Rebuild 3.2 miles of 69 kV single circuit 336 ACSR between Garrettsville and Ledges as double circuit 477 ACSS to establish the Garrettsville-Dilworth and Garrettsville-Newton Falls 69 kV Lines (S1475.2)
- Install 14.4 MVAR capacitor at Parkman substation (S1475.3)

Estimated Project Cost: $7.7M

Projected IS Date: 12/31/2018

Status: Conceptual



ATSI Transmission Zone: Supplemental Adams 69kV Ring Bus Project

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Operational Flexibility and Efficiency

- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.

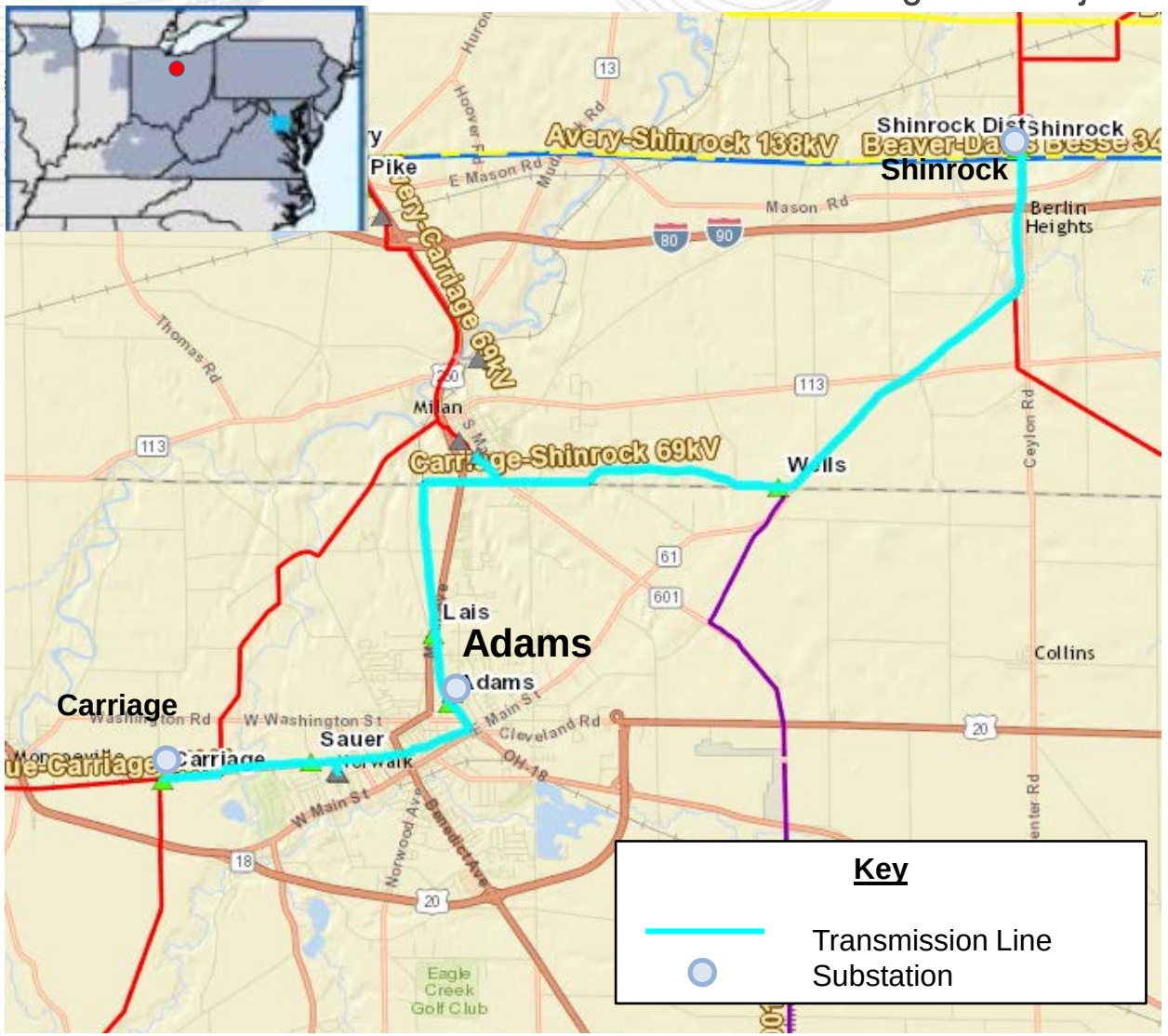
Selected Solution:

- Convert Adam substation to a four (4) breaker / future five (5) ring bus. (S1476.1)
- Reconfigure Adams substation to include terminals for: Carriage-Adams 69kV, Adams-Shinrock 69kV, Adams transformers #1 and #2 to make the Substation layout to support line-load-line configuration. (S1476.2)

Estimated Project Cost: $6.2M

Projected IS Date: 12/01/2018

Status: Conceptual



ATSI Transmission Zone: Supplemental
Richwood (Kirby) 69 kV Rebuild

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):
Equipment Material Condition, Performance and Risk

- Improve system reliability and performance.
- Remove obsolete and deteriorated equipment.
- Upgrade to current FE Standards

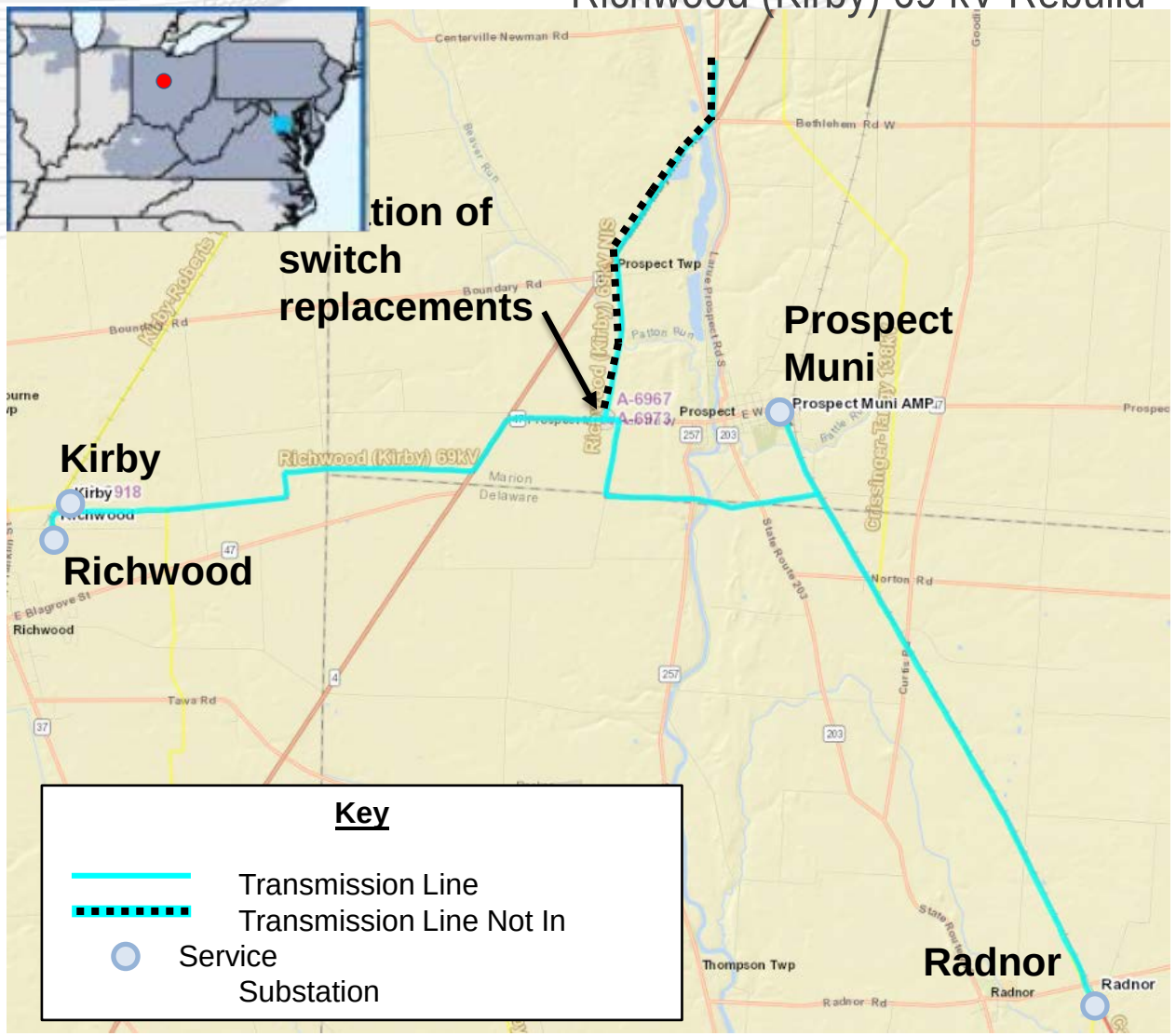
Selected Solution:

- Rebuild 12.6 miles of single circuit 3/0 ACSR Kirby-Radnor 69 kV line with 336 ACSR and replace existing two-way switch with two (2) separate one-way switches. (S1477)

Estimated Project Cost: $14.3M

Projected IS Date: 05/01/2019

Status: Conceptual



ATSI Transmission Zone: Supplemental Brookside-Homer 69 kV Rebuild

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Equipment Material Condition, Performance and Risk

- Improve system reliability and performance
- Remove obsolete & deteriorated equipment.
- Upgrade to current FE Standards

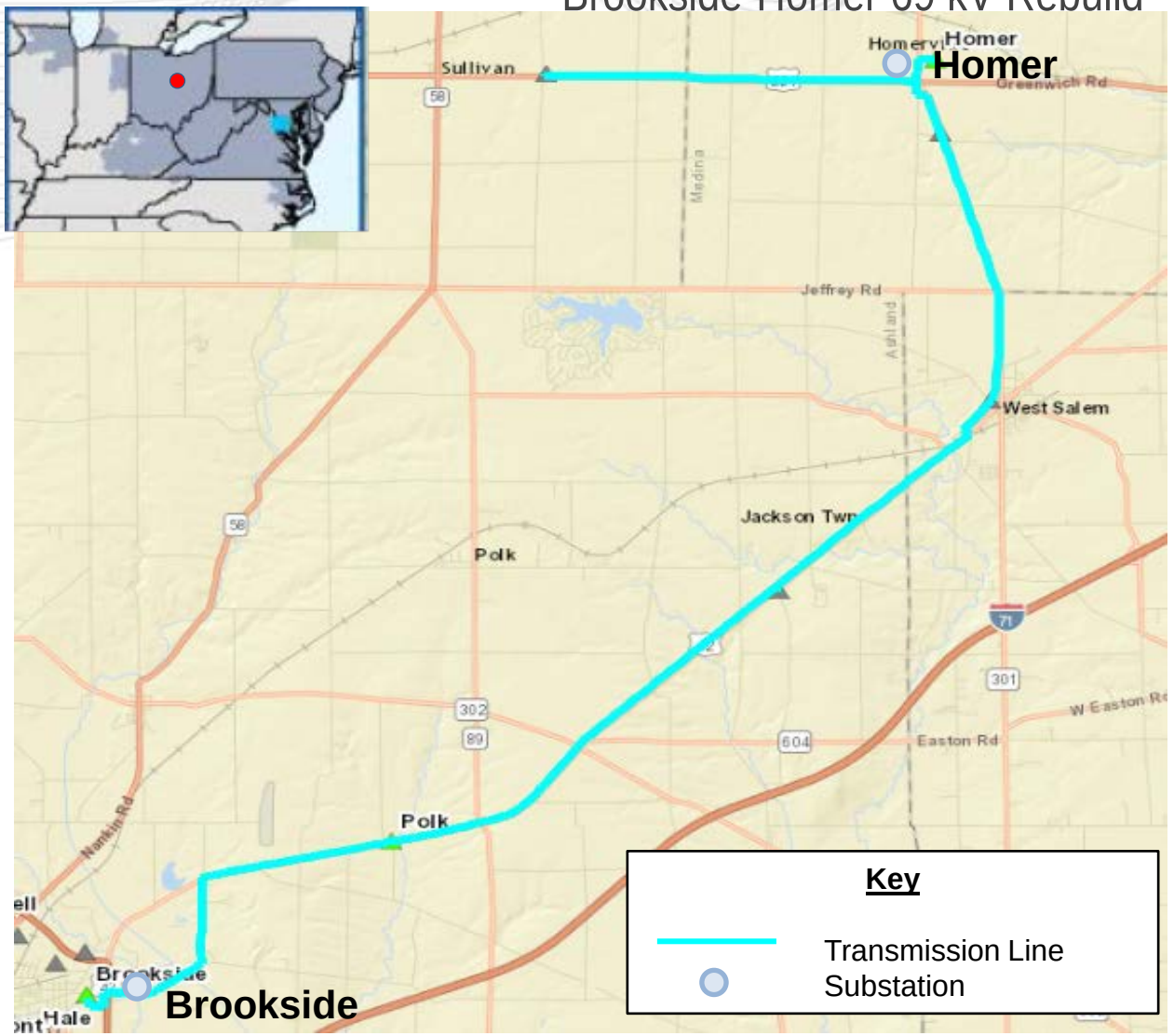
Selected Solution:

- Rebuild the Brookside-Homer 69 kV (29.6 miles) mix of conductor sizes (1/0, 2/0, 3/0 and 336 ACSR conductors) as single circuit 69 kV with 477 ACSR but designed for future capability of double circuit 138/69 kV. (S1478)

Estimated Project Cost: $27.4M

Projected IS Date: 06/01/2018

Status: Construction



ATSI Transmission Zone: Supplemental Lemoyne-Midway 138 kV line

Previously presented on 1/8/2018 SRRTEP

Problem Statement (Scope and Need/Drivers):

Equipment Material Condition, Performance and Risk

- Improve degraded equipment performance.
- Remove obsolete and deteriorated equipment.
- Upgrade to current FE Standards

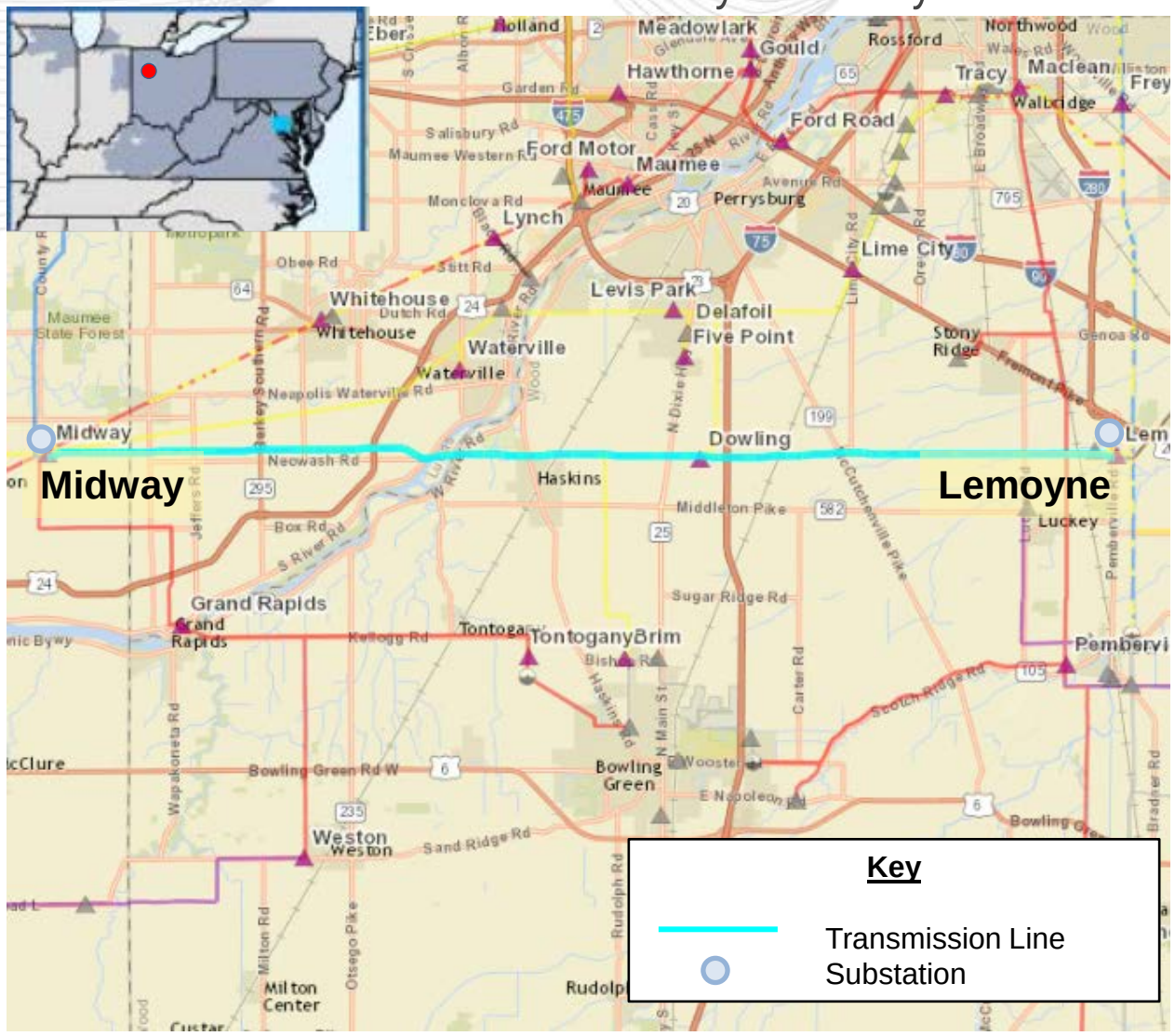
Selected Solution:

- Rebuild Lemoyne-Midway 138 kV line with 477 kcmil ACSS (24.5 miles). (S1479)

Estimated Project Cost: $17.6M

Projected IS Date: 12/1/2017

Status: Construction



ComEd Transmission Zone: Supplemental Lena Second 138-34kV transformer

Previously presented on 1/8/2018 SRRTEP

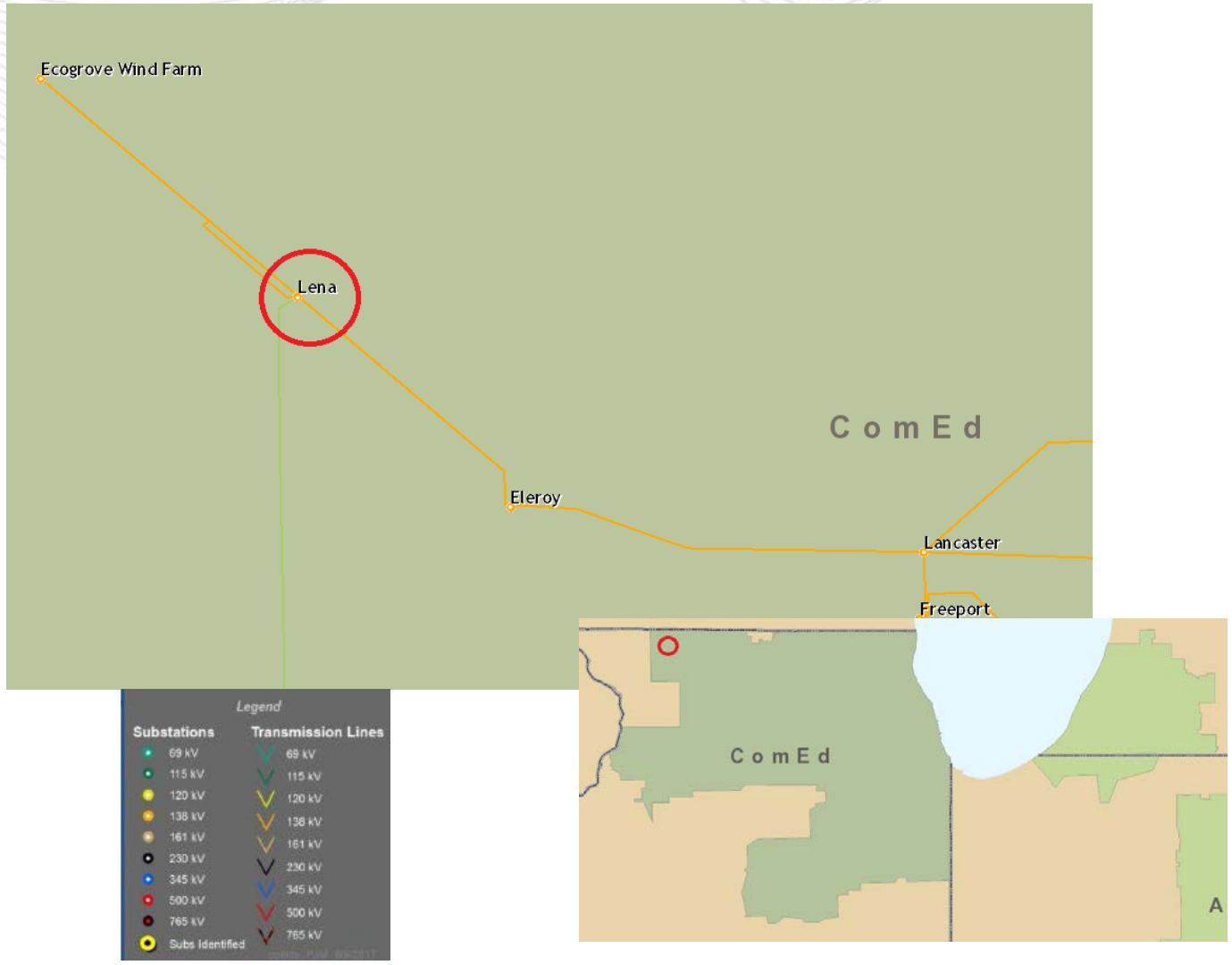
Problem Statement:
Need Additional 34kV transformation capacity in Lena area.
Lena contain one 138-34kV transformer. A transformer failure requires Freeport station to pick up all the Lena load. Second transformer allows Lena to support all load for a transformer failure.

Selected Solution:
Install a new 138-34kV transformer with high side and low side breakers at Lena, Expand the 34kV switchgear, Replace line circuit switchers with 138kV breakers, Install new 138kV bus tie breaker (S1480.1)
Normally close 138kV line 11904 into Lena, the 11904 circuit switcher is normally open and Normally open the new 138kV bus tie breaker (S1480.2)

Estimated Cost: $0 Transmission
$7.1M Distribution

Projected In-service: 6/1/2019

Project Status: Engineering



ComEd Transmission Zone: Supplement
138kV line 17714 Wave Trap Replacement

Previously presented on 1/8/2018 SRRTEP

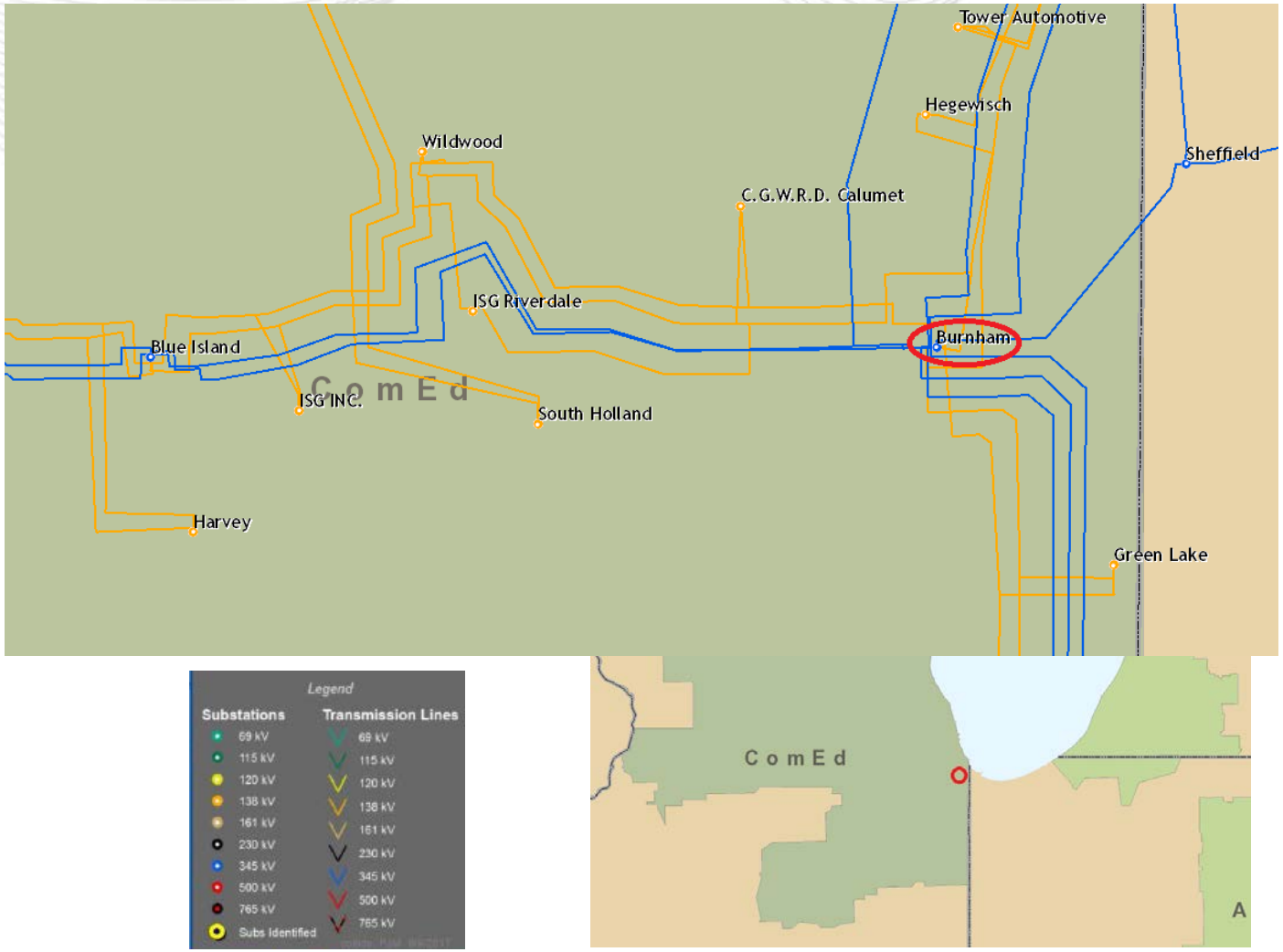
Problem Statement:
138kV line 17714 (Burnham - Wildwood)wave trap needs to be replaced due to material condition.

Selected Solution:
Replace the wave trap at the Burnham substation for 138kV line 17714 (Burnham - Wildwood) (**S1481**)

Estimated Cost: $50K

Projected In-service: 12/31/2018

Project Status: Engineering



ComEd Transmission Zone: Supplemental Modernize 138kV Relays

Previously presented on 1/8/2018 SRRTEP

Problem Statement:

Replacing obsolete electromechanically relays with microprocessor relays

- Improved performance
- Add SCADA connectivity
- Allow real time data gathering of relay events
- Replacement relays may be difficult to obtain

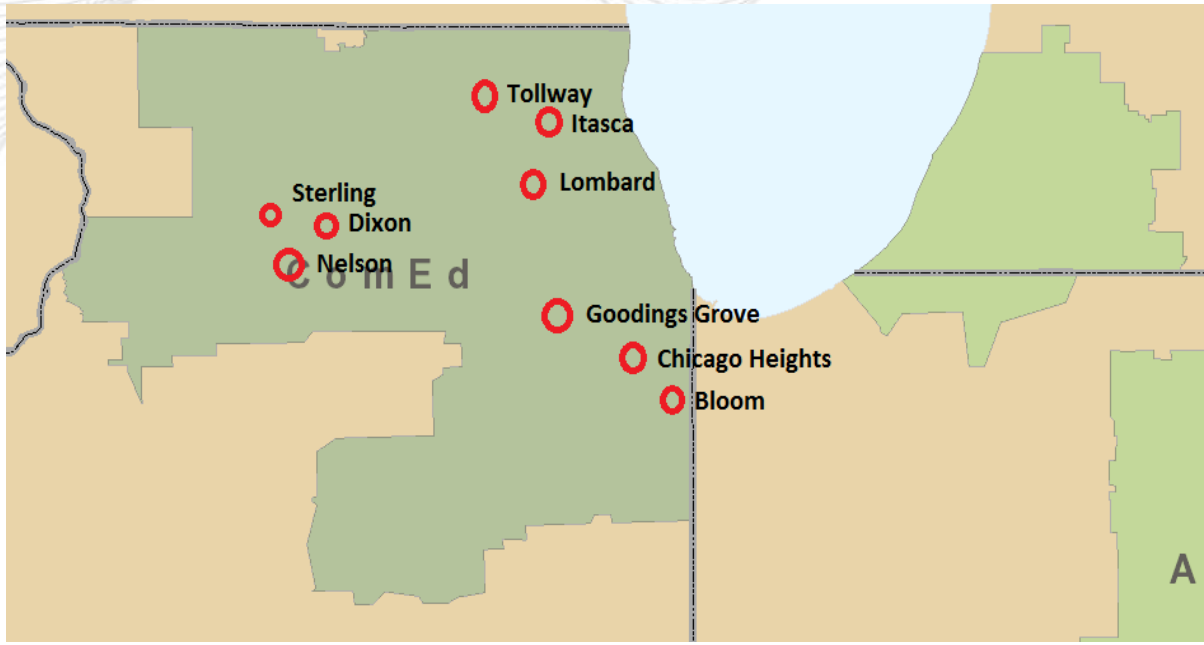
138kV Lines to be updated

11603 (Goodings Grove)	12016 (Lombard)	12016 (Itasca)	12411 (Dixon)
12411 (Sterling)	15508 (Nelson)	15508 (Dixon)	18513 (Tollway)
7306 (Bloom)	7306 (Chicago Heights)	6701 (Congress)	6702 (Congress)

Selected Solution:

Update relay packages at various location:

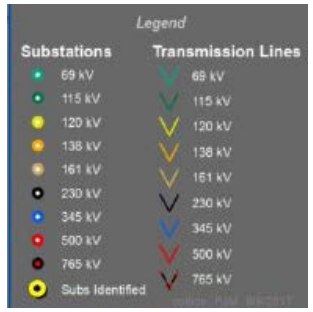
- Update relay packages for the 138kV Line 11603 (Goodings Grove -Crestwood), the upgrade is at Goodings (S1482.1)
- Update relay packages for the 138kV Line 12411 (a three terminal line from Maryland, Dixon, and Sterling), the upgrade is at Dixon and Sterling. (S1482.3)
- Update relay packages for the 138kV Line 12016 (Lombard - Itasca), the upgrade is at Lombard and Itasca. (S1482.2)
- Update relay packages for the 138kV Line 15508 (a three terminal line from Nelson, Dixon, and Kewanee), the upgrade is at Nelson and Dixon. (S1482.4)
- Update relay packages for the 138kV Line 18513 (a three terminal line from Tollway, Rockford Energy Center and Dundee), the upgrade is at Tollway. (S1482.5)
- Update relay packages for the 138kV Line 7306 (Bloom - Chicago Heights), The upgrade is at Bloom and Chicago Heights. (S1482.6)
- Update relay packages for the 138kV Line 6701 (Congress - Medical Center), Upgrade is at Congress. (S1482.7)
- Update relay packages for the 138kV Line 6702 (Congress - Medical Center), Upgrade is at Congress. (S1482.8)



Estimated Cost:
Transmission $320K per terminal

Projected In-service: 6/1/2018

Project Status: Engineering



ComEd Transmission Zone: Supplemental Modernize 138kV Relays

Previously presented on 1/8/2018 SRRTEP

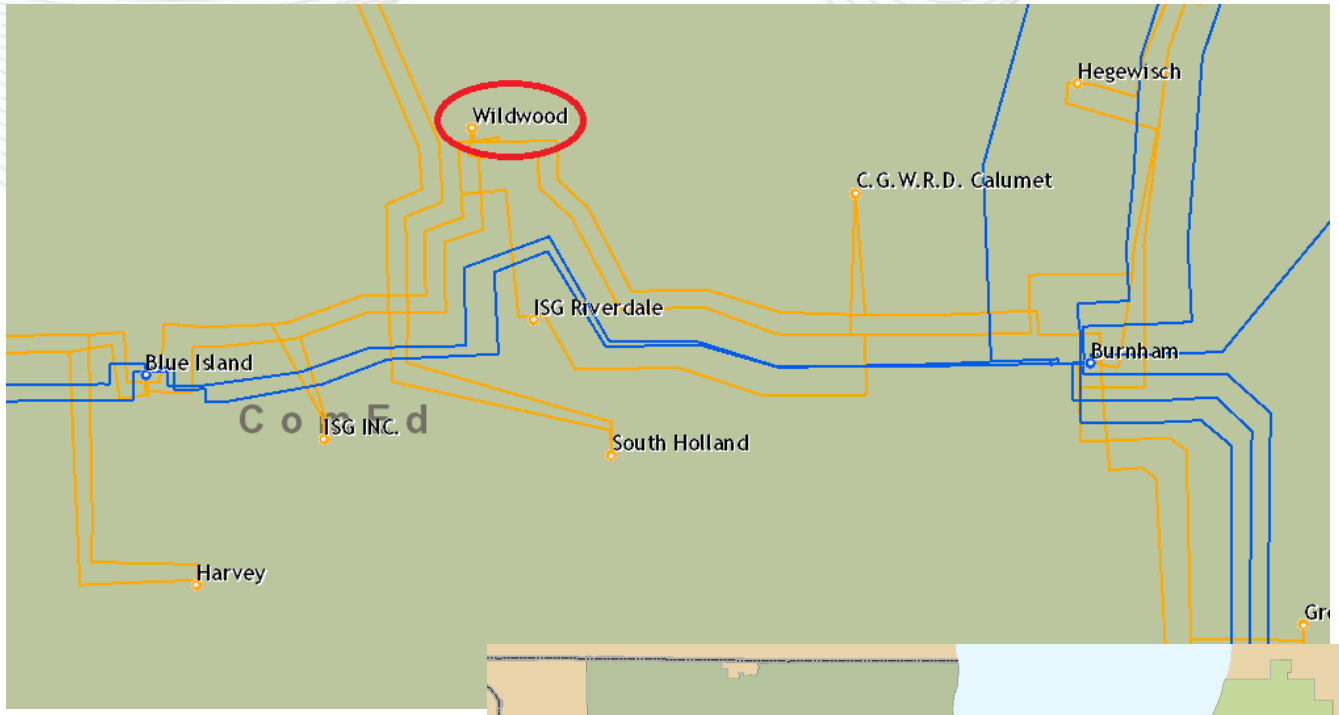
Problem Statement:
138kV line 17714 (Burnham - Wildwood) relays need to be upgraded for NERC PRC-023 Compliance

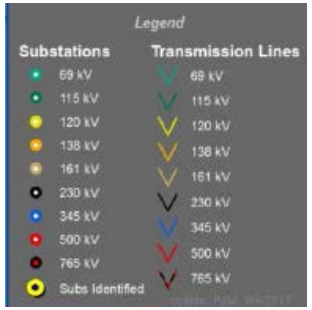
Selected Solution:
Update 138kV line 17714 (Burnham - Wildwood) relays at Wildwood (S1483)

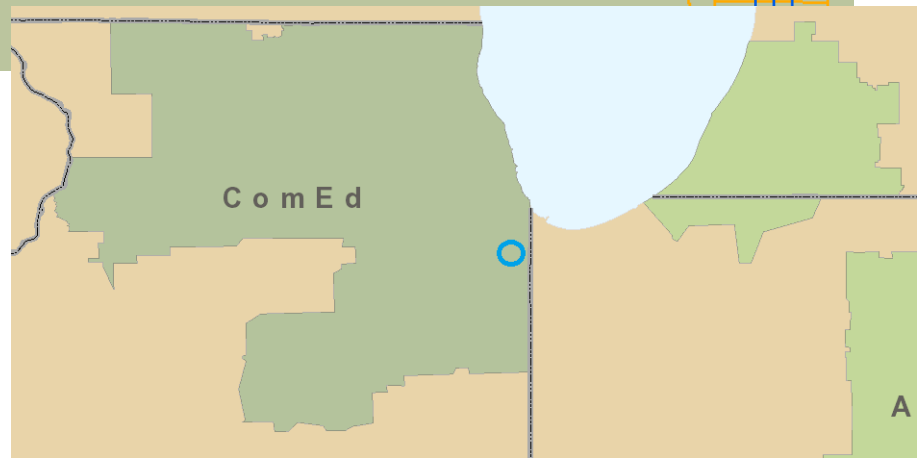
Estimated Cost: Transmission $320K

Projected In-service: 6/1/2018

Project Status: Engineering







DEOK Transmission Zone: Supplemental
Augustine – Install 138/13 kV Transformer

Previously presented on 1/8/2018 SRRTEP

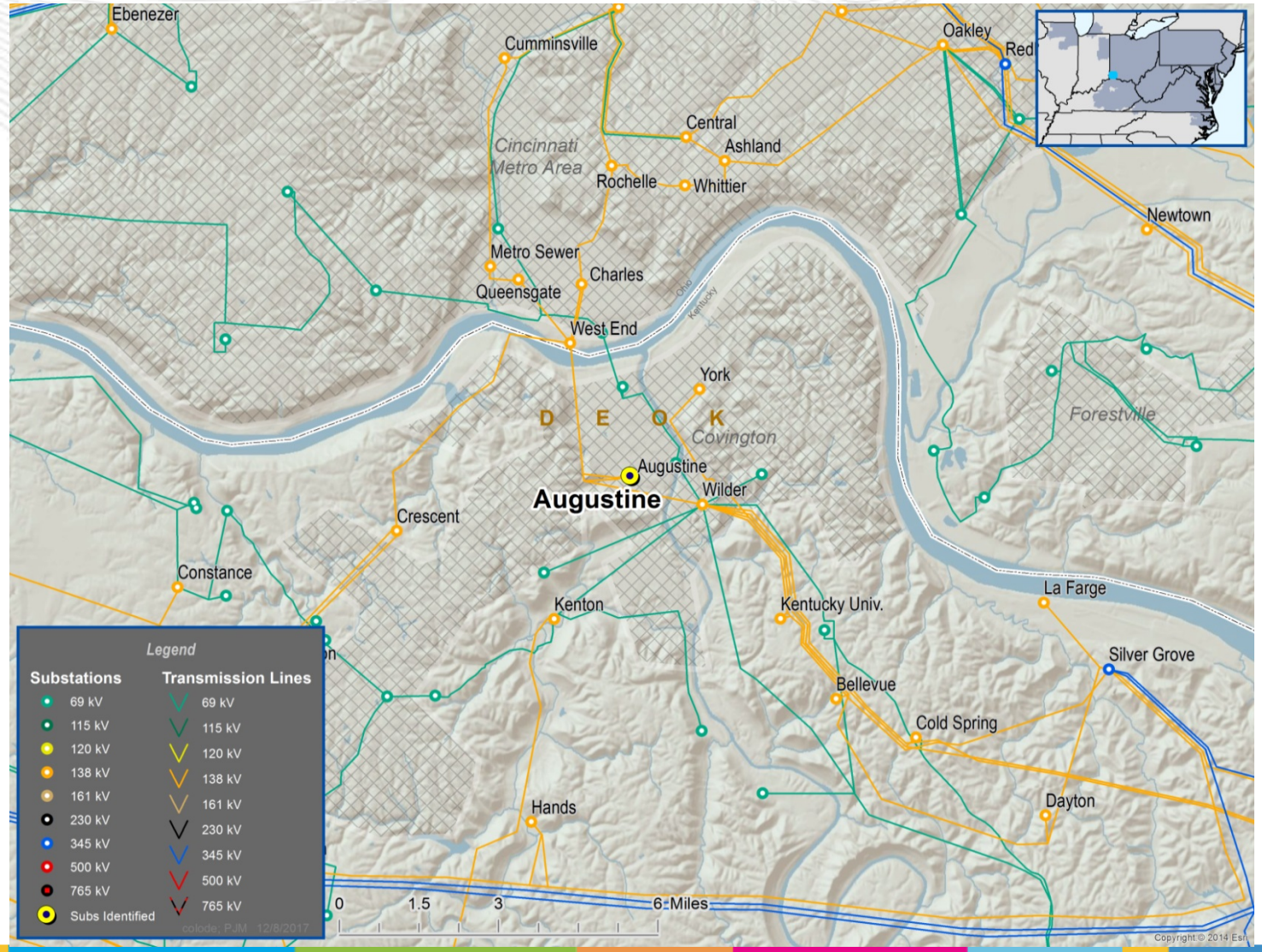
Problem Statement:
Augustine had a single transformer with two secondary windings each feeding individual distribution buses. When that transformer failed its emergency replacement did not have the full capacity of the failed transformer. More capacity is needed for the substation.
Driver : Operational Flexibility and Efficiency, Risk

Selected Solution:
Add a second 138/13 kV, 22 MVA transformer to feed the Augustine bus. Reconfigure the substation so that the load is distributed across the three transformer/buses. (S1484)

Estimated Cost: $0.35M

Projected In-service: 12/1/2018

Project Status: Engineering



DEOK Transmission Zone: Supplemental Warren-Nickel 138 kV Feeder Rebuild

Previously presented on 1/8/2018 SRRTEP

Problem Statement:
The 138 kV feeder between Warren and Nickel substations is aged and in deteriorating condition (1940's era). The feeder has seen an increase in outages in the recent past due to its condition.

Driver: Equipment Material Condition, Performance and Risk

Selected Solution:
Rebuild 5.8 miles of feeder between Warren and Nickel 138kV substations with 76 new structures, hardware, and conductor. Capacity of the line will increase from 198MVA to 300MVA. (S1485)

Estimated Cost: $15M

Projected In-service: 12/1/2018

Project Status: Engineering

AEP Transmission Zone: Supplemental
East End Fostoria-Riverview

Previously presented on 1/8/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The existing 12.8 mile, 69 kV line section between East End Fostoria and Riverview was originally constructed in 1912 using wood pole & lattice structures with #1 Copper and 3/0 Copper conductor (31 MVA rating). There are 81 open conditions on this line. The line has also experienced 50,680 Customer Minutes of Interruption (CMI). As part of the line rebuild, the switching structures for Bascom will also be replaced.

Selected Solution:

Rebuild 11.3 miles of line between East End Fostoria – Riverview 69kV with 795 ACSR (129 MVA rating) and steel poles. (S1486.1)

Estimated Cost: $12.4M

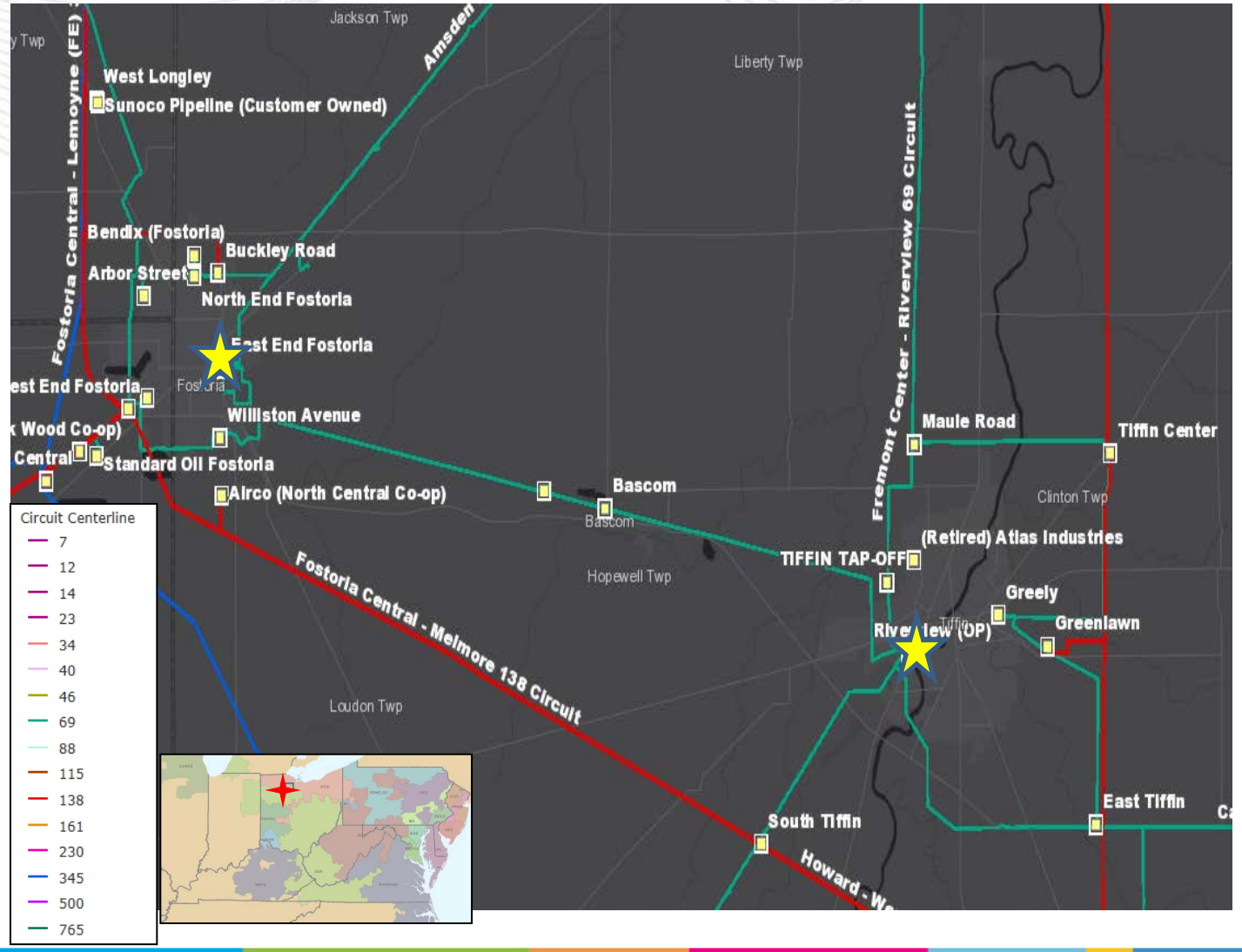
Install new Bascom 69 kV 1200 amp line switches. (S1486.2)

Estimated Cost: $0.8M

Total Estimated Transmission Cost: $13.2M

Projected In-service: 11/01/2018

Project Status: Under Construction



AEP Transmission Zone: Supplemental Harrison-Poston Line Rebuild

Previously presented on 1/8/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Poston - Harrison 138 kV Line is 54.4 miles long and was built in 1953 utilizing wood pole H-Frame structures and 636 ACSR conductor (223 MVA rating). The existing 138 kV line is in need of major repair. The poles and crossarms are deteriorated so severely that they have become a hazard to effective maintenance practices. There are 269 open conditions spread along the entire distance of this line.

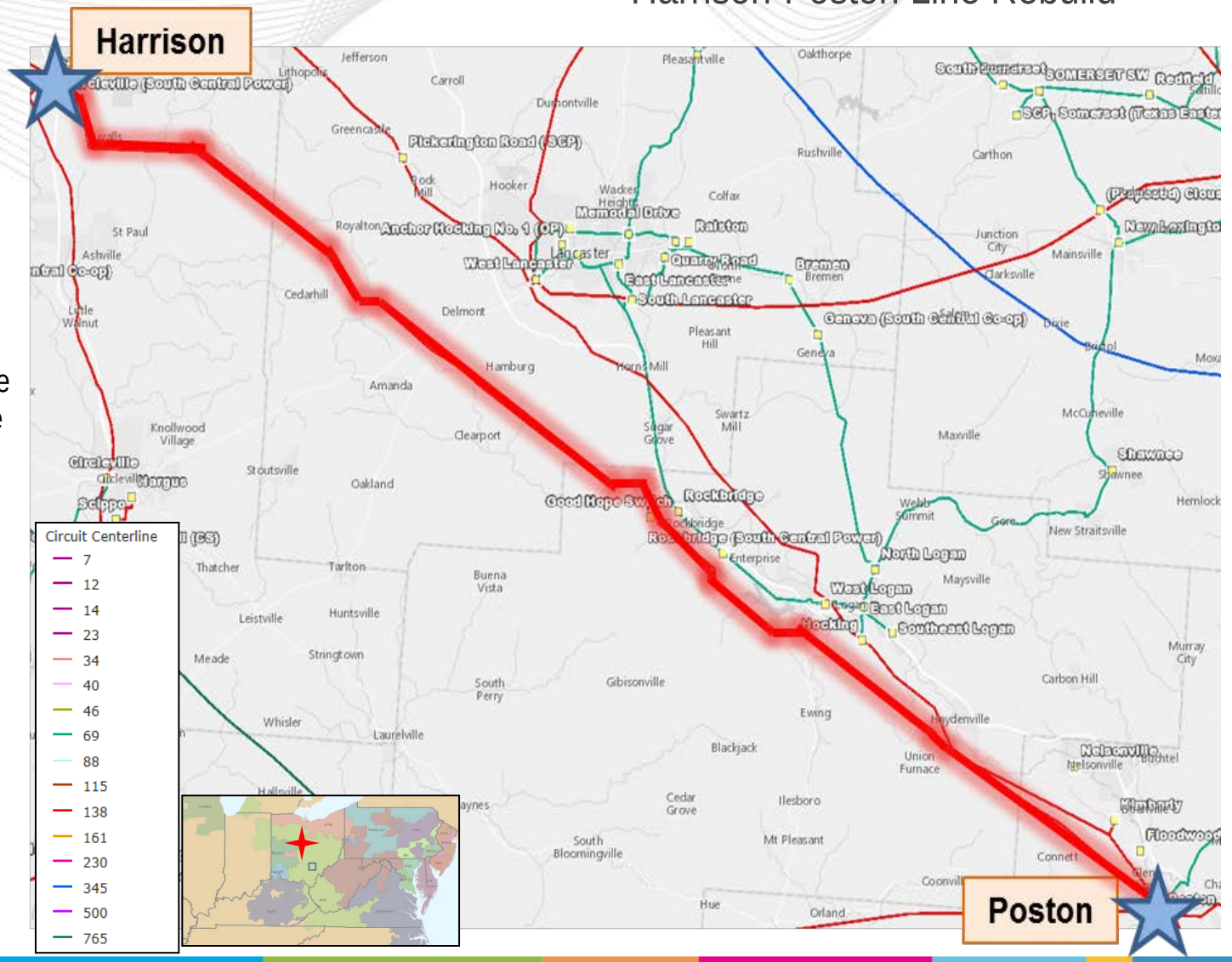
Selected Solution:

Rebuild 54.4 miles of line between Harrison and Poston 138kV stations with 1033 ACSR (296 MVA rating) and steel poles. (S1487)

Estimated Transmission Cost: $61.9M

Projected In-service: 12/31/2019

Project Status: Under Construction



AEP Transmission Zone: Supplemental Dennison-Newcomerstown Rebuild

Previously presented on 1/8/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Newcomerstown-Dennison 69kV transmission line was originally built between 1925-1929 with wood poles and 3/0 copper conductor (46 MVA rating). While the line has been rehabbed over the decades, the line is now in very poor condition, with heavy deterioration on poles & cross-arms and various encroachments. It has 71 open conditions including but not limited to encroachments, burned poles, broken/damaged poles & arms, broken guy wires, damaged insulators, pole rot, and woodpecker damage. Between 2013-2016, the customers served from the transmission line have been subject to 9 million minutes of customer-interruption.

Operational Flexibility and Efficiency

Lock 17 station and Frontier Co-op are served off a 1.6-mile radial tap, which prevents T-Line maintenance and adversely impacts reliability due to having one source of power. The tap will be rebuilt as a double-circuit loop into Lock 17, with switches placed inside the station, which will permit T-Line repairs and improve operational flexibility.

Lock 17 has a 69kV MOAB/ground-switch combination unit for the transformer protection scheme, which requires remote-breaker-clearing on the entire Newcomerstown-Newport 69kV circuit, taking customers out of service. This protection system will be replaced with a 69kV circuit switcher and relaying. In addition, SCADA functionality will be added to Lock 17 via an RTU installation.

The Belden Switch 69kV MOAB switch will be retired. MOAB switches will be installed in the upgraded Lock 17 station. The MOAB installation score exceeds AEP's Forced Outage Index (FOI) guidelines for installing motor-operated switches (22 compared to the threshold of 6).

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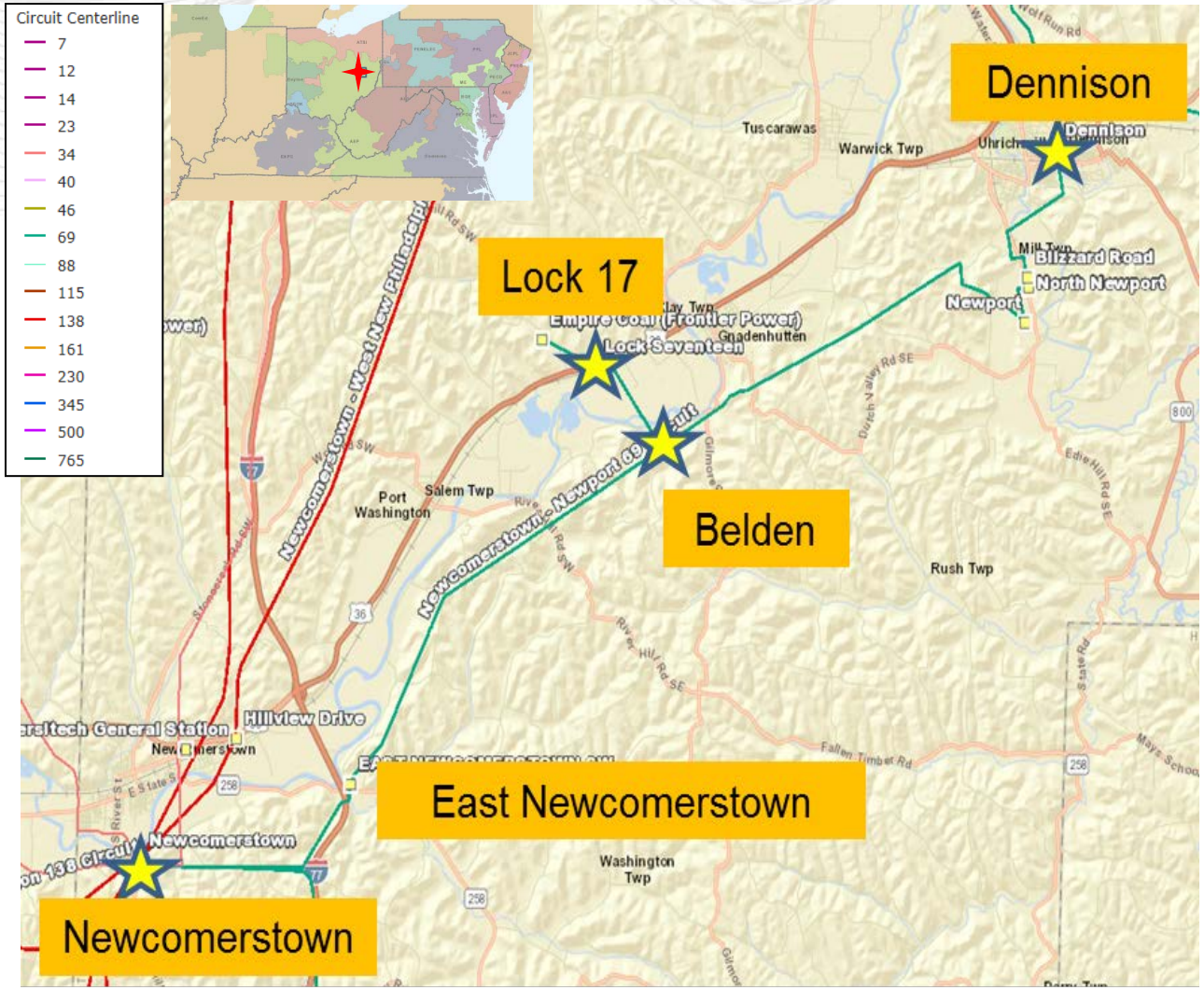

AEP Transmission Zone: Supplemental Dennison-Newcomerstown Rebuild

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Selected Solution:

Rebuild the 20-mile 69kV transmission line between Newcomerstown and Dennison stations with 1033 ACSR (148 MVA rating). (S1488.1) Estimated Cost : $28.5M

Rebuild the 1.6-mile radial tap to Lock 17 station as a double-circuit 69kV loop with 1033 ACSR (148 MVA rating). (S1488.2) Estimated Cost : $3.4M

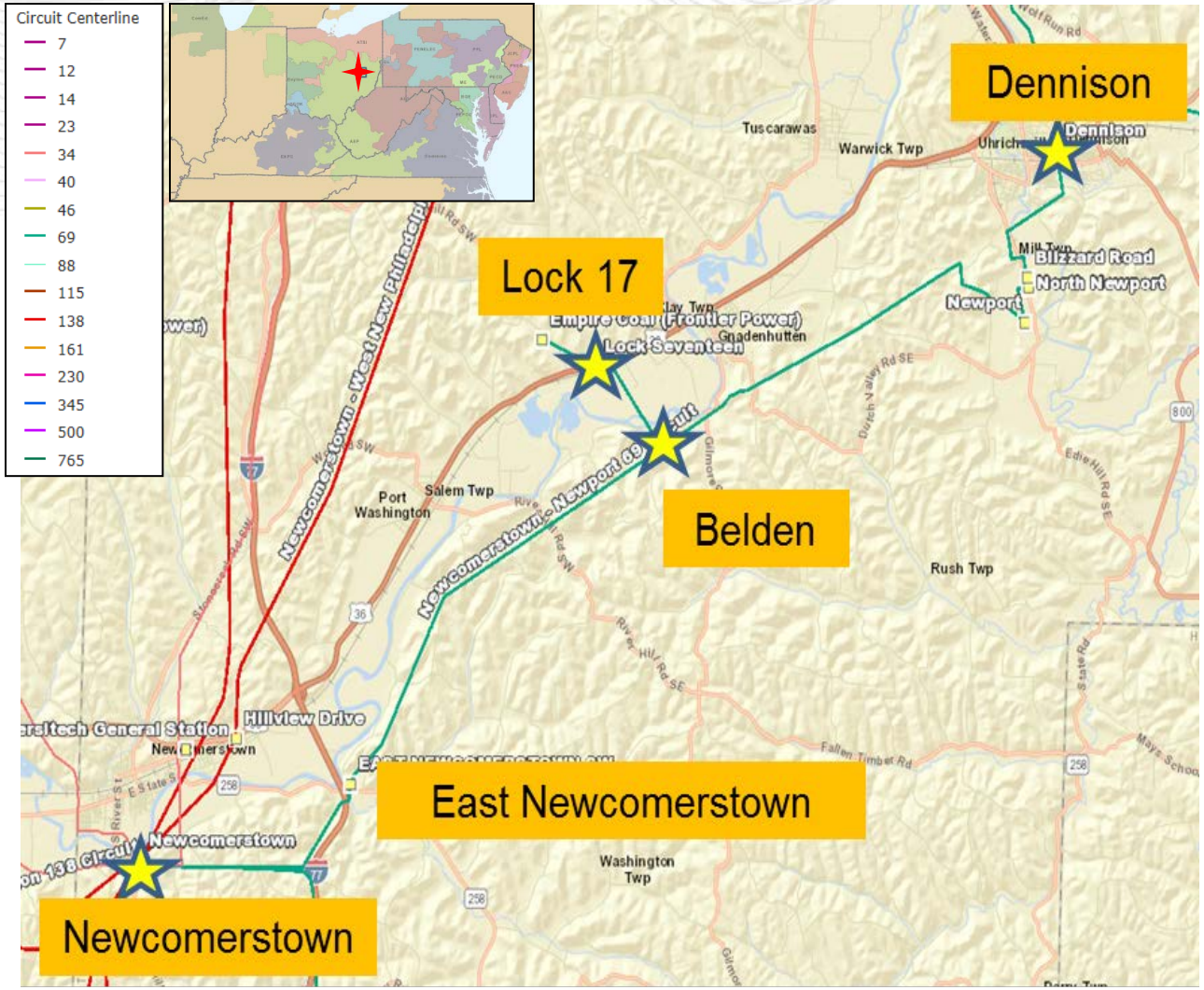
At Lock 17 69kV station, add a 69kV station bay structure and 2- 69kV MOAB switches. Relocate the 69kV cap bank and expand to 10.8 MVAR. Replace the transformer protection with a circuit switcher (S1488.3). Estimated Cost : $1.3M

Replace East Newcomerstown 69kV Switch with a new 2-way switch. Retire Belden 69kV switch. (S1488.4) Estimated Cost : $0.2M

Total Estimated Transmission Cost: $33.4M

Projected In-service: 12/01/2019

Project Status: Under Construction



AEP Transmission Zone: Supplemental Southwest Lima Breaker Replacement

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

At Southwest Lima station, circuit breakers J, J1, J2 and K are all 138 kV 40 kA air blast, PK-type breakers manufactured in 1969. Air blast breakers tends to fail violently and when they do bushings usually explode which expel shards of ceramic and could potentially harm anyone at the station. In addition, PKs are no longer supported by vendors and cannot be integrated to modern relaying packages. Breaker K2 is an SF6 type 145-PA. Even though PAs are SF6, they have started giving the field problems due to significant seal issues in their design that result in low SF6 gas pressure. Field crews have tried repairing these breakers but after seal issues pop up it is very difficult to return the breaker to 100% operation. SF6 has been added in the past, with little to no improvement on the condition on this breaker type. Fault operation counts for CB J2, J, and K2 are 20, 25, and 39 respectively.

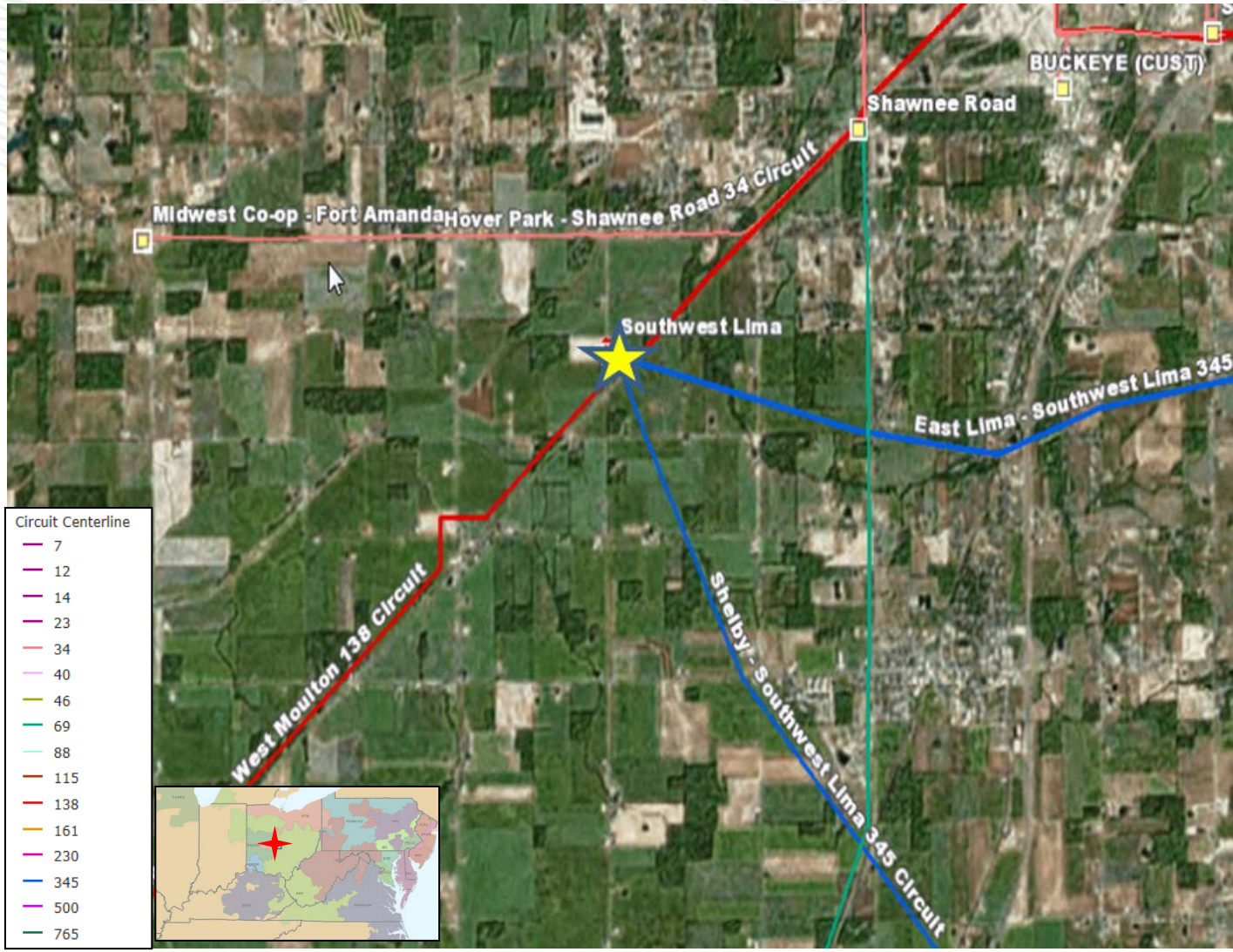
Selected Solution:

Replace existing 138 kV breakers J, J1, J2, K, and K2 at Southwest Lima with new 138 kV 3000 A 63 KA breakers. (S1489)

Estimated Transmission Cost: $1.8M

Projected In-service: 06/01/2019

Project Status: Engineering



Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Portland area is non-recoverable in case of a failure. Load growth is slow but steady and transformer maintenance is restricted to only a few weeks per year. A transformer failure recovery has to be by a mobile transformer. To mitigate this, there needs to be a second distribution feeder at North Portland.

There currently are four Motor Operated Air Break Switches (MOABs) in series on the Portland – Berne circuit. Having more than three MOABs in series on a circuit introduces increased chance of mis-operation and requires complex protection schemes. It is AEP current standard to not allow more than 3-MOABs in series. To mitigate this, a line breaker is required at a new station.

Transformer #1 at North Portland is beginning to show signs of deterioration. Drivers for replacement include dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), and accessory damage (bushings).

Operational Flexibility and Efficiency:

The Berne – Portland line has experienced 39 momentary forced outages over the past 10 years and has a CMI of 1,040,639 over the last 3 years. 69% of this CMI value was triggered by the multiple unprotected stations on this line. Installing a breaker will effectively separate the City of Portland from the REMC owned Trinity Tap as well as 14.3 miles of exposure and will significantly improve the area system performance and overall reliability.

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AEP Transmission Zone: Supplemental
North Portland Station

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Selected Solution:
Retire North Portland Station. Install 2 69kV buses separated by a 2000A switch. At the 69kV bus 1, install a 69kV 3000A 40kA circuit breaker 'D'. Install two 20MVA 69/12kV transformers with high side 2000A circuit switcher and low side 12kV 2000A circuit breakers. Install 2 15kV main and transfer buses separated by a 2000A circuit breaker. Install 6 1200A circuit breakers on the 6 12kV station exits. (S1436.1)

Rebuild the Portland Extension portion of the Berne – Portland 69kV circuit to the new station utilizing 556.5 ACSR (102 MVA rating). (S1436.2)

Estimated Transmission Cost $3.5M

Projected In-service: 12/03/2018

Project Status: Engineering

AEP Transmission Zone: Supplemental North Wellsville 69 kV Station Upgrades

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

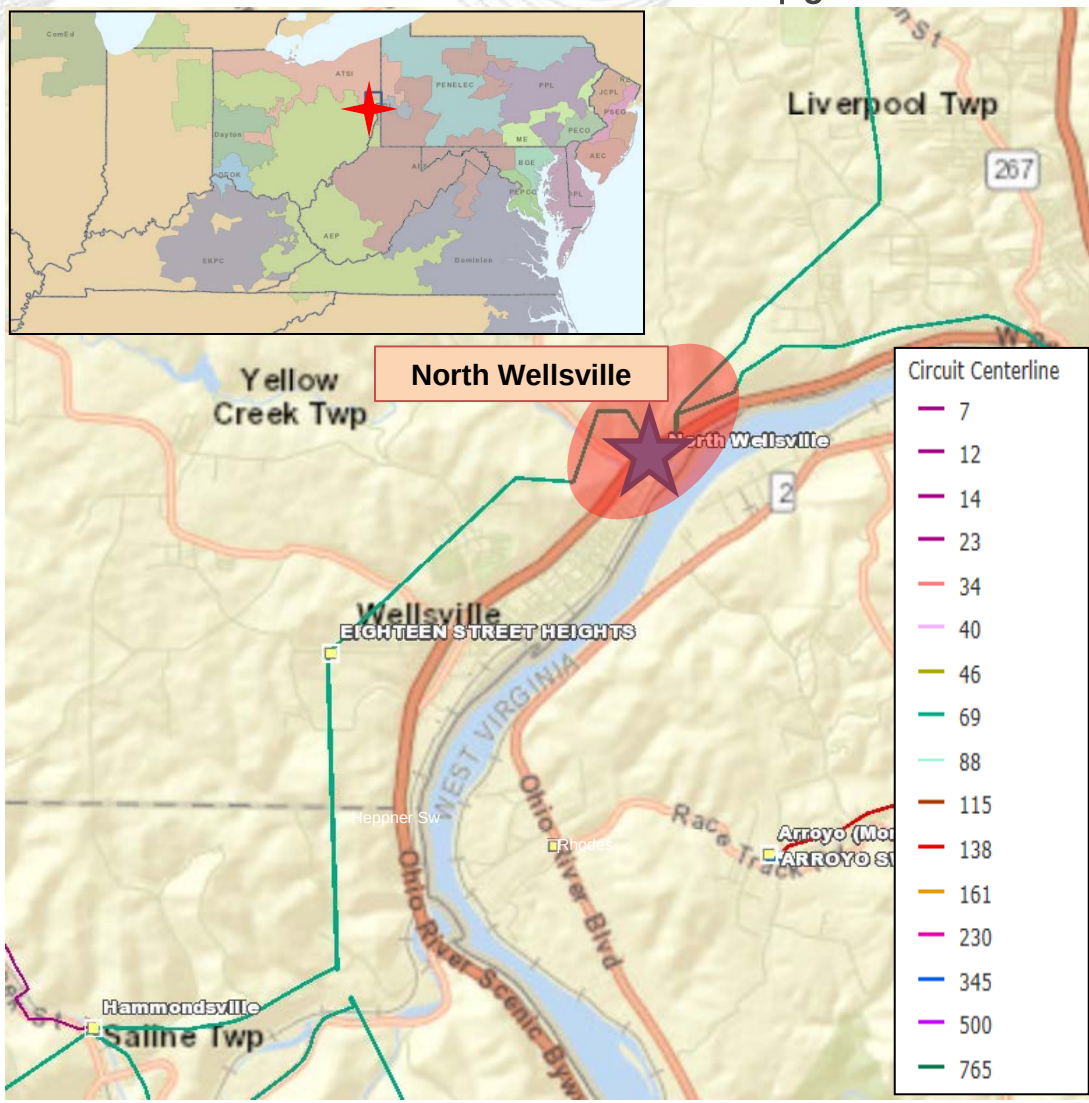
North Wellsville 69kV breakers L & M are GE 'FK' 600 A 8kA oil-filled breakers made in 1951. They have operated for 74 and 43 faults respectively, above the manufacturer recommendation of 10. These breakers have had problems with oil leaks in recent years. The breaker foundations have deteriorated significantly. Finding spare repair parts for these breakers is very challenging. There are 6- 69kV 600-amp switches in need of replacement. The 69kV circuits utilize electromechanical relays which are recommended for an upgrade. Pilot wire relaying is used on the circuit to Hammondsville, which has been unreliable. The 69kV bus CCVT's are also in poor condition.

Of the 40 protective relays in the control house, 36 are electromechanical and 2 are solid-state units which are recommended for replacement due to poor performance, high maintenance costs, and lack of fault event recording capabilities. Due to the extent of protection upgrades needed, a prefabricated drop-in-control-module (DICM) will be utilized, as the station can't be completely taken out of service during construction.

Operational Flexibility and Efficiency:

The 69-12kV distribution transformer lacks a high-side protective device, so the entire 69kV bus is tripped for a distribution transformer fault or 12kV bus fault (opens 3- 69kV circuits plus a 69kV cap bank). There are three overlapping zones of protection (69kV bus, 69-12kV transformer, 12kV bus). This arrangement reduces the life of the transmission breakers by tripping for faults in any zone. Installing a 69kV circuit switcher for the transformer will address these problems.

The existing AEP fiber-optic telecom network in the area will be extended into North Wellsville and 69kV remote terminals, to improve the capability of EMS, SCADA, and system protection equipment.



AEP Transmission Zone: Supplemental North Wellsville 69 kV Station Upgrades

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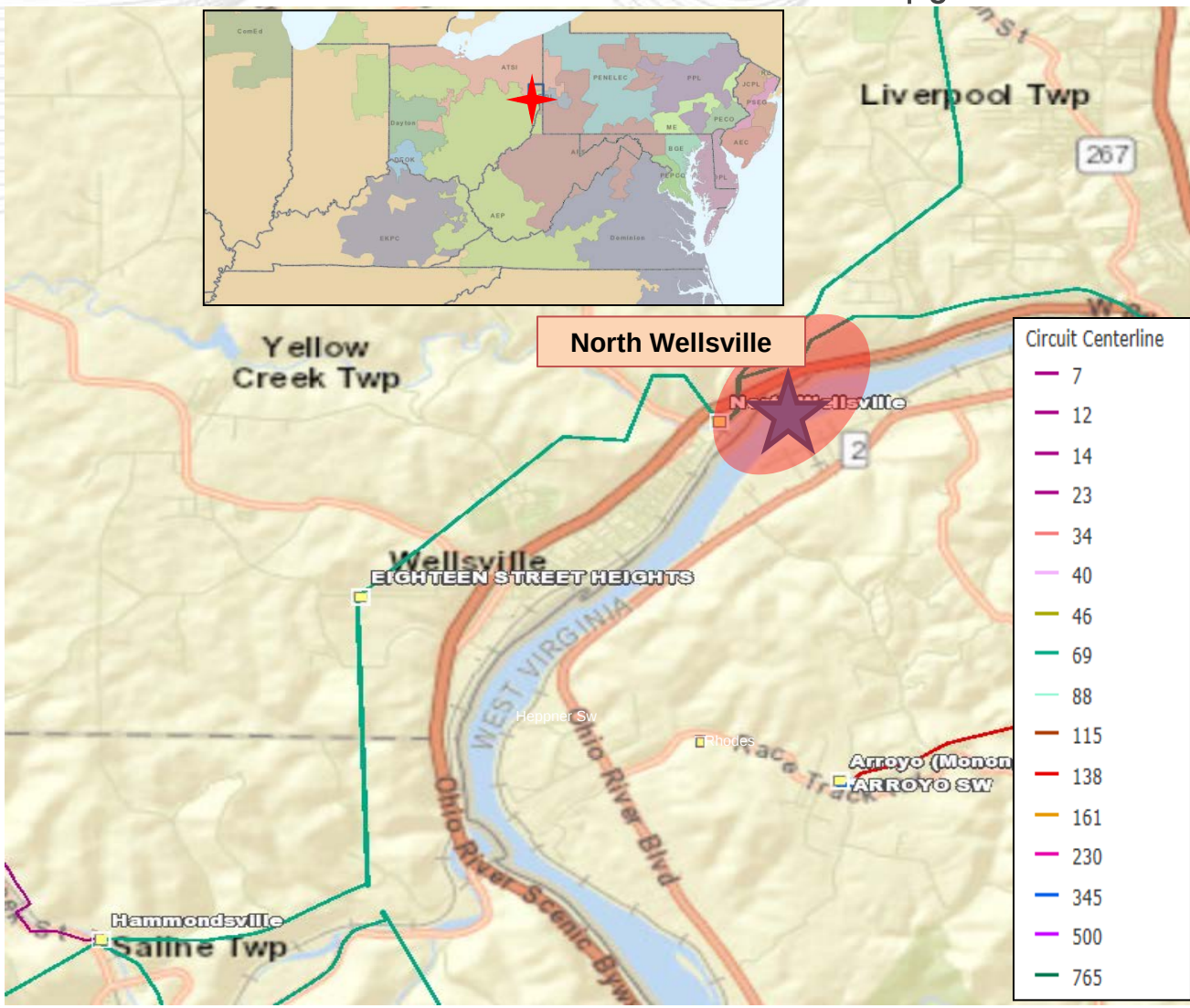
Selected Solution:
At North Wellsville station, replace 69kV oil breakers L & M with new 3000A 40 kA breakers; replace all 69kV disconnect switches; add 69kV transformer protection with circuit switcher & relaying; install distribution DICM to house new 69 & 12kV protection/communications; replace 12kV bus voltage regulator; replace both 12kV feeder breakers and protection/controls. (S1437)

Estimated Transmission Cost $1.3M

Projected In-service: 12/1/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Pendleton Breaker and Relay Replacement

Previously presented on 1/8/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk/Operational Flexibility:

The 34.5 kV oil breakers E, F, G, H, and K at Pendleton station are 2000 A 36 kA FK and CF type breakers manufactured between 1952 and 1971. Oil breakers, in general, have become more difficult to maintain due to the required oil handling. Oil spills occur often during routine maintenance and failures, which can become an environmental concern. Other drivers include age, bushing damage, number of fault operations, and a lack of available repair parts. Breaker G has experienced 30 fault operations. Breaker E has experienced 42 fault operations. Breaker F has experienced 36 fault operations. The manufacturer recommendation for fault interruptions is 10.

138kV breakers M and N at Pendleton station are 1200A 17.5kA models from 1951 and have had 18 and 13 fault operations respectively, which is higher than the manufacturer recommendation of 10. 138kV Breaker P being replaced is a 800A 17.5A model manufactured in 1946.

Operational Flexibility and Efficiency:

Currently a fault from transformer 2 requires 3 138kV breakers to operate in order to clear. Adding a circuit switcher is recommended to prolong the life of the new 138kV breakers.

AEP Transmission Zone: Supplemental
Pendleton Breaker and Relay Replacement

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Potential Solution

At Pendleton station, replace 34kV CBs “H”, “F”, “E”, “G”, and “K” with 2000A 38kV 25kA breakers. Replace 138kV CB’s “M”, “P”, and “N” with 3000A 40kA breakers. Install a 3000A 40kA circuit switcher on the high side of transformer #2. (S1490)

Estimated Transmission Cost $6.1M

Projected In-service: 3/31/2018

Project Status: Construction

AEP Transmission Zone: Supplemental Tiffin Center Breaker Replacements

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Breakers 'A' and 'B' at Tiffin Center station are 1200A 21 kA oil medium breakers manufactured in 1965 with fault counts of 149 and 73 respectively. Oil breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. The drivers for replacement of these breakers are age, number of fault operations, a lack of available repair parts, and PCB content.

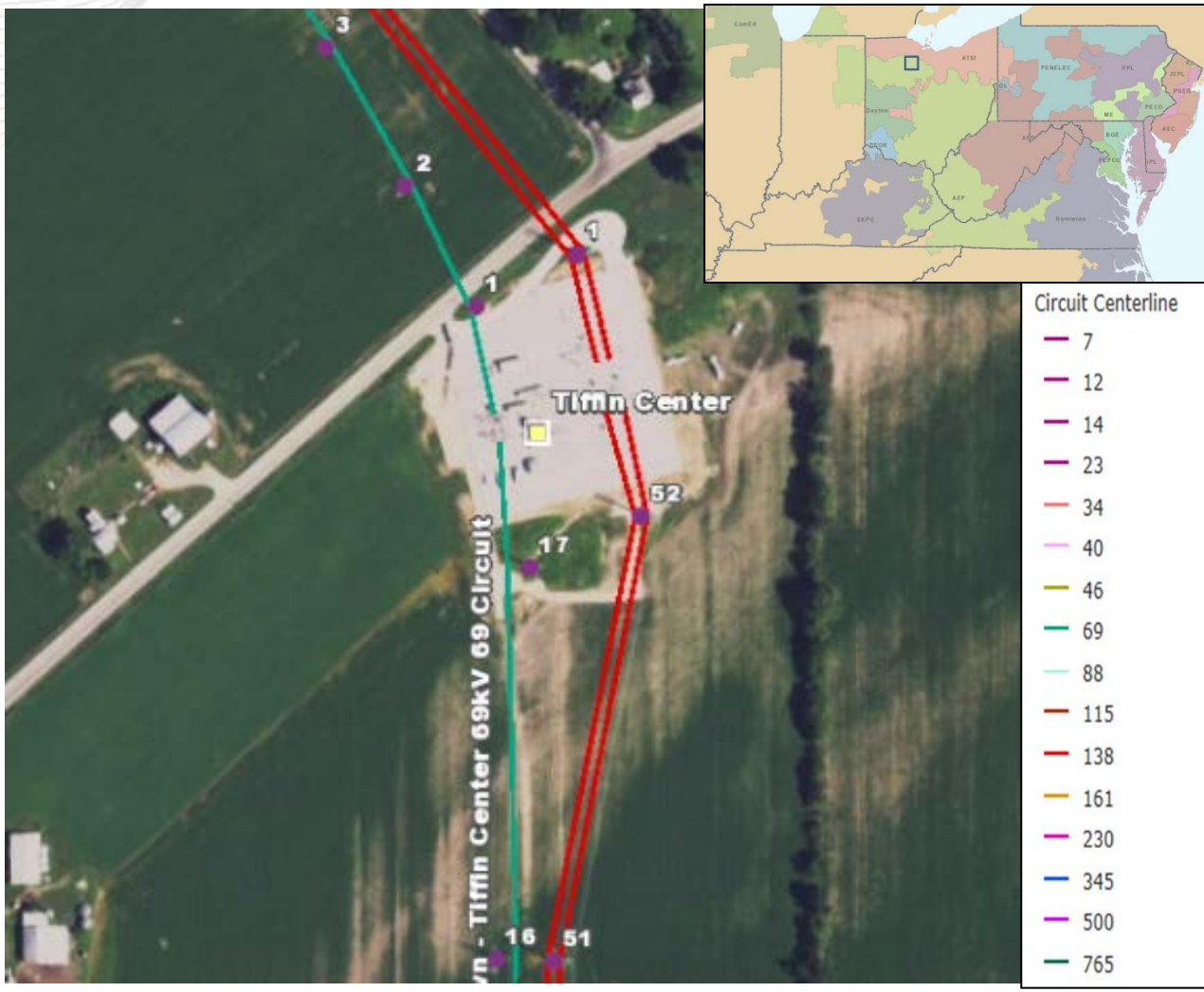
Selected Solution:

At Tiffin Center 69KV station, replace 69kV breaker 'A' and 'B' with 3000A 40kA breakers and associated equipment. (S1491)

Estimated Transmission Cost: $1.24M

Projected In-service: 03/16/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental Wharncliffe CB Replacement

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Wharncliffe 46 kV circuit breakers “A”, “B”, & ”C” have all significantly exceeded (A = 228 operations , B = 175 operations , C = 60 operations) the manufacturer’s designed number of fault operations of 10. In addition, all three breakers are ME Type EPB 1200 A 20 kA breakers and are on the obsolete breakers list. This type of breaker has very few parts for repairs and AEP has been working towards eliminating these breakers from the system

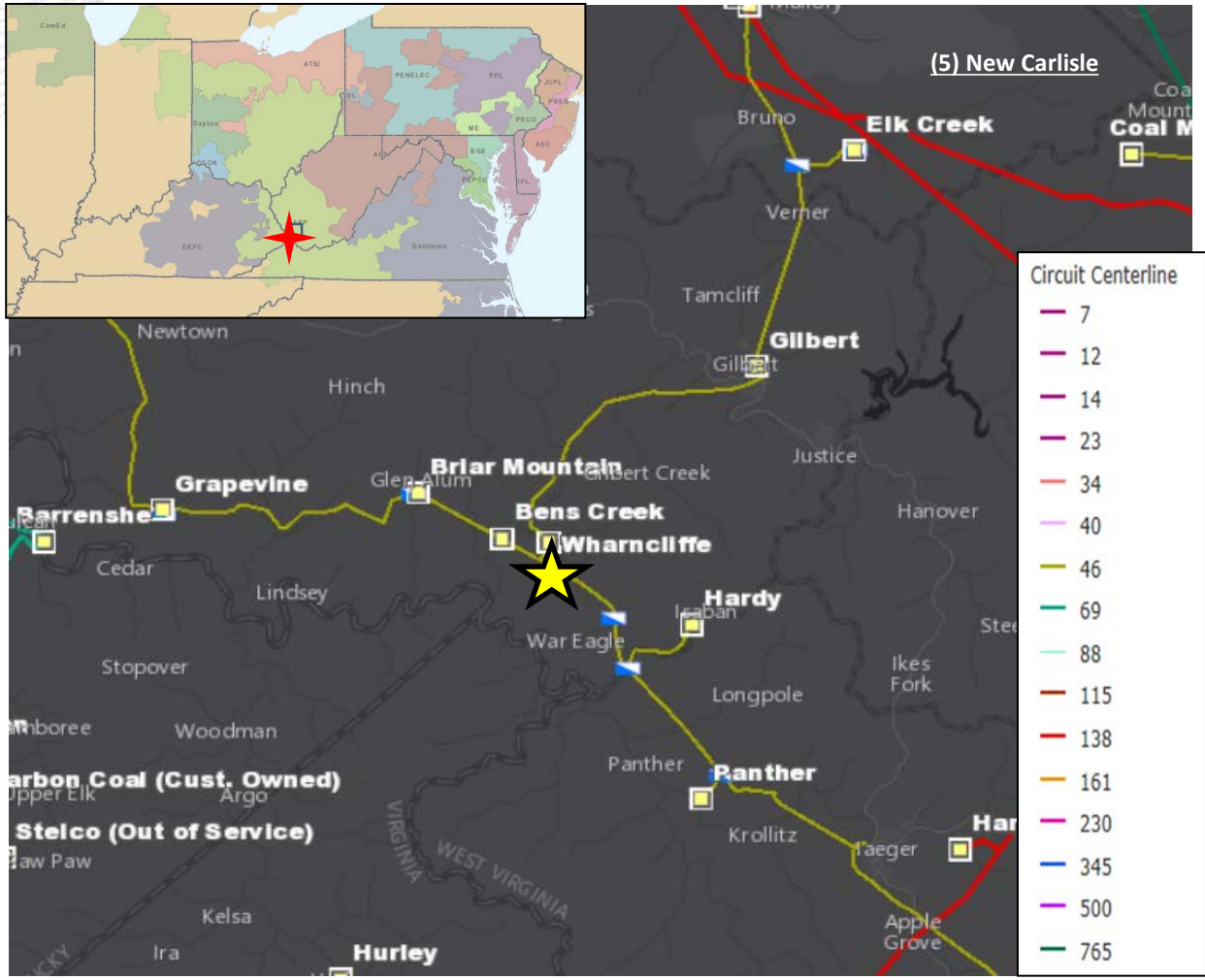
Selected Solution:

Replace existing Wharncliffe 46KV circuit breakers A, B, and C with 3000 A 40 kA circuit breakers. (S1492)

Estimated Transmission Cost $ 3.41M

Projected In-service: 06/01/2018

Project Status: Scoping



AEP Transmission Zone: Supplemental Madison 69 kV Loop

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

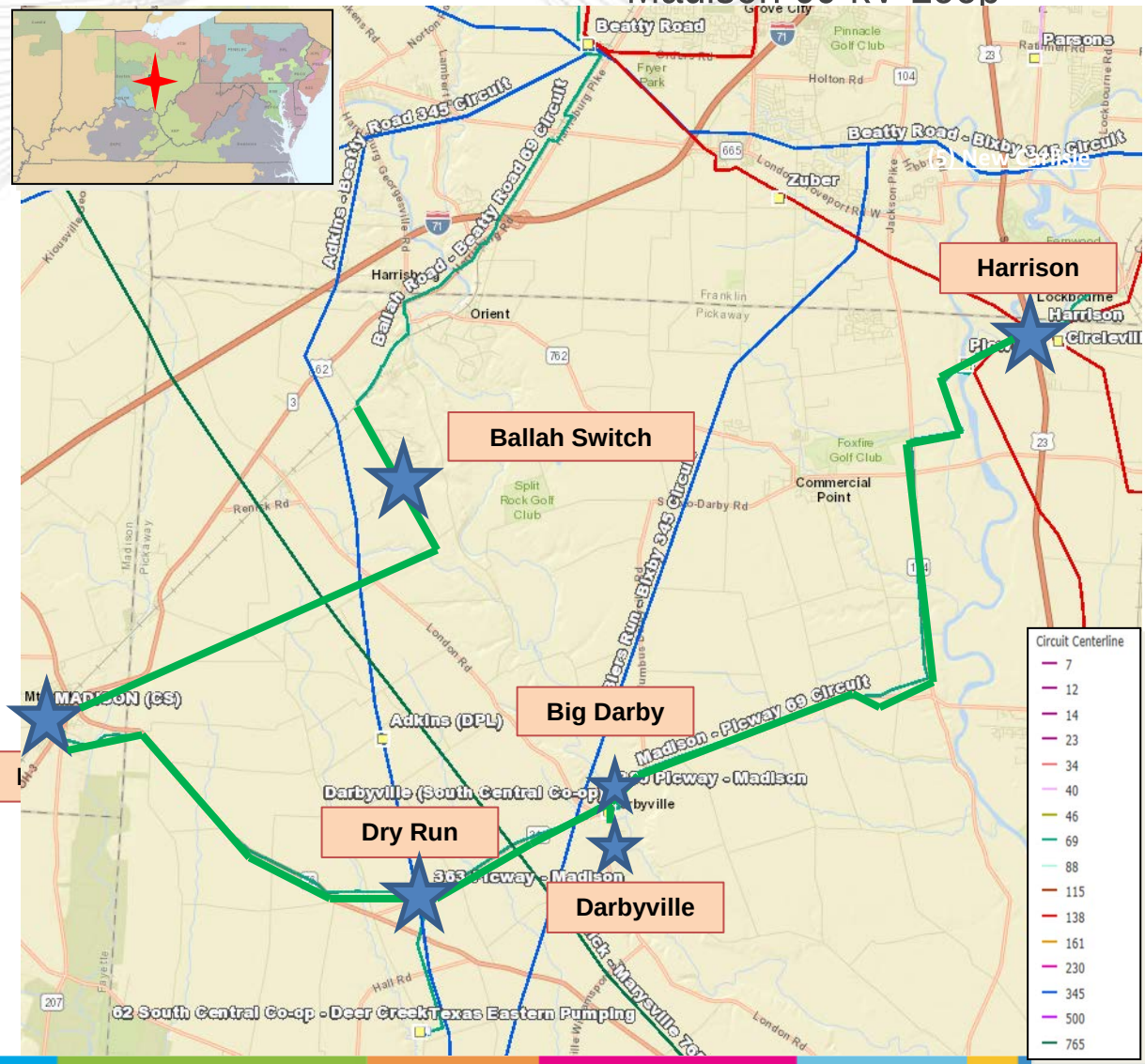
Equipment Material/Condition/Performance/Risk:

The Harrison-Madison 69kV circuit (made up of Picway-Madison, vintage 1944 & Picway Harrison, vintage 1969) is in very poor condition and in need of rebuild. 15.29 miles of the 24.2 mile line is 73 years old and 16.4 miles of it is comprised of copper conductor (25 MVA rating). There are 248 known conditions as of the last inspection. Due to the radial nature of the line, it cannot be rebuilt without first completing and closing the loop at Madison station in order to avoid extensive customer outages.

The transmission line operations crew receives multiple call outs on this line, and it's construction makes it difficult to repair. There are also co-op customers and a pipeline customer served off this line that are affected when the line is outaged.

Four circuit breakers at Harrison station are showing signs of deterioration. These breakers were installed in the late 1960's and early 1970's and use oil as the interrupting medium. Oil breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. The drivers for replacement of these breakers are age, bushing damage, no repair part availability, amount of fault operations and PCB content. Fault operation counts at Harrison include 13 on 69kV CB 61, 58 on 69kV CB 62, and 23 on 69kV CB 63, which exceed the manufacturer's recommended limit of 10.

Harrison 138/69kV transformer 1 is also showing signs deterioration. Drivers for transformer replacement include age, dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events) and accessory damage (bushings).



AEP Transmission Zone: Supplemental Madison 69 kV Loop

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Operational Flexibility and Efficiency:
A normally opened configuration at Str. 280 (near the Darbyville tap location) allows for limited temporary recovery of loads at Deer Creek, Darbyville, Clark Lakes, Texas Eastern Co., and Madison stations for outages involving Str. 280 to Harrison branch. This configuration depends on utilizing normally radial customer owned 69kV transmission line. However, there are not recovery options if the outages involve Str. 280 to Madison branch. Existing small conductors also limit the load recovery options in this configuration.

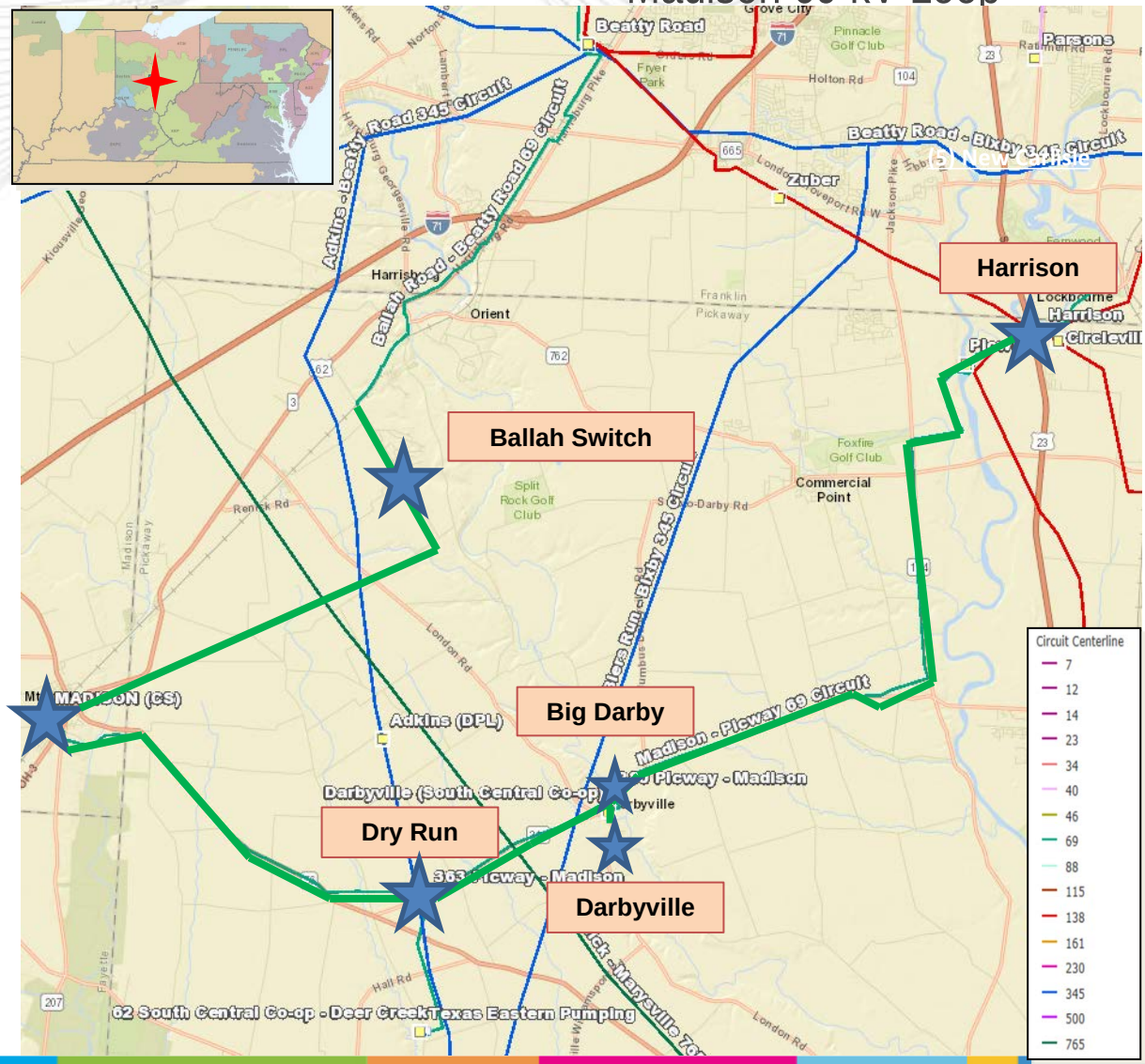
Customer Service:
SCP has approached AEP to help address numerous outages affecting customers in this area.

Selected Solution:
Build a new Beatty-Madison 69 kV line utilizing 795 ACSR (129MVA rating) in new ROW. Acquire existing 636 ACSR & 336 ACSR (73 MVA rating) in existing ROW. (S1493.1) Estimated Transmission Cost: $16.2M
Rebuild single circuit 69kV line from Harrison to Madison with 795 ACSR (129 MVA rating), mostly in existing ROW. (S1493.2) Estimated Transmission Cost: $23.4M
Rebuild tap to Darbyville as double circuit 795 ACSR (129 MVA rating). (S1493.3)
Estimated Transmission Cost: $0.9M
At Harrison station, replace the 138/69kV transformer with a 90 MVA. Install 3-69kV CB's with 2,000A 40kA breakers. Install 1-138kV CB with a 3,000A 63kA breaker. Install a 14.4 MVAr 69kV capacitor. (S1493.4)
Estimated Transmission Cost: $5.8M
At Madison station, install 2 new 69kV 2,000A 40kA CB's and 1 600A 40kA ckt switcher. (S1493.5)
Estimated Transmission Cost: $3.0M
At Big Darby Switch, Dry Run Switch, and Ballah Switch, upgrade with 2000A switches at new locations. Retire old switches (S1493.6) Estimated Transmission Cost: $1.3M

Total Estimated Transmission Cost: $50.6M

Projected In-service: 12/1/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental
Meadowbrook Station

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Breakers C and D are currently not in use and are accruing yearly O&M costs. Due to the cost, retirement is recommended.

Operational Flexibility and Efficiency

Currently there are three overlapping zones of protection at Meadowbrook station: the 34.5kV bus, the 138/34.5kV transformer and the Pendleton – Madison line. It is AEP's current standard to not allow for an overlap of more than two protection zones. The configuration at Meadowbrook does not meet AEP's current standards as three protection zones share the same relays thus increasing the probability of mis-operations. Also, a transformer protection zone overlapping with a bus and line protection zones does not allow for bus one-shot and high-speed reclosing schemes, respectively. This adds restoration delays and significantly reduces reliability. Also, this arrangement reduces the life of breakers by tripping them for events in any of the three protection zones.

Selected Solution:

Retire out of service breakers "C" and "D" at Meadowbrook station and install a high side 138kV 3000A 40kA breaker for transformer protection. (S1494)

Estimated Transmission Cost: $2.5M

Projected In-service: 11/1/2018

Project Status: Scoping

AEP Transmission Zone: Supplemental
Deer Creek-Sorenson Rebuild

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

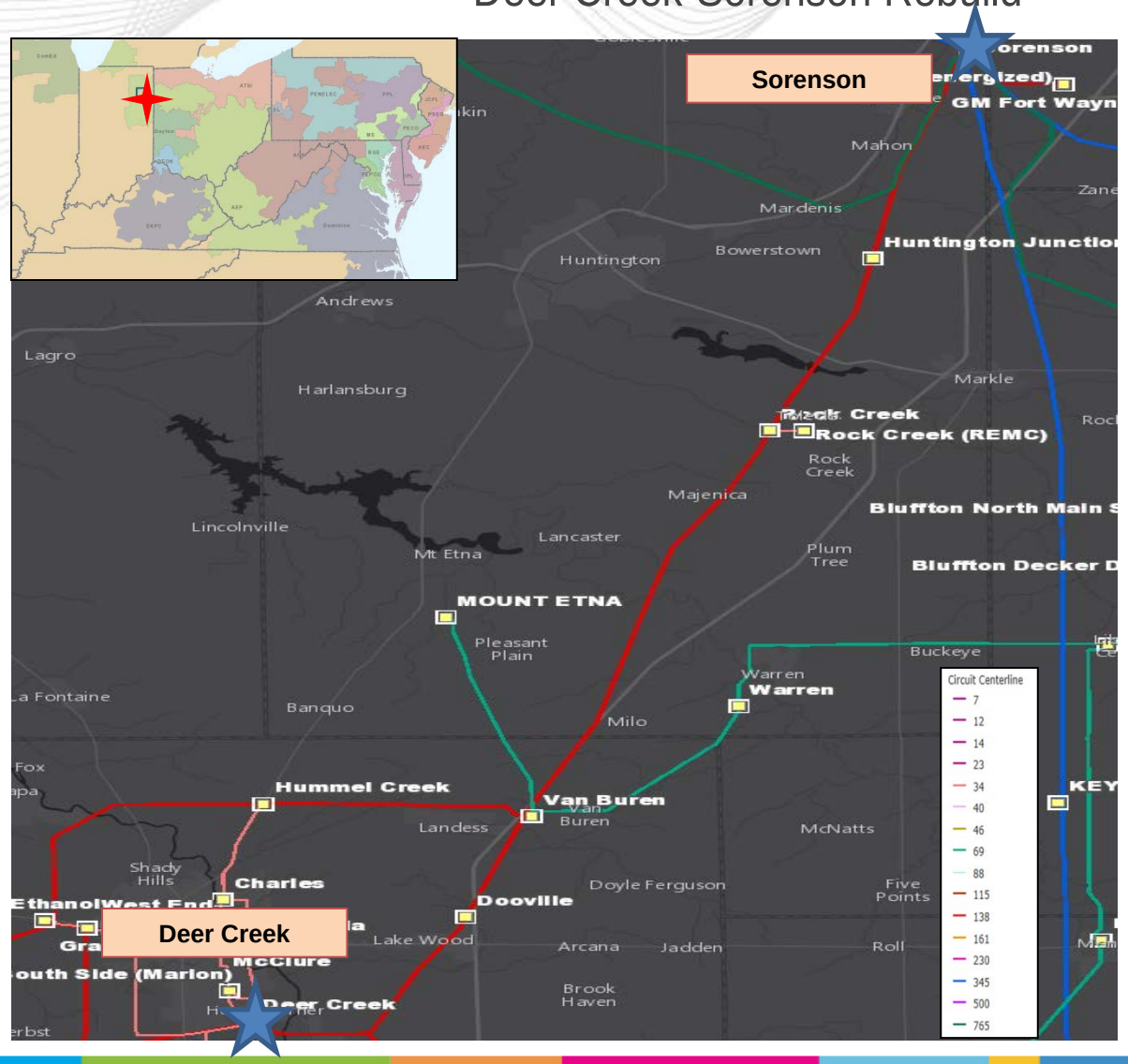
Equipment Material/Condition/Performance/Risk:

The Deer Creek – Sorenson double circuit line has 236 open conditions and is comprised of conductor and towers from 1928 with mostly 397 ACSR conductor (167 MVA rating) along the 36 mile length. It is currently subject to corroded towers; broken clamps; broken dampers; burnt insulators; vine hazards and broken shield wire.

Design standards from the 1920s do not meet modern standards for strength, resilience, and horizontal and vertical clearances for safety. Underlying land rights secured prior to the line's original construction do not contain modern protective language which would provide the ability to properly manage non-conforming land uses. The ability to control building encroachments and intrusive vegetation were often not included in the language of the original easements. This transmission line has exceeded its original life expectancy. Age and normal deterioration of the line, now over ninety (90) years old, warrants its complete replacement.

Operational Flexibility and Efficiency

Due to the relative length of the line, wind exposure, and perpendicularity of this line to the prevailing winds, the Deer Creek – Sorenson circuit has had a history of "galloping" which has led to 30 momentary interruptions across the Deer Creek – Hummel Creek – Sorenson circuit and 43 momentary interruptions on the Delaware – Sorenson circuit in the last 10 years alone. Rebuilding this line with structures and configurations more suited for high wind environments is required.



AEP Transmission Zone: Supplemental
Deer Creek-Sorenson Rebuild

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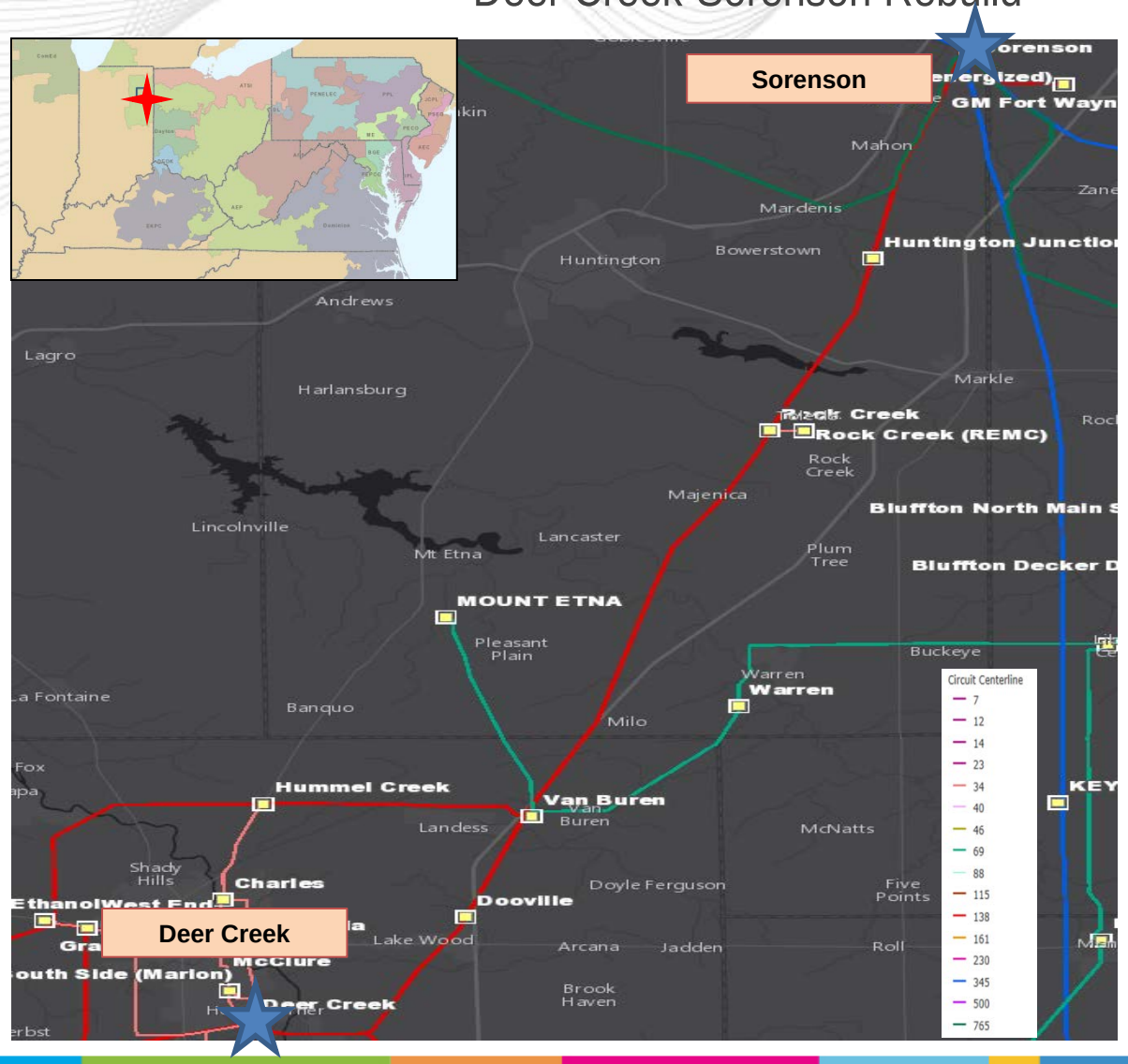
Selected Solution:
Rebuild ~32 miles of the Delaware – Sorenson & Sorenson – Deer Creek 138kV double circuit line using 795ACSR (257 MVA rating). (S1495.1)
Estimated Transmission Cost: $82.6M

Rebuild ~3 miles of the Deer Creek 138kV double circuit extension using 795 ACSR (257 MVA rating). (S1495.2)
Estimated Transmission Cost: $1.7M

Total Estimated Transmission Cost: $84.3M

Projected In-service: 12/2/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental Anthony-Lakeside Rebuild

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Original construction of the Anthony-Lakeside 34.5 kV line is estimated to be from the 1950's, is approximately 2 miles long, and consists of 72 wood pole structures and 336 AAC conductor (36 MVA rating). Currently, this line has 21 open conditions, most of which include rotten wood poles and burnt/broken conductor. Recommendations to address the physical condition of this line have been received from Transmission Field Services.

In addition to the replacement of the transmission line, the associated remote end station circuit breakers "A" and "B" at Water Pollution and "H" at Anthony are 1950's and 1970's vintage, which are recommended for replacement due to their age and physical condition.

The Anthony-Lakeside 34.5 kV line serves the City of Fort Wayne's water treatment plant as well as temporary service for their tunnel boring project to improve the City's waste water system. The line rebuild and breaker replacements will address the age and condition issues of these facilities and aim to improve the reliability of service to the City of Fort Wayne and local network.

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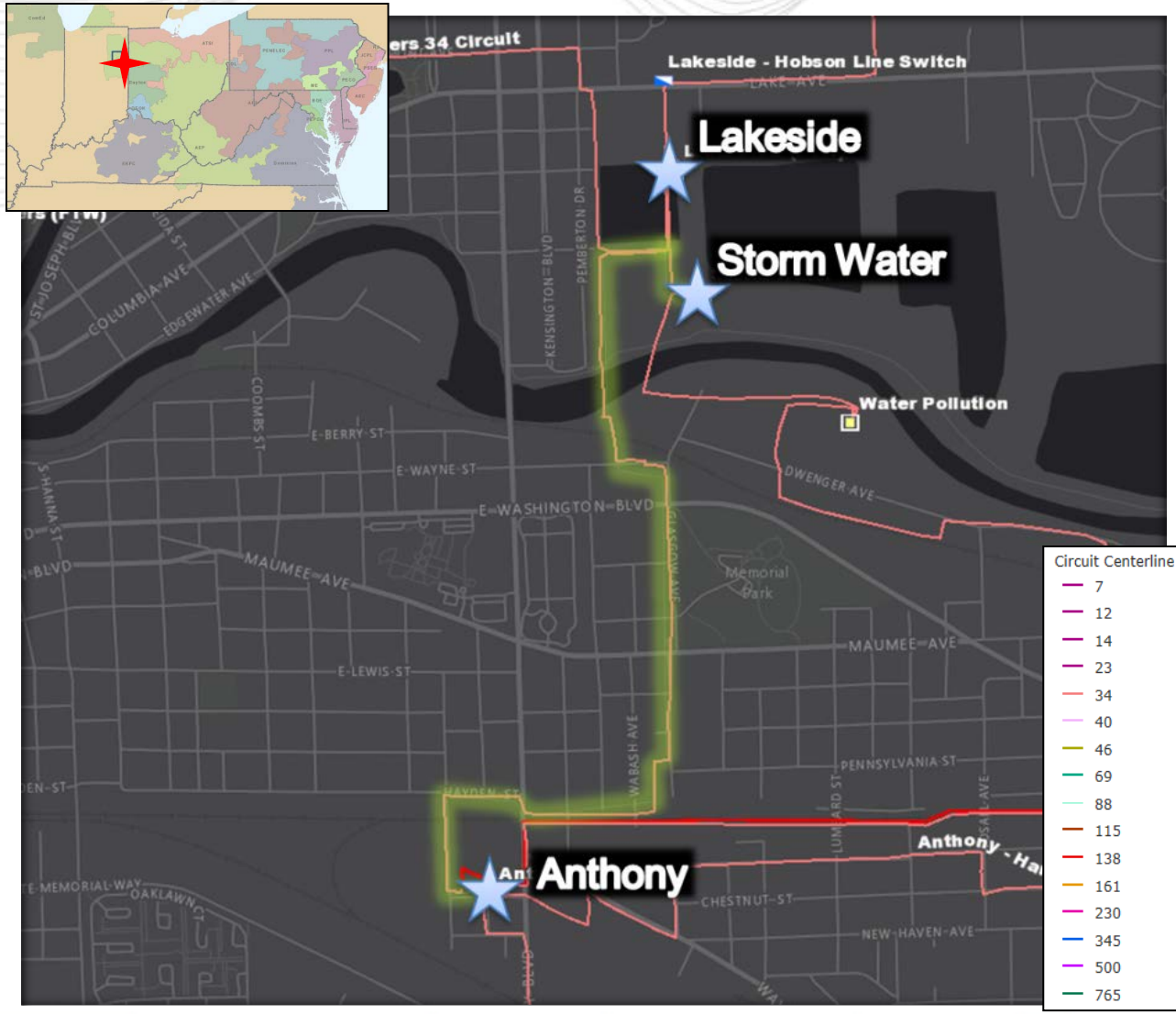

AEP Transmission Zone: Supplemental Anthony-Lakeside Rebuild

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Selected Solution:
Rebuild approximately 2 miles of single circuit line with 795 ACSR from Anthony Station to structure 66 (just south of Lakeside station) and continue to Storm Water Station. This conductor type was selected to match the remaining overhead conductor capability of the circuit. The remaining portion of line (north of structure 66) will be retired along with Lakeside station. The rebuilt 34.5 kV circuit from Anthony-Storm Water 34.5 kV will be limited by 600 A switches at Storm Water creating an overall rating of 41/45 MVA (SN/SE) and 53/57 MVA (WN/WE). (S1496.1) Estimated Cost: $7.0M

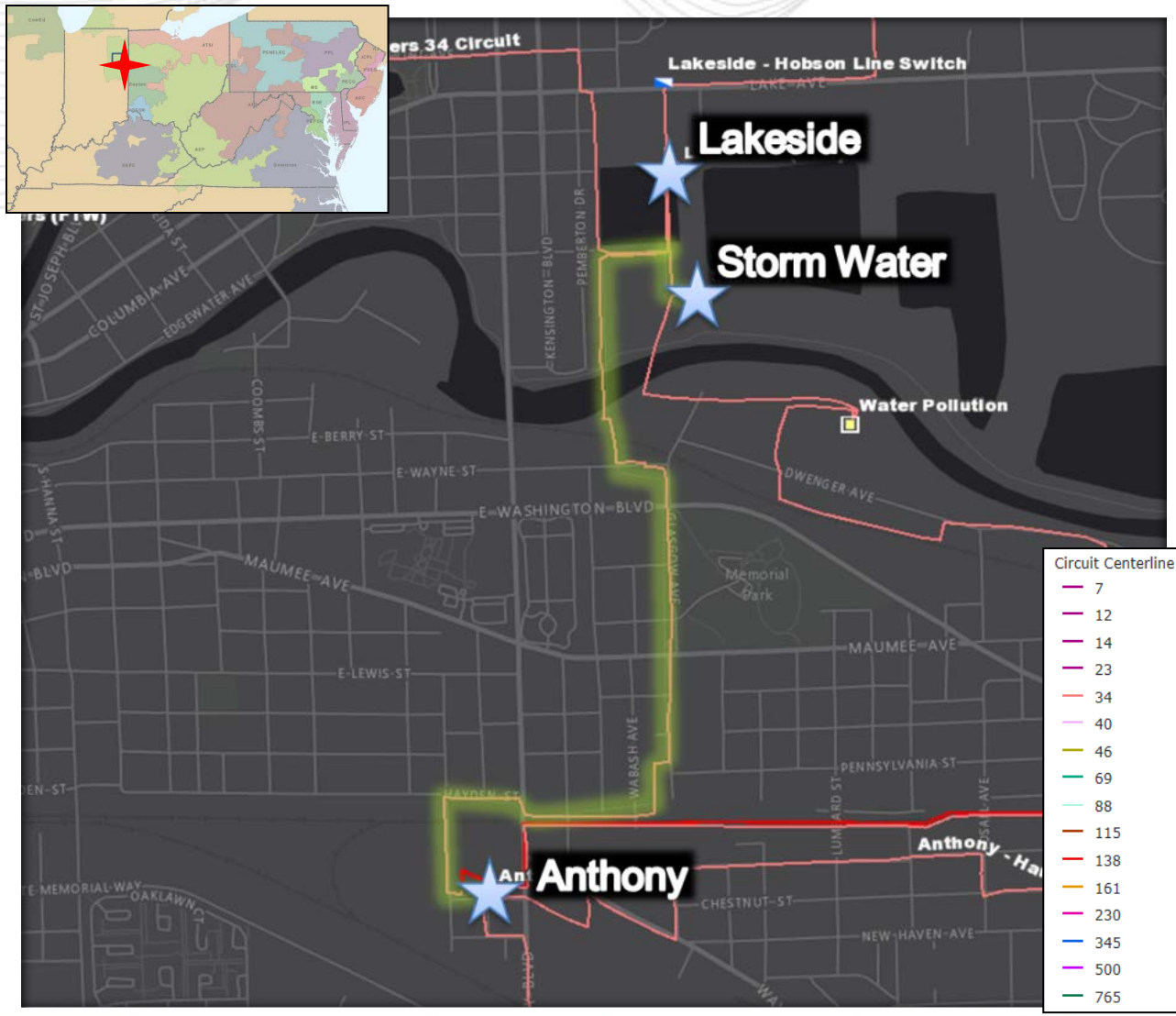
At Water Pollution Station, replace 34.5 kV circuit breakers “A” and “B” with 1200 A, 25 kA ABB breakers. (S1496.2) Estimated Cost: $0.8M

At Anthony Station, replace 34.5 kV circuit breaker “H” with a 1200 A, 25 kA ABB breaker. (S1496.3) Estimated Cost: $0.9M

Total Estimated Transmission Cost: $8.7M

Projected In-service: 05/30/2020

Project Status: Scoping



AEP Transmission Zone: Supplemental Baileysville-Bolt Rebuild

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Baileysville – Bolt 46 kV circuit has experienced 4.5 million customer minutes of interruption from 2013 to 2016. Approximately 16 miles of the 19 mile long circuit utilizes wood pole structures from the 1940s with 3/0 and 4/0 ACSR conductor (29 MVA rating). In addition, this line has a shield wire along only 13% of the structures and lightening strikes are a frequent occurrence. There are currently 39 category A open conditions along the circuit. These open conditions include damaged/rotted poles and cross arms. Our circuit breaker guideline justifies installing a breaker at McGraws Station towards Baileysvile Station with a Momentary/Permanent Outage Index (MPOI) calculation of 273, above the 200 threshold.

Selected Solution:

Rebuild ~16.6 miles of the Baileysville-Bolt line with 795 ACSR conductor to 138 kV standards (energized at 46 kV, 86 MVA rating). Existing ROW will be used when possible but supplemental ROW may be needed in order to build to 138kV standards. ADSS will be installed on the new line. (S1497.1)

Estimated Cost: $25.8M

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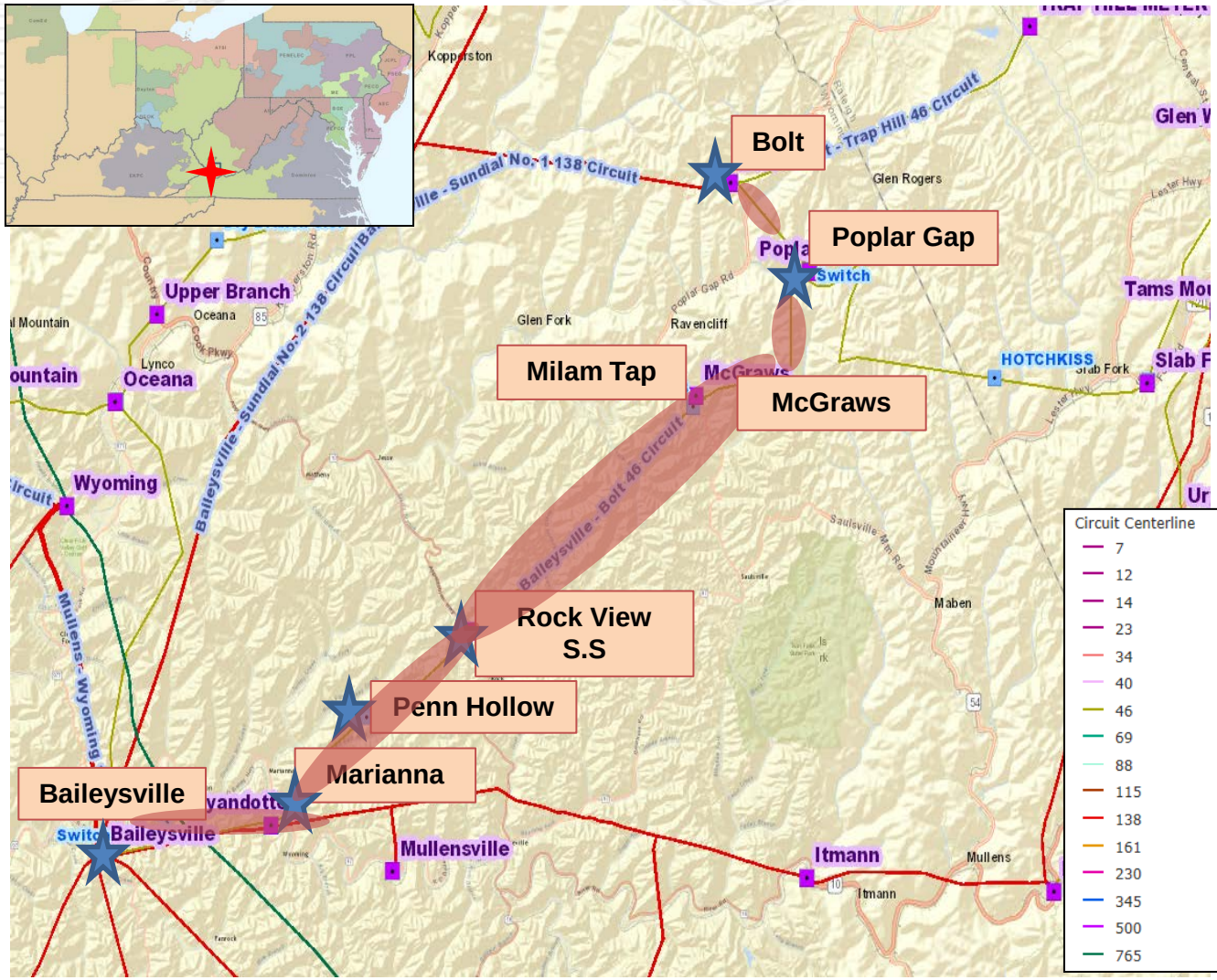

AEP Transmission Zone: Supplemental Baileysville-Bolt Rebuild

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At Baileysville Station, replace 46kV bus/risers and switches on circuit breaker E. (S1497.2) Estimated Cost: $0.6M

At Marianna Station, replace the existing switches with a 1200A phase-over-phase switch and replace the bus/risers. (S1497.3) Estimated Cost: $0.0M

At Rock View Station, replace the existing switches with a 1200A phase-over-phase switch. (S1497.4) Estimated Cost: $0.4M

At Poplar Gap Station, replace the existing switches with a 1200A phase-over-phase switch. (S1497.5) Estimated Cost: $0.6M

Retire Milam Tap Station. (S1497.6) Estimated Cost: $0.0M

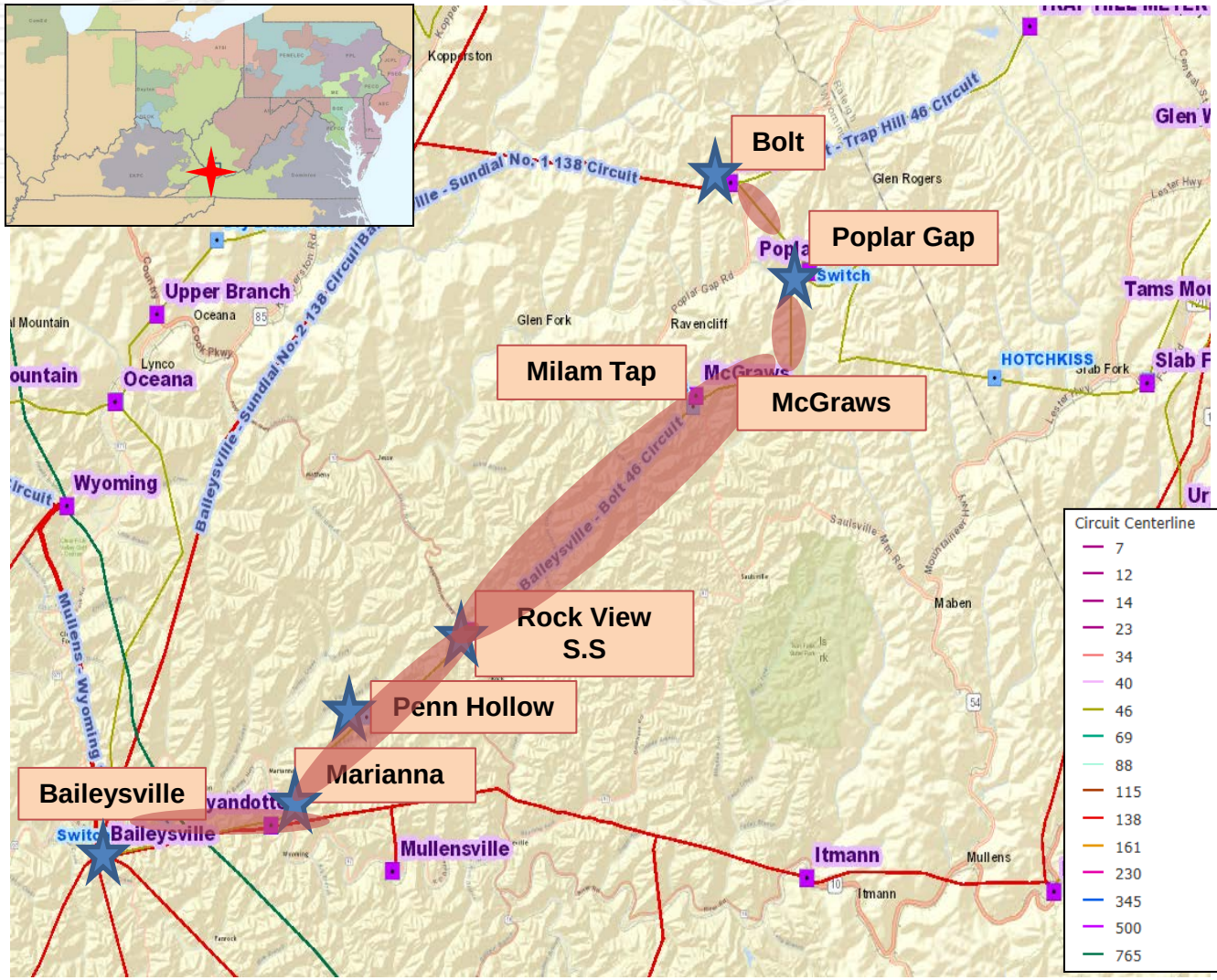
Retire Penn Hollow Tap Station. (S1497.7) Estimated Cost: $0.0M

Install a 3000A circuit breaker at McGraws Station towards Baileysville. (S1497.8) Estimated Cost: $1.2M

Total Estimated Transmission Cost: $28.6M

Projected In-service: 12/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Delaware-Madison Rebuild

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Delaware – Madison 138kV line is a 1928 vintage circuit that has a total of 100 open conditions across its ~19 miles including burnt insulators, broken shield wire, loose conductor hardware, broken guy wires, and broken ground lead wires. It was constructed with 397 ACSR conductor (167 MVA rating).

In addition, the line riser at Delaware will be replaced so that it doesn't limit the new ~19 mile long line.

Operational Flexibility and Efficiency

Daleville station is configured in a non-standard configuration. Because of this, any work on the transformer requires that the line be taken out of service. Reconfiguring this station's switches will eliminate unnecessary maintenance outages.

Selected Solution:

Rebuild the ~19 miles of the Delaware – Madison double circuit 138kV line utilizing double circuit 556.5 ACSR 26/7 (SN:204 SE:284 WN: 258 WE: 319). (S1498.1)

Estimated Cost: $54.3M

Replace risers at Delaware station with 1200A AAC jumpers. (S1498.2)

Estimated Cost: $0.3M

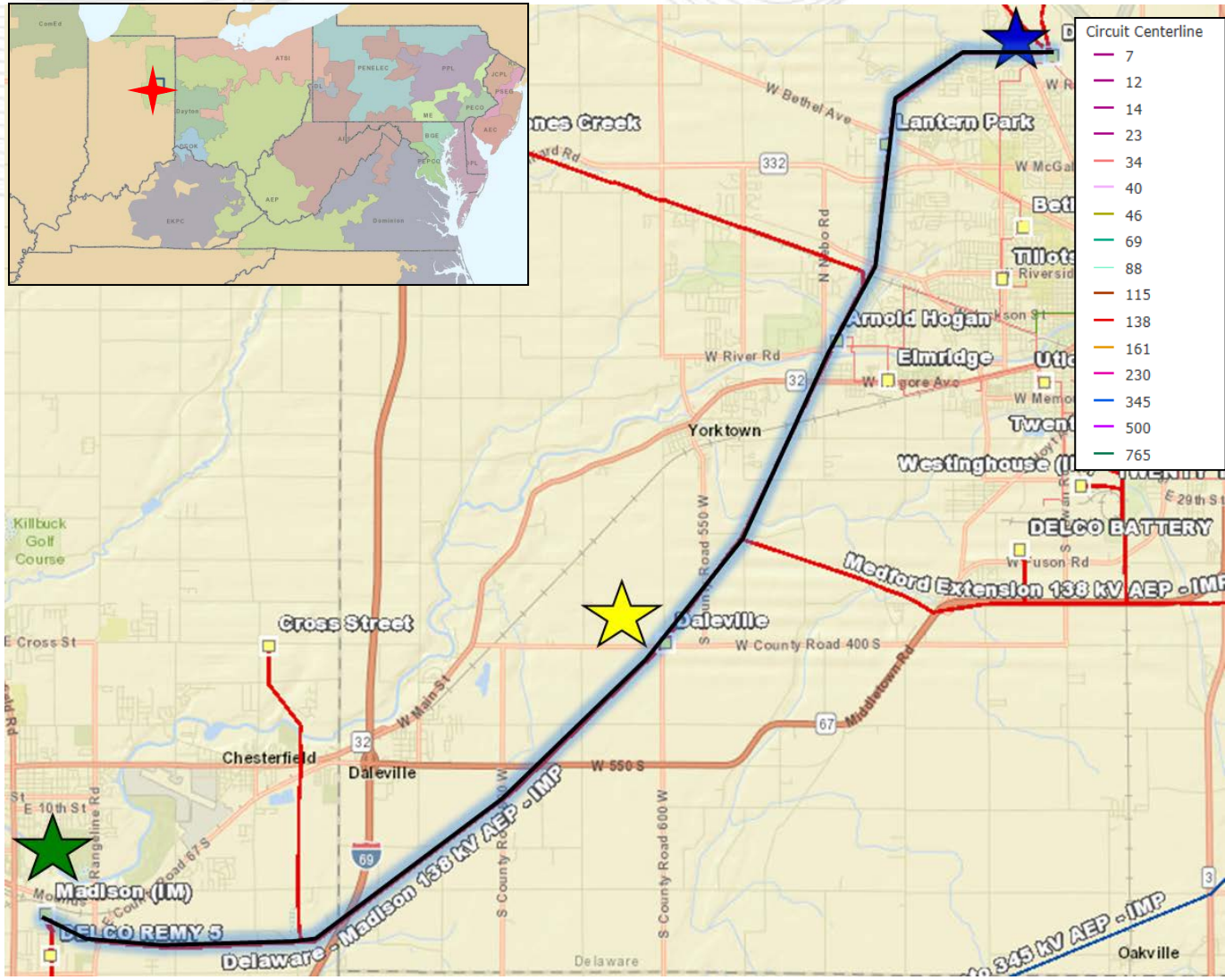
Replace the switches at Daleville station with 2000A 100kA switches (S1498.3)

Estimated Cost: $0.1M

Total Estimated Transmission Cost: $54.7M

Projected In-service: 12/31/2021

Project Status: Scoping



AEP Transmission Zone: Supplemental Dennison-West New Philadelphia Upgrades

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Breaker L at West New Philadelphia station is a McGraw-Edison oil breaker manufactured in 1962. In general, oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. Oil spills occur frequently with failures and while performing routine maintenance, which, is an environmental hazard. Additionally, breaker L has experienced 104 fault operations.

Operational Flexibility and Efficiency

Dennison – West New Philadelphia 69kV has been responsible for 3.9 million minutes of CMI over the prior 3 years. 60% of the outage-duration was due to Station Equipment problems.

Malfunctioning MOAB flip-flop switching scheme at New Philadelphia has been inoperable since 2012. Lack of SCADA at Schoenbrunn & New Philly limits system operator's ability. RTU's will be installed at both stations, to provide real-time power flow data (voltage, currents, MW/MVAR) to system operators.

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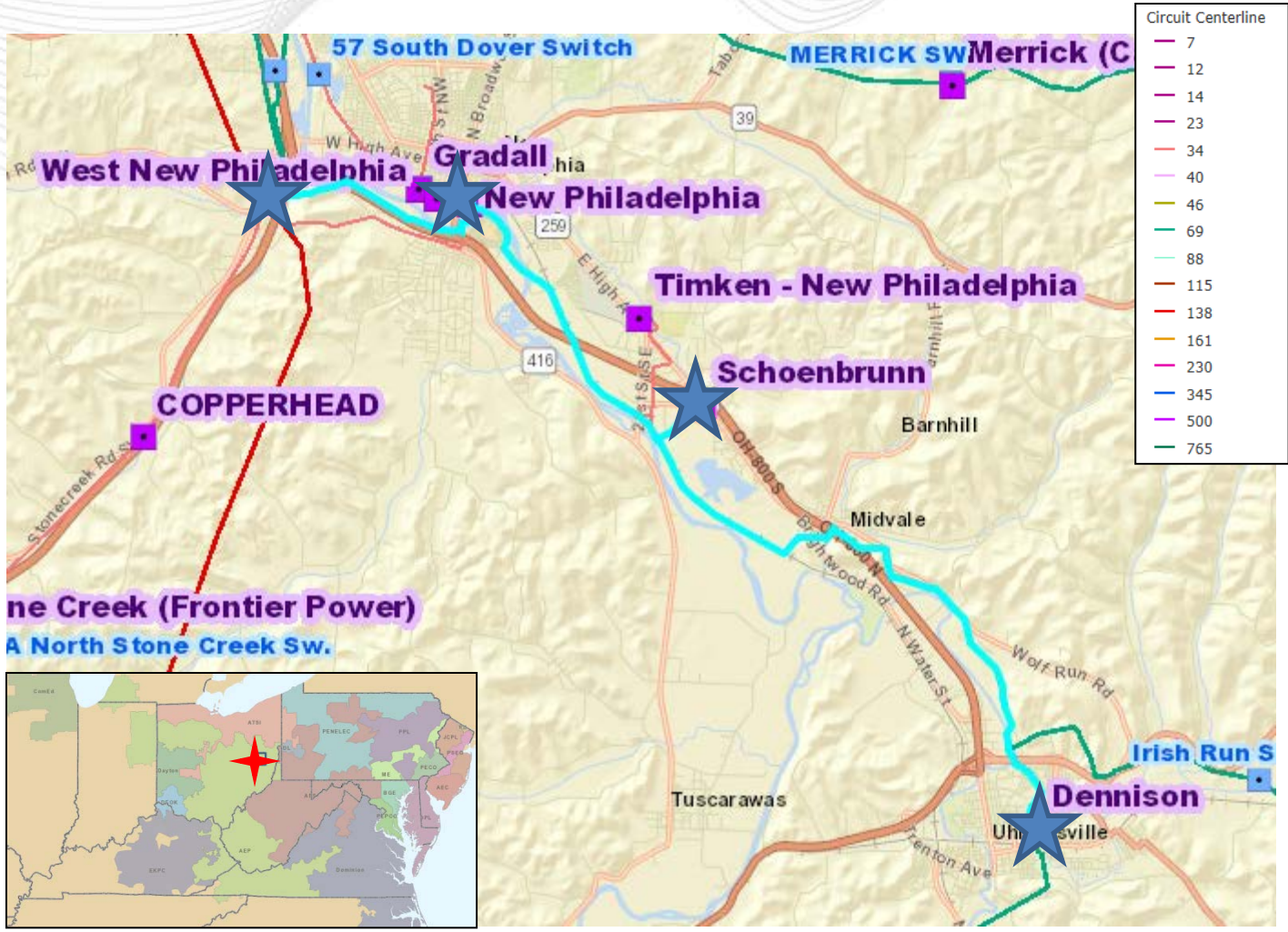

AEP Transmission Zone: Supplemental Dennison-West New Philadelphia Upgrades

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Two 69kV hard taps will be eliminated as part of the project (just outside West New Philly station, and near New Philly). Hard taps are problematic when doing maintenance on the circuit or stations involved.
The New Philly 69kV breakers prevent a 69kV T-Line outage from taking out the 69kV cap bank there; this cap bank is valuable for supporting system voltages. The Momentary Permanent Outage Index (MPOI) calculations support installing breakers at New Philadelphia (230, above the 200 threshold).

There are large AEP Ohio distribution load centers served from New Philly station (24 MVA peak, 4800 customers) and Schoenbrunn (23 MVA, 3500 customers). Today, a line fault would outage 8300 customers or 47 MVA of load at summer peak. Additional breakers at Schoenbrunn are recommended to help keep these customers in service for line faults. The MOAB/ground switch at Schoenbrunn will be replaced. MOAB/ground switch combinations induce a fault on the system, tripping remote breakers for a transformer fault, reducing the life and increasing relay coordination complexity for the transformer protection.

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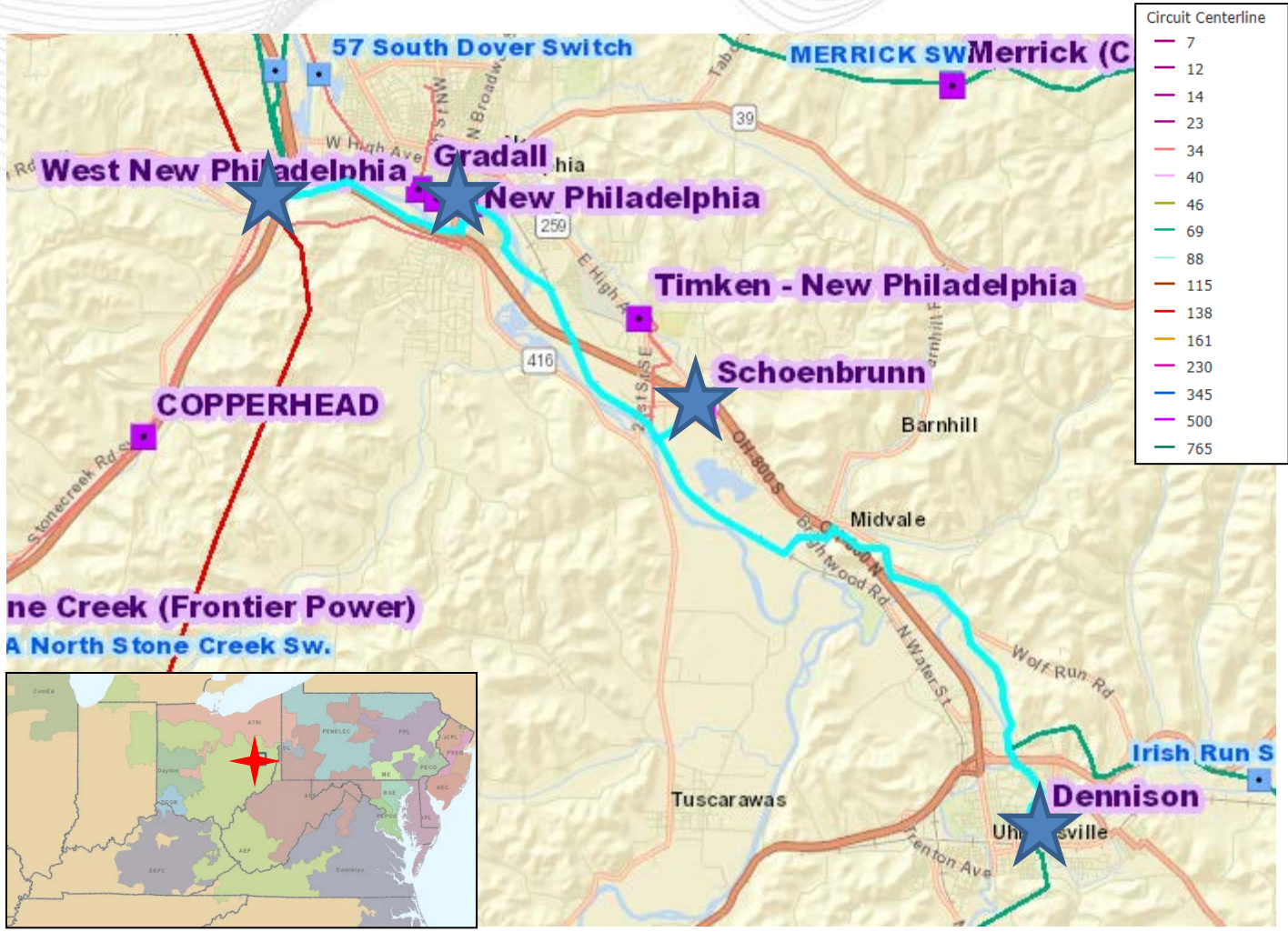

AEP Transmission Zone: Supplemental Dennison-West New Philadelphia Upgrades

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Selected Solution:
Remove the 69kV hard taps outside of West New Philly & New Philly stations. 6-wire the between West New Philly-New Philly stations (2.4 miles). Modify the Schoenbrunn double-circuit loop due to station expansion. (S1499.1) Estimated Cost: $1.7M

At West New Philly 69kV station, upgrade relaying toward Dennison; replace 69kV circuit breaker 'L' (to Beartown); install a breaker on the low-side of the 138-69kV transformer. (S1499.2) Estimated Cost: $2.6M

At New Philly 69-34kV station, replace inoperable 69kV MOAB flip-flop switching scheme with breakers and relays. Upgrade RTU & expand SCADA functionality. Install a distribution bus-tie breaker. (S1499.3) Estimated Cost: $1.2M

At Schoenbrunn 69-12kV station, replace 69kV MOAB/ground-switch transformer protection with circuit switcher protection scheme. Add RTU & SCADA. Install 69kV bay with 2- circuit breakers. (S1499.4) Estimated Cost: $1.7M

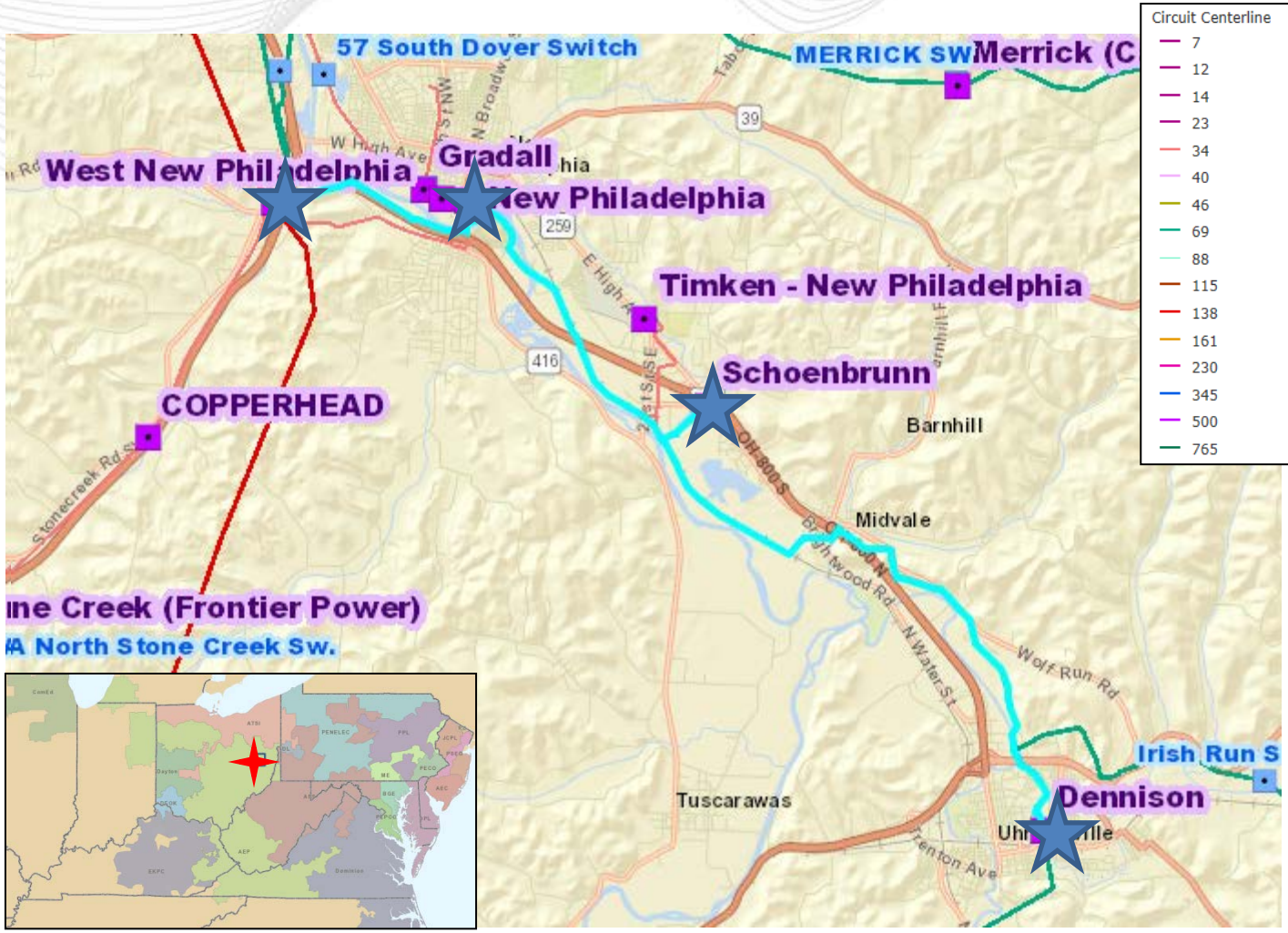
At Dennison 69kV station, upgrade relaying toward West New Philly. (S1499.5) Estimated Cost: $0.3M

Extend ADSS fiber into Schoenbrunn and New Philly stations for SCADA/protection needs. (S1499.6) Estimated Cost: $0.1M

Total Estimated Transmission Cost: $7.6M

Projected In-service: 06/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Bethel Upgrades

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Circuit Breaker #103, #104, #106, & #107 at Bethel Road station are late 1960's vintage oil filled breakers without oil containment. All of these oil filled breakers have exceeded their life expectancy for full fault operations.

The Distribution transformers #1 & #2 are both large units with load transferability both at the distribution bus and at the distribution circuit level. XF#1 is nearly 40 years old with no automated high side protection and XF#2 only utilizes a MOAB for high side protection. In the existing configuration, failure of either unit will interrupt part of the transmission 138kV through path and failure of both XF's will fragment the 138kV ring bus.

Operational Flexibility and Efficiency

Addition of the distribution high side circuit switchers will allow automatic isolation for transformer faults as well as remote isolation for better control by operations.

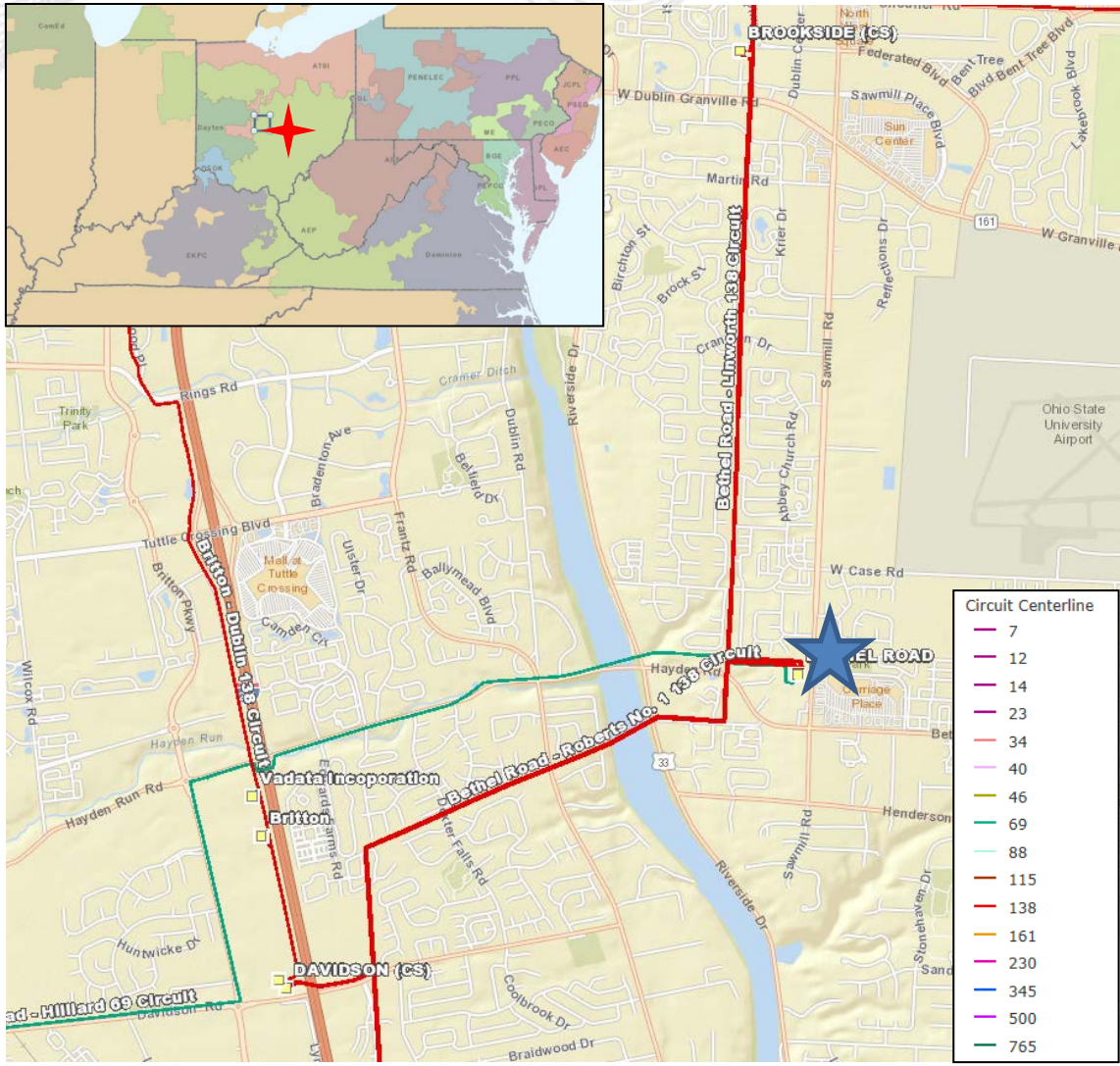
Selected Solution:

Bethel Road station: Replace 4-138kV 1600A 40kA CB's and associated disconnect switches with equipment rated for 3000A 40kA. Replace various 138kV switches and miscellaneous hardware for rehab needs. Install new DICM with multiple relay packages and remote relaying. Install 450 ft of plastibeton trench, 300ft of conduit, 500 ft of 4/0 copper grounding. Install 3-3ph sets of CCVT's. Install 2-138kV distribution transformer ckt switchers (S1500)

Total Estimated Transmission Cost: $3.5M

Projected In-service: 12/01/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental
Boone – Ward Hollow Rebuild

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

From 2013 – 2016, the Boone – Ward Hollow 46 kV circuit has experienced 8 Permanent and 5 Momentary outages resulting in 393,000 customer minutes of interruption. Over 90% of the structures that make up the approximately 17.5 mile circuit were installed in 1920 with 2/0 Copper conductor (27 MVA rating) and only 21% of the circuit is shielded for lightning protection. These service interruptions are due to a lack of shielding. Additionally, there are 35 current open A conditions consisting of pole, conductor and hardware damage.

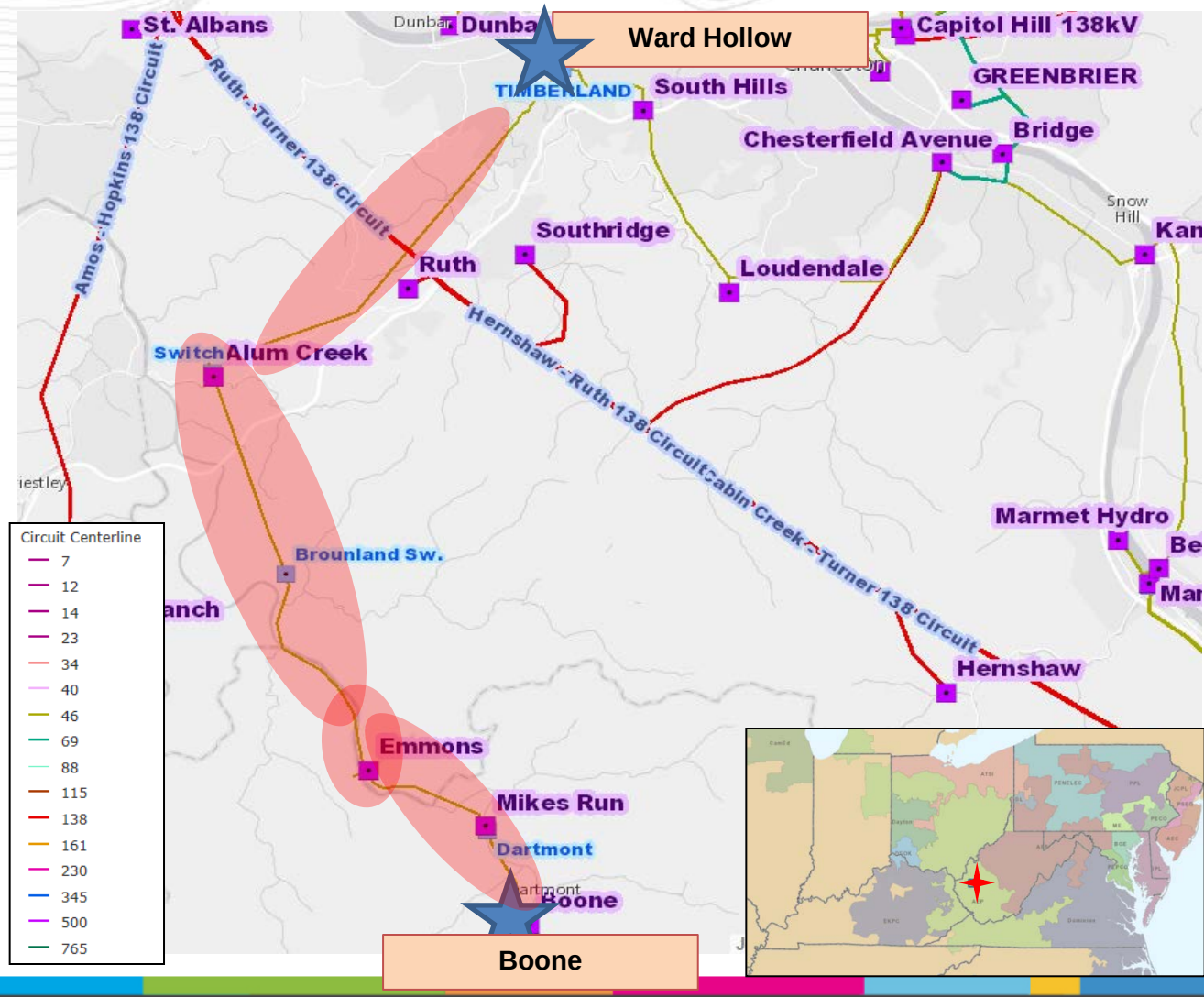
Selected Solution:

Rebuild ~17.5 miles of the Boone – Ward Hollow circuit utilizing 795 26/7 ACSR (86 MVA rating) at 69 kV standards (operated at 46 kV). Switching structures at Mikes Run, Emmons, and Alum Creek will be replaced with a standard 3-way Phase Over Phase Switch. Retire Timberland Switching Station. (S1501)

Total Estimated Transmission Cost: $32.7M

Projected In-service: 12/01/2020

Project Status: Engineering



AEP Transmission Zone: Supplemental Byllesby Breaker Replacement

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Breakers “B” & “D” at Byllesby are FK type breakers and are over 50 years old. These are oil breakers that have become more difficult to maintain due to oil handling requirements. In general, oil spills occur often during routine maintenance and failures with these types of breakers. Other drivers include potential PCB content, damage to bushings, and exceeding the manufacturer recommended number of fault operations (10). Byllesby breakers “B” & “D” have experienced 39 and 50 fault operations, respectively.

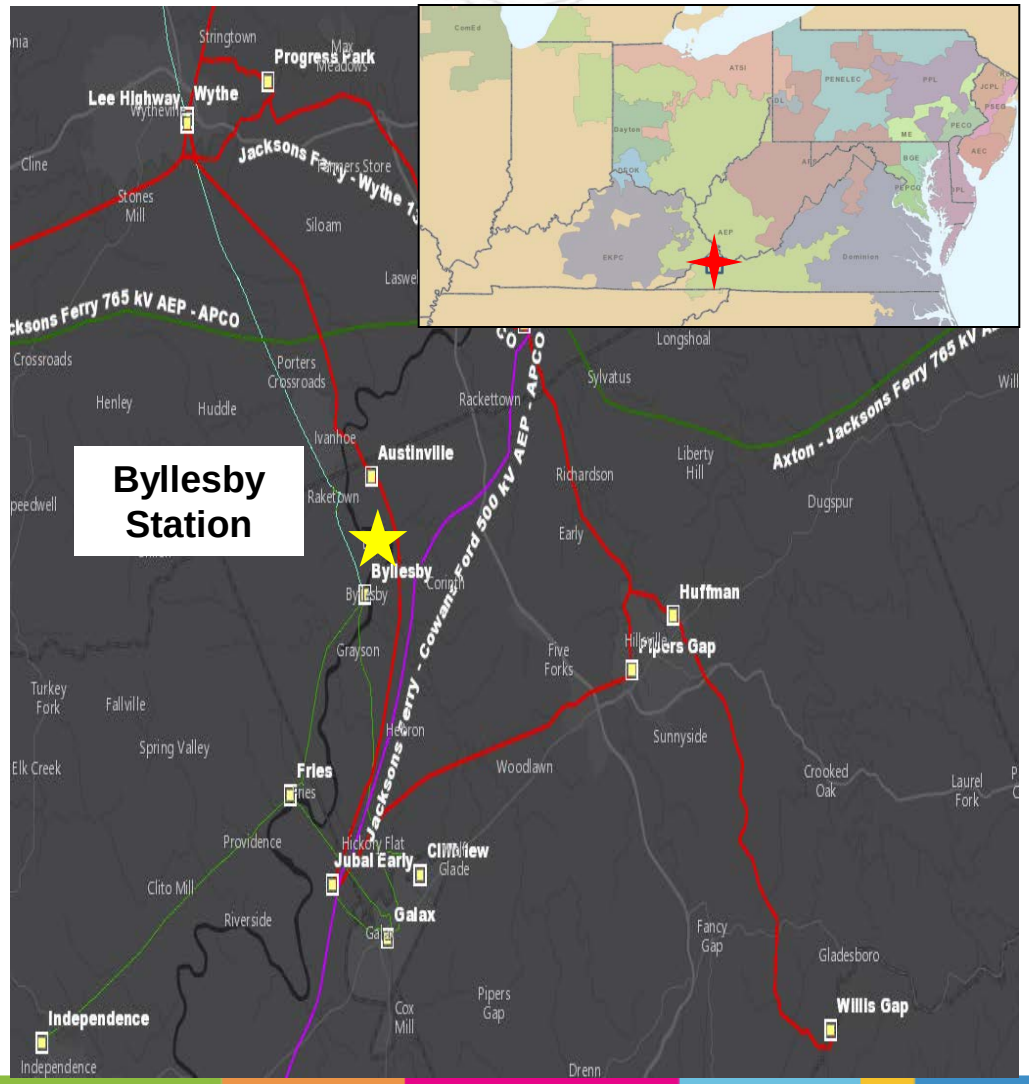
Selected Solution:

Replace existing Byllesby 69 kV 1200A 17.5kA circuit breaker “B” with 3000 A 40 kA breaker.
Replace existing 69 kV Byllesby 1200A 21 kA circuit breaker “D” with 3000 A 40 kA breaker. (S1502)

Total Estimated Transmission Cost: $0.4M

Projected In-service: 9/01/2018

Project Status: Scoping



AEP Transmission Zone: Supplemental Clinchfield Breaker Replacement

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Breakers “A” & “B” at Clinchfield are FK type oil breakers and are 1958 vintage. These oil breakers are difficult to maintain due to oil handling requirements. In general, oil spills occur often during routine maintenance and failures with these types of breakers. Other drivers include potential PCB content, damage to bushings, and exceeding the manufacturer’s recommended number of fault operations (10). Clinchfield breakers “A” & “B” have experienced 101 and 58 fault operations, respectively. The MOAB/ground switch at Clinchfield will be replaced. MOAB/ground switch combinations induce a fault on the system, tripping remote breakers for a transformer fault, reducing the life and increasing relay coordination complexity for the transformer protection.

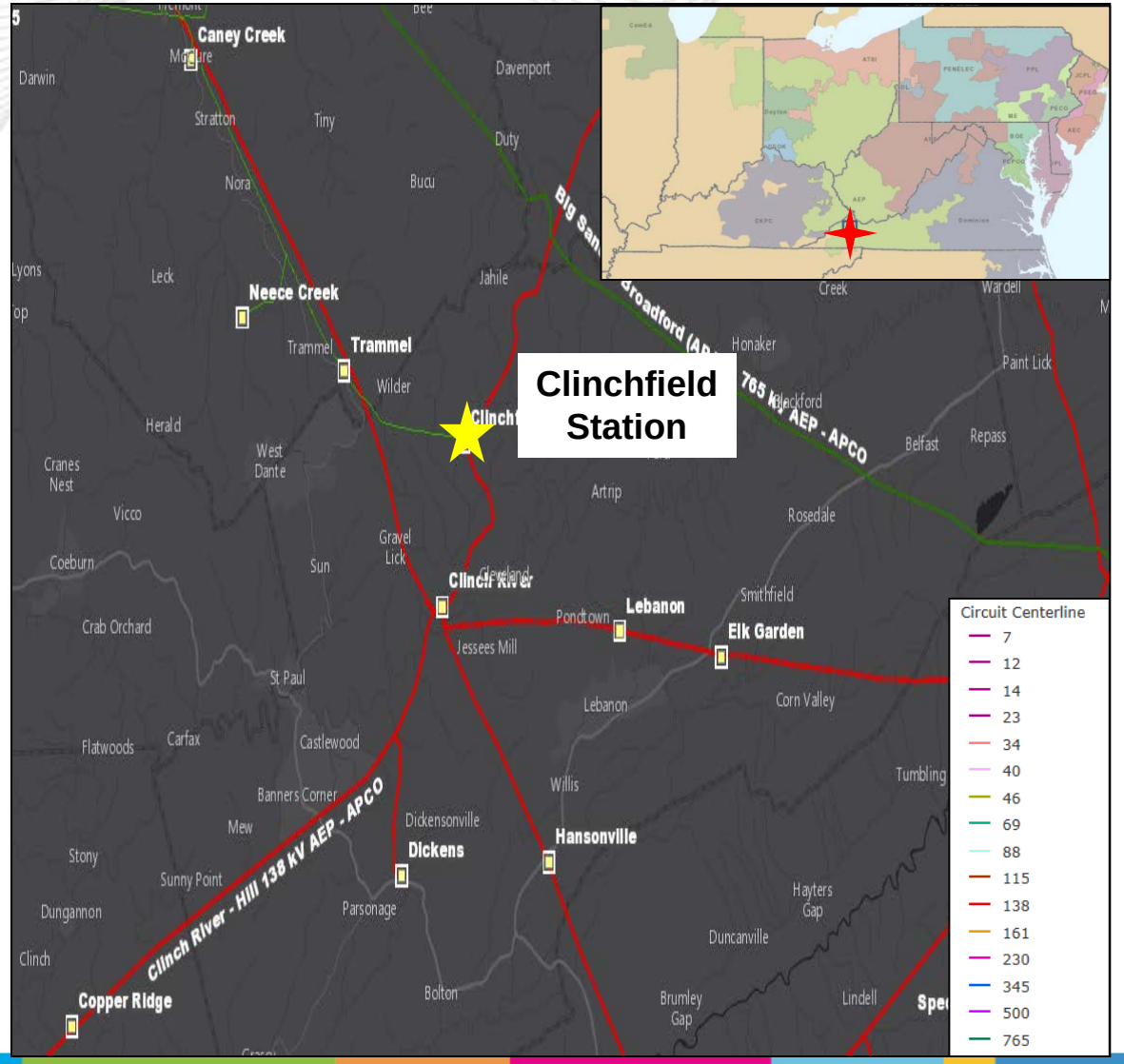
Selected Solution:

Replace the existing ground switch MOAB on the high side of the Clinchfield 138/69 kV transformer #1 with a circuit switcher. Replace the existing 69 kV 1200 A 12.5 kA circuit breakers “A” and “B” with 3000 A 40 kA breakers. (S1503)

Total Estimated Transmission Cost: $0.4M

Projected In-service: 9/01/2018

Project Status: Scoping



AEP Transmission Zone: Supplemental Heft Switch Installation

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Operational Flexibility and Efficiency

This project will eliminate an existing hard tap and serve the customer with a 69kV phase over phase switch, which is more efficient, convenient, and safer for our field service employees. In addition, the new circuit that the customer will be served off of has 30% less outages per 100 miles for both permanent and momentary outages, as well as having 13% reduced permanent outage duration.

One switch on the through-path of the line (towards Bremen) will be have fully rated attachments (loop-splitting/line–dropping/load-dropping), auto-sectionalizing and SCADA indication/control.

The Forced Outage Index (FOI) calculation supports the installation of MOABs at this location (11.9 score, above the threshold of 6).

Customer Service:

The existing circuit that the customer is on will be undergoing structure replacements that would require the customer to take numerous outages that they are unable to manage. By changing circuits, they can take a more manageable outage that is shorter in duration due to our ability to build the new switch in the clear.

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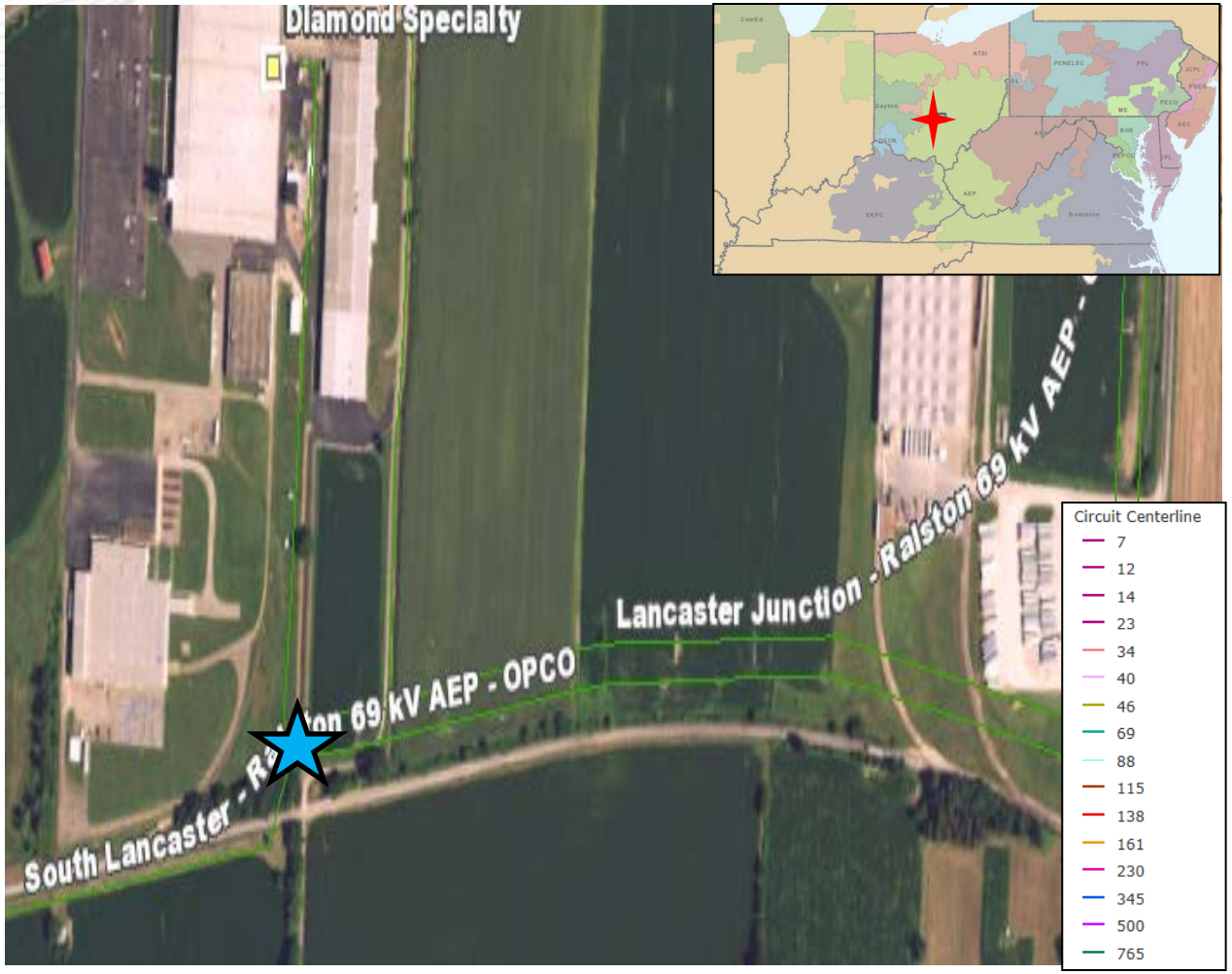


AEP Transmission Zone: Supplemental Heft Switch Installation

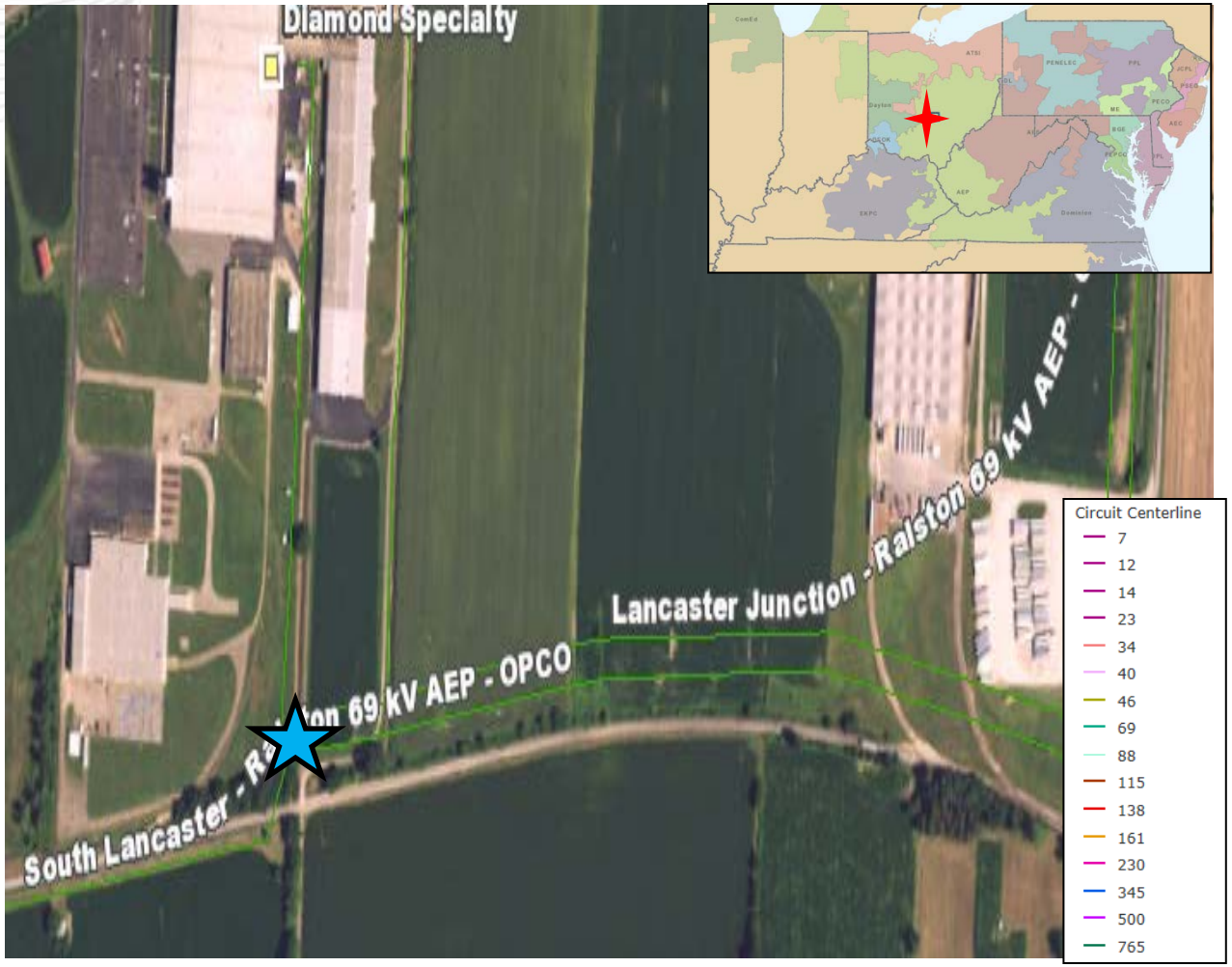
Continued from previous slide…

Selected Solution:
Install new 69kV 2-way switch with MOAB on the E. Lancaster – Ralston – W. Lancaster 69kV circuit. Retire existing structures that are no longer required. (S1504)

Total Estimated Transmission Cost: $1.6M

Projected In-service: 06/01/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental Huff Creek Breaker Replacement

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Breakers “A” & “B” at Huff Creek are FK type breakers and are over 50 years old. These are oil breakers that have become more difficult to maintain due to oil handling requirements. In general, oil spills occur often during routine maintenance and failures with these types of breakers. Other drivers include potential PCB content, damage to bushings, and exceeding the manufacturer’s recommended number of fault operations (10). Huff Creek breakers “A” & “B” have experienced 166 and 219 fault operations, respectively.

Operational Flexibility and Efficiency

The MOAB/ground switch will be replaced. MOAB/ground switch combinations induce a fault on the system, tripping remote breakers for a transformer fault, reducing the life of the transformer and increasing relay coordination complexity for the transformer protection.

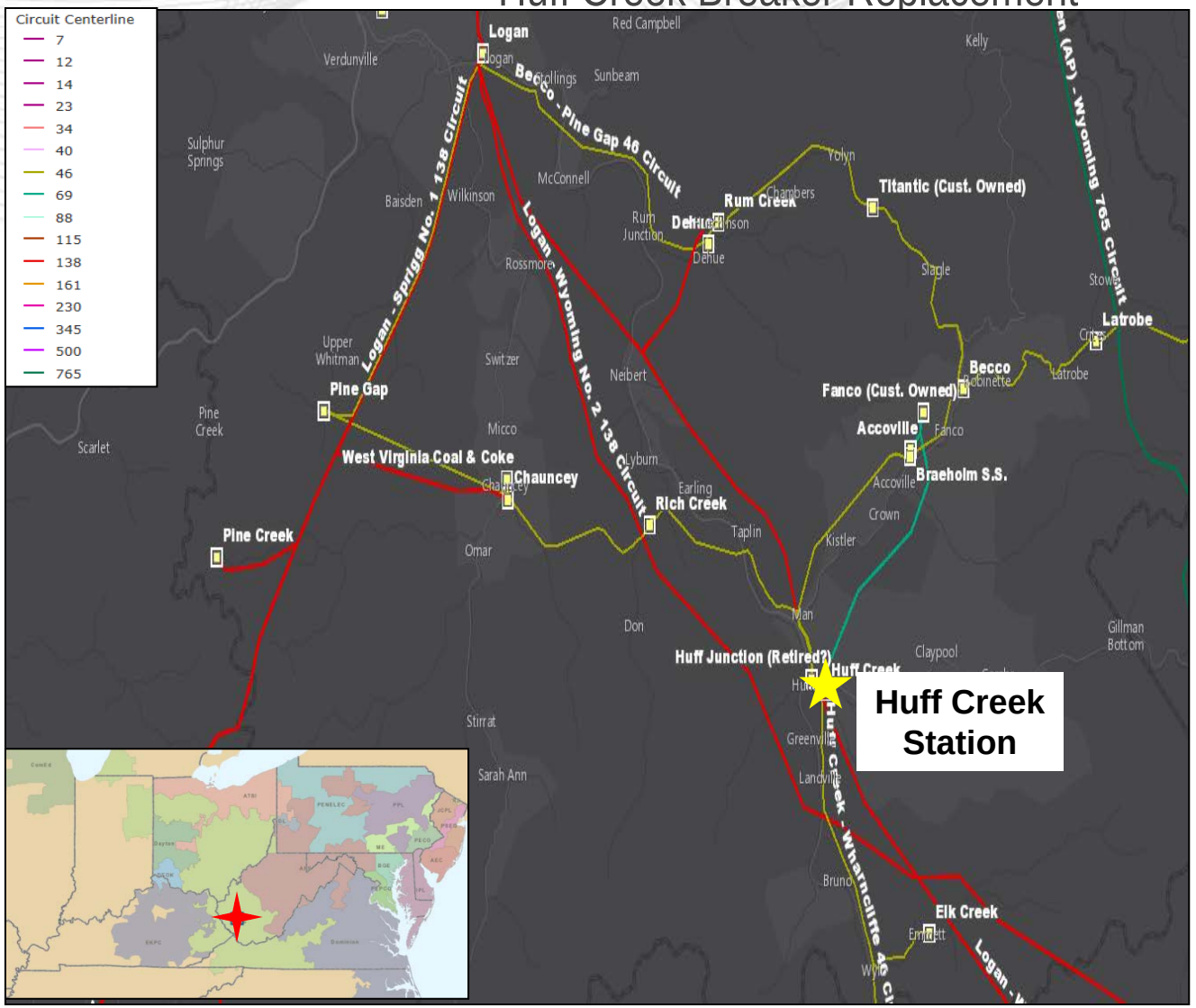
Selected Solution:

Replace existing Huff Creek 46 kV 1200A 21 kA circuit breakers “A” and “B” with 69 kV 3000 A 40 kA breakers. Replace the 138 kV Ground Switch MOAB with a new 3000 A 40 kA circuit switcher. (S1505)

Total Estimated Transmission Cost: $0.8M

Projected In-service: 09/01/2018

Project Status: Scoping



AEP Transmission Zone: Supplemental Kammer 69 kV Station Rebuild

Previously presented on 1/30/2018 SRRTEP

Problem Statement:
This project is an extension of the PJM Baseline project B2605, Kammer-Moundsville 69kV, which resolves thermal overloads and has a need-date of 6/1/2019.

Equipment Material/Condition/Performance/Risk:
The 5 Kammer 69kV breakers are McGraw-Edison oil-filled units manufactured between 1968-1975 and all lack oil containment systems. The breakers have experienced lifetime fault operations in the range of 12 to 94 operations, above the manufacturer's recommendation of 10 fault operations. The breaker foundations and support structures are deteriorating. The 138-69kV transformer lacks an oil containment system; several surge arrestors are missing from the 69kV circuit exits. The 138kV steel take-off structure is in very poor condition due to rust/corrosion.

The 41 relays in the existing control building consist of 39 electromechanical relays, 1 legacy GE microprocessor relay, 1 static relay, and a legacy RTU unit. Electromechanical relays have significant limitations with regard to fault data collection and retention. The GE microprocessor relay model (DLP) is one of the worst-performing types on the AEP system, due to many sister unit failures, and static relays are very labor-intensive to keep operating. There is not sufficient space in the existing control building to replace these relays and RTU; therefore, a drop-in control module will be installed. The carrier equipment on the George Washington 69kV circuit needs replaced due to not being compliant with AEP Protection standards.

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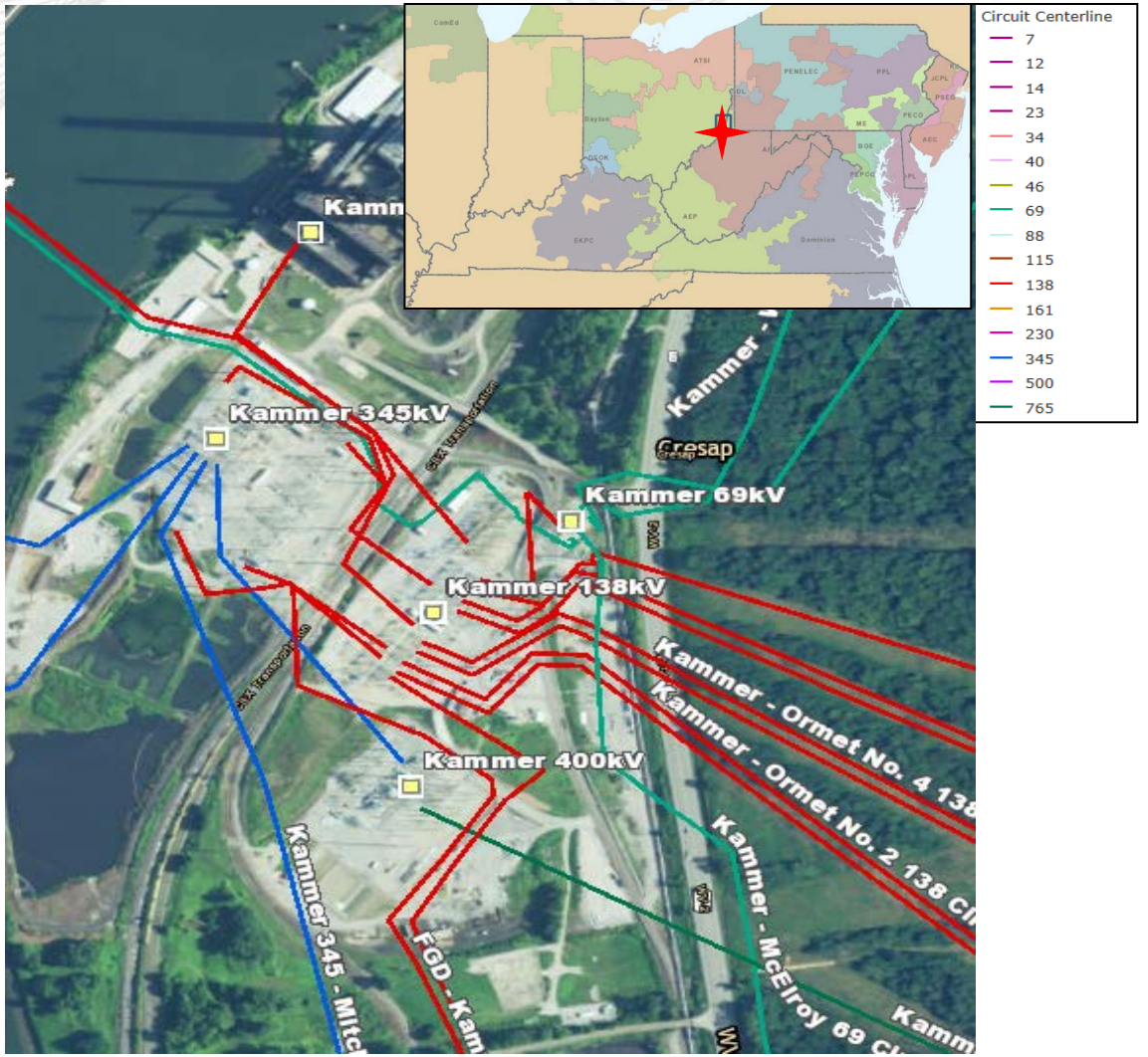

AEP Transmission Zone: Supplemental Kammer 69 kV Station Rebuild

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Operational Flexibility and Efficiency

Currently, a breaker-failure condition of 69kV bus-tie breaker GG would trip 69kV breakers KK, JJ, II, HH, as well as 138kV breakers B & B2, for a total of 6 breakers required to isolated the fault, requiring an overly complex protection scheme. In addition, the bus protection zone for 69kV bus 1 overlaps with the 138-69kV transformer protection zone, creating a large differential zone of protection. Also, the 69kV station lacks full SCADA control and real-time metering capabilities, reducing the effectiveness of Transmission Operations when monitoring the local area. As part of the station rebuild, full SCADA and EMS capabilities will be added to the station.

Due to the criticality of the Kammer 138-69kV transformer to the area, it could not be taken out of service for 3 months and relocated during construction, so a new transformer will be installed as part of the project. There are also no mobile 138-69KV transformers of high enough capacity to meet the local sub-transmission loading requirements. The existing Kammer transformer will be returned to stock as a spare for other projects.

Customer Service:

The Kammer 69kV station provides critical start-up power to the nearby Mitchell power plant, so the entire 69kV station cannot be taken out of service for a lengthy duration. In addition, taking the Kammer 69kV station out of service would make the following customer stations radially served during construction (6-9 months): AEP Distribution stations- 2, Industrial stations- 4. Plus, the Kammer-Powhattan 69kV loop (circuits #1 & #2) is only sourced from Kammer 69kV, with no alternate feed on the system, so it is impossible to take Kammer 69kV entirely out, due to the customers served on this local loop (1 AEP Distribution & 1 Industrial load).

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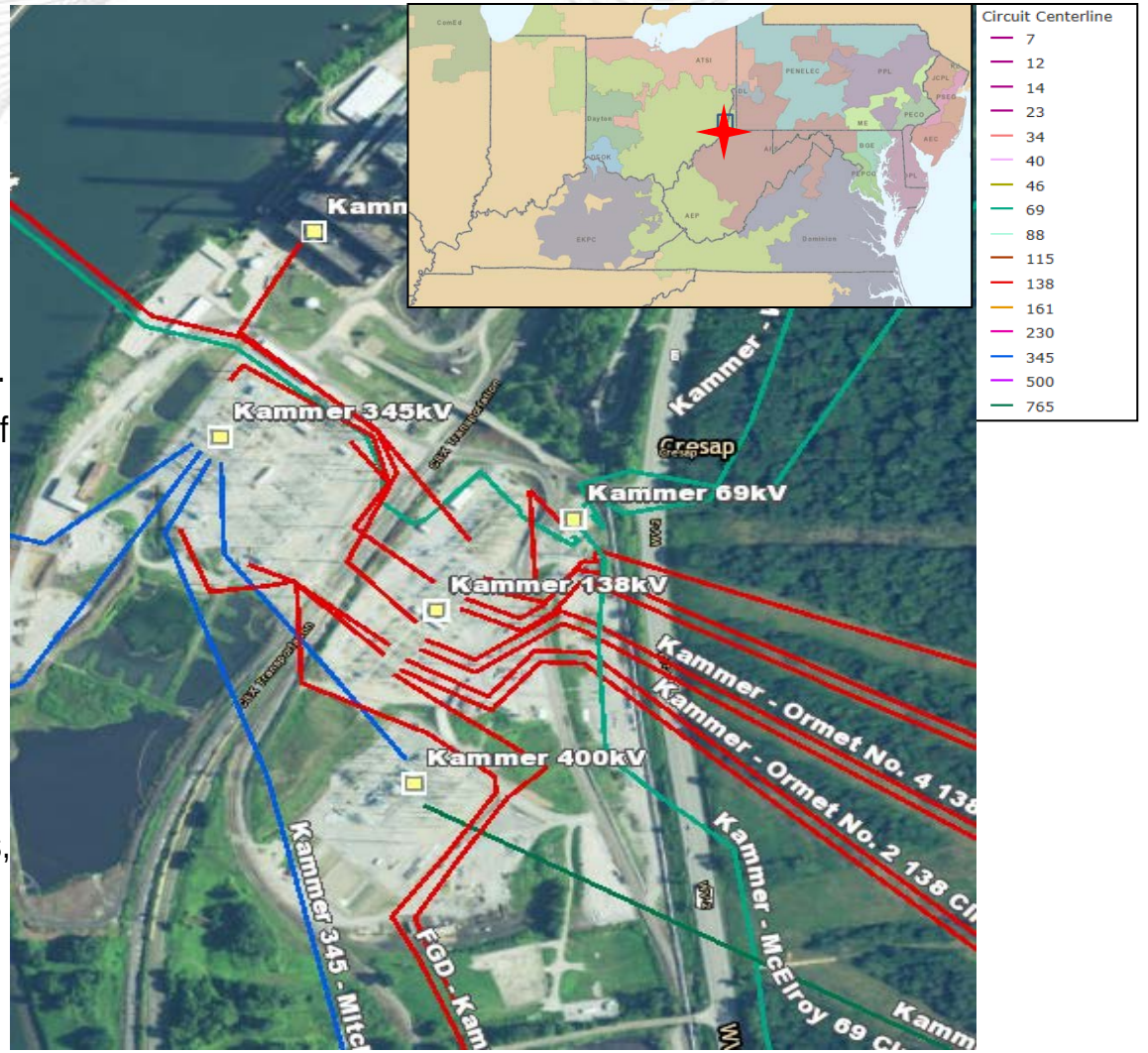

AEP Transmission Zone: Supplemental Kammer 69 kV Station Rebuild

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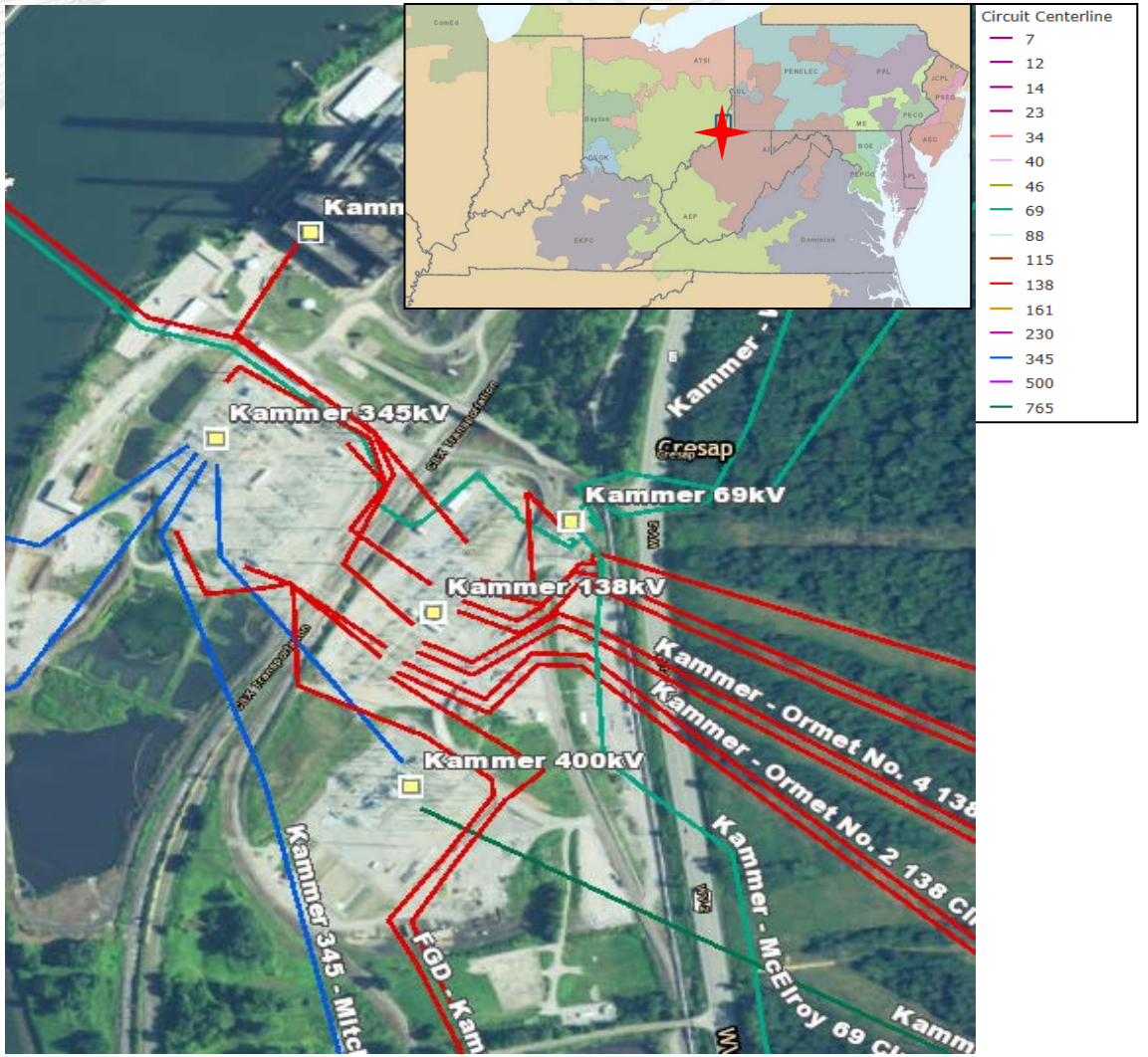
Selected Solution:
Kammer Station: Construct a new 69kV breaker-and-a-half station with 8 breakers (3000 A, 40kA); 4- 69kV circuit exits and 1- 138-69kV transformer position; install a 28.8 MVAR, 69kV cap bank; install a new 138-69kV transformer (130 MVA) to facilitate construction in-the-clear. (S1506.1)
Estimated Cost: $7.7M

Remove existing 69kV station entirely (5 breakers, bus-work, etc.). (S1506.2)
Estimated Cost: $0.2M

Total Estimated Transmission Cost: $7.9M

Projected In-service: 06/01/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental South Bend Breaker Replacements

Previously presented on 1/30/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

At South Bend station, 34.5 kV Circuit Breakers K, J, M, P and R and 69kV Circuit Breaker A are GE 'FK' oil-filled breaker manufactured in 1968 and 1953. The 34.5 kV breakers are 2000A 42 kA models. The 69 kV breaker is an 1800 A 27 kA model. These Circuit Breakers are oil filled Breakers without oil containment. Breaker A (114), J (75), P (19), and R (109) are above the manufacturer recommend threshold for full fault operations. Oil filled breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance and can become an environmental hazard. The breakers have numerous issues related to age, high moisture readings, fault operation exceeding manufacturer life expectancy and bushing maintenance issues. The 34.5kV Circuit Breaker N is a SF6 breaker which is not build to 69kV standards and the 34.5kV South Bend Station has future plans of being converted to 69kV, so circuit breaker N was replaced with a 69kV breaker.

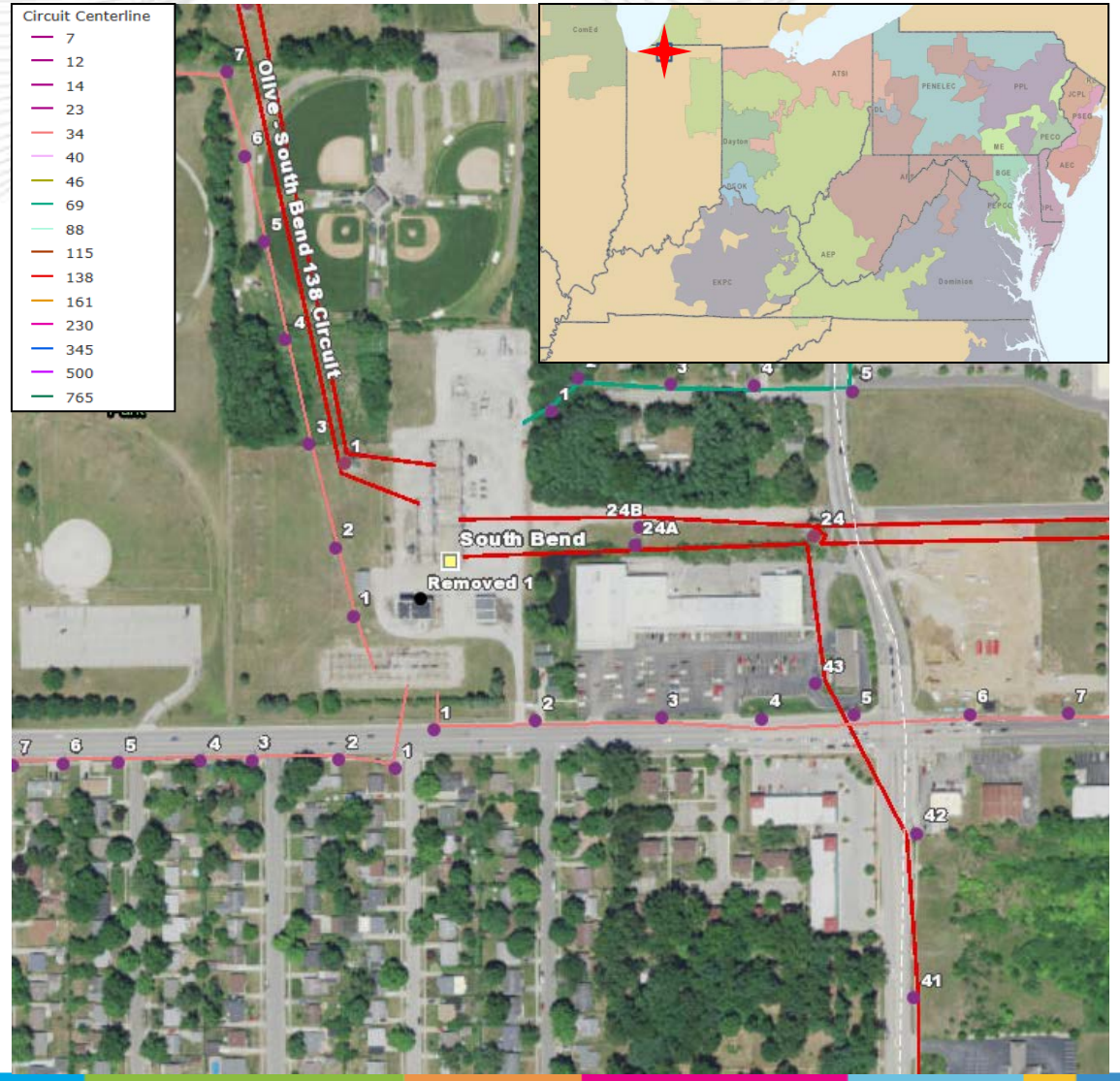
Selected Solution:

Replace South Bend 69kV circuit breaker A and 34.5kV circuit breakers K, J, M, N, P and R with 3000A 40kA breakers. (S1507)

Estimated Transmission Cost: $4.6M

Projected In-service: 3/31/2018

Project Status: Under Construction



AEP Transmission Zone: Supplemental
Stubey Road – Sturgis Rebuild

Previously presented on 1/8/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 3 mile long Stubey Road – Sturgis line portion currently is subject to 18 open conditions and is wood pole construction from 1953 with 4/0 ACSR and 556 ACSR conductor (50 MVA rating). This line is currently subject to stolen, broken and missing ground lead wire; corroded shield wire; and burnt or broken insulators.

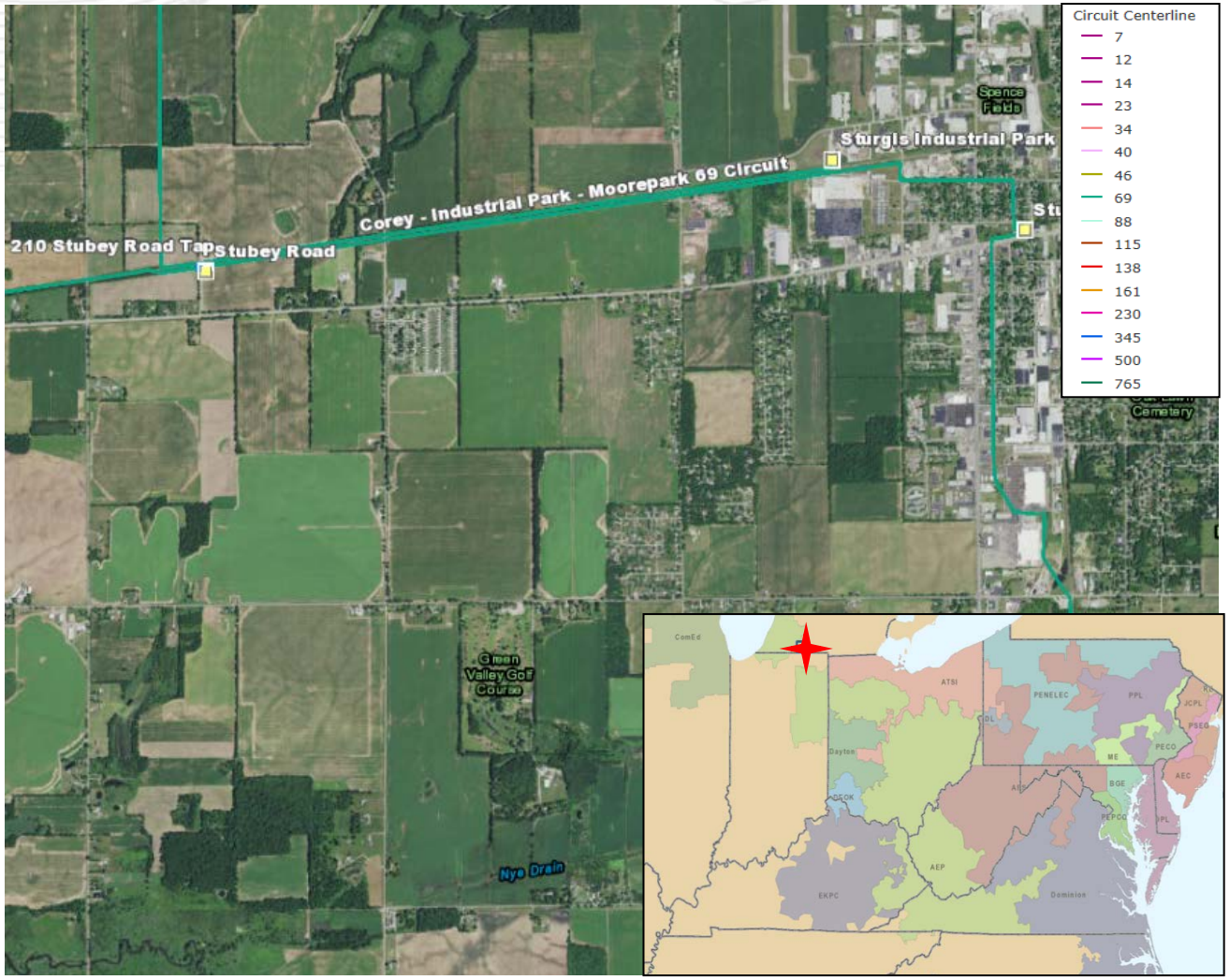
Selected Solution:

Rebuild the ~3 miles of the Stubey Road – Sturgis 69kV circuit utilizing 795 ACSR (76 MVA rating) (S1522)

Estimated Transmission Cost: $5.3 M

Projected In-service: 03/30/2018

Project Status: Construction



Next Steps

Upcoming Western SRRTEP Dates

West	Start	End
3/27/2018	12:00	4:00
5/30/2018	12:00	4:00
7/27/2018	12:00	4:00
9/28/2018	12:00	4:00
11/29/2018	12:00	4:00

Questions?

or

RTEP@pjm.com

Revision History

2/7/2018– V1 – Original version posted to pjm.com

2/9/2018– V2 – Add Slides #46-48, Mink station project

2/13/2018– V3 –Slide #11, Remove “Baseline” from the title

2/16/2018– V4 – Remove original Slides #24 and #25

– Cost updates in Slide #10, Change “MOAB” to “CB”

– Add Slide #108

3/2/2018– V5 –Slide #8, Change “17714” to “17712”

3/12/2018– V6 –Slide #81, #86, and #107, Change Projected IS Date