Sub Regional RTEP Committee
PJM West

April 17, 2018

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http://www.pjm.com/-/media/committees-groups/committees/srrtep-w/20180327/20180327-reliability-analysis-update.ashx

First Review

Baseline Reliability and Supplemental Projects

AEP Transmission Zone: Supplemental Adams-Rarden

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Adams-Rarden line was constructed in 1962 using 4/0 ACSR (50 MVA). There are 193 category A Conditions (116 structures); a portion of those are on a radial tap (16 structures), serving Davon substation. Over the previous 3 years there were 547,876 customer minutes of interruption.

Operational Flexibility and Efficiency

The line cannot be taken out of service while it is being rebuilt. The FOI justifies the addition of MOABs.

Potential Solution

Rebuild the 69kV Adams-Rarden line. The new line will be rebuilt adjacent to the existing one leaving the old line in service until the work is completed in the existing ROW as feasible. Supplemental ROW easements will be obtained where necessary. The new 69kV line will be built with 795 ACSR (125 MVA).

Estimated Cost: $18.7M

The switch at the Peebles Tap will be replaced with a 3- way SCADA-controlled MOAB switch. A new 3-way SCADA-controlled MOAB switch will be installed at the Davon Tap.

Estimated Cost: $1.6M

Total Estimated Transmission Cost: $20.3M

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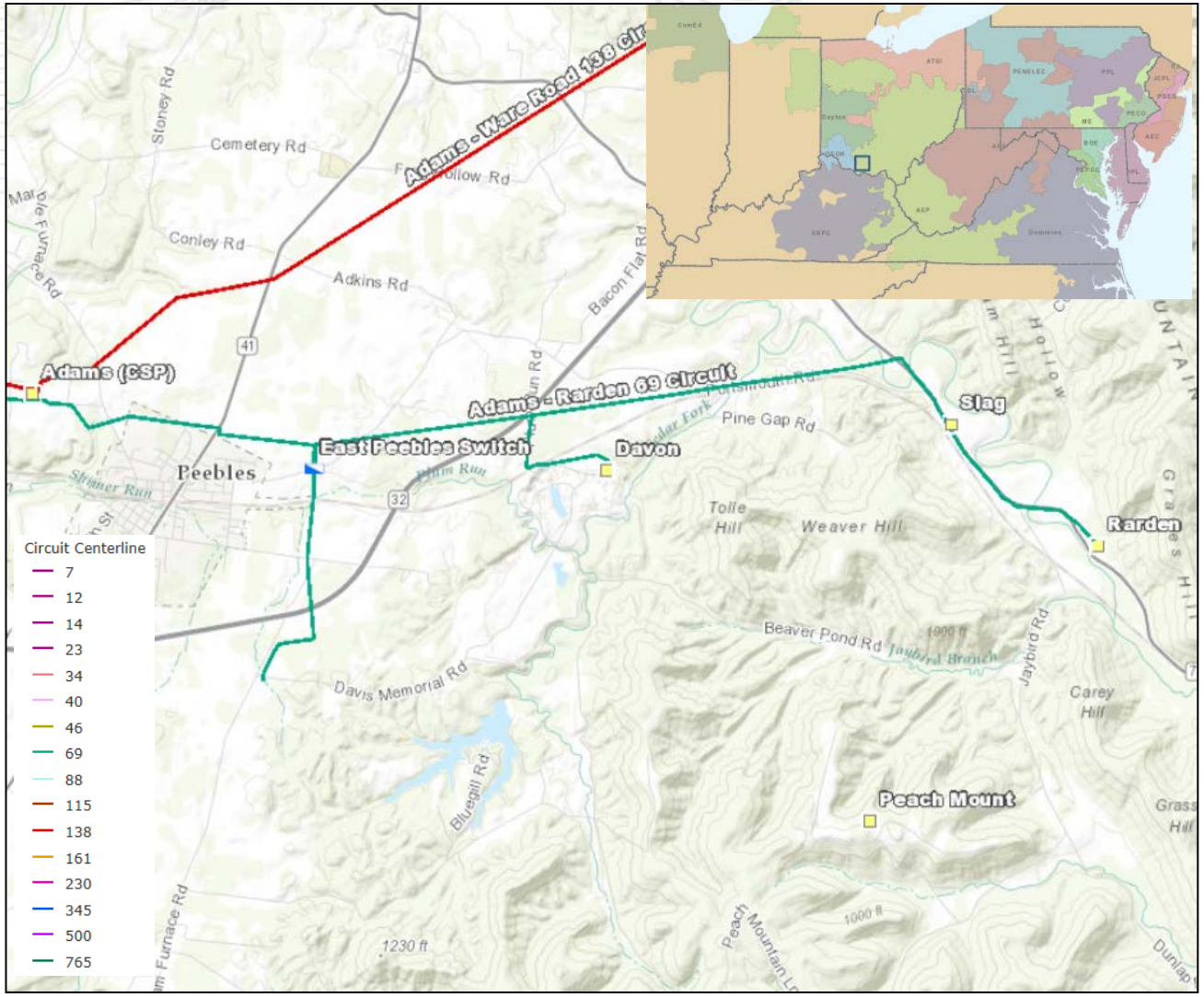

AEP Transmission Zone: Supplemental Adams-Rarden

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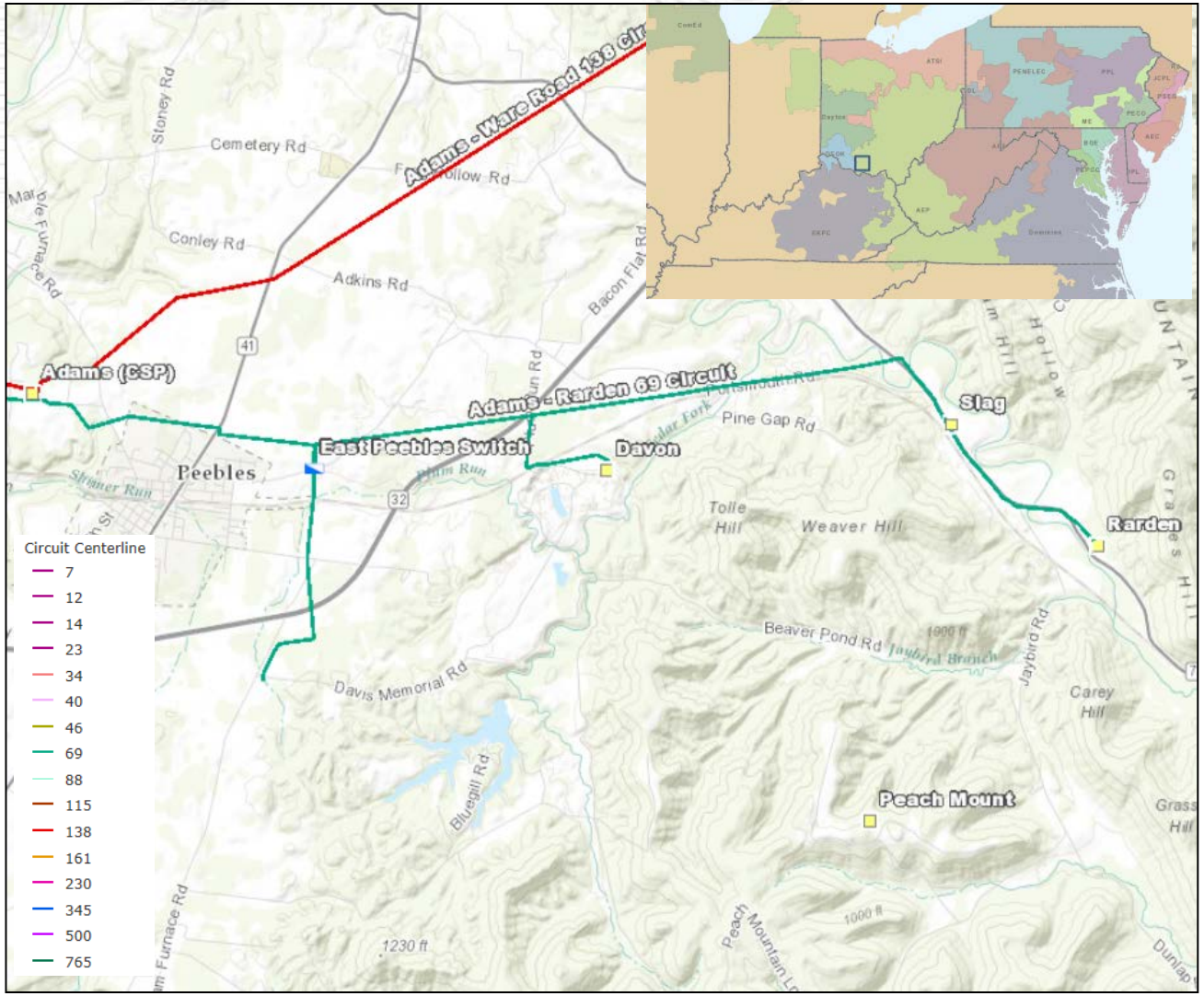
Alternatives:

Build a second source into Peebles from Friendship Station (Portsmouth area) 18 miles away. This option was not chosen because the line route crosses the Wayne National Forest and would require extensive time and expense for environmental permitting and acquiring right of way. It also still leaves roughly half the line and customers radial. Estimated Cost: $50-60M.

Rebuild the Adams-Rarden line while the circuit is energized (hot work). This option was not chosen due to safety hazards. Estimated Cost: $16M.

Projected In-service: 6/1/2020

Project Status: Engineering



AEP Transmission Zone: Supplemental
Auburn – Kendallville 69 kV Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Auburn-Kendallville 69 kV line asset was constructed in 1954 using wood pole structures and 4/0 ACSR and 4/0 Cu overhead conductor types (50 MVA rating). Approximately 38% of the Auburn-Kendallville structures have open condition issues contributing to a 3 year CMI of 104,041 minutes of interruption affecting approximately 600 customers. Circuit breakers "A" (1952), "B" (1958) and "M" (1971) at Kendallville Station and the remote end breaker "A" (1952) at Albion Station are FK-type 1200A oil breakers that were identified for replacement. In general, these "FK" type oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. Oil spills are frequent with failures and routine maintenance which is also an environmental hazard.

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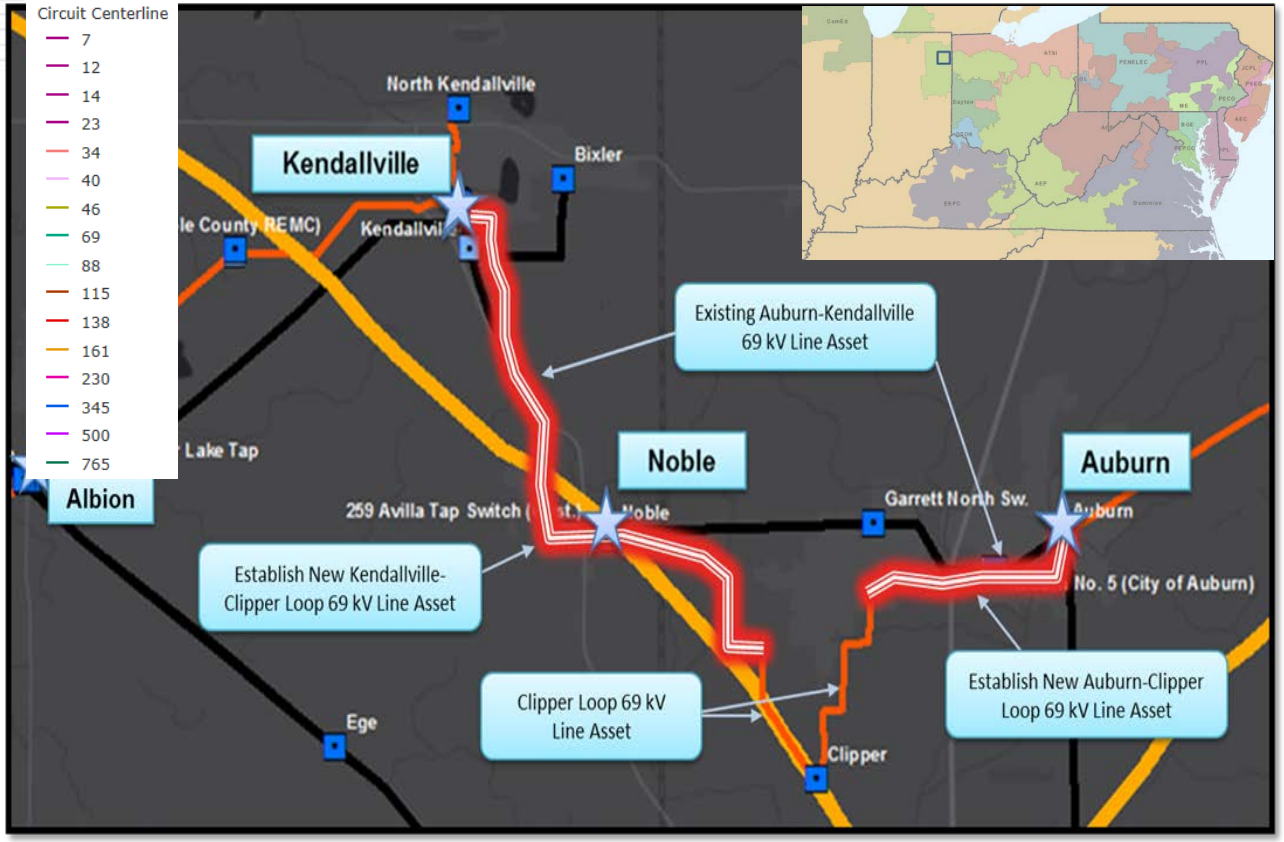

AEP Transmission Zone: Supplemental
Auburn – Kendallville 69 kV Rebuild

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Potential Solution

Rebuild the existing Auburn-Kendallville 69 kV line asset using 556 ACSR 26/7 "Dove" overhead conductor (~15 miles, 102 MVA rating) Estimated Cost: $14.9M

At Kendallville Station, replace 69 kV circuit breakers A, B and M and associated equipment with 69 kV, 40 kA, 3000 A circuit breakers. Estimated Cost: $1.7M

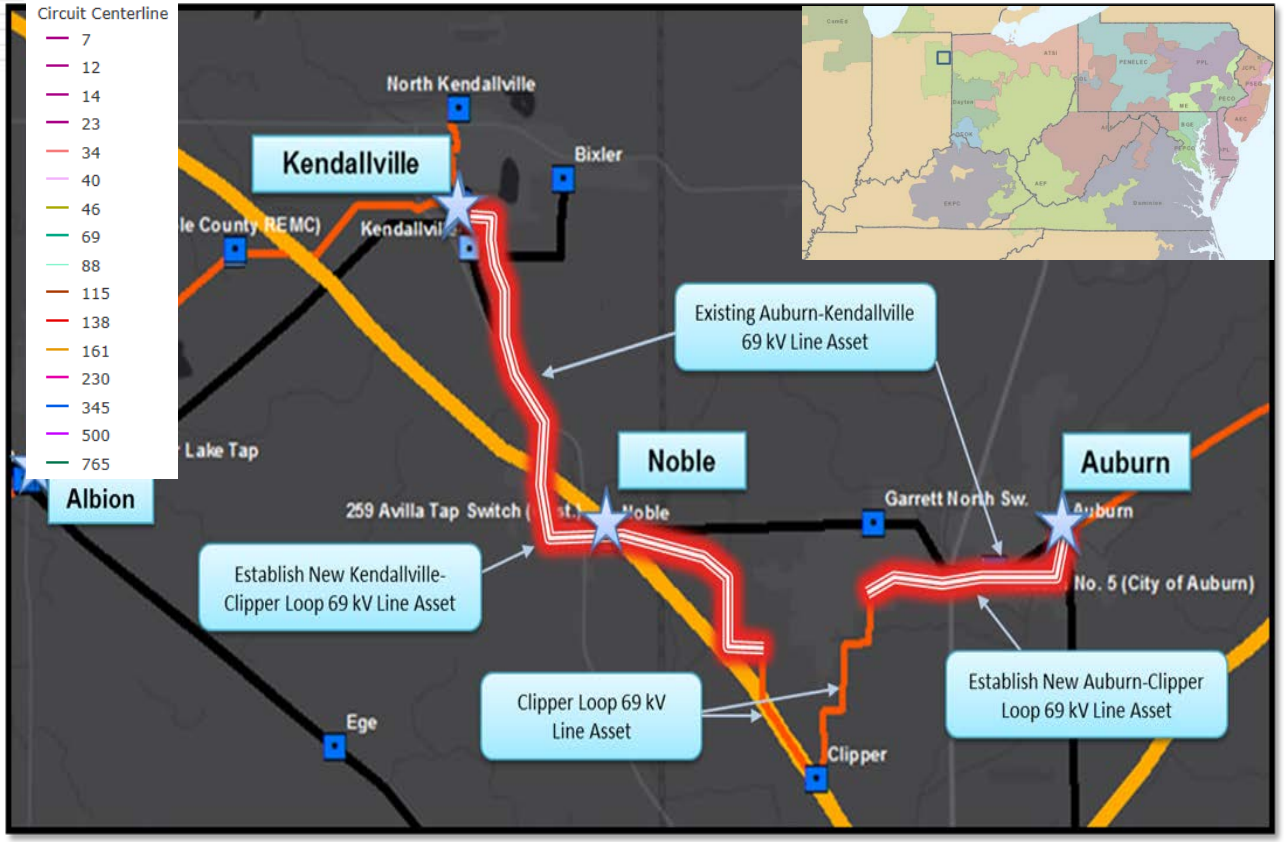
At Albion Station, replace 69 kV circuit breaker A and associated equipment with 69 kV, 40 kA, 3000 A circuit breaker. Estimated Cost: $0.3M

Total Estimated Transmission Cost: $16.9M

Alternatives:
No viable cost-effective transmission alternative was identified.

Projected In-service: 06/30/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
Buckley Road Area Improvements

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Breakers 'A' and 'C' at Buckley Road station are vintage 1975, 1800 A, 27 kA oil medium models with fault counts of 7 and 82 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 potential PCB content.

Breaker 'D' will be added at Buckley Road to improve high side transformer protection by eliminating the existing ground switch and MOAB scheme. This will improve reliability by more effectively isolating faults on either side of the breaker so that the 69kV lines are not affected by a 138kV line fault and vice versa or faults in the transformer.

The Allendale – Fremont Center 69kV line is predominately 1917 era construction and is made up of the Amsden – Fremont Center 69kV and Buckley Road – East End Fostoria 69kV Circuits. The significant age of the structures, conductor, and shield wire has prompted the need for a line rebuild. There are 11 category A conditions and 29 category B conditions along on this line.

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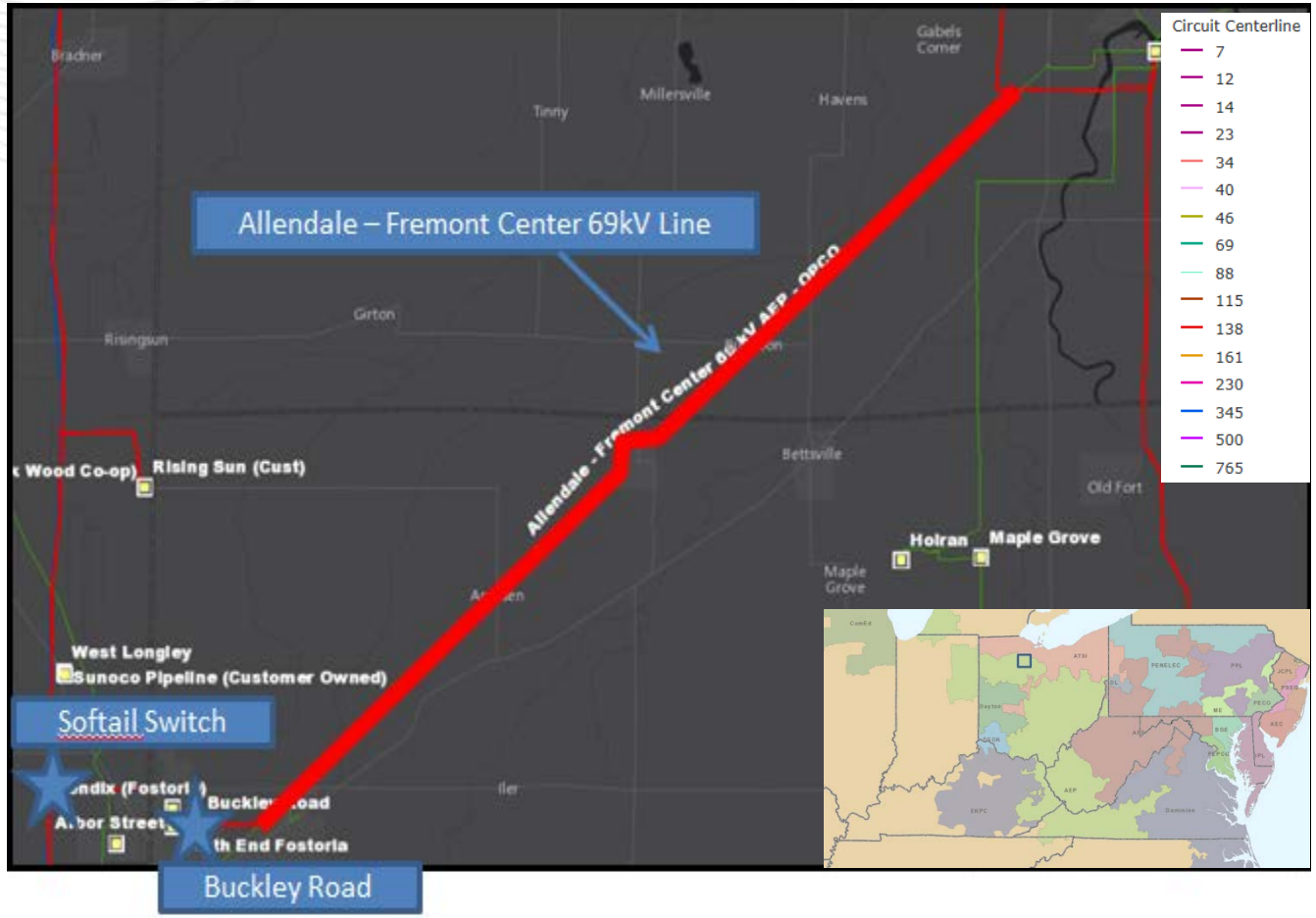

AEP Transmission Zone: Supplemental
Buckley Road Area Improvements

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Operational Flexibility and Efficiency

Rebuilding the Allendale – Fremont Center 69kV line to 138kV standards will provide operational flexibility and efficiency benefits when a conversion to 138kV operation is conducted in the future. The conversion to 138kV will create a direct path between Buckley Road and Fremont Center stations; the 69kV path is currently kept normally open at Amsden Switch due to the low-rated conductor section that exists on the Allendale – Fremont Center 69kV line. Future conversion will also allow Buckley Road to have 138kV looped service; currently the station is radially fed from Fostoria Central station.

Customer Service:

Softail Switch is being installed as requested by Buckeye Power on behalf of NCEC, to improve reliability and operational flexibility for their Rising Sun delivery point. The new three-way GOAB switch replaces the existing hard tap allowing Rising Sun to be switched back into service during an outage at Buckley Road station. The Buckley Road – Fostoria Central 138kV circuit information has been provided in the appendix for reference.

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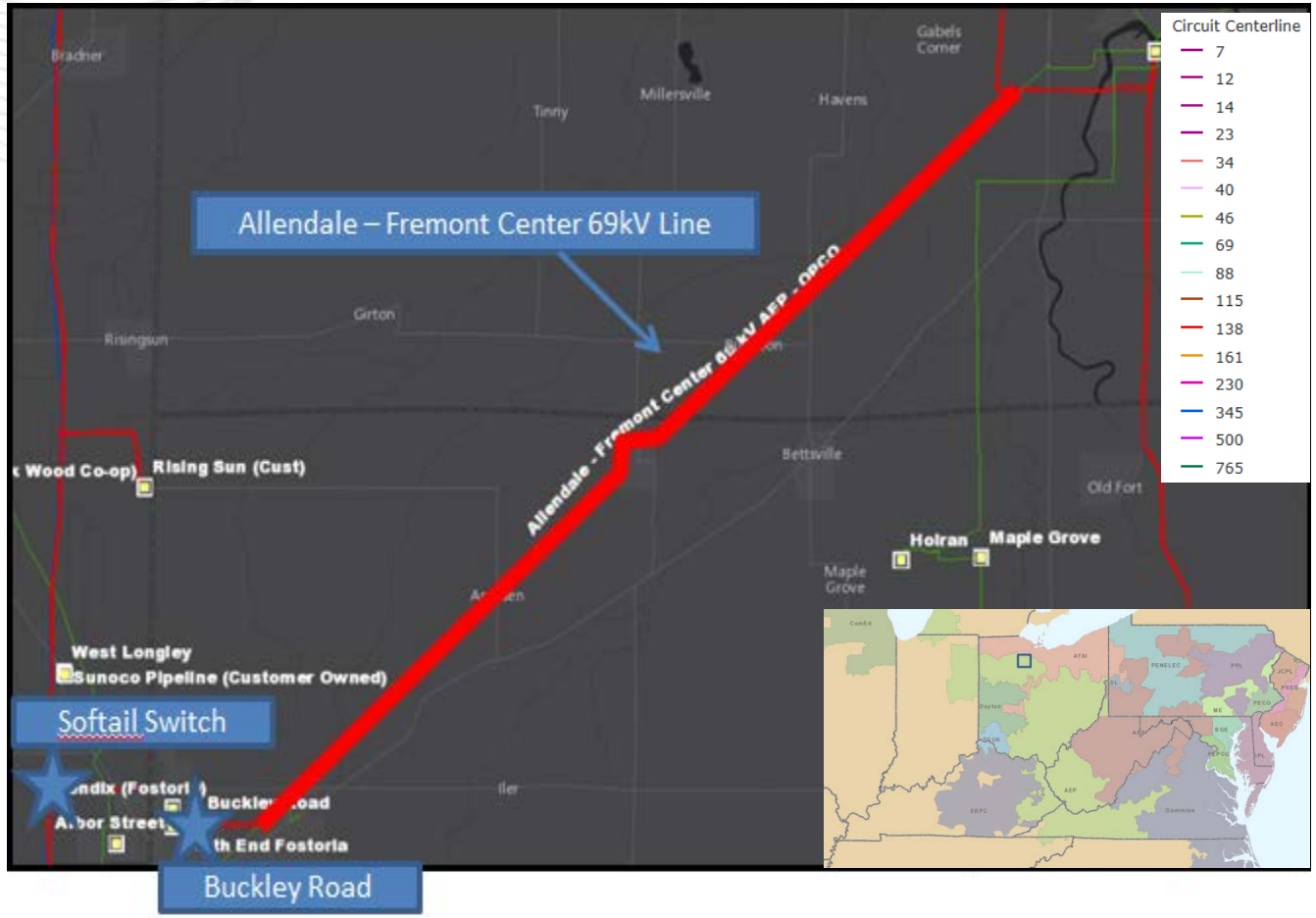

AEP Transmission Zone: Supplemental
Buckley Road Area Improvements

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Potential Solution

At Buckley Road Station, replace 69kV breaker 'A' and 'C' with 3000A 40kA breakers and associated equipment. Add 3000A 40kA 138kV circuit breaker 'D' for high side protection of transformer #1. This will replace the existing ground switching protection currently at the station. Estimated Cost: $2.6M

At Softail Switch, replace the hard tap for the Rising Sun delivery point, on the Buckley Road – Fostoria Central 138kV Line, with a 2000A three-way phase-over-phase switch. Estimated Cost: $1.06M

Rebuild approximately 15.2 miles of the Allendale – Fremont Center 69kV Line with 138kV line construction operated at 69kV. The new line will be double circuit 138kV construction for 0.6 miles at the Allendale end so that the customer served at Weaver Switch can remain served at 69kV even after a future 138kV conversion of the rebuilt line. The remaining 14.6 miles of line rebuild will be single circuit 138kV construction. Estimated Cost: $22.2M

Total Estimated Transmission Cost: $25.9M

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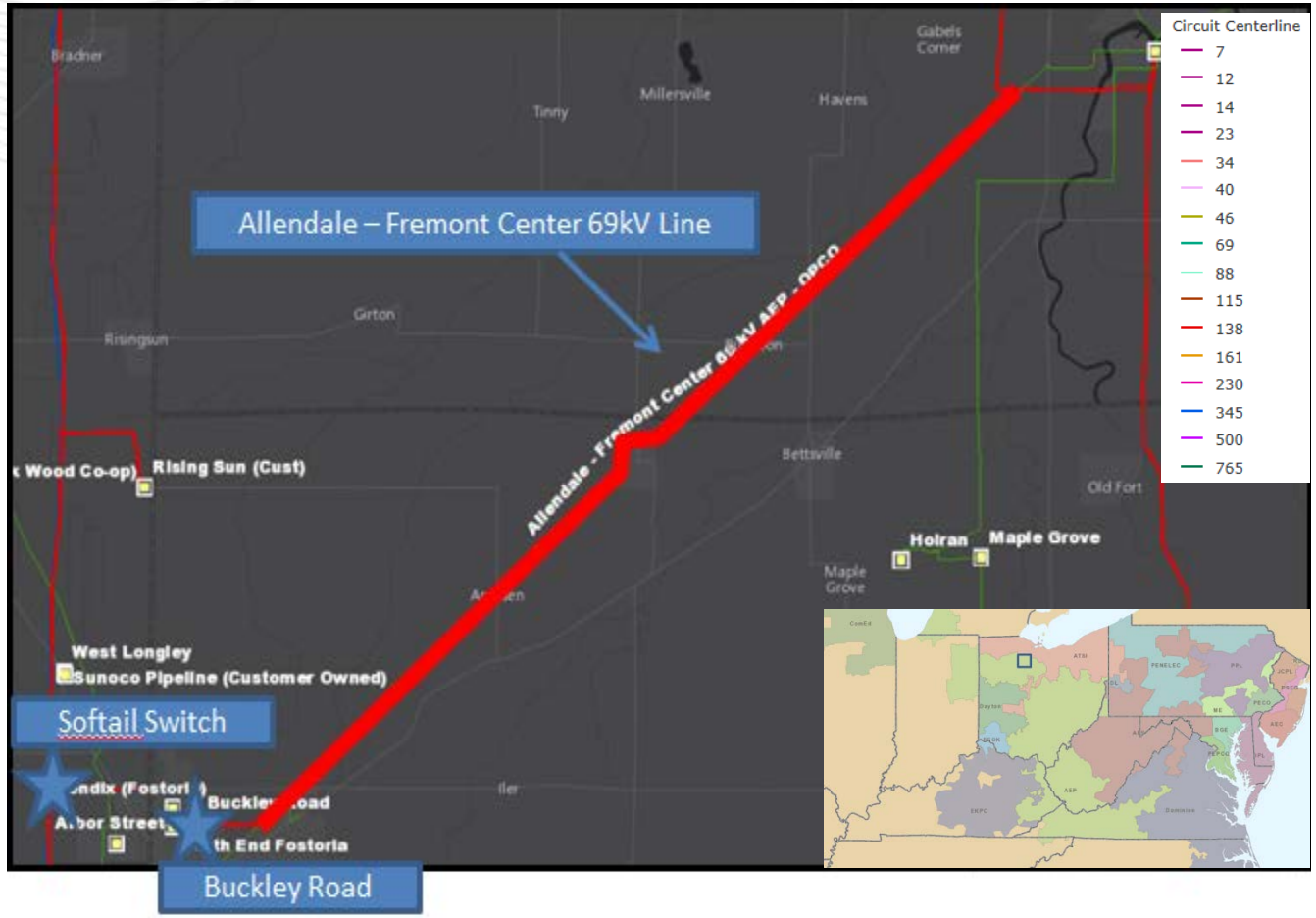

AEP Transmission Zone: Supplemental
Buckley Road Area Improvements

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Alternatives:

Upgrade Softail Switch to MOABs

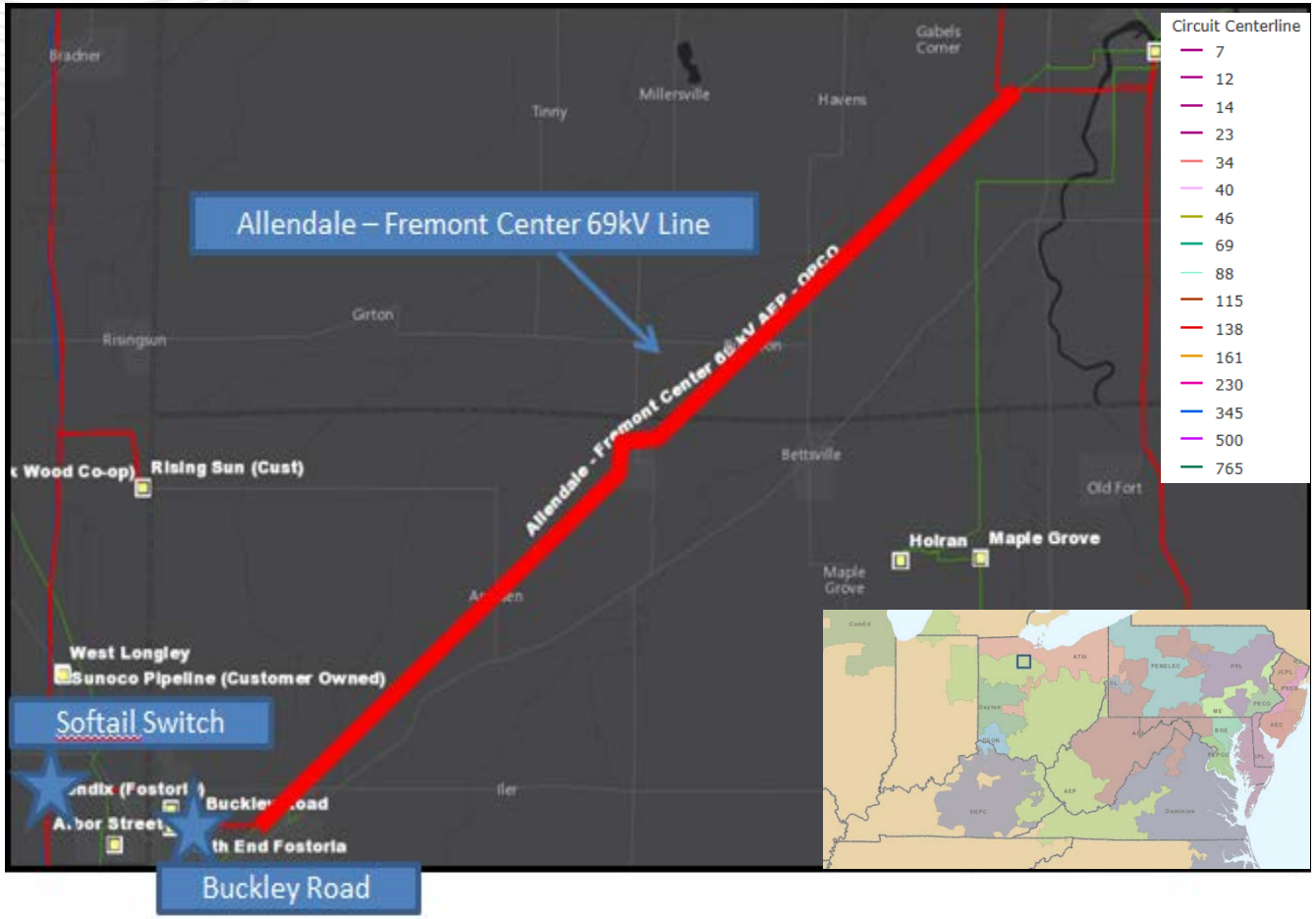
The installation of MOABs was reviewed at Softail Switch, but was determined that the additional cost would not provide significant additional benefit. FOI calculation did not support the need for installation of MOAB switches. Upgrading the switches to MOABs would cost an additional $260k beyond the selected design.

Rebuild Allendale – Fremont Center to 69kV Standard

Not rebuilding the Allendale – Fremont Center Line to 138kV standard and instead building to 69kV standard is possible, but would limit the operational and reliability benefits gained by allowing for a future conversion to 138kV. The 138kV future conversion will allow Buckley Road 138kV looped service and allow the mutual support between the Fostoria and Fremont areas that does not exist on the 69kV path today, due to necessity of keeping a normally open switch at the Amsden Switch location.

Projected In-service: 12/31/2020

Project Status: Engineering



AEP Transmission Zone: Supplemental Charger Station

Problem Statement:

Operational Flexibility and Efficiency

The current 138 kV transmission line configuration entering Ligonier Station consists of two “hard taps” which are non-standard and contribute to customer interruptions. The existing line-tie looprupter is unable to split the loop flow when needing to split the circuit tie after it has been closed for planned work or customer load recovery reasons. To safely open the looprupter switch the customers must be interrupted by drop-and-pick switching. Reconstructing the station to a standard configuration will modernize the station, reduce customer interruptions, enhance operational flexibility, and eliminate a legacy transmission system configuration deficiency.

Customer Service:

The associated line rebuild of the Robison Park-Twin Branch 138 kV line (s1336), which serves the existing Ligonier station, will require a re-route to eliminate several encroachments caused by construction of business underneath the line. By adjusting the ROW route slightly, this avoided the need to purchase several local businesses directly underneath the line, which was appreciated by the local community and Mayor. The re-route of this line to the south of the existing station site provided an opportunity to establish a new station with sufficient property size to accommodate the layout of the 3 breaker ring bus, improving the reliability and performance of the customers served from this station.

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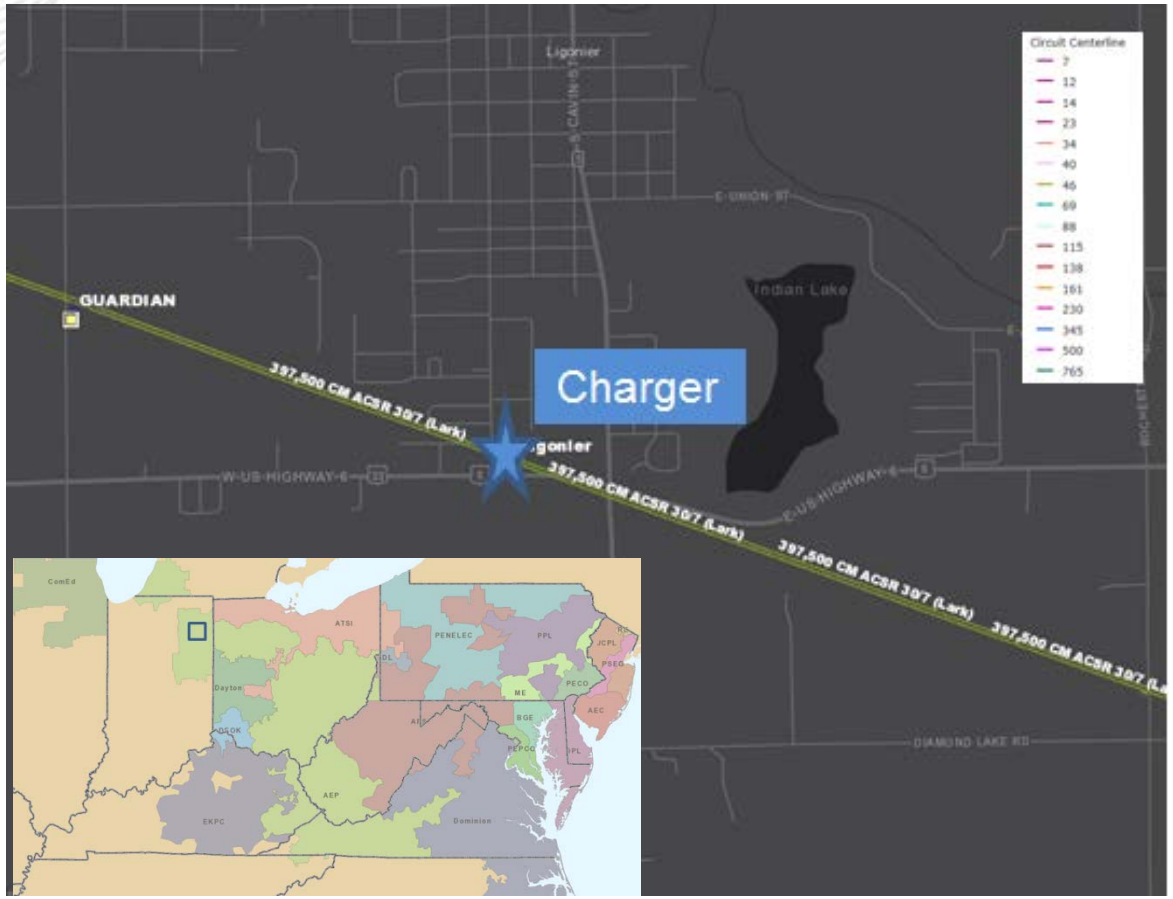

AEP Transmission Zone: Supplemental Charger Station

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Potential Solution

Construct a new 138 kV tie line from the new Charger 138 kV Switching Station to the existing Ligonier Station using 795 ACSR conductor. **Estimated Cost:** $0.6M

Construct new 3-breaker ring bus 138 kV switching station across the road from the existing I&M 138/12 kV Ligonier Station, allowing a 138 kV transmission line reroute through an area with multiple underlying commercial building encroachments. Equipment consists of 138 kV, 40 kA, 3000 A circuit breakers and 3000 A disconnect switches. **Estimated Cost:** $6.5M

Expand existing Ligonier Station. **Estimated Cost:** $0.1M

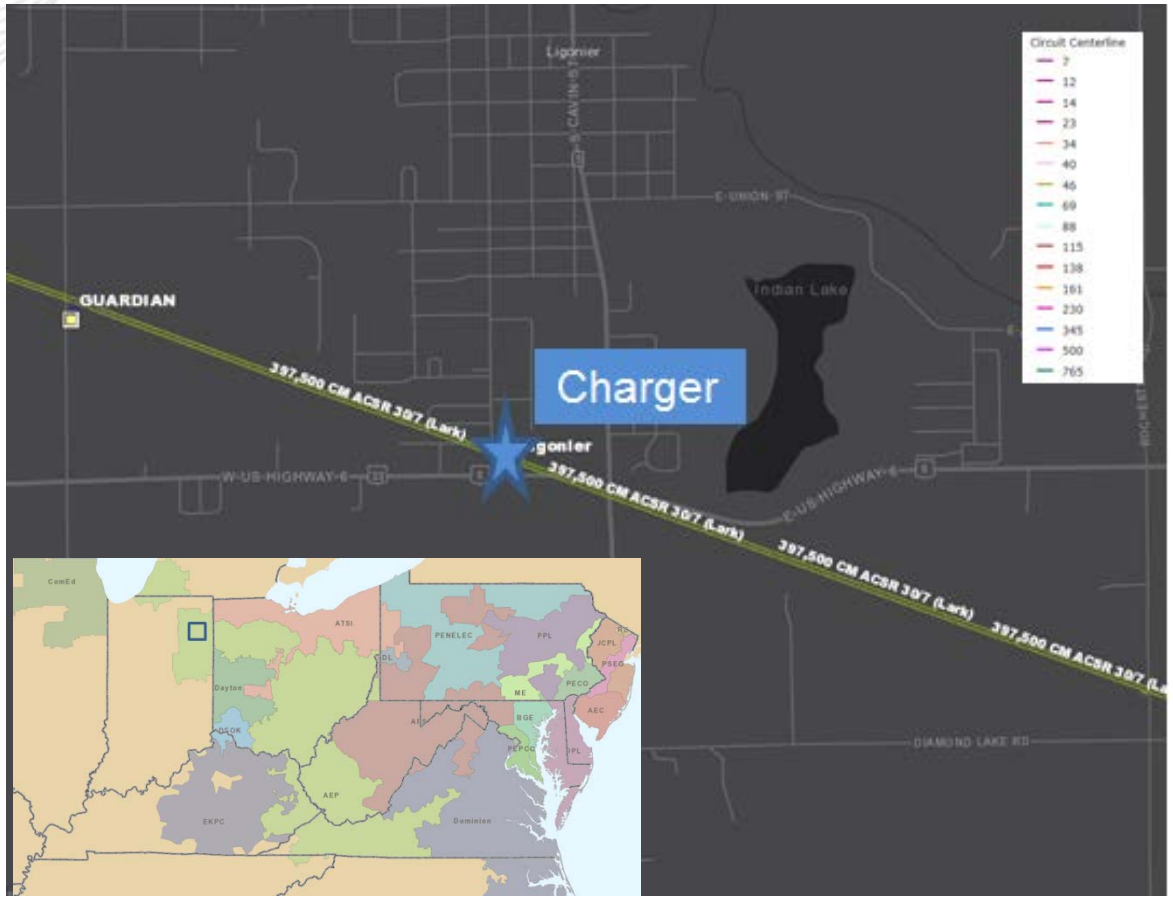
Total Estimated Transmission Cost: $7.2M

Alternatives:

Install a “lonesome” breaker layout at Charger station including two line MOABs, a bus tie breaker and two high-side circuit switchers on each distribution transformer. While this arrangement was considered, the benefit of establishing a 3 breaker ring bus proved more beneficial from a performance/reliability standpoint as well as providing a future opportunity to incorporate the other 138 kV circuit located on the double circuit line the station will be served from. Estimated cost: $4.0M

Projected In-service: 12/31/2018

Project Status: Scoping



AEP Transmission Zone: Supplemental Columbus Grove-Ottawa 69kV Line Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Ottawa-Columbus Grove 69kV line is mostly wood pole construction with the oldest structures dated at 66 years old (vintage 1951) and the vast majority of the line at or above 50 years old with 3/0 ACSR 6/1 Pigeon conductor (44 MVA) . Also, the East Lima-East Ottawa 69kV circuit has CMI of more than 251,509. There are a variety of conditions including rotting poles, splitting and rotting cross arms, burnt insulators, and insect damage. Newer steel poles on this line were replacements required due to a derecho in recent years where the older wood poles were broken. The newer steel poles are not targeted for replacement except as is necessary to complete the targeted work. North Columbus Grove Switch has experienced alignment problems on a wood pole and needs to be replaced.

East Ottawa station currently utilizes 3 transmission oil CB's, requiring rehab driven replacement based on age and condition. The 69 kV CB's L, N, and K have experienced 16, 55, and 42 fault interruptions respectively and were manufactured in 1966. Additionally, the 69kV cap switcher is a Mark V model and has had a number of operations that has led to issues with the interrupters. Mark V cap switchers have a track record of mechanical problems and have been recommended for replacement due to these issues in addition to the fact that they don't integrate well into modern relaying packages. Spare parts for Mark V cap switchers are also becoming more difficult to find.

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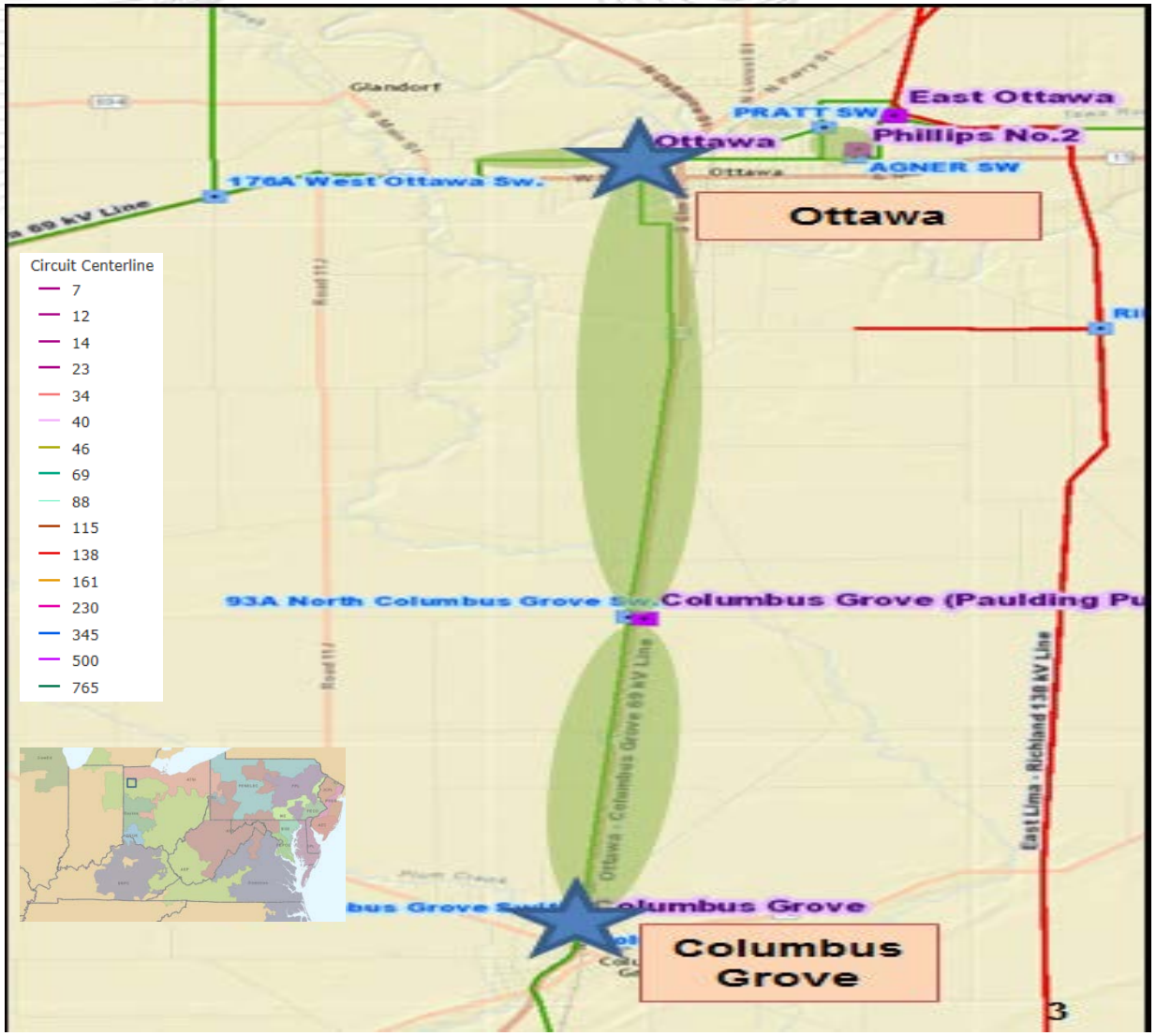

AEP Transmission Zone: Supplemental Columbus Grove-Ottawa 69kV Line Rebuild

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Operational Flexibility and Efficiency

69/12kV Ottawa station is currently radially served from two short radial hard taps into station MOABs, one of which is operated N.O. The line between Kalida and the new Glandorf site includes 13 miles of exposure (including a 5.3 mile radial to Miller City) through a wind prone area of primarily farm land. The line between East Ottawa and the new Glandorf site includes 2.3 miles of exposure that crosses the flood prone Blanchard river and includes a few short stretches of forested area and several residential properties with nearby trees. Adding CB's on each side of Glandorf station will provide automated protection from potential failures on the Kalida-East Ottawa and will provide remote operational flexibility to recover from complications in the area such as flooding conditions.

With the reconfiguration of Agner switch, a N.O. switch and a line in the bus zone of protection will be eliminated. This switch and connected load will be relocated to the East Lima-East Ottawa 69kV circuit. The location of this load makes further sectionalizing of the line desirable. Given the need to replace the switches at North Columbus Grove Switch and the relative exposure involved, North Columbus Grove Switch was selected as the best location for motorizing a switch.

East Ottawa Station has experienced 2,965,627 of CMI. Extended outages were experienced during the 2012 derecho when several structures had to be replaced to restore service to all customers. East Ottawa Station is surrounded on three sides by the Blanchard River which has severely flooded the station at least twice in the past, rendering the station unusable until flood waters receded.

Customer Service:

A new station at a different location is needed to avoid the flooding problem in the future. AEP-Ohio has elected to retire Ottawa station and replace it with Glandorf station, largely to address this flooding issue. The majority of equipment in the station is in need of replacement, and the Distribution company has requested to move the station due to flooding at the site.

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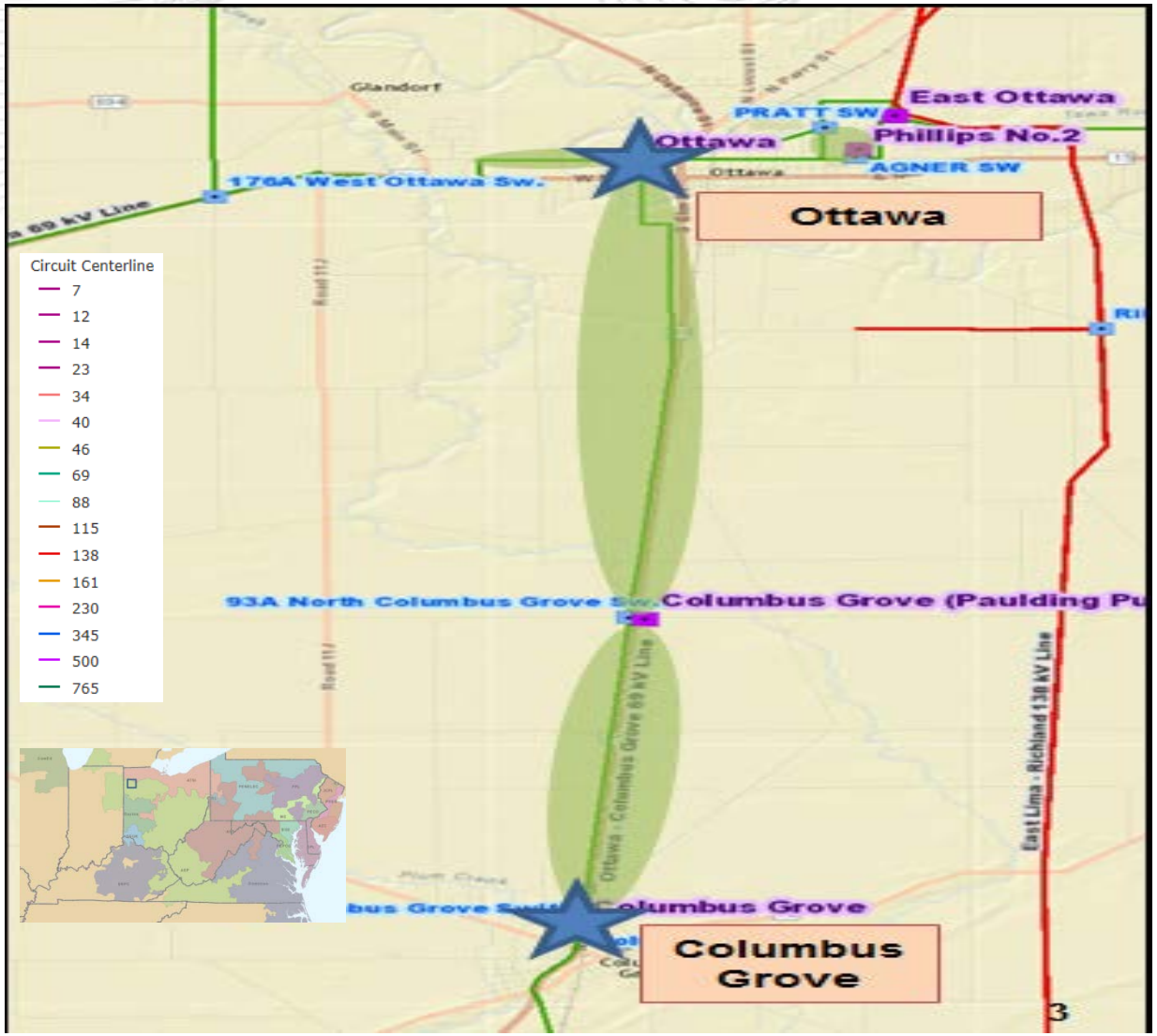

AEP Transmission Zone: Supplemental Columbus Grove-Ottawa 69kV Line Rebuild

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Potential Solution

Rebuild 6.91 miles on Columbus Grove-Ottawa 69kV line with 795 ACSR (128 MVA rating) in existing ROW. Remove taps to Ottawa station. Build 69kV line extensions to serve Glandorf station using 795 ACSR. Retire Pratt Extension 69kV Line. Reconfigure 69kV connections at Agner Switch. Remove line sections and de-energized conductor that will no longer be needed. Estimated Cost: $13.0M

Replace 69/12kV Ottawa station with 69/12kV Glandorf station at a new station site. Upgrade existing 3 way switch at North Columbus Grove to 3 way switch with 1 MOAB. Replace 3-69kV CB's and 1-69kV cap switcher at East Ottawa. Estimated Cost: $6.1M

Total Estimated Transmission Cost: $19.1M

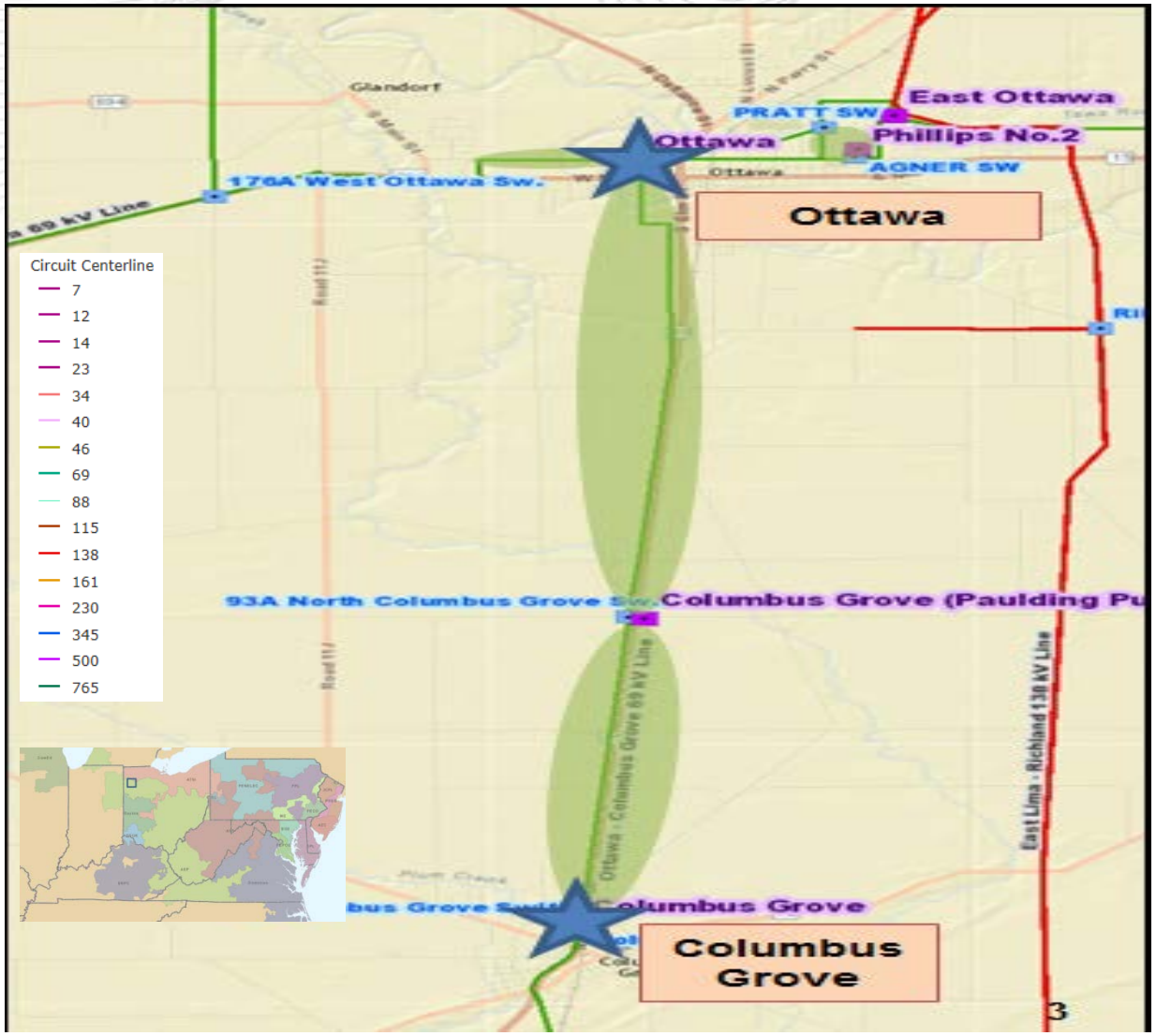
Alternatives:

Line rebuild and CB rehab work at East Ottawa, no replacement of Ottawa station. AEP-Ohio Distribution has decided that they are not willing to leave Ottawa station in its current location due to the high risk of flooding. Ignoring this, Ottawa station causes two separate 3 terminal line conditions making proper protection of the area very difficult. Estimated Cost: $19M

Scope as currently proposed with addition of CB installation at Columbus Grove and additional MOAB installations. The CB installation at Columbus Grove very quickly escalated in scope to larger costs that were deemed unjustified at this time given load growth, system condition / reliability, and customer needs. Estimated Cost: $23.4M

Projected In-service: 12/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Delphos Area 69 kV Line Rebuilds

Problem Statement:

Equipment Material/Condition/Performance/Risk:

There are 284 open conditions on the North Delphos – Van Wert circuit, which was originally constructed in 1926 with 2/0 Copper conductor (40 MVA rating). There are 727 open conditions on the North Delphos – West Moulton section, constructed in 1927 with 2/0 Copper. Existing lines between Delphos and Van Wert and between East Delphos and North Spencerville are almost entirely cross arm construction with vertical post insulators, which is not a current AEP standard. Along the East Delphos-Kossuth circuit, many vertical post insulators have burn marks, showing signs of in-service failures. Many insulators on both lines are tie-top type, and some existing wood pole structures have bay-o-nets supporting the shield wire, which are prone to failure. Existing line between North Spencerville and Kossuth is mostly burnt-colored horizontal post insulators with many leaning poles and bay-o-nets. The ability to repair breakdowns of the obsolete conductor size and type on both lines is becoming increasingly difficult due to limited availability of materials. Existing shield wire conductor types are obsolete for use as shield wires on the AEP system, and some are even unavailable as a like-kind breakdown replacement. Both lines have distribution underbuild, which mechanically consumes pole strength. Legacy underlying easement rights for a line of this vintage are inadequate by present day AEP Transmission standards.

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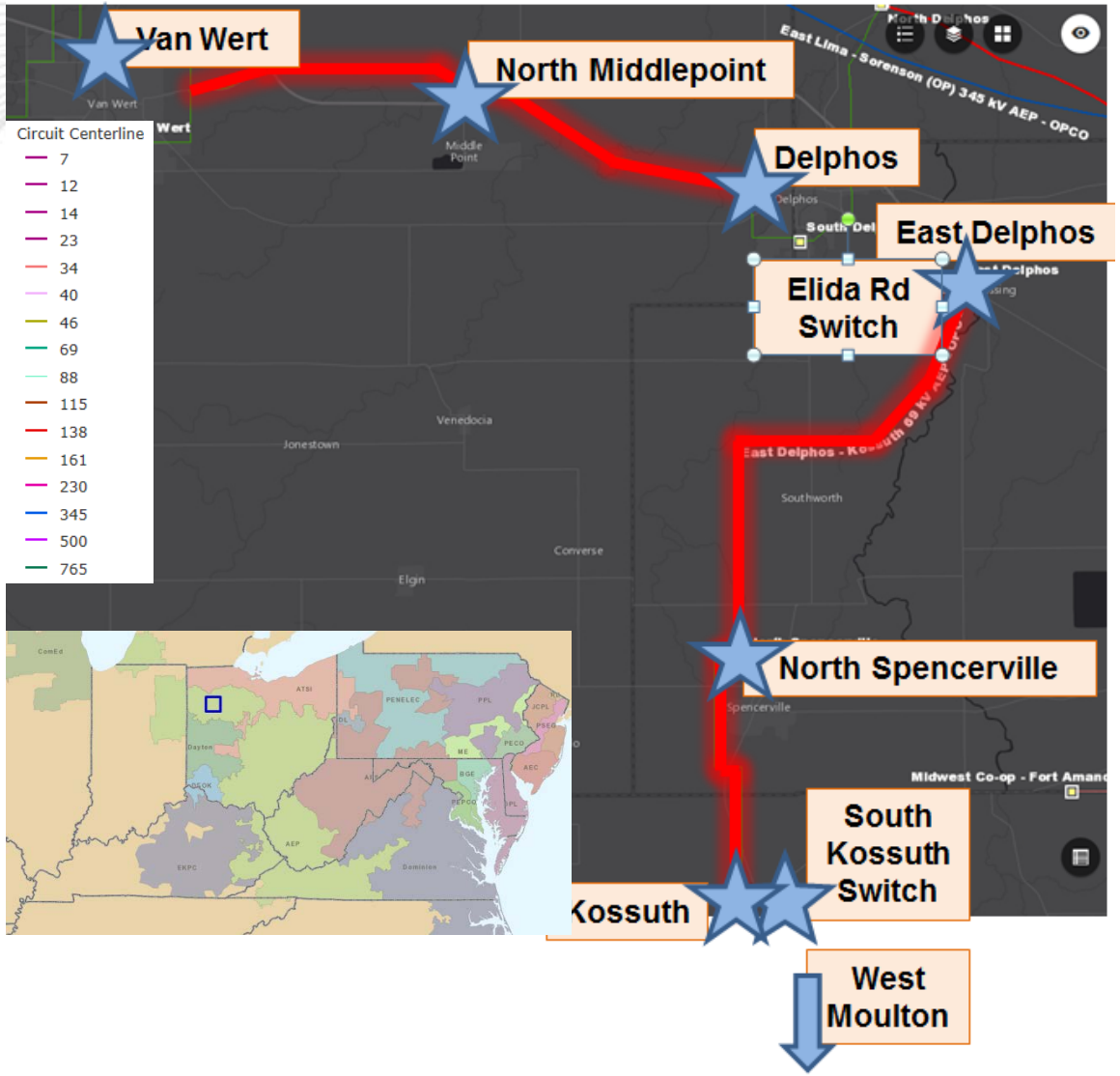

AEP Transmission Zone: Supplemental Delphos Area 69 kV Line Rebuilds

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Operational Flexibility and Efficiency

North Spencerville station will be rebuilt to include new bus work and two new Transmission CBs. The new CBs at North Spencerville will break up the North Delphos-West Moulton circuit. This will greatly improve the circuit's reliability because the stations will no longer be exposed to 29 miles of line, and this will eliminate the ground switch MOAB scheme at North Spencerville. There are currently 2466 customers on this line with approximately 18.6 MVA of load. There have been 25 total sustained or momentary outages on this line from 2013 to present. By placing breakers at North Spencerville, customers will no longer be interrupted by line faults. Current CMI for this circuit is 161,901.

At North Middlepoint station, there will be one new MOAB looking toward station Vanwert and another motor mech operated switch looking toward Delphos. This will improve the circuit reliability thus improving the SAIFI numbers because the minutes of interruption will be decreased. Also there will be new circuit switcher at the high side of the transformer which will allow any temporary fault on the bus to restore and will not allow faults on the distribution to effect the transmission.

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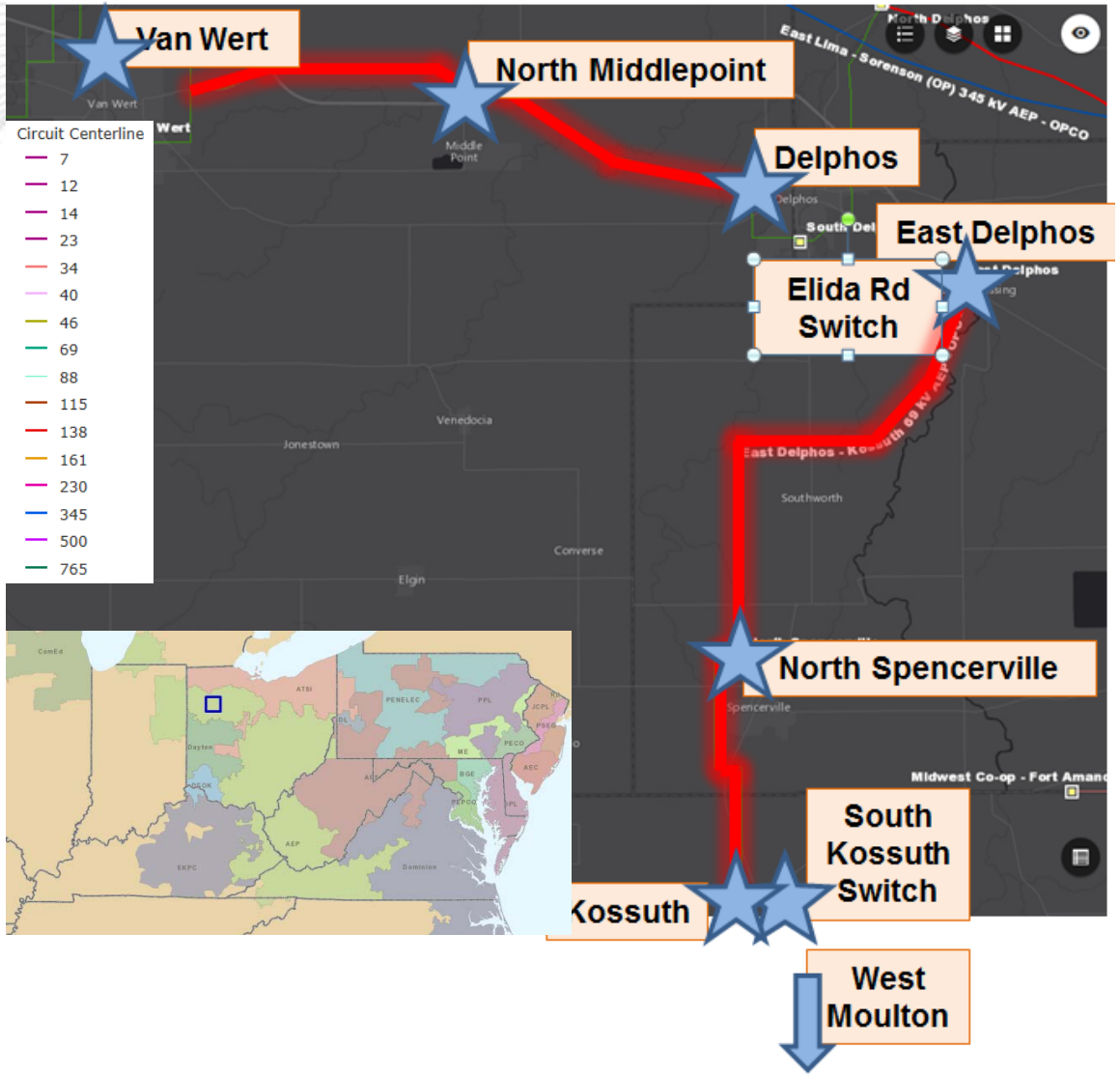

AEP Transmission Zone: Supplemental Delphos Area 69 kV Line Rebuilds

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Potential Solution

Rebuild North Spencerville station. Install two 69 kV CBs. **Estimated Cost:** $1.2M

At North Middlepoint station, construct new high side switching facilities. Install one MOAB, Switch and Circuit Switcher. **Estimated Cost:** $0.3M

At South Kossuth station, install a new 1-way switch toward North Spencerville, retire the existing 1-way switch and build a section of line in the clear on the north side of the highway. **Estimated Cost:** $0.2M

Rebuild existing Delphos – Van Wert 69 kV line (~11.4 miles) with 795 ACSR (128 MVA rating), including partial line reroute. **Estimated Cost:** $12.3M

Rebuild existing East Delphos – Kossuth 69 kV line (~15.5 miles) with 795 ACSR, including partial reroute. **Estimated Cost:** $16.1M

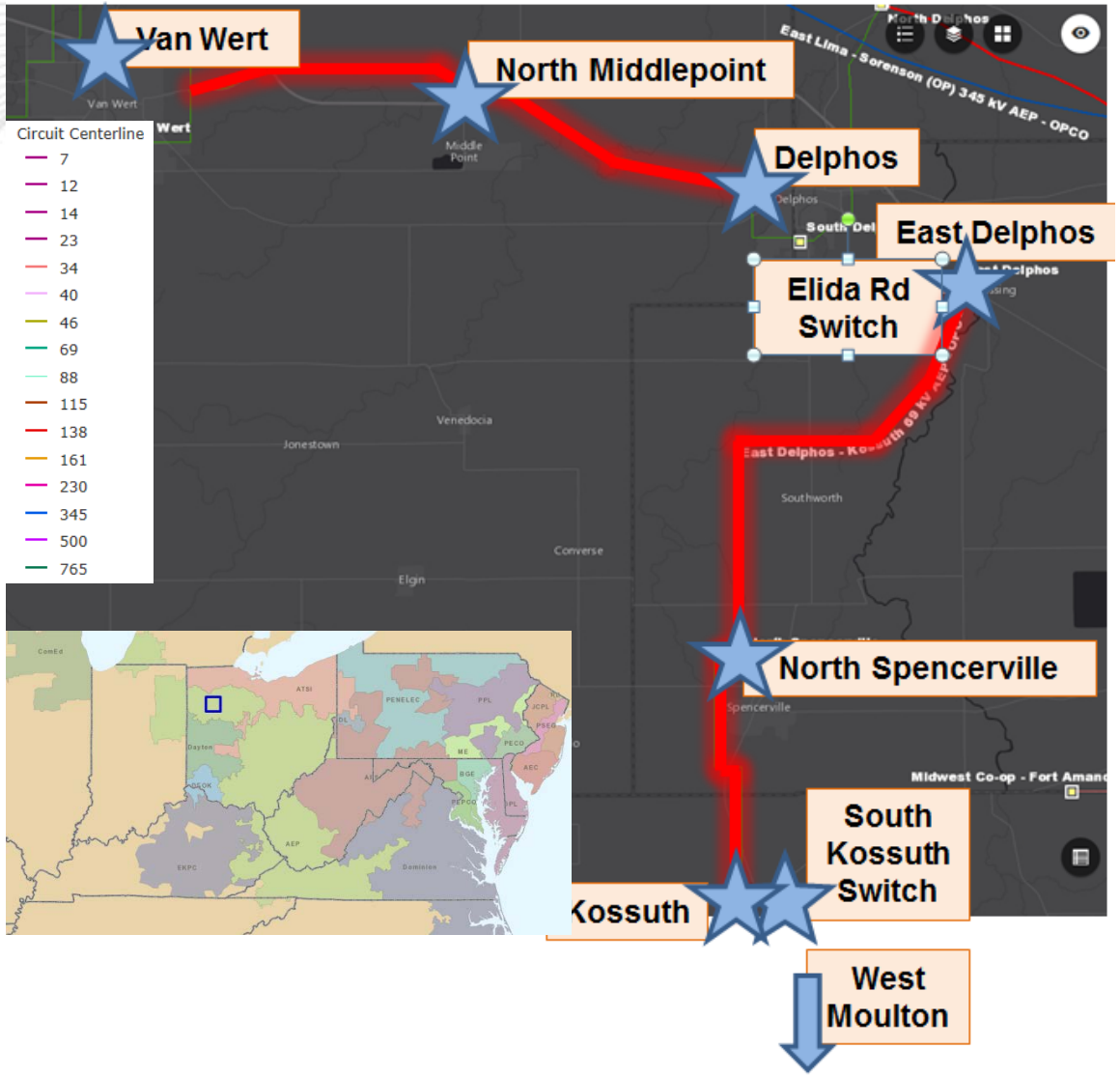
Total Estimated Transmission Cost: $30.1M

Alternatives:

Adjust the scope at North Spencerville by installing a new box bay with MOABS and new controls. Installing MOABs at North Spencerville does not provide the reliability or full outage minimizing effects of installing CBs at the station to relieve the high CMI (781,560) of this circuit. Estimated Cost: $29M

Projected In-service: 12/31/2020

Project Status: Engineering



AEP Transmission Zone: Supplemental Gavin Plant 69kV Bus Upgrade

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 69kV CB's BJ, BK, and BH at Gavin are all oil breakers without oil containment. 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. These breakers are also models that are worthy of replacement due to their reliability, and lack of spare part availability. Meigs CB-BJ is 1 of 33 remaining CG-48-72.5-20-1200 circuit breakers remaining on AEP's system, and CB-BK/CB-BH are 2 of 45 remaining FK-72.5-27000-10 circuit breakers remaining on the system. Breaker BJ and BH both have exceeded their manufacturers recommended fault operations (28 and 18 respectively).

Customer Service:

Gavin is the largest coal power plant in Ohio, with 2.64 GW Nameplate capacity. The two units' sources of operating power for start up and coal handling are the 138-69 kV Gavin Transformers. The loss of either of the 138-69kV transformers will prevent continuous operation of one of the 1.3GW units.

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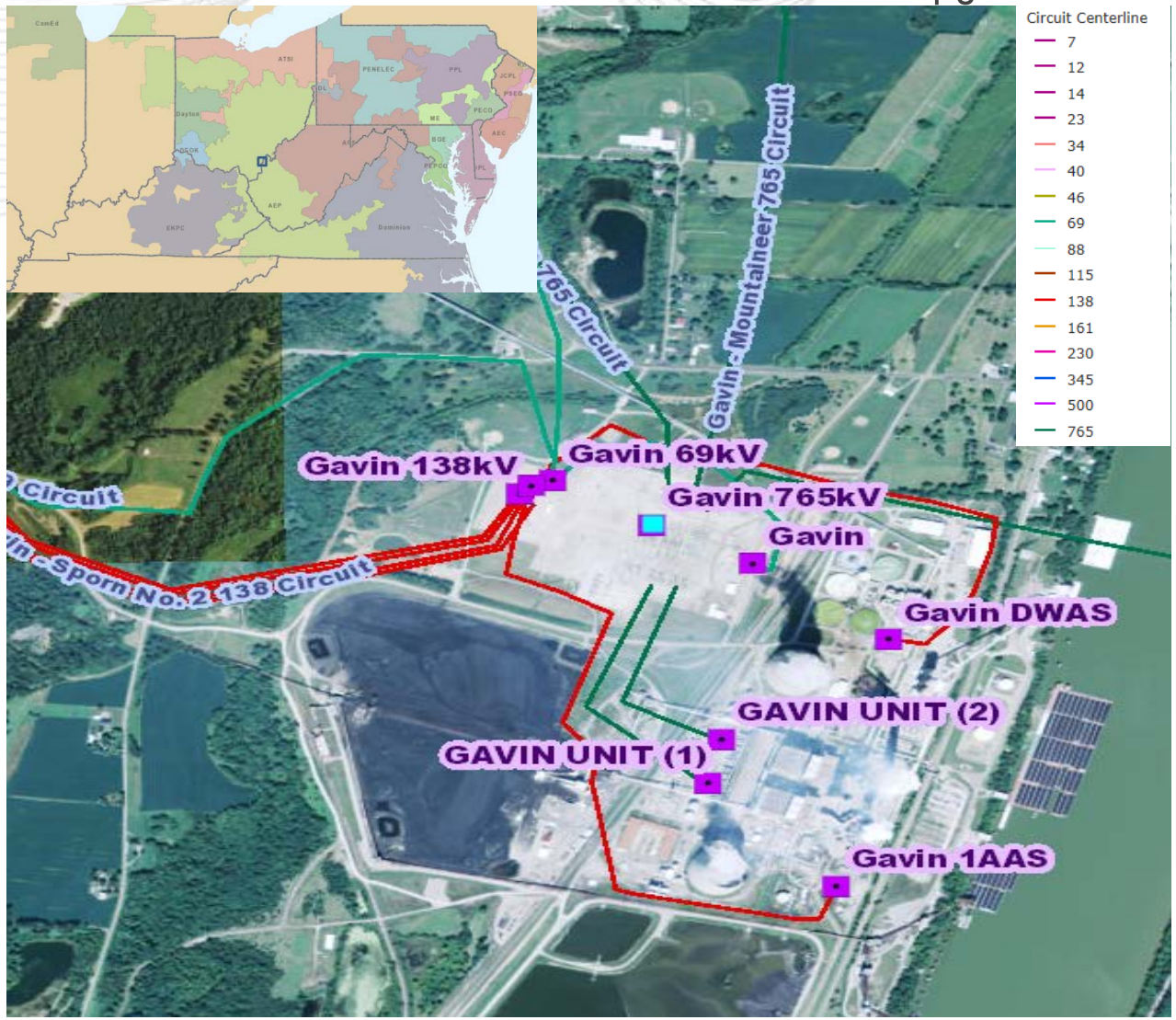

AEP Transmission Zone: Supplemental Gavin Plant 69kV Bus Upgrade

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Potential Solution

Rebuild the existing 69kV yard as a 6-CB ring bus station, using 2000A, 40kA breakers. The Plant's existing auxiliary power source, the 138-69 kV transformer #2, will terminate into the ring along with the local service 138-69kV transformer #1. Add 1 new CB (138 kV) at the high side of the transformer #1. The station's auxiliary power will then be supplied from the ring. Associated PCE upgrades Estimated Cost: $9.2M

Modify existing line exits out of Gavin station. Estimated Cost: $0.3M

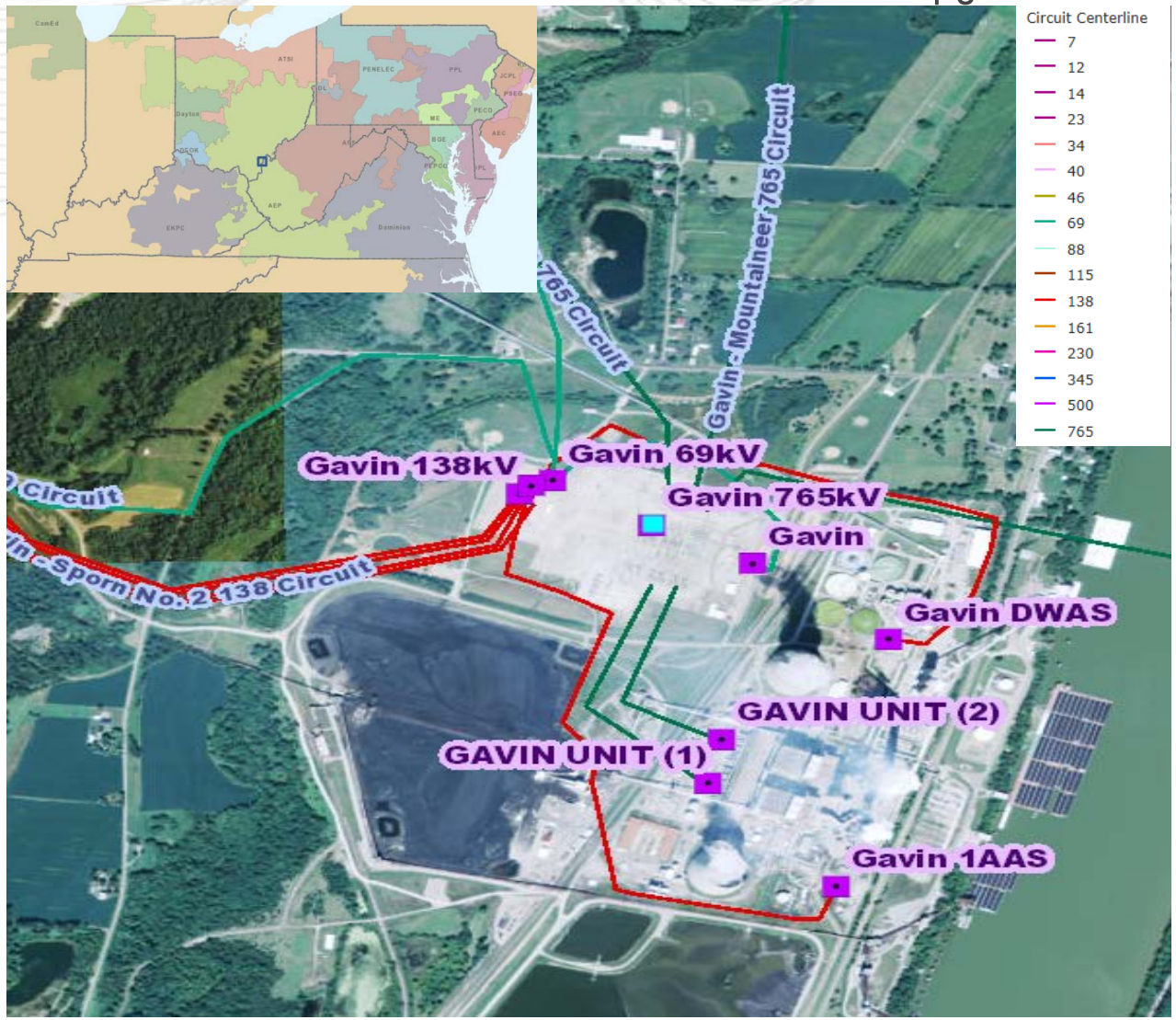
Total Estimated Transmission Cost: $9.5M

Alternatives:

An alternative to the proposed project would be to complete the 69 kV substation redesign with a breaker-and-a-half configuration, taking the station service feeds off the end buses and putting them into a new breaker string. The design would require three additional 69kV breakers, associated buswork and equipment. The alternate solution would increase the station's reliability, but was not chosen due to the higher cost. Estimated Cost: $10.5M

Projected In-service: 06/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental North Canton 69kV Upgrades

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The North Canton 69-12kV distribution transformer failed. 69kV breakers E & G are oil-filled breakers made in 1963 (CF-48 model). The 69kV CB's E and G at North Canton are oil breakers without oil containment. 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. These breakers are also models that that are worthy of replacement due to their past reliability, and lack of spare part availability. These breakers have exceeded the designed number of full fault operations (10) with 12 and 26 fault operations respectively.

The distribution XFMR was made in 1968 and failed in 2017 (since that time load has been transferred to adjacent distribution stations where possible, or by using a mobile sub during peak periods).

The 69kV circuit protection uses electromechanical relays and pilot wire, which is more prone to misoperations and has issues in finding repair parts. The 69kV protection will be upgraded to microprocessor relays and fiber-optic communications. The 69kV bus protection currently utilizes an older IAC electromechanical scheme, which needs upgraded to modern bus-differential protection. The RTU is also of an obsolete vintage and needs to be replaced.

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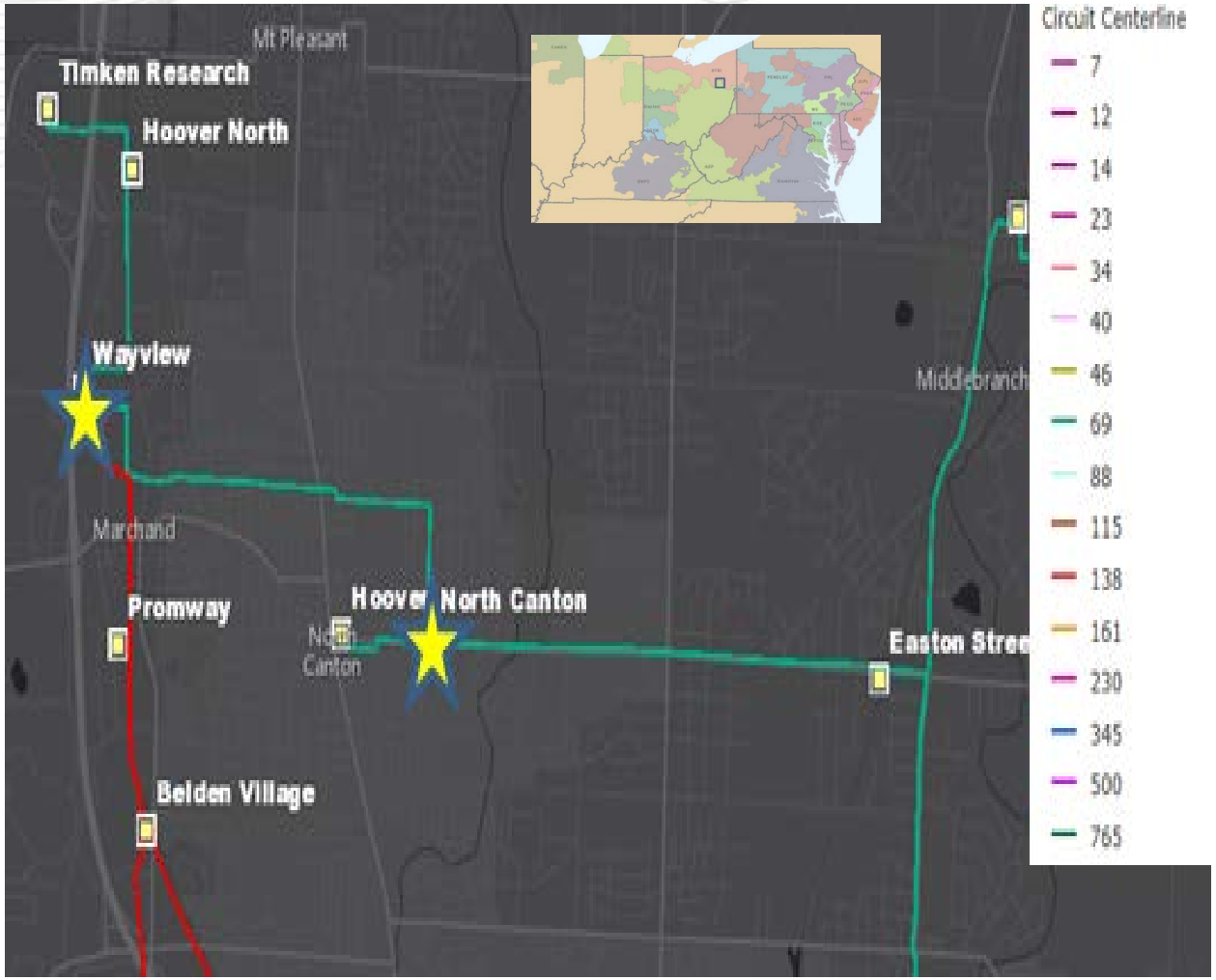

AEP Transmission Zone: Supplemental North Canton 69kV Upgrades

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Operational Flexibility and Efficiency

Currently the North Canton-Hoover 69kV circuit is tapped directly to the North Canton 69kV bus, without a fault-interrupting device. As a result, a fault on the 69kV T-Line, or at the high-side of the Hoover customer's station would take out the entire North Canton station, including the substantial amount of distribution load (21 MVA peak, 5200 customers). In addition, the failed distribution transformer at North Canton only had a high-side MOAB switch, which required tripping the entire 69kV bus to remove XFMR faults, plus outaged the Hoover customer. A 69kV circuit switcher will be installed to protect the XFMR and properly isolate faults.

Currently, there are 3 separate zones of protection lumped together: Hoover 69kV circuit, N. Canton 69-12kV XFMR, N. Canton 69KV bus. Adding the 3rd 69kV breaker, plus the XFMR circuit switcher will greatly improve reliability for customers in the area.

To facilitate the 69kV & 12kV improvements at the small urban station, the 69kV cap bank needs to be removed. This system change was studied in conjunction with AEP Operations, and no adverse effects were found.

Operational Flexiblity:

The pilot wire communications scheme between North Canton and Wayview 69kV will be replaced with a modern fiber-optic communications channel, increasing the resiliency of the sub-transmission grid.

Customer Service:

By installing the 3rd 69kV breaker and 69kV circuit switcher, reliability will be improved for the Hoover 69kV customer and North Canton AEP Ohio distribution customers. Today, a fault for either customer will interrupt the other. This risk will be eliminated due to this project.

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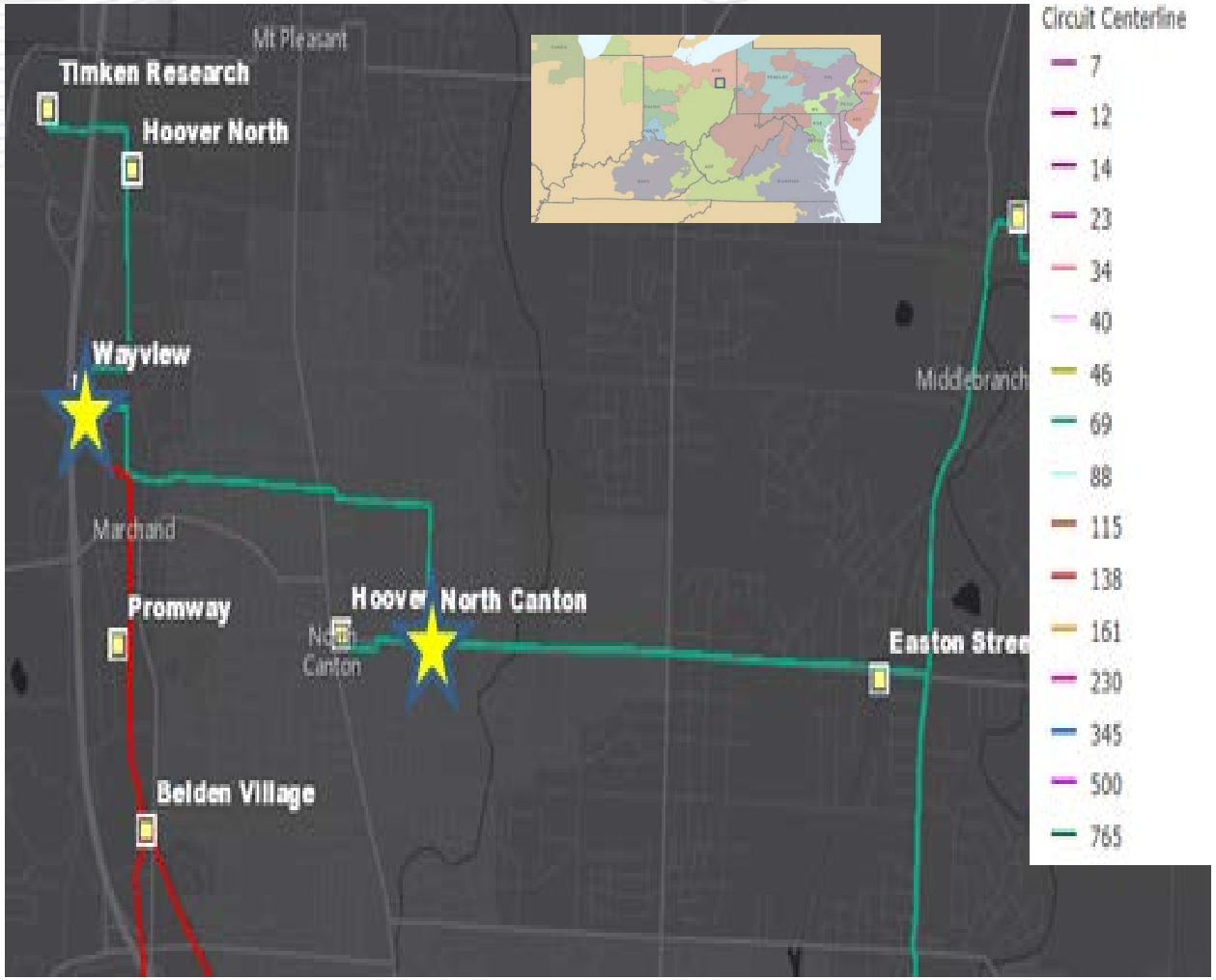

AEP Transmission Zone: Supplemental North Canton 69kV Upgrades

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Potential Solution

At North Canton station, rebuild 69kV bay, install 3- 69kV gas breakers, remove 69kV cap bank. Replace failed 69-12kV distribution transformer and other associated distribution work. Upgrade the Wayview 69kV remote-end circuit protection to coordinate with North Canton.

Total Estimated Transmission Cost : $3.2M

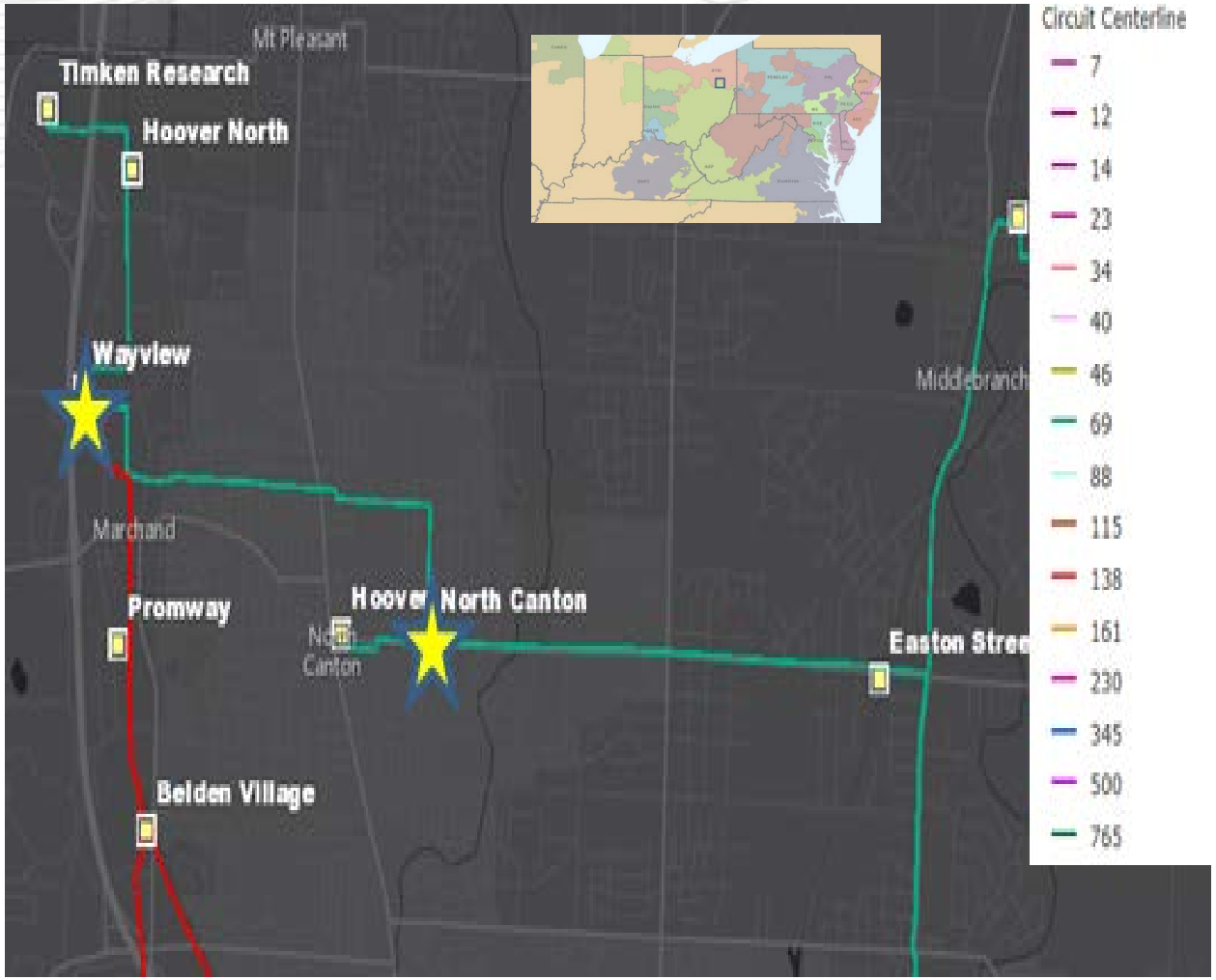
Alternatives:

The additional breaker on the 69kV radial line to Hoover could potentially be skipped; however, this would leave an operational risk to the station (a fault on the 69kV T-line, or high side of customer station would cause an outage to the entire North Canton distribution station, and make the other 2- 69kV circuits radial).

Alternative Cost: $2.8 million (excludes the 3rd breaker toward Hoover)

Projected In-service: 12/01/2018

Project Status: Engineering



AEP Transmission Zone: Supplemental Northeast Canton Upgrades

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The four 69kV breakers at NE Canton station are oil-filled units between 43-57 years old with between 16 and 38 fault operations on them. The transformer is a 3-winding model (138-69-12kV), with distribution load served off of the tertiary. The XFMR is 55 years old and is in poor condition. NE Canton has wood station support structures on the 138kV & 69kV, which are deteriorating. The control house consists of 70 electromechanical relays, 4 static relays, and zero modern microprocessor relays. Electromechanical and static relays are more prone to failure and a challenge to find replacement parts.

West Canton 138kV breaker C is 31 years old and a rare model, making repairs & maintenance difficult.

Oakwood 69kV breaker is oil-filled (55 years old) and in poor condition, and relays are electromechanical.

Diamond Street 69kV breaker is oil-filled (55 years old) and in poor condition and relays are obsolete. A leased-line pilot wire communications scheme is used for area system protection, which is obsolete and prone to service interruptions in the coming years.

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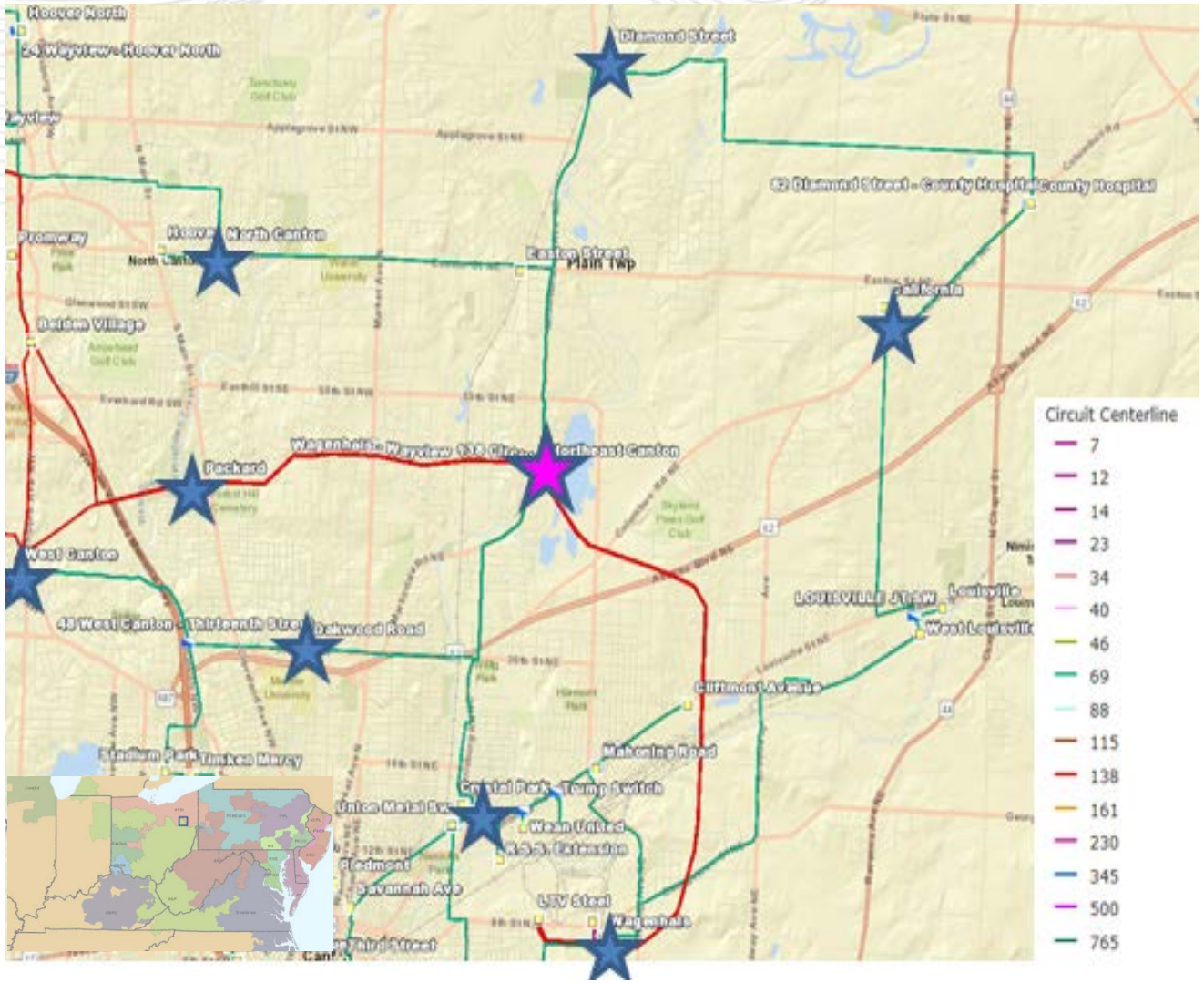

AEP Transmission Zone: Supplemental Northeast Canton Upgrades

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Operational Flexibility and Efficiency

The Wagenhals-NE Canton-West Canton 138kV circuit is a 3-terminal line, due to the 138-69kV source at NE Canton; this is a protection challenge and places customer load at risk. The NE Canton XMFR doesn't have a high-side breaker (only motor-operated switch and remote-end tripping scheme); this places the XFMR at a higher risk of fault damage, and unnecessarily outages customers at NE Canton & Packard stations. The NE Canton XFMR has distribution load served off of the 12kV tertiary winding, with no isolation device, which is a reliability risk to the transmission system. The 138kV line switches at Packard will be converted to motor-operated switch with auto-sectionalizing, due to the large load center served there, and meeting AEP's MPOI calculation threshold. The 69kV breaker and MOAB switch installations adhere to AEP's MPOI/FOI guidelines.

Infrastructure Resilience:

The Telecom fiber network will be connected by the hub at NE Canton station; this will upgrade the communications network utilized by EMS/SCADA and protective relaying. The outdated pilot wire system will be retired. In addition, today NE Canton has very little SCADA functionality, which is inadequate for such a critical station.

Customer Service:

This project will improve service reliability for many AEP Ohio distribution customers in the area, as well as the transmission customer served from Diamond Street station.

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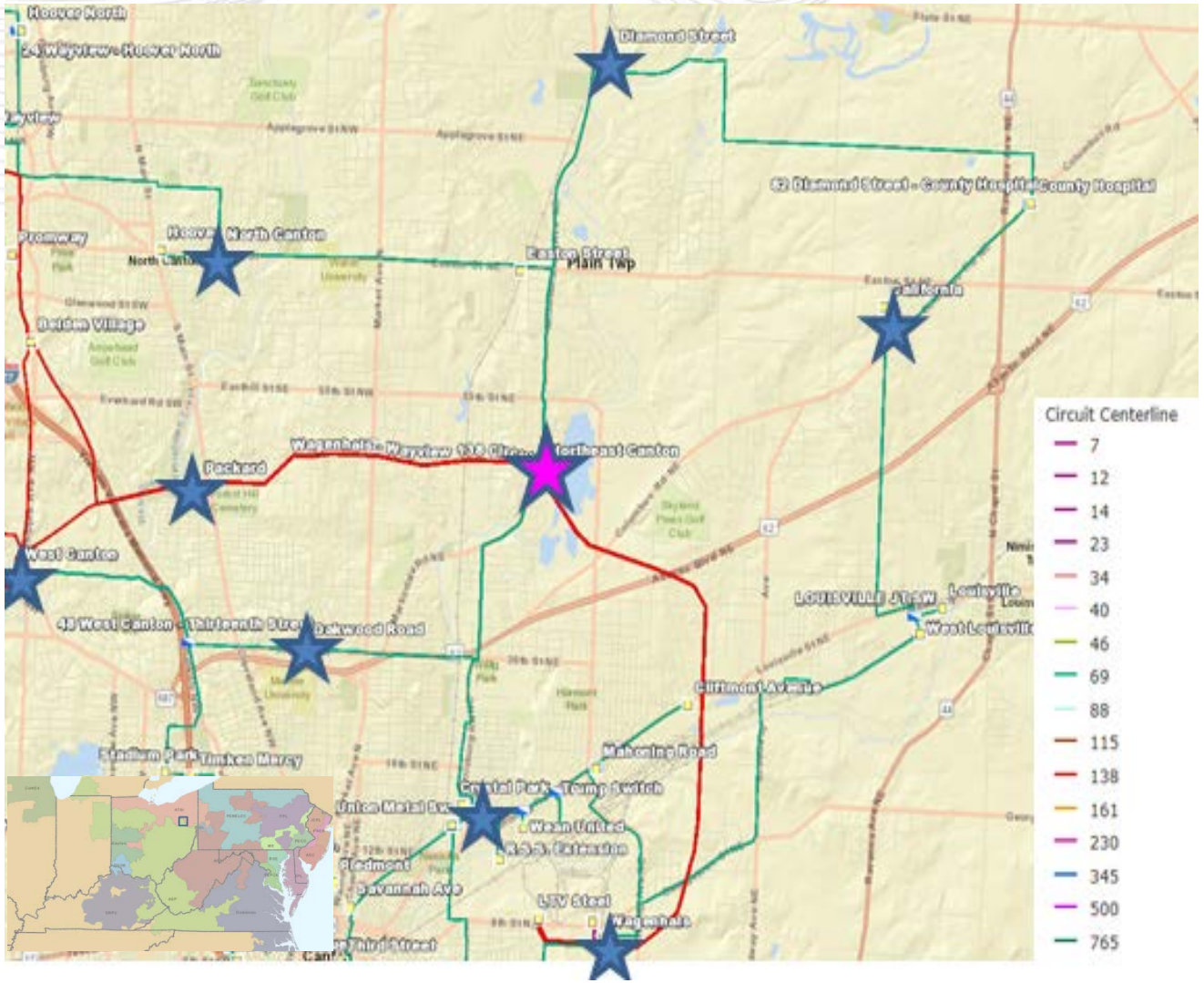

AEP Transmission Zone: Supplemental Northeast Canton Upgrades

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Potential Solution

Rebuild the NE Canton 138/69/12kV station on the existing property. Install a 138kV 4-breaker ring bus, 138-12kV distribution transformer, 138-69kV, 90 MVA transformer, 69kV 6-breaker ring bus, 69kV cap bank (14 MVAR). At West Canton 138, replace 138kV breaker, disconnects & relays. At Wagenhals 138, change relay settings to coordinate with NE Canton. At Packard 138, convert manual line switches (2) to auto-sectionalizing MOAB's. At Stanley Court 69, upgrade relays to coordinate with NE Canton (fiber-based). At Oakwood Rd 69, replace 69kV breaker & relays. At Diamond St 69, remove 69kV breakers (2) and replace with sectionalizing MOAB's (This change is due to lack of space and poor condition of existing control house, which doesn't permit 2 new gas breakers and modern relays to be installed). At California, relocate the breakers from Diamond St (2) and install new relays.

Total Estimated Transmission Cost: $11.9M

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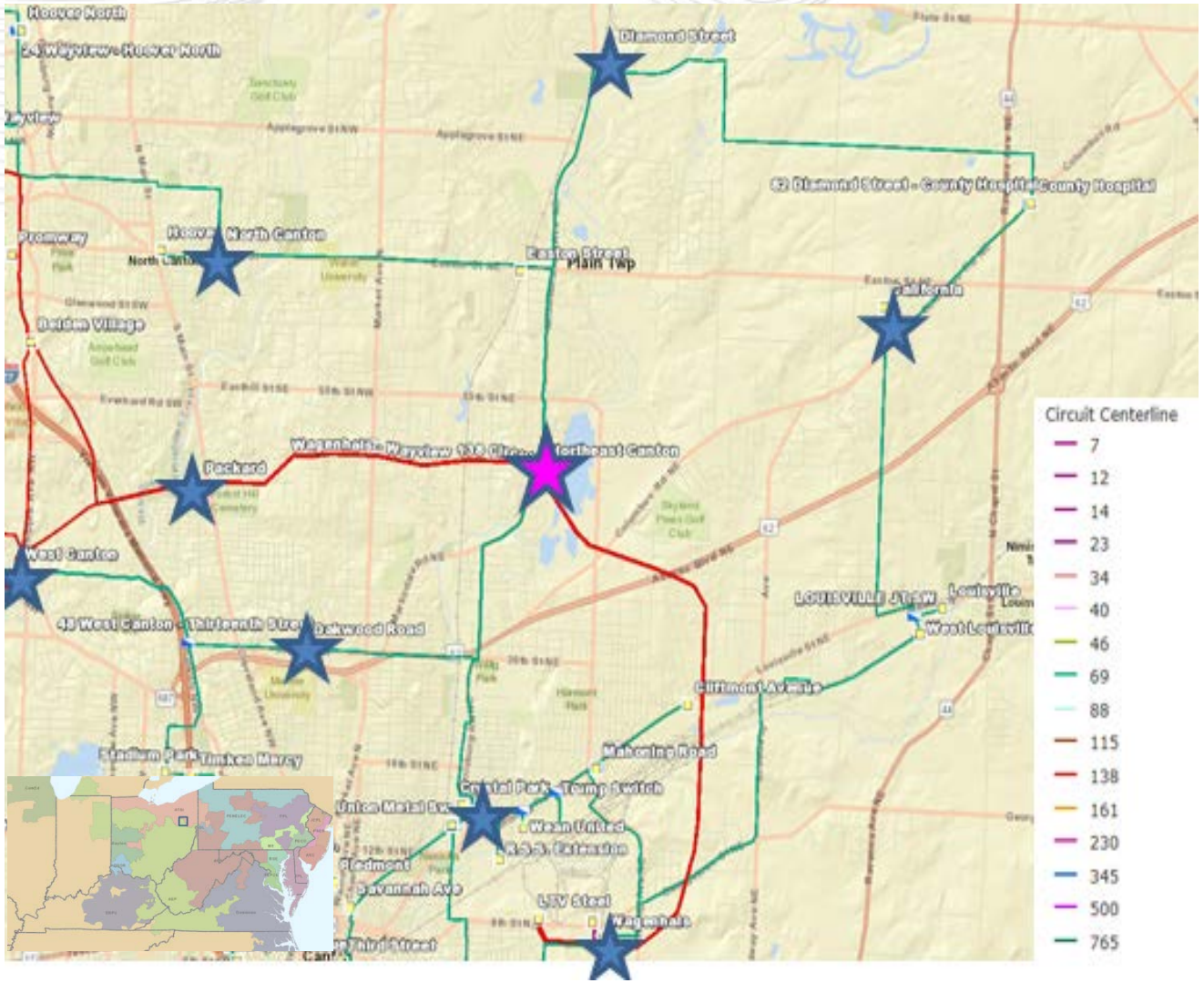

AEP Transmission Zone: Supplemental Northeast Canton Upgrades

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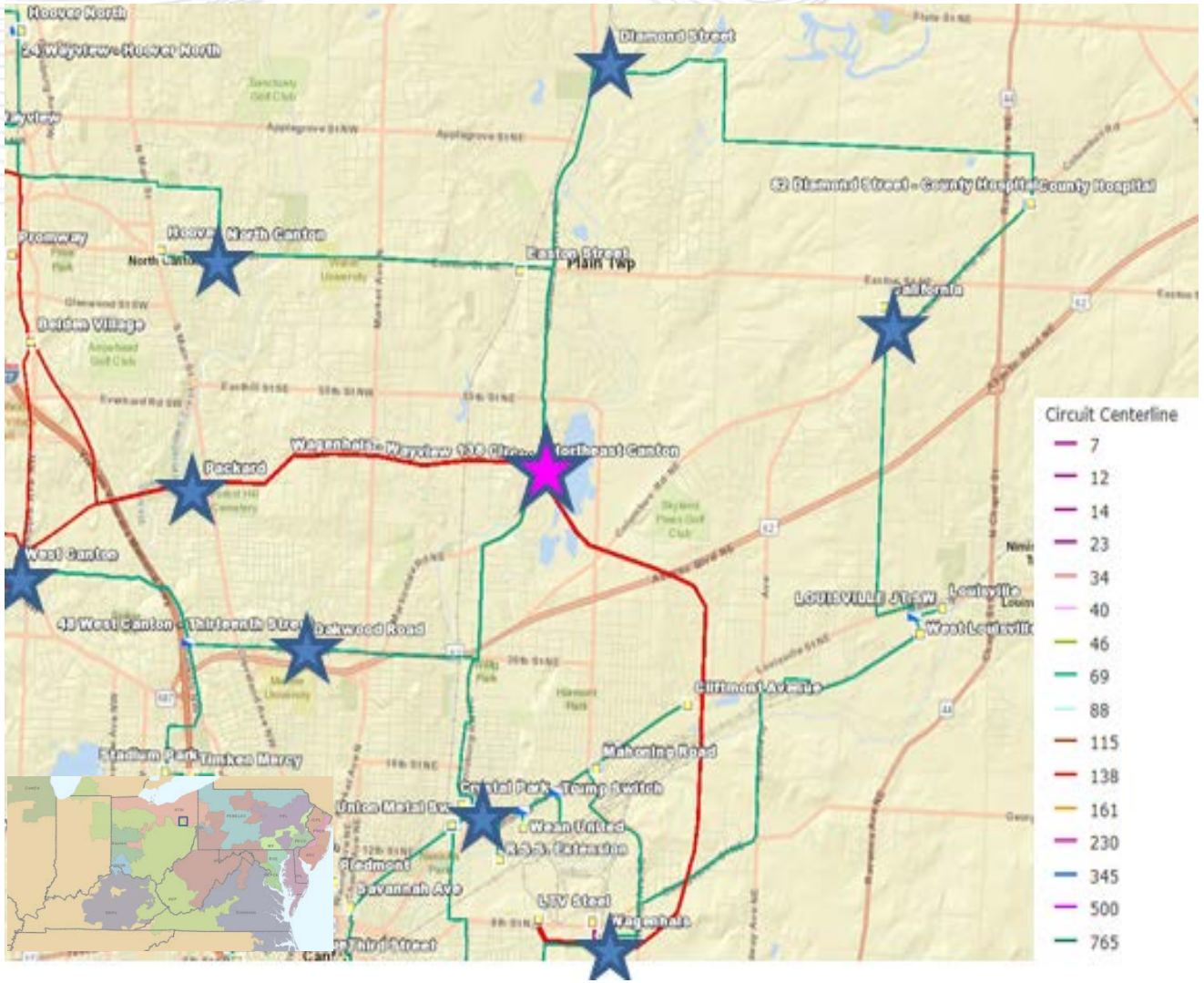
Alternatives:

Rather than rebuild the NE Canton 138/69/12kV station on the existing property, the idea of rebuilding on a greenfield property just east of the existing station was evaluated. This would have made outage-scheduling much simpler and allowed all station equipment and structures to be brought up to current design standards. However, after doing due diligence, the site east of NE Canton had many environmental challenges that made a large new station there infeasible. Estimated Cost: $20-25 million (including remote ends of NE Canton); however, the environmental/siting concerns may have made this alternative impossible to construct

Projected In-service: 12/01/2020

Project Status: Scoping



AEP Transmission Zone: Supplemental Waverly-Adams-Seaman 138 kV Line Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 32.8 mile Waverly-Adams-Seaman 138 kV line was built in 1954 with 336 ACSR conductor (150 MVA rating). On the 244 structures on this line, there are 153 open conditions. There have been over 1 Million customer minutes of interruption in a 3-year period. The conditions include: rotten cross-arms, burnt/broken insulators, and loose/broken conductor hardware. The average duration of sustained outage is 2.8 hours.

The majority of the Adams-Seaman 69kV line was built in 1939 with 336 ACSR (75 MVA rating). The line extends 11.9 miles radially from Seaman to serve Sardinia. On the line's 440 structures, there are 401 open conditions. Of the 401 conditions between Adams and Sardinia, approximately 88 conditions are in the Adams-Seaman section (97 structures). There have been 8 momentary and 5 sustained outages on this circuit over the last 3 years. The 69kV line is needed to serve Adams Coop's 69-12kV Lawshe load, and to provide a back up source for Seaman and Adams.

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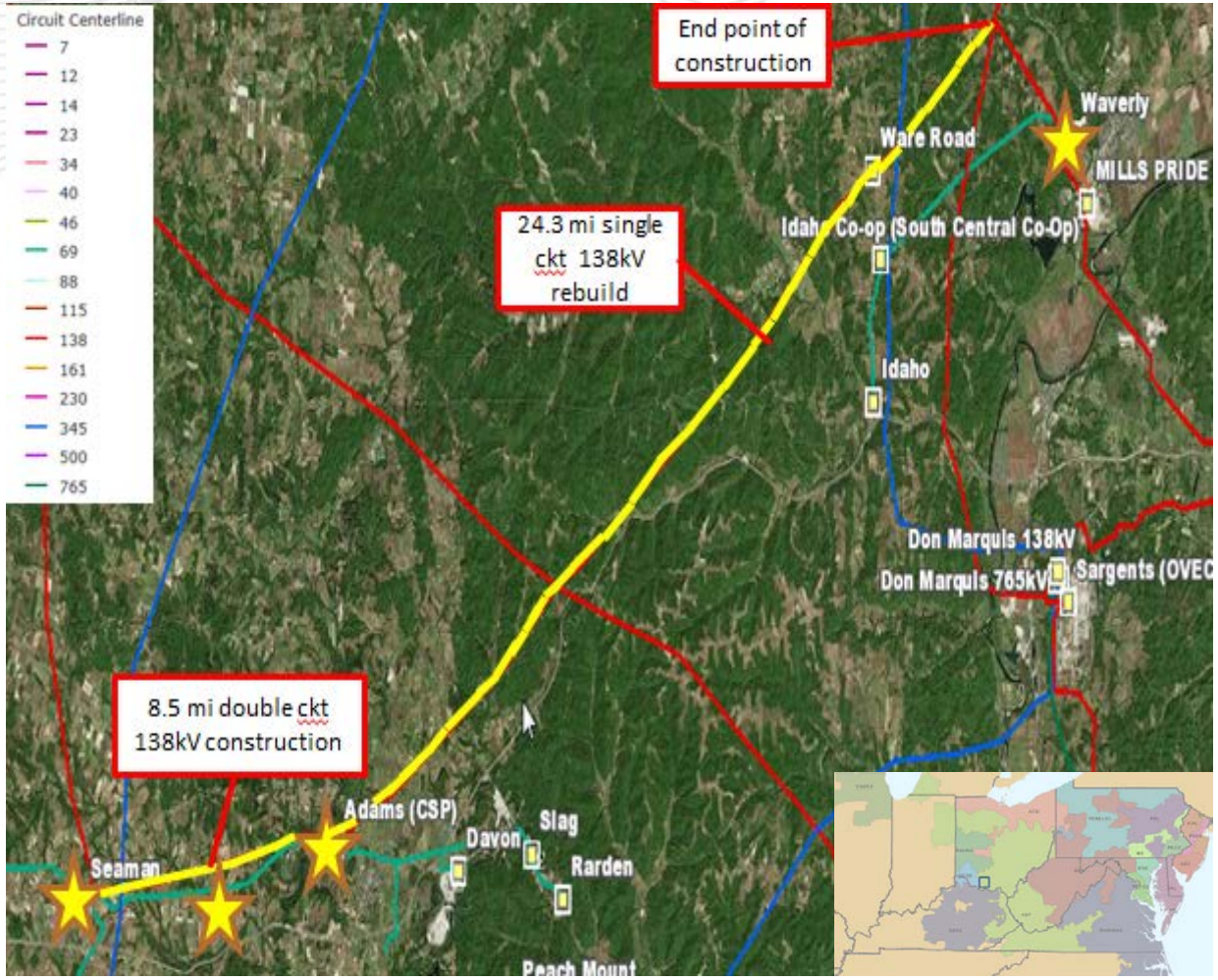

AEP Transmission Zone: Supplemental Waverly-Adams-Seaman 138 kV Line Rebuild

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Potential Solution

Rebuild the 138kV line from Waverly to Adams utilizing 1033.5 ACSR (296 MVA). The rebuild will begin at structure 22 west of Waverly where the line changes to the Waverly-Ross line and continue 24.3 miles to Adams Substation. The remaining 3.1-mile section from structure 22 to Waverly is newer double ckt construction and was not identified for renewal at this time. Remove old line after rebuild complete. Estimated Cost: $42.0M

There are two independent lines less than 1/2 mile apart between Seaman and Adams, one 138kV and one 69kV. Since both of the lines are in need of repair, the lines will be rebuilt as a double circuit for approximately 8.5 miles. Both lines will use 1033.5 ACSR. Remove old lines after rebuild complete. There will also need to be a short single ckt tap for Lawshe. Estimated Cost: $23.0M

A three-way POP switch structure will be constructed outside Lawshe substation. Estimated Cost: $1.0M

Total Estimated Transmission Cost: $66.0M

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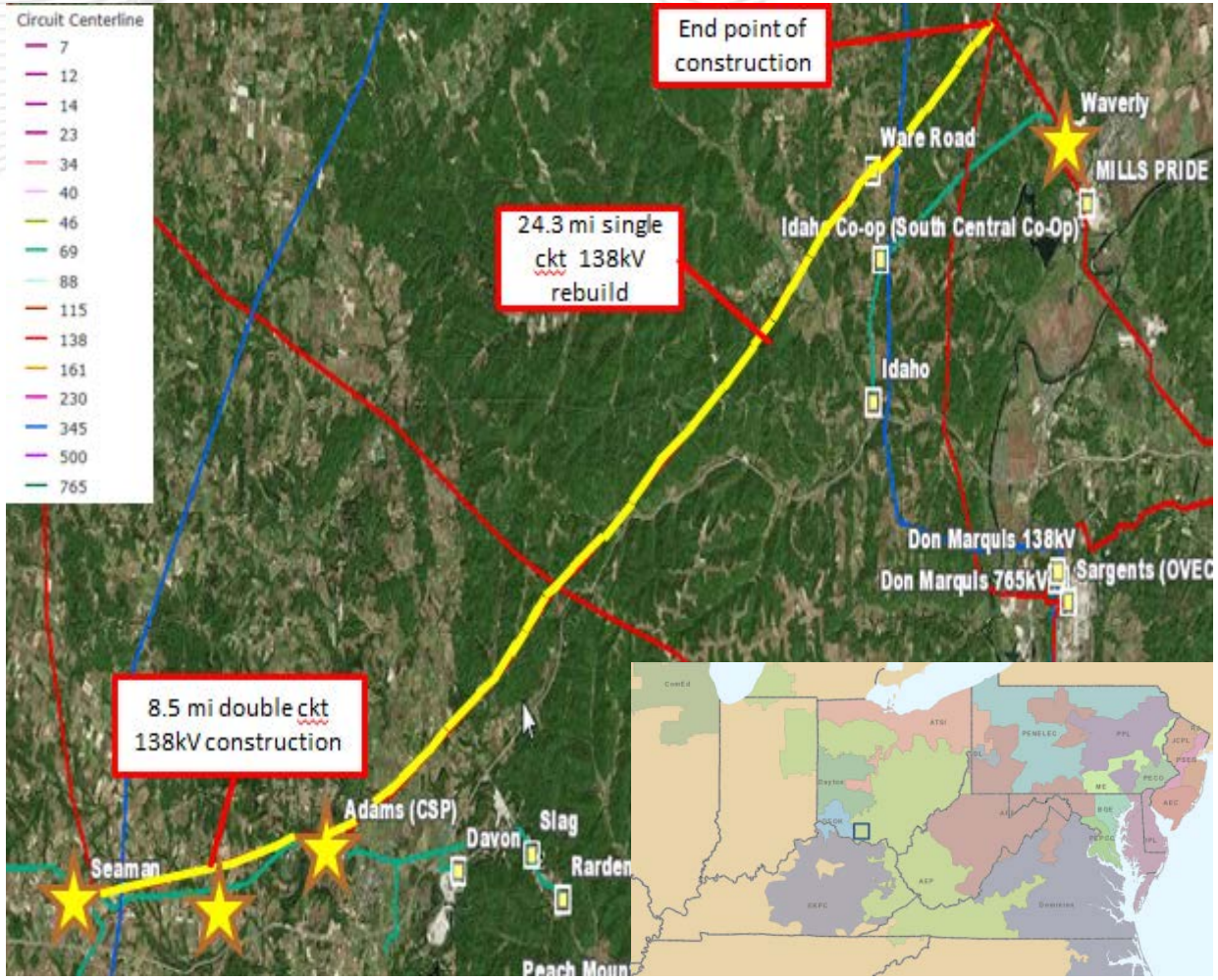

AEP Transmission Zone: Supplemental Waverly-Adams-Seaman 138 kV Line Rebuild

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Alternatives:

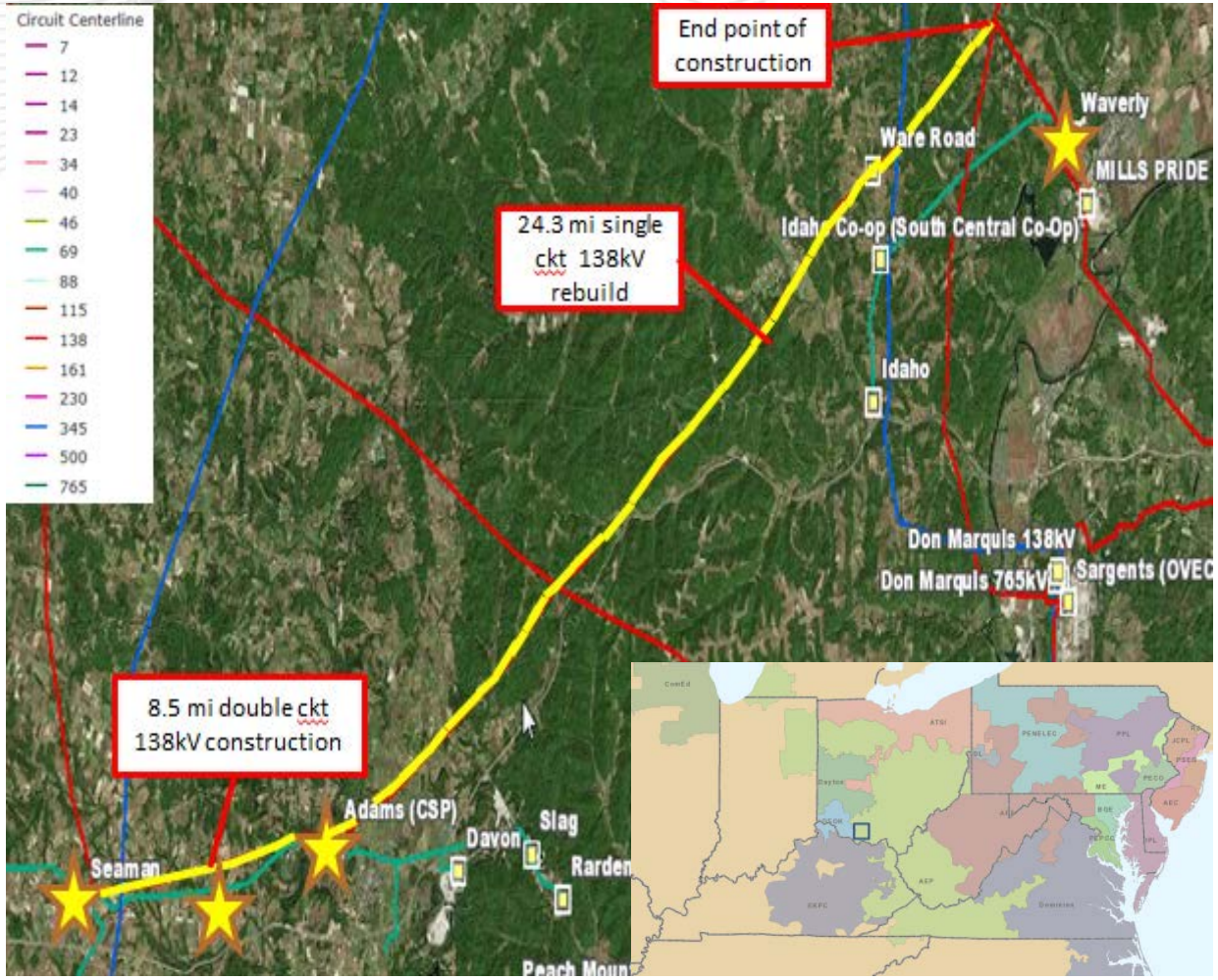
Rebuild 4.3 miles from Waverly to Ware double circuit. Install a new 4-CB ring bus substation at the existing junction of the 138kV Marquis-Ross and Waverly-Adams lines. Install new 3-CB ring bus substation at the junction of the 138kV Millbrook Park-Hillsboro and Adams-Waverly lines. Retire 12 mile section from Ware to the 138kV Hillsboro-Millbrook Park line junction. Rebuild the 8 miles Adams to the new station on the Hillsboro-Millbrook Park line. Rebuild the Seaman-Adams line the same as the proposed project. This project was not chosen due to cost and the Ware Rd station would be on a double circuit line. Estimated Cost: $70M

Rebuild 4.3 miles from Waverly to Ware double circuit. Install new 4-CB ring bus substation at the existing junction of the 138kV Marquis-Ross and Waverly-Adams lines. Retire the 20 mile section from Ware to Adams. Construct a new 345-138kV substation near Seaman, tapping the 345kV Stuart-Atlanta line. Rebuild the Seaman-Adams 138kV line as a double circuit and rebuild the Seaman-Adams 69kV line in-place. This project was not chosen due to cost. Estimated Cost: $101M

Rebuild the 138kV and 69kV lines between Seaman and Adams individually along their existing centerlines. Install a new switch at the Lawshe Tap. This project was not chosen due to cost. Estimated Cost: $76M

Projected In-service: 06/01/2021

Project Status: Engineering



AEP Transmission Zone: Supplemental
Twin Branch – Benton Harbor Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Twin Branch-Benton Harbor 138kV line asset is split up in two assets (IN & MI) and consists of different circuit sections: Benton Harbor-Riverside, Riverside-Kenzie Creek, Hickory Creek-Kenzie Creek, Kenzie Creek-Sauk Trail and Sauk Trail-Twin Branch. The original Twin Branch-Benton Harbor line assets were placed in service in 1929. The line assets combined have a total of 489 structures of which 65% are still from 1929. In addition, roughly 77% of the 397 ACSR conductor is still from 1929. The line assets' obsolete design included installation of armor grip suspension assemblies that were installed to extend the life of the conductors originally. Over the life of the line, through maintenance and remediation work, crews have found broken conductor strands under the armor grip suspensions due to long term exposure to Aeolian vibration. Crews have also found spots where the steel core of the conductor has been significantly corroded at the low point of sag. There are numerous issues with insulators along the line as evidenced by the 97 reported conditions associated with insulators and insulator suspensions. Many of these insulators have lost their outer glaze, allowing contaminant buildup, compromised electrical integrity and growing risk of electrical failure. Also, original easement language does not include ability to control building encroachments.

The Hickory Creek-Kenzie Creek has experienced 3 sustained outages over the last three years, resulting in 775,945 Customer Minutes of Interruption.

The Benton Harbor extension is 1969 vintage and is currently subject to 64 open conditions across its 34 structures including broken conductor strands; burnt insulator; and burnt, chipped and contaminated insulator suspension.

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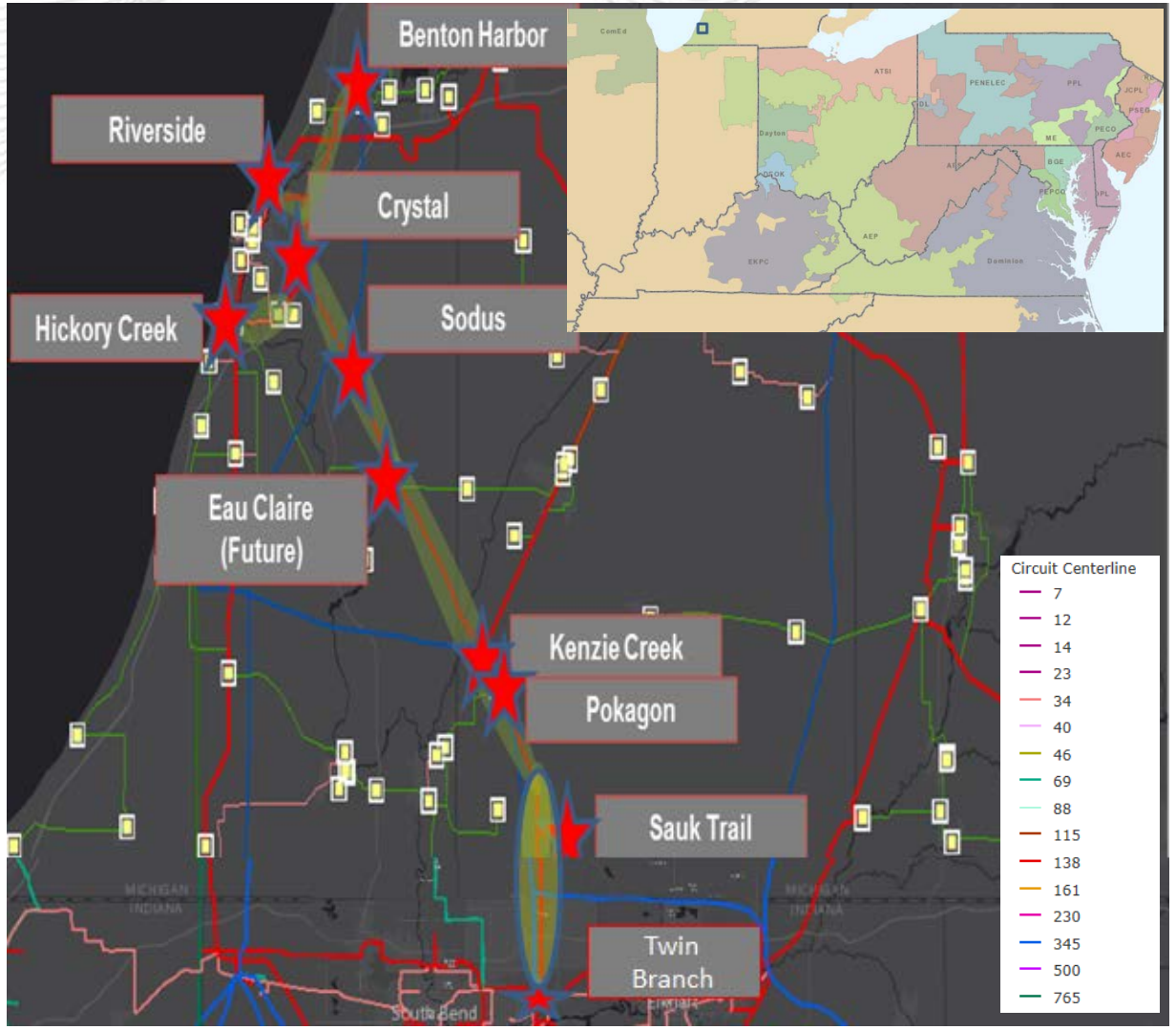

AEP Transmission Zone: Supplemental
Twin Branch – Benton Harbor Rebuild

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The Hickory Creek extension is 1951 vintage and is currently subject to 10 open conditions across its 27 structures including burnt insulator; and chipped and broken insulator suspension. In addition to this, the Hickory Creek extension currently has 3 river crossings and has a location where the line is in danger of being washed away by the St Joseph River.

The Twin Branch – Benton Harbor is 1929 vintage and is currently subject to 106 open A conditions across its 218 structures including broken conductor; burnt insulator; broken insulator suspension and loose shield wire hardware.

<u>Operational Flexibility and Efficiency:</u>

The Twin Branch-Benton Harbor double circuit 138 kV line is one of three critical 138 kV sources into Michigan. The existing conductor is currently the most limiting element in this corridor and moving to a higher capacity conductor will match the capability of other area facilities and provide the necessary system strength and prepare the grid for future load or generation changes.

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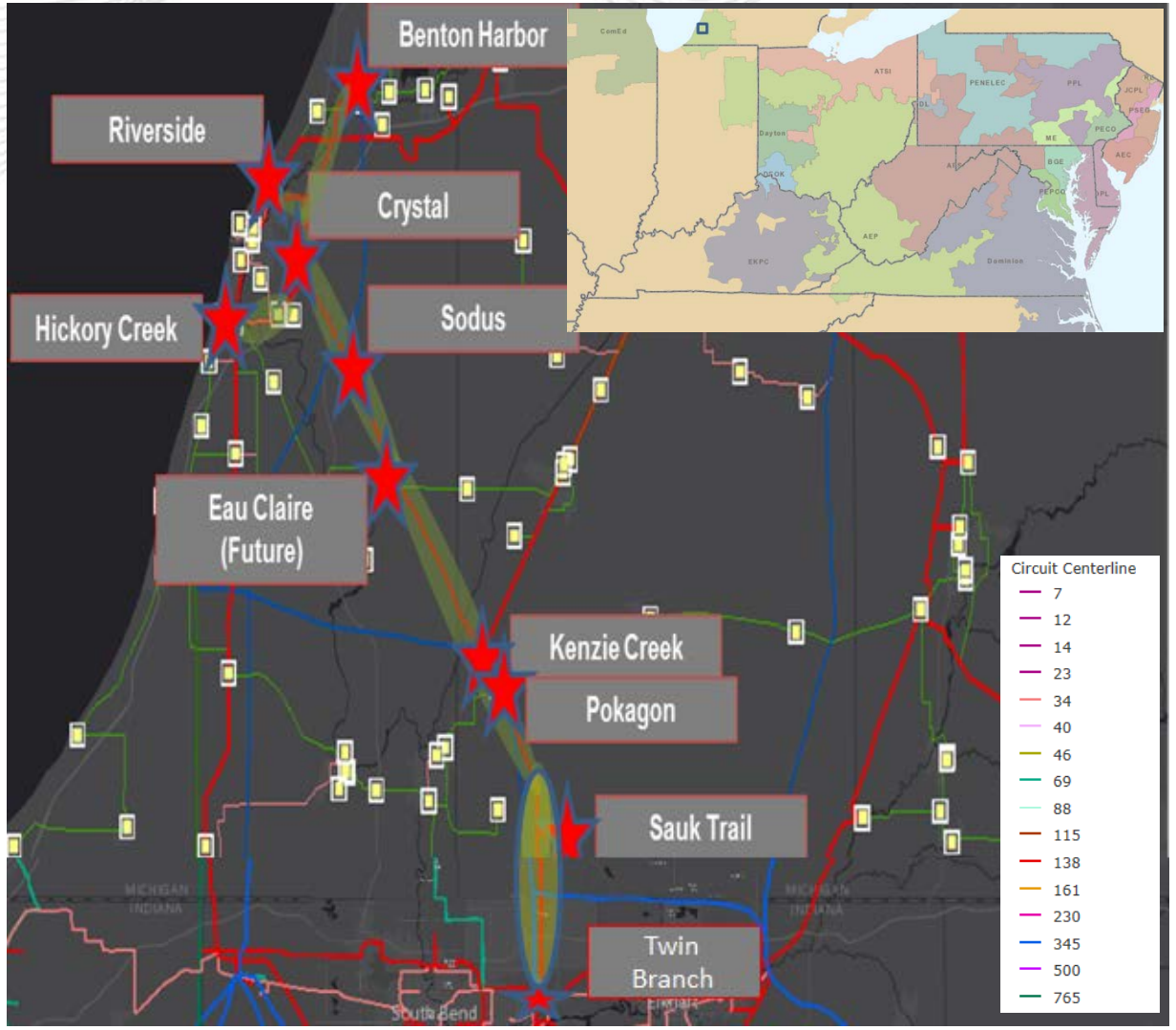

AEP Transmission Zone: Supplemental Twin Branch – Benton Harbor Rebuild

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Potential Solution

Rebuild the roughly 43 miles from the Twin Branch to Riverside station with double circuit 138kV 1033.5 ACSR (296 MVA rating). Estimated Cost: $94.3M

Rebuild the 6 mile double circuit Benton Harbor 138kV extension with double circuit 138kV 1033.5 ACSR. Estimated Cost: $16.9M

Rebuild the 5 mile double circuit Hickory Creek 138kV Extension with double circuit 138kV 1033.5 ACSR. Estimated Cost: $16.5M

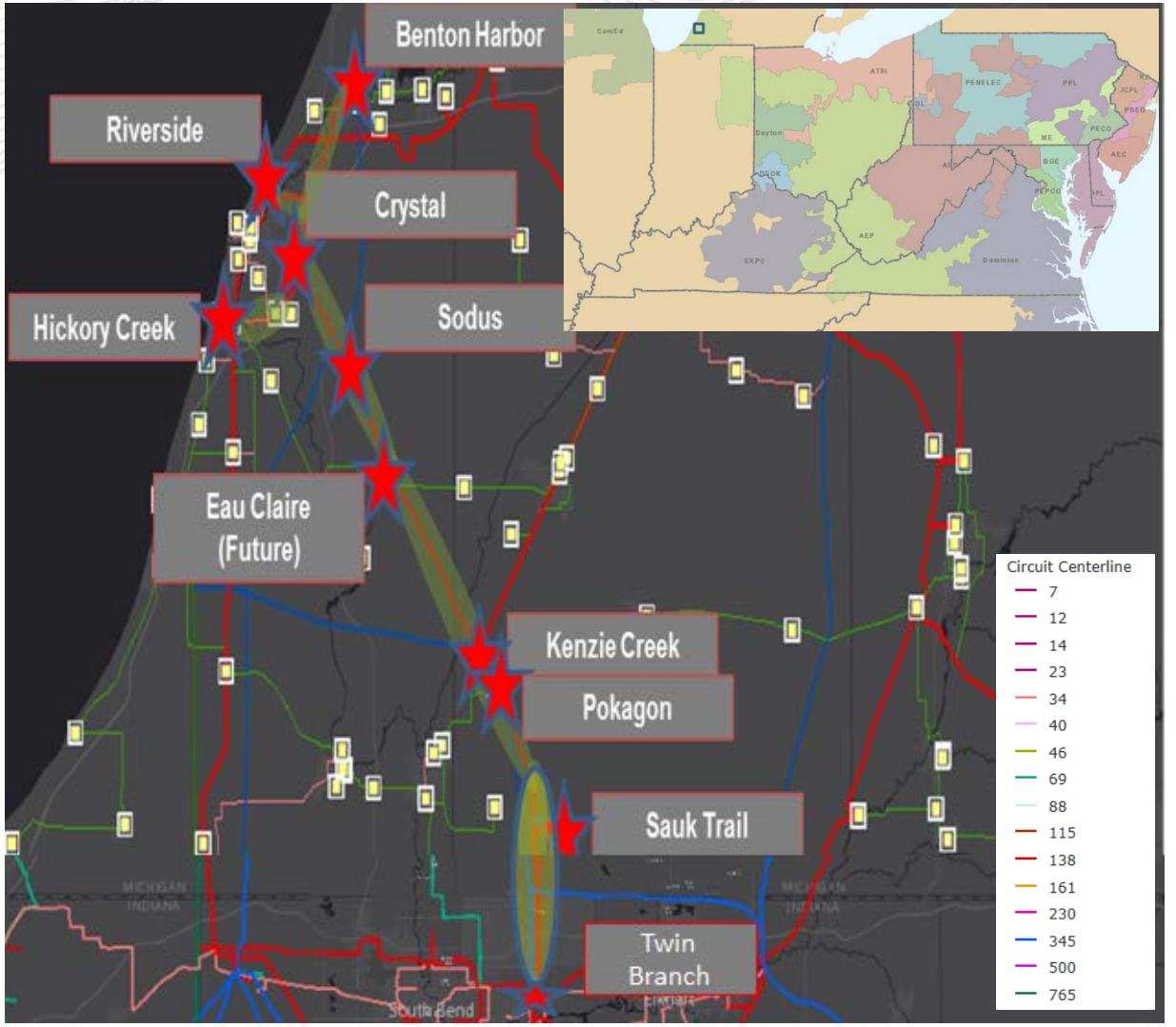
Total Estimated Transmission Cost: $127.7M

Alternatives:

Rebuild entire line as greenfield: Due to the feasibility of outages, centerline rebuilds are being recommended where the terrain allows.

Projected In-service: 12/01/2021

Project Status: Scoping



AEP Transmission Zone: Supplemental
West Bellaire-Moundsville 69kV Circuit Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 20-mile 69kV Moundsville-West Bellaire circuit has a 3-year CMI total of 6.76 million minutes of customer interruption. Very lengthy outages have resulted from degraded T-Line structures, inoperable sectionalizing equipment, and rugged terrain. 91% of the outage duration and 75% of the outage frequency was due to T-Line equipment problems.

The line has 141 open conditions. Examples include broken poles, hazard trees, woodpecker damage, pole rot, and broken insulators.

The majority of circuit (9 miles) was built in 1943 with 3/0 & 4/0 copper conductor and copperweld ground wire (runs north-south, 46 MVA rating)). The Glencoe-Bellaire 69kV line (4.4 miles) was built in 1913, but reconductored in 1970 with 556 ACSR conductor (runs east-west between West Bellaire and Bellaire, 100 MVA rating). The Shadyside and Monroe Street 69kV radial T-Line taps were built in 1944 & 1960, with 4/0 or 2/0 ACSR conductor (40 MVA rating) and are in very poor condition.

Operational Flexibility and Efficiency

West Monroe Street Switch (MOAB) and West Shadyside Switch are inoperable (since 2010), so are now hard taps. Monroe Street and Shadyside distribution stations are served off long radial taps through rugged terrain; their distribution load is non-recoverable (cannot be picked up by other stations). Per AEP's MPOI/FOI calculations, the data exceeds the guideline for installing MOAB switches. However, due to the number of taps and existing MOAB at Bellaire station, more than 3 MOAB's cannot be installed in series (due to protection/timing complications); therefore two breakers will be installed at Monroe Street to sectionalize this 20-mile circuit.

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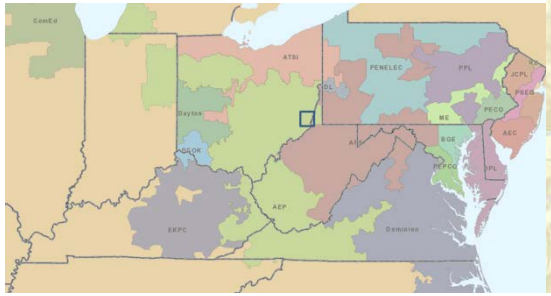

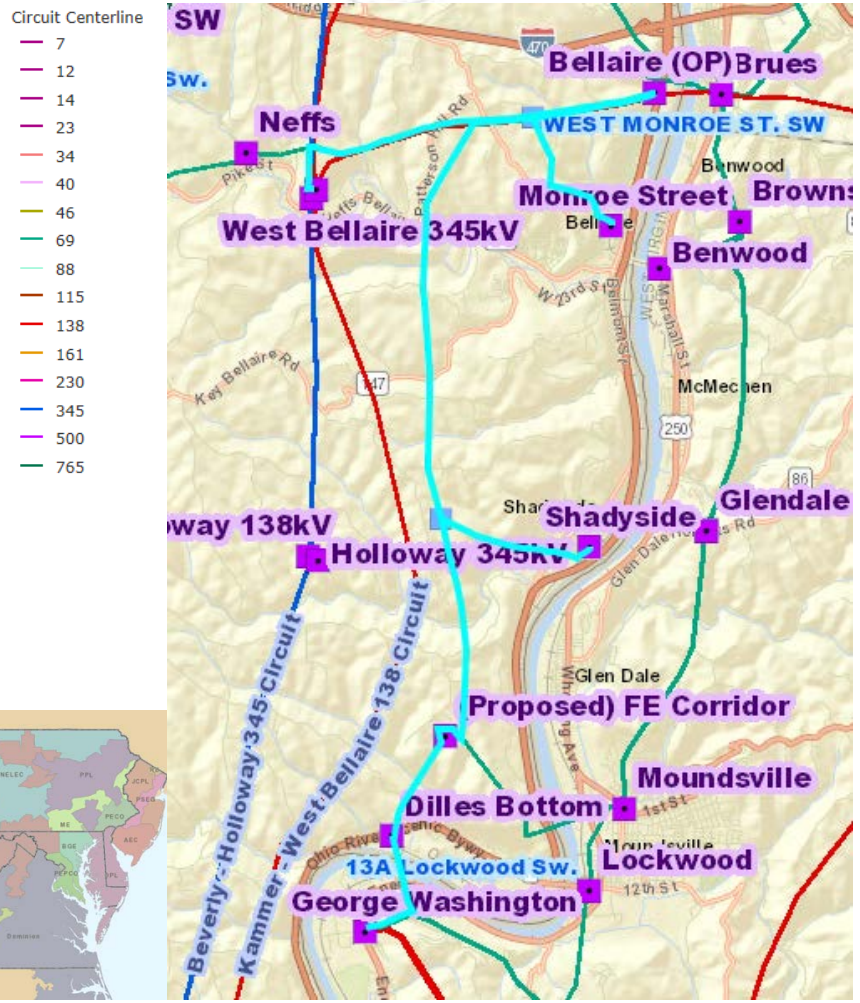

AEP Transmission Zone: Supplemental
West Bellaire-Moundsville 69kV Circuit Rebuild

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The 69kV MOAB/ground-switch transformer protection scheme at Monroe Street will be replaced with a circuit switcher & relays. Note that at the Shadyside distribution station there is not sufficient space to install a 69kV circuit switcher, and the transformer is too large to permit fusing.

Customer Service:

The circuit has suffered from poor reliability historically, which will be improved through the T-Line rebuild and station upgrades. The circuit currently serves 6,100 AEP Ohio distribution customers, and 24 MW of peak load.

Potential Solution

Rebuild the West Bellaire-Moundsville 69kV circuit; utilize 795 ACSR conductor (128 MVA rating). *Note that the section from West Bellaire east to structure #31 will not be rebuilt, due to adequate condition (2.4 miles). The extension into Monroe Street will be rebuilt as a double-circuit loop. The extension into Shadyside will be mostly rebuilt as a double-circuit loop (except for final 0.5 mile, due to route constraints). Estimated Cost: $39.7M

Convert Monroe Street to in-and-out with 2- 69kV breakers; replace 12kV breakers & regulators; install 69kV circuit switcher. Remove inoperable line switches at West Monroe Street and West Shadyside. Install new 3-way MOAB switch with sectionalizing and SCADA at Shadyside. Estimated Cost: $2.6M

Total Estimated Transmission Cost: $42.3M

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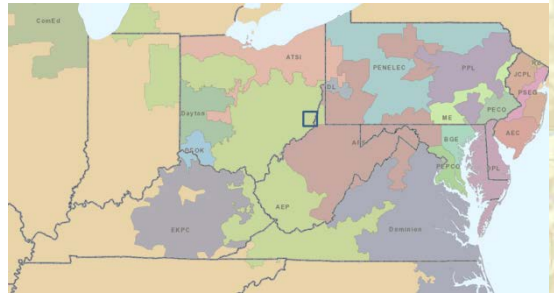

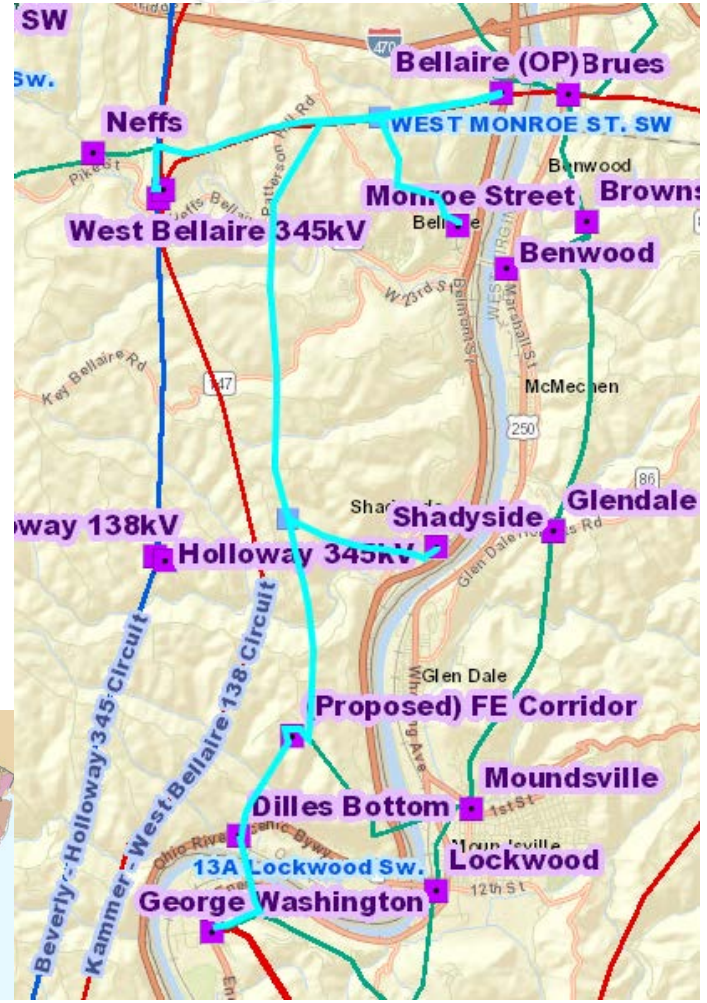

AEP Transmission Zone: Supplemental
West Bellaire-Moundsville 69kV Circuit Rebuild

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Alternatives:

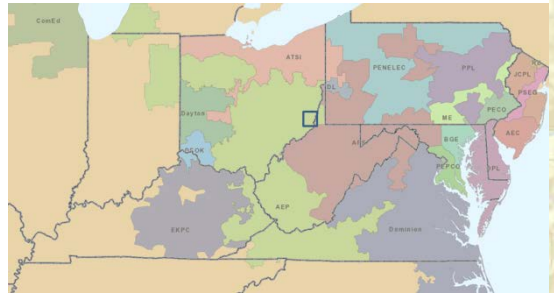
For the T-Line, no viable cost-effective alternative exists, due to the poor condition. Various T-Line route alternatives were evaluated by AEP T-Line, Right-of-Way, Siting and Outreach personnel. These alternatives would have potentially followed the Ohio River & Route 7 and traversed through the cities of Bellaire and Shadyside. However, due to the dense residential areas involved, the challenging terrain near the river and major highway, this T-Line re-route alternative was ultimately eliminated from consideration. It would have likely faced considerable public opposition and construction challenges. Cost is comparable to chosen project, due to less T-Line mileage involved, but more ROW, Siting and Outreach costs on the greenfield line route.

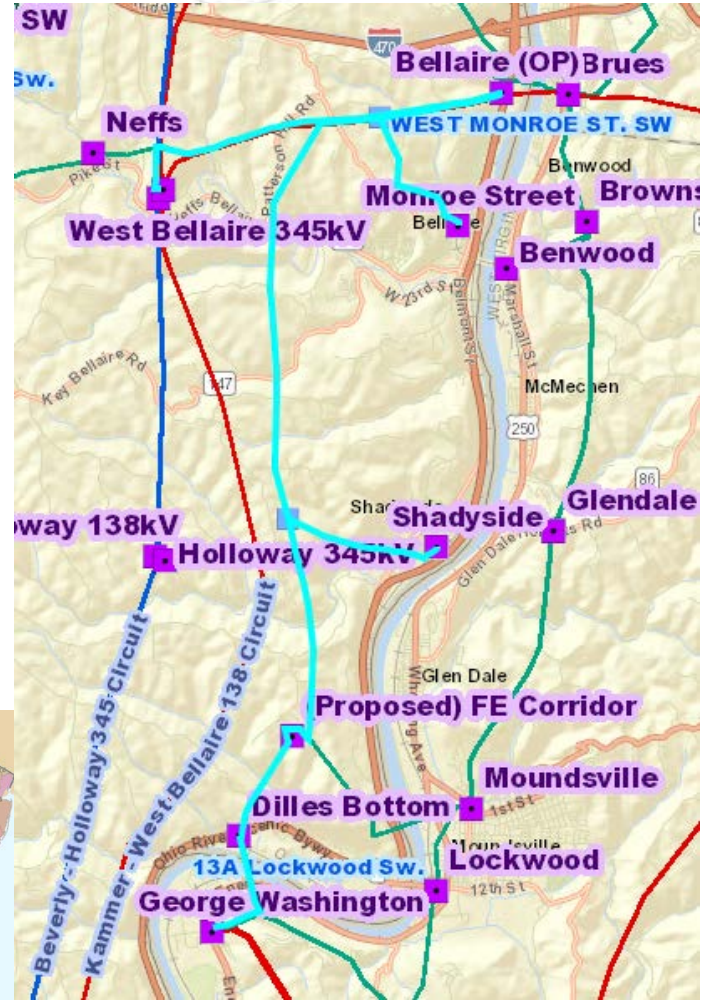
Also, the first 2.4 miles of 69kV T-line leaving West Bellaire was found to be in adequate condition (rehabbed/reconductored in the 1970's) and will not be touched as part of this project. This represents a savings of $4-5 million, compared to rebuilding the entire 69kV circuit.

Bringing double-circuit 138kV into the town of Shadyside isn't feasible, due to dense housing. In addition, Distribution would have to convert their station from 69 kV to 138 kV. Eliminating the Shadyside-Monroe St 69kV section would create a 69kV "island" of load only sourced from West Bellaire 69kV (Monroe Street & Bellaire stations). This is not as reliable as having 2 independent sources of 69kV power (from West Bellaire & Moundsville), as a West Bellaire 69kV bus fault would take out the source and drop customer loads. With this 69kV removal plan, we'd lose a 69kV source to West Bellaire and to Moundsville. For various N-1-1 contingencies in the area, it is beneficial for each station to remain networked to the other.

Projected In-service: 12/01/2022

Project Status: Scoping





AEP Transmission Zone: Supplemental Whitaker Station Rebuild

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 34.5/12kV Transformer #2 at Whitaker Station, manufactured in 1973, is showing signs of deterioration. The unit has extremely high values of combustible gasses and carbon dioxide. The unit has experienced overheating temperature faults. Also, the interfacial tension is extremely low proving that the oil is in poor condition. The LTC DGA values are high for Ethylene and the LTC compartment shows visible leaks. Drivers for replacement of the transformer include breakdown in dielectric strength (insulation system), short circuit strength (winding short circuit strength breakdown due to magnitude of short circuit fault events), oil quality issues and accessory problems (bushings, pumps etc.).

The 12kV Circuit Breakers A and B manufactured in 1968 are oil filled breakers without oil containments. 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. Breaker A has had 221 fault operations and breaker B has had 84 fault operations. The manufacturer recommendation is 10 for this type of breaker. The Breakers have numerous issues related to age, wear, PCB content, maintenance issues and no repair part availability.

Adding the Bus Tie Circuit breaker will keep the distribution customer energized when we lose one of the two lines serving this station.

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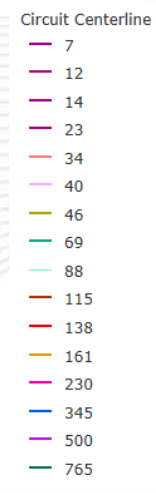

AEP Transmission Zone: Supplemental Whitaker Station Rebuild

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Potential Solution

At Whitaker Station, install one 69kV, 40 kA, 3000A Bus Tie Circuit Breaker along with associated distribution work to rebuild the station. **Estimated Cost:** $1.2M

Rebuild Whitaker - Kline 34.5kV for Distribution under-build. **Estimated Cost:** $0.5M

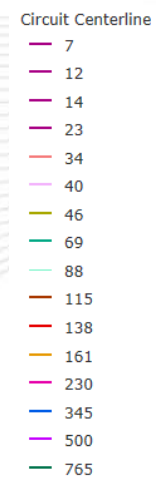
Total Estimated Transmission Cost: $1.6M

Alternates

Rebuild station in existing footprint. This would require an extended customer outage. Due to this and the extensive nature of the rebuild, this alternative was not chosen.

Projected In-service: 12/01/2018

Project Status: Scoping



Second Review

Baseline Reliability and Supplemental Projects

DEOK Transmission Zone: Supplemental
Princeton – Port Union 69 kV Feeder Rebuild

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:
The 69 kV feeder between Princeton and Port Union substations is aged and in deteriorating condition (1950's era).

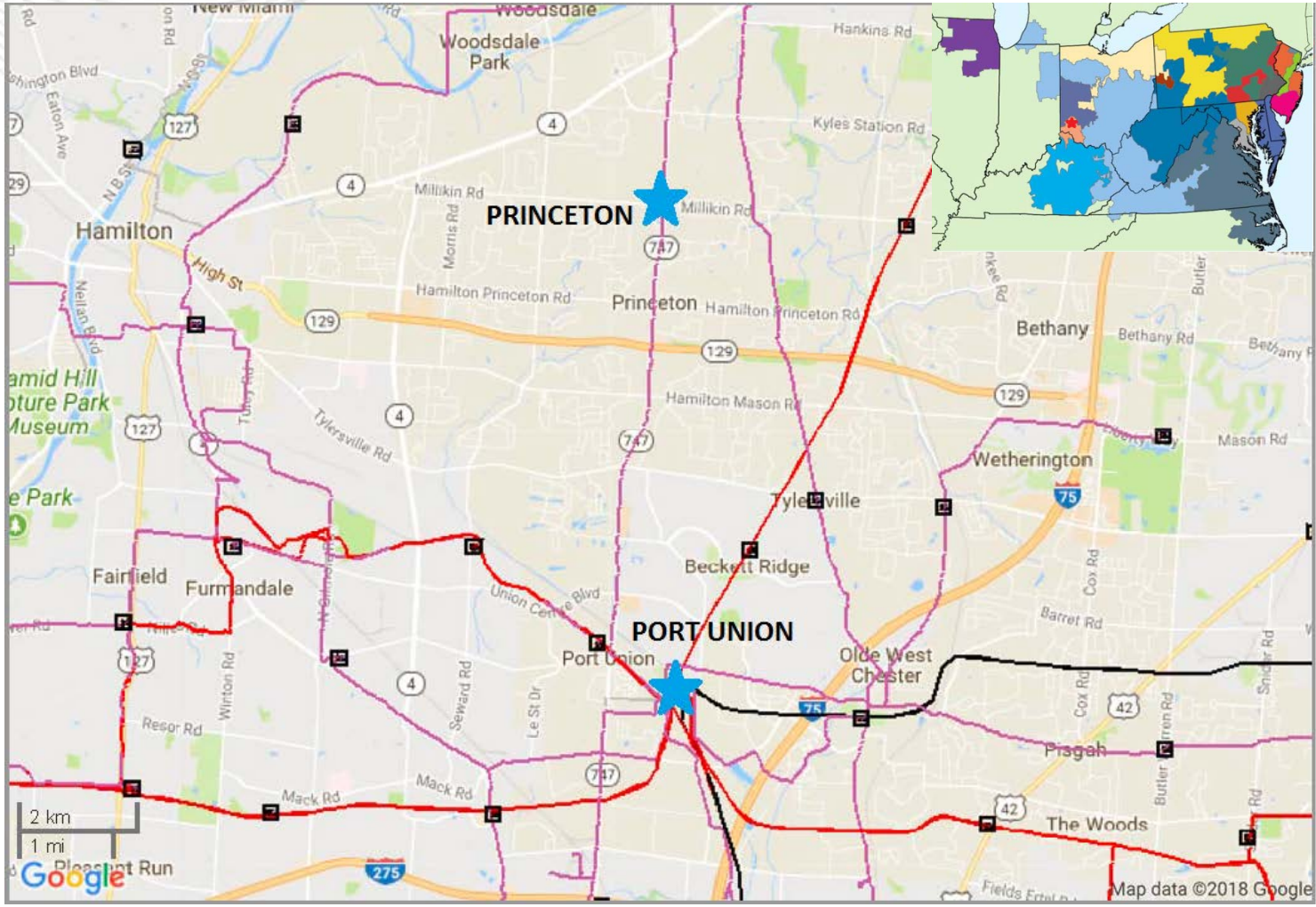
Driver: Equipment Material Condition, Performance and Risk

Selected Solution:
Rebuild 5.8 miles of feeder between Princeton and Port Union substations with 161 new structures, hardware, and conductor. Capacity of the line will increase from 99 MVA to 121 MVA (terminal eq. limited). (S1587)

Estimated Transmission Cost: $7.5 M

Projected In-service: 12/1/2018

Project Status: Scoping



DUQ Transmission Zone: Supplemental Panther Hollow Cut in

Previously Presented: 3/27/2018 SRRTEP

Problem Statement (Scope):
The Oakland 138-23kV substation has exceeded its capacity to reliably serve the increased and projected distribution load growth in the area. The Oakland substation has a peak distribution load of 204MVA.

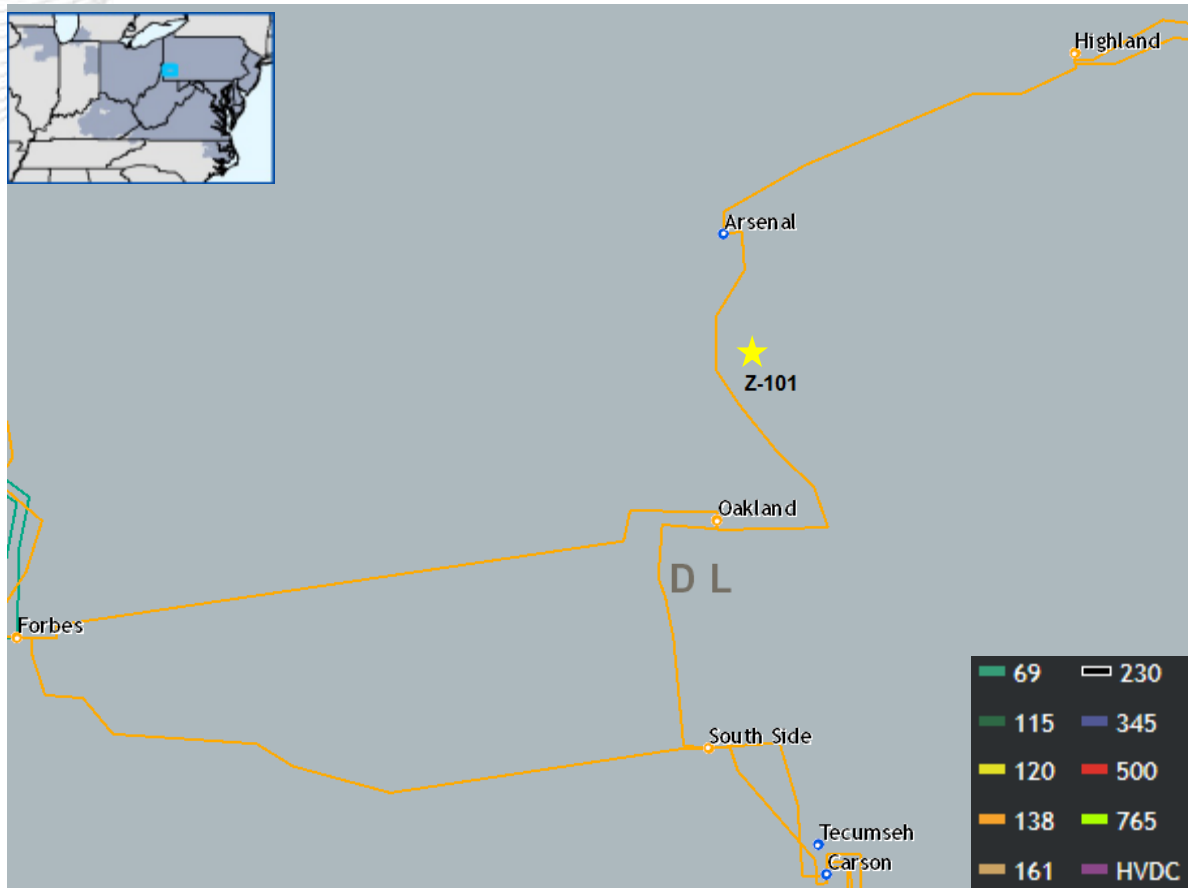
Drivers: Customer Service, Operational Flexibility and Efficiency

Selected Solution:
Establish a new 138-23kV substation (Panther Hollow) utilizing the existing Arsenal-Oakland (Z-101) 138kV circuit as a looped transmission source. (S1588)

Estimated Transmission Cost: $16.8M

Projected In-Service Date (Expected IS Date): 5/31/2020

Status: Conceptual



AEP Transmission Zone: Supplemental Mink Station

Previously Presented: 2/17/2018 SRRTEP

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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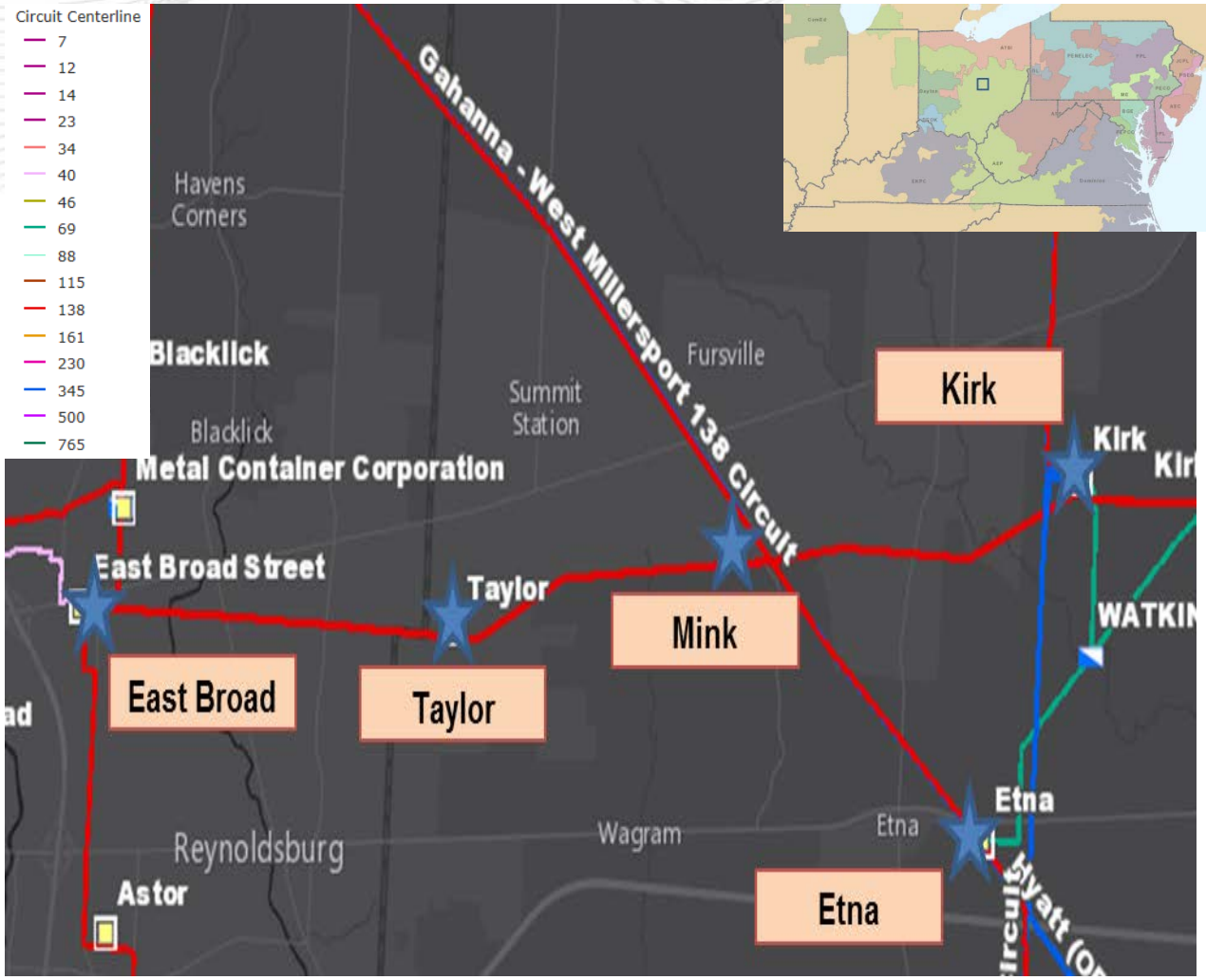

AEP Transmission Zone: Supplemental Mink Station

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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). (S1561.1)

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. (S1561.2)

Estimated Cost: $5.1M

East Broad Station: Replace circuit breakers 5 and 6 and line relaying with 2-138kV 3000A 63kA circuit breakers. (S1561.3)

Estimated Cost: $1.5M

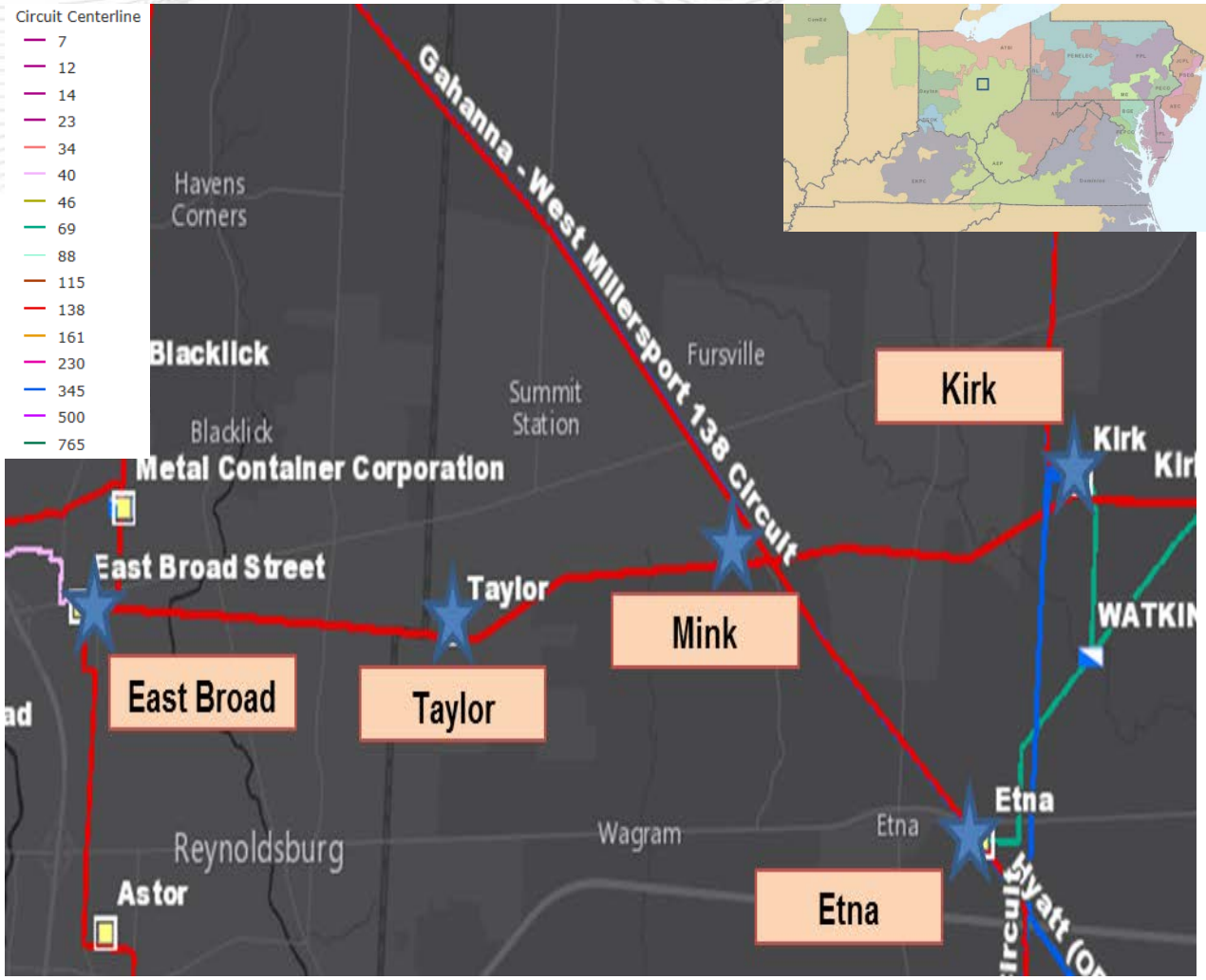
Taylor Station: Remote end relaying. (S1561.4)

Estimated Cost: $0.3M

Total Estimated Transmission Cost: $7.5M

Projected In-service: 6/29/2018

Project Status: Under Construction



AEP Transmission Zone: Supplemental Auburn Breakers

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Auburn 69 kV circuit breaker 'A' is a 600 A, GE 'FK' oil-filled breaker installed in 1956 and circuit breaker 'D' is a 1200 A, GE 'FK' oil-filled breaker installed in 1957. In general, oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. Oil spills are frequent with failures and routine maintenance which is also an environmental hazard.

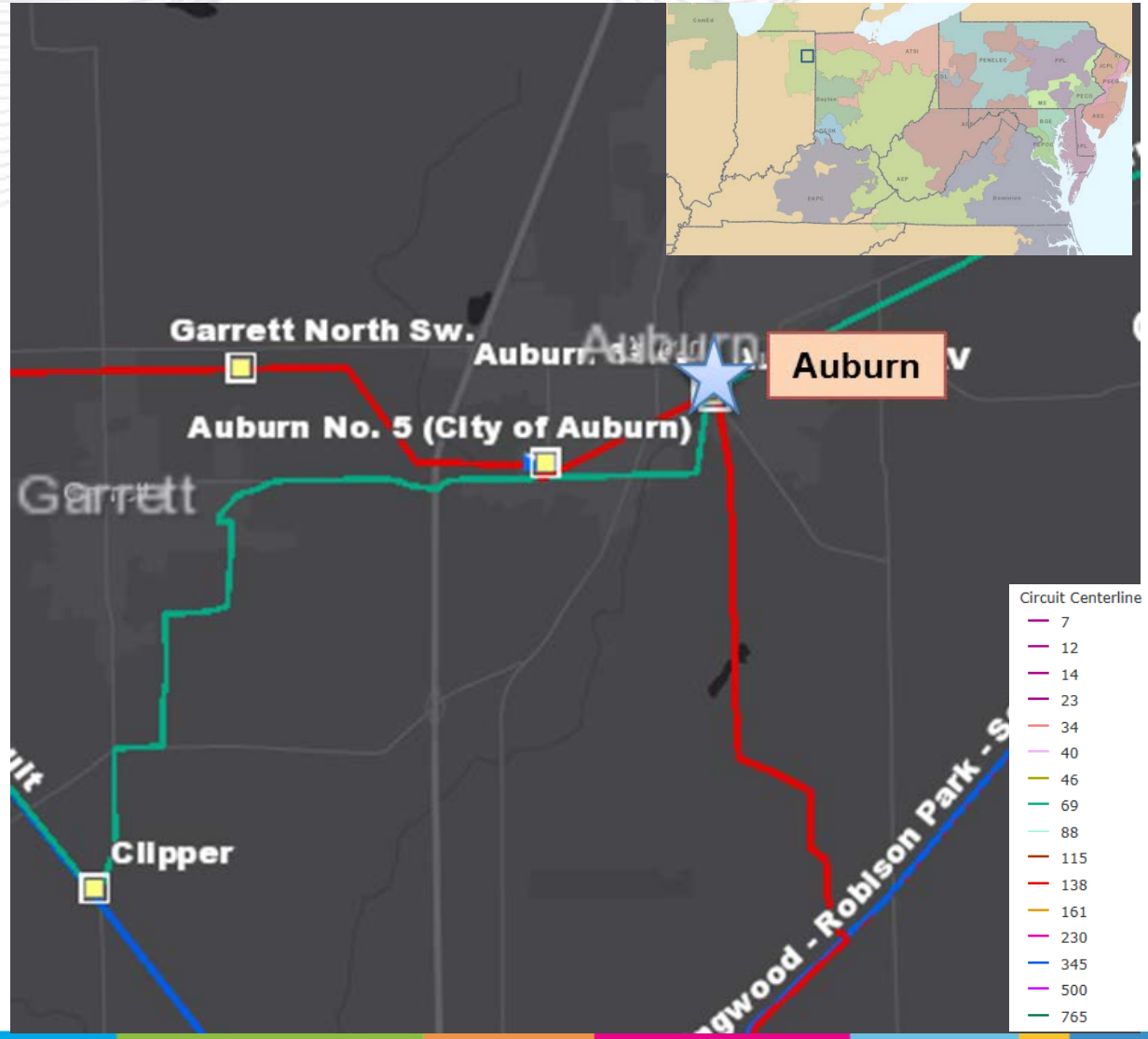
Selected Solution:

At Auburn station, replace 69 kV breakers "A" and "D" with 40 kA, 3000 A, 69 kV circuit breakers. (S1589)

Estimated Transmission Cost: $1.6M

Projected In-service: 6/1/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Butler Station

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Butler 69 kV circuit breaker 'A' is a 1200 A, GE 'FK' oil-filled breaker installed in 1957. In general, oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. It has also operated through 68 fault operations, exceeding the manufacturer recommendation of 10. Oil spills are frequent with failures and routine maintenance which is also an environmental hazard. Capacitor Switchers "AA" and "BB" are Mark types which no longer work with modern relaying packages causing protection and coordination issues.

Operational Flexibility and Efficiency

Replace Butler station MOABs "X" and "Y" with 69 kV CBs to improve the reliability of the Auburn-Hamilton 69 kV circuit. Currently, Hamilton Station is fed radially out of Butler Station (along with two hard tapped customers) on a ~7.5 mile radial line which is susceptible to dropping load for faults on the Auburn-Butler 69 kV circuit momentarily due to existing MOAB line protection. In addition, customers served from Butler station will also benefit from the MOAB upgrades to circuit breakers at Butler Station, eliminating exposure to line faults.

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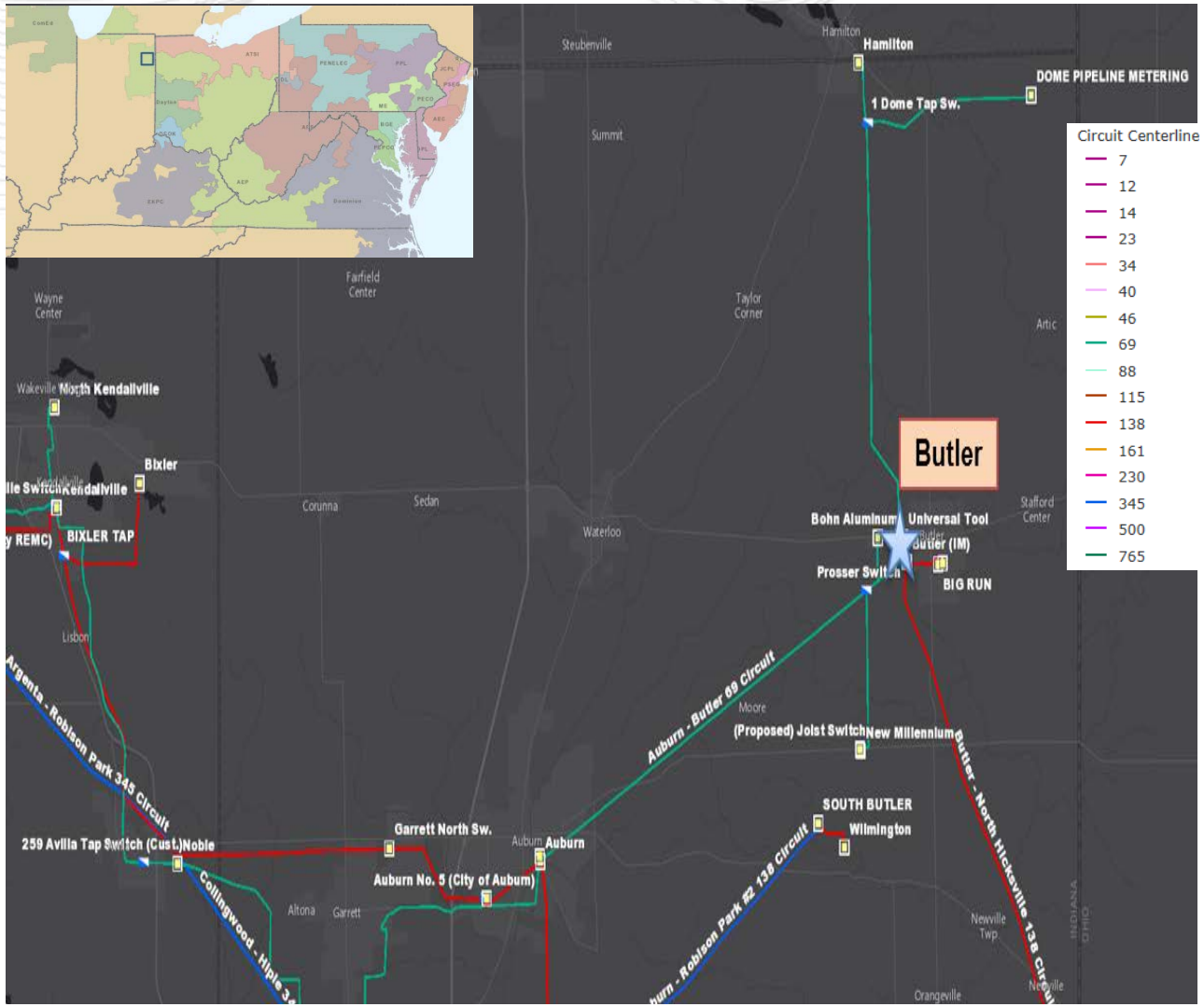

AEP Transmission Zone: Supplemental Butler Station

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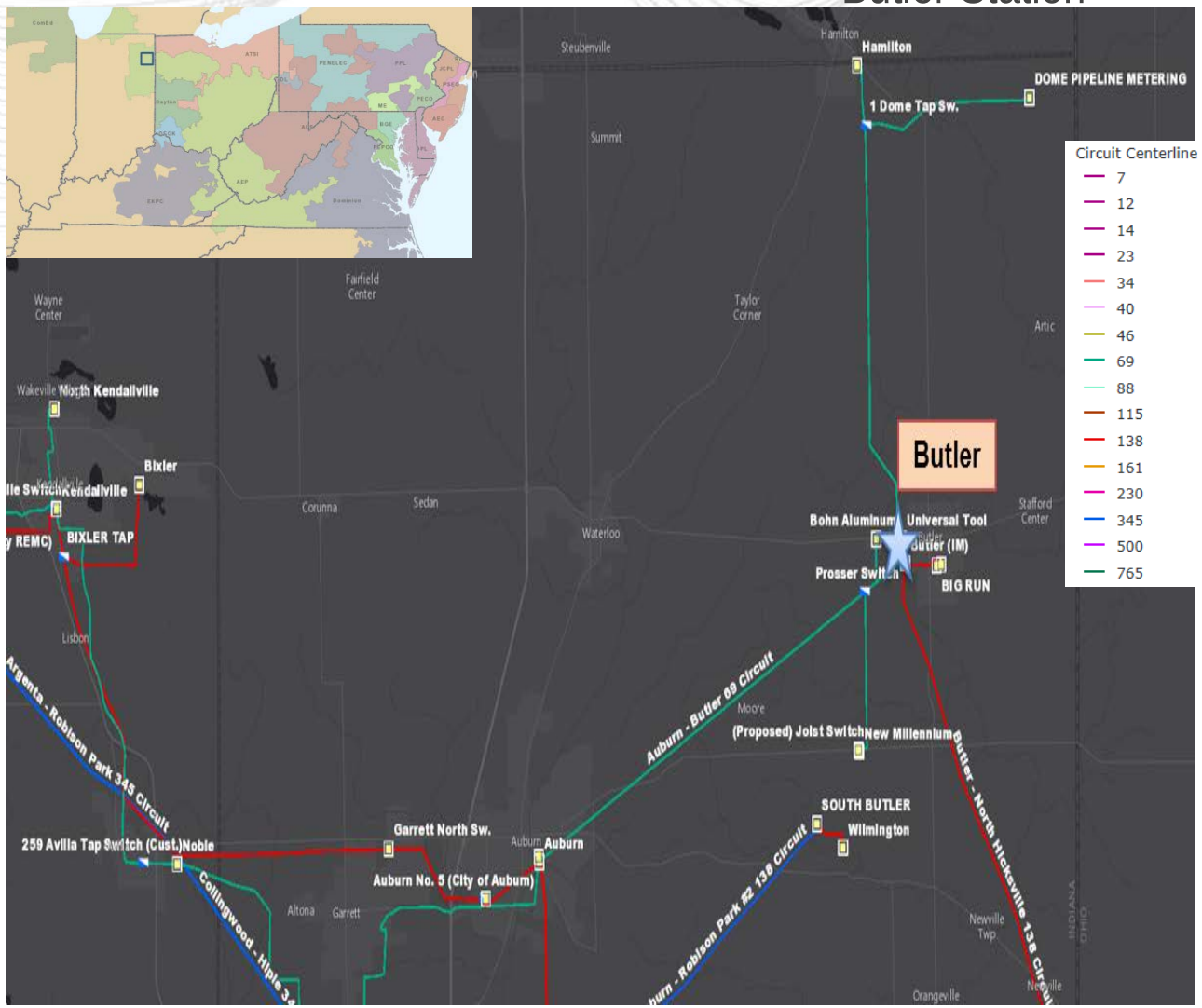
Selected Solution

At Butler station, replace 69 kV breaker “A”, replace 69 kV MOABs “X” and “Y” with 69 kV breakers, replace 69 kV cap switchers “AA” and “BB” (S&C Mark V) with 3000 A, 40 kA circuit breakers. (S1590)

Estimated Transmission Cost: $2.5M

Projected In-service: 6/1/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
East Huntington Station

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The existing 34.5 kV circuit breakers “A”, “D”, “E”, “H”, and “I” at East Huntington are all 1800 A 27 kA FK oil type breakers that are all 46 years old. 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. Other drivers include damage to bushings and an excessive number of fault operations exceeding the recommendations of the manufacturer. East Huntington breakers “A”, “D”, “E”, “H”, and “I” have experienced 10, 13, 14, 16, and 10 fault operations respectively. The manufacturer’s recommendation for this type of breaker is 10.

Operational Flexibility and Efficiency

Circuit switchers will be added to the high side of transformers #1 and #4 at East Huntington station to separate dissimilar zones of protection.

A 138 kV bus-tie circuit breaker will be added at East Huntington to better sectionalize the four transformers currently off the single 138 kV bus.

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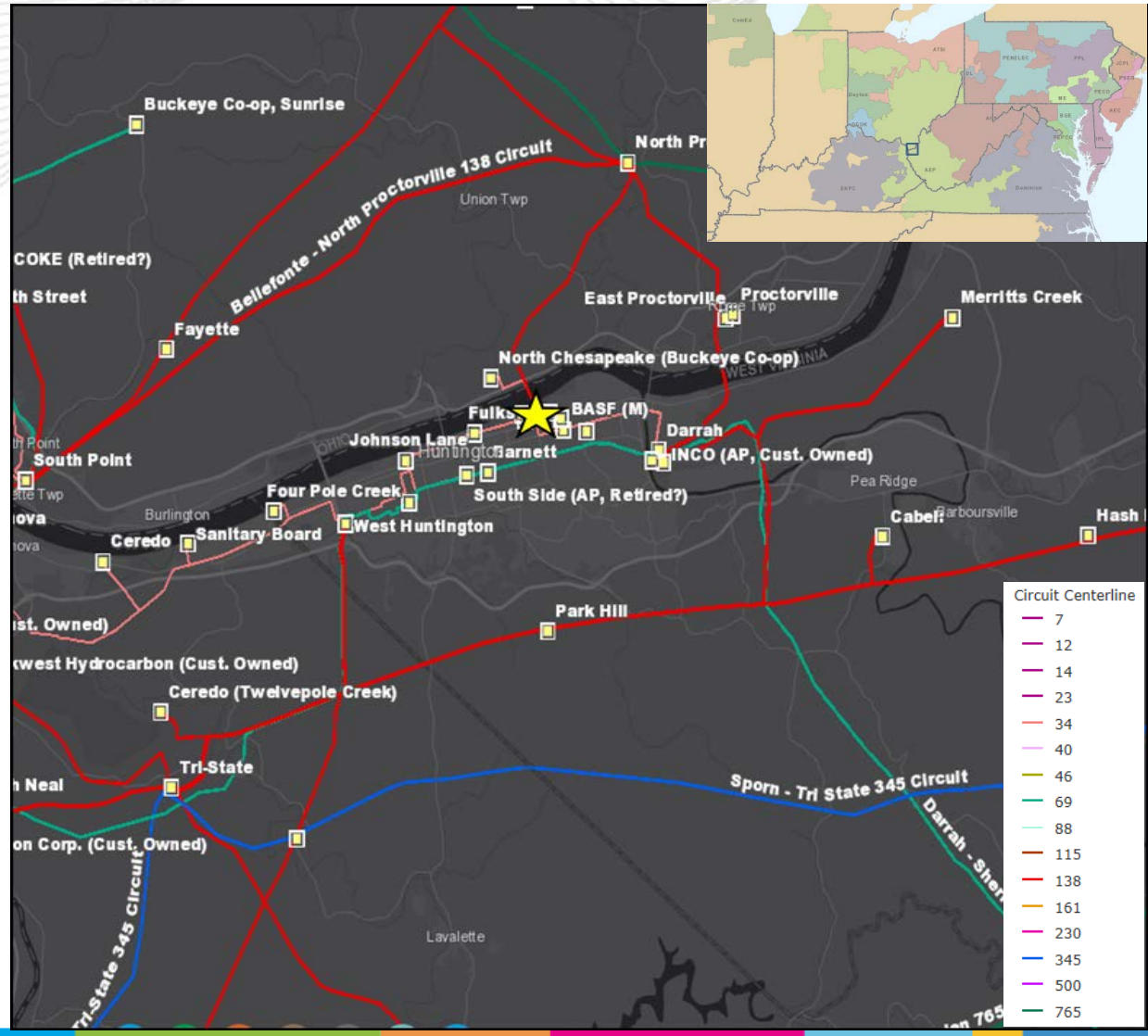

AEP Transmission Zone: Supplemental
East Huntington Station

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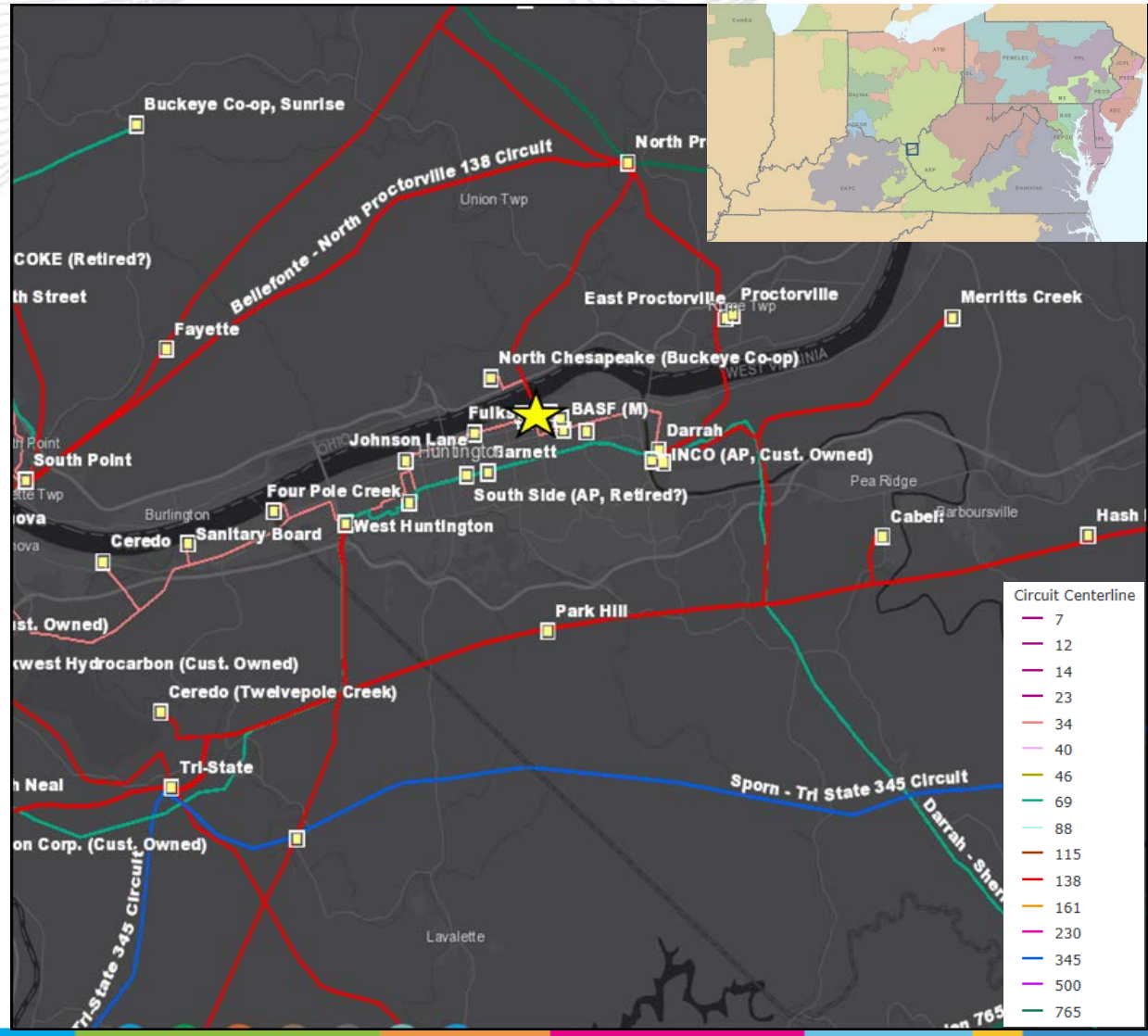
Selected Solution

At East Huntington station, replace 34.5 kV circuit breakers “A”, “D”, “E”, “H”, and “I” with new 3000 A 40 kA 34.5 kV circuit breakers. Add 3000 A 40 kA 138 kV circuit switchers to the high side of East Huntington transformers #1 and #4 to replace the existing Ground Switch MOAB’s. Install a new 3000A 40 kA 138 kV circuit breaker to split the existing single 138 kV bus. Add a fuse to the high side of the 34/12 kV transformer #2. (S1591)

Estimated Cost: $4.5M

Projected In-service: 6/1/2020

Project Status: Scoping



AEP Transmission Zone: Supplemental
Elkhart Network

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Customer Service:

This is an AEP Distribution driven project. The Elkhart UG Network is presently served via 2-34.5 kV Feeders and 2- 4 kV feeders from Elkhart Hydro Station. The present arrangement and configuration is not in compliance with the AEP Distribution Network Planning Criteria regarding UG primary feeder separation and UG secondary replacement. Harrison Station and it's two 69/13.8 KV transformers is necessary to allow the redesign and reconfiguration of the UG Elkhart Network system by 12/2018. Specifically Harrison Station will provide 4-13.8 kV feeders which will allow the separation of the UG Primary and compliance with the AEP Distribution Network Planning Criteria. The reasoning behind this is as follows: The UG Elkhart system is being designed for mixed contingency operation, shall have the feeders arranged with no more than two feeders of the same network in common duct, manholes or vaults, and shall have the feeders connected so that loss of no single duct bank, manhole or vault causes an outage to any network customer, including the single-contingency portions all per AEP Distribution Network Planning Criteria and Distribution Network Systems Center of Excellence.

The current Harrison St station is fed from a radial 34.5kV sub transmission line which would need to be looped and rebuilt to provide a high level of reliability for the network. The decision was made to rebuild at 69kV to modernize the transmission into the Elkhart area and prepare for further revitalization plans by the city. The transmission work will also convert Lusher station to 69kV operation upgrade facilities at Dunlap and Concord stations. Elkhart Hydro will have all network facilities retired and distribution equipment replaced that is at the end of its engineered life.

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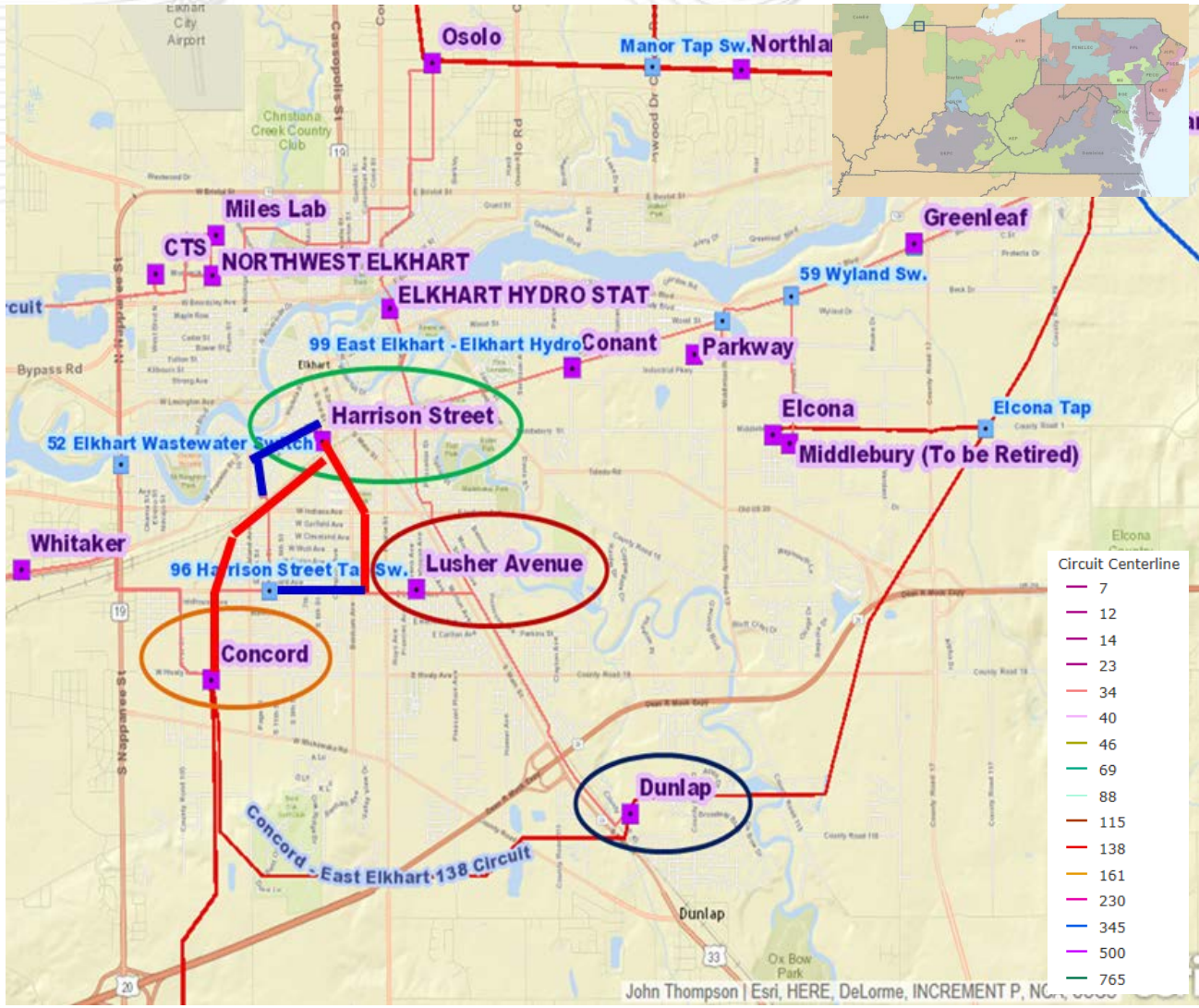

AEP Transmission Zone: Supplemental
Elkhart Network

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Equipment Material/Condition/Performance/Risk:

Elkhart Hydro is a station that presently supplies the Elkhart underground distribution network via two 1950's vintage 34.5/4 kV transformers. The 34.5/4 kV GSU transformer 1 at Elkhart Hydro Substation has high values of ethylene and carbon oxides that began increasing in 2004. The CO/CO2 ratio has been fluctuating between the warning and alarm limit since 2005 indicating that this unit has degraded paper insulation. Additionally, the interfacial tension and power factor are trending in a direction that shows degradation of the transformer oil. This unit has aged insulating materials. The 34.5/4kV transformer 2 at Elkhart Hydro Substation has low values of combustible gasses. The 34.5/12kV transformer 3 at Elkhart Hydro Substation has high values of hydrogen and carbon oxides that have been steadily rising since 1993. The hydrogen and carbon monoxide fluctuate in a similar manner and the unit has experienced partial discharge events. Additionally, the interfacial tension indicates that the oil is in poor quality and the moisture content is high. The transformer insulating system is degraded. Elkhart Hydro station 4 kV equipment is indoor, obsolete, characterized by very compact clearances, and has a vintage estimated in the 1920's. The 1975 vintage 34.5/12kV transformer 2 at Lusher Avenue Substation has an extremely high value for Ethane. This unit has experienced overheating faults which has deteriorated the paper insulation. The 1970 vintage 138/12kV transformer 1 and 1976 vintage transformer 2 at Dunlap Substation has high carbon dioxide values and the bushing dielectric data. The unit has low values of combustible gases.

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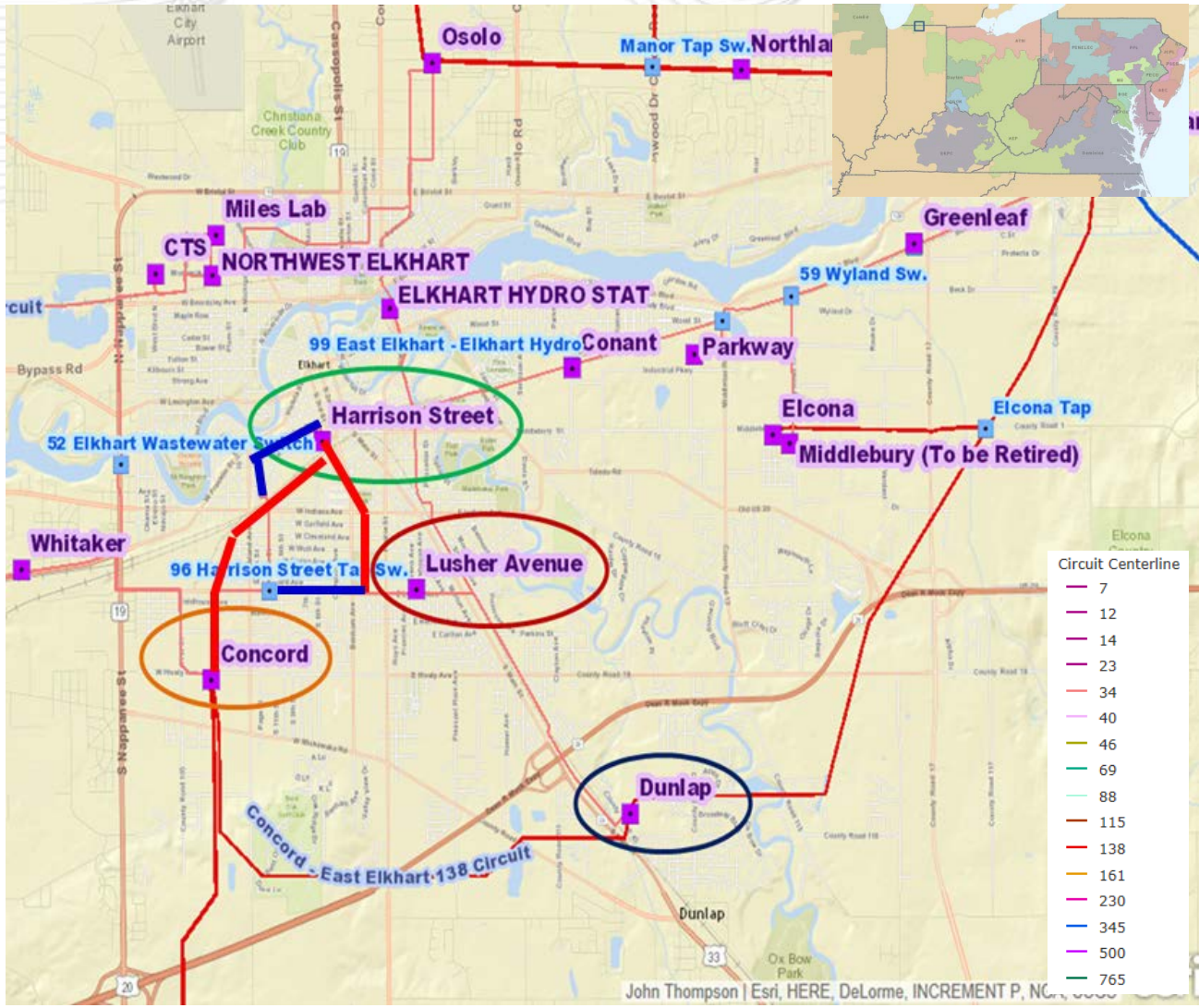

AEP Transmission Zone: Supplemental Elkhart Network

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The 1950's and 1960's vintage 34.5kV circuit breakers A, D, E, F, G, and H, at Elkhart Hydro Substation have operated through 38, 26, 30,18 & 4 fault operations. The 1987 vintage 34.5kV Cap Switcher J has operated through 44 fault operations. The 1952 vintage 34.5kV circuit breakers A and B at Lusher Avenue Substation have operated through 8 & 14 fault operations. The 1972 vintage 34.5kV circuit breakers H and J at Dunlap Substation have operated through 28 & 45 fault operations. These Circuit Breakers are oil filled FK-breakers without oil containment. These breakers have the following documented conditions: age; bushing problems; unavailability of spare parts; lifetime fault operations count; and high moisture readings. In general, oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. Oil spills are frequent with failures and routine maintenance which can be an environmental hazard. All these circuit breakers are above the manufacturer recommended limit for full fault operations except the 34.5kV circuit breaker H at Elkhart Hydro and A & J at Lusher Avenue.

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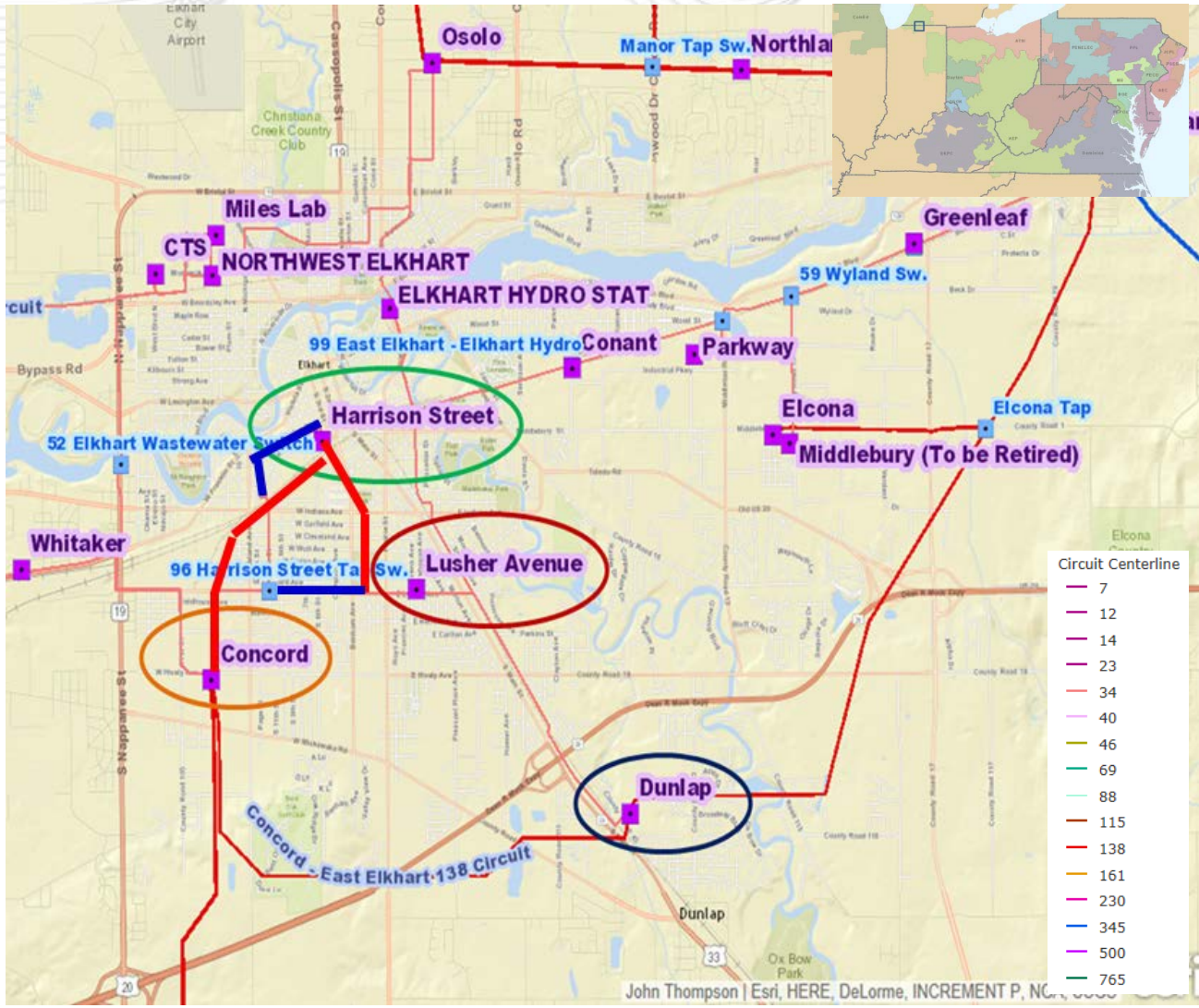

AEP Transmission Zone: Supplemental
Elkhart Network

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Selected Solution

Rebuild Harrison Street station as a 69kV ring bus station using 3000A 40kA breakers. (S1592.1) Estimated Cost: $4.2M

Rebuild Lusher Avenue as a 69kV station using a DT1 FK F1 3000A 40kA model bus tie breaker with 2 MOABS on the line exits. (S1592.2) Estimated Cost: $1.8M

Install a 69kV 3000A 40kA breaker at Concord station toward Harrison Street. Install a 69kV (34.5kV operated) 3000A 40kA breaker at Concord station toward AE COMP. (S1592.3) Estimated Cost: $2.3M

At Dunlap Station replace transformer 2 with a 138/69-34.5kV 90MVA transformer. The transformer will have a high side 3000A 40kA circuit switcher. Install two 138kV line breakers using 3000A 40kA breakers. Replace circuit breaker 'H' and 'J' with 69kV 3000A 40kA models. (S1592.4) Estimated Cost: $11.6M

Rebuild Elkhart Hydro to 69kV standards but operate it at 34.5kV. Replace circuit breaker 'F' and 'A' with 3000A 40kA breakers. Install a 3000A 40 kA 69kV line breaker. (S1592.5) Estimated Cost: $8.7M

Remove Harrison Street Tap Switch. (S1592.6) Estimated Cost: $0.1M

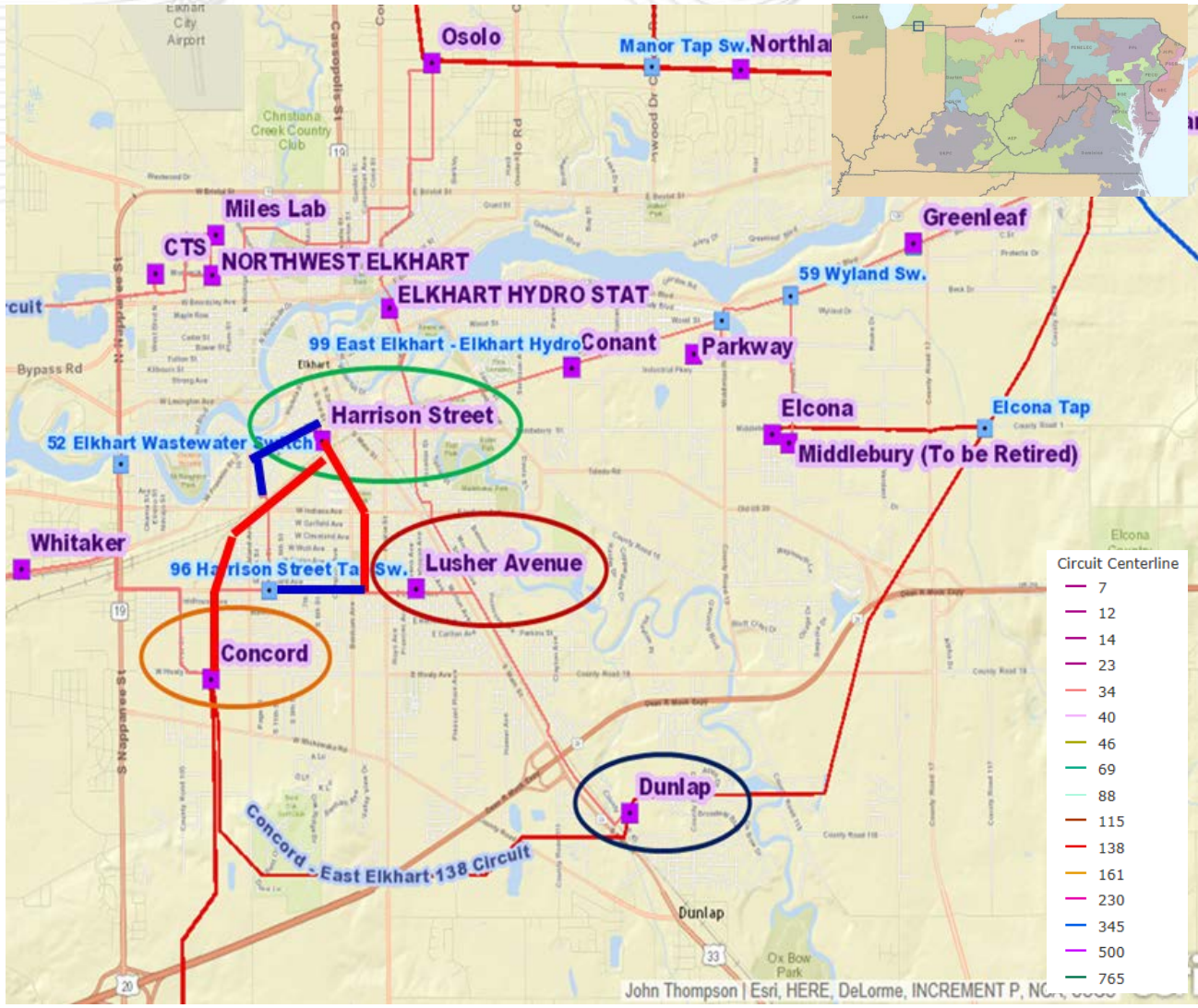
Build ~1.5 miles of line from the existing Concord – Wolf de-energized 138kV line to Harrison Street at 69kV utilizing 795 ACSR (64 MVA rating). After this, retire the line portion from AE Comp – Harrison Street. (S1592.7) Estimated Cost: $4.4M

Build ~1.5 miles from the Dunlap – Concord line to Harrison Street station. Rebuild .5 miles of the existing Dunlap – Lusher line to 69kV standards and retire the portion between Harrison Street Tap and the new line. All new line will utilize 795 ACSR (64 MVA rating). (S1592.8) Estimated Cost: $5.8M

Total Estimated Transmission Cost: $38.9M

Projected In-service: 4/1/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
Berrien Springs

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Derby Station: The 69kV CBs F, G, and H and the 34.5kV CB K at Derby Substation are oil filled GE-FK breakers. Failure of these units generally results in fire and oil spillage within the substation. The units are severely rusted and the foundation is deteriorated. These breakers have significantly exceeded the designed number of full fault operations (10) with 40, 40, 49, and 53 fault operations, respectively.

The 138/69/34 transformer was commissioned in 1961 and is also in poor condition. This bank has experienced high energy faults and has ever increasing oil contamination.

Berrien Springs Station: The two transformers are approaching 70 years of service and are all in poor condition. Also, the 34.5 kV CB's are approaching 50 years of service and have experienced numerous faults and are all in poor condition. The 34.5 kV switch yard sits on an elevated concrete platform directly above the fish ladder and lacks oil containment or proper equipment grounding (safety concern). The deteriorated condition of this platform is of significant concern. Also, all drainage around the station goes directly to the river and with this station being located below the dam on the St. Joseph River, uncontained oil spills have direct access to Lake Michigan. There's no ability to expand the 34.5/12 kV system which is an already an atypical arrangement (one of only 3 in I&M) to which distribution has previously requested replacement. The control house lacks space and the equipment is outdated and unable to communicate with our current IED relays.

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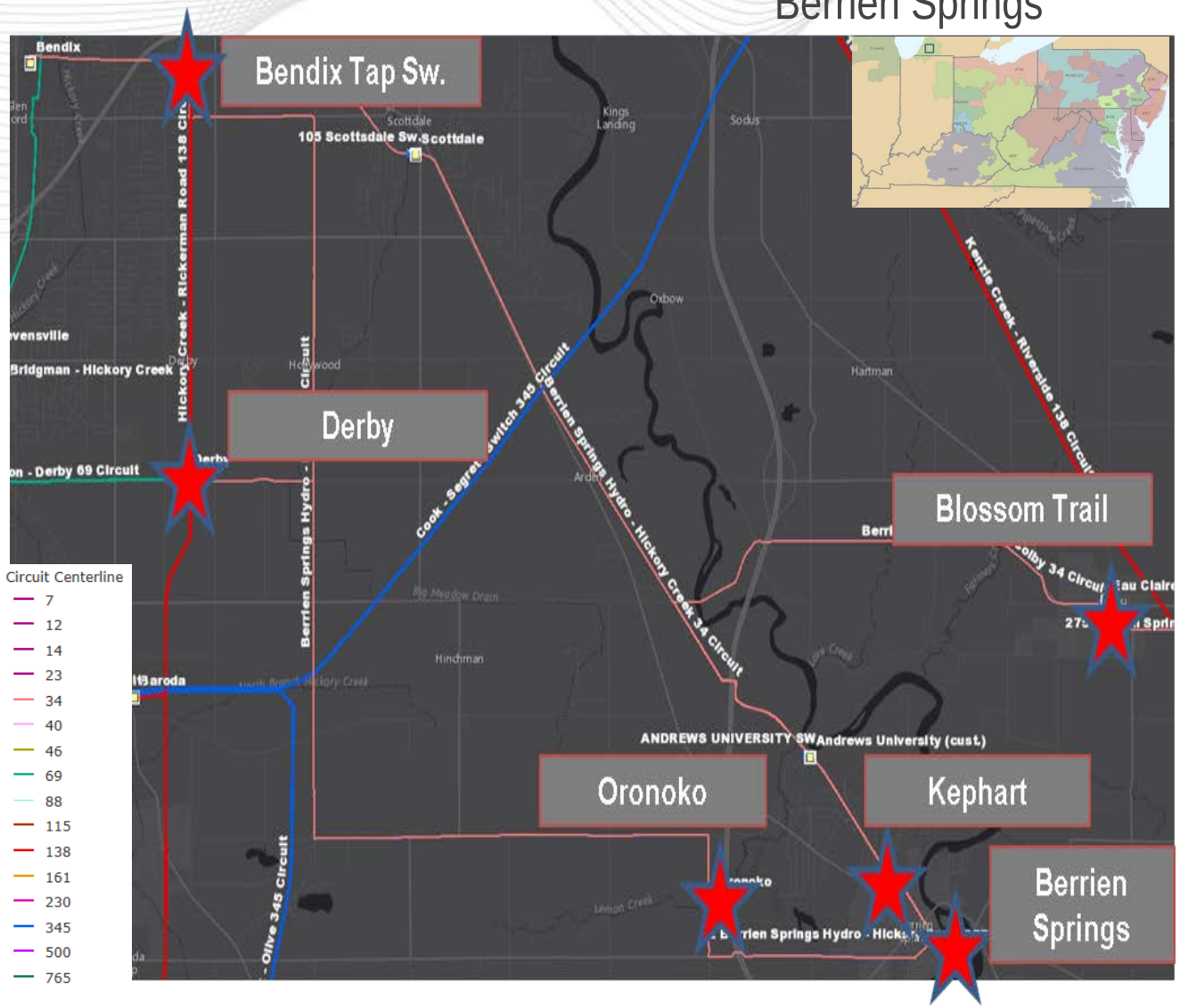

AEP Transmission Zone: Supplemental
Berrien Springs

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Oronoko Station: I&M Distribution has ongoing failures with the 34.5 kV underground terminations at Oronoko and Derby Stations. These cables are at the end of their expected life.

Line Assets: From 2014 to 2017 the Berrien Springs Hydro – Derby line was subject to 1,575,738 Customer Minutes of Interruption (CMI). The underground components of the Berrien Springs Hydro – Derby circuit were built in the 1970's. The cable manufacturing technology and insulating compounds produced during this time period results in contaminant levels far exceeding today's standard; this notion is accepted in the utility industry. Formation of cable tress inside the insulation layer leads to ever increasing risk of electrical breakdown and failure. The high end of life expectancy for cables of this vintage is generally predicted to be at 35-40 years of age. Additionally, the component that is part of the Derby Tap Line Asset is a non-standard size of the XLPE (cross-linked polyethylene) cable. In November of 2015, there was a failure on the phase 2 cable entrance at Oronoko which led to a 50 day outage. In April of 2016, there was a failure on the Phase 1 cable on the Derby Tap which resulted in a 79 day outage. The Berrien Springs Hydro – Derby circuit was built with wood structures and mostly 4/0 ACSR conductor. The total open conditions, 226, date from 2009 – 2017. Some of the structure conditions reported were broken and split cross arms, disconnected x-braces and rot. Currently, 119 of the 462 structures have at least one open condition.

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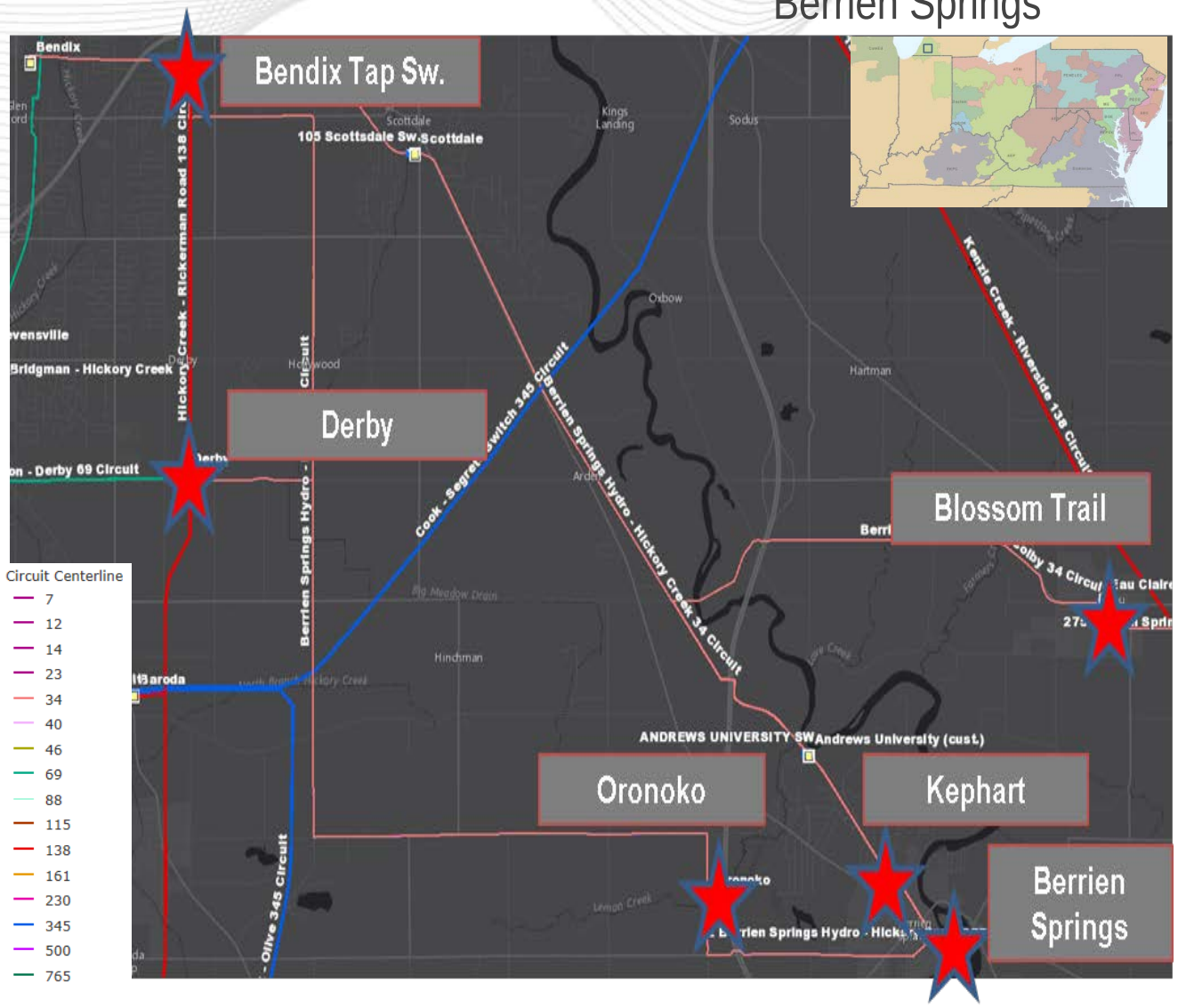

AEP Transmission Zone: Supplemental
Berrien Springs

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Operational Flexibility and Efficiency

Historically the loss of the Hickory Creek and Derby sources have resulted in low voltages and voltage instability. DDC has reported that the voltage switching transients during 34.5 kV operations are approaching 8 volts (on a 124 volt base) when a lose of Hickory Creek 34.5 kV is experienced. The remoteness of AEP's Berrien Springs Hydro generation from stronger 138 or 69 kV systems has long been an issue. The introduction of a new 138 kV source near Eau Claire, MI would provide the opportunity to strengthen the grid and restore stability to the area with 138/69/34.5 kV transformation. This project will also prepare our 34.5kV network for future 69kV conversions and will eliminate drop and pickup issues when transferring distribution loads.

The Berrien Springs Hydro – Derby line is a combination of underground and overhead cables. When underground and overhead are mixed, the circuit must be operated in manual reclose to protect the underground cable section from additional damage to the underground cable caused by reclosing into a fault. If for some reason a circuit is operated with automatic reclosing like an all overhead circuit, there is great risk to causing additional (catastrophic) damage to the cable if the fault is still present.

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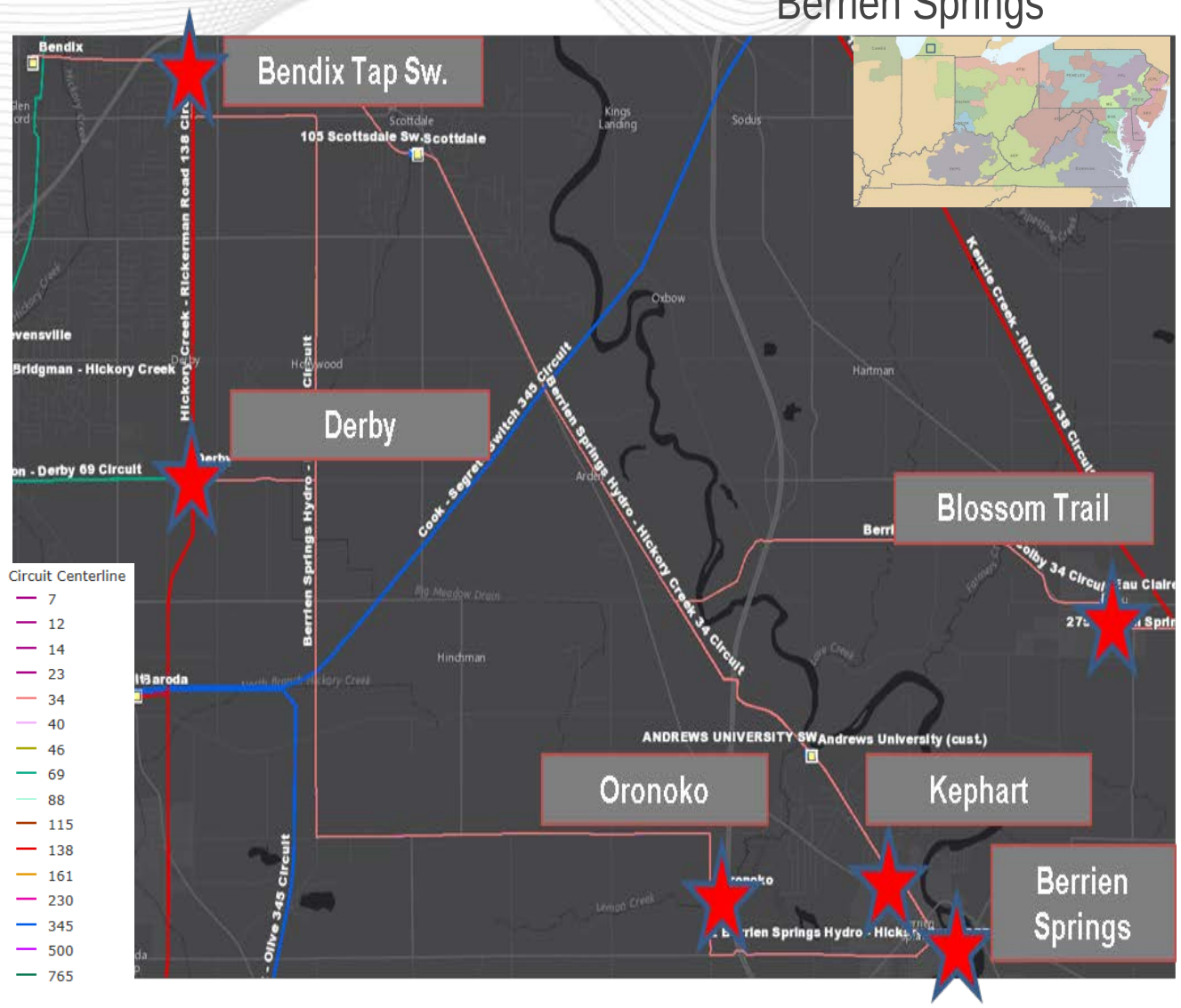

AEP Transmission Zone: Supplemental
Berrien Springs

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Selected Solution

Derby - Bendix: Relocate line exits and eliminate the need for underground 69/34kV lines at Derby. Replace Bendix Tap Sw. Pole. (S1593.1) Estimated Cost: $2.5M

Berrien Springs Hydro - Oronoko - Hickory Creek 34.5kV: Eliminate UG 69kV section at Oronoko. Rebuild ~1.3mi of 34.5 kV as 69kV double circuit. Build line extension to the proposed site for Kephart station. (S1593.2) Estimated Cost: $0.9M

Rebuild Derby station in the clear. Proposed station will have (2) 138kV CBs, (4) 69kV CBs, (1) 34.5 CB, (1) dual voltage 138-69/34.5kV transformer with a circuit switcher on the primary. (S1593.3) Estimated Cost: $4.0M

Construct a new Kephart station with (2) 69kV CBs, (1) 34.5kV CB, (1) 69/12kV transformer, (1) 69/34.5kV transformer, and (3) 12kV CB's. Construct a 69kV yard that can accommodate 34.5kV and 69kV operation. (S1593.4) Estimated Cost: $1.9M

At Berrien Springs, retire existing 34.5kV yard, concrete platform and associated transmission equipment. Install (2) 69kV CBs and replace 69kV CB "H" on the primary side of T1. (S1593.5) Estimated Cost: $2.5M

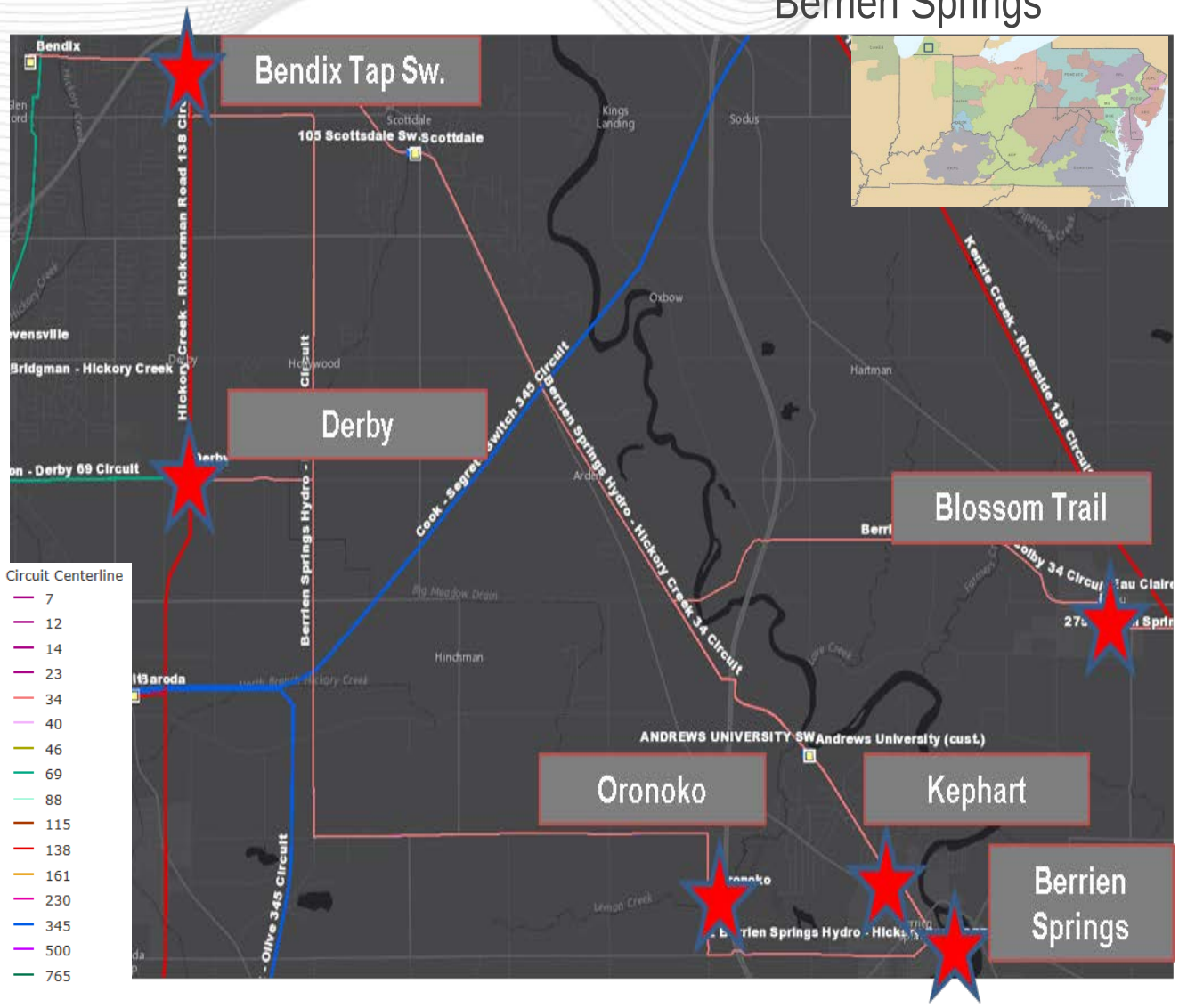
At Blossom Trail, install (1) dual voltage 138-69/34.5kV transformer, (4) 138kV CBs, (1) 138kV CS, (1) 69kV CB , (1) 34.5 CB, and (1) 34.5 ground bank. (S1593.6) Estimated Cost: $6.0M

Replace Bendix tap switch with 1200A 69kV phase over phase switch. (S1593.7) Estimated Cost: $0.6M

Total Estimated Transmission Cost: $18.4M

Projected In-service: 6/1/2020

Project Status: Scoping



AEP Transmission Zone: Supplemental
Brice Station

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Customer Service:

AEP-Ohio has requested a new 138kV delivery point capable of serving 3-50 MVA transformers to address their concerns as listed below.

- Two Distribution circuits from Astor are nearing 90% capabilities. Load transfer options are exhausted.
- One Distribution circuit from Shannon is forecasted to exceed 90% capability in 2018 and 100% capability in 2019 with confirmed additions of block loads. Only temporary load transfers can be utilized as the forecasted loads for all feeders in the area would be exhausted.
- Reynoldsburg 34.5kV/13.2kV Station (served from Distribution line) is radially fed and has no method for recovery in the event of a full station outage. This area has a history of reliability problems and complaints.
- AEP Ohio has been approached numerous times about relocating Reynoldsburg Station by the City of Reynoldsburg for economic development purposes.
- Reynoldsburg and Pataskala areas along I-70 are active residential and commercial load growth centers. No appreciable capacity left on existing facilities.
- With load transfers from Shannon Station to this station, would have ability to utilize the freed up capacity on the Shannon circuits to pick up load from of the areas served by the northern circuits out of Bixby that are starting to have capacity issues.
- With the addition of the Brice Station, we would have sufficient facilities in a very marketable location to push economic development opportunities.

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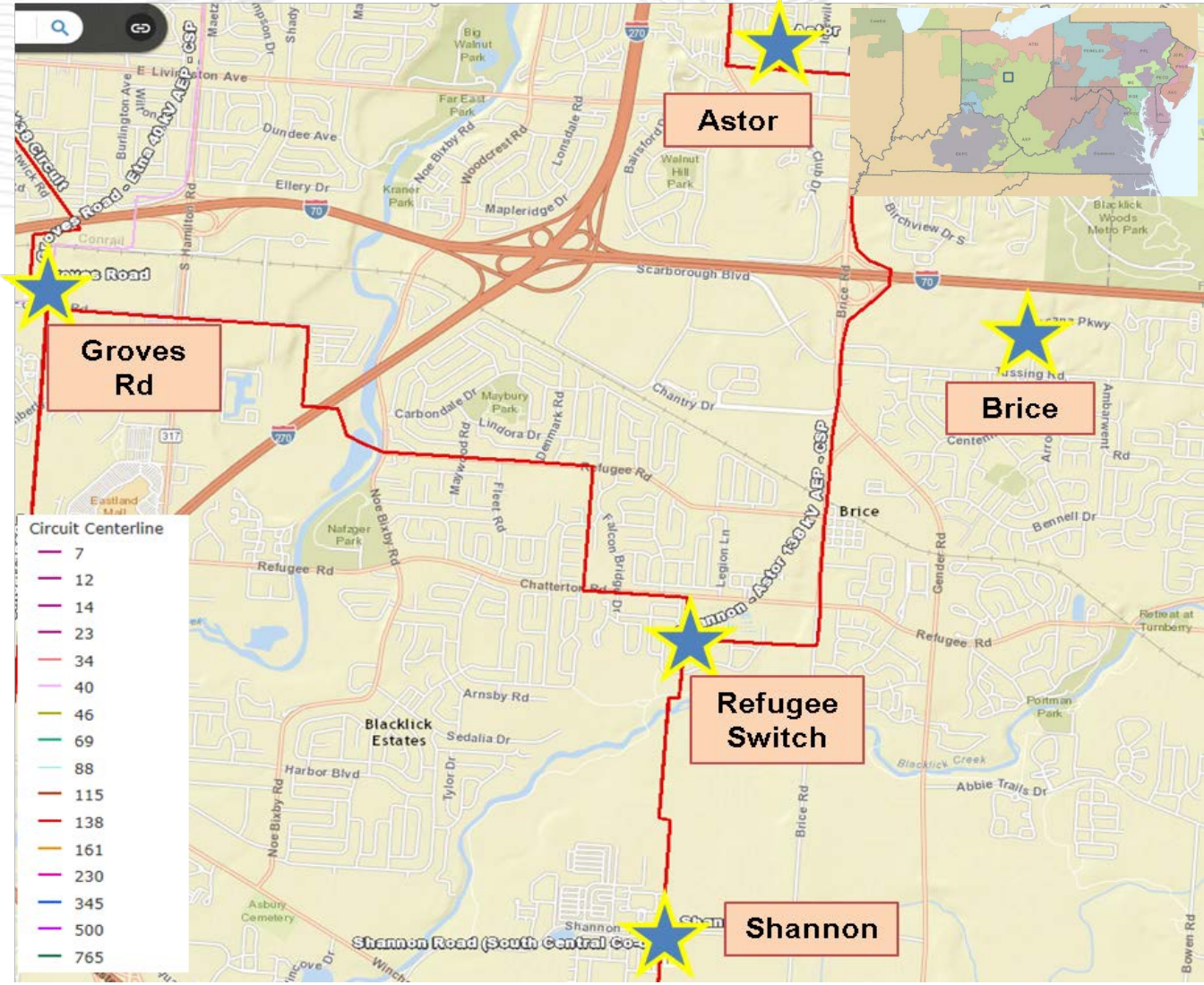

AEP Transmission Zone: Supplemental
Brice Station

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Operational Flexibility and Efficiency

Columbus is a large urban load center. AEP-Ohio routinely utilizes larger than average Distribution transformers in this area due to load density needs, distribution line routing difficulties, and other reasons. Use of such large Distribution transformers as well as unique combinations of transformer windings operated in parallel tends to put large amounts of customer load at risk. For this reason, circuit breakers will be installed at Brice.

Specifically, in the area of the new Brice station installation, the new station will cut into an existing 3 terminal line. A longer term solution will be required to address the 3 terminal line issue but, in the meantime, it is necessary to avoid increasing load and line exposure to this outdated configuration.

Selected Solution

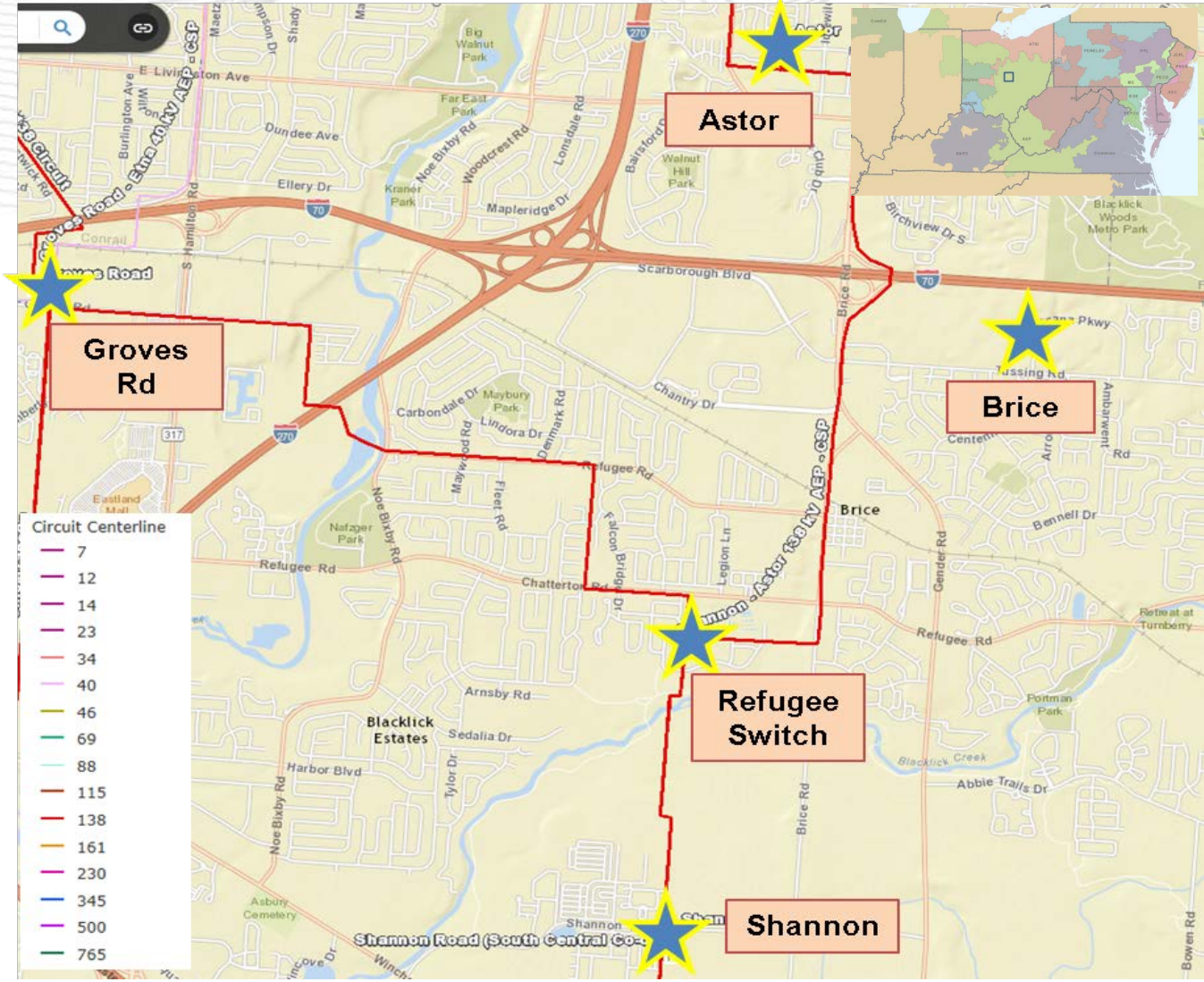
Cut into existing Astor-Groves-Shannon 138kV circuit with 0.69 miles of new double circuit 795 ACSR (257 MVA rating). (S1594.1) Estimated Cost: $0.8M

Construct a new Brice station as a ring bus laid out for breaker and a half. Install 3-138kV 3000A 40kA CB's. (S1594.2) Estimated Cost: $1.5M

Total Estimated Transmission Cost: $2.3M ($4.0M for Distribution Cost)

Projected In-service: 10/21/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
Darrah Station

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The existing 34.5 kV circuit breakers “C”, “D”, “F”, “G”, “I”, “J”, and “N” at Darrah are all FK oil type breakers that are all between 45-70 years old. 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. Other drivers include damage to bushings and an excessive number of fault operations exceeding the manufacturers recommendations. Darrah breakers “C”, “D”, “F”, “G”, “I”, “J”, and “N” have experienced 12, 10, 85, 22, 1, 18, and 90 fault operations respectively. The manufacturer’s recommendation for this type of breaker is 10.

138 kV circuit breaker “T” at Darrah is a FGK oil type breaker that is close to 60 years old. These oil breakers share similar concerns to the FK types listed above. Darrah breaker “T” has experienced 23 fault operations, exceeding the manufacturer’s recommendation of 10.

Darrah’s 138/34.5 kV Transformer #1 (vintage 1949) and is showing dielectric breakdown (insulation), accessory damage (bushings/windings) and short circuit breakdown (due to amount of through faults).

Operational Flexibility and Efficiency

Circuit switchers will be added to the high side of transformers #1, #2, #3, and #4 at Darrah Station to separate dissimilar zones of protection. Installation of a circuit switcher was evaluated for transformer #5 at Darrah. It was determined a switcher could not be added without a complete relocation of the transformer and its low side bus work or a significant reconfiguration of the 138 kV bus at Darrah.

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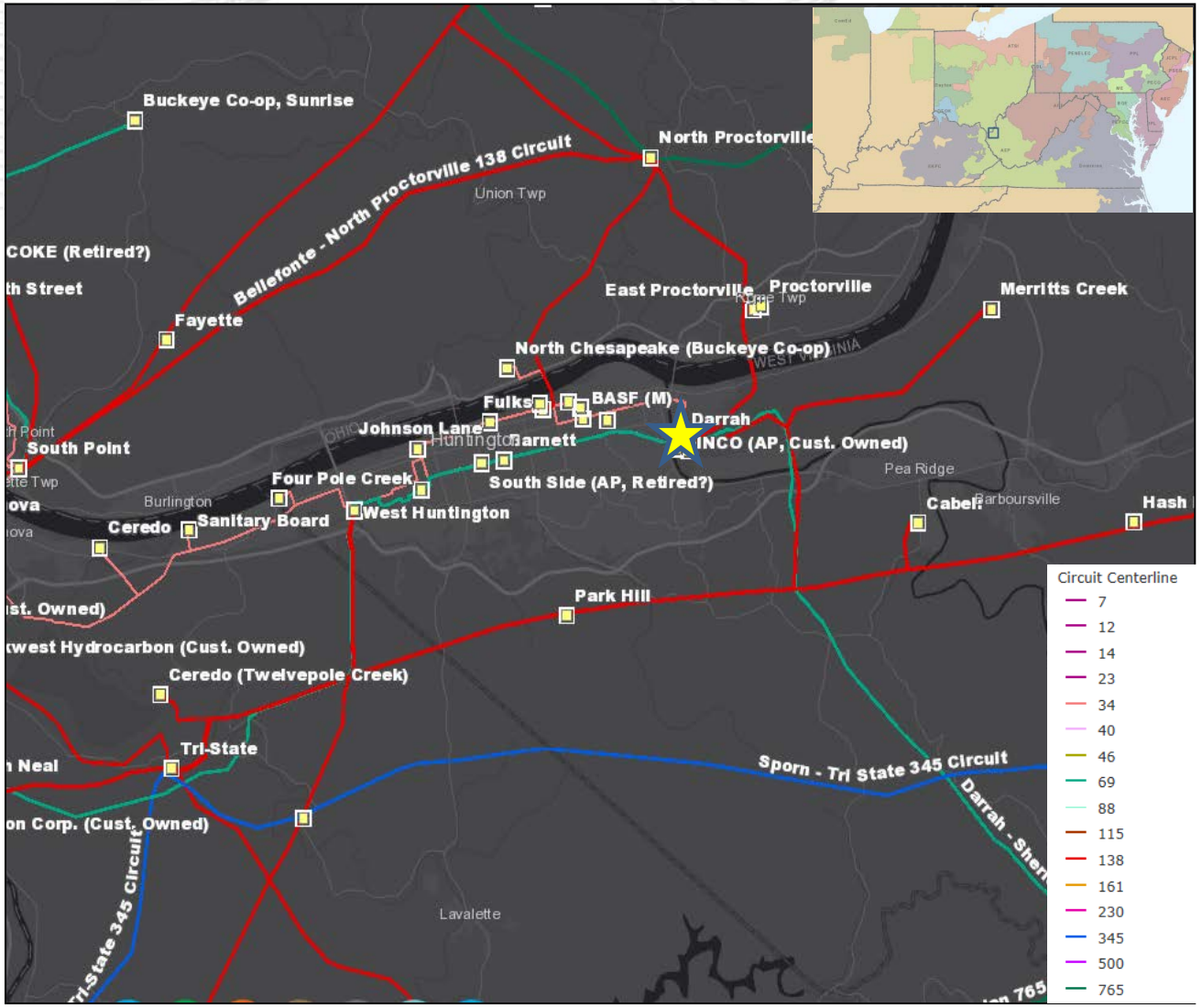

AEP Transmission Zone: Supplemental
Darrah Station

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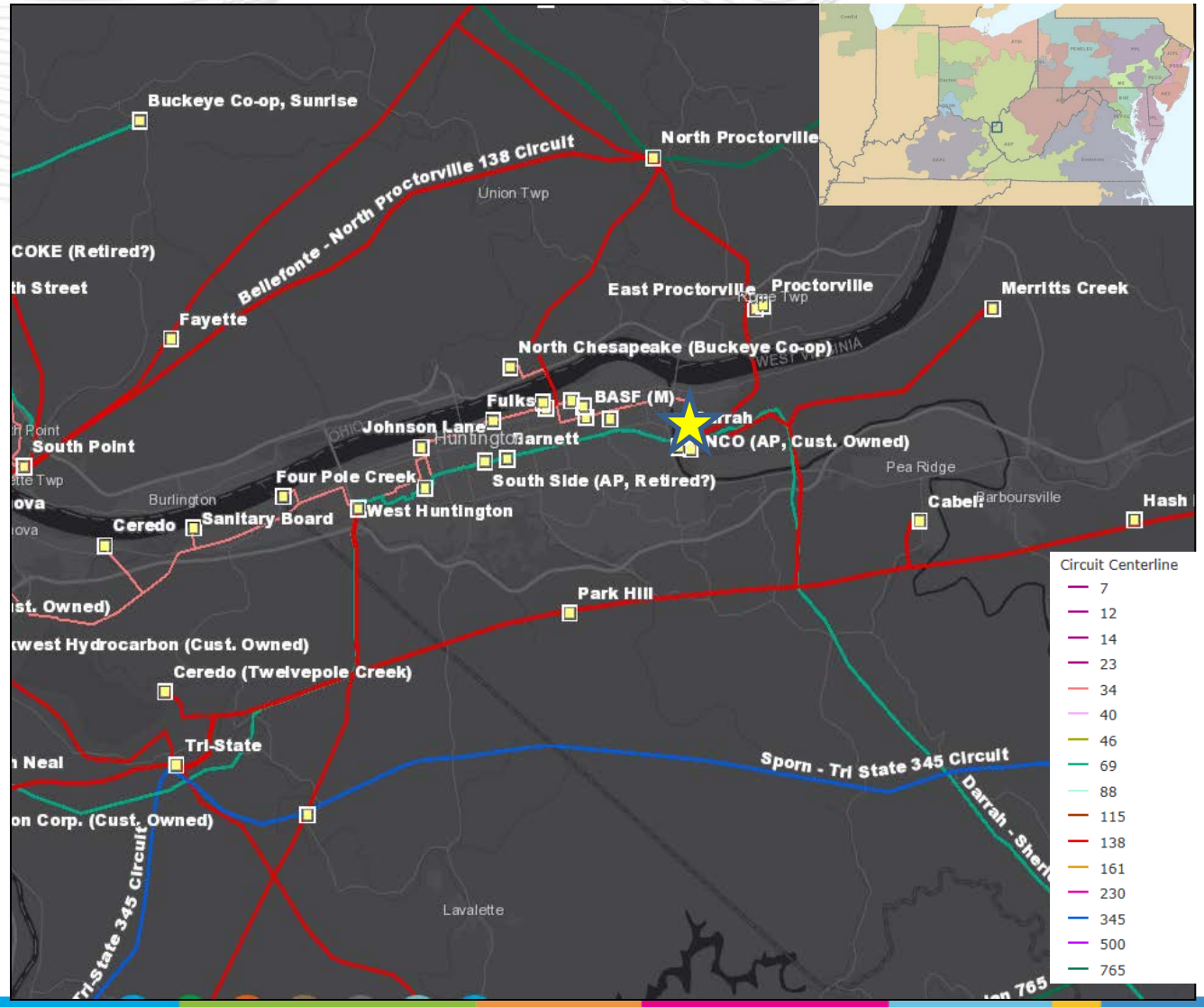
Selected Solution

At Darrah station, replace the existing 1600 A 42 kA 138 kV circuit breaker “T” with a new 3000 A 40 kA 138 kV circuit breaker. Replace the existing 1200 A 17 kA 34.5 kV circuit breakers “C”, “D”, “F”, and “I” with new 3000 A 40 kA 34.5 kV. Replace the existing 1800 A 27 kA 34.5 kV circuit breakers “J”, “G”, and “N” with new 3000 A 40 kA 34.5 kV circuit breakers. 138 kV circuit switchers will be added to the high side of Darrah transformers #1, #2, #3, and #4. The existing 45 MVA 138/34.5 kV transformer #1 will be replaced by 138/69/34.5 kV transformer with a 50 MVA tertiary. (S1595)

Estimated Transmission Cost: $11.5M

Projected In-service: 6/1/2020

Project Status: Engineering



AEP Transmission Zone: Supplemental Dearington Area

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

South Lynchburg station 69 kV circuit breakers 'D' & 'C' and Dearington station 69 kV circuit breakers 'L', 'K' & 'M' are oil type breakers without oil containment containment manufactured between 1959 and 1969. In general, oil breakers have become increasingly difficult to maintain due to the oil handling requirements. Oil spills are frequent with failures and routine maintenance. Other drivers include damage to bushings. South Lynchburg CB 'D' is also legacy oil-filled FK type breakers which have little to no replacement parts. 69KV circuit breaker 'C' is a EPB Gas Circuit Breaker with gas leaks, bushing failures, and CT gasket problems.

The 69 kV network lines in the area is currently protected with pilot wire technology. Copper pilot wire is a relatively obsolete technology, which makes it increasingly difficult to find suitable pilot wire cable and hardware parts. Consequently, we are avoiding like-kind replacement of pilot wire because the technology will be increasingly difficult to maintain.

At Dearington station the station battery voltage its being changed from 48 vdc to 125 vdc (AEP standard). Reusing Cap Switcher 'AA' would have required modifying the controls and motor to work with 125 vdc, which, is a very difficult and costly task. The CS can be a safety hazard as the gas sensor cannot be monitor remotely. One has to be standing in front of the CS to determine if adequate pressure is available to operate. This becomes a safety hazard if the gas is depleted and it is called on to operate.

Customer Service:

Dearington station serves critical loads in the Lynchburg, VA area. These customers include the Lynchburg General Hospital, Lynchburg College, EC Glass High School, and two nursing homes. Adding a bus tie breaker at Dearington station will limit the exposure to customers in the area.

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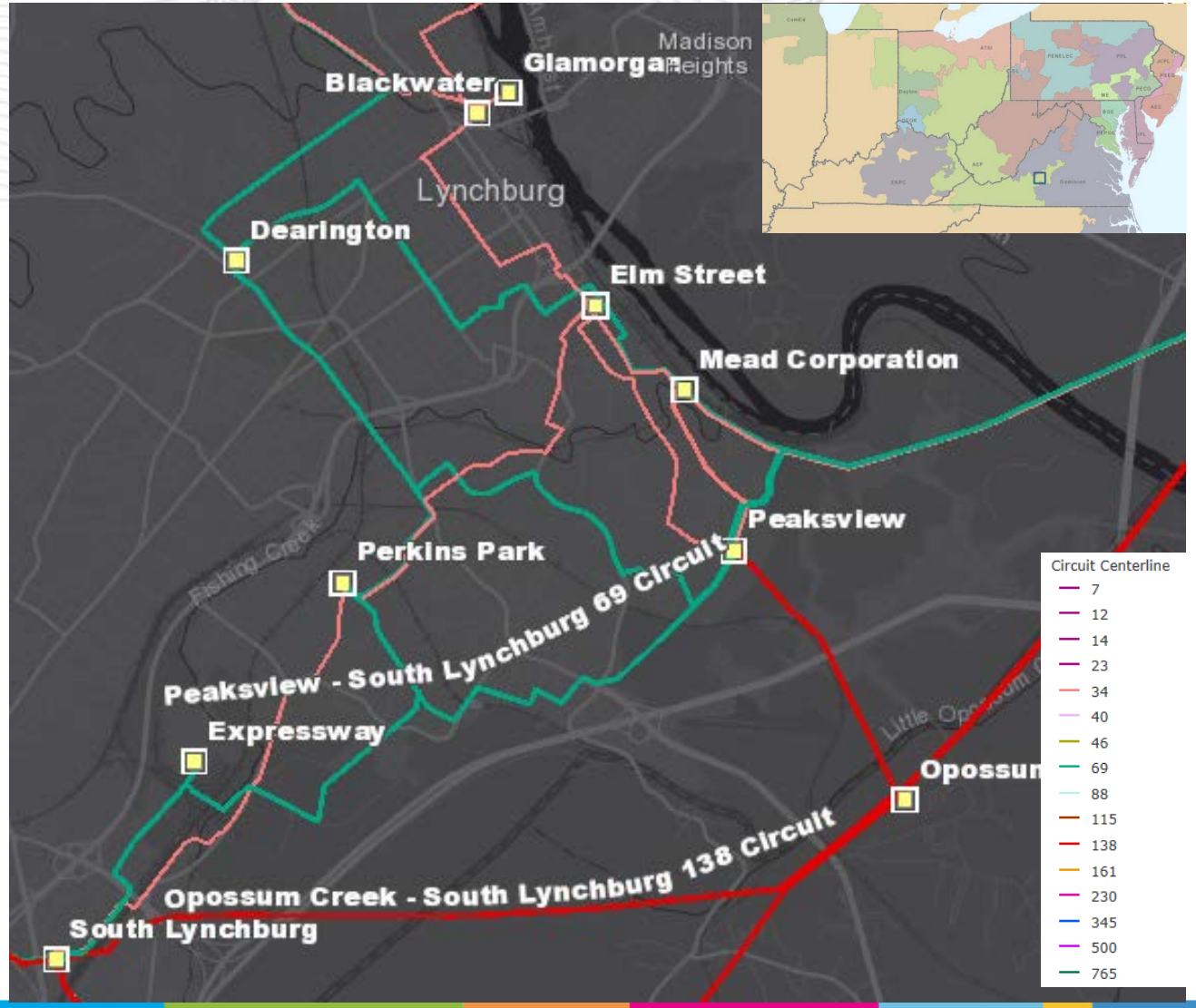

AEP Transmission Zone: Supplemental Dearington Area

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Selected Solution

At South Lynchburg station, replace the existing 69 kV/1200 A/21 kA CB “C” and the 69 kV/1200 A/11.3 kA CB “D” with 3000 A/40 kA circuit breakers. Install new control relays for breakers. Retire pilot wire from the Peaksview and Skimmer 69 kV line relays and install new line relays. (S1596.1) Estimated Cost: $1.3M

At Peaksview station, retire pilot wire from the Dearington #1 & #2 and South Lynchburg 69 kV lines and install new line relays. Install a 20’ building expansion to accommodate new relays and RTU. (S1596.2) Estimated Cost: $1.9M

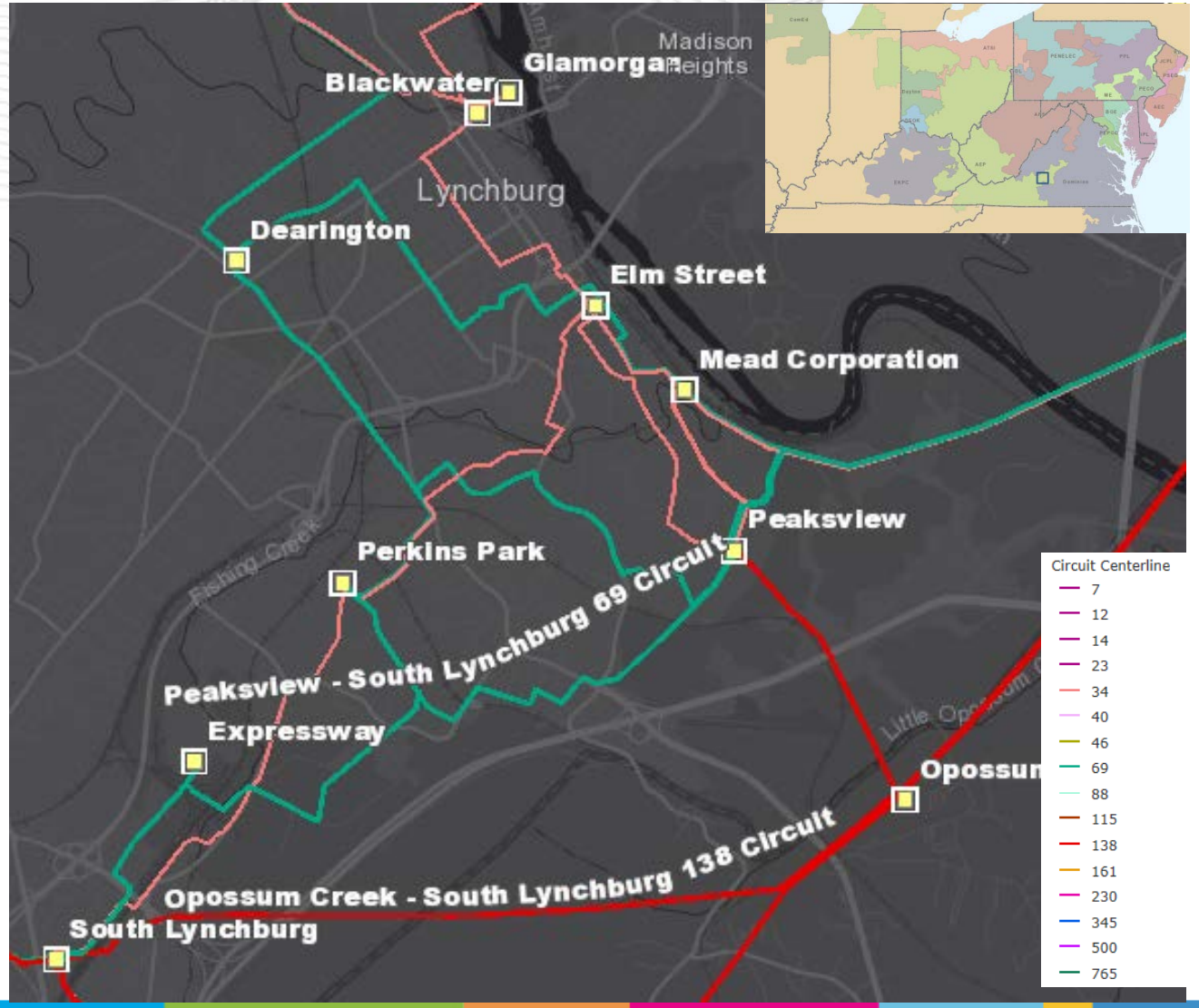
At Dearington station, replace the existing 69 kV/1200 A/21 kA CB ‘s “L”, “M”, and “K” with 3000 A/40 kA circuit breakers. Install a new 69 kV/3000 A/40 kA bus tie breaker. Retire pilot wire from the Peaksview #1 & #2 and Reusens lines and install new line relays. Replace existing 69 kV/400 A/40 kA circuit switcher “AA” with a new 420 A/18 kA circuit switcher. Install new DICM to accommodate all new relays and RTU. (S1596.3)Estimated Cost: $0M

At Perkins Park station, retire pilot wire from the Dearington and Peaksview lines and install new line relays. Install high side circuit switcher on distribution transformer. Install new RTU. (S1596.4) Estimated Cost: $0M

Total Estimated Transmission Cost: $3.2M

Projected In-service: 8/31/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental
East Logan

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The East Logan 69 kV circuit breakers “M” and “N” are showing signs of deterioration. These breakers are 1969 vintage oil breakers. 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 can become an environmental hazard. The drivers for replacement of these breakers are age, bushing damage, number of fault operations, and a lack of available repair parts. Circuit breaker “M” and “N” have fault operations of 185 and 69 respectively. Circuit switcher AA is a Mark type switcher 1970 vintage. Mark switchers are being recommended for replacement due to their inability to coordinate with modern relaying packages. 54 of the 57 relays at East Logan are either electromechanical or static type. 33 of these are Transmission. The new line relays needed CCVT’s to be installed . Cable and trenching was needed to connect these to the DICM which is in a different location because of space constraints. A backup station service was needed for the 69 kV as there was none at the station currently.

Customer Service:

The rehab upgrades are being done to align with AEP Ohio work. They will be replacing their 69/12 kV transformer, installing a new feeder, constructing a new 12 kV bus, upgrading 12 kV circuit breakers, installing a 69 kV circuit switcher, installing feeder regulators, installing a DICM and replacing outdated equipment.

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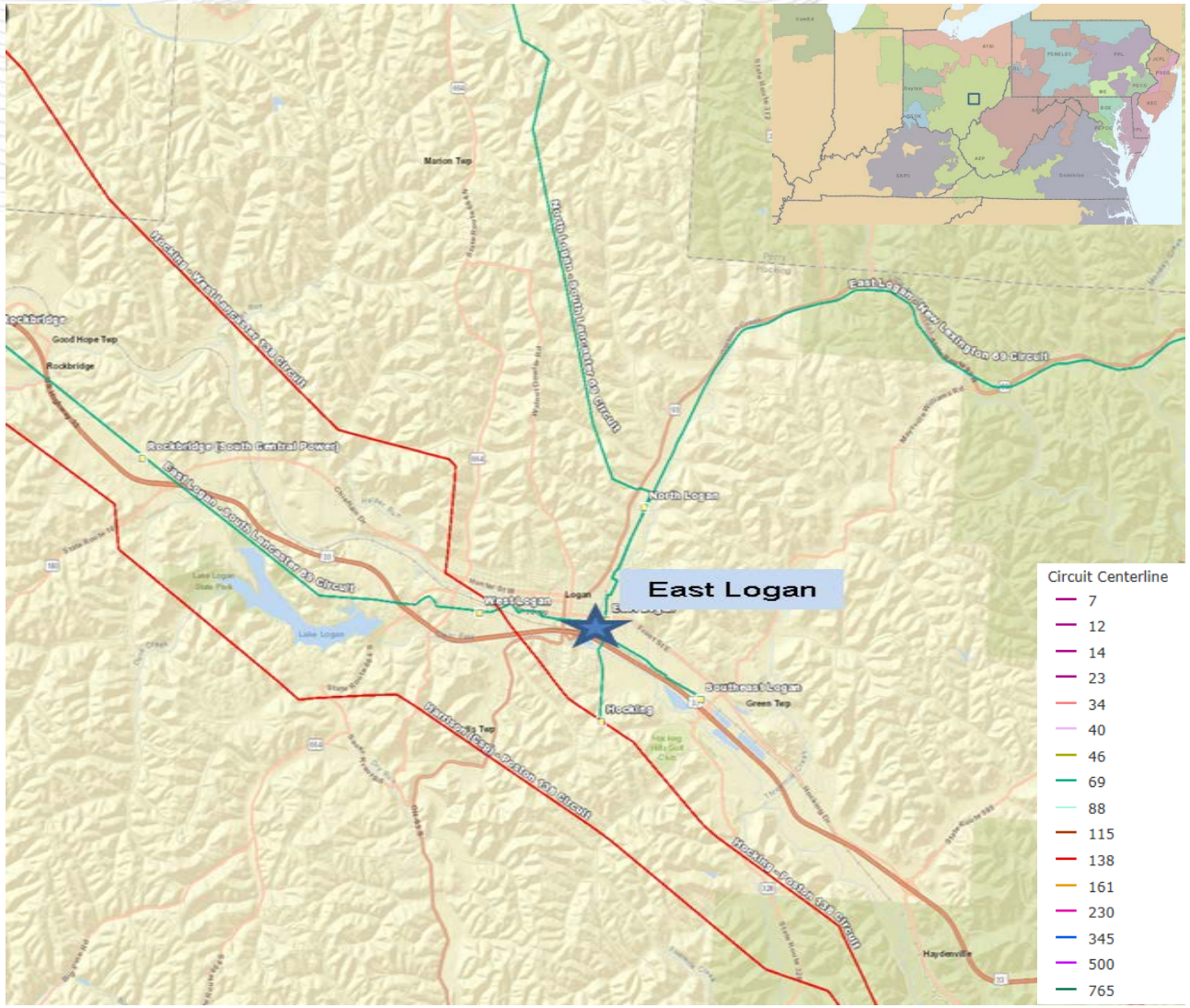

AEP Transmission Zone: Supplemental
East Logan

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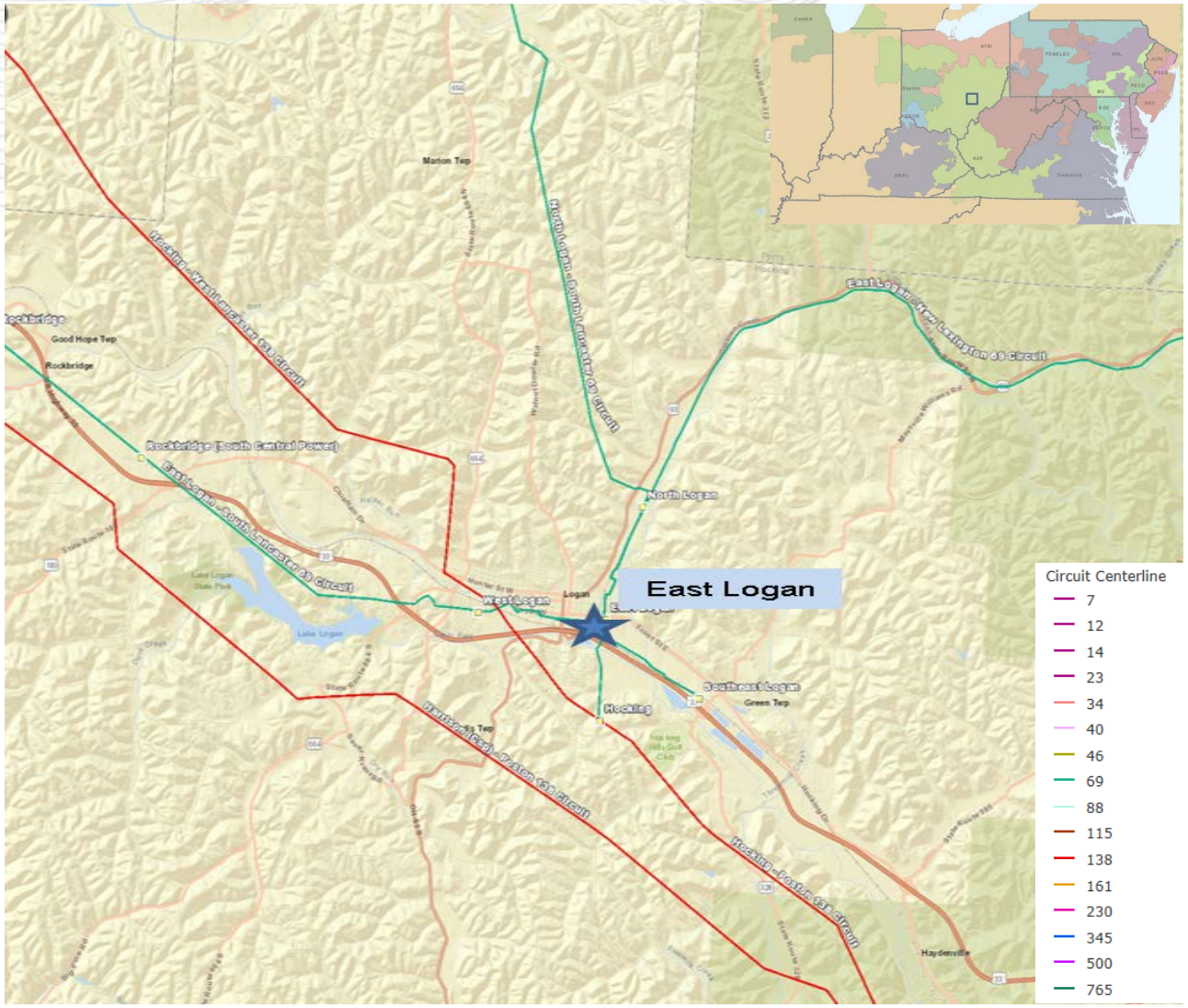
Selected Solution:

At East Logan station, replace 69 kV circuit breakers “M” and “N”. Replace the 69 kV capacitor bank. Install 15 69 kV CCVT’s. Replace 33 electromechanical relays. Install cable and trenching to connect CCVTs to the DICM. Install station backup service. (S1597)

Estimated Transmission Cost: $4.0M

Projected In-service: 5/1/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental Hancock

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Hancock station 138 kV circuit breakers 'A', 'B' & 'C', 69 kV circuit breakers 'CA', 'M' and 'N', 34 kV circuit breakers 'J', 'I', 'P', 'R' & 'S' are oil type breakers without oil containment. In general, oil breakers have become increasingly difficult to maintain due to the oil handling requirements. Oil spills are frequent with failures and routine maintenance which is also an environmental hazard. Other drivers include damage to bushings. CBs 'A', 'B', 'C', 'CA', 'N', 'J', 'I' & 'P' are also legacy oil-filled FK type breakers which have little to no replacement parts. 69KV circuit breaker 'Q' is a EPB Gas Circuit Breaker with gas leaks, bushing failures and CT gasket problems.

Hancock 138/69/34.5 kV Transformer #2, 1951 vintage, is currently in a poor physical and operational condition. All three single phase transformers are showing short circuit strength breakdown caused through fault events, gassing of the unit, and a significant number of overheating events. There is an upward trending of oil moisture content resulting in downward trending to the oil dielectric strength. Increasing moisture content is a resultant of water ingress through aged gaskets, tank or pump leaks, or a breakdown of paper insulation of the transformer windings. In the Phase 1 tank, the most current reading for ethylene is at IEEE Condition 3 and has been steadily rising over the bank's lifetime. In the Phase 2 and 3 tanks, the most current reading for carbon dioxide is at IEEE Condition 3 and 2, respectively, and has recently been on the rise.

Circuit Switcher BB is an Mark V which is no longer supported by the manufacturer and parts are not available. We have to scavenge for parts during maintenance. These are older designed circuit switchers with old controls that no longer coordinate well with modern relaying.

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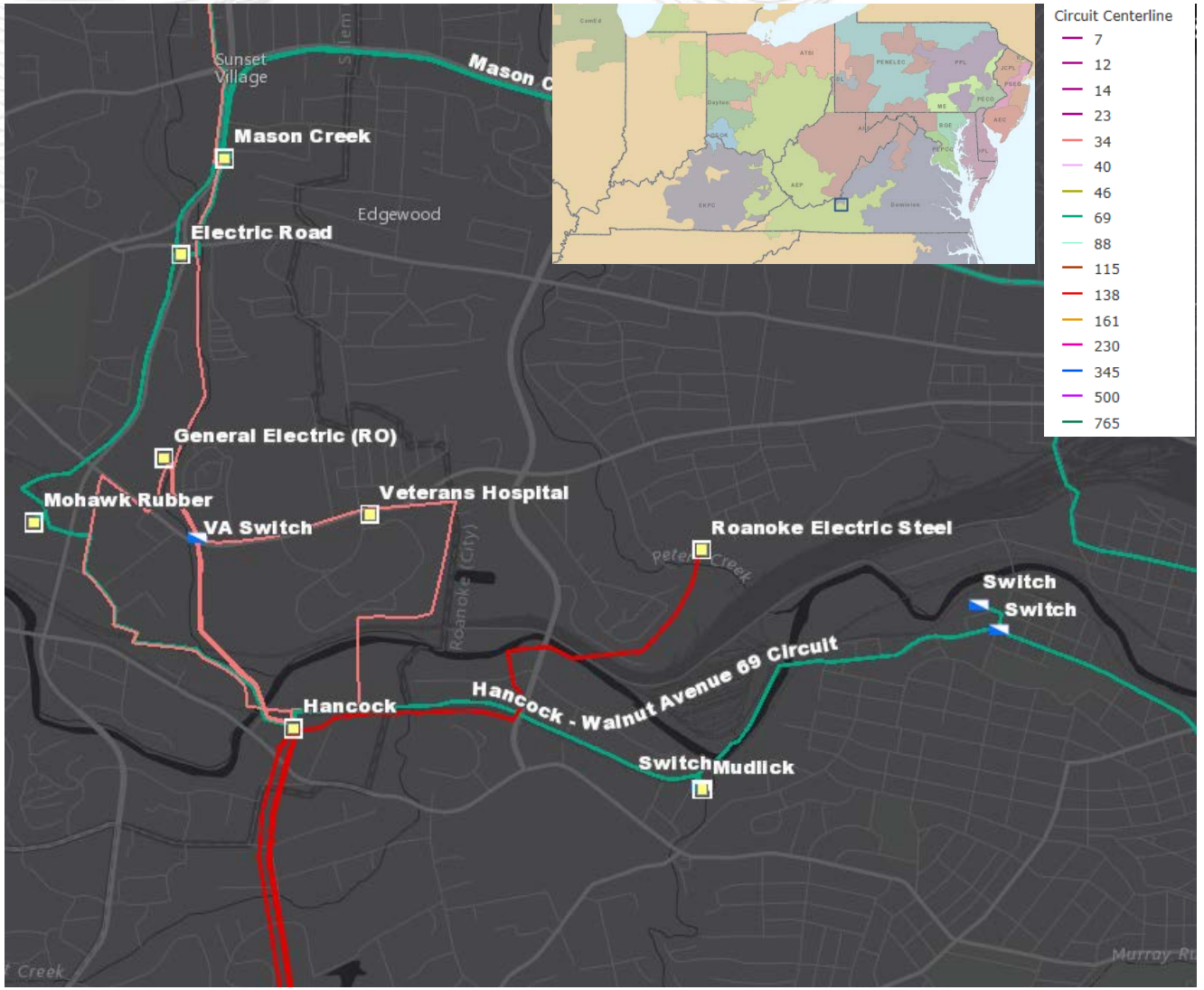

AEP Transmission Zone: Supplemental Hancock

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69 kV Mason Creek and Walnut Ave. 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 will be increasingly difficult to maintain.

Operational Flexibility and Efficiency

The breaker and half configuration will break the three dissimilar zones of protection (138 kV bus #2, transformer #1 and transformer #2), increase reliability, and allow for shorter maintenance outages. With the current configuration we are susceptible to a station outage with a breaker failure of 138 kV bus tie breaker "F".

Customer Service:

Hancock is a critical station for customers in the area. It feeds Roanoke Electric Steel, VA Hospital, General Electric and City of Salem.

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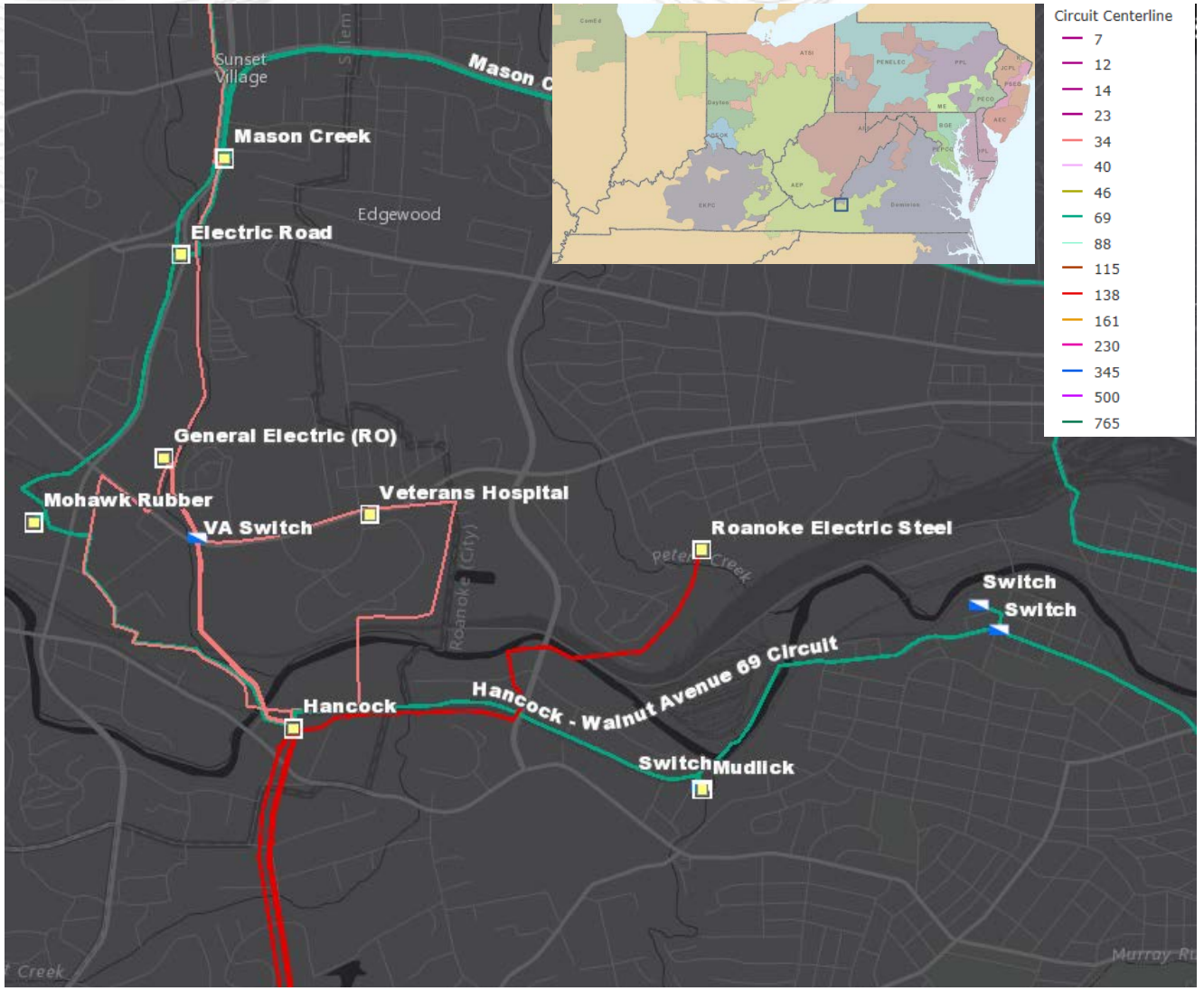

AEP Transmission Zone: Supplemental Hancock

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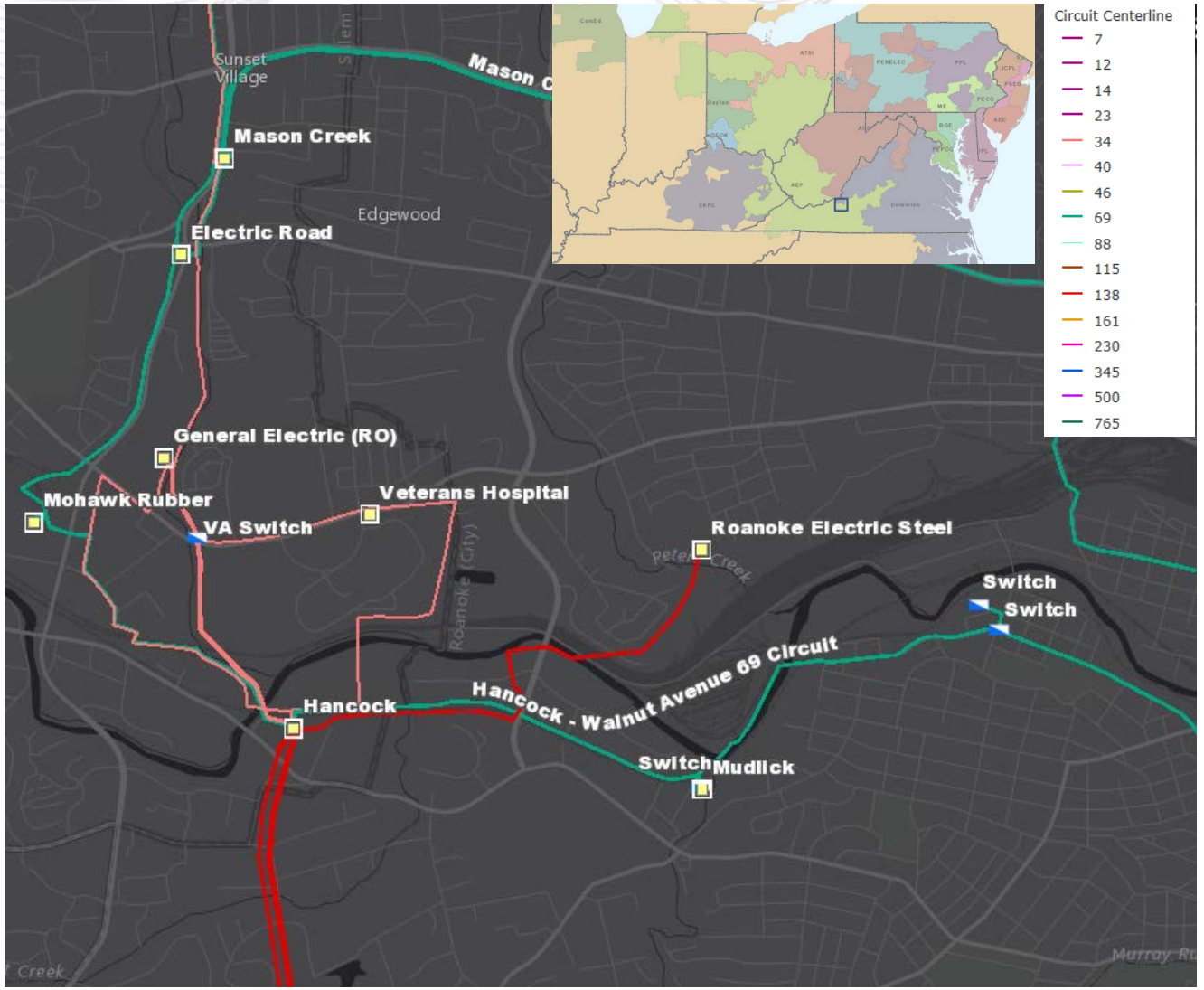
Selected Solution:

At Hancock station, build a new 138 kV breaker and half configuration with 3 strings. Install 9 new 3000 A/40 kA circuit breakers. Replace the existing 69 kV/27 kA/1800 A CB “N” and “CA”, 1200 A/21 kA CB “M” and 2000 A/31.5 kA CB “Q” with 3000 A/40 kA circuit breakers. Replace the existing 34.5 kV/560 A/12 kA CB “R” and “S”, 1200 A/16.8 kA CB “I” with 1200 A/25 kA circuit breakers. Install new DICM. Replace 138/34 45 MVA Transformer #2 with new 138/69/34.5kV 130MVA. Add new 138/34.5 kV 30 MVA Transformer #3 with high side Circuit Switcher (3000 A, 40 kA). Replace the existing 138 kV 1200 A/61 kA Circuit Switcher “BB” with new 650A, 31.5 kA CS. Replace 138kV Bus #1, 34.5kV Bus #1 and 34.5kVBus #2 CCVT’s. Replace 34.5 kV Circuit Breakers “P” and “J” with new 34.5 kV, 3000 A, 40 kA CB’s. Replace 34.5 kV Capacitor Bank Circuit Switcher “AA” with new 40 kA CS. Install Bus Regulators on 34.5kV Bus #3. Replace remote end line relaying. (S1598)

Estimated Transmission Cost: $30.0M

Projected In-service: 12/18/2021

Project Status: Scoping



AEP Transmission Zone: Supplemental Hillsboro-Hutchings Rebuild

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 36 miles of transmission line sections from Hillsboro to Hutchings Tap were constructed in 1943 using wood pole structures with 477 ACSR conductor (185 MVA rating). There are 1,098 open conditions on this line, including rotten cross-arms, burnt/broken insulators, and loose/broken conductor hardware.

Operational Flexibility and Efficiency

In the event there is a failure of the line between Hillsboro and Hutchings, the driving time can be approximately 1-2 hours from the Chillicothe Service Center to Middleboro Switch. A MOAB will allow for automatic sectionalizing.

Selected Solution

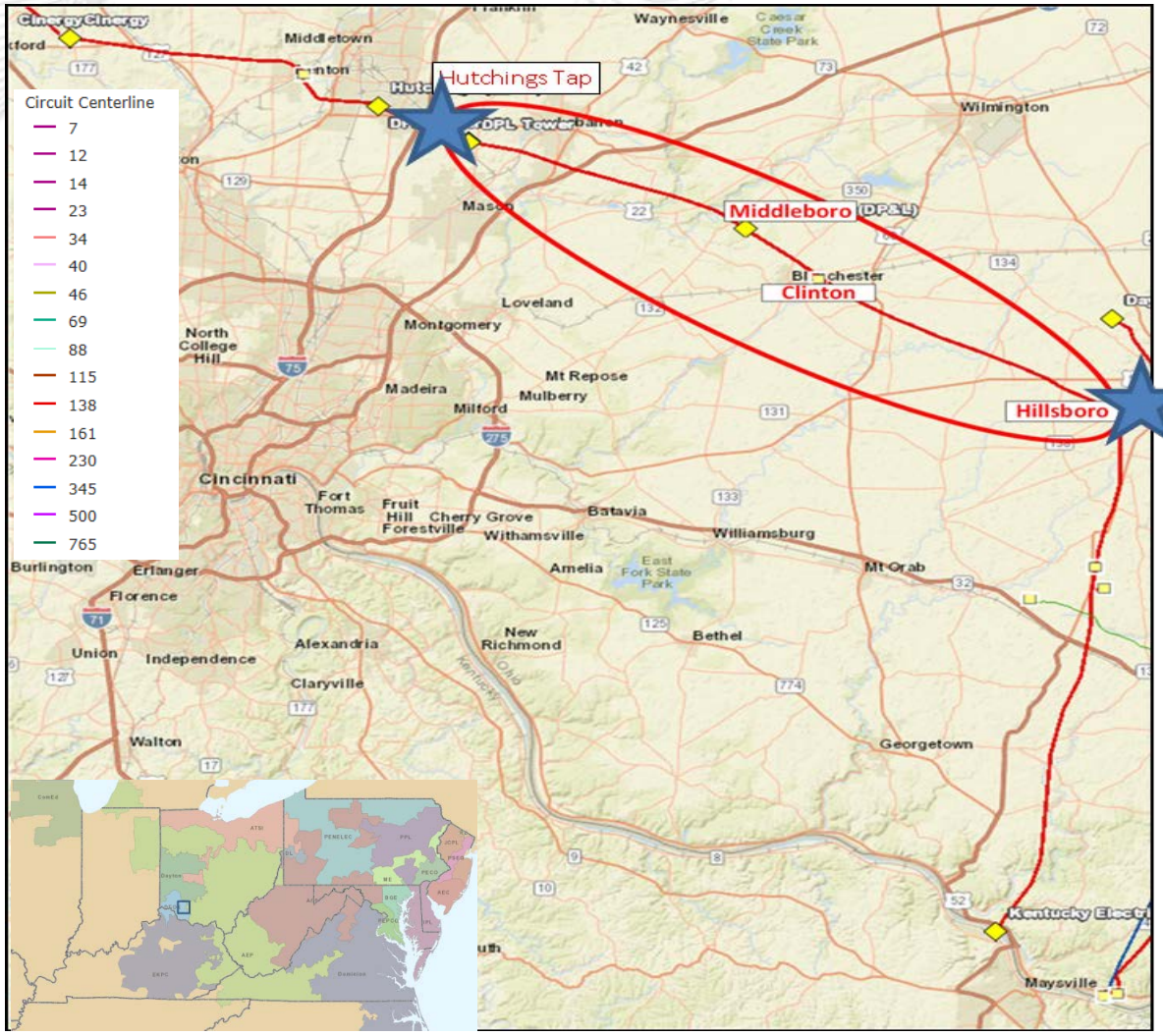
Rebuild two 138kV transmission lines between Hillsboro and Hutchings Tap as double circuit construction. Construct the 19-mile AEP segment from Middleboro to Hutchings Tap as a single circuit line using 954 ACSR conductor. (S1599.1) Estimated Cost: $113.1M

The 1200 A switch at Middleboro will be upgraded to 2000 A. The new switch will have SCADA control, auto sectionalizing and loop opening/line dropping capability. (S1599.2) Estimated Cost: $1.5M

Total Estimated Transmission Cost: $114.6M

Projected In-service: 12/01/2021

Project Status: Scoping



AEP Transmission Zone: Supplemental
IGC Beckley

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Customer Service:

ICG Beckley request to serve projected 1.5 MW of load on the Bradley – Tams Mtn. 46 kV line. Obligation to serve customer.

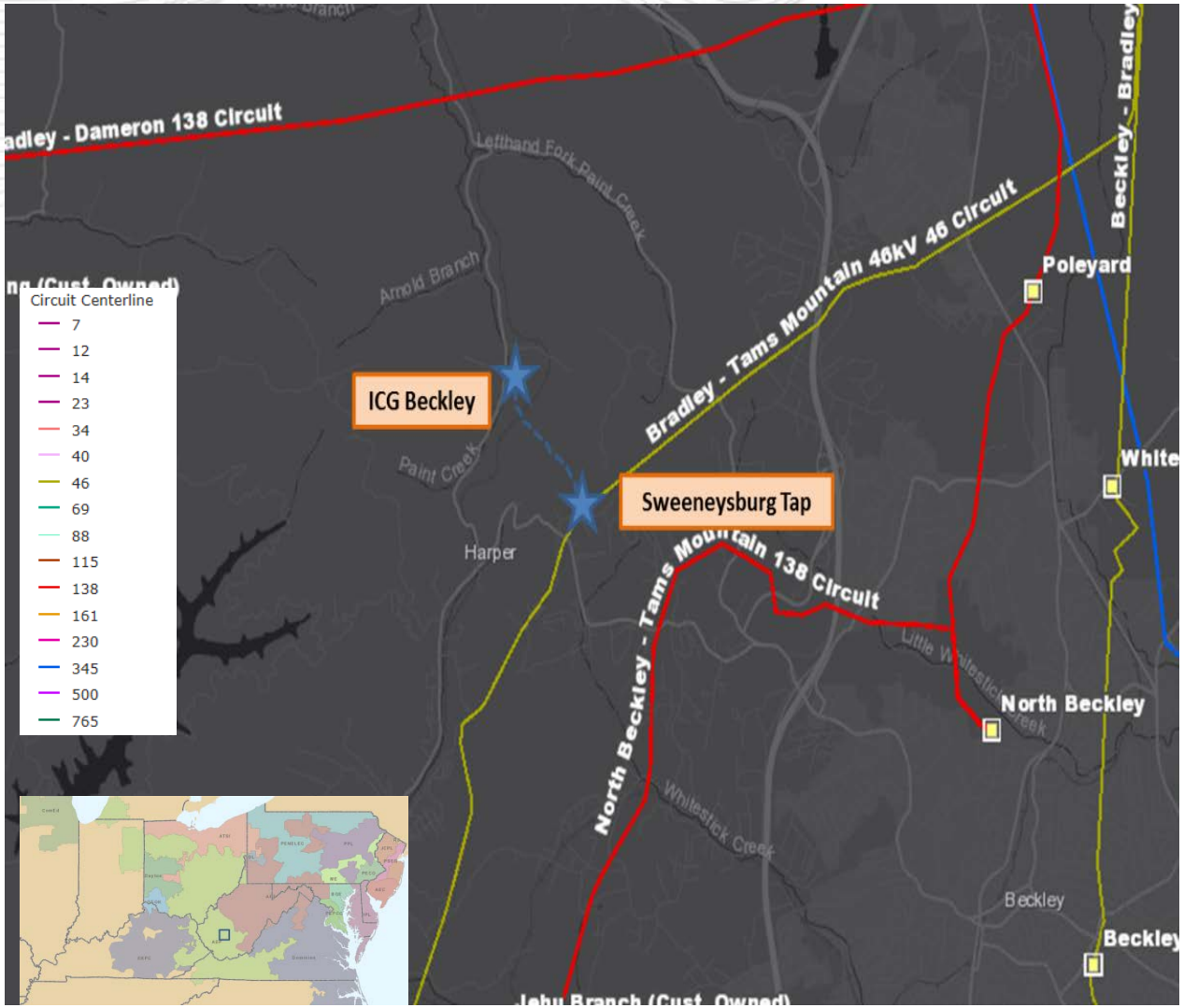
Selected Solution:

Tap the Bradley-Tams Mountain 46 kV line and install a 69 kV, 1200A 3-way switch. Install low side metering. (S1600)

Estimated Transmission Cost: $0.5M

Projected In-service: 06/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Johnsons Lane

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The existing 34.5 kV circuit breakers “E”, “F”, and “W” at Johnsons Lane are all FK oil type breakers. Breaker “E” was manufactured in 1955 with breakers “F” and “W” manufactured in 1971. 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. Other drivers include damage to bushings.

Operational Flexibility and Efficiency

Appalachian Power Distribution is currently working on a project to convert the 4 kV distribution out of Johnsons Lane to 34.5 kV. Once complete, the existing 34.5/4 kV transformer at the station will no longer be required and will be retired. After the 34.5/4 kV transformer is retired the 34.5 kV bus tie circuit breaker will be retired and a new 34.5 circuit breaker will be installed on the high side of transformer #1 to separate dissimilar zones of protection.

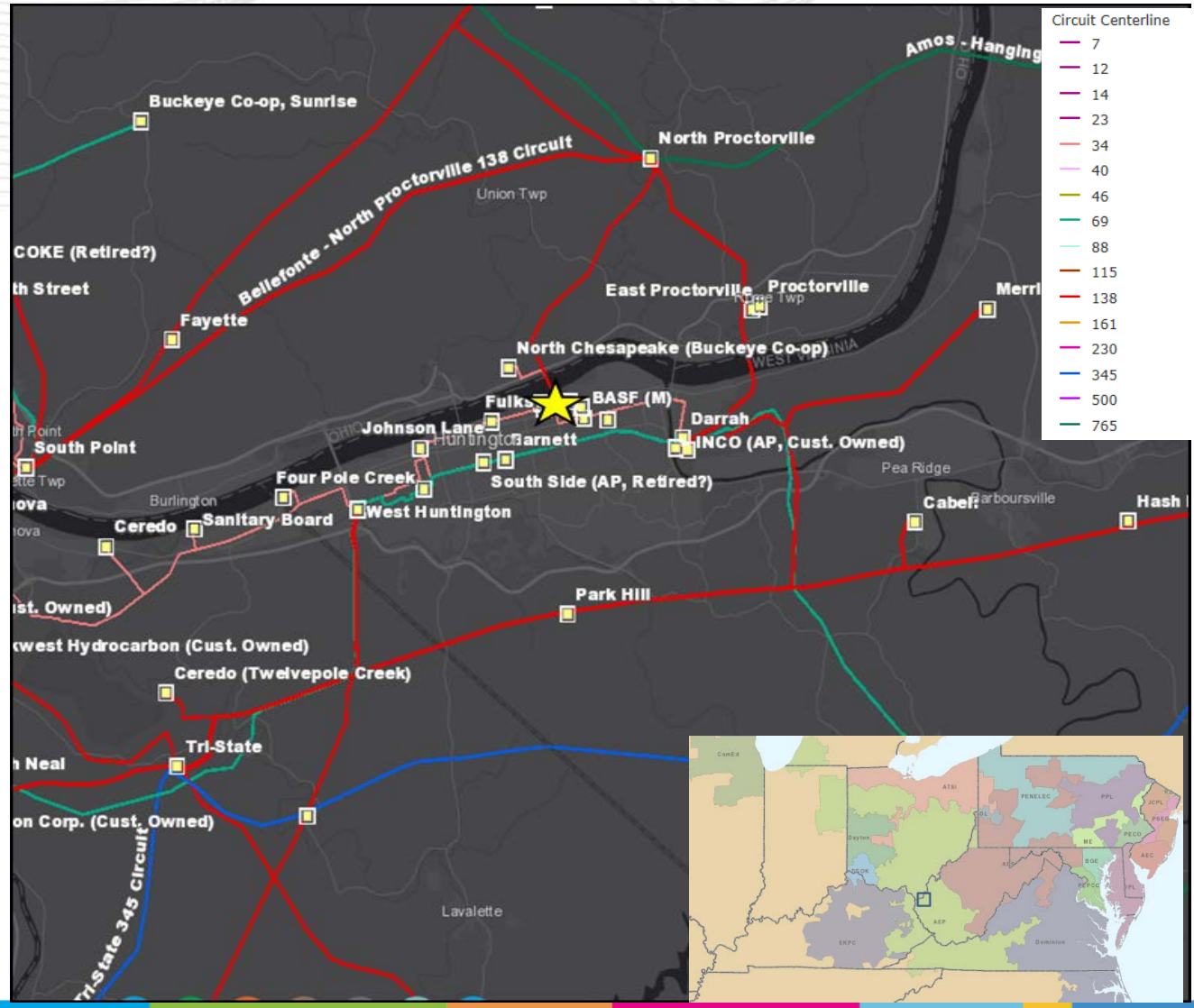
Selected Solution:

Retire the existing 1200 A 17 kA 34.5 kV bus tie circuit breaker “E” at Johnsons Lane. Install a new 3000 A 40 kA 34.5 kV circuit breaker on the high side of transformer #1. Replace the existing 1800 A 27 kA 34.5 kV circuit breakers “F” and “W” at Johnsons Lane with new 3000 A 40 kA 34.5 kV circuit breakers. (S1601)

Estimated Transmission Cost: $0M

Projected In-service: 12/1/2020

Project Status: Scoping



AEP Transmission Zone: Supplemental Limberlost

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Customer Service

Distribution customers served by the South Berne – Geneva circuit experience frequent outages. Contributing to the number of interruptions is significant amount of distribution line exposure between the load center and South Berne Station. One large customer, Red Gold, has experienced 447 minutes of interruption in the last 3 years. Due to the current distribution circuit configuration, there are limited recovery options for this circuit. A station outage at South Berne Station results in 7 MVA of unrecoverable load until repairs are made or a mobile substation can be set. Also due to current circuit configuration, load transfers for routine maintenance are limited. Customers served off Berne-Portland 69 kV circuit experience frequent outages due to lack of sectionalizing along the line. In addition to this, the Berne – Portland line currently has 1,000,000+ CMI. In order to reduce the complexity of the protection scheme and to reduce fault exposure, AEP recommends installing a new "Limberlost" station off the Berne-Portland 69 kV circuit. Installing two MOABs at Limberlost would put four MOABs in series on this line. AEP's current practices and standards do not recommend more than three MOABs in series, so adding circuit breaker facing Portland station and a MOAB facing Berne station is recommended in order to resolve reliability issues and decrease the number of MOABs in series. This project is resulting from a request from I&M distribution.

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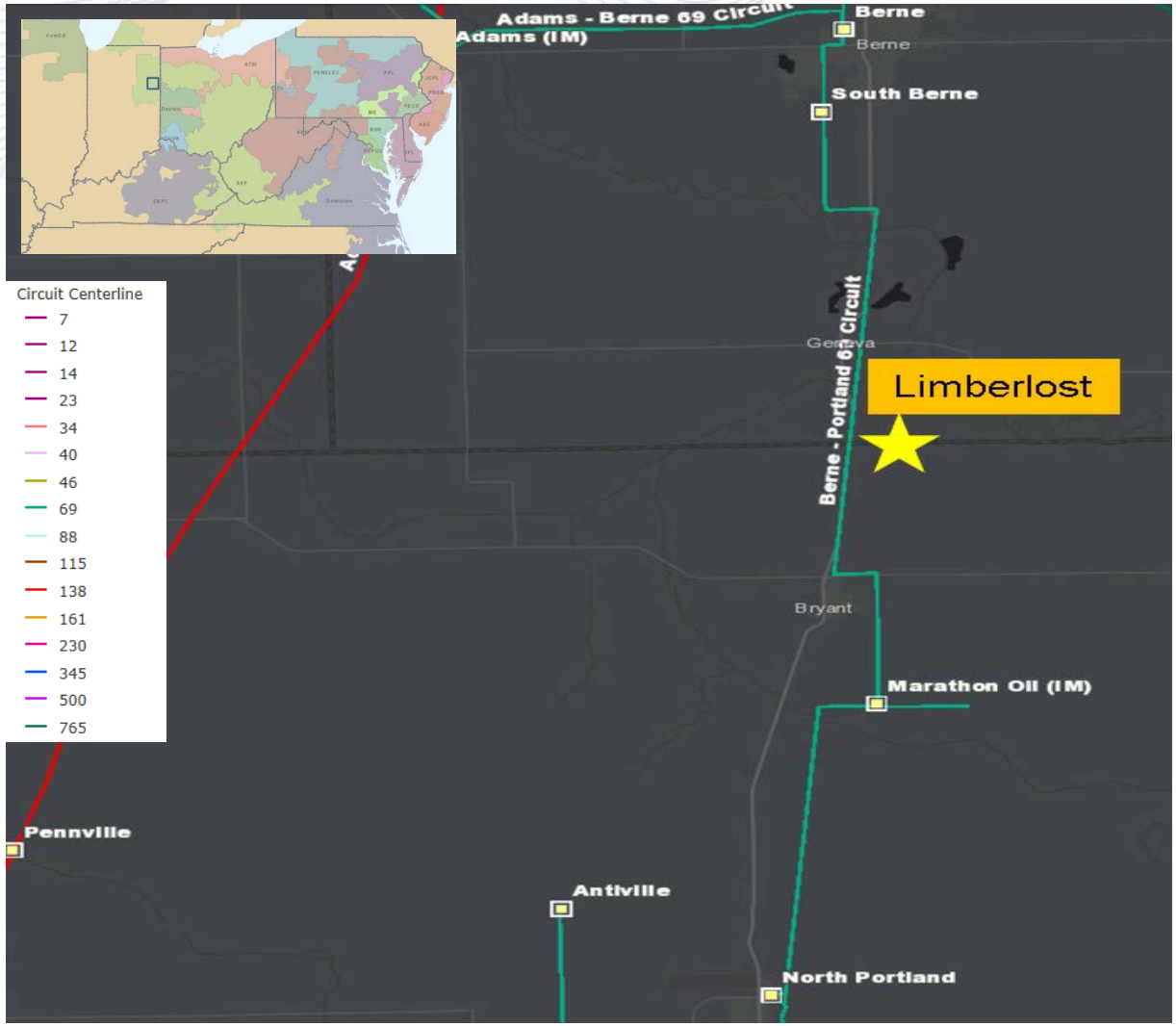

AEP Transmission Zone: Supplemental Limberlost

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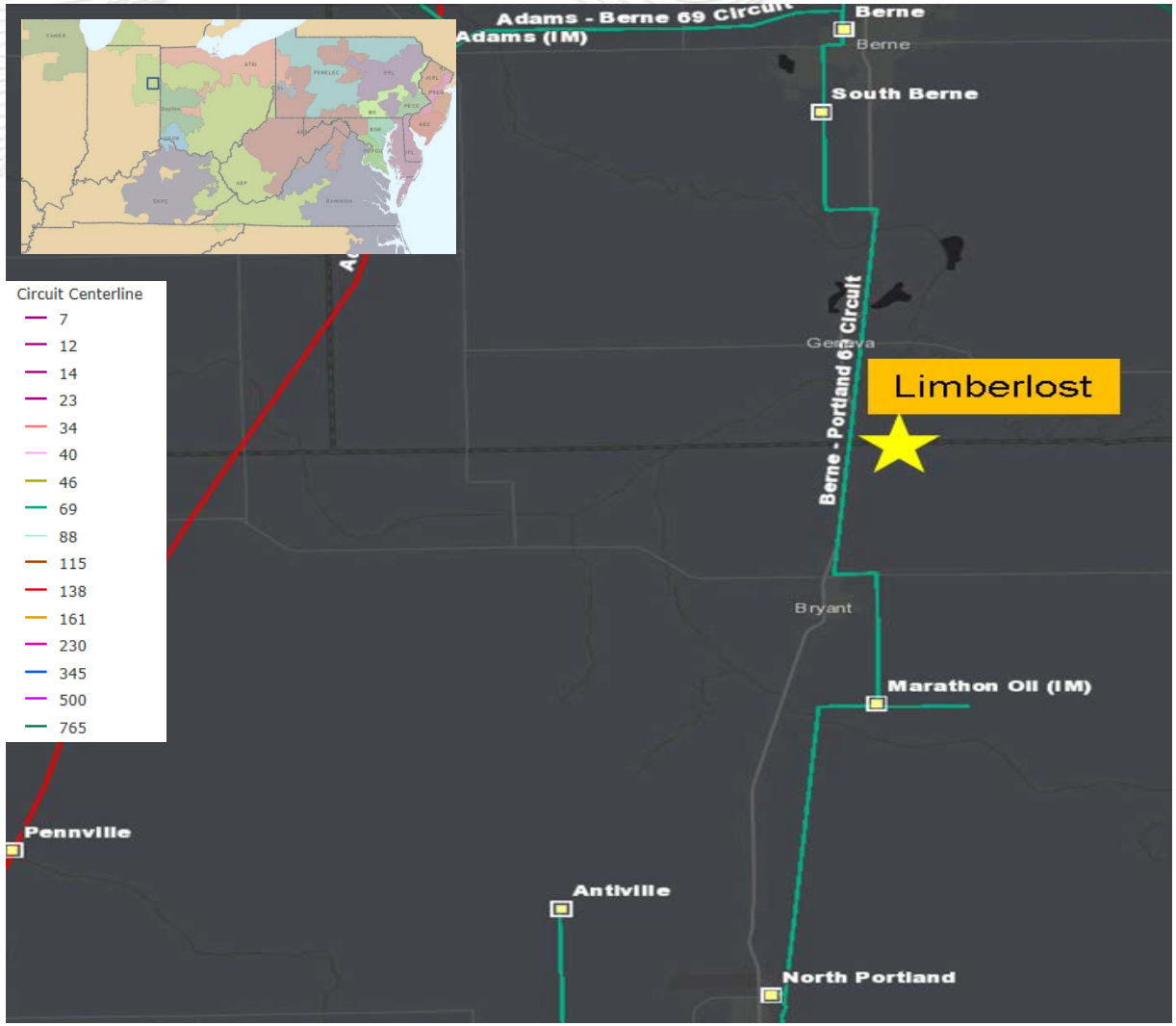
Selected Solution

Cut the Berne-Portland 69 kV line into a new substation called Limberlost. Establish new Limberlost station by installing a 69 kV breaker and MOAB along with a 69/12 kV transformer and two 12 kV feeders. (S1602)

Estimated Cost: $4.0M

Projected In-service: 12/1/2018

Project Status: Scoping



AEP Transmission Zone: Supplemental Madison

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The transformer at Madison is a vintage from 1964. The CO/CO2 ratio is above the warning threshold and the interfacial tension is trending downward. This data shows that the units insulation is degrading and should be addressed. Additionally, the unit has experienced serious leaking issues since 2015. Due to the mentioned notices, AEP recommends the replacement of transformer 1. The 1964 vintage 34.5kV circuit breaker's B, C, E, and H at Madison Substation are oil filled FK-breakers without oil containment. Additionally, all of the breakers, are in deteriorating condition and breakers B and C have fault operations beyond the manufacturers recommended limit. AEP recommends the replacement of all circuit breakers mentioned due to the stated conditions. Breakers B and C have 17 and 11 fault operations respectively. Currently the foundations of the 34.5kV yard are severely deteriorated and need to be addressed.

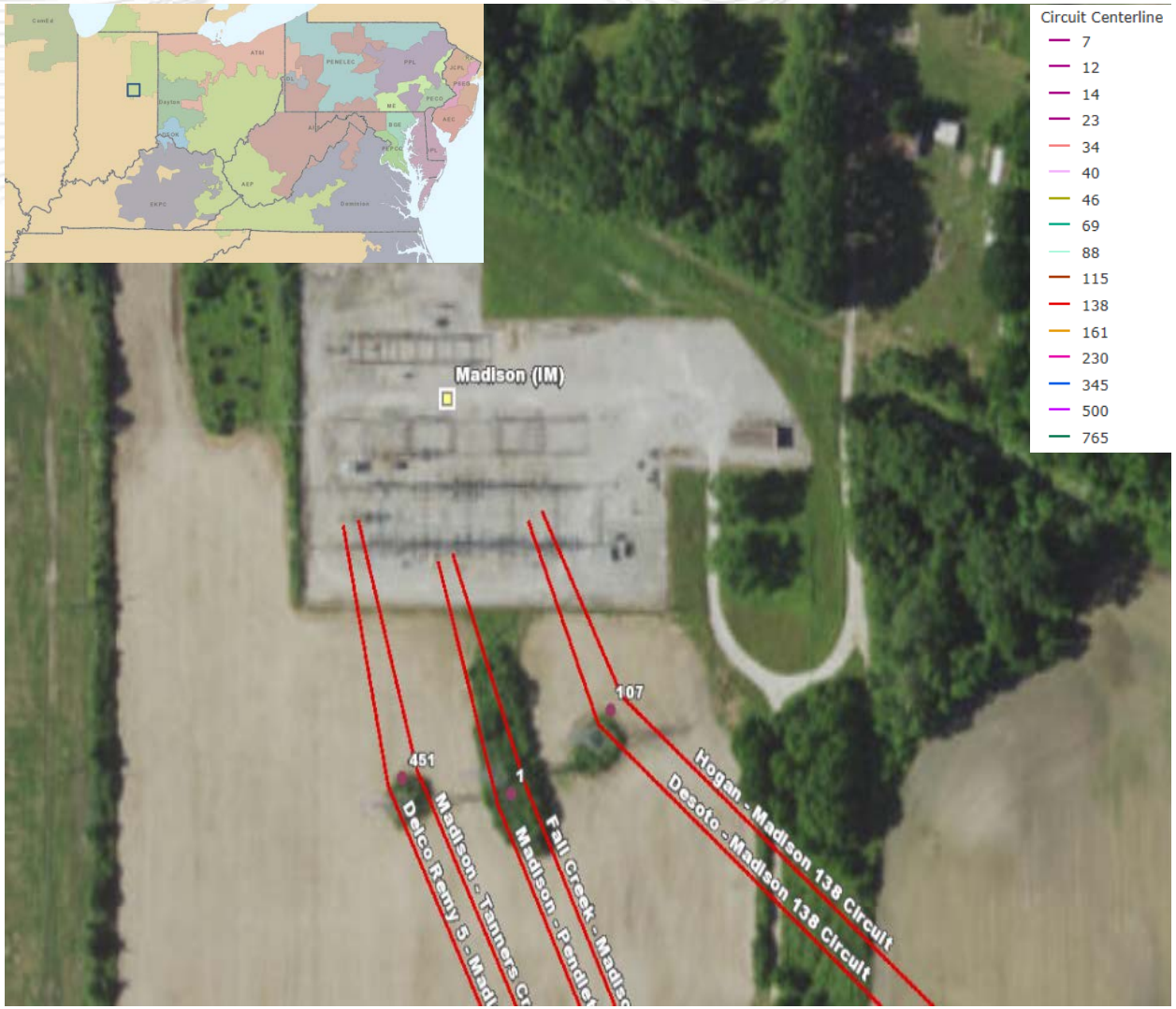
Selected Solution:

At Madison substation, replace Breaker 'B', 'H' and 'C' with new 34.5kV 25kA 1200A models. Remove Breaker 'E'. Replace the 138/34.5kV transformer with a new 138/34.5kV 75MVA model with a high side switcher. Remove bus 1 and reroute all lines to the rebuilt bus 2. (S1603)

Estimated Cost: $5.7M

Projected In-service: 12/30/2019

Project Status: Scoping



Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

This project is an extension of the adjacent Malvern-Oneida 69kV rebuild, which resolves thermal overloads (PJM Baseline #B2796). This Supplemental project will rebuild the remaining 3.5 miles of the circuit to Pekin, as well as replace the aging Pekin circuit breaker. After the associated Baseline line rebuild (B2796), this 3.5 mile section is loaded to 94% SE for the worst N-1-1 contingency pair (51 MVA loading/54 MVA rating, leaving only 3 MVA of margin for future area load growth). This area has had large block load additions from industrial customers, 3 MVA is not enough margin for long-term planning.

The T-Line was built in the early 1960's on wood poles that are in poor condition; it utilizes 4/0 copper conductor (54 MVA rating) and 11/32" copperweld shield wire, both of which are no longer stocked in storerooms, making it difficult to perform field repairs & public relocations, potentially leading to higher O&M costs and outage restoration times. Note that the actual copper conductor dates to 1922 and has become brittle (assuming it was re-used through the decades). The T-Line section has the following open condition count: A2- 10 (broken braces, ground-leads, insulators; burned insulators); A3- 1 (broken ground-lead); B- 1 (leaning pole); Forestry concerns- 7; for a total count of 19 concerns. A stretch of 21 structures are built in the style of having 3 crossarms with conductor & insulators only on one side, where the unequal weighting and style of the knee braces has lead to numerous maintenance calls in recent years.

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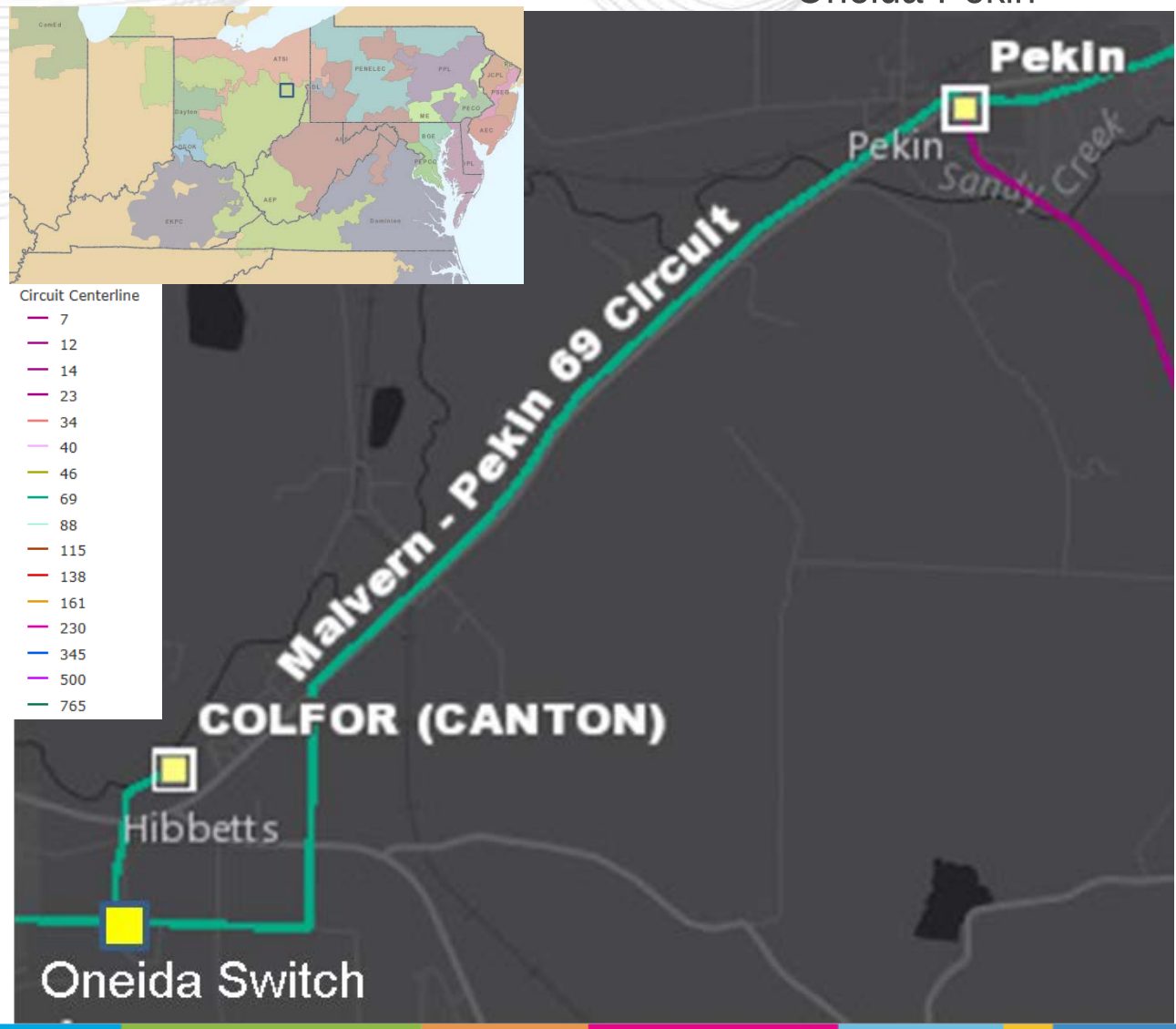

AEP Transmission Zone: Supplemental Oneida-Pekin

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In the 2013-2017 timeframe, the Malvern-Pekin 69KV circuit has experienced 9 momentary outages and 7 sustained outages, with an average outage duration of 7.1 hours. The circuit currently serves 3- Buckeye Power co-op stations and one large industrial company. The outages have been due to vegetation fall-in, storms, animal contact, and broken cross-arms.

Circuit breaker 'A', at Pekin, is an 'FK' oil breaker that is 52 years old; it is recommended for replacement due to age, lack of spare parts, and number of fault operations: 111 fault operations in its lifetime, versus a manufacturer recommendation of 10.

The associated controls and relays will need upgraded to coordinate with AEP's fiber-based protection scheme.

Selected Solution

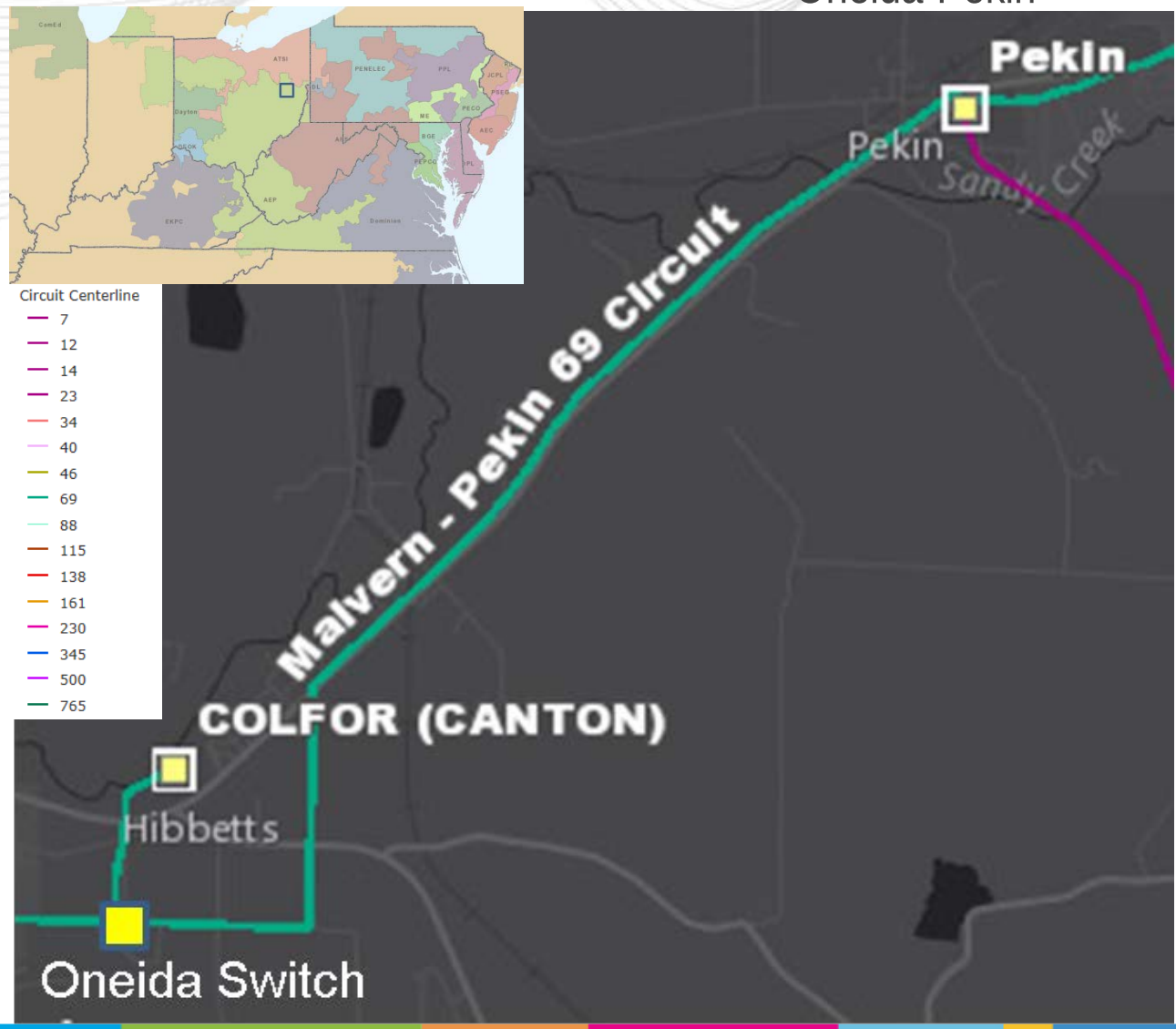
Rebuild 69kV transmission line from Oneida Switch to Pekin (3.5 miles) with 795 ACSR (125 MVA rating). Update & modify right-of-way to accommodate the rebuild. Remove the old T-Line. (S1604.1) **Estimated Cost: $5.4M**

At Pekin station, replace 69kV oil breaker 'A' with an SF6 gas breaker (40kA unit). Upgrade relays for circuit protection to June Road. Replace 69kV disconnect switch (line side of breaker A). Upgrade breaker risers to exceed ampacity of new T-Line. (S1604.2) **Estimated Cost: $0.5M**

Total Estimated Transmission Cost: $5.9M

Projected In-service: 12/1/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental Provident Switch

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Customer Service:

This project will directly improve system reliability for AMP wholesale customer (St. Clairsville), by eliminating hard tap configuration. Also improves area reliability for AEP Ohio distribution customers (served via the following stations on the 3-terminal line: Highland Terrace, St. Clairsville, Pleasant Grove, Bannock Road, Flushing) and South Central Co-op customers (at Shepherdstown), all of which could otherwise be affected by the Glencoe-Bannock-Robyville 69kV 3-terminal line misoperations.

Operational Flexibility and Efficiency:

The new station eliminates a 28-mile 3-terminal line which is inherently unreliable (Glencoe-Bannock-Robyville 69kV). It aligns the area's 69kV circuit protection (Glencoe-Robyville + Flushing-Smyrna 69kV), which will all be fiber-based, as a result of other projects in the works. Also, today there are 4- MOAB auto-sectionalizing switches in series on this circuit, which is no longer permitted protection-wise, due to the likelihood of miscoordination. Installing breakers will split the circuit, to have 2 MOAB's on each branch.

In addition, 400 feet from the existing Provident Switch pole, St. Clairsville Municipal's Hess station is connected via a 'hard tap' (lacks proper line sectionalizing switches). This causes St Clairsville to take an outage whenever T-Line maintenance work must be done nearby, and also has a negative impact on transmission system sectionalizing and outage restoration.

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AEP Transmission Zone: Supplemental
Provident Switch

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In the past 5 years, the Glencoe-Robyville 69kV 2-terminal circuit has experienced 20 momentary outages and 7 sustained outage events (with an average duration for customers of 19.1 hours). A significant number of the outages have been due to protection misoperation and station equipment issues, which will only worsen once the circuit becomes a 3-terminal circuit in 2021 (by connecting the radial circuits via the Flushing-Smyrna project). Installing this new ring bus station will greatly improve operational flexibility and reduce the frequency and duration of transmission outage events.

The protective relays and controls at Bannock station cannot be adequately upgraded to match the remote-ends at Provident and Flushing (which will utilize fiber-based microprocessor relays). There is no control house, and the site is not suitable for a new control house. 69kV MOAB switches are reasonable in this case to provide adequate reliability for the distribution station. Today the basic overcurrent protection is adequate on the radial line to Flushing, but once Flushing is networked to Smyrna, the protection is not adequate (not capable of 2-way protection).

Selected Solution:

Re-route Glencoe-Robyville-Flushing 69kV circuit to connect to new Provident Switch station. (S1605.1) Estimated Cost: $0.5M

Construct a new 4-breaker 69kV ring bus station called Provident; provide service to St Clairsville Muni's Hess station. Update relay settings at remote-ends. Retire 69kV breaker at Bannock station. Install 2- 69kV MOAB switches with auto-sectionalizing. Install new revenue metering at Hess station. Coordinate protection with Provident Station. (S1605.2) Estimated Cost: $3.1M

Total Estimated Transmission Cost: $3.6M

Projected In-service: 12/1/2021

Project Status: Scoping

AEP Transmission Zone: Supplemental Reaver

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Customer Service:

AEP-Ohio's transformer loads at Briggsdale are at 93% capacity with no physical space for expansion. A relatively large load increase is anticipated in the area in the near term. Area distribution circuits are loaded so that adequate relief with adequate backup redundancy is not available. As a result, AEP-Ohio has requested a new 138kV delivery point, named Reaver, that is expandable to serve up to 4-50 MVA transformers worth of distribution load.

Operational Flexibility and Efficiency:

The only two delivery points currently served from the Wilson-McComb 40kV system are Briggsdale and Phillipi. Briggsdale is the AEP-Ohio distribution station and Phillipi is a customer owned station that has been designed for easy conversion to 138kV in the future. Working with AEP-Ohio and the customer at Phillipi, an area plan has been developed to convert these loads to 138kV and retire all of the local 40kV system. The next step in this plan is to transfer the Briggsdale load to a new 138kV sourced distribution station named Reaver. This will allow one of the two 40kV circuits to be de-energized. The elimination of Briggsdale station is necessary to properly plan for the rehab needs at Wilson station, the remaining 40kV to 138kV conversion of Phillipi station, and an increase in available distribution capacity at McComb due to freeing up the currently reserved transmission capacity on the existing transformers.

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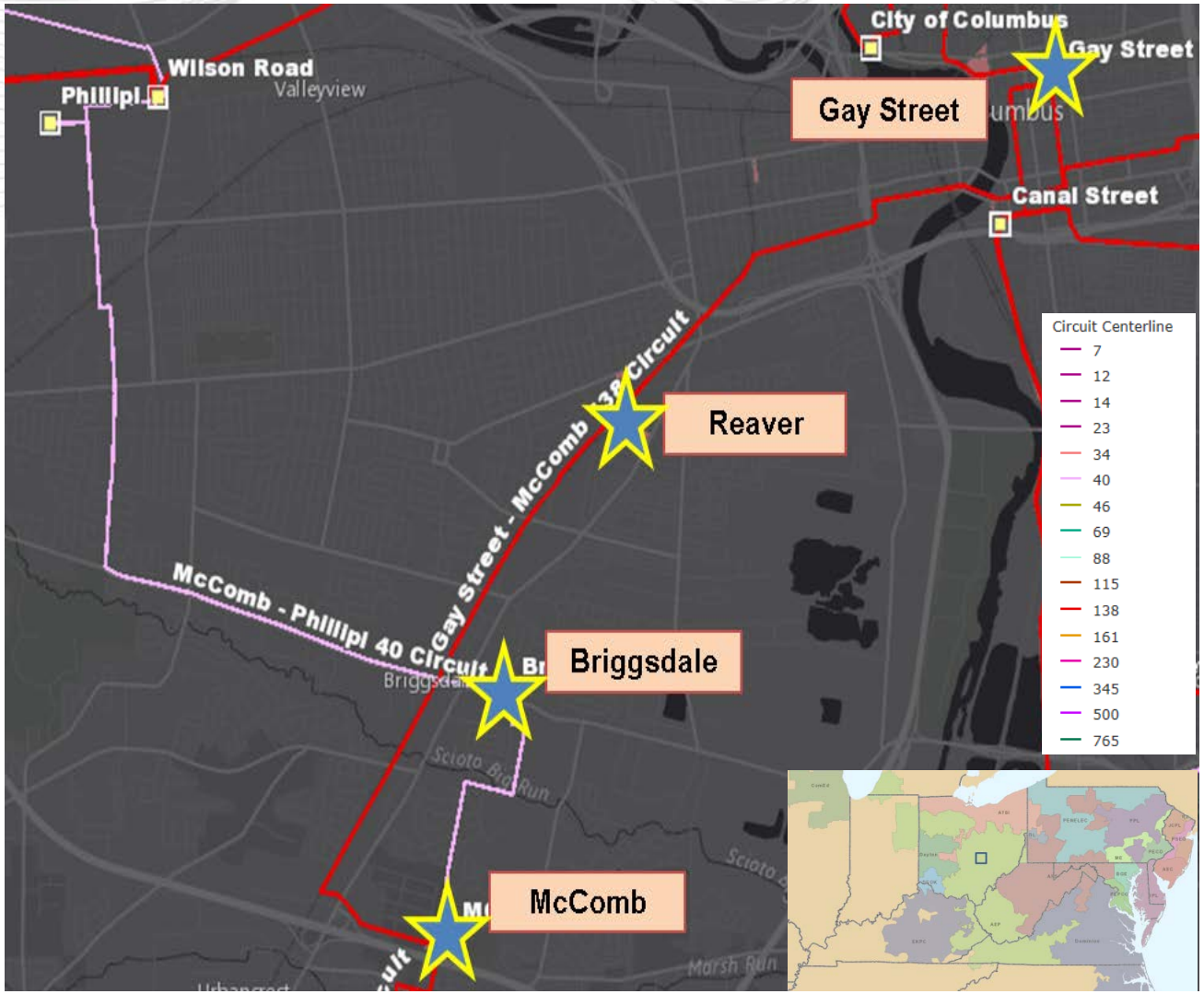

AEP Transmission Zone: Supplemental Reaver

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Equipment Material/Condition/Performance/Risk:

The majority of equipment at Wilson station is in need of rehab driven replacement. The 40kV system between Wilson and McComb is antiquated, obsolete, and in poor condition. Significant portions of this system are in the process of being converted to 69kV with the final solution to completely eliminate the 40kV system.

138kV CB's 101E & 101C are both oil type and approx. 50 years old, and both have exceeded the recommended number fault operations.

Selected Solution

Construct a new 138/13kV station (Reaver) with 2-3,000A 40kA 138 kV CB's. (S1606.1) Estimated Cost: $2.4M

Retire and remove Briggsdale station. (S1606.2) Estimated Cost: $0.2M

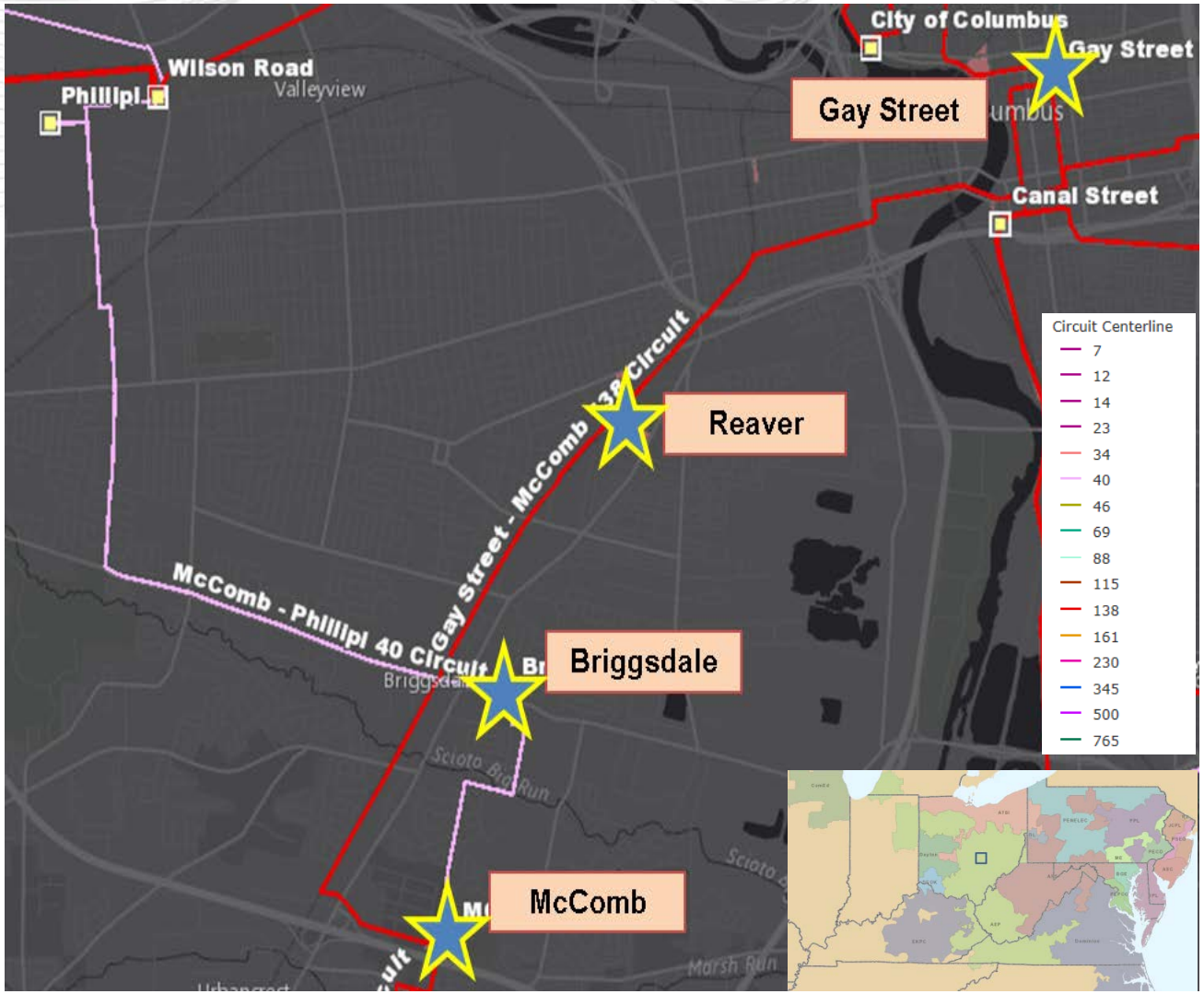
At McComb station, replace 2-138kV 1600A 40kA CB's 101C & 101E and disconnect switches with 3,000A 40kA CB's. (S1606.3) Estimated Cost: $1.3M

Cut Reaver station into existing Gay Street-McComb 138kV circuit with very short construction of 636 ACSR 26/7 Grosbeak conductor (223 MVA rating). (S1606.4) Estimated Cost: $0.7M

Total Estimated Transmission Cost: $4.6M

Projected In-service: 12/1/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental Reusens

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Reusens Station: The 138 kV CB “AB” is a PK air blast breaker, which currently require hearing protection be used for personnel within the substation. PK air blast breakers have a tendency to fail catastrophically, which, cause sharp pieces of porcelain from their bushings are typically expelled causing potential safety hazard to field personnel. In addition, the ability to get spare parts for these breakers is becoming increasingly difficult. The Manufacturers recommended number of fault operations is 10. CB “AB” has experienced 118 operations. 69 kV circuit breaker “AA”, “BB” & “CC” are 1962 vintage oil type breakers without oil containment. In general, oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. Oil spills are frequent with failures and routine maintenance which is also an environmental hazard. CB “AA” has experienced 60 operations, “BB” has experienced 103 operations, and “CC” has experienced 51 operations.

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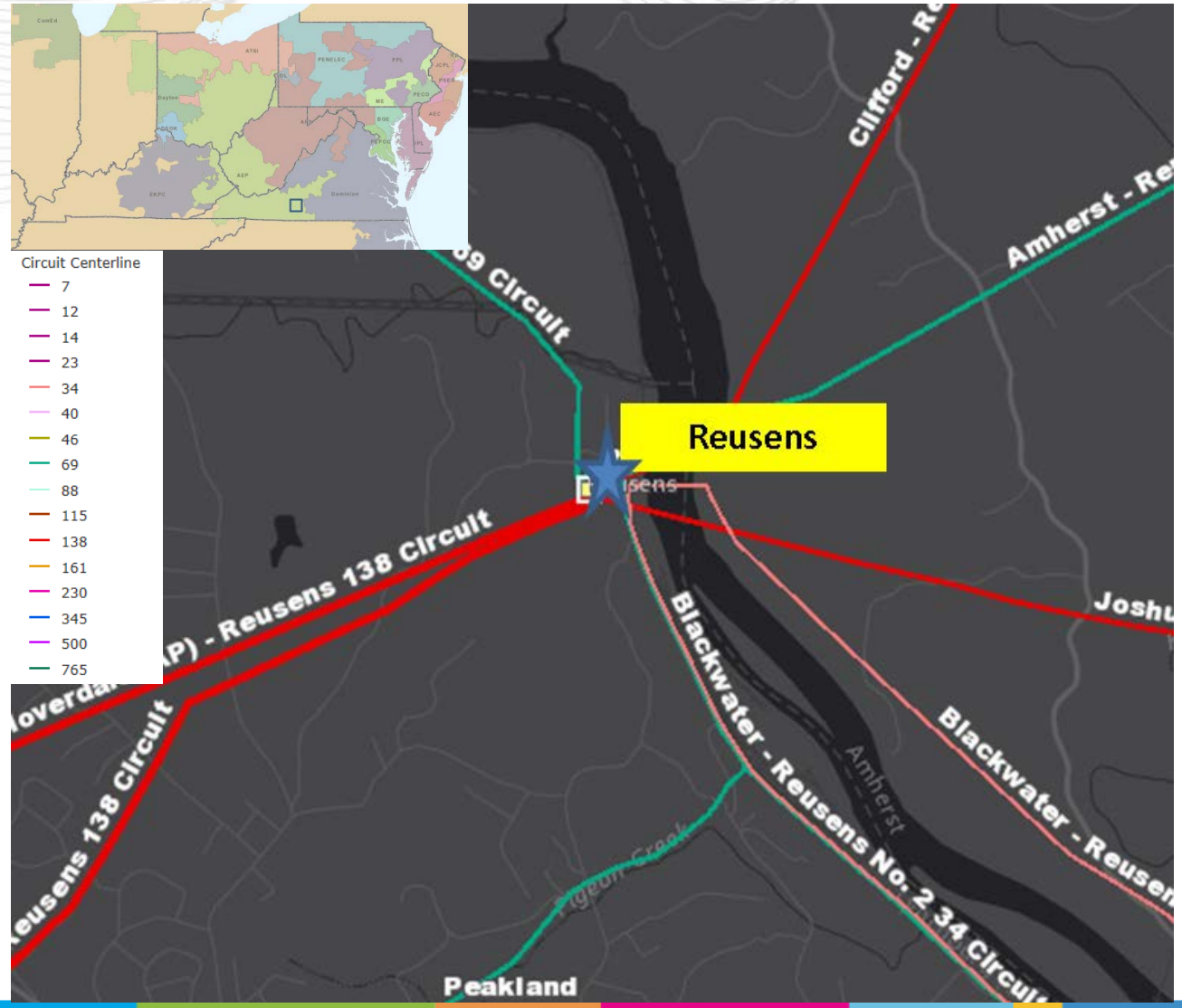

AEP Transmission Zone: Supplemental Reusens

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138 kV 3000 A 50 kA CB “D” is a vintage 1980 GA gas mechanical two pressure air blast breaker no longer supported by the manufacturer. These breakers require extensive maintenance to keep them from leaking air. Due to their excessive leaks, we had a program some years back to maintain/rebuild all GA breakers. The rebuild required 400 man-hours per breaker to rebuild. From AEP’s experience, we determined that it was more cost effective to replace these breakers which will eventually leak again. CB “D” has experienced 52 operations. The existing Transformer #1, vintage 1951, has seen major through fault events which has contributed to extremely elevated levels of combustible gases and carbonization of insulating paper. The existing Transformer # 2, vintage 1954, has also seen numerous major through fault events causing significant gassing of the unit and upward trending moisture content in the oil. The high side circuit switchers is being installed on Transformer #1, #2, and # 3 will break up dissimilar zones of protection, which causes over tripping and miss-operations. In addition, this current lack of sectionalizing makes it difficult to perform routine maintenance work. Circuit switcher “DD” is an VMB type, which, is no longer supported by the manufacturer and parts are difficult to obtain. This CS is a poor cold weather performer due to the use of fiberglass parts in the interrupter which expand and contract with the weather causing miss operations. Due to their age and design we are seeing increased contact resistance on most units. Circuit Switcher “AC “ is a Mark III which the manufacturer no longer makes parts for. We have to scavenge for parts to do routine maintenance. These are older designed circuit switchers with old controls that no longer coordinate well with modern relaying.

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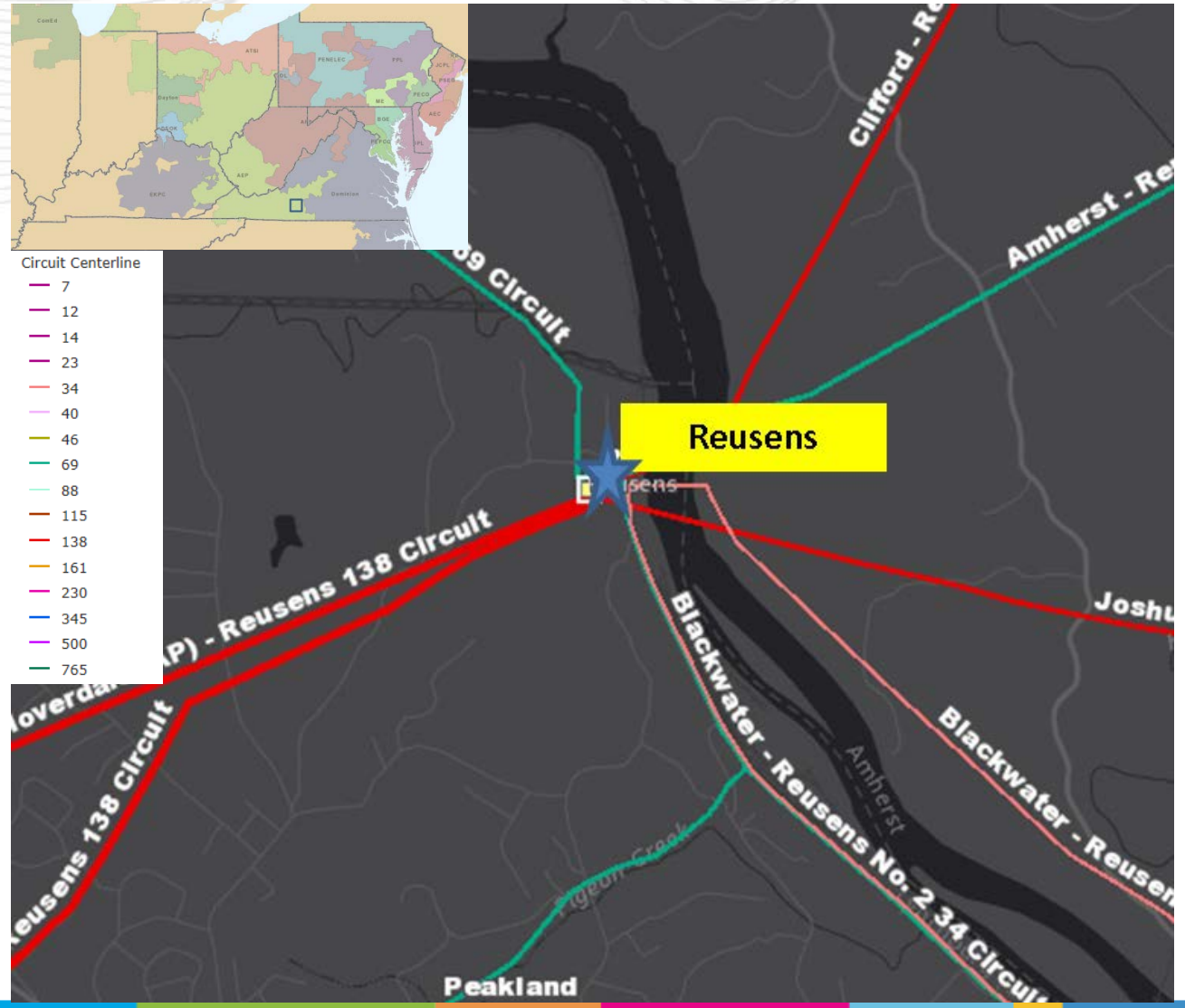

AEP Transmission Zone: Supplemental Reusens

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Moseley Station: The addition of CB "B" & Transformer # 1's high side circuit switcher are being installed to break up dissimilar zones of protection on the 138 kV system, which causes misoperations and over tripping. The 138 kV CB "A" is 1959 vintage oil filled breaker without oil containment and has experienced 176 operations. The 69 kV CB "E", which feeds the Town of Bedford, is a 1967 vintage oil filled breaker without oil containment and has experienced 101 operations. In general, oil breakers have become increasingly difficult to maintain due to the oil handling associated with them. Oil spills are frequent with failures and routine maintenance which is also an environmental hazard.

Clifford Station: The 138 kV CB "F" and Transformer #1's high side CB "XT1" are being added to break up dissimilar zones of protection on the 138kV, which could cause misoperations and over tripping.

Operational Flexibility and Efficiency:

Ground switch MOAB's are being replaced to prevent intentional induce a faults 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.

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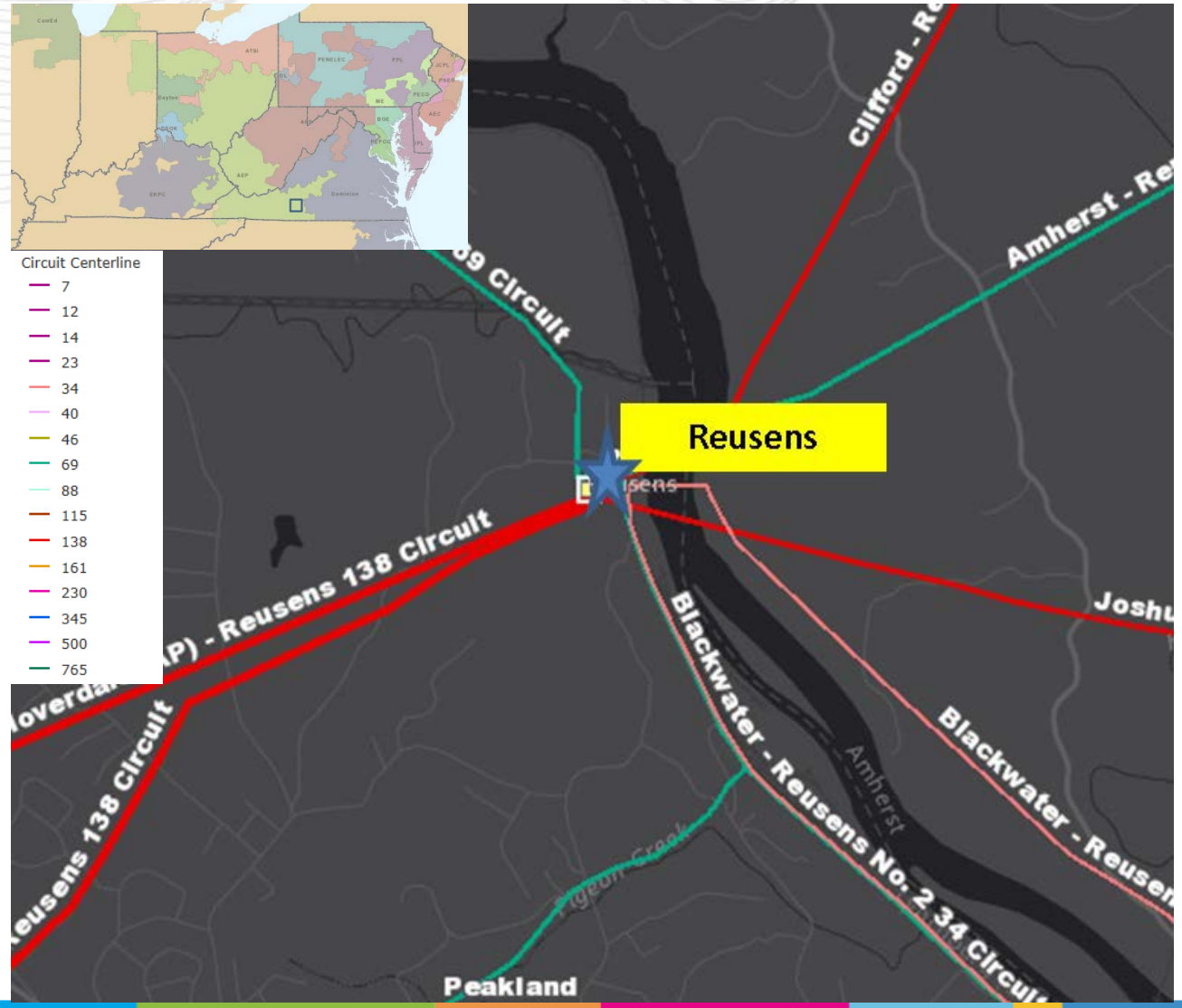

AEP Transmission Zone: Supplemental Reusens

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Selected Solution

At Reusens station, replace existing 3000 A 40 kA 138 kV CB's "AB" & "D" with new 3000 A 40 kA CB. Replace existing 138/34.5 kV 130 MVA XF's #1 & XF #2 with new 138/34.5 kV 130 MVA XF's. Add new 3000 A 40 kA 138 kV circuit switchers "XT1"," XT2", "XT4" on the high side of their respective transformers. Replace existing 1200 A 61 kA 138 kV cap switcher "AC" with new 650 A 31.5 kA cap switcher. Replace existing 300 A 12.5 kA 69 kV cap switcher "DD" with new 420 A 15 kA cap switcher. Install a new 3000 A 40 kA 69 kV CB "XB4L" to the low side of XF #4. Replace existing 1200 A 69 kV CBs "AA", "BB", & "CC" with new 3000 A 40 kA CB's. Replace the 138/69 kV 60 MVA XF #4 with a new 138/70.5/13 kV 130 MVA transformer. (S1607.1) Estimated Cost: $12.6M

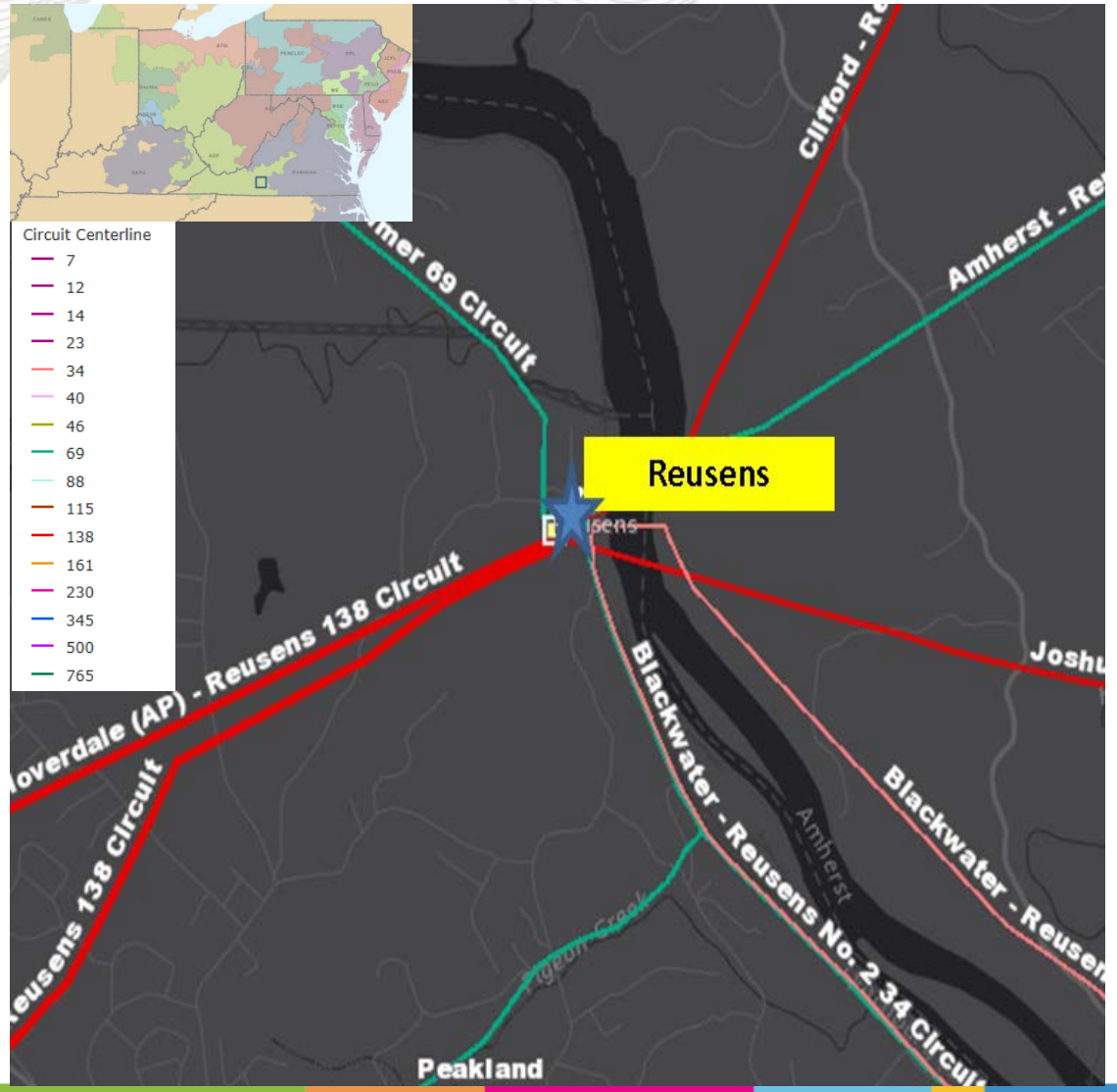
At Mosely station, replace existing 800 A 17.5 kA 138 kV CB "A" with new 3000 A 40 kA CB. Add a new 3000 A 138 kV 40 kA line CB "B" on the Roanoke exit. Replace existing 1200 A 69 kV CB "E" with new 3000 A 40 kA CB. Replace the existing 1200 A 61 kA grounding switch MOAB "Z1" with new 3000 A 40 kA circuit switcher "XT1". (S1607.2) Estimated Cost: $4.7M

At Clifford station, Replace existing MOAB "Y" with new 3000 A 40 kA 138 kV CB "F" on the Boxwood line exit. replace grounding switch MOAB "Z1" with new 3000 A 40 kA circuit switcher "XT1". 138/46 kV Transformer #3 ground switch MOAB will be retired on a separate baseline project. (S1607.3) Estimated Cost: $3.4M

Total Estimated Transmission Cost: $20.7M

Projected In-service: 12/31/2022

Project Status: Engineering



AEP Transmission Zone: Supplemental Haviland-West Van Wert

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

There are 332 open conditions on the Haviland – S. Van Wert circuit, the majority of which are on the Haviland – W. Van Wert line section.

The subject 69 kV line in Van Wert County, Ohio was originally constructed in 1955. The vast majority of the original-vintage poles are 55 ft. class 4 wood poles. These original vintage poles are far undersized in terms of both height and strength when compared to today's AEP Transmission standards.

Since January 1, 2002 there have been at least eight (8) instances of cascading pole failures during adverse weather, each resulting in a long-duration sustained transmission line outage which interrupted the transmission source to two (2) AEP Ohio distribution stations (South Convoy and Ohio City) and one (1) Paulding-Putnam Electric Cooperative substation (Convoy). These two AEP Ohio distribution stations supply approximately 1350 retail customers. In addition to the cascading pole failure events there have been other sustained outages due to broken insulators, broken crossarms, and broken shield wires.

The majority of the original-vintage tangent wood poles are insulated with 66 kV rated brown porcelain horizontal post insulators. This type of insulator is no longer standard on the AEP system. AEP's experience has shown that this size and type of insulator is subject to base and end fitting separation from the porcelain body when subjected to climatic thermal cycling. They are also prone to electrical backflash.

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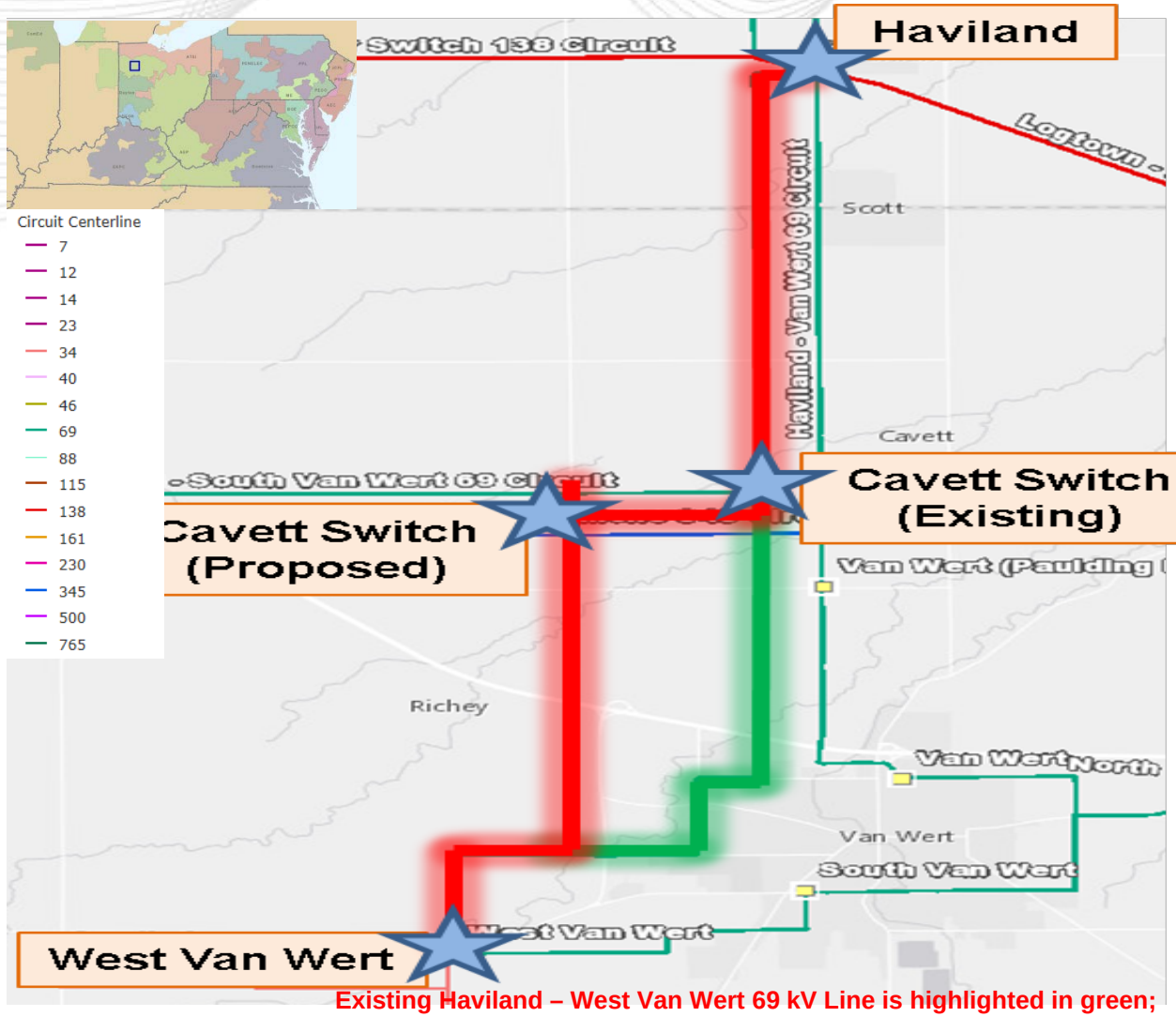

Existing Haviland – West Van Wert 69 kV Line is highlighted in green; Proposed rebuild is highlighted in red.

AEP Transmission Zone: Supplemental Haviland-West Van Wert

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Some original vintage poles utilize wood crossarm construction with either vertical post insulators or suspension insulator strings. The life expectancy of wood crossarms is far less than that of wood poles, meaning the required timing of the replacement of the major structural components is not synchronized. This results in the inspection failure rate of crossarms being higher than the inspection failure rate of poles. The cost to access poles in an environmentally responsible way to replace defective crossarms can result in the decision being made to prematurely replace older poles too, prior to the poles actually being judged as defective. Construction types that do not utilize crossarms resolve this issue.

Crossarms and support braces of this vintage are typically undersized, more closely resembling distribution crossarm assemblies. End splitting and suspension insulator string fallout is an elevated risk.

A portion of the line utilizes 4/0 copper phase conductors (50 MVA rating). This size and type of conductor is obsolete on the AEP system, meaning it can be difficult to splice and repair due to lack of available stock materials.

The majority of the shield wire on the line is either 5/16" EHS steel or No. 1 copper 3-strand. Both of these shield wire sizes and types are obsolete on the AEP system, meaning they can be difficult to splice and repair due to lack of available stock materials.

Many of the original-vintage wood poles utilize non-standard crossarm-type bay-o-nets extending from the pole top to support the shield wire. Bay-o-nets decay at the same rate as wood crossarms, meaning bay-o-net replacement is typically required prior to the pole itself needing to be replaced. Bay-o-net top rot and splitting also poses the risk of dropping the shield wire into the top or center phase conductor, and resulting sustained outage to the circuit.

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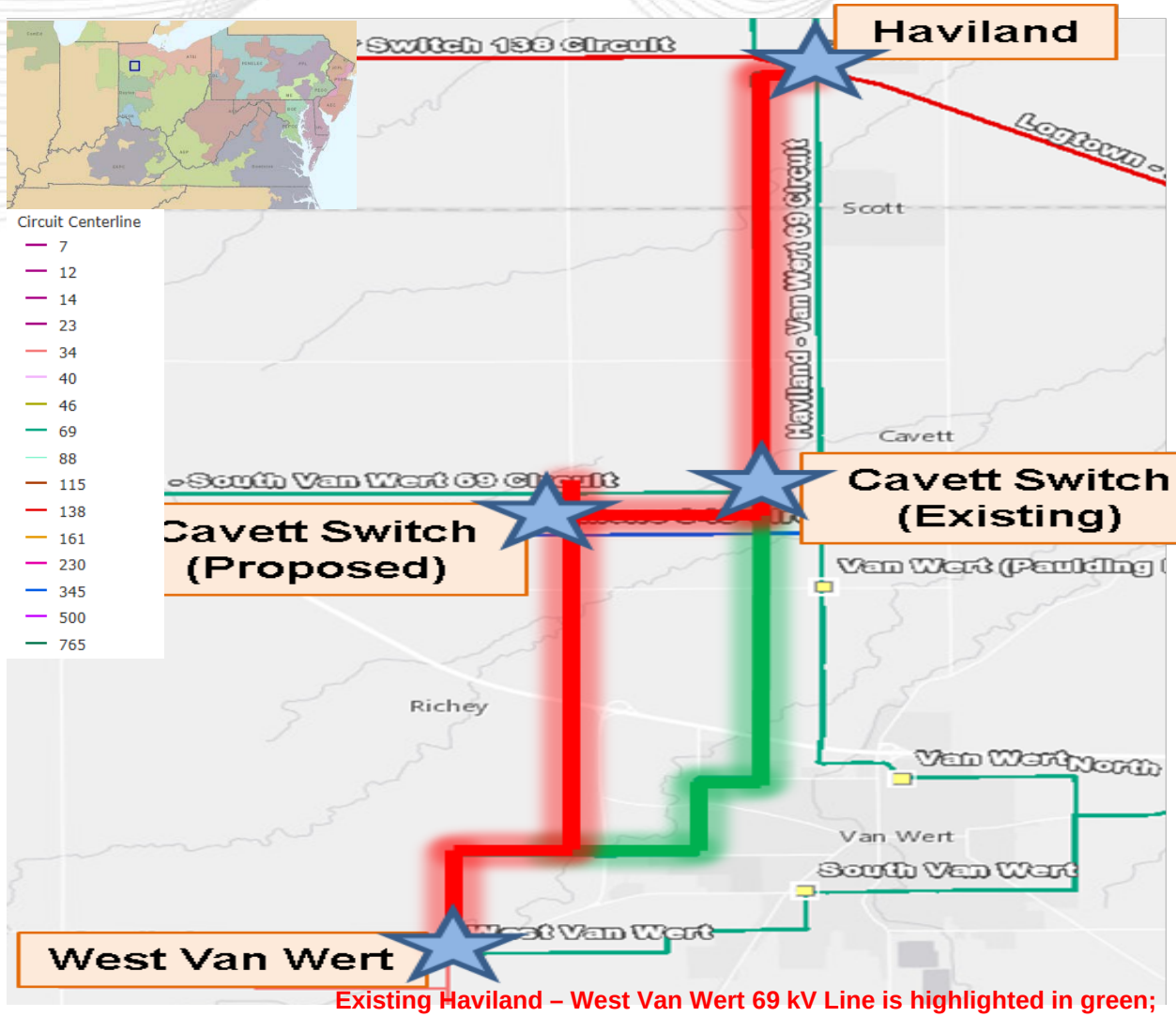

Existing Haviland – West Van Wert 69 kV Line is highlighted in green; Proposed rebuild is highlighted in red.

AEP Transmission Zone: Supplemental Haviland-West Van Wert

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Existing grounding is only every other structure. This is not the current AEP standard. Grounding electrodes are typically a butt-wrap, which can be high impedance and less effective than driven rods.

Some of the line has distribution underbuilt. Distribution underbuilt mechanical loads consume pole strength, adding to the risk of future cascading pole failure events.

Legacy underlying land rights for a line of this vintage are typically inadequate by present day AEP standards, offering less-than-desired protective rights for encroachment control and vegetation management.

Operational Flexibility and Efficiency

The FOI calculation justifies a MOAB at Cavett Switch facing toward West Van Wert.

Selected Solution

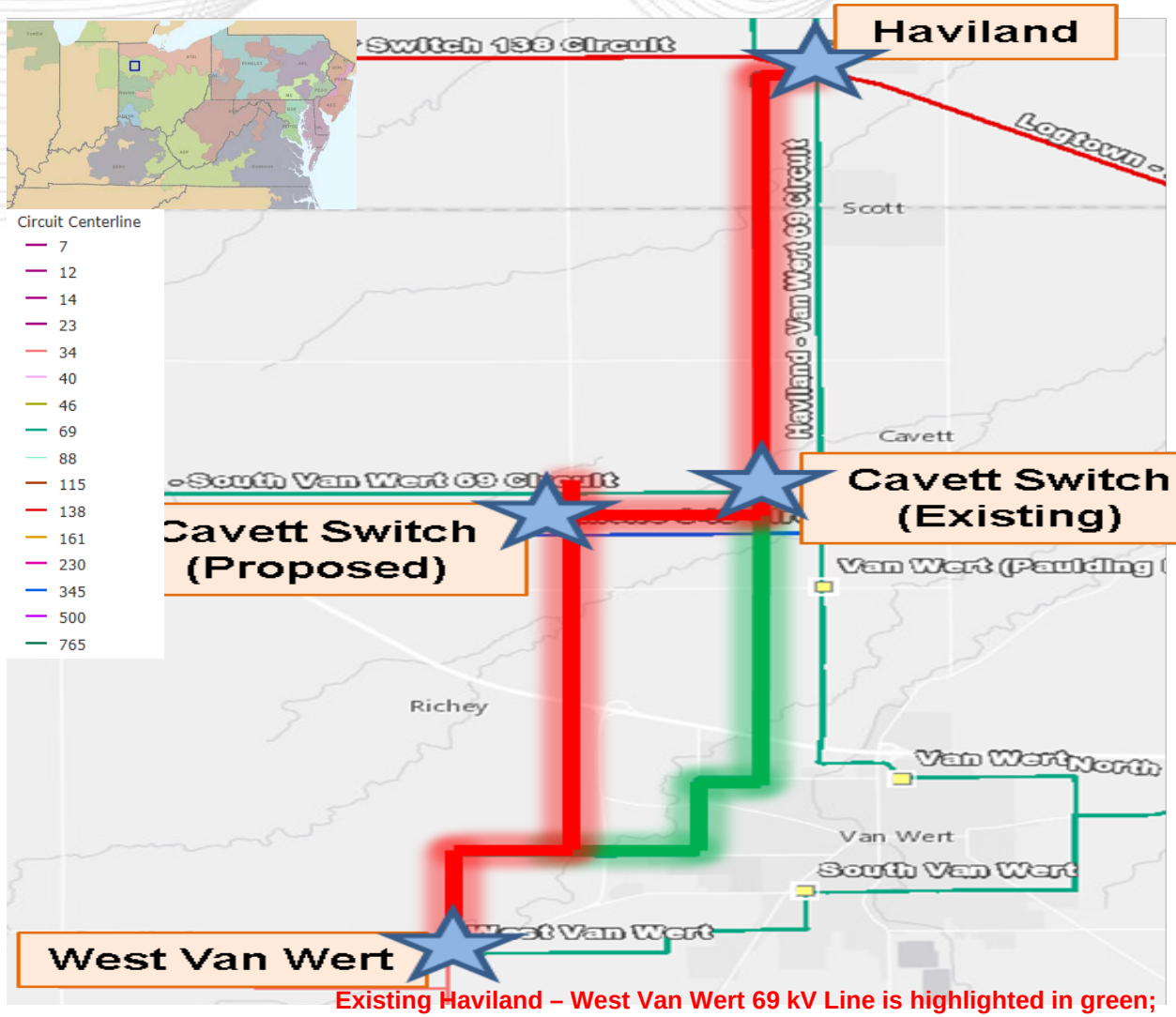
Retire existing Cavett 2-way line switch. Replace with 3-way line switch on new route with MOAB facing West Van Wert. (S1608.1) **Estimated Cost:** $0.3M

Rebuild existing Haviland–West Van Wert 69 kV line asset (~14.6 miles) with 795 ACSR conductor (68 MVA rating, non-conductor limited), including partial line reroute. Remove old 211.6 ACSR, 4/0 Copper, and 336.4 ACSR conductor. (S1608.2) **Estimated Cost:** $15.7M

Total Estimated Transmission Cost: $16.0M

Projected In-service: 12/31/2020

Project Status: Engineering



Existing Haviland – West Van Wert 69 kV Line is highlighted in green; Proposed rebuild is highlighted in red.

AEP Transmission Zone: Supplemental Sardinia

Previously Presented: 3/27/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The existing 11.9 mile, 69 kV radial line section between Seaman and Sardinia was constructed in 1938 using wood pole structures with 336 ACSR conductor (60 MVA rating). There are 363 open A conditions on the entire 20.3-mile line from Adams to Seaman including the radial to Sardinia. The 11.9-mile section has approximately 60% of those (217). The conditions include rotten cross-arms, burnt/broken insulators, and loose/broken conductor hardware.

Operational Flexibility and Efficiency

AEP Ohio Stations Sardinia and Wildcat have transfer capability between them. Installing 138 kV circuit breakers will help keep customers in service.

Selected Solution:

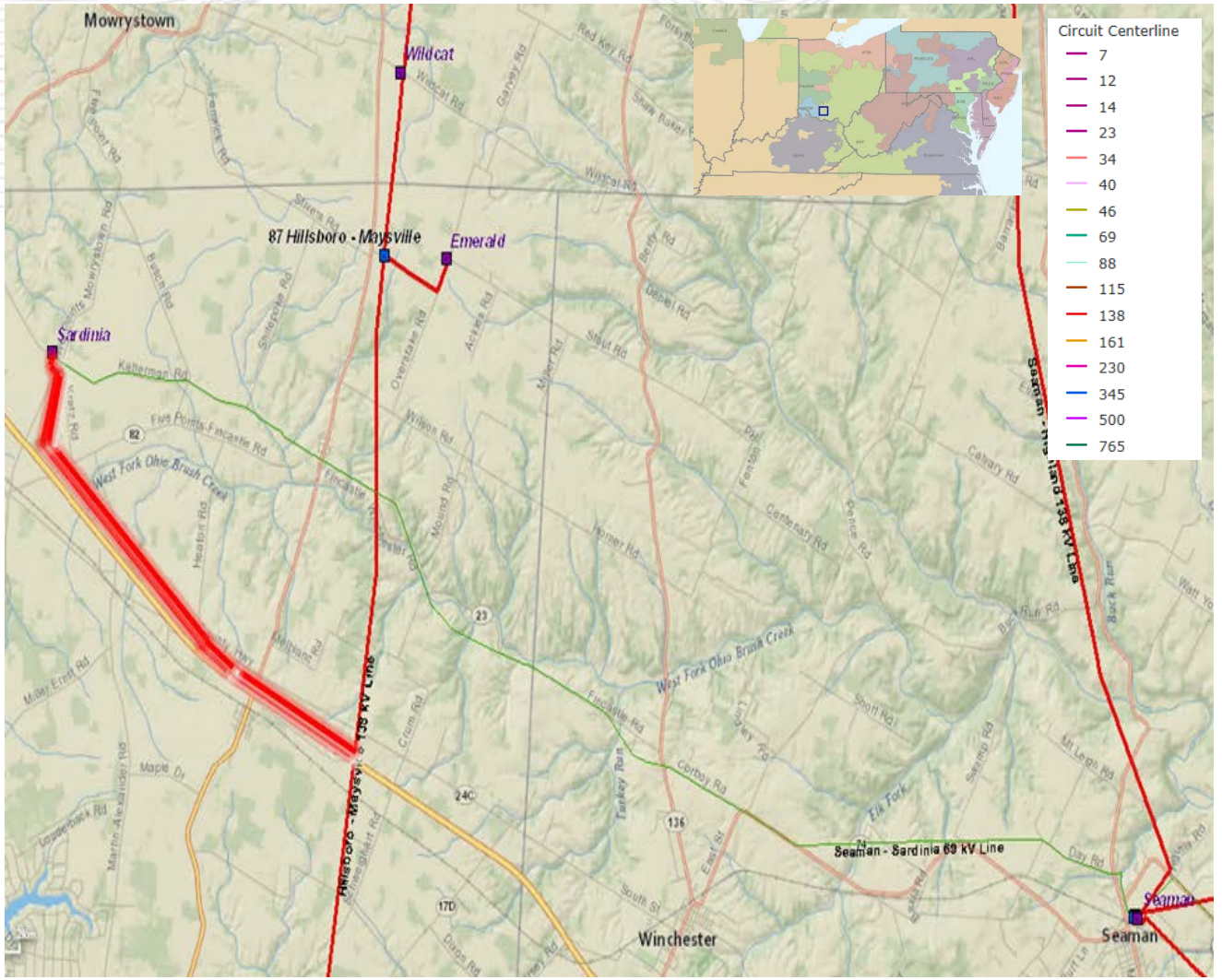
Build a 4.5-mile 138kV double circuit line from Sardinia Station to tap point on the Kenton – Wildcat 138kV circuit, capable of 200 MVA. Once complete, remove the 11.9-mile 69kV Seaman-Sardinia transmission line and associated 69kV equipment at the Seaman and Sardinia substations. (S1609.1) **Estimated Cost: $14.0M**

Install 138 kV bus and two 138 kV circuit breakers at Sardinia station. (S1609.2) **Estimated Cost: $3.0M**

Total Estimated Transmission Cost: $17.0M

Projected In-service: 12/1/2021

Project Status: Scoping



Next Steps

Upcoming Western SRRTEP Dates

West	Start	End
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

4/09/2018 – V1 – Original version posted to pjm.com

4/26/2018 – V2 – Slide #43: Corrected Previously Presented: 4/17/2018 SRTEAC to 2/17/2018 SRTEAC
– Slide #22: Change "Resilience" to "Operational Flexibility"
– Slide #16: Updated Transmission Costs

5/15/2018 – V3 – Slide #84: Added detailed cost and Changed Projected IS Date: from 6/29/2019 to 12/31/2022

6/26/2018 – V4 – Slide #4: Add statement about ROW.
– Slide #15: Add statement about equipment condition and flooding concern
– Slide #25: Add number of fault operations
– Slide #37: Add alternative regarding double-circuit 138kV line
– Slide #62: Add year of manufacture to breakers. Corrected breaker reference from "Q" to "C"
– Slide #70: Change project cost from $0M to $0.5M
– Slide #72: Change driver to "Customer Service" and note that customer was I&M distribution
– Slide #78: Add paragraph about line protection
– Slide #63: Add estimated cost of project components