Sub Regional RTEP Committee
PJM West

July 27, 2018

First Review

Baseline Reliability and Supplemental Projects

AEP Transmission Zone: Baseline
B2798 Cancellation

Cancel B2798

B2798 was presented in 5/31/2017 PJM West SRTEAC

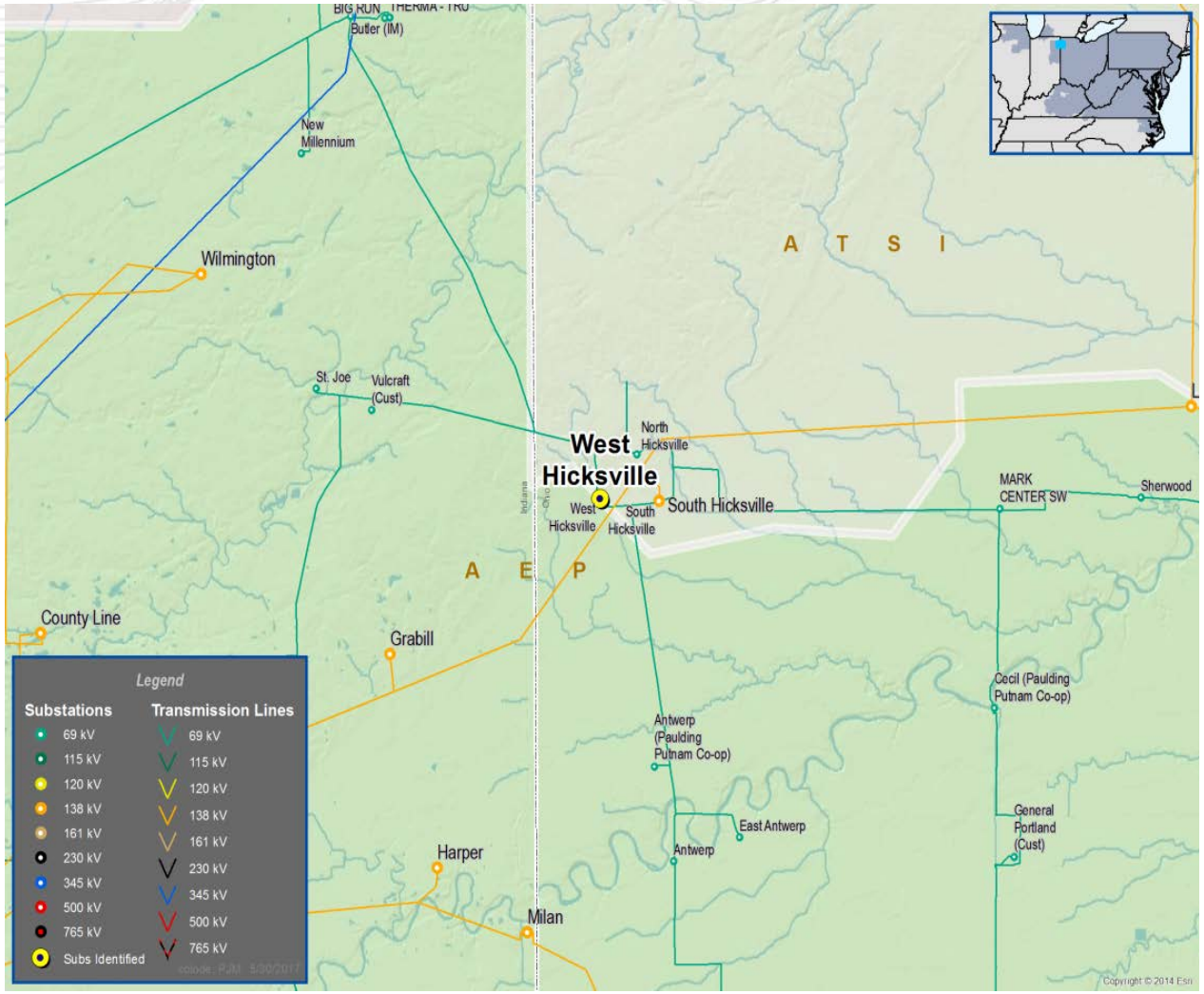
B2798: Install a 14.4 MVAr capacitor bank at West Hicksville station. Replace ground switch/MOAB at West Hicksville with a circuit switcher

Original Driver: AEP TO Criteria Violation -Low voltage violation (0.905 pu) at West Hicksville station for loss of the South Hicksville 69 kV bus in the 2021 RTEP case. –Hicksville, Ohio

TEAC Cost: $1.3M

Required IS date: 6/1/2021

Reason for Cancellation: Load model correction at St. Joe tap station (reduced more than half).



DEOK Transmission Zone: Supplement
Silver Grove Replace 345/138 kV Transformer

Problem Statement:
400 MVA TB 23 shows high levels of dissolved combustible gasses. There is no breaker between the high side of TB 23 and the 345kV bus. If TB 23 faults or its low side breaker fails the 345kV circuit between Zimmer, Silver Grove and Red Bank substations is lost. The low side circuit breaker connecting TB 23 to the 138kV bus is oil filled, obsolete and spare parts are no longer available.

Driver: Equipment Condition, Performance and Risk

Potential Solution:
Replace the Sliver Grove 345/138kV transformer 23 with a transformer of the same capacity, install a circuit breaker on the high side keeping the 345kV circuit in service for the fault or failure, replace the low side circuit breaker.

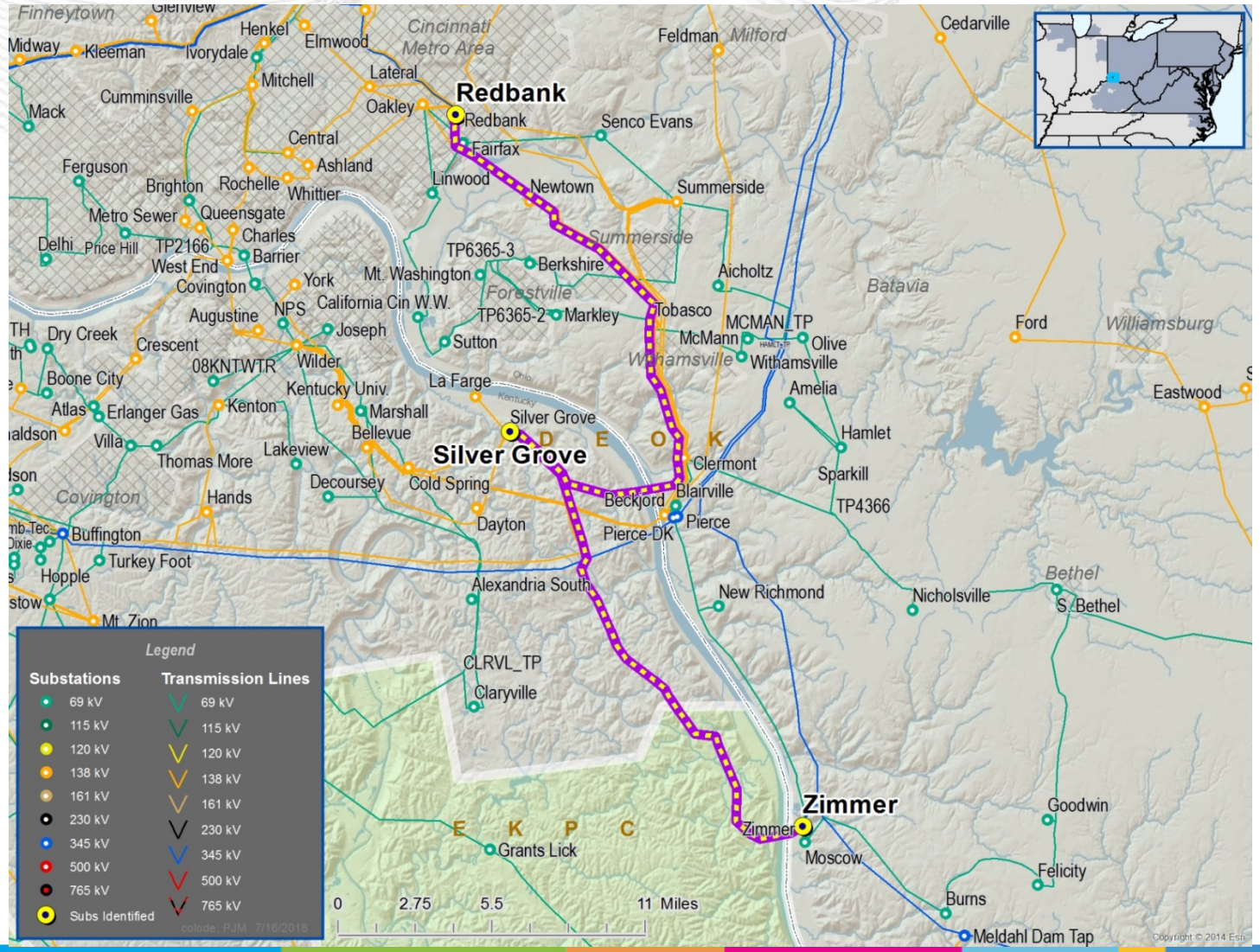
Estimated Cost: $7.8 M

Alternatives:

- None

Projected In-service: 12-31-2019

Project Status: Scoping



APS Transmission Zone: Supplemental
Perryman Customer Load

Problem Statement (Immediate Need):

Customer Service

- Provide 138 kV service to new customer
- Customer load 14 MW

Potential Solution:

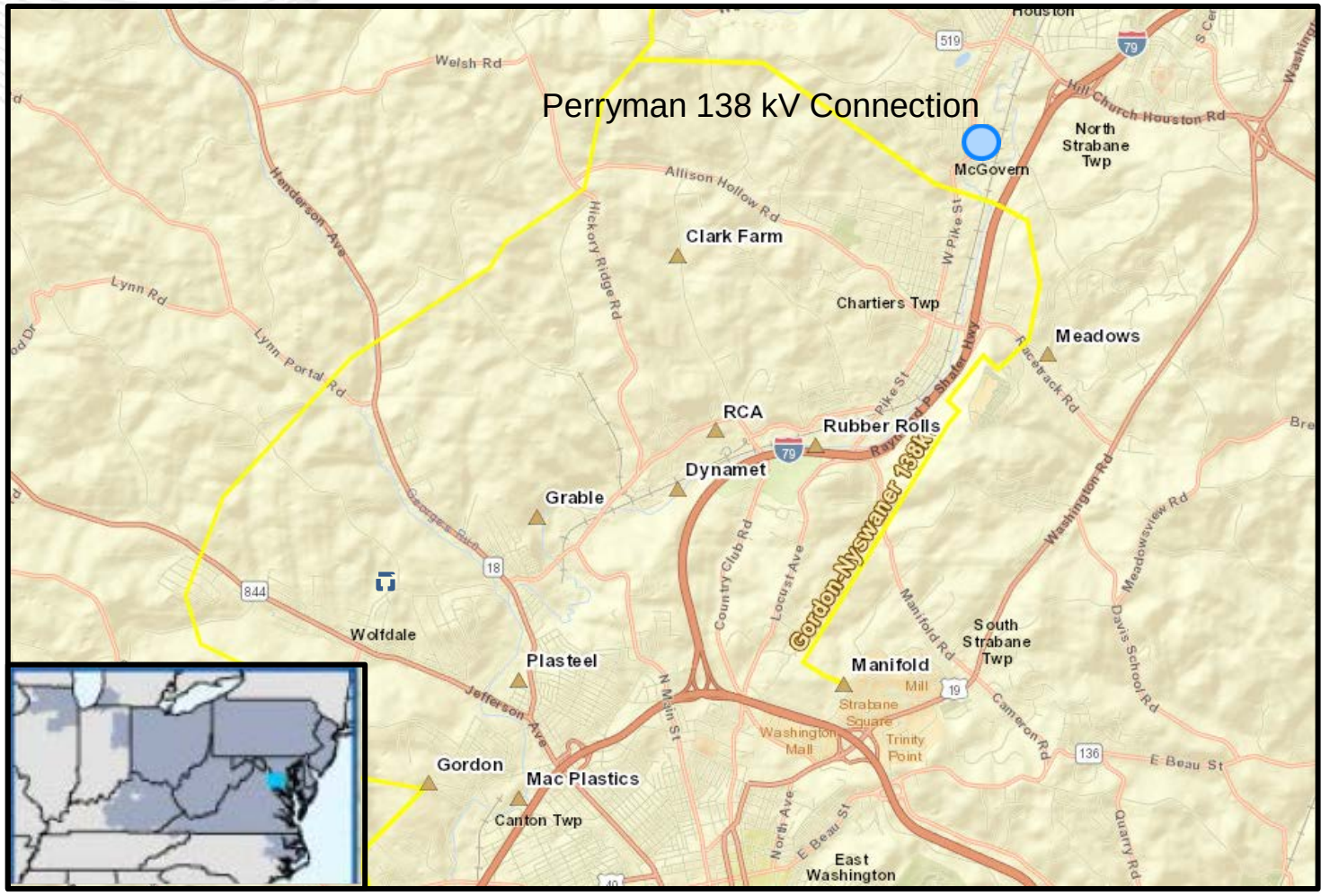
Perryman Company- Provide 138 kV Service

- Tap the existing Manifold – Gordon 138 kV line.
- Install 2 – 138 kV Line Switches
- Install 138 kV Wavetrap at tap
- Install 138 kV Tap Switch
- Construct ~500 ft of 336 ACSR 138 kV line to Customer Substation

Estimated Project Cost: $0.13 M

Projected IS Date: 9/01/2019

Status: Conceptual



ComEd Transmission Zone: Supplement
Chicago Heights Hardening

Problem Statement:

2017 emergent project to replace failed 138kV line 11712 breaker moved Chicago Heights transformer 79 from line 11712 to line 7306

Transformer 79 is still connected to a transmission line

Chicago Heights substation is a straight bus with multiple elements on the same bus

Potential Solution:

Install new 138kV bus tie breaker

Install new transformer high side breaker and move transformer connection from line 7306 to the 138kV bus

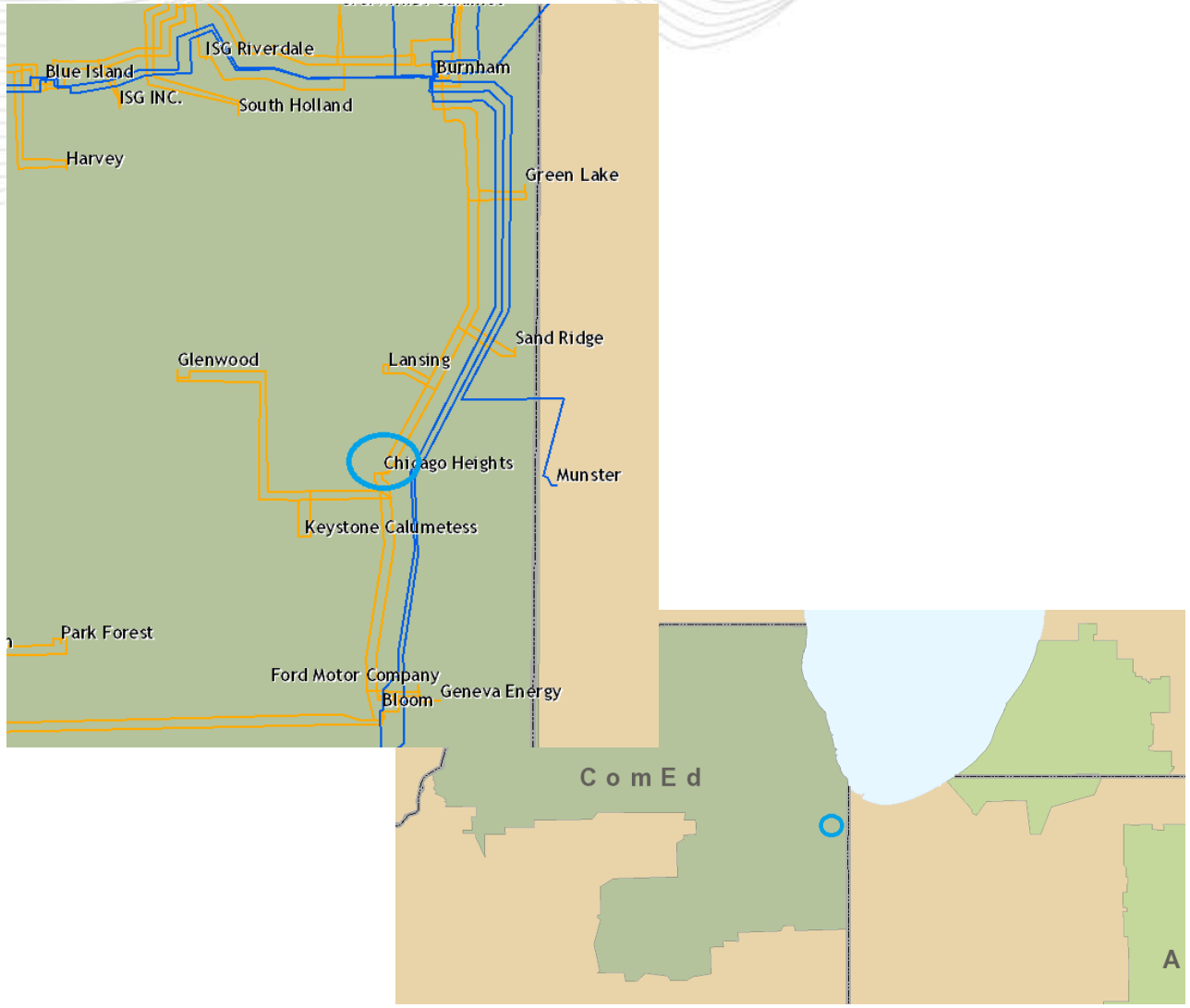
Estimated Cost: $4.5M

Alternatives:

- Do nothing

Projected In-service: 12/31/2018

Project Status: Engineering



ComEd Transmission Zone: Supplement
Continue Itasca Expansion

Problem Statement:
Continued load growth in the Elk Grove Village area requires additional 34kV capacity.

Potential Solution:
Install third 138kV to 34kV transformer.
Move 138kV line 12015 to the 138kV Itasca bus extension

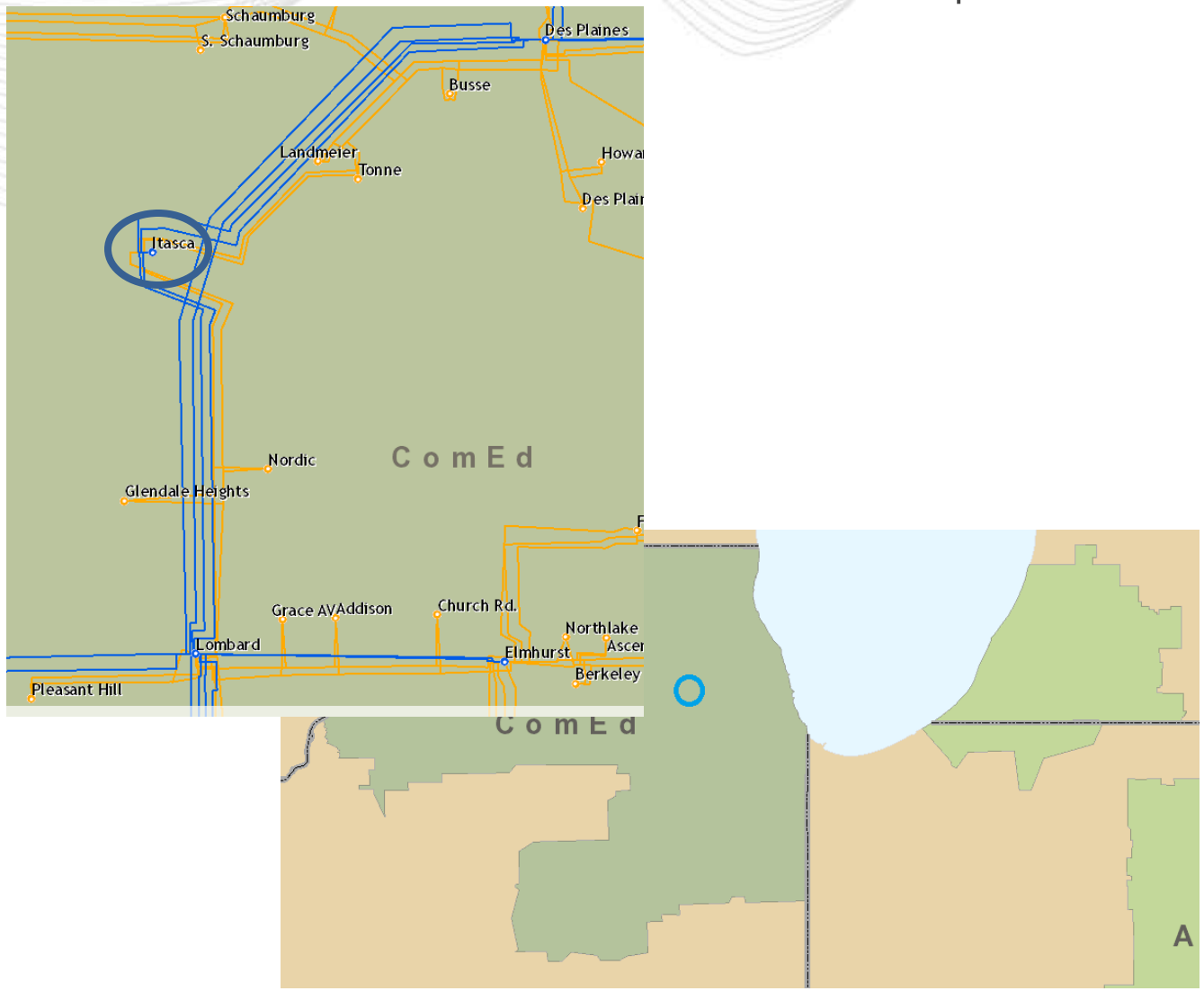
Estimated Cost: $2.2M Transmission

Alternatives:

- None

Projected In-service: 6/1/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental Service to Braidy Aluminum

Problem Statement:

Customer Service:

Braidy Industries has requested electric service with a peak demand of 60 MW for their Aluminum Mill operation at the EastPark Industrial Center in Boyd County, KY.

Kentucky Power Distribution has requested a new delivery point (Ramey station) to provide load relief to nearby distribution circuits and stations along with a reduction of distribution line exposure.

Kentucky Power Distribution has requested a new delivery point at the proposed Moore Hollow station to serve industrial customers at the EastPark Industrial Center and to reduce exposure on customers served out of the existing Princess station.

Operational Flexibility and Efficiency

The 69/34.5 kV transformer at Princess station utilizes a ground switch MOAB scheme as part of the high side transformer protection.

The 69/12 kV transformer at Hoods Creek station utilizes a ground switch MOAB scheme as part of the high side transformer protection.

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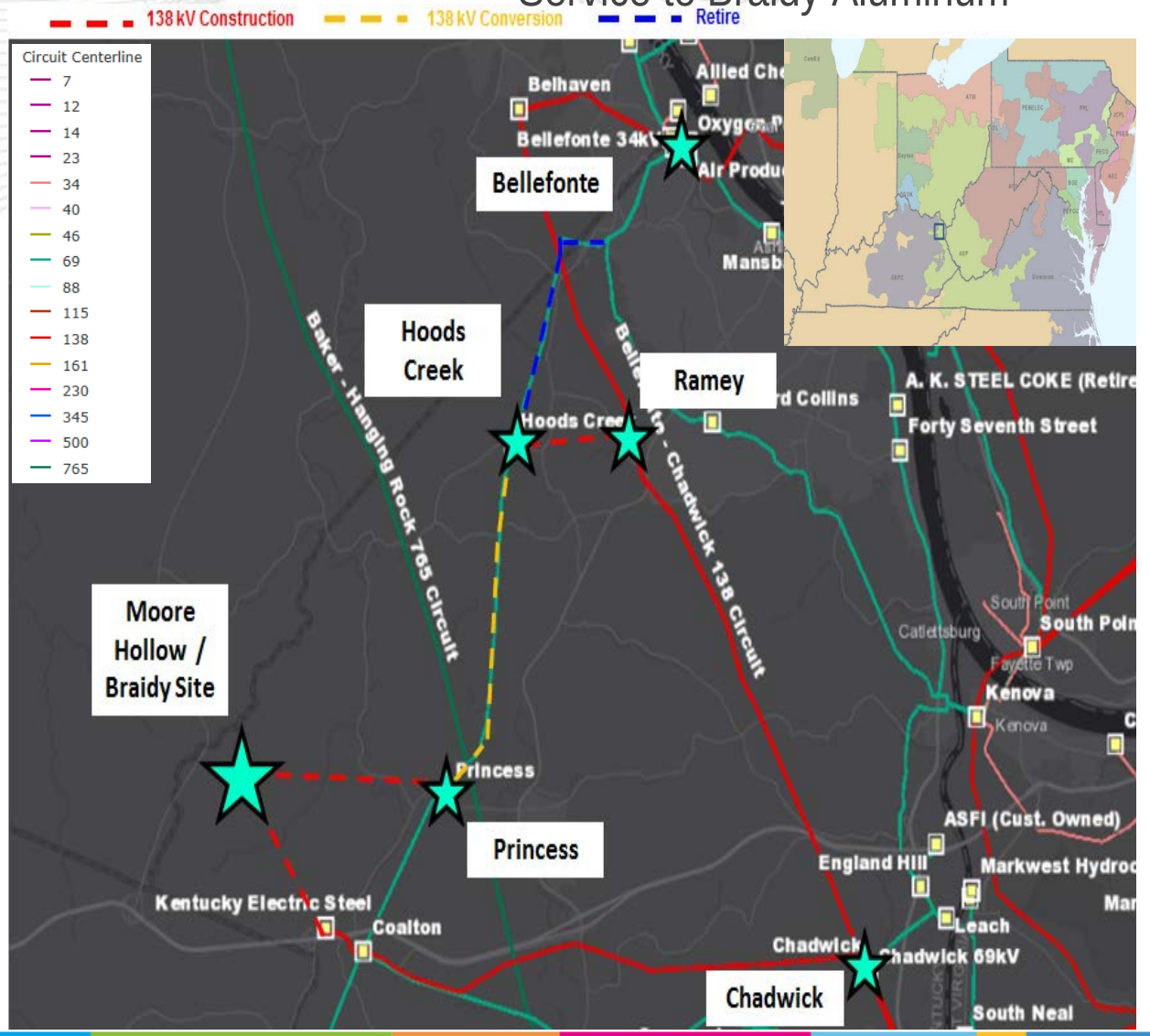

AEP Transmission Zone: Supplemental Service to Braidy Aluminum

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Equipment Material/Condition/Performance/Risk:

The 69/12 kV Transformer #1 at Hoods Creek station is 1969 vintage and is showing dielectric breakdown (insulation), accessory damage (bushings/windings) and short circuit breakdown (due to through faults). Hoods Creek station is comprised of a four pole wood crib design. The wood poles that make up the station show condition issues associated with rot and wood pecker holes. The existing transformer at Hoods Creek is currently sitting on a wood tie foundation.

The 69/34.5 kV Transformer #1 at Princess station is 1962 vintage and is showing dielectric breakdown (insulation), accessory damage (bushings/windings) and short circuit breakdown (due to through faults). The existing transformer at Princess station is currently sitting on a wood tie foundation.

The 69 kV circuit breaker 'Z' at Bellefonte is an FK oil type breaker that was 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 and an excessive number of fault operations exceeding the manufacturers recommendations. Bellefonte breaker 'Z' has experienced 17 fault operations respectively. The manufacturer's recommendation for this type of breaker is 10.

The 34.5 kV circuit breakers 'A' and 'B' at Princess station are VWVE oil type breakers manufactured in 1992. VWVE breakers carry similar concerns to those of the FK breaker listed above. Princess circuit breakers 'A' and 'B' have experienced 66 and 36 fault operations respectively. The manufacturer's recommendation for this type of breaker is 20. S&C circuit switcher 'AA' at Princess station is an S&C 2030 type with no gas monitor, sister units on the AEP system have a history of gas loss, interrupter failures, and operating mechanism failures.

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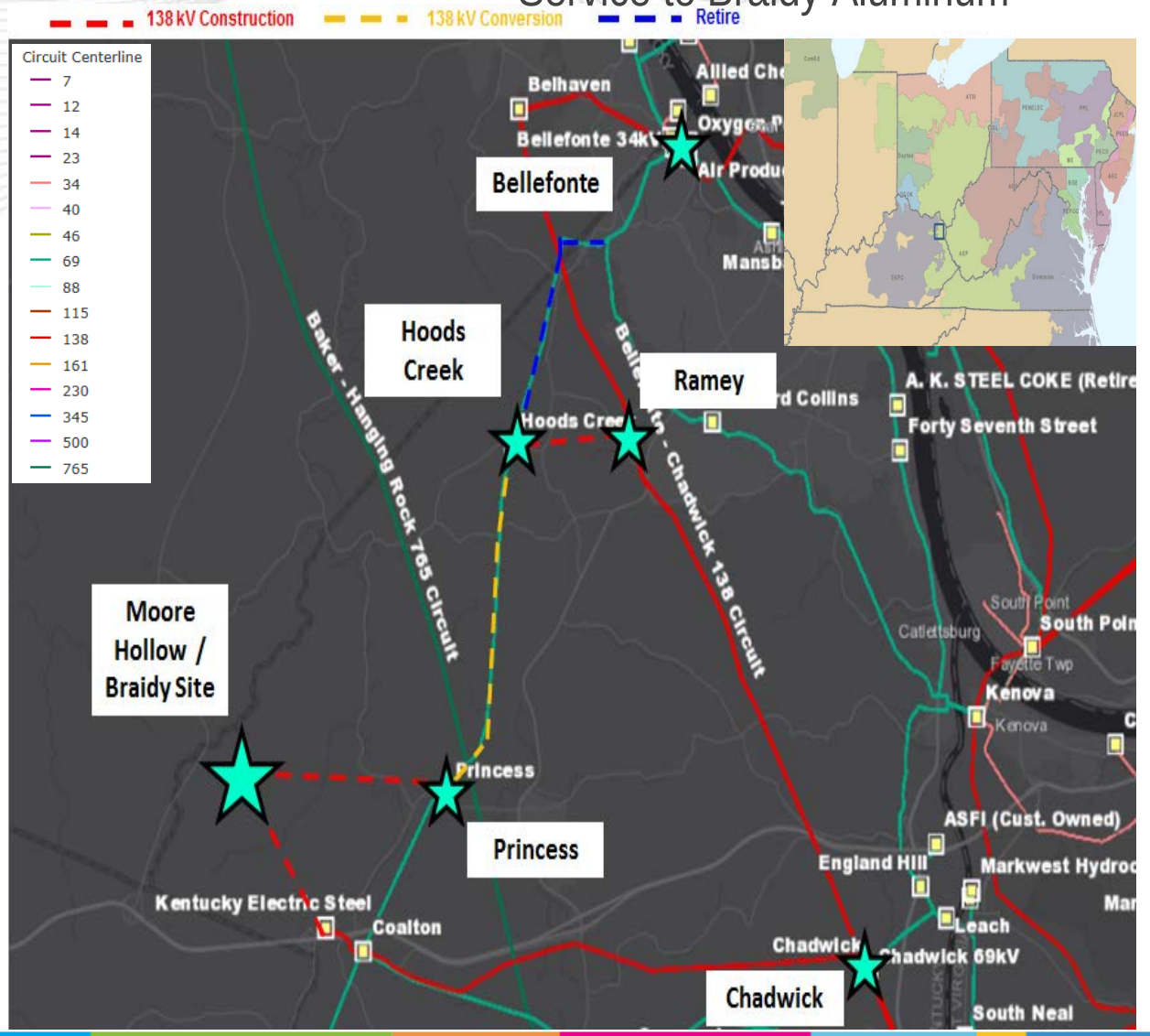

AEP Transmission Zone: Supplemental Service to Braidy Aluminum

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Potential Solution

Construct a new greenfield station named Moore Hollow. Six 138 kV CBs (3000 A 40 kA) will be installed as well as a 138/34.5 kV transformer (30 MVA) and a 57.6 MVAR capacitor at the station. Estimated Cost: $ 13.6M

Construct a 2.7 mile 138 kV line extension between Moore Hollow and Kentucky Electric Steel. At this time the existing KES metering structure will be retired due to the announced closure of the KES plant. Estimated Cost: $ 8.4M

At Chadwick Station, remote end relaying work will be required. Estimated Cost: $0.4M

Construct a new greenfield station, named Ramey, tapping the Bellefonte – Grangston 138 kV circuit. Four 138 kV CBs (3000 A 40 kA) will be installed as well as a 138/12kV XF (25 MVA). AEP already owns the land at the proposed Ramey station site. Estimated Cost: $ 0M

Construct a new 2.8 mile 138 kV extension from Ramey to the existing Bellefonte – Coalton line. Estimated Cost: $10.5M

Convert the existing Bellefonte to Coalton 69 kV line between Bellefonte and Princess to 138 kV (line is built to 138 kV standards). Estimated Cost: $3.8M

Retire CB 'Z' at Bellefonte station. Estimated Cost: $0.1M

Convert Hoods Creek station to 138 kV by rebuilding the station in the adjacent lot with a 138/12 kV XF. Estimated Cost: $ 0M

Convert Princess station to 138 kV by installing five 138 kV CBs (3000 A 40 kA), a 138/69 kV XF (to Coalton), and a 138/34.5 kV XF. Estimated Cost: $5.7M

Construct 3.4 mile 138 kV line between Princess and Moore Hollow stations. Estimated Cost: $11.5M

Total Estimated Transmission Cost: $54M - $63.4M

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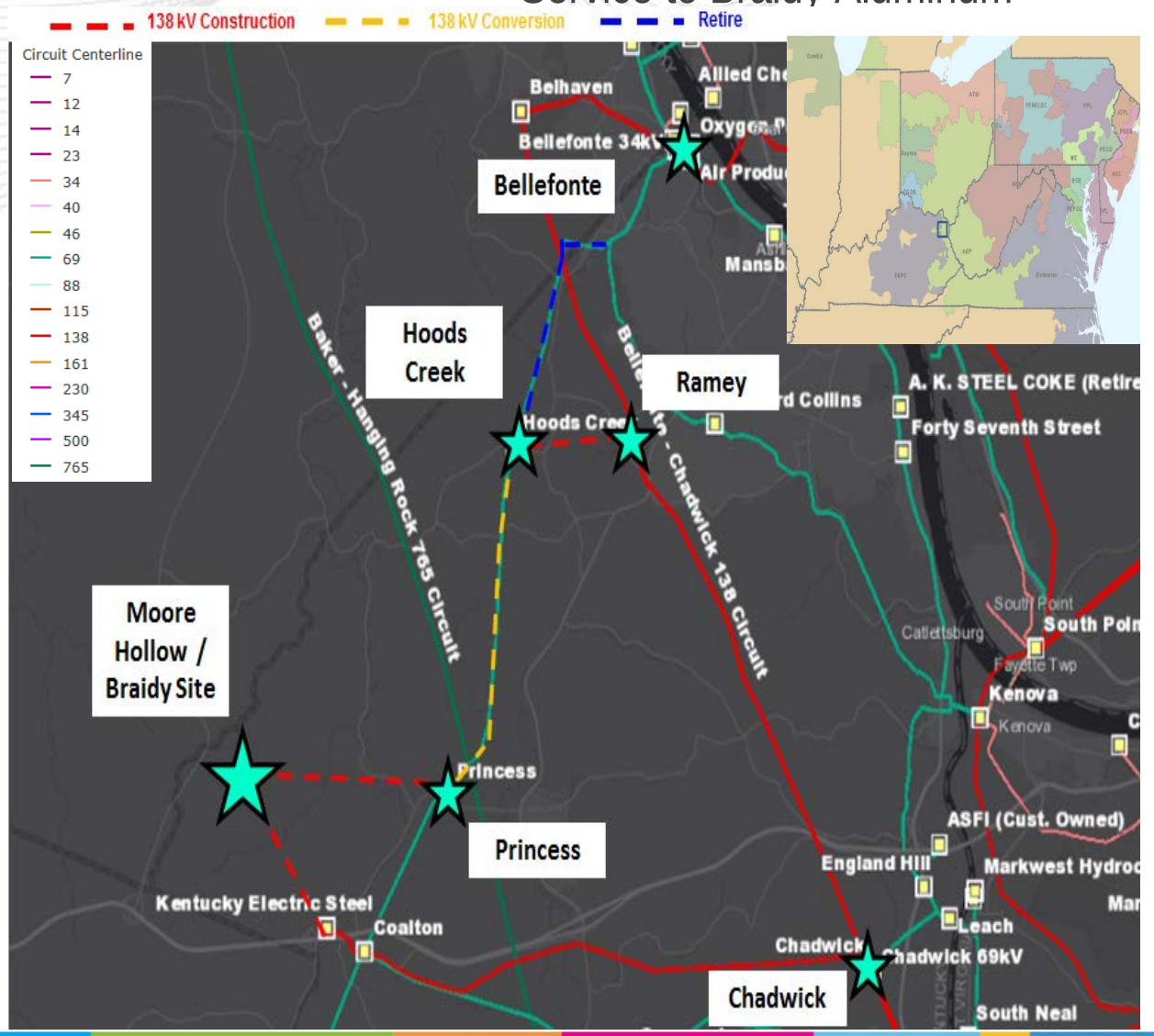

AEP Transmission Zone: Supplemental Service to Braidy Aluminum

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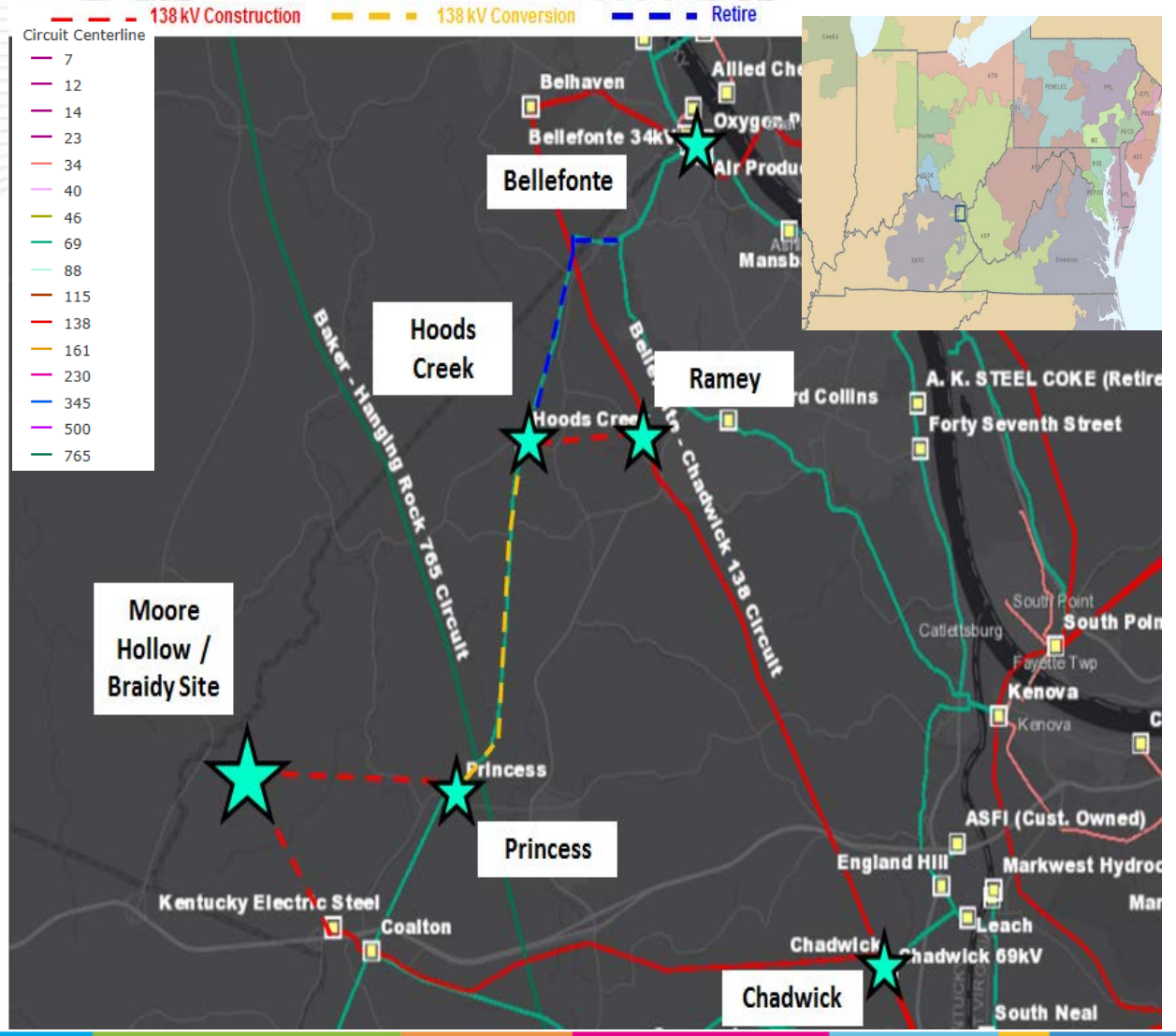
Alternative:
Build 138 kV line extensions directly from KES (~2.7 mi.) and Ramey Stations (~ 11 miles) to the new Moore Hollow station. The dense residential areas surrounding Ramey and other potential station sites would make it challenging to construct a completely greenfield line route without a significant impact on nearby populations. In addition, this alternative would not address the existing transmission owner needs at Hoods Creek and Princess stations or make use of the existing infrastructure built to 138 kV standards.
Alternative Transmission Cost: ~$62 million

Projected In-service: 12/1/2021

Project Status: Scoping



AEP Transmission Zone: Supplemental Hammondsville 69kV Station Upgrades

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Hammondsville 69-12kV station is in need of major upgrade, due to the poor condition of the equipment. The station serves as a local hub of the sub-transmission network, with 4- circuit connections. Performing these needed upgrades at the same time as the B2606 baseline project is beneficial from an engineering/construction standpoint.

69kV circuit breakers A, B, & C are oil breakers without oil containment. Oil breaker maintenance has become more difficult in recent years due to the handling requirements and the potential for environmental risks. These 3 breakers are GE 'FK' style, which have been prioritized as needing upgraded, due to subpar reliability and lack of spare parts. The breakers were made between 1969-1975 and have experienced fault operations of 34, 70 and 81, far above the recommended limit of 10.

The station has 46 protective relays, and 41 are in immediate need of replacement (40 electromechanical and 1 static). The relays are more prone to misoperation and lack fault data collection and retention capability. In addition, the current system protection to North Wellsville uses a pilot wire communications scheme (dependent on phone company), which has been in an abnormal state for several years, placing customer load at risk. The protection to South Toronto uses a dated custom high-speed relaying scheme, which is prone to misoperations.

Customer Service:

Hammondsville serves one 69-12kV AEP distribution transformer. The fusing will be replaced with a high-side circuit switcher & relaying, permitting trip and reclose functionality for momentary faults. This will reduce the duration of outages for local customers.

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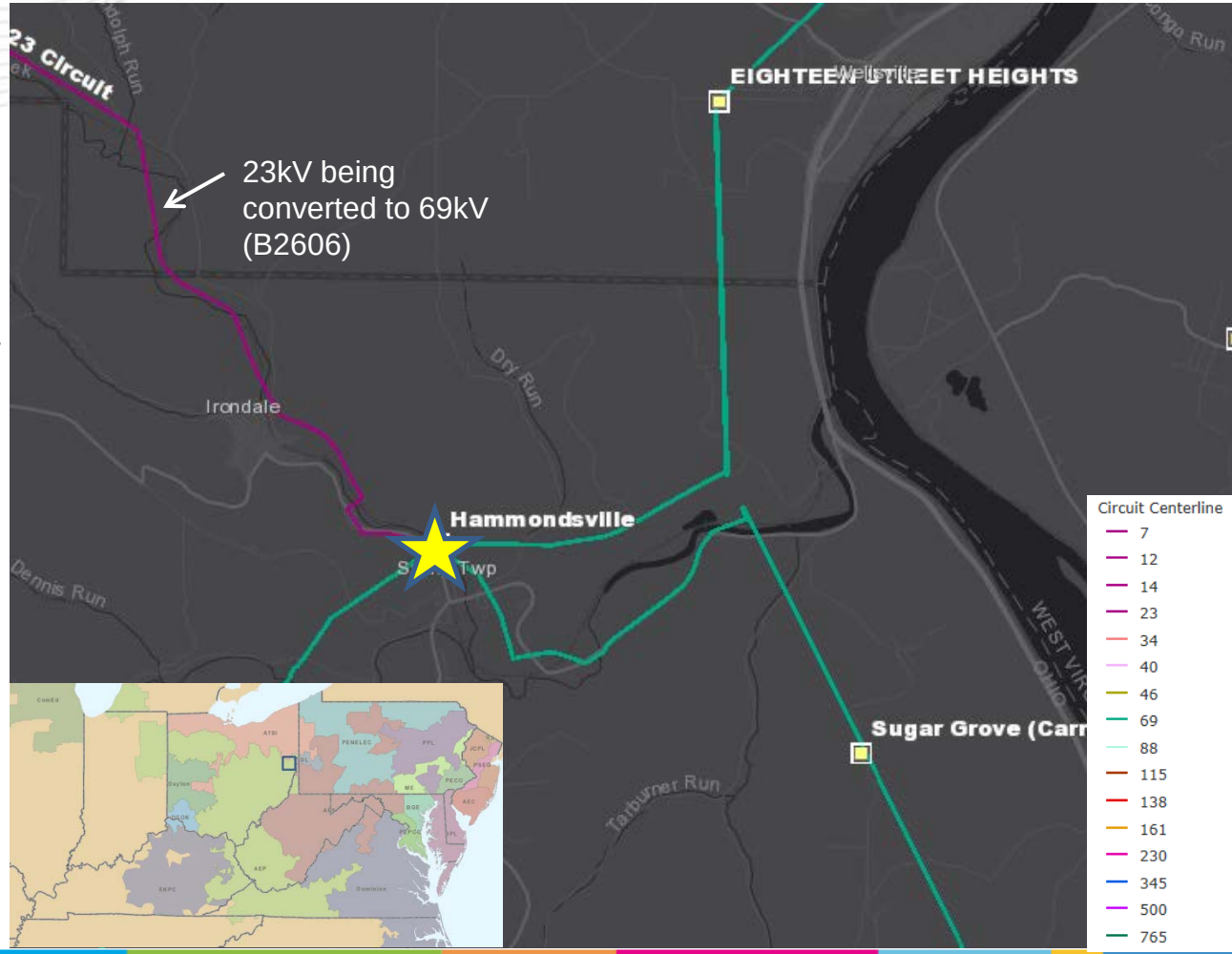

AEP Transmission Zone: Supplemental Hammondsville 69kV Station Upgrades

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Potential Solution:

At Hammondsville 69kV station: replace 69kV oil circuit breakers A, B, & C with gas breakers, replace disconnect switches & CCVT's; upgrade line relays; upgrade bus differential protection; install a new DICM (old control building to be removed); add SCADA. Replace transformer fuses with a circuit switcher. Estimated Cost: $3.9 M

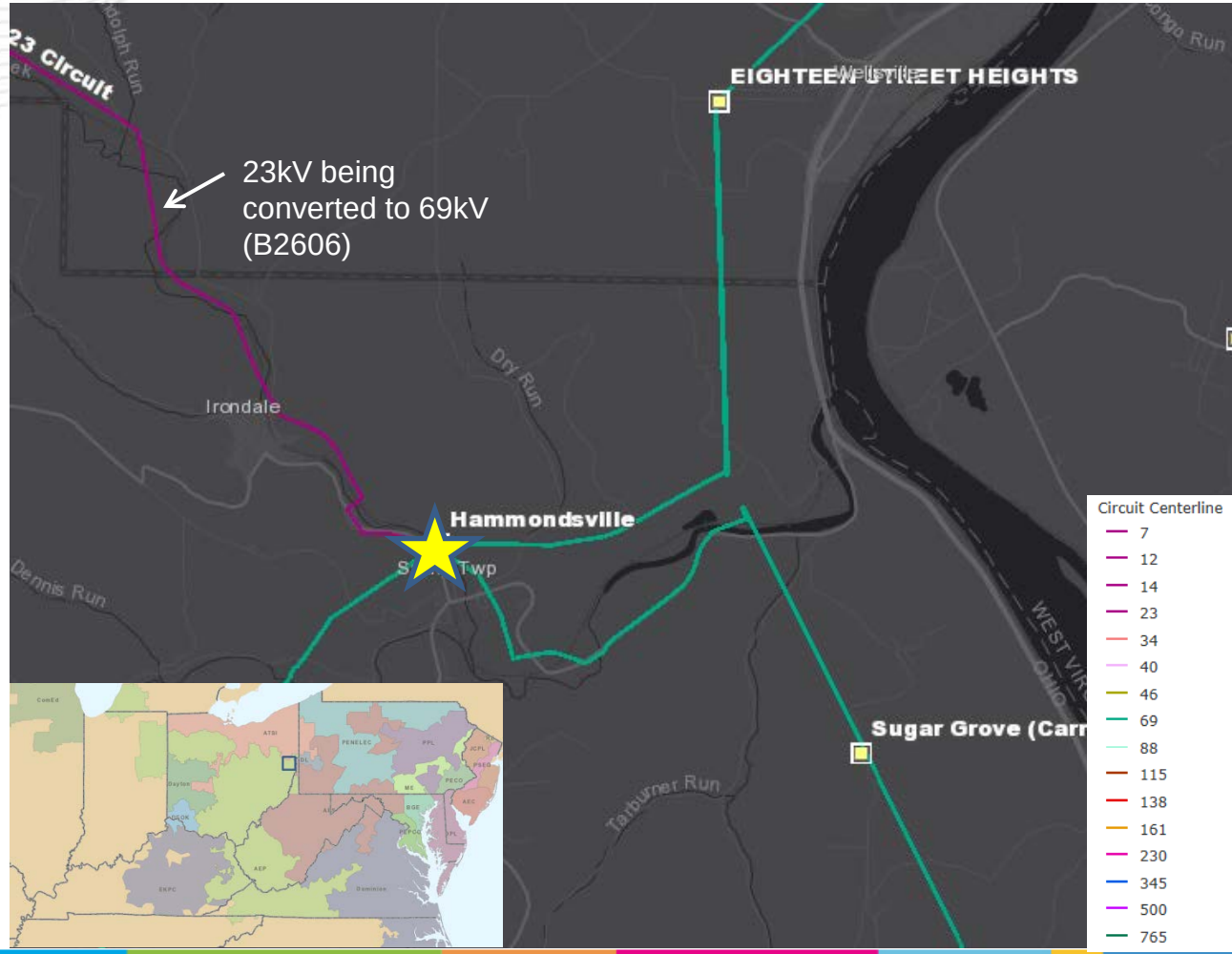
Alternatives:

Rather than replace this aging equipment at the present time (as part of the PJM Baseline project), defer the work to later years. This would entail keeping the majority of the transmission equipment as oil-filled breakers and electromechanical relays. This solution is not optimal, due to the intricacies of the station protection, cabling, & wiring, in relation to the control house(s). Doing only the 69kV circuit to Bane would result in one modern fiber-based protection scheme in one control house, while the equipment in need of an upgrade is kept in the older building. It would be costly to modify the new control building in later years and then incorporate the 3 other 69kV circuits' protection and breaker controls. Doing all of the upgrades at once results in a more reliable configuration, reduces overall costs, and removes the aging equipment that pose a risk to system reliability in the region.

Alternative Cost: $5.2 M (~$1 M increase; to execute the station rehab work in future years, and have to redo protection/controls/SCADA, etc.)

Projected In-service: 12/1/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
Divelbiss 69 kV switching station and Academia station upgrades

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Academia station 69 kV circuit breakers “A” and “D” are showing signs of deterioration. Circuit breaker “A” has had 115 fault operations and circuit breaker “D” has had 259 fault operations (manufacturer recommended limit is 10). These breakers are oil breakers. Oil breaker maintenance has become more difficult due to the oil handling required to maintain them. Academia station transformer #1 138/69/12 kV is showing significant signs of deterioration. Drivers for replacement include dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), and accessory damage (bushings).

Operational Flexibility and Efficiency:

A scope change is being done to S0770 as Divelbiss (previously know as East Fredericktown Switch). This station will be built into a 69 kV four circuit breaker ring bus versus a 69 kV two circuit breaker box bay configuration as originally proposed. There have been approximately 2 million customer minutes of interruptions. There is approximately 28 MW of load. It is optimal for sectionalizing because this prevents taking out customers or stations unnecessarily. This is also optimal for protection because each line will have its own protection zone. With a single breaker towards a radial circuit, bypasses or outages would be needed to the customers when maintenance is required. With a ring maintenance outages do not require customer outages. This project will replace S0770, which will be cancelled.

S0770 : Replace 69 kV GOAB switch and BOAB switch "W" at East Fredericktown Switch with 69 kV circuit breakers

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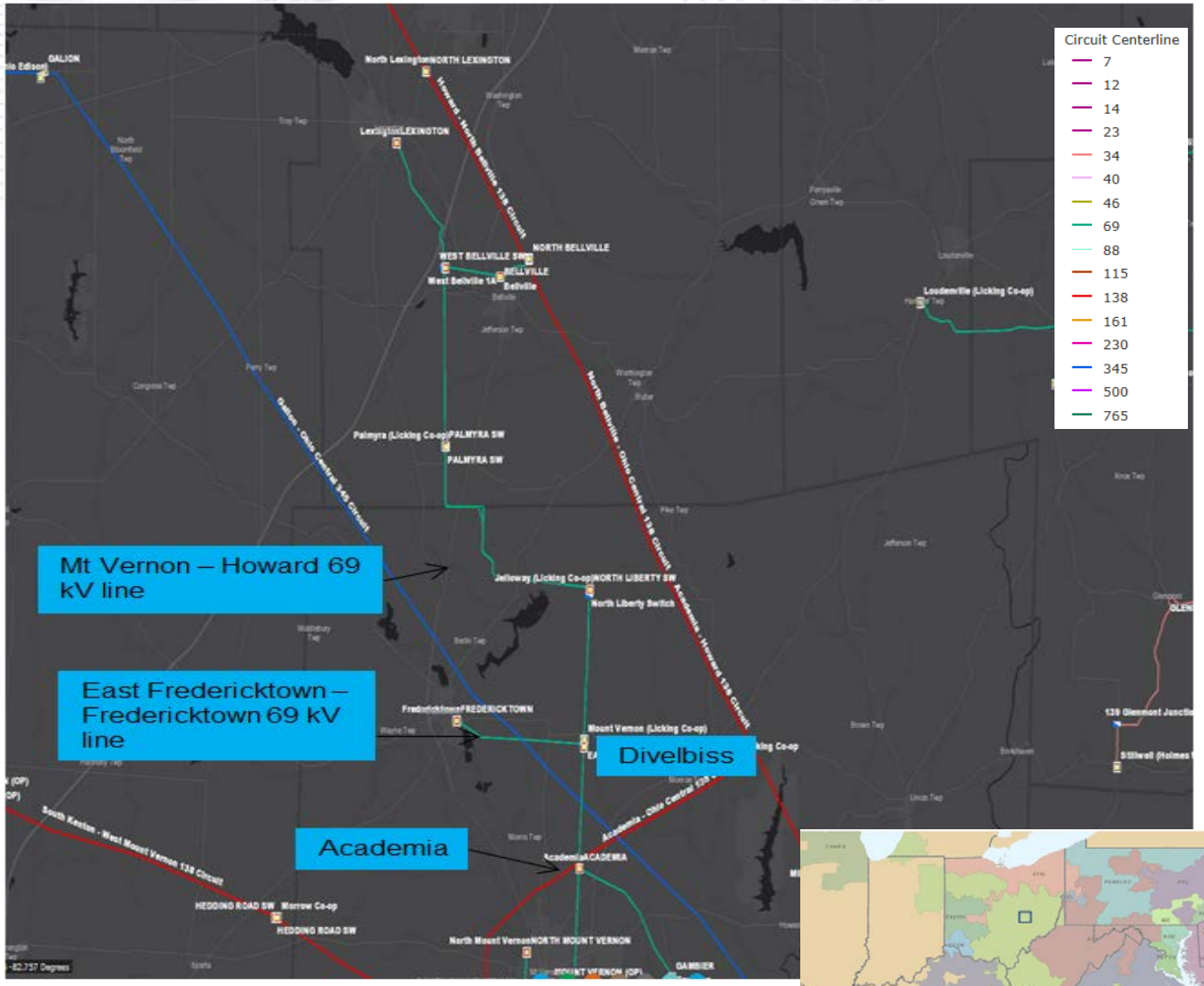

AEP Transmission Zone: Supplemental
Divelbiss 69 kV switching station and Academia station upgrades

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Potential Solution

At Divelbiss station install four 69 kV 2000 A 40 kA circuit breakers in a ring bus configuration. Also install fiber cable extension at the station. Estimated Cost: $7.5M

At Academia station, replace the138/69/12 kV 115 MVA transformer with a 138/69 kV 130 MVA transformer. Replace the 69 kV circuit breaker “A" and circuit breaker “D" each with 3000 A 40 kA circuit breakers. Estimated Cost: $4.5M

Relocate the Mt Vernon – Howard 69 kV line and the East Fredericktown – Fredericktown 69 kV line to the new Divelbiss switch station. Additionally, install two deadend structures at the East Fredericktown – Licking CO-OP – Mount Vernon 69 kV line to accommodate the new Divelbiss switch station Estimated Cost: $1.3M

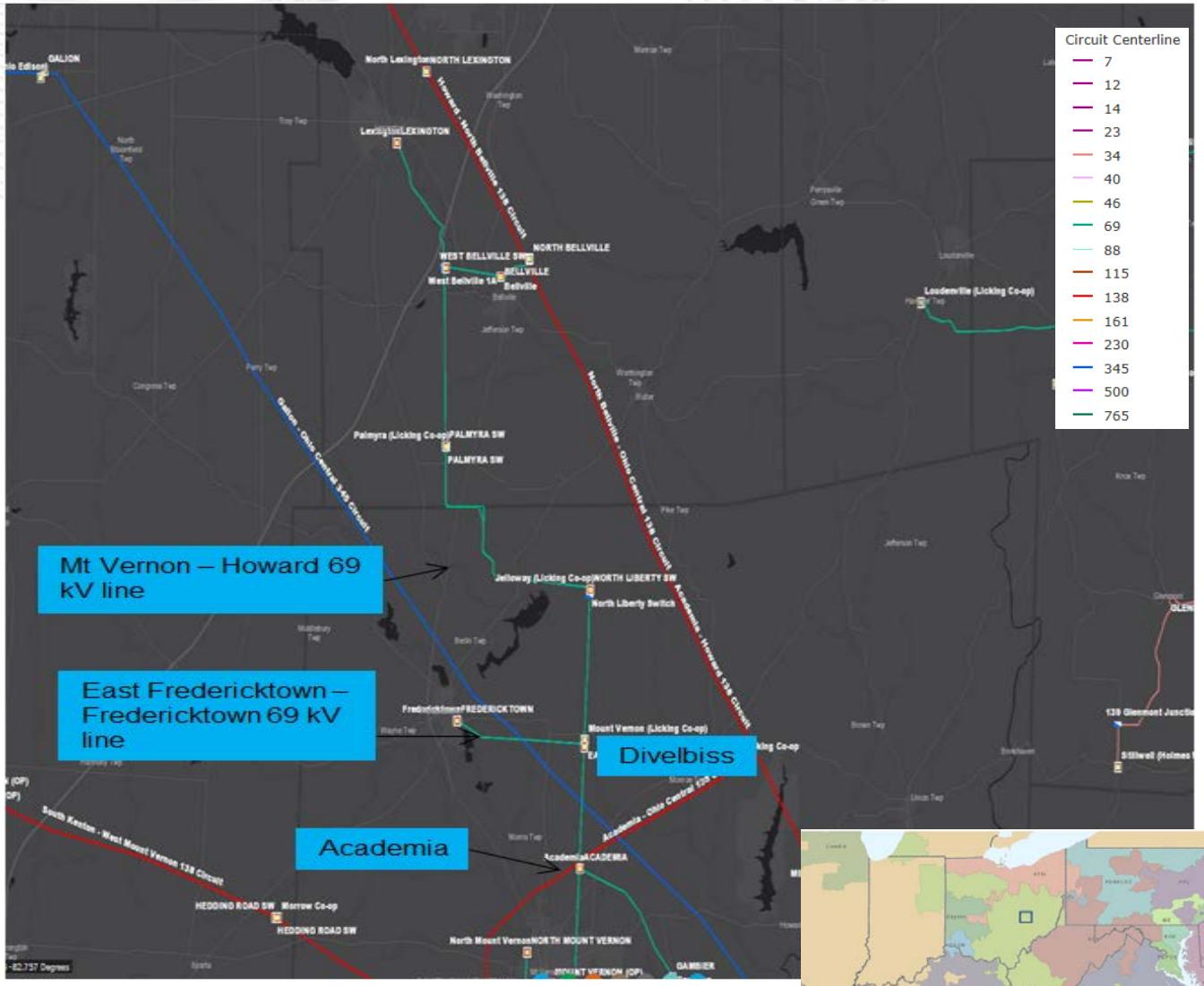
Total Estimated Transmission Cost: $13.3M

Alternatives:

No viable cost-effective transmission alternative was identified.

Projected In-service: 12/31/2019

Project Status: Engineering



AEP Transmission Zone: Supplemental Gable

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Dillonvale-Smithfield 69kV circuit was originally built in the 1930's and consists of #1 copper and 4/0 ACSR conductor. Retiring this asset and transferring load to Gable will improve reliability for customers. Installing a transformer at the existing Gable station will permit the aging Smithfield station and radial 69kV circuit from Dillonvale to be retired. The Gable source will be more reliable, due to having 3- 138kV sources.

Customer Service:

AEP Ohio has a forecasted transformer overload at Smithfield in 2019 (7 MVA nameplate; capability of 8.2 MVA summer & 9.4 MVA winter; forecasted peak of 8.7 MVA summer & 11 MVA winter). This is due to large block load additions from area shale gas customers.

Potential Solution

Retire the 4.5-mile radial 69kV circuit between Dillonvale and Smithfield and Smithfield station.

Estimated Transmission Cost: $3.1M

Alternatives:

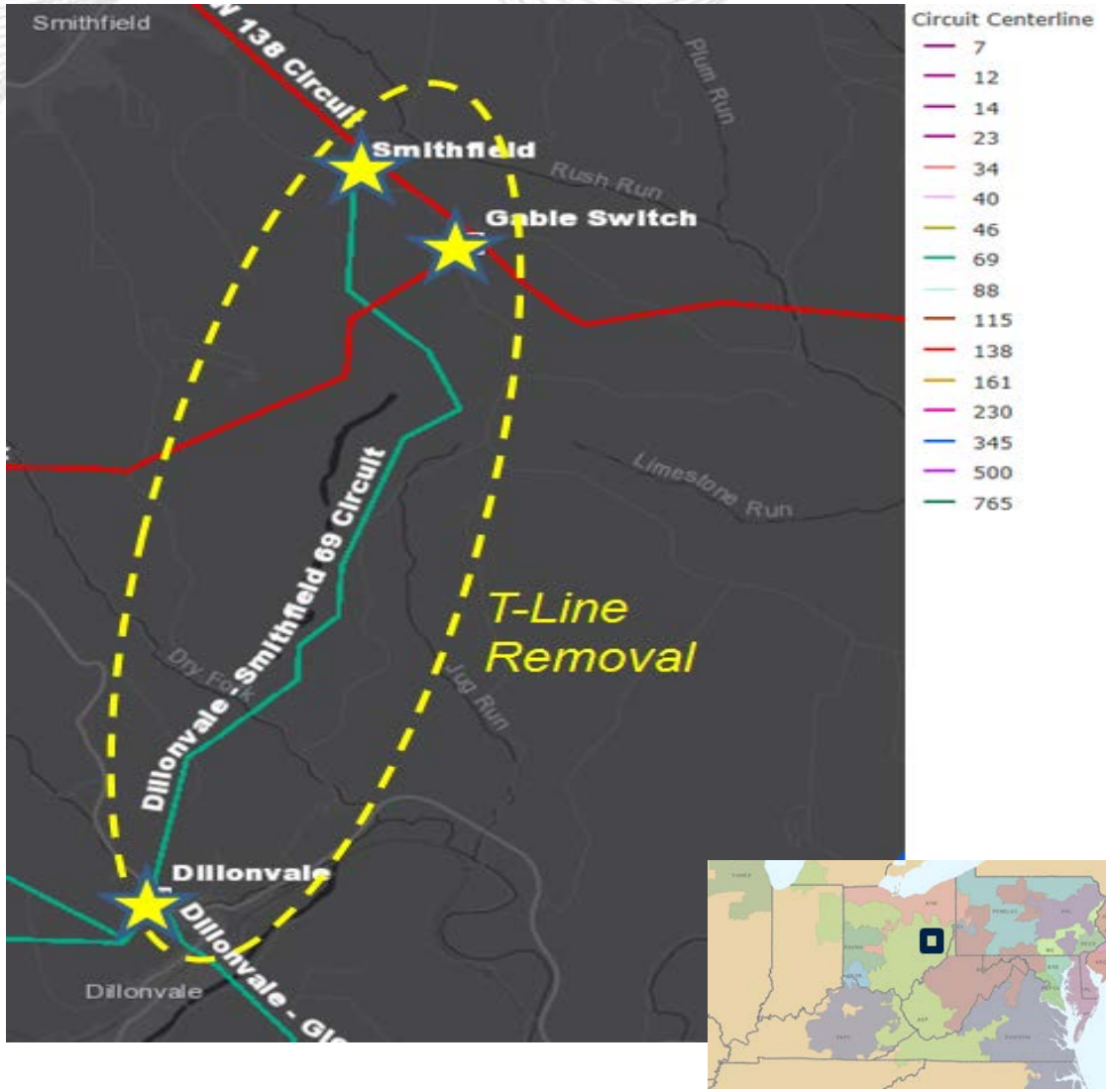
To address the distribution transformer overload, install a larger 69-12kV transformer at Smithfield, which would also require a circuit switcher instead of the current fusing. The small Smithfield site cannot be easily expanded to accommodate these upgrades, without the risk of affecting reliability for distribution customers.

In addition, the radial service to Smithfield would eventually need addressed. To loop the 69kV, it would require approximately 3.5-4 miles of double-circuit 69kV (to loop into Dillonvale-Parlett 69kV), or possibly install a 138-69kV transformer at Gable station, with 0.7 miles of 69kV line extension . Either of these options would be costly, and still not address the 1930's-era Dillonvale-Smithfield 69kV transmission line.

Total alternative cost = $20-25 million

Projected In-service: 06/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental
Jug Street

Problem Statement:

Customer Service:

AEP Ohio has indicated their existing 50MVA transformer at Jug Street is projected to overload in the very near future and, as a result, has requested connection for a second 50 MVA transformer at Jug Street.

Potential Solution:

At Jug Street, install a new 3,000A 138kV 63kA CB to accommodate the new transformer.

Estimated Cost: $0.5M

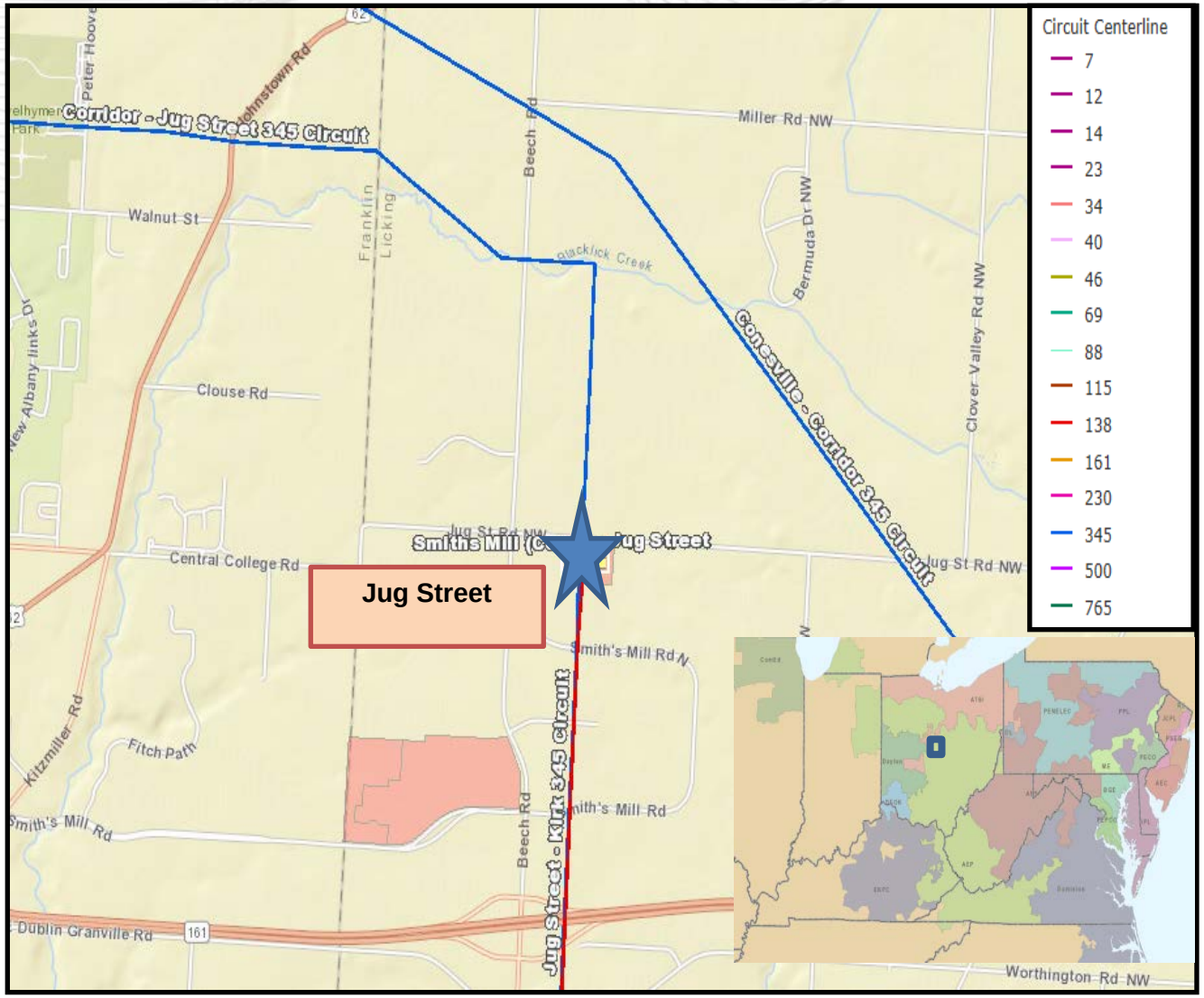
Total Estimated Transmission Cost: $0.5M

Alternatives:

Install new station on an existing or new site to relieve existing load from Jug Street Station. Installing a single 138kV CB along with the required Distribution equipment at the existing station is much more cost effective and timely than constructing a new station. $10M

Projected In-service: 06/01/2019

Project Status: Scoping



AEP Transmission Zone: Supplemental Friendship Loop

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The 17-mile long 69 kV Central Portsmouth-North Portsmouth line was built between 1959 and 1966 using wood-pole structures with a combination of 176.9 ACSR and 336 ACSR conductor, with a 41 MVA summer thermal rating. The 176.9 ACSR is an uncommon conductor used in the past and spare parts are an issue. There are 192 open A conditions distributed among the 139 poles on this line. The conditions include: rotten cross-arms, burnt/broken insulators, and loose/broken conductor hardware. The Central Portsmouth-North Portsmouth 69 kV circuit has an MPOI of 350 with 2,141,467 customer-minutes of interruption over the last three years.

At North Portsmouth the 138-69 kV transformer T1 (installed 1958) is recommended for replacement with factors such as moisture content, oil quality, and age. The 138 kV oil-filled breakers C (installed 1948), D (installed 1975) and 69 kV CB A (installed 1954) are at over 80% of their fault interrupting capability for 3-phase faults, and have experienced 27, 7 and 53 operations respectively, with C and A exceeding the manufacturer recommended limit of 10 fault operations. Other factors driving the replacement are age and scarce availability of spare parts.

The central Portsmouth breakers G and H are both 1975 oil-filled breakers with 29 and 25 operations respectively, exceeding the manufacturer recommendation of 10 fault operations. The breakers both exceed AEP's threshold for replacement with conditions including: 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 is also an environmental hazard.

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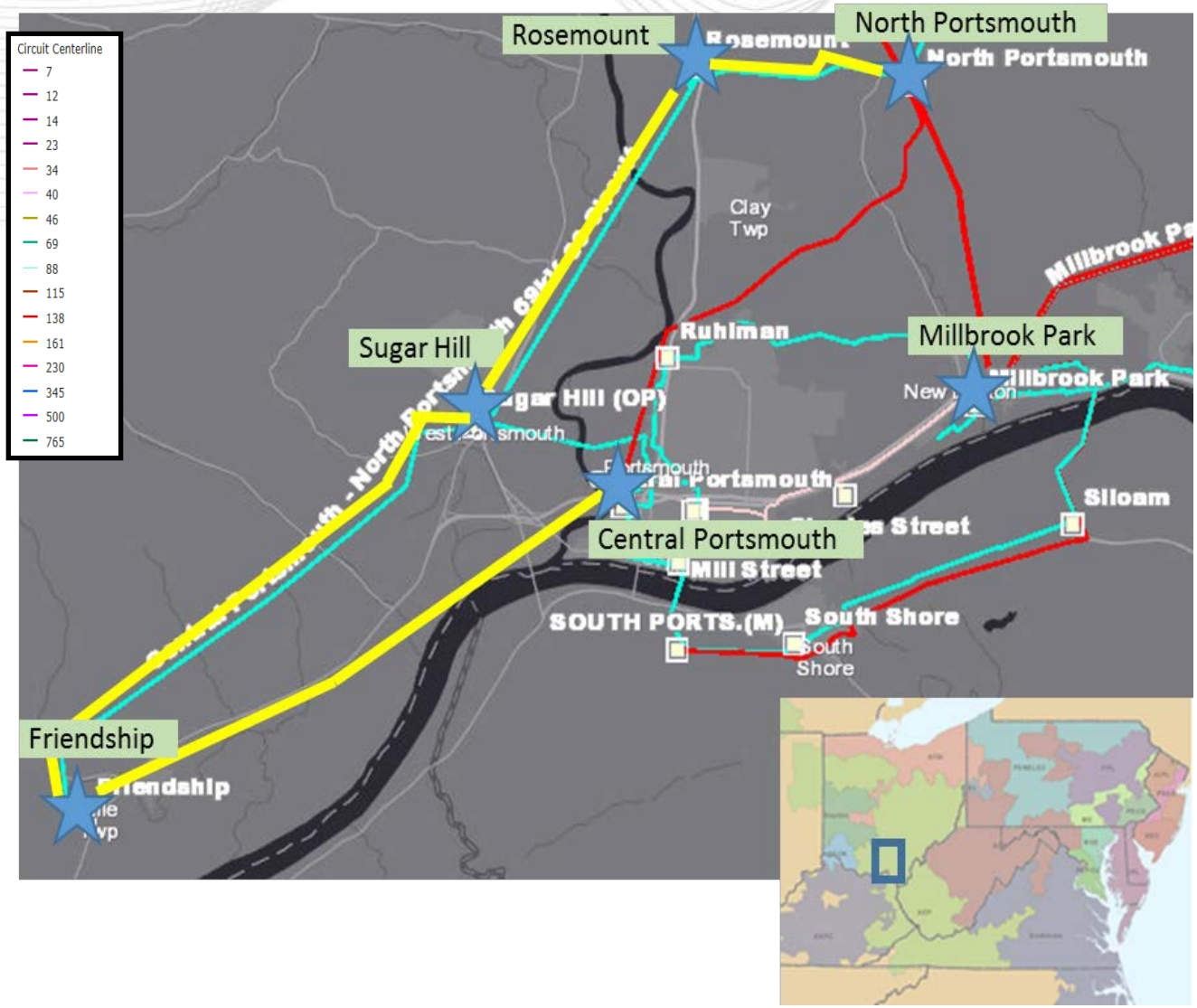

AEP Transmission Zone: Supplemental Friendship Loop

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Potential Solution:

Build a new 8.5 mile 69kV line from Friendship Station to Central Portsmouth Station, using 556 ACSR (102MVA) and remove the old Central Portsmouth-Sugar Hill Line. Rebuild the remaining 13.9 miles of the Friendship Loop from North Portsmouth to Rosemount, from Rosemount to Sugar Hill and from Sugar Hill to Friendship using 556 ACSR (102 MVA) and ADSS. Estimated Cost: $41.8M

At Friendship station, install a 69kV line CB & line MOAB. At Sugar Hill station, upgrade bus though-path and replace switches to accommodate the line reconfigurations. At North Portsmouth, replace 138-69kV transformer with a 90 MVA unit with a 138kV circuit switcher, replace 138kV CB C and 69kV CB A. Remove bus tie 138kV CB D and install a new 138kV CB to isolate Millbrook Park line. Install a new 69kV CB on low side of the transformer. At Millbrook Park, replace relay & install a CCVT on North Portsmouth Line. At Central Portsmouth, replace 138kV CBs G & H. At Rosemount, install two line MOAB switches inside substation and replace the ground switch MOAB with a 69kV circuit switcher. Estimated Cost: $12.6M

Total Estimated Transmission Cost: $54.4M

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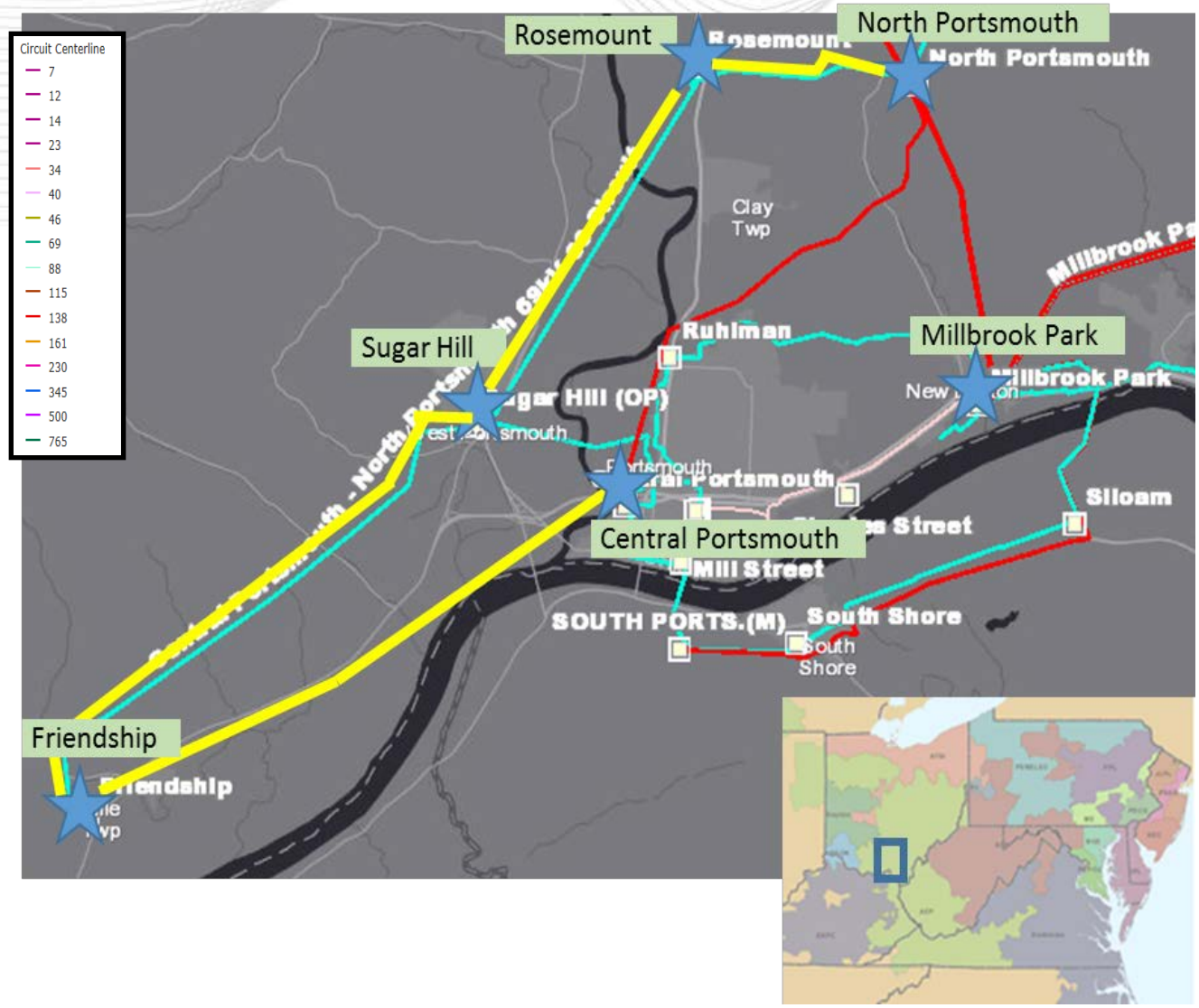

AEP Transmission Zone: Supplemental Friendship Loop

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Alternatives:

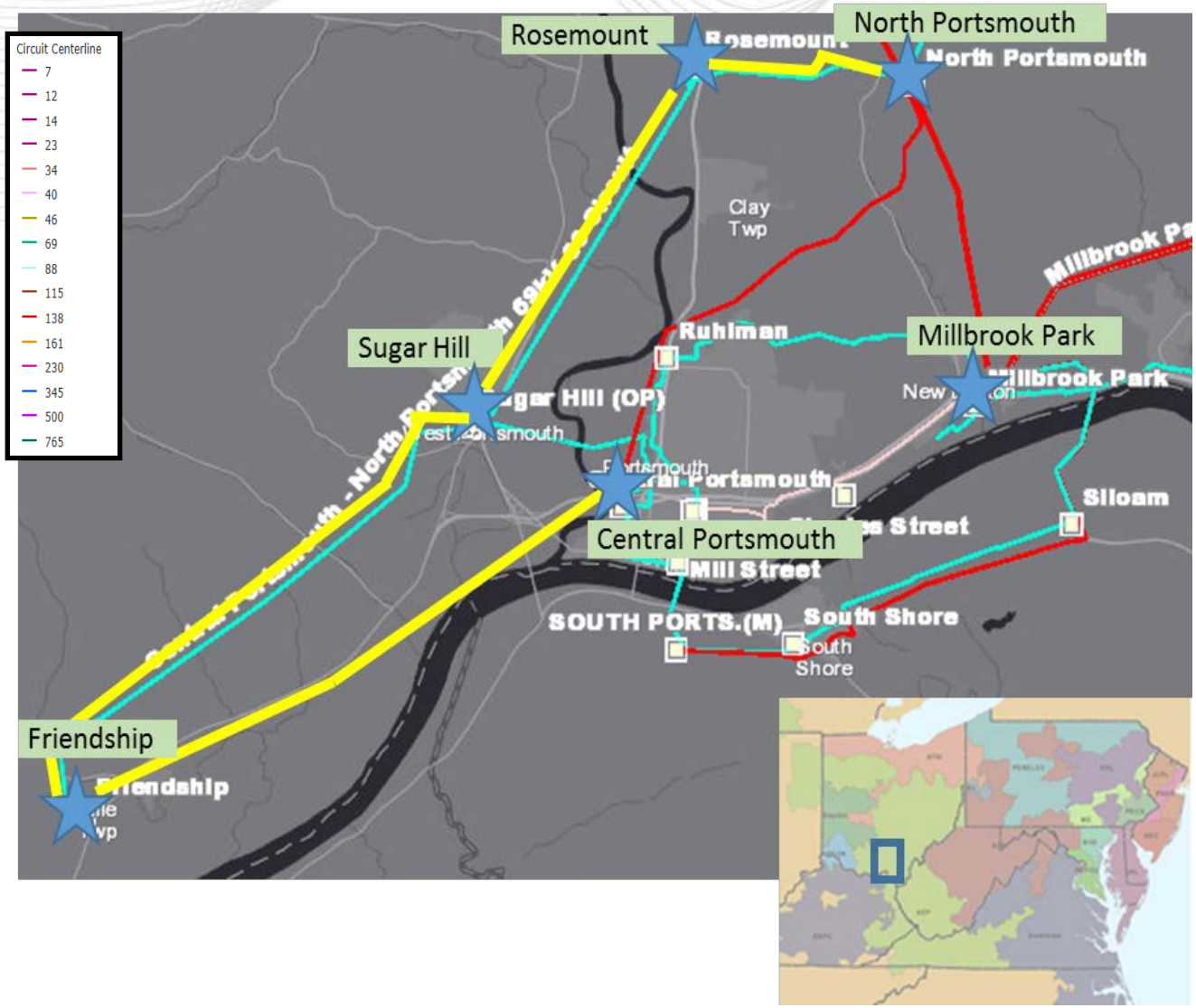
An alternate design was considered that would double-circuit the line 6.6 miles from Friendship back to Sugar Hill. To keep Friendship in service during construction a new line would need to be built adjacent to the existing line, expanding the existing right of way. The line from Central Portsmouth to Sugar Hill would be also be rebuilt along with the other line rehab sections. This design was not chosen because it was a less reliable solution and due to cost. Estimated cost: $64M

A second alternate design was considered that would follow the proposed project, but instead of looping Friendship station back to Central Portsmouth, build a ~25 mile greenfield line from Friendship up to Peebles Substation (Adams Coop). This solution was not chosen due to anticipated ROW and permitting concerns as well as cost. Estimated Cost: $103M

A third alternate (the original design) would add circuit breakers at Friendship, Sugar Hill and Rosemount stations to protect all the line segments. It would also add two more breakers at North Portsmouth, to isolate transformer faults from the buses. This design was not chosen due to the higher cost from the six additional breakers and associated station costs. Estimated Cost: $66M

Projected In-service: 04/01/2023

Project Status: Scoping



AEP Transmission Zone: Supplemental Ridgely

Problem Statement:

Customer Service:

AEP Ohio Distribution requested a new delivery point to serve their Ridgely station by 6/2020. The initial load is approximately 27 MVA with future growth anticipated. The initial 27 MVA load is being transferred from four adjacent Stations, but future new load is expected.

Potential Solution:

Install a new 0.1 miles 138 kV loop from Ridgely station to the Kirk – Newark Center 138 kV circuit (Conesville – Kirk 138 kV line) with the conductor size 1590 ACSR 54/19. **Estimated Cost: $0.7M**

At Ridgely station install a new 138 kV bus with two 2000 A line Moab switches. The station will have space to expand in the future if needed. Fiber will also be installed at Ridgely station. **Estimated Cost: $1.6M**

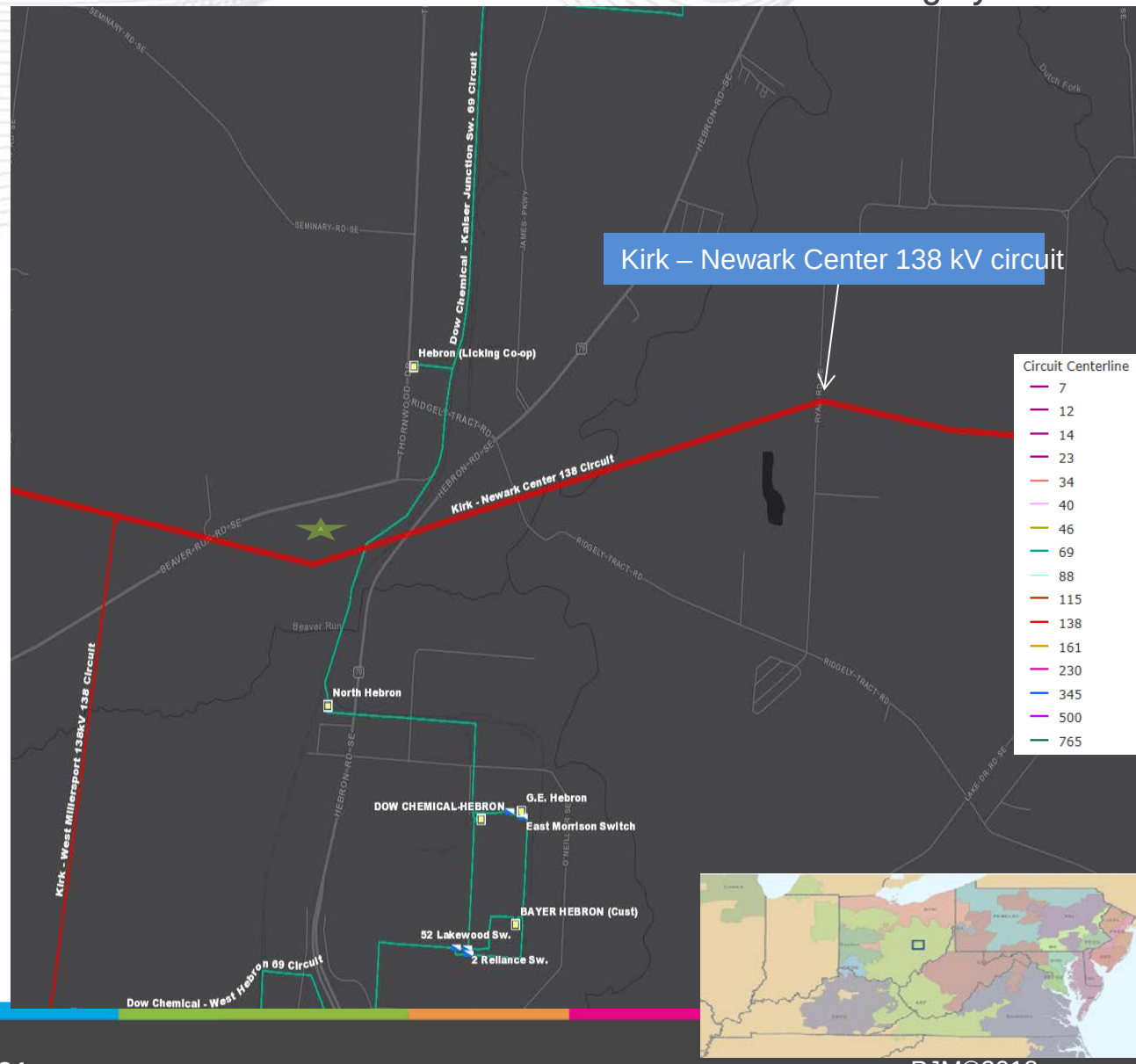
Total Estimated Transmission Cost: $2.3M

Alternatives:

Connect the AEP Ohio delivery point to the Dow Chemical – Kaiser Junction Sw 69 kV circuit was considered but given the anticipated spec loads of the area (140 MW) and the AEP Ohio Distribution build out load of 150 MVA, a 138 kV delivery point was the best option. Approximate cost of $950,000.

Projected In-service: 06/30/2020

Project Status: Engineering



Second Review

Baseline Reliability and Supplemental Projects

DEOK Transmission Zone: Supplemental
South Bethel – Brown 69 kV Feeder Rebuild

Previously Presented: 6/26/2018 SRRTEP

Problem Statement:

The 69 kV feeder between South Bethel and Brown substations is aged and in deteriorating condition (1970's era).

Driver: Equipment Material Condition, Performance and Risk

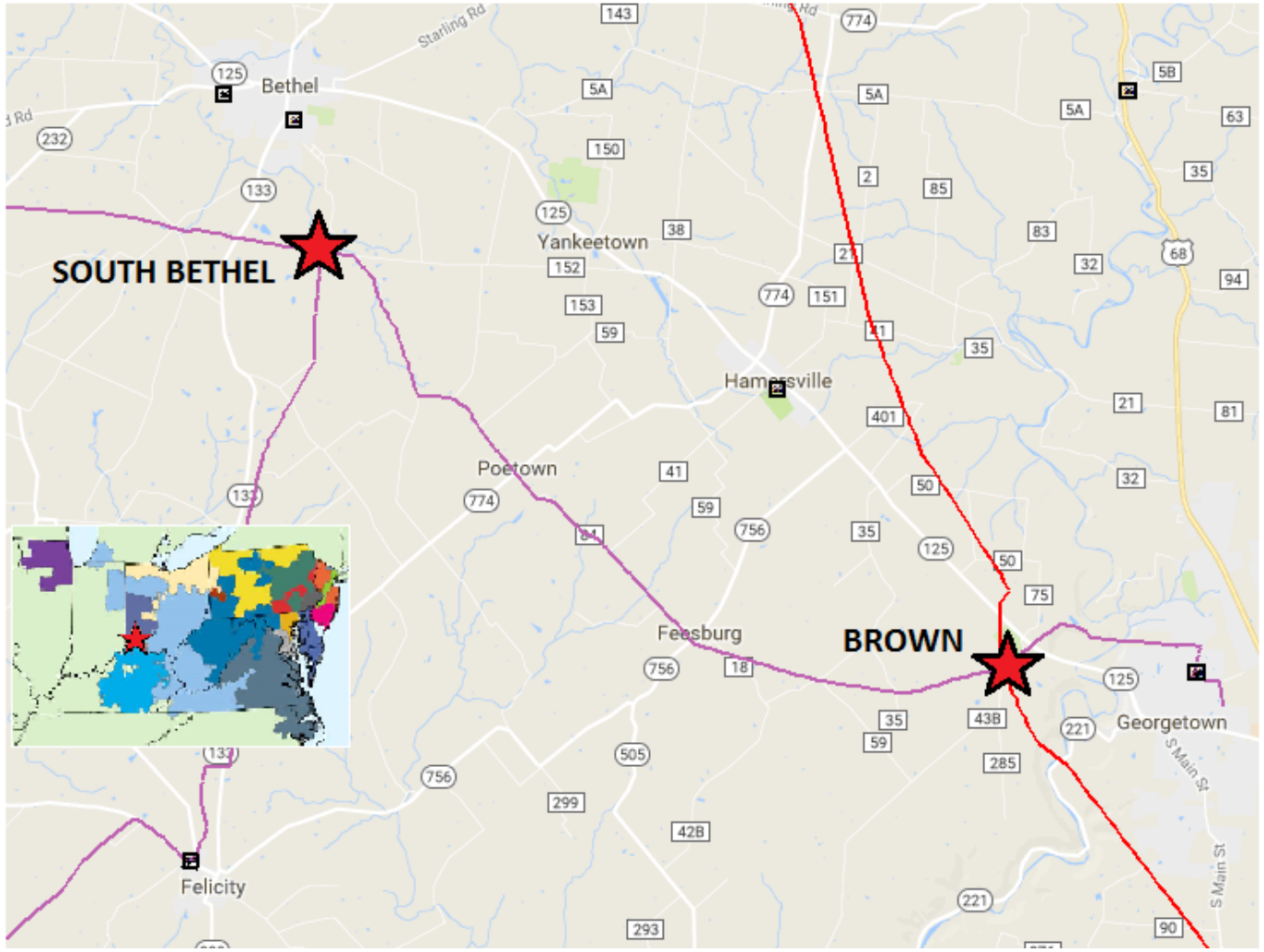
Selected Solution:

Rebuild 9.8 miles of feeder between South Bethel and Brown substations with new structures, hardware, and conductor. Replace one 69 kV switch. Capacity of the line will increase from 97 MVA to 150 MVA (conductor limited). (S1669)

Estimated Cost: $10.0 M

Projected In-service: 6-1-2019

Project Status: Engineering



AEP Transmission Zone: Supplemental
Tams Mountain Station Rebuild

Previously Presented: 6/26/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Tams Mountain 46 kV circuit breakers A, B, C, D and E are all oil-filled breakers installed in 1965. In general, oil breakers are difficult to maintain. Oil spills are frequent with failures and routine maintenance which is also an environmental risk. All five 46 kV breakers have exceeded the manufacturer's expected number of 10 fault operations; A: 237 fault ops, B: 248 fault ops, C: 113 fault ops, D: 84 fault ops, E: 63 fault ops.

Tams Mountain 138/69/46 kV XFR #1 (vintage 1965) is showing rising ethane, ethylene, and methane levels. All three gas concentrations are trending upwards. Despite decreasing moisture content, the dielectric strength has continued to decline. The short circuit strength has been deteriorated by the amount of thermal through faults.

Sophia 46 kV circuit breaker C is an oil-filled breaker manufactured in 1965. In general oil breakers are difficult to maintain. Oil spills are frequent with failures and routine maintenance which is also an environmental risk. Breaker C has experienced 41 fault operations which exceeds the manufacturer's expectation of 10 fault operations.

Operational Flexibility and Efficiency

The Tams Mountain – Mullens 138 kV and Tams Mountain – Pemberton 138 kV lines currently connect and create a three terminal line at Tams Mountain 138 kV bus #2. Two new 138 kV breakers will be installed and the station will be re-configured into a ring bus to eliminate the three terminal line at the station. The Ground-Switch MOAB on the high side of the 138/69/46 kV transformer at Tams Mountain is obsolete and creates an overlap in the zones of protection.

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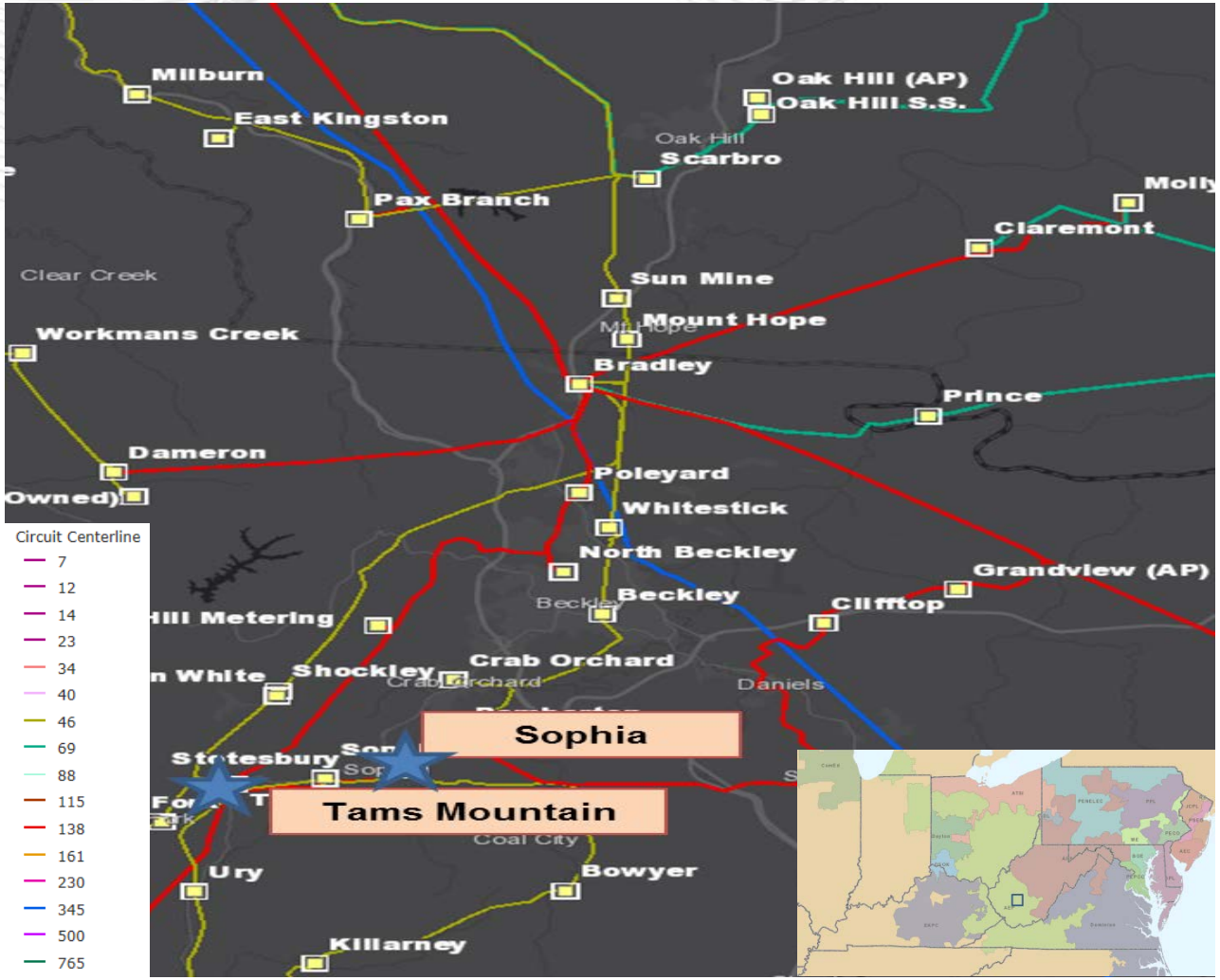

AEP Transmission Zone: Supplemental Tams Mountain Station Rebuild

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Selected Solution:

At Tams Mtn. Station, replace all 46 kV CB's (A, B, C, D, E) with 3000 A 40 kA CB's designed to 138 kV standards in ring bus operated at 46 kV. Replace the 138 kV GR. SW. MOAB with a new circuit switcher. Retire 138 kV bus tie breaker 'F' and establish one 138 kV bus. Install two new 3000 A 40 kA 138 kV CB's on Pierpont 138 kV line and Pemberton 138 kV lines. Replace existing 138/69/46 kV 40 MVA XFR with a new 138/69/46 130 MVA XFR. Reconfigure transmission lines entering the station to accommodate new ring configuration. (S1667.1) Estimated Trans. Cost: $19.7M

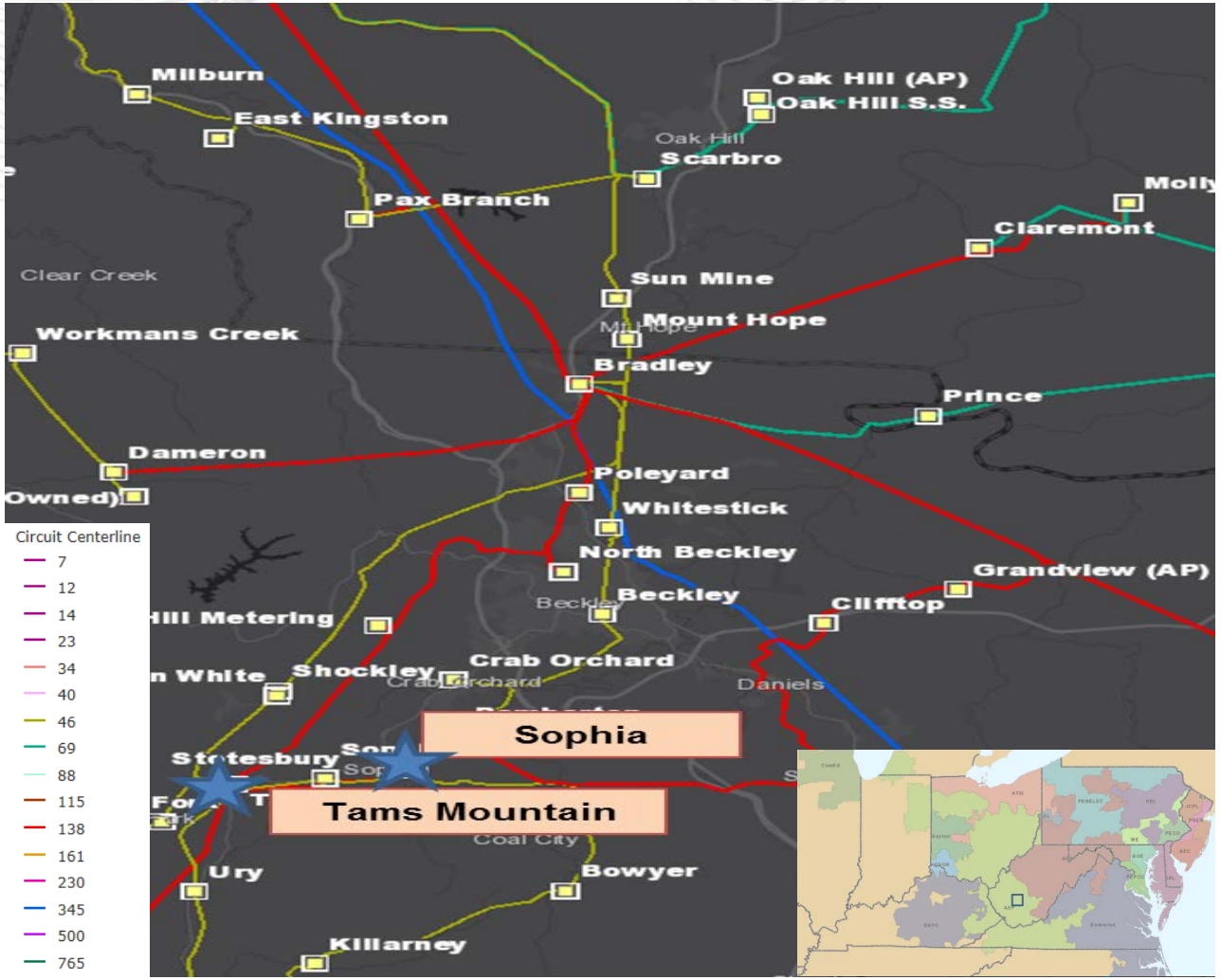
Sophia 46 kV Station remote end work to upgrade line relays, replace existing 1200 A 21 kA circuit breaker "C" with a new 3000 A 40 kA 69 kV CB. (S1667.2)
Estimated Trans. Cost: $0.9M

Pemberton 138 kV Station remote end relay work. (S1667.3) Estimated Trans. Cost: $0.6M

Total Estimated Transmission Cost: $21.2M

Projected In-service: 6/1/2021

Project Status: Scoping



AEP Transmission Zone: Supplemental Joshua Falls

Previously Presented: 6/26/2018 SRRTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

Joshua Falls: The Gas Insulated Station (GIS) at Joshua Falls, installed in 1979 , will only operate if the hydraulic pressure is at a minimum of 5000 psi. The hydraulic gears that are used to open and close the circuit breakers were leaking hydraulic oil at a high rate, and therefore we were not able to keep the pressure to 5000 psi. The hydraulic reservoirs needed to have hydraulic fluid added weekly to maintain adequate fluid levels in the system. Many of the hydraulic seals have deteriorated, causing additional oil leakage. Because the oil leakage was so severe, the circuit breakers often didn't have enough pressure to close when required. When this situation occurred, field personnel are dispatched to the station to re-pressurize the system. Because of the nature of the GIS issues, AEP installed a temporary station in 2014 until the new 138 kV yard could be rebuilt in the clear.

765/138 kV transformer #1 phase 1 (vintage 1980) is showing short circuit strength breakdown caused through fault events, gassing of the unit (high readings for ethane and methane), 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.

765/138 kV transformer #1 phase 3 (vintage 1992) is showing short circuit strength breakdown caused by thermal through fault events that this unit has experienced. These events have led to gassing of the unit and carbonization of the insulating paper, showing high readings of carbon dioxide and carbon monoxide. Phase 3 has shown signs of accelerated winding aging from the recent hot spot indicated on the low side winding well above the alert level. Similar transformer units have seen failures in the windings.

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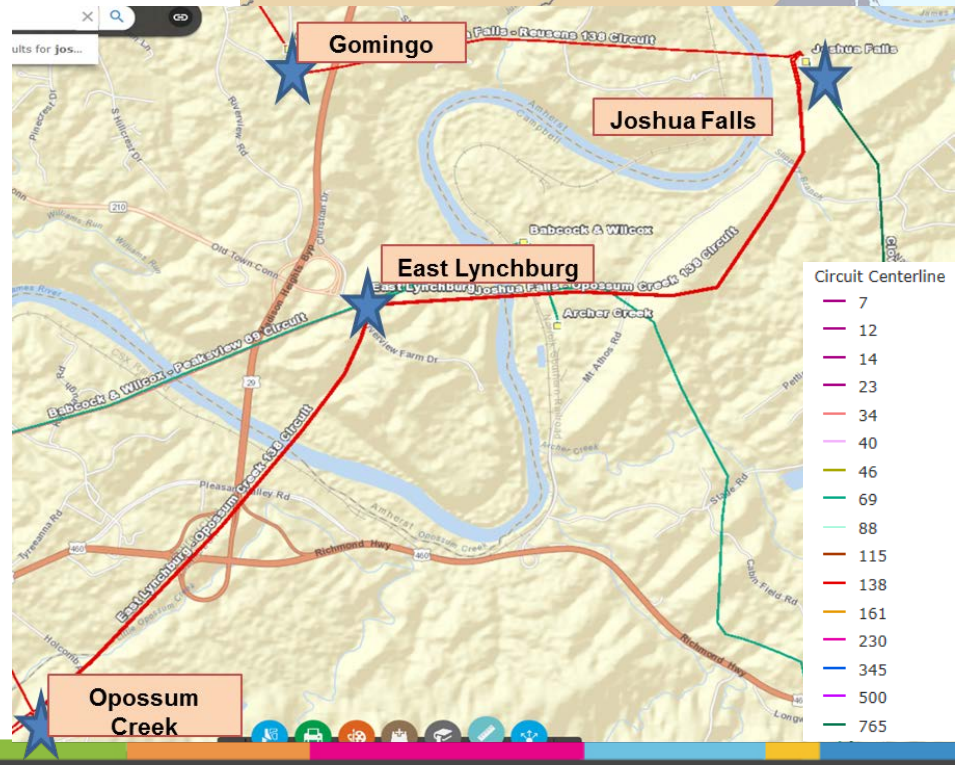
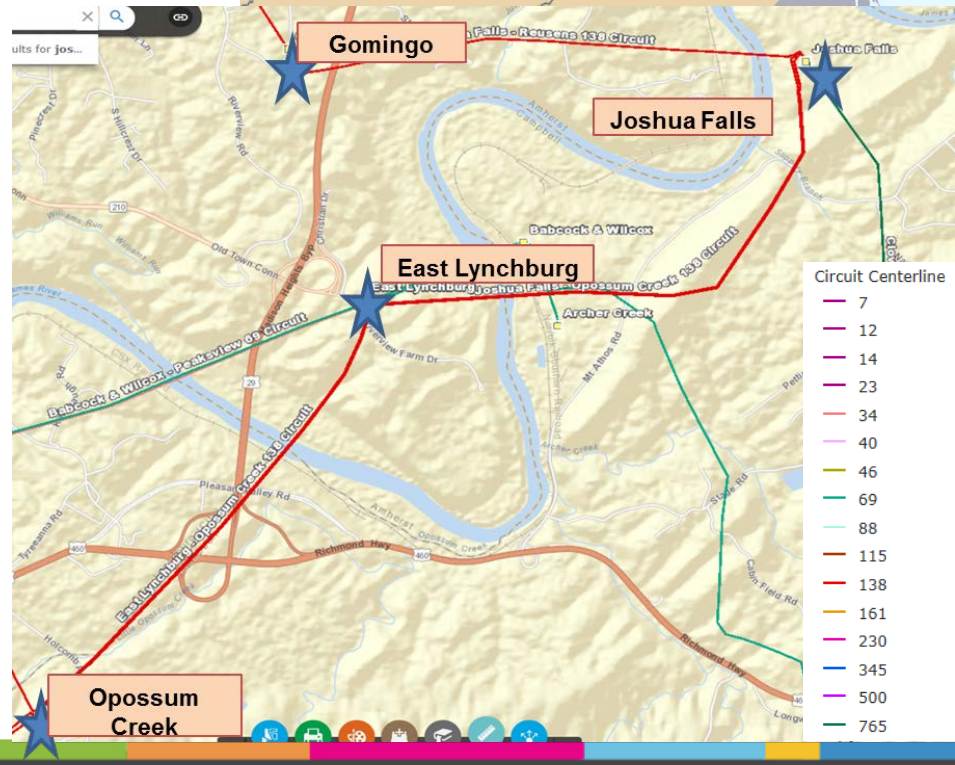


AEP Transmission Zone: Supplemental Joshua Falls



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East Lynchburg: The 138 kV circuit breaker "K" (vintage 1974) at East Lynchburg is an air blast PK type breaker, which have become a safety concern due to their catastrophic and violent failures. During failures sharp pieces of porcelain are expelled, which can be a hazard to field personnel. In addition, CB "K" has experienced 70 fault operations exceeding manufacturers recommended fault operations of 10. The East Lynchburg 34.5 kV circuit breaker "A" (vintage 1956) is an oil type breaker without oil containment. These oil breakers have become more difficult to maintain due to the required oil handling. In general, oil spills occur more frequently during routine maintenance and failures with these types of breakers. Other drivers include damage to bushings. CB "A" has experienced 33 operations, exceed the manufacturers recommended number of 10. Circuit Switcher "AA" is a MARK V unit, which have presented AEP with a large amount of failures and misoperations.

Operational Flexibility and Efficiency

There are currently three dissimilar zones of protection at East Lynchburg station: 138 kV Opossum Cr. line, 138/69/34.5 kV XF #1, and the 69 kV Babcock & Wilcox line. This configuration can lead to misoperations and over tripping.

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AEP Transmission Zone: Supplemental Joshua Falls

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Selected Solution:

At Joshua Falls, retire the existing 138 kV yard at Joshua Falls Station and build a new one in the clear. The new 138 kV yard includes two 138 kV busses and 4-3000 A/63 kA circuit breakers in a breaker and a half layout. In addition, primary and backup single phase station service transformers will be added on bus 1 & 2 respectively. New CCVT's will be installed on the 138 kV lines and busses. A new 16'x 48' DICM will also be needed for this new station. In the Joshua Falls 765 kV yard a bus will be established to allow the spare 765/138 kV bank to be switchable. Electromechanical relaying packages on the transformers and line exit will be upgraded. A DICM will be required in this 765kV yard. Replace 765/138 kV 250 MVA phase 1 & 3 with new 250 MVA transformers. (S1668.1) Estimated Cost: $34.6M

Construct 0.25 miles of 1590 ACSR (operated at 138kV) connecting the Joshua Falls 765 kV station to the new 138 kV yard. (S1668.2) Estimated Cost: $0.5M

Install 0.25 miles of 1590 ACSR connecting the Gomingo – Joshua Falls line to the new 138 kV yard. (S1668.3) Estimated Cost: $0.8M

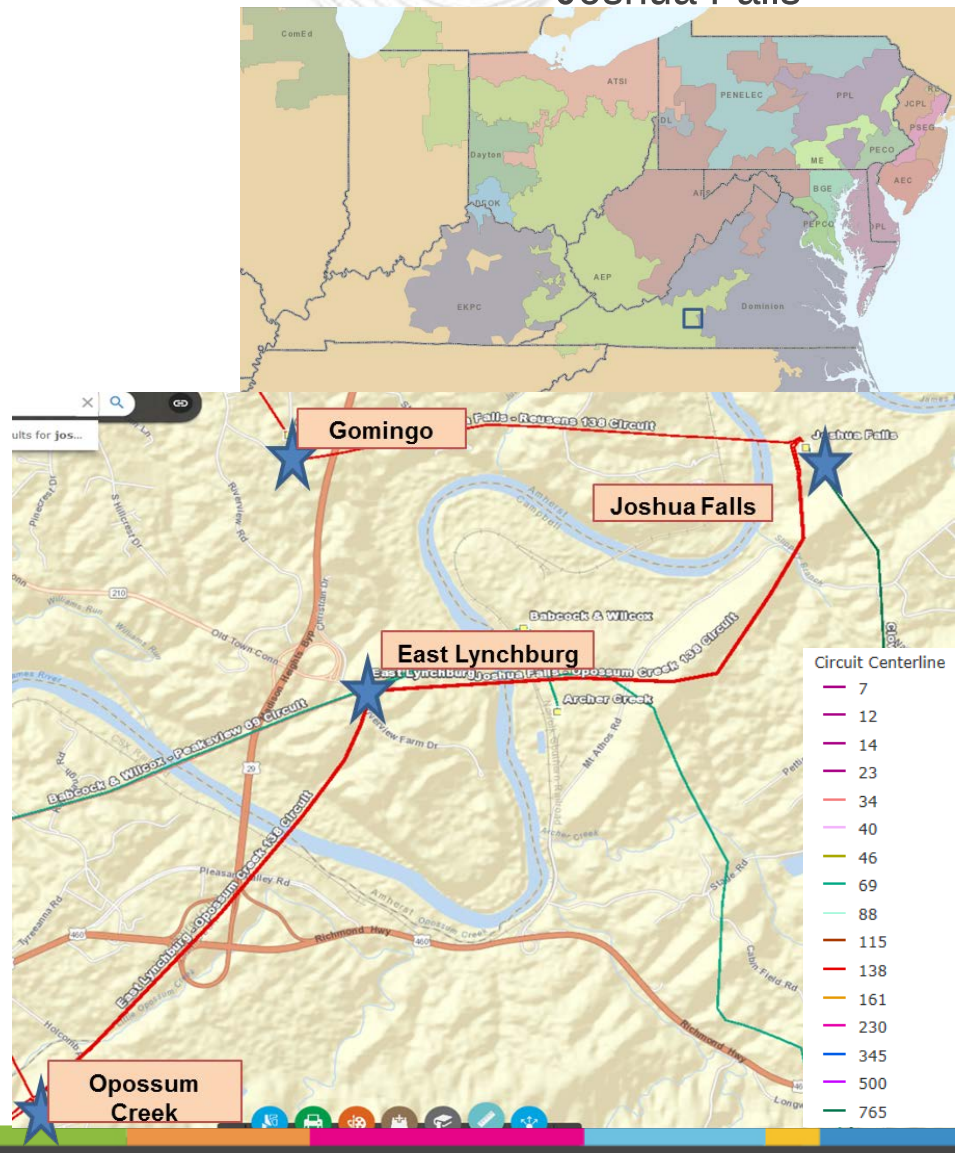
Install 0.4 miles of double circuited 1590 ACSR connecting the Opossum Creek and Easy Lynchburg lines to the new 138 kV yard. (S1668.4) Estimated Cost: $1.1M

At East Lynchburg, install a new 3000 A/40 kA 138 kV circuit breaker "L" towards Opossum Creek. Replace the existing circuit breaker 3000 A/50 kA "K" with a 3000 A/40 kA 138 kV circuit breaker. Install a new 3000 A/40 kA circuit breaker "F" on the 69 kV station exit. Replace the existing 1200 A/17 kA 34.5 kV circuit breaker "A" with a 1200 A/25 kA breaker. Install a new station service transformer on the 138 kV bus and replace the existing 34.5 kV station service transformer (used for a backup). Retire capswitcher "AA" and 57.6 MVAR capacitor bank. (S1668.5) Estimated Cost: $3.7M

Total Estimated Transmission Cost: $40.7M

Projected In-service: 7/31/2020

Project Status: Engineering



Next Steps

Upcoming Western SRRTEP Dates

West	Start	End
8/31/2018	9:00	1:00
9/28/2018	12:00	4:00
10/26/2018	12:00	4:00
11/29/2018	12:00	4:00
12/5/2018	12:00	4:00

RTEP@pjm.com to Be Retired

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

Revision History

7/23/2018 – V1 – Original version posted to pjm.com