

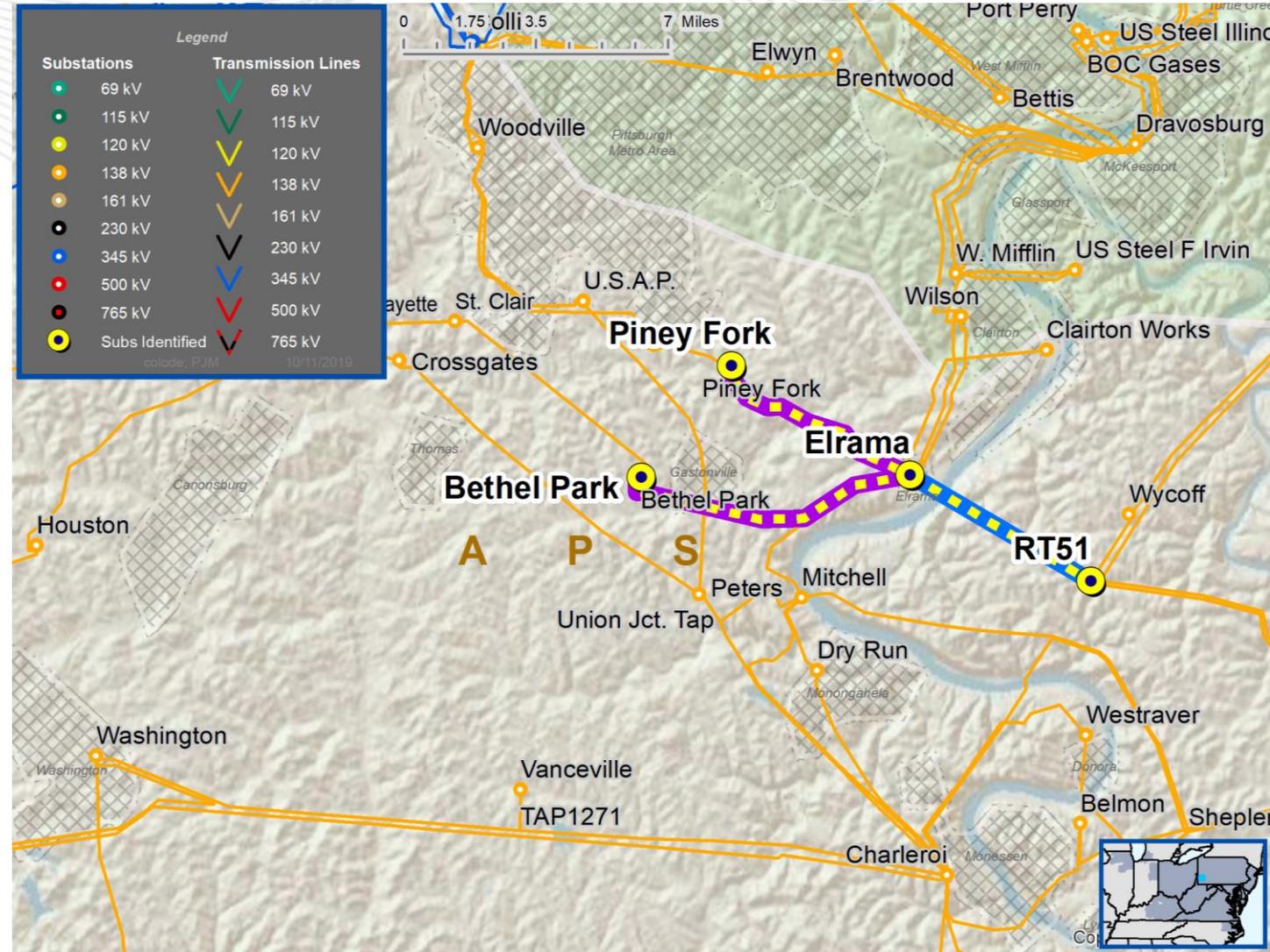
Appendix: Previously Reviewed Baseline Upgrade Recommendations for the February 2020 PJM Board Review

Problem Statement: Missing Scope

- The need for B3064 (DLCO) was confirmed for FE reinstatement - Expand Elrama 138 kV substation to loop in the existing USS Steel Clariton - Piney Fork 138 kV line.
- FE identified the missing scope of the projects driven by DLCO's B3064.

Recommended Solution:

- B3064.2, B3064.3 (APS) - Upgrade line relaying at Piney Fork and Bethel Park for Piney Fork – Elrama 138 kV line and Bethel Park – Elrama 138 kV line.
- **Required IS Date:** 06/01/2021
- **Projected IS Date:** 06/01/2021
- **Estimated Project Cost:** \$0.6M
- **First Read TEAC date:** 09/12/19



Problem Statement: Generation Deliverability

- Mitchell – Elrama 138 kV line is overloaded for the for the tower contingency of tripping two Route 51 – Elarma 138 kV lines.

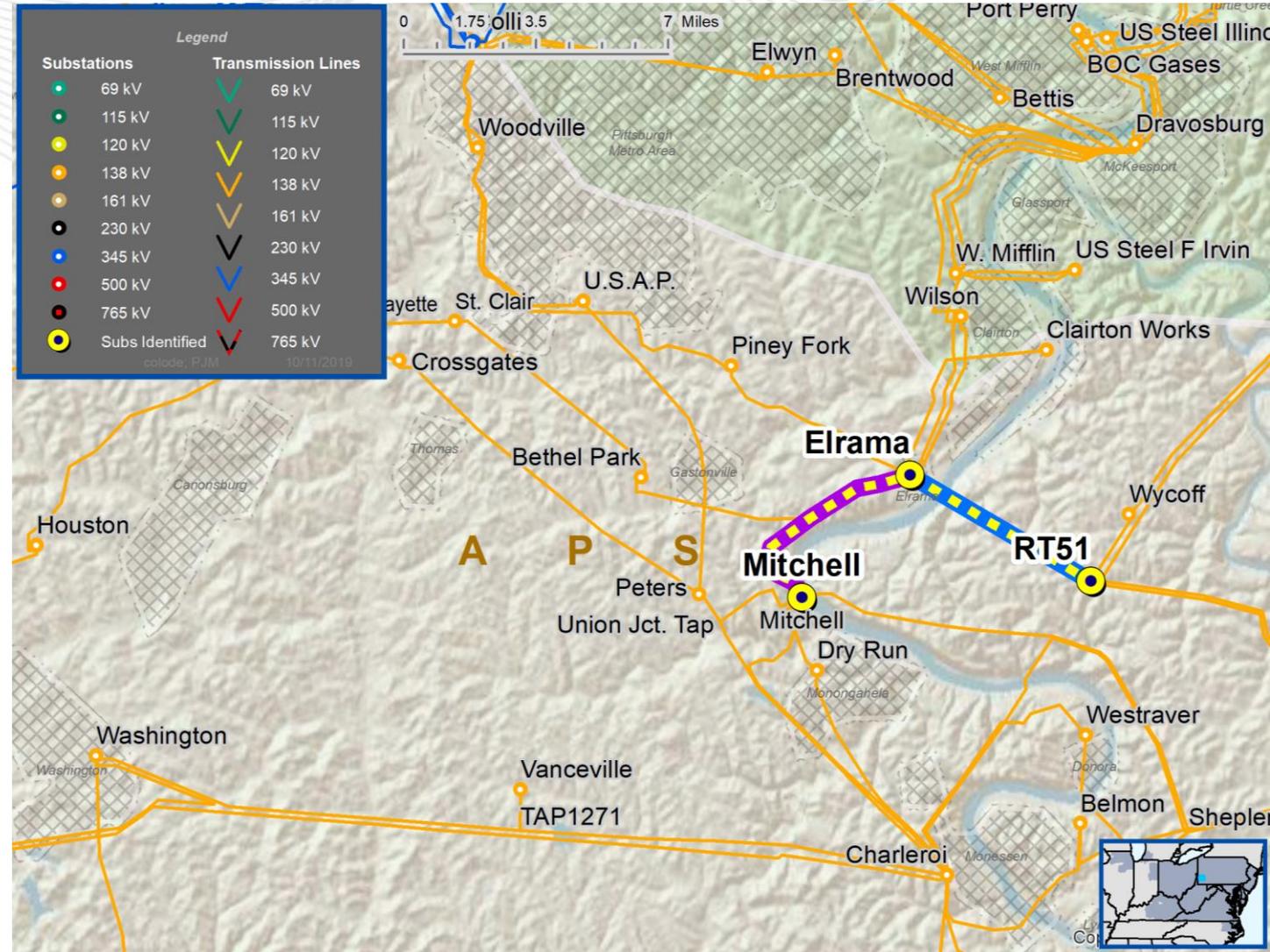
Recommended Solution:

- B3015.8 (APS) – Re-establish work of B3015.6 (canceled 2/2019) - upgrade terminal equipment at Mitchell for Mitchell – Elarma 138 kV line.

Existing Scope Rating: SN 498 MVA / SE 600 MVA

New Scope Rating: SN 790 MVA / SE 838 MVA

- Required IS Date:** 06/01/2021
- Projected IS Date:** 06/01/2021
- Estimated Project Cost:** \$2M
- First Read TEAC date:** 09/12/19



Problem Statement: N-1-1 thermal AEP FERC 715 violation

Garden Creek – Whetstone 69 kV line is overloaded for the following scenarios.

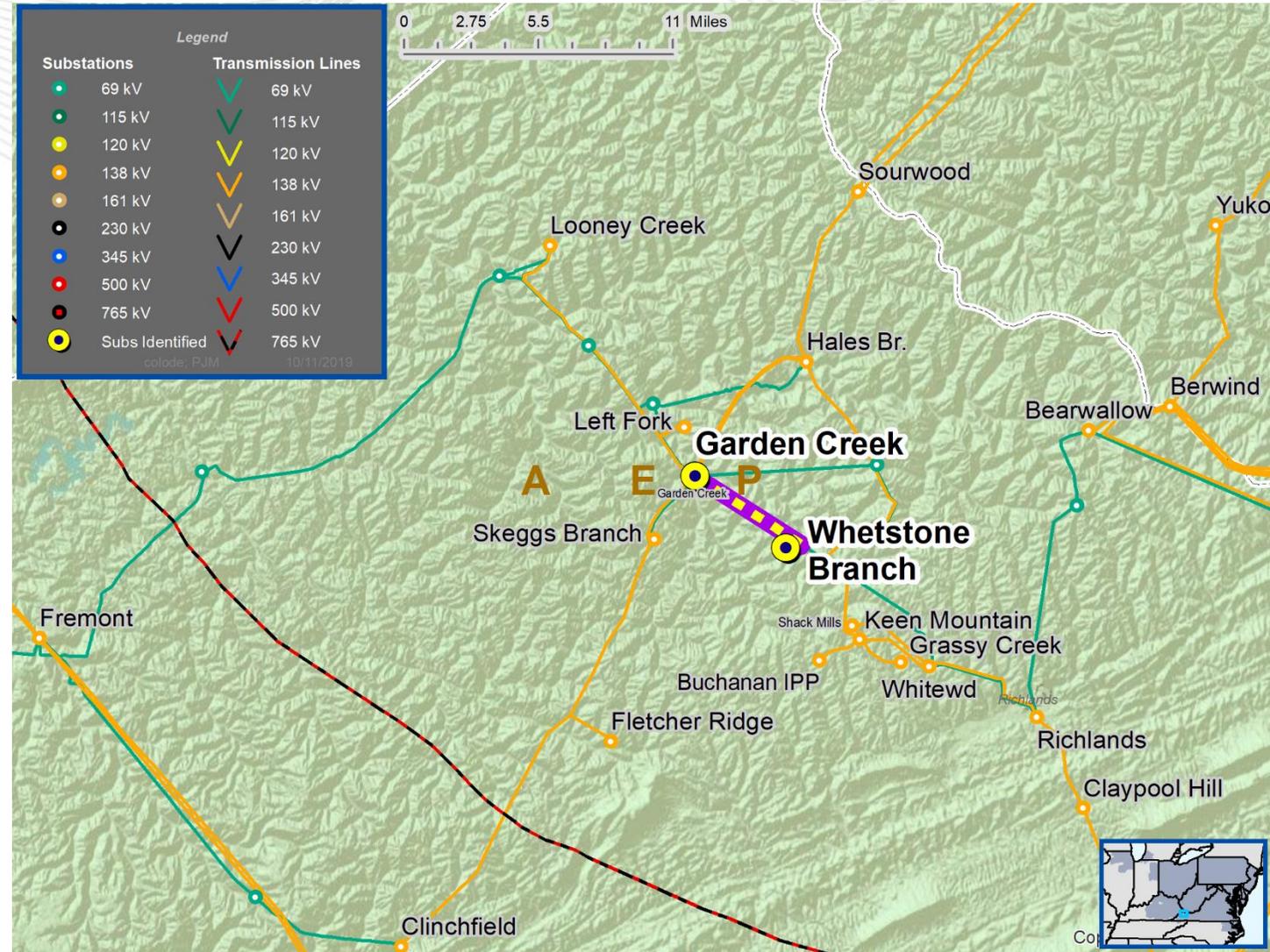
- Single contingency loss of Richland - Broadford 138 kV line followed by single contingency loss of the Garden Creek - Shack Mills 138 kV line.
- Single contingency loss of Richlands - Broadford 138 kV line followed by single contingency loss of the Whitewood – Hales Branch 138 kV line.

Recommended Solution:

- Rebuild the Garden Creek - Whetstone 69 kV line (4.65 mile) (b3139).
- Existing Scope Rating: 44 MVA SN / 44 MVA SE
- New Scope Rating: 102 MVA SN / 142 MVA SE

Required IS Date: 06/01/2023
Projected IS Date: 06/01/2023

Estimated Project Cost: \$14M



Problem Statement: N-1-1 thermal AEP FERC 715 violation

Whetstone - Knox Creek - Coal Creek 69kV line is overloaded for the following scenarios:

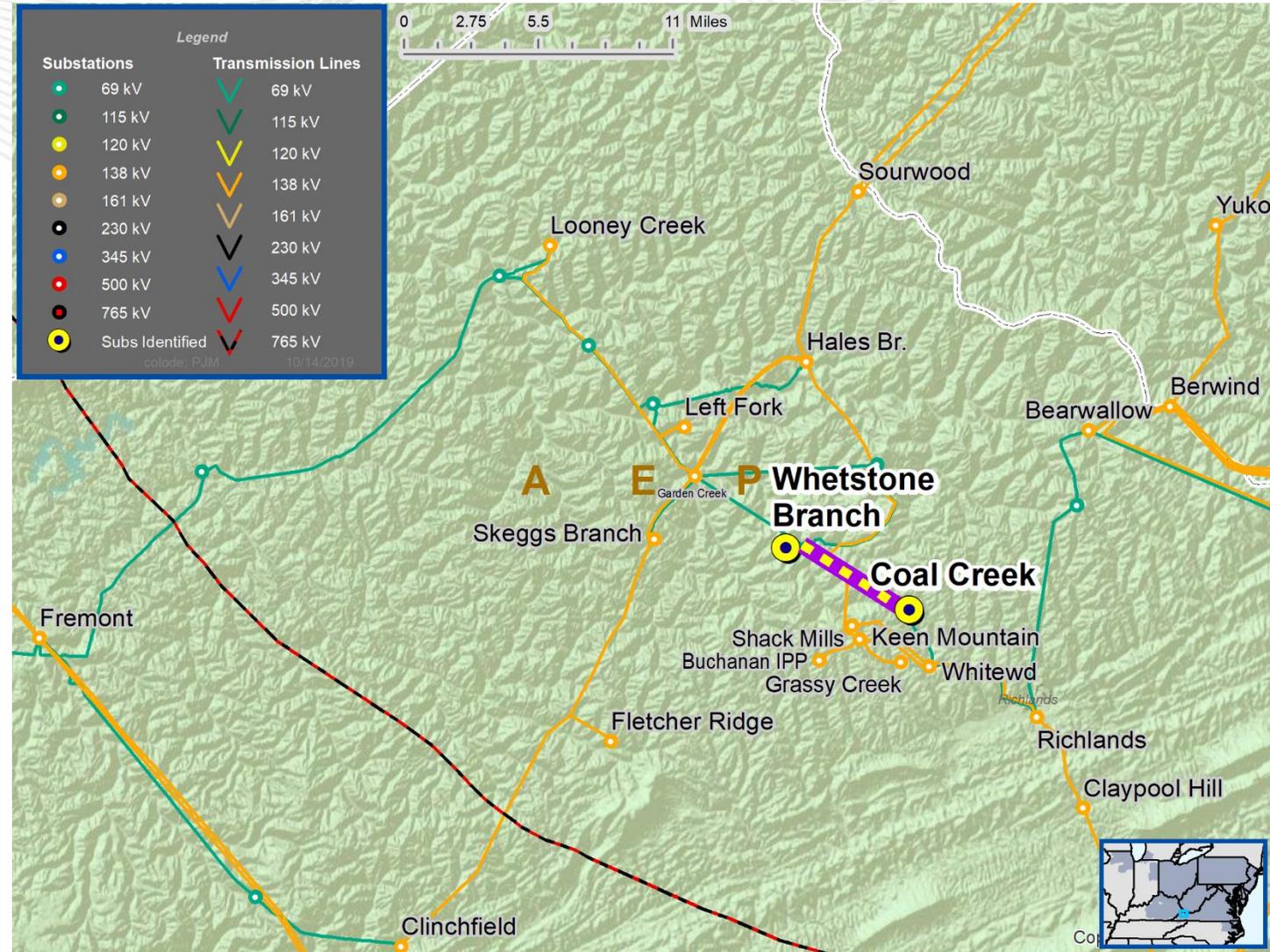
- Single contingency loss of Richlands - Broadford 138 kV line followed by single contingency loss of the Whitewood – Hales Branch 138 kV line.
- Single contingency loss of Clinch River – Hales Branch 138 kV line followed by single contingency loss of the Richlands – Whitewood 138 k line.

Recommended Solution:

- Rebuild the Whetstone - Knox Creek 69 kV line (3.1 mile) (b3140).
- Rebuild the Knox Creek –Coal Creek 69 kV line (2.9 mile) (b3141).
- Existing Scope Rating: 44 MVA SN / 44 MVA SE
- New Scope Rating: 102 MVA SN / 142 MVA SE

Required IS Date: 06/01/2023
Projected IS Date: 06/01/2023

Estimated Project Cost: \$9M – b3140
\$9M – b3141





DPL Transmission Zone: Baseline

Process Stage: Second Review

Previously Presented: 10/21/2019

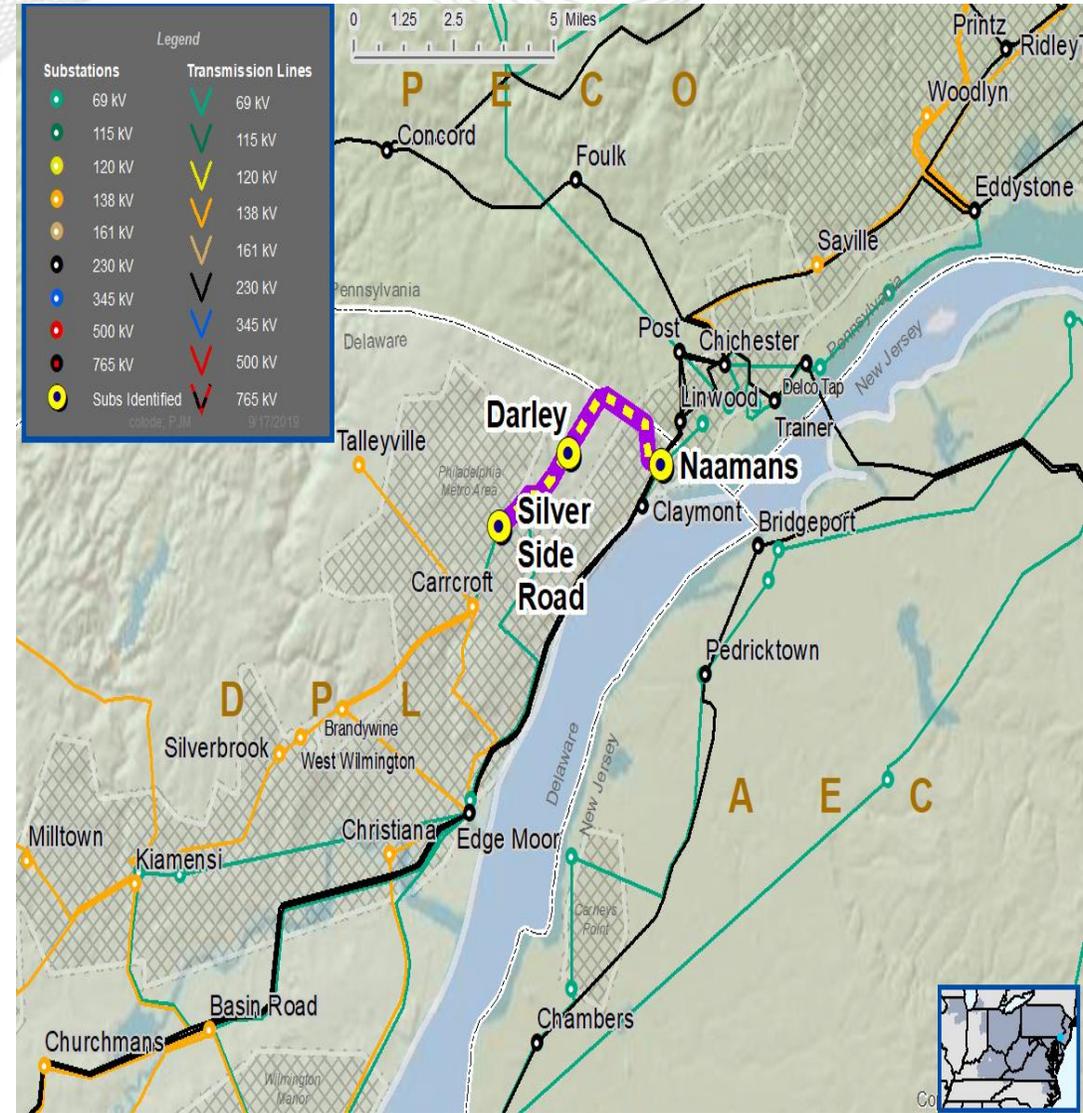
Summer and Winter: [GD-S537, GDS538], [GD-W441 and GD-W442]

Problem Statement:

The Naamans – Darley – Silver Side Rd 69 kV circuit is overloaded for a tower line outage, loss of Edge Moor – Claymont and Edge Moor – Linwood 230 kV circuits, in the Winter generation deliverability study. The circuit is rated at 105N/136E, 137N/175E Summer and 121N/153E, 158N/197E Winter

Proposed Solutions

PJM Proposal ID	Proposing Entity	Description	Cost (\$M)
626	Exelon	Install a series reactor on the Silverside-Darley line	1.000
820	Exelon	Install a SmartWire device in series with the Silverside-Darley line	2.000
673	Exelon	Replace terminal equipment and implement reconductoring of the Silverside-Darley and Darley-Naamans lines to achieve ratings of 232 MVA normal and 239 MVA emergency (Silverside-Darley) and 174 MVA normal and 194 MVA emergency (Darley-Naamans)	5.500
174	Exelon	Construct a new 69 kV line between Edge Moor and Claymont Substation. Create a new terminal position at Edge Moor substation and utilize an open terminal position at Claymont Substation.	17.000
036	Exelon	Construct new 230 kV line from Edge Moor Substation to New Substation near Linwood Substation (PECO). New substation will tie in the Chichester to Linwood 230 kV Line (PECO).	36.575
522	Exelon	Construct new 230 kV line from Edge Moor to Chichester substation and perform associated upgrades at substations to accommodate new line.	37.900
637	Exelon	Construct new 230 kV line from Harmony Substation to New Substation near Linwood Substation (PECO). New substation will tie in the Chichester to Linwood 230 kV Line (PECO).	69.000
839	Exelon	Construct new 230 kV line from Harmony to Chichester substation and perform associated upgrades at substations to accommodate new line.	71.000





DPL Transmission Zone: Baseline

Process Stage: Second Review

Previously Presented: 10/21/2019

Summer and Winter: [GD-S537, GDS538], [GD-W441 and GD-W442]

Problem Statement:

The Naamans – Darley – Silver Side Rd 69 kV circuit is overloaded for a tower line outage, loss of Edge Moor – Claymont and Edge Moor – Linwood 230 kV circuits, in the Winter generation deliverability study. The circuit is rated at 105N/136E, 137N/175E Summer and 121N/153E, 158N/197E Winter

Recommended Solution

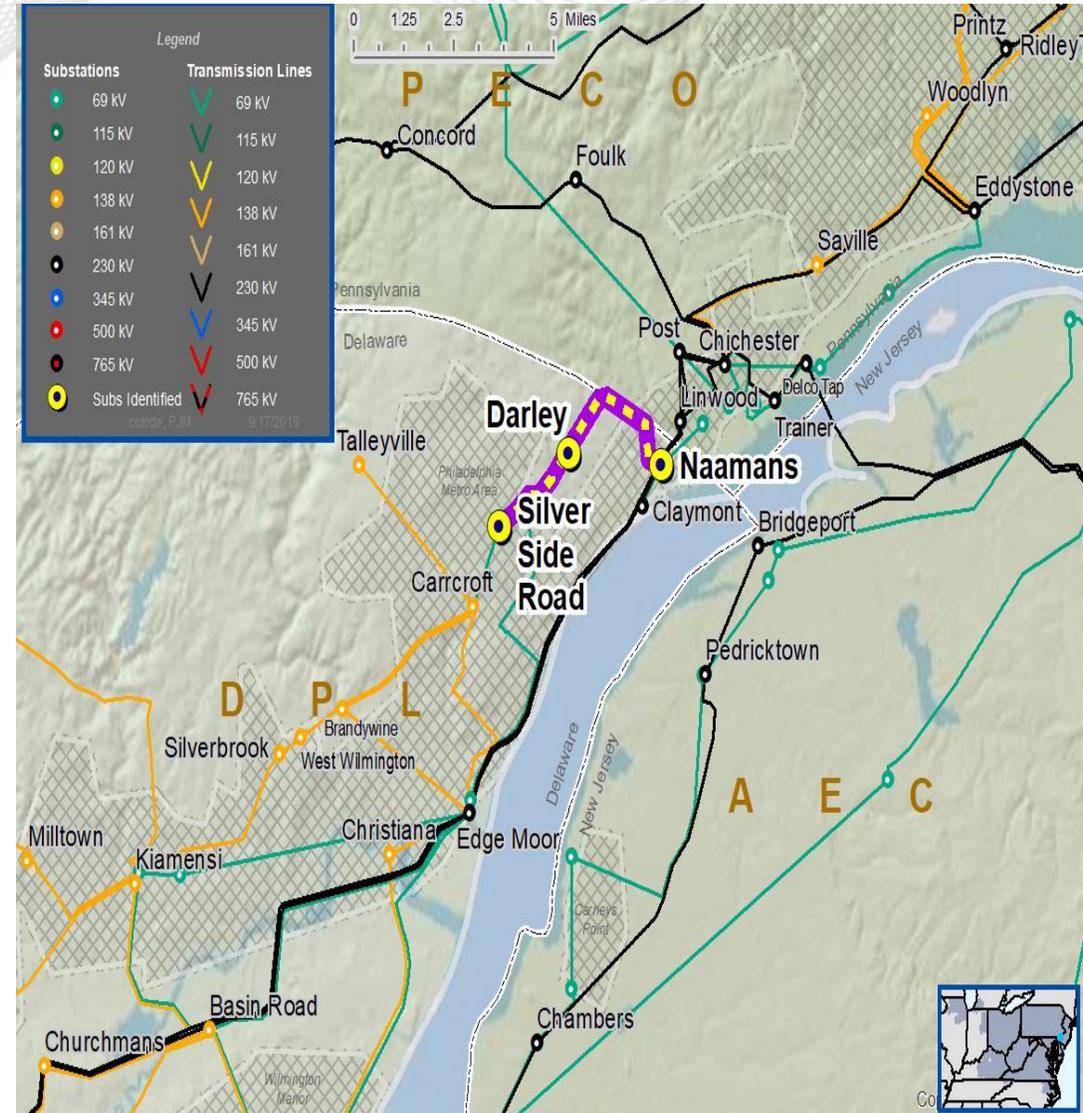
Replace terminal equipment and implement reconductoring of the Silverside-Darley and Darley-Naamans 69 kV lines to achieve ratings of 232N/239E summer MVA, 241N/269E winter MVA (Silverside-Darley) and 174N/194E summer MVA , 205N/235E winter MVA (Darley-Naamans). (B3143)

Estimated Project Cost : \$5.5 M

Required In-Service Date: 6/1/2024

Projected In-Service Date: 6/1/2024

Status: Conceptual





Penelc Transmission Zone: Baseline

Process Stage: Second Review

Previously Presented: 9/24/2019

Criteria: First Energy Planning Criteria Violation

Assumption Reference: FERC 715

Model Used for Analysis: 2019 Series 2024 Summer RTEP

Proposal Window Exclusion: Below 200 kV

Problem Statement:

The Jackson Rd. – Nanty GL 46 kV circuit is overloaded for the loss of the parallel Jackson Rd – Nanty 46 kV line, in both Summer and Winter studies.

The line is rated at 25N/25E Summer and Winter. The circuit is loaded to 108% of 25 MVA Summer emergency rating and 102.8% of 25 MVA Winter emergency rating.

Recommended Solution:

Jackson Road – Nanty Glo 46 kV SJN Line: Upgrade Bus Conductor & Relay Panels

- At Jackson Road, terminal equipment to be replaced includes line relaying and substation conductor. **(b3144.1)**
- At Nanty Glo, terminal equipment to be replaced includes line relaying and substation conductor. **(b3144.2)**

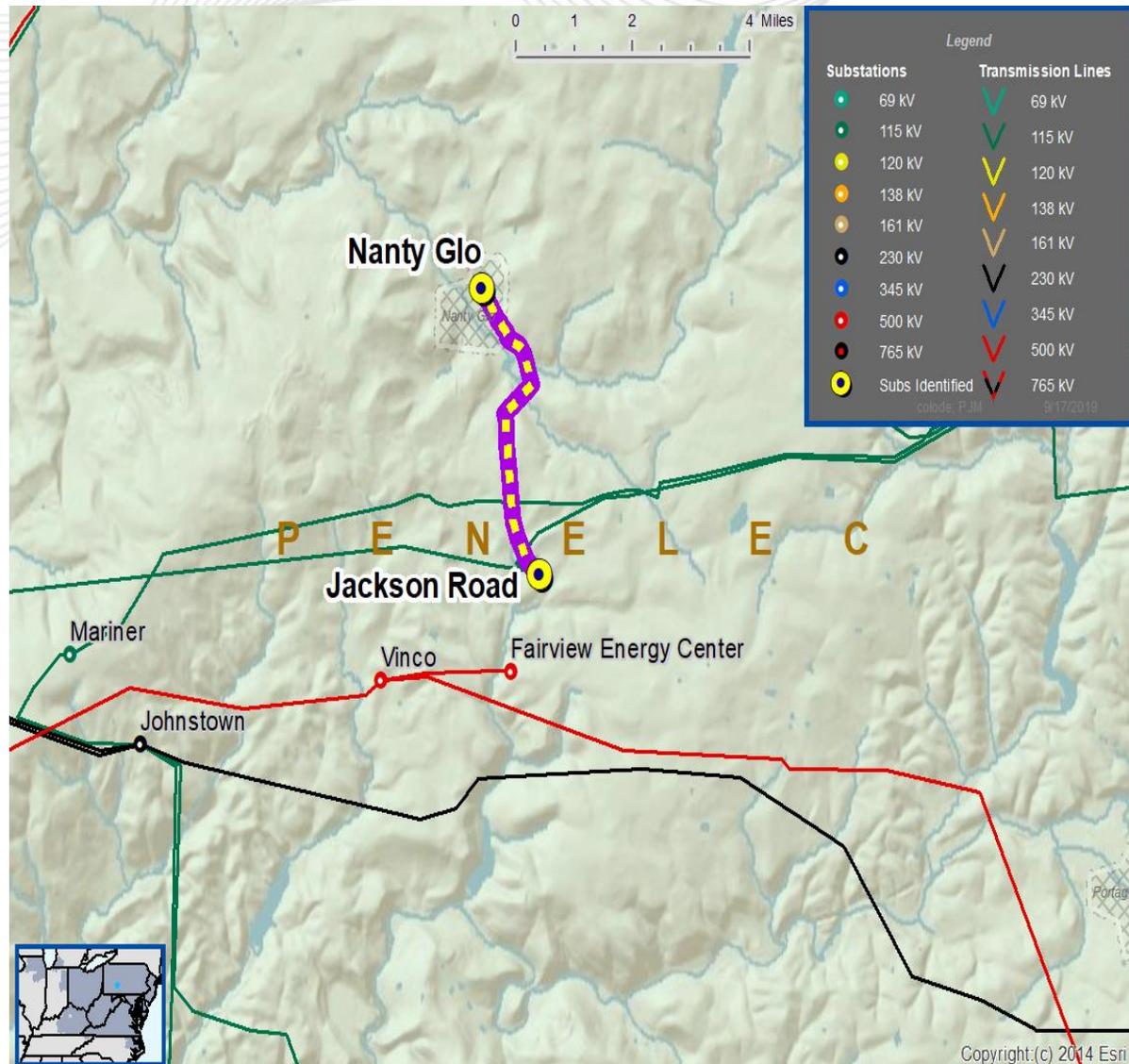
New rating → 53N/64E MVA summer, 60N/76E MVA winter

Estimated Project Cost : \$1.5 M

Required In-Service Date: 6/1/2024

Projected In-Service Date: 6/1/2024

Status: Conceptual



Process Stage: Second Review

Previously Presented: 10/21/2019

Baseline Reliability: Immediate Need Exclusion

Problem Statement: Short Circuit

The Richmond 69kV breaker "140" is overdutied.

Significant Driver:

Case Correction – Richmond 7 Transformer modeling correction

Recommended Solution:

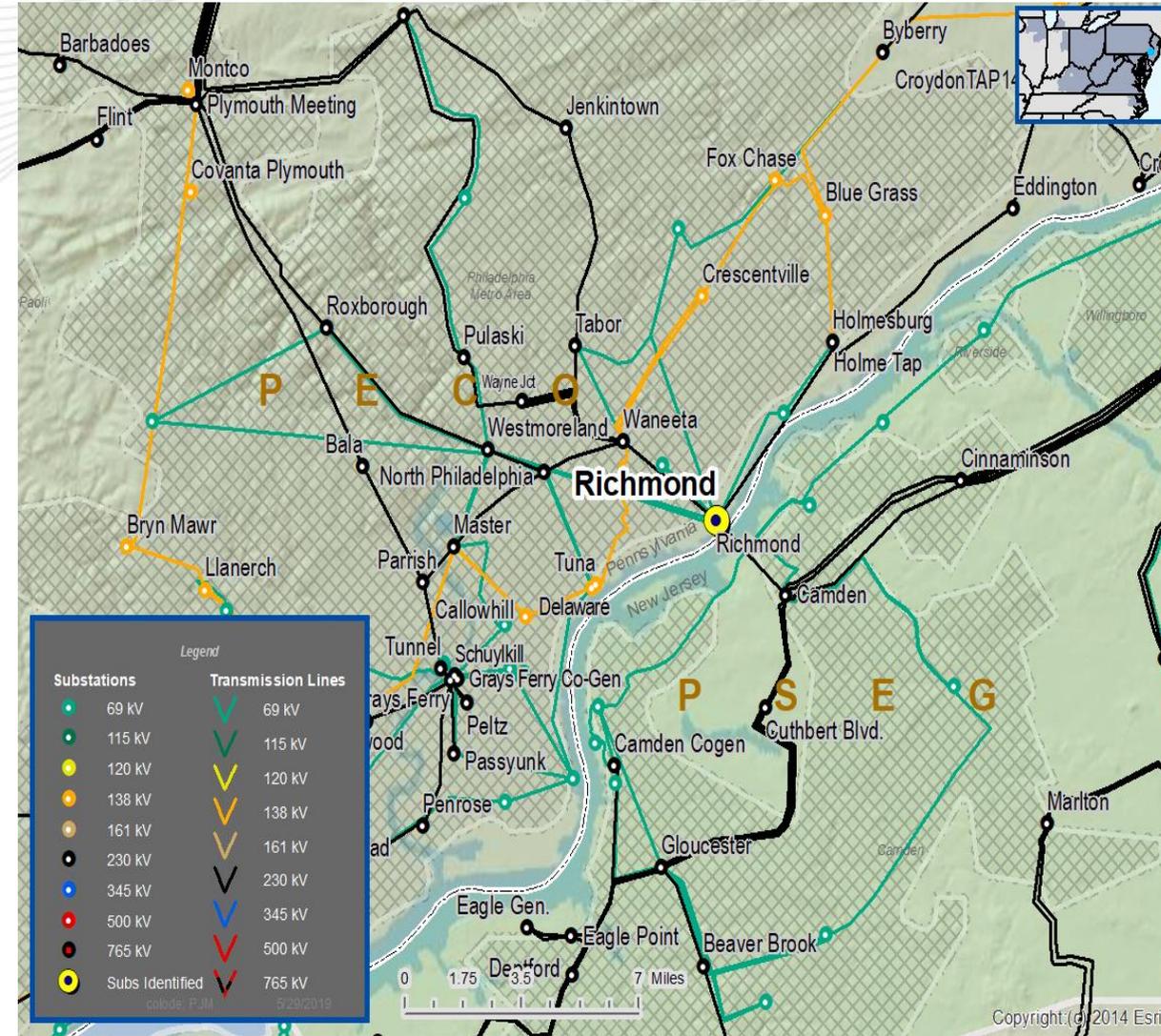
Replace the Richmond 69kV breaker "140" with a 40kA breaker (b3146)

Estimated Project Cost: \$0.415 M

Required In-service Date: Immediate Need

Projected In-service Date: 6/1/2021

Project Status: Conceptual



Process Stage: Recommended Solution

Criteria: TO Planning Criteria

Assumption Reference: FERC 715

Model Used for Analysis: RTEP 2020 LL Stability Base Case

Proposal Window Exclusion: FERC 715 (TO Criteria)

Problem Statement:

Three-phase delayed-cleared faults at Electric Junction 138kV blue bus on TSS111 Electric Junction 345/138 kV Transformer 81 or 82, or line 11106 or line 11102, result in instability at TSS 951 Aurora EC units 3 and 4

Existing Facility Rating: N/A

Preliminary Facility Rating: N/A

Recommended Solution:

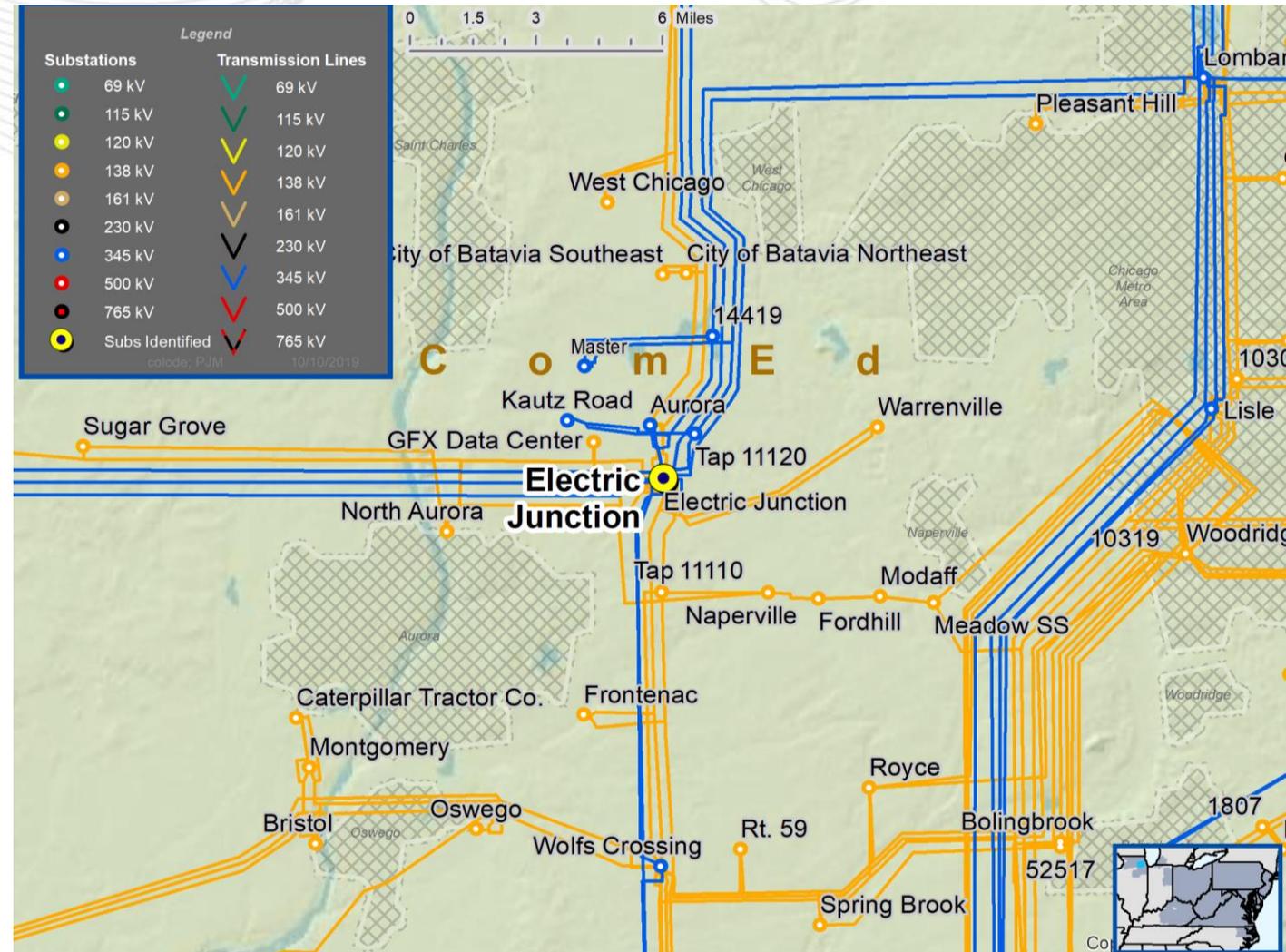
(B3147) Modify 138kV blue bus total clearing times at TSS111 Electric Junction to 11 cycles for fault on 345/138kV Transformer 81, and to 13 cycles for faults on 138kV Line 11106, 138kV Line 11102 and 345/138kV Transformer 82

Estimated Cost: \$ 0.25M

Required In-Service: 12/31/2020

Projected In-Service: 12/31/2020

Previously Presented: 10/25/2019



Process Stage: Recommended Solution

Criteria: TO Criteria Violation

Assumption Reference: FERC 715

Model Used for Analysis: 2021 RTEP Winter

Proposal Window Exclusion: FERC 715 (TO Criteria)

Problem Statement:

TO criteria thermal violations are identified on Bradley – Sun 46kV line section (108% of emergency rating) and Tams Mountain – Glen White 46 kV line section (129% of emergency rating) for N-1-1 contingencies (Bradley 138/69/46 kV XFR outage and Pemberton – Beckley 46 kV line) in the 2021 Winter RTEP Case. For the same contingency pair, voltage magnitudes drop below 0.92pu at Beckley 46 kV (0.86pu), Whitestick 46 kV (0.86pu), Bradley 46 kV (0.88pu), Mt. Hope 46 kV (0.90pu and Sun 46 kV (0.90pu) and voltage deviations are greater than 8% at Sun 46 kV Station, Mt. Hope 46 kV Station, Bradley 46 kV Station, Whitestick 46 kV Station, and Beckley 46 kV Station.

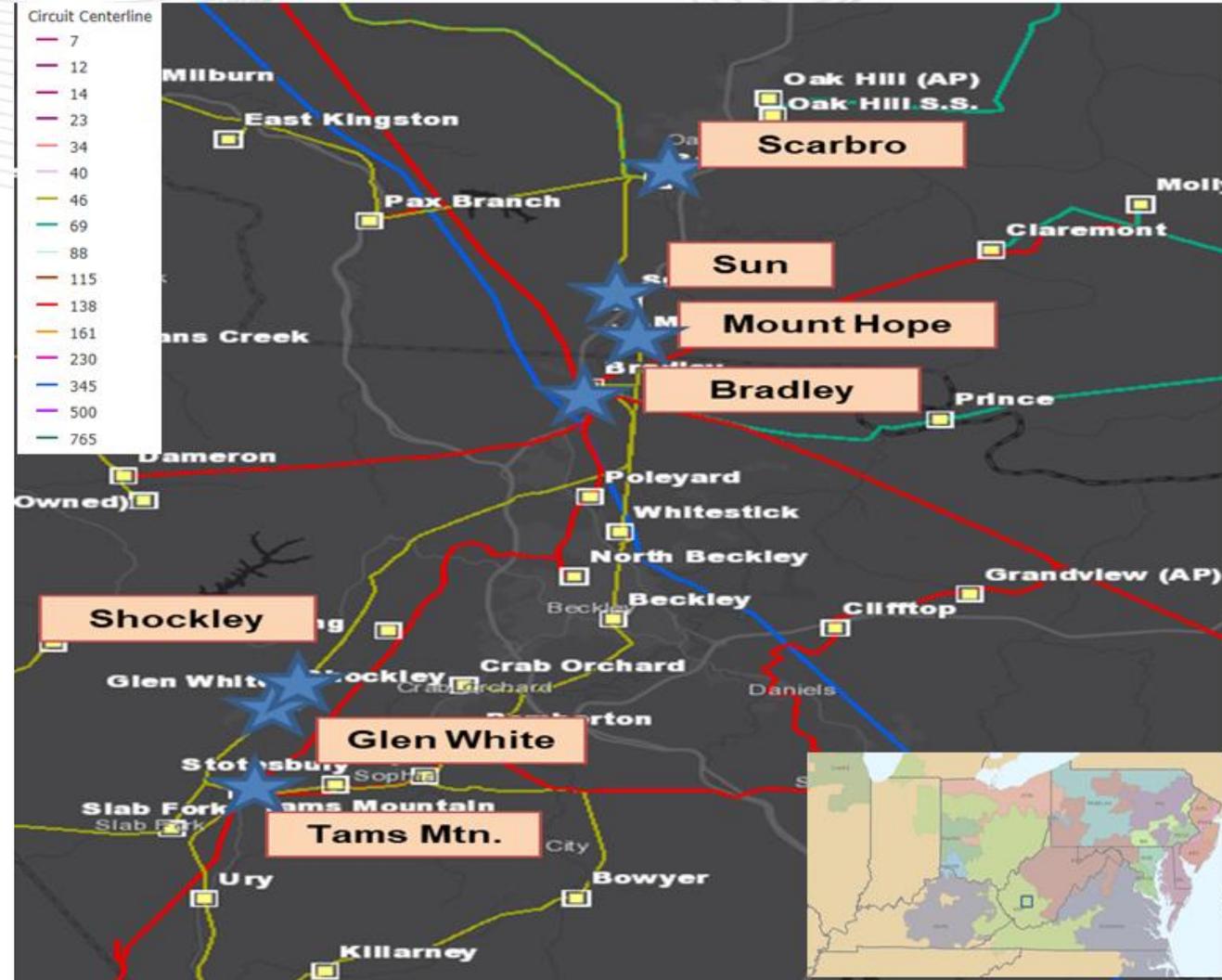
Additionally, Bradley –Scarbro 46 kV Circuit has Equipment material / Condition / Performance / Risk issues shown in Supplemental Need AEP-2019-AP049

Existing Facility Rating:

From Bus #	From Bus Name	To Bus #	To Bus Name	KV	ID	SN/SE/WN/WE
244876	05BRADLEY	244902	05SUN	46	1	31/31/43/43
244899	05SCARBRO	244902	05SUN	46	1	31/31/43/43

Preliminary Facility Rating:

From Bus #	From Bus Name	To Bus #	To Bus Name	KV	ID	SN/SE/WN/WE
244876	05BRADLEY	244902	05SUN	46	1	86/86/108/108
244899	05SCARBRO	244902	05SUN	46	1	86/86/108/108



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Recommended Solution:

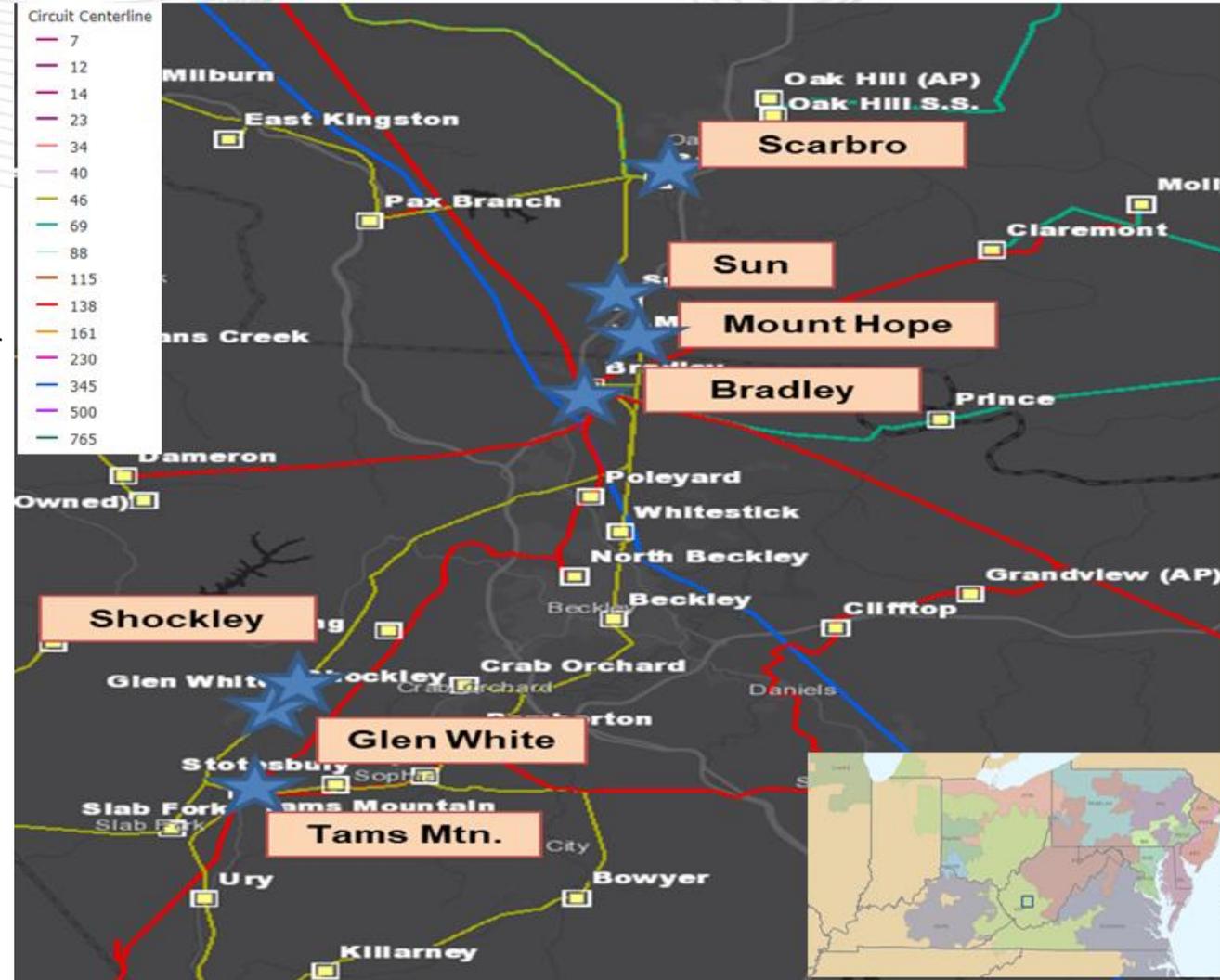
- (B3148.1) Rebuild the 46 kV Bradley-Scarbro line. The new line will be rebuilt adjacent to the existing one leaving the old line in service until the work is completed. The new 46 kV line will be built with 795 ACSR (120 MVA) and 69 kV standards. **Estimated Cost: \$22.2M**
- (B3148.2) Bradley remote end station work, replace 46 kV bus, install new 12 MVAR capacitor bank. **Estimated Cost: \$3.3M**
- (B3148.3) The switch at Sun Station will be replaced with a 2- way SCADA-controlled MOAB switch. **Estimated Cost: \$0.9M**
- (B3148.4) Remote end work and associated equipment at Scarbro Station. **Estimated Cost: \$1.3M**
- (B3148.5) Retire Mt. Hope Station and transfer load to existing Sun Station. **Estimated Cost: \$0.0M**

Total Estimated Transmission Cost: \$27.7M

Required In-service: 12/1/2021

Projected In-service: 6/1/2021

Previously Presented: 10/25/2019



Process Stage: Recommended Solution

Criteria: TO Planning Criteria

Assumption Reference: FERC 715

Model Used for Analysis: 2024 RTEP Summer

Proposal Window Exclusion: FERC 715

Problem Statement:

For loss of Marathon – Limberlost 69kV and Adams – Berne 69kV, the Decatur – South Decatur 69kV circuit overloads to 112% of the 50MVA 4/0 ACSR line conductor rating

Existing Facility Rating: 50/50/63/63 MVA for SN/SE/WN/WE

Preliminary Facility Rating: 82/90/107/113 MVA for SN/SE/WN/WE

Recommended Solution:

Decatur – South Decatur 69kV line

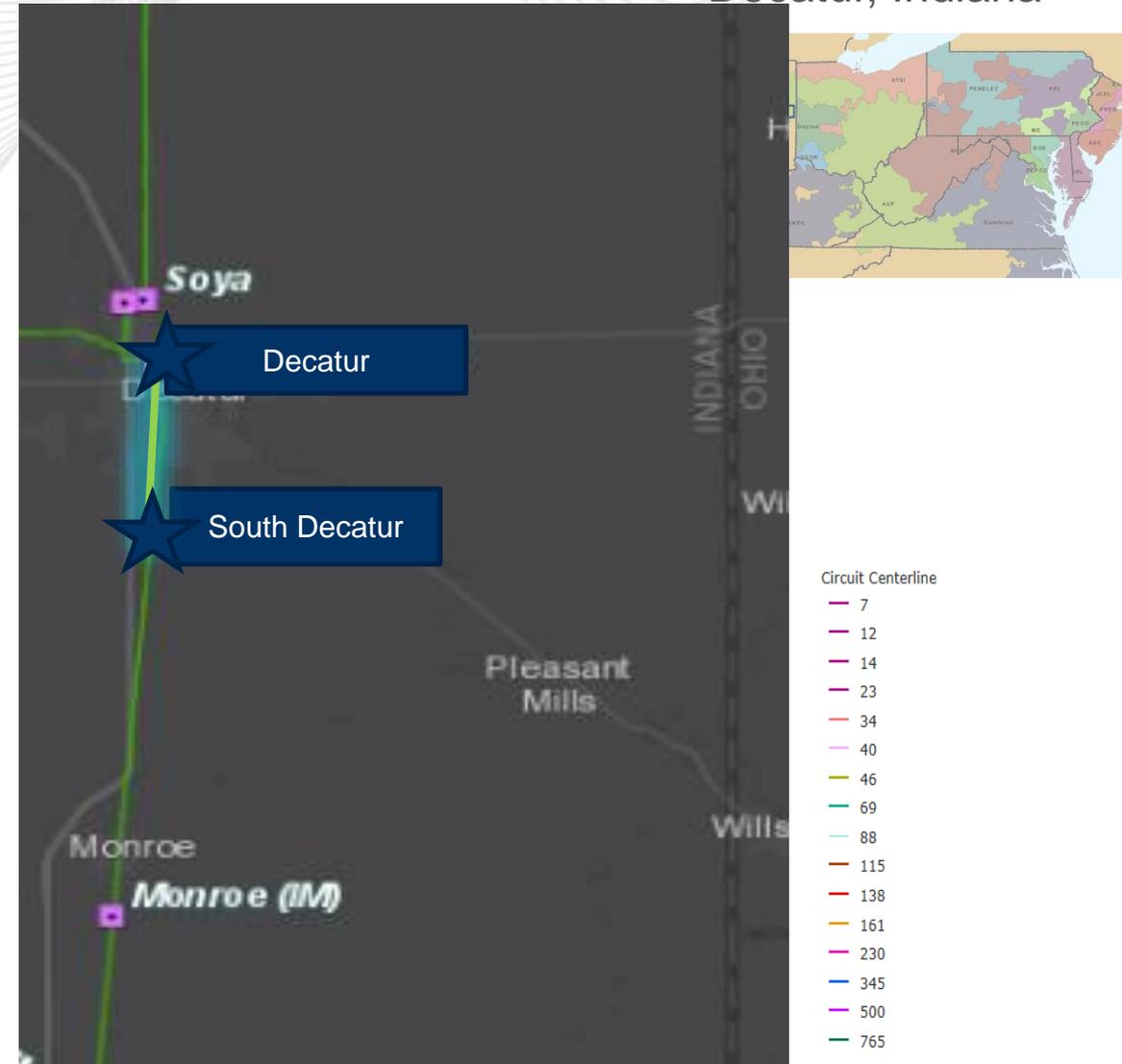
(B3149) Rebuild the 2.3 mile Decatur – South Decatur 69kV line using 556 ACSR in order to alleviate the overload.

Estimated Cost: \$9.3M

Required IS Date: 6/1/2024

Projected IS Date: 10/15/2021

Previously Presented: 11/22/2019



Process Stage: Recommended Solution

Criteria: TO Planning Criteria

Assumption Reference: FERC 715

Model Used for Analysis: 2024 RTEP Summer

Proposal Window Exclusion: FERC 715

Problem Statement:

For loss of Desoto – Jay 138kV and Magley – Allen 138kV, Hillcrest – Ferguson 69kV overloads to 107.7% of the 54MVA 4/0 CU conductor rating. The line is also overloaded for multiple other contingency pairs.

Existing Facility Rating: N/A

Preliminary Facility Rating: 323/451/408/506 MVA for SN/SE/WN/SE for 05BAER – Cut in point of the Aviation- Ellison Rd 138kV line

Recommended Solution:

Baer/Ferguson station

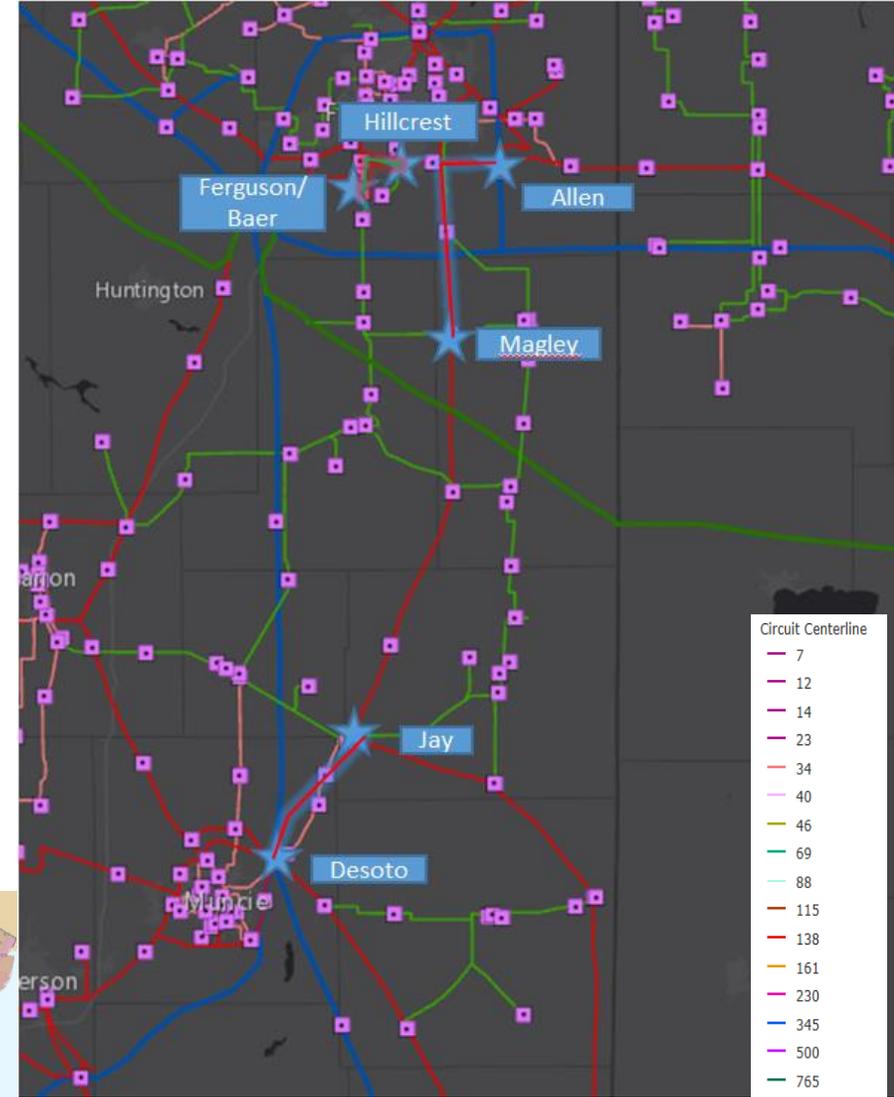
(B3150) Rebuild Ferguson 69/12kV station in the clear as the 138/12kV Baer station and connect it to a ~1 mile double circuit 138kV extension from the Aviation – Ellison Rd 138kV line to remove the load from the 69 kV line.

Total Estimated Transmission Cost: \$6.4M

Required IS Date: 6/01/2024

Projected IS Date: 10/1/2023

Previously Presented: 11/22/2019



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For the N-1-1 loss of Saturn – Columbia 138kV and Illinois Road 138/69 XFR (knocks out Illinois Road 69kV bus) the following issues occur:

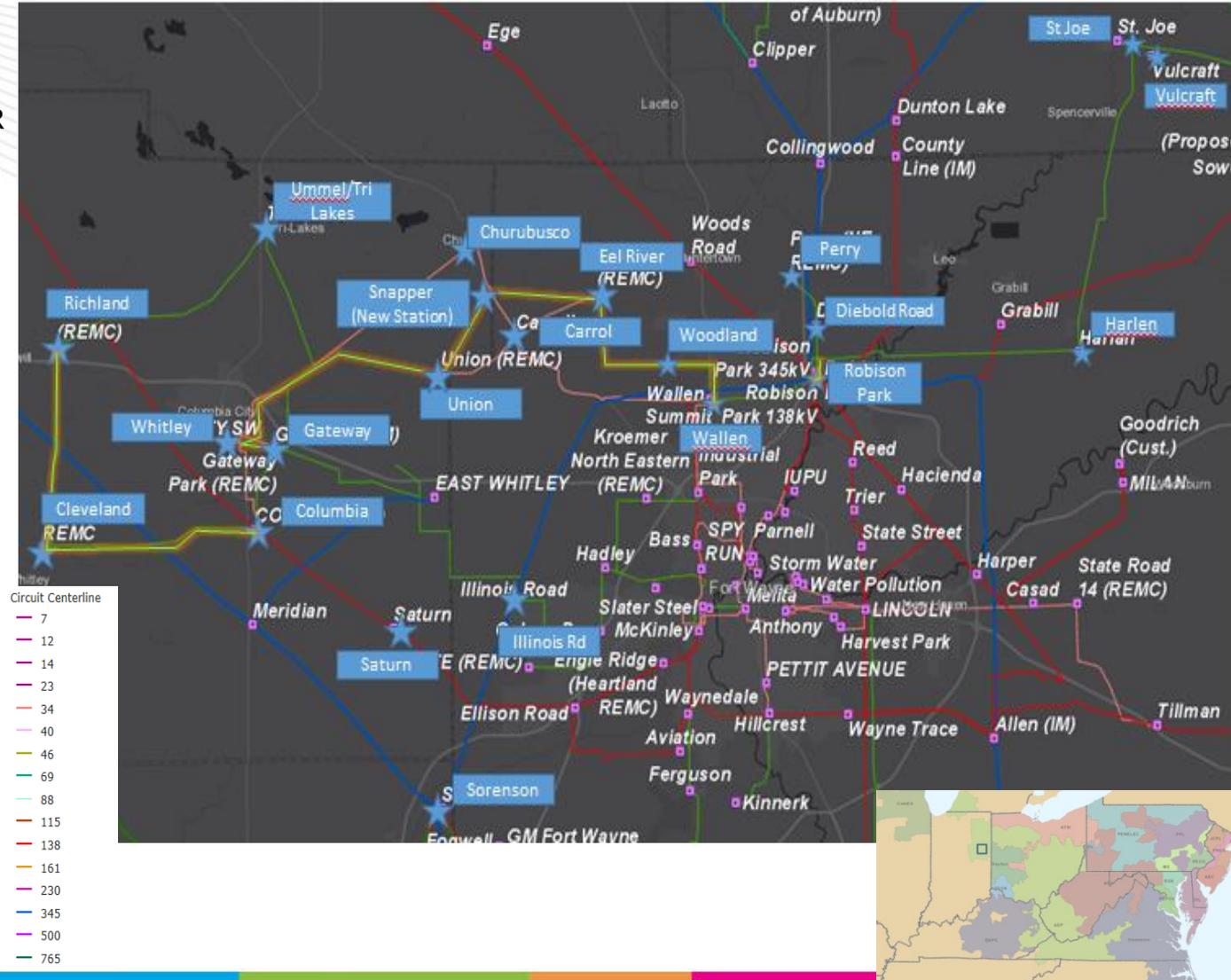
- 108.2% overload of the Carroll – Churubusco 34.5kV 17MVA limit (1/0 CU conductor); 103% overload of the 138/69kV XFR 2 at Columbia station.
- The area experiences voltage violations with voltages as low as .866 pu and voltage drops as high as 8.9% at the Whitley 34.5kV bus and affects the following load serving buses. Whitley 34.5kV, Ummel 69kV, Tri Lake 69kV, Richland 69kV, LincolnWay 69kV, Gateway 69kV, Cleveland 69kV and Churubusco 34.5kV

For the N-1 loss of Columbia 138kV breaker “D”:

- 132.4% overload of the Wallen – Carroll 34.5kV 17MVA limit (1/0 CU conductor);
- The Whitley 34.5 experiences a voltage of .906 with a Vdrop of 8.2%

For the N-1-1 loss of Rob Park 138/69/34.5kV XFR 4 and Wallen 138/69/34.5kV XFR 2 the following issues occur.

- 108.3% overload of the St Joe – Vulcraft 69kV 50MVA limit (4/0 ACSR)
- The area experiences voltage violations with voltages as low as .82 pu and voltage drops as high as 19.2% at the Perry 69kV bus and affects the following load serving buses. Perry 69kV, Woodland 69kV, Harlan 69kV and Diebold 69kV.



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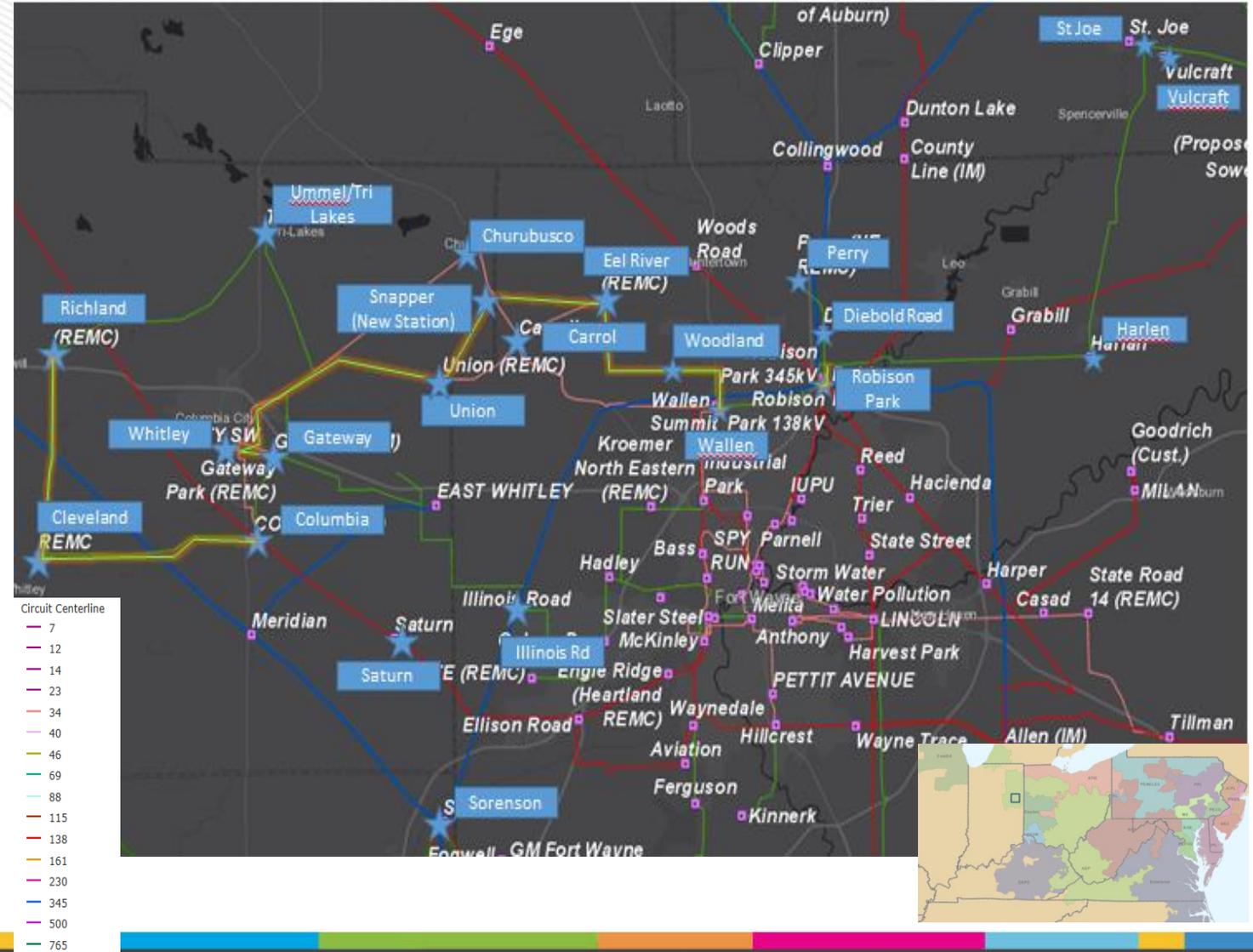
For the N-1-1 loss of Saturn – Sorenson 138kV and Gateway 69/34.5kV Transformer (knocks out the 69kV bus) the following issues occur:

- The area experiences voltage violations with voltages as low as .897 at Richland 69kV, Tri-Lake 69kV and Ummel 69kV

For the N-1-1 loss of Saturn – Sorenson 138kV and Columbia XFR 2 the following issue occurs:

- The Whitley bus drops to .906 PU

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Existing Facility Rating:

Gateway-Whitley 34.5kV circuit: 27/35/36/41 MVA for SN/SE/WN/WE

Whitley-Churubusco-Carroll-Wallen 34.5kV circuit: 17/17/24/24 for SN/SE/WN/WE

Columbia 138/69/34.5kV transformer: 67/74/67/74 MVA for SN/SE/WN/WE

Columbia – Gateway 69KV circuit: 75/75/94/94 MVA for SN/SE/WN/WE

Columbia – Cleveland – Richland 69KV circuit: 34/34/42/42 MVA for SN/SE/WN/WE

Diebold – Robison NP 69KV circuit: 50/50/63/63 MVA for SN/SE/WN/WE

Preliminary Facility Rating:

Gateway - Whitley – Union 8 SS – Snapper – Eel RV8 SS – Bobay SS - Wallen 69kV circuit: 102/102/129/129 MVA for SN/SE/WN/WE

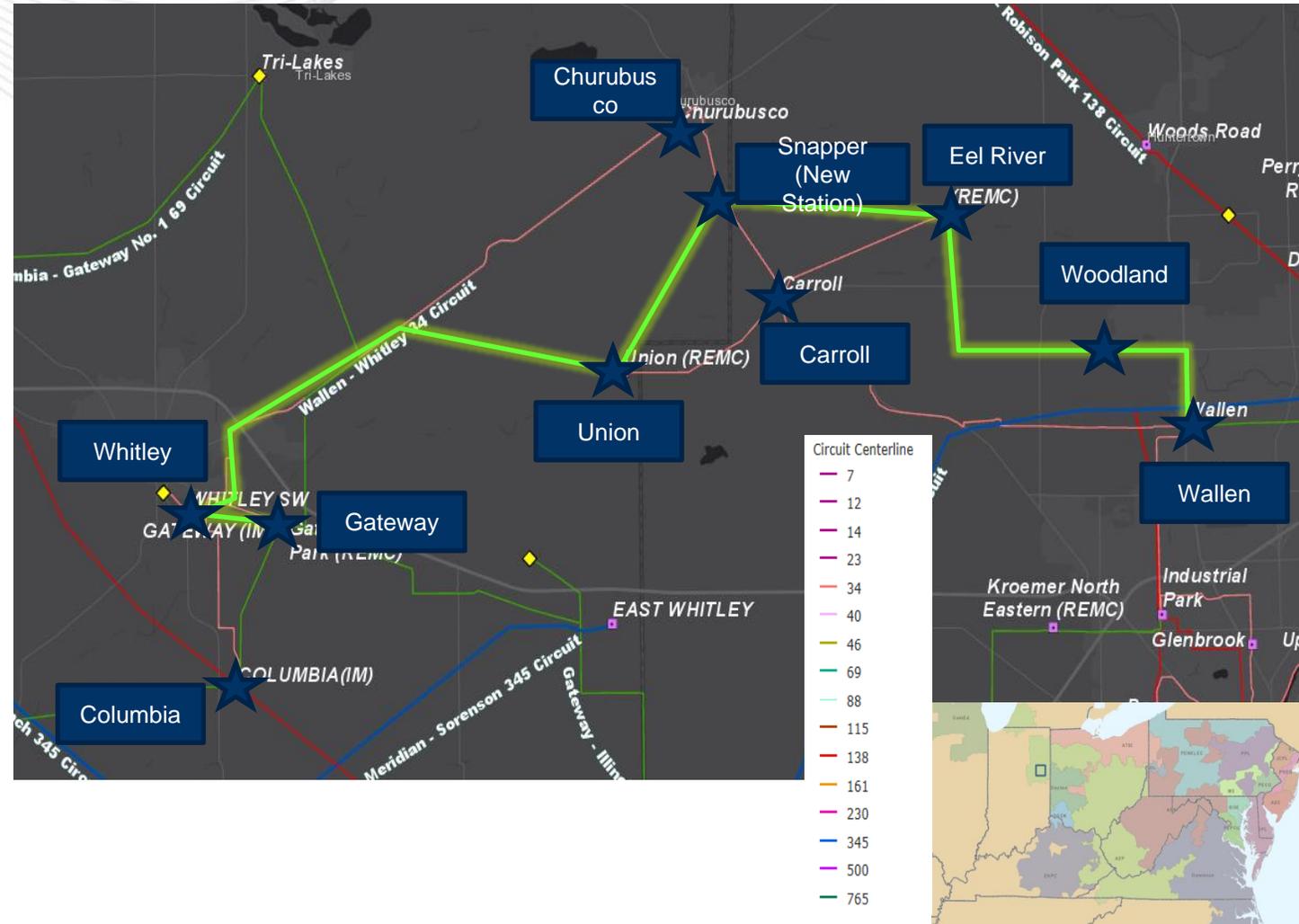
Columbia 138/69kV transformer #1 and #2: 90/90/90/90 MVA for SN/SE/WN/WE

Columbia – Gateway 69KV circuit: 102/102/129/129 MVA for SN/SE/WN/WE

Columbia – Cleveland – Richland 69KV circuit: 102/102/129/129 MVA for SN/SE/WN/WE

Diebold – Robison NP 69KV circuit: 102/102/129/129 MVA for SN/SE/WN/WE

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Recommended Solution:

(B3151.1) Rebuild the ~30 mile Gateway – Wallen 34.5kV circuit as the ~27 mile Gateway – Wallen 69kV circuit.

Estimated Cost: \$43.3M

(B3151.2) Retire the ~3 miles Columbia – Whitley 34.5kV line.

Estimated Cost: \$0.5M

(B3151.3) At Gateway station, remove all 34.5kV equipment and install a 69kV CB for the new Whitley line entrance.

Estimated Cost: \$1M

(B3151.4) Rebuild Whitley as a 69kV station with 2 line CB's and a bus tie CB. **Estimated Cost: \$4.2M**

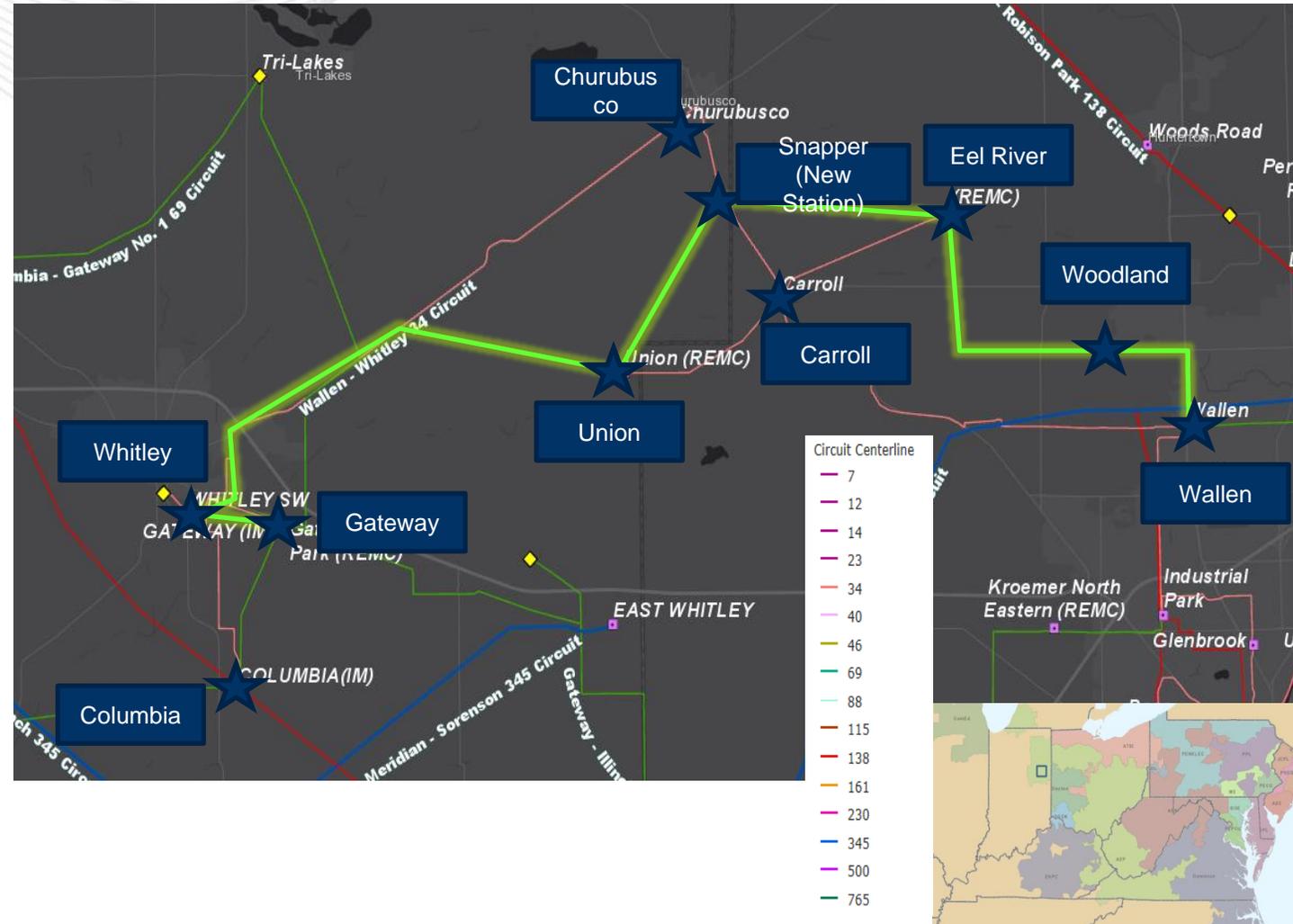
(B3151.5) Replace the Union 34.5kV Switch with a 69kV Switch structure. **Estimated Cost: \$0.6M**

(B3151.6) Replace the Eel River 34.5kV Switch with a 69kV Switch structure. **Estimated Cost: \$0.6M**

(B3151.7) Install a 69kV Bobay Sw at Woodland Station. **Estimated Cost: \$0.6M**

(B3151.8) Replace Carroll and Churubusco 34.5kV stations with the 69kV Snapper station. Snapper will have 2 line CB's, a bus tie CB and a 14.4 Mvar cap bank. **Estimated Cost: \$8.7M**

(B3151.9) Remove 34.5 kV CB AD at Wallen station. **Estimated Cost: \$0.3M**



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AEP Transmission Zone: Baseline Western Fort Wayne Improvements

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Proposed Solution:

(B3151.10) Rebuild the 2.5 mile Columbia – Gateway 69kV line.

Estimated Cost: \$6.2M

(B3151.11) Rebuild Columbia station in the clear as a 138/69kV station with 2 138/69kV XFR's and a 4 CB ring on the high and low side. Station will re-use breaker's 69kV breakers "J", "K" and 138kV breaker "D".

Estimated Cost: \$15M

(B3151.12) Rebuild the 13 mile Columbia – Richland 69kV line.

Estimated Cost: \$29.3M

(B3151.13) Rebuild the .5 mile Whitley – Columbia city 1 line as 69kV.

Estimated Cost: \$1.0M

(B3151.14) Rebuild the .5 mile Whitley – Columbia city 2 line as 69kV.

Estimated Cost: \$0.7M

(B3151.15) Rebuild the .6 mile double circuit section of the Rob Park – South Hicksville/Rob Park – Diebold Road as 69kV.

Estimated Cost: \$1.0M

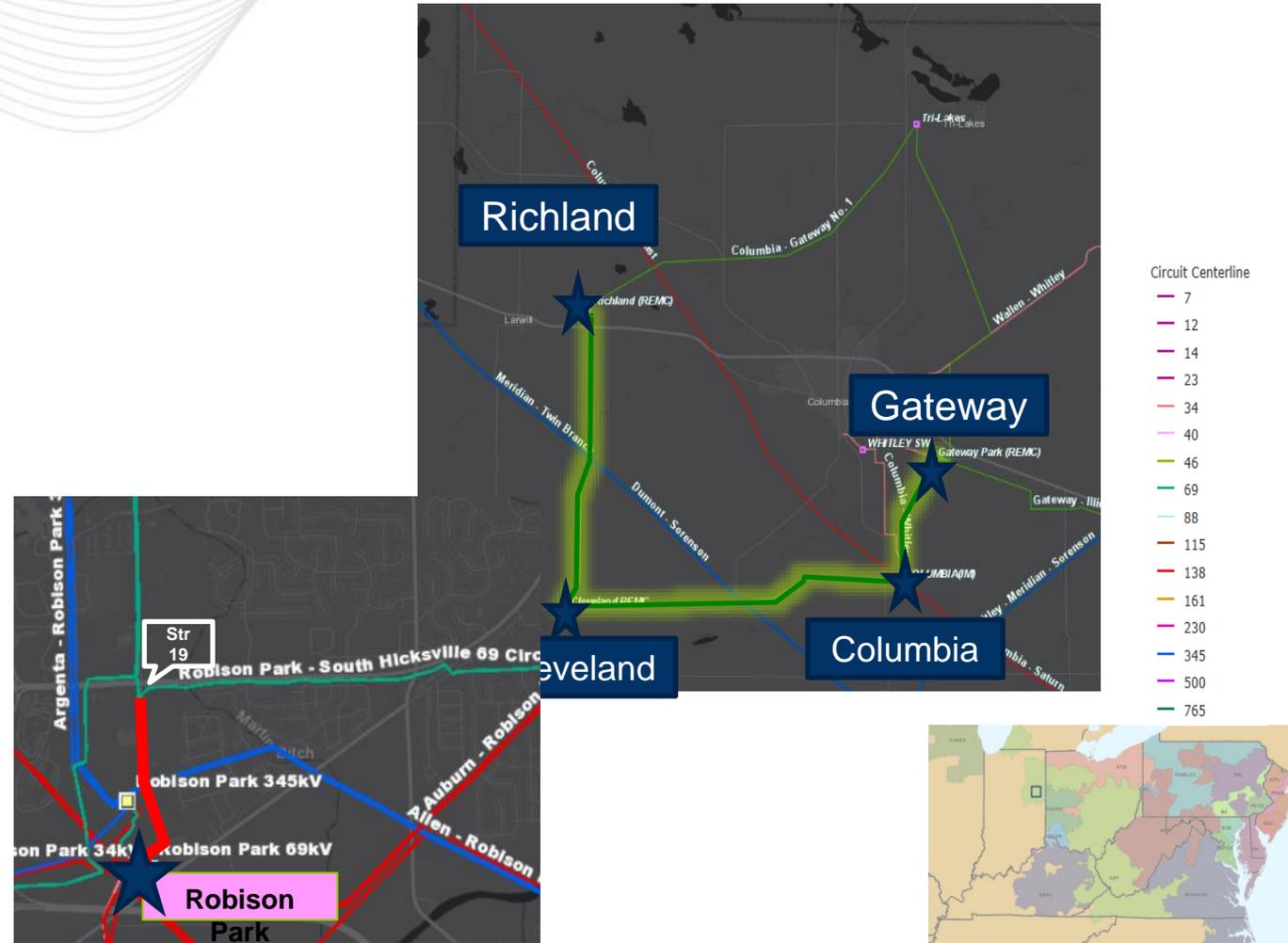
Total Estimated Transmission Cost: \$113M

Ancillary Benefits: This project addresses the asset renewal needs presented as need number AEP-2019-IM020 presented on 11/22/2019

Required In Service Date: 6/1/2024

Projected IS Date: 3/4/2022

Previously Presented: 11/22/2019





AMPT: Baseline Amherst

Process Stage: Recommended Solution

Criteria: TO Planning Criteria

Assumption Reference: FERC 715

Model Used for Analysis: RTEP 2024 Summer Base Case

Proposal Window Exclusion: FERC 715 (TO Criteria)

Problem Statement: Amherst #2 – Amherst #1 – Nordson Line Tap topology violates AMPT TO Criteria for Single point radial exposure (Currently 39.29 MW-mile, Limit is set to 30 MW-mile in AMPT TO guidelines). Note: ATSI-2019-004 (added to local plan 10/2019) revises the MW-Mile calculation, violation still valid)

Existing Facility Rating: N/A

Proposed Solution (B3153):

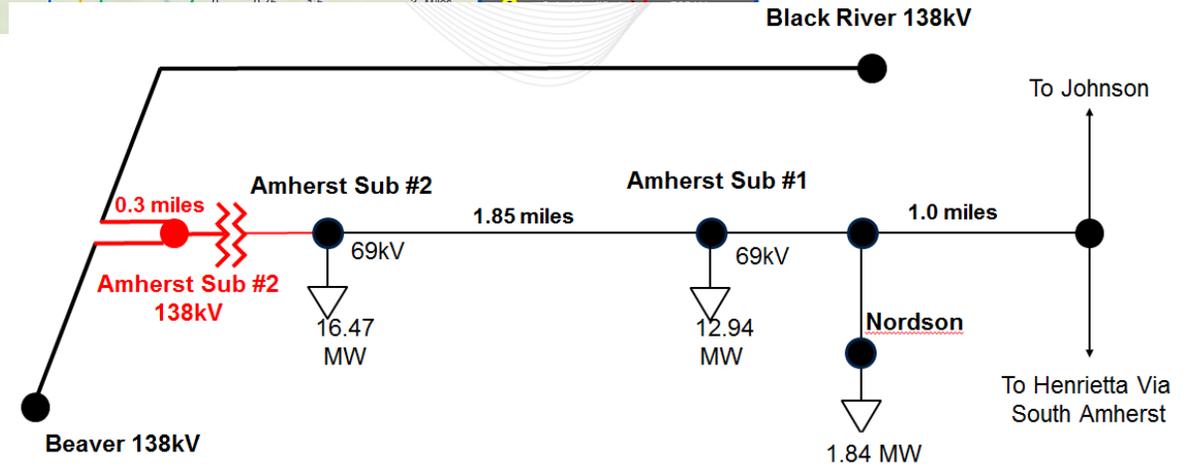
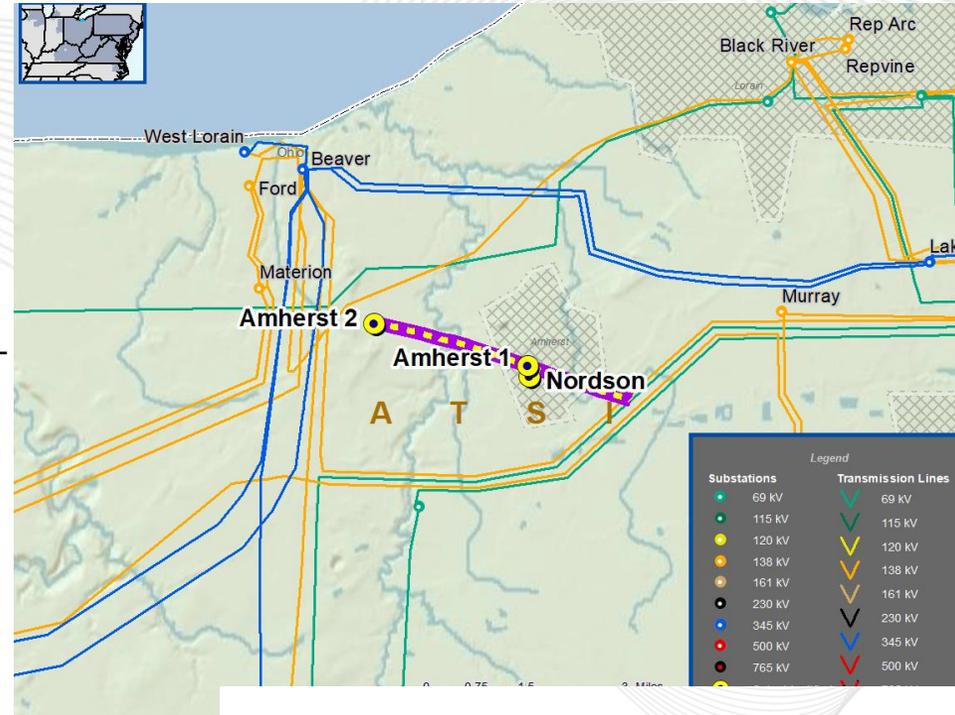
Construct a greenfield 0.3 mile 138kV double circuit line tapping the Beaver-Black River (ATSI) 138 kV line; Install five monopole 138kV double circuit steel structures with concrete foundations and string 1590 ACSR conductor. (\$1.3M)
 Expand the Amherst #2 Substation with the installation of three 138kV circuit breakers; one 138/69/12kV 130 MVA transformers; two 69kV circuit breaker (\$5.7M).
 Install One 69kV breaker towards Nordson (\$0.5M)

Estimated Cost: \$ 7.5M

Alternatives:

- 1) Rebuild existing 69 kV line to double ckt - \$9.6M
- 2) New Amherst 2 – South Amherst 69 kV line – \$10.7M
- 3) Same as proposed w/ different route - \$8.4M

Required In-Service: 6/1/2020





Penelc Transmission Zone: Baseline

Process Stage: Second Review

Previously Presented: 9/24/2019

Criteria: First Energy Planning Criteria Violation

Assumption Reference: FERC 715

Model Used for Analysis: 2019 Series 2024 Summer RTEP

Proposal Window Exclusion: Below 200 kV

Problem Statement:

The loss of the Yeagertown 230/46 kV transformer #4 causes low voltage violations at Yeagertown, Logan, Mcveytwn, Maitland, and Atknsn 46 kV stations, in the Winter study.

Recommended Solution:

Logan 46 kV Capacitor

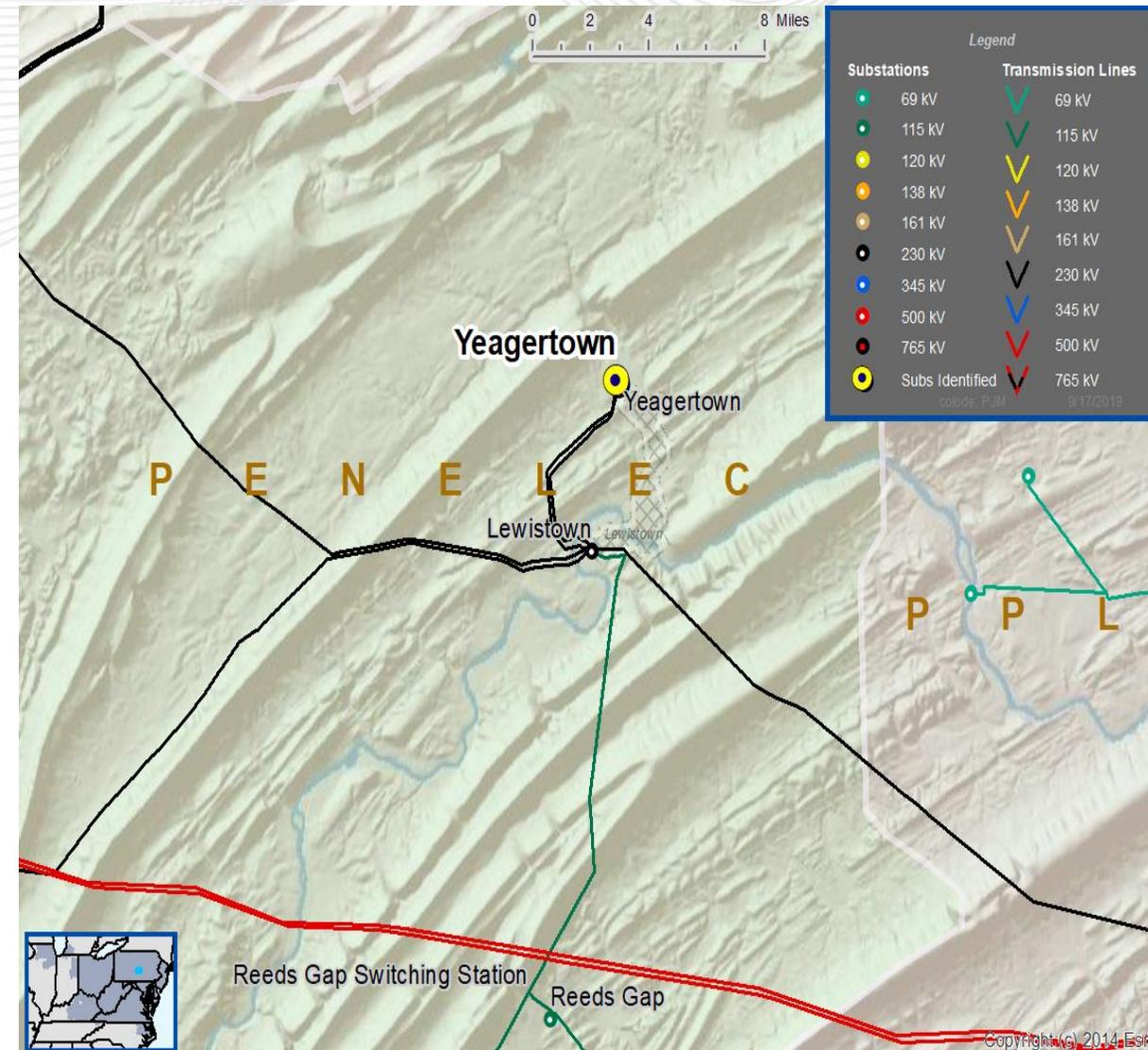
- Install one 13.2 MVAR 46 kV capacitor. **(B3154)**

Estimated Project Cost : \$1.7 M

Required In-Service Date: 6/1/2024

Projected In-Service Date: 6/1/2024

Status: Conceptual



Process Stage: Second Review

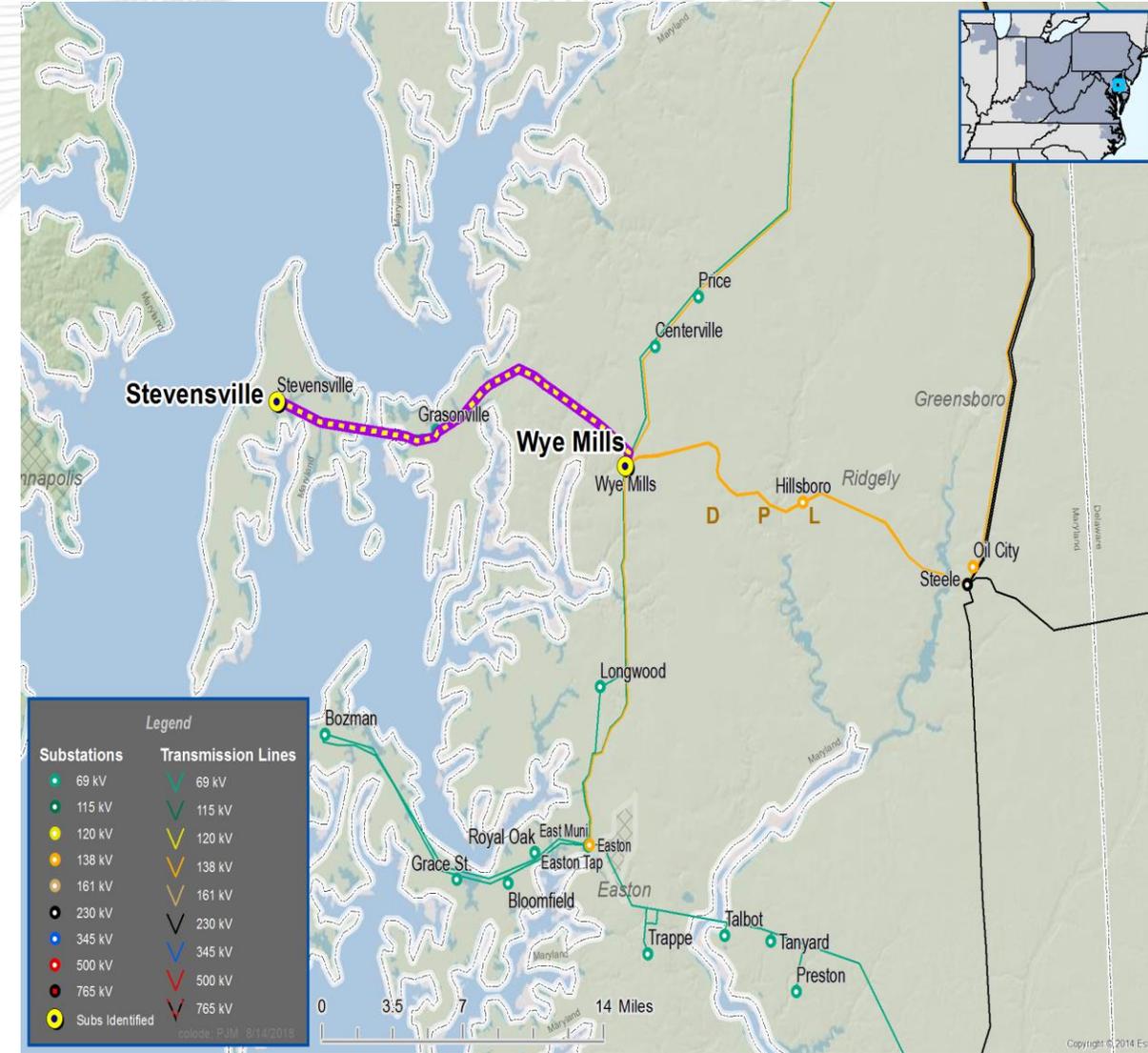
Previously Presented: 9/21/2018

Generation Deliverability (Winter)

Proposal Window Exclusion: Below 200 kV

Problem Statement:

- The Wye Mills – Stevensville 69 kV is overloaded for a single contingency loss of the Wye Mills to Grasonville 69 kV circuit. (FG# GD-W12). Existing Rating: 69N/90E MVA summer rating and 77N/102E MVA Winter rating.



Process Stage: Second Review

Previously Presented: 9/21/2018

Recommended Solution:

- Rebuild approximately 12 miles of Wye Mills – Stevensville 69 kV line to achieve needed ampacity. **(B3155)**
- New Rating: 92N/122E MVA summer rating and 121N/153E MVA winter rating.

Alternatives Considered:

- Install battery storage device at/near Grasonville Substation - \$25M+
 - Higher cost alternative
 - Does not provide adequate relief in the event of future load growth
- Construct new line from Wye Mills to Grasonville - \$30M
 - Higher cost alternative
 - Presents greater constructability concerns

Estimated Project Cost: \$15 M

Required IS Date: 12/1/2023

Expected IS Date: 3/31/2024

Status: Conceptual

