

Appendix: Previously Reviewed Baseline Upgrade Recommendations for the December 2021 PJM Board Review

Note: Items presented as second reads at the November 2021 TEAC will also be recommended for Board approval.

Changes for Existing Projects

Baseline Reliability Projects



2021 Acceleration Analysis

- Scope
 - Determine which Reliability upgrades, if any, have an economic benefit if accelerated or modified
- Study Years
 - 2022 and 2026 set of economic input assumptions used to study impacts of approved RTEP projects
- Process
 - Compare market congestion for near term vs. future topology
 - Estimate economic impact of accelerating planned reliability upgrades

- Finalized PROMOD modeling work for 2022 and 2026 (AS-IS topology) cases
- Completed PROMOD simulations
 - 2022 and 2026 study years with 2022 Topology (AS-IS Topology)
 - 2022 and 2026 study years with 2026 Topology (RTEP Topology)
- Compared the board approved reliability upgrades with the congestion reductions between the AS-IS and the RTEP Base cases



Acceleration Analysis: 2022 Load, Generation and Economic Assumptions

Congestion Decreases Associated With Approved Reliability Projects - 2022 Study Year			2022 Study Year			Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD
			2022 Topology	2026 Topology	Year 2022 Congestion (\$ Millions)			
Constraint Name	AREA	TYPE	Year 2022 Congestion (\$ Millions)	Year 2022 Congestion (\$ Millions)	Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD	
MORGAN - CHERRY RUN 138kV	APS	LINE	\$2.6	\$0.0	\$2.6	B3240: Upgrade Cherry Run and Morgan terminals	2025	
GORE - STONEWALL 138kV	APS	LINE	\$50.0	\$0.0	\$50.0	B3242: Reconfigure Stonewall 138 kV substation	2025	

Note: For a particular flowgate, the congestion savings for the 2022 study year are calculated as the difference in simulated congestion between the PROMOD case with AS-IS topology and the PROMOD case with the RTEP topology.



Acceleration Analysis: 2026 Load, Generation and Economic Assumptions

Congestion Decreases Associated With Approved Reliability Projects - 2026 Study Year			2026 Study year			Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD
			2022 Topology	2026 Topology	Year 2026 Congestion (\$ Millions)			
Constraint Name	AREA	TYPE	Year 2026 Congestion (\$ Millions)	Year 2026 Congestion (\$ Millions)	Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD	
MORGAN - CHERRY RUN 138kV	APS	LINE	\$6.6	\$0.0	\$6.6	B3240: Upgrade Cherry Run and Morgan terminals	2025	
GORE - STONEWALL 138kV	APS	LINE	\$51.3	\$0.0	\$51.3	B3242: Reconfigure Stonewall 138 kV substation	2025	

Note: For a particular flowgate, the congestion savings for the 2026 study year are calculated as the difference in simulated congestion between the PROMOD case with AS-IS topology and the PROMOD case with the RTEP topology.

- Acceleration analysis has been completed;
 - Project B3240, a \$0.23 million upgrade of terminal equipment on Morgan – Cherry Run 138 kV will be accelerated to June 2024 at no additional cost.
 - Project B3242, a \$13.3 million reconfiguration of the Stonewall 138 kV substation cannot be accelerated at this time.

Problem Statement: Generation Deliverability Violation – Zimmer Deactivation

- Thermal violation: Shepler Hill Jct – Mitchell 138 kV line
- Contingency: N-2

Recommended Solution:

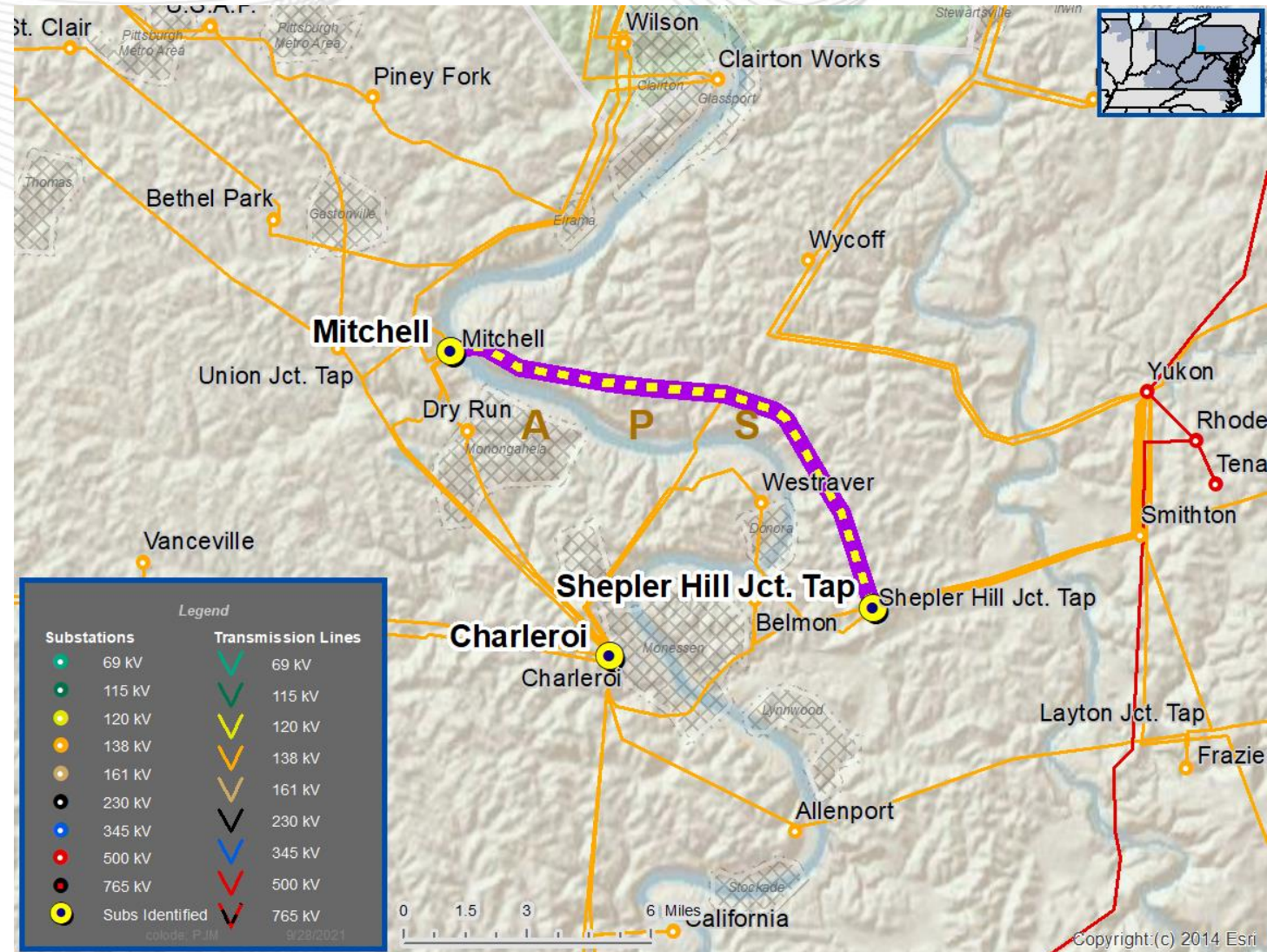
- Existing b3214 - Reconductor the Yukon – Smithton – Shepler Hill Jct 138 kV Line. Upgrade terminal equipment at Yukon and replace line relaying at Mitchell and Charleroi.

Required IS Date: 06/01/2022

Projected IS Date: 06/01/2023

Previous TEAC Date: 06/02/2020

* Operating measures identified to mitigate reliability impacts in interim.



Problem Statement: Generation Deliverability and N-1-1 thermal – Indian River 4 Deactivation

- Thermal violation: Vienna - Nelson 138 kV line
- Contingency: N-2, and various N-1 combinations

Potential Solution:

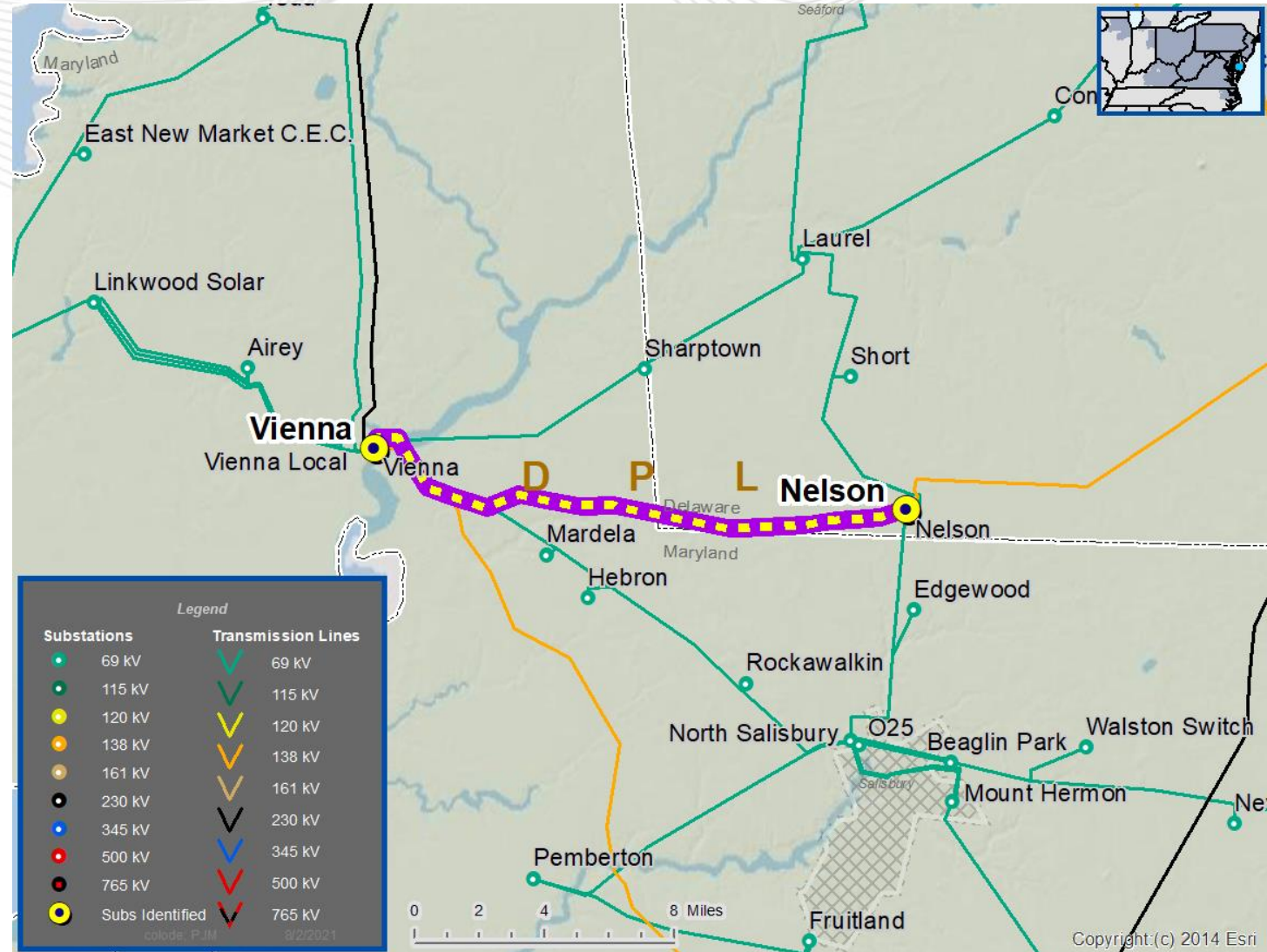
- New baseline b3326 – Rebuild the Vienna – Nelson 138 kV line.
- Current Rating: 101 MVA SN/ 144 MVA SE
- New Rating: 273 MVA SN/ 348 MVA SE

Estimated Cost: \$ 38.5M

Required IS Date: 06/01/2022

Projected IS Date: 12/31/2026

* Operating measures are not available in interim. PJM Planning / Operations and Transmission Owner are continuing to investigate mitigation.



Problem Statement: Generation Deliverability - Indian River 4 Deactivation

- Thermal violation: Vaughn – Kent 69 kV line
- Contingency: N-2

Potential Solution:

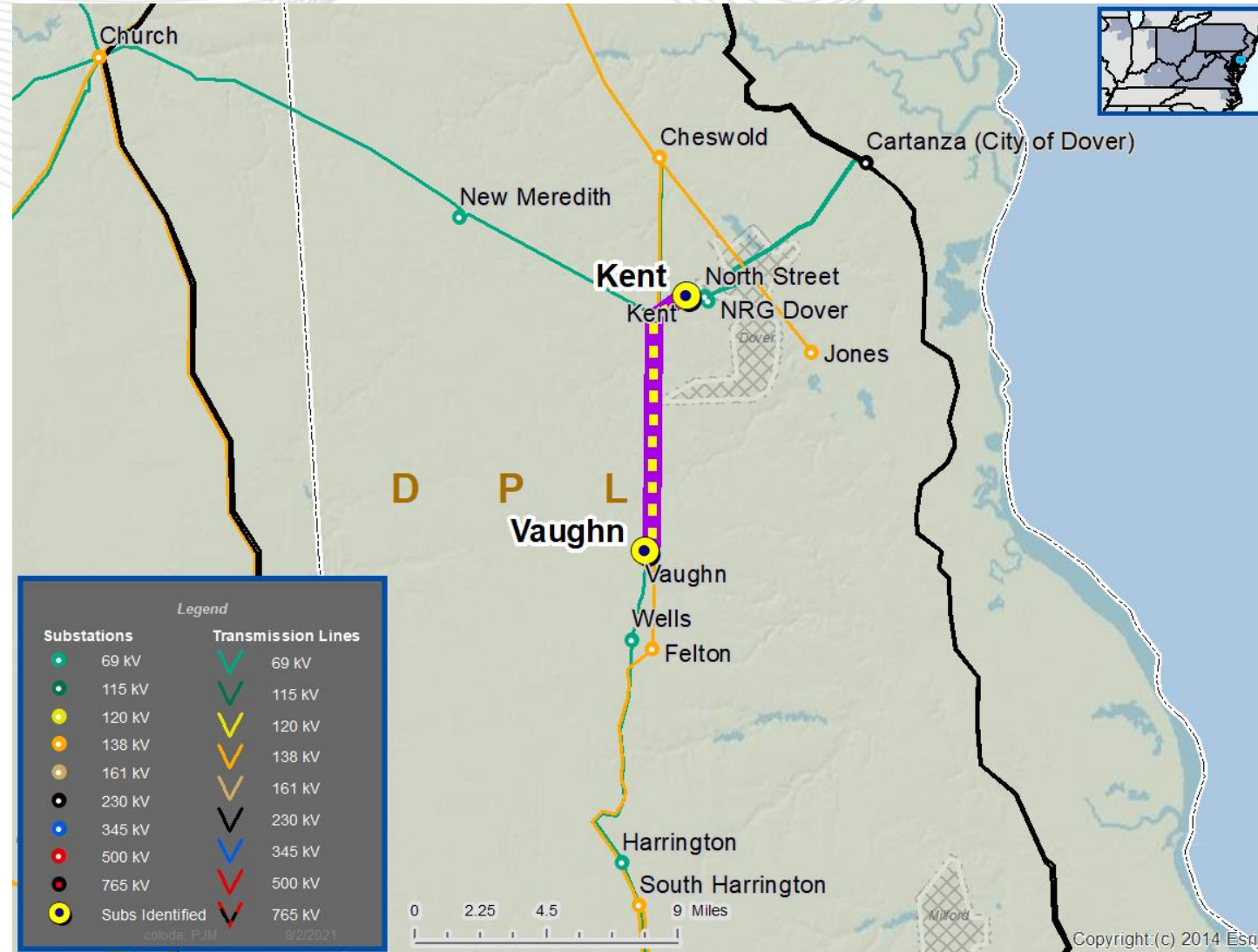
- New baseline b3327 – Upgrade the disconnect switch at Kent.
- Current Rating: 82 MVA SN/ 93 MVA SE
- New Rating: 136 MVA SN/ 165 MVA SE

Estimated Cost: \$ 0.25M

Required IS Date: 06/01/2022

Projected IS Date: 12/31/2022

* Operating measures are not available in interim. PJM Planning / Operations and Transmission Owner are continuing to investigate mitigation.



Problem Statement: N-1-1 Thermal Violation - Indian River 4 Deactivation

- Thermal violation: Vienna – Vienna 138 kV line
- Contingency: various N-1 combinations

Potential Solution:

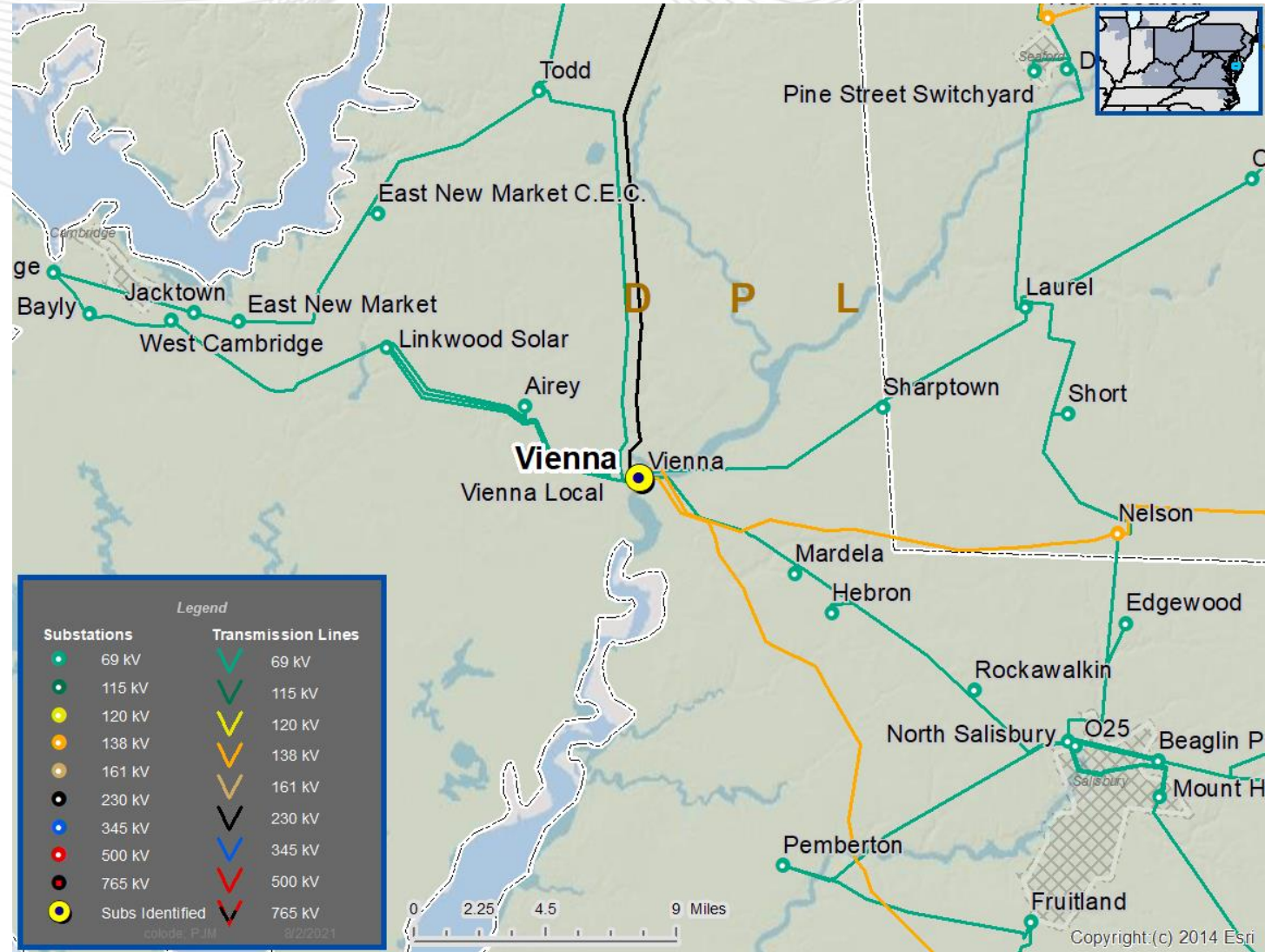
- New baseline b3328 – Upgrade the disconnect switch and CT
- Current Rating: 329 MVA SN/ 372 MVA SE
- New Rating: 392 MVA SN/ 458 MVA SE

Estimated Cost: \$ 0.25M

Required IS Date: 06/01/2022

Projected IS Date: 12/31/2022

* Operating measures are not available in interim. PJM Planning / Operations and Transmission Owner are continuing to investigate mitigation.





DPL Transmission Zone

Problem Statement: N-1-1 Thermal Violation - Indian River 4 Deactivation

- Thermal violation: Farmview – Milford 138 kV line
- Contingency: various N-1 combinations

Potential Solution:

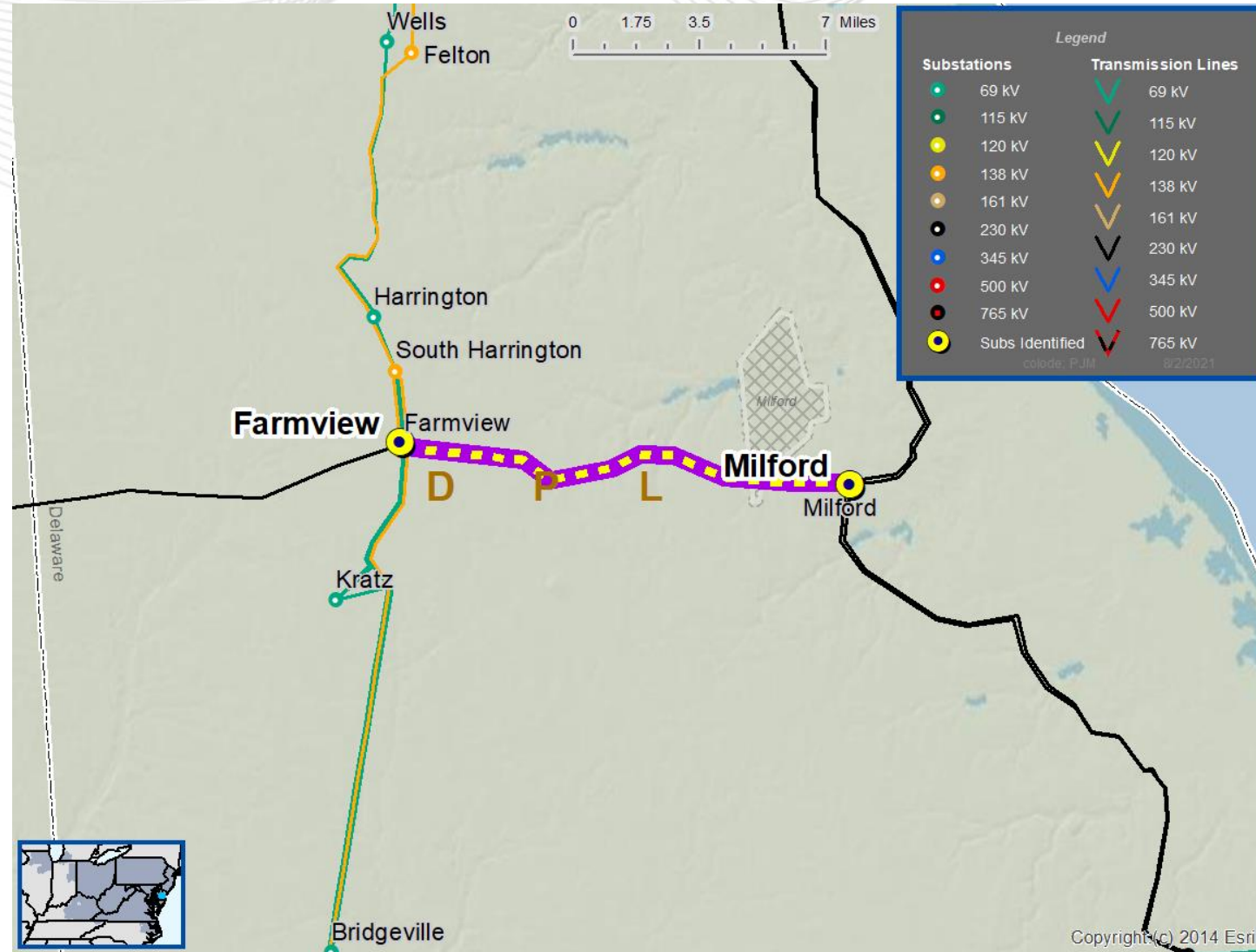
- New baseline b3329 – **Rerate the Farmview –Milford 138 kV line**
- Current Rating: 167 MVA SN/ 240 MVA SE
- New Rating: **218 MVA SN/ 292 MVA SE**

Estimated Cost: \$ 0.3M

Required IS Date: 06/01/2022

Projected IS Date: 12/31/2022

* Operating measures are not available in interim. PJM Planning / Operations and Transmission Owner are continuing to investigate mitigation.



Problem Statement: N-1-1 Thermal Violation - Indian River 4 Deactivation

- Thermal violation: Farmview – S. Harrington 138 kV line
- Contingency: various N-1 combinations

Potential Solution:

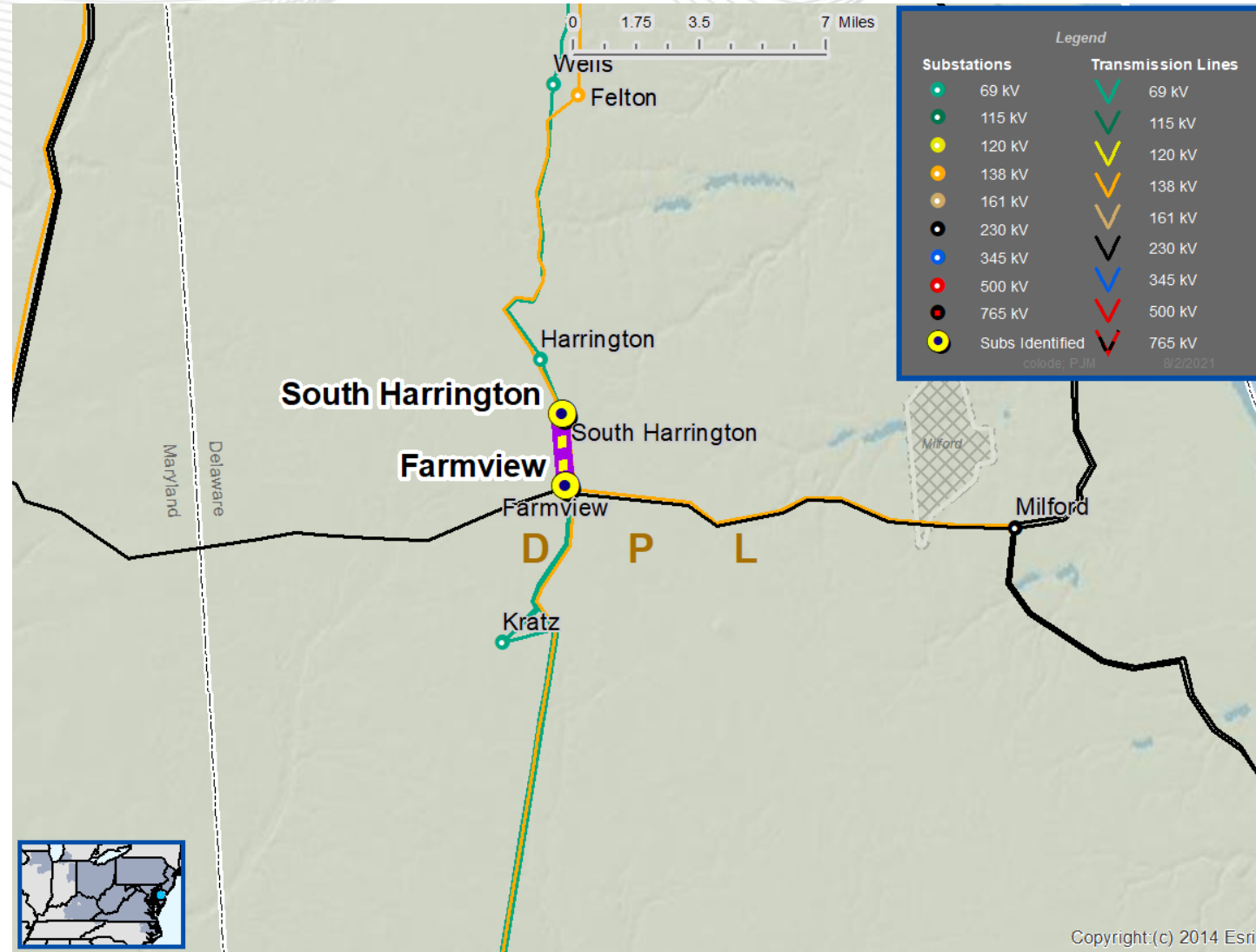
- New baseline b3330 – **Rerate the Farmview – S. Harrington 138 kV line**
- Current Rating: 167 MVA SN/ 242 MVA SE
- New Rating: **218 MVA SN/ 292 MVA SE**

Estimated Cost: \$ 0.25M

Required IS Date: 06/01/2022

Projected IS Date: 12/31/2022

* Operating measures are not available in interim. PJM Planning / Operations and Transmission Owner are continuing to investigate mitigation.



Problem Statement: N-1-1 Thermal Violation - Indian River 4 Deactivation

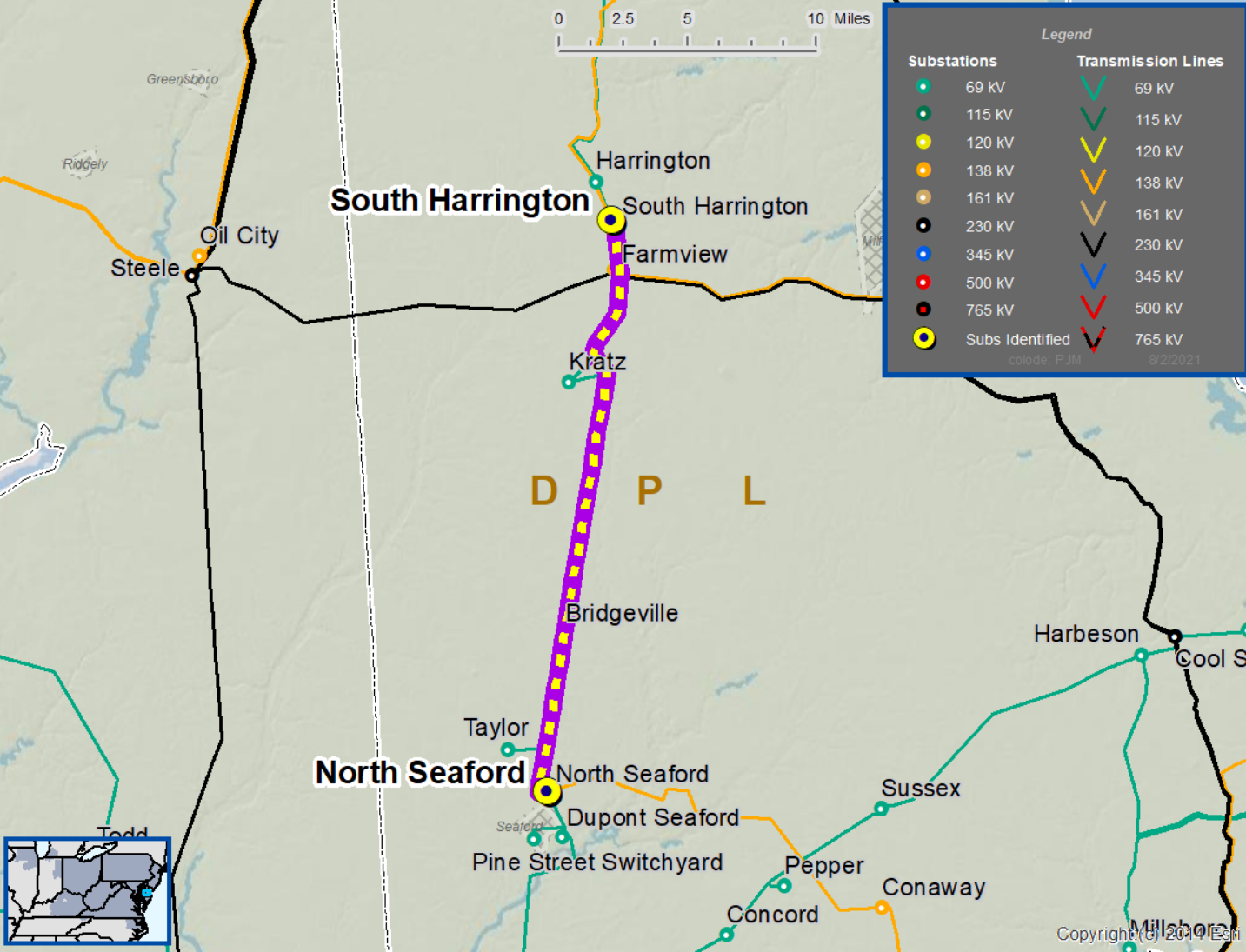
- Thermal violation: S. Harrington – North Seaford 138 kV line
- Contingency: various N-1 combinations

Potential Solution:

- New baseline b3331 – Upgrade stranded bus and relay at Seaford
- Current Rating: 183 MVA SN/ 247 MVA SE
- New Rating: 273 MVA SN/ 347 MVA SE

Estimated Cost: \$ 0.5M
Required IS Date: 06/01/2022
Projected IS Date: 12/31/2022

* Operating measures are not available in interim. PJM Planning / Operations and Transmission Owner are continuing to investigate mitigation.



Problem Statement: N-1-1 Thermal Violation - Indian River 4 Deactivation

- Thermal violation: Steel – Milford 230 kV line
- Contingency: various N-1 combinations

Potential Solution:

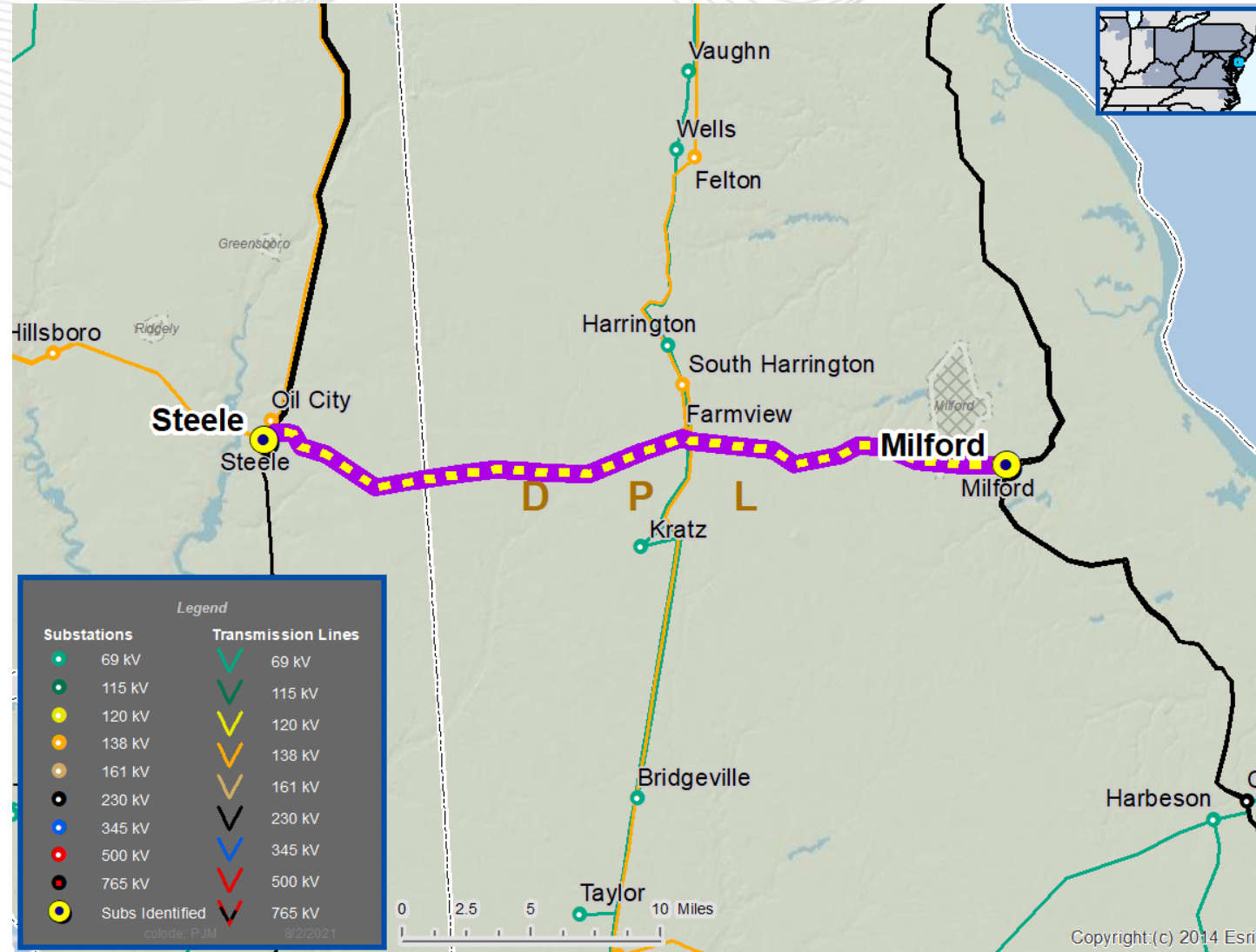
- New baseline **B3332 – Rerate the Steel – Milford 230 kV line**
- Current Rating: 395 MVA SN/ 552 MVA SE
- New Rating: 653 MVA SN/ 799 MVA SE

Estimated Cost: \$ **0.6M**

Required IS Date: 06/01/2022

Projected IS Date: **12/31/2022**

* Operating measures are not available in interim. PJM Planning / Operations and Transmission Owner are continuing to investigate mitigation.





AMPT Transmission Zone: Baseline Bowling Green (B3159) Scope Change

Previously Presented: 12/18/2019 SRRTEP, 1/17/2020 SRRTEP
(Changes are marked in Red)

Solution Criteria: TO Planning Criteria

Assumption Reference: AMPT FERC 715

Model Used for Analysis: RTEP 2024 Summer

Proposal Window Exclusion: FERC 715 (TO Criteria), Below 100kV

Problem Statement:

The transmission system in and around the area of Bowling Green (BG) OH, is currently arranged as a three source network. The sources are Midway – Grand Rapids 69kV, Brim - BG Sub 5 69kV, and Maclean – Pemberville 69kV. Thermal overloads and voltage violations (see next slide) have been identified on the 69kV in the area of bowling green and Pemberville during the N-1-1 loss of Brim – BG Substation #5 69kV line, combined with either the loss of the Midway – Grand Rapids 69kV or Maclean – Pemberville 69kV line.

Proposed Solution (B3159):

Establish a new 138/69kV substation. Install one 138kV circuit breaker, one 138/69kV 130 MVA Transformer, three 69kV circuit breakers. Construct a 0.15 mile 138kV 795 ACSR transmission line between the FE Brim 138/69kV substation and the newly proposed AMPT substation (three steel poles). Loop the BG Sub #5 – BG Sub #2 69kV line in and out of the newly established substation. **Complete the remote end terminal work at BG substations #2 and #5 to accommodate the new substation.**

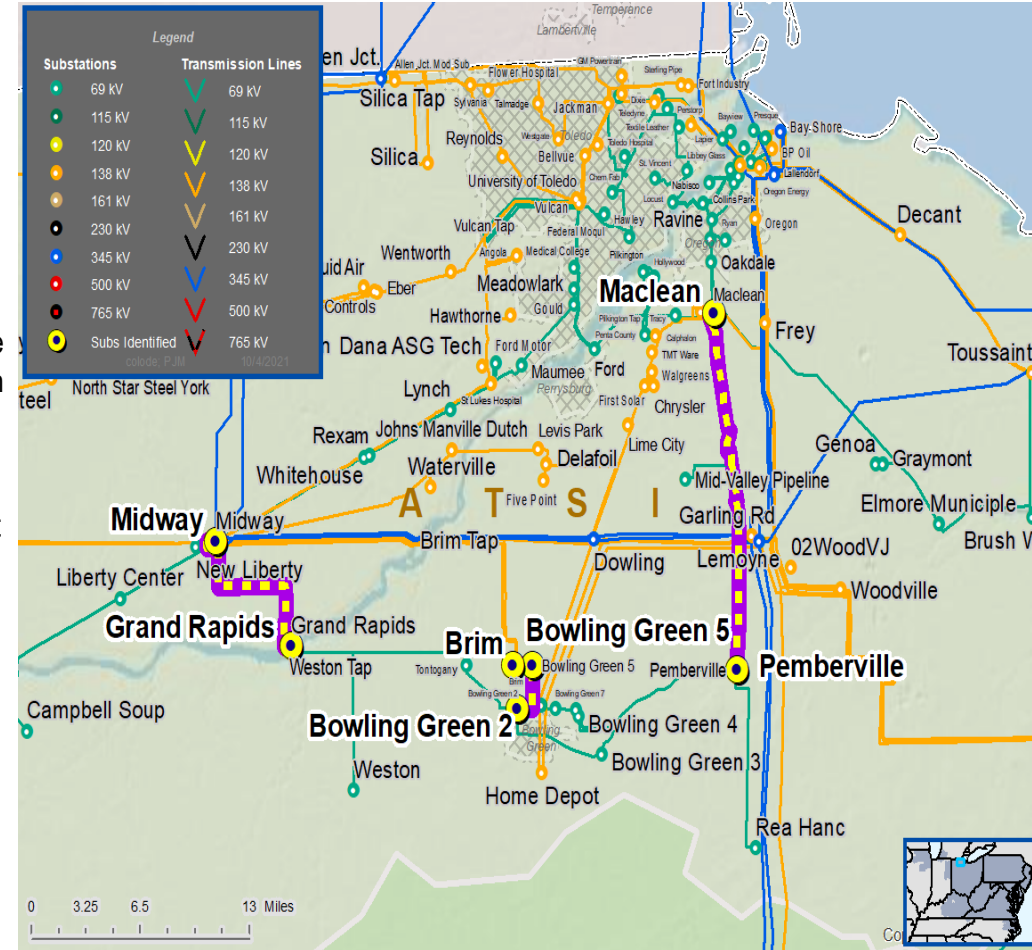
Reason for Revision: The original cost was a conceptual planning estimate and after more detailed engineering, has been determined to be low. Some costs were not originally included (remote end work), and others were based on industry guides that experience has now proven to be low. The latest estimated cost includes material escalation, and more detailed estimates of site-related costs, design, on-site construction support, internal labor, and contingency.

Total Estimated Transmission Baseline Cost: \$5.7M-\$ 10.1M

Required IS Date: 6/1/2024

Projected IS Date: 6/1/2022

Status: Construction



Recommended Solution

Baseline Reliability Projects

Problem Statement: Generation Deliverability Violation – Zimmer Deactivation

- Thermal violation: Benton – Riverside 138 kV line
- Contingency: N-2

Recommended Solution:

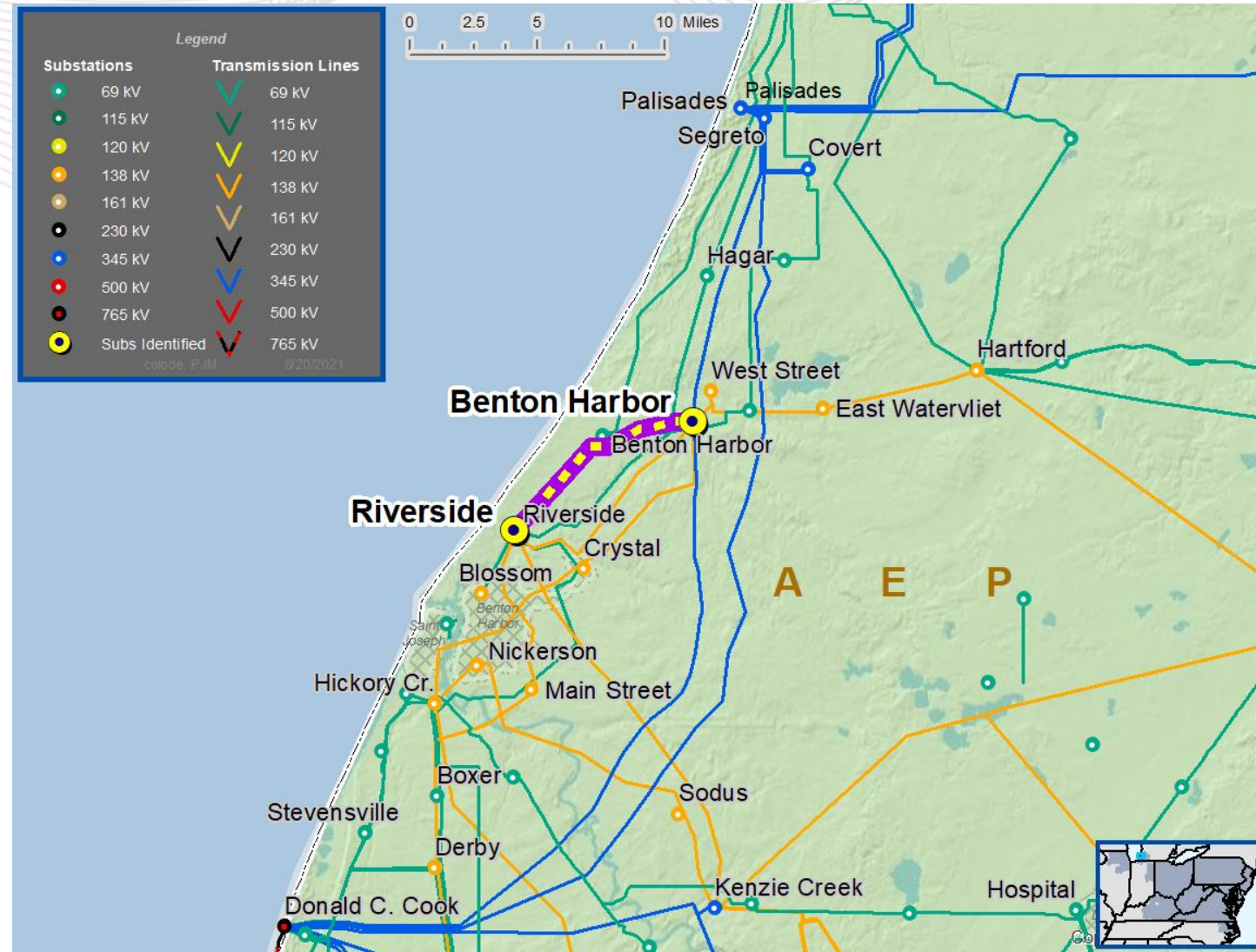
- New baseline b3336 – previously known as S1622.2: Rebuild Benton Harbor-Riverside 138kV double circuit extension (6 miles).
- Current Rating: 136 MVA SN/ 167 MVA SE
- New Rating: 187 MVA SN/ 240 MVA SE

Estimated Cost: \$14.9M

Required IS Date: 06/01/2022

Projected IS Date: 11/01/2021

Previous TEAC Date: 05/21/2018



Problem Statement: Generation Deliverability Violation – Zimmer Deactivation

- Thermal violation: Miami Fort – Hebron Tap 138 kV line
- Contingency: N-2

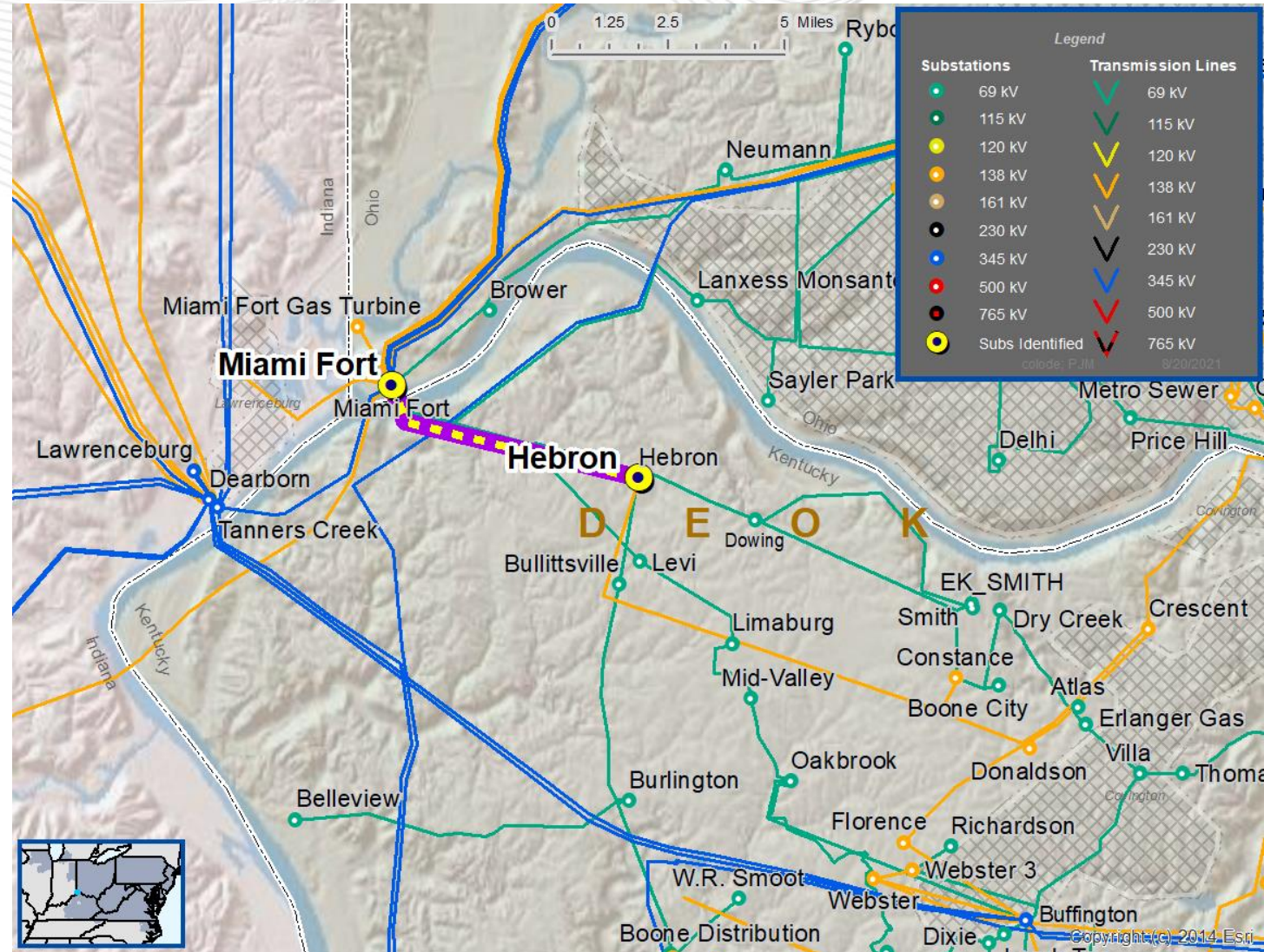
Recommended Solution:

- New baseline b3334 – Rebuild the section of Miami Fort – Hebron Tap 138 kV
- Current Rating: 238 MVA SN/ 238 MVA SE
- New Rating: 301 MVA SN/ 301 MVA SE

Required IS Date: 06/01/2022

Projected IS Date: 11/30/2026

Operating measures identified to mitigate reliability impacts in interim.





Dayton Transmission Zone: Baseline Marysville Reactive Support

Process Stage: Recommended Solution

Criteria: Dayton 715 Criteria

Assumption Reference: 2026 RTEP assumption

Model Used for Analysis: 2026 RTEP cases

Proposal Window Exclusion: Below 200 kV

Problem Statement:

FG: Dayton- VM1

In 2026 Summer RTEP case, low voltage violation at the Marysville 69kV bus is identified for a N-1 contingency.

Existing Facility Rating:

Branch	SN/SE/WN/WE (MVA)
09MARYSV -09WOODST 69KV	50/55/50/55





Dayton Transmission Zone: Baseline Marysville Reactive Support

Recommended Solution:

Marysville Substation: Install two 69kV 16.6 MVAR cap banks; Install five 69kV circuit breakers; Upgrade station relaying; Replace 600A wave trap on the Marysville -Kings Creek 69kV (6660) Circuit. Estimated Cost: \$2.43M (B3341.1)

Darby Substation: Upgrade remote end relaying at Darby substation
Estimated Cost: \$0.25M (B3341.2)

Kings Creek: Upgrade remote end relaying at Kings Creek Estimated Cost: \$0.25M (B3341.3)

*Replacement of 600A wave trap on the Marysville - Kings Creek 69kV (6660) circuit is required as part of the project since the additional breaker installation on the Marysville - Darby 69kV circuit would result in a N-1 thermal overload of the 600A wave trap.

Total Estimated Cost: \$2.93M

Preliminary Facility Rating:

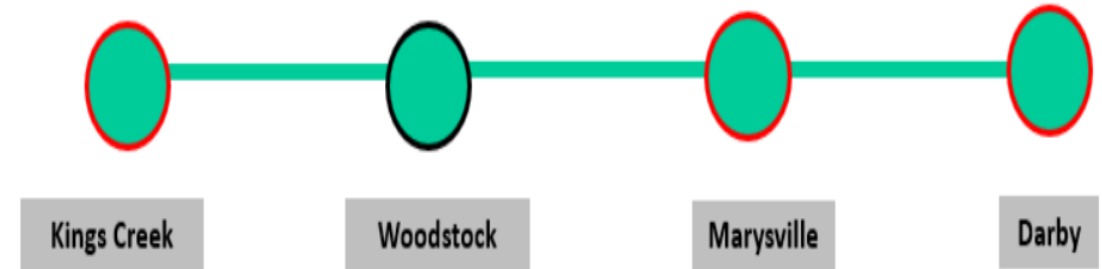
Branch	SN/SE/WN/WE (MVA)
09MARYSV -09WOODST 69KV	80/96/101/112

Alternatives: None

Required IS date: 6/1/2026

Projected IS date: 3/1/2026

Previously Presented: 9/17/2021





AEP Transmission Zone: Baseline

Kenny 138kV Breakers "102" and "106" Replacement

Process Stage: Recommended Solution

Criteria: Over Duty Breaker

Assumption Reference: 2026 RTEP assumption

Model Used for Analysis: 2026 short circuit model

Proposal Window Exclusion: Below 200kV

Problem Statement: Flowgates SC-3, SC-4

In 2026 RTEP short circuit model, Two (2) Kenny 138kV breakers are over duty: "102" (SC-3) and "106" (SC-4)

Existing Facility Rating: 2000A, 40 kA interrupting rating

Recommended Solution:

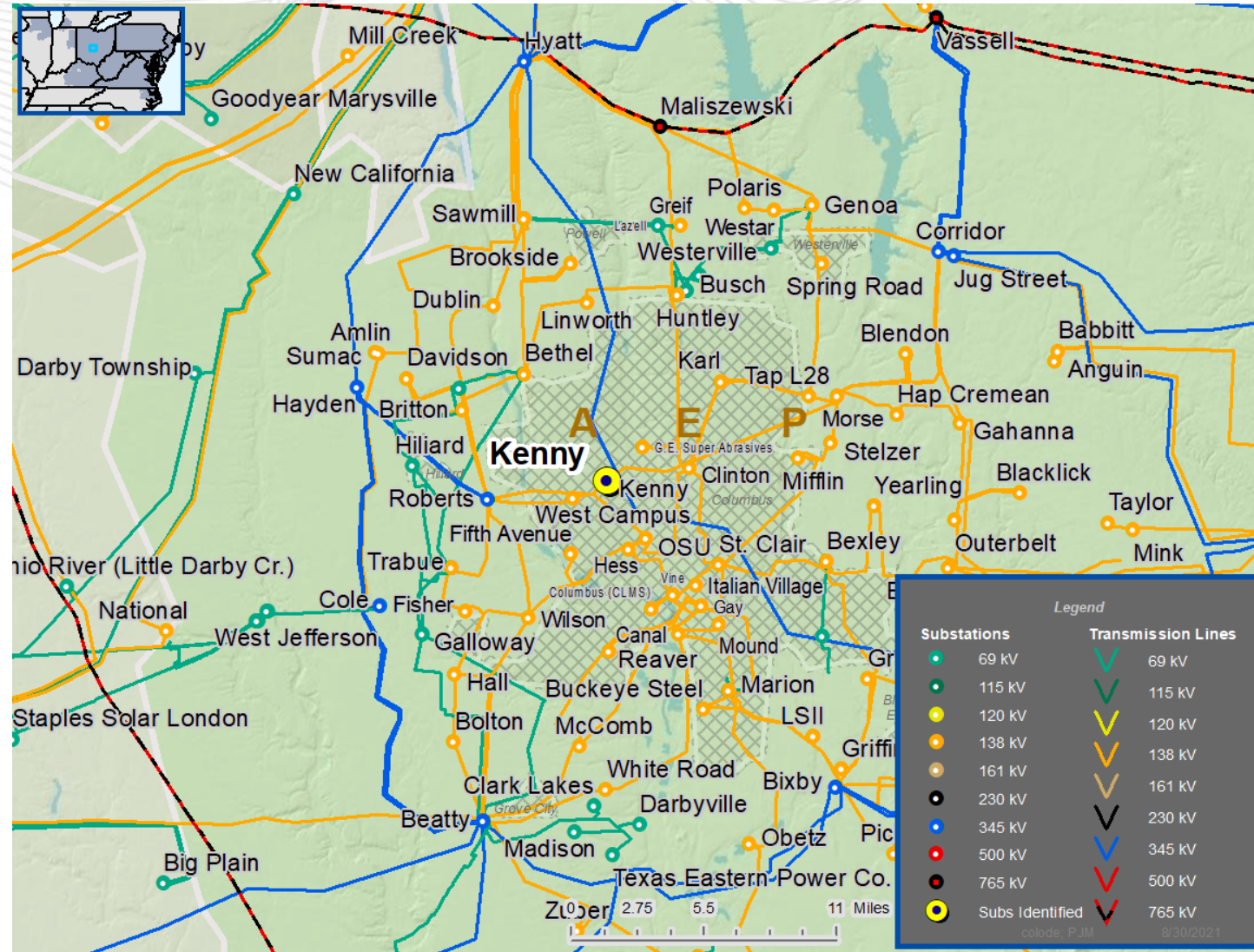
Replace the two (2) Kenny 138kV breakers, "102" (SC-3) and "106" (SC-4), each with a 3000A, 63 kA interrupting breaker (**B3338**)

Estimated Cost: \$0.76M Total or \$0.38M Each

Required In-Service: 6/1/2026

Projected In-Service: 9/1/2025

Previously Presented: 9/17/2021





AEP Transmission Zone: Baseline Canal 138kV Breaker "3" Replacement

Process Stage: Recommended Solution

Criteria: Over Duty Breaker

Assumption Reference: 2026 RTEP assumption

Model Used for Analysis: 2026 short circuit model

Proposal Window Exclusion: Below 200kV

Problem Statement: Flowgate SC-5

In 2026 RTEP short circuit model, One (1) Canal 138kV breaker is over duty: "3"

Existing Facility Rating: 3000A, 40 kA interrupting rating

Recommended Solution:

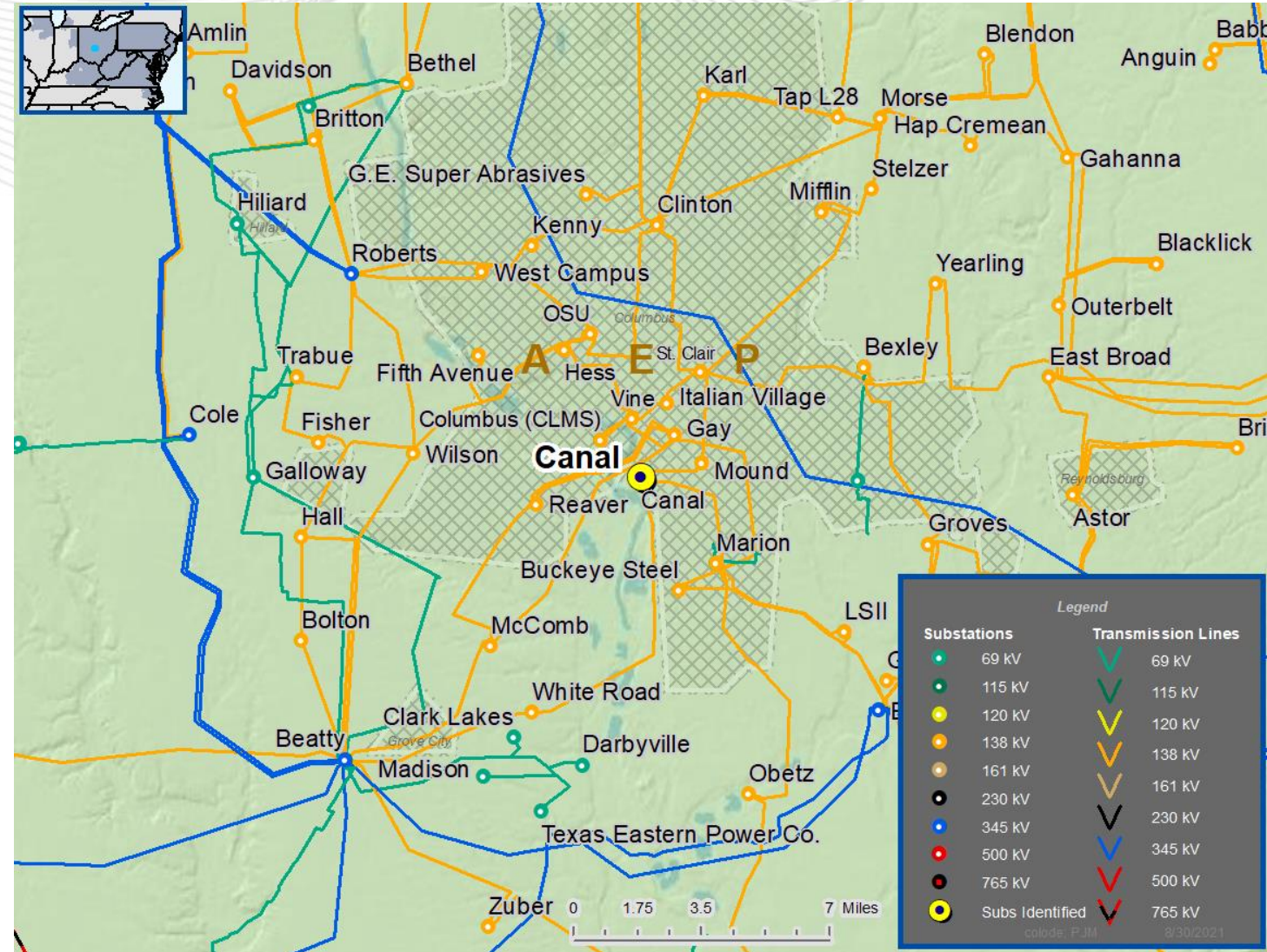
Replace the one (1) Canal 138kV breaker "3" with 3000A, 63 kA breaker (B3339)

Estimated Cost: \$0.48M

Required In-Service: 6/1/2026

Projected In-Service: 9/1/2025

Previously Presented: 9/17/2021





AEP Transmission Zone: Baseline Hyatt 138kV Breaker “101N” Replacement

Process Stage: Recommended Solution

Criteria: Over Duty Breaker

Assumption Reference: 2026 RTEP assumption

Model Used for Analysis: 2026 short circuit model

Proposal Window Exclusion: Below 200kV

Problem Statement: Flowgate SC-6

In 2026 RTEP short circuit model, One (1) Hyatt 138kV breaker is over duty: “AB1(101N)”

Existing Facility Rating: 3000A, 50 kA interrupting rating

Recommended Solution:

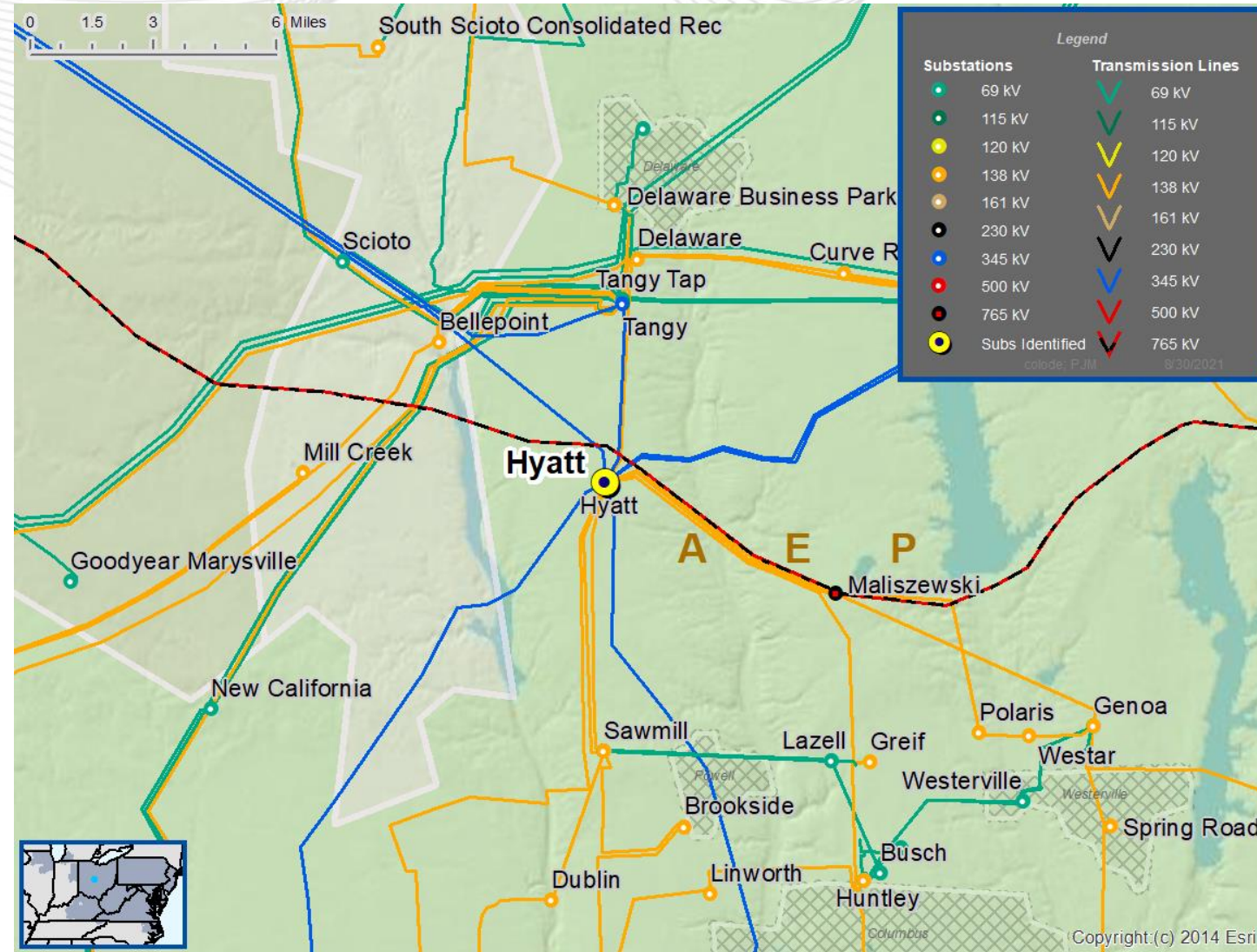
Replace the one (1) Hyatt 138kV breaker “AB1(101N)” with 3000A, 63 kA interrupting breaker (**B3337**)

Estimated Cost: \$0.48M

Required In-Service: 6/1/2026

Projected In-Service: 9/1/2025

Previously Presented: 9/17/2021



DLC Transmission Zone: Baseline Cheswick 138kV Breaker “Z-53 LF_3” Replacement

Process Stage: Recommended Solution

Criteria: Over Duty Breaker

Additional Benefits: N/A

Assumption Reference: 2026 RTEP Assumption

Model Used for Analysis: 2026 short circuit model

Proposal Window Exclusion: Below 200 kV

Problem Statement: Flowgate SC-1

Cheswick 138kV Substation:

In 2026 RTEP short circuit model, One (1) Cheswick 138kV breaker is over duty: “Z-53 LF_3”

Recommended Solution:

Replace one (1) Cheswick 138kV breaker with a 3000A, 63kA breaker:

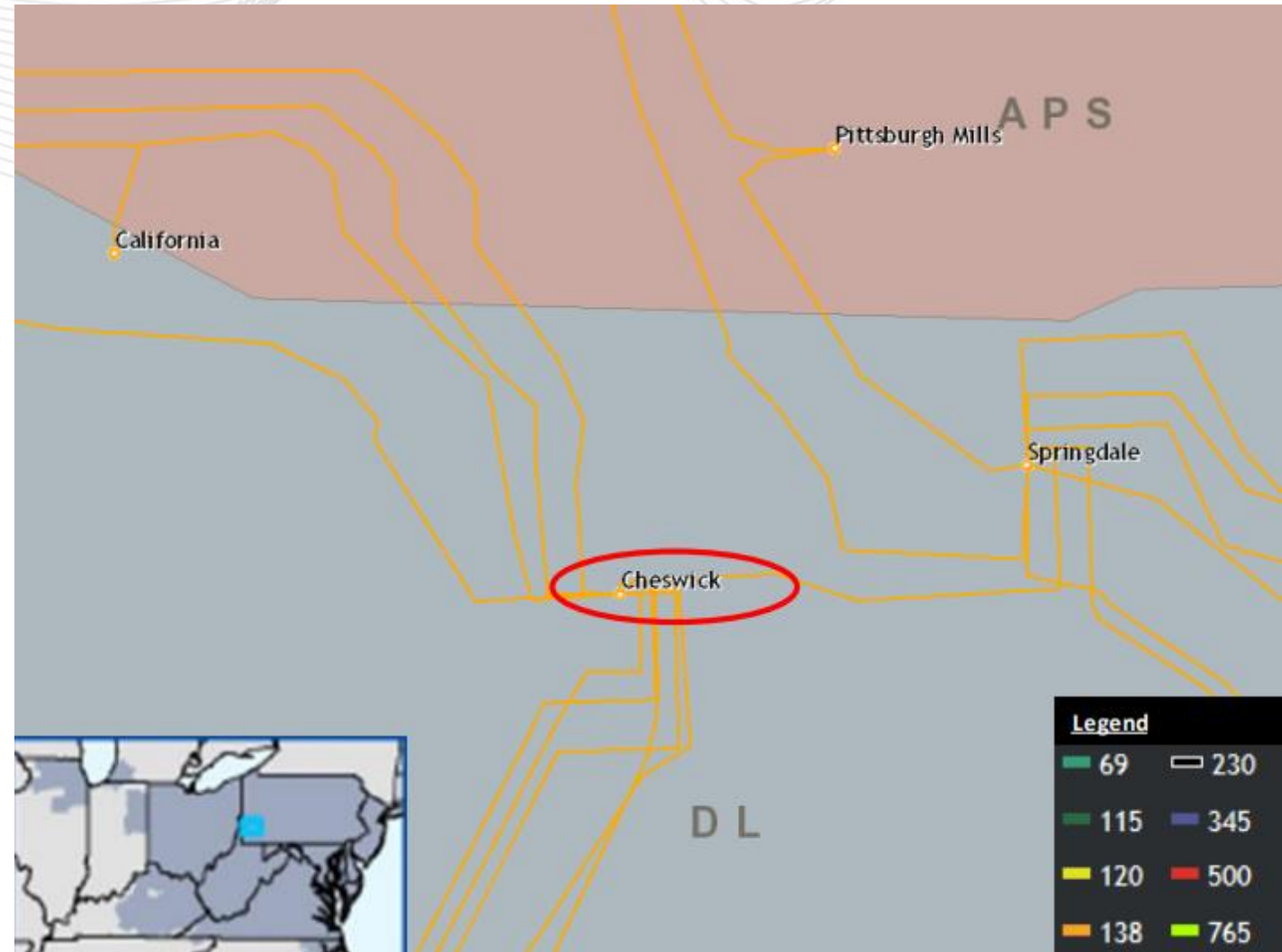
“Z-53 LF_3” . (B3340)

Estimated Cost: \$0.35 M

Required In-Service: 6/1/2026

Projected In-Service: 6/1/2026

Previously Presented: 9/17/2021



Problem Statement: Generation Deliverability – Avon Lake 9 and 10

- Thermal violation: Marquis 345/138 kV #3 transformer
- Contingency: N-2

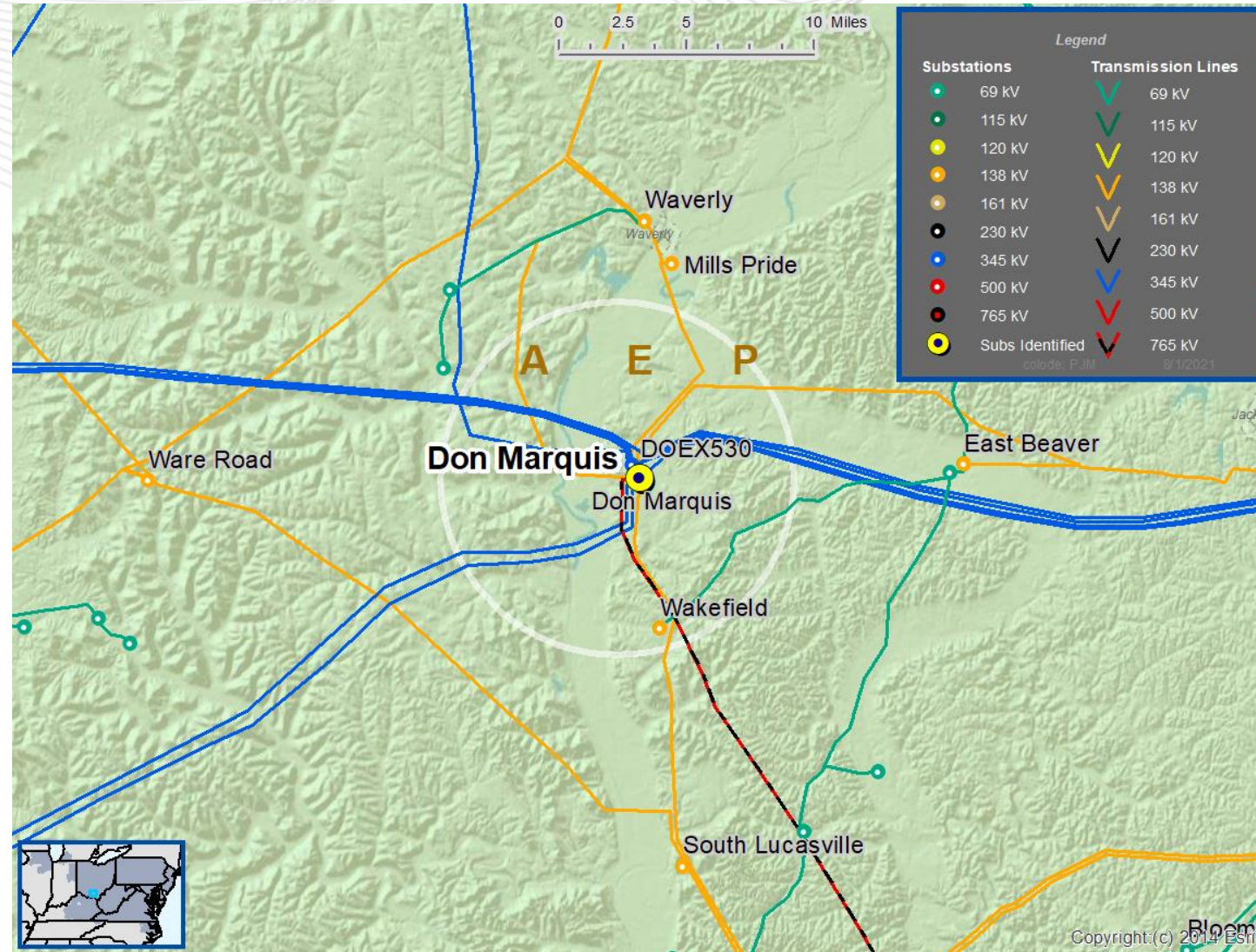
Recommended Solution:

- New baseline b3320 – Replacing CT at Don Marquis 345 kV
- Current Rating: 463 MVA SN/ 463 MVA SE
- New Rating: 501 MVA SN/ 564 MVA SE

Estimated Cost: \$ 80K

Required IS Date: 06/01/2022

Projected IS Date: 06/01/2022





Dominion Transmission Zone

Problem Statement: Generation Deliverability – Morgantown 1&2

- Thermal violation: Cranes Corner – Stafford 230 kV
- Contingency: N-1

Recommended Solution:

- New baseline b3321 – Rebuild Cranes Corner – Stafford 230 kV
- Current Rating: 722 MVA SN/ 722 MVA SE
- New Rating: 1047 MVA SN/ 1047 MVA SE

Estimated Cost: **\$ 19.6M**

Required IS Date: 06/01/2022

Projected IS Date: 12/31/2023

* Operating measures identified to mitigate reliability impacts in interim.

