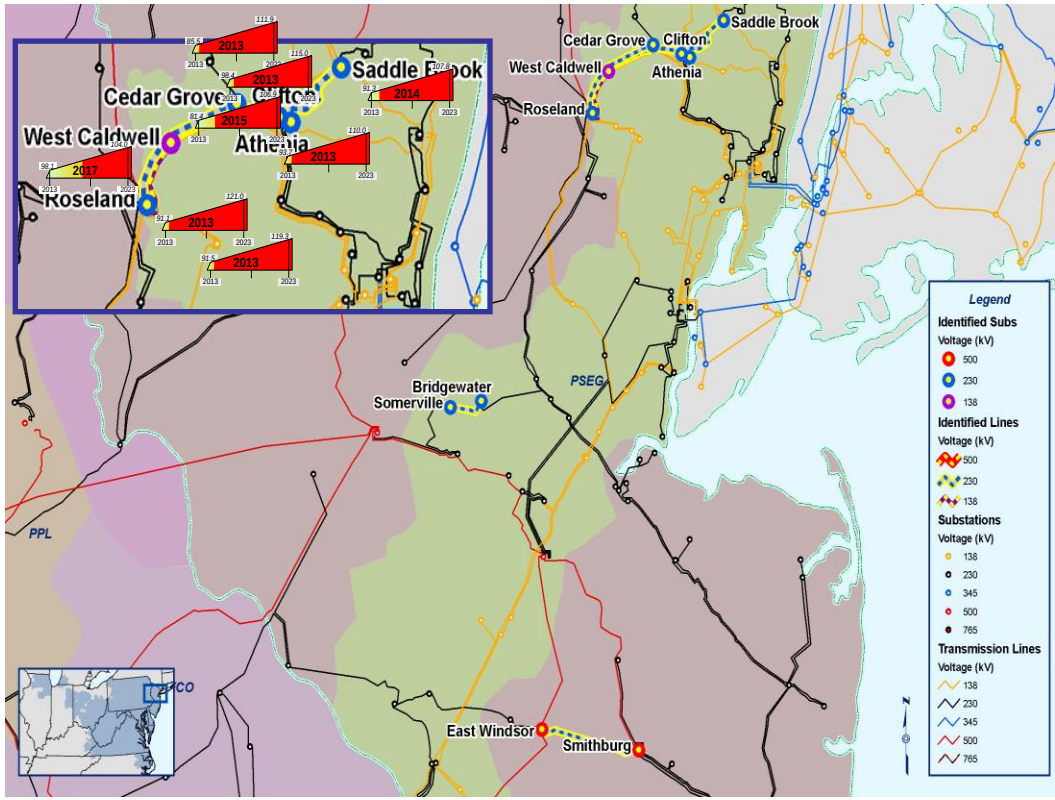
Reliability Analysis Update

TEAC Meeting

August 20, 2008

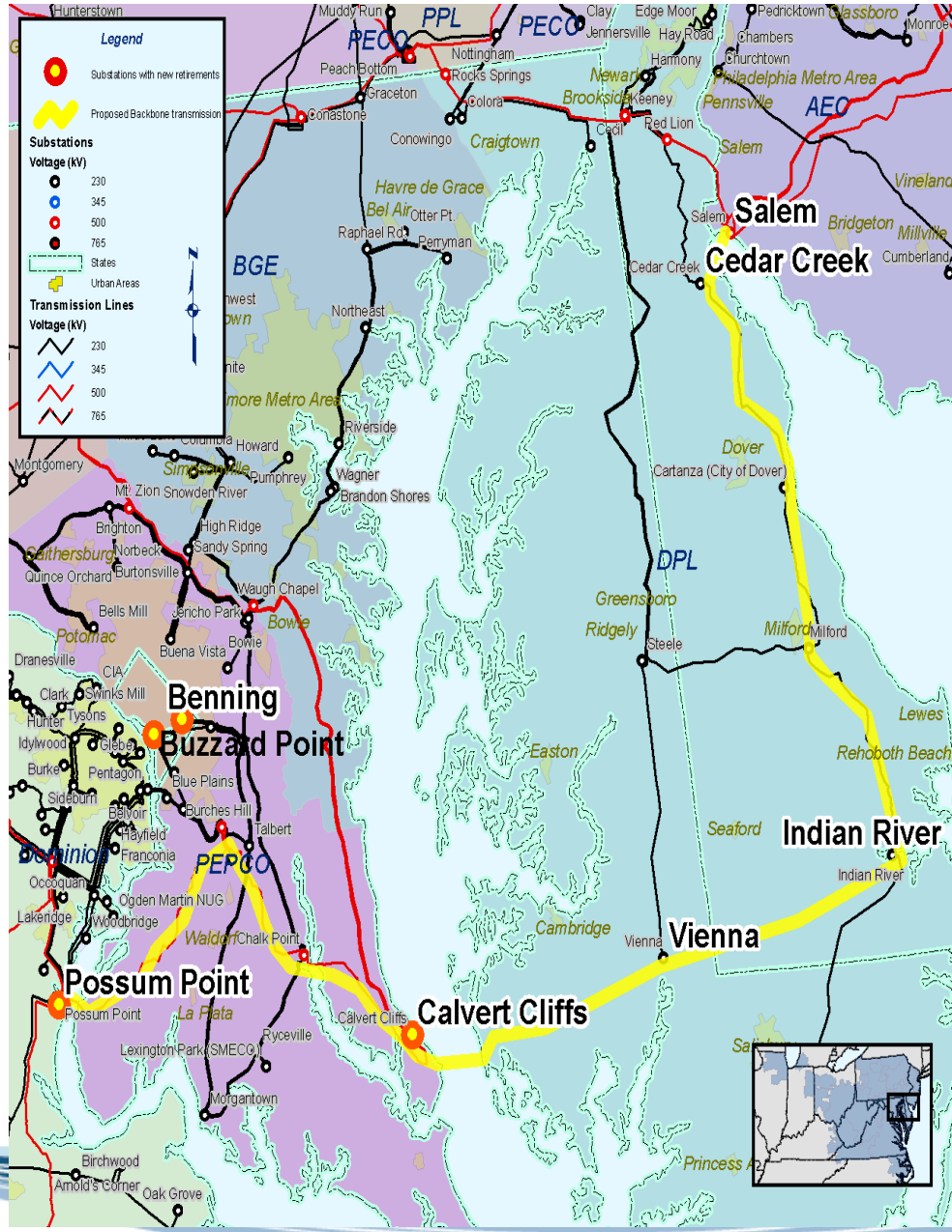
Northern New Jersey Update

- Two alternatives are being evaluated to address the issues identified in Northern New Jersey
  - 230 kV Option: rebuild several existing 138 kV lines and associated substations at 230 kV
  - 500 kV Option: extend a new 500 kV line from Branchburg to Roseland to Hudson along with some underlying 230 kV reinforcements
- PJM has hired an independent engineering firm to evaluate the cost, constructability and effectiveness of each option.
- Results of the study will be shared with stakeholders at a follow-up TEAC meeting



Mid-Atlantic Power Pathway (MAPP) Project Update

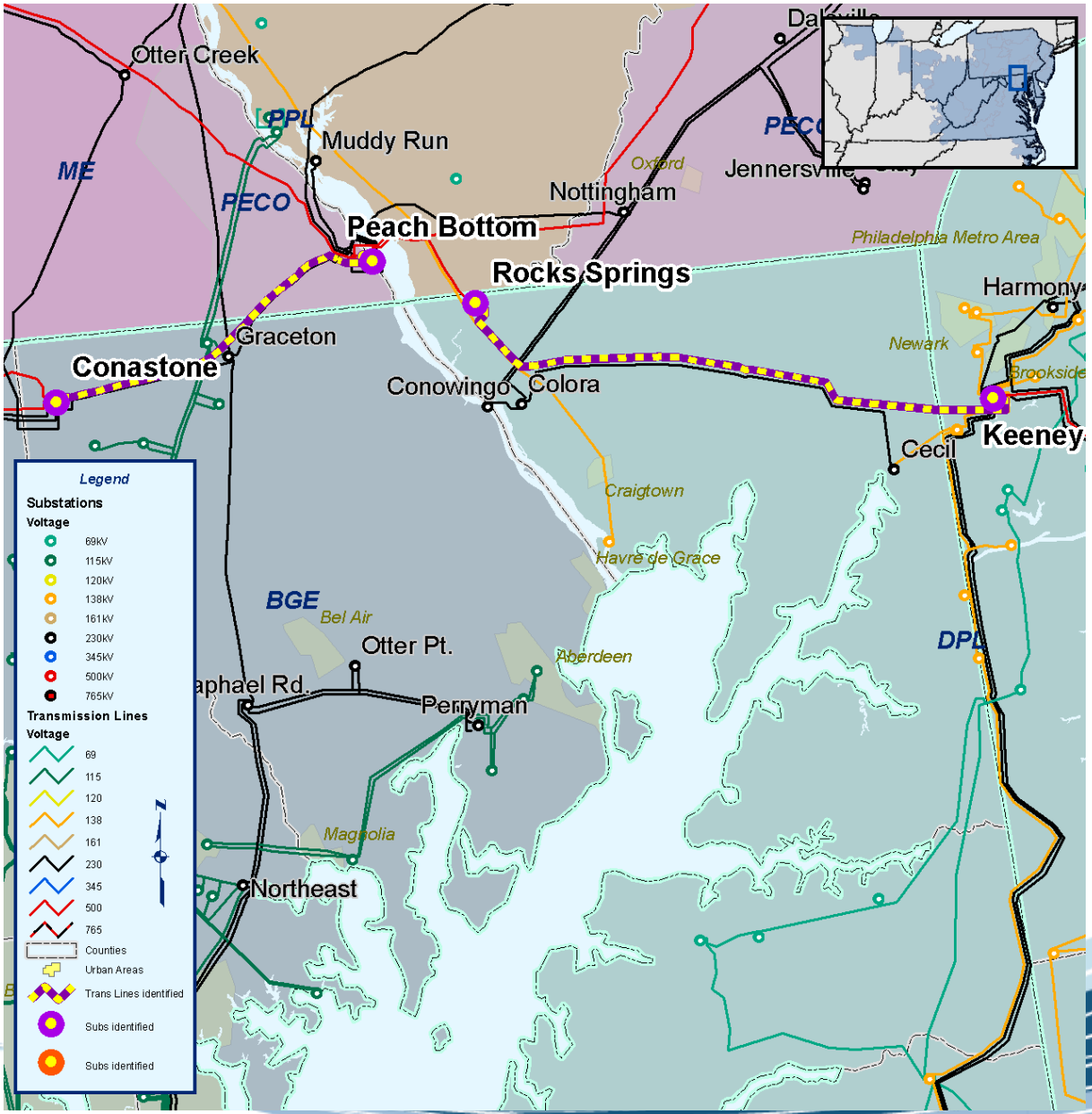
- AC versus DC
- Continue to work with PHI on the cost differences and risks associated with each technology



2013 Reactive Analysis

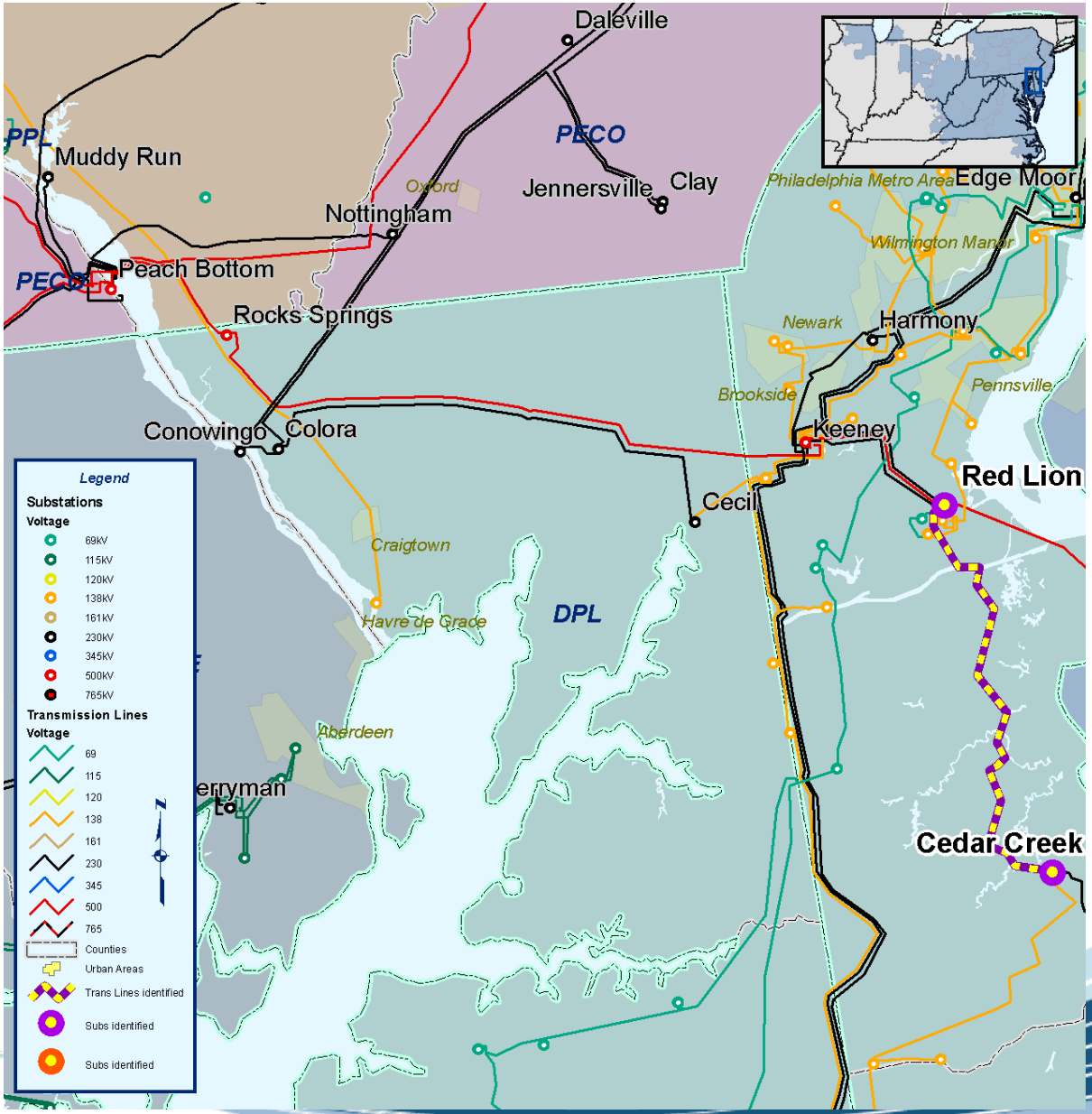
2013 CETO Voltage Analysis – MAAC

- Voltage collapses:
  - Loss of Conastone – Peach Bottom 500 kV line
  - Loss of Keeney – Rock Spring 500 kV line
- Low voltage violation:
  - Cochranville 230 kV bus / loss of Peach Bottom – Rock Spring 500 kV line



2013 CETO Voltage Analysis – EMAAC

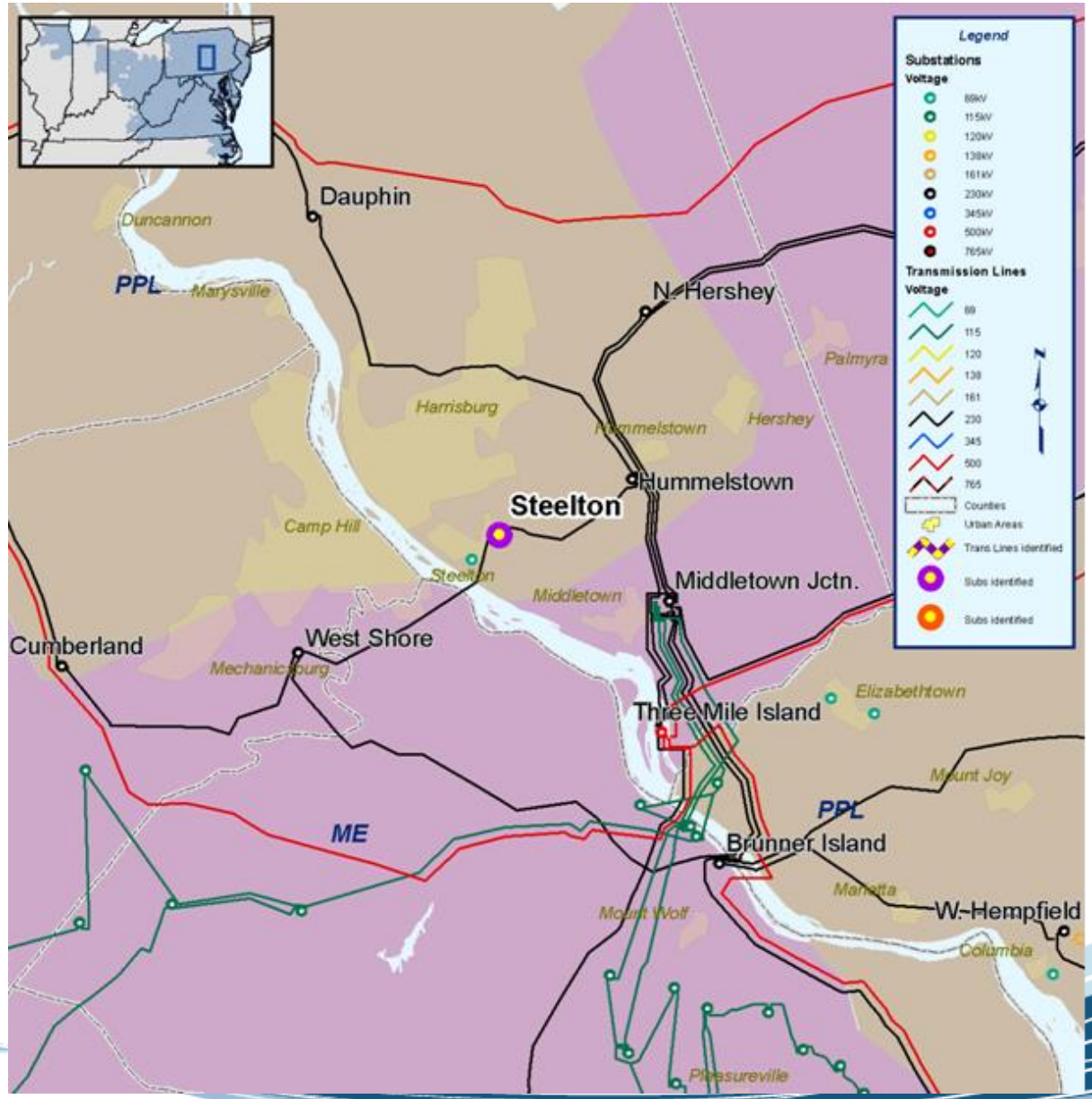
- Voltage collapse:
  - Loss of Cedar Creek – Red Lion 230 kV line
- Low voltage violations:
  - Cochranville 230 kV bus / loss of Rock Spring – Keeney 500 kV line
  - Cochranville 230 kV bus / loss of Peach Bottom – Rock Spring 500 kV line



2013 N-2 Baseline Upgrades

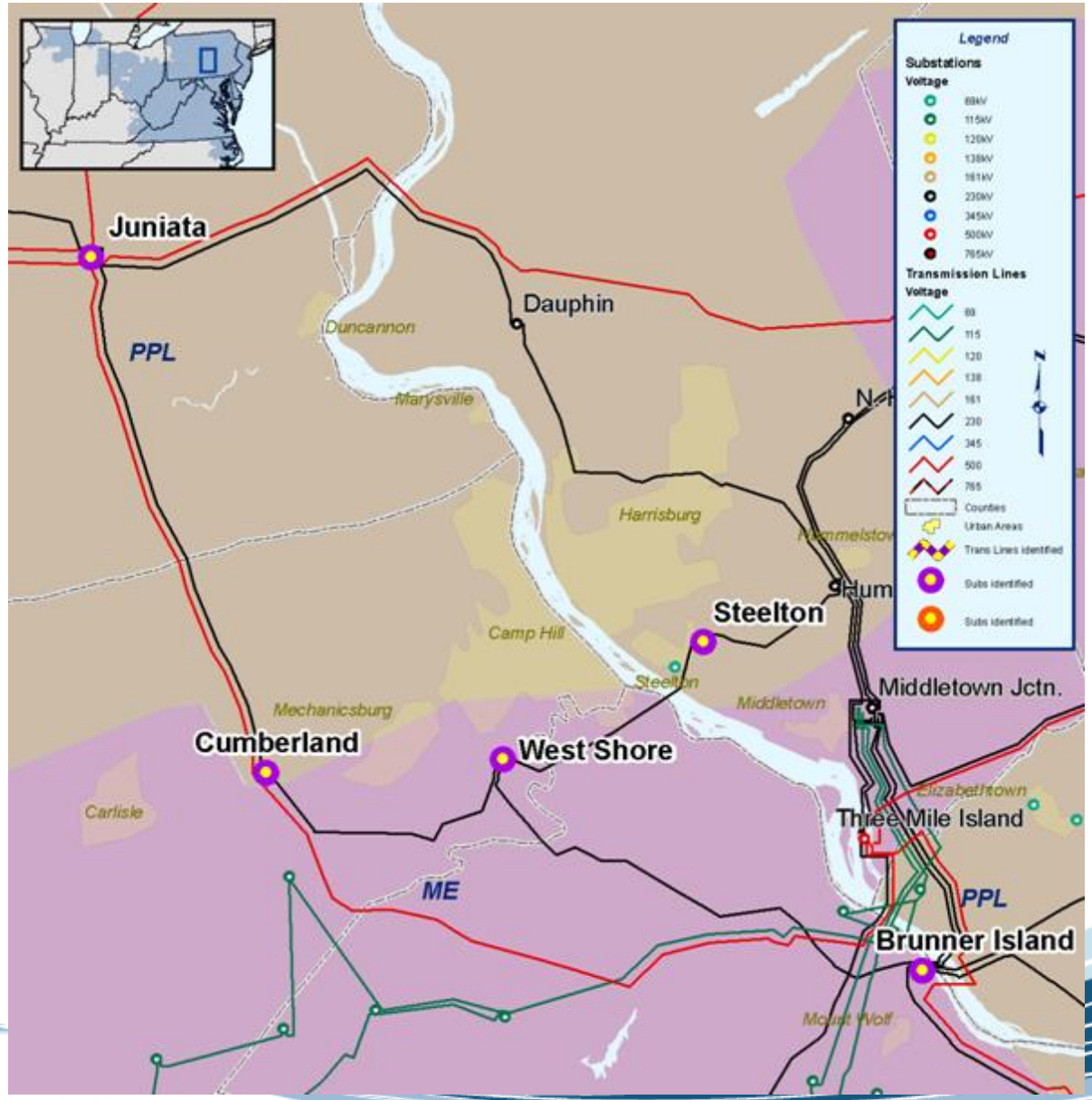
PPL N-2 Baseline Upgrades

- Steel Tap - Steelton 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer
- Steelton-Steel H1 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer
- Steelton-Steel H3 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer



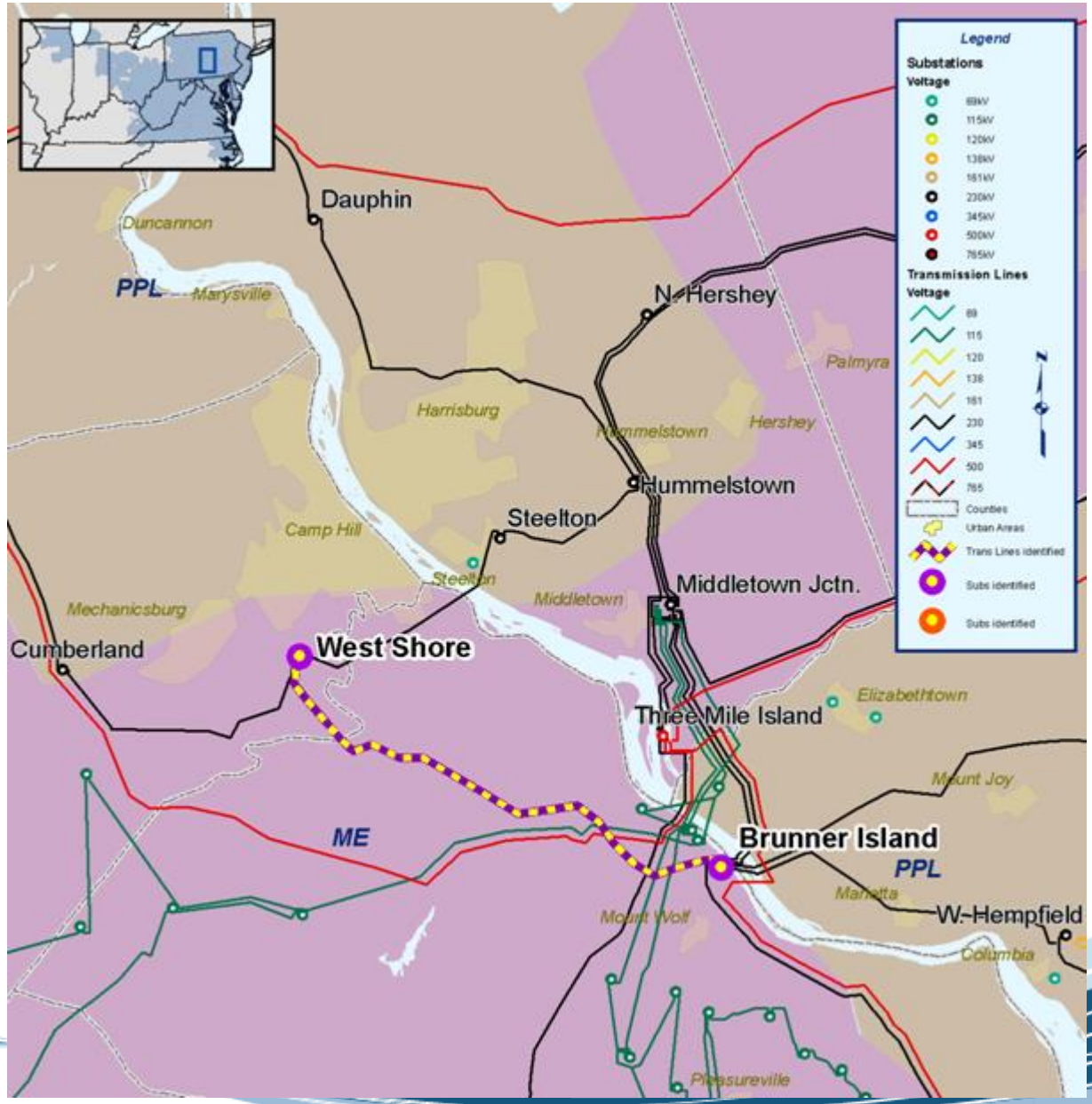
PPL N-2 Baseline Upgrades

- Brunner Island - West Shore 230 kV line / loss of Cumberland - Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of Steel Tap 230 kV bus and Steelton #1 230/69 kV transformer
- West Shore - Steelton 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer
- Juniata - Cumberland 230 kV line / loss of Brunner Island - West Shore 230 kV line and West Shore #2 230/69 kV transformer + loss of Steel Tap 230 kV bus and Steelton #1 230/69 kV transformer



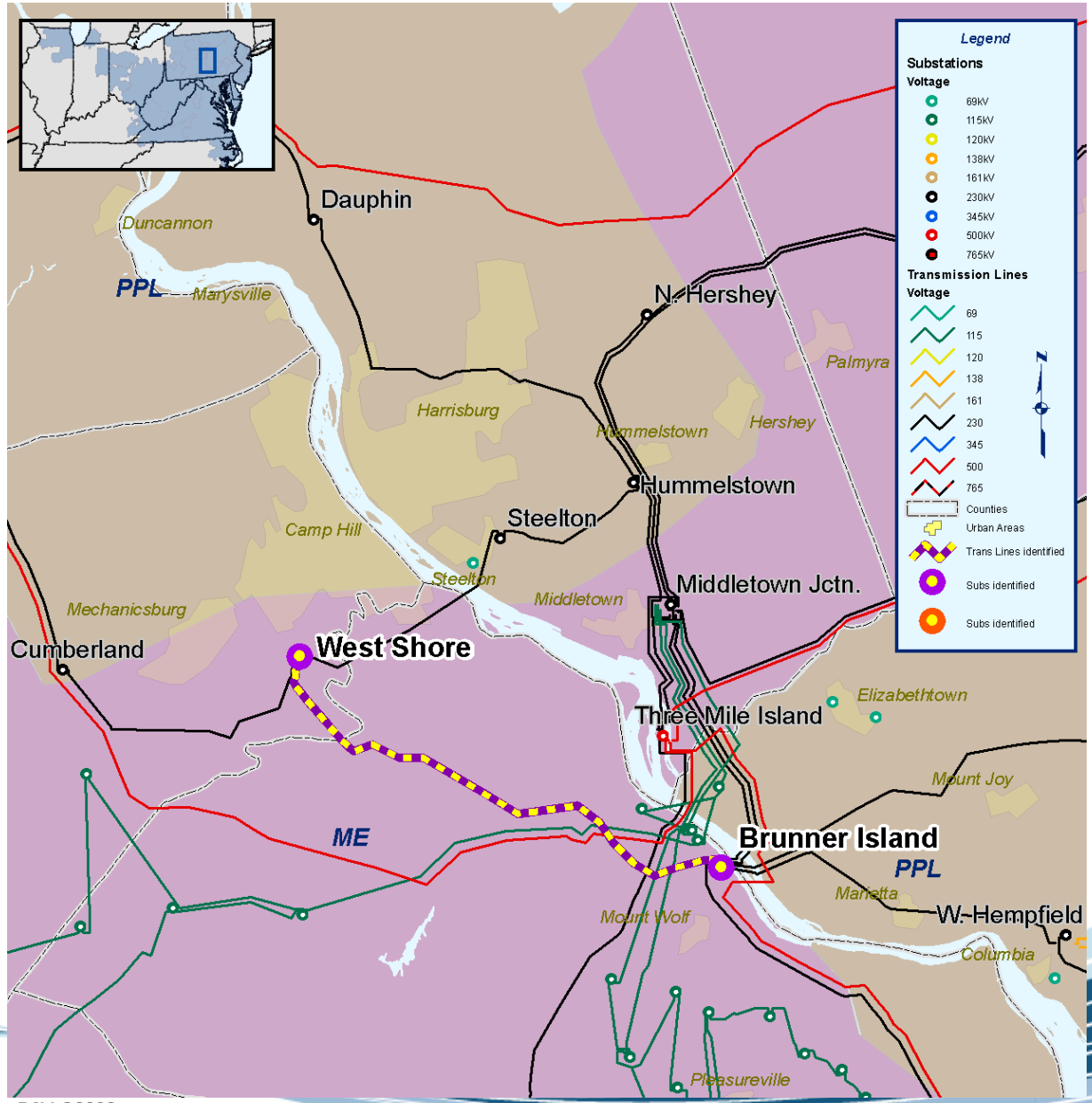
PPL N-2 Baseline Upgrades

- The following upgrade addresses the previous 6 violations
- Rebuild existing Brunner Island – West Shore 230 kV line and add 2nd Brunner Island – West Shore 230 kV line
- Estimated Project Cost: $34 M
- Expected IS Date: 6/01/2013



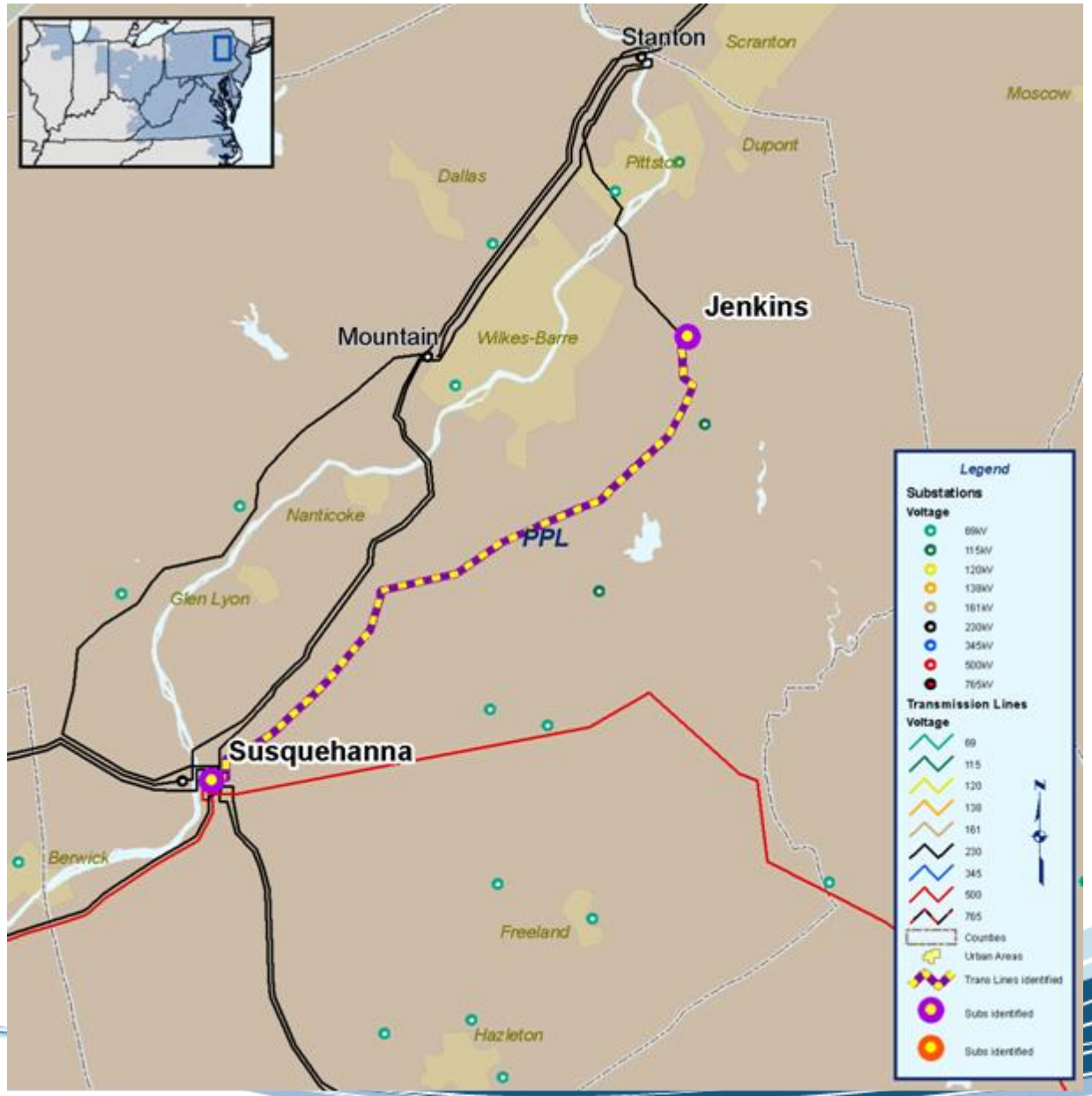
PPL N-2 Baseline Upgrades

- The following upgrade addresses the previous 6 violations prior to the Brunner Island – West Shore 230 kV line rebuild in 2013
- SPS Scheme to drop 190 MVA of 69 kV radial load at West Shore and 56 MVA of 69 kV radial load at Cumberland
- Estimated Project Cost: $0 M
- Expected IS Date: 6/01/2010



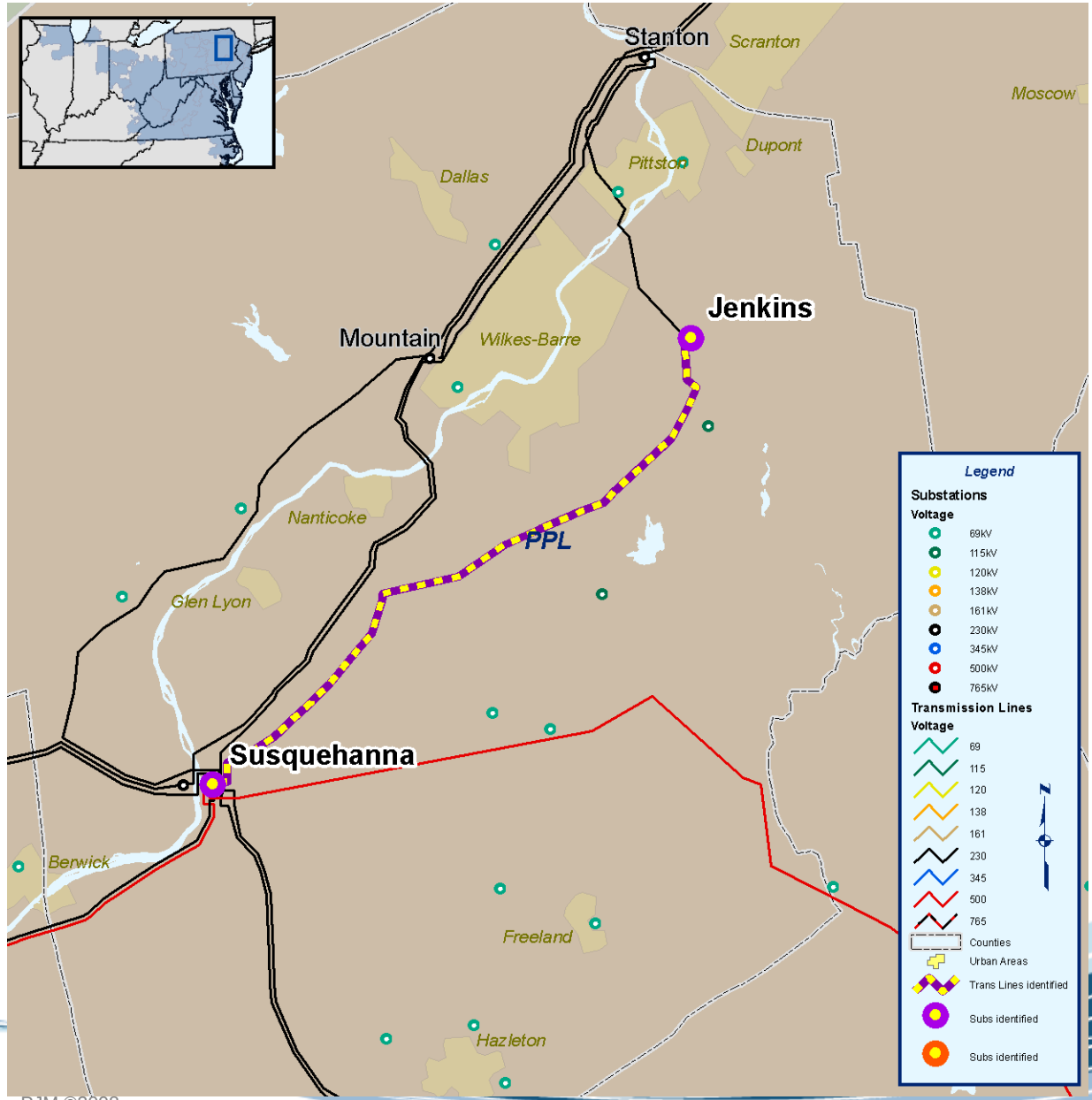
PPL N-2 Baseline Upgrades

- Susquehanna – Jenkins 230 kV line / loss of Susquehanna – Lackawanna 500 kV line + loss of Mountain Tap 230 kV bus
- Susquehanna – Jenkins 230 kV line / loss of Susquehanna – Lackawanna 500 kV line + loss of Susquehanna-Mountain Tap 230 kV line
- Susquehanna – Jenkins 230 kV line / loss of Susquehanna – Lackawanna 500 kV line + loss of Stanton-H1 230 kV bus



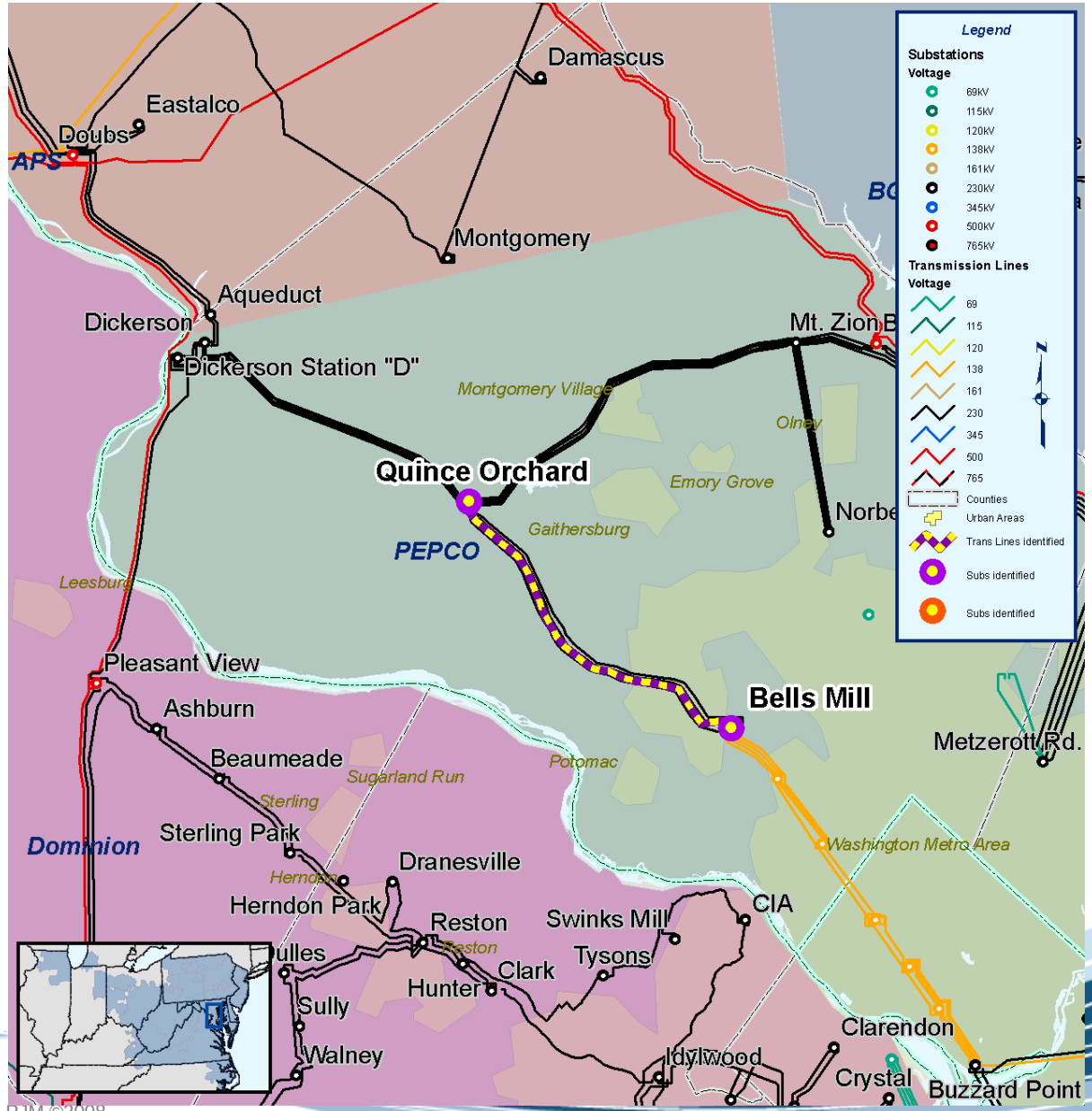
PPL N-2 Baseline Upgrades

- The following upgrade addresses the previous 3 violations
- Proposed Solution: SPS Scheme at Jenkins substation to open the Stanton #1 and Stanton #2 230 kV circuit breakers after the second contingency
- Estimated Project Cost: $0 M
- Expected IS Date: 6/01/2013



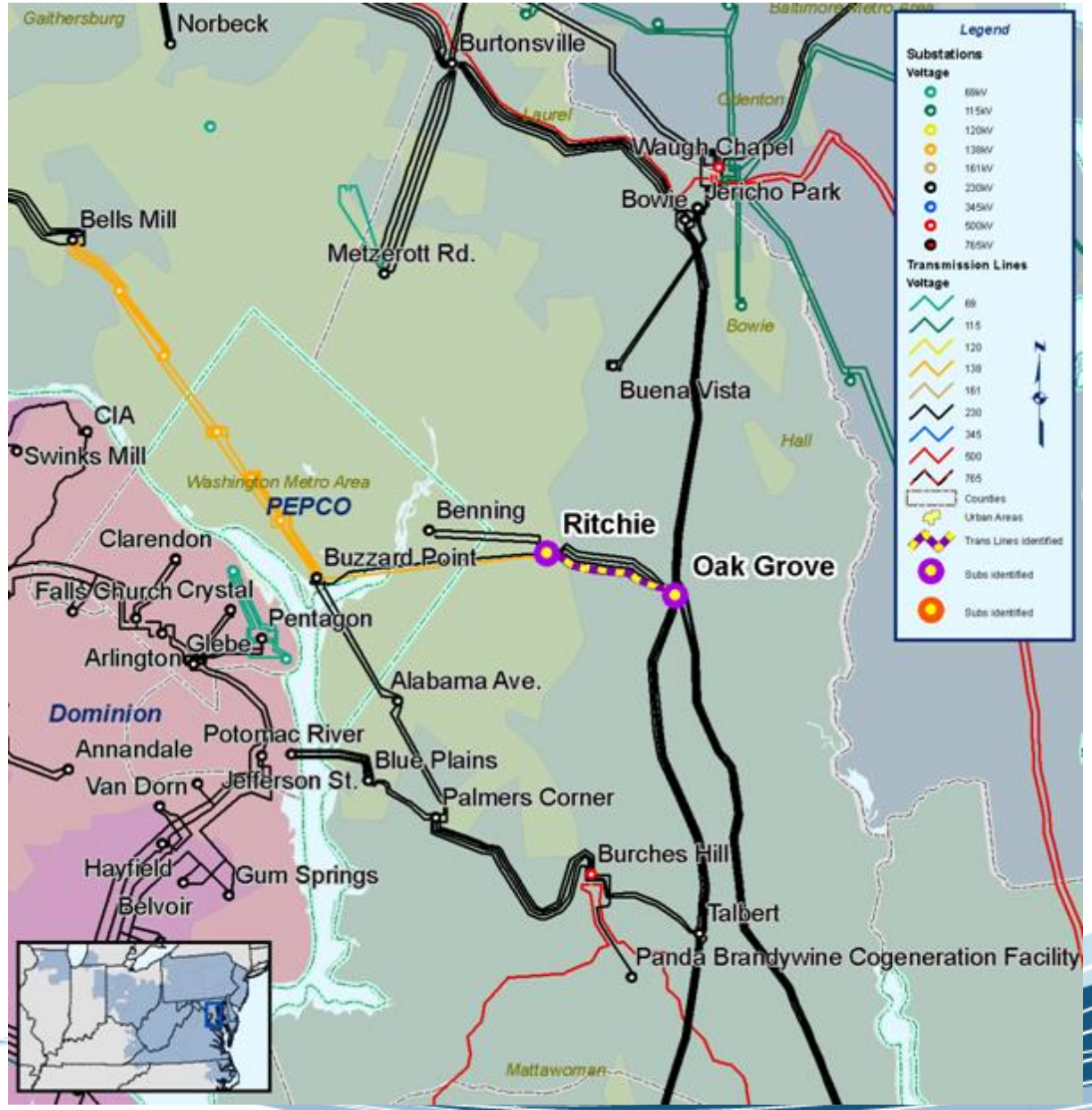
PEPCO N-2 Baseline Upgrades

- Quince Orchard – Bells Mill (030) 230 kV line / loss of Bells Mill (028) 230 kV bus + loss of Bells Mill (029) 230 kV bus
- Quince Orchard – Bells Mill (028) 230 kV line / loss of Bells Mill (029) 230 kV bus + loss of Bells Mill (031) 230 kV bus
- Recommended Solution: Upgrade terminal equipment on both lines
- Estimated Project Cost: $1.415 M
- Expected IS Date: 6/01/2012



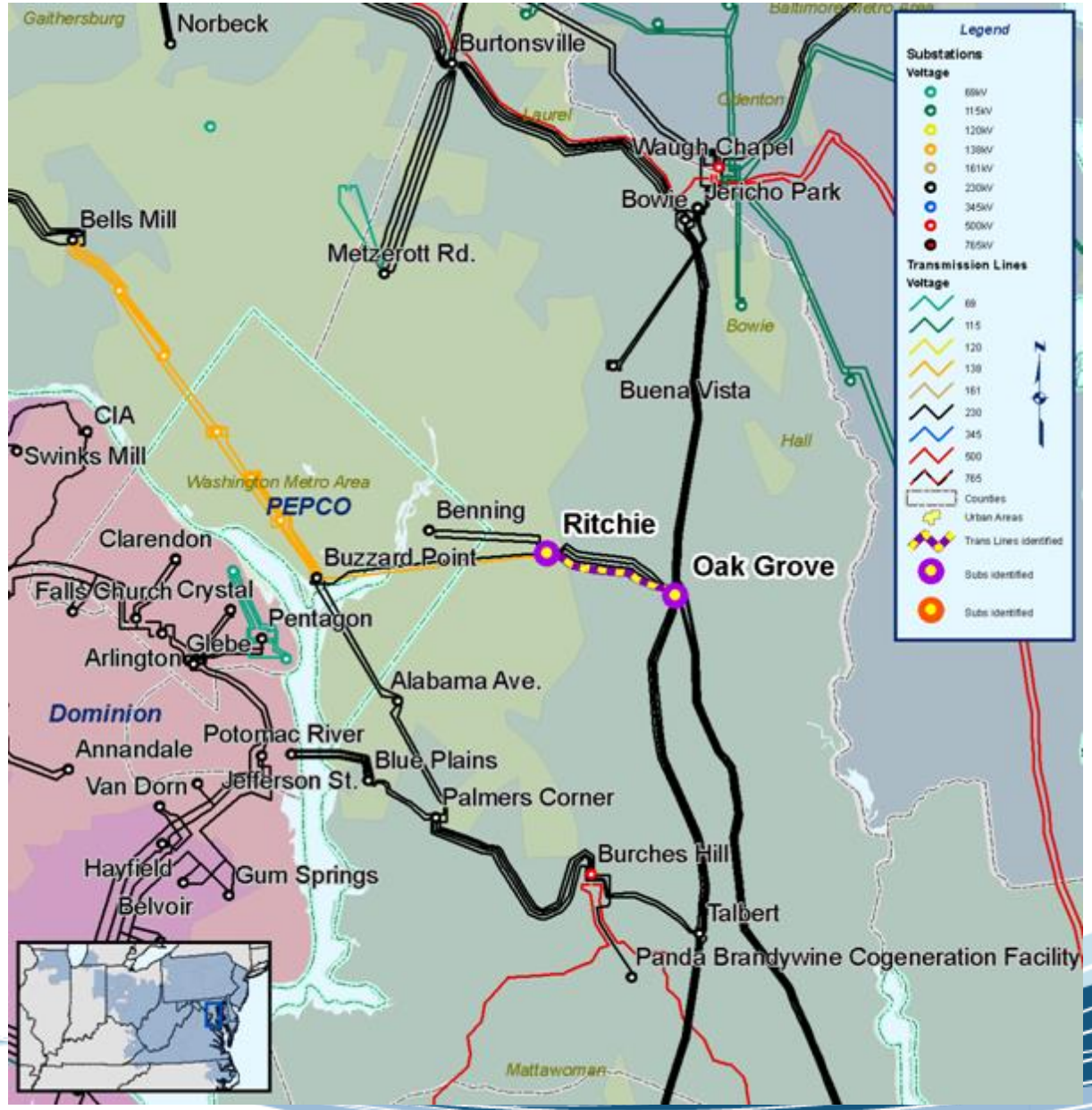
PEPCO N-2 Baseline Upgrades

- Oak Grove – Ritchie 23061 230 kV line / loss of Oak Grove – Ritchie 23058 230 kV line + loss of Oak Grove – Ritchie 23060 230 kV line
- Recommended Solution: Upgrade Oak Grove – Ritchie 23061 230 kV line
- Estimated Project Cost: $3.25 M
- Expected IS Date: 6/01/2013



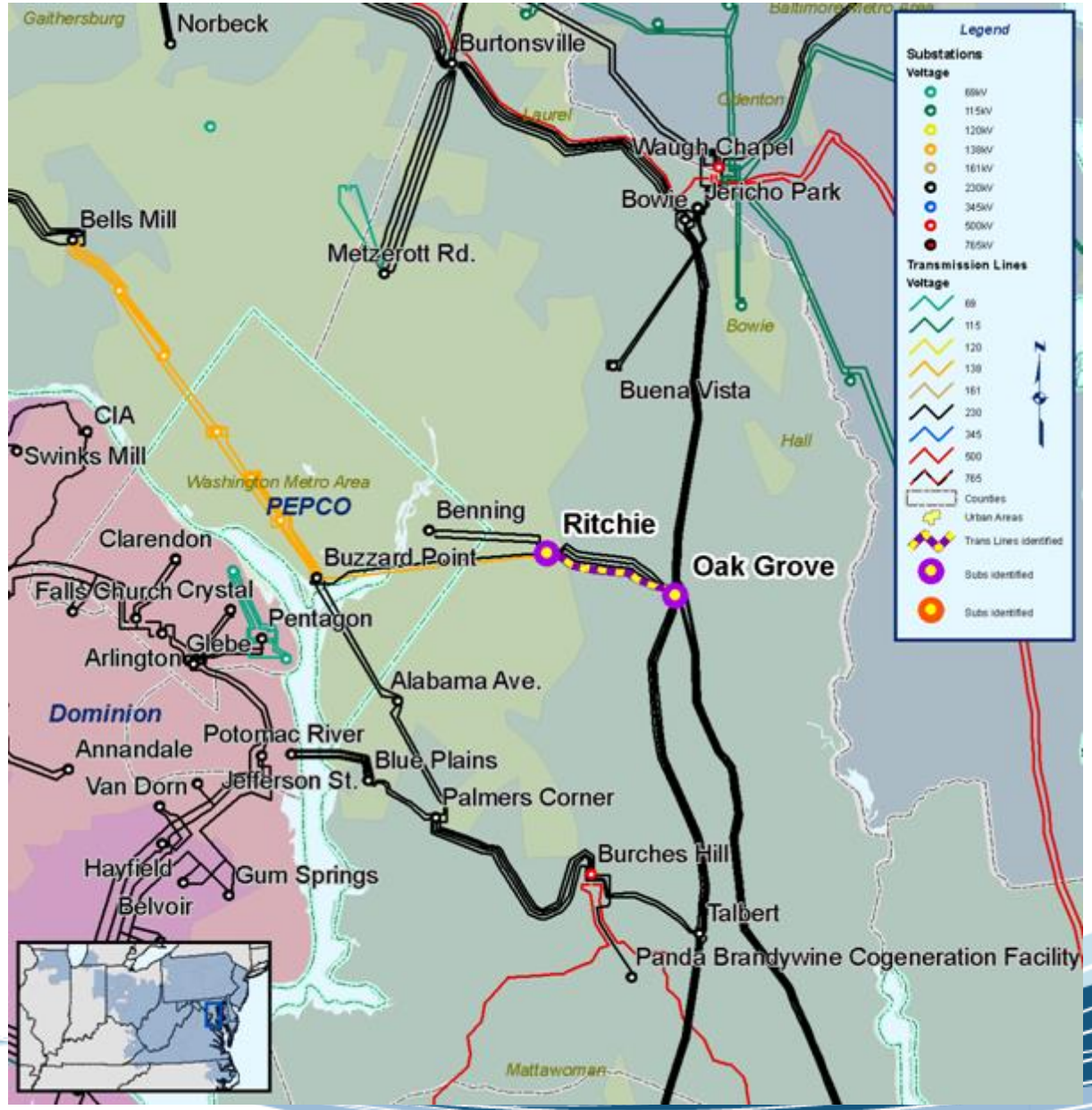
PEPCO N-2 Baseline Upgrades

- Oak Grove – Ritchie 23058 230 kV line / loss of Oak Grove – Ritchie 23059 230 kV line + loss of Oak Grove – Ritchie 23060 230 kV line
- Recommended Solution: Upgrade Oak Grove – Ritchie 23058 230 kV line
- Estimated Project Cost: $3.25 M
- Expected IS Date: 6/01/2013



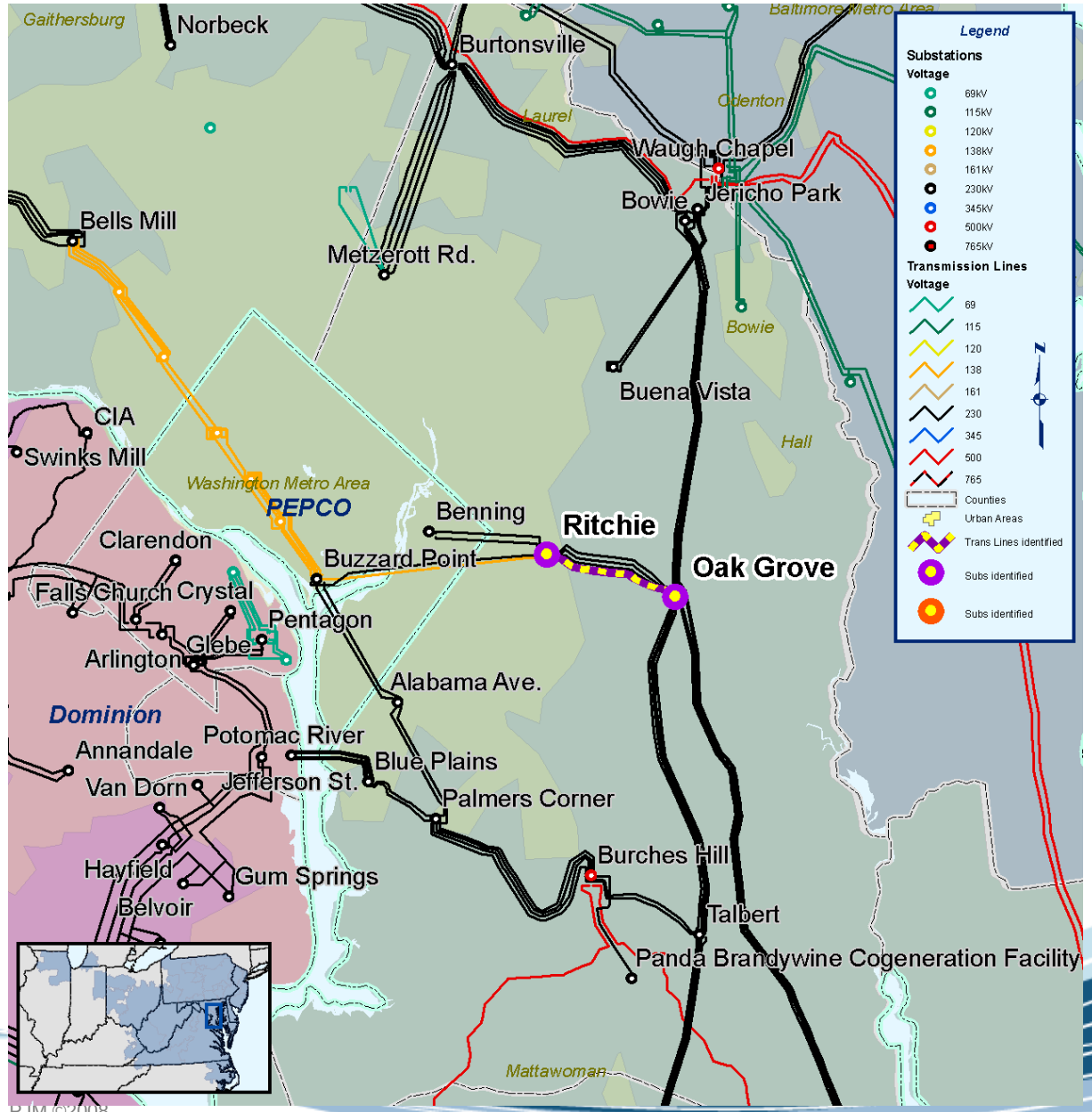
PEPCO N-2 Baseline Upgrades

- Oak Grove – Ritchie 23059 230 kV line / loss of Oak Grove – Ritchie 23058 230 kV line + loss of Oak Grove – Ritchie 23060 230 kV line
- Recommended Solution: Upgrade Oak Grove – Ritchie 23059 230 kV line
- Estimated Project Cost: $3.25 M
- Expected IS Date: 6/01/2013



PEPCO N-2 Baseline Upgrades

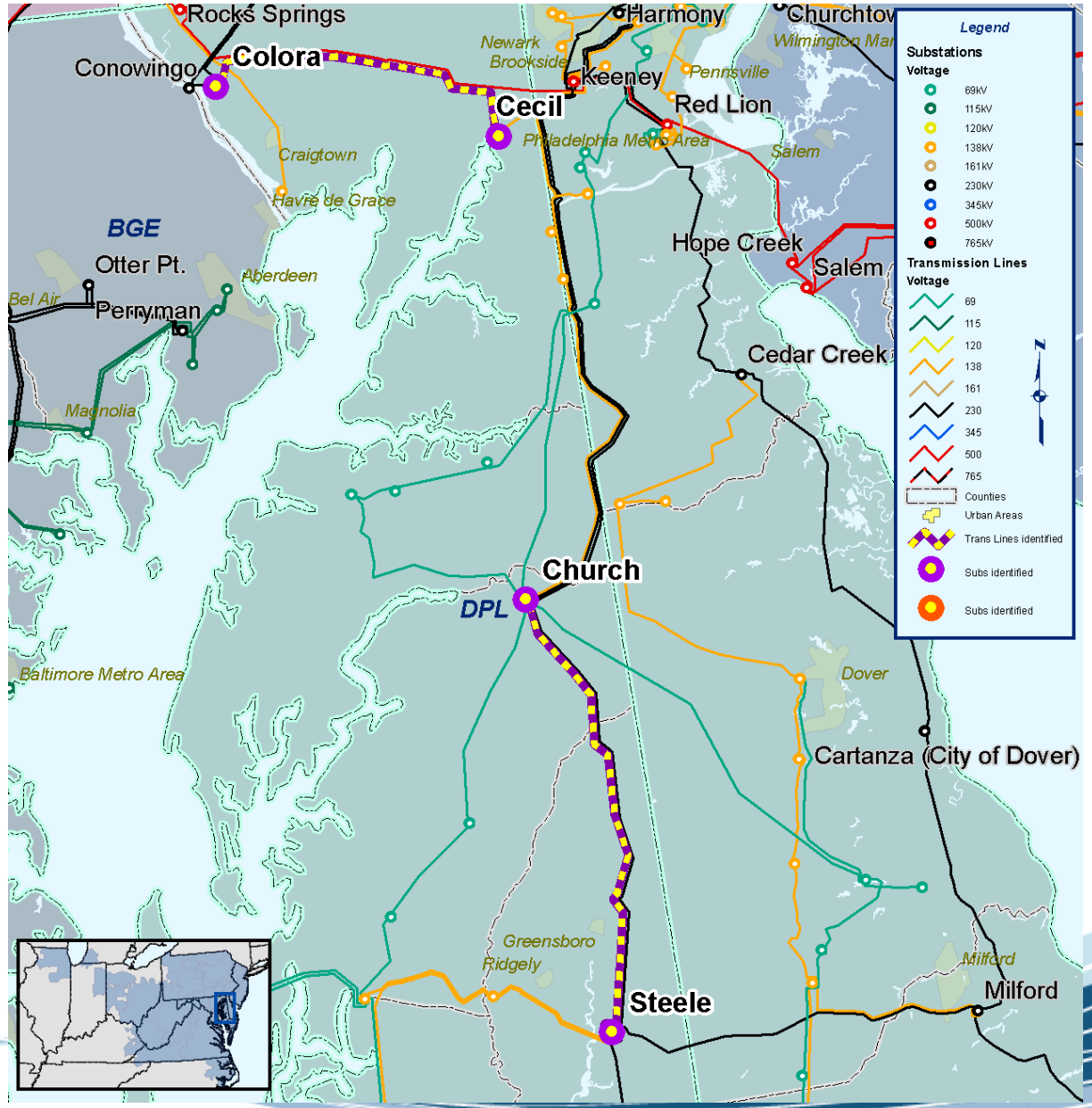
- Oak Grove – Ritchie 23060 230 kV line / loss of Oak Grove – Ritchie 23058 230 kV line + loss of Oak Grove – Ritchie 23059 230 kV line
- Recommended Solution: Upgrade Oak Grove – Ritchie 23060 230 kV line
- Estimated Project Cost: $3.25 M
- Expected IS Date: 6/01/2013



DPL N-2 Baseline Upgrades

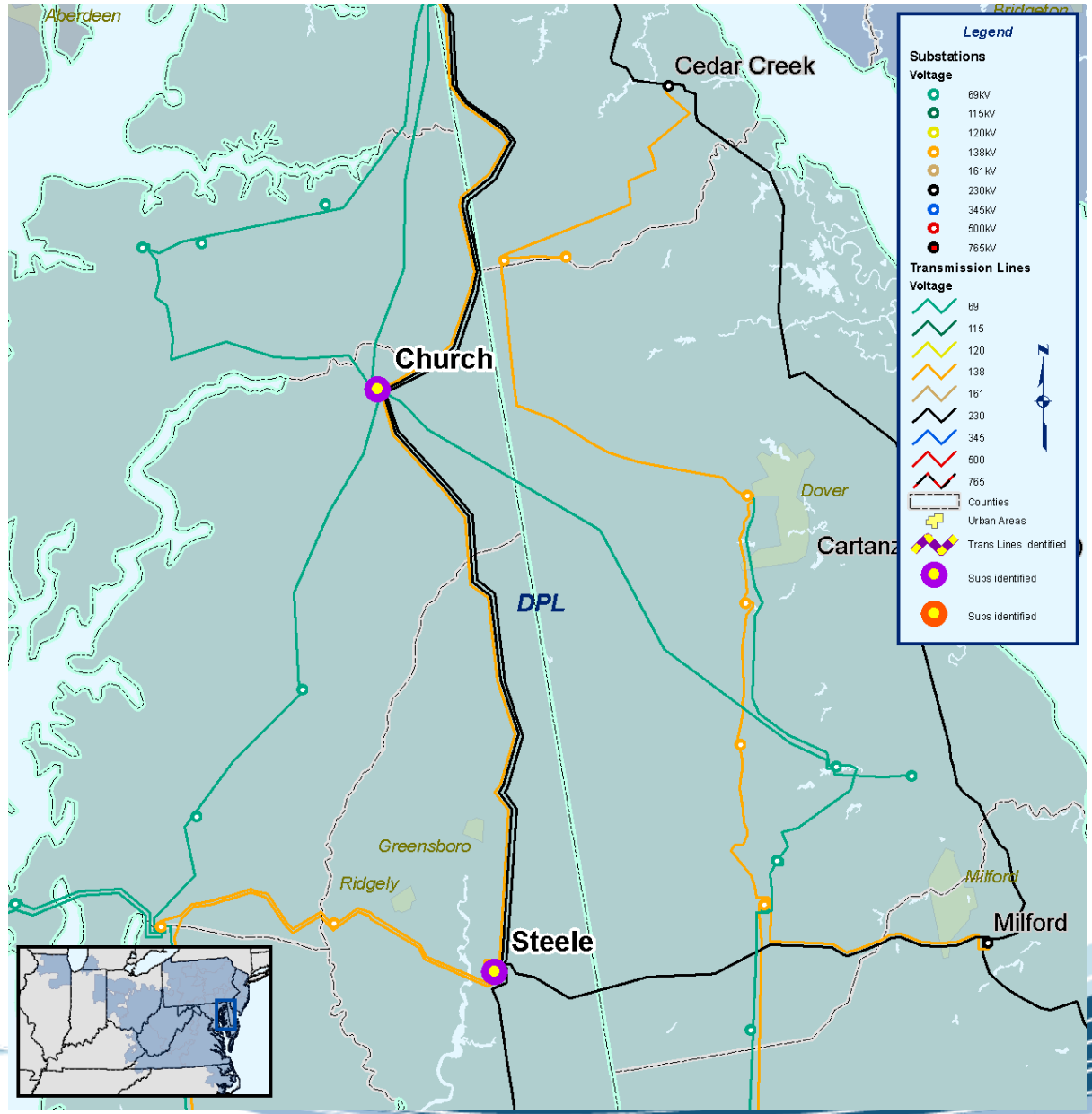
- Cecil - Colora 230 kV line / loss of Lums – Reybold 138 kV line + loss of Glasgow – Keeney 138 kV line
- Oil City – Steele 138 kV line / loss of Glasgow – Mount Pleasant 138 kV line + loss of Lums - Reybold 138 kV line
- Oil City – Church 138 kV line / loss of Glasgow – Mount Pleasant 138 kV line + loss of Lums - Reybold 138 kV line
- Recommended Solution: Build a new Church – Wye Mills 138 kV line
- Estimated Project Cost: $17.5 M

• Expected IS Date: 6/01/2013



DPL N-2 Baseline Upgrades

- Steele 230/138 kV transformer AT21 / loss of Steele 230/138 kV transformer AT20 + loss of Mount Pleasant – Townsend 138 kV line
- Steele 230/138 kV transformer AT20 / loss of Steele 230/138 kV transformer AT21 + loss of Mount Pleasant – Townsend 138 kV line
- Townsend – Church 138 kV line / loss of Steele 230/138 kV transformer AT20 + loss of Steele 230/138 kV transformer AT21
- Recommended Solution: Add a 3rd Steele 230/138 kV transformer
- Estimated Project Cost: $8 M
- Expected IS Date: 6/01/2013

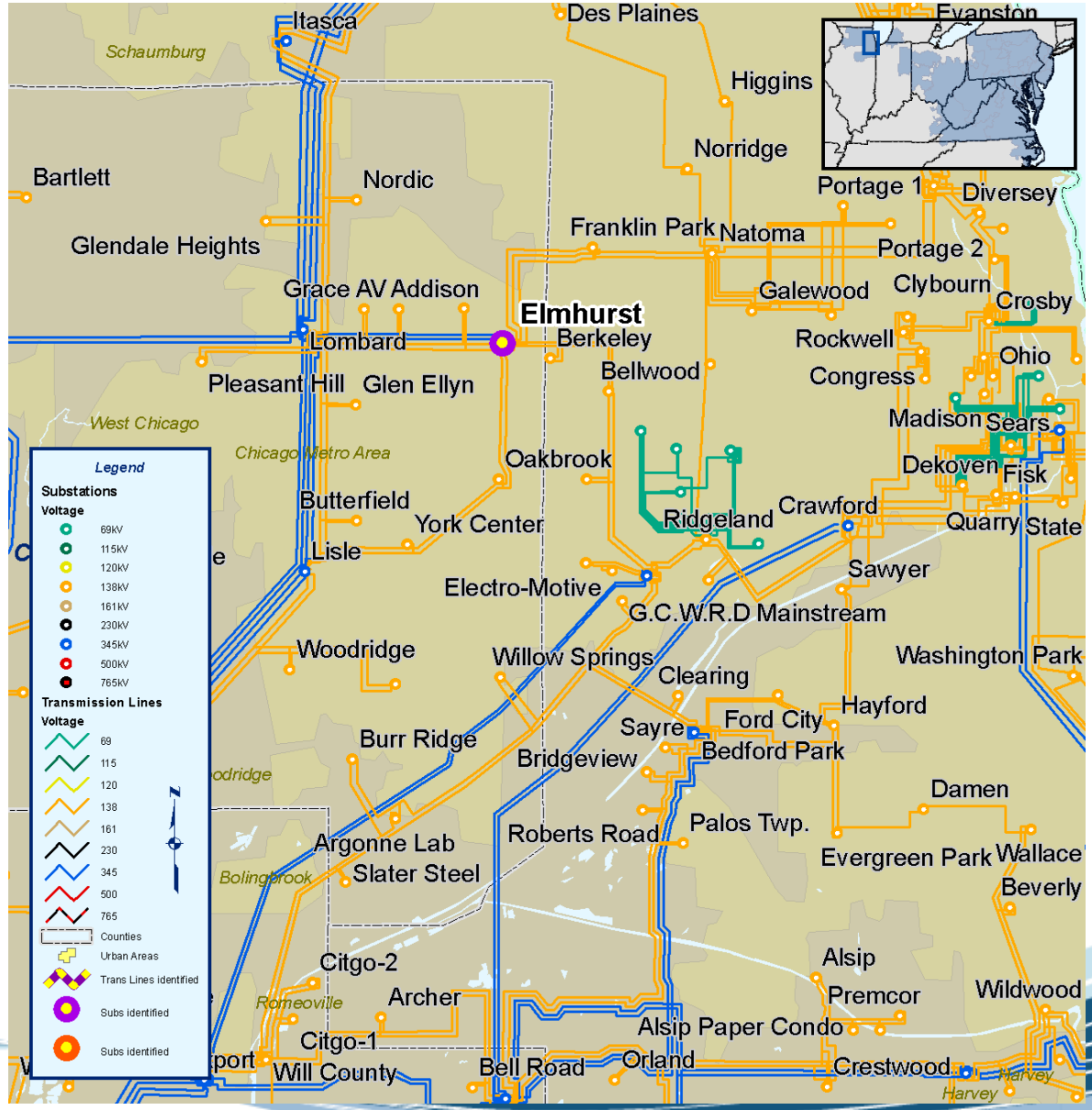


ComED Baseline Upgrades

2013 CETO ComED Load Deliverability / Northeast Subzone Discussion Update

Dynamic Voltage Criteria & Voltage Stability Criteria

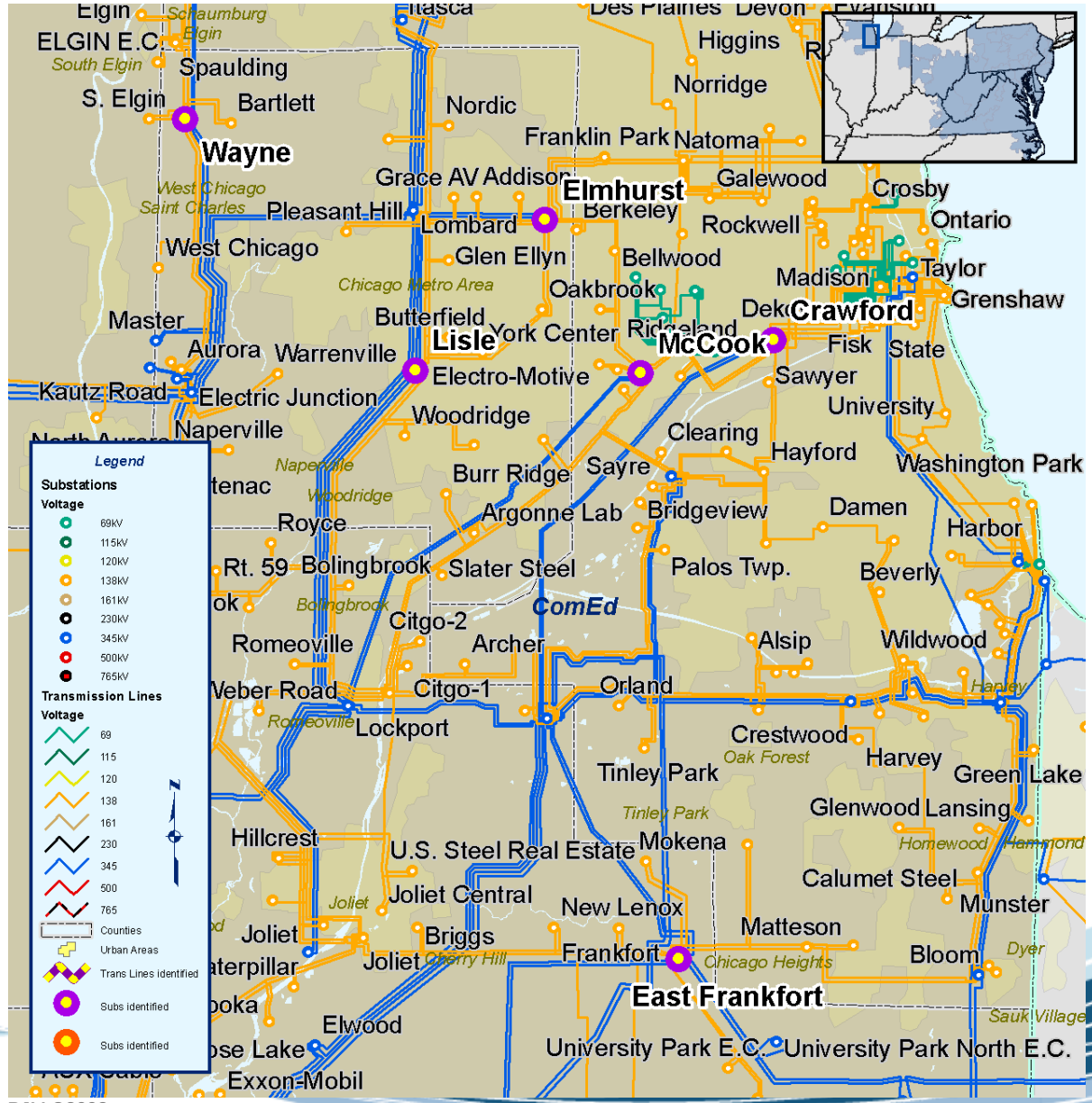
- Solution: Add a 300 MVAR SVC at Elmhurst 138 kV “Red”
- Solution: Add a 300 MVAR SVC at Elmhurst 138 kV “Blue”



2013 CETO ComED Load Deliverability / Northeast Subzone Discussion Update

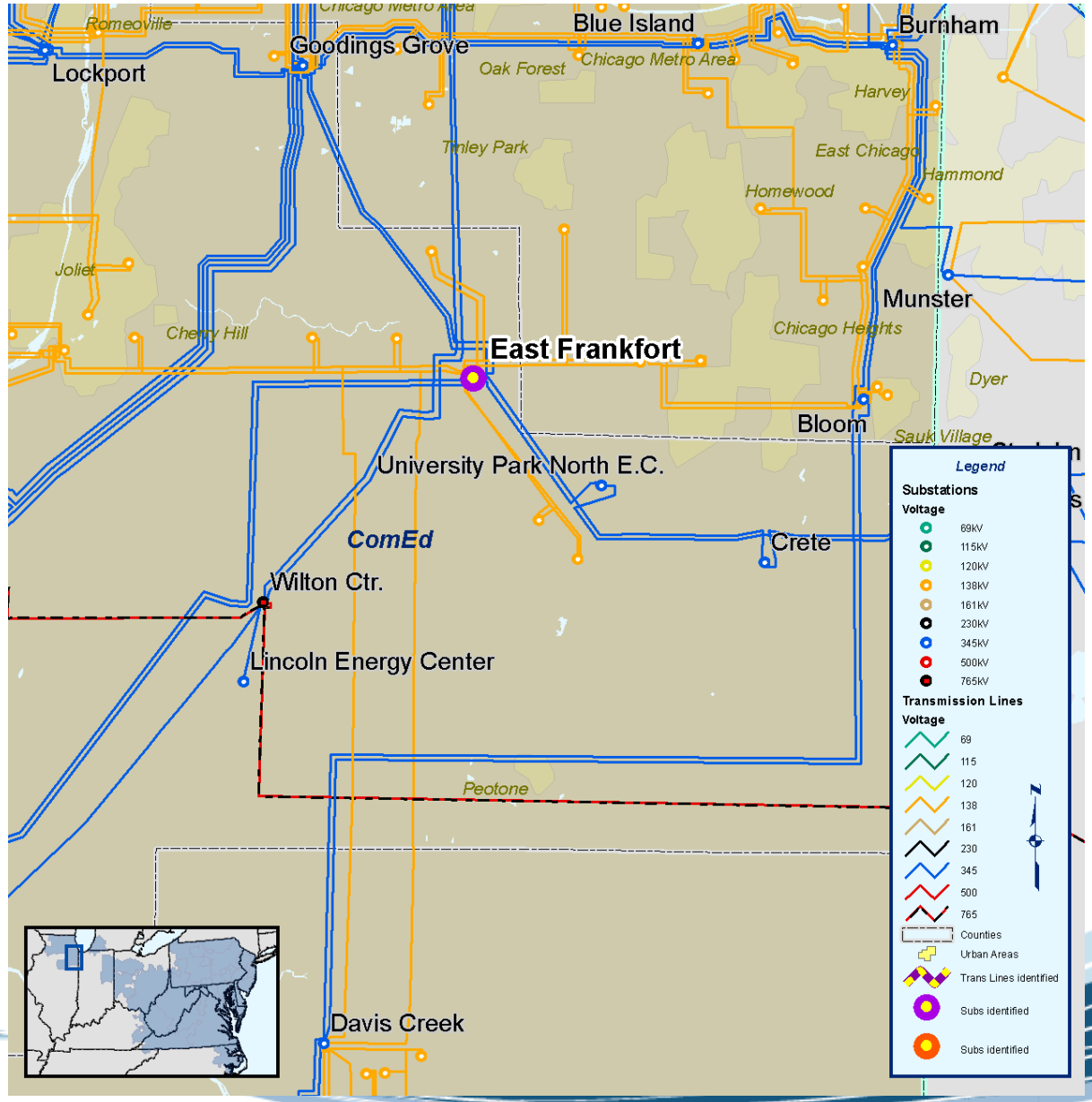
Voltage Stability

- Solution: Install 115.2 MVAR switched capacitors at the following locations:
  - East Frankfort 138 kV
  - Lisle 138 kV Red
  - Lisle 138 kV Blue
  - McCook 138 kV Red
  - McCook 138 kV Blue
  - Wayne 138 kV Blue
  - Wayne 138 kV Red
  - Crawford 138 kV Blue
  - Crawford 138 kV Red
  - Bedford 138 kV Blue
  - Bedford 138 kV Red
  - Wolfs 138 kV (57.6 MVAR)



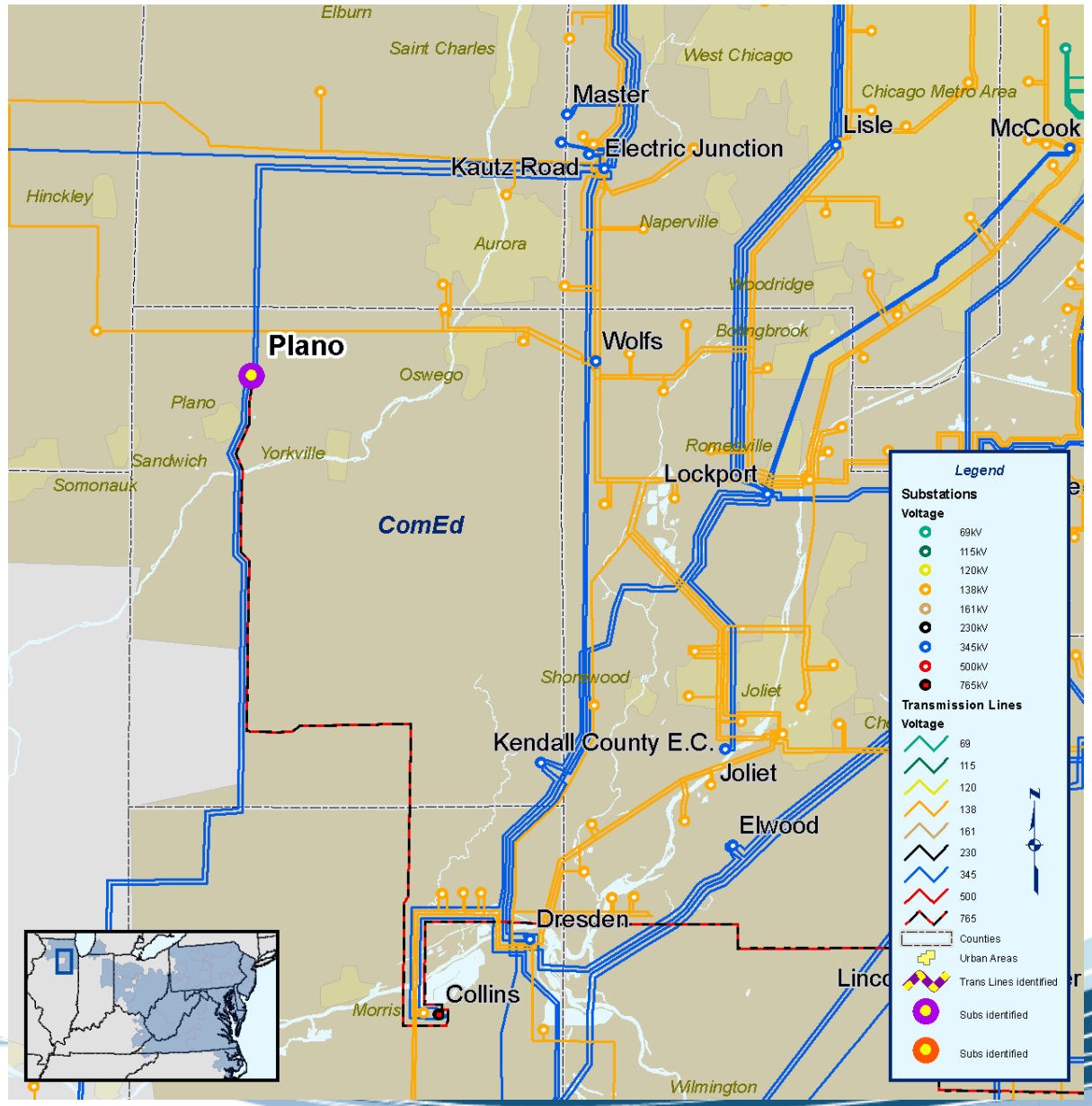
Potential ComEd Baseline Upgrades

- Thermal Overload of East Frankfort – Goodings Grove 345 kV “Red”
- No contingency – all facilities in Service
- Solution: Add a 2nd East Frankfort 345 / 138 kV Autotransformer
- Generator and Load Deliverability
- IS Date: June 2013
- Cost Estimate: TBD



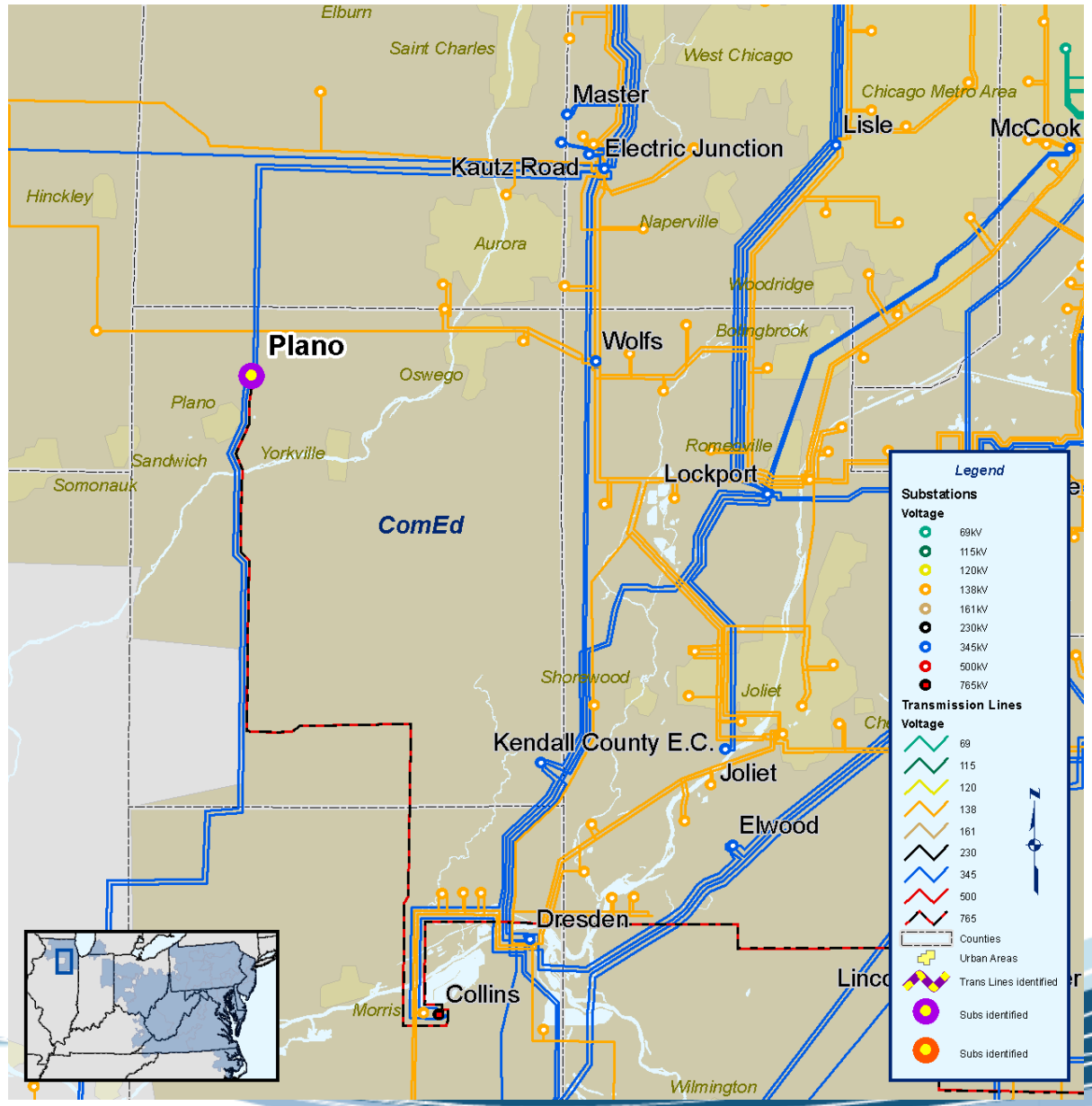
ComEd Baseline Upgrades

- Thermal overload of Wolfs 345/138 kV “Blue” transformer for the loss of the Wolfs 345/138 kV “Red” transformer
- Thermal overload of Wolfs – Oswego 138 KV “Blue” for the outage of Wolfs – Oswego 138 kV “Red”
- Solution for both violations: Replace the existing baseline upgrade to install a 2nd Wolfs 345/138 kV transformer. The replacement project is a 345/138 kV transformer at Plano “Red”
- Generator Deliverability
- Estimated Project Cost: TBD
- IS Date: June 2013



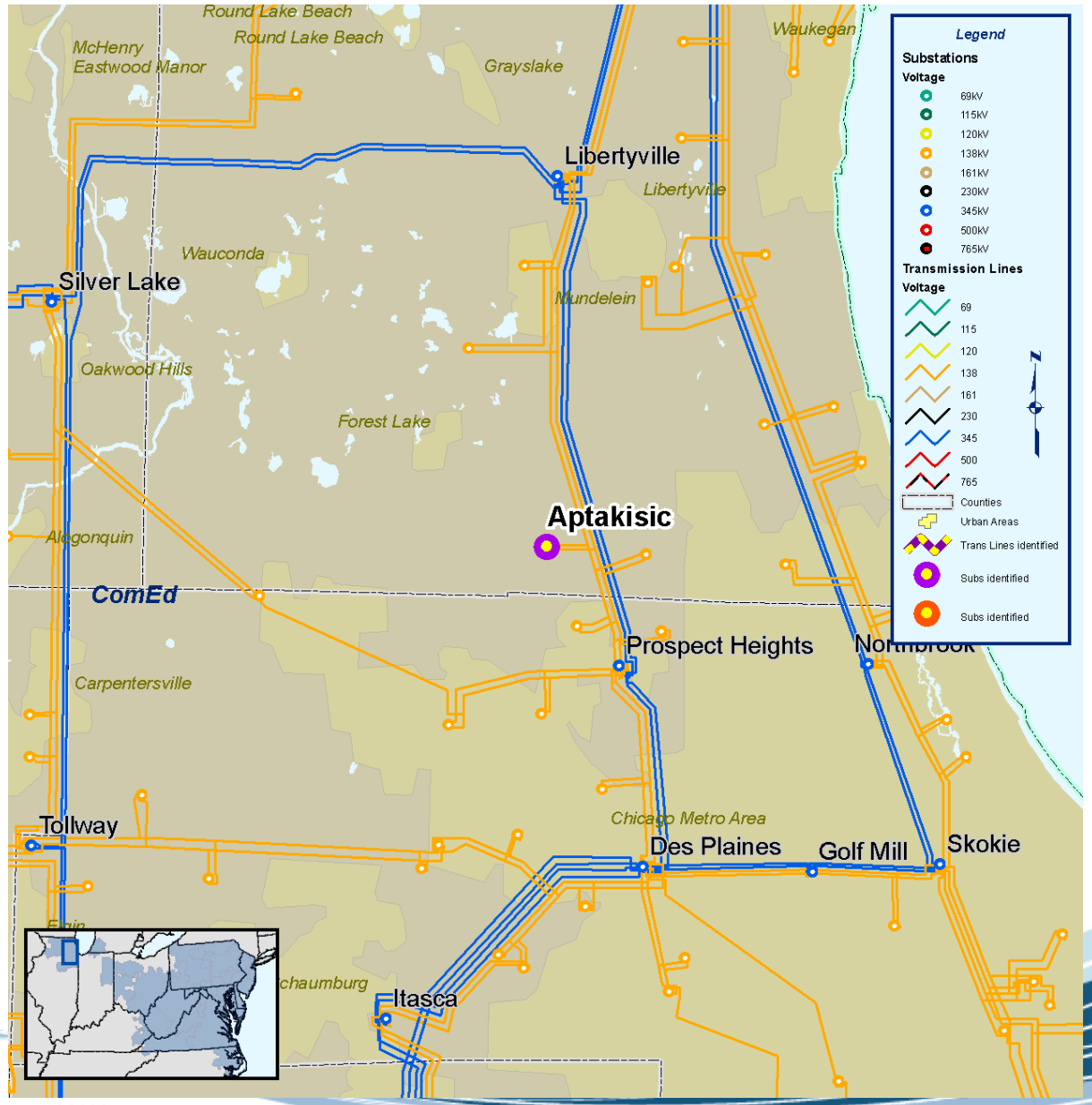
ComEd Baseline Upgrades

- Thermal overload of Plano – Electric Junction 345 kV "Red" for the loss of the parallel circuit
- Solution: Install a second 345/138 kV transformer at Plano "Red"
- Generator Deliverability
- Estimated Project Cost: TBD
- IS Date: June 2013



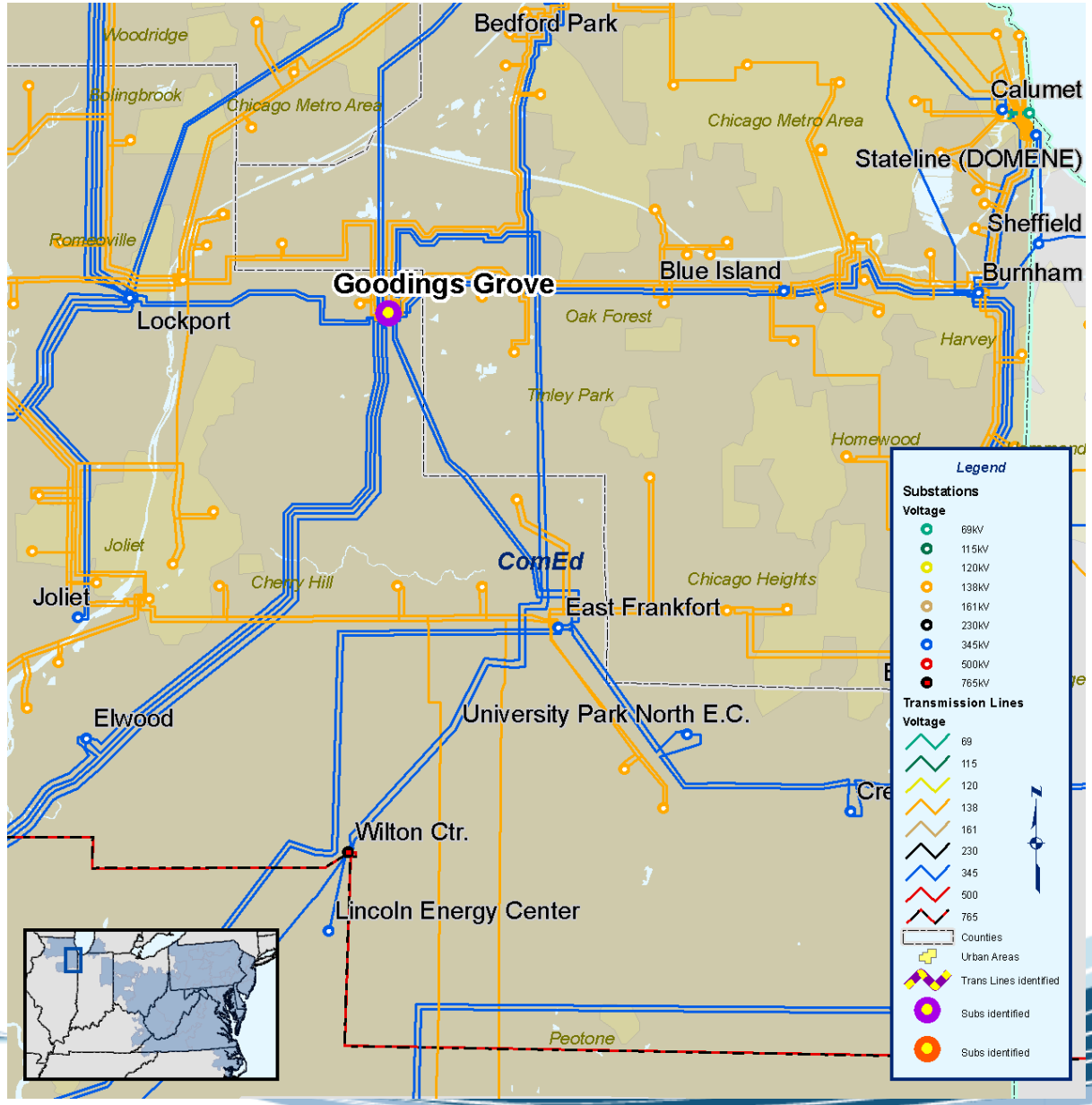
ComEd Baseline Upgrades

- Thermal overload of Prospect Heights 345/138 kV “Red” transformer for the loss of Prospect Heights – Leithton 138 kV line 11708
- Solution: Add a breaker at Aptakisic 138 kV to split the line in two for the 11708 contingency
- Load Deliverability
- Expected IS Date: 6/01/2013
- Cost estimate: TBD



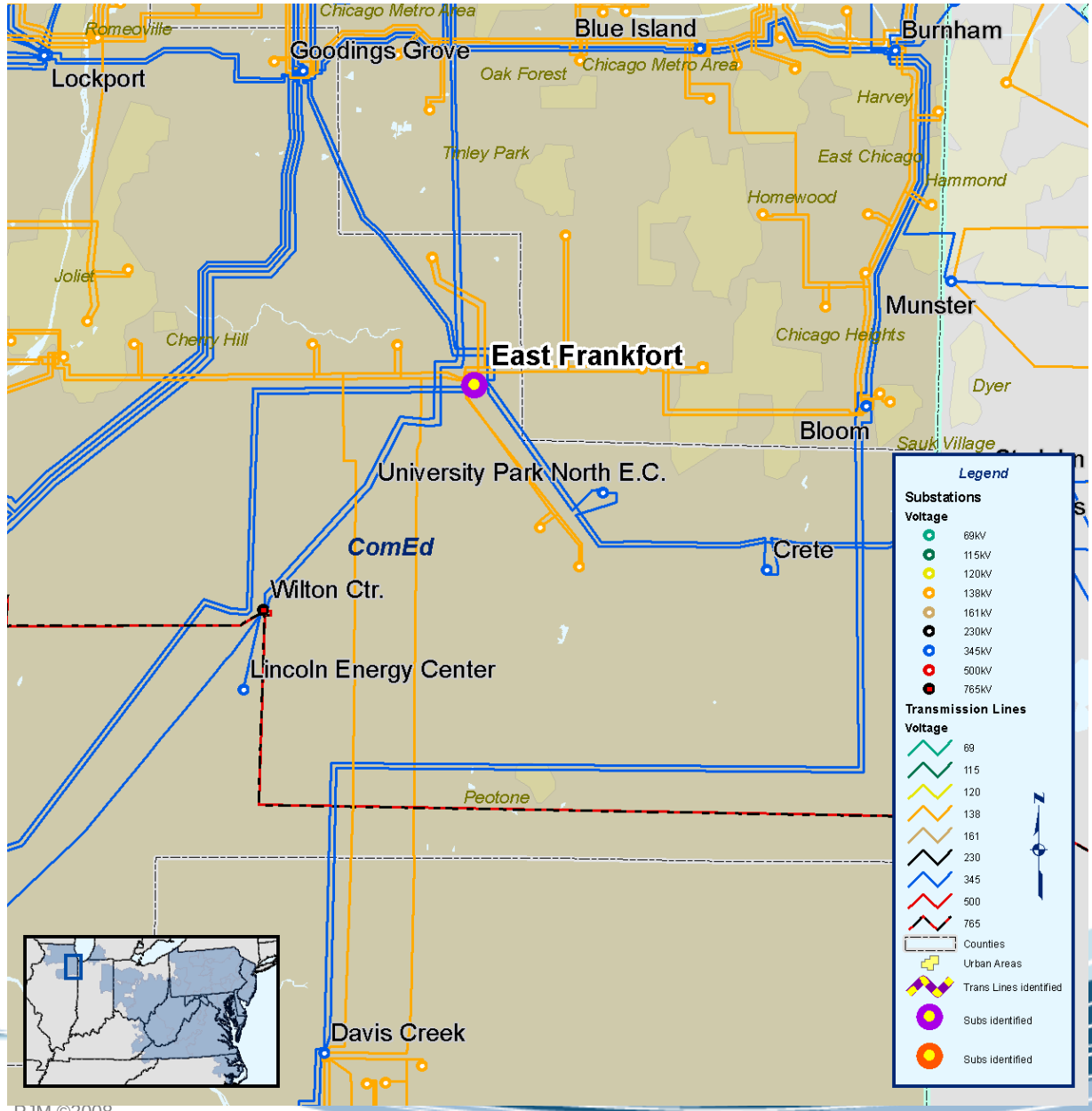
ComEd Baseline Upgrades

- Thermal overload of Goodings Grove 345/138 kV “Red” transformer for the loss of Blue Island – Alsip 138 kV
- Solution: Install a third 345/138 kV transformer at Goodings Grove “Red”
- Generator Deliverability
- IS Date: June 2013
- Cost Estimate: TBD



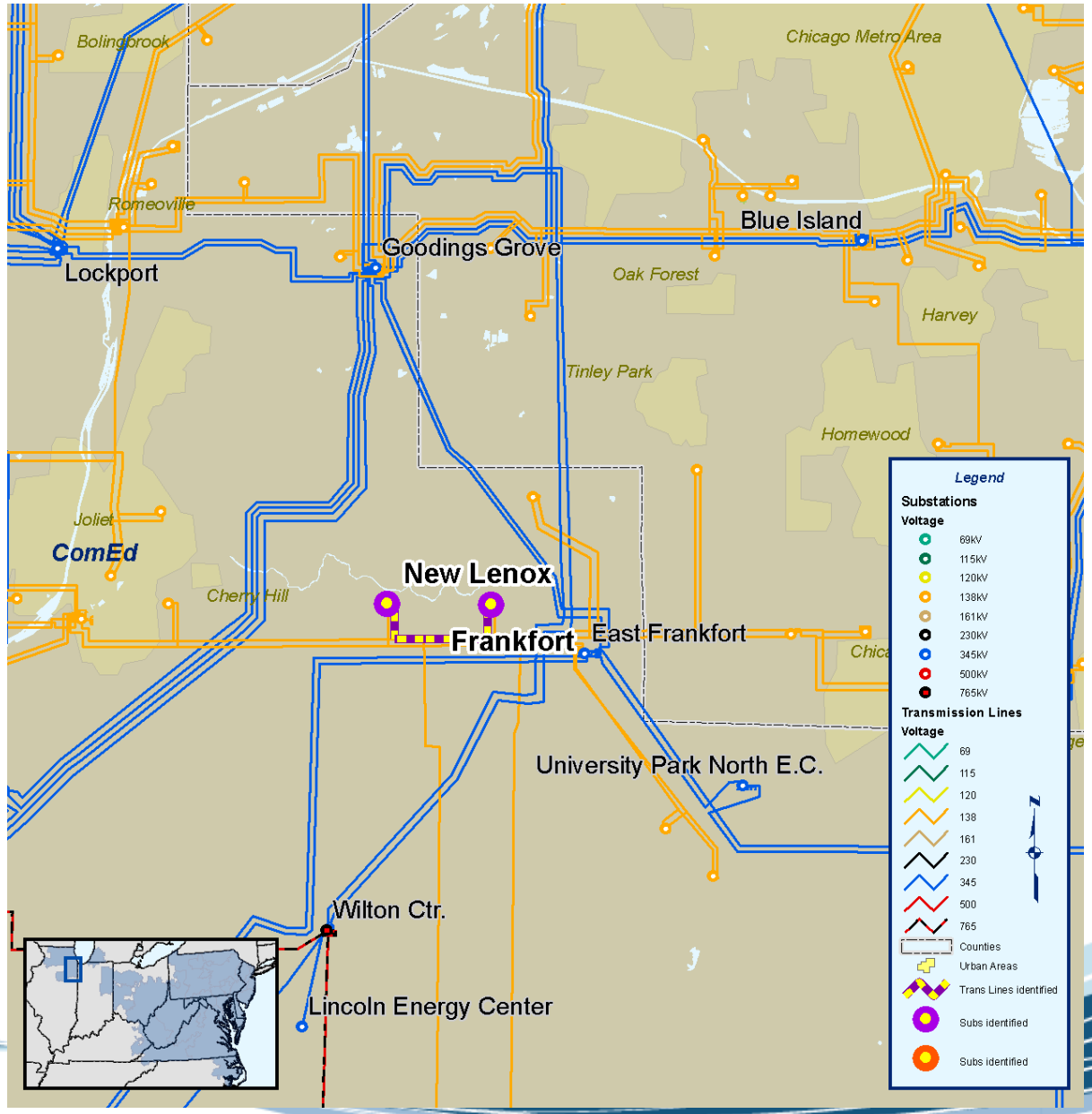
ComEd Baseline Upgrades

- Thermal overload of East Frankfort – Goodings Grove 345 kV “Blue”
- No contingency – all Facilities in Service
- Solution: Install a 2nd East Frankfort 345/138 kV Autotransformer and reconductor Country Club Hills – Matteson 138 kV
- Load Deliverability
- IS Date: June 2013
- Cost Estimate: TBD



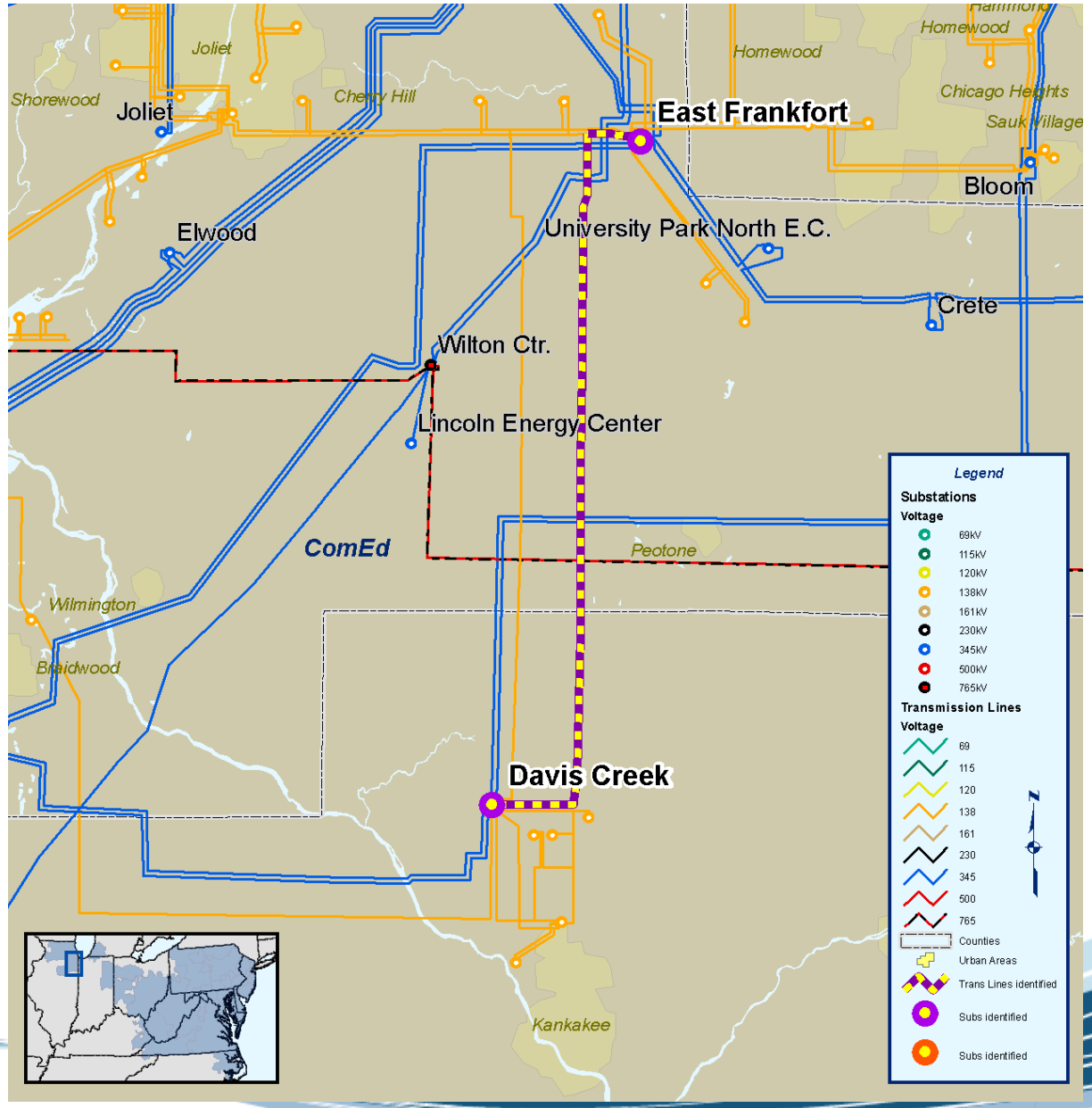
ComEd Baseline Upgrade

- Thermal overload of 0902 Frankfort – New Lenox 138 kV for the loss of Dresden – Shorewood 138 kV
- Solution: Reconductor line 0902 Frankfort - New Lenox 138 kV
- Expected IS Date: 6/01/2013
- Cost Estimate: TBD



ComEd Baseline Upgrade

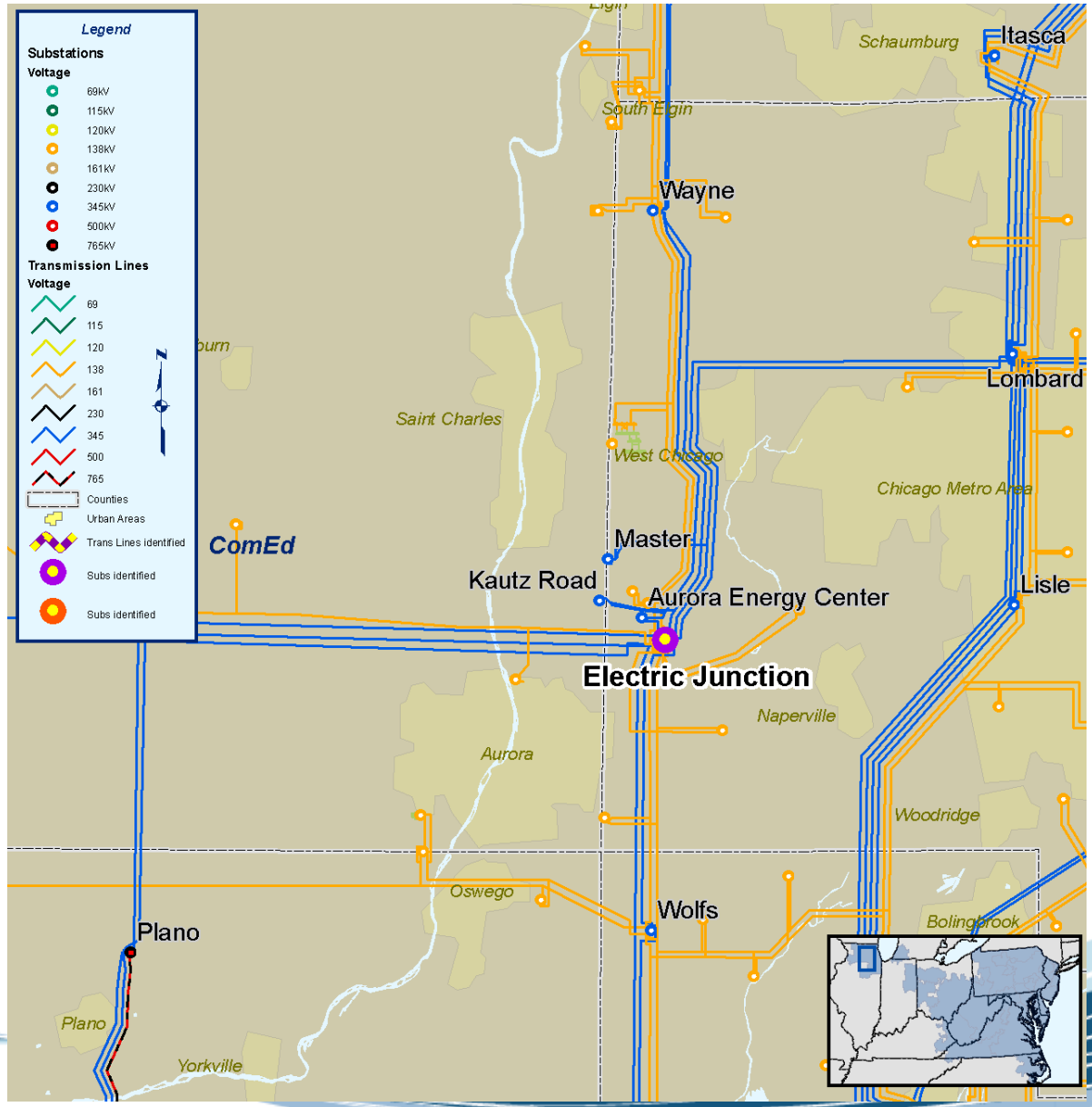
- Thermal overload of 138 kV line 0902 between E. Frankfort TSS 66 and Davis Creek TSS 86 tap for the loss of East Frankfort – Matteson 138 kV
- Solution: Increase the capacity of the overloaded section
- Expected IS Date: 6/01/2013
- Cost Estimate: TBD



ComED Supplemental Upgrades

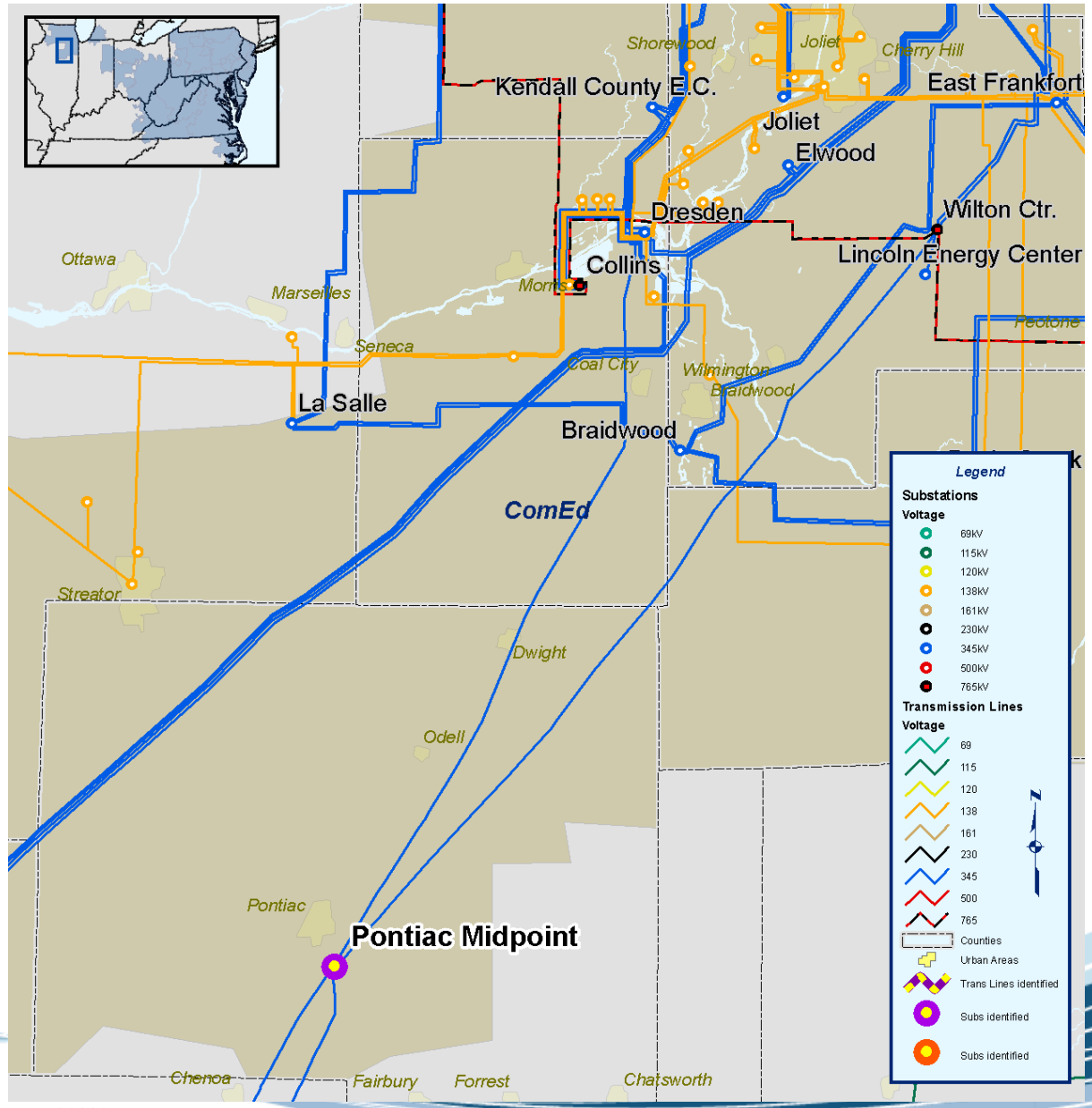
ComEd Supplemental Upgrade

- Provide new service to a data customer west of Electric Junction on lines 11104 & 11106
- Supplemental Project
- Expected IS Date: 6/01/2013



ComEd Supplemental Upgrade

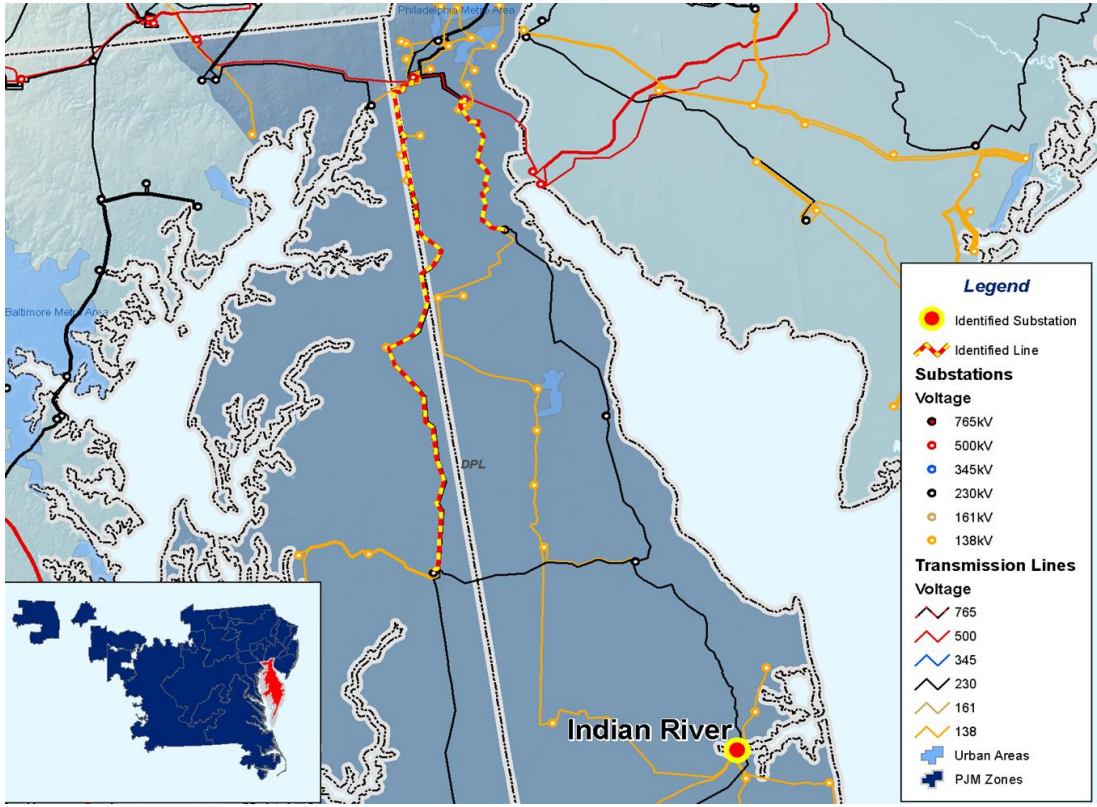
- Add 345/138 kV Transformer 81 at Pontiac to serve a new customer interconnection
- Supplemental Project
- Expected IS Date: 6/01/2013



Delmarva Baseline

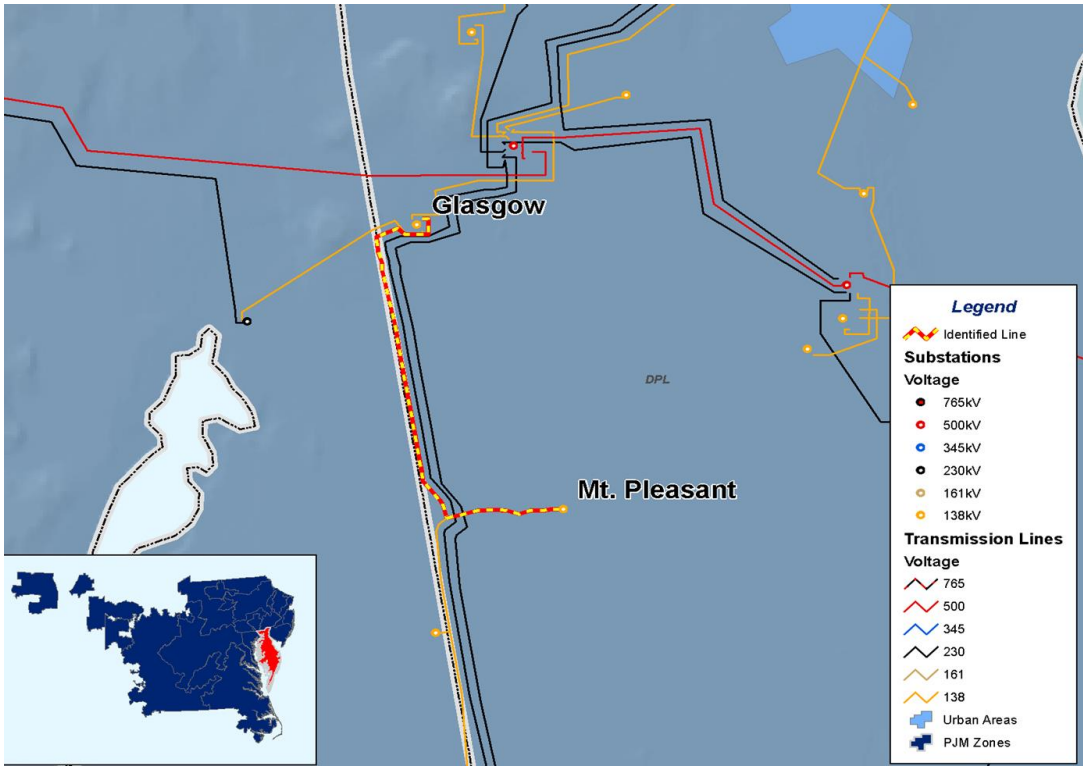
Load Deliverability Violation - Delmarva

- Voltage collapse / loss of Indian River unit 3
- Voltage collapse / loss of Cedar Creek - Red Lion 230 kV line
- Voltage collapse / loss of Keeney - Steele 230 kV line
- Recommended Solution: Convert the 138 kV network path from Vienna to Loretto to Piney Grove to 230 kV and add 230/138 kV transformer at Loretto 230 kV station
- Estimated cost: $40M
- Expected in-service date: June 1, 2013



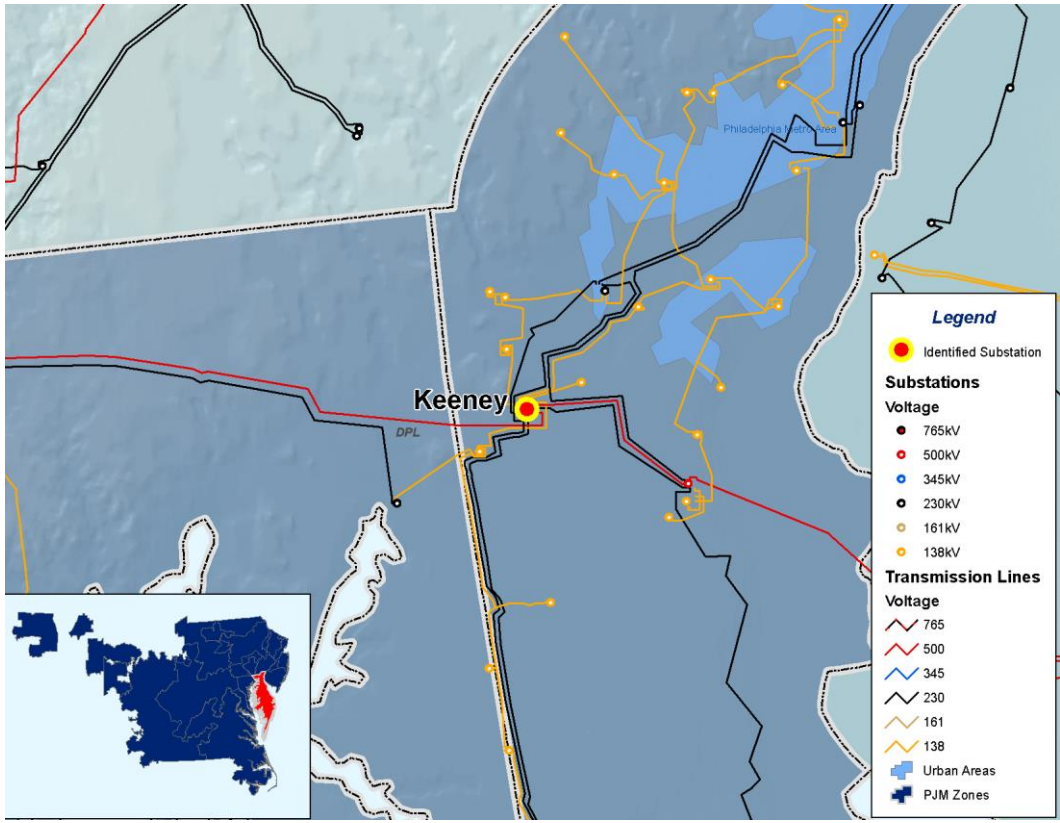
Load Deliverability Violation - Delmarva South

- Glasgow - Mt. Pleasant 138 kV line / loss of Lums Pond - Reybold 138 kV line
  - See solution for the same line on Delmarva load deliverability violation slide
- Delmarva South load deliverability test also has same voltage violations as Delmarva load deliverability as well as several issues on the underlying 138 kV and 69 kV
  - See solution for the same voltage issues on Delmarva load deliverability violation slide



Generation Deliverability Violation – Delmarva

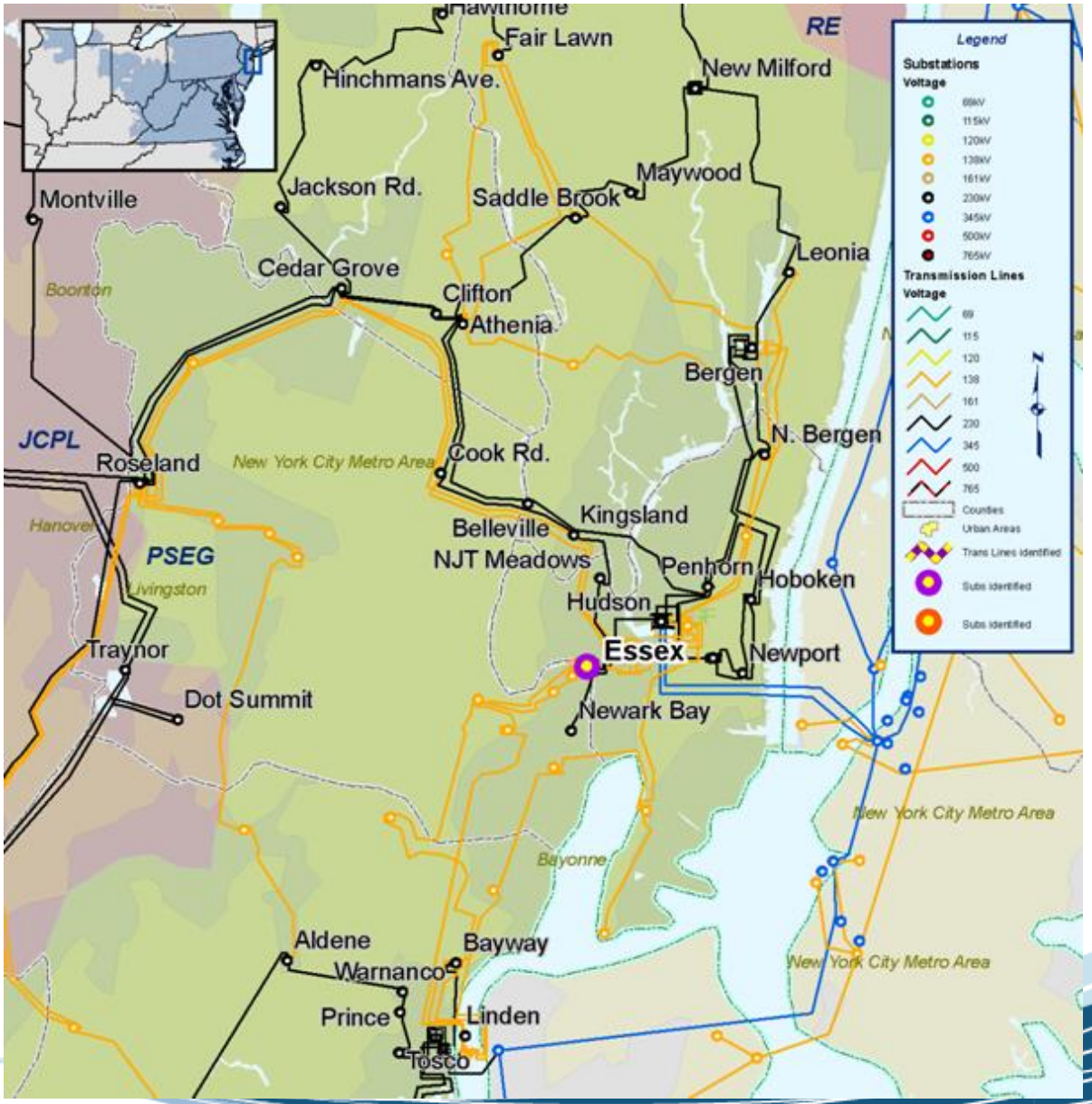
- Keeney 500/230 kV transformer CKT 1 / Loss of Keeney – Red Lion + Keeney 500/230 kV transformer CKT 2 (Line_FB)
- Keeney 500/230 kV transformer CKT 2 / Loss of Keeney – Red Lion + Keeney 500/230 kV transformer CKT1 (Line_FB)
- Recommended Solution: Add two additional breakers at Keeney 500 kV
- Estimated cost: $4.5M
- Expected in-service date: June 1, 2013



Short Circuit Upgrades

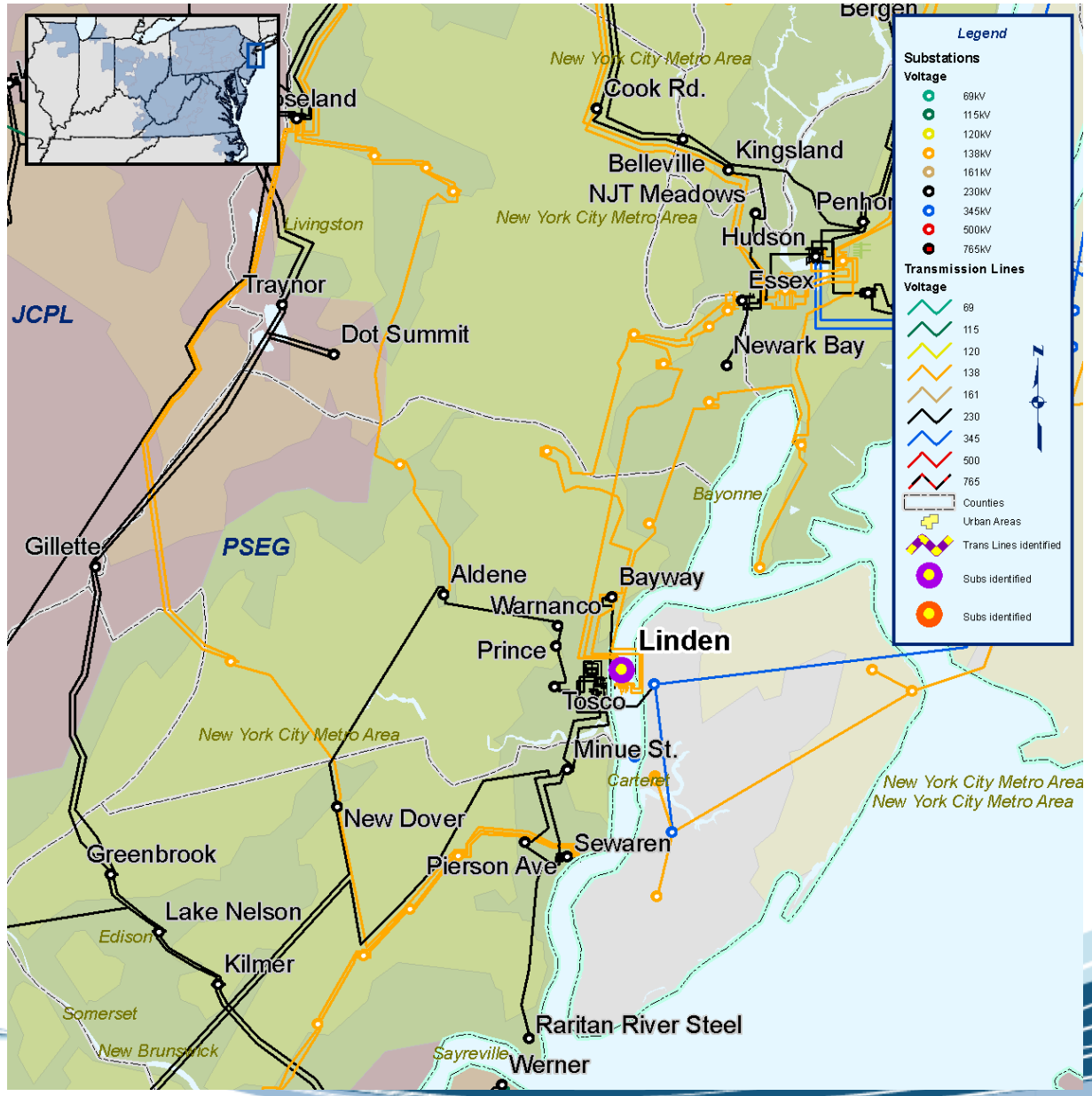
PS Breaker Upgrades

- Replace Essex 138 kV breakers 4LM, 1LM, 1BM, 2BM
- Estimated Project Cost: $0.400 M per breaker
- Expected IS Date: 6/01/2009



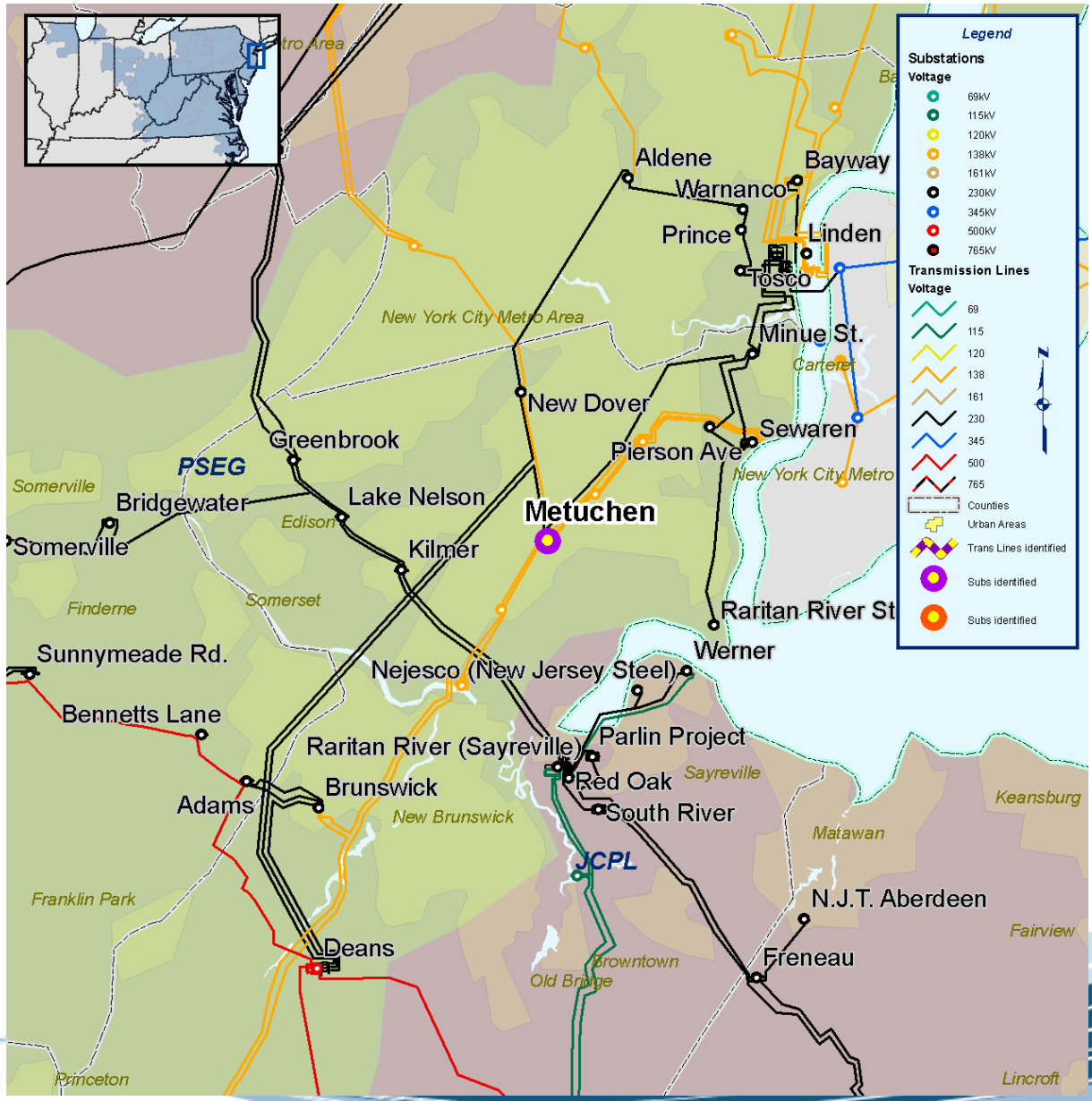
PS Breaker Upgrades

- Replace Linden 138 kV breaker 3
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2009



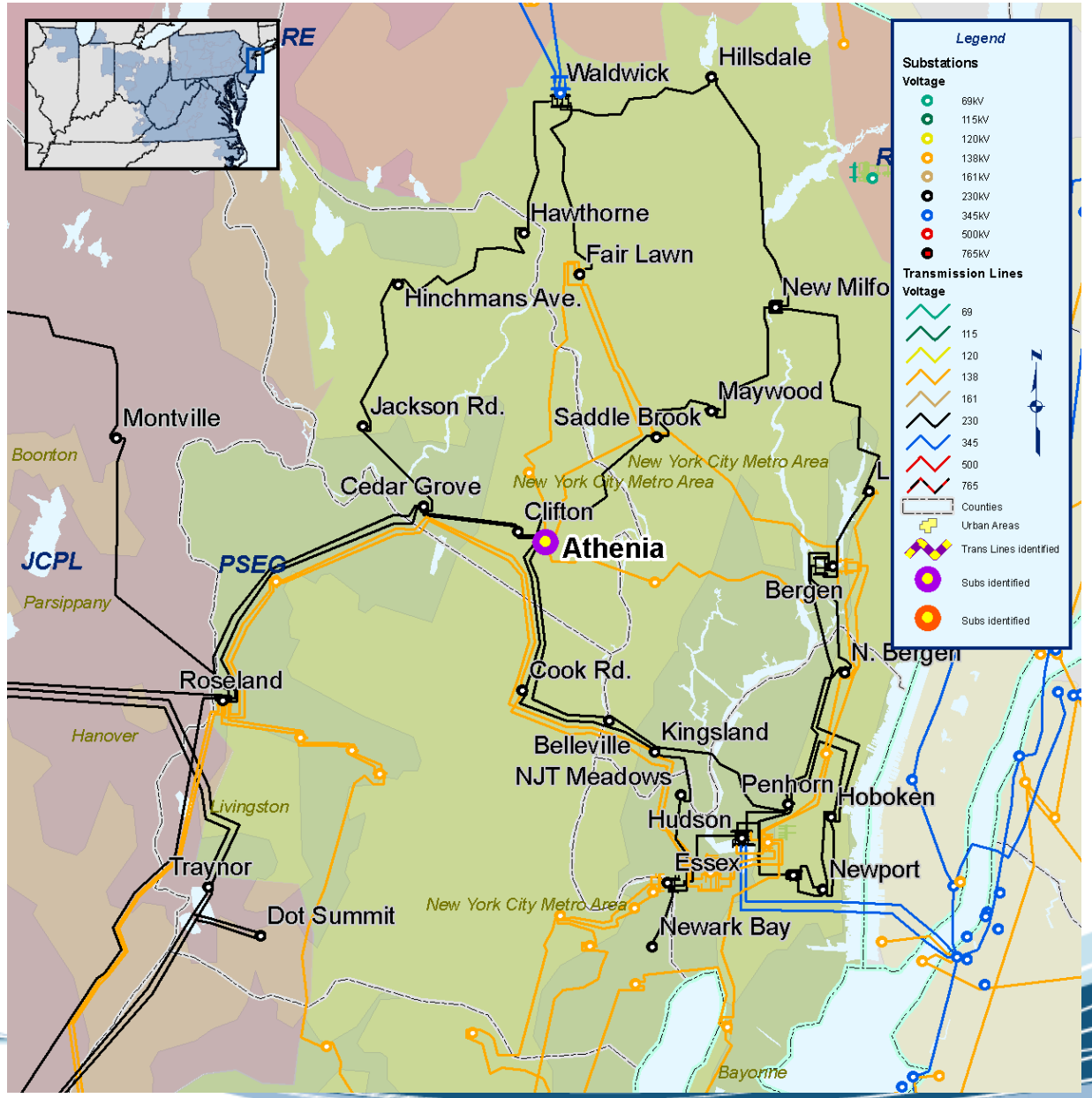
PS Breaker Upgrades

- Replace Metuchen 138 kV breaker '2-2 transfer'
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2009



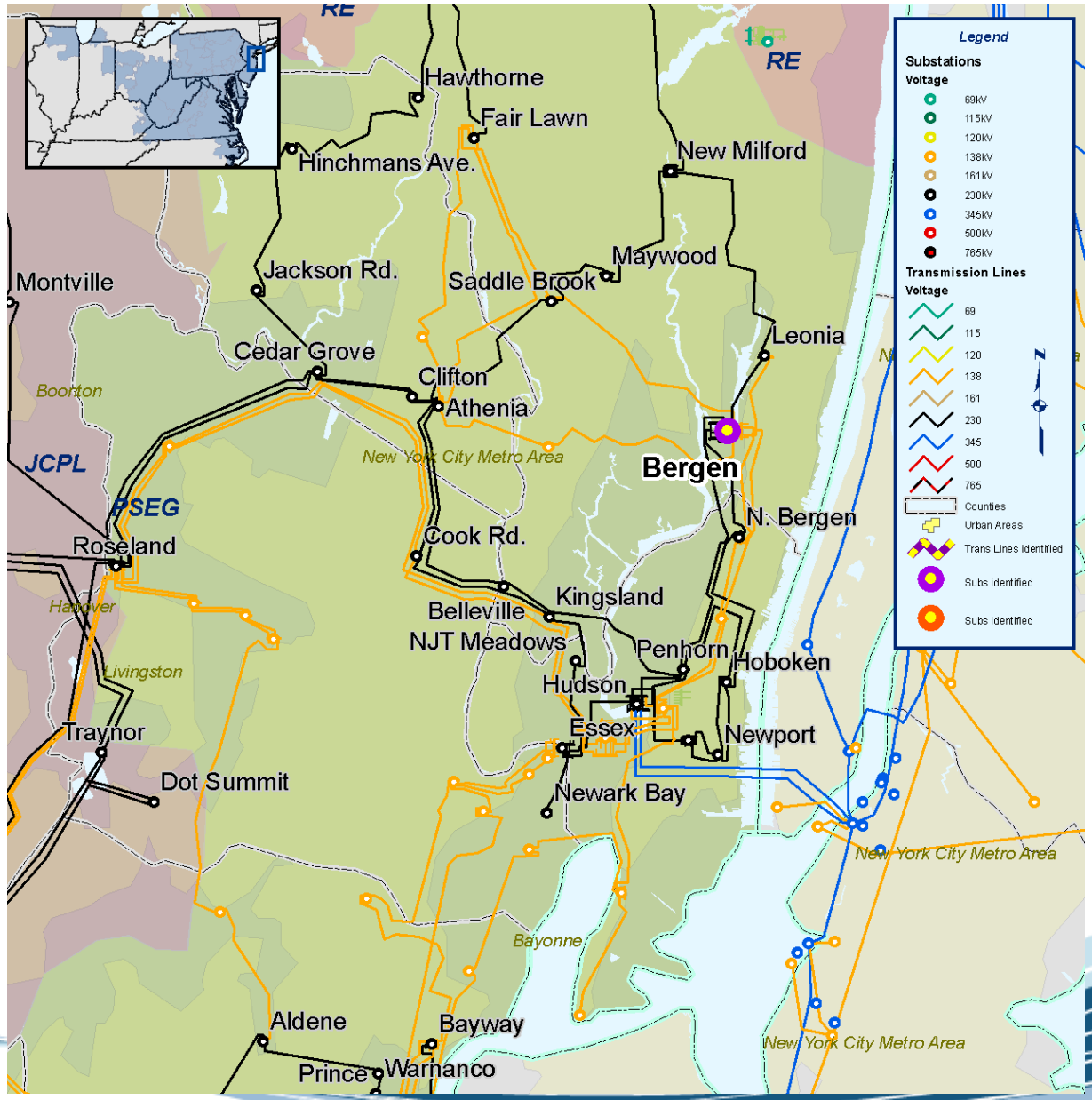
PS Breaker Upgrades

- Replace Athenia 230 kV breaker 31H
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2012



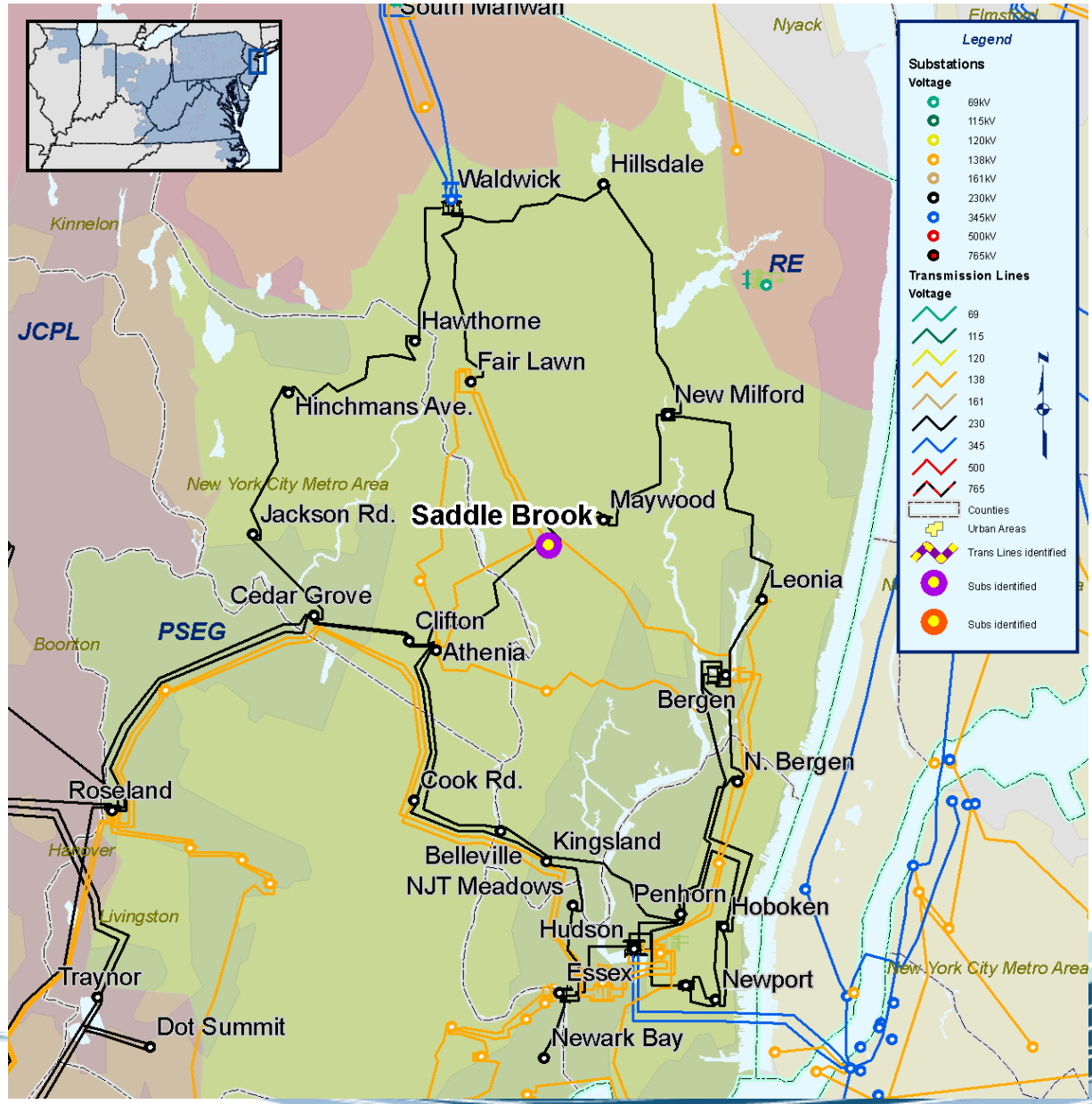
PS Breaker Upgrades

- Replace Bergen 230 kV breaker 10H
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2012



PS Breaker Upgrades

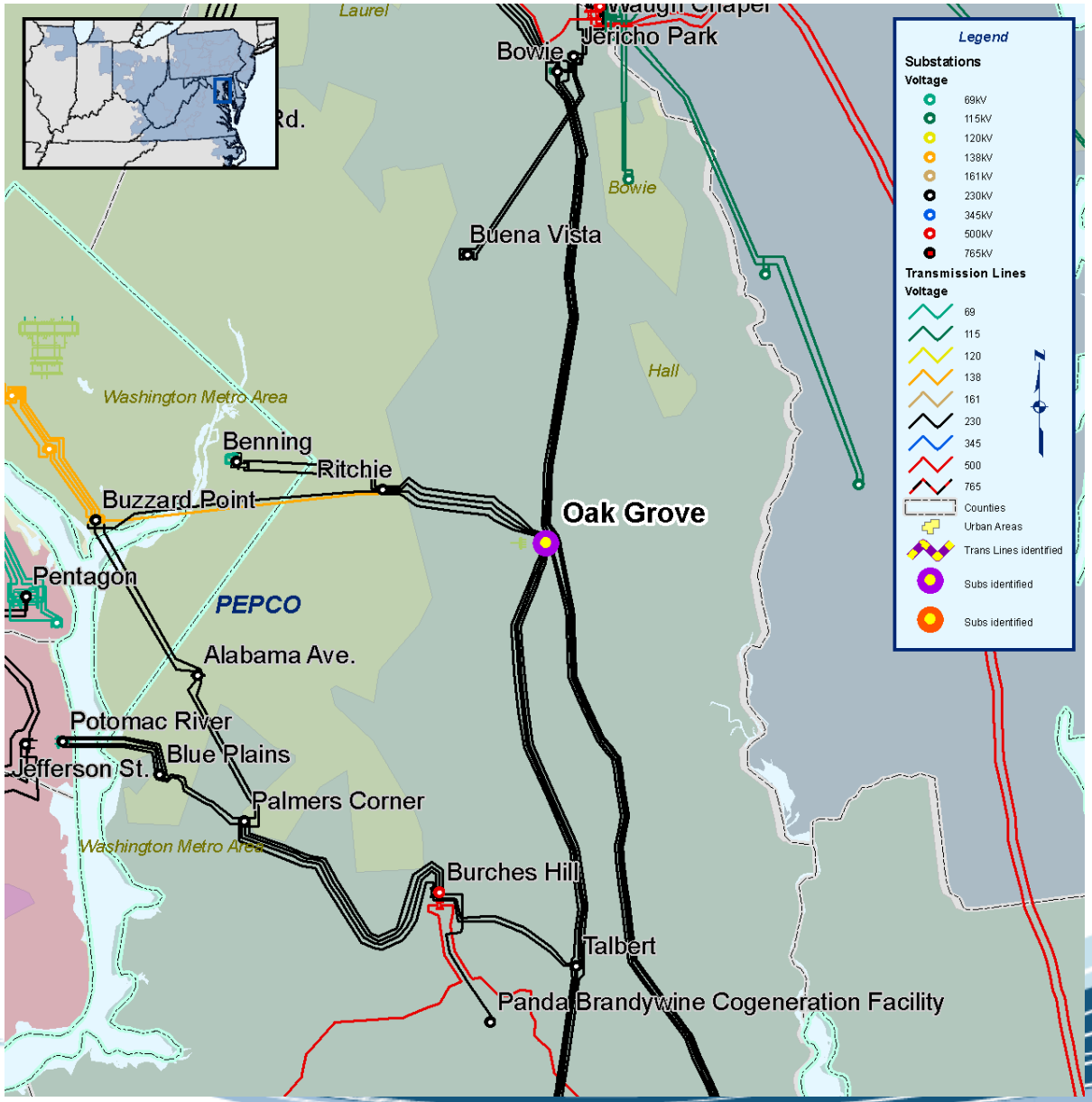
- Replace Saddlebrook 230 kV breaker 21P
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2012



PEPCO Breaker Upgrades

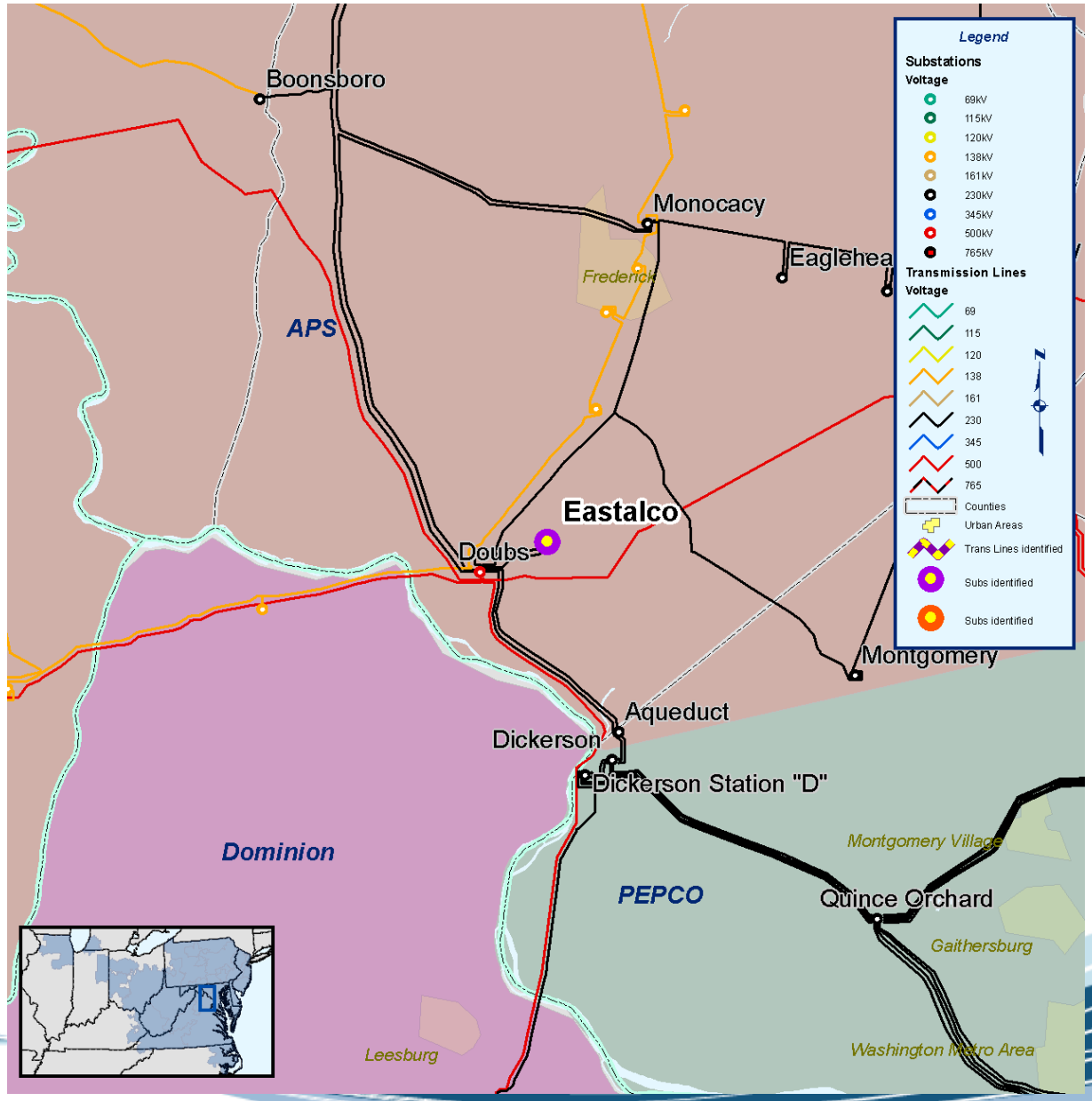
- Replace 13 Oak Grove 230 kV breakers
- Original Driver: Q48 – Calvert Cliffs nuclear project due in 12/15/2015
- Baseline driver: PEPCO 2012 Baseline upgrades
- Estimated Cost:

  $1.5 M per breaker
- Expected IS Date: 6/01/2012



AP Breaker Upgrades

- Replace Eastalco 230 kV breaker D-26, D-28, and D-31
- Estimated Project Cost: $0.300 M per breaker
- Expected IS Date: 6/01/2012

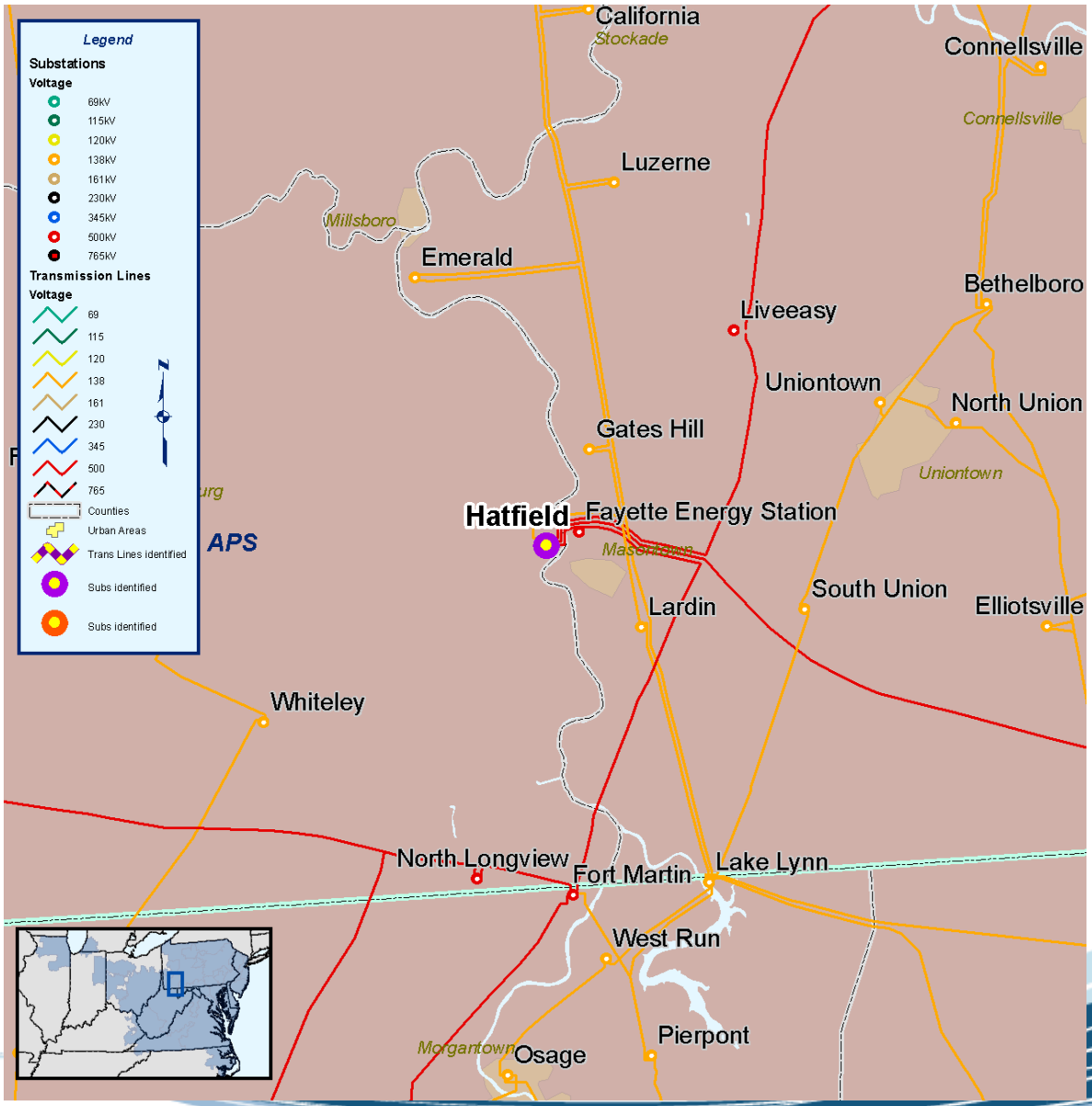


Previously Reviewed Upgrades for PJM Board Approval

APS Baseline Upgrades

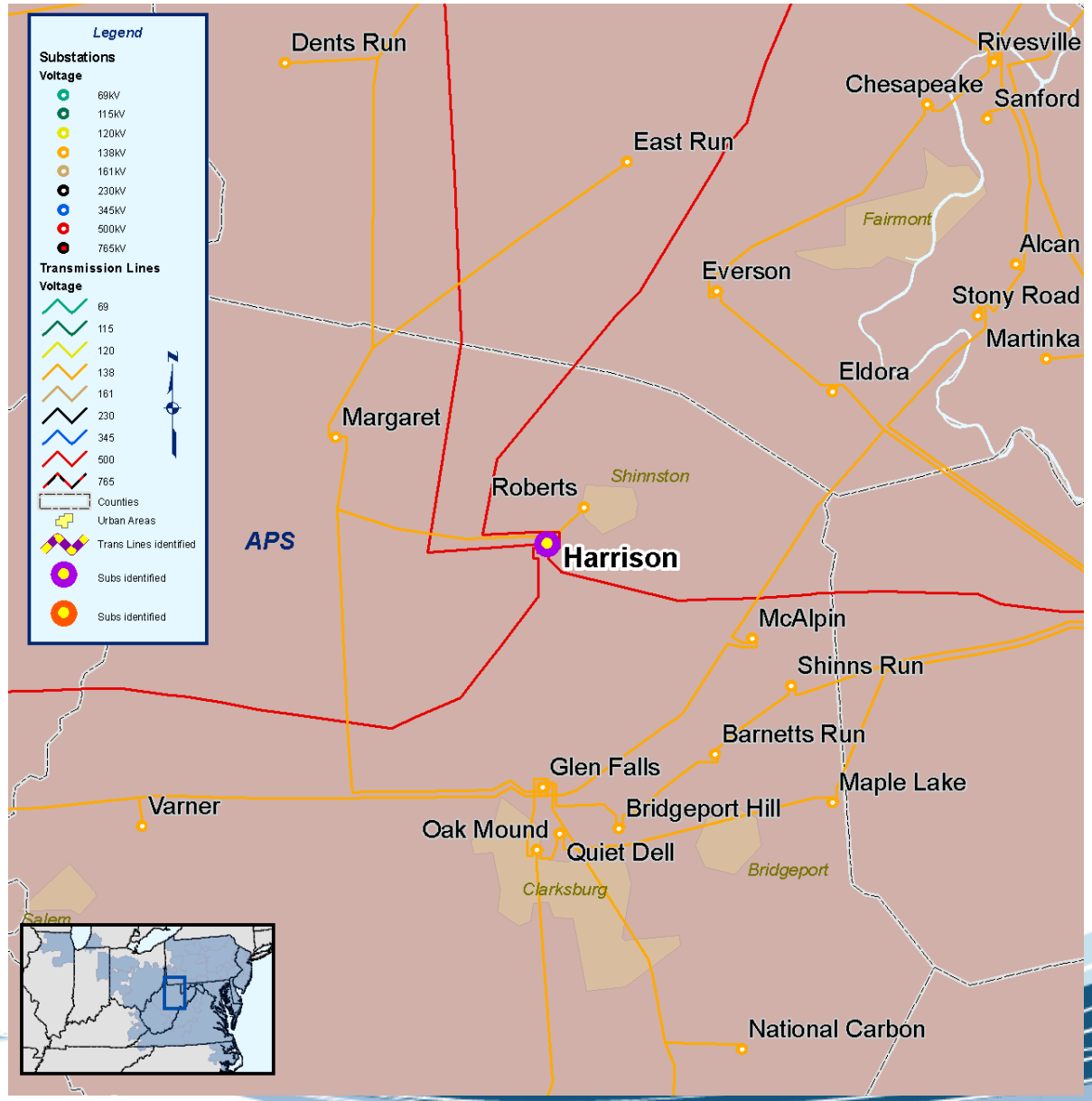
APS Short Circuit Baseline Upgrades

- Upgrade (per ABB inspection) Hatfield 500 kV breakers due to Short Circuit
  - HFL-1
  - HFL-3
  - HFL-4
  - HFL-6
  - HFL-7
  - HFL-9
- Estimated Project Cost: $60K per breaker
- IS Date: 6/1/2011



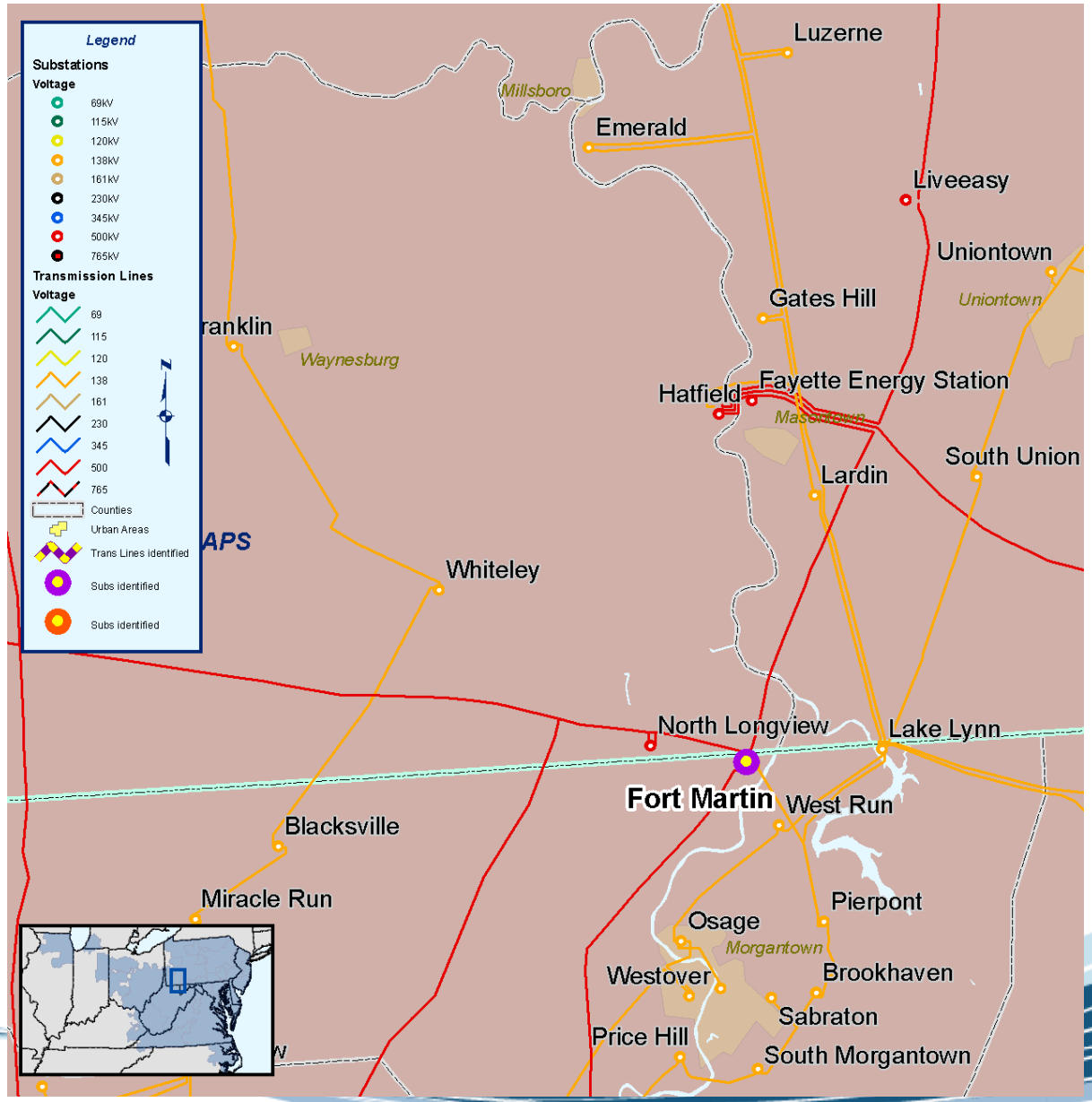
APS Short Circuit Baseline Upgrades

- Replace Harrison 500 kV breaker HL-3
- Estimated Cost: $0.7M
- Upgrade (per ABB inspection) Harrison 500 kV breakers due to Short Circuit
  - HL-6
  - HL-7
  - HL-8
  - HL-10
- Estimated Cost: $60K per breaker
- IS Date: 6/1/2011



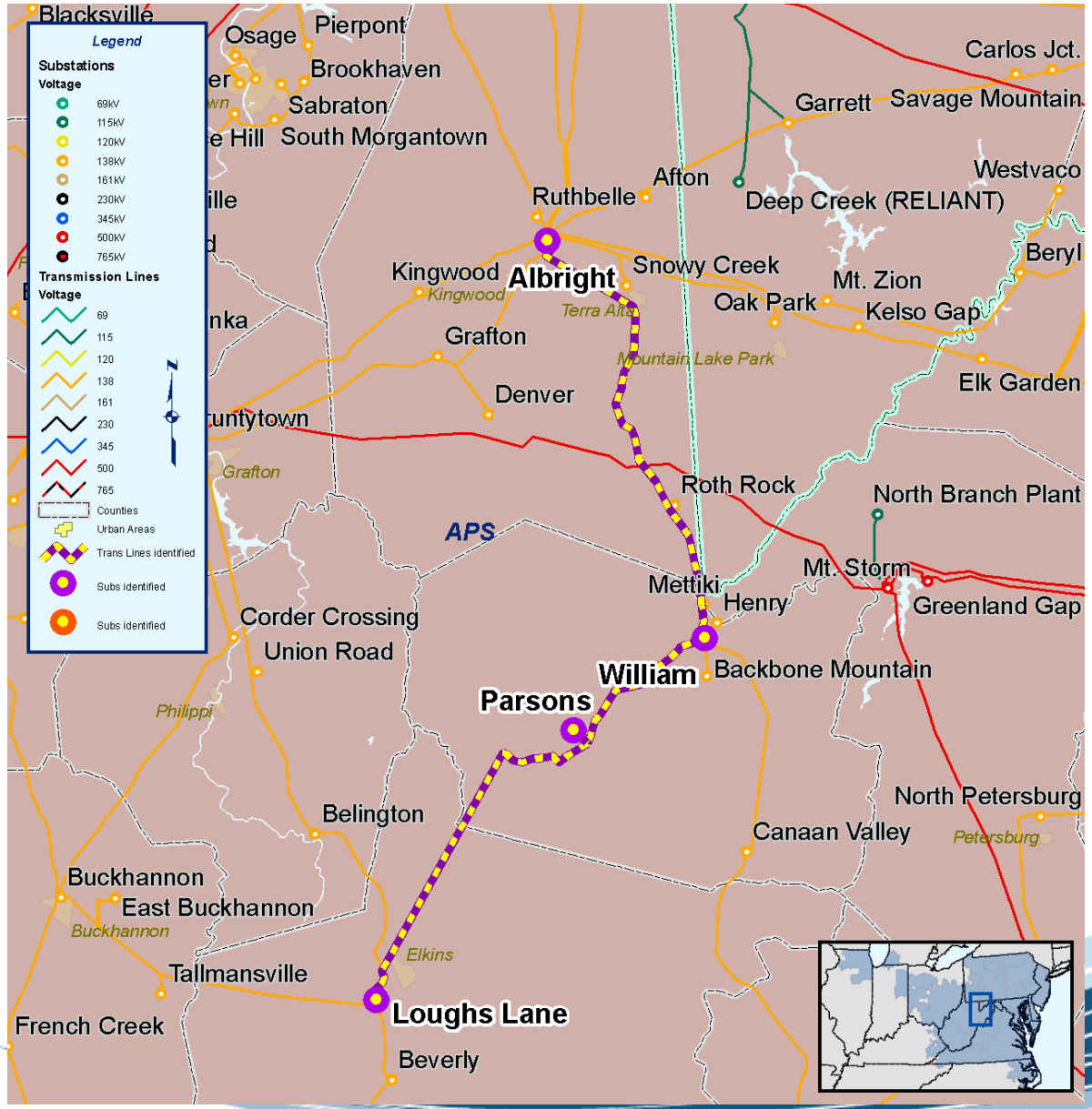
APS Short Circuit Baseline Upgrades

- Replace Fort Martin 500 kV breaker 'FL-1'due to Short Circuit
- Estimated Project Cost: $ 0.7 M
- IS Date: 6/1/2011



APS Baseline Upgrades

- Generator Deliverability Problem: The Albright – Loughs Lane 138 kV path is overloaded for various Category C contingencies on the 138 kV system in West Virginia
- Solution: Reconductor Albright - Mettiki - William - Parsons - Loughs Lane 138 kV with 954 ACSR
- Estimated Project Cost: $14.7M
- IS Date: 6/1/2011

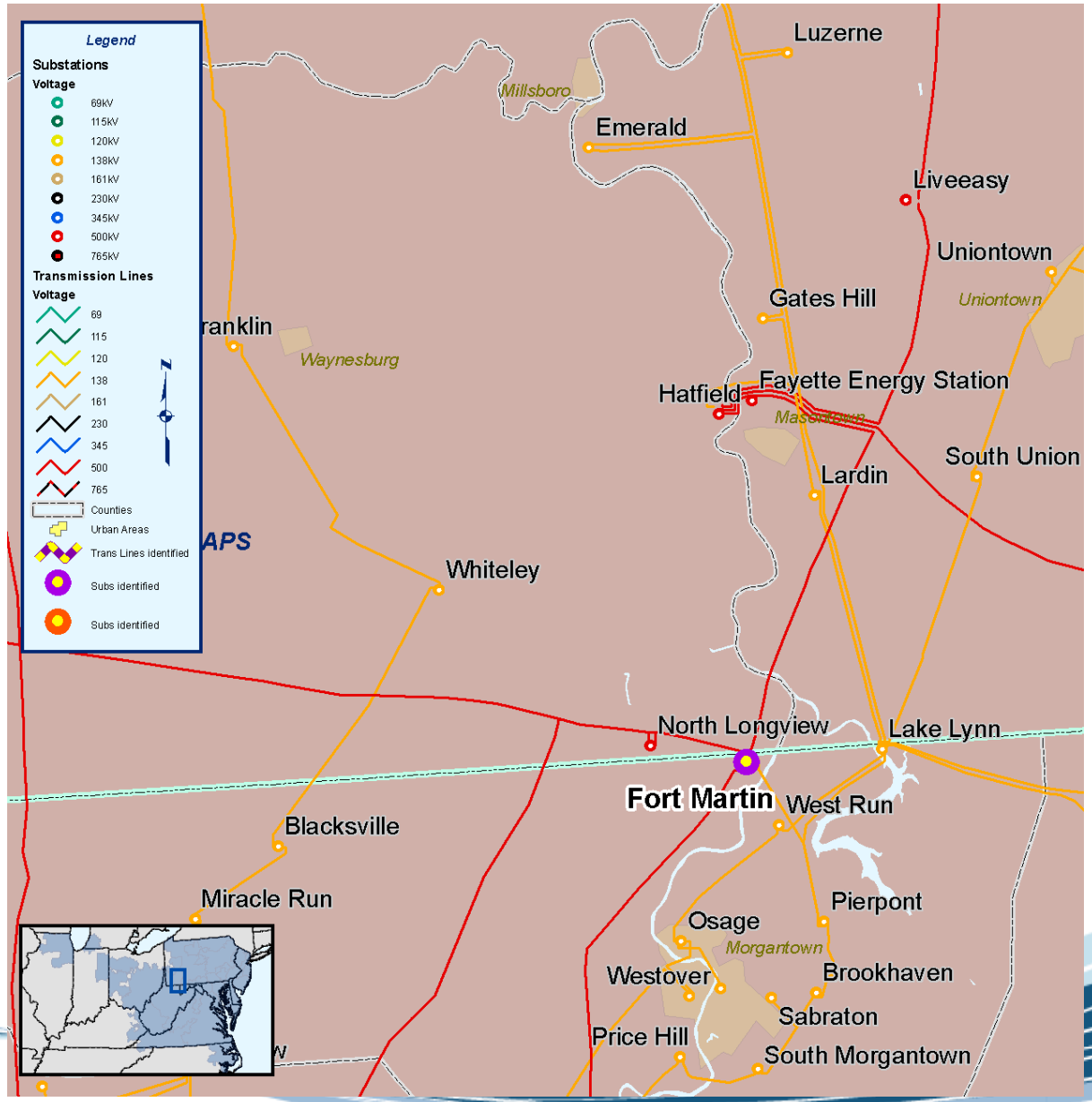


APS Baseline Upgrades

- Generator Deliverability Problem: Overload of Butler – Cabot 138 kV ckt “E” for the loss of the parallel circuit and Cabrey Junction 138 kV
- Solution: Reconfigure circuits in the Butler - Cabot 138 kV
- Estimated Project Cost: $ 1.18 M
- IS Date: 6/1/2012

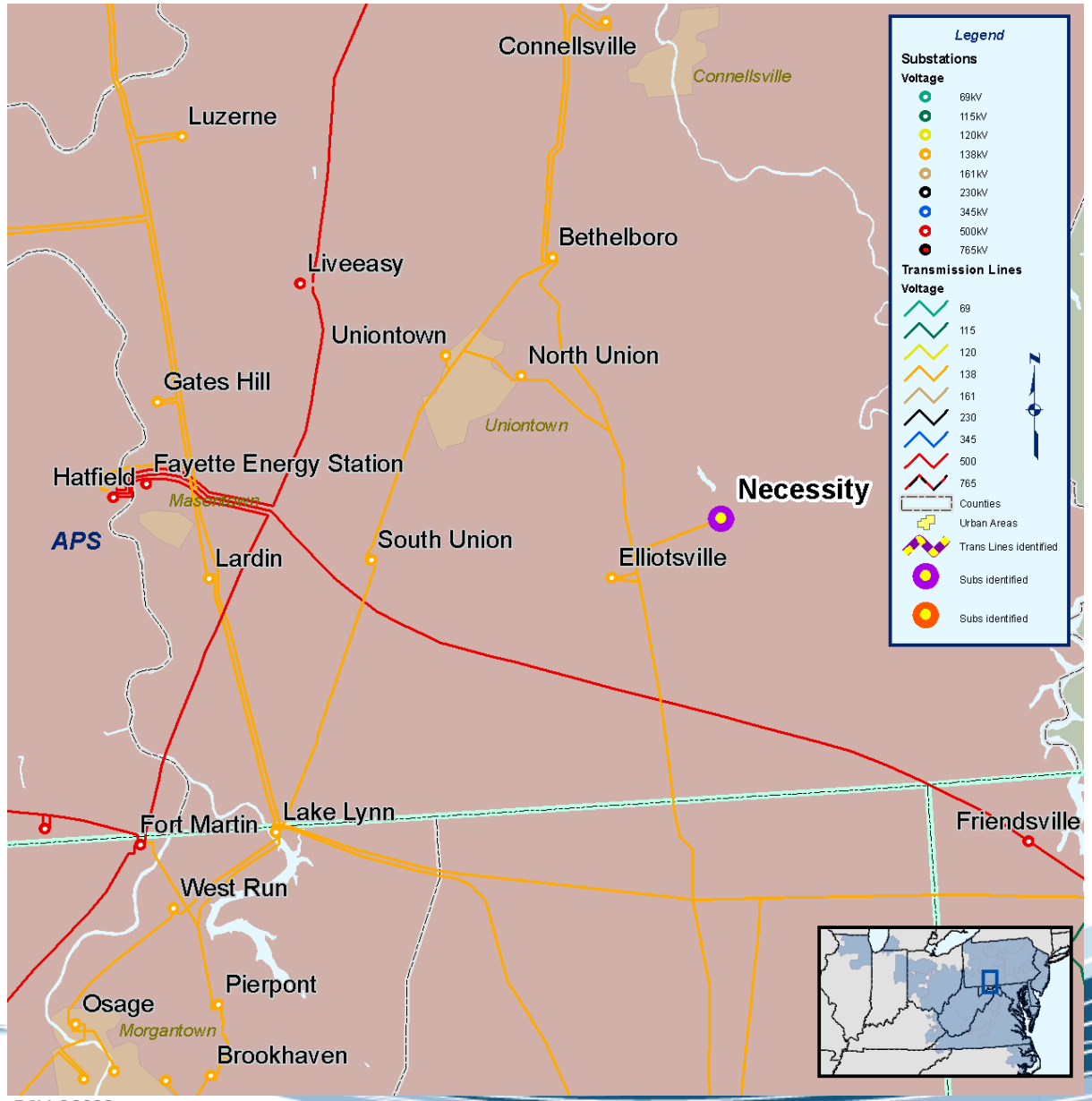
APS Baseline Upgrades

- Replace Fort Martin 500 kV breaker 'FL-1'due to Short Circuit
- Estimated Project Cost: $ 0.7 M
- IS Date: 6/1/2011



APS Baseline Upgrades

- Install 33 MVAR 138 kV Capacitor at Necessity due to Low Voltage Magnitude for the loss of Bethelboro – North Union Tap 138 kV
- Estimated Project Cost: $ 0.77 M
- IS Date: 6/1/2009

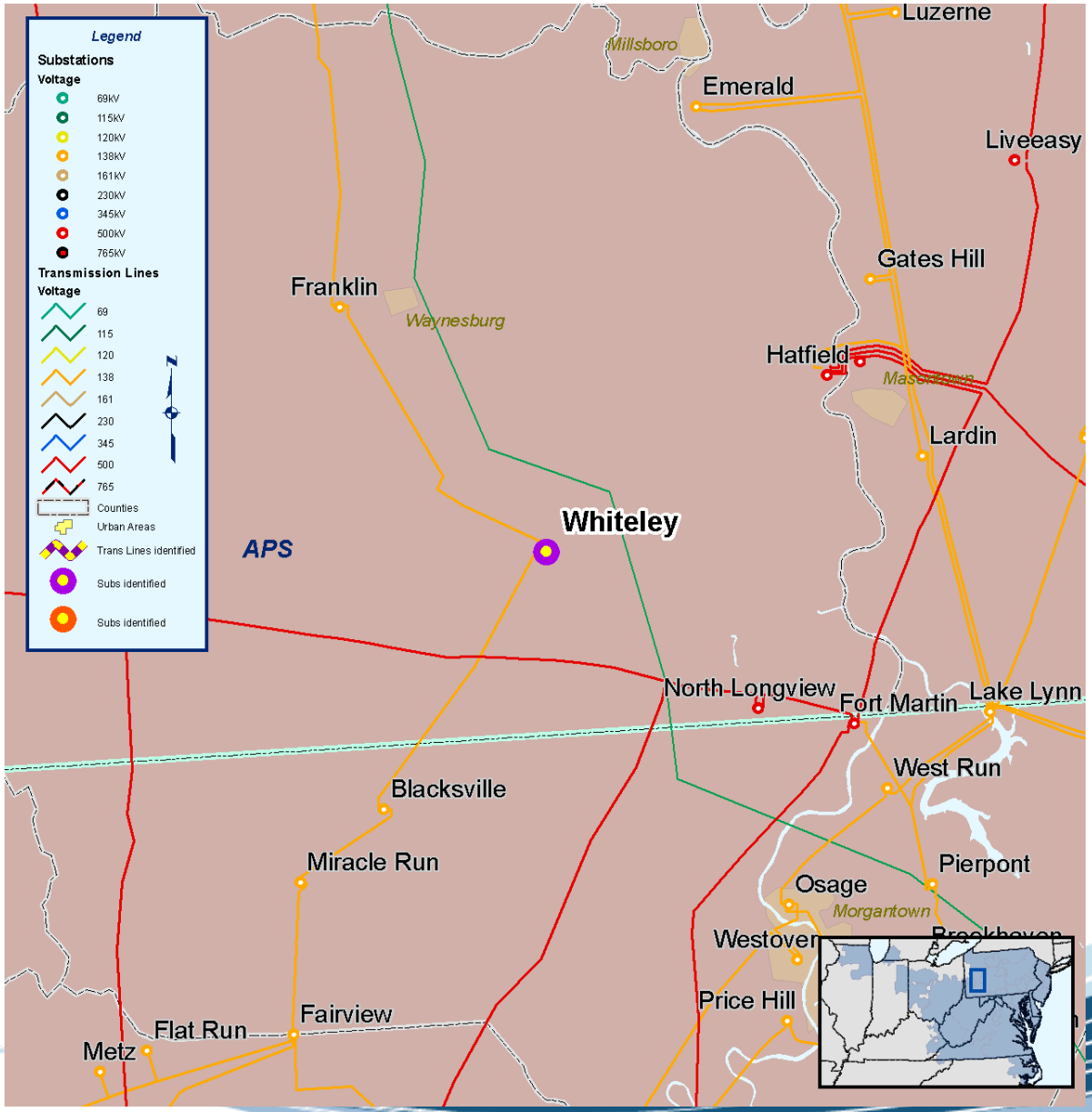


APS Baseline Upgrades

- Increase Cecil 138 kV Capacitor size to 44 MVAR due to low voltage magnitude for the loss of Wylie Ridge – Smith 138 kV
- Estimated Project Cost: $ 0.1 M
- IS Date: 6/1/2010
- Replace five 138 kV breakers at Cecil due to increased Short Circuit fault duty as a result of the addition of the Prexy substation
- Estimated Project Cost: $ 0.45 M
- IS Date: 6/1/2010

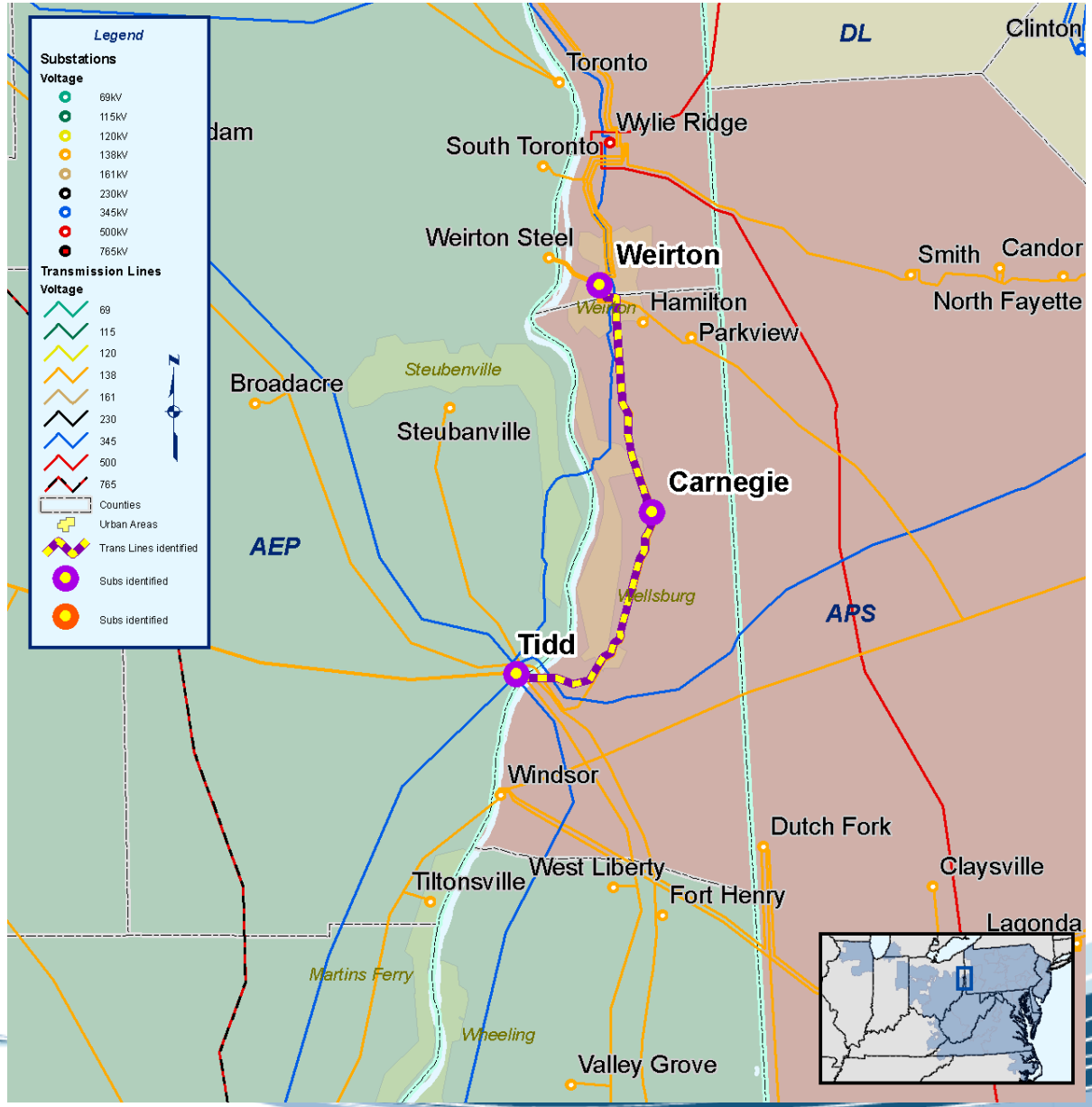
APS Baseline Upgrades

- Increase Whiteley 138 kV Capacitor size to 44 MVAR due to Low Voltage Magnitude for the loss of Fairview – Miracle Run 138 kV
- Estimated Project Cost: $ 0.64 M
- IS Date: 6/1/2010



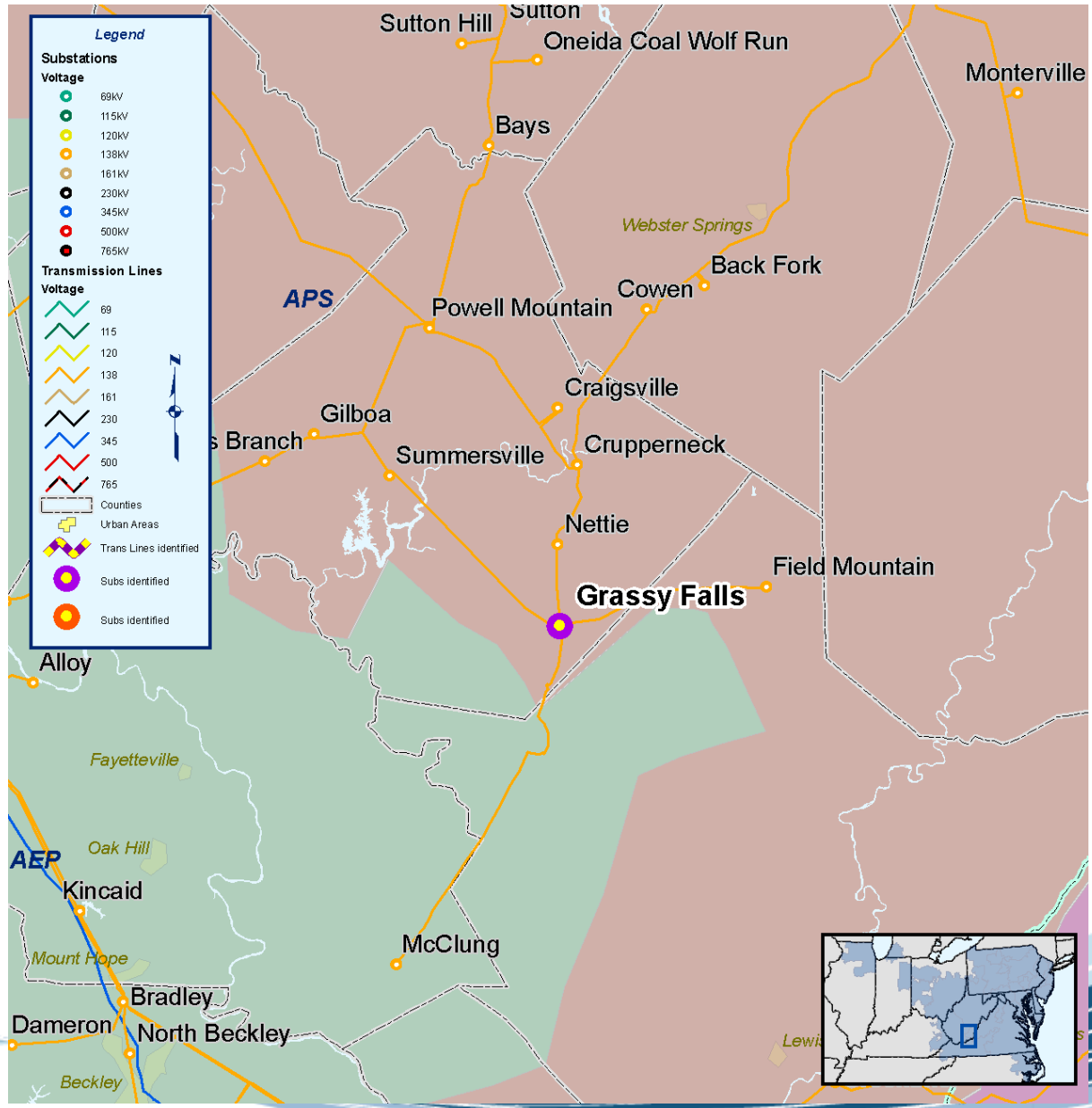
APS Baseline Upgrades

- Problem: Thermal overload of Tidd – Carnegie – Weirton 138 kV for the loss of Tidd – Mahans Lane 138 kV
- Solution: Reconductor AP portion of Tidd - Carnegie 138 kV and Carnegie - Weirton 138 kV with 954 ACSR due to Thermal Overload
- Estimated Project Cost: $ 3.16 M
- IS Date: 6/1/2011



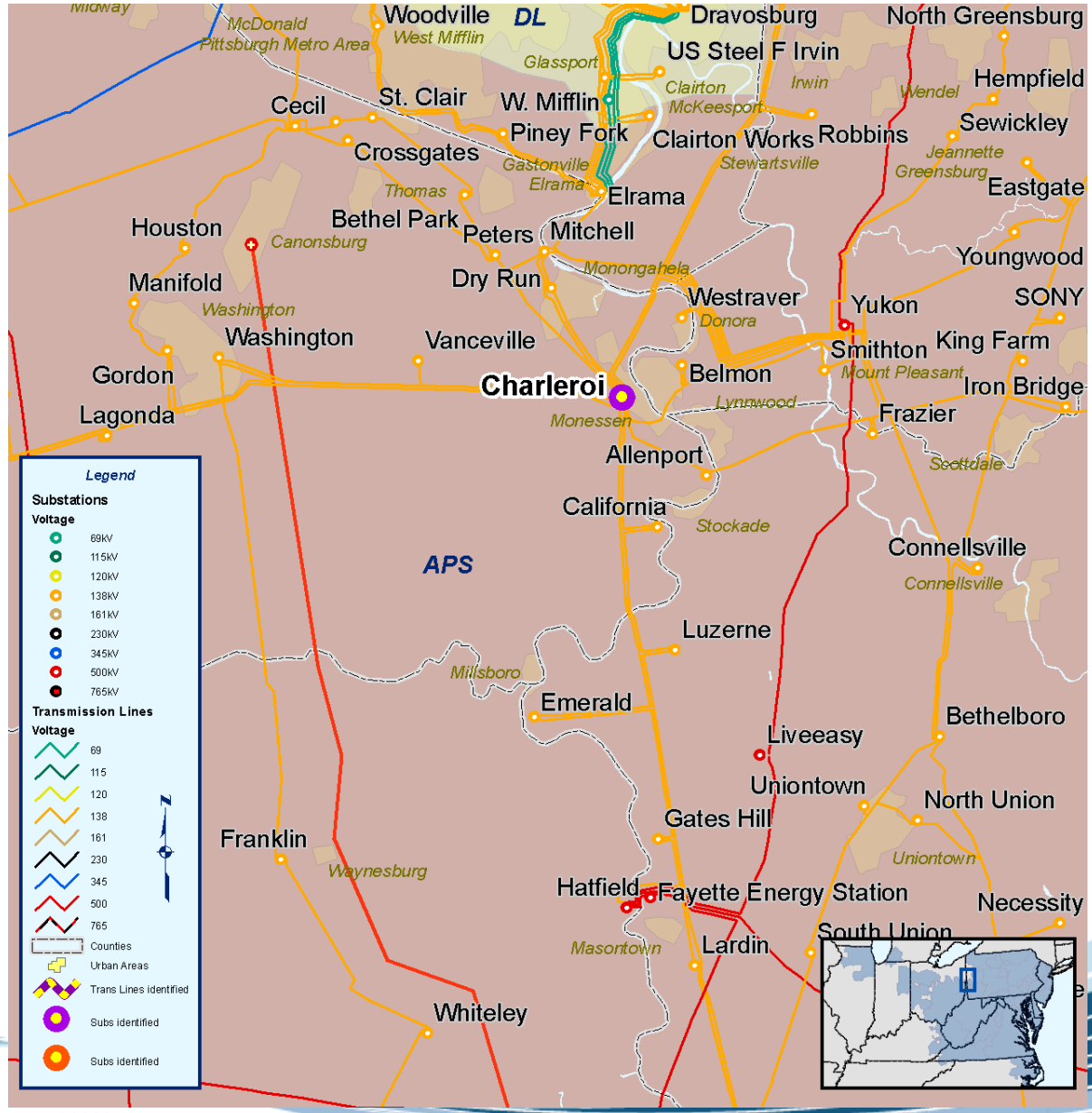
APS Baseline Upgrades

- Install 40.8 MVAR 138 kV capacitor at Grassy Falls due to Voltage Magnitude for a stuck breaker at Powell Mountain 138 kV
- Estimated Project Cost: $ 0.5 M
- IS Date: 6/1/2010



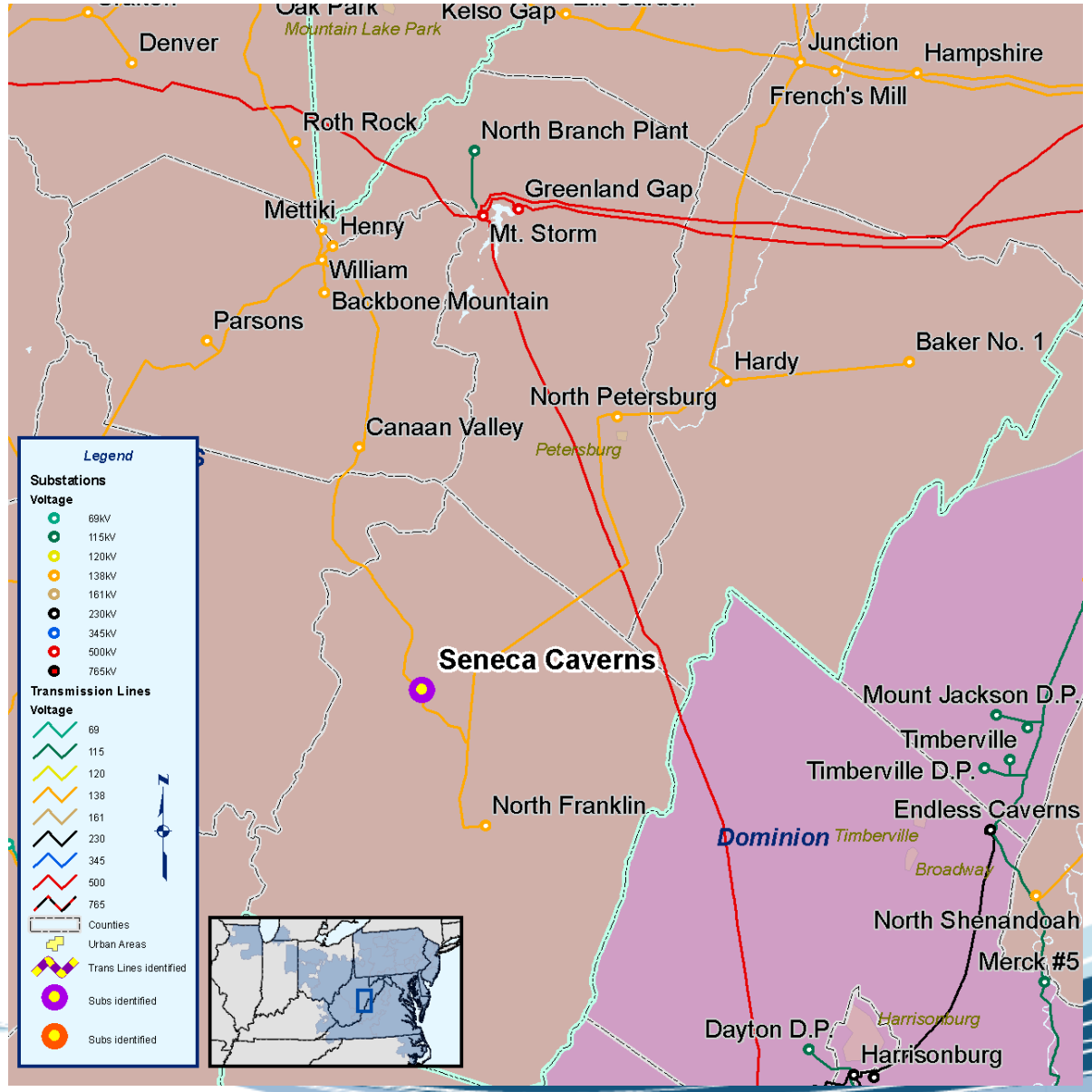
APS Baseline Upgrades

- Replace #1 and #2 138 kV breakers at Charleroi due to increased Short Circuit fault duty as a result of the addition of the Prexy substation
- Estimated Project Cost: $ 0.45 M
- IS Date: 6/1/2009



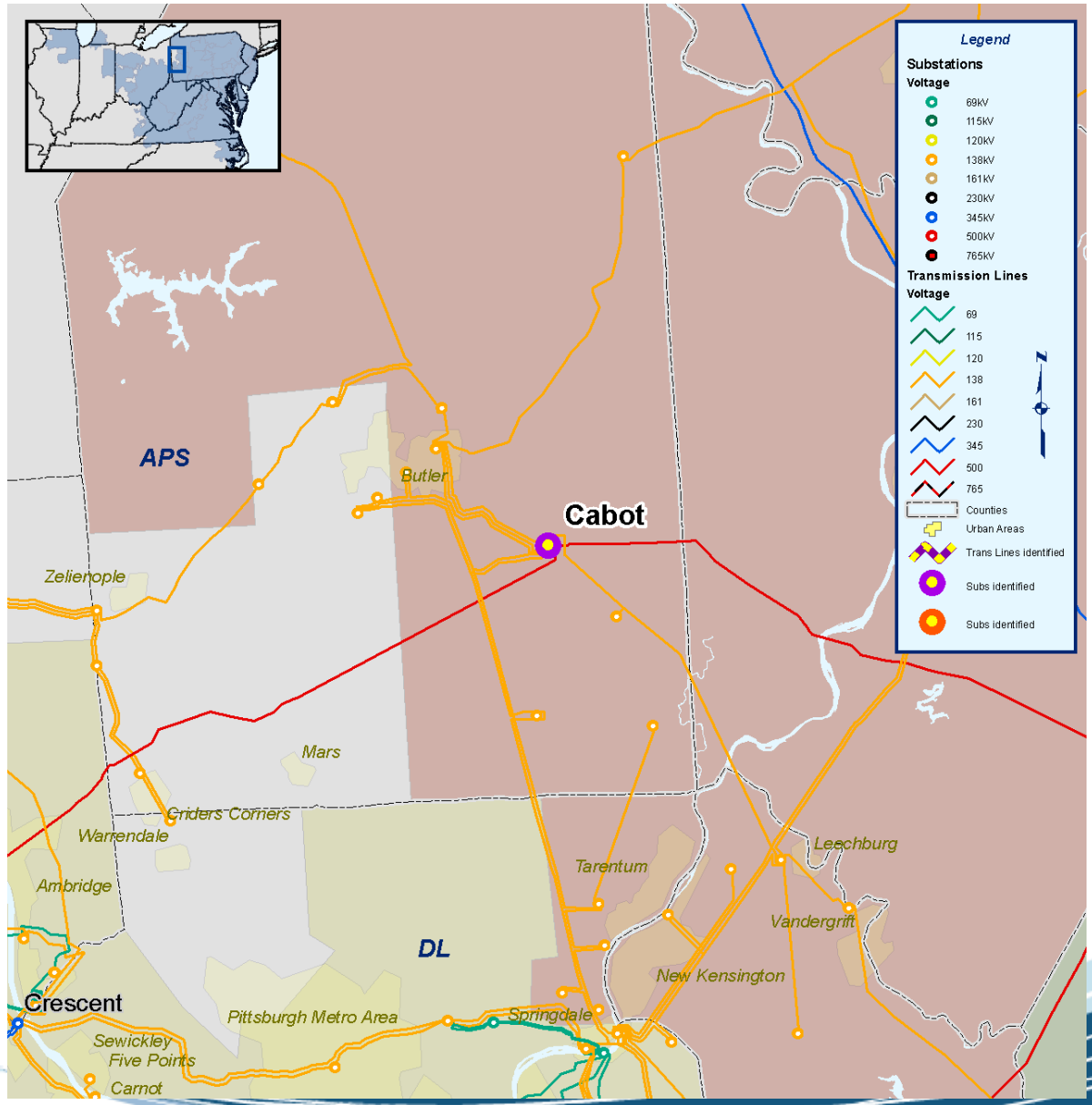
APS Baseline Upgrades

- Install 25.2 MVAR 138 kV Capacitor at Seneca Caverns due to low voltage magnitude for the loss of Hardy - Junction 138 kV
- Estimated Project Cost: $ 0.63 M
- IS Date: 6/1/2010



APS Baseline Upgrades

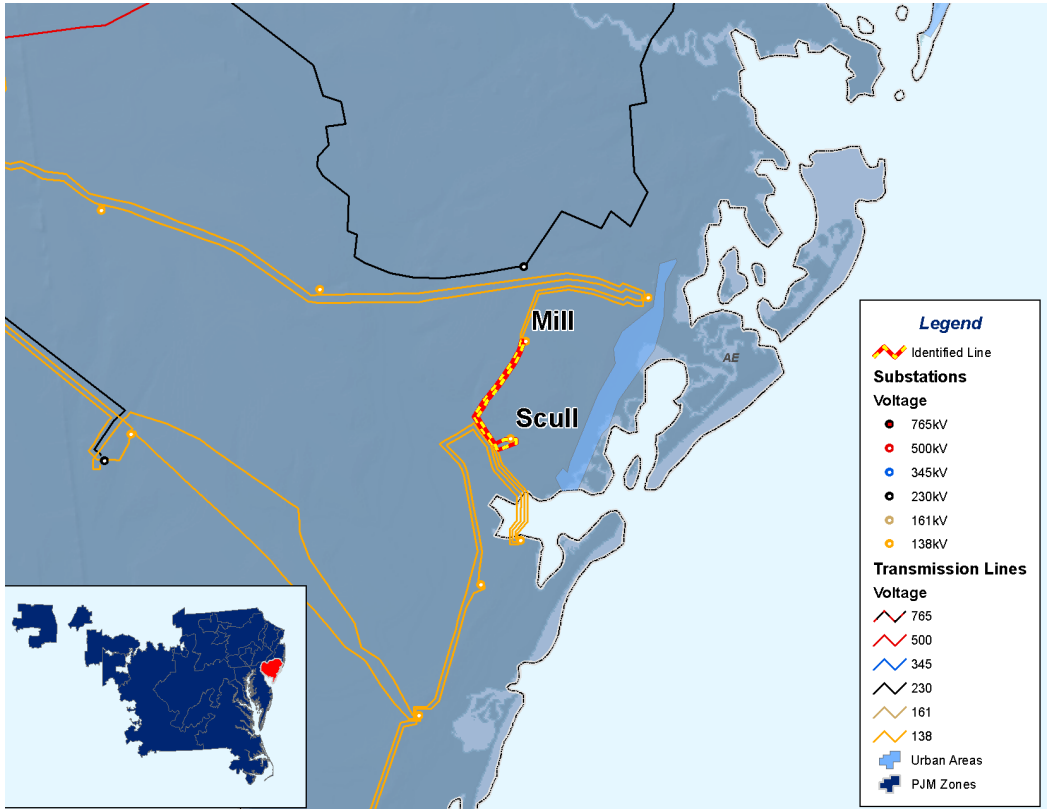
- Overload on the Cabot #1 500/138 kV for the bus fault contingency of the #2 Main 500 kV bus resulting in loss of the #2 and #4 banks,
- Estimated Project Cost: $
- IS Date: 6/1/2011



Atlantic Electric Baseline Upgrades

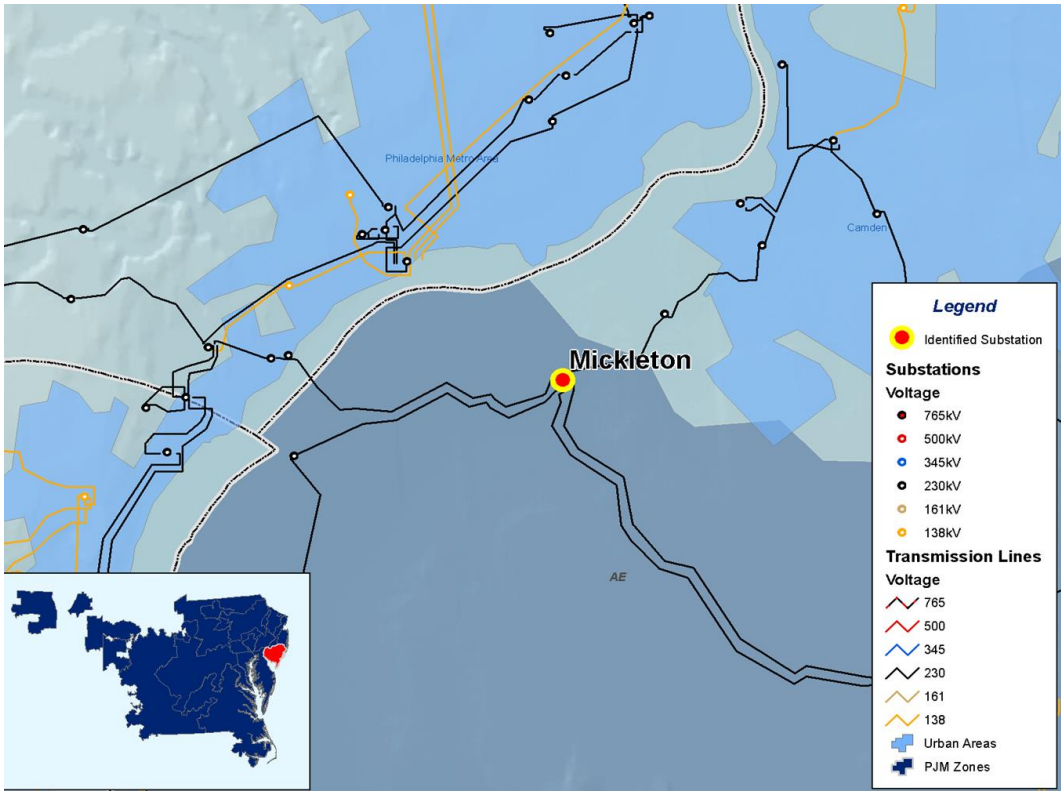
Generation Deliverability Violation – Atlantic Electric

- Scull #2 – Mill #2 138 kV line / Loss of the other circuit (Single)
- Recommended Solution: Upgrade a strand bus at MILL
- Estimated cost: $0.2M
- Expected in-service date: June 1, 2013



Load Deliverability Violation - Atlantic Electric

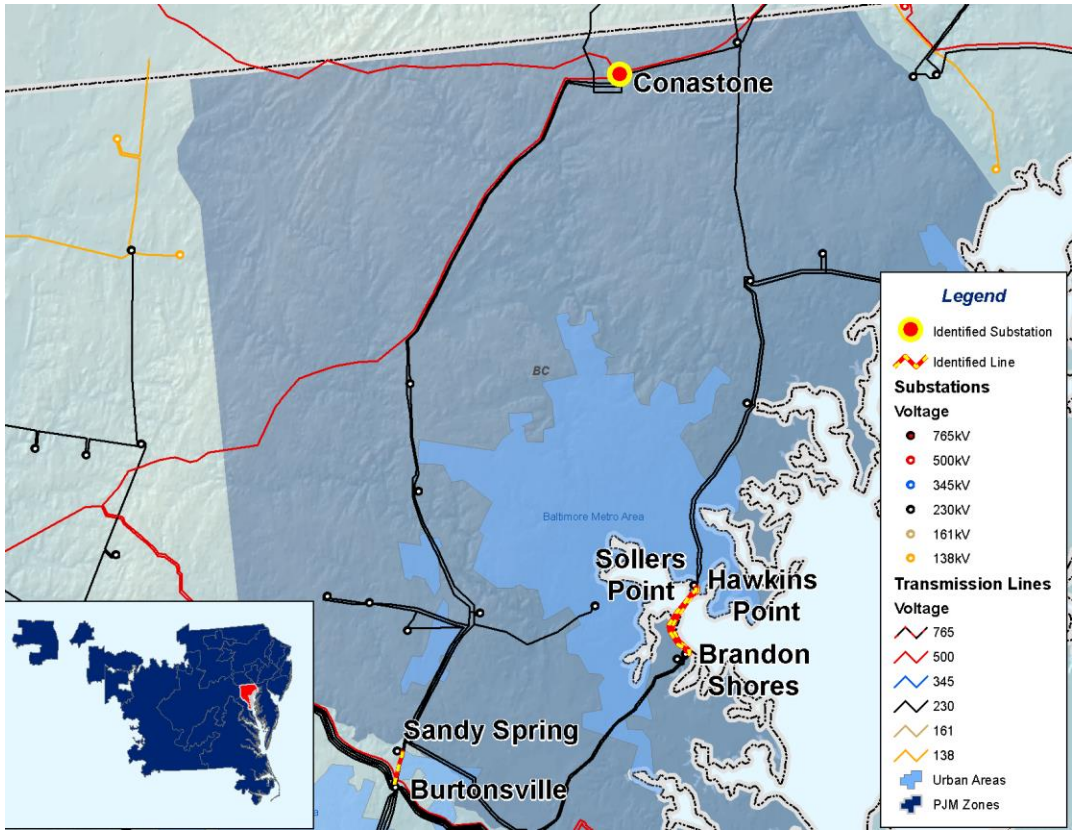
- Mickleton 230/69 kV transformer #4 / loss of the Mickleton 230/69kV transformer #1
- Recommended Solution: Move the Monroe 230/69 kV transformer to Mickleton
- Estimated cost: $1.24 M
- Expected in-service date: June 1, 2013



BG&E Baseline Upgrades

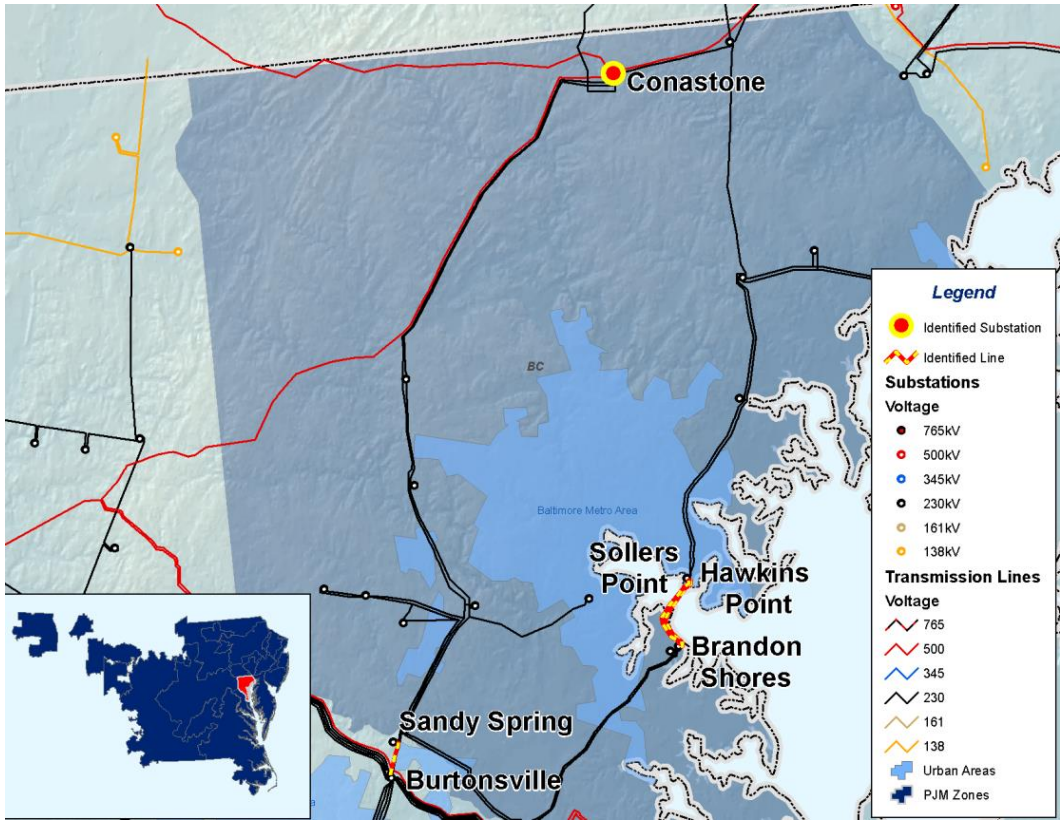
Generation Deliverability Violation – BG&E

- Brandon Shores – Hawkins Point Terminal 230 kV line / Loss of Brandon Shores – Hawkins Point Terminal – Sollers Point Terminal (#2344) 230 kV line and Brandon Shores 5T Breaker failed (Line_FB)
- Sollers Point Terminal – Riverside 230 kV line CKT 2345 / Loss of Brandon Shores – Hawkins Point Terminal – Sollers Point Terminal (#2344) 230 kV line and Brandon Shores 5T Breaker failed (Line_FB)
- Recommended Solution: Replace 230 kV breaker and associated CTs at Riverside on 2345 line. Replace all dead-end structures at Brandon Shores, Hawkins Point, Sollers Point and Riverside. Install a second conductor per phase on the spans entering each station. Brandon Shores – Hawkins Point N/E = 1243/1386 MVA. Sollers Pt. – Brandon Shores N/E = 1174/1386 MVA
- Expected service date: June 1, 2013
- Estimated Cost $1.5 M



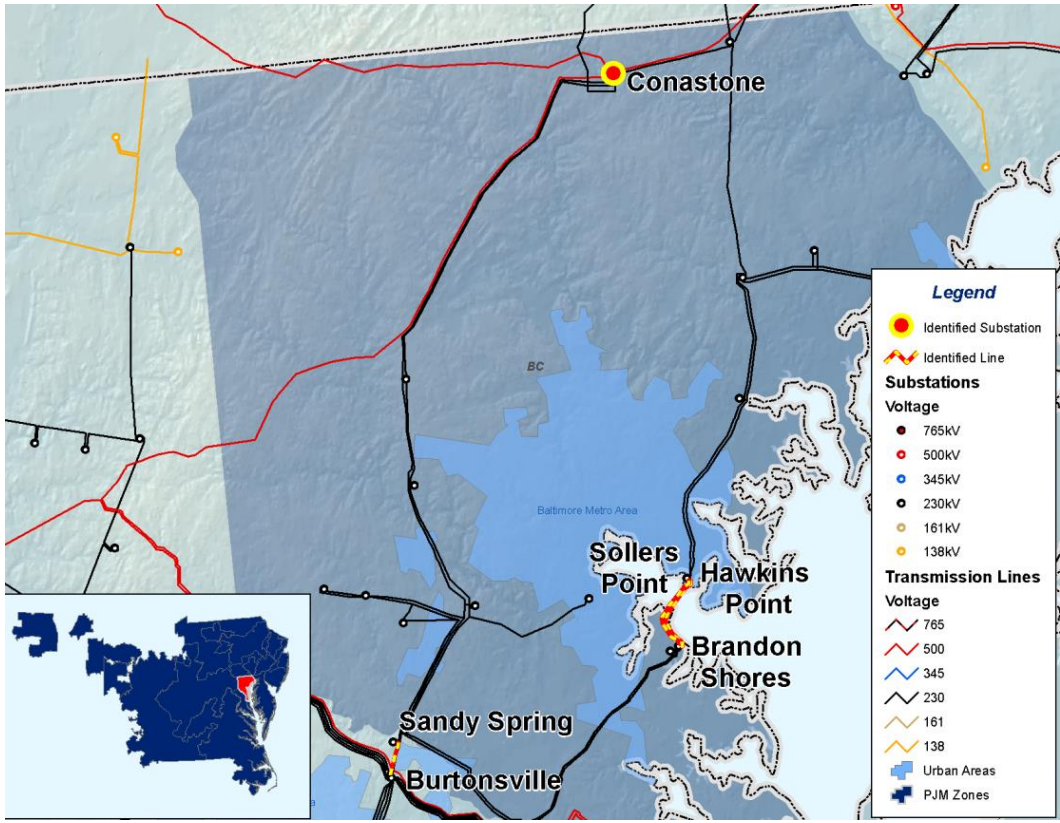
Generation Deliverability Violation – BG&E

- Conastone 500/230 kV transformer CKT 1 / Loss of Conastone – Peach Bottom 500 kV line + Conastone 500/230 kV transformer CKT 2 (Line_FB)
  - The limitation on the transformer is associated bus
  - The bus will be replaced as part of the transformer replacement (B0298)



Generation Deliverability Violation – BG&E

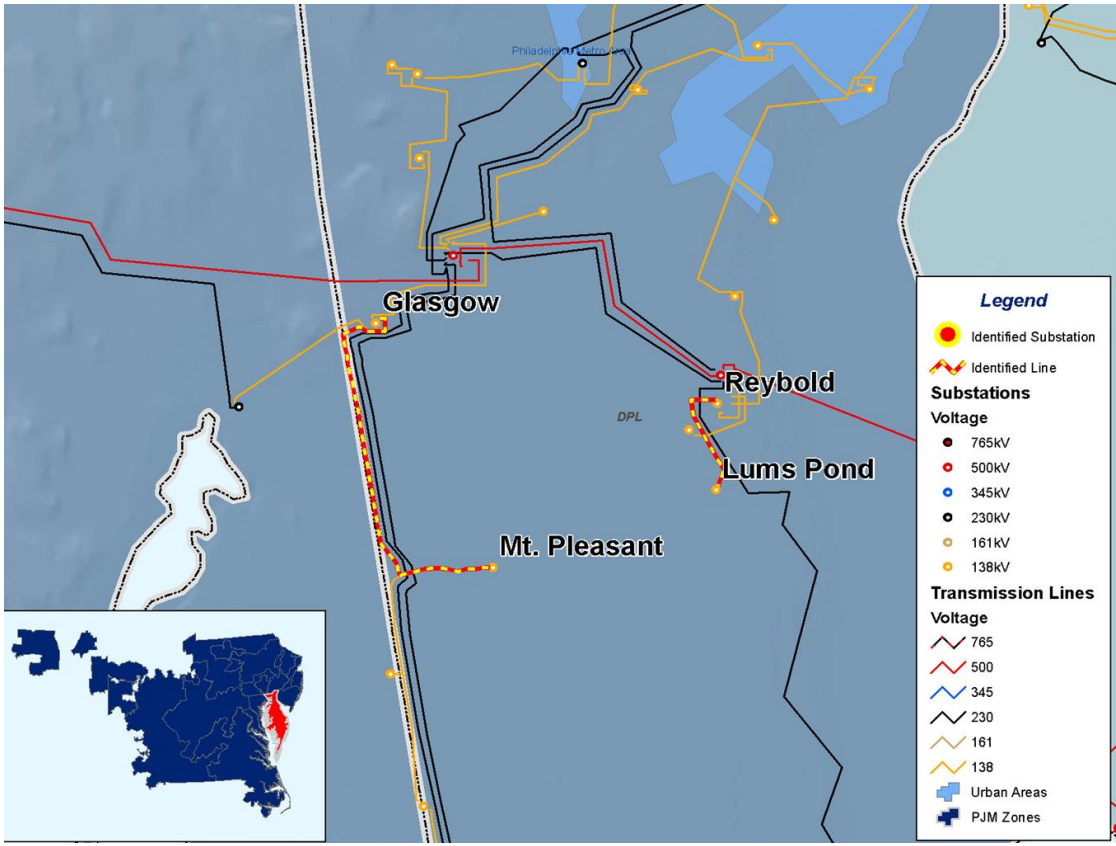
- Burtonsville – Sandy Spring 230 kV line CKT #2314 / Loss of High Ridge – Sandy Springs – Burtonsville CKT # 2334 (Single)
- Burtonsville – Sandy Spring 230 kV line CKT #2334 / Loss of High Ridge – Sandy Springs – Burtonsville CKT # 2314 (Single)
- Recommended Solution: Rebuild each line (0.2 miles each) to increase the normal rating to 968 MVA and the emergency rating to 1227 MVA
- Expected in-service: June 1, 2013
- Estimated cost: $0.27 M per line



Delmarva Baseline Upgrades

Load Deliverability Violation - Delmarva

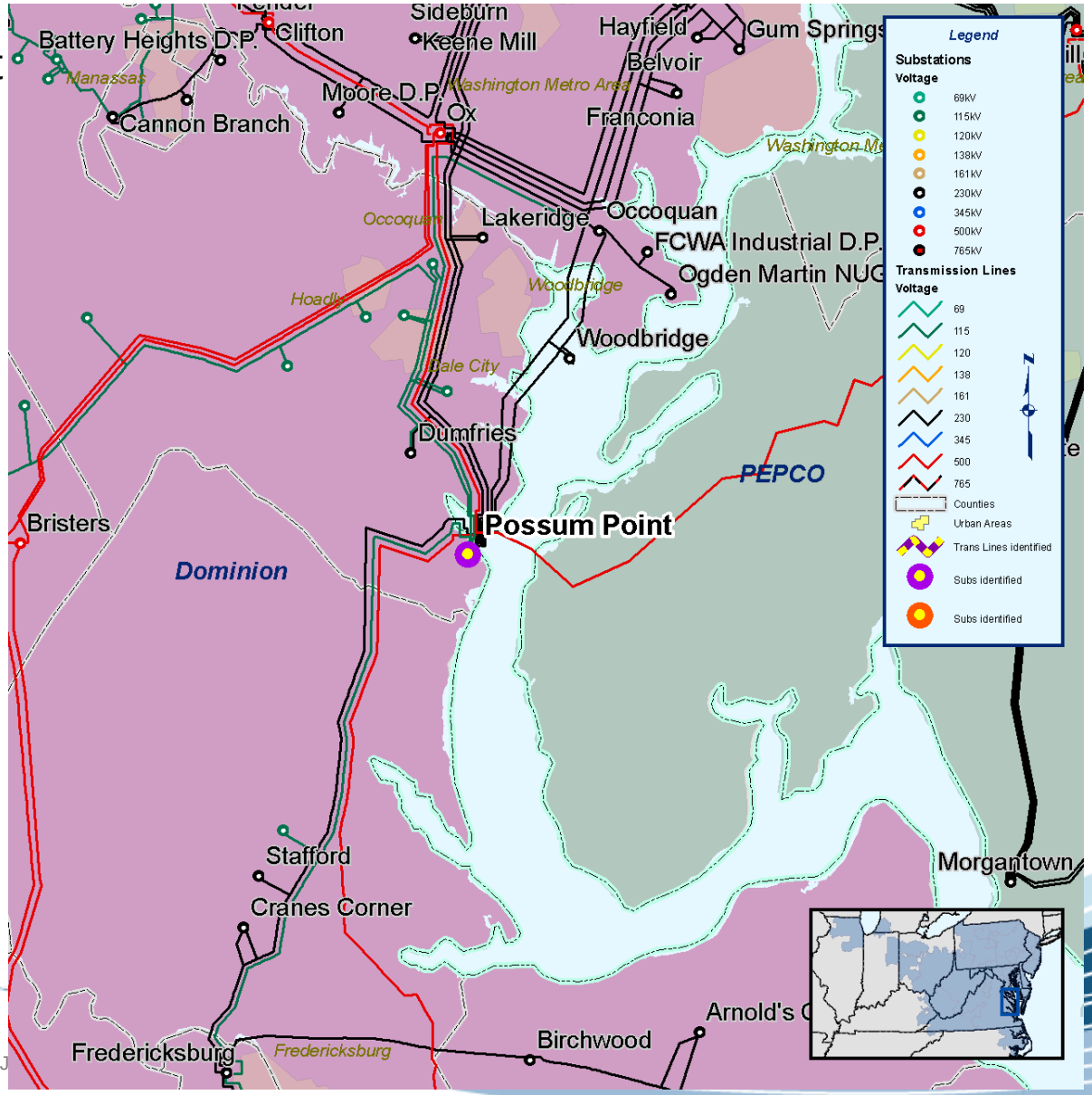
- Reybold – Lums Pond 138 kV line for the loss of Glasgow – Keeney 138 kV line
- Recommended Solution: Replace two circuit breakers to bring the emergency rating up to 348 MVA
- Estimated cost: $1.0M
- Expected in-service: June 1, 2013
- Glasgow – Mt. Pleasant 138 kV line for the loss of Lums Pond – Reybold 138 kV line
- Recommended Solution: Rebuild 10 miles of Glasgow to Mt. Pleasant 138 kV line to bring the normal rating to 298 MVA and the emergency rating to 333 MVA
- Estimated cost: $5.7 M
- Expected in-service: June 1, 2013



Dominion Baseline Upgrades

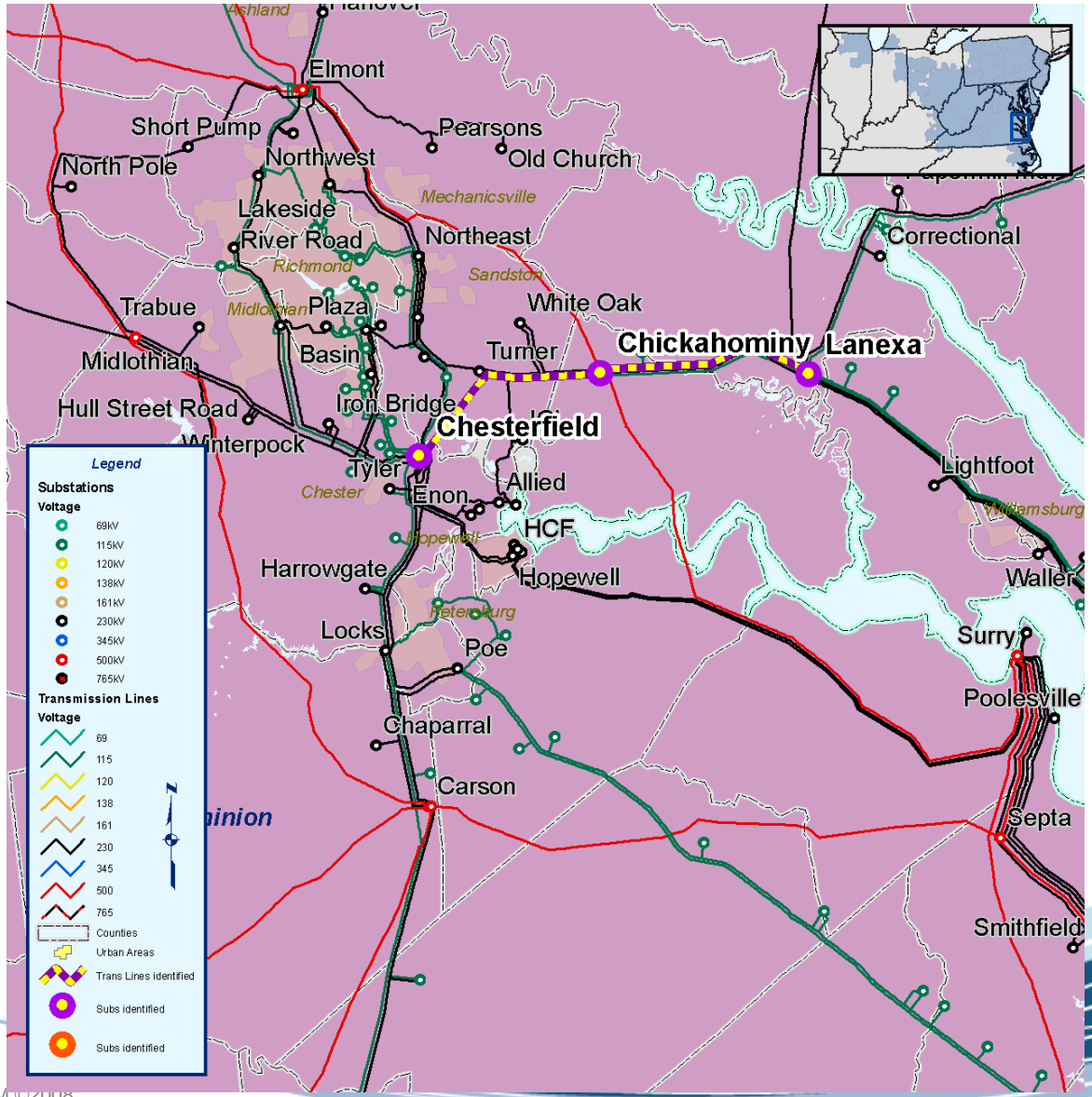
Possum Point Second 230-115 kV Autotransformer

- When the Possum Point #3 Unit is out and the outage of the Fredricksburg 230-115 kV Tx or the outage of the Fredricksburg to Possum Pt 115 kV line occurs the Possum Point 230-115 kV Tx. overloads.
- Solution: Install 2nd 230-115 kV Tx.
- Expected service date: May 2009
- Est. Cost: $3.5 M



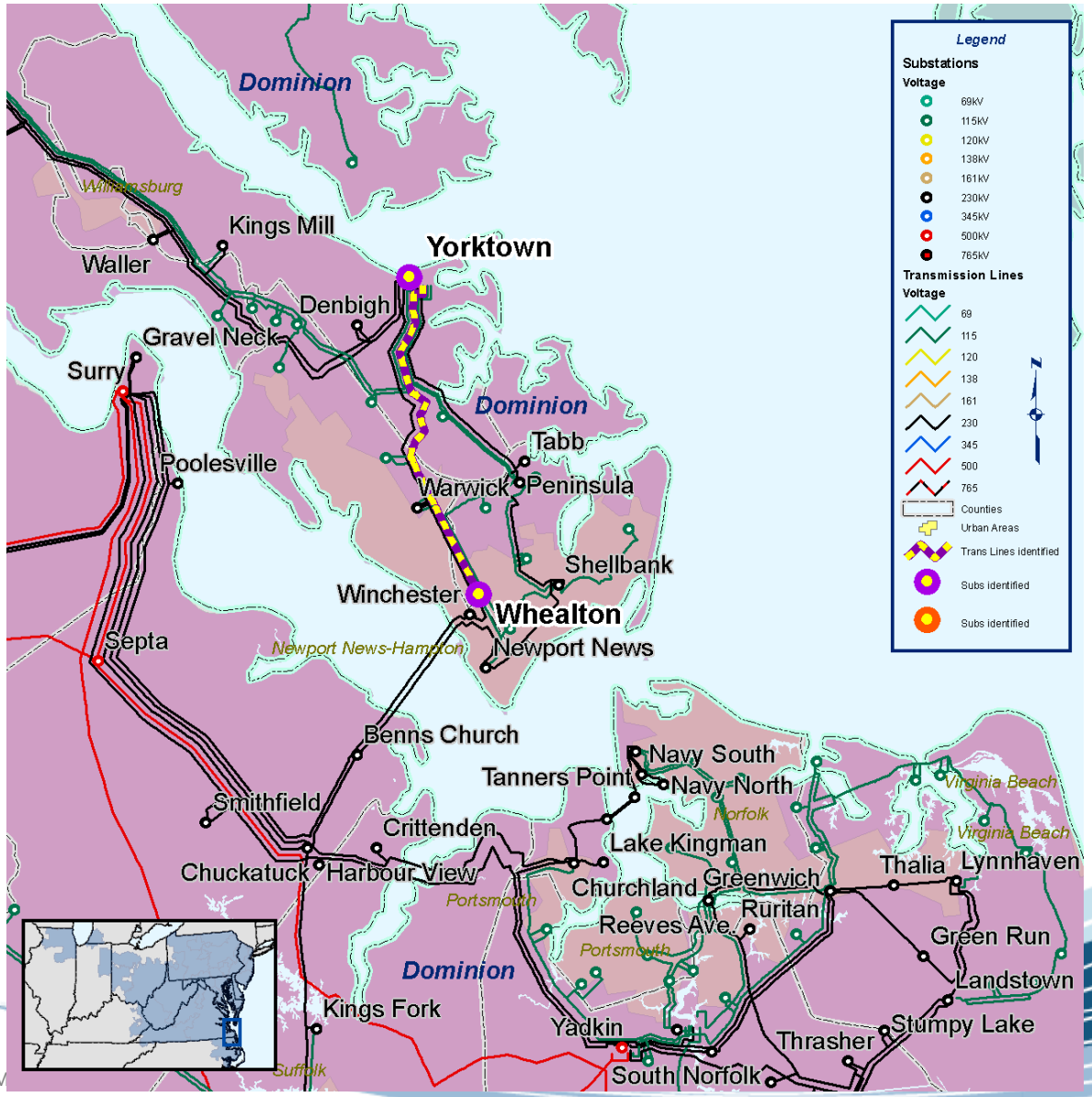
Dominion Baseline Upgrade - Elko Substation

- Lanexa to Chesterfield is overloaded for the loss of Chickahominy to Lanexa
- Chickahominy to Lanexa is overloaded for the loss of Birchwood to Northern Neck
- Solution: Build new Elko station and transfer load from Turner and Providence Forge stations
- Expected service date: May 2009
- Est. Cost: $2.2 M



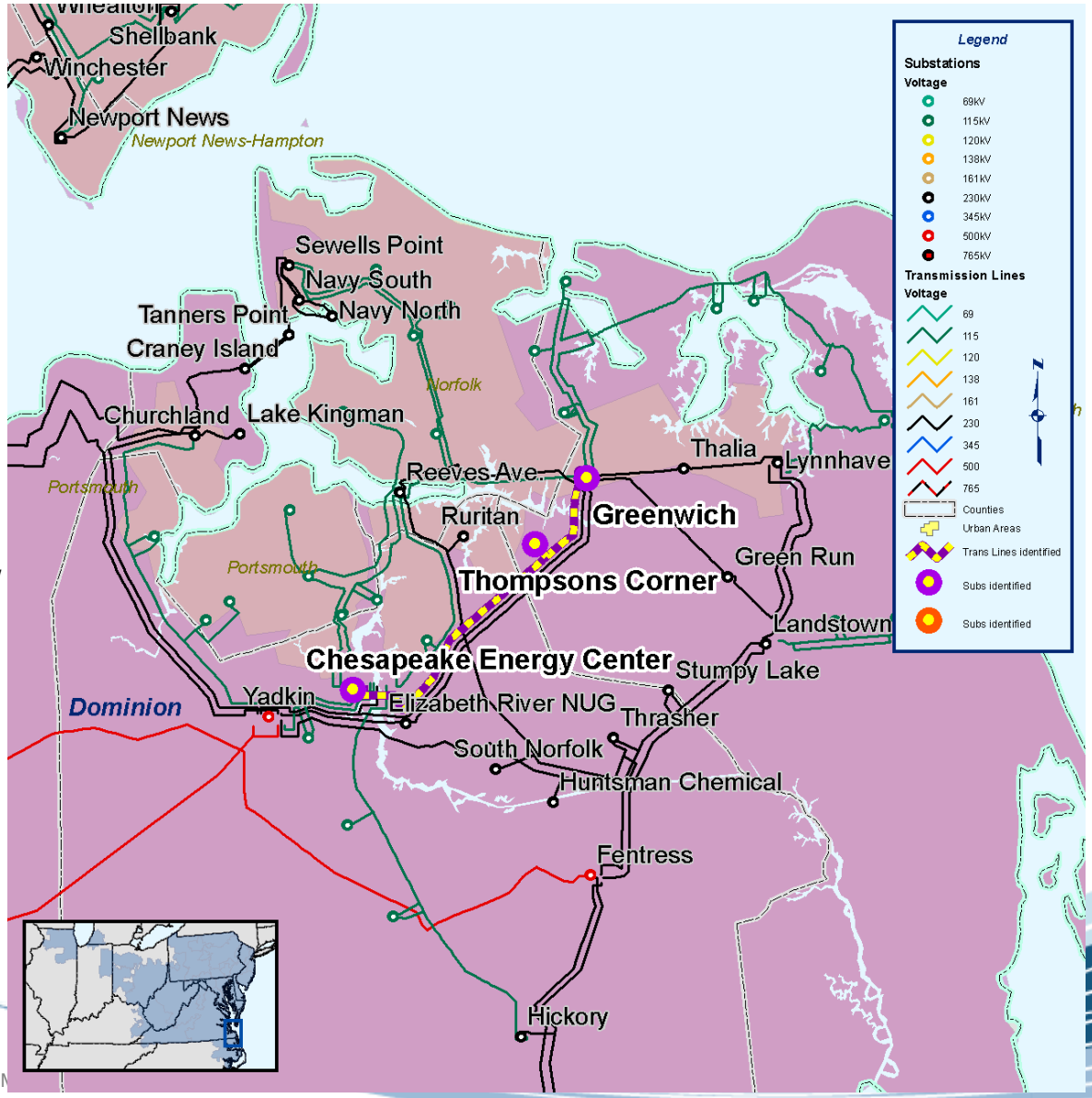
Dominion Baseline Upgrade - Yorktown-Whealton 115 kV

- TheYorktown to Whealton 115 kV line overloads for an outage of the remote end of the line
- Solution: Rebuild 17.5 miles of the line for a new summer rating of 262 MVA
- Expected service date: May 2009
- Est. Cost: $18.0 M



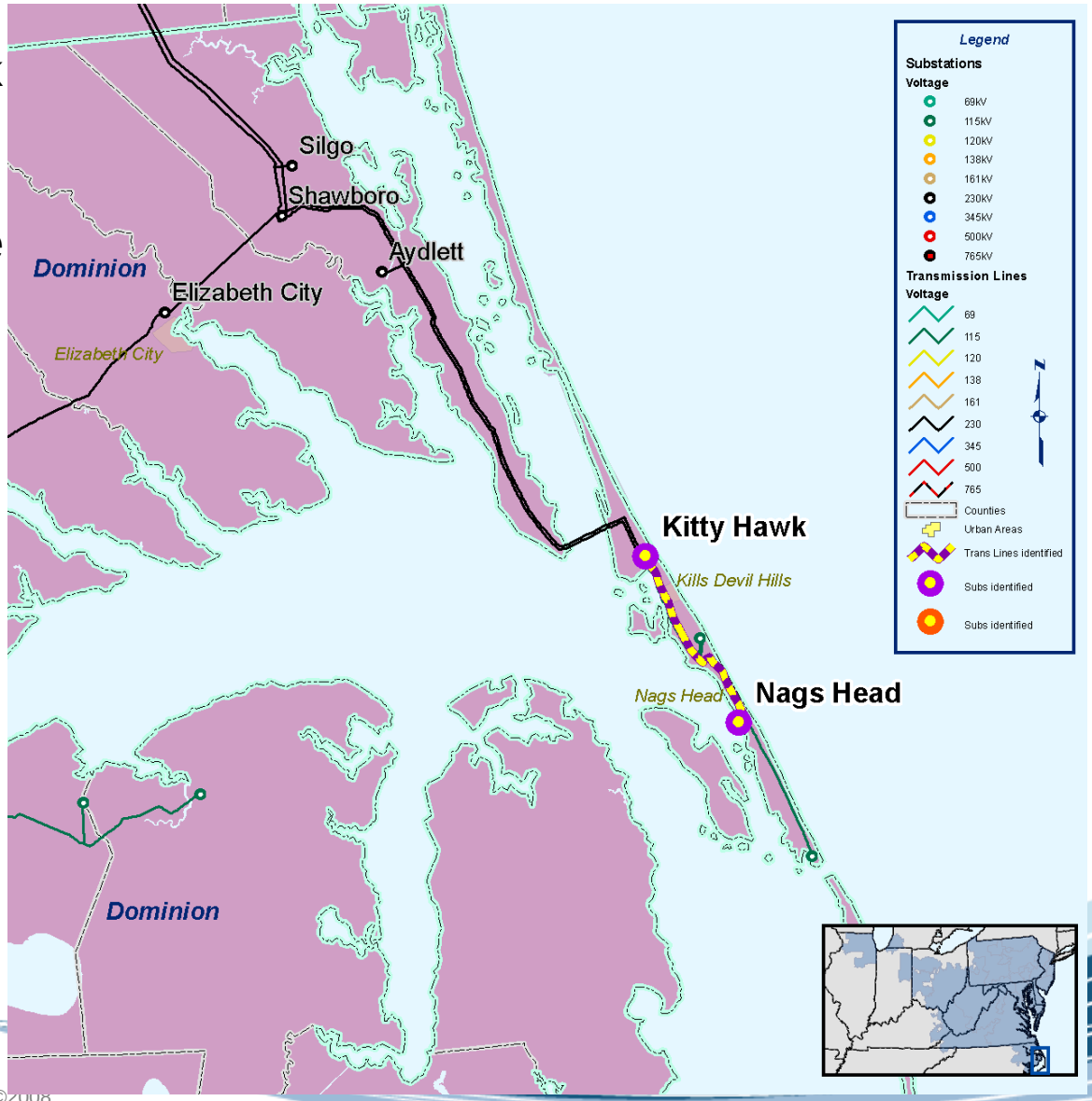
Dominion Baseline - Greenwich-Thomson Corner 115 kV

- For an outage of the Chesapeake Energy Center end of the Greenwich – Chesapeake Energy Center line, the Greenwich end of the line overloads
- Solution: Increase the rating on 2.56 miles of the line between Greenwich and Thompson Corner. New rating to be 257 MVA.
- Expected service Date: May 2009
- Est. Cost: $4.0 M



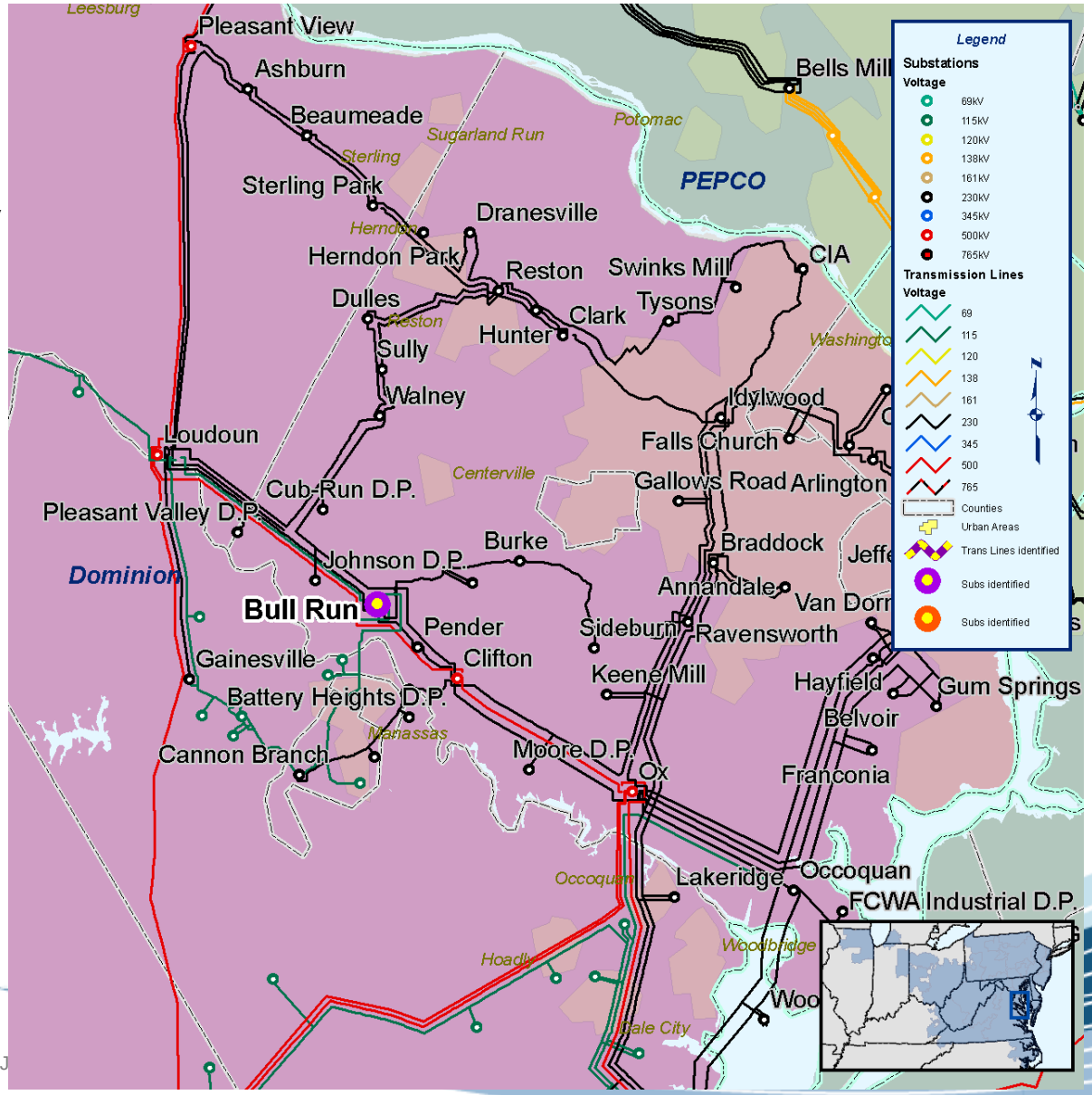
Kitty Hawk to Colington 115 kV Line

- The loading on Kitty Hawk to Nag's Head exceed 100 MW
- Solution: Build 115 kV line from Kitty Hawk to Colington 115 kV.
  - Colington on the existing line and Nag's Head and Light House DP on new line.
- Service Date: May 2009



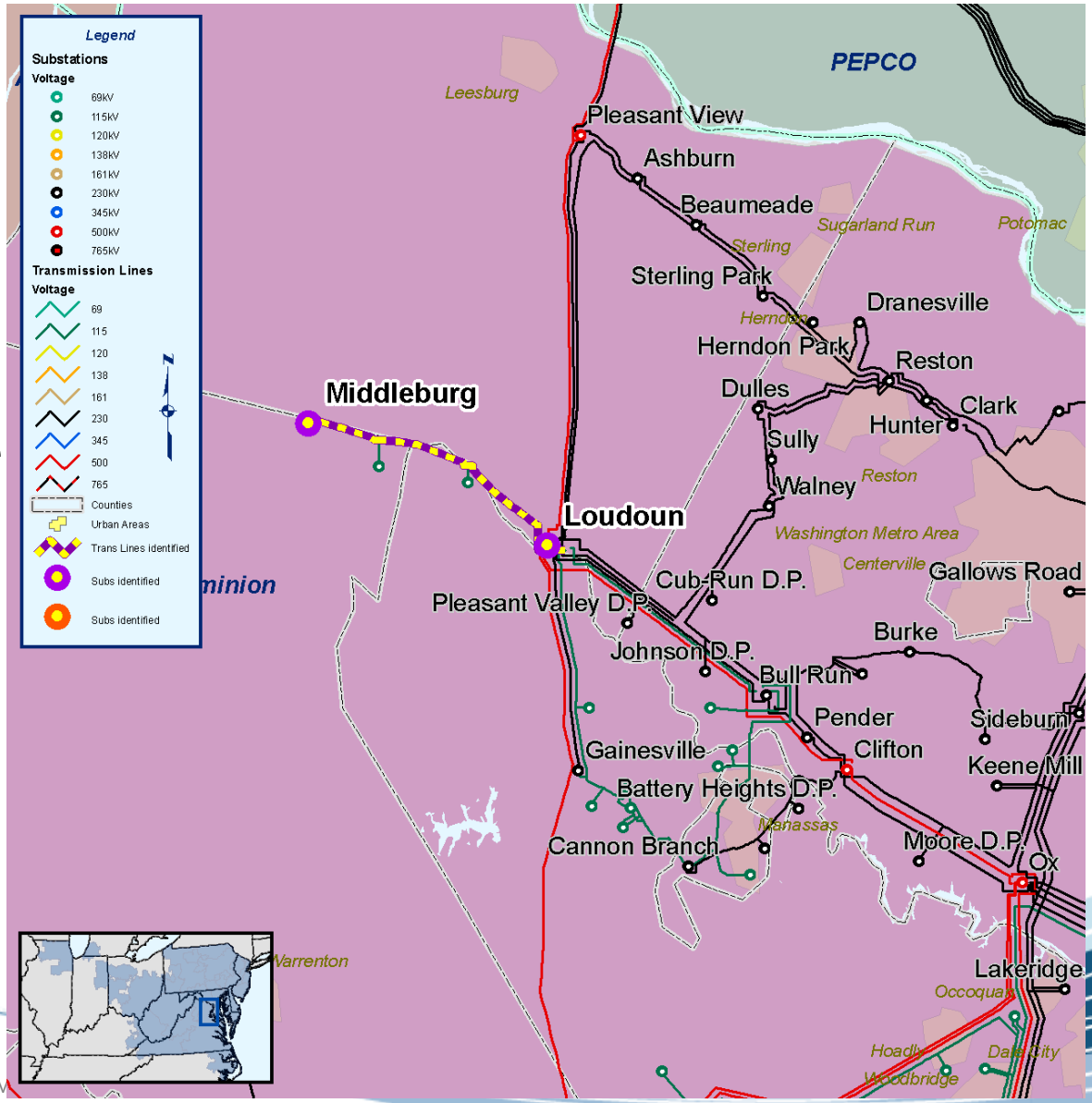
Dominion Baseline - Bull Run 2nd 230-115 kV

- For N-2 events involving the loss of any combination of Bull Run #3 230-115 kV, Loudoun #3 230-115 kV or Loudoun #4 230-115 kV, the remaining autotransformer exceeds it's emergency rating
- Solution: Add a second Bull Run 230-115 kV autotransformer
- Expected service date: May 2009
- Est. Cost: $3.0 M



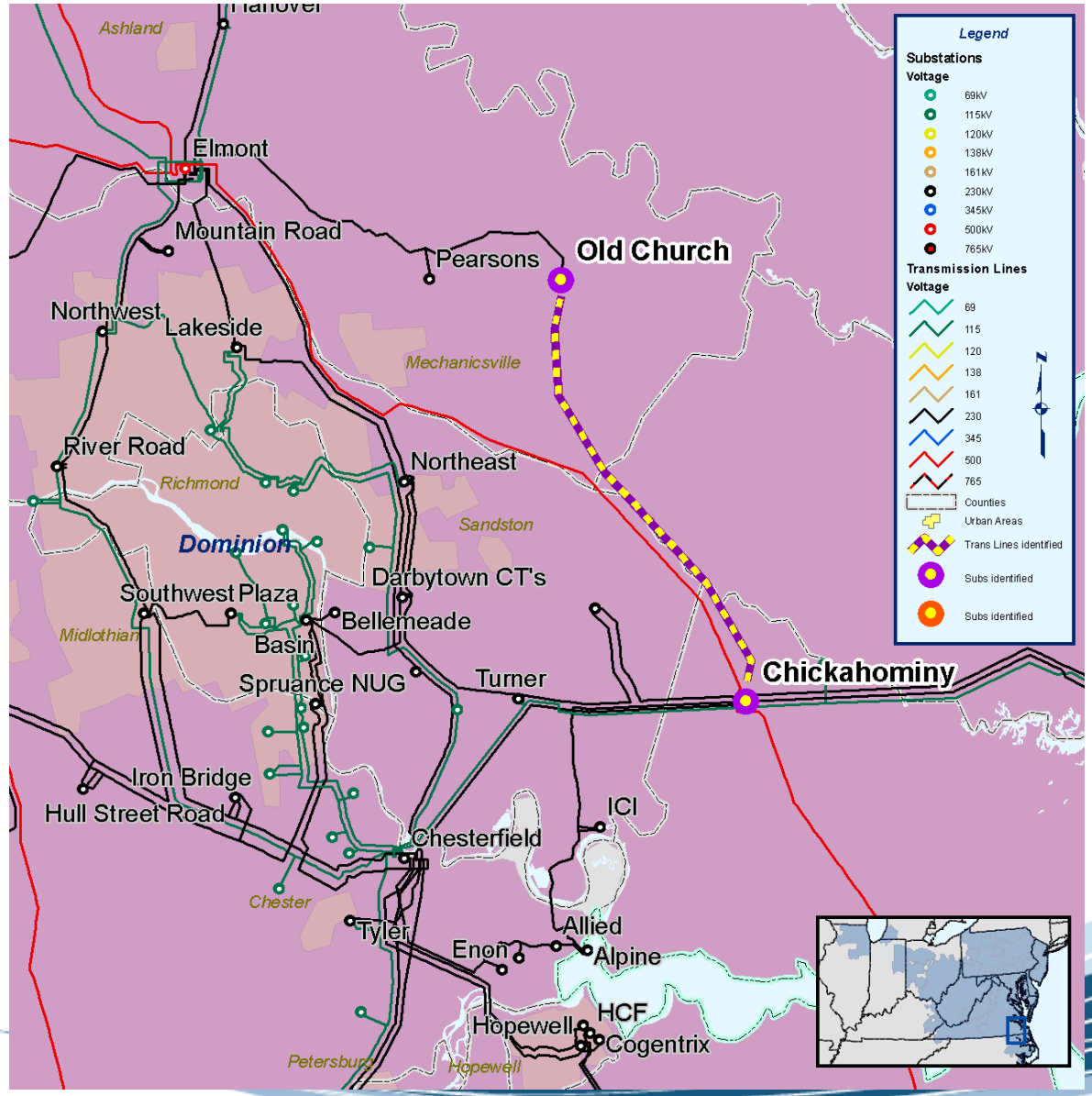
Dominion Baseline – Loudoun to Middleburg 115 kV

- A section of the radial Loudoun to Middleburg line is expected to be overloaded due to increased load at various delivery points on the line
- Solution: Increase the rating of the line between Loudoun and Cedar Grove to at least 150 MVA
- Expected service date: May 2009
- Est. Cost: $0.2 M



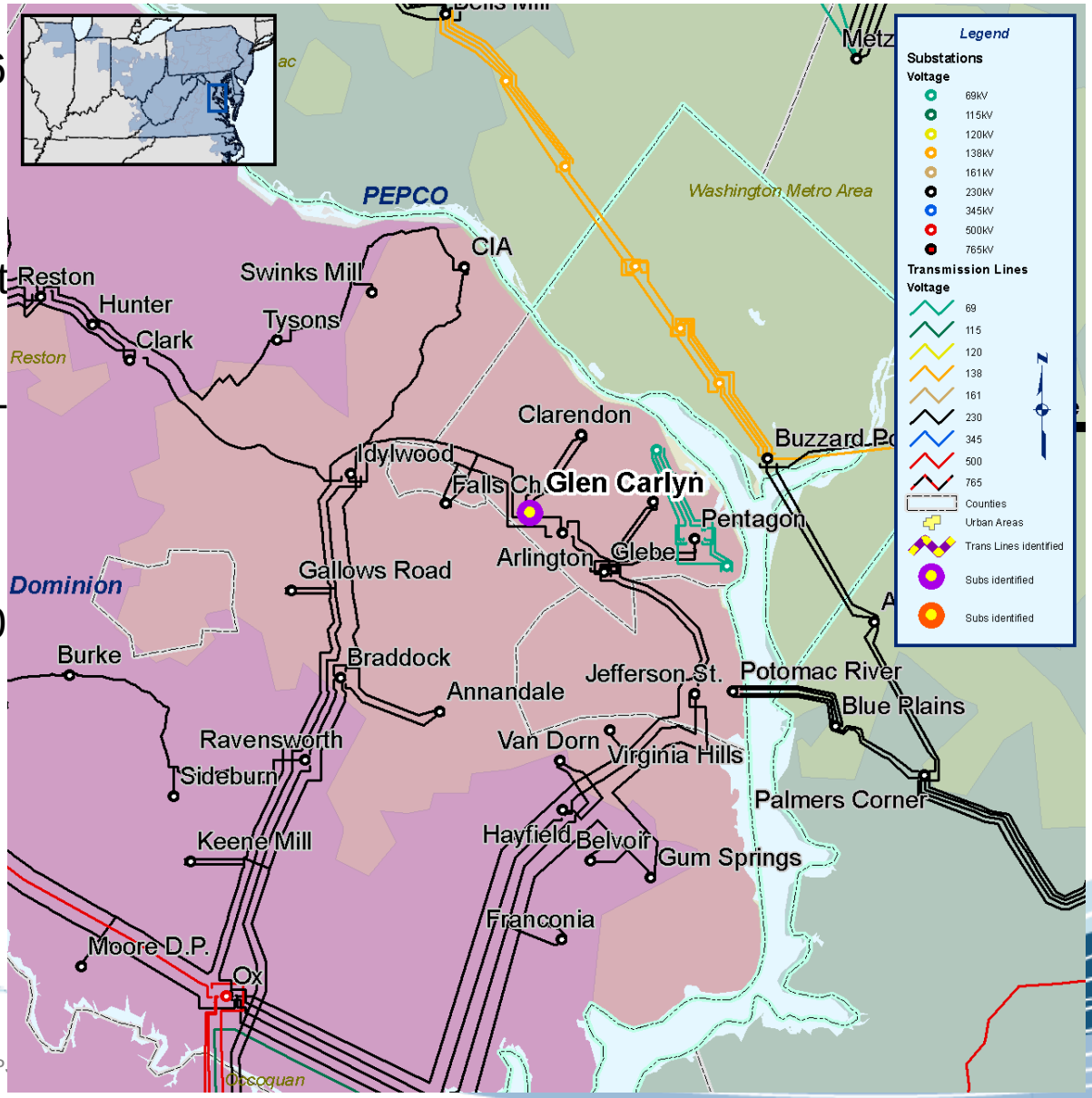
Chickahominy-Old Church 230 kV Line

- Line loading at Pearsons and Old Church Subs. exceeds 100 MVA.
- Solution: Extend the line from Old Church to Chickahominy 230 kV
- Expected Service Date: November 2009
- Est. Cost $17.0 M



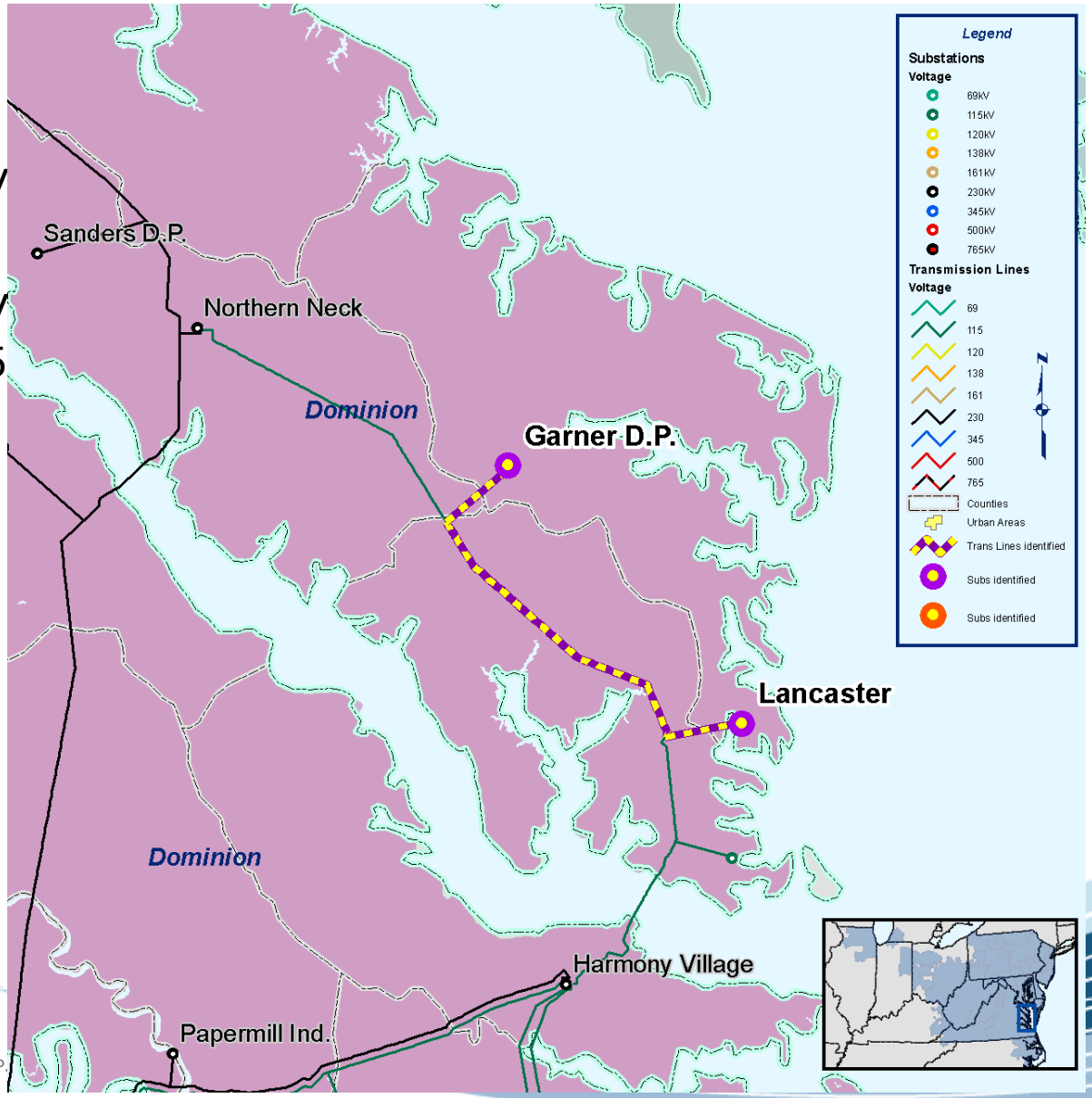
Glen Carlyn Line 251 GIS Project

- For the loss of line #266 and line #273 into Glen Carlyn, Tx. #1 and #3 along with line #277 and line #278 will be out of service.
- Solution: Loop line #251 Idylwood to Arlington into the GIS sub.
- Service Date: May 2010
- Est. Cost: $25.0 M



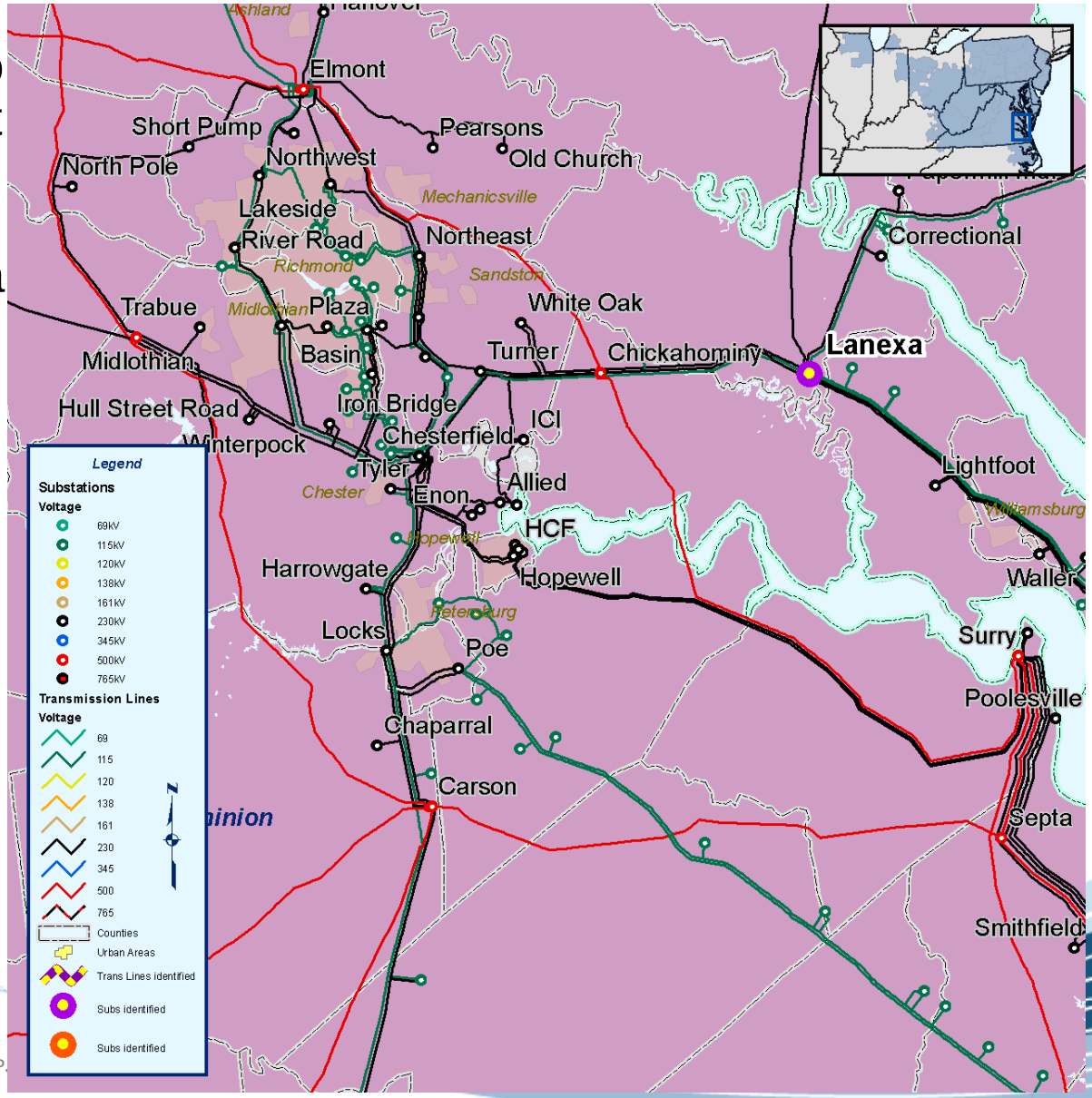
Dominion Baseline – Garner to Lancaster 115 kV

- The Garner to Lancaster portion of Northern Neck to Harmony Village 115 kV line overloads for the loss of Lanexa to Harmony Village 230 kV
- Solution: Re-tension 15 miles of the line for a new summer rating of 216 MVA
- Expected service date: May 2010
- Est. Cost: $5.5 M



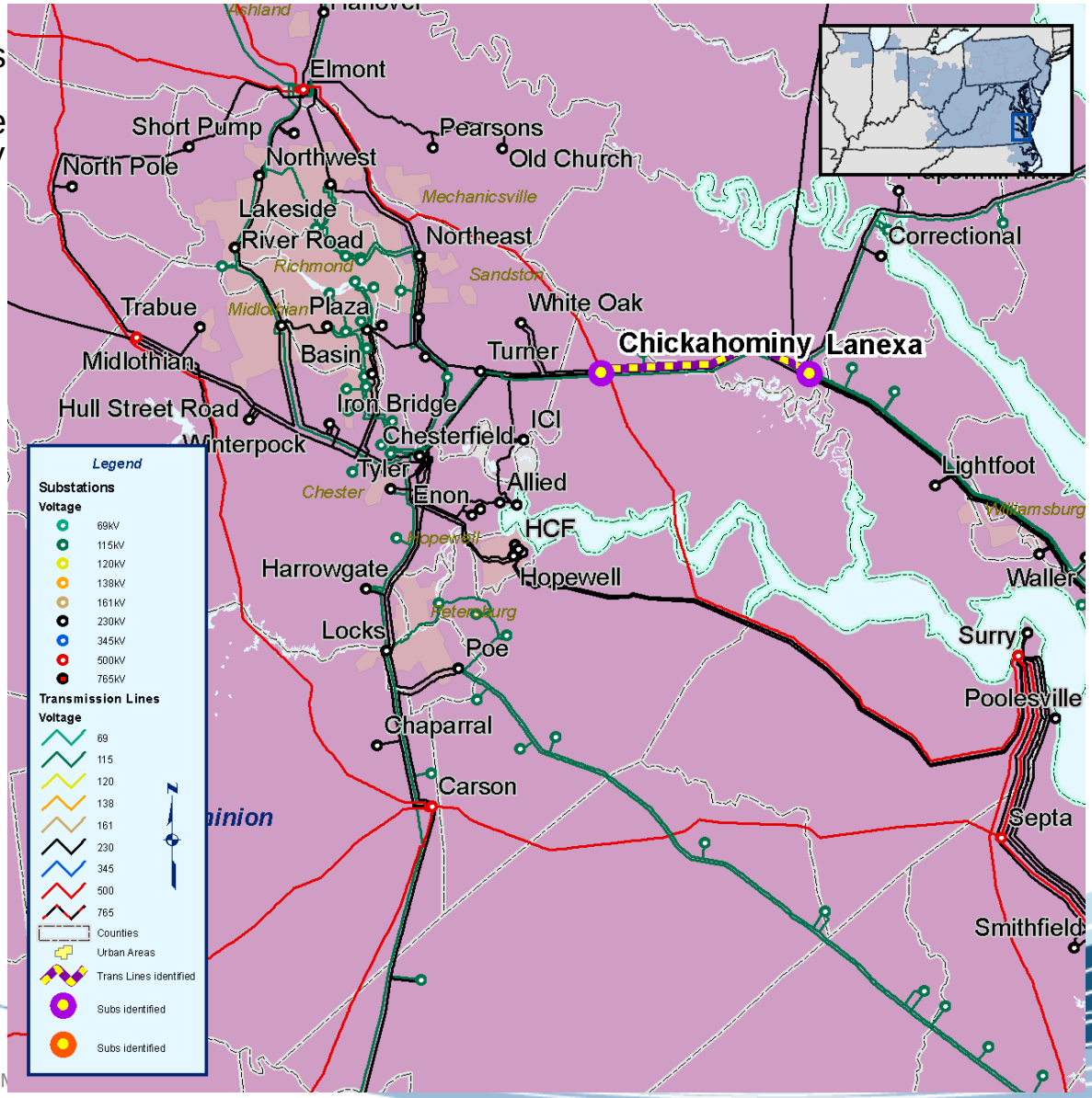
Dominion Baseline - Lanexa 230-115 kV

- Loss of the Lanexa to Correctional segment of Lanexa to Harmony Village overloads the Lanexa 230-115 kV autotransformer
- Solution: Add a second 230-115 kV autotransformer at Lanexa
- Expected service date: May 2010
- Est. Cost: $3.2 M



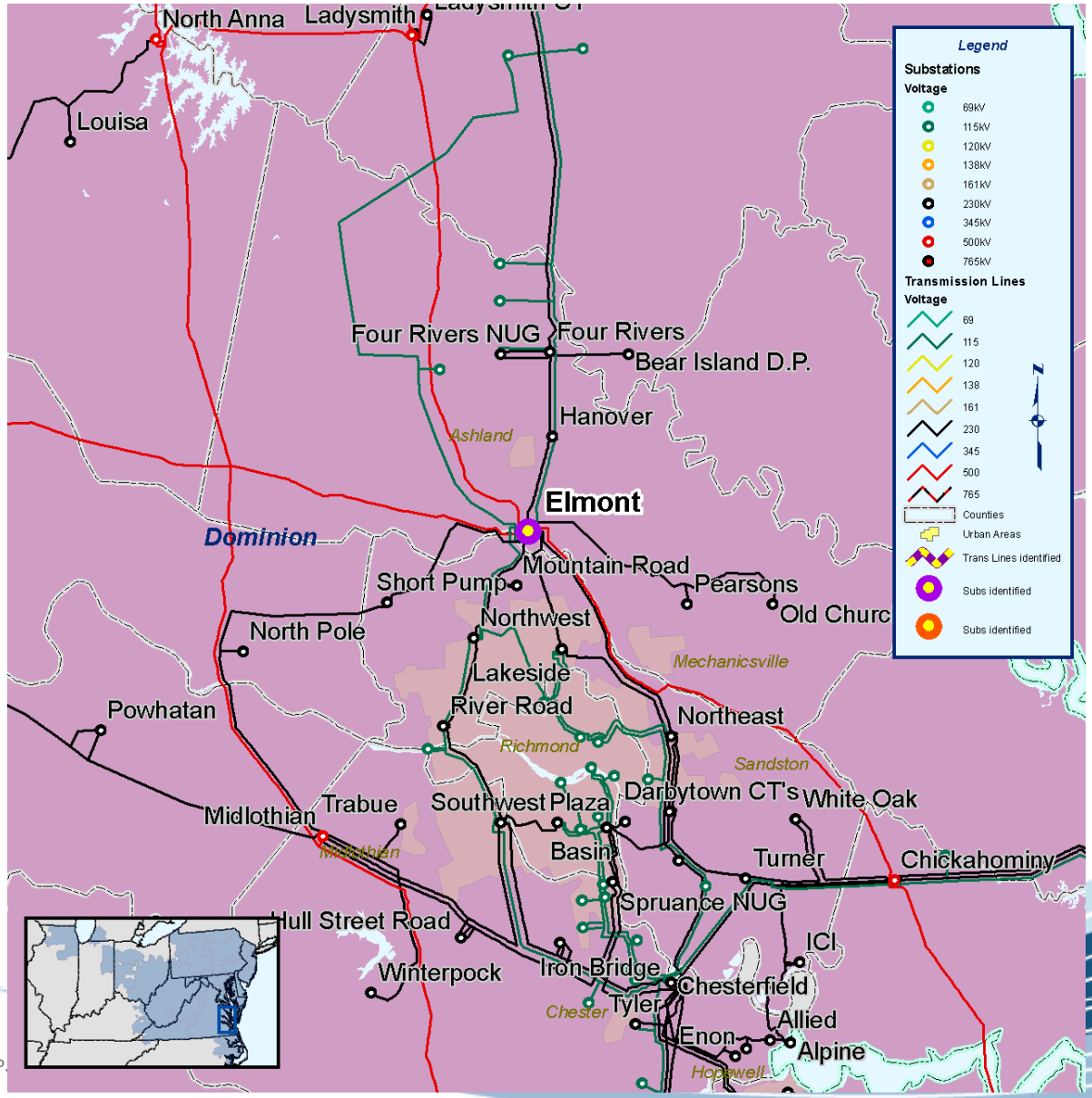
Dominion Baseline -New 230 kV Line Chickahominy - Lanexa

- In 2010 James River crossing is overloaded for the loss of Chickahominy to Yortown or the loss of Lanexa to Chickahominy
- In 2012 a portion of the Chesterfield to Lanexa line between Chesterfield and Turner overloads for the loss of Chickahominy to Lanexa
- Chickahominy to Lanexa overloads for the loss of Birchwood to Northern Neck
- Chickahominy to Lanexa overloads for the loss of Chickahominy to Harmony Village
- Solution: Build a parallel Chickahominy to Lanexa 230 kV line
- In-service date: May 2010
- Est. Cost: $3.5 M



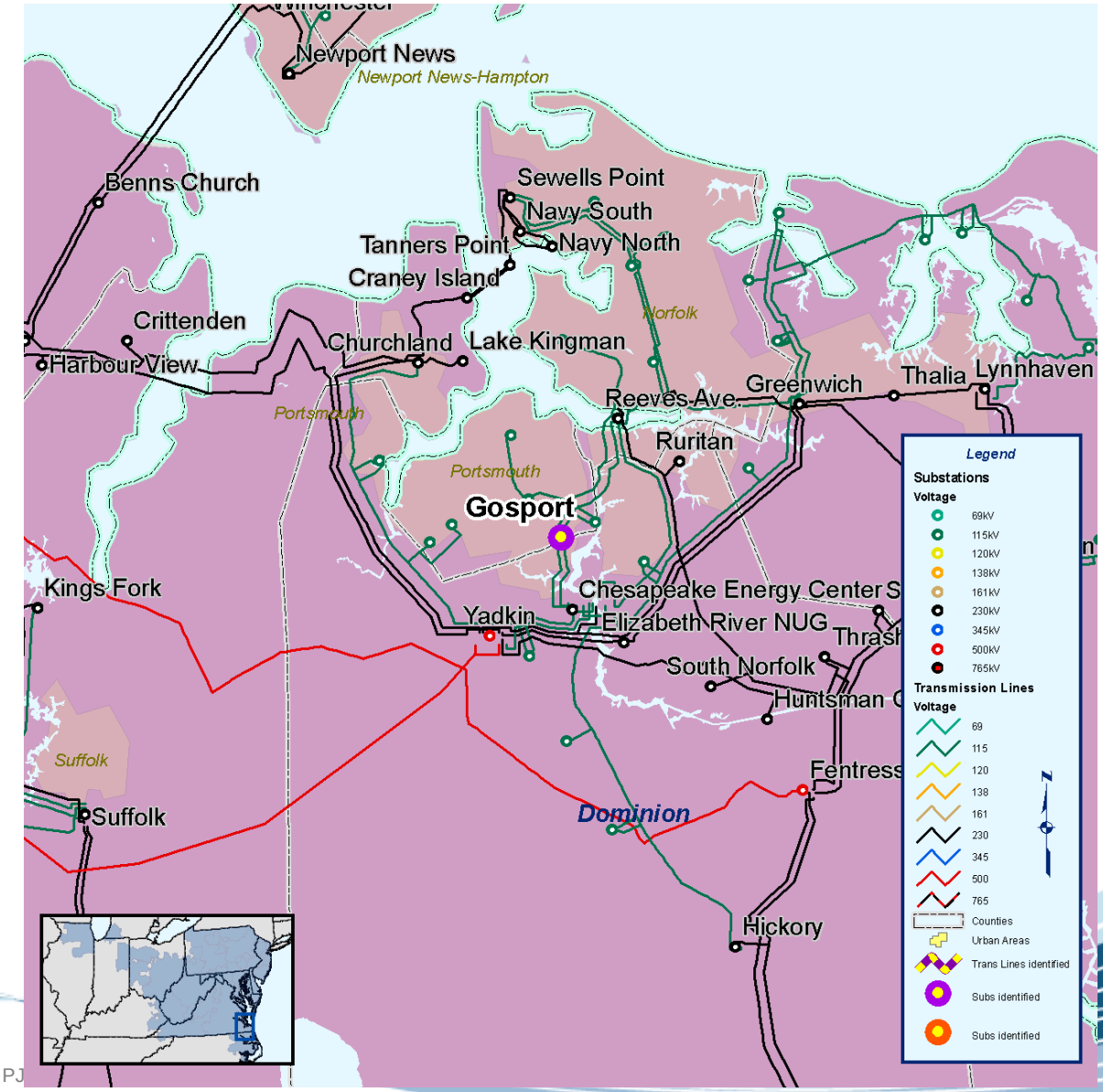
Dominion Baseline Upgrade -Elmont 230-115 kV autotransformer

- The Northwest 230-115 kV autotransformer overloads for the loss of Elmont to Northwest 230 kV line
- Solution: Install a second Elmont 230-115 kV autotransformer
- In-service date: May 2010
- Est. Cost: $4.5 M



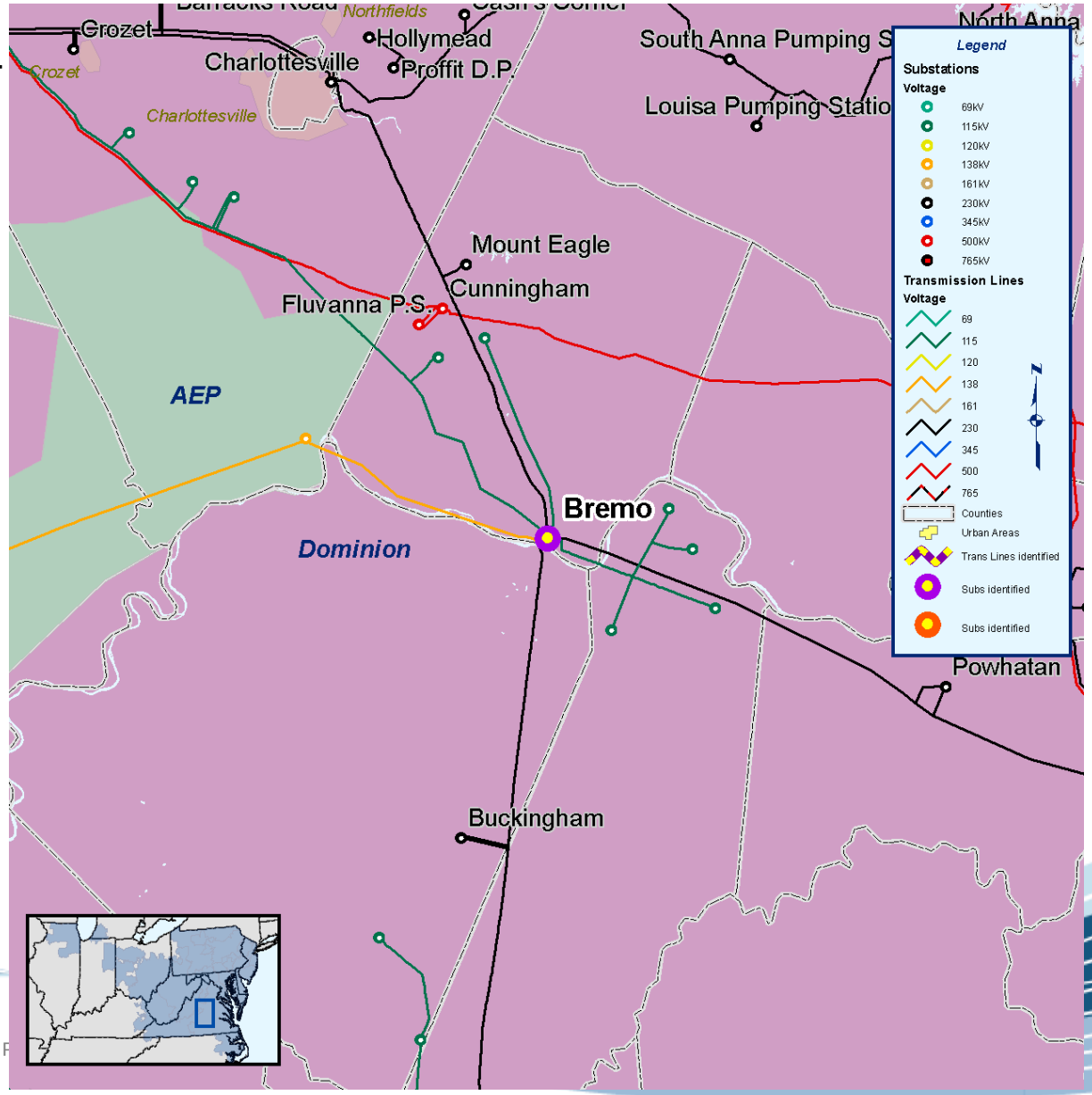
Dominion Baseline Upgrade –Install Dual Primary Protection Schemes on Gosport lines #62 and #51 at remote terminals

- Stability concerns exist at Gosport 115 kV for double line to ground faults.
- Solution: Install dual primary protection schemes on lines #62 and #51 at remote terminals
- Expected service date: May 2010
- Est. Cost: $0.46 M



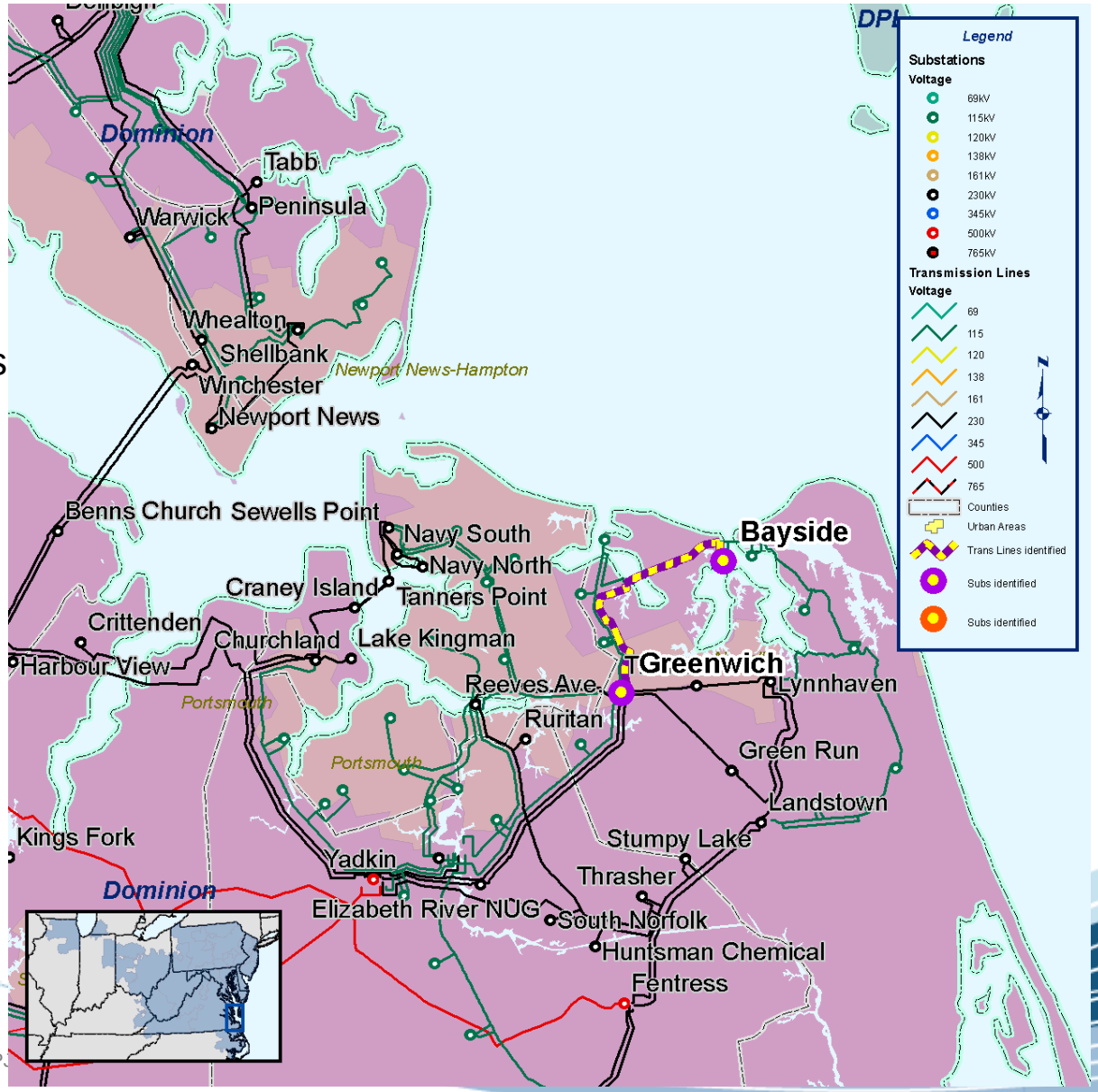
Dominion Baseline - Bremo 115 kV, 33 MVAr Capacitor Bank

- Loss of the Bremo 230-115 kV autotransformer is causing low voltage on the 115 kV system at Bremo
- Solution: Install a 33 MVAR capacitor on the Bremo 115 kV
- In-service: May 2011
- Est. Cost: $0.5 M



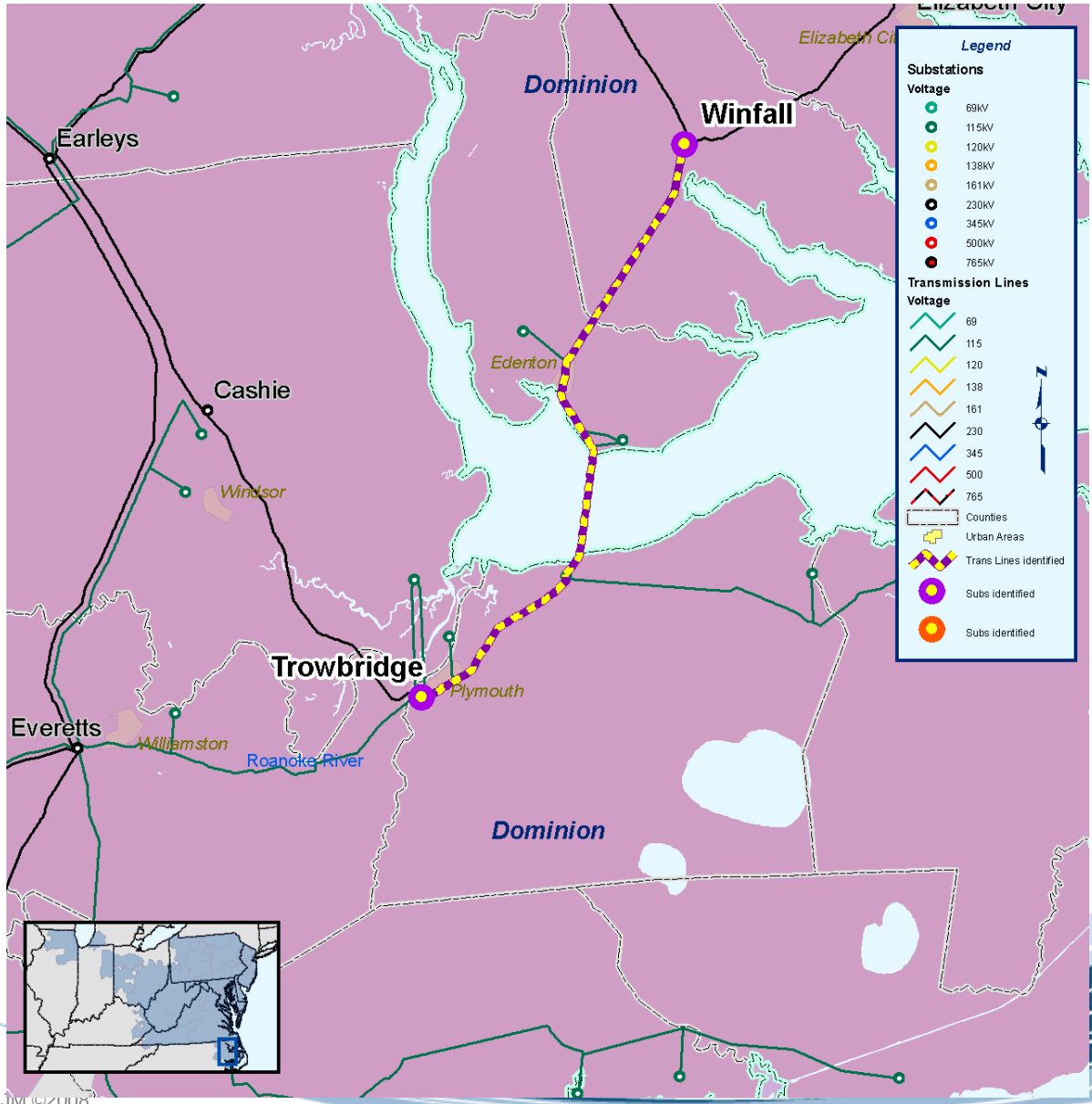
Dominion Baseline Upgrade- Reconductor Bayside-Greenwich and Greenwich-Davis Corner

- The Bayside to Greenwich portion of Greenwich to Virginia Beach overloads for the loss of Greenwich to Amphibious Base
- The Greenwich to Davis Corner portion of Greenwich to Amphibious Base overloads for the loss of Greenwich to Virginia Beach
- Solution: Reconductor Greenwich to Virginia Beach to bring it up to a summer rating of 261 MVA. Reconductor the Greenwich to Amphibious Base line to bring it up to 291 MVA
- In-service: May 2011
- Est. Cost: $2.1 M



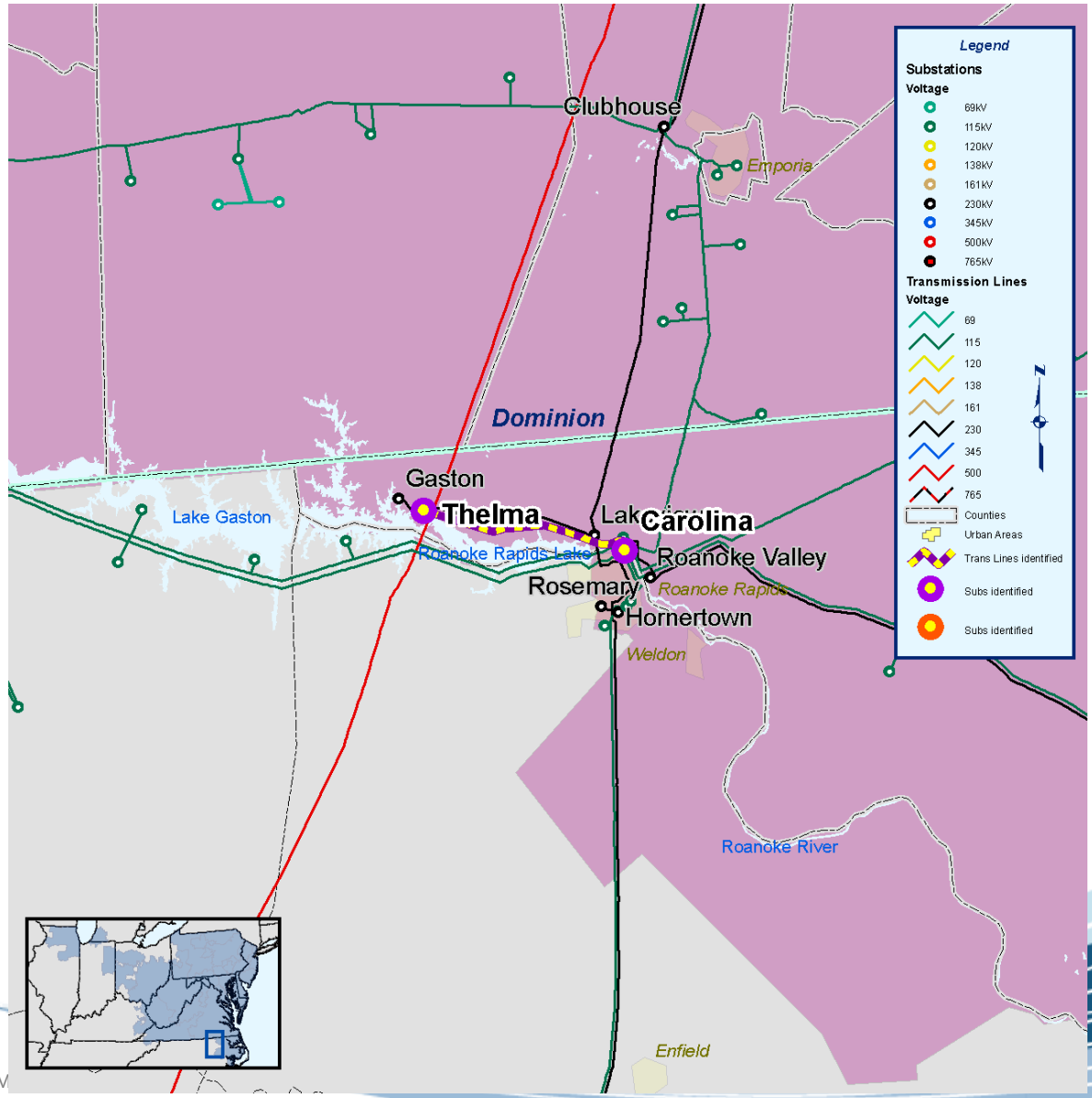
Dominion Baseline Upgrade - Re-build line Trowbridge – Winfall 115 kV

- The Trowbridge to Winfall 115 kV overloads for the outage of the Elizabeth City to Shawboro 230 kV and the Suffolk to Winfall 230 kV.
- Solution: Re-build Trowbridge to Winfall 115 kV
- Expected in-service date: June 2011
- Est. Cost: $16.4 M



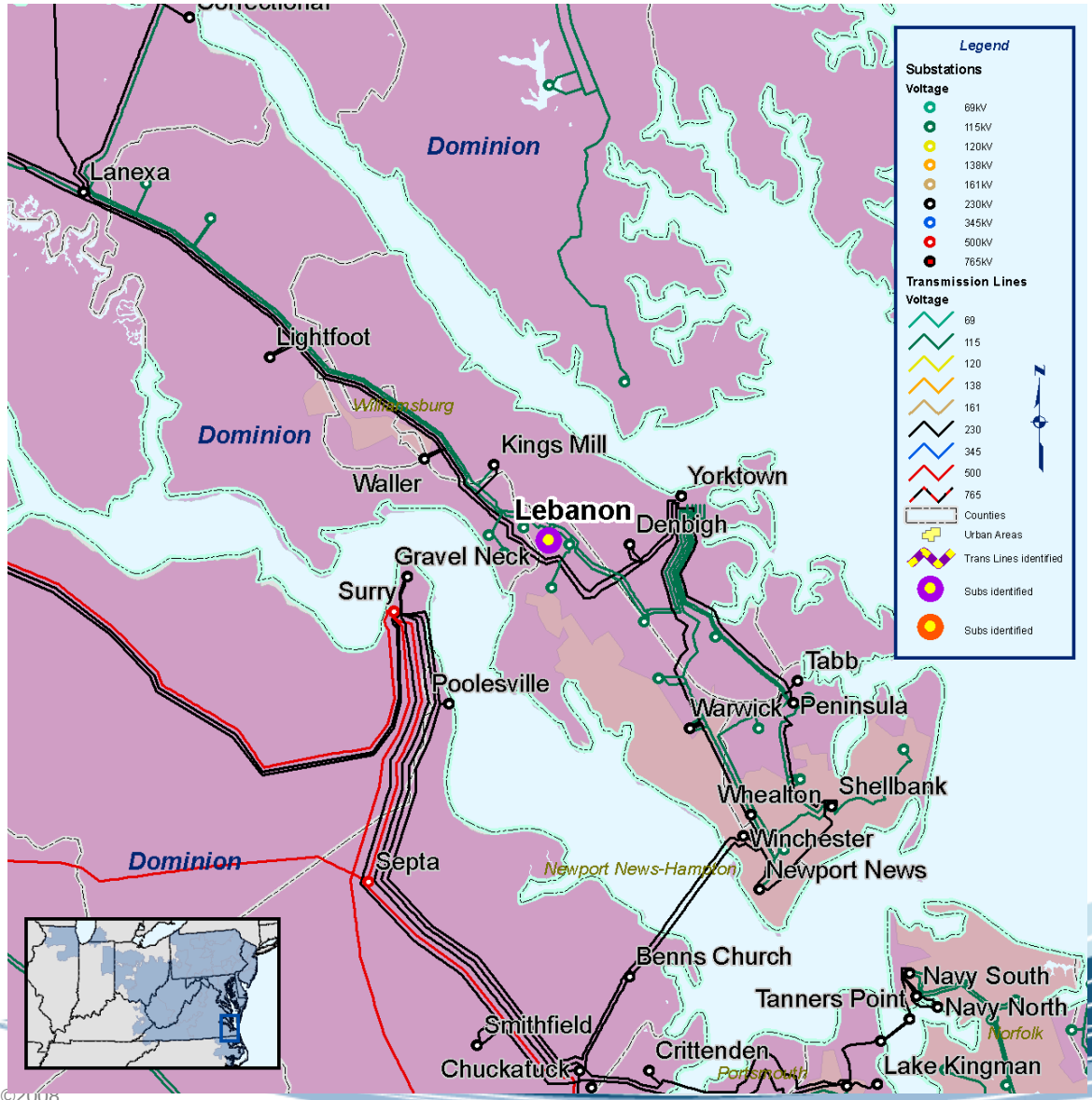
Dominion Baseline Upgrade – Terminate line #213 into Lakeview 230 kV

- The Carolina 230-115 kV autotransformer overloads for the loss of Earleys – Roanoke Valley and Carolina – Thelma.
- The Carolina – Thelma line overloads for the loss of Earleys – Roanoke Valley and the Carolina 230-115 kV autotransformer.
- Solution: Terminate the Thelma to Carolina 230 kV circuit into Lakeview 230 kV.
- Expected service date: June 2011
- Est. Cost: $4.0 M



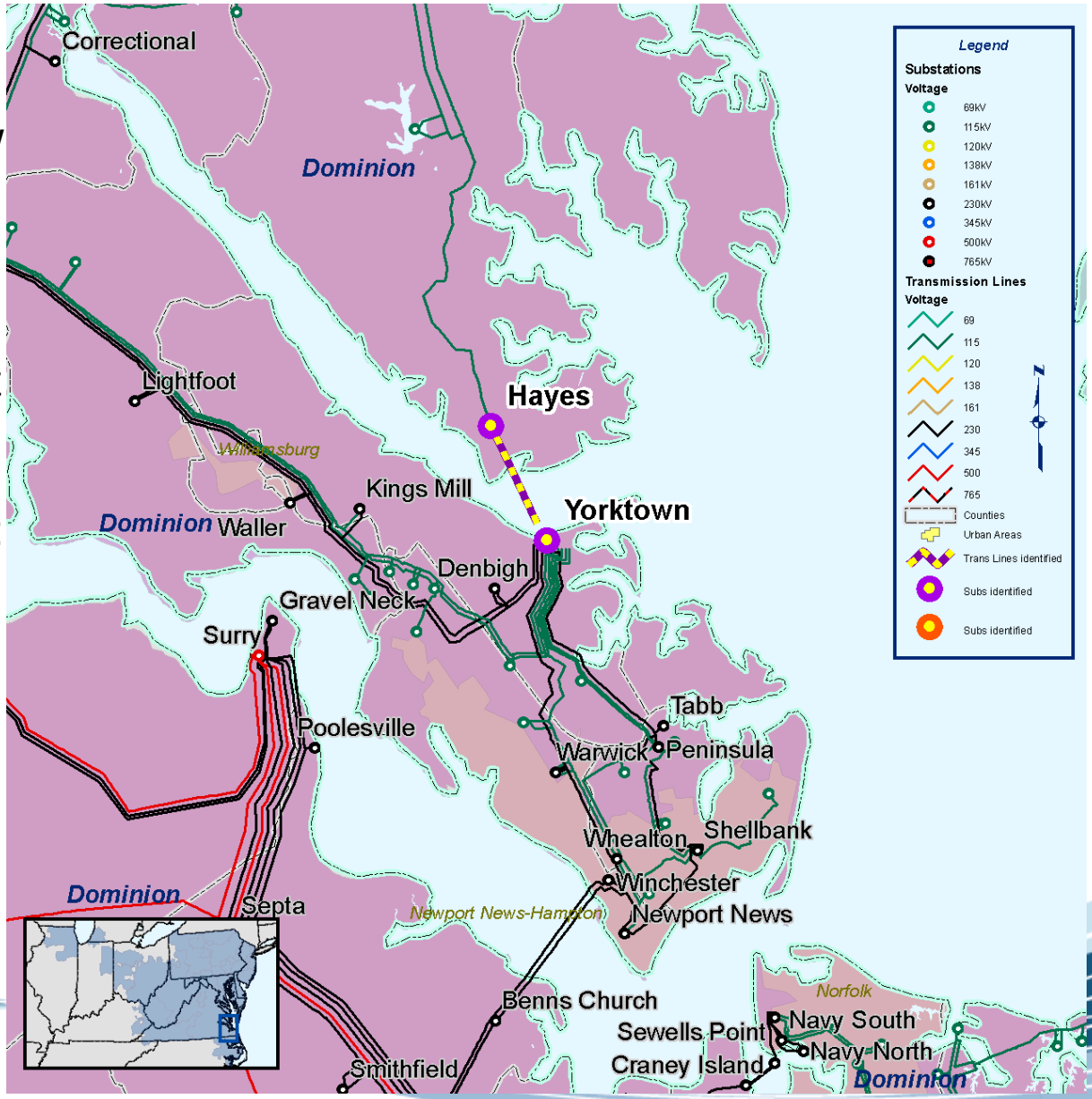
Dominion Baseline Upgrade - Lebanon 115 kV Capacitor

- Loss of the Yorktown to Lanexa 115 kV line results in low voltage at Grafton and Lebanon
- Solution: Install 29.7 MVAR capacitor at Lebanon
- Expected service date: May 2012
- Est. Cost: $0.5 M



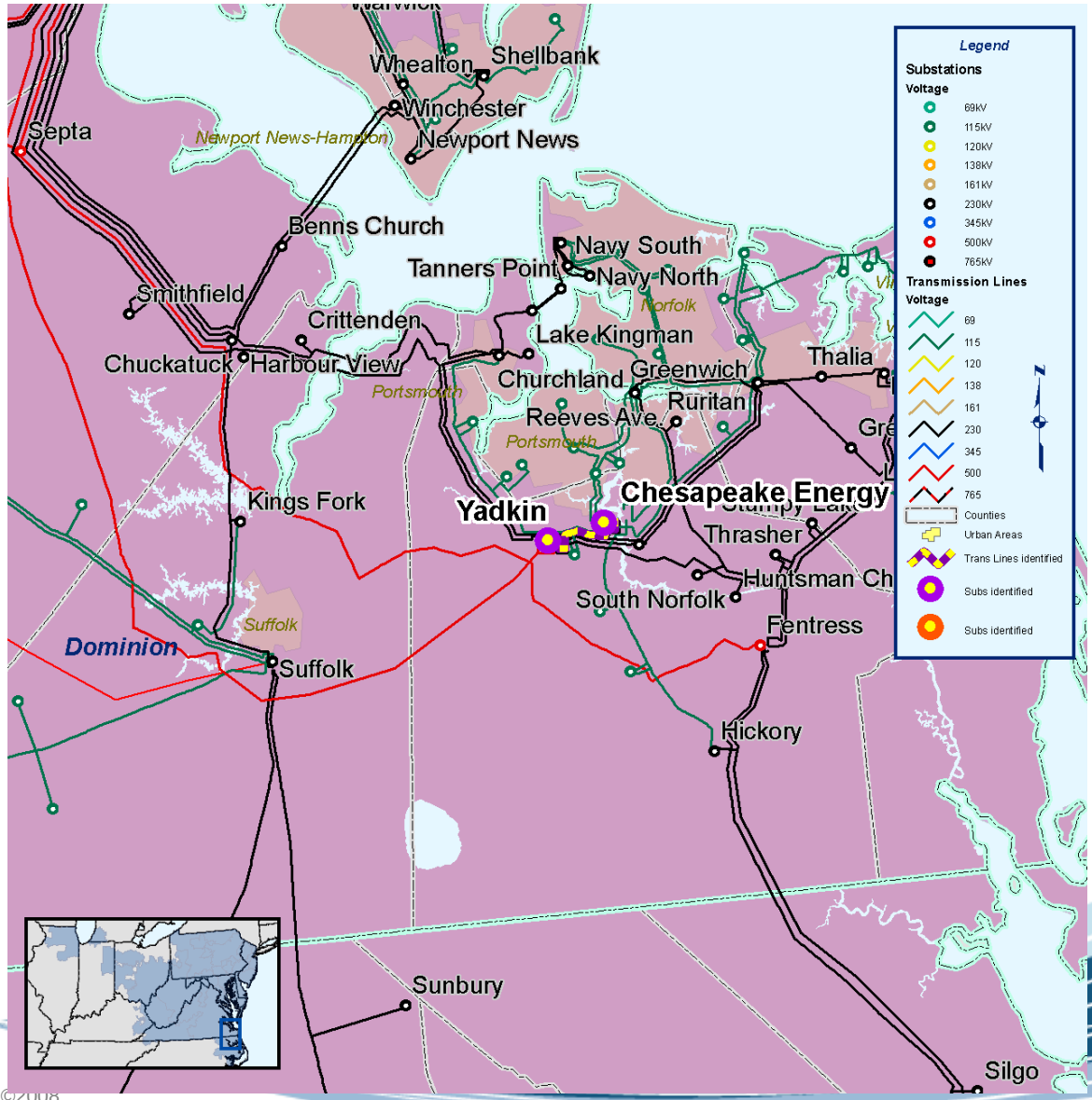
Dominion Baseline Upgrade - Hayes to Yorktown 115 kV

- Loss of Lanexa to Harmony results in low voltage on underlying 115 kV
- Solution: Build a new 230 kV line from Yorktown to Hayes but operate at 115 kV initially
- Expected service date: May 2012
- Est. Cost: $25.0 M



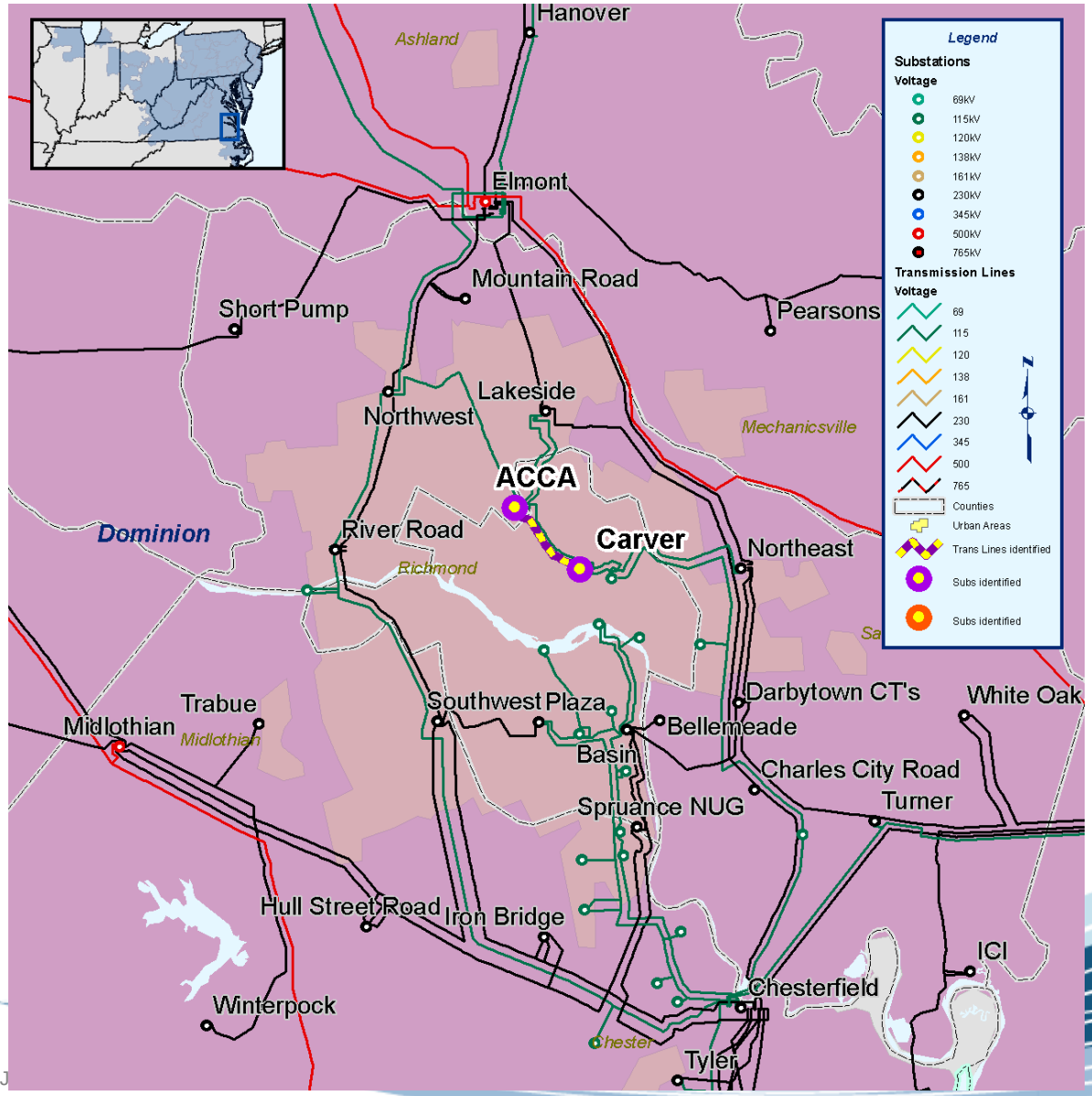
Dominion Baseline Upgrade - Upgrade Chesapeake-Yadkin

- Chesapeake to Yadkin 115 kV is overloaded for the loss of Chesapeake to Yadkin 230 kV with reduced generation at Chesapeake #4 off (221MW)
- Solution: Reconductor Chesapeake to Yadkin 115 kV line
- Expected service date: May 2012
- Est. Cost: $2.0 M



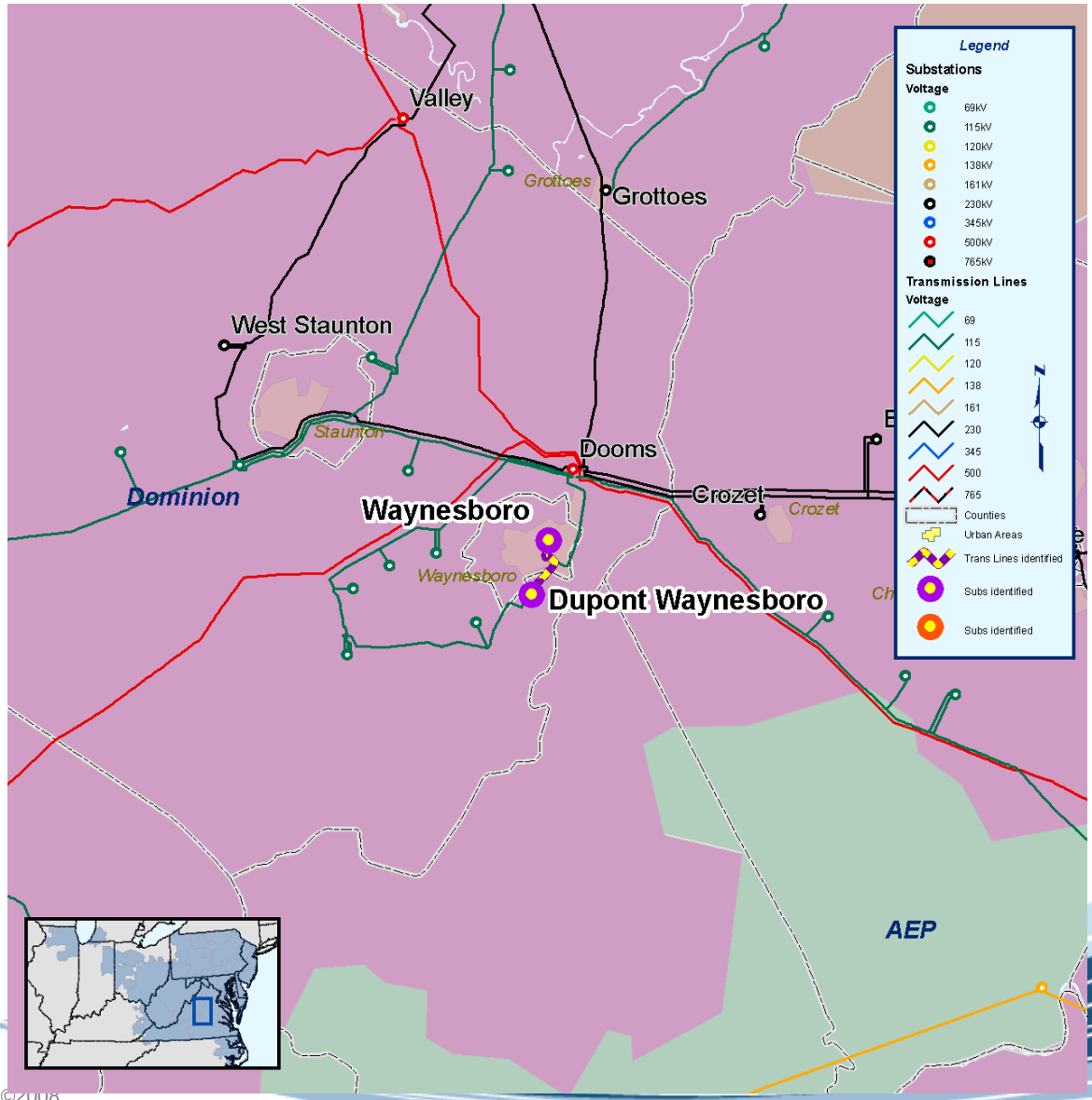
Dominion Baseline Upgrade – Upgrade Chesterfield-Shockoe and ACCA-Carver

- Chesterfield to Shockoe is overloaded for the loss of ACCA to Carver and visa-versa
- Solution: Reconductor and replace terminal equipment on line 17 and replace the wave trap on line 88
- Expected service date: May 2012
- Est. Cost: $0.3 M



Dominion Baseline Upgrade - Dupont-Waynesboro 115kV Capacitor

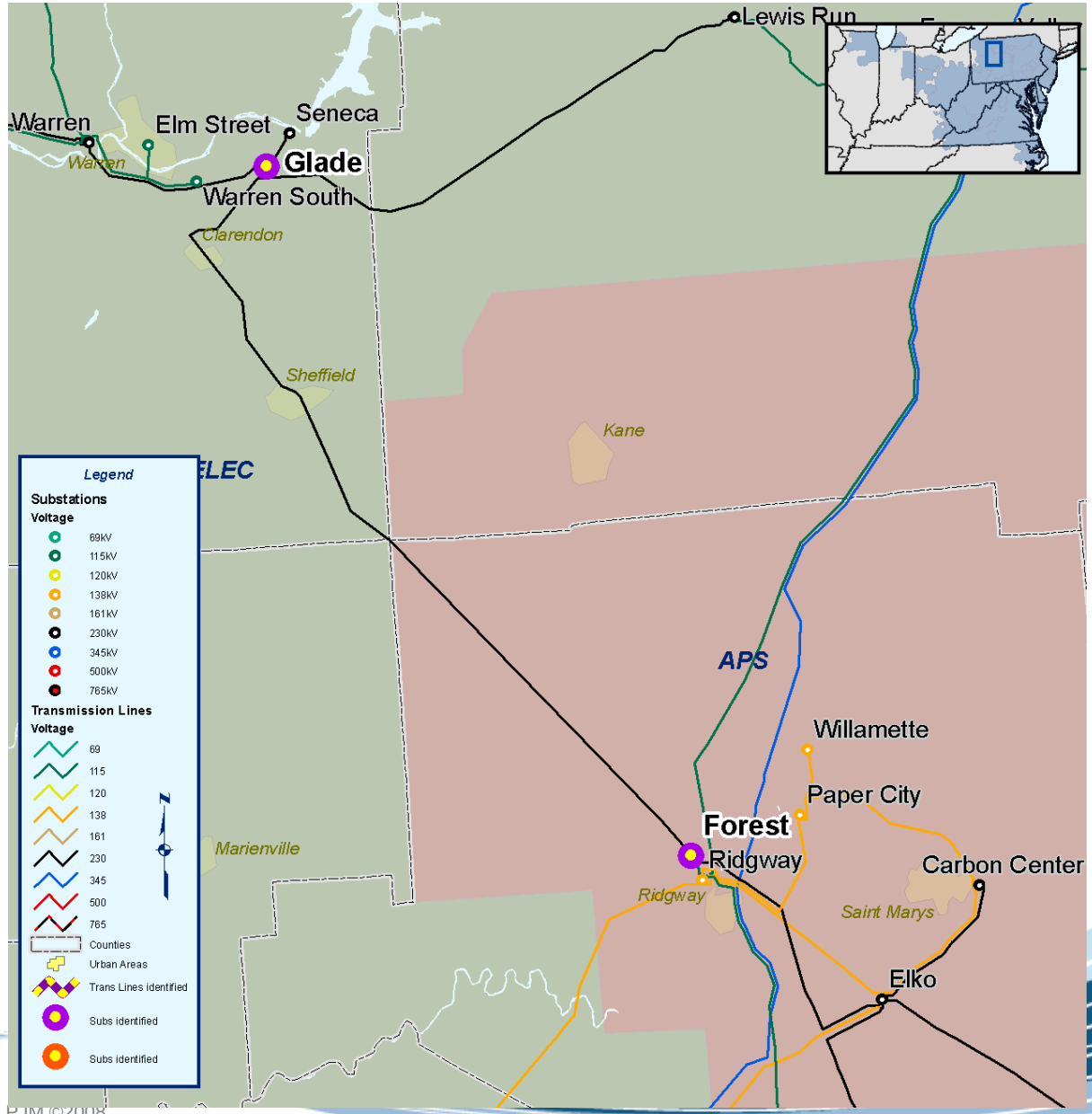
- Loss of the Dooms source of Dooms to Dupont Waynesboro line results in low voltage at Waynesboro
- Install a new 115 kV capacitor at Dupont-Waynesboro substation
- Expected in-service date: May 2013
- Est. Cost: $0.5 M



First Energy Baseline Upgrades

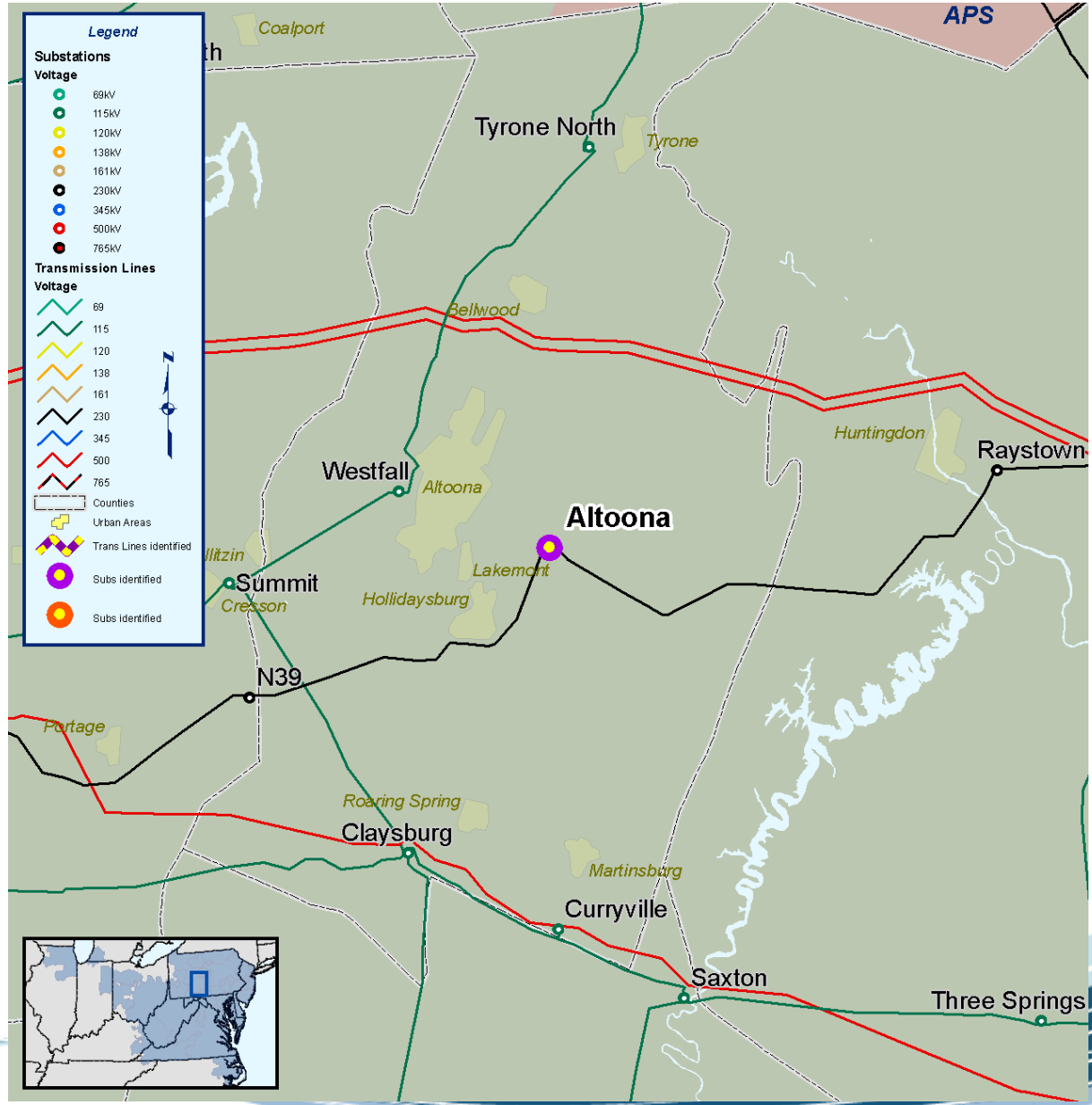
PN Baseline Upgrades due to FE Criteria

- Voltage collapse / Forest 230 kV circuit breaker fault causing the loss of the Forest-Glade Tap 230 kV line
- Reconfigure and expand the Glade 230 kV ring bus to eliminate the Glade Tap 230 kV 3-terminal line
- Estimated Project Cost: $5.64 M
- Expected IS Date: 6/01/2010



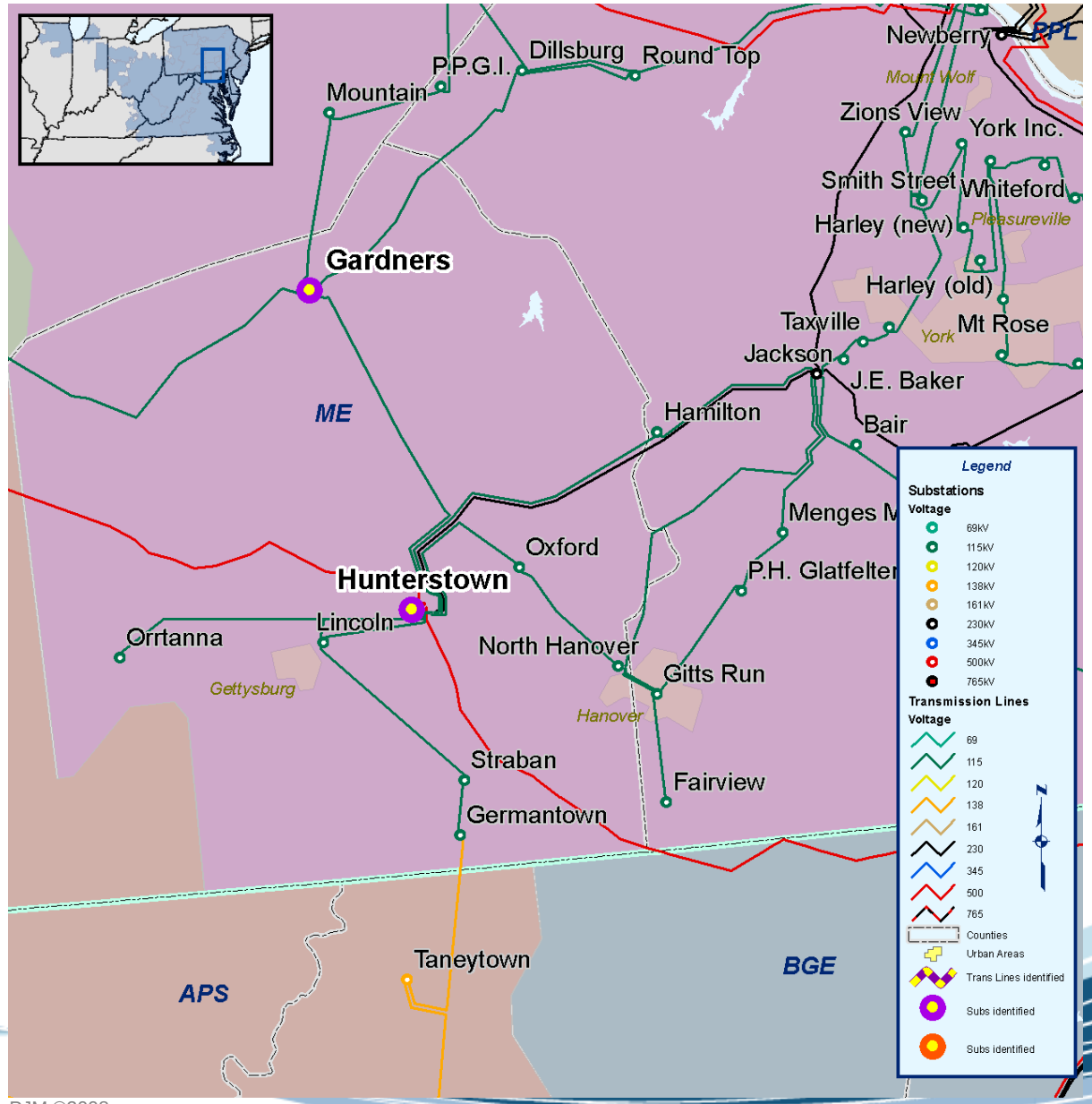
PN Baseline Upgrades due to FE Criteria

- Altoona 230/46 kV transformer #1 / loss of Altoona-Raystown 230 kV line and Altoona 230/46 kV transformer #2
- Add 3 breakers to form a ring bus at Altoona 230 kV
- Estimated Project Cost: $2.73 M
- Expected IS Date: 6/01/2010



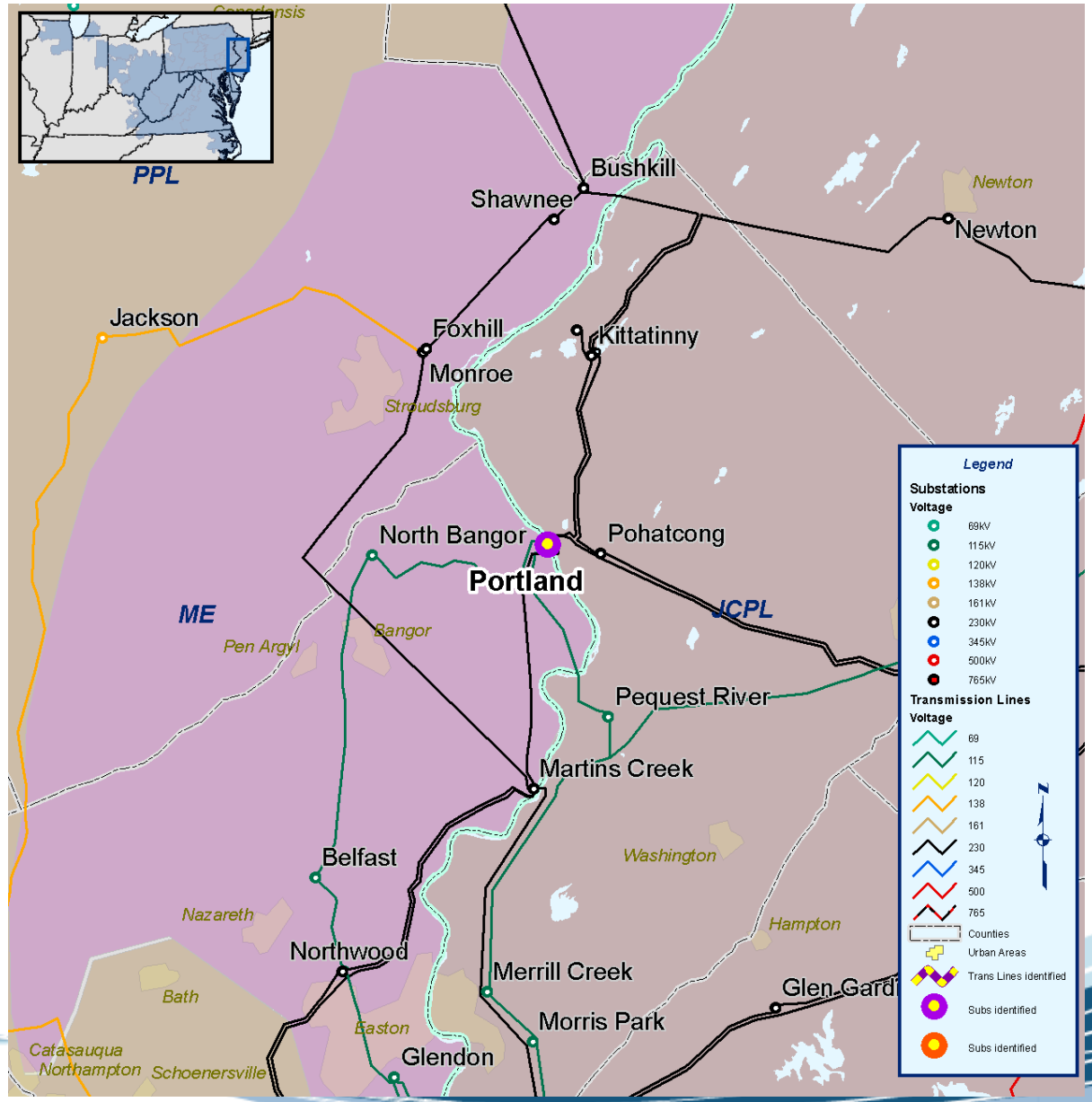
ME Baseline Upgrades

- Driver: Violation of FE Thermal Criteria / Hunterstown - Texas Eastern Tap - Gardners 115 kV
- Solution: Rebuild Hunterstown - Texas Eastern Tap 115
- Estimated Project Cost: $2.1 M
- IS Date: 6/1/2008
- Solution: Rebuild Texas Eastern Tap - Gardners 115 kV and associated upgrades at Gardners including disconnect switches
- Estimated Project Cost: $1.9 M
- IS Date: 5/1/2009



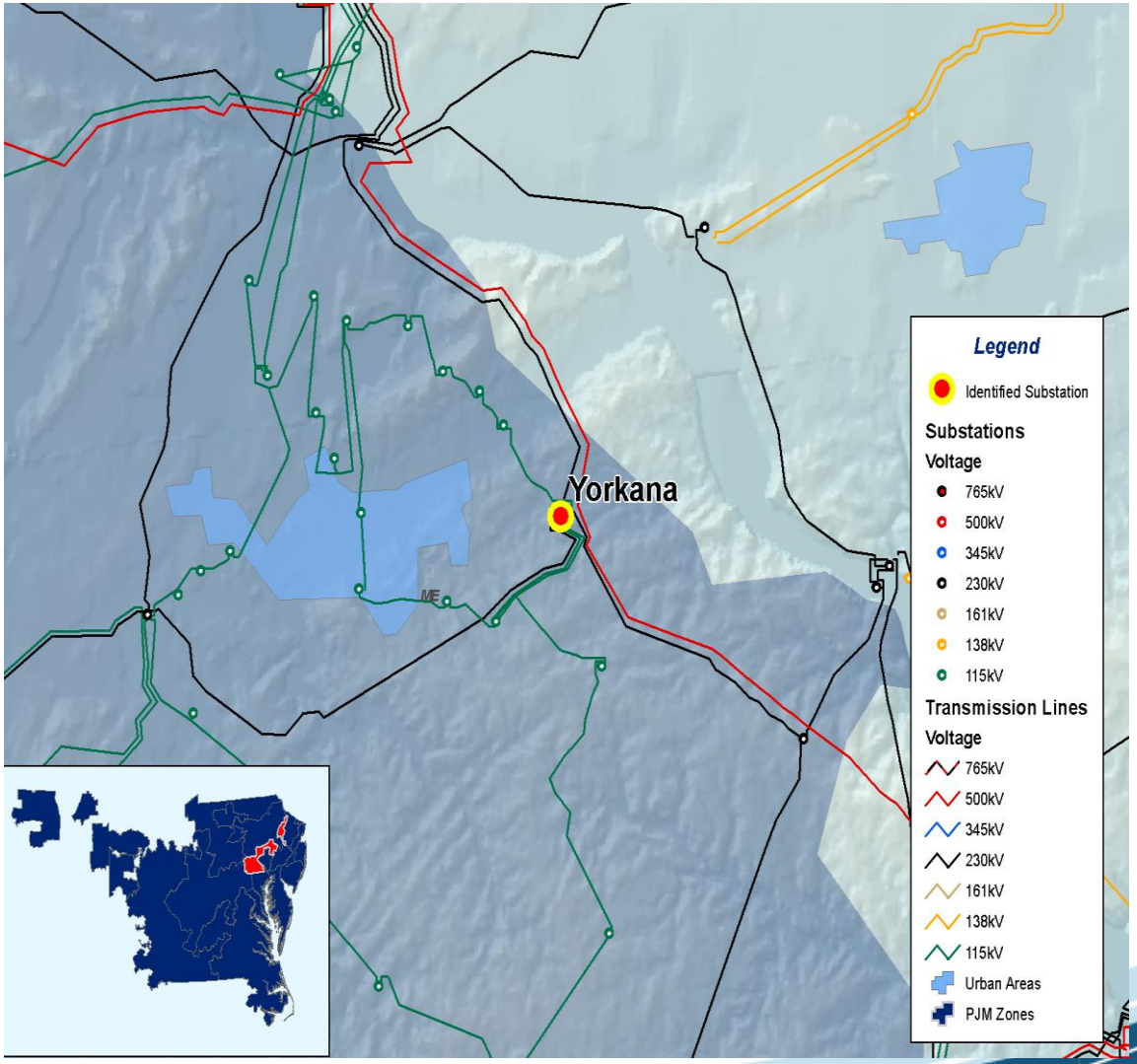
ME Baseline Upgrades

- Replace disconnect switch at Portland on the Portland-Kittatinny 230 kV circuit
- Estimated Project Cost:
- IS Date: 6/1/2011



Generation Deliverability Violation - METED

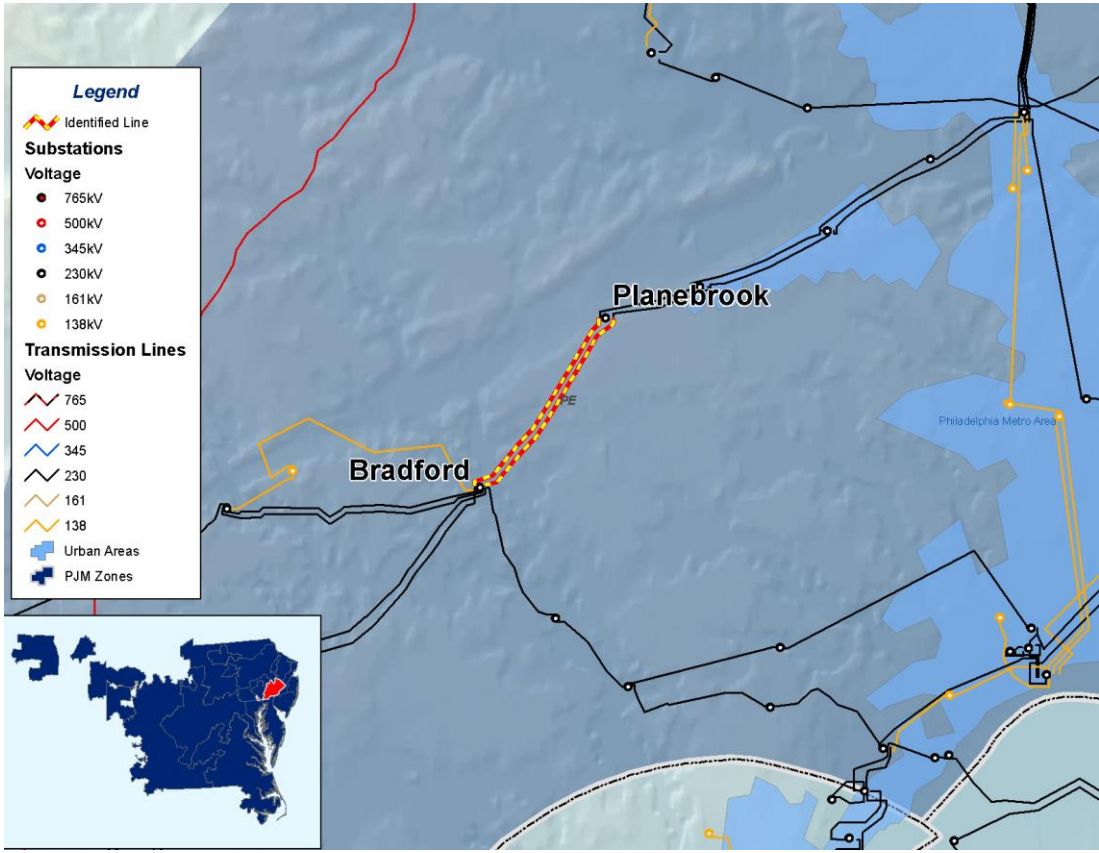
- Yorkana 230/115 kV transformer bank 4 / losses of Yorkana-Jackson 230 kV line and Yorkana 230/115 kV bank 3 (also load deliverability violation)
- Recommended Solution: Add Yorkana 115 kV tie bus breaker
- Estimated Project Cost: $952,700
- IS Date: 6/1/2013



PECO Baseline Upgrades

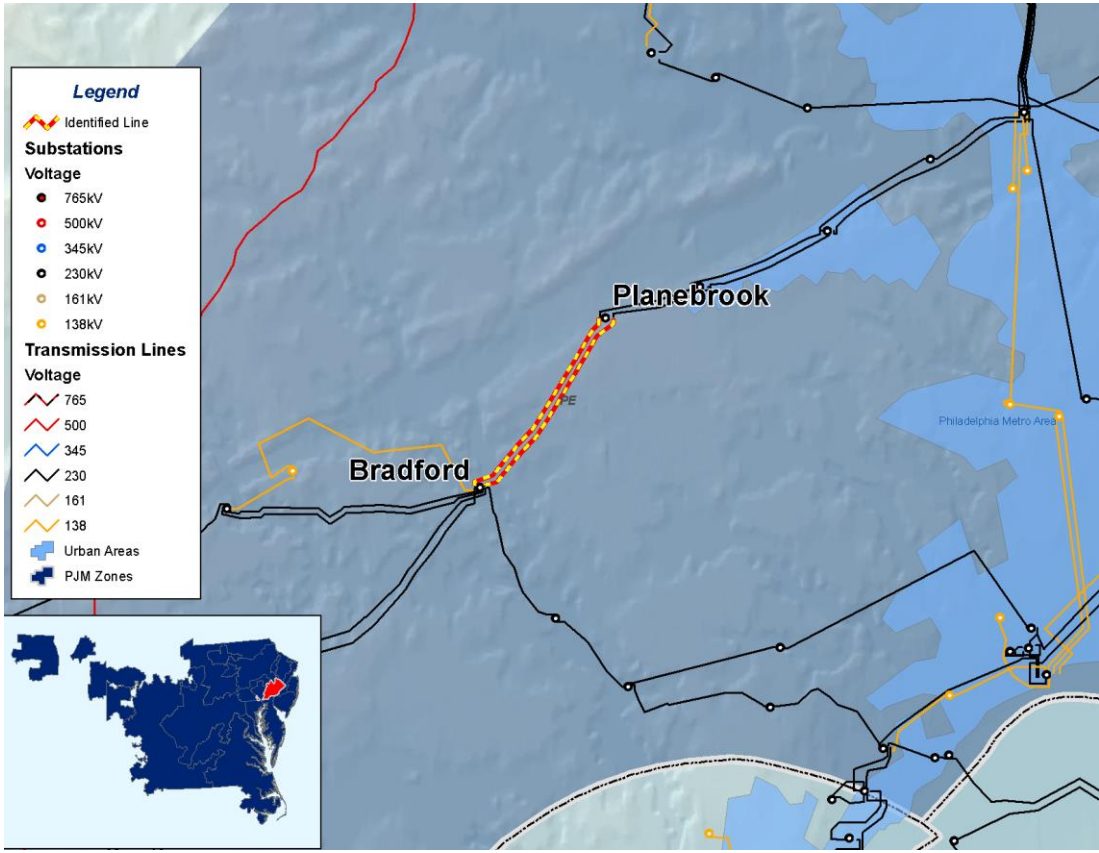
Generation Deliverability Violation - PECO

- Bradford – Planebrook 230 kV line CKT 220-02 / Loss of the other 230 kV line (Single)
- Recommended Solution: Reconductor the line to provide a normal rating of 677 MVA and an emergency rating of 827 MVA
- Expected in-service: June 1, 2013
- Estimated cost: $7.0 M



Generation Deliverability Violation - PECO

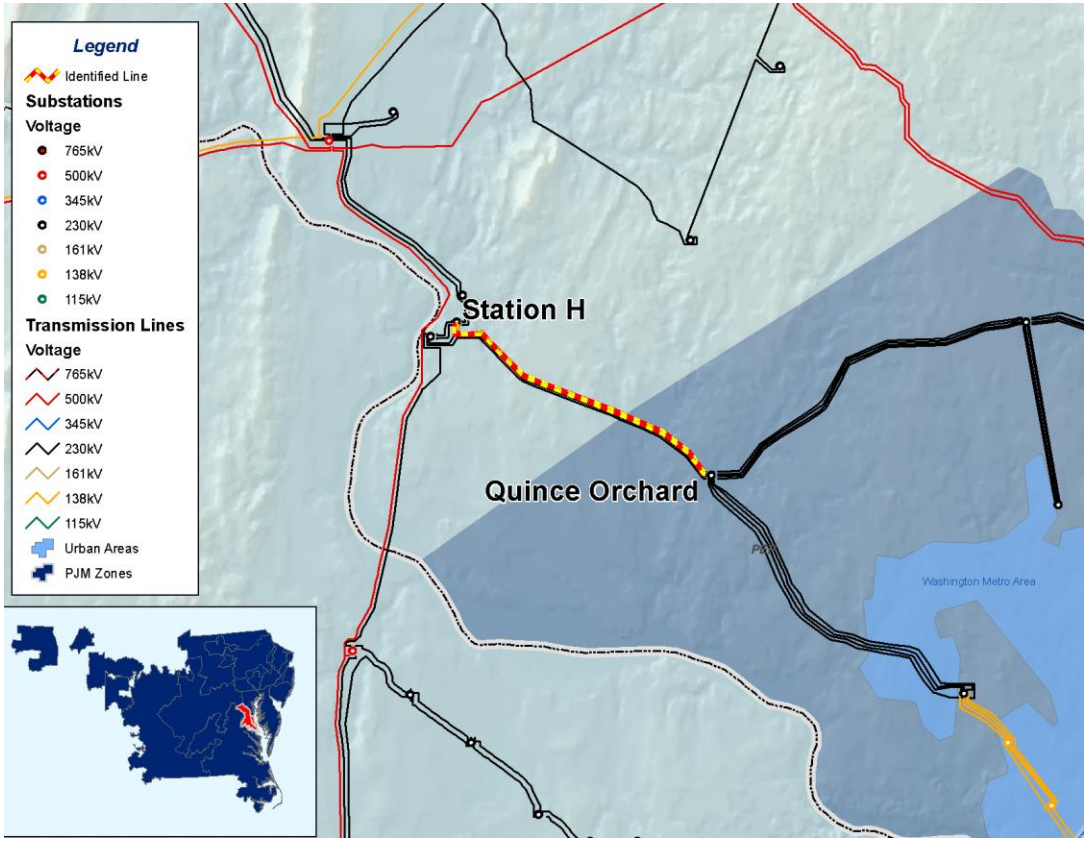
- Bradford – Planebrook 230 kV line CKT 220-31 / Loss of Bradford – Planebrook 230 kV line + Bradford CB 220 failed (Line_FB)
- Recommended Solution: Reconductor the line to provide a normal rating of 677 MVA and an emergency rating of 827 MVA
- Expected in-service: June 1, 2013
- Estimated cost: $7.5 M



PEPCO Baseline Upgrades

Generation Deliverability Violation – PEPCO

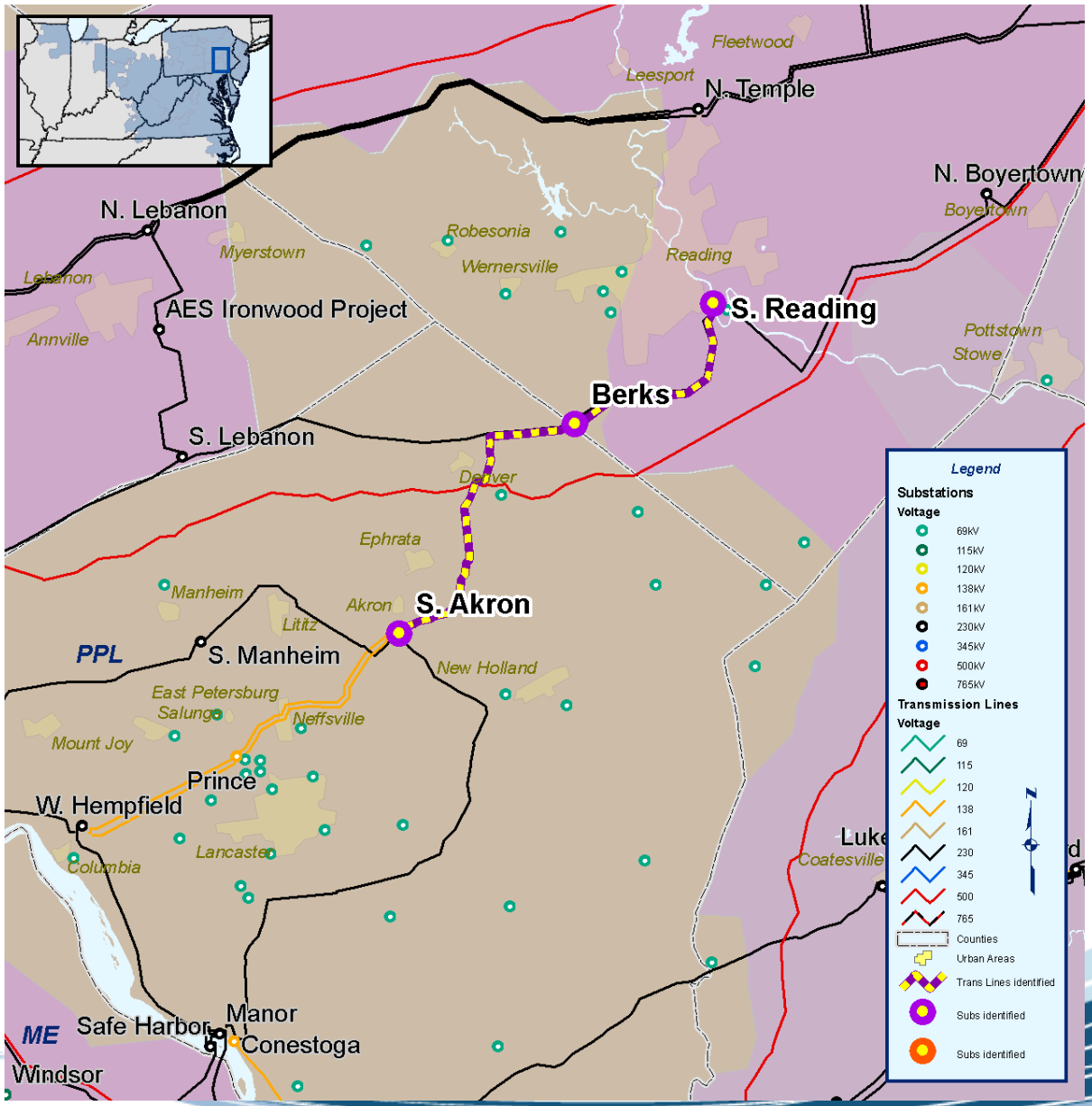
- Station H – Quince Orchard 230 kV line / Loss of Dickerson – Quince Orchard DCTL
- Recommended Solution: Upgrade circuit to 3,000 amps using the ACCR
- Expected in-service date: June 1, 2013
- Estimated cost: $6.252M



PP&L Upgrades

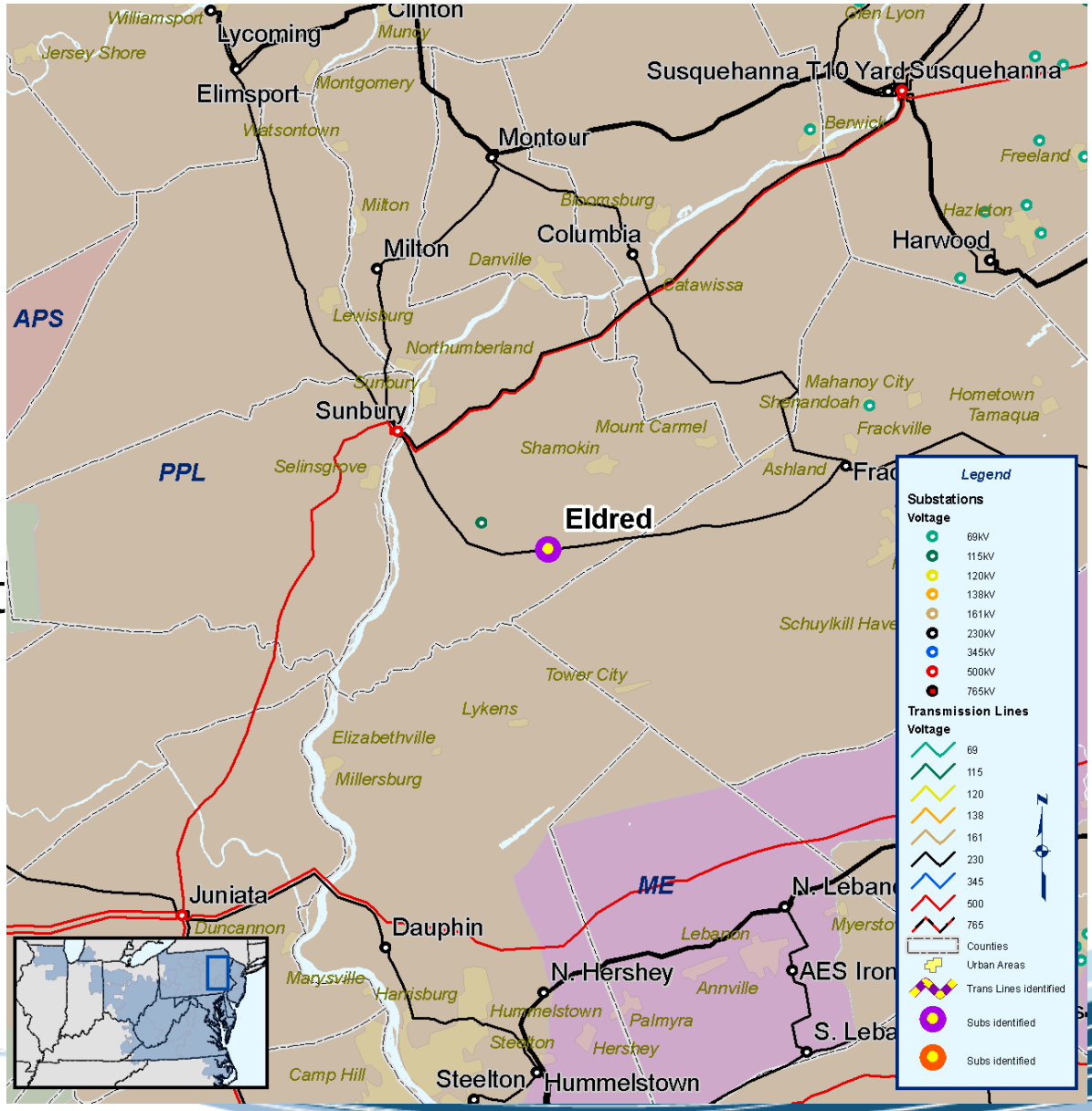
PPL Baseline Upgrades

- 210 MVA load loss / loss of double circuit South Akron-South Reading 230 kV lines and Berks transformers #1 and #2
- Exceeds PPL guidelines for maximum allowable load loss
- Berks Substation modification on Berks-South Akron 230 kV Line. Modification will isolate the line fault on the South Akron line and will allow Berks transformer #2 to be energized by the South Lebanon 230kV circuit
- Estimated Project Cost: $0.523 M
- Expected IS Date: 5/01/2010



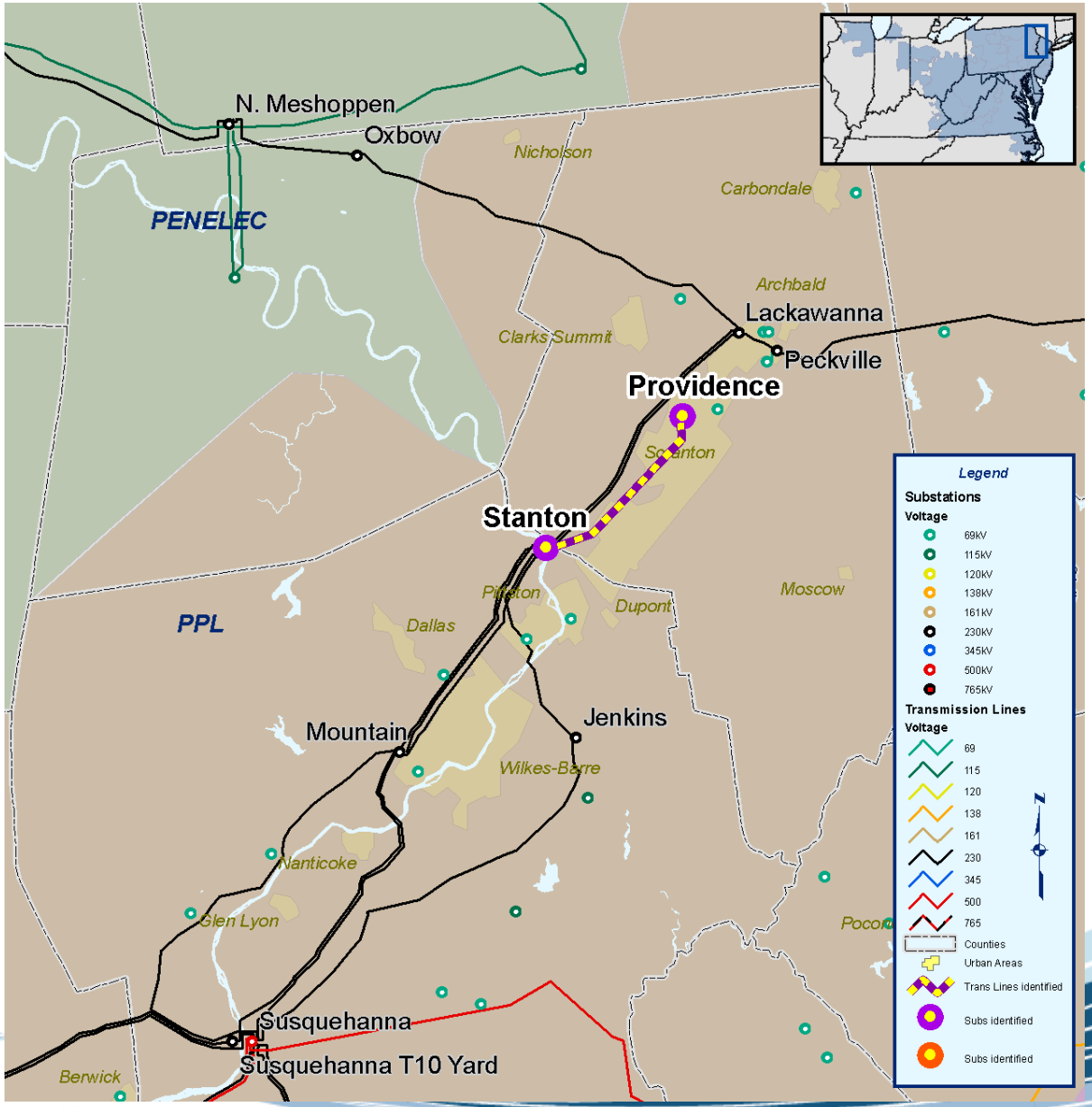
PPL Baseline Upgrades

- Eldred-Pine Grove 69 kV Line / basecase
- Eldred-Pine Grove 69 kV Line Rebuild Part 2: 8 Miles
- Estimated Project Cost: $10.22 M
- IS Date: 5/1/2012



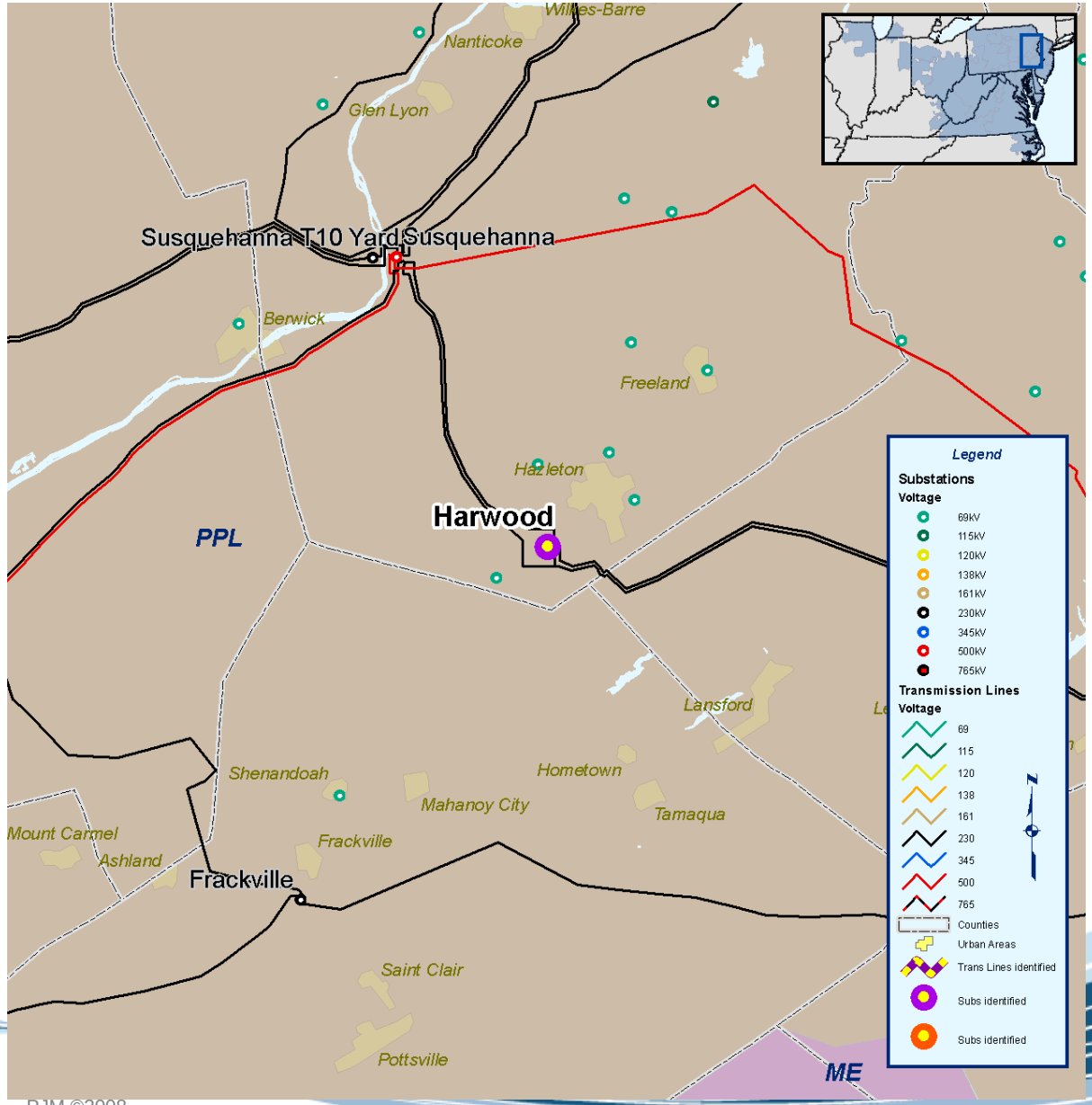
PPL Baseline Upgrades

- Several overloads in Lackawanna/Providence 69 kV area / loss of DCTL Lackawanna-Mountain 230 kV line and Lackawanna-Stanton 230 kV line
- Stanton-Providence #1 & #2 69 kV Line: Reconductor/Rebuild w/ 69 kV Design: Approximately 8 Miles Total
- Estimated Project Cost: $4.89 M
- IS Date: 5/1/2011



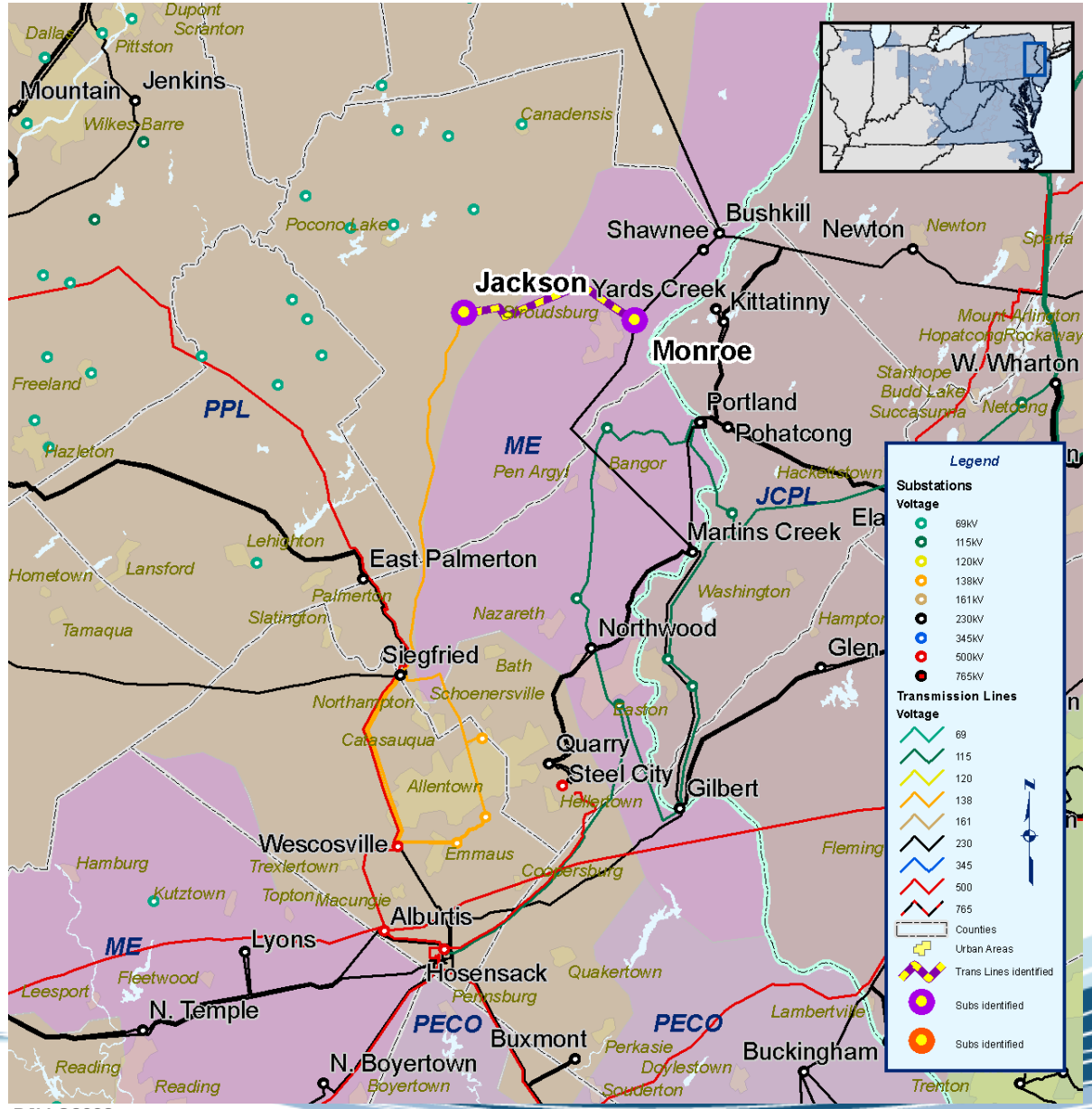
PPL Baseline Upgrades

- Harwood 230/69 kV transformer / loss of DCTL Susquehanna-Harwood #1 & #2 230 kV lines
- Harwood Substation: Add 150MVA, 230/138/69 Transformer #6
- Estimated Project Cost: $13.97 M
- IS Date: 11/1/2011



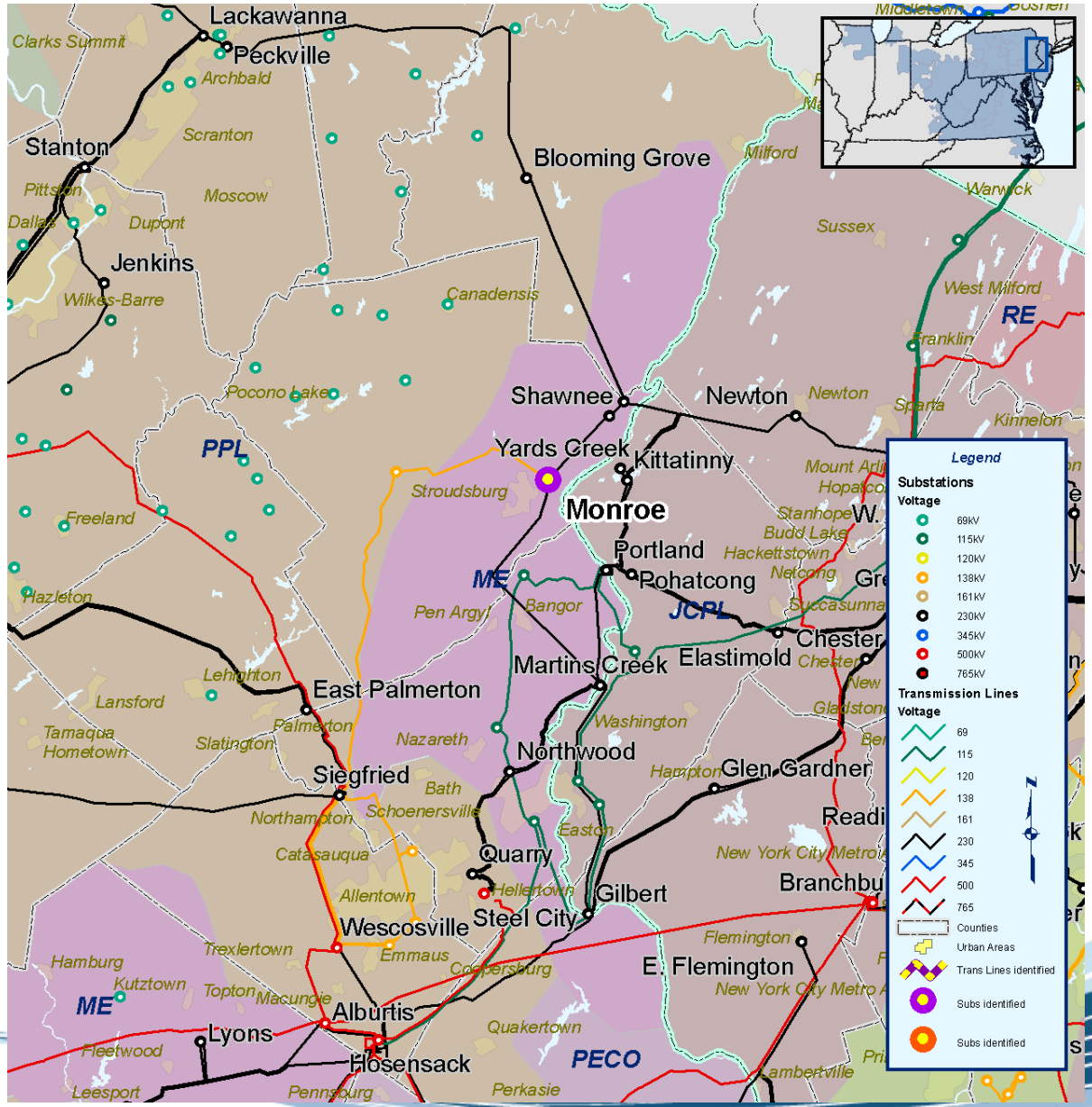
PPL Baseline Upgrades

- Siegfried-Jackson 138 kV line / loss of Monroe-Jackson 138 kV line and low voltage in Jackson 69 kV area
- Bartonsville Substation- New 138kV tap off Monroe-Jackson #1
- Stroudsburg Substation: New 138kv Taps from Monroe-Jackson Lines
- Gilbert Substation: New 138kV tap off Siegfried-Jackson #2 to Transformer #2
- Estimated Project Cost: $1.95 M
- IS Date: 11/1/2010



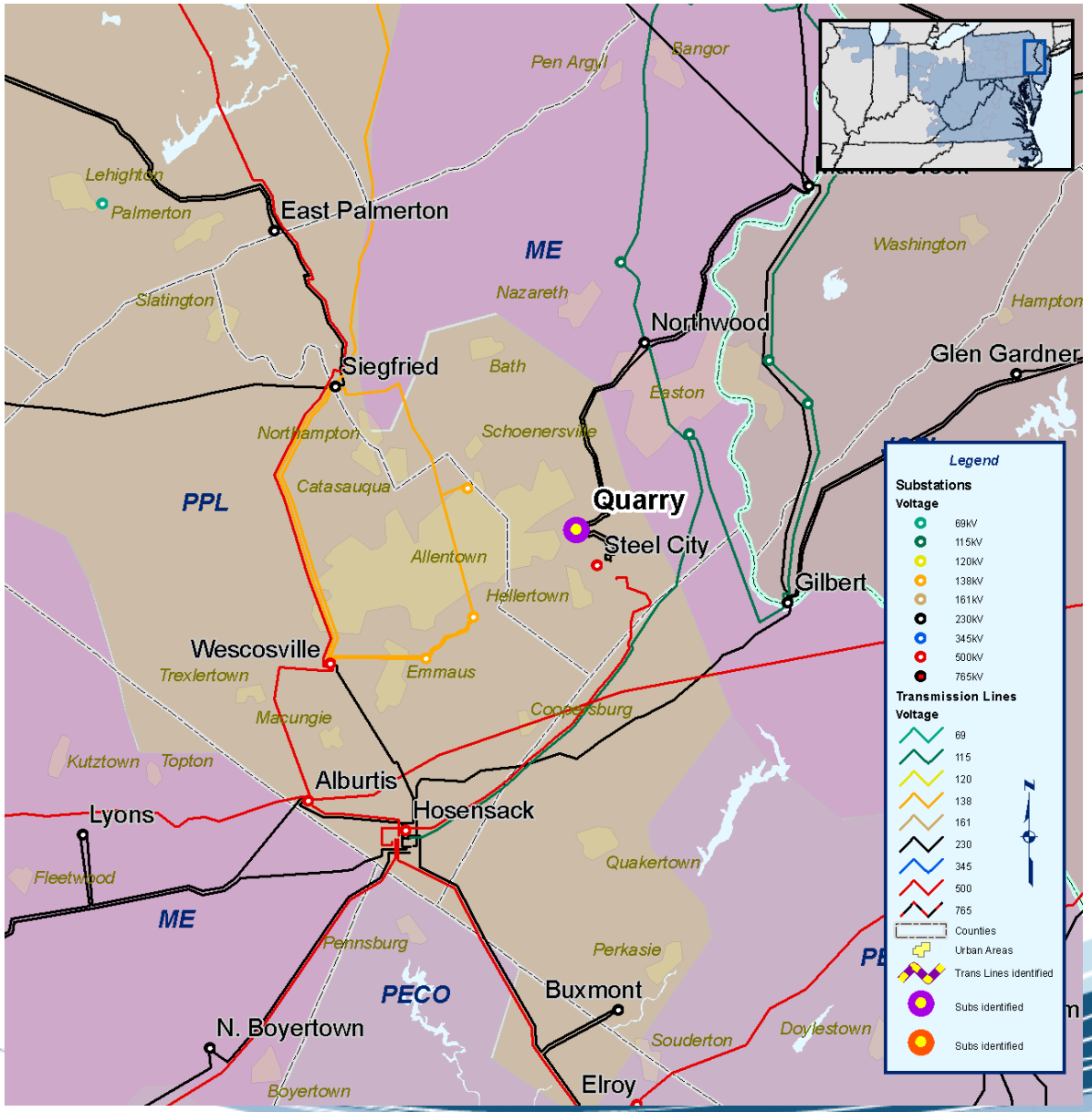
PPL Baseline Upgrades

- Siegfried-Jackson 138 kV line / loss of Monroe-Jackson 138 kV line and low voltage in Jackson 69 kV area
- Monroe 230-138 kV Substation: New 138 kV Line and Terminal
- Siegfried 230/138 kV Substation: New 138 kV Line and Terminal, Add Second Circuit to Siegfried-Jackson for 8.0 Miles
- Jackson 138/69 kV Substation: 138 kV Yard Upgrades and Transmission Line Rearrangements
- Estimated Project Cost: $10.03 M
- IS Date: 11/1/2010



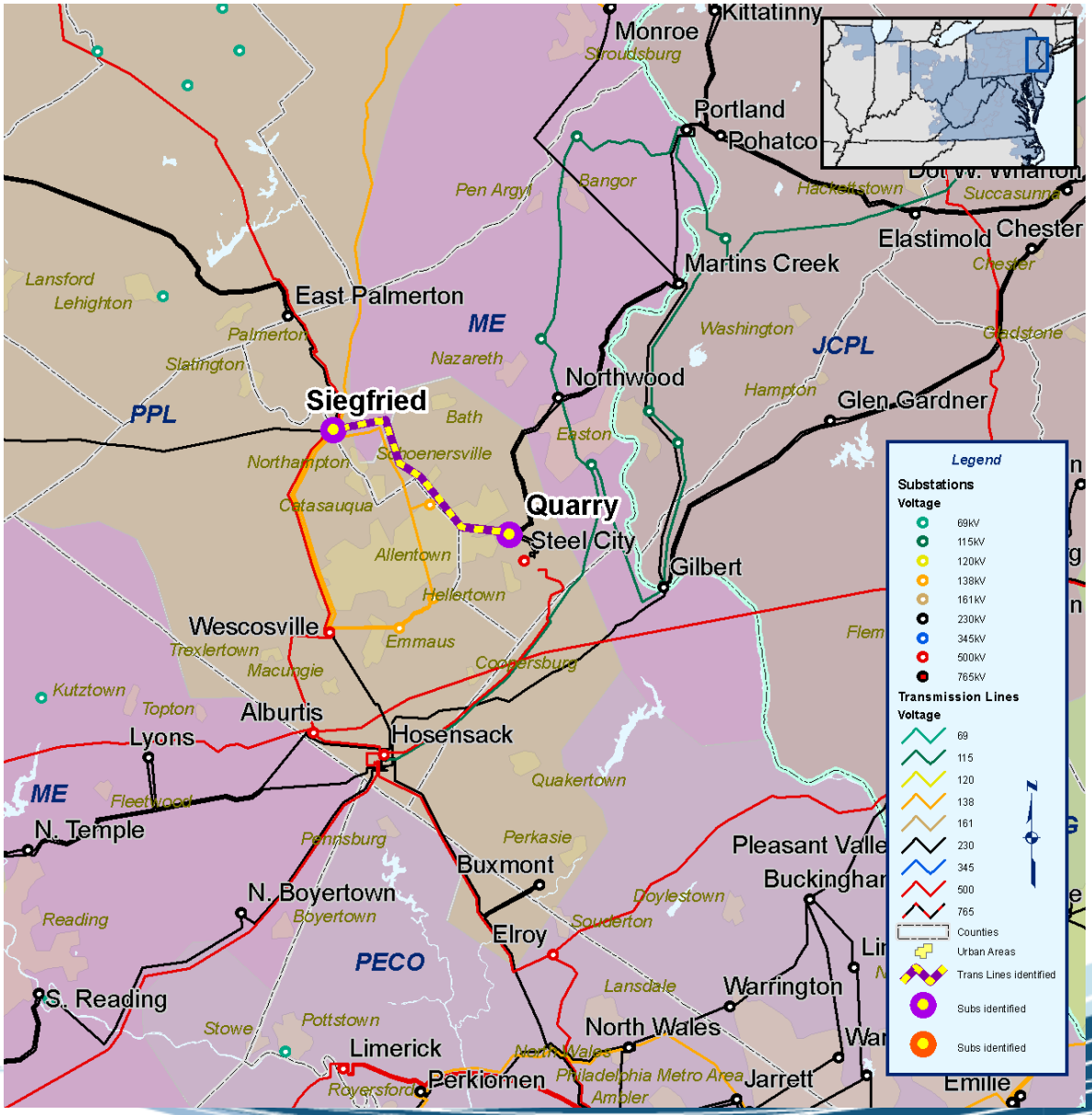
PPL Baseline Upgrades

- South Farmersville 69 kV overloads / basecase
- South Farmersville Substation: New 69kV Tap off Nazareth-Quarry #2 to Transformer #2
- Estimated Project Cost: $0.40 M
- IS Date: 5/1/2011



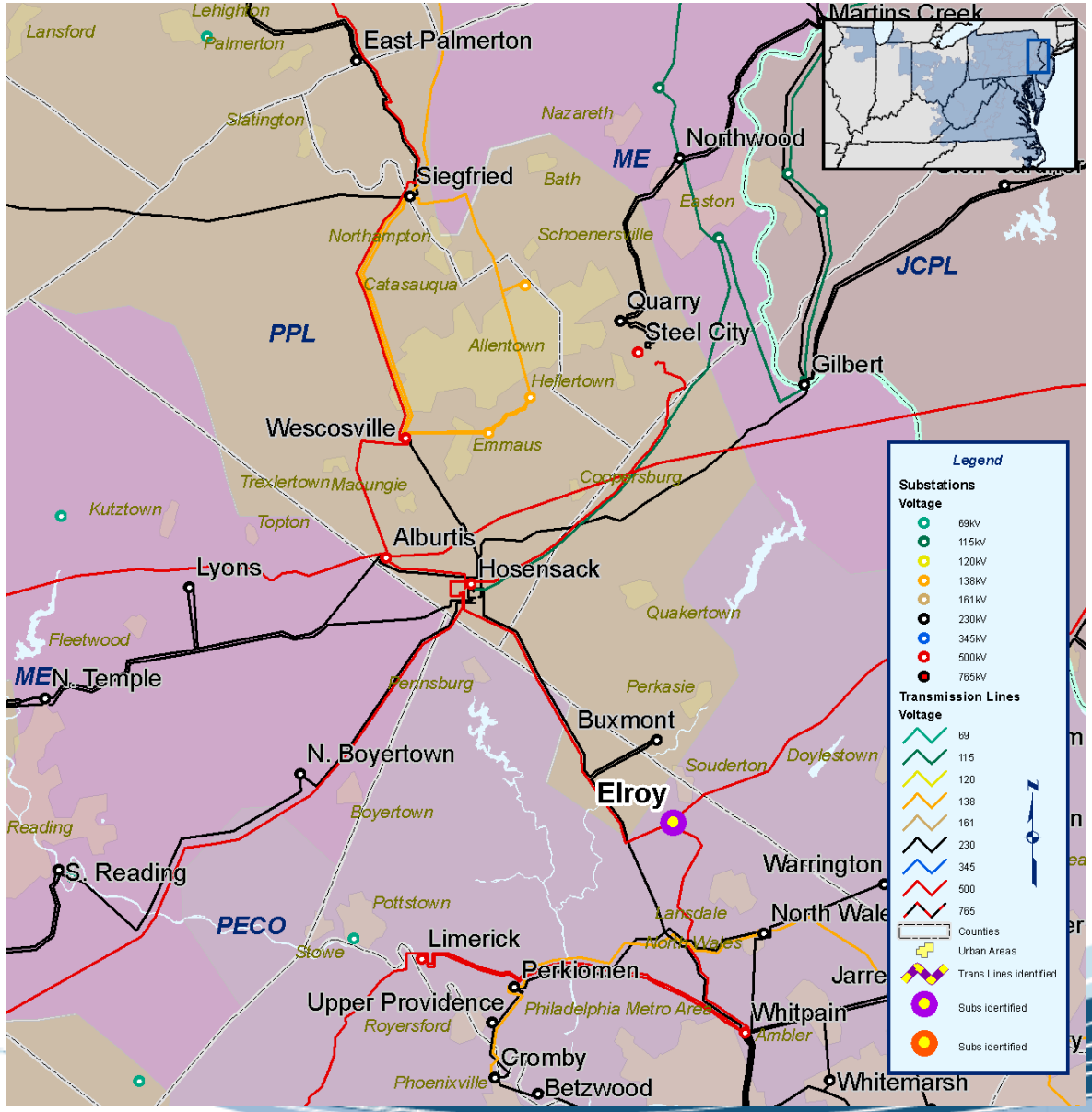
PPL Baseline Upgrades

- Siegfried-Quarry 69 kV Line / basecase
- Siegfried-Quarry 69 kV Line Rebuild from Siegfried to North Bethlehem: 6.7 Miles
- Estimated Project Cost: $5.0 M
- IS Date: 5/1/2011



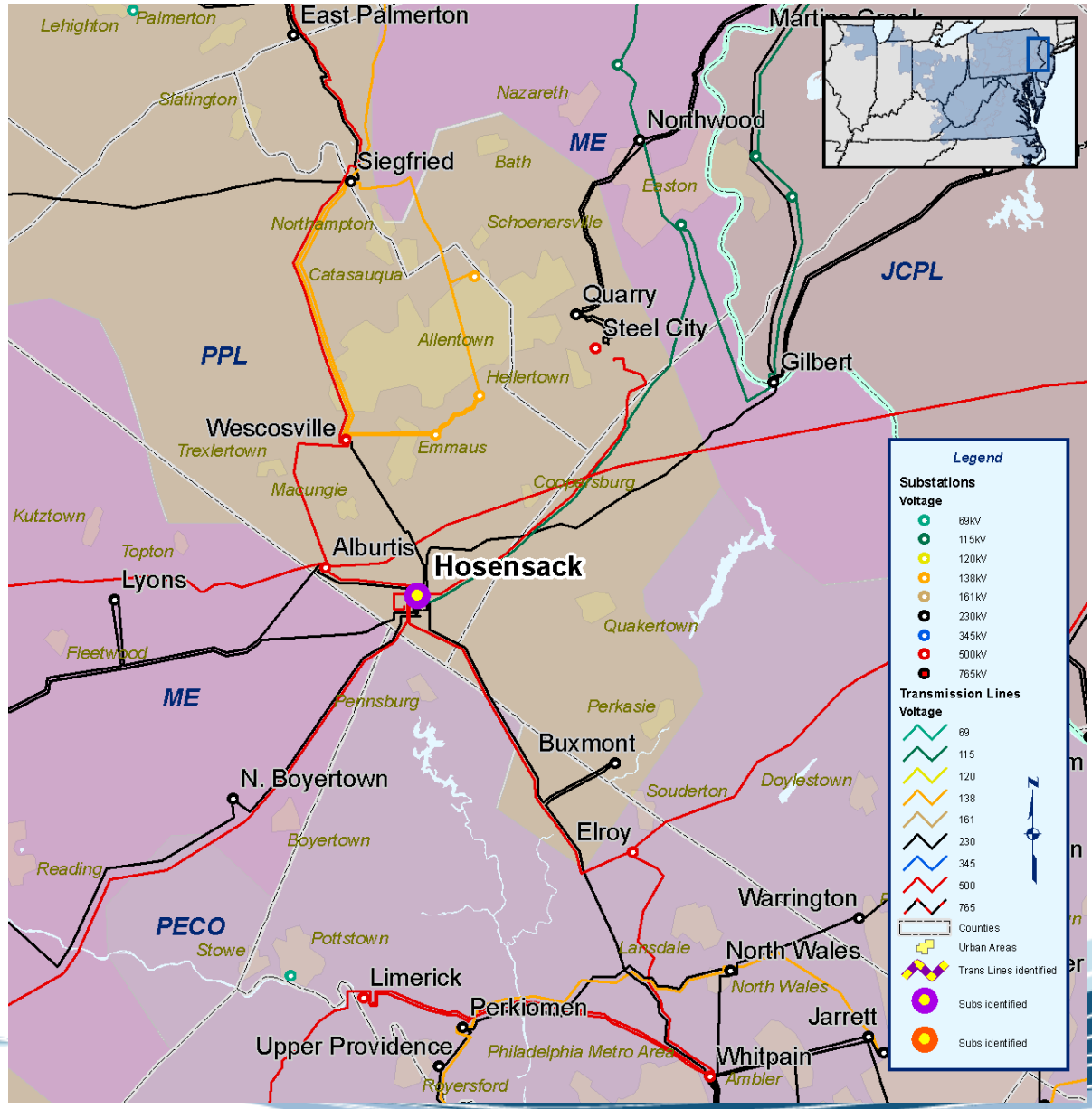
PPL Baseline Upgrades

- Buxmont-Hatfield #3 69 kV line / loss of Buxmont-Hatfield #4 69 kV line
- Elroy 138/69 kV transformer / loss of Hosensack-Buxmont 230 kV line and associated Buxmont 230/69 kV T2.
- Elroy Substation Expansion and New Elroy-Hatfield 138/69 kV Double Circuit Lines: 1.9 Miles
- Estimated Project Cost: $38.42 M
- IS Date: 5/1/2013



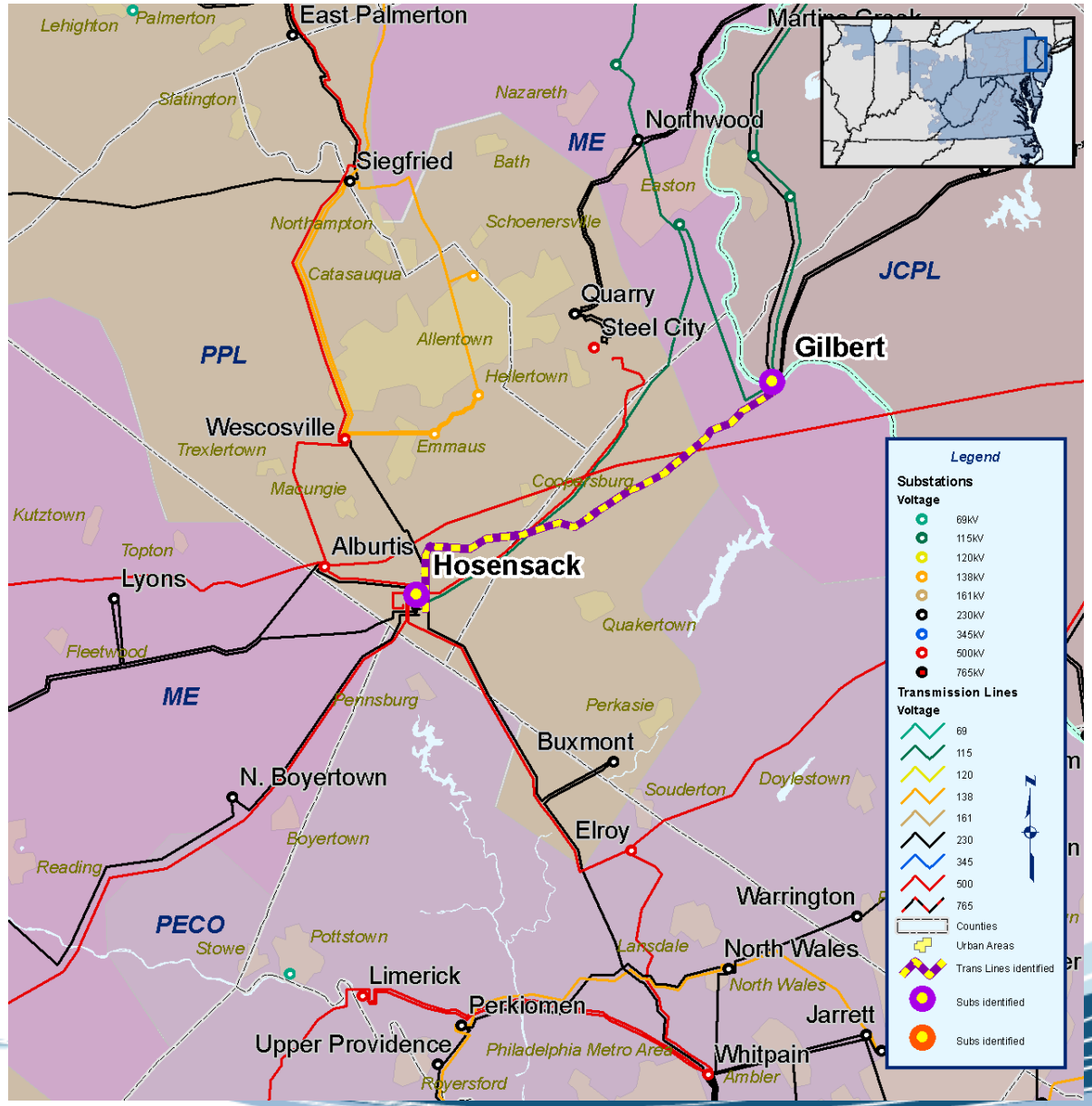
PPL Baseline Upgrades

- Quarry-Elliott Heights #1 69 kV Line / loss of Quarry-Elliott Heights #3 69 kV Line
- Seidersville-Quakertown 138/69 kV Reconductor/ Rebuild 12 Miles and Hosensack New 75 MVA, 230/69 kV Transformer #4
- Estimated Project Cost: $23.14 M
- IS Date: 5/1/2009



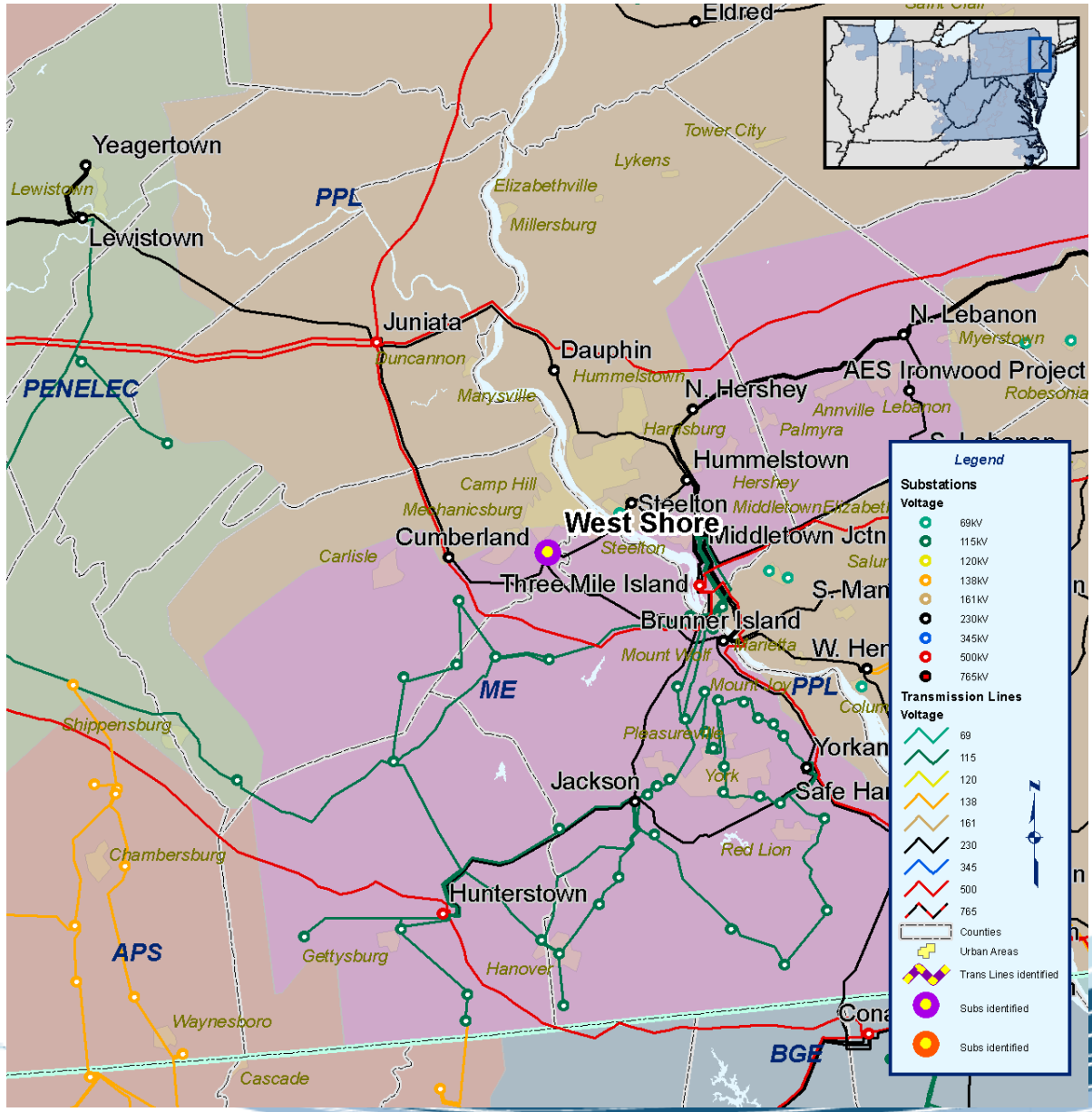
PPL Baseline Upgrades

- Buxmont-Quakertown #2 69 kV line / loss of Buxmont-Quakertown #1 69 kV Line
- New Springfield 230/69 kV Substation and Transmission Line Connections
- Estimated Project Cost: $16.40 M
- IS Date: 5/1/2011



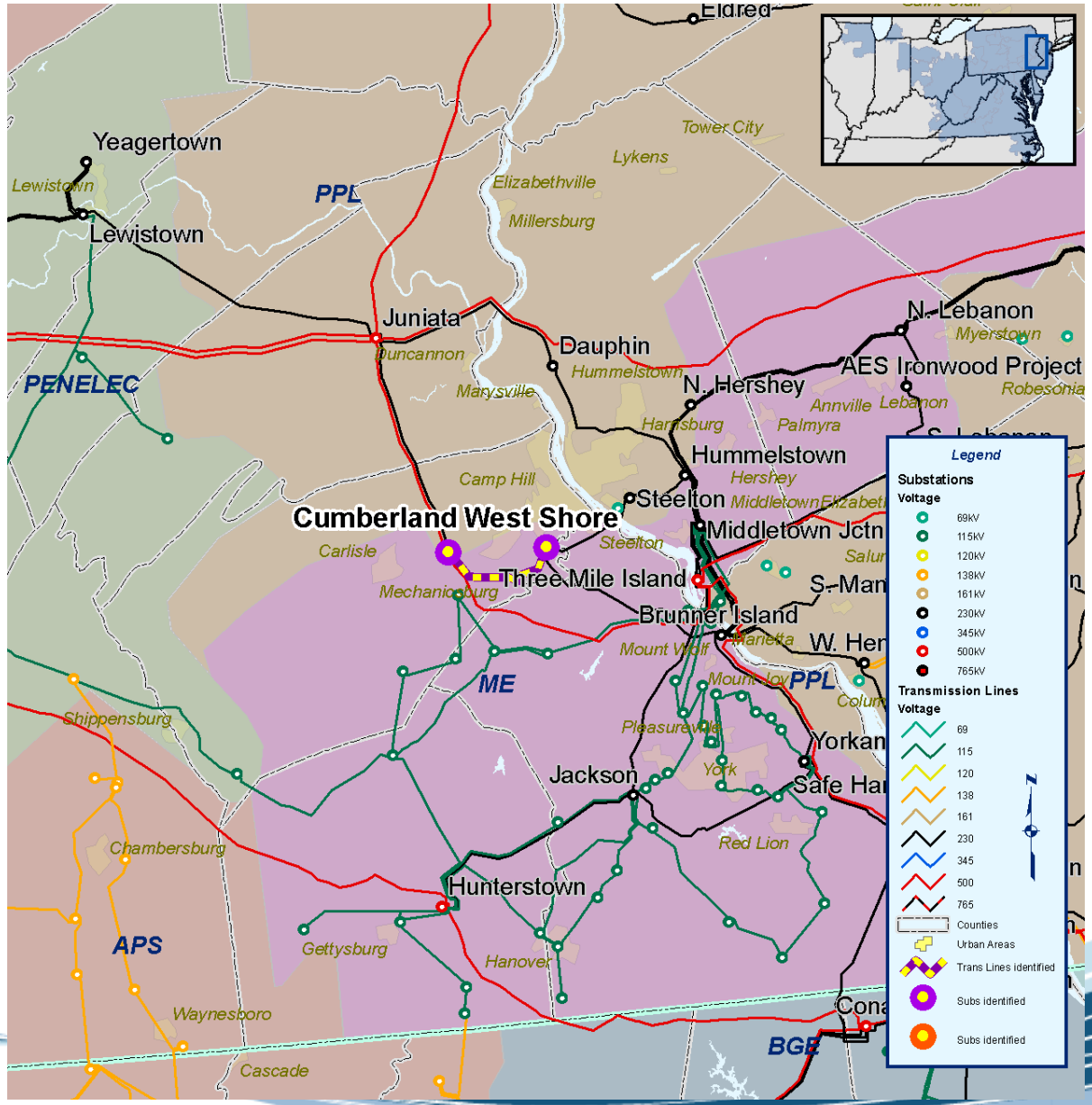
PPL Baseline Upgrades

- West Shore-Cumberland #1 69 kV line / loss of West Shore 69 kV bus section 2
- New Double Circuit 138/69 kV Line from West Shore to Whitehill Taps: 1.3 Miles
- Estimated Project Cost: $4.91 M
- IS Date: 5/1/2013



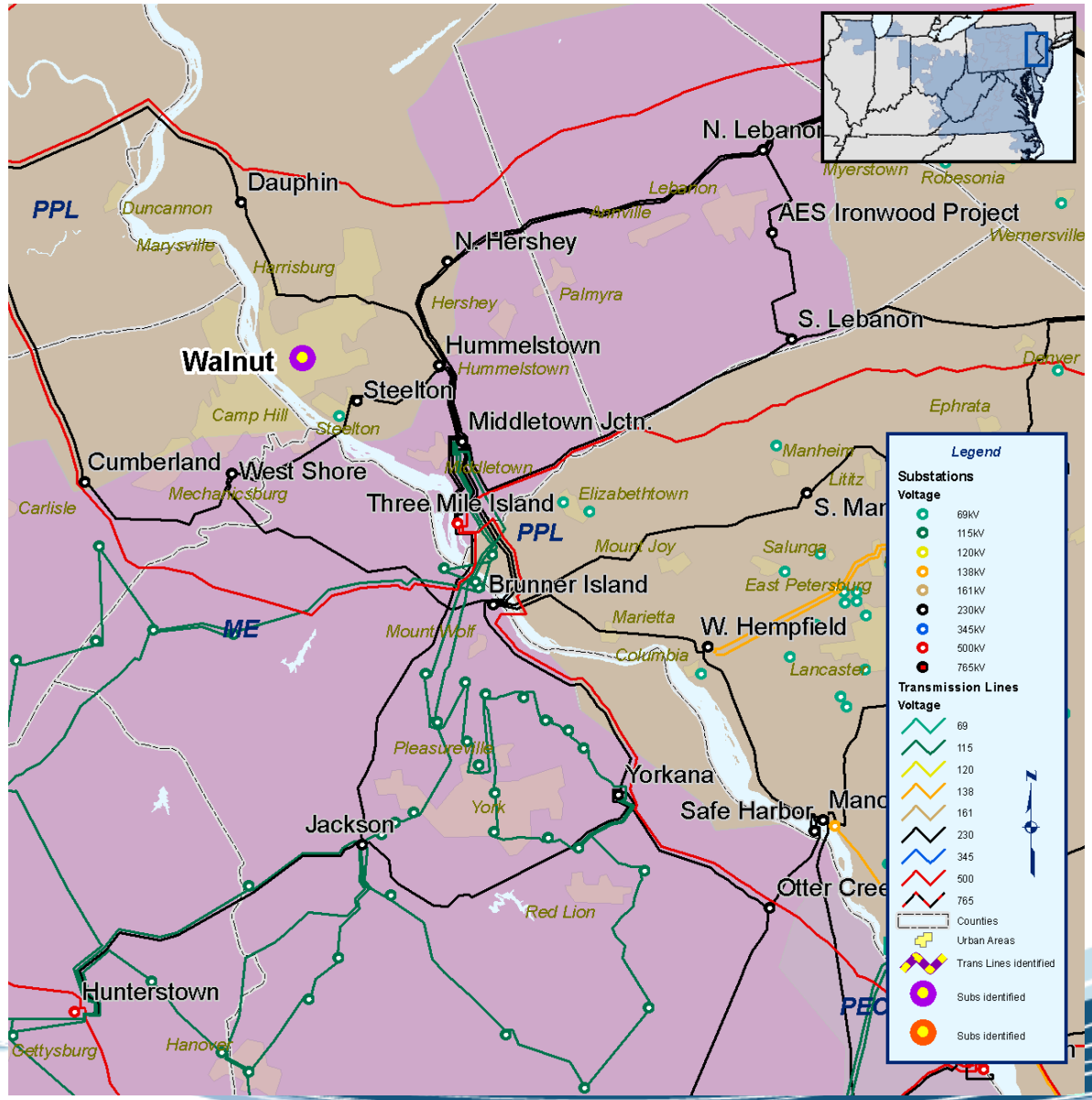
PPL Baseline Upgrades

- West Shore-Cumberland #2 69 kV line / basecase
- Cumberland-West Shore 69 kV Double Circuit Line: Reconductor 3.7 Miles from Cumberland to Wertzville
- Estimated Project Cost: $2.87 M
- IS Date: 12/1/2009
- West Shore-Cumberland #3 & #4 69 kV lines / Cumberland #1 & #2 230/69 kV transformers
- Reconductor West Shore-Cumberland #3 & #4 69 kV Lines from Mt. Allen to Rossmoyne: 1.6 Miles
- Estimated Project Cost: $1.03 M
- IS Date: 5/1/2013



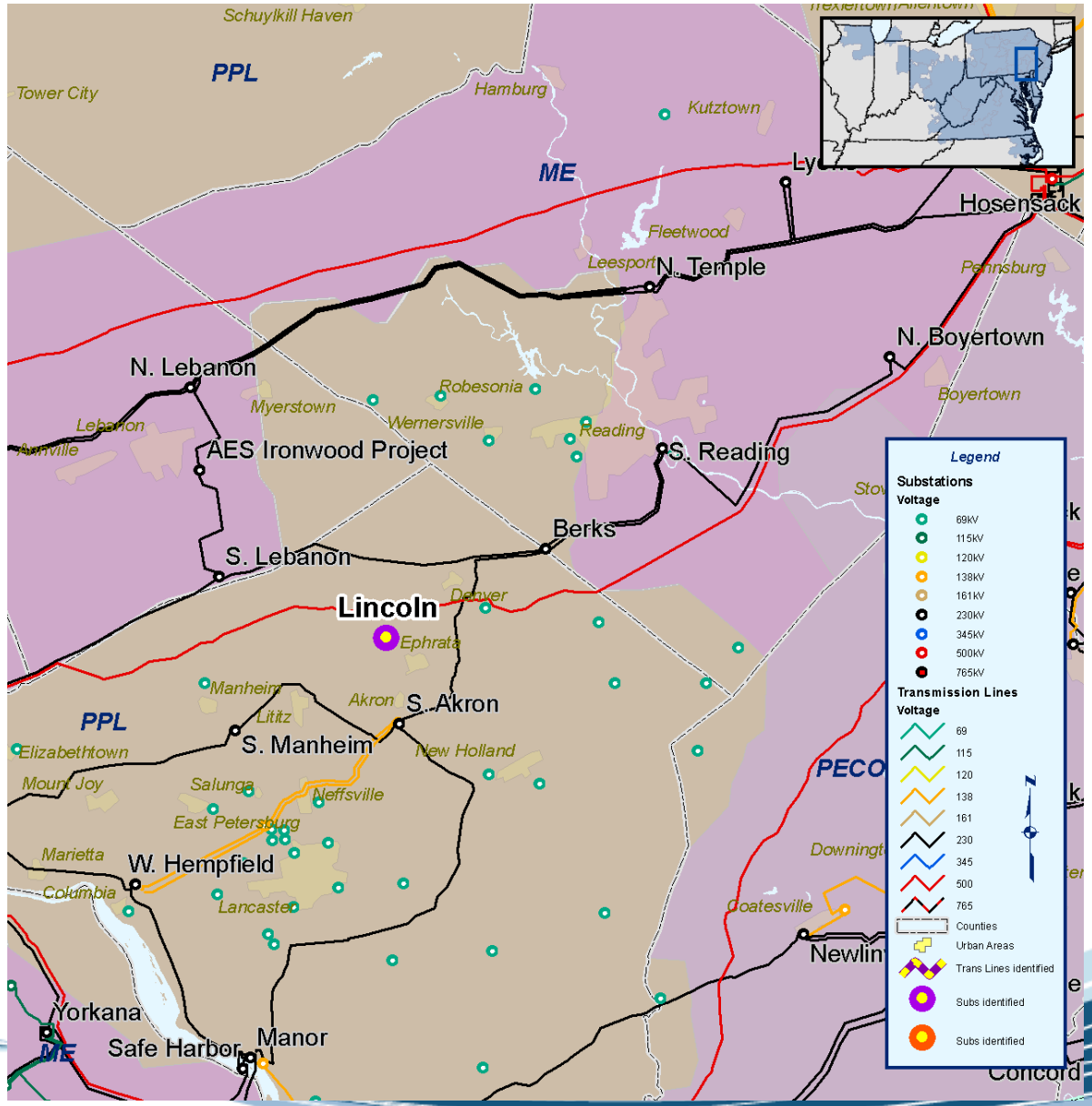
PPL Baseline Upgrades

- Harrisburg-Captial Park #1 69 kV line / loss of Dauphin 69 kV bus section 1
- Replace UG Cable from Walnut Substation to Center City Harrisburg Substation for Higher Ampacity: 0.25 Miles
- Estimated Project Cost: $1.73 M
- IS Date: 5/1/2013



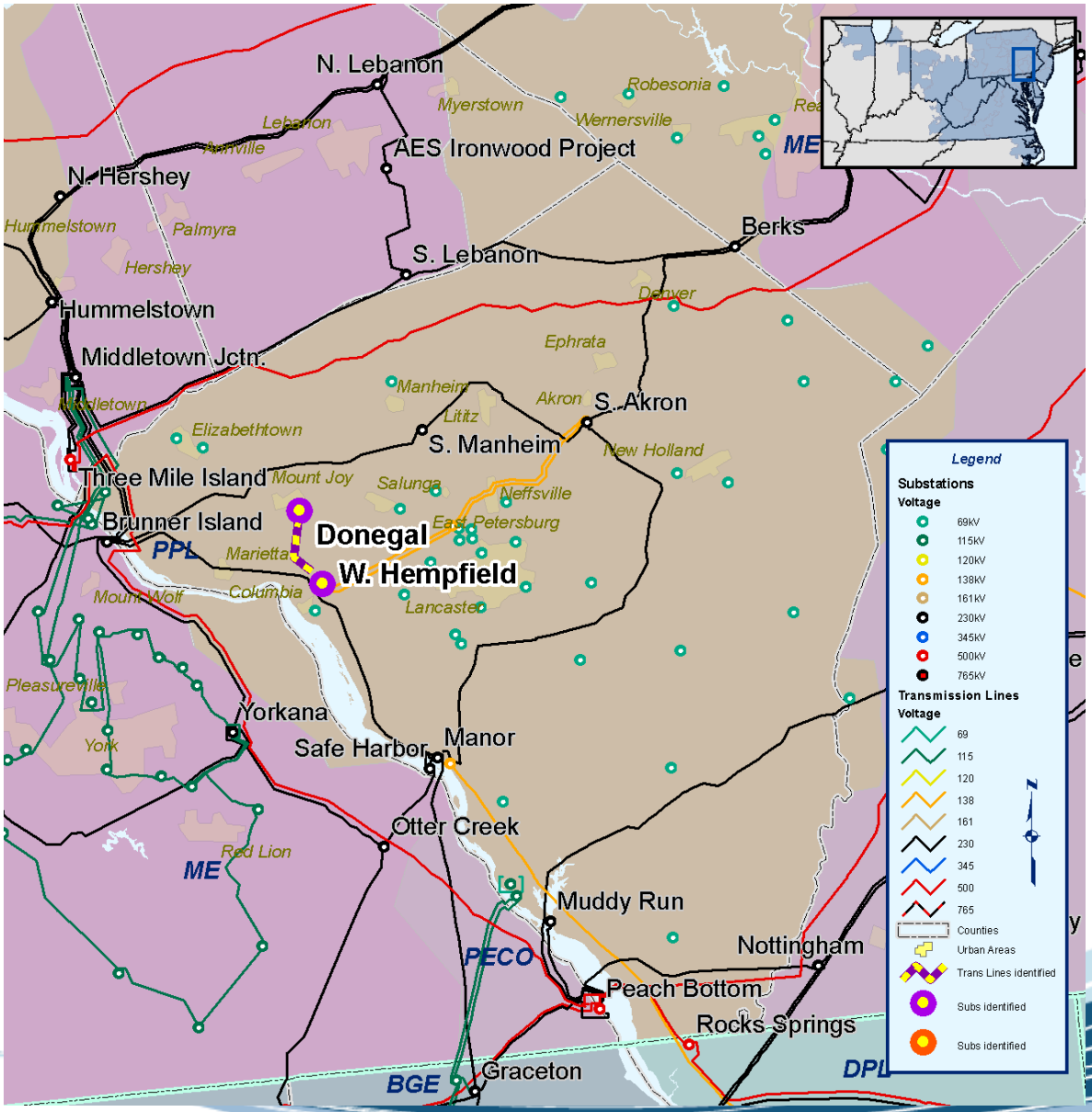
PPL Baseline Upgrades

- Lincoln 69 kV transformer / basecase
- Lincoln Substation- 69 kV Tap to Convert to Modified Twin A
- Estimated Project Cost: $0.12 M
- IS Date: 11/1/2012



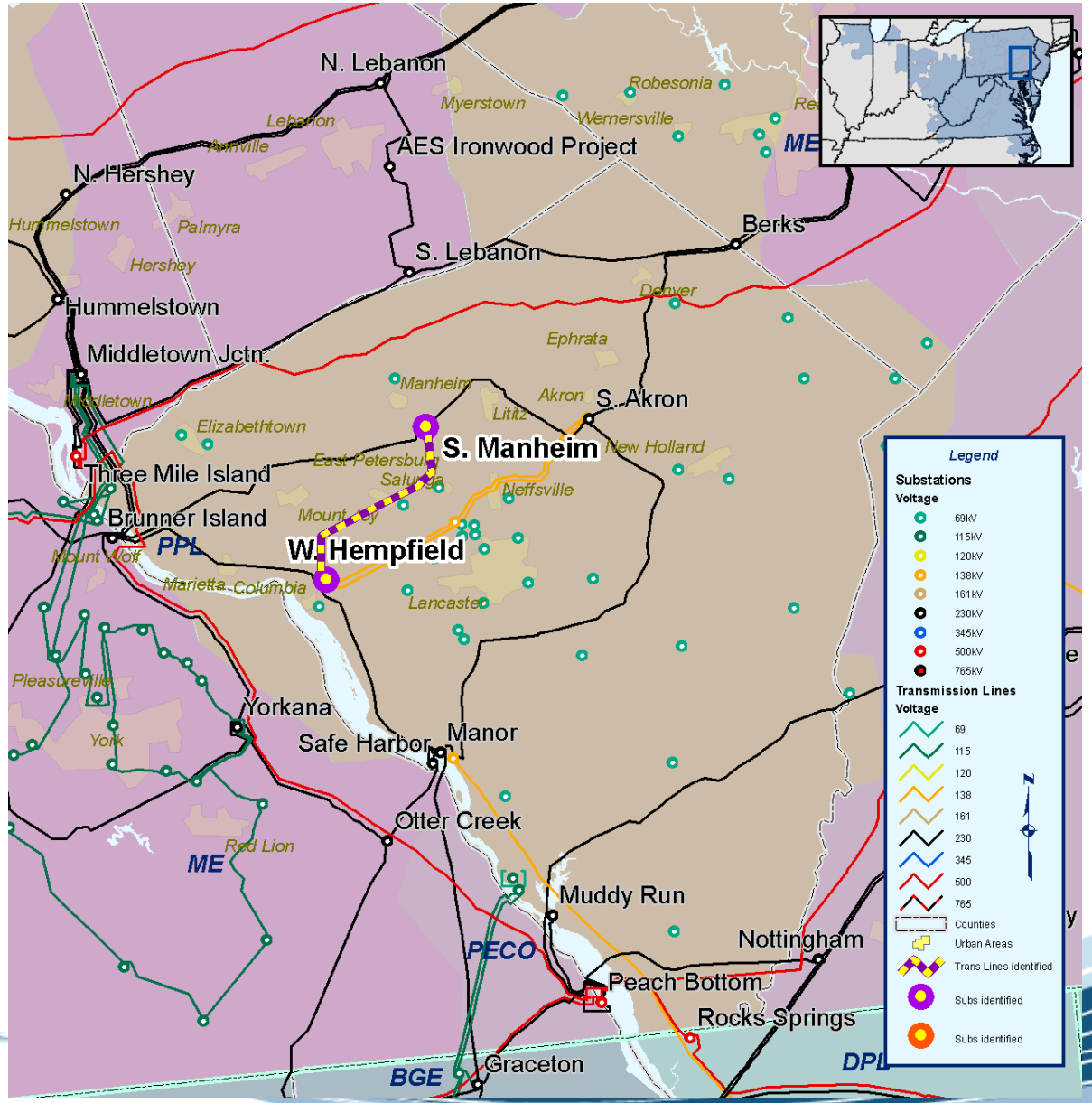
PPL Baseline Upgrades

- W. Hempfield - Donegal 69 kV Line / loss of DCTL West Hempfield-Grin & West Hempfield-Hummelston 69 kV lines
- W. Hempfield - Donegal 69 kV Line - Reconductor/Rebuild from Landisville Tap to Mt. Joy Substation to Double Circuit 69 kV: 2 Miles
- W. Hempfield - Donegal 69 kV line - Reconductor/Rebuild to Double Circuit from Mt. Joy Substation to Donegal Substation: 2 Miles
- Terminate new S.Manheim-Donegal 69 kV Circuit into South Manheim #3 69 kV Bay
- Estimated Project Cost: $4.50 M
- IS Date: 10/1/2013



PPL Baseline Upgrades

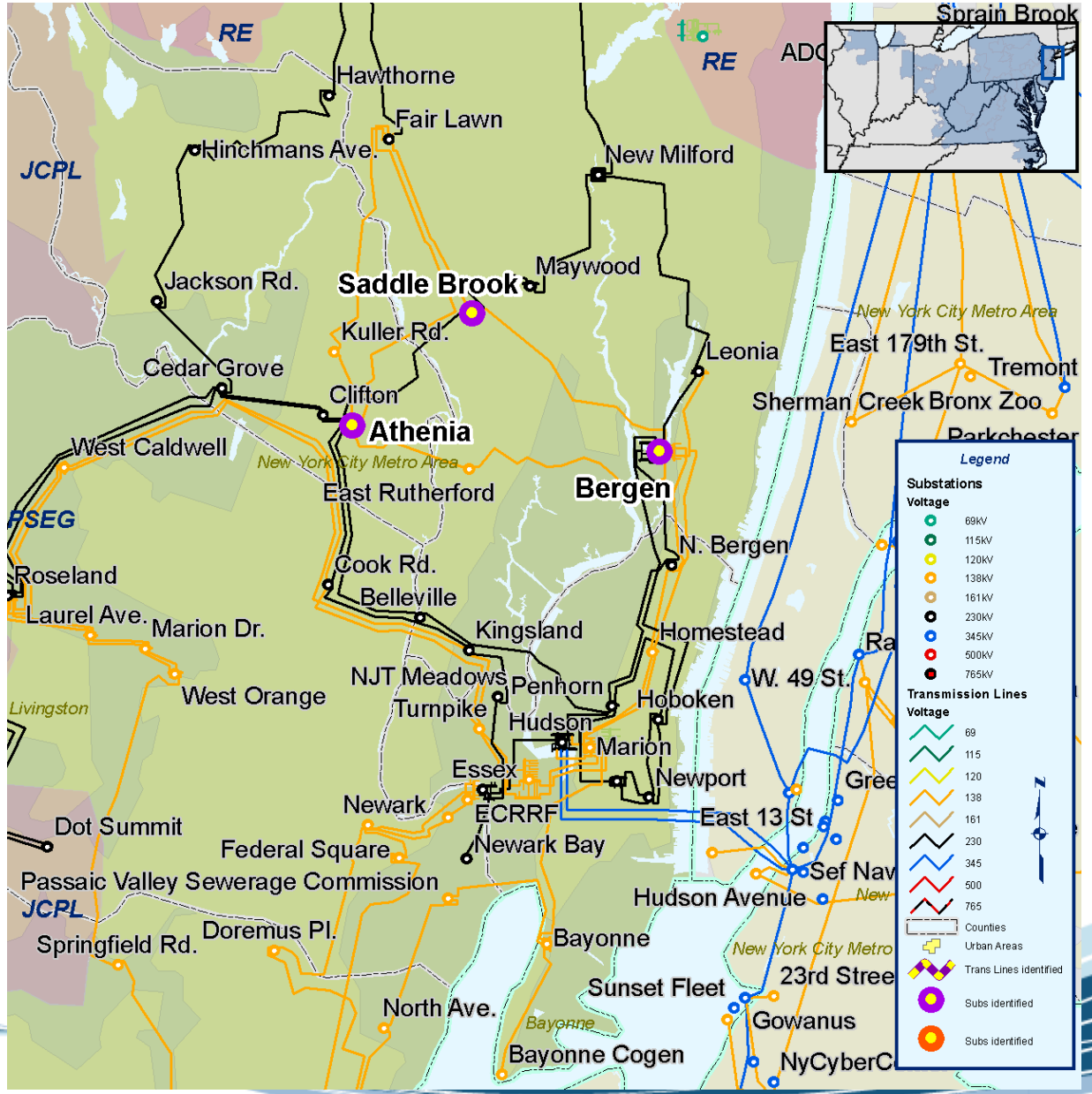
- W. Hempfield - Donegal 69 kV Line / loss of DCTL West Hempfield-Grin & West Hempfield-Hummelston 69 kV lines
- South Manheim-West Hempfield #3 69 kV Line-Rebuild from South Manheim to near Fuller Tap for Double Circuit 69 kV: 1.0 Mile
- West Hempfield - South Manheim #3 69 kV Line - Reconductor from Fuller tap to Landisville: Double Circuit 4.1 Miles
- Estimated Project Cost: $5.66 M
- IS Date: 9/1/2011



PSE&G Baseline Upgrades

PSEG Baseline Upgrades

- Driver: Short Circuit Violation
- Replace Athenia 230 kV breaker 31H due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2012
- Replace Bergen 230 kV breaker 10H due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2012
- Replace Saddlebrook 230 kV breaker 21P due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2012



PSEG Baseline Upgrades

- Driver: 2009 Base Conditions
- Replace Essex 138 kV breakers due to Short Circuit
  - 4LM (C1355 line to ECRRF)
  - 1LM (220-1 TX)
  - 1BM (BS1-3 tie)
  - 2BM (BS3-4 tie)
- Estimated Project Cost each: $ 0.4 M
- IS Date: 6/1/2009

PSEG Baseline Upgrades

- Driver: 2009 Base Conditions
- Replace Linden 138 kV breaker 3 (132-7 TX) due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2009
- Replace Metuchen 138 kV breaker '2-2 Transfer' due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2009