Building A Resilient Campus Energy Infrastructure Network

University of Virginia 35kV Undergrounding

University of Virginia Overview

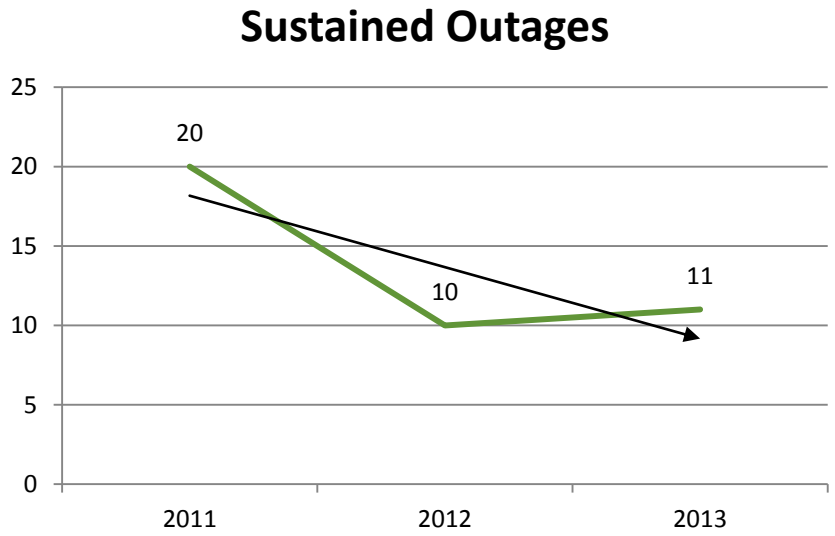
- #2 Best Public National Public University (US News 2016)
- $2.5 billion operating revenue (only 5.2% from state)
- 15,891 undergraduate students + 6,500 graduate & professional students
- 16,024 total staff
- #1 Hospital in Virginia
- Level 1 trauma care center

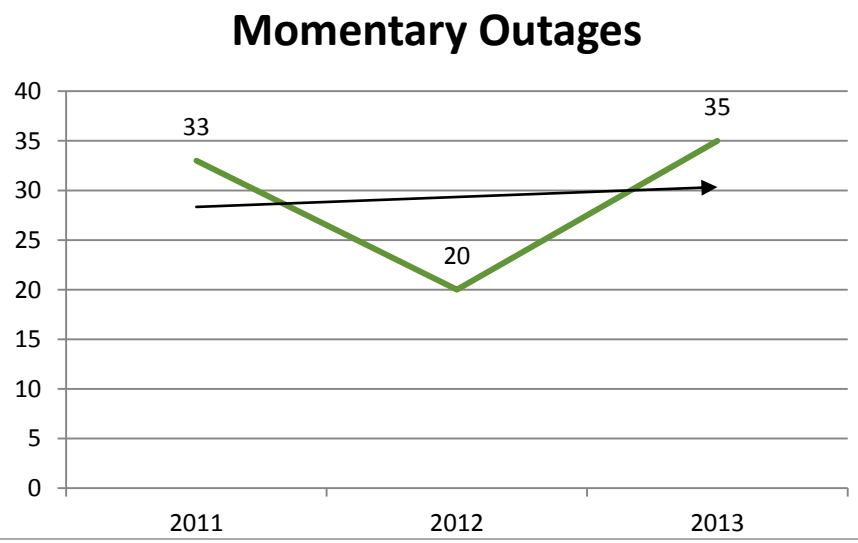
UNIVERSITY of VIRGINIA Dominion Dewberry

University of Virginia Overview

- Four buildings serve as State Emergency Shelters
- Three 34.5kV to 12.5kV electric substations serve University; the substations are equipped with redundant service from Dominion.
- 55 MW combined demand across three substations
- Pay $17 million annually in bills

Identifying The Problem





- Outages due to overhead exposure/ weather–trees (limited ROW), vehicle accidents, animals, fog, etc.
- Impact of outages on research/hospital
- Definition of an outage
- Not conducive to world class research/hospital
- In 2014, formed high level group with Managers, Directors and Vice Presidents from both UVa and Dominion (12-14).
- A series of meetings were held.
- Visited Dominion operations center to share best practices; enhanced communications

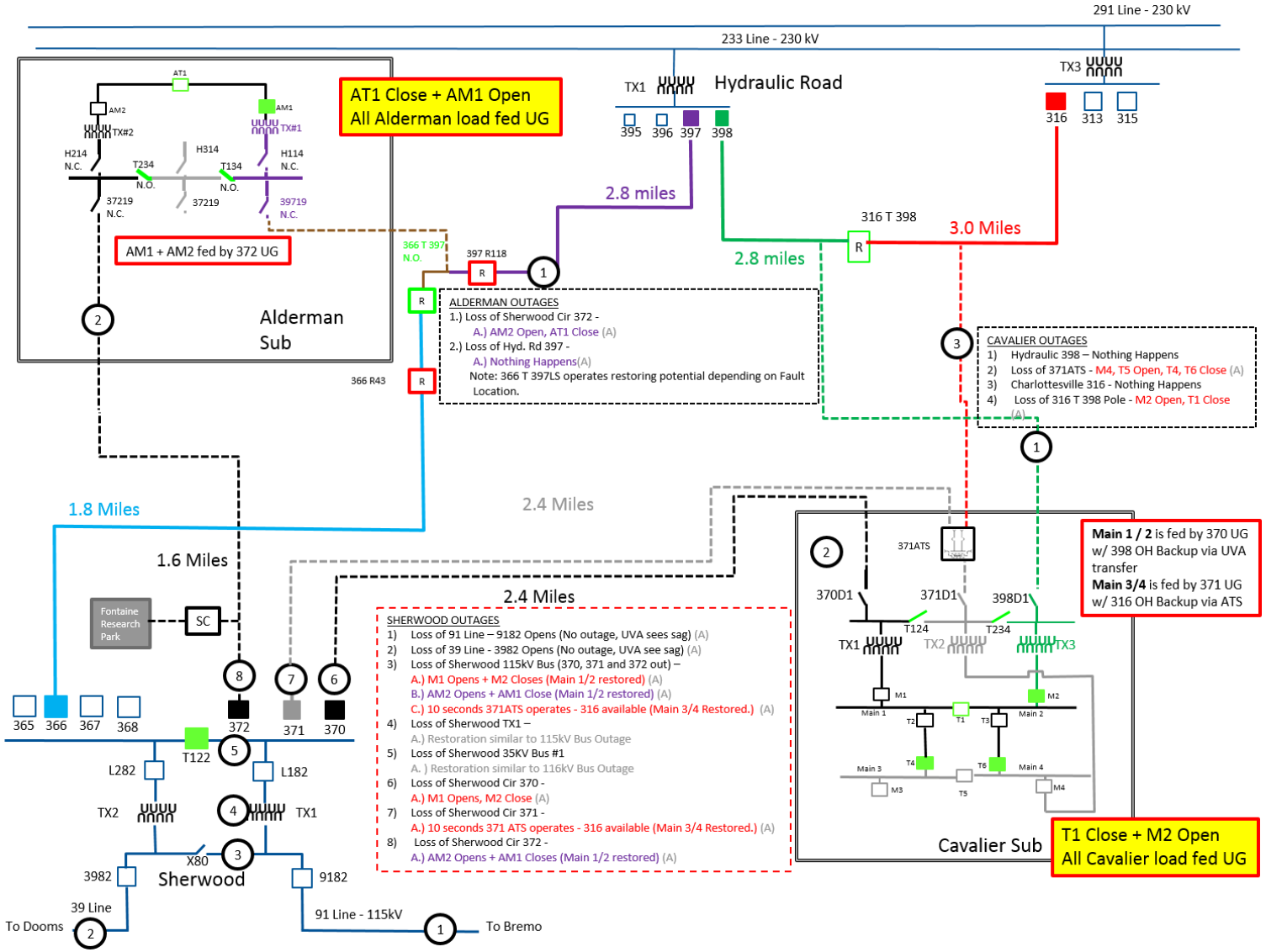
Identifying The Solution

- Option 1 – Rearrangement with existing circuits
  - Partial direct burial
- Option 2 – Transmission lines to Alderman and Cavalier
  - Substation area expansion by 1-2 acres and 120’ right of way
  - Need FERC; Option if University were to be built today
  - 94% improvement to Alderman & Cavalier substations
- Option 3 (Recommended) – 3 Underground express feeders
  - Dedicated bus at Dominion substation and a **high speed transfer switch** at UVa substation.
  - 90% improvement to Cavalier and Alderman; Closest to transmission

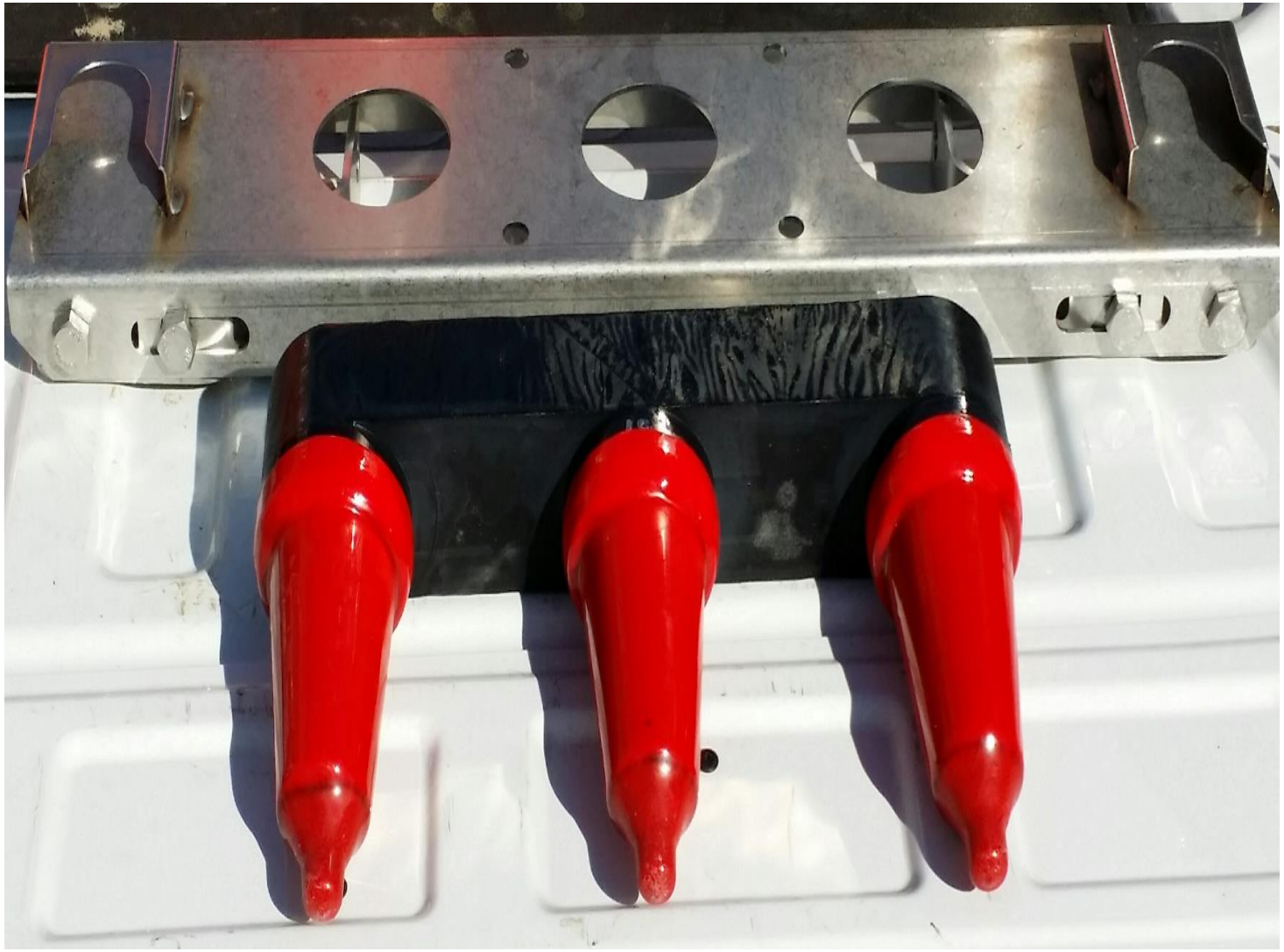
Collaboration Between UVA and Dominion

- Sharing of responsibilities/cost; leadership commitment
- Why UVa took up ductbank construction?
  - TERF ~35%
  - Property lines/ easements
  - Control of timeline
- Ductbank and Vault specifications/negotiations
- Inspections
- Fixed Asset Agreement (very much close to an easement)
- Master License Agreement
- Maintenance Agreement

Dominion Proposed Arrangement



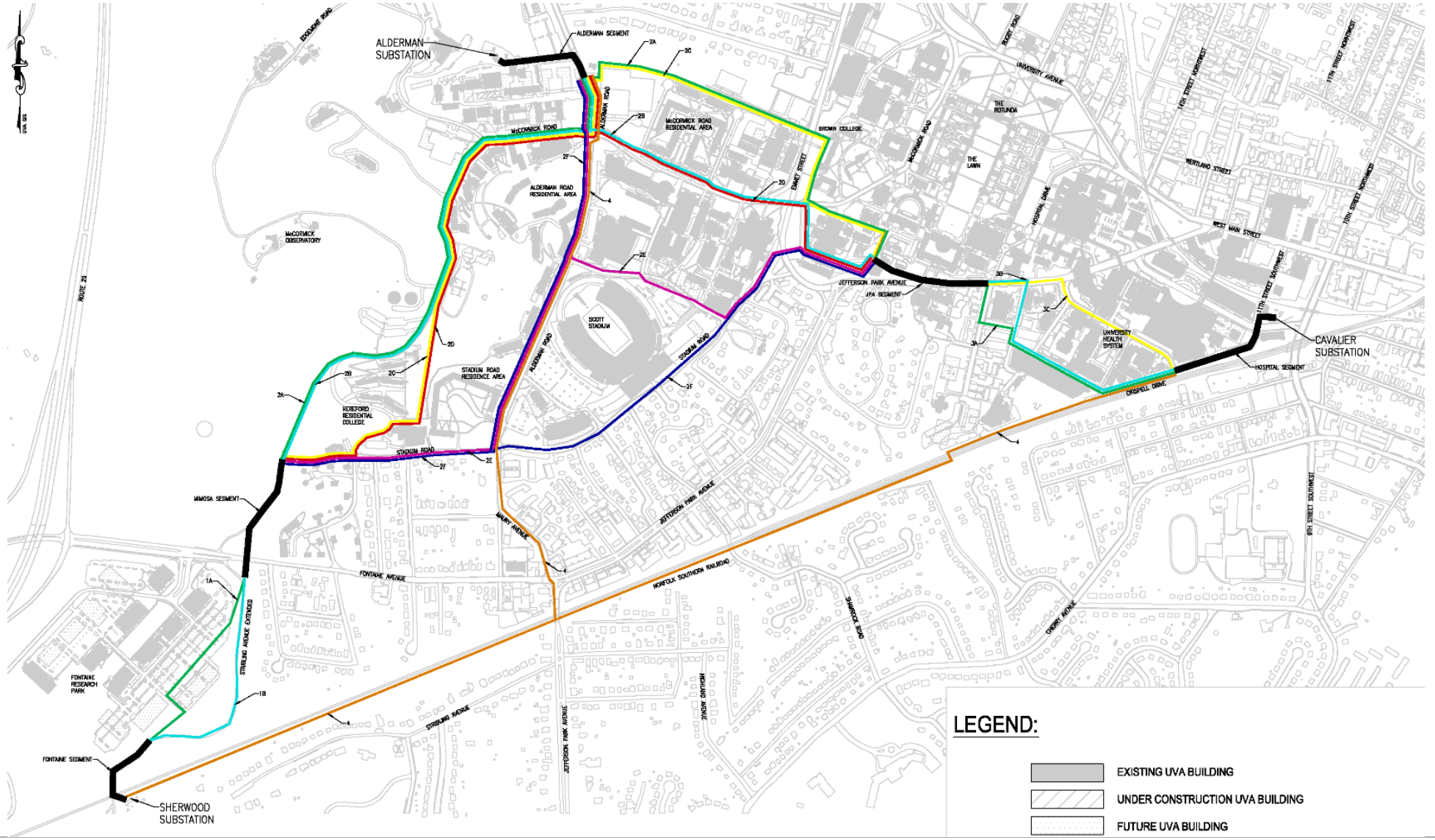
- Deadbreak Junctions install every ½ Mile to sectionalize and troubleshoot cable



Benefits of Collaboration

Designing the Project

Routing Study Alignments



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Routing Study Criteria

Transportation (15%)	Constructability (40%)	Environmental (30%)	Land Use (15%)
Total ADT along Route	Ductbank length	Floodplain	UVA Property
No. signalized intersections	Conduit length	Wetlands	Other Property Impacts
No. intersections	No. utility crossings	Historic Spills/Incidents	Easement Acquisition
No. Bus Stops	Areas of steep slope	Cultural Resources	Future Building
Length of Bike Lanes	Area under pavement	Architectural Resources	
	Area under landscape areas	Vegetation Impacts	
	Construction Access	Stormwater Impacts	
	Maintenance Access	Permitting Duration/Risk	
	Soil/Rock suitability		
	Construction Duration		

Routing Matrix with Data

Electrical Ductbank - Routing Options								
Constructability Factors -30%	**Option 1**		**Option 2**		**Option 3**		**Option 4**	
	Underground	Ranking	Underground	Ranking	Underground	Ranking	Underground	Ranking
Overall Length (lf)	15,000.00	3	14,775.00	1	15,675.00	9	14,661.00	1
Length of 2-way ductbank (lf)	2,225.00	3	1,075.00	1	3,725.00	9	5,179.00	9
Length of 4-way ductbank (lf)	6,300.00	1	7,100.00	3	7,275.00	9	6,043.00	1
Length of 6-way ductbank (lf)	6,475.00	3	6,600.00	9	4,675.00	3	3,439.00	1
Estimated Construction Duration (weeks @ 100 l.f./week)	150	3	148	1	157	9	147	1
Constructability Factor Weighted Subtotals	**45450.00**		**14923.00**		**142488.00**		**14808.00**	

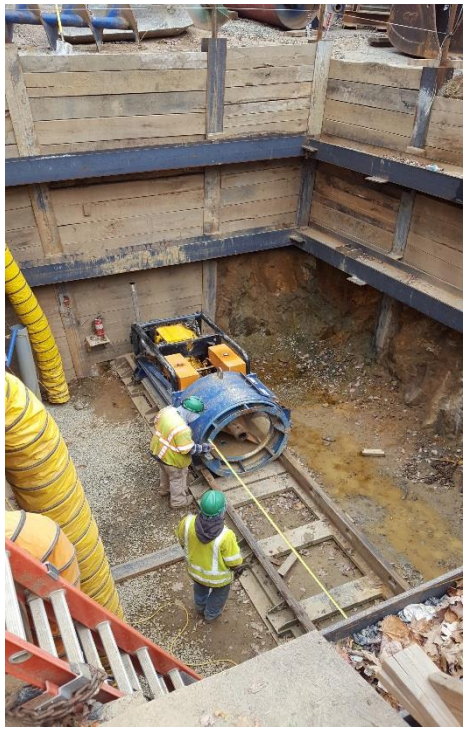
Routing Study Results

Design Phase

- Stakeholder Coordination
- Field Investigations
  - Utility Designations/Test Pits
    - Water, sewer, communications
  - Geotechnical Investigations
    - Route borings, crossings
  - Route Surveying
    - Above grade features, topo, limits of construction

Design Phase

- 2.96 miles total length
- 12.85 miles of conduit
- 6-way, 4-way, 2-way concrete encased ductbank
- 8-inch conduit
- Vaults every 500-600 LF
  - Large Vaults 8’x8’x16’ interior dims
  - Small Vaults 6’x7’x12’ interior dims



Construction Phase

- Scheduled Completion July 2017
- Scheduled Activation September 2017