BRAC (Base Realignment and Closure)
MD 355 Crossing Project

Timothy Cupples, P.E.
Frank Kingsley

April 14, 2022

AGENDA

1. Biographies
2. Objectives of this Presentation
3. Project Purpose and Background
4. Construction Challenges and Innovations
5. Conclusion

1. Biographies

- Timothy Cupples, P.E. - Division Chief, Transportation Engineering, Montgomery County DOT
- BS in Civil Engineering from Worcester Polytechnic Institute
- MS in Civil Engineering from the University of Maryland
- 30 years of experience in the private sector as well as local and federal government
- Past President of the County Engineers Association of Maryland

1. Biographies

- Frank Kingsley - Section Chief, Highway Services, Montgomery County DOT
- Has been with Montgomery County DOT for 24 years
- Served as the Manager for the Annual Sidewalk Program for 3 years
- Project Manager for the BRAC MD 355 Crossing Project for the last 5 years
- NICET Certified in Land Development

2. Objectives of this Presentation

- Encouraging excellence throughout the BRAC MD 355 Crossing Project
  - Overcome obstacles
  - Allow innovation
  - Adopt a flexible management structure
  - Employ cost saving measures
- 1.0 PDH

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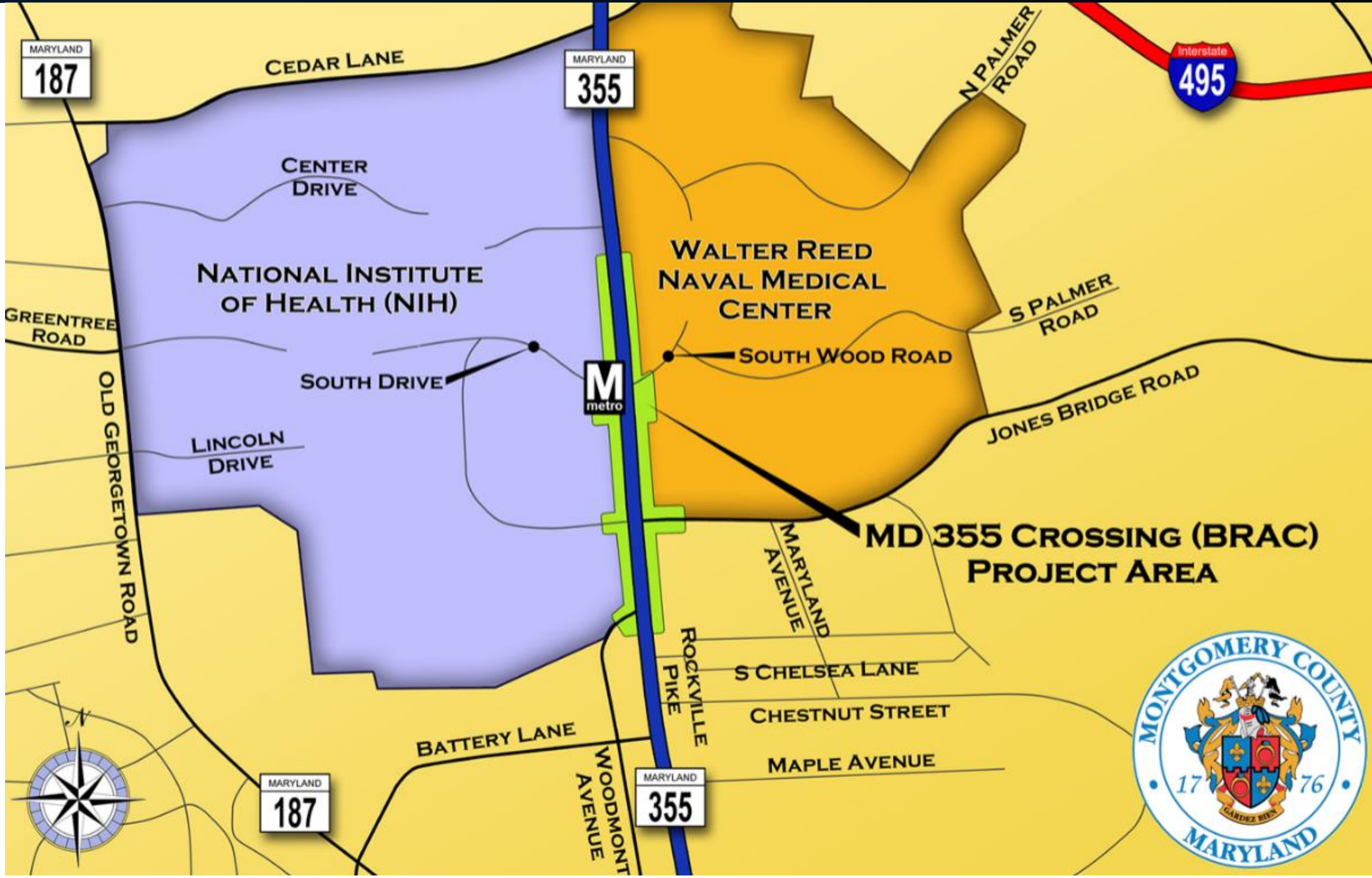
3. Project Purpose and Background

- Surrounding area
  - National Institutes of Health
    - 18,000 staff
    - Largest employer in Montgomery County
  - MD Route 355
    - 55,000 ADT (2011)
  - 56,000 residents
  - 70,000 jobs
  - Priority Funding Area
    - Smart Growth/TDM/Transit



3. Project Purpose and Background

- 2005 base realignment and closure (2005 U.S. Act of Congress)
  - Walter Reed Army Medical Center
    - 16,000 annual admissions
    - 500,000 annual visitors
    - 1135 physicians and nurses
    - 600 paraprofessionals
  - National Naval Medical Center
    - 8,000 annual admissions
    - 455,000 annual visitors
    - 4,500 staff
- Bases merged in 2011
  - 2nd largest employer in MC
  - 7,000 employees
  - 1,000,000 annual visitors

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3. Project Purpose and Background

- Medical Center Metro Station
  - 11,000 passengers daily
  - Entrance west of MD 355
  - Kiss 'N Ride
  - Increased pedestrians crossing MD 355
  - 3,000 daily (pre-BRAC)
  - 7,000 daily (post-BRAC)

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3. Project Purpose and Background

- Enhance access to mass transit
- Improve mobility and safety of pedestrians and bicyclists crossing MD 355
- Improve traffic operations at the existing intersections of South Wood Road, South Drive and MD 355

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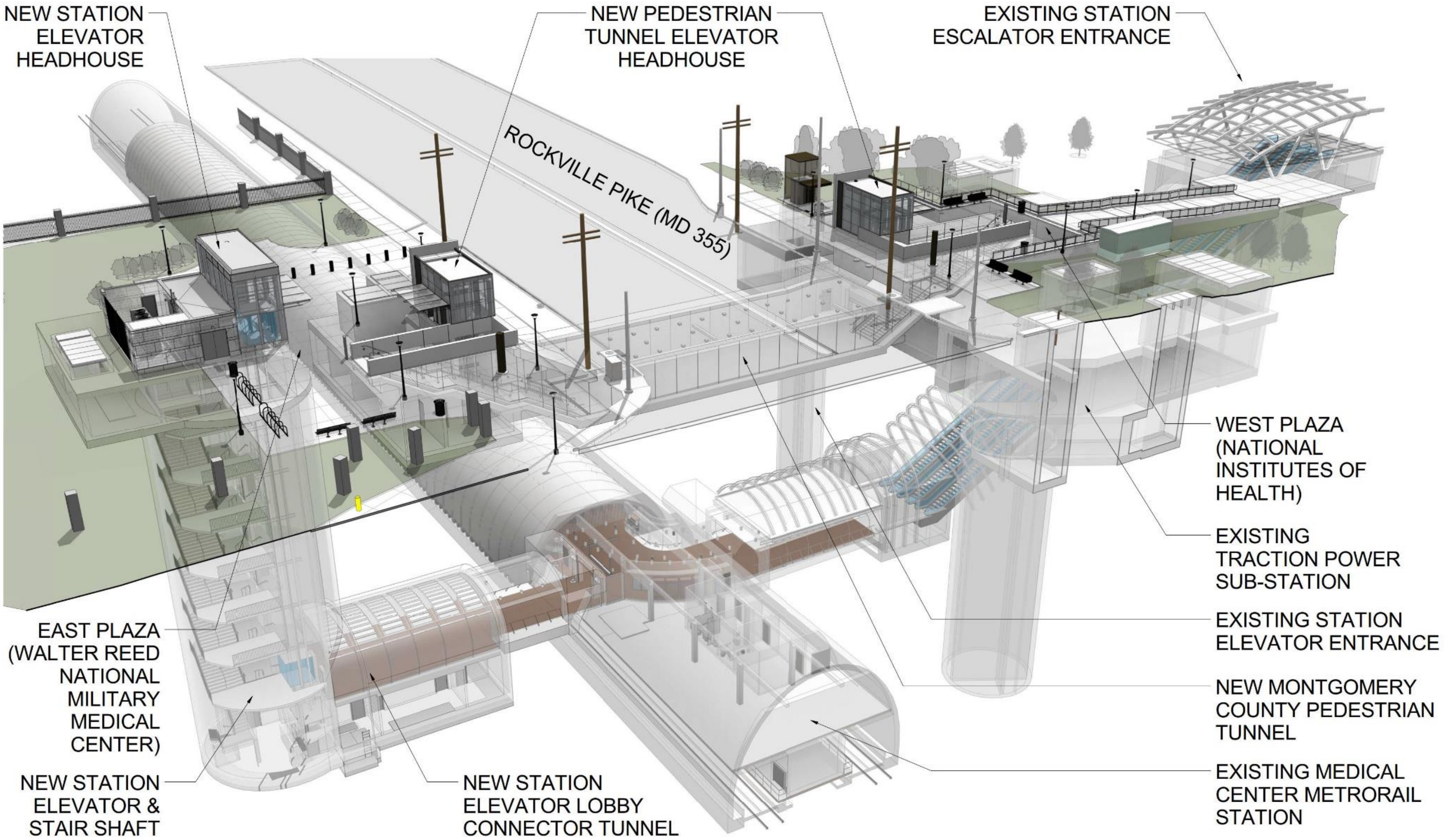
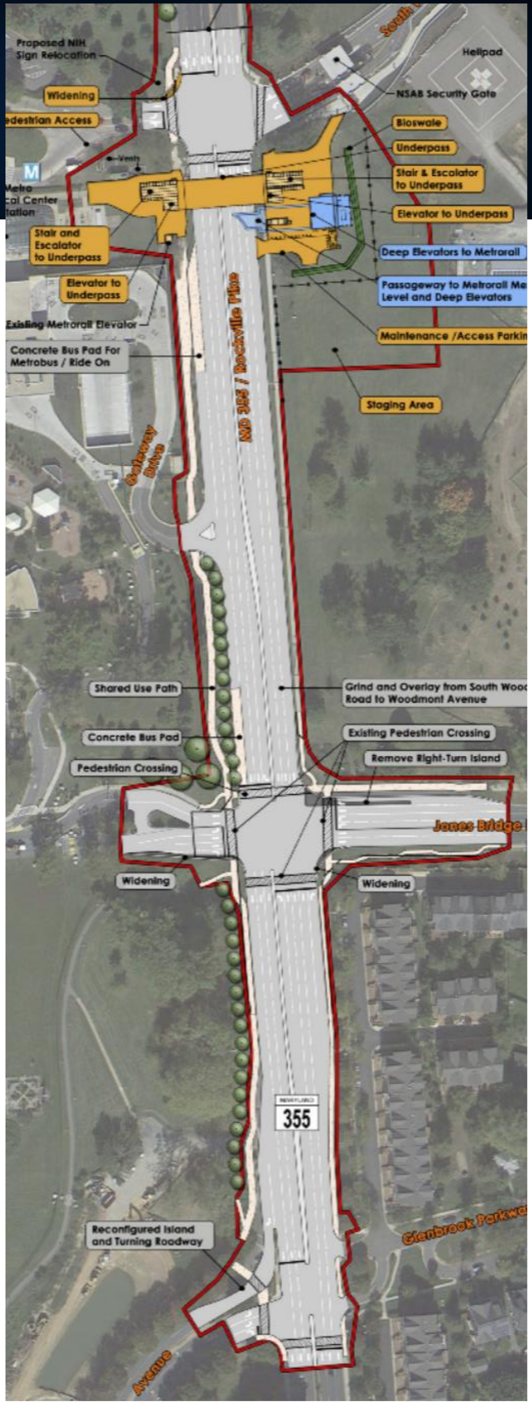

NEW STATION ELEVATOR HEADHOUSE
NEW PEDESTRIAN TUNNEL ELEVATOR HEADHOUSE
EXISTING STATION ESCALATOR ENTRANCE
ROCKVILLE PIKE (MD 355)
WEST PLAZA (NATIONAL INSTITUTES OF HEALTH)
EXISTING TRACTION POWER SUB-STATION
EXISTING STATION ELEVATOR ENTRANCE
NEW MONTGOMERY COUNTY PEDESTRIAN TUNNEL
EXISTING MEDICAL CENTER METRORAIL STATION
EAST PLAZA (WALTER REED NATIONAL MILITARY MEDICAL CENTER)
NEW STATION ELEVATOR & STAIR SHAFT
NEW STATION ELEVATOR LOBBY CONNECTOR TUNNEL

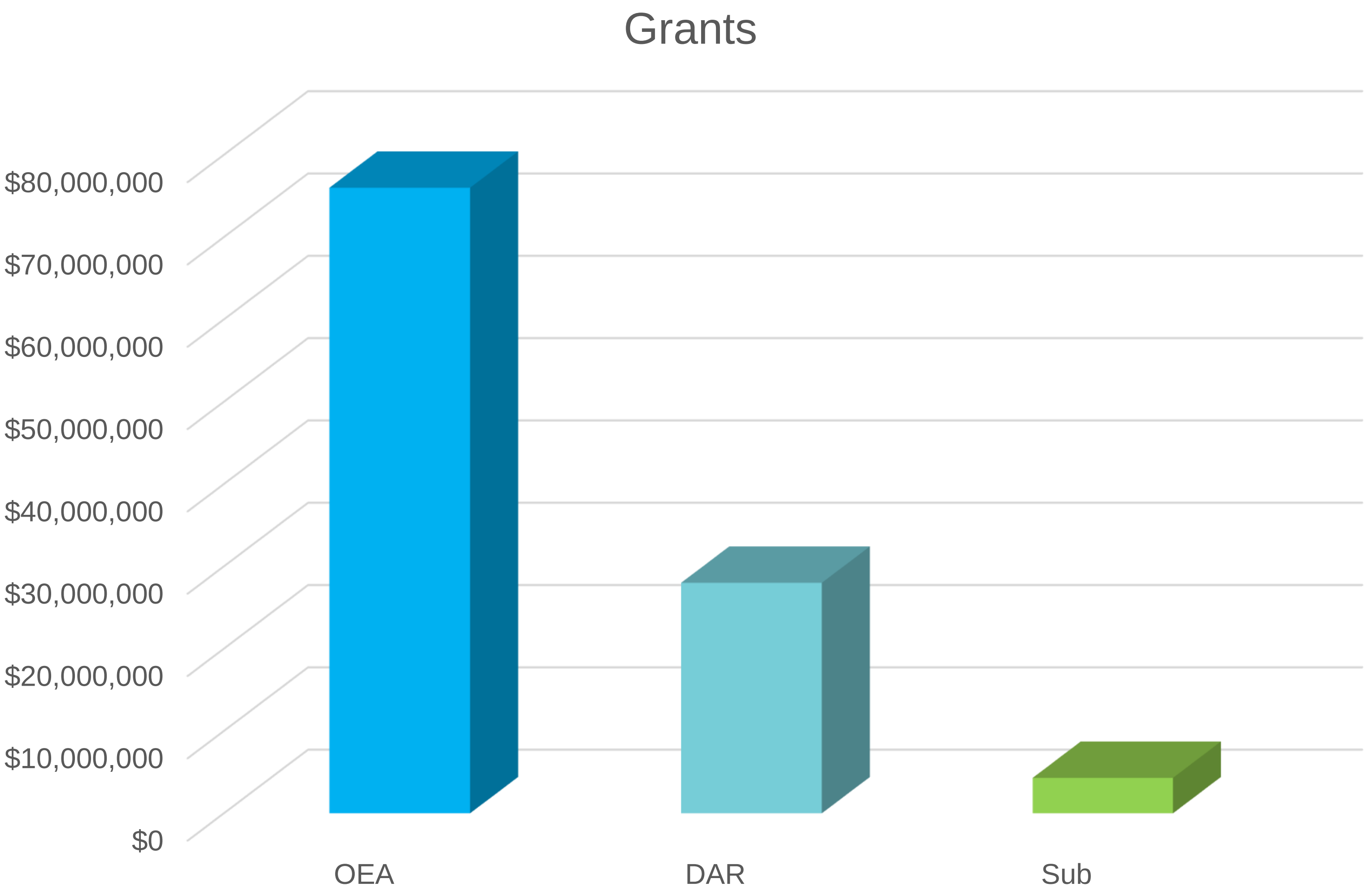
3. Project Purpose and Background

- Partnering with MDOT SHA
  - MD 355-Jones Bridge Road Improvements
    - Intersection improvement
    - Road realignment
    - New pedestrian safety enhancements
    - Signal modifications
  - MD 355-Woodmont Avenue Improvements
    - Intersection improvement
    - Road realignment
    - New pedestrian safety enhancements
    - Signal modifications



3. Project Purpose and Background

- Funding - $108.3 Million
  - Office of Economic Adjustment
    - $76 Million in Grants to Montgomery County
  - Defense Access Roads Program
    - $28 Million Grant to Montgomery County via FHWA
    - First DAR Transit Project
  - Sub-Grant Agreement with Montgomery County
    - $4.3 Million Grant from OEA

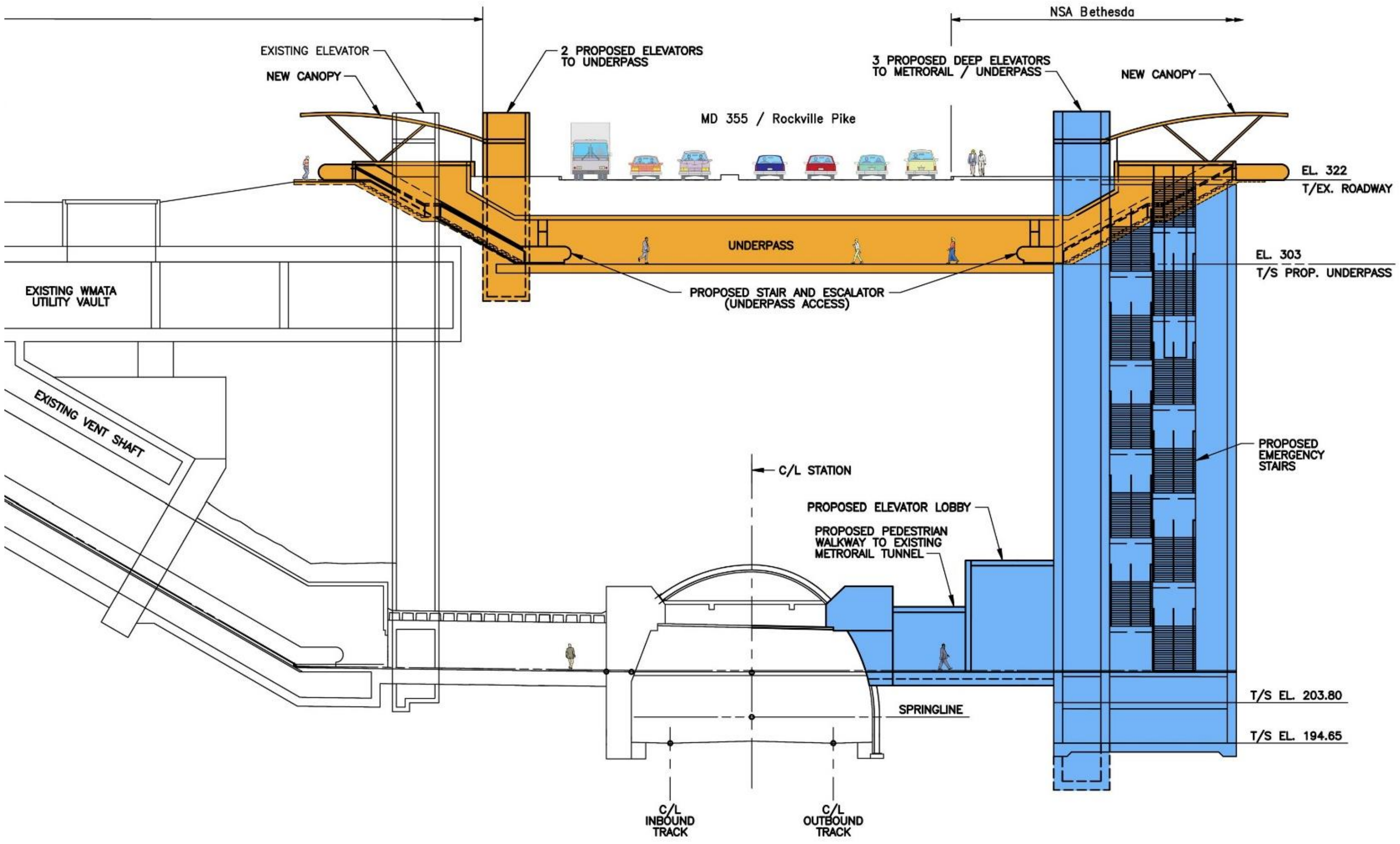


3. Project Purpose and Background

- Six-way Memorandum of Understanding (MOU)
  - Established pre-bid

4. Construction Challenges and Innovations

A. Accelerated Temporary Bridge Construction and Removal
   - Find way to minimize traffic impacts to daily riders on MD 355
B. Underpass Tunnel
   - Avoid utility relocations
C. Elevator Shaft and Connecting Tunnel
   - Excavation (Blasting)



4.A. Accelerated Temporary Bridge Construction and Removal

- Challenges:
  - MD355 has 7 lanes of traffic with ADT of 55,000 VPD
  - Find way to minimize traffic impacts to daily riders on MD 355
  - Avoid any long-term traffic shifts while constructing underpass
  - Intersection serves main public entrance onto NSA Bethesda Campus
  - Serves the WMATA Medical Center Station entrance and NIH Visitor Entrance
  - Work within a maximum of two lanes, northbound or southbound
  - Critical to note is that work site is located within 100’ of a signalized intersection
- Innovations:
  - Construct a temporary street deck (bridge) to maintain normal weekday traffic patterns while new underpass was constructed below
  - Night and weekend work to minimize traffic impacts
  - Contractor competed on schedule

4.A. Accelerated Temporary Bridge Construction and Removal

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4.A. Accelerated Temporary Bridge Construction and Removal

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4.B. Underpass Tunnel

- Challenges:
  - Avoid utility relocations
  - Support WMATA Traction Power Substation
  - Construct the tunnel without impacting traffic
- Innovations:
  - By lowering underpass and changing construction methods for additional $500,000, saved $7 million in utility relocations
  - Installed accelerated temporary bridge deck
  - With temporary bridge deck in place, the underpass was excavated
  - Constructed Cast-in-Place (CIP) concrete tunnel structure
  - Backfilled on top of tunnel to within 6’ of roadway surface with lightweight cellular concrete (30 PCF/ 40 PSI)
    - Placed all backfill material through a manifold that avoided need for ANY lane closures
    - Fill also served to support all the utilities

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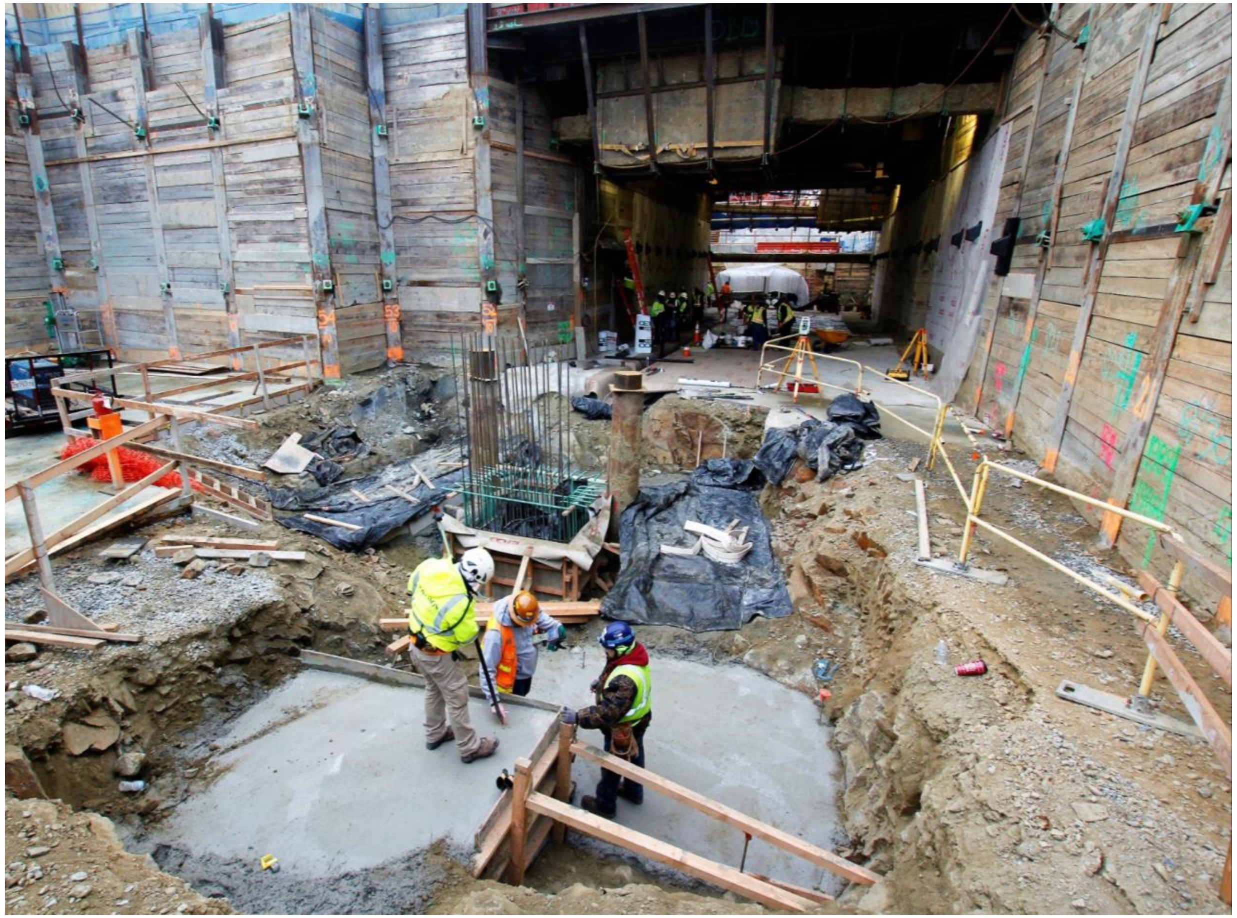
4.B. Underpass Tunnel



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4.B. Underpass Tunnel

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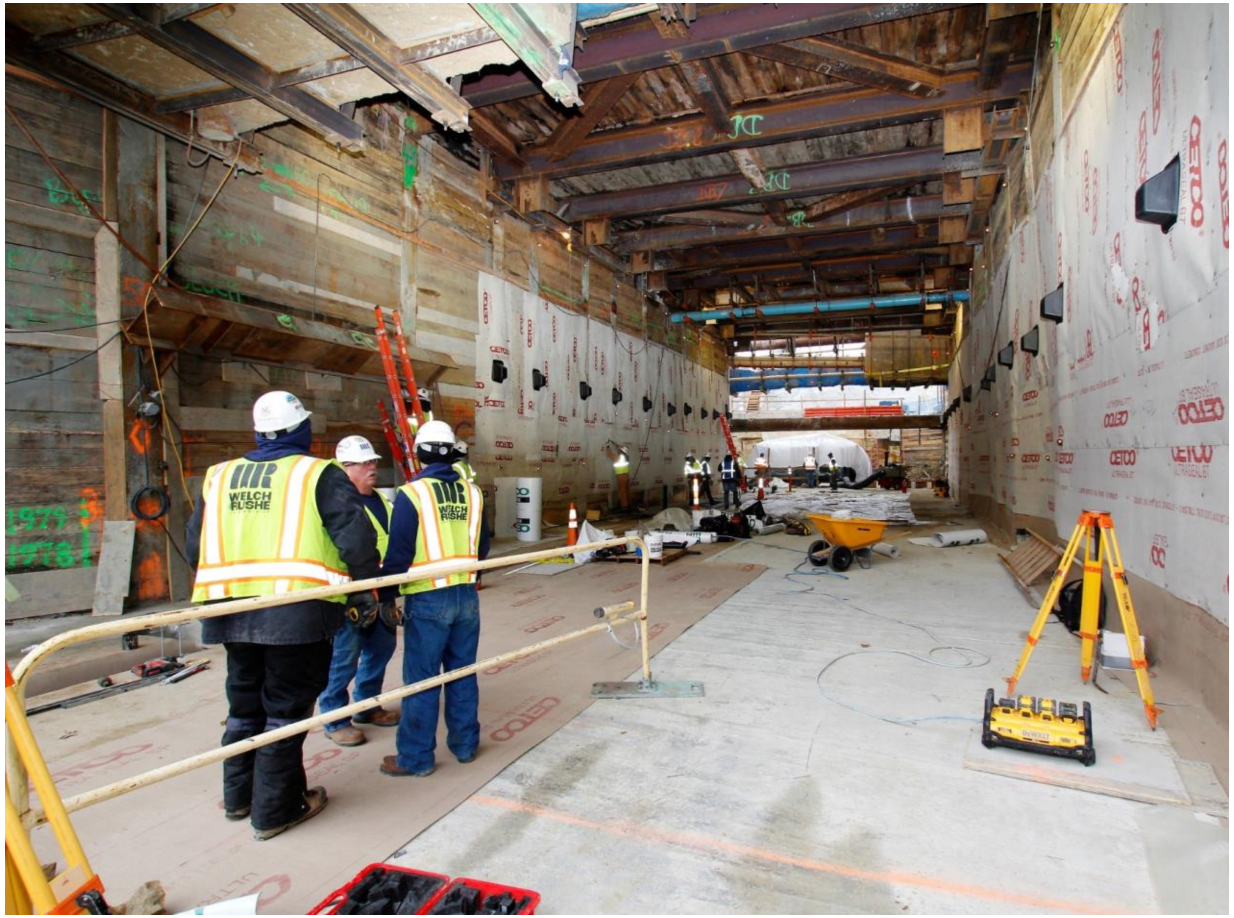


4.B. Underpass Tunnel

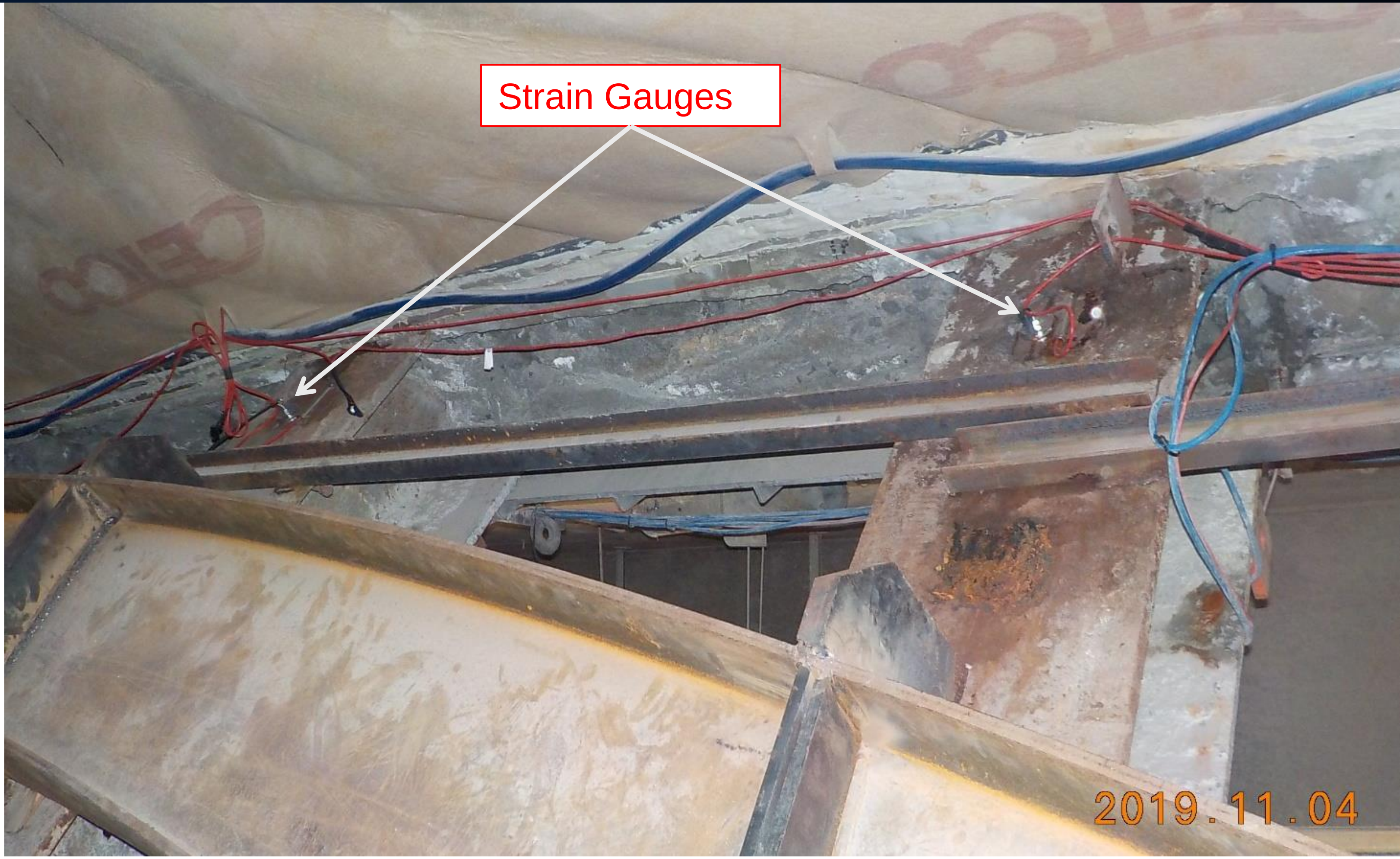
4.C. Elevator Shaft and Connecting Tunnel

- Challenges:
  - Existing rock
  - Vibration threshold
  - Avoid impacting traffic
  - No on-site stockpile
  - Breakthrough into existing station
- Innovations:
  - Non-prescriptive RFP included open language to allow for bidder creativity
  - Blasting using liquid emulsion
  - Search for alternate solutions to fracture rock for removal
  - Coordination with local law enforcement and safety
  - Immediate debris removal

4.C. Elevator Shaft and Connecting Tunnel

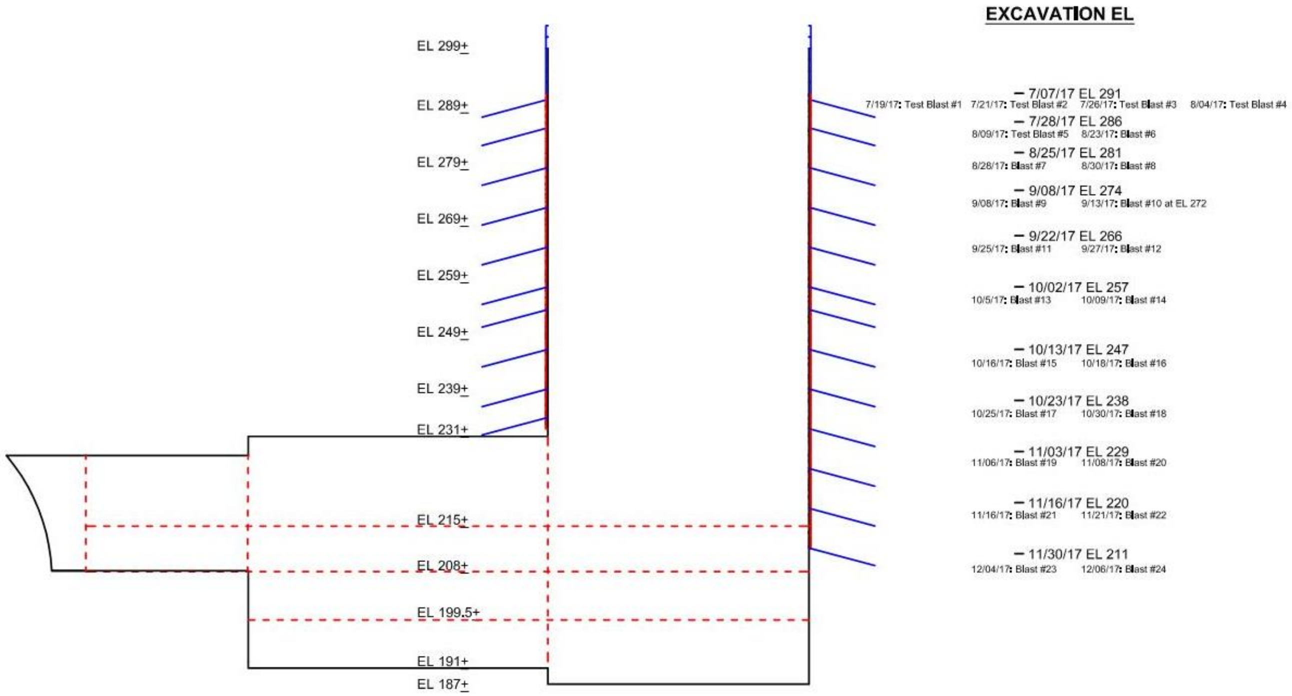
4.C. Elevator Shaft and Connecting Tunnel - Blasting

- Planned rock excavation method
  - Drill and Shoot with High Explosives
- Project Requirements
  - Maximum peak particle velocity (PPV) 2 in./sec. vibration for adjacent structures
  - Robust monitoring program
  - WMATA tunnels remain in service during excavation



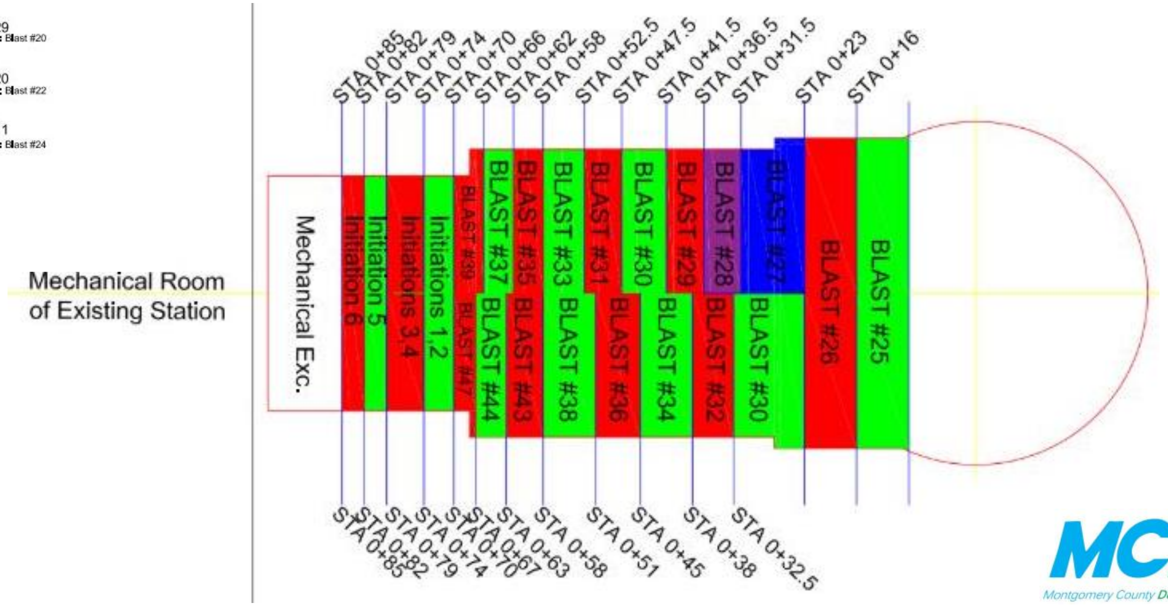
4.C. Elevator Shaft and Connecting Tunnel - Blasting

- Planned blasting patterns



Elevator Shaft

Connecting Tunnel



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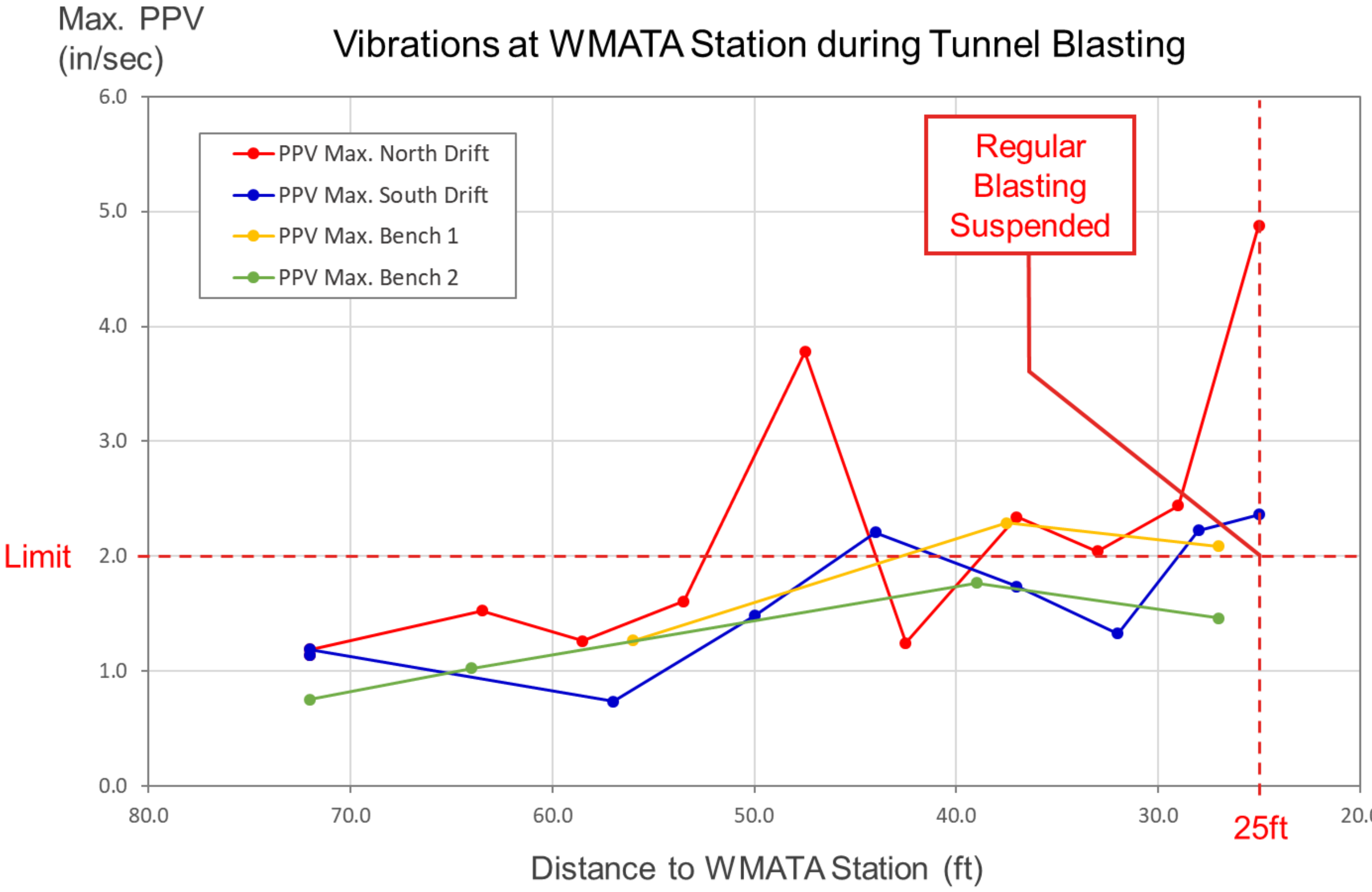
4.C. Elevator Shaft and Connecting Tunnel - Blasting

- Vibration results
  - Higher than expected vibrations on approach to station tunnel
  - Inconsistent data outputs for some vibration monitors
- Attempt to reduce vibration
  - Modify blast hole patterns and depths
  - Modify charge weights per delay
  - Vary the relief hole patterns around the blast initiation point
- Still could not achieve PPV 2 in./sec.
- RISK – Switch to mechanical excavation 30’ from station vs 10’ as planned
  - Would add over 2 months to the critical path



4.C. Elevator Shaft and Connecting Tunnel - Blasting

- Blasting team considers innovative chemical product being used in South Africa (NxBurst)
  - Was reported to produce about ½ the vibrations of traditional high explosives
  - BUT the product had no known use in the US in an application like ours

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4.C. Elevator Shaft and Connecting Tunnel - Blasting

- What is NxBurst?
  - A stable chemical mixture that is packaged in cartridges
  - It is packed and stemmed like traditional explosives
  - Drill holes set than those used for explosives
  - Initiated with blasting caps in similar delay pattern to explosives
  - Upon initiation the chemicals rapidly react expanding as they form steam and CO2
  - Shatters rock thru tensile fracture versus explosive concussion

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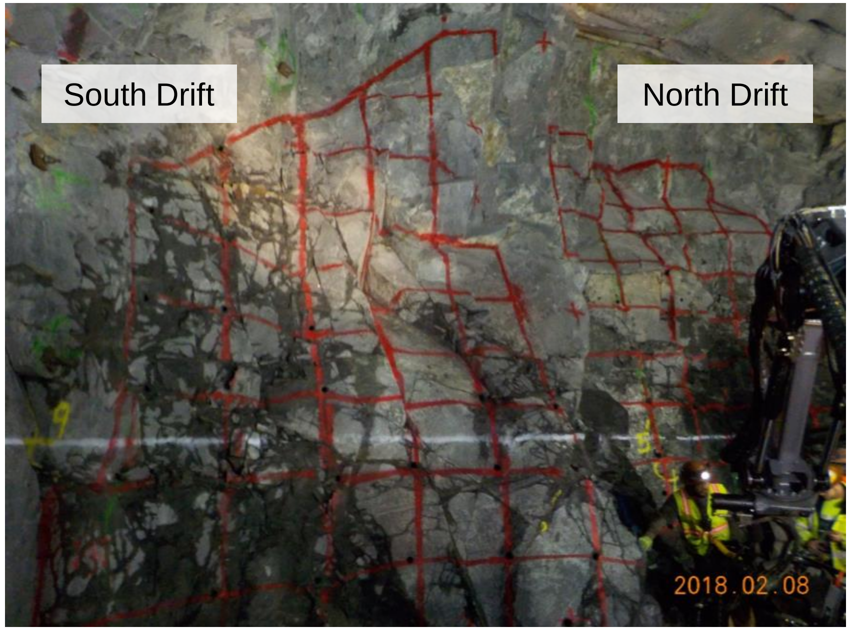
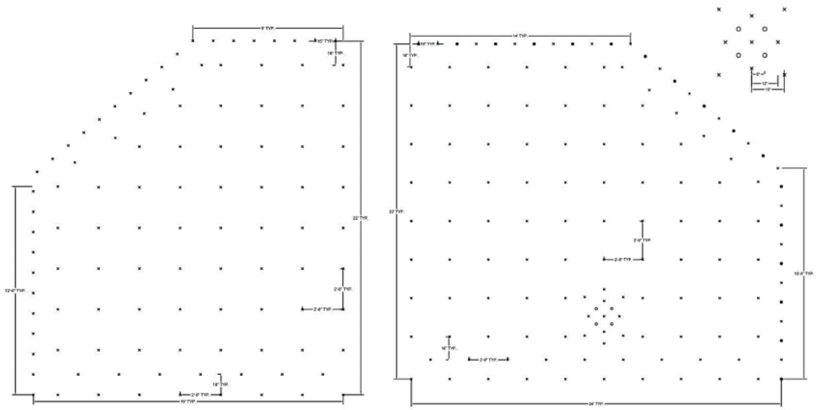
4.C. Elevator Shaft and Connecting Tunnel - Blasting

- Implement alternative blasting method
  - Order NxBurst from South Africa and start transit logistics to US and through US Customs
  - Prepare information package and get blasting permit modified with County Fire Marshall
  - Prepare Product Submission and a revised blasting plan for expedited approval by County and WMATA
  - Obtain training and certifications from manufacturer on use on NxBurst product
  - Perform a new test blast program to demonstrate lower vibrations could be achieved
  - Successfully resumed production “initiation” program
- OUTCOME
  - Lower vibrations within PPV 2 in./sec.
  - Completed “blasting” program to within 10’ of Station

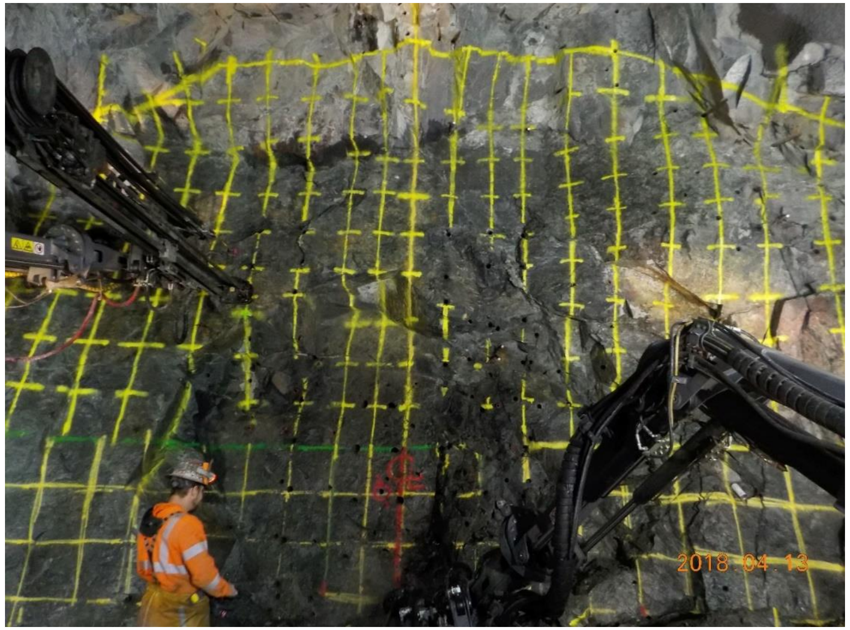
4.C. Elevator Shaft and Connecting Tunnel - Blasting

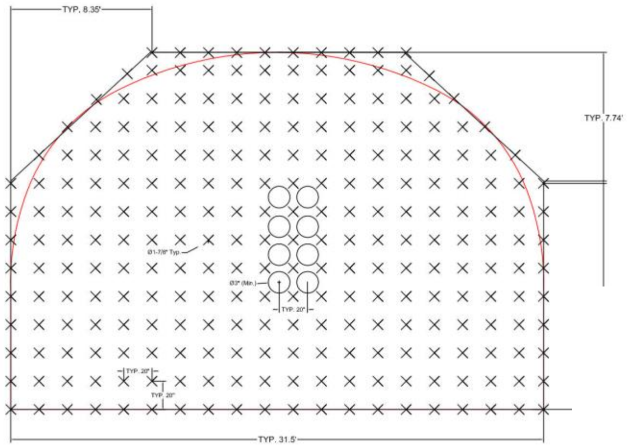
Drilling blastholes for explosives





Drilling blastholes for NxBurst





4.C. Elevator Shaft and Connecting Tunnel - Blasting

Blasting with traditional explosives

4.C. Elevator Shaft and Connecting Tunnel - Blasting

Initiation of NxBurst

4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Challenges:

- Breakthrough at Medical Center Station at a location that was not planned during original design of the existing station
  - Previous entrance expansions were built with knock-out panels during original construction
- Breakthrough would be occurring into an active mechanical service room and immediately over an active rail track
- Excavation conditions close to breakthrough were unknown
- Permanent cavern support consists of –
  - Initial rock bolt supports with steel fiber shotcrete
  - W14 steel rib sets located at 5’ on center
  - Final WWF reinforced shotcrete shell

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4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Innovations:

- Developed a comprehensive monitoring program
  - Understand existing station performance
  - Establish baseline conditions prior to start of excavation
  - Monitor station structure during breakthrough and modifications
- Completed detailed 3D model to predict structural responses to new tunnel excavation
- Created a detailed 13 phase sequence of work that included –
  - Initial bracing support, final rock exaction sequence at face of tunnel
  - Installation of permanent support elements to capture ribs
  - Rib removal and final tunnel passageway CIP

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4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Drilling center cut for mechanical excavation

First round of center cut using mechanical excavation

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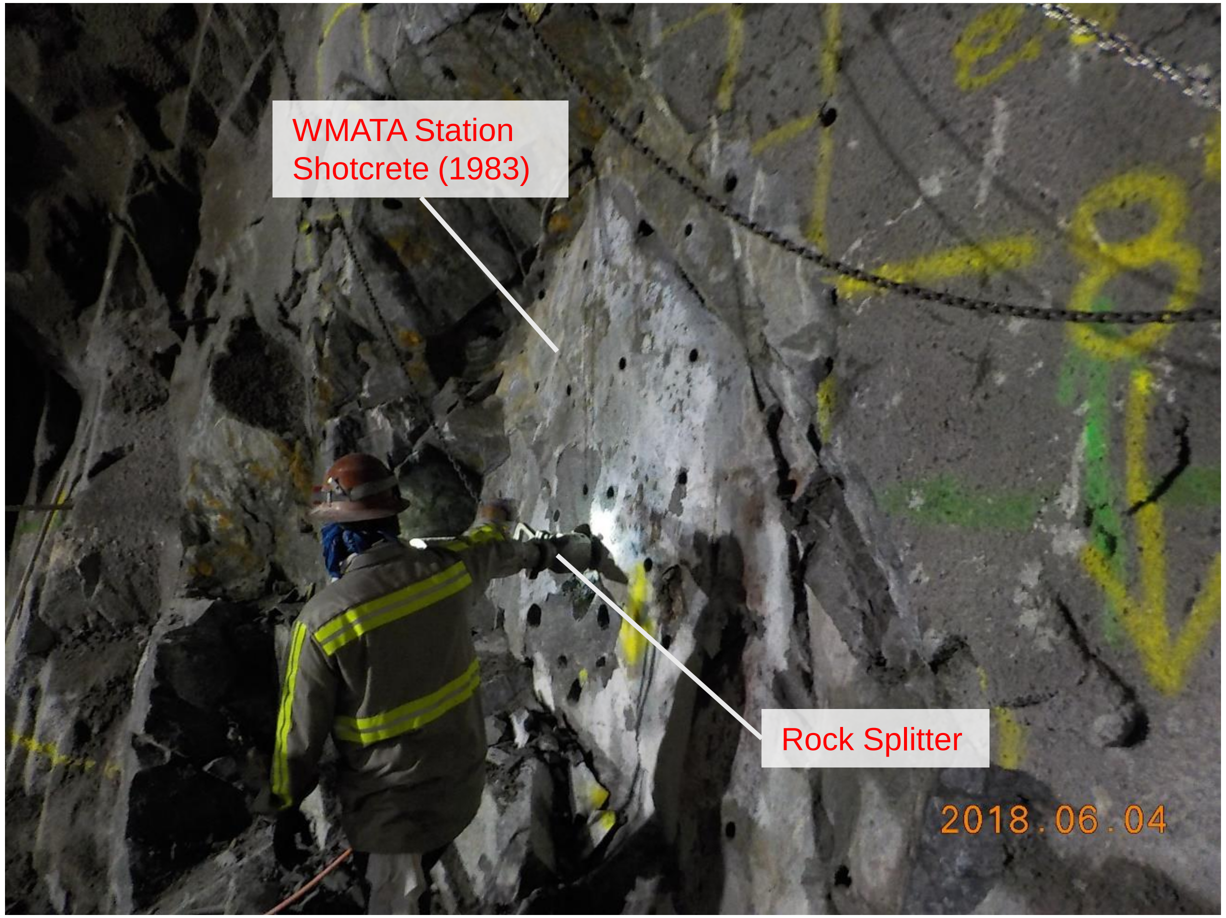
4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Mechanical tunnel excavation overview



Mechanical excavation with rock splitter

4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Breakthrough window into WMATA station

Initial support for breakthrough window

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4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Full set of steel ribs exposed

Breakthrough conservation until final support installation

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4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Pickup girder at breakthrough – view from WMATA station into tunnel

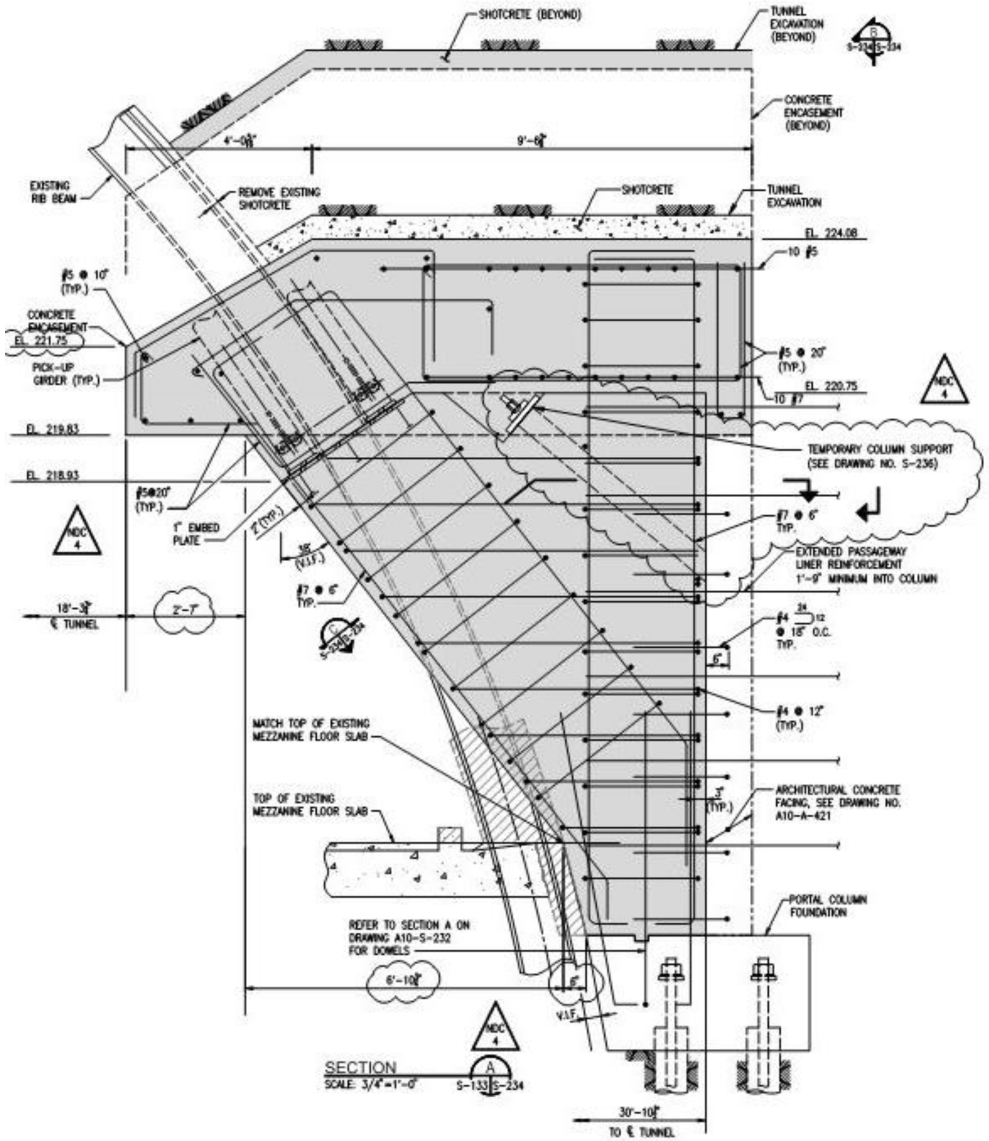
4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

View from tunnel at breakthrough into WMATA station – steel ribs ready for cutting

4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

Cutting the lower part of the steel ribs

4.C. Elevator Shaft and Connecting Tunnel - Breakthrough



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4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

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4.C. Elevator Shaft and Connecting Tunnel - Breakthrough

View of the tunnel/passageway after final lining concrete – preparation of topping slab

4.C. Elevator Shaft and Connecting Tunnel

5. Conclusions

- This Project encompassed numerous aspects that repeatedly encouraged excellence by:
  - Overcoming obstacles
  - Allowing innovation
  - Supporting a flexible management structure
  - Employing cost saving measures

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