Challenges and results of using hand mining to tunnel the McAlpine Creek relief sewer
OUTLINE

- Project overview
- NCDOT Permitting
- Geotechnical investigations/reports
- Contract Documents
- Tunnel Construction
The project
## Phase 3 tunnels

Four NCDOT roadways, three CDOT roadways and CSX Railway

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<tr>
<th>Roadway</th>
<th>Pipe Size</th>
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<td>Colony Road</td>
<td>66” Pipe (108 LF of 108” ID Tunnel)</td>
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Tunnel permitting – Start early
NCDOT Permitting Timeline

Initially submitted encroachment permit package for the Providence Road tunnel on March 24, 2011. Submittal requirements:
- Drawings, Specifications, Calculations and Geotechnical data
- Professional Engineer’s certification that “the construction of the proposed tunnel will be safe and not damage the roadway”.

Review comments received: June 7, 2011
Main comment to provide settlement calculations. Additional geotechnical investigation(s) required in order to gather data necessary to prepare settlement calculations

Resubmittal on November 11, 2011

Additional comments received on December 1, 2011

Remaining tunnels submitted to NCDOT on December 13, 2011

Final approval for Providence Rd. tunnel received on February 3, 2012 and on February 14, 2012 for remaining tunnels

Total elapsed time: Eleven Months
Initial submittal to CSX Transportation Inc. made on January 9, 2012 along with a review fee of $6,000.

Statement of Fees received from CSX on March 29, 2012:
Amount Due= $18,150.00
  Project Coordination Fee - $150
  General Liability Insurance Surcharge, if applicable - $6,000
  One-Time License Fee - $12,000
Amount Due= $18,150

Resubmitted executed Facility Encroachment Agreement with $12,150 fee (General Liability Insurance Surcharge waived) on May 17, 2012.

The fully-executed original of Encroachment Agreement received January 03, 2013.

Total elapsed time: one year
Geotechnical investigations / reports

- Original geotechnical investigation report dated March, 2000
- Number of bore holes
  - Generalized Subsurface Profile - an approximate subsurface stratigraphy along the proposed tunnel
  - Disclaimer statement that Partially Weathered Rock (PWR), intermittent rock lenses and boulders may be encountered...
Geotechnical investigations / reports

- Generalized Subsurface Profile
Geotechnical investigations / reports

• Additional geotechnical investigation(s) required in order to gather data necessary to prepare settlement calculations.
  
  o An empirical method was used to calculate the ground surface settlement. Results indicated that maximum settlement anticipated would be non-damaging settlement to the existing pavement.
Contract documents
Prime contractors/subcontractors

- 16 Prime contractors and 3 tunnel subcontractors were prequalified.
- Discovered during bid process that one tunnel subcontractor was “out of business” and another was not going to bid.
- Added Tunneling Subcontractor’s Qualifications Statement to the documents and allowed tunneling sub-contractors to submit qualifications at the time of the Bid.
Pay Item Description

- Sanitary Sewer Pipe Installed in Tunnels — Lump Sum Price Bid shall include:
  - Rock excavation

- Include excavation and removal of any and all obstacles

- Establish pay item for unexpected delays
Tunnel construction
surveying

- Control
- Alignment and grade monitoring
- Settlement monitoring
control

- M&C set specific control point for each tunnel
- M&C set offsets for tunnel begin and end
- M&C set offsets for tunnel shaft excavation “cut”
- M&C transfer control points
Alignment and grade monitoring

- Alignment and grade check (approximately every 50 feet)
- Alignment adjustments
Checking A&G
Settlement monitoring

- Establish grid of points
  - Along centerline
  - Ten-foot offset

- Leica ScanStation C10
  - Provides High-Definition Surveying™
  - Scanner, battery, controller, data storage
    - and video camera

- Data Presentation
  - Spreadsheets and image
Settlement monitoring

- Image from scanner
McALPINE CREEK

INDEPENDENCE BOULEVARD

INDEPENDENCE SLAB CONTROL POINT TABLE

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Work in railroad right-of-way
Start early
December 9 - Submitted Outside Party Request Form to start the CSX tunnel installation process

January 9 - Contacted Shannon & Wilson (CSX’s Engineering Consultant)

January 10 – Submitted settlement monitoring plan etc., to S&W, FL

January 13 – Submitted same to S&W representative in SC

- S&W/CSX put out for bid for flaggers (tentative date for flagger availability January 23.

January 14 – Tunnel pre-installation meeting

January 21 – Allowed to proceed.
Work in ncdot right-of-way

Providence Road
Pre-Installation Meeting for the Providence Road Tunnel scheduled for March 27, 2013

No one from NCDOT attended

McKim & Creed forwarded “tunnel” information, including planned procedures, to NCDOT

McKim & Creed met NCDOT in the field, May 20, 2013
  ◦ Noted pre-existing settlement/cracking of the pavement

Tunneling operations commenced - soil conditions inside the tunnel were described as solid & dry, good dig-able material.

Tunnel shaft was flooded June 20, 2013
• Material in tunnel changes to wet, gray sandy material.

• **June 20, 2013** - Cracks in asphalt observed. NCDOT shut down the tunneling operation.

• Contractor installed an asphalt wedge as a temporary fix.
• Results of GPR and auger core indicated no voids were present under slab
• **July 8, 2013** NCDOT shut down the tunneling operations again until the reasons for the settlement and remediation actions for the settlement have been investigated.

• Settlement investigation started **July 9, 2013**.

- Soil characteristics of the existing subgrade were less than desirable. The existing fill beneath the roadway sampled in these investigations also consisted of sandy silt with a soft consistency. The alluvial soils beneath the fill soils consisted of silt with sand, indicating a very soft to soft consistency.
• Numerous emails, telephone calls and meetings between **July 2013 and March 2014**
  ◦ Plan to monitor settlement and prepare a restoration plan to commence once tunneling was complete
  ◦ Extended until after dewatering in the vicinity was complete

• **Providence Road Approach Slab Pre-Installation Meeting - March 25, 2014**

• **April 24, 2014** – Restoration Plan
  ◦ Remove/replace both south side approach slabs of the Providence Road Bridge
  ◦ Remove/replace the concrete median and sidewalks on both sides of the roadway.
  ◦ Remove/replace five (5) foot section of asphalt beyond the south side approach slabs

• Actual restoration occurred **June 20th – June 24th**
Debris from the removed southside bridge approach slabs.
View of the rebar placement at the southbound side.

Contractor installing the curb and gutter along the northbound side of Providence Rd.

View of contractor placing the approach slab concrete on the southbound side of Providence Rd.
Csx railroad monitoring
Flagman must be present
### Contractor's Monitoring System

- **Contractor’s surveyor** – daily basis
- **McKim & Creed check** – weekly basis

#### Monitoring Points

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#### Monitoring Points (5)

- **Public Water Supply**
- **CSX Railroad**
- **54" San. Sewer**

#### Notes:
1. Track Centerline Monuments (P-9)
2. Tunnel Bore Centerline Monuments (P-13)
3. Start Tunnel Monuments at 20' from header launching and receiving pits. Monuments to be spaced at 10' intervals.
4. Start Center Track Monuments on Tunnel Bore and Track Centerline and Space Along Track Centerline at 10' Intervals (To be Field Adjusted Based On Railroad Tie Locations)
5. Negative (-) = Left Side Offset
   Positive (+) = Right Side Offset

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**McKim & Creed**

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E-mail: info@mkcreed.com

[Visit our website](http://www.mkcreed.com)
• Adjusted methods based on monitoring results
  ◦ Increased frequency of grouting annular space
  ◦ Added grout injection points
  ◦ Re-grouted completed liner plates
  ◦ Sounded liner plates
Disposal of tunnel spoil

- CSX prefers the spoil be disposed of on their property
- Mecklenburg County FDP prohibits fill in floodplain
- Off-CSX property disposal requires soil be tested, transported, and disposed of in accordance with CSX policy managed by their environmental agent, CCR Environmental Solutions
- Not included in CLTWater’s agreement with CSX
Identify Utility Conflicts—Start Early

Piedmont Natural Gas Pipeline at Colony Road Tunnel

- Colony Road Tunnel alignment conflict with PNG pipeline
- Request to re-locate approximately 300 feet of existing pipeline
- Charlotte Water and PNG agreement
- City of Charlotte City council approval
- Easement acquisition
- Relocation complete
Piedmont Natural Gas Pipeline at Sardis Road Tunnel

- Sardis Road Tunnel elevation conflict
- Request to re-locate approximately 150 feet of existing pipeline
- Charlotte Water and PNG agreement
- City of Charlotte City council approval
- Relocation complete
Thank you for the opportunity.

Questions