

2019 NSSGA **1**

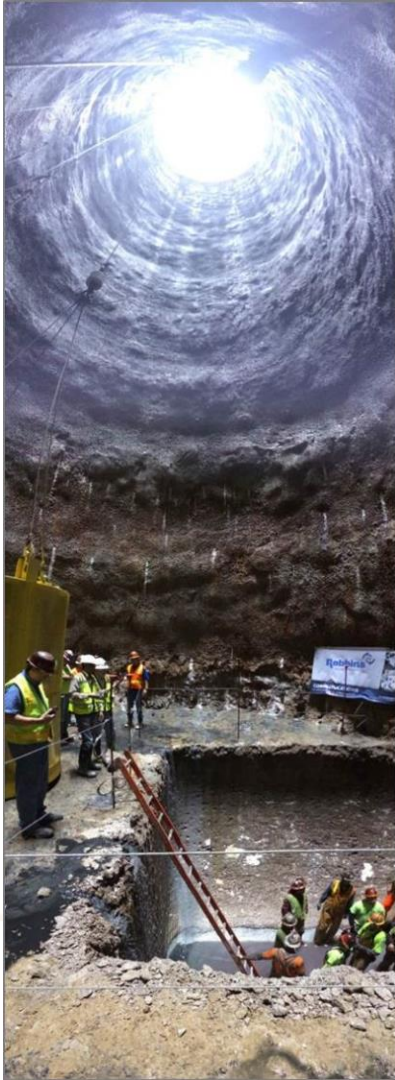


AGG1

AGGREGATES ACADEMY & EXPO

FEB. 12-14, 2019 | INDIANAPOLIS, IN

REV YOUR ENGINES!



Protecting Our Waterways

The DigIndy

Tunnel Program

November 12, 2019

Presentation by:

Michael Miller, PE – Construction Manager, Citizens Energy Group



Presentation Overview

- Combined and Separated Sewer Systems History
- Combined Sewer Overflow (CSO) Regulations
- Indianapolis' CSO Problem
- Indianapolis' Consent Decree / Long Term Control Plan Solution
- Geotechnical Program
- Dig Indy Tunnel System Update



The Problem: Indy's Combined Sewer Overflows



Combined Sewer Systems

Regulations:

- Clean Water Act (1972)
- Combined Sewer Overflow Policy (1994) & Minimum Controls Policy (1995)
- Financial Capability Guidance (1997)
- Water Quality Standards Guidance (2001)

Challenges:

- Significant capital costs for compliance
- CSO communities have higher wastewater rates
- Low income affordability
- Uncertain closure with U.S. EPA

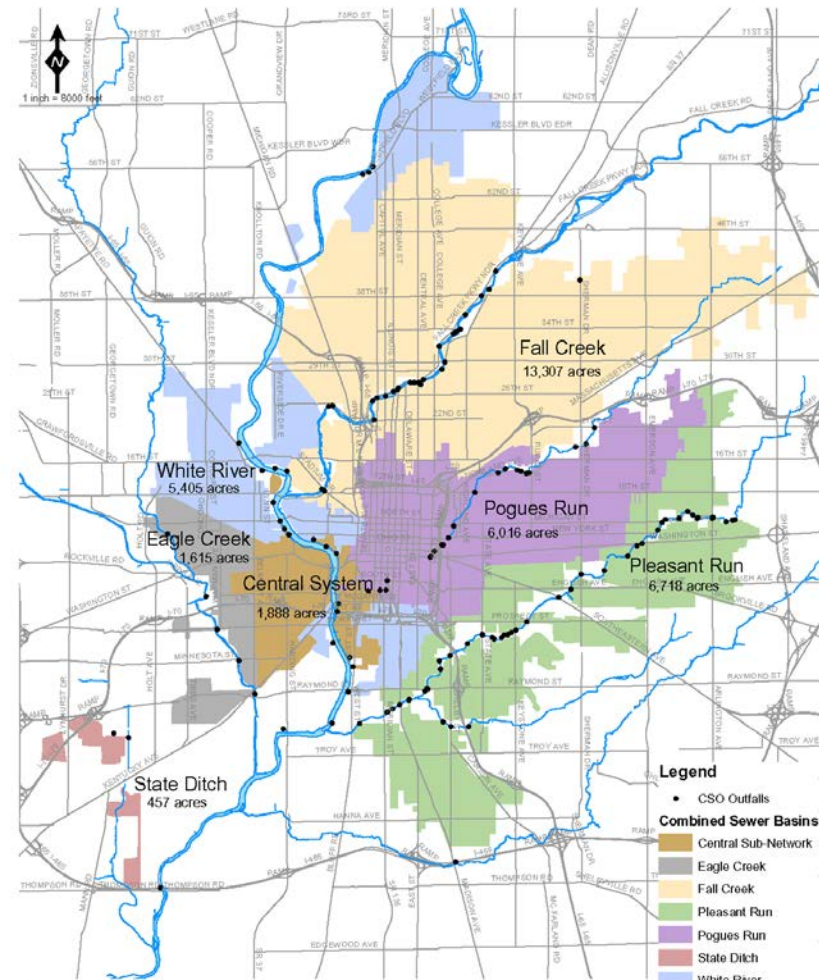
Solutions & Benefits:

- Consent Decree (CD):
 - Agreement between City of Indianapolis, Citizens, U.S EPA and IDEM (2005)
 - All parties agreed that the LTCP process, per CSO Policy and Indiana law, was followed
- Benefits: Cleaner waterways, public health/recreation and development along waterways



Indy's Combined Sewer Overflows

- CSO Discharge Points (134)
- CSO Discharge Area (55 square miles)
- CSO Discharge Locations
 - White River Fall Creek
 - Pogues Run Pleasant Run
 - Eagle Creek
- CSO Frequency:
 - 60+/- times in a typical year
- CSO Discharge Volumes:
 - (Historically) ~5-6 billion gallons - typical year
 - (Currently) DRTC & Eagle Creek Deep Tunnel are now capturing up to 1 billion gallons more raw sewage per year



Legend

- CSO Outfalls
- Combined Sewer Basins**
- Central Sub-Network
- Eagle Creek
- Fall Creek
- Pleasant Run
- Pogues Run
- State Ditch
- White River

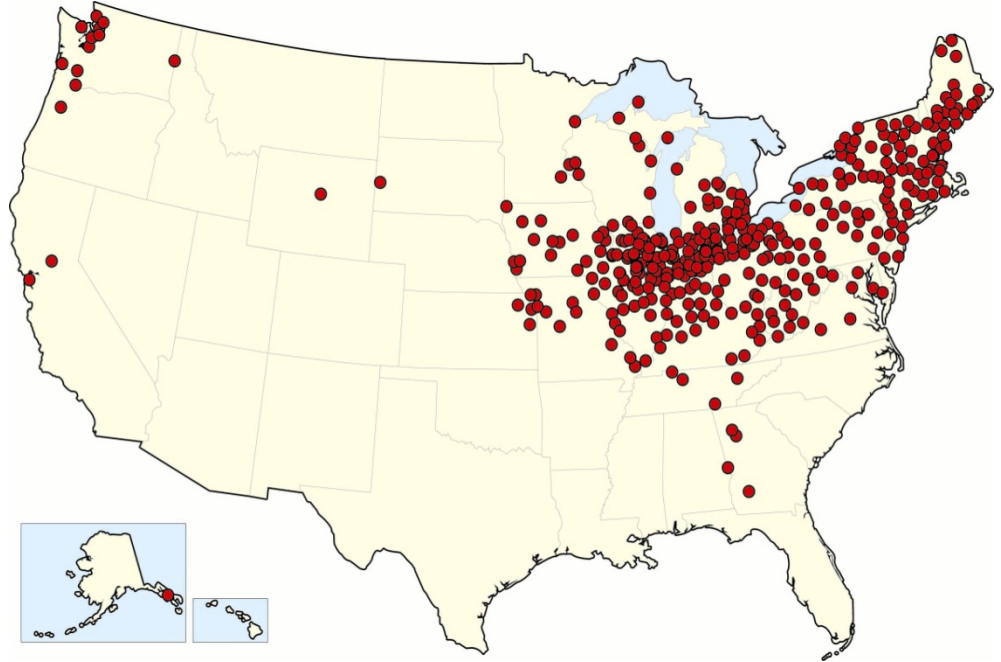
Note:
1. A total of 35,405 acres of combined sewer are proposed to be separated.
2. The combined sewer basins include separated sewers that are connected to the combined sewers.

Systemwide Plan 3
April 22, 2004

We Are Not Alone



Over 100 Indiana Cities / Towns



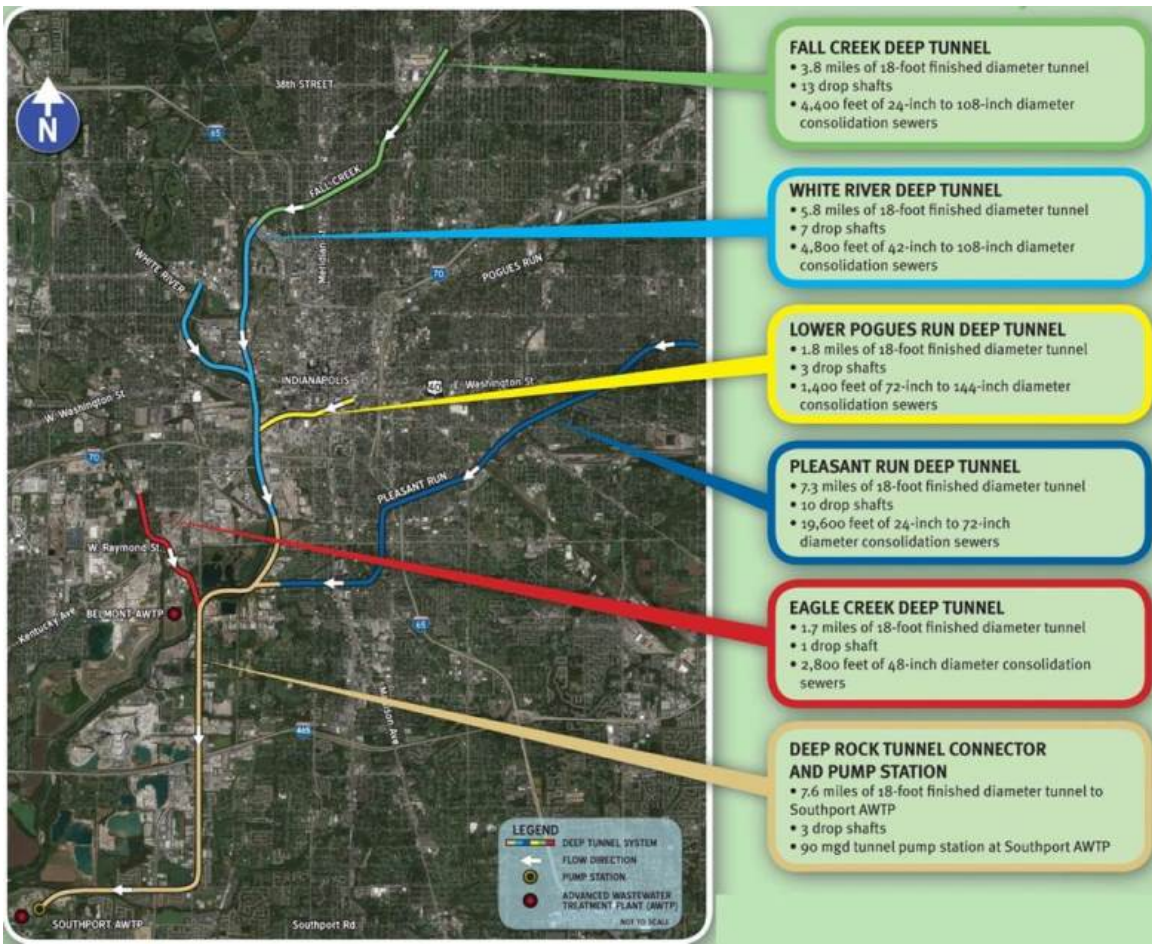
Close to 800 U.S. Cities

Sustainable Solutions – Indy's CSO LTCP Overview

- Multi-Faceted CSO Long Term Control Plan:
 - Using Existing System Capacity
 - Expanding / Upgrading Advanced Wastewater Treatment Plants
 - Constructing New Storage and Conveyance

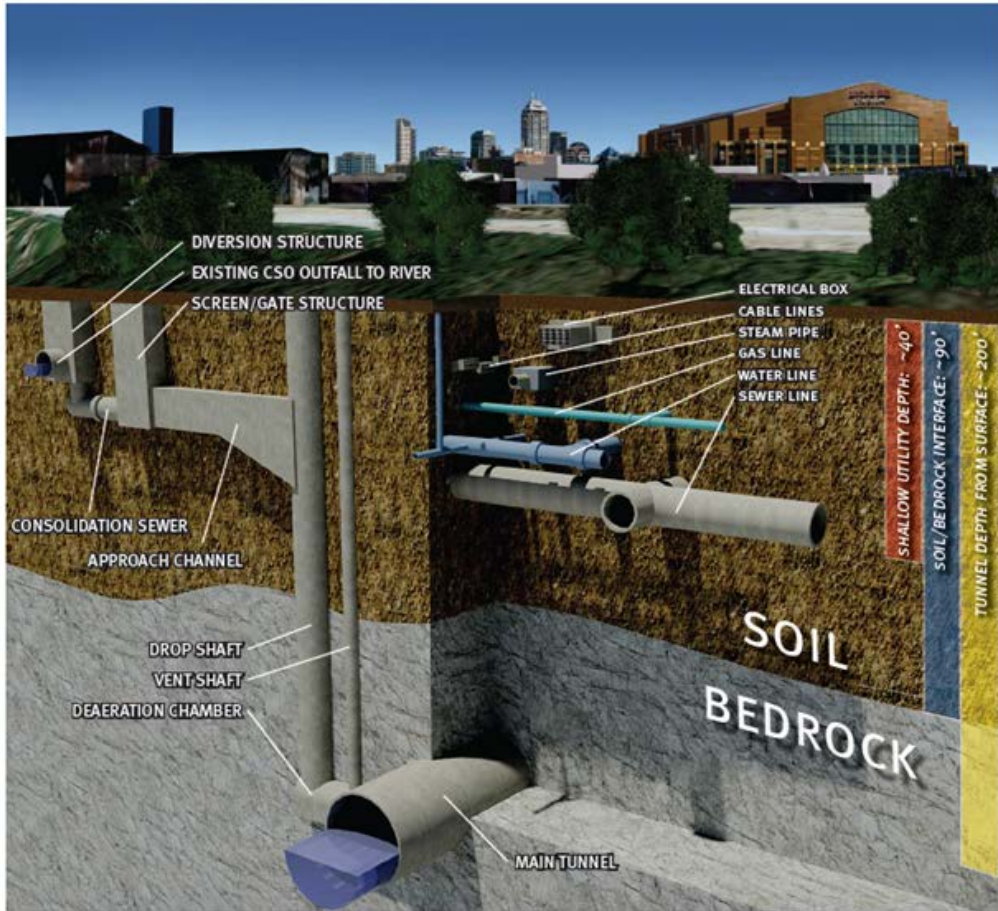


Overview of the DigIndy System



- Six deep rock tunnel segments
- 28 miles of deep rock tunnel
- 250 feet deep
- 20-foot bore
- 12-inch concrete liner
- 18-foot finished tunnel
- 270+ million gallons
- 13 years to construct
- Completed by 2025

TUNNEL SYSTEM COMPONENTS



Deep Tunnel Components



Consent Decree Milestones



- 12/31/2017 – Deep Rock Tunnel Connector ✓
- 12/31/2017 – DRTC Pump Station ✓
- 12/31/2018 – Eagle Creek Deep Tunnel ✓
- 12/31/2021 – White River Tunnel
- 12/31/2021 – Lower Pogues Run Tunnel
- 12/31/2021 – Upper Pogues Run CSO Abatement
- 12/31/2025 – Fall Creek Tunnel
- 12/31/2025 – Pleasant Run Tunnel

Geotechnical Program Summary

Geotechnical Investigations



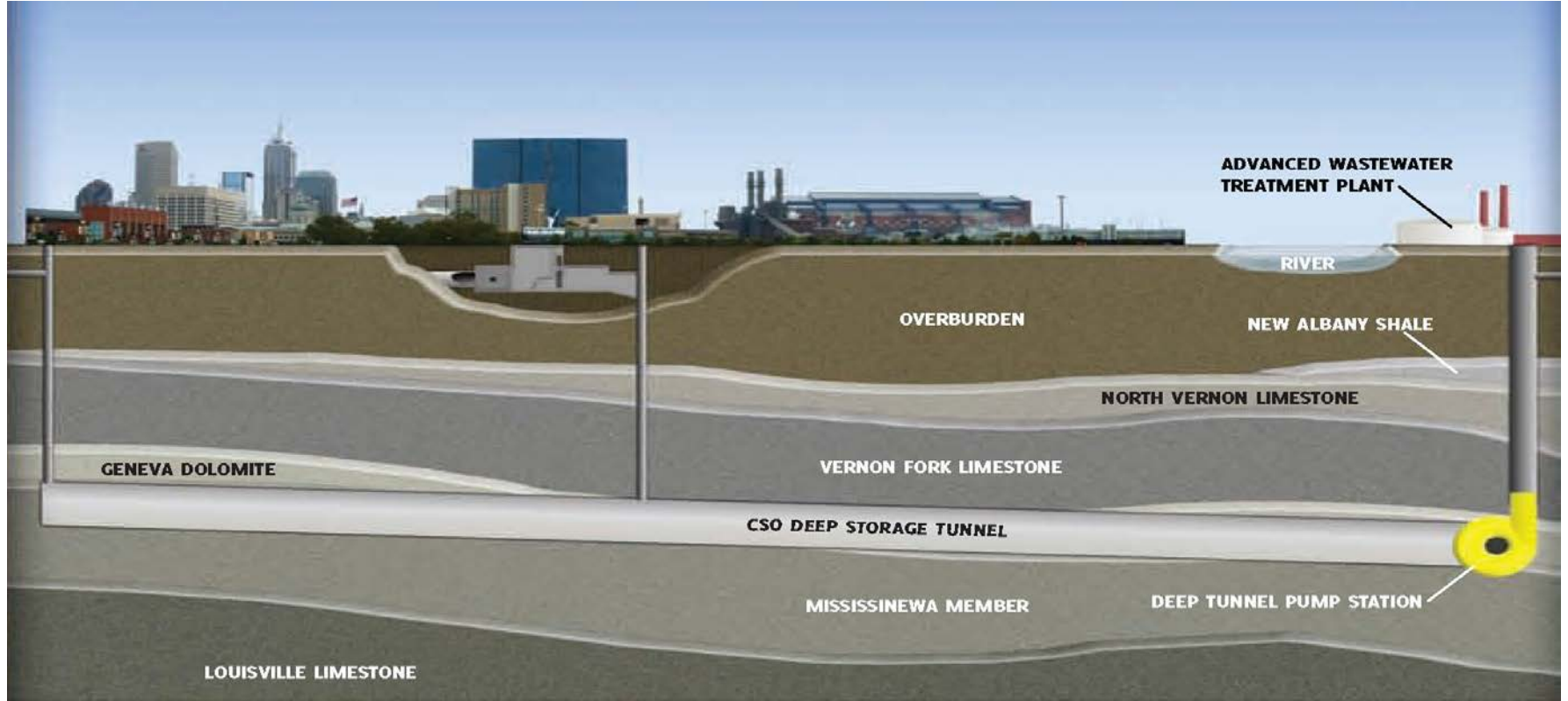
- Over 350 borings drilled up to 300 feet below the ground surface
- Vertical and inclined deep rock borings performed
- Piezometers and cluster monitoring wells set in vertical borings
- Sampling and testing of physical rock and soil characteristics
- Soil and groundwater environmental screening and sampling
- Hydraulic packer testing of bedrock permeability

Summary of Geotechnical Findings

- Rock Quality Designation (RQD) indicates bedrock is sound and relatively consistent, and not heavily fractured
- Unconfined Compressive Strength (UCS) averaged 9,000 to 10,000 pounds per square inch (psi)
- Tunneling-Related Rock Testing
 - Drilling Rate Index – High to Extremely High (66 to 82)
 - Bit Wear Index – Very Low to Extremely Low (6 to 12)



Illustrative Representation of Indianapolis' Geology





T&UC

FEATURE ARTICLE

TBM mining for the Deep Rock Tunnel Connector project

Figure 1
Overall alignment of the Indianapolis Deep Rock Tunnel Connector project.

| Line | TUNNEL CURVE DATA | | |
|----------|-------------------|---------|---------|
| | Station | Radius | Length |
| Line 1 | 1+00.00 | 100.00' | 100.00' |
| Line 2 | 1+100.00 | 100.00' | 100.00' |
| Line 3 | 1+200.00 | 100.00' | 100.00' |
| Line 4 | 1+300.00 | 100.00' | 100.00' |
| Line 5 | 1+400.00 | 100.00' | 100.00' |
| Line 6 | 1+500.00 | 100.00' | 100.00' |
| Line 7 | 1+600.00 | 100.00' | 100.00' |
| Line 8 | 1+700.00 | 100.00' | 100.00' |
| Line 9 | 1+800.00 | 100.00' | 100.00' |
| Line 10 | 1+900.00 | 100.00' | 100.00' |
| Line 11 | 2+000.00 | 100.00' | 100.00' |
| Line 12 | 2+100.00 | 100.00' | 100.00' |
| Line 13 | 2+200.00 | 100.00' | 100.00' |
| Line 14 | 2+300.00 | 100.00' | 100.00' |
| Line 15 | 2+400.00 | 100.00' | 100.00' |
| Line 16 | 2+500.00 | 100.00' | 100.00' |
| Line 17 | 2+600.00 | 100.00' | 100.00' |
| Line 18 | 2+700.00 | 100.00' | 100.00' |
| Line 19 | 2+800.00 | 100.00' | 100.00' |
| Line 20 | 2+900.00 | 100.00' | 100.00' |
| Line 21 | 3+000.00 | 100.00' | 100.00' |
| Line 22 | 3+100.00 | 100.00' | 100.00' |
| Line 23 | 3+200.00 | 100.00' | 100.00' |
| Line 24 | 3+300.00 | 100.00' | 100.00' |
| Line 25 | 3+400.00 | 100.00' | 100.00' |
| Line 26 | 3+500.00 | 100.00' | 100.00' |
| Line 27 | 3+600.00 | 100.00' | 100.00' |
| Line 28 | 3+700.00 | 100.00' | 100.00' |
| Line 29 | 3+800.00 | 100.00' | 100.00' |
| Line 30 | 3+900.00 | 100.00' | 100.00' |
| Line 31 | 4+000.00 | 100.00' | 100.00' |
| Line 32 | 4+100.00 | 100.00' | 100.00' |
| Line 33 | 4+200.00 | 100.00' | 100.00' |
| Line 34 | 4+300.00 | 100.00' | 100.00' |
| Line 35 | 4+400.00 | 100.00' | 100.00' |
| Line 36 | 4+500.00 | 100.00' | 100.00' |
| Line 37 | 4+600.00 | 100.00' | 100.00' |
| Line 38 | 4+700.00 | 100.00' | 100.00' |
| Line 39 | 4+800.00 | 100.00' | 100.00' |
| Line 40 | 4+900.00 | 100.00' | 100.00' |
| Line 41 | 5+000.00 | 100.00' | 100.00' |
| Line 42 | 5+100.00 | 100.00' | 100.00' |
| Line 43 | 5+200.00 | 100.00' | 100.00' |
| Line 44 | 5+300.00 | 100.00' | 100.00' |
| Line 45 | 5+400.00 | 100.00' | 100.00' |
| Line 46 | 5+500.00 | 100.00' | 100.00' |
| Line 47 | 5+600.00 | 100.00' | 100.00' |
| Line 48 | 5+700.00 | 100.00' | 100.00' |
| Line 49 | 5+800.00 | 100.00' | 100.00' |
| Line 50 | 5+900.00 | 100.00' | 100.00' |
| Line 51 | 6+000.00 | 100.00' | 100.00' |
| Line 52 | 6+100.00 | 100.00' | 100.00' |
| Line 53 | 6+200.00 | 100.00' | 100.00' |
| Line 54 | 6+300.00 | 100.00' | 100.00' |
| Line 55 | 6+400.00 | 100.00' | 100.00' |
| Line 56 | 6+500.00 | 100.00' | 100.00' |
| Line 57 | 6+600.00 | 100.00' | 100.00' |
| Line 58 | 6+700.00 | 100.00' | 100.00' |
| Line 59 | 6+800.00 | 100.00' | 100.00' |
| Line 60 | 6+900.00 | 100.00' | 100.00' |
| Line 61 | 7+000.00 | 100.00' | 100.00' |
| Line 62 | 7+100.00 | 100.00' | 100.00' |
| Line 63 | 7+200.00 | 100.00' | 100.00' |
| Line 64 | 7+300.00 | 100.00' | 100.00' |
| Line 65 | 7+400.00 | 100.00' | 100.00' |
| Line 66 | 7+500.00 | 100.00' | 100.00' |
| Line 67 | 7+600.00 | 100.00' | 100.00' |
| Line 68 | 7+700.00 | 100.00' | 100.00' |
| Line 69 | 7+800.00 | 100.00' | 100.00' |
| Line 70 | 7+900.00 | 100.00' | 100.00' |
| Line 71 | 8+000.00 | 100.00' | 100.00' |
| Line 72 | 8+100.00 | 100.00' | 100.00' |
| Line 73 | 8+200.00 | 100.00' | 100.00' |
| Line 74 | 8+300.00 | 100.00' | 100.00' |
| Line 75 | 8+400.00 | 100.00' | 100.00' |
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| Line 77 | 8+600.00 | 100.00' | 100.00' |
| Line 78 | 8+700.00 | 100.00' | 100.00' |
| Line 79 | 8+800.00 | 100.00' | 100.00' |
| Line 80 | 8+900.00 | 100.00' | 100.00' |
| Line 81 | 9+000.00 | 100.00' | 100.00' |
| Line 82 | 9+100.00 | 100.00' | 100.00' |
| Line 83 | 9+200.00 | 100.00' | 100.00' |
| Line 84 | 9+300.00 | 100.00' | 100.00' |
| Line 85 | 9+400.00 | 100.00' | 100.00' |
| Line 86 | 9+500.00 | 100.00' | 100.00' |
| Line 87 | 9+600.00 | 100.00' | 100.00' |
| Line 88 | 9+700.00 | 100.00' | 100.00' |
| Line 89 | 9+800.00 | 100.00' | 100.00' |
| Line 90 | 9+900.00 | 100.00' | 100.00' |
| Line 91 | 10+000.00 | 100.00' | 100.00' |
| Line 92 | 10+100.00 | 100.00' | 100.00' |
| Line 93 | 10+200.00 | 100.00' | 100.00' |
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| Line 97 | 10+600.00 | 100.00' | 100.00' |
| Line 98 | 10+700.00 | 100.00' | 100.00' |
| Line 99 | 10+800.00 | 100.00' | 100.00' |
| Line 100 | 10+900.00 | 100.00' | 100.00' |

Geology
The Deep Rock Tunnel Connector project (DRTC) is located in the city of Indianapolis, Indiana. The project is owned by the City of Indianapolis and is being constructed by the S.K. Jay Construction Company. The project is a 1.5-mile-long, 30-foot-diameter tunnel that will connect the city's existing sewer system to the White River. The project is a joint venture between the City of Indianapolis and the S.K. Jay Construction Company. The project is a 1.5-mile-long, 30-foot-diameter tunnel that will connect the city's existing sewer system to the White River. The project is a joint venture between the City of Indianapolis and the S.K. Jay Construction Company.

Michael Shulkin, Eric Macklin and Mark Gray
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Environmental & Sustainability
Program Management

FOCUS pages 15-19
CONSTRUCTION & DEVELOPMENT

Big project, low profile

Go behind the scenes of \$1.9B sewer overhaul dug by machine that helped tunnel NYC subway

When you think of sewer overhauls, you probably think of the city streets being dug up and replaced with new pipes. But in Indianapolis, a different kind of sewer overhaul is underway. A \$1.9-billion project is being completed using a large tunneling machine to dig a new sewer line under the city. The project is a joint venture between the City of Indianapolis and the S.K. Jay Construction Company. The project is a 1.5-mile-long, 30-foot-diameter tunnel that will connect the city's existing sewer system to the White River. The project is a joint venture between the City of Indianapolis and the S.K. Jay Construction Company.

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(PROFILE) Citizens Energy Group

Energyized Operators

Citizens Energy Group has found success managing gas, wastewater and water utilities in Indianapolis. *By Alan Dorich*

After nearly a year, Citizens Energy Group has not only weathered through a difficult year, but it's also weathered a year that saw the company's stock price rise to a new high. The company's success is due to its focus on operational excellence and its commitment to its customers. Citizens Energy Group has found success managing gas, wastewater and water utilities in Indianapolis.

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INDIANA

AHEAD OF THE CURVE

Progress on Indianapolis' deep rock tunnels has gained a boost from its continuous conveyor systems. Desiree Willis, of The Robbins Company, reports

In a business world of volatility, where change is constant and the only constant is change, it's important to stay ahead of the curve. Citizens Energy Group has found success managing gas, wastewater and water utilities in Indianapolis. The project is a 1.5-mile-long, 30-foot-diameter tunnel that will connect the city's existing sewer system to the White River. The project is a joint venture between the City of Indianapolis and the S.K. Jay Construction Company.

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THE INDIANA

Digester

WATER ENVIRONMENT ASSOCIATION

Inside Indianapolis Deep Rock Tunnel System

[INSIDE]

- Eleven Steps to a Sanitary Sewer System
- Wastewater Challenge Recap
- Legal Corner
- and more...

TBM TUNNEL BUSINESS MAGAZINE

Robbins TBM Races to Finish Line in Indianapolis

Posted on Apr 8, 2015 in [News](#) | [Comments](#)

Now complete, the deep tunnel project will reduce the amount of raw sewage overflows and clean up tributaries along the White River in Indianapolis.

On March 5, 2015, a Robbins 30.2-ft diameter Main Beaver TBM finished boring a 9,275-ft extension tunnel, known as the Eagle Creek Tunnel, for the Indianapolis Deep Tunnel System. The contractor, S.K. Jay Construction Company, had much to celebrate. It's the proud of our world record, and most of all our crew and the hard work they have done as a team, working together to accomplish a project of this size," explained Steve Lipofsky, Project Manager, for S.K. Jay. "We finished the first 12.5 km (41,000-ft) of the main tunnel almost a year ahead of schedule. The first leg of what will be remarkable is that we were still able to flow into the original contractual dates," continued Lipofsky.

The completion of the first leg of a much larger tunnel system brings three critical SCS that flow into the nearby White River, and will go online in 2017. The completed tunnels bring the city one step closer to

north american

Tunneling

Journal

June/July 2015

www.suretydig.com

THE SECRET TO FAST TUNNELING
CONTINUOUS CONVEYORS ARE KEY

Robbins

SEE PAGE 10

RESOLVING
CONTRACTORS' CHALLENGES ON PROJECTS

CHALLENGE ON PROJECTS
CONTRACTORS' CHALLENGES ON PROJECTS

T&UC UNDERGROUND CONSTRUCTION

NEWS NEWS NEWS

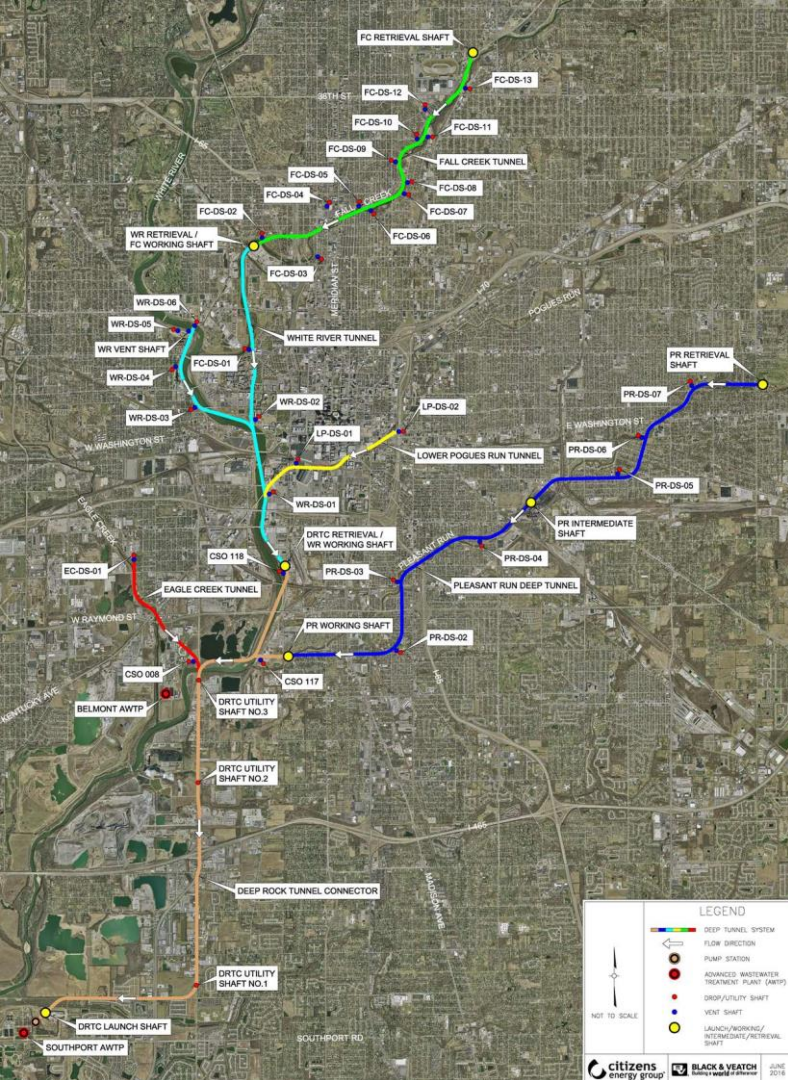
Robbins TBM begins work on North Link project

The City of Indianapolis' largest sewer tunnel completed in the

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The completion of the first leg of a much larger tunnel system brings three critical SCS that flow into the nearby White River, and will go online in 2017. The completed tunnels bring the city one step closer to

Deep Tunnel System Project Locations

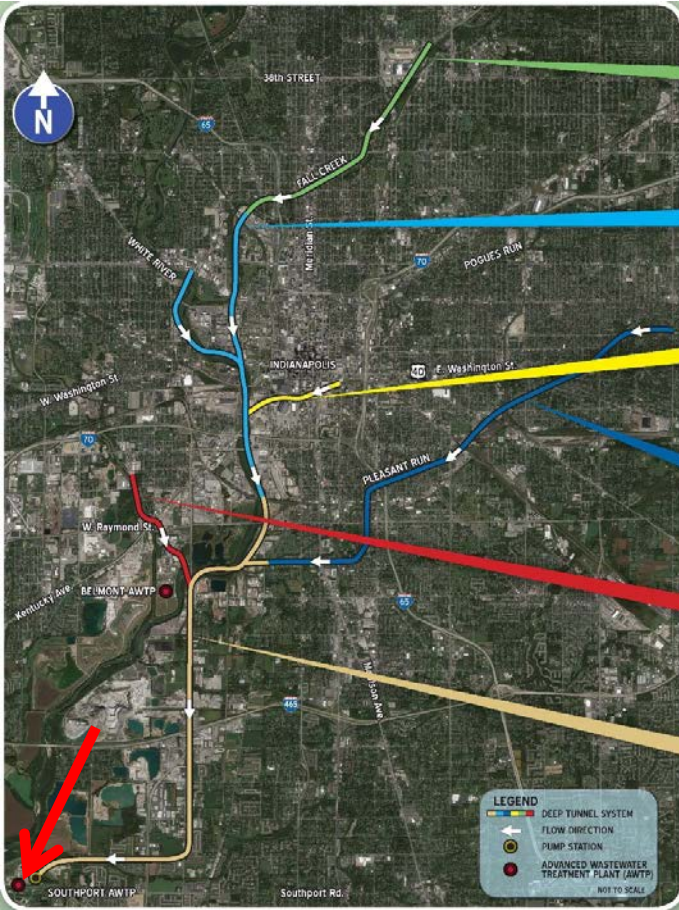


Fall Creek Drop Shaft FC-06





Fall Creek CCS Phase I Meridian Street Diversion Structure



FALL CREEK DEEP TUNNEL

- 3.8 miles of 18-foot finished diameter tunnel
- 13 drop shafts
- 4,400 feet of 24-inch to 108-inch diameter consolidation sewers

WHITE RIVER DEEP TUNNEL

- 5.8 miles of 18-foot finished diameter tunnel
- 7 drop shafts
- 4,800 feet of 42-inch to 108-inch diameter consolidation sewers

LOWER POGUES RUN DEEP TUNNEL

- 1.8 miles of 18-foot finished diameter tunnel
- 3 drop shafts
- 1,400 feet of 72-inch to 144-inch diameter consolidation sewers

PLEASANT RUN DEEP TUNNEL

- 7.3 miles of 18-foot finished diameter tunnel
- 10 drop shafts
- 19,600 feet of 24-inch to 72-inch diameter consolidation sewers

EAGLE CREEK DEEP TUNNEL

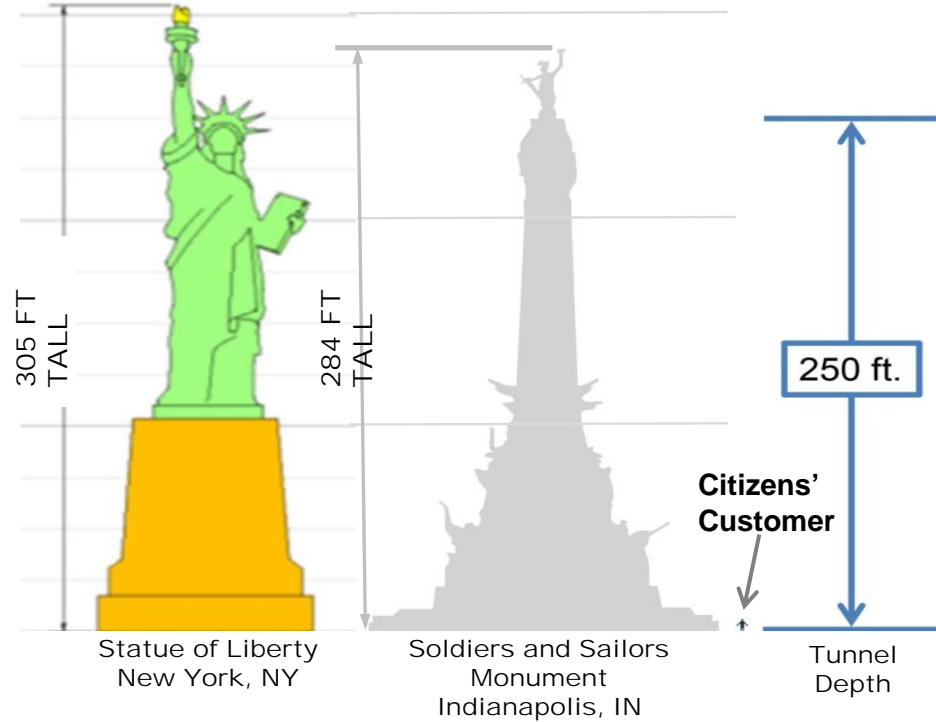
- 1.7 miles of 18-foot finished diameter tunnel
- 1 drop shaft
- 2,800 feet of 48-inch diameter consolidation sewers

DEEP ROCK TUNNEL CONNECTOR AND PUMP STATION

- 7.6 miles of 18-foot finished diameter tunnel to Southport AWTP
- 3 drop shafts
- 90 mgd tunnel pump station at Southport AWTP

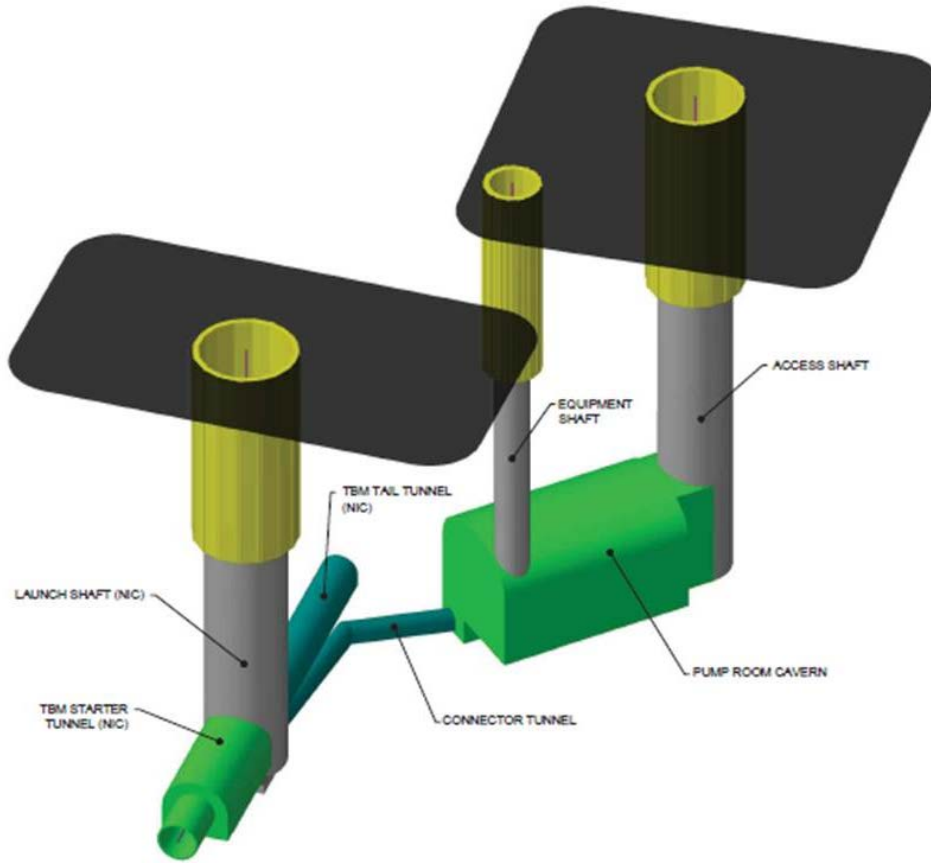


How deep is “Deep”?



DRTC Pump Station

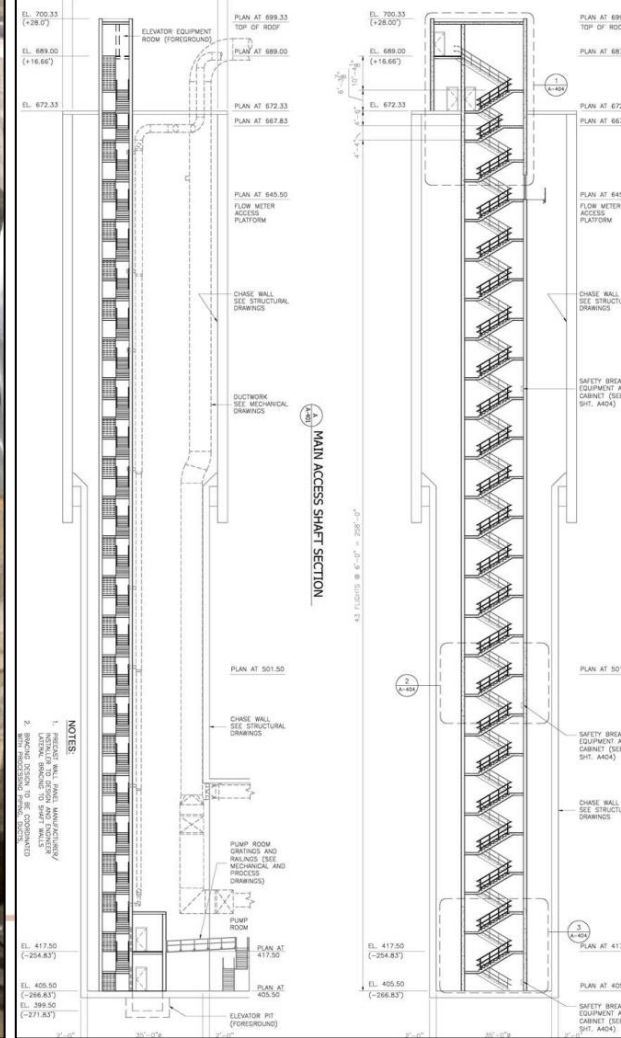
- Construction Start – April 2014
- Operation – December 2017
- Current Construction Costs - ~\$75M





DRTC Pump Station Cavern

- 100 feet long
- 60 feet wide
- 75 feet high
- Domed Arch Ceiling
- 700+ Rock Bolts
- 90+ Blasts to Excavate

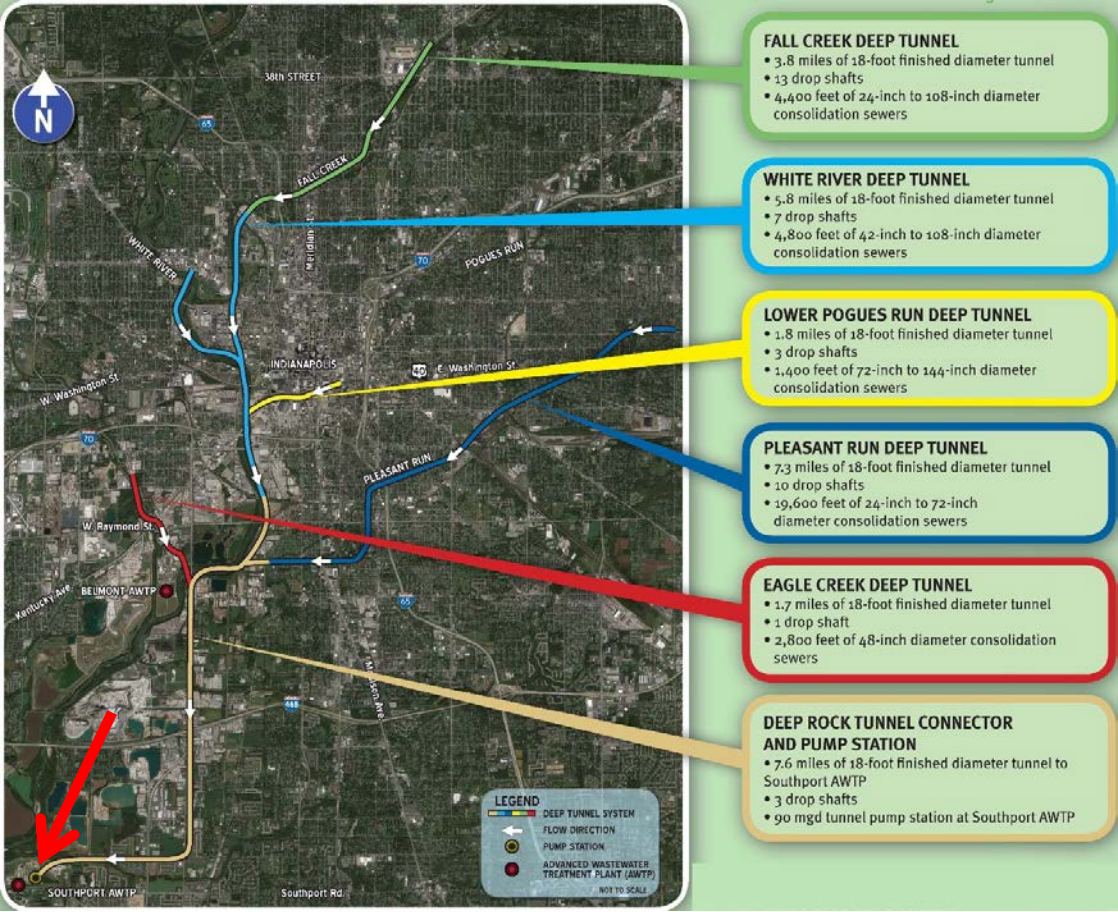


Pump Station Elevator and Stair Tower

Finished Floor to Cavern Floor

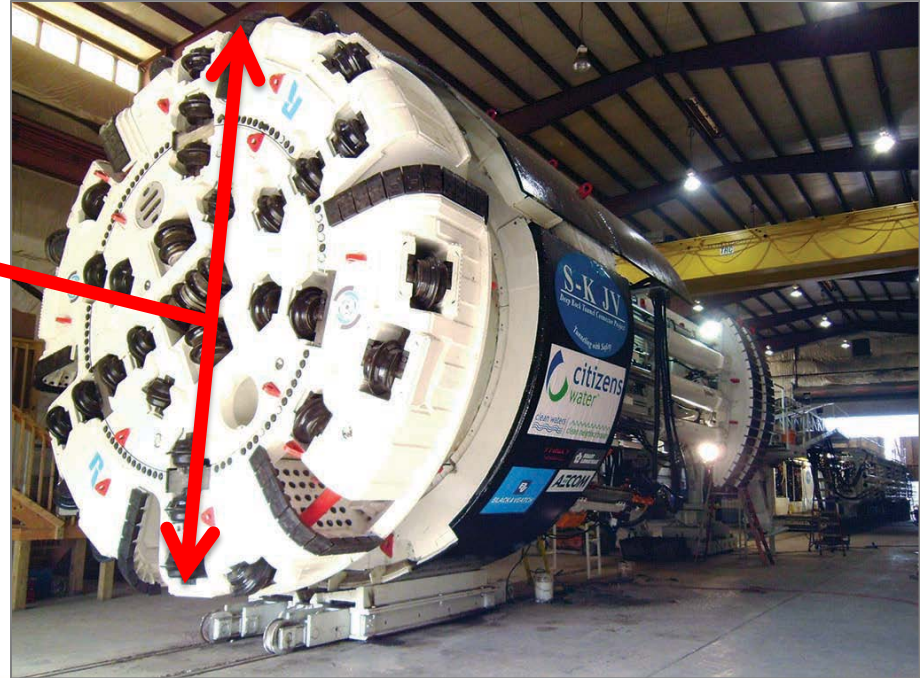
- 266.83 feet
- 22-1/2 flights of stairs
- 495 individual steps
- 3 safety breathing equipment cabinets

Deep Rock Tunnel Connector



The Deep Rock Tunnel Connector & Eagle Creek Deep Tunnel

- First two legs of Citizens' 28-mile deep tunnel system
- 9.6 miles long
- 250 feet deep
- 20' bore diameter
- 12'' thick concrete liner
- 18' finished diameter
- \$220,000,000
- Construction complete, December 2017



DRTC – TBM Fun Facts

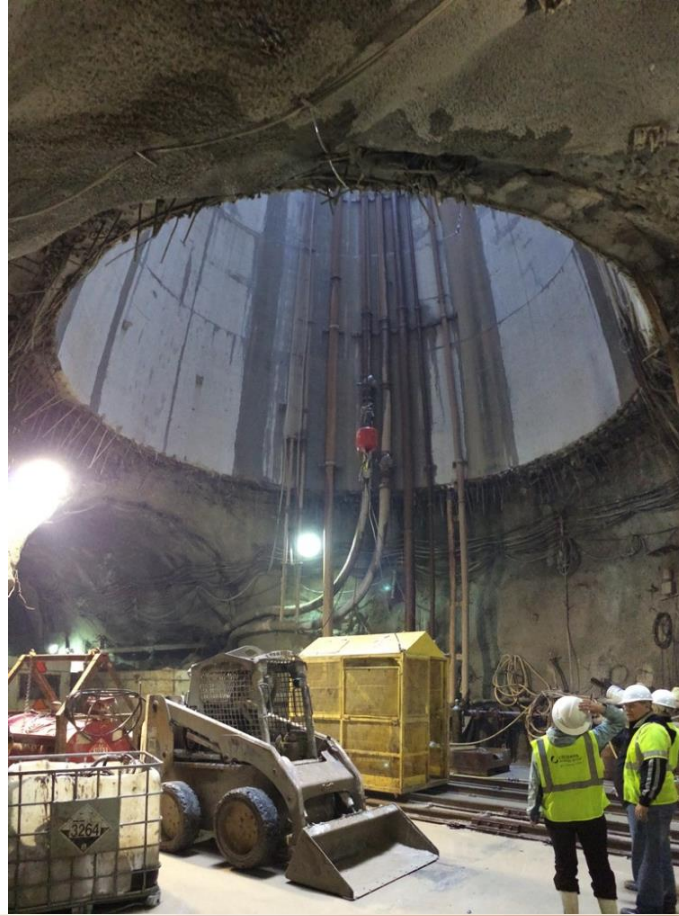
- 16 trailing gear decks
- 39 disc cutters (19" dia.) – 280 lbs each
- Cutter head - 92.5 tons
- Entire TBM - 450 tons
- Eight (8) 450hp electric motors
- Cutter head turns at ~ 8rpm
- Cutter head torque - 2,405,737 ft-lbs
- Gripper pads exert up to 7M lbs of force against the rock
- Cutter head exert up to 3M lbs of thrust at the face
- One foot of mined rock = approx. 20 yd³ of rock spoils



DRTC Launch Shaft / Mining Shaft



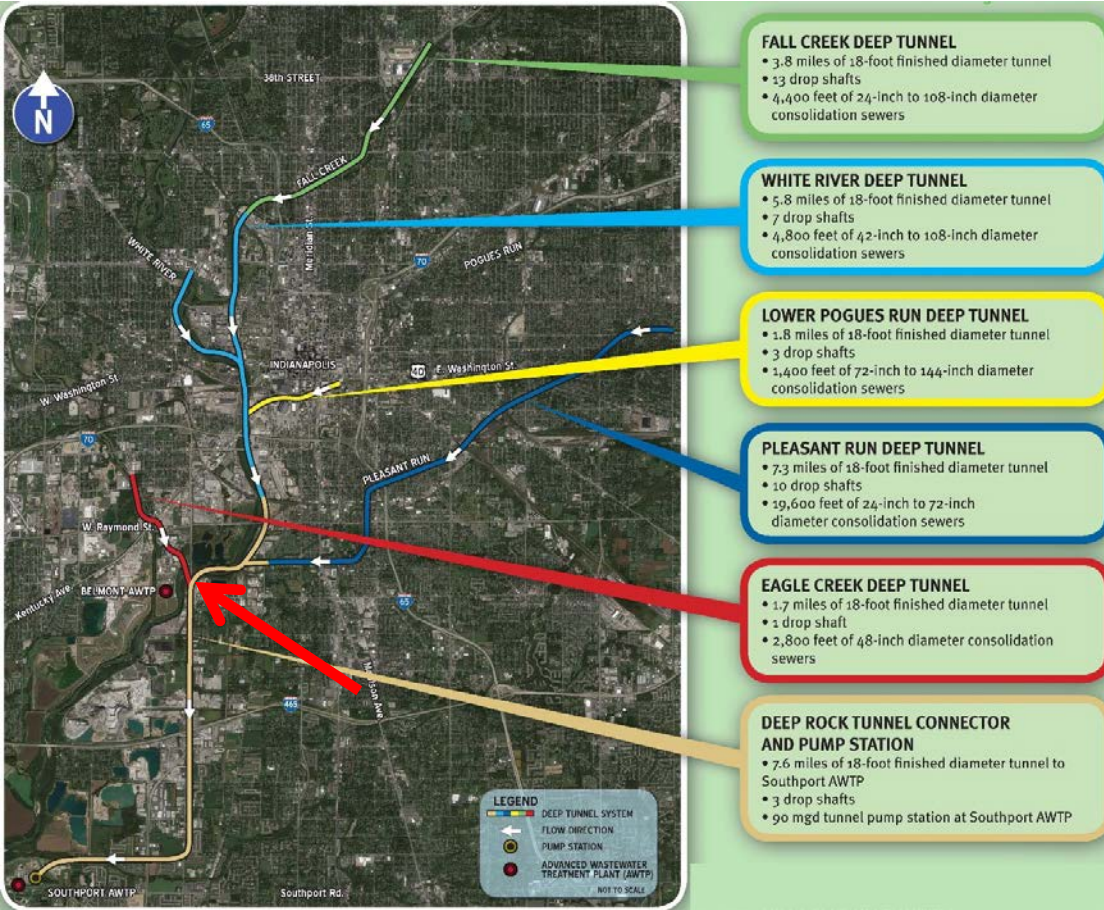
Launch Shaft



DRTC – Mined Tunnel



Eagle Creek Tunnel



Eagle Creek Bifurcation



Unique Spoils



DRTC – TBM World Records

- Most Feet Mined - One Day
409.89 feet
- Most Feet Mined - One Week
1,690.04 feet
- Most Feet Mined - One Month
5,755.15 feet



DRTC – Break Through



Concrete Lining - Formwork

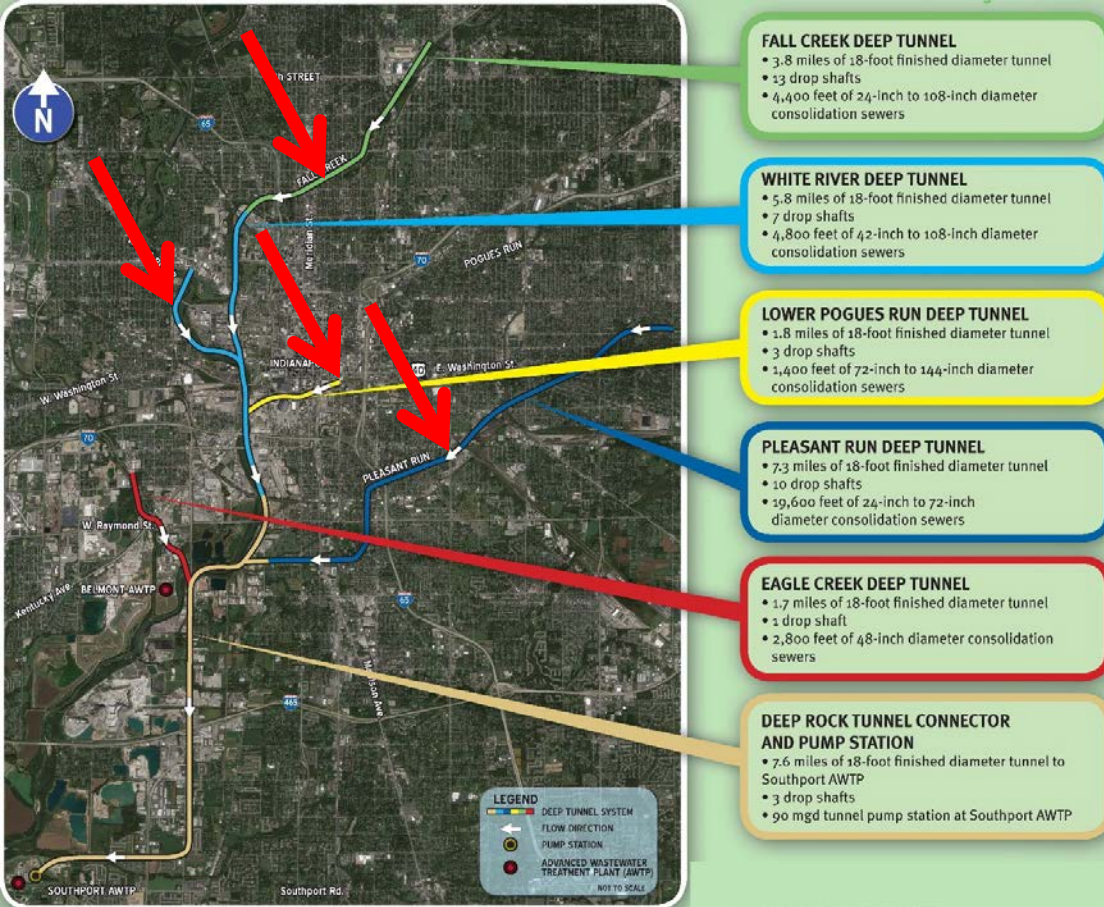


DRTC Completed Tunnel





What's Next?



Two Down – Four to Go

- White River Tunnel - 2021
- Lower Pogues Run Tunnel - 2021
- Fall Creek Tunnel - 2025
- Pleasant Run Tunnel - 2025

White River & Lower Pogues Run

- 3rd and 4th legs of DigIndy system
- 7.8 miles feet of rock tunnel
- Construction began September 2016
- First segment of White River Tunnel and all Lower Pogues Run tunnel mining is complete
- \$200,000,000 contract value
- December 31, 2021





Acknowledgements

- Deep Rock Tunnel Connector & Pump Station and Eagle Creek Deep Tunnel
 - Designer – AECOM
 - Construction Administrator – AECOM
 - Tunnel Contractor – Shea Kiewit JV
 - Pump Station Contractor – Renda Southland JV
- White River, Lower Pogues Run, Fall Creek and Pleasant Run Tunnels
 - Designer – Black & Veatch
 - Construction Administrator – AECOM
 - Tunnel Contractor – Shea Kiewit JV
 - Consolidation Sewer Contractor(s) - TBD

