

INDIANAPOLIS' DIGINDY PROGRAM APPROACHES THE FINISH LINE

Tunneling Complete on 28-mile CSO System



Like many jurisdictions across the country, the City of Indianapolis is in the process of addressing combined sewer overflows (CSOs) entering local rivers and waterways. Building combined sewers, which carry both sanitary and stormwater flows, was common practice throughout the United States as cities developed in the 19th and 20th centuries.

Today, cities are working to reduce or eliminate the amount of untreated wastewater that spills over into the environment when rains overload the capacity of the combined sewer system. According to the U.S. EPA, there are approximately 700 cities in the United States with combined sewer systems. In Indianapolis, planners are using the tried-and-true approach of building large underground tunnels to capture and store wastewater that would otherwise discharge into the environment, as designed in the previous century.

The \$2 billion DigIndy program is the result of planning efforts to address CSOs. It comprises a network of 28 miles of 18-ft ID tunnels, in addition to other sewer system and treatment plant improvements. The program resulted from a consent decree signed by the U.S. EPA and the City in 2006. The DigIndy program is administered by Citizens Energy Group, which became party to the consent decree when it acquired the water and wastewater systems in Indianapolis in 2011.

Under the oversight of Citizens, a total of six tunnels segments have been fully excavated, with four of the six in service. The Deep Rock Tunnel Connector, the first of the tunnel segments to begin construction, was awarded to the joint venture of Shea-Kiewit (SK), which was subsequently awarded a contract to construct all six of the segments. When completed, the DigIndy Tunnel System will store more than 250 million gallons of wastewater that will eventually be treated at the Southport Advanced Wastewater Treatment Plant.

The DigIndy program includes:

- Deep Rock Tunnel Connector: 39,362 lf of tunnel; 3 CSO connecting structures/deaeration chambers and adits. Put into service in 2017.
- Eagle Creek Tunnel: 9,175 lf of tunnel (added as a change order to the Deep Rock Tunnel Connector project); one CSO connecting structure/plunge drop. Put into service in 2017.
- White River Tunnel: 30,628 lf of tunnel; 2 bifurcations; 7 CSO connecting structures/deaeration chambers and adits. Put into service in 2021.
- Lower Pogue's Run Tunnel: 10,182 ft, bifurcates from White River Tunnel; 2 CSO connecting structures/deaeration chambers and adits. Put into service in 2021.
- Fall Creek Tunnel: 20,244 lf of tunnel; 10 CSO connecting structures/deaeration chambers and adits. Tunneling and lining complete.
- Pleasant Run Tunnel: 41,472 lf of tunnel; eight CSO connecting structures/deaeration chambers and adits. Tunneling complete.

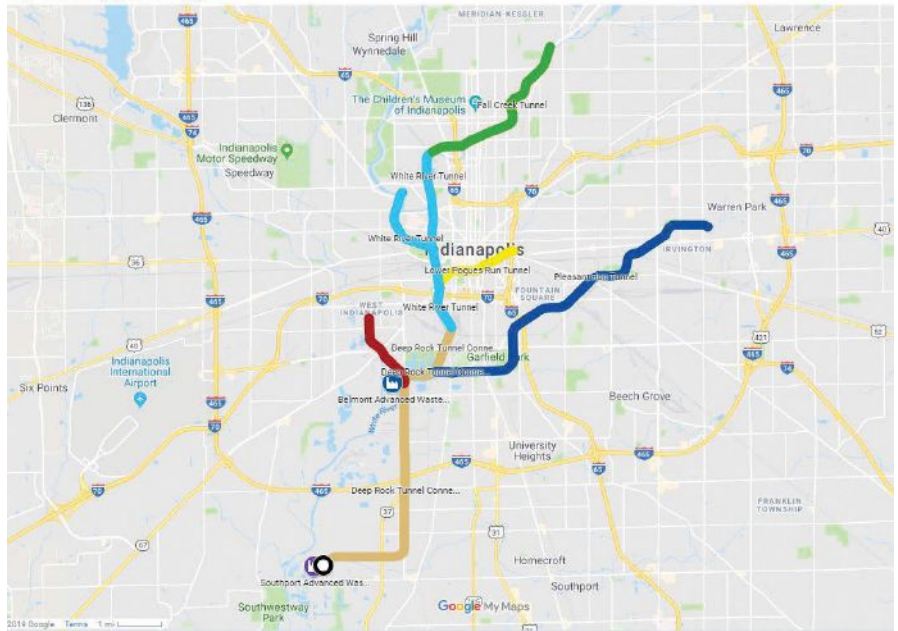
All tunnels were built using the same 20-ft, 2-in. OD refurbished Robbins hard-rock tunnel boring machine, originally manufactured in 1980, reconfigured for the Indianapolis geology. The tunnels are lined using Everest forms with a 1-ft thick cast-in-place concrete lining for a finished diameter of 18 ft.

PLANNING

Not surprisingly, planning a \$2 billion program that includes more than 28 miles of large diameter tunnels is quite the undertaking. Planning and design began in earnest in 2006 as the city entered into the consent decree with EPA, which stipulated that the work was to be completed by 2025.

Early activities included geotechnical exploration, which identified a zone of limestone and dolomite approximately 250 ft deep

Tunnel System Map



that was conducive to tunneling. Identifying the alignments presented the challenge of real estate acquisitions and third-party interactions that inevitably occur on a project of this magnitude.

“Ideally we try to stay within public rights of way when selecting tunnel alignments, but there were many sections where we needed to acquire subsurface easements,” said Mike Miller, project manager for Citizens. “This is a challenge when you are dealing with a few hundred easements, but it can also be complicated by the fact that we may not be building on the property for five to 10 years, and in that time there may be redevelopment or improvements in the adjacent areas. As a result we worked with the city to try to anticipate future development and complete our projects in advance so that we wouldn’t have to go back and disturb the area.”

On the White River and Fall Creek projects, for example, drop shafts and vent shafts were constructed in advance of tunneling, with ties being completed with minimal disturbance.

To help ease the impacts on third parties and bolster community support, Citizens embarked on an ambitious public outreach program. Citizens’ corporate affairs department is adept at dealing with print and broadcast media, government agencies, and civic and neighborhood groups. Outreach includes public meetings, presentations to various community groups and schools, and mailings and digital media campaigns. “We were very conscious of the need for outreach early on and have tried to be as transparent as possible,” Miller said.

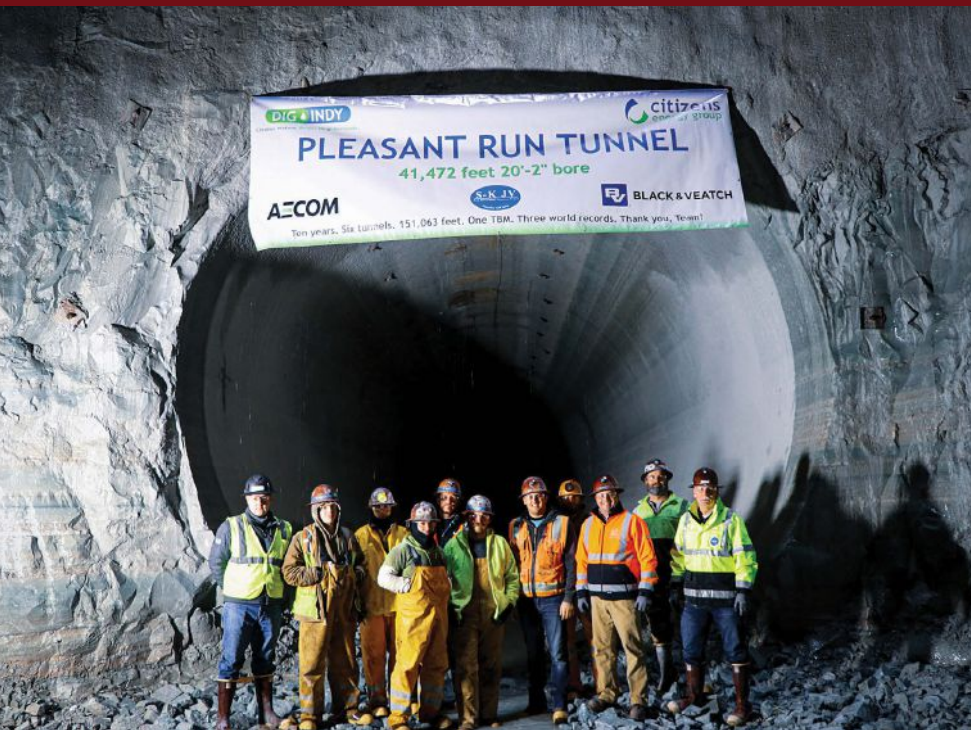
EVOLVING PLANS

As the program moved forward with its initial plan and schedule, Citizens recognized opportunities to make changes to maintain efficiency and meet its milestones. One of the major changes was a restructuring of how the work was awarded.

The initial plan was to bid the Deep Rock Tunnel Connector, the White River and Lower Pogue's Run Tunnels, and the Fall Creek and Pleasant Run Tunnels as separate contracts. However, Citizens recognized an opportunity to pick up schedule, and potentially lower cost, by altering its plans. The decision was made to move up the construction package on the White River and Lower Pogue's Run Tunnels, and Citizens negotiated a contract with SK for the joint venture to complete all the remaining tunnel work. The Eagle Creek Tunnel, originally envisioned as a soft-ground interceptor, was also reconfigured as a deep tunnel and added by change order to the Deep Rock Tunnel Connector.

This enabled Citizens to realize two important benefits. First, the early completion of these projects allowed the same TBM to be used for the following tunnel runs. Second, the long-term contract with SK helped retain a skilled tunnel workforce in an increasingly tight labor market.

“The fact that we had a long-term project enabled us to retain our workforce for several years, and that was a huge reason for our success,” said Max Engen, tunnel superintendent for SK. “Indianapolis didn’t have a history in tunnel construction prior to the start of



the program, but the labor force grew to be a skilled group of top-notch tunnel builders.”

While Citizens originally envisioned that it would take two TBMs to complete the program early, it made the decision early on to allow the use of refurbished vs. new machines, a decision that worked out favorably as a rebuilt Robbins hard-rock TBM performed well throughout the entirety

of the program. The use of the two-pass tunneling system allowed the contractor to complete lining operations on one segment while beginning mining on the next.

“It had always been assumed that we would need two TBMs to build the tunnels, but when we started looking at bidding White River and Lower Pogues Run earlier, we realized that we could potentially be able to build the entire system with one machine,” Miller said. “It was a challenge to get the design packages ready almost a year ahead of when we had planned, but the potential benefits were apparent. The fact that we were able to select a contractor to take on all four of those design packages really helped alleviate some of the stress in meeting the milestones. It also gave us the ability to procure in a non-traditional manner and react in the middle of the program, which resulted in savings overall to the program.”

CONSTRUCTION

With some designs incomplete at the time of the negotiated contract, Citizens had the added benefit of getting contractor input on the design with respect to constructability and cost. Results of early contractor involvement included the use of synthetic fiber vs. traditional reinforcement for near-surface work, allowing easier tie-in connections at a later date, and maintaining consistent diameters for large diameter shafts, which resulted in a simplified construction approach and lower cost.

Perhaps one of the most significant

changes to the original plan was SK’s ability to back the machine up through completed tunnel segments, which resulted in the elimination of large retrieval shafts at several locations. The SK team first used this procedure at the end of Deep Rock Tunnel Connector, backing the machine up to build the Eagle Creek Tunnel, which was added a change order to the Deep Rock Tunnel Connector. In total, the TBM was backed up over 9 miles and only traveled over land once for the entire 28-mile system. At the end of each tunnel run, the machine was refurbished for its next run.

While the geology was generally favorable for tunneling, water inflow was a concern throughout the project area. Initially, pre-excavation grouting was done at the contractor’s discretion, but based on experience during the Deep Rock Tunnel Connector, Citizens and SK altered the approach to share the risk. The new approach required the contractor to perform probe drilling, followed by pre-excavation grouting for groundwater cutoff if inflow exceeded an established threshold. At that point, pre-excavation grouting was performed with predetermined time and material rates.

On the Lower Pogues Run Tunnel, a section of weaker rock was encountered where water inflow was different from other sections. Brierley Associates was called in to assess the situation and make recommendations for future tunnel works. In this section, a unique solution was devised. Water inflow through the walls led to a welded PVC liner (supplied by Renesco) being installed prior to concrete final lining. “That was a bit of an experiment with the PVC liner being installed with more than 200 ft of head, but it worked out well and the finished tunnel was dry,” Miller said.

To date, all tunnel excavation is completed, with lining recently complete on the Fall Creek Tunnel. However, SK still has plenty of work ahead. As of December 2022, remaining work included construction of adits and de-aeration chambers, and tunnel lining of the Pleasant Run Tunnel, which was scheduled to start this spring. The entire program included the construction of about 9,000 ft of adits, performed by drill-and-shoot. It is anticipated that SK will finish its underground work this year. Beyond SK’s portion of the work, near-surface construction continues by local contractors Bowen Engineering and F.A. Wilhelm. Midwest Mole also performed a portion of hand-mine tunneling as part of the program. “Even though we have completed tunneling and are nearing the end, we have more active sites now than we’ve ever had,” Miller said.



LOOKING BACK

One of the key features of the DigIndy program was Citizens's willingness and ability to negotiate a long-term contract with SK to complete the entire 28-mile tunnel network, along with its affiliated shafts and adits. Having SK on board as the design process advanced for future works allowed the benefits of early contractor involvement, according to Christian Heinz, project manager for SK. "Coming on board before project designs were completed allowed us to have input – it essentially ended up being like CMAR project. While there weren't many significant changes, there were many small changes provided cost and schedule benefits."

Naturally, a \$2 billion program spanning two decades takes a monumental effort from a range of parties. "For a project of this magnitude to be successful it takes a massive team of people. Credit goes to all parties involved, including the consultants, contractors, the city, the permitting agencies and the team at Citizens," Miller said.

The team approach that developed throughout the program also played an important role in the impending timely and successful completion of the project. "Having such a good relationship with the owners and engineers definitely helped our construction team in the field," Engen said. "It was always open-minded communication between all parties, and that helped mitigate any issues that would come up. Everyone wanted to see us succeed and they helped out in any way to see that happen."

PROJECT TEAM

Owner: Citizens Energy Group

Tunnel Contractor: Shea-Kiewit

Designers: AECOM (Deep Rock Tunnel Connector, Eagle Creek Tunnel); Black & Veatch (Lower Pogues Run Tunnel, White River Tunnel, Fall Creek Tunnel, Pleasant Run Tunnel)

Construction Manager: AECOM

Owner's Third-Party Consultant: Brierley Associates

TBM Manufacturer: Robbins

Combined Consolidation Sewer Contractors: F.A. Wilhelm, Bowen Engineering Corp.



Kiewit

DRIVEN.

For those who get the job done.

Kiewit is currently hiring:

Interns, Field Engineers, Estimators,
Superintendents, Safety Managers and more

Apply for our
job openings:



Want a career that can take you places? Look no further.

kiewitjobs.com