Tunnel Solutions

BLACK & VEATCH FOCUSES ON WATER, WASTEWATER AND STORMWATER TUNNELING CHALLENGES, AND EFFECTIVELY MANAGING UNDERGROUND RISKS
Forces of Nature Meet Forces of Knowledge

We’re developing sustainable, comprehensive solutions that balance performance, costs and risks with clients’ needs and resources.

For nearly a century, clients have looked to Black & Veatch for water conveyance and storage solutions. That’s because we offer the best technical knowledge and risk-managed answers to move and harness water.

We work with clients in all types of geologic, environmental and community settings to select sustainable and advanced tunneling technologies that solve conveyance challenges involving:

- Water
- Wastewater
- Stormwater
- Combined sewer overflows
- Hydropower

We’ve completed nearly 10,000 projects and more than 12,000 miles of water, wastewater and stormwater conveyance worldwide. We offer the comprehensive expertise to successfully and efficiently integrate tunnels to complement clients’ large, complex water supply, storage and treatment facilities and projects.

“THE DESIGN AND CONSTRUCTION OF THE NORTHWEST SIDE RELIEF SEWER SET A STANDARD FOR FUTURE TUNNEL PROJECTS FOR MMSD WITH RESPECT TO ADDRESSING AND MANAGING UNDERGROUND CONSTRUCTION CHALLENGES AND RISKS.”

Kevin Shafer, Executive Director, Milwaukee Metropolitan Sewerage District

Seasoned Experts, Strategic Solutions

We understand that water conveyance is not “just another tunnel,” as even small leaks can add up to big losses or expenses over time. Our expertise includes water-tight and pressurized systems, corrosion protection, alternative tunnel liners and pipelines — whether it’s a new or rehab project.

We’re skilled in underground construction, excavation techniques and microtunneling. Our team consists
of virtually every discipline applicable to tunnel engineering involving water use or reuse:

- Project managers
- Tunnel and geotechnical engineers
- Specialty engineers
- Geologists and environmental specialists
- Pressure tunnels and penstock experts
- Resident engineers and construction professionals
- Potable water, wastewater, stormwater/combined sewer overflow experts

Our tunneling experts can help you with:

- Hydraulic modeling and controls
- Risk management
- Instrumentation and monitoring
- Lining systems design
- Contaminated materials and groundwater mitigation
- Procurement and bid reviews

Our experts offer a full range of rehab skills, from structural to safety. We do structural inspections and condition assessments through a variety of methods, including intra-tunnel videotaping. Our trenchless techniques expertise includes:

- Cured-in-place pipe
- Pipe jacking
- Sliplining
- Fold and form
- Epoxy coating
- Pipe bursting
- Directional drilling

Prominent Projects, Proven Results

Our projects span the globe. That means you get the most qualified team — and one that offers industry best practices. Some of our projects include:

100-Year Tunnel Under Historic Charleston, S.C.
Charleston’s underground wastewater tunnels are as impressive as the city’s well-known landmarks and attractions. That’s because Black & Veatch helped create a conveyance system built to last into the 22nd century.

For Phases 2 and 3 of Charleston’s multi-year plan, Black & Veatch has provided planning, design, construction management and resident engineering for the Ashley and Cooper River Tunnel Projects. Our advanced solutions minimized impacts on tourism, historically significant structures and the environment. They successful dealt with the design and construction challenges posed by the deep silts and sands of this vibrant coastal community.

The River Mountains Tunnel in Nevada

Through a seismically active, hard-rock stretch of Nevada mountain and desert, Black & Veatch set new standards for tunnel design, engineering and construction. The River Mountains Tunnel conveys treated water from the Alfred Merritt Smith Water Treatment Plant, adjacent to Lake Mead, to the Las Vegas area.

Black & Veatch delivered final plans, specifications and contract documents within nine months. To accurately design the required regulatory storage and a key surge tower, Black & Veatch built a hydraulic model to determine maximum operational effectiveness. The Black & Veatch-specified tunnel boring machine continued to press forward during construction, setting — and still holding — the industry record for hard-rock tunneling advance rates.
Scituate Aqueduct Rehabilitation
Providence, Rhode Island

- Fast track design-build delivery included inspections, design, and construction.
- 4½ miles long; 120 feet below ground; the 7½-foot-wide tunnel included both circular and horseshoe-shaped sections.
- New access structures were designed and constructed at both ends of the tunnel.

This 1920s tunnel served a critical system function but required major repairs to sustain operation and minimize groundwater infiltration. Black & Veatch’s fast-track one-year design-build solution beat an aggressive 12-month schedule by two months—saving costs that the client reallocated to expand the project’s scope.

Schedule wasn’t the only challenge. Black & Veatch’s skilled structural inspection identified advantageous repair strategies up front, and careful planning enabled inspection and study at low demand periods. To avoid contamination, Black & Veatch implemented advanced safety procedures, including a disinfection regimen for workers and equipment, and evacuation procedures to accommodate an emergency return-to-service.

Rampart No. 1 Tunnel Rehabilitation
Colorado Springs, Colorado

- 9,000-foot elevation with limited site access.
- 4,000-foot-long, 9-foot diameter tunnel with interior carrier pipe.
- Prior to slip lining with HDPE, a 40-foot “test pull" confirmed internal diameters and friction factors.
- Extensive forensic testing enabled rehabilitation of existing carrier pipe rather than entire tunnel.

Portals and sections of this 4,000-foot tunnel constructed through Pikes Peaks granite had collapsed. Unknown conditions and hidden risks presented difficult obstacles to planning the appropriate repairs.

Black & Veatch performed a broad inspection and analysis of both the tunnel and carrier pipe, enabling the owner to confidently stage an efficient plan for rehabilitation. Thorough reviews of records, extensive intra-tunnel videotaping, hydraulic analysis and other forensic investigations were performed and ultimately formed a strong foundation for a successful approach. This process included consideration of eight carrier pipe alternatives and five technique options to pinpoint the most cost-effective, best fit solution.
Bi-County Water Tunnel
Washington, D.C.

- A large-diameter water main in a challenging urban setting.
- Successfully managed multiple concerns, priorities and community objectives.
- B&V involvement: planning, conceptual design, detailed design and construction management.

Like most successful urban undertakings, this project, above, requires a wide range of expertise to reach completion. The multi-specialty Black & Veatch team includes experts in urban alignment studies, large diameter water conveyance, environmental impact, pipeline and tunnel design, project management of large capital projects, public relations, community outreach, and more.

The client is enjoying a single point of responsibility, free from bias and conflict of interest. When complete, the 33,000-foot, 84-inch diameter water main is expected to service the community for nearly a century.

Jollyville Transmission Main
Austin, Texas

- More than 34,000 linear feet of 84-inch pipe constructed via tunnel.
- Balancing environmental, regulatory, agency, public, geologic, operational and economic challenges.
- B&V involvement: final alignment, detailed design and resident engineering during construction.

With the City of Austin expected to exceed the capacity of its existing treatment system and in the process of developing a new water treatment plant, Black & Veatch designed a new transmission system to convey water from the new facility into the distribution system.

The transmission main consists of approximately 34,500 linear feet of 84-inch pipe constructed via a tunnel up to 350 feet below the ground using three tunnel boring machines.

With the site bordering the Balcones Canyonlands Preserve and sitting atop the Edwards Aquifer, the project team has balanced all elements of the triple bottom line by avoiding environmental harm and social impacts while controlling costs of constructing heavy infrastructure.
Denny Way-Mercer St. CSO Tunnel
Seattle, Washington

- Preliminary and final design and engineering, 120-mgd pump station, odor control facilities, bay outfall.
- Risk management measures included groundwater inflow controls, soft ground monitoring and mitigation, and extensive geotechnical instrumentation program.
- Difficult urban setting constructed under busy streets, numerous public and private structures, and a large underground parking garage.

The picturesque Elliot Bay at Puget Sound was plagued by an all-too common problem: combined sewer overflows were significantly compromising aquatic life and water quality in the heavily-used recreational waters.

The 15-foot diameter, 1⅓-mile Denny Way-Mercer St. Tunnel successfully solved the problem with solid design and engineering. The soft-ground, urban setting dictated meticulous attention to risk management factors, and Black & Veatch used a multi-pronged approach to reduce the owner’s risk. Despite the difficulty, no structurally damaging settlements were noted at the conclusion of this outstanding project.

Field’s Point Tunnel Pump Station
Providence, Rhode Island

- 50-mgd pump station constructed 300-feet deep in rock.
- Includes four sets of two-stage pumping units and at-grade support facilities.
- Preliminary and detailed design, cost estimates, geotechnical data review and analysis.

As part of the city’s overall, long-term CSO program, the Narragansett Bay Commission knew it was essential to mitigate CSO discharges to the Narragansett Bay. Black & Veatch’s design for the underground Field’s Point Tunnel Pump Station was an key milestone toward achieving the owner’s far-reaching water quality goals.

With broad staff expertise in multiple disciplines, Black & Veatch was distinctly qualified. Working collaboratively with a multi-firm team, Black & Veatch designed a facility to pump CSO collected in a 62-million-gallon, deep-rock storage tunnel to a nearby wastewater treatment plant.
OSIS Augmentation Relief Sewer (OARS) Phases 1 and 2
Columbus, Ohio

- 20-foot-diameter tunnel with a total length of nearly 4 1/2 miles to provide 50 million gallons of storage capacity.
- Large-diameter deep shafts up to 220-feet-deep through soil and rock.
- Diversion structures with vortex drop shafts and de-aeration chambers; odor control biofilters at urban shaft sites.

The Olentangy Scioto Interceptor Sewer (OSIS) Augmentation Relief Sewer project, known as OARS, above, is the largest, most complex and environmentally-important project in the City of Columbus’ history. Driven by the negotiated settlement of the city’s Combined Sewer Overflow (CSO) Consent Decree, the successful implementation of this project is critical for more effective and compliant CSO system performance. This project will dramatically reduce CSOs, preventing more than 1 billion gallons of overflow each year into the river, through additional storage and conveyance capacity.

Black & Veatch is leading the construction management team for the multi construction contract project, and both phases are estimated for substantial completion in 2017.

Ashley River Tunnel Replacement
Charleston, South Carolina

- 12,000 feet of deep tunnel containing 20- to 54-inch diameter carrier pipes surrounded by cellular concrete grout.
- One main and two subsidiary working shafts, two retrieval shafts, and three drop-pipe ventilation shafts; 1500 feet of 12- to 30-inch diameter microtunnel sewers.
- Complex urban setting encompassed historical district with ongoing heavy tourist traffic.

Deterioration of existing wastewater tunnels was rapidly escalating into a crisis, and demanded aggressive, fast-tracked engineering, design and construction.

In a highly urbanized, historic district, community outreach and communication were critical, as were accommodations for area tourism and low surface settlement.

The Black & Veatch team minimized construction risk with careful balance of best methods and site analysis, constructing the tunnel in specific geological formations where risk was minimized.

Designed and built to serve for a century in a harsh, corrosive environment, the unobtrusive solution is invisible to millions of tourists, with screening and odor control facilities hidden under Charleston’s streets.
Fall Creek & White River CSO Tunnel
Indianapolis, Indiana

- Evaluation study and preliminary design for CSO facilities to minimize to 97 percent the number of overflow events from 43 outfalls along these waterways.
- Tunnels from 26 to 45 feet in diameter, 10 miles long were evaluated, with preliminary design for 300-foot-deep, 150-mgd pump station.
- Water-specific expertise drives novel solution to safely route CSO through city well fields and navigate high-value urban structures.

Warning signs along picturesque waterways are a stark reminder of the growing health issues surrounding CSOs, in Indianapolis and across the country.

Embarking on a farsighted plan, the city hired Black & Veatch to conduct studies and develop a preliminary design. The deep tunnel system, which will cross the heart of downtown Indianapolis, meets the needs of the client, the community, regulatory agencies and others.

A team of specialists, including experts in tunneling, deep pump stations, force mains, outfall structures, water quality and risk management worked in tandem on the complex, long-term plan.

Overflow Control Program
Kansas City, Missouri

- Long-term control program for combined sewer basins with evaluation of two of the city’s oldest developed watersheds in the city’s vital urban core.
- Complex hydrologic and hydraulic modeling including 93 miles of CSS piping within a 16-square-mile basin area.
- Miles of tunnels from 15 to 26 feet in diameter were adopted in the conceptual plan that integrated CSO and flood control solutions.

Kansas City leaders are working toward compliance with Clean Water Act regulations, but, as in many U.S. cities, are challenged with complex systems and aging infrastructure. Black & Veatch is a key partner in helping the city overcome the challenges with smart planning, feasible long-term solutions, public education and green infrastructure concepts. A diverse team of Black & Veatch specialists in geo-engineering, water resources and water treatment is working closely within Kansas City’s $1 billion-plus overflow control program.

Comprehensive models developed by Black & Veatch serve as integral tools to formulate alternatives for this timely and cost-effective program, encompassing CSO and storm water flooding relief, hydraulic modeling and tunnel design.
Bi-County Water Tunnel
Washington, D.C.
Black & Veatch used a series of assessment, management and mitigation procedures to address the challenging urban setting of this 30,000-foot-long water main with excavated diameter of 12 feet. A risk register was assembled in close collaboration with the client and was successfully used to track action items and mitigate risks in accordance with the principles of the Code of Practice.

Northwest Side Relief Sewer
Milwaukee, Wisconsin
Underlying the success of this massive tunnel was Black & Veatch’s multi-tiered risk mitigation strategy. The company established baselines for sharing risks among stakeholders and used a diverse range of methods and techniques—including complete risk evasion, prescriptive construction measures and an intelligent insurance strategy—to minimize risk.

Smart Tools And Strategies For Risk Management
- General contract conditions specifically developed for underground work.
- Geotechnical Baseline Reports (GBRs).
- Selective specification of prescriptive construction methods.
- Quantitative assessments of appropriate project contingencies for cost and schedule.
- Tailored bid sheets for specialized construction activities.
- Contractor pre-qualification.
- Early contractor involvement/feedback on design submittal.
- Pre-advertisement conferences ensure clear communication of project requirements.
- Escrow bid documents.
- Pre-award conferences with preferred contractors promote accurate, comprehensive bids.
- Quality-based or best value selection of contractors.
- Major equipment and specialty work submittal included in bid documents.
- Baselines in the GBR and flexible pay items help mitigate changes within the contract framework.
- Dispute Review Board (DRB).

Black & Veatch’s approach to risk management is among the most intelligent and comprehensive in underground construction. We offer you experience that includes leadership in the U.S. underground industry as well as risk management methods successfully applied around the world.
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