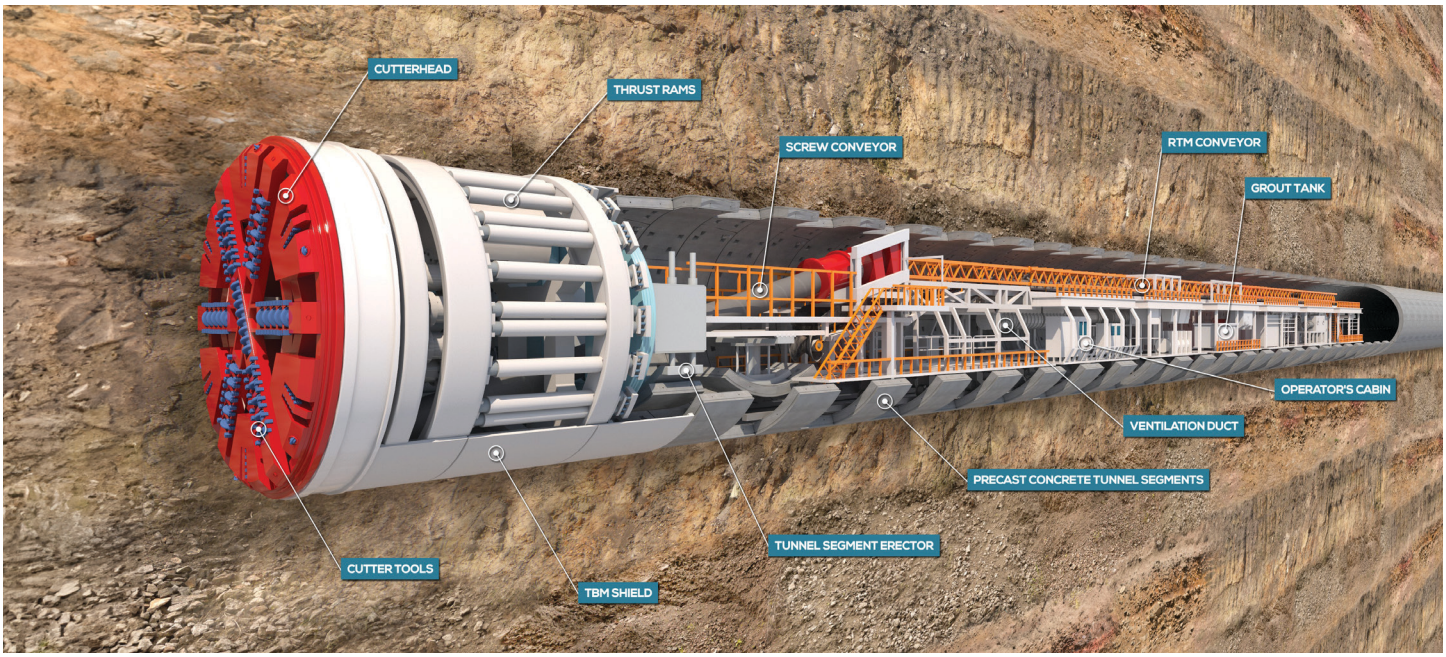
A CLOSER LOOK: THE TUNNEL

Using a team of world-class engineers with decades of tunneling experience, the Delta Conveyance Design & Construction Authority (DCA), working at the direction of the Department of Water Resources (DWR), conceptually designed a tunnel that will be resilient to flood and earthquakes and operate mainly by gravity flow to deliver water to the Bay Area, San Joaquin Valley, Central California and Southern California.



The Delta Conveyance Project would utilize an earth pressure-balanced Tunnel Boring Machine (TBM) like the one shown above.

Tunnel Design and Construction Basics

The Delta Conveyance Project tunnel construction is expected to take place in a predominantly rural area at depths ranging from 100 to 130 feet below ground surface to the top of the crown of the tunnel. Considering the geotechnical information gathered thus far which indicates Delta soils consisting mostly of sand, silt, and clay, utilizing an earth pressure-balanced Tunnel Boring Machine (TBM) would be the most appropriate method for excavating the soils along the intended alignment. The TBM will employ a large rotating cutter head to excavate soil for construction of the tunnel. Pre-cast concrete tunnel segments will be transported from the tunnel launch shaft to the TBM, which are then erected to form rings. As the TBM advances forward, additional rings are attached to form a continuous tunnel lining. These rings are sealed with gaskets to prevent water leaking into or out of the tunnel, thereby avoiding any adverse effects to local groundwater levels, and also maintaining ground stability.

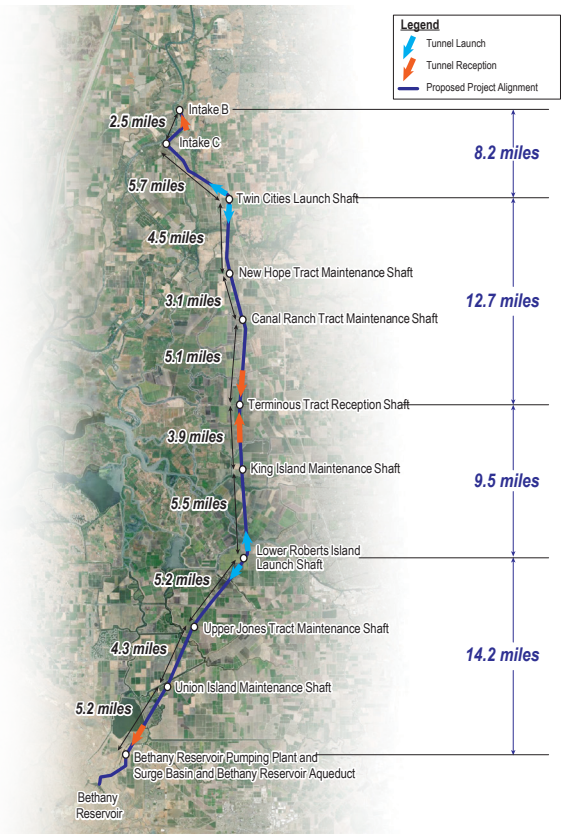
Proven Tunneling Technology

Tunneling technology is constantly evolving and is widely utilized and successfully employed in projects both in California and around the world. It has increasingly become the preferred method for mitigating environmental impacts in large-scale projects, such as the Delta Conveyance Project. The following tunnel projects share similar characteristics with the tunnel of the Delta Conveyance Project:

- **Joint Water Pollution Control Plant Effluent Outfall Tunnel in Whittier, CA** – The new tunnel, ranging in depth from 50 to 450 feet, is currently being excavated using a single heading spanning approximately 7 miles in length. The TBM was launched from a shaft constructed with diaphragm walls, ensuring a watertight enclosure. The tunnel is being excavated within saturated soils and very weak rock formations, similar to the Delta Conveyance Project.

- **HS2 Chiltern Tunnel in Buckinghamshire and Herfordshire, England** – The two tunnels will each be 10 miles long with an excavated diameter of approximately 32 feet which is similar in diameter and tunnel drive distance to the Delta Conveyance Project. The vertical tunnel alignment will reach depths of up to 300 feet and will be excavated by two pressurized TBMs.

Projects are situated in urban areas, in close proximity to infrastructure, buildings, and urban activities. Tunneling operations for these construction projects has been ongoing for periods ranging from 5 and 36 months and they have not resulted in any damage from tunneling vibrations nor has any surface noise been detected from the TBMs.



Delta Conveyance Project Tunneling Overview

A maximum of four TBMs would simultaneously operate along various sections of the tunnel alignment as "tunnel drives." All tunneling activities would commence at the launch shafts at either Twin Cities or Lower Roberts Island. All materials and workers would enter and exit from the launch shafts, traveling the length of the constructed tunnel to the TBM where the tunnel excavation and lining construction would occur.

The excavated soil, also referred to as Reusable Tunnel Material (RTM) because of its anticipated potential for reuse, is transported from the TBM through the tunnel via conveyor belts to the launch shaft. Once at the launch shaft, the RTM is conveyed to the ground surface where it undergoes testing, drying, and is then stockpiled.

TBMs are expected to advance approximately 2 miles per year and some routine maintenance will be performed from within the tunnel. Like all machinery, TBMs require periodic maintenance to ensure continued acceptable performance. The project designates maintenance shafts every 4 to 6 miles along the tunnel drive for anticipated major maintenance. As the TBM progresses, it passes through these maintenance shafts, allowing workers to perform maintenance activities such as cutterhead inspection and repairs. The shafts are open at the surface and enable maintenance to be conducted in "free air" or non-pressurized atmosphere. The maintenance shafts are also utilized for ventilating the tunnels during construction and serve as emergency exits for workers in case an unforeseen emergency arises.

At the conclusion of each tunnel drive, reception shafts will be used for removing TBMs. The machines will be disassembled and lifted to the ground surface in sections for further dismantling.

Operation and Maintenance of the Tunnel

DCA has positioned a new pumping plant at the southern end of the tunnel to enable water to flow by gravity from the northern intakes to new pumps near the Bethany Reservoir. The tunnels and shafts would be designed to be low-maintenance facilities. All of the shafts and associated access roads will remain after construction, and these shafts will be covered to prevent unauthorized access. After the initial inspection, tunnel inspections could occur using autonomous underwater vehicles or remotely operated vehicles without the need to dewater the tunnel.

Advantages of Tunneling

Tunnels have many advantages compared to surface conveyance infrastructure such as canals and aqueducts, including:

- Significantly fewer surface impacts
- Enhanced earthquake resilience
- Zero water loss due to evapotranspiration
- Unaffected by surface flooding (as designed with elevated shaft pads and risers)

Engineering a Reliable Water Supply for California

The DCA's mission is to plan, permit, design, and build a modernized state-of-the-art, sustainable, resilient, environmentally responsive, and cost-effective Delta Conveyance Project that resolves the long-standing need to assure affordable State Water Project reliability serving future generations of Californians in a way that respects the uniqueness of the Delta as a place and its communities.