



Water Conveyance

Client
City of Seattle

Location
Seattle, Washington, USA

Pipeline Replacement

Project Highlights

- The Tolt Pipeline No. 1 Replacement Project was completed in 17 months, with costs approximately 10 percent below the planned budget
- Construction was successfully completed during the region's worst rain season in 100 years
- Fourteen miles of 54- to 81-inch-diameter welded steel pipe constructed in steep terrain with slopes as steep as 40 percent
- Tunnel construction at two river crossings was staged to avoid impacts to native fisheries
- Fast-track project was completed without interruption of service to the City's customers



Project Description

The City of Seattle depends on the Tolt River Pipeline for 30 percent of its water supply. Following a major pipeline failure, premature corrosion was found to be reducing the pipeline strength and reliability along a portion of its route. Also, increasing demand required additional conveyance capacity.

CH2M HILL was retained to provide engineering services to replace or parallel more than 14 miles of 54- to 81-inch pipeline, replacing Tolt Pipeline No. 1 and designing the new Tolt Pipeline No. 2. Work on Pipeline No. 1 consisted of replacing 4 miles of 81-inch-diameter pipe. Work on Pipeline No. 2 comprised three phases. Phase 1 involved 2.5 miles of 54-inch-diameter pipe; Phase 2 consisted of 4 miles of 60-inch-diameter pipe; and Phase 3 involved 4 miles of 78-inch-diameter pipe.

Phases 2 and 3 design for Tolt Pipeline No. 2 resulted in two bid packages. The "West" package went to bid in March 1998. The "East" package went to bid in April 1999.

Services provided by the CH2M HILL team included existing pipeline operation analysis, route selection, aerial photography and mapping, geotechnical survey, corrosion investigation and cathodic protection design, surge analysis, interference studies, agency coordination, public involvement coordination, cost estimating, preliminary and final design, constructibility review, and construction management. CH2M HILL also provided predesign for the 120-mgd Tolt Filtration Plant. Pipeline route selection involved screening 20 potential routes; four were selected for detailed evaluation. Each was rated according to costs, hydraulics, environmental concerns, and right-of-way and permit acquisition feasibility. Each was also analyzed for its ability to meet an adjacent purveyor's hydraulic criteria. In addition to designing pipeline segments in rugged, rural terrain, CH2M HILL designed stretches of pipeline and managed construction in congested urban areas.



To maintain service, Tolt Pipeline No. 1 replacement was scheduled for winter, when water demand is low. Aerial photography and mapping, geotechnical survey, corrosion investigation, preliminary and final design, and engineering services during construction were accomplished in 5 months. The project included 2,000 feet of 60-inch-diameter pipe, 19,650 feet of 81-inch-diameter pipe, and three large valve stations. The maximum operating pressure of this pipeline is 325 psi, and the design flow varies from 78 mgd (60-inch) to 175 mgd (81-inch). Construction activities at rivers and streams were coordinated with resource agency staff and staged to avoid impacts to anadromous fish.

Because the pipeline had to remain in service during the peak use period and could only be shut down during late fall and winter, it was necessary to complete the design on a tight schedule and to prepurchase pipe.

To expedite construction, pipe and valves were pre-purchased by the City while final design was being completed. The prepurchase documents consisted of 31 drawing sheets, and the installation contract consisted of 60 sheets. The compressed project schedule required close coordination with the State Highway Department, the State Department of Ecology, and King County. The Tolt Pipeline No. project was completed in 17 months, and costs were approximately 10 percent below the planned budget.

Tolt Pipeline No. 2 crosses the Sammamish and Snoqualmie rivers, several streams and roads, and two railroads. The pipeline traverses areas of steep terrain with slopes greater than 40 percent, as well as wetlands, requiring special foundation design and surface restoration. To mitigate construction impacts in wetlands and at stream crossings, desilting ponds were constructed to control sediment and maintain water quality. Also, chlorinated water used for final pipeline disinfection was dechlorinated with temporary facilities prior to discharge to the environment.

In addition to design and construction management, CH2M HILL was responsible for preparing an Environmental Impact Statement (EIS) and acquiring permits, easements, and rights-of-way. Environmental issues included wetlands, steep slopes and associated erosion concerns, seismic concerns, adjacent 230-kV power lines with associated concerns for induced current and corrosion, permitting within King County, steel pipe design for test pressures to 425 psi, large-diameter line valves, blowoff discharge to streams or sewers, and erosion and sedimentation control features for all-weather construction. Alternative methods were evaluated for constructing river crossings, while minimizing impacts to anadromous fish. The 54-inch Sammamish River crossing was constructed by open-cut trenching inside steel sheet-piling. The 75-inch-diameter Snoqualmie River crossing was constructed by microtunneling 2,200 feet.