

# Difficult start for Vancouver's twin tunnels

There is still much to do before two Robbins TBMs can begin work on the Seymour–Capilano water tunnels project in Vancouver. *T&TNA* contributor **Tonia Jurbin** visited the project to report the scope of works and causes for delays.

**M**obilization and initial shaft sinking at the start of the Seymour–Capilano Filtration Project in Vancouver has taken longer than expected. Following notice to proceed in September 2004, excavation of the 180m deep x 11m diameter (600ft x 36ft) access working shaft by the Bilfinger Berger/Frucon JV was scheduled for completion by end of May 2005. It was early November however before the shaft reached tunnel elevation and

drill+blast of the TBM assembly chambers and launch tunnels could begin.

Bilfinger Berger (Canada) (BBC) Inc.'s contract is at the heart of the Greater Vancouver Regional District's \$Can600 million water supply upgrade. When complete the project's new filtration plant at the Seymour site will be Canada's largest. The two 7.2km long, 3.8m diameter tunnels (4.3 mile x 12.5ft) will connect two of the District's three reservoirs to carry raw

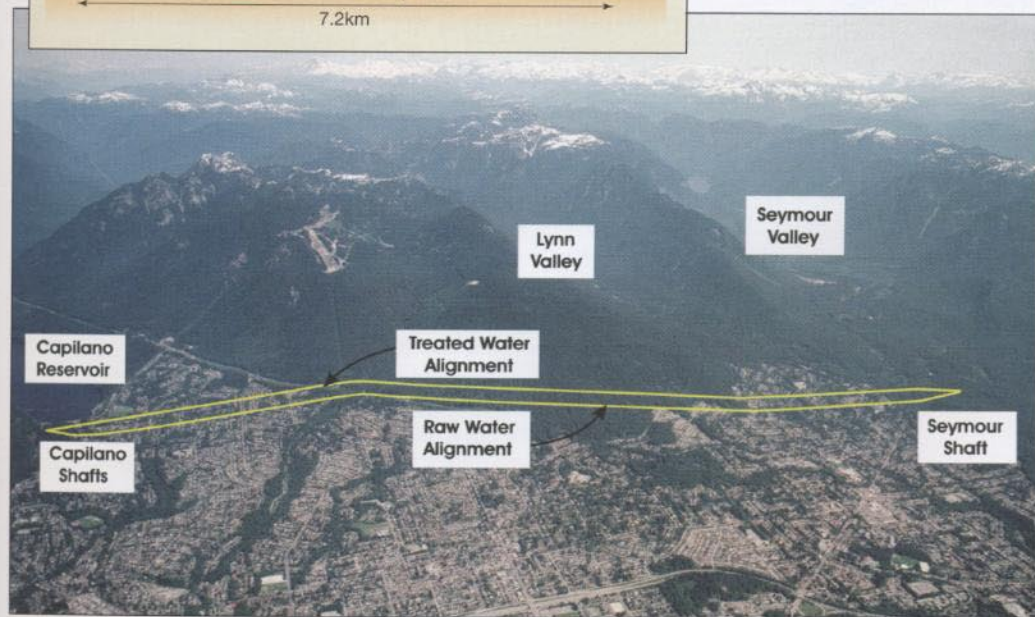
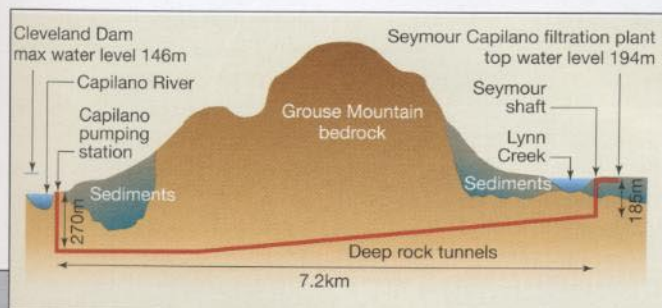


Mixed-face conditions complicated shaft sinking excavation



Drill+blast of the TBM assembly chambers and starter tunnels started in November

Fig 1. Longitudinal section of the twin downhill TBM drives from Seymour to Capilano



Plan of the two tunnels superimposed on the spectacular Grouse Mountain project location

water from the Capilano reservoir to the Seymour filtration plant and deliver treated water back to Capilano for supply into the District's distribution network. With the tunnels, the project includes a new pump station, an energy recovery plant and three deep operating shafts.

The meat of the undertaking is the tunneling but before 160 trailers loaded with TBM parts can be delivered to site, work concentrated on sinking the Seymour access shaft. Preliminary drilling at the original site of the shaft revealed 300ft of saturated sands and gravels that would have made for tough shaft sinking. Ground freezing was considered but geotechnical testing showed the groundwater was moving so quickly it would add heat to the freeze wall faster than the freeze plant could remove it. Geophysical methods, backed up by drilling, allowed the shaft to be relocated by about 200ft to an identified rock knoll under about 100ft of bouldery overburden.

After casting the shaft collar, the



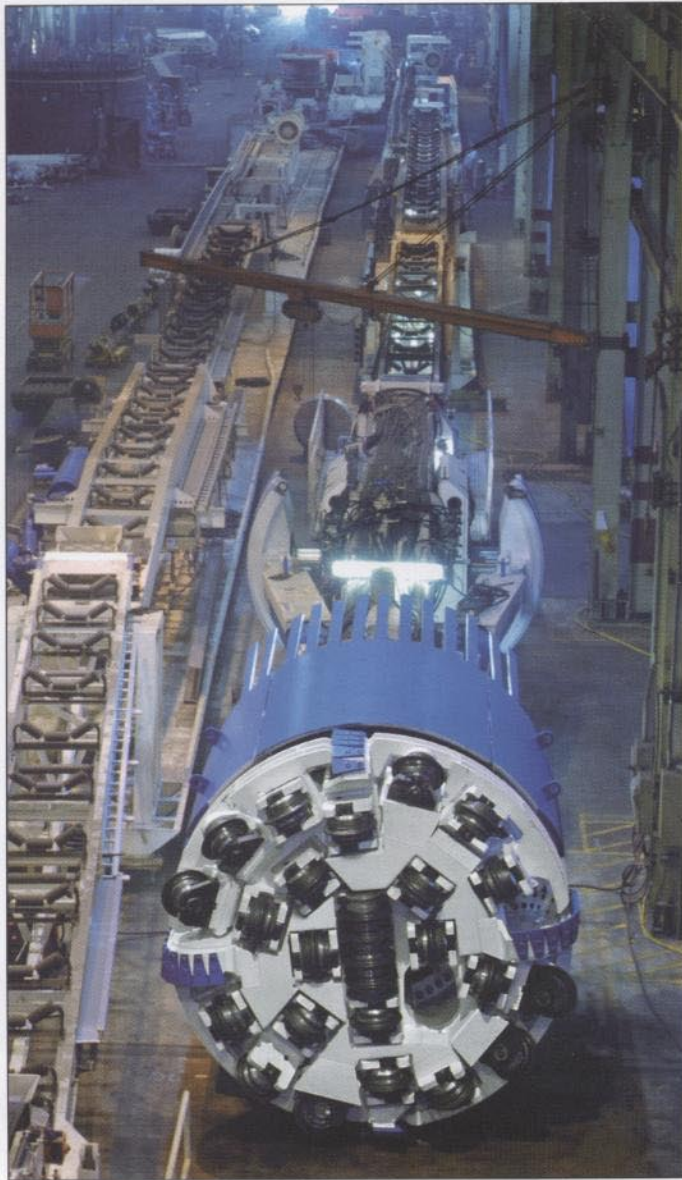
first 30m (100ft) of the 180m (600ft) deep shaft was sunk using wire mesh, lattice ring girders, and shotcreting in 3ft lifts. Once into rock, 10ft lifts were blasted out using 180 holes and 485 pounds of charge per lift. About 3,500yd<sup>3</sup> of overburden and 24,000yd<sup>3</sup> of rock was generated by shaft sinking. Zones of mixed face conditions made shaft excavation more difficult than anticipated. Completing the shaft without serious injuries or accident was a major safety achievement for BBC.

With both TBMs working out of the one Seymour access shaft, drill+blast excavation of two 130m (425ft) long launch chambers and 76m (250ft) long tail tunnels began in November. These plus, the tunnels, the end chambers, and the two shafts at Capilano will generate another 233,500yd<sup>3</sup> of material. The 260m x 4m diameter shafts at Capilano (850ft deep x 13ft) will be raised-bored once the tunnels and the end chambers are complete.

When finished, the TBMs will be pulled back through the tunnel, dismantled and removed through the Seymour shaft. The 4m diameter Capilano shafts are too small for hoisting TBM parts.

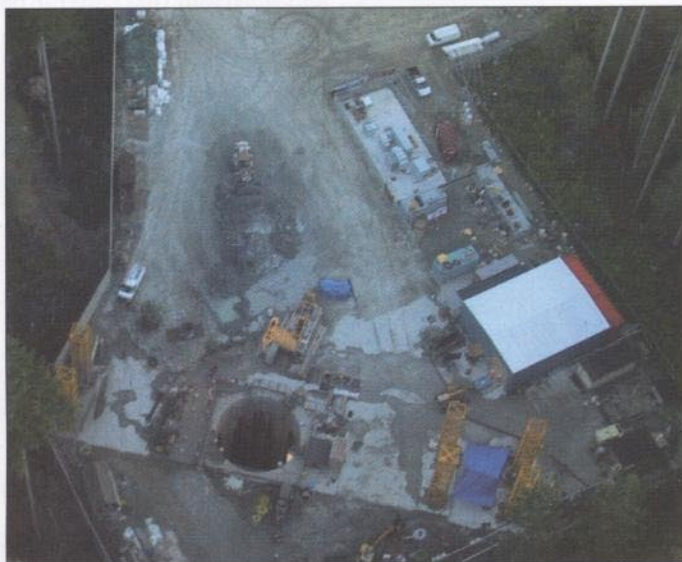
Excavated material will be stock piled for possible re-use within the Lower Seymour Conservation Reserve.

The Vancouver contract is the start of Bilfinger Berger's presence in North America. Establishing itself in the market as well as mobilizing a large contract in a new environment has been a time consuming challenge for the German company according to Christian



*Above: Factory testing of the first of two Robbins TBMs for the project*

*Below: Preparations to assemble the gantry crane over the Seymour working shaft*



lays, Bilfinger Berger also wrestled with the bureaucratic difficulties of starting a business in Canada. Mundane tasks such as setting up trailers, purchasing office supplies, finding reliable suppliers of goods and services have all taken some time at the front end. Having worked on large projects in five countries Genschel's experience shows. "We've done everything necessary to be good neighbors, especially with respect to noise reduction, and we can now blast 24h/day 7 days/week. In our bid we were only going to work 20h/day 5 days/week, so I am confident we will meet our contract end date of October 2008."

Delivery of the two new High Performance Robbins TBMs from Solon, Ohio has been put back from the original mid-2005 due dates several times and are now to be delivered in early March and early April 2006 for assembly and anticipated launch some six weeks later. Fitted with 26 19in cutters, the two 3.8m diameter TBMs are expected to work through what is described in the geotechnical baseline report (GBR) as mainly high quality granite/granodiorite bedrock of up to 250MPa, and are programmed to achieve an average of 100ft (30m)/day/machine working two production shifts and a 4h maintenance shift/24h working day, six days/week.

A major challenge for the TBM drives will be the 2.33% downhill gradient from Seymour to Capilano (Fig 1). As well as making rail-bound muck removal a challenge, particular care will be required to manage the considerable volumes of ground water expected to move through discreet joints in the rock. "We have to be prepared to deal with large volumes of water on short notice," explained Genschel.

BBC was awarded the twin tunnels contract in September 2004 as the lowest of three bids at \$Can99.65 million (*T&TNA*, Sept 2004, p9). With provision of geotechnical baseline and geotechnical data reports as well as a disputes review board, and escrow of bid documents, Bilfinger Berger bid aggressively for the contract. It was also recently selected in joint venture with Kiewit to complete the Eastside Willamette River CSO contract in Portland by the City's Bureau of Environmental Services (*T&TNA*, Sept 2005, p6). ■

Genschel, Project Manager for BBC. Genschel discussed the early difficulties when *T&TNA* visited the site in April 2005. "One of the bigger challenges in coming to Canada is that it seems everybody is working in a watertight compartment and not looking at the team as a whole. The men are good hardworking people, but the level of professional education of the trades is rather low. I have noticed that the older workers seem to be better trained, while the younger guys want to work but they lack experience. There doesn't appear to be much loyalty between employers and the labor force. I was surprised at how easy it is to dismiss guys and for guys to quit. It is also difficult to work in an environment where the crane operator cannot be asked to use the excavator or an excavator operator to use a shovel."

In addition to construction de-