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A most boring story

Decade-long engineering feat ensures clean water for generations

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the start of two 7.1-kilometre tunnels that move water from the Capilano Reservoir under Grouse Mountain to the Seymour-Capilano Filtration Plant and back. The project has been in the works for more than 10 years. Photo Metro Vancouver

In the late 1930s, a five-year-old Ralph Sultan rode the streetcar with family to what is today the site of Capilano Lake, well before it had been dammed.

"I remember what seemed like a long walk up there and here's the Capilano River. My brothers explained to me 'That's our drinking water.' They didn't seem to worry too much about running down and having a pee by the side," West Vancouver-Capilano's MLA said. "We've come a long way."

The anecdote drew raucous laughter from the dozens of dignitaries, engineers, bureaucrats and media gathered at the edge of Capilano Lake last week to mark the completion and operation of the Seymour-Capilano Water Filtration Project.

The \$800-million undertaking to provide drinking water to Lower Mainland residents has been in the works since 2002.

Since the On switch was hit earlier this month, the system has been taking water from the Capilano Reservoir, pumping it 7.1 kilometres under Grouse Mountain and Mount Fromme to the Seymour-Capilano Filtration Plant at the top of Lillooet Road where it is filtered, chlorinated and disinfected before being pumped back to the Capilano end.

There is some flexibility in the system but, generally, the Capilano water mains service West Vancouver, the District of North Vancouver, Vancouver, Richmond, Delta and Point Roberts during the high-demand summer months.

City of North Vancouver Mayor and chairman of the Metro Vancouver utilities committee Darrell Mussatto called it "one of the most significant missions Metro Vancouver has ever undertaken."

"With the twin tunnels now in operation, we'll have the capacity to treat up to 1.8 billion litres of water a day — enough to fill 750 Olympic-sized swimming pools. That's a lot of drinking water," he said.

After three years of engineering and design work, drilling and blasting for the first shaft at the Seymour end started in 2005. When crews reached 180 metres down, they dug a cavern big enough to hold two massive tunnel boring machines that would slowly grind away 3.8-metre twin tunnels to connect the system.

"It's just an unbelievable feeling. You get down there, 180 metres underground and you board the train and at one point, it was a 40-minute ride to get to the excavation point," said Goran Oljaca, a Metro engineer who has worked on the project since its inception.

Things were going as smoothly as a machine grinding through rock could until late 2007 when a worker was hit on the head by a falling fragment of rock. Contractor Bilfinger Berger's workers walked off the job in January 2008, citing safety concerns. The company had dug just over half of the tunnels and been paid \$44 million of their \$99-million contract.

Metro insisted its own consulting engineers had deemed the tunnels stable and eventually fired Bilfinger and hired a new contractor. The company responded with a \$22.5-million lawsuit against Metro and the District of North Vancouver for work already completed, damages and the return of its \$5-million tunnelling machines.

In 2009, the Metro Vancouver board upped the original \$600-million budget to \$820 million, reflecting the increased costs resulting from the delay and launched a countersuit against Bilfinger for the difference.

With the lawsuits outstanding and a new contractor in place, work resumed boring the rest of the way to the project's western edge. Litigation in the suits continues today.

Once the tunnel machines reached the Capilano end, crews at the surface drilled a pilot hole 270 metres down to the cavern and rigged up a raiseboring machine that would cut away the rock bit by bit from the bottom up.

More complicated, absolutely, but Metro staff identified it as the best option to use after residents in the area lobbied to keep the blasting and truckloads of debris out of their neighbourhood.

But that didn't stop noise complaints from flooding in to the District of North Vancouver and Metro Vancouver over the course of the project. People reported a grinding or humming noise that kept them up at night, though Oljaca said the noise wasn't coming from the tunnel boring machines.

"When we were doing blasting at the Seymour shafts, yes, the blasting was definitely heard. When the tunnel boring machines started work or when the raiseboring started, that was not heard at all. We monitored that. We did noise measurements during the project," he said.

Perhaps the one positive that came from the lawsuits and year-long delay in the work was confirmation that it wasn't the tunnel boring machines keeping people up.

"Interestingly enough, we had those complaints even when the tunnel boring machines were stopped," Oljaca said.

In late 2011, the raiseboring cutterhead punched through the earth, effectively ending the tunnelling portion of the project.

All the excavated material had to be removed out of the tunnel by train, brought to the surface by elevator and then trucked to an open pit four kilometres north of Seymour Lake — a byproduct of the Seymour dam built in the 1950s. All told, more than 75,000 cubic metres of granite debris from each tunnel — about the same capacity as two of Shell Oil's B Class LNG tankers — had to be disposed of.

With the tunnels done, crews began installing steel pipes to send the water to the filtration plant at the Seymour end where it could receive another level of protection above chlorination and disinfection. Earlier treatment methods made the water safe to drink but couldn't do anything about parasites or silt and mud making it into the system.

In 2006, the Lower Mainland's water system was hit with a turbidity event that resulted in the largest ever boil-water advisory issued in North America. It would be four more years before the filtration plant would come online.

Dr. Patricia Daly, chief medical health officer for Vancouver Coastal Health, praised the public health leaders and politicians of 2002 for pushing to build a system that prevents future illness when more visible cracks in the health-care system like overflowing ERs and long wait times for surgery dominate the discourse.

"There were people who, in the absence of a crisis — we didn't have a big outbreak of disease from this watershed, had the foresight to recognize that we needed to invest over \$800 million to build the filtration plant," she said. "It's going to make our lives a lot easier in public health. We know we won't have to worry about those heavy rainfalls in the fall anymore."

Just before the water enters the mains destined for homes and businesses, it accomplishes one final feat.

The western end of the tunnel is about 40 metres deeper than the eastern end, resulting in water picking up speed and pressure. To harness this and dissipate the pressure, engineers designed a turbine that would recapture between 28 and 44 per cent of the energy required to run the Capilano pumps and feeds it right back into the system. The trip takes about six hours, one way.

People on the western half of the Lower Mainland whose taps are connected to the Capilano station will notice the difference this summer if the response Metro Vancouver got when the Seymour filtration plant came online in 2009 is any indication.

"People started complaining that they had blue in their tubs. It was definitely noticeable. The blue was coming because that's how clean and clear the water was. Before that, we had a bit of a reddish colour and that was coming from turbidity and natural iron in watershed," Oljaca said.

The cost of the project has been borne by Metro Vancouver's residents through utility bills. Today, Metro charges 64 cents per 1,000 litres of water.

While Metro Vancouver's 2.4 million residents are entering a new era of stable access to clean water, Metro staff are already in the planning stages for future upgrades of the system as the population grows by another million people over the next 20 years, Oljaca said.

"To provide potable water to an additional one million people, we would have to be continuously improving our system and some point, we'll have to tap into new sources of water supply," he said.

The next project on the horizon is increasing the capacity from Coquitlam Lake with a new intake and treatment plant, though Metro isn't projecting to have that online until 2028 with hopes of delaying it even longer by encouraging water conservation among Metro residents and businesses.

It's usually the politicians who are quoted upon completion of a great public works project but Oljaca has a close relationship with the Seymour-Capilano Filtration Project. He started as a senior engineer on the project in 2002, and has since been promoted to Metro Vancouver's director of engineering and construction in water services. Last word goes to him.

"This is so great. It's so exciting for all of us staff at Metro Vancouver. In my personal opinion, this is exciting for the whole region," he said. "It's just a huge undertaking that we can all be proud of for generations to come."

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