

As the hole opening proceeded the tunnel was up sized to 850mm diameter. The tunnel could not be reamed the full length because the ground conditions at Cambridge Terrace were so weak that the tunnel would not hold open. A carefully balanced fluid system was maintained for the duration of the hole opening.



▲ UUL fluid recycling plant



▲ Drill Rig & support equipment relocated to Cambridge Tce



▲ The 710mm diameter polyethylene pipe is connected to the barrel reamer and drill string ready for installation

The pipe was installed into the tunnel over a twelve hour period. This included stopping for four hours to weld the two pipes together and reaming the final 30m of tunnel in the collapsing ground.



▲ Barrel reamer utilised to counter sinkage in the soft ground sections of the 200m long drill shot



In tandem with the tunnel opening operation the 710mm diameter, SDR 11 polyethylene pipe was delivered and welded into two 100m long pipe strings. Once welded and tested they were positioned ready to be pulled into the tunnel. The front end of one string was fitted with a steel towing cone and connected to the drill string.



On completion of the pipe installation a cement plug was pumped around the pipe at each end to control ground water tracking along the outside of the pipe. The pipeline was pressure tested, CCTV undertaken and handed over to the alliance.

This was a technically difficult project with an expectation of high accuracy in immensely variable ground conditions and tight working space. Due to the fast track construction, hundreds of workers and dozens of sub contractors compete for space to undertake their component of the work., this requiring a high level of time management and communication. A team approach by all involved contributed to the ultimate success of the storm water outlet pipe from the Memorial Park Tunnel in down town Wellington.

Photos and Story by Neil Vanner.

**“The success of the (\$133m) project depends on it”**

quote Memorial Park Alliance Project Team



**Installation of a 710 diameter trenchless storm water pipe**



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## To honour the fallen

The Memorial Park traffic tunnel project in Buckle Street, Wellington is in full swing to be completed by ANZAC day 2015. This date marks the 100 year anniversary of the Gallipoli campaign.

The project of "national importance" involves undergrounding the traffic on Buckle Street and building a memorial park in front of the National War Memorial where the unknown Soldier was laid to rest in 2004.



▲ National War Memorial Carillon on Anzac Day, 25 April 1932.

The project is twofold and achieves another step towards improving traffic flow to the airport through the Wellington CBD. Lowering Buckle Street by 9m created a low point in the cut and cover tunnel thereby creating a stormwater collection issue. So a gravity pipeline was required to connect the tunnel's low point to the existing storm-water network at the top of Cambridge Terrace (next to the Basin Reserve). This was no easy task. To maintain a gradient the pipe needed to pass within centimetres under a brick arch sewer constructed 100 years ago and no one really knew its' foundation construction details. The pipeline would also need to pass under SH1 at depth and then beneath an historic building before exiting in Cambridge Terrace. The ground conditions are variable and range from rock under Buckle Street to marine sediments in Cambridge Terrace. When the first European settlers arrived in Wellington around 1840 there was a shallow lagoon on the site that the Basin Reserve is now located, which was linked to the harbor by a stream following the route of what is today Kent and Cambridge Terrace. The colonists planned to turn the lagoon into an inland anchorage for the city. However, when New Zealand's most powerful earthquake on record struck in 1855, the area was raised by two metres and the lagoon instead became a swamp. The ground conditions at this end of the drill shot were a real concern to the success of the pipeline.



The accuracy expectations for the placement of the pipe line by the Memorial Park construction alliance were of the highest standard and bordering on unrealistic given the changeable ground conditions.

Universal Underground Ltd (UUL) was awarded the project in July 2013 and was chosen for their depth of experience which would provide the best chance of achieving the highest quality outcome.

UUL established their largest Horizontal Drill rig, a Robbins Universal 200x240 (100 ton pull back). This drill has a proven track record and has the current record for installation of the longest on-shore HDD pipeline in New Zealand, a 1036m long pipe with a total pipe weight of 200 tons.



▲ Access was difficult- It was necessary to crane support equipment into the trench.



▲ Robins Universal 200 x 240 Horizontal Directional Drill Rig

The pilot hole was drilled with the drill rig set up in the traffic trench. This was necessary to avoid drill rod sinkage in the softer ground closer to the Basin Reserve. A Para-Track 2 location system was used and requires running a wire along the ground surface to induce a current into the ground for the drill head to follow. Although the Para-Track 2 is one of the most advanced underground location systems available it struggled to provide the required information at a critical section along the deepest point under SH1. Contributing to the Para-Track 2's difficulties was the presence of manmade electro-magnetic interference. A cell tower 30m away, high voltage underground power cables and more than 10,000 large magnetically charged moving vehicles crossing the drill path daily. A DCI eclipse transmitter was run in parallel with the Para-Track 2 and when the field from the above ground wire was turned off, additional information could be obtained to make comparisons. Grade information was never compromised because the drill head was hardwired back to the on-board drill computer with a wire connection down the inside of every drill rod. The 200m long pilot hole was drilled without compromising the grade or the line; only reaching its maximum allowable tolerance once.



▲ Non-magnetic tooling fitted with ParaTrack II and DCI Eclipse location sensors.



▲ Removing the non mag drilling head with the scorpion pipe wrench.

The Drill rig was now re-located in the night to Cambridge Terrace and a back cutter (reamer) connected to the drill string. In order to reduce fluid consumption UUL's mobile solids control fluid recycle plant was introduced to the system. The recycler reduces fluid consumption, fluid waste and drilling additives. This saves money and reduces impact on the environment.

Construction access was the most difficult ever encountered by UUL and most of the support equipment was craned into position.

