WHEN "TOO HARD" IS NOT ACCEPTABLE – MARINE PARADE WASTEWATER UPGRADE

Jason Climo (Veolia), Simon Leary (Queenstown Lakes District Council), Jekabs Rozitis (Veolia)

ABSTRACT (500 WORDS MAXIMUM)

When QLDC went to market for the 3 Waters O&M contract in 2014, it was with an expectation that the contractor would accept shared risk, be "frank and fearless" as a trusted advisor to council, and display the management courage to respectfully and persuasively challenge QLDC decision making. In this new contractual culture, it was no longer adequate for the contractor to merely notify council of the nature of the risk; it has required the contractor to engage closely with council to ensure that the risk is communicated at the right levels, and collaboratively develop a solution.

One such risk has been associated with Marine Parade Wastewater Pumpstation. This pumpstation is located in central Queenstown in an area of extremely high public amenity, environmental sensitivity and historical significance. All year round the area is full of tourists enjoying the lake and mountain views, taking jet boat rides or pleasure cruises, shopping or visiting the botanic gardens.

The pumpstation takes wastewater from a large percentage of Queenstown – from Sunshine Bay, Fernhill, Arthurs Point and the CBD. With limited options to increase pump station capacity, the average flow of 80 L/s means that the pumps run every three minutes, and the wet well has only seven minutes storage.

Recognising the critical risk of this asset, Queenstown Lakes District Council (QLDC) and Veolia have implemented a number of measures to ensure redundancy in the pumps, control gear, telemetry and power supply over the years. However, the mild steel risers, manifold and asbestos cement rising main have always been single points of failure and solutions have always been put into the "too hard" basket. This has been due to the considerable constraints on site:

- A pristine local environment
- High public amenity values and crowded public area
- Noise sensitive neighbours with the Novotel being directly adjacent
- International profile, especially if something goes wrong
- High water table
- Loose unconsolidated gravels
- Numerous historically significant trees over the pipe alignment.
- Operational constraints due to only seven minutes' storage being available

The culture built during the O&M retender process has driven greater focus to develop a robust solution, and made it unacceptable to continually defer action. This paper describes how a solution has been developed and is being delivered. Central to this has been close partnership between Veolia and QLDC technical staff, and early contractor involvement to carefully work through construction methodology and work sequencing. Project risks have also been controlled through innovative technologies such as laser scanning, hydroexcavation and slip-lining. These technologies have enabled precise fabrication of parts, minimizing worker time in hazardous environments, have eliminated all silt mobilization into the nearby Lake Wakatipu and Horne Creek and have limited disruption to the public through avoiding extensive open trenching.

Regardless of the significant challenges and constraints and increasing scope, the project was successfully delivered in June 2018 for $820 k.

KEYWORDS

Trenchless, wastewater main, slip-lining

PRESENTER PROFILE

Jekabs Rozitis has over 10 years' experience in designing and managing water supply systems and was Veolia's manager of the Queenstown operations and maintenance contract as this project was being developed.

1 INTRODUCTION

1.1 CONTRACT CONTEXT

In 2012 Queenstown Lakes District embarked on an extensive organisational restructure to improve decision making and service delivery. This included building a new infrastructure team and a step-change towards a coherent and standardized framework for management of operational contracts. The new approach was based on the NZS3917 contract form, with the following principles (Moogan & Lind, 2015):

- By undertaking stringent procurement processes, QLDC ensured the right partner was selected to act as a trusted adviser, empowered to make all necessary operational decisions so that QLDC could focus their efforts at the strategic asset management level.
- The contract explicitly defined a culture of shared success and failure – no one party would "own" a risk, or a challenge.
- The contract included an increased focus on governance, with senior leadership from QLDC and the contractor meeting quarterly to review performance and address challenges, in particular progress against key risks.

Veolia, who had been delivering the 3 Waters O&M services since 2008 under a variety of different contract forms, were again successful in a competitive retender in 2015, and took the opportunity to reset their delivery model to match the new contract requirements.

From an operational viewpoint, the most significant change was that the ongoing tricky challenges could no longer be put on a risk register indefinitely. "We told you about it" was no longer an adequate risk management strategy – the contractor was obliged to continue to escalate significant risks and proactively propose solutions. Failure due to inaction by QLDC would be regarded as much a failure of the contractor to communicate the significance of the issue to the appropriate levels in council.

1.2 THE TECHNICAL DETAILS

Marine Parade Wastewater Pumpstation takes approximately 40% of the wastewater flows of urban Queenstown. The station's catchment includes Arthurs Point to the north, Sunshine Bay and Fernhill to the west, and the local flows from the CDB and areas of Queenstown Hill west of Sydney St. The pump station is located in a lakefront park of great public amenity that is extremely popular with locals and visitors and experiences high foot traffic, being midway between the CBD and the Botanic Gardens. The pump station has very little storage capacity (approximately seven minutes).

This facility has been recognized as one of the highest risk sites amongst the 3 Waters Assets, and a number of measures have been implemented to ensure service continuity. These de-risking measures have been:

- Three large (75 kW ABS – AFP 2002) pumps in place, each able to pump peak flow individually which have been overhauled between 2014 and 2016
- A 440 kVA generator on site with automatic changeover, which is tested six monthly and recently had the fuel pump rebuilt
- Three layers of redundant, battery-backed local control – pressure transducer into a Siemens MR200 primary control backed up by an ultrasonic transducer through the local RTU backed up by a direct dry contact to all pumps from high-high level floats.
- A cellular RTU kept as critical spare to ensure ongoing visibility of performance in the event that the radio telemetry network fails
- Installation of stainless steel cable supports to prevent pump power cables from being entrained into the pumps
- Planning of an additional pump station and major network upgrades to divert flows from Arthurs Point, Sunshine Bay and Fernhill around the CDB.

A single-point of failure still existed at the pump discharge manifold and rising main, which had been communicated to council in previous contracts, but not escalated nor pursued. Given the highly prominent site, with large volumes of vehicular and foot traffic, the inability to take any part of the system off line and the proximity to the Novotel, whose patrons would be sensitive to odour and noise, the issue was parked in the "too hard" basket, with a general idea that eventually the new pump station might solve the issue.

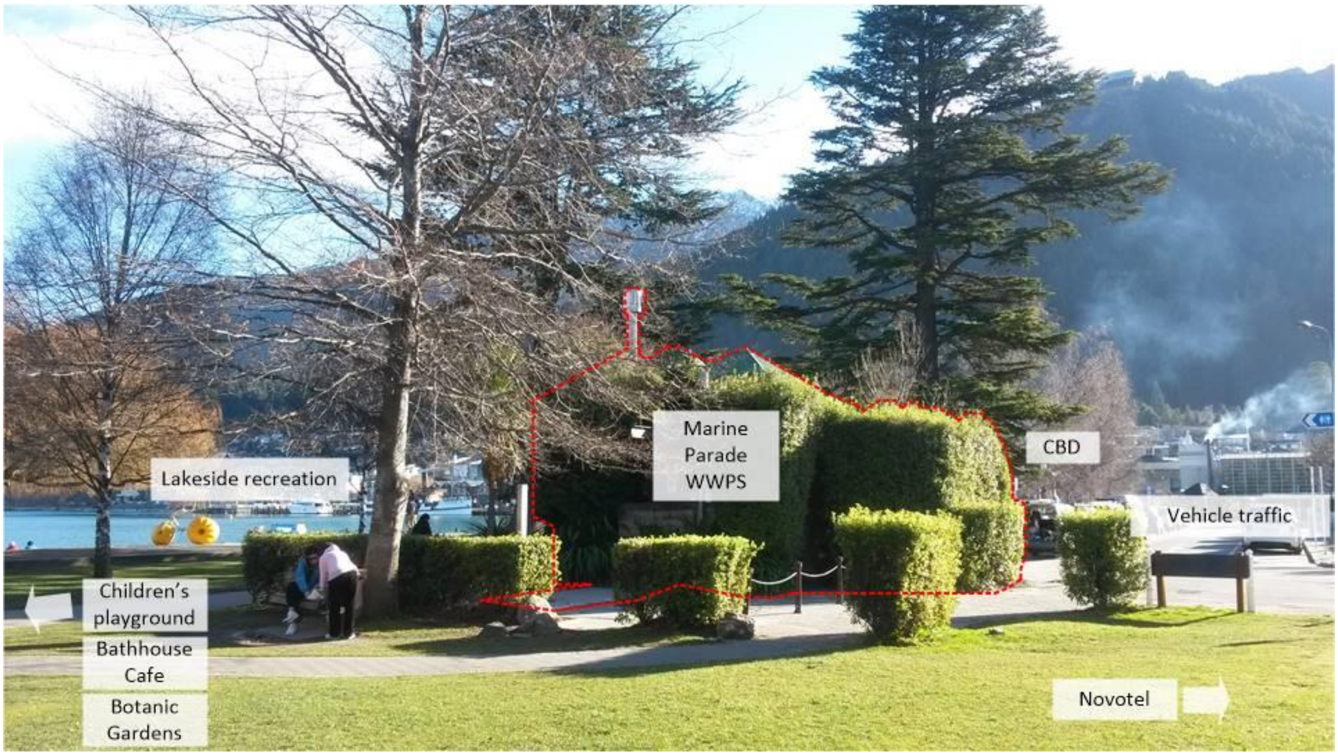

Figure 1: Lakeside WWPS, possibly the most beautiful sewer pump-station in the world, surrounded by popular places to go and popular things to do

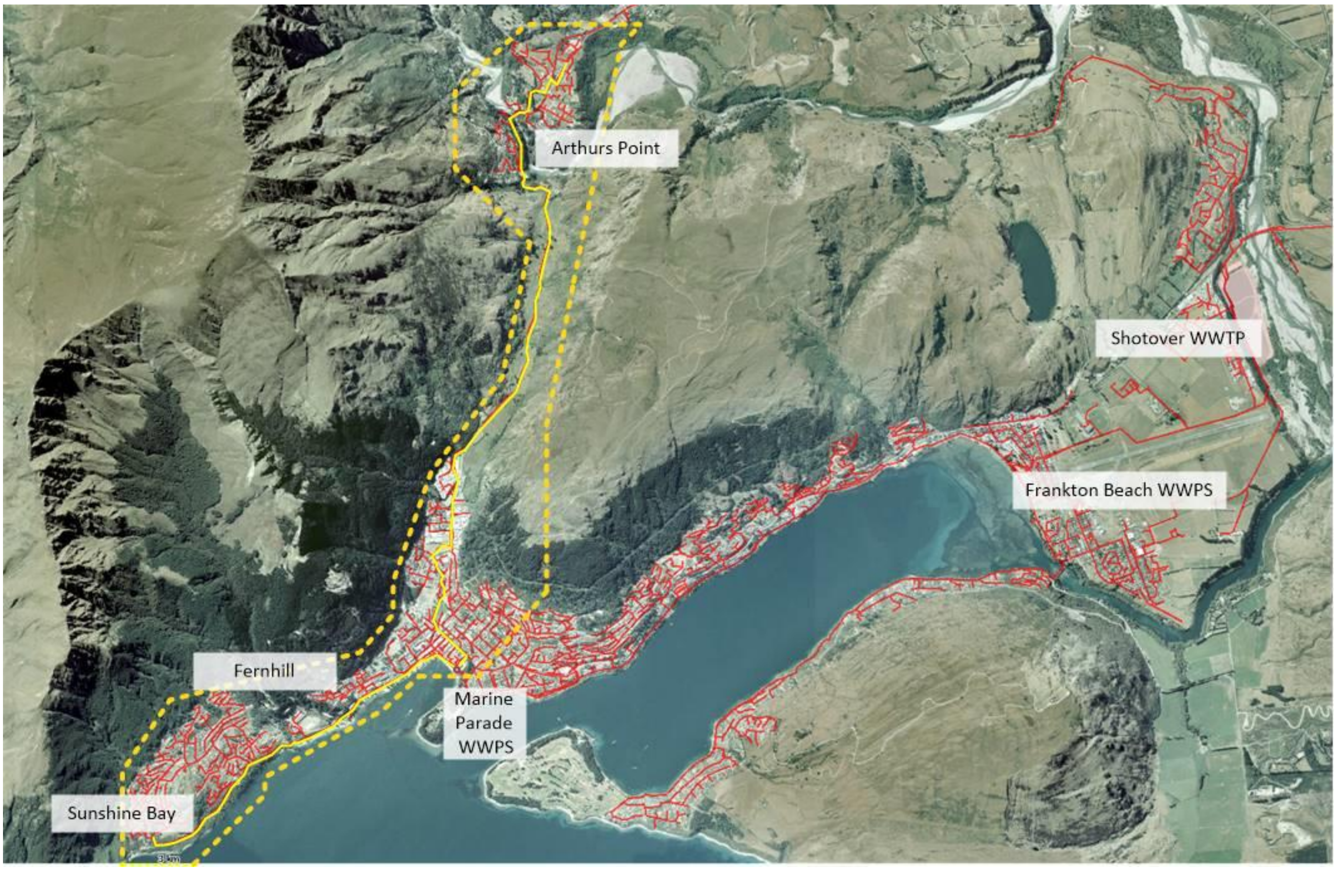

Figure 2: All waste from the catchment indicated in orange flows through Marine Parade WWPS. Main trunk collector and rising main shown in yellow.

2 DEVELOPING THE SOLUTION

2.1 INITIATING THE PROJECT

With the retender of the O&M contract, QLDC were very clear in their expectation that the successful contractor will bring the management courage to challenge their Infrastructure Team, and the drive the awareness of critical issues. This was supported by the shared nature of contract risks, alignment of the language and frameworks used to assess risk, and enhanced focus on governance through the Core Group. The quarterly review of the highest risks by senior leadership from both organisations meant that both teams were given a strong mandate and resourcing to resolve matters which had traditionally languished in the "too hard" basket.

Being aware of issues at Marine Parade, Veolia engaged the appropriate contractual mechanisms, and issued a number of Early Warnings to describe the issue, rated it according to QLDC's risk framework, and proposed solutions (with budget estimates).

Within QLDC, part of the structural changes lead to increased resourcing within the infrastructure team. The new team was able to better focus on understanding and managing risk and consider how proposed work fit into their strategic vision. As a result, QLDC was more agile – able to intelligently compare competing risks and reallocate resources in a structured and prioritized way.

QLDC's project manager worked very closely with Veolia's operations and capital works teams to understand the constraints, agree on mitigation principles, and schedule a staged response. The challenges, along with the mitigation strategy were:

Challenge	*Mitigation*
High water table adjacent to lake – flooding of works	Minimise open trenching, initiate enabling works to address I&I upstream of WWPS
Loose, unconsolidated gravels – instability of works	Minimise open trenching
Extremely popular area with the public	Schedule work to avoid large public events, such as Winter Festival. Close communication with affected stakeholders such as the Novotel Careful traffic management of pedestrians Consideration of vehicle traffic management for work on Park Street
Variable record quality	Detailed survey of existing and abandoned assets – CCTV and above ground with GPS confirmation Laser scanning of wet-well to get accurate asset measurements Potholing with hydro-excavator to confirm alignments Early contractor involvement for tendered components to review and modify methodology in light of investigation results
Operational constraints – critical infrastructure that can't be taken off-line	Careful planning and scheduling with clearly communicated hold points for all critical items
Environmentally and historically sensitive area	Careful sediment control – hydro-excavation wherever possible Close engagement with stakeholders – QLDC Parks and Reserves to agree on pipe alignment and excavations to avoid impact on historically significant trees

The solution required three components: modifications to the live wet-well and pump station to make provision for interfacing with a duplicate rising main, laying of the duplicate rising main and interfacing with the downstream network. To reduce the risks of work on the wetwell, an enabling project of decreasing inflow and infiltration (I&I) in the upstream manholes was undertaken which resulted in a noticeable step change in lowered flows through the pump station. Based on the value of these enabling works, they were directly procured from Veolia, as the O&M contractor.

Given the operational risks, and the value of the project, the wetwell modification was also directly procured from Veolia, and was initiated while the tender for the pipeline and downstream interface were put to market. Veolia submitted a successful bid for the pipeline component based on overall value and quality – in particular understanding the key risks and having a credible and detailed methodology to address them. Additionally, there were a number of significant uncertainties around the detail of how the new main will interface with downstream infrastructure, which Veolia were best placed to manage efficiently given their knowledge of the assets.

For both the pump station modifications and the pipeline project, Veolia worked in close collaboration with engineering consultant to investigate site conditions, and to refine the scope and methodology based on the outcomes of the investigations.

Figure 3: General arrangement of rising main alignment

2.2 MODIFYING THE WETWELL

The pump riser pipework, brackets and rails were in poor condition. Additionally, the discharge manifold was mild concrete-lined steel, and not suitable for the conditions. Weeping was observed from a number of the welds. This had been observed at other pump stations in the district, prompting projects to rectify them.

Given the challenges with operational constraints, and the high flows constantly entering the well from both sides, it wasn’t desirable to enter the well to confirm measurements. Therefore, a laser scan was undertaken instead to offer a high-resolution, low-risk alternative.

Figure 4: Examples of asset condition. Corrosion on flange bolts of riser (left) and rail bracket coming away from wall (right)

To enable well entry, it was necessary to control the flows going into the well. This was achieved by firstly examining flow patterns to schedule the phases of work. Then a pump around was arranged using a Selwood S150 mobile pump and inflatable bungs to isolate the Fernhill inflow during off-peak time so that a temporary baffle could be fitted to that outlet. Once the baffle had been fitted, the pump-around was reversed to ensure that all flow went through the baffled inlet, minimizing exposure to operators working in the well.

Figure 5: During a low-flow period, an inflatable bung was inserted into the pipe from Fernhill (at the black line) and a pump-around set-up (yellow) to enable fitting of a temporary baffle to protect workers in the well (right photo).

New risers were designed, constructed from 316SS, with two takeoffs at the top end. One takeoff would bolt into the existing manifold, and the

Figure 6: Replacement risers ready for transport to site

second one would be blanked off initially, but allow piping to a new manifold in a valve chamber on the other side of the well.

These risers were locally manufactured, with excess length on the end to allow confirmation of fit on site. To confirm the bottom flange pattern, the methodology included removing the old riser from one pump and sending it to the local engineering workshop to copy the pattern on the replacement risers. At the same time, one of the new risers was lowered into position to confirm the length. The new riser was also returned to the workshop for cutting to length, passivating, and welding of the appropriate flange and backing ring. One riser was replaced at a time to ensure availability of at least two pumps at all times.

All work in the well was undertaken under confined space entry and working at heights conditions, using a ladder with fall arrest for access to remove the fixings for the riser and bolting the replacement in place. For removing the old pipework penetrating the well's wall, a suspended scaffold work platform was installed with PE sheet to catch debris and prevent concrete chunks from being entrained by the pumps.

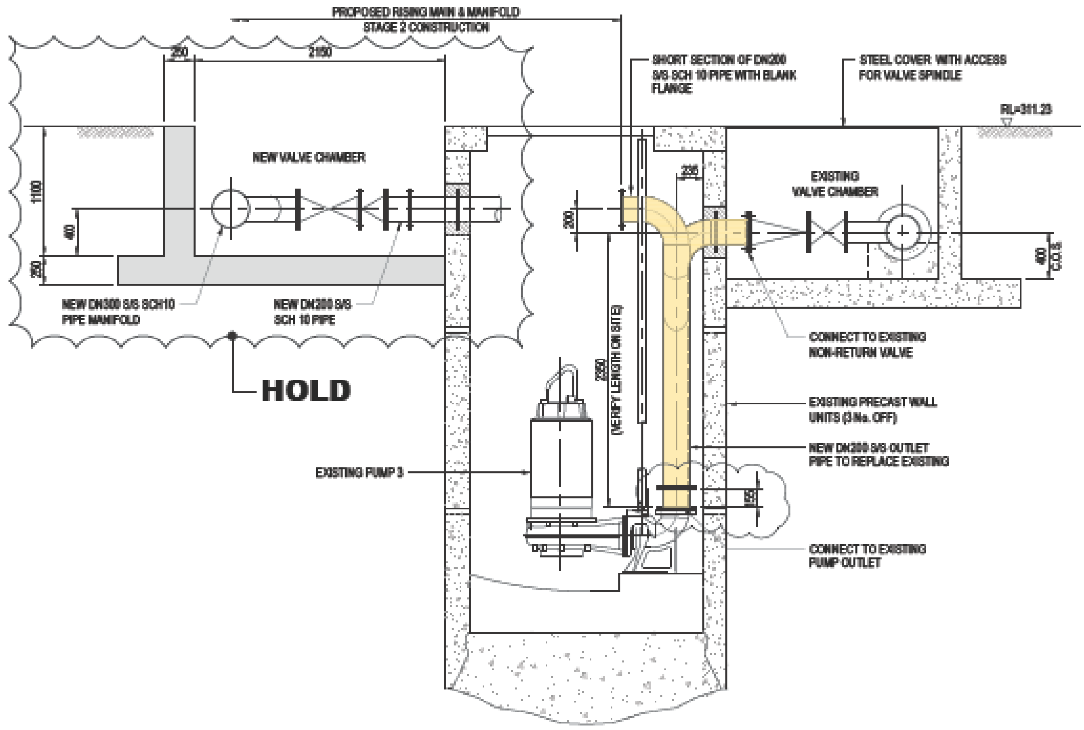

Figure 7: Elevation view of the new risers (orange shaded) with an additional blanked-off take-off to a future valve pit and manifold

By following a carefully considered and thoroughly detailed method statement with clearly defined hold points, the work was successfully completed with no disruptions to service.

2.3 DUPLICATING THE RISING MAIN

It was known that an abandoned DN300 asbestos cement and concrete main existed along the required alignment. Given the number of constraints detailed above, the preferred option was to slip-line a 280OD PE pipe, bursting in sections as required.

However, this required considerable planning and surveying to make sure that the line was where recorded. For example, a section had been removed from the corner of Park Street, meaning that either the pipe would need to be open trenched, or pulling pits would need to established in the Park Street carriageway. This would lead to many weeks of traffic disruption in a very busy area. The methodology was revised after identifying this missing section. A DN300 duct was very quickly installed in the missing section to enable the full pull, with minimal traffic disruption. This enabled establishment of the third pit off the carriageway, and in an area where pipe strings could be easily welded and laid down.

Figure 8: Detailed investigation and measurement identified a missing section in the abandoned main. Replacement duct (left) was laid within a short space of time, minimizing traffic restrictions on Park St, allowing pull pit and welding to be established off the carriageway (right).

Another aspect which was impacted by variable records was the design of footings of the pedestrian bridge across Horne Creek between the first and second pits. The dimensions of this footing were larger than records showed, and interfered with the pull under the creek, leading to an injury in the team. This needed to be excavated and the excess footing removed. By using the hydroexcavator the footing could be very precisely exposed without any silt mobilization into the creek.

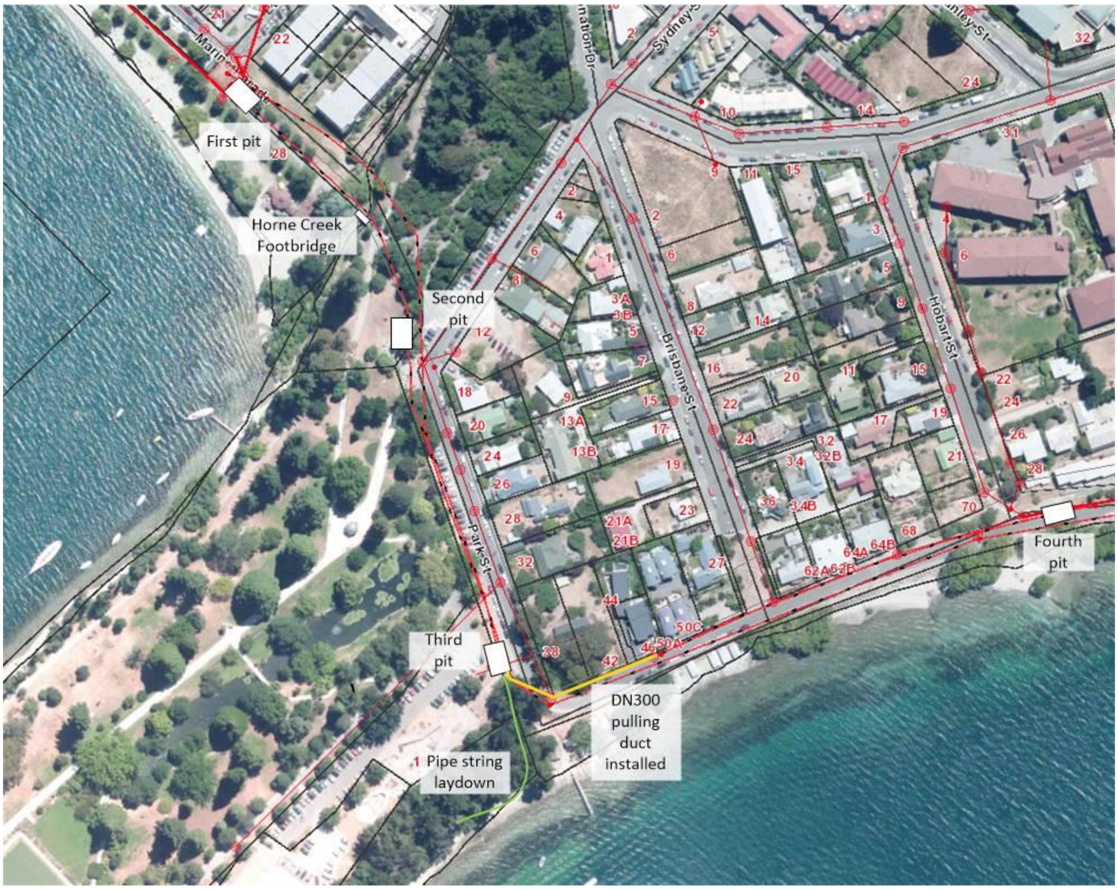

Figure 9: Overview of works through the Botanic Gardens. Minimal impact on public amenity, environmental and historical values through slip-lining. Adjusting the plan to suit found conditions avoided disruption to Park Street traffic

As a result of the careful measurement and planning, with critical areas GPS located and/or potholed, joining all strings together progressed smoothly.

Critical areas were GPS located and/or potholed to ensure that the correct fittings were available to suit the pipe alignment. An example of this is the 45 degree electrofusion coupling at the third pit, which perfectly suited the alignment of both pulled strings

Figure 10: Having the right fitting in the right place, the result of careful planning and careful measurement

2.4 INTERFACE INTO THE NETWORK

The constraints and condition of downstream network assets weren't well understood, and required flexibility and adaptability to manage.

Initially it was thought that the rising main would run to Park St pump station (Figure 3). However, with undersized pumps, this facility would have needed significant upgrades to accommodate the additional flow. The power to site wasn't sufficient for larger pumps, so a new transformer and switchboards would have been required, and probably an upgrade of the rising main. The larger pumps would also be cycling on and off frequently due to the small volume of the wet-well. At an estimated cost of $600 k, this was not seen to realise sufficient risk reduction to be worthwhile.

A variation was agreed to carry on to Cecil Road by open trench. In this case, the variable records worked in favour of the project: an abandoned line recorded in GIS as DN150 EW was actually DN300 concrete, and therefore could be used as a duct, avoiding disruptive excavations along Frankton Trail.

Figure 11: No margin for error working on live sewer assets this close to the lake

However, the manhole on top of the rising main is in very poor condition, and crowded with lots of penetrations and would not have taken another one. A new manhole was needed, installed onto a live asset (a DN600 concrete main constantly at half flow and above), within 100 m of a pristine water body.

The solution was to partly expose the DN600 pipe and pour supports under it so that a 1050 long section could be completely exposed. A manhole riser was then lowered over the exposed pipe with penetrations cut to accommodate all required inflows, including a future pipe. Reinforcing steel was then placed under the pipe, and concrete mass poured and haunched to suit the incoming pipes. Finally the top of the concrete pipe was removed, and shaped to suit the haunching, and the new rising main joined in.

Figure 12: Building a manhole over live sewer assets.

On the other end of the rising main, and Marine Parade Pump Station, the new valve pit was constructed, and connected to the pump riser tees, and the new main.

Figure 13: On completion, hardly a trace that a major, complex project on critical infrastructure has been delivered.

CONCLUSIONS

This was a challenging piece of work on critical infrastructure, which despite the complexity, changing scope and methodology and various festivals and events in the area, was delivered cost effectively and in a reasonable timeframe. All surprises were promptly and effectively resolved through open and transparent communication, detailed planning and investigation and proactive and experienced problem solving.

Contributing to this success were:

- A contract form which incentivizes behavior aligned with council's intent
- Culture of trust and collaboration. Both trust by the council that their contractor could get on with it and solve their problems, and trust by the contractor that council would be open to frank and fearless challenging of their decision making
- Early Contractor Involvement to manage unquantifiable risks
- An engaged contractor with extensive experience of the assets
- No interfaces between O&M and Construction contractor – easy to underestimate the impact of this, particularly on such a complex project
- Culture of healthy and respectful challenging between QLDC, the contractor and the consultant to drive the best outcome.
- Willingness to spend time and effort upfront to ensure that problems could be addressed efficiently.

A detailed debrief session was held with all stakeholders, and key lessons learned were:

- Greater early engagement with QLDC's Parks and Reserves
- The assumptions around the footbridge footings could have been challenged more robustly, and confirmed before it impacted on the project and the delivery team
- Greater detail on hydraulic modelling may have supported a lower diameter pipe and less interference during pulls.

Overall however, this approach has resulted in high quality infrastructure with proven, excellent hydraulic performance. Disruption to the community was minimized, and excellent value for money was achieved.

ACKNOWLEDGEMENTS

The success of this project was driven by the excellent work of Adrian Hodge, Capital Works Team Leader for Veolia and his team, as well as Lane Vermaas, who was QLDC's Project Manager taking charge of the delivery of the project.

REFERENCES

Moogan, E. & Lind, M., '*Failing to Challenge the Status Quo – The Risk to the Client and the Contractor. A Contract Management Case Study'*, paper presented to the IPWEA2015 conference, Rotorua, 7-10 June, viewed 12 July 2018, < https://www.ipwea.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=25a7aba6-453d-405b-9908-168c4e655a1d>