

ENSURING A SAFE FUTURE DRINKING WATER SUPPLY FOR THE RANGITAIKI PLAINS

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ABSTRACT

Bores at Braemar Springs, Johnson Road and Tahuna Road historically supplied the Edgecumbe and Te Teko townships and rural Rangitaiki Plains area. Braemar and Johnson Road water contain levels of arsenic and antimony above the DWSNZ. The shallow, flood affected Tahuna Road bore did not comply with DWSNZ. These sources are not Secure Water Sources for human consumption but are suitable for rural and agricultural use.

Whakatāne District Council (WDC) must provide a potable water service complying with DWSNZ to Edgecumbe and Te Teko. The remainder of the Rangitaiki Plains water service must comply with RADWS. Both of these services must meet pressure and flow standards. The Otumahi Water Supply Scheme initially solved all these issues but budgetary constraints and permitting limitations restricted the extent to which this could be achieved. WDC consulted the public and local Iwi to prioritize sub-regions within the network to reduce the scheme. Edgecumbe and Te Teko were identified as townships where the DWSNZ apply. Eastern Rangitaiki Plains can continue being supplied to RADWS.

The final Otumahi Water Supply Scheme developed an existing bore and constructed new treatment and pumping facilities on council land at Paul Road. A 169m deep bore with DWSNZ compliant water characteristics exists on site. Bore headworks, chlorine and caustic dosing facilities, storage tanks and a pump station were constructed for the scheme.

A second contract constructed 9.3km of watermain from Paul Road to Edgecumbe including the Braemar bypass. These pipelines include two bridge crossings and a bypass to deliver RADWS water to the eastern Rangitaiki Plains. A third contract upgraded the Tahuna Rd WTP to supply Te Teko with DWSNZ compliant water. This paper outlines the scheme from planning to handover and discusses issues encountered. WDC's considerable efforts to provide safe drinking water for its people are highlighted.

KEYWORDS

Water Supply Upgrade, Water Quality, Drinking Water standards for New Zealand, Pipeline, Treatment Plant, Chlorination, Ultraviolet Disinfection, Caustic

NOMENCLATURE

WTP = Water Treatment Plant | WDC = Whakatane District Council | DWSNZ = Drinking Water Standards for New Zealand | RADWS = Rural and Agricultural Drinking Water Standards

PRESENTER PROFILE

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Mrs. Leilani Salanguit – Project Engineer at Whakatane District Council. Leilani is the Project Manager of the Paul Road and Tahuna Road water supply projects.

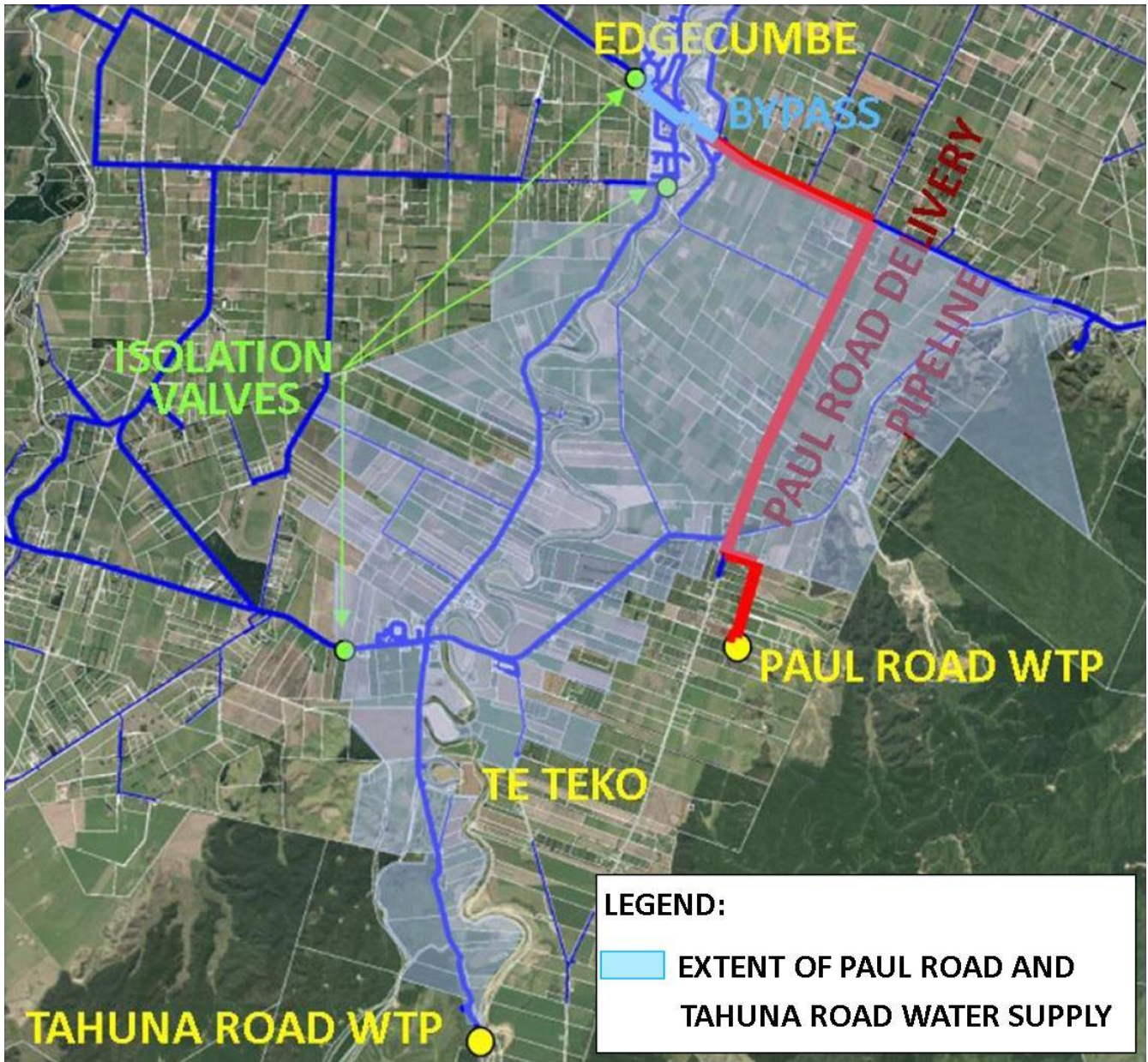


Figure 1: Rangitaiki Plains Water Supply Network

1 INTRODUCTION

Edgecumbe and Te Teko townships are supplied from the Rangitaiki Plains water supply. This has three water sources, the Braemar Spring, Tahuna Road Bore and the Johnson Road Bore. The Braemar source is of moderate quality with elevated levels of arsenic (.023 mg/L). These exceed the DWSNZ Maximum Acceptable Value (MAV) of 0.01 mg/L. The Tahuna and Johnson Road bores are not classed as secure having only partial barriers to contamination. All supplies are chlorinated. The Johnson Road source has recorded arsenic levels of 0.018 mg/L and 0.11 mg/L. The lack of barriers preventing protozoa contamination and the elevated arsenic levels are the main health risks causing a lack of compliance with DWSNZ.

Two Arsenic removal technologies have been investigated by WDC in the past, coagulation/sedimentation/filtration/UV and G2 Absorbent Media /UV. Both options are effective treatments however arsenic contaminated sludge is a by-product that must be disposed of separately. Specific arsenic removal was not considered appropriate as 60-80% of the flow would require treatment. The capital cost of this option was considered too high for the community to bear as it required a new site and green field water treatment plant (Opus Preliminary Design Report for Edgecumbe Drinking water supply). Where the Rangitāiki Water Supply is used for stock water, treatment to RADWS is all that is required.

A new source at Paul Road was drilled, pump tested and found to be secure. Resource consent has been secured with an instantaneous flow limit of 61 l/s and a daily limit of 5280 m³/day.

Water from Paul Road could only be supplied to Edgecumbe and Te Teko because of budgetary constraints and resource consent limits on the water take. This solution complied with the guidelines set by the DWSNZ for Rural Agricultural Drinking Water Supply.

A 50 year water strategy developed by Opus International Consultants Ltd for WDC in 2011 provided a number of options to upgrade the Rangitaiki Plains Water Supply. The option selected by WDC optimized the use of funding and accommodated the resource consent limitations while still complying with DWSNZ. The scheme delivers an "on demand" water supply without a storage reservoir. The proposed scheme was subsequently named the Otumahi Water Supply.

WDC engaged Pattle Delamore Partners Ltd (PDP) to develop the concept into a detailed design for a bore field, treatment plant, pump station and bulk supply main. The Te Teko township is supplied with potable drinking water from Tahuna Road. A combination of the Otumahi Water Supply Scheme and an upgrade of Tahuna Road provide a joint water supply to service Edgecumbe, Te Teko and adjoining areas.

2 PLANNING AND CONSENTS

Pattle Delamore Partners Limited (PDP) assisted WDC in the consents analysis for Otumahi Water Supply scheme. The consents required were as follows:

- Building consent for the Water Treatment Plant (WTP) building;
- Earthworks consent for the pipeline as the total volume of excavated material exceeded 5,000 m³;

- Land use consent for the storage and use of dangerous chemicals (Caustic and Chlorine) at the Paul Road site and the construction of the pump station building and 250 m³ steel tank;
- Property consent involved an easement agreement between Kiwirail and WDC to construct and operate in their land.

PDP completed an assessment of environmental effects and a HSNO assessment for the land use consent application.

3 DESIGN

3.1 DELIVERY PIPELINE FROM PAUL ROAD

PDP began detailed design of the Otumahi Water Supply project in June 2016. The pipeline conveys potable water for 8.01 km from a new pump station at 124 Paul Road to the connection at Edgecumbe. It consists of 1.53 km of 355 OD PE100 SDR13.6 pipe, 4.11 km of 280 OD PE100 SDR13.6 pipe and 2.37 km of 250 OD PE100 SDR13.6 pipe.

5.64 km of the water main was constructed in the road reserve and 2.37 km was constructed on Kiwi Rail land adjacent to the railway line. The key elements undertaken by PDP in the design are listed below.



Photograph 1: Otumahi Delivery Pipeline installation

3.1.1 ROUTE SELECTION

The pipeline was installed in the berm out of the carriageway to minimise construction costs. The route was chosen to avoid clashes with other services. The alignments chosen have clear space within the road reserve that allows construction with a minimum impact on traffic and the road structure.

3.1.2 ISOLATION FROM BRAEMAR SPRING

Isolating the Braemar Spring removes the source of water with excessive concentrations of arsenic and antimony from the supply network. The loss of this water source also lowers the pressure and flow to the eastern area of the Rangitaiki Plains. A bypass was installed to allow Braemar Spring to continue supplying Eastern Rangitaiki at the required pressure and flow. This part of the water supply network is separated from the Edgecumbe network where the DWSNZ are met. This bypass is made up of 1.12 km of

1800D-PE100 SDR-13.6 pipe along Bridge St, Tawa St and State Highway 2 plus 178 metres of 150NB 316SS pipe over the Rangitaiki Bridge. The bypass main utilizes existing pipework as much as possible to reduce construction costs.

3.1.3 PIPE BRIDGE CROSSINGS

Pipe bridge crossings have been installed at the Reids Canal and Rangitaiki River Bridges on SH2. The new pipeline from Paul Road crosses the Reids Canal before connecting into the existing Edgecumbe water supply system near Hydro Road. The Braemar Spring bypass crosses the Rangitaiki River to link with the Eastern Rangitaiki Plains part of the network. Both crossings are 150NB 316SS pipework.

3.1.4 DESIGN FLOW REVIEW AND PIPE SIZING

Opus developed a model of the potable water network which was used to determine pipe sizes for the original water supply option. PDP reviewed the model and made changes to allow for budgetary and permitting constraints then re-evaluated pipe sizes for the Otumahi Water Supply scheme ultimately approved.

PDP's pipe network model was also used to determine pressure values in the network and to specify the pipe. PDP prepared a transient model to locate air valves along the pipeline.

3.2 WATER TREATMENT PLANT AT PAUL ROAD

The Paul road facility can be extended to include three additional bores. Population growth forecasts and previous network modelling by Opus indicate the future peak hour demand from the entire Rangitaiki Plains will be approximately 120 l/s. The three planned bores at the Paul Road site will satisfy the future demand.

Detailed design of the Paul Road facility began in June 2016. PDP undertook the following key elements of design.

3.2.1 SITE LAYOUT

The layout of the booster pump and treatment facility must ensure there is a safe distance between neighboring properties and the hazardous chemicals stored at the site. Containers of compressed Chlorine gas and a 30% solution of sodium hydroxide are kept at the facility to treat the raw water before it is pumped into the reticulation network. AS/NZS 2927 stipulates that a chemical storage facility must be a minimum distance of 50 metres from the nearest residence.

The access road layout was designed using the turning circles of servicing and supply vehicles to ensure clear unconfined access to the facility.

The Paul Road site is in a very quiet rural environment where noise can travel significant distances. The Building containing the booster pumps and electrical equipment is constructed with filled concrete blockwork and an insulated roof to prevent noise escaping into the surrounding environment. The bore pump is 95 metres below ground so will not generate significant noise at the surface.



Photograph 2: Otumahi Bore Site Treatment Plant

3.2.2 BORE PUMP AND HEADWORKS



Photograph 3: Bore Head pipework.

An initial assessment of drawdown in the pumped bore and a neighbouring bore planned for future development has been undertaken by others. Mean values of the hydraulic parameters determined in the assessment have been used to estimate the draw down in the existing Paul Road bore and the future adjacent second bore. The cumulative drawdown in both pumping bores is predicted to be around 81m after pumping 10,368 m³/day (120 l/s), from both bores for 365 days.

The existing 250mm diameter bore at the Paul Road was drilled in 2010 to investigate the aquifer. The investigation concluded that the water from this bore meets or exceeds the requirements of the DWSNZ (Opus International Consultants Ltd, 2010). Age testing of the bore indicated that the water was between 50 and 150 years old and that less than 0.005% of the water present in the aquifer was less than one year old. This satisfies the residence time criterion (Section 4.5.21) in the DWSNZ (GNS Science Ltd, 2010).

Other measures were undertaken during the design to ensure the bore is compliant with DWSNZ. The existing bore has a sloping concrete apron surrounded by a fence offset 5m from the edge to keep stock away from bore headworks. A tap is provided at the bore to enable sampling of the raw water to ensure compliance with DWSNZ.

The bore pump transfers raw water through the treatment plant and into a 250 m³ contact tank. A 75kW SP 160-7-aa Grundfos pump was selected for the new bore. This pump can deliver 50 l/s from the bore when the water level has been drawn down to maximum 81 metre depth predicted by modelling. This pump also requires 60 metres of pressure head to operate on its pump curve. The bore pump is positioned 95 metres below the ground surface. The 14 metre difference in depth between the maximum drawdown level and the bore pump protects the pump from running dry when additional bores are installed at the site.

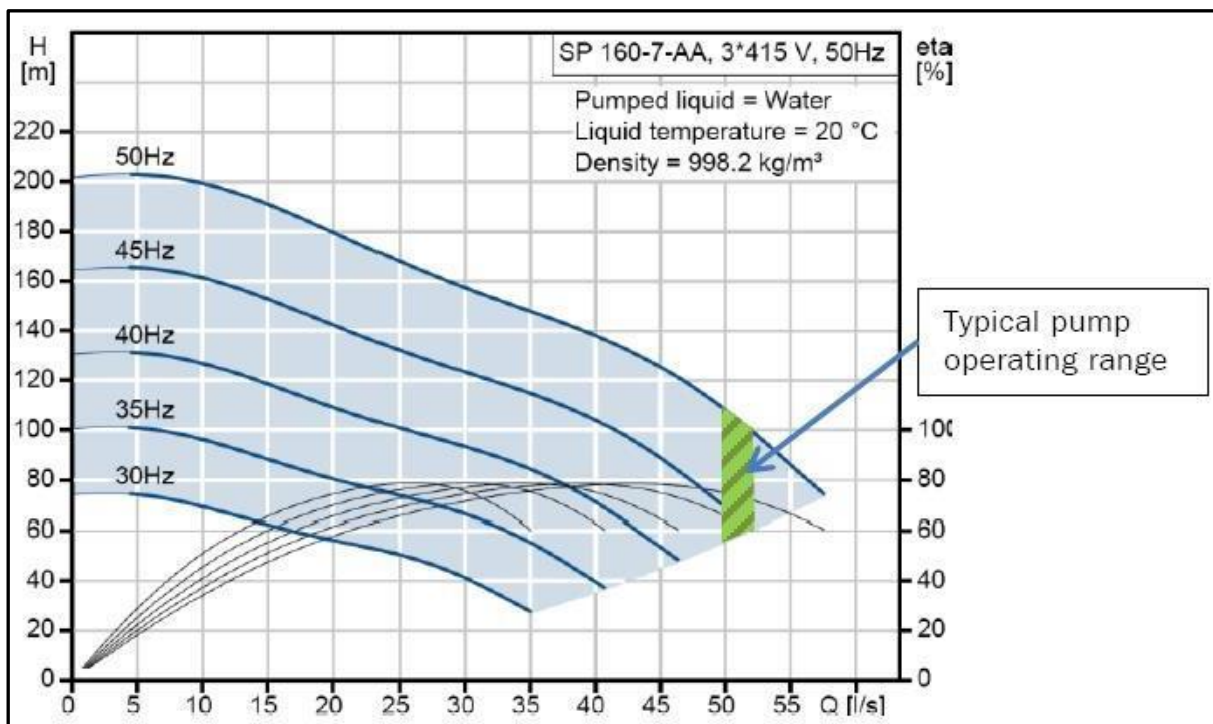


Figure 2: Paul Road Bore Pump Curve

3.2.3 BOOSTER PUMP STATION

The Paul Road WTP site is at an elevation of approximately RL 114 m (Moturiki Datum +100m). A 77 m pump head was adopted at the Paul Road WTP to match the system pressure identified by Opus at Te Teko and Braemar Reservoirs. The various water source levels are shown on the schematic of the Plains Water Supply below (PDP, 2017b).

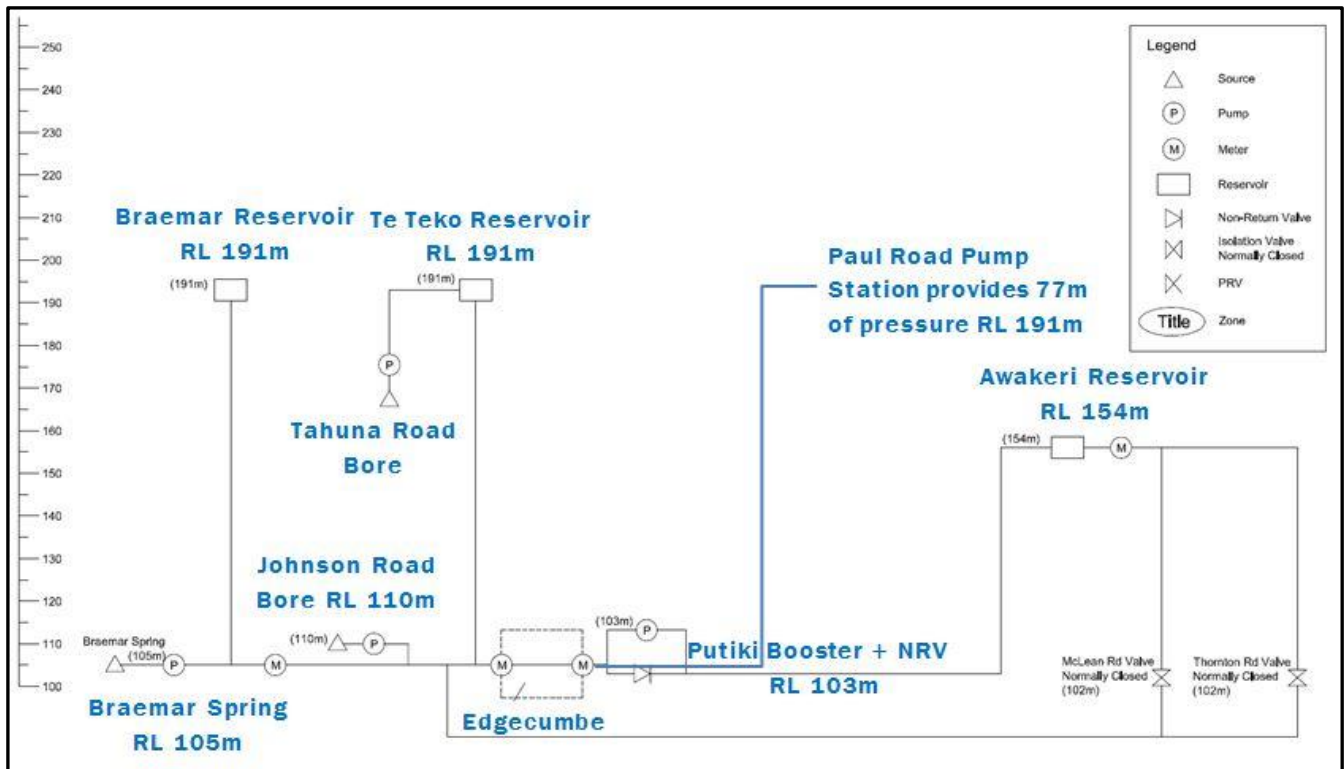


Figure 3: Rangitaiki Plains Water Supply Schematic

The booster pumps draw treated water from the contact tank and will operate on VSD control to maintain a steady outlet pressure of 77m on the discharge side of the WTP during periods of normal demand. The outlet pressure can be reduced during off peak period to reduce power consumption. The booster pump skid consists of the following three pumps.

- The CRE20-6 Jockey Pump will operate between 0 and 8.5 l/s.
- The first CR90-3-2 Pump will take over when the flow exceeds 6 l/s (with the CRE20-6 shutting down) and run through to 30 l/s.
- The second CR90-3-2 Pump will remain as a standby in case of pump failure.



Photograph 4: Booster Pump and Manifold

The pumps will always sit very close to their maximum efficiency point throughout the range of expected duty points to minimizing energy consumption. The main booster pump curves and fixed outlet pressure are shown below.

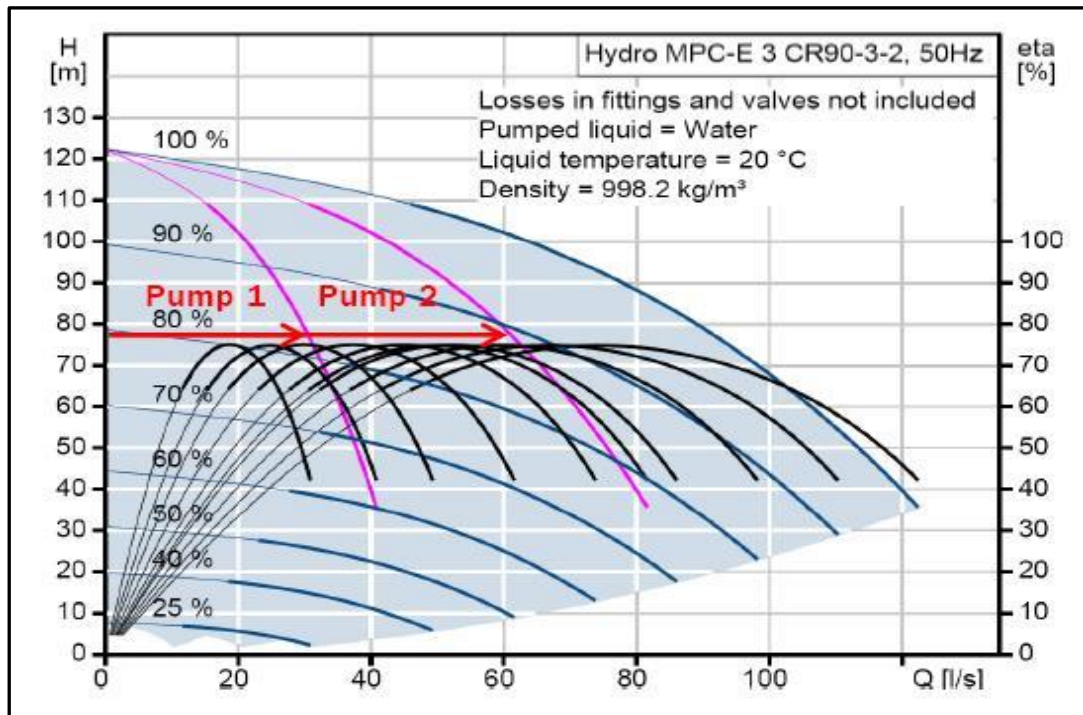


Figure 4: Paul Road Booster Pump Curve

3.2.4 TANKS

A 250 m³ contact tank and a 31 m³ maintenance tank were selected to provide chlorine residence time before water is pumped into the network. The contact tank provides approximately 3 hours of storage at the present peak demand flow of 24 l/s. This is well above the 30 minutes residence time required by the DWSNZ. Both tanks have been designed assuming the importance level of 3 (IL3) required by the building code for potable water treatment facilities.

The 31m³ maintenance tank maintains service while the contact tank is isolated for maintenance. This tank provides approximately 20 minutes retention at 24 l/s. Although, this is less than the 30 minutes required by the DWSNZ, the remaining 10 minutes is provided by the delivery pipework within the treatment plant site.

Both tanks have an emergency overflow in case of instrumentation failure. These overflows are directed onto the adjacent ground. The risk of instrument failure is further mitigated by a backup system.

Both tanks are emptied for maintenance through drainage pipes directed to the on-site stormwater soakage pit. The contact tank will take up to 8 hours (overnight) to drain and the maintenance tank will be drained after each use.

3.2.5 TREATMENT

The new facility includes chlorine and 30% sodium hydroxide (caustic) dosing. Caustic dosing is controlled by the pH meter and a pH of approximately 7.5 is maintained by the system. 5000 litres of caustic solution is held in two HSNO approved tanks bolted to the floor inside the building. The tanks will be filled from a tanker through a camlock fitting on the outside of the building minimizing entry into a hazardous space. The ground

surrounding the delivery area outside the building is sealed with a concrete apron. The apron has sufficient storage capacity to contain the accidental spill volume equal to the largest compartment in the delivery truck (about 7,000 litres). Spills inside the building will be contained in a concrete bund. A plan of the caustic dosing facility is shown below.

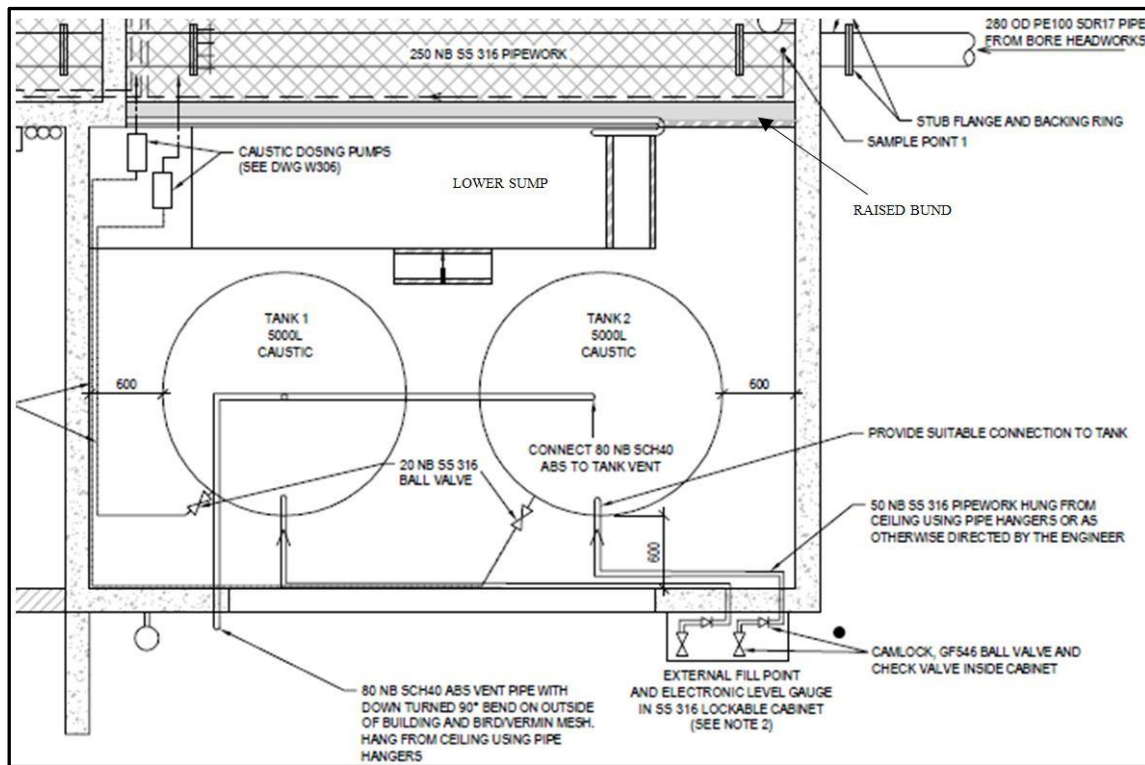


Figure 5: Caustic Room Layout

The chlorine gas is stored inside the building in a 920 kg chlorine gas drum and a 70 kg backup chlorine gas cylinder. A gas leak detector linked to an alarm system has been installed in the building and emergency valves isolate chlorine cylinders if a leak occurs. The 920 kg chlorine gas drum is supported on rails which extend out onto the concrete pad outside the building. The drum can be easily loaded and unloaded directly from a truck when required. Based on the expected chlorine gas usage, it is estimated the chlorine drum will provide sufficient gas for approximately 2 years.

Two chlorine booster pumps, installed in duty/standby configuration, deliver chlorine carry-water to the contact tank supply pipework. This system ensures chlorine dosing can be undertaken even when the delivery pump station is not operational.

3.3 WATER TREATMENT PLANT AT TAHUNA ROAD

PDP was engaged by WDC in September 2016 to undertake the investigation and detailed design for the upgrade of the Tahuna Road Water Supply. The existing Tahuna Road WTP did not meet the DWSNZ because of inadequate protection against contamination at the bore headworks and because the treatment processes did not provide the required treatment to achieve protozoal compliance. New cartridge filters and a UV system has been installed to provide treatment to a level higher than that required by DWSNZ.



Photograph 5: Tahuna Road WTP after Upgrade

3.3.1 BORE PUMP COMPLIANCE AND SELECTION

Raw water is drawn from an unconfined aquifer. The bore is approximately 16 m deep (with the top of screen estimated to be 13.3 m BGL) and located in a flood zone. This characteristic prevents the bore from achieving a secure status under the DWSNZ criteria. Previously the bore head was not sealed at the surface and was prone to ingress of surface water and contaminants. The bore casing was raised 500 mm above the 100 year flood level and sealed to prevent ingress of surface water and contaminants. A new sloping concrete pad was installed around the casing and a new fence was constructed around the perimeter of the site to further improve the protection from the ingress of contaminants to comply with DWSNZ.

A new bore pump was required due to the increased pump capacity required to pump through the cartridge filters. Grundfos and Lowara pumps were considered for this application and a Lowara was selected as it provides additional clearance within the bore casing. The pump will operate on a variable speed drive and the motor has been sized to allow operation up to 60 Hz. This provides the optimum arrangements of minimum energy consumption when the cartridge filters are clean whilst still maintaining high flow capacity when filters are fouled. Operation of the bore pump has been summarised below. The VSD will target a set operating flow of 19 L/s and as the filters foul the VSD will ramp the pump speed up to maintain 19 L/s. Once the pump motor speed reaches 60 Hz, the pumped flow will continue to reduce as the filters continue to foul. When the pressure differential across the filter reaches a preset level the system will alarm and shutdown. The cartridges will be replaced at that time.

Bore Pump Operating Principals

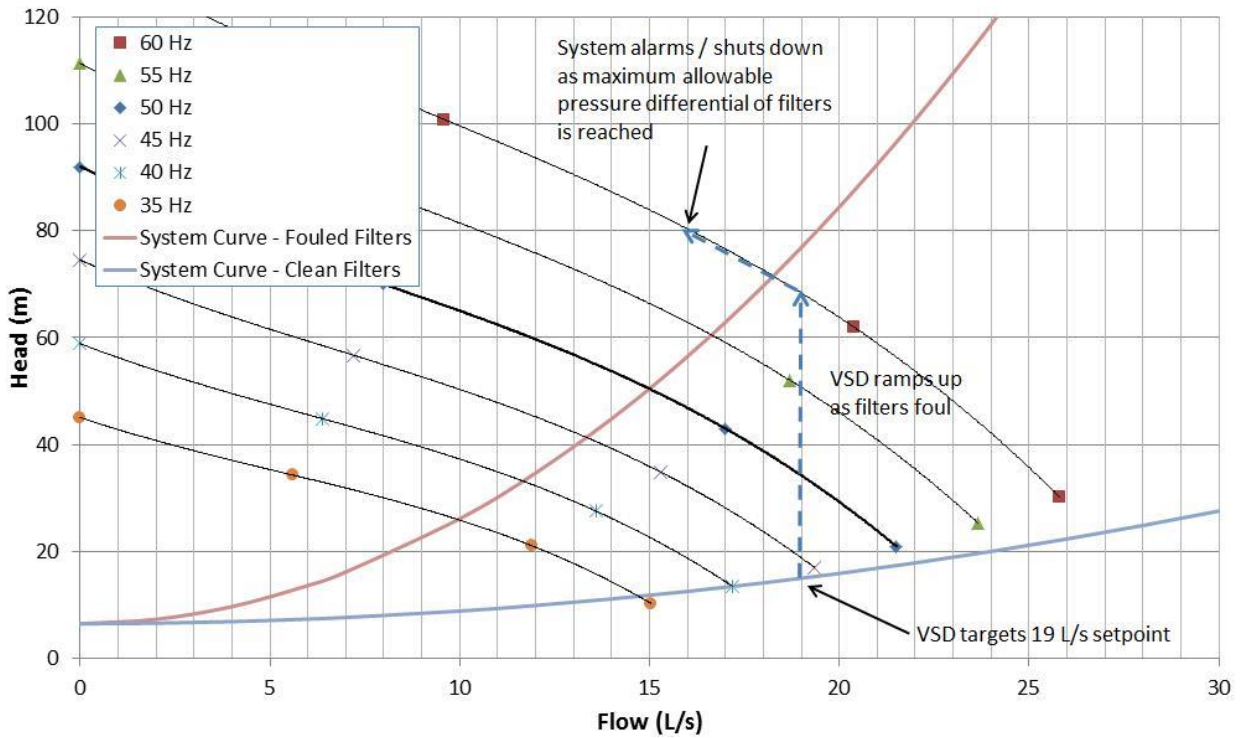


Figure 6: Tahuna Rd Bore Pump Operation

3.3.2 HIGH LIFT PUMPS

The existing horizontally mounted high-lift pumps were operating at the peak of their electrical and hydraulic capacity at 50 Hz limiting the flow from the site. They pump from the treatment plant up to the reservoir. These were replaced with vertically mounted pumps which provide additional operational head to allow for pumping through the new UV system and also raise the pump motors above the 100 year flood level. The existing pumps could not be mounted vertically.

The new pumps are operated in a duty / standby sequence and are programmed to maintain a set water level in the Te Teko Reservoir. VSDs control the delivery flow rate. This will limit pump starts and stops to optimise UV sterilisation. The system pump curves are shown below along with the operating principals.

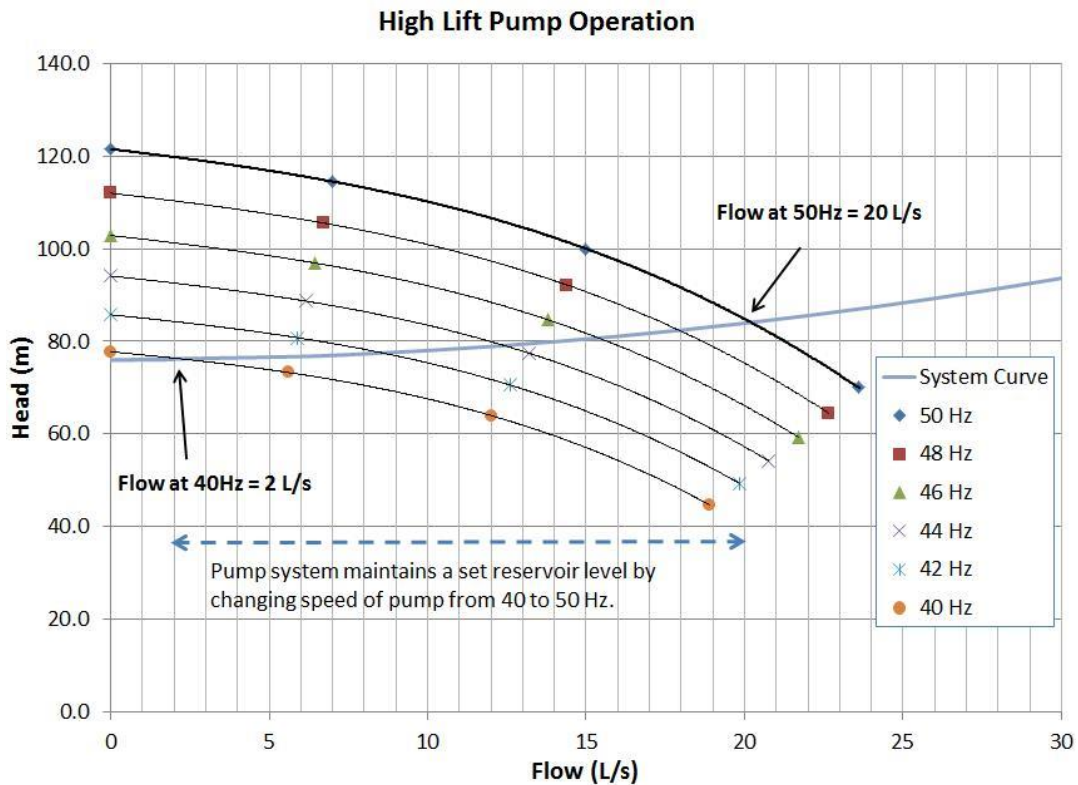


Figure 7: Tahuna Road High Lift Pumps Operation

3.3.3 WATER TANK

A new 31m³ flow balancing water tank has replaced the existing 25m³ water tank at the site. This will reduce the number of stop / starts of the bore pump and reduce the time and volume of the bore water discharged to waste. The tank also provides additional buffering capacity, in case additional flow capacity is required at the site and a second bore is installed at the site in the future.

3.3.4 TREATMENT COMPLIANCE

The old hypochlorite system has been replaced with chlorine gas at the site to provide residual disinfection in the network and achieve the requirements of the DWSNZ. The chlorination rate is set to achieve 1ppm of chlorine residual leaving the WTP at Tahuna Road. The chlorine retention time is over 6 hours, well above the minimum 30 minutes requirement of the DWSNZ. On-site storage and off-site storage at Te Teko Reservoir provide the chlorine retention time.

The previous treatment processes did not achieve the requirements of the DWSNZ. A shallow bore requires 3 log credits for protozoal compliance. Cartridge filtration with ultraviolet light (UV) disinfection provides a total of 5 log credits (2 and 3 log credits respectively).

The site experiences elevated levels of turbidity when the adjacent river rises. This suggests a direct link between the bore and surface water. If the site was conservatively assumed to be a surface water source, the DWSNZ would require a 5 log credit treatment. The new treatment infrastructure provides 5 log credits.

3.3.5 SUMMARY

The equipment selected, the hydraulic capacity and the treatment capacity of each aspect of the process at the site has been summarised in the table below.

Table 1: Tahuna Road Design Summary

| Design Aspect | Details | General Notes | Capacity (l/s) |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Existing Bore | 6" bore (154 mm inside diameter) with top of screen depth estimated at 13.3 m BGL from on-site measurements and total depth of 16 m (WDC website) | Measured static water level of 1.5 m BGL, estimated 2.0 m BGL during pumping at 16 l/s | 19 |
| Bore Pump | Lowara Z660/6 with 22 kW motor | - Capable of pumping at 19 l/s | |
| Cartridge Filters | 2 No. 3M CUNO High Flow Cartridge Filters including 3 x 15/10/5 Micron Cartridges and 3 x 1 Micron Cartridges installed in series | - Capacity of up to 55 l/s. - 15/10/5 micron filters provide pre-treatment - 1 micron filters provides drinking water compliance - Wasting required at the start of each filtering cycle (each time bore pump starts) | 55 |
| Wasting Valve | DN 100 electrically actuated butterfly valve, brand not specified | - Discharges a set volume of water to waste at the beginning of each bore pump cycle | - |
| Chlorination | 2 x 70 kg Chlorine gas cylinders with automated switchover, scales, 400 g/hr chlorination and gas leak detector | - Capacity well in excess of 50 l/s | >50 |
| High-Lift Pumps | Lowara pump skid with 2 x 66SV04 22 kW pumps | - Single pump capacity of 21 l/s - Dual pump capacity of 32 l/s (although inadequate electrical capacity at the site to deliver this) | 21 |
| UV Unit | Trojan UV Swift SC D03 Model Reactor with 3 lamps and approximately 1 kW peak consumption | - Capacity of 15 l/s at 92% UVT - Capacity of 22 l/s at 94% UVT - Maximum validated flow of 27 l/s | 22 |
| Pipework | Stainless Steel 316, hygienic tube | Ranges in size from 80 NB to 150 NB, allows for operation of 2 high-lift pumps and makes some provision for a second bore in future. | 32 |
| Storage Tank | 31 m ³ water tank for storage | Provides additional capacity to cater for a future bore at site | - |

3.4 DESIGN CHALLENGES

3.4.1 MODELLED PEAK FLOW

The 24 l/s peak flow demand from the Paul Road site is based on Opus modelling and is a key assumption used in PDP's design. The flow was used to size the various pipelines for the Otumahi Water Supply. Water usage of 250 l/person/d, a population of 1,600 and a peak hour factor of 5 was assumed. The peak flow demand is 23 l/s. This provides some confidence in the design flow of 24 l/s derived by Opus.

3.4.2 SECURITY OF SUPPLY AND WATER PRESSURE

The new "on demand" pumping system at Paul Road does not have any terminal storage and will stop functioning during pump failure or maintenance of the pump station and/or pipeline. To overcome this situation, PDP has allowed for a 350kVa Generator at the site, which will automatically start up during a power failure and maintain the pressure in Edgecumbe.

In the event of shut down of the pump station (i.e. maintenance or generator fails), WDC will open the isolation valves in the network so flow from Braemar Reservoir can provide water for Edgecumbe. Before the isolation valves are opened the Otumahi Water Supply at Paul Road will continue to be drained by demand from Edgecumbe.

4 CONSTRUCTION

PDP assisted WDC with tender evaluation and award for all the construction contracts. PDP assisted the Engineer's Representative and provided technical advice during construction of all the contracts. The construction for Otumahi Water Supply delivery pipeline began in Dec 2016, bore site development began in Feb 2017 and Tahuna Road Water Supply Upgrade was completed in March 2017. PDP supervised the pipe pressure tests, flushing and disinfection of the tanks and pipework as part of the construction supervision of all contracts. PDP also took soil samples, tested bedding compaction, undertook general site inspections and performed Health and Safety Audits on the Contractors.

4.1 CONSTRUCTION ISSUES

4.1.1 FLOODING

Both bores at Tahuna Road and Paul Road are above the 100 year flood level, have a sloping concrete pad around the casing and a fence around the perimeter of the site or bore that meet DWSNZ.

During the 2004 flood event, Whakatane recorded 249 mm of rain in two days. This is equivalent to a 100 year return period storm (PDP, 2017). The historical tide line of this event which partially drowned the existing pump station building is still evident on the pump station wall at Tahuna Road. An image from this event is shown in Photograph 6. The top bore casing flange was raised 560 mm to comply with the DWSNZ (Ministry of Health, 2008) requirement that this flange is 500 mm above the 100 year flood level.

Photograph 7 shows flooding experienced later in April 2017 after the upgrade and demonstrates the success of the design. All of the equipment inside the pump station including the vertically mounted pumps are now above the flood level.



Photograph 6: Previous Pump Station Layout



Photograph 7: Upgraded Pump Station Layout

4.1.2 WEATHER DELAY

The construction period for all of the projects optimised use of the summer construction season so weather conditions were generally fine. However, in April 2017, the weather conditions became very intense with heavy rain and flooding, which led to unprecedented river levels throughout the Bay of Plenty. This resulted in a flood bank breach at the Rangitaiki River and all of Edgecumbe to the west of the river became flooded (Refer to Photograph 8).

The Otumahi Water Supply project was delayed by 2 weeks due to the flooding as the contractor resources were used to help restore Edgecumbe. The extreme storm conditions raised the water table along the length of the pipe risking pipe floatation in constructed / backfilled areas along the route. The laid pipe was full of pressure tested water that prevented uplift. The water table took several weeks to recede, increasing dewatering costs. The wet weather and high water table created more difficulties for the contractor on site so open trenching was replaced with HDD techniques in some sections to minimise the additional cost resulting from the flood.



Photograph 8: Edgecumbe Flooding in April 2017

4.1.3 LOW COMPACTION ISSUE

PDP undertook SCALA Penetrometer tests to check the bedding around the pipeline along the pipeline route. Most of the results were reasonable with compaction strengths of 70 kPa. Wherever the results showed poor soil strength (i.e. <50 kPa), the contractor was issued with a Notice to Contractor (NTC) to remediate the bedding. This was achieved by excavating down to the pipe, inspecting the suitability of the material and re-compacting suitable material and backfill.

The bedding material initially selected was Rhyolite. This was later changed to PAP7 (density of 1.4 tonne per cubic metre), so adequate compaction could be achieved. The upgrade to PAP7 was treated as a variation and resulted in an increase in cost. The soft clayey soil and traces of pumice encountered in Kiwirail land were extremely difficult to compact.

The rest of the route mostly consisted of good sandy material, especially along Western Drain Road. In situ material was used for bedding, where good ground conditions were present to reduce cost.

4.1.4 AGGRESSIVE GROUNDWATER / ACIDIC SOIL TESTING

PDP carried out soil corrosivity testing along the pipeline route to check for acidic soils and groundwater as these can cause corrosion of concrete structures. In our case, these concrete structures are the below ground concrete valve chambers located along the route. The parameters tested were pH, sulphate, acid soluble sulphate and water soluble sulphate. The results indicated no potential for acidic soil conditions. The governing parameters (acid soluble sulphate and water soluble sulphate) were below their detection limits and well below the limits in Concrete Standards (NZS 3101).

5 COMMISSIONING

Tahuna Road Water Treatment Plant was commissioned in March 2017. Most of the equipment including UV unit, chlorine gas system, cartridge filters, stainless pipework, pumps and tank were commissioned by the head and nominated contractor in the presence of the engineer. The commissioning process went smoothly.

The Paul Road WTP will be commissioned in August 2017. A commissioning plan has been prepared, which includes the responsibilities of personal, testing of bore pump system, water testing, flushing, disinfection, training and handover. The plan also includes a programme for these phases.

5.1 BORE AND BOOSTER PUMPS FLUSHING

Multiple checks are required for commissioning of the bore pump and associated valves. The bore will be thoroughly flushed through a hydrant to remove any sediment and provide the cleanest water possible. A direct lay flat hose will be connected to the hydrant to direct water to the on-site soakpit. The bore pump will be ramped up to ensure flushing is undertaken at a suitable rate of 50 l/s (maximum flow achieved from bore).

The pump set point on the booster pumps will first be lowered to 77 m (the standard operating head). The booster pump skid will be tested through the range of flows from 0 to 60 l/s after the final pressure test has been completed. The hydrant at the end of the main will be opened until the flow pumped through delivery main reaches at least 60 l/s after correct operation is confirmed. A flow of 60 l/s is required to achieve over minimum scour velocities of 0.75 m/s to remove sediments and entrained air in the

355mm OD PE pipework. There will be significant head loss through the main at this pumping rate (>55 m). The system will be operated at a minimum flow of 55 l/s for 110 minutes equivalent to 3 pipe volumes of the 355 OD PE100 pipe.

5.2 WATER TESTING OF TANK AND PIPELINE FLUSHING

The contact and maintenance tanks will be pumped full of water from the bore pump and will be held for 3 days. Incremental measurements will be taken by the engineer and contractor to check for any leaks in the tanks. This test will be completed after all the process pipework has passed pressure test.

At the completion of the delivery pipeline, there will be approximately 8 km of pipework which has successfully passed pressure testing. This length of pipe will be full of tested water (377 m³), which was initially obtained from the Edgumbe fire station and has been sitting in the pipe for months. A lay flat hose will be connected to the hydrant on the delivery main near Hydro Road (CH = 8000m). The hydrant will be slowly cracked open and the water will be tested for presence of chlorine using pool strips. If the level of chlorine is greater than 0.2ppm (Watercare's Standards), the water will be directed to the Hydro Road wastewater pump station, otherwise it will be discharged to the local stormwater network. All gate valves and air valves on the delivery main will be left opened during flushing, excluding those connecting to the pre-existing water network.

5.3 DISINFECTION

The disinfection of the delivery pipeline will take approximately 5 days including 2 days for disinfection and 3 days for discharge to Hydro Road pump station. This phase will not be commenced until PDP/WDC and the Contractor are confident the system can be made fully functional within 10 days. It will involve filling the pipeline (377 m³) with super chlorinated water (25 ppm) from the treatment plant site. FAC testing will be undertaken at the final hydrant until suitable chlorine residual is achieved. Any water with a chlorine residual in excess of 0.2 ppm during the filling of the main will be directed to the Hydro Road wastewater pump station at a rate not exceeding 1.5 l/s (calculated based on hydraulic capacity of pump station). Moreover, no discharge to the Hydro Road wastewater pump station will occur on days of rainfall in excess of 10mm, or when over 30mm has fallen in the preceding 3 days. This is to ensure that the Edgumbe WWTP does not receive additional flow on days when flows through the WWTP are already elevated.

5.4 TRIAL PERIOD

The first one to three months after commissioning will be the trial period in which the Paul Road system will run in conjunction with Braemar and Tahuna Road. The trial period will help resolve all commissioning and operational issues. Once the Paul Road facility starts supplying water to the network reliably, the Braemar supply will be safely isolated.

The combined operation will allow Paul road to be shut down at any time to remediate operational issues without loss of water supply to the consumers. Paul Road is an on-demand system with no backup reservoir storage. Manual intervention will be required to ensure continued supply of potable water to consumers when mechanical failure occurs at the plant.

The trial period will also allow the WDC operations staff to become familiar with the overall operation of the plant and teething issues can be safely resolved while a high level of network flexibility is available to provide support.

6 CONCLUSIONS

PDP has worked with WDC throughout the entire duration of this project from planning, through design and construction to commissioning and handover to provide the Edgecumbe and Te Teko townships with a safe drinking water supply. The Paul road facility can be further developed by drilling additional production bores to meet the future water supply demand. The upgrade at Paul Road and Tahuna Road will supply Edgecumbe and Te Teko townships with safe drinking water compliant with DWSNZ. The solution selected by WDC optimises the use of funding to meet DWNZS requirements.

ACKNOWLEDGEMENTS

The authors would like to acknowledge everyone involved in the above projects to supply the Rangitaiki Plains with safe drinking water supply including suppliers, contractors, Whakatane District Council and Pattle Delamore Partners employees.

REFERENCES

PDP Ltd, 2017. Tahuna Road Water Supply Upgrade: Design Report, Tauranga: Pattle Delamore Partners Ltd.

PDP Ltd, 2017b. Otumahi (Paul Road) Water Supply – Detailed Design Report, Tauranga: Pattle Delamore Partners Ltd.

GNS Science Ltd, 2010. Groundwater Residence Time Determination for the Paul Road Bore. Lower Hutt: GNS Science Ltd.

Ministry of Health, 2008. NZDWS. Wellington: Ministry of Health.

Opus International Consultants Ltd, 2010. Paul Road Bore Results and Recommendation Report. Whakatane: Opus International Consultants Ltd.

Opus International Consultants Ltd, 2011. Plains 50 Year Strategy Study. Christchurch: Opus International Consultants Ltd.