

# LOW RIVER CONTINGENCY FOR HAMILTON'S WATER TREATMENT PLANT – KEEPING THE FLOW WHEN THE RIVER GOES LOW.

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## ABSTRACT

Hamilton City is dependent on the Waikato River as its sole raw water source. The water treatment plant receives water through a fixed river intake structure, which places the city's water supply at extreme risk if river levels drop below it.

In three of the last four summers river levels have fallen to critical levels due to drought in the Lake Taupo catchment which supplies the river. Climate change forecasts suggest seasonal river levels are likely to further reduce, meaning abstraction may become impossible with current infrastructure. An emergency plan to pump water into the Treatment Plant intake structure from a deeper part of the river has been deployed in the past, but never implemented, and was only ever a 'band-aid' solution which would still impose severe water restrictions on residents and businesses.

Amending the intake structures was budgeted at \$26M, and would expose the city to further risk as operation of the intake structure would be compromised, if not halted, during a three-year construction phase

This paper outlines the investigation into the cause and effect of lower Waikato River levels, with a focus on resilience for the water treatment plant and the decision to construct and deploy a floating pumping platform capable of maintaining water supply to the city during periods of low river levels. This interim solution had to be able to supply 70 million litres of water daily for the city, and be scalable to allow for increased water demand (up to 90 million litres daily) over the next 15 years. Following funding approval in February 2015, it had to be designed and built to provide security of supply in the 2015/16 summer.

This paper also describes the Treasury Better Business Case model applied in the project approval process, design and construction hurdles which had to be overcome, the integration of the project with existing infrastructure and design amendments required to meet changing river levels during commissioning.

The completed project enables the deferment of \$26M in capital works for 15 years, provides an alternative pumping solution during construction of the long term solution, and with a 12-month construction time was available to deploy if needed in the 2015/16 summer. During March 2016, the new \$2.4m interim structure was lifted into the Waikato River for initial commissioning and testing.

## KEYWORDS

**Water treatment, water abstraction, Waikato River, contingency planning, business case, resilience, climate change, risk management, design.**

## 1 'CITY WATERS HAVE GOT YOU COVERED!'

**"City Waters have got you covered!"**

It was a simple statement, made by local breakfast radio host Camille Guzzwell, as she broadcast live from a floating pump platform on the Waikato River in March 2016. A 400-tonne-capacity crane had just lowered the 50-tonne platform into the river, as Hamilton City Council delivered a solution for the city's water supply.

In simple terms, those six words summed up the public view of what the floating platform was for – ensuring the city of Hamilton could access water from the river during exceptionally-low river levels and providing security of supply for the city’s 150,000 residents.

But that statement belied the bigger picture of the project. The platform, or barge as it is colloquially referred to, represented more than addressing a looming issue for the city.

The project, delivered by Council’s City Infrastructure team, was measured against a full Treasury Better Business Case standard, it avoided the need for \$26 million in capital works for another 15 years, it met the Ministry for the Environment’s key principles in addressing climate change, and it was delivered under its initial \$3.25 million budget. The innovative solution for predicted lower river levels was ready to deliver 70 megalitres of water daily for the city ahead of the anticipated dry autumn of 2016 and is scalable to allow additional pumps to provide up to 90 megalitres daily in the future.

For the bubbly radio host though, as she stood aboard the barge on that March morning, the project meant just one thing – that Hamilton City Council and its Waters team was looking after its community.

## 2 FINDING A SOLUTION

### 2.1 THE RIVER IS EVERYTHING

*Photograph 1: The completed barge, ready for the three-storey high pump housings, is lowered into the Waikato River in February 2016.*

Understanding the need for the barge, and its associated pumps and equipment, requires an understanding of the river. Ngati Hau have a saying, of another river,; *Ko au te awa. Ko te awa ko au* (I am the river. The river is me).

For the people of Hamilton, the river is everything.

For millennia, a river has flowed across the Waikato basin. At one stage it flowed into what is now the Thames estuary but the eruptions that formed Lake Taupo and subsequent cataclysmic water and earth movements forged a channel for the river’s present course around 17,000 years ago.

For centuries, the river has sustained the region’s communities and it is today the sole source of water for the city’s water treatment plant. Commissioned in 1971, the plant currently abstracts and treats an average of 55 million litres a day, while peak summer usage in the city can reach over 80 million litres a day.

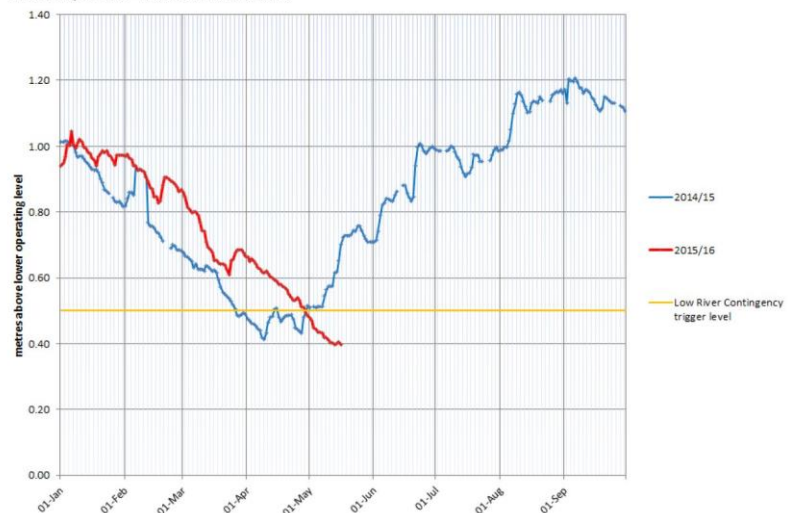
The fixed intake structure for the water treatment plant means water can only be accessed when river levels are high enough.

During periods of low river levels brought on by drought conditions and lower storage levels in Lake Taupo, the treatment plant’s ability to abstract water is compromised as the river level drops.

Once water reaches a critical level, the existing infrastructure is unable to supply water for the city.



**Lake Taupo Level** (Data source: mightyriver.co.nz)



*Photograph 2: A snapshot of the seasonal changes in Lake Taupo, on 16 May 2016, showing the levels dipping to a point where planned deployment of a low river contingency is considered.*

In four out of the last eight years the river level has dropped to a point where a contingency plan has been deployed. This involved hiring a barge and mounting temporary pumps on it to take water from a deeper part of the river. This contingency has never been used ‘in anger’ as weather conditions have changed and river levels have remained above critical levels.

While this temporary solution would have provided the city with some water, it was an emergency option only, and would still have required significant restrictions on the city’s water usage. At best, it was expected to deliver 50 million litres a day, at a time when the city’s daily usage requires a further 20 million litres daily, and is expected to reach 90 million litres a day within the next 15 years.

The contingency was also heavily reliant on external providers and had to be deployed far earlier than when it might be required, to ensure availability. This meant significantly-increased costs for the city. A further risk factor was the lack of redundancy in the contingency plan, which meant critical reliance on single components if it were to be deployed and operated.

Forecasting had suggested that longer dry periods in the region would increase the risk the river levels will drop below the intake levels. Compounding the climatic factors has been a steady degradation of the mean bed level of the river, with studies showing water level falls of around 20mm per year at the city’s Victoria Bridge.

This combination of factors, plus the increasing water demand from one of the fastest-growing populations in New Zealand, presented an extreme risk to the city. The temporary contingency plan reduced this risk profile to very high, which was unacceptable.

A more robust solution needed to be found for Hamilton.

## **2.2 THE BUSINESS CASE**



*Photograph 3: City Waters staff and contractors with the barge platform after it was assembled at the Hamilton’s water treatment plant in January 2016, illustrating the scale of the pontoons.*

Hamilton City Council’s management policy supports the development of robust business cases for all major capital projects. The Low River Contingency Project, as the solution was termed, was assessed against the Treasury 2010 Better Business Case model.

This standard requires assessments for the Strategic Case, Economic Case, Commercial Case, Financial Case, and Management Case. This means there are clear expectations, and a common understanding of risk and cost through the organisation, from a governance level, through project sponsor, and to the project manager.

It is an approach which is gaining ground in the industry, as City Waters Manager Andrew Parsons explains: “I understand that a business case approach to infrastructure investment decision-making is becoming increasingly more important across the New Zealand water sector, however, it is an embedded approach within Hamilton

City Council. It provides a strong framework for smart investment decisions and demonstrates value to the public.”

The five-case model incorporates:

- Strategic case- a compelling case for change, strategic fit and business needs;
- Economic case- preferred option that optimises value for money;
- Commercial case- commercially viable over the project term;
- Financial case- affordable from available funding; and
- Management case- achievable and can be successfully delivered

The Council set aside a funding allocation of \$3.25 million in the 2014/15 Annual Plan to deliver an alternative option to manage the risk of future low river levels.

Essentially, there were only three options:

- retain the current temporary contingency plan,
- modify the existing intake structure for the treatment plant to enable abstraction of water at lower river levels,
- or develop an interim, more robust, contingency plan which could provide for the needs of the city until a long term solution was constructed.

These options were reviewed in the business case, and it became clear that only one was going to be viable – that of creating a bespoke floating platform to pump water to the treatment plant intakes.

The first option, retaining the existing contingency plan, carried too high a risk for the city – a risk which would only increase as the city grew.

The second option of making changes to the intake structure had already been identified as a long-term need for the city, but at an estimated cost of \$26 million it was not provided for in the funding allocated in the 2012-22 10-Year Plan. Changing the intakes would mean either modifying the existing structure, building a new permanent structure, or extending the intakes further into the Waikato River. Identifying the best long-term solution for the city, while managing the environmental and consenting risks involved in major civil works in the river, required further investigations and scoping.

Even if these hurdles were overcome, the scale of the work meant there would be no possibility of an operational solution to the forecast lower river levels for the 2016 summer.

A further complication was that as the city has only one water-treatment plant, any major renovation or rebuild of the existing intake structure could compromise the plant’s ability to abstract water during construction.

*Photograph 4: The platform in place at Hamilton’s water intake structure on the banks of the Waikato River.*



The third option presented in February 2015 – of developing an interim intake structure – provided a solution which did more than just solve the immediate issue of the 2015/16 El Nino summer. The option would:

- mitigate the risks associated with the existing contingency plan
- be constructed within budget and largely in the 2014/15 financial year.
- ensure sufficient water is abstracted to meet current and future demand; up to 70 million litres on completion and 90 million litres by 2030, although existing summer water restrictions would still be an integral part of the response.
- The project would also include the investigations and scoping to more accurately identify the best long-term solution for the city.



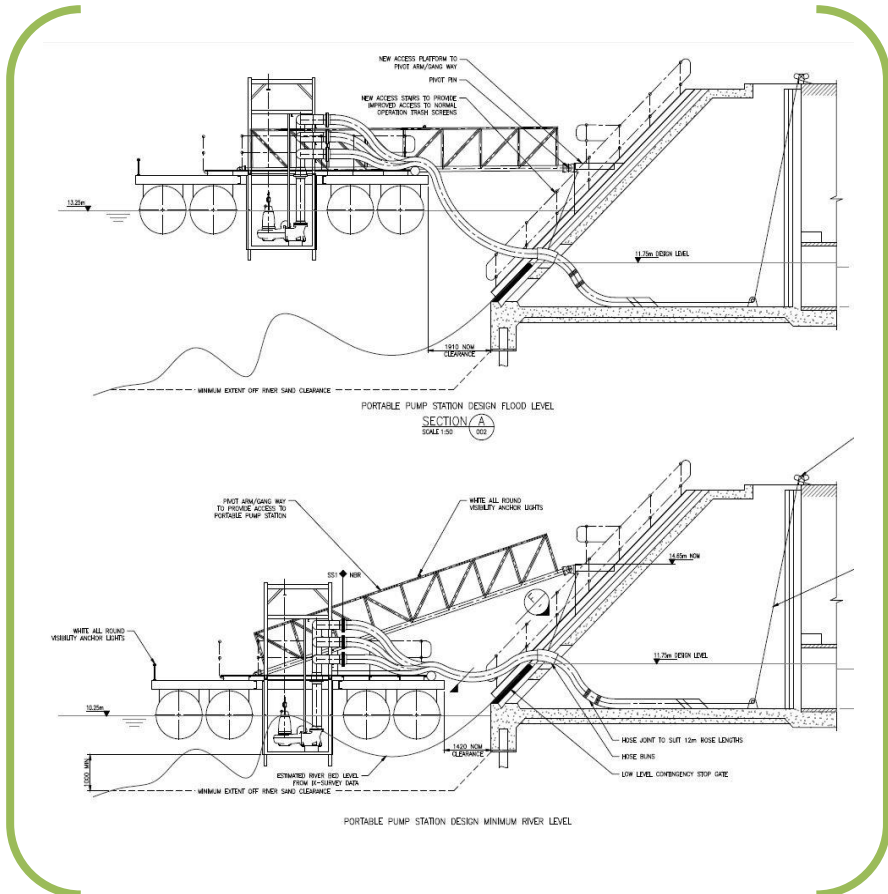
As Andrew Parsons says: “A low-river contingency project was always going to be required before we could construct the permanent lowering of the treatment plant intake in the longer term.

“This means this project is more than delivering a contingency project to manage risk now, rather it is an integral part of the future \$26 million intake structure lowering and rebuild project. In other words, the community gets the financial benefit of not having to spend \$26m now while still managing water supply risk.”

## 2.3 THE DESIGN

The interim intake structure, a floating pump platform, was a much-enhanced version of the existing contingency plan and included constructing a barge and pumps which would be stored on site when not in use. A key part of the project was including the automation and integration of this equipment into the treatment plant’s operations and electrical supply upgrades.

Downers, with MTL as structural designers, were appointed in the 2014/14 financial year to complete designs with a view to award the physical build the same year. The designs were delayed while changes were made to the location of a bespoke storage shed, the size of the platform to suit the selected pumps, and power supply and control systems.



*Photograph 5: Initial platform designs showing capability to operate in reduced river levels, providing for ability for the city to abstract water at levels during which the existing intake structure would be compromised.*

The designs were also amended to allow for provision of 70 million litres from day one of operation, with the ability to supply 90 million litres daily in the future. There were further design adjustments to fully integrate the solution with the plant’s Scada control system to allow remote control and operation of the pump platform and associated alarms.

Ergo were appointed to design the upgrade of the Low Lift Transformers, with changes to these designs to allow for the capacity of the gantry crane, while new fire and blast regulations meant moving the location of the new transformers.

GHD were appointed to prepare feasibility options for a permanent solution for the existing intake structures.

At the same time, WEL Works were appointed to upgrade the 11KV Ring Main Unit supplying power to the plant and to the low river pump station, while an order was placed with Xylem for six 15 kilowatt pumps.

Through a competitive procurement process Brian Perry Civil was awarded the contract for the manufacture and delivery of the pumping platform as well as the electrical supply and controls, civil works at the existing inlet structure and deployment and commissioning of the new pump platform. They were also to build a new storage shed and complete other minor improvements. Temporary work was required on the access road from the water treatment plant to the intake structures to allow the delivery of the completed pumping platform to the river; and to cater for the 400-tonne capacity crane required to place the components of the 50-tonne barge in the water.

In 2015 UGL were appointed to upgrade the low lift transformers, while MWH were appointed to carry out further geotech investigations, as well as provide MSQA services and program management. The project manager was MWH's Hamilton-based Principal Project Manager for Water and Waste, Steve Shortt.

The construction phase of the pumping platform took around eight months, although work continued on a purpose built 15.5m square shed, 6.5m high, to store the platform.



*Photograph 6: The completed pumping platform awaits the installation of the suction hoses in February 2016.*

The platform's major steel work was manufactured by specialist mechanical fabricators in Napier and transported by heavy transport to Hamilton by road.

Suction hoses were imported from Italy – Steve Shortt jokingly refers to them as his "Prada pipes" - while electrical work and controls were by a Hamilton specialist subcontractor.

The finished platform measures 12.5m long and is 9.0m wide, and is around 2m high. When placed in the water, around 750mm of the pontoons are under water. The pontoons themselves are 1.4m in diameter and are in eight segments.

The platform holds two pump baskets, which are each 3m by 2m, and 5.7m high. Each pump structure weighs around eight tonnes, and they are lowered individually into the platform once it is in the river. The pump baskets protrude beneath the platform, with around 1.2m below the surface of the water, while each of the main hoses that supply water to the treatment plant intake structure weigh around a tonne each.

Fully assembled and operating, the barge and pumps weigh close to 50 tonnes including the 10m-long pivot arms which secure the barge to the intake structure.

A specialist heavy lift operator provided the equipment and expertise for the three-part lift – using a 400-tonne capacity crane rigged with a fly jib and 130 tonne of counterweights. The crane travelled by road to the launch site, along with four heavy-lift trucks carrying the lifting equipment and counterweights.

Ironically, higher-than-expected river levels delayed the initial testing phase, but the platform and pumps were ready if climatic conditions again compromised the city's water supply.

### **3 CONCLUSIONS**

The platform was launched in March 2016, and had a three-week testing programme which included liaising with Mighty River Power to test at lower river levels.

The testing was a complete success, and provided confidence that the low river contingency could supply the required 70 million litres to secure supply for the city even during times of exceptionally-low river levels.

"If required, the platform would have been available for use in mid-April which is when the low river risk has traditionally been the greatest," Andrew Parsons says.

By simply being available, the low river contingency project has already been a success.

It provides security of supply for the city, and has enabled a \$26 million deferral of capital expenditure. It also provides a solution for any future restriction of access to water which may occur during the planned major upgrade to the existing intake structures on the banks of the Waikato River.



Perhaps just as importantly, it provides a tangible and highly visible reminder to the residents of Hamilton, in an era of world-wide changing weather patterns and uncertainty over the resilience of current infrastructure, that their Council has got their back.

As radio host Camille Guzzwell so eloquently phrased it, live on air, on that March morning:

“City Waters have got you covered!”

