

MONITORING OF THE RIVER RECHARGE WITH GROUNDWATER SCHEME

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Abstract

Kāpiti Coast District Council's award-winning River Recharge with Groundwater (RRwGW) scheme has now been monitored through two summers. The 78 pages of consent conditions required an extensive network of monitoring sites and supporting systems be set up focussing on four ecosystems:

- Waikanae borefield
- Seven small coastal streams
- 13 wetlands
- Waikanae River.

This paper describes the setting up of that network and systems, the changes that have been made to the consents to recognise the practicalities both on-the-ground and in the monitoring framework, the results of the monitoring and how this is being reported to the regulator/ stakeholders/ public (e.g. a website for the 150 private well owners who are potentially affected), the workings of the innovative Adaptive Management Group, and what the future might hold for the optimisation of monitoring of RRwGW.

Three key points that are explored and documented are:

- Because RRwGW was an innovative water supply scheme, a conservative approach was taken in the consenting, resulting in a high level of monitoring. Council is hoping it will be able to optimise the level of monitoring in the short to medium term, as the degree of uncertainty around the actual effects reduces over time.
- How a collaborative and pragmatic approach to the monitoring has resulted in more efficient and effective data gathering and reporting.
- How adaptive management can work in practice.

Key Words

Kāpiti, Waikanae River, groundwater, river recharge, monitoring, adaptive management

Introduction

The Waikanae River is the water source for Kāpiti Coast District Council's drinking-water supply for the communities of Waikanae, Paraparaumu and Raumati. In September 2013, resource consent was granted for the River Recharge with Groundwater (RRwGW) scheme for a 35-year term.

RRwGW is an innovative solution that uses groundwater, pumped from the Council's existing borefield in Waikanae, to recharge the Waikanae River and maintain the river's residual flow requirements downstream of the water treatment plant intake. This enables continued abstraction from the preferred Waikanae River source during

times of low river flows, rather than switching over to the groundwater source for supply as happened previously. The groundwater-sourced drinking-water was the cause of community dissatisfaction as the water quality (hardness and saltiness) was disliked by the community.

The suite of resource consents for the RRwGW scheme comprises five consents, as listed below, with a total of 78 pages of conditions:

- abstraction and use of water from the Waikanae River
- abstraction and use of groundwater from the Waikanae Borefield
- discharge of groundwater to the Waikanae River

- construction and operation of groundwater bores within the Waikanae Borefield
- construction and operation of structures in the Waikanae River.

Because RRwGW was an innovative water supply scheme (a first of its type in New Zealand), the consents apply a conservative approach and require Kāpiti Coast District Council (Council) to undertake extensive monitoring of four hydrological and biological systems:

- Waikanae borefield
- Seven small coastal streams
- 13 wetlands
- Waikanae River.

Council collects over 1400 manual and 136 automated parameters from these systems.

The monitoring has been divided into two phases by the consents: baseline and ongoing. The 3 years of baseline monitoring is intended to gather additional reference information on the four ecosystems that will then be used to inform the development of an ongoing monitoring programme and ongoing management triggers to identify and mitigate potential adverse effects.

There has been much work in setting up the network of monitoring sites and associated systems. Through the implementation of the suite of consents there have also been changes to the consent conditions required to recognise the practicalities both on-the-ground and in the monitoring framework. The scheme has now been monitored over two summers, with reporting of the results to the regulator, stakeholders and the public.

An integral and innovative part of the RRwGW scheme is the Adaptive Management Group that can make recommendations for changes to monitoring or management actions in response to monitoring results or issues raised by stakeholders. The current phase of baseline monitoring is quite resource intensive, despite automating much of it, and as further monitoring data is collected over time, opportunities for optimising the monitoring of RRwGW will continue to be sought by Council.

Set up of Monitoring Network and Supporting Systems

Monitoring Sites

Council's existing groundwater monitoring network for the Waikanae Borefield has been extended with the drilling of 12 new monitoring wells. There are now 27 monitoring wells that are used for collecting continuous water level data to monitor drawdown in the shallow and deep aquifers, as well as electrical conductivity data collection to monitor saline intrusion in wells along the coast. The groundwater monitoring wells are located in road reserve or Council parks. Water level and electrical conductivity sensors were installed in the new monitoring wells, and existing equipment replaced for consistency. Each monitoring well site is equipped with telemetry for continuous monitoring. Groundwater monitoring sites that were in existence at the commencement of the consent, and had historic water level data, have interim triggers. If interim triggers are exceeded, alarms are generated by Council's SCADA system and automatic notifications are emailed to Council, Greater Wellington Regional Council (GWRC) and CH2M Beca (engaged by Council to assist with managing compliance with the RRwGW resource consents). There are then prescribed actions to take based on the level of trigger: alert, action or cease. Seven of the existing monitoring wells are operated by GWRC. For these sites the equipment is unchanged, but GWRC's and Council's monitoring systems have been configured such that water level information is automatically transferred from GWRC to Council's SCADA system approximately every two hours.

Monitoring sites on seven small coastal streams have been established to monitor potential effects of the abstraction of groundwater from the deep aquifer for RRwGW on the flow regime and ecology of the small streams that are in the vicinity of the Waikanae Borefield. Each stream site is equipped with in-stream sensors to continuously measure dissolved oxygen, temperature and water level during the summer months, plus a piezometer adjacent to the stream for shallow groundwater level monitoring. Two of the stream sites have telemetry, whilst the other five sites have data loggers which are downloaded monthly. Manual ecological monitoring is also carried out at the stream sites.

Thirteen wetlands in the vicinity of the Waikanae Borefield are monitored for potential groundwater drawdown effects. Shallow groundwater levels are monitored via piezometers with water level recorders. Where possible existing piezometers operated by either GWRC or the alliance that is constructing the Mackays to Peka Peka Expressway have been utilised. Many of the sites have telemetry, whilst others have loggers that are downloaded monthly. Manual ecological monitoring is also carried out at the wetland sites. Similar to the Waikanae Borefield, interim triggers on shallow groundwater levels apply to the wetland monitoring sites.

There are five monitoring sites on the Waikanae River; two upstream of the water treatment plant intake and three downstream. These sites are visited fortnightly or weekly during the summer monitoring period by ecologists for in-river sampling. There is no equipment installed at these sites and no continuous data collection.

Some of the monitoring sites for the wetlands and small coastal streams are on private land. For these sites Council has put in place agreements with landowners to permit installation and ongoing access to the monitoring sites.

Council procured the monitoring equipment and then tendered a separate contract for the installation of the sensors and telemetry. Council staff and its automation provider completed the PLC and SCADA integration for the telemetered sites.

Data Management

With the collection of a vast amount of monitoring data collected automatically and manually across more than 50 sites for a variety of different parameters (136 and 1400 plus parameters respectively), the management and analysis of this data needs to be streamlined to facilitate reporting to the regulator, stakeholders and public. Council is using WaterOutlook as the data management and reporting system for RRwGW. WaterOutlook pulls data from Council's SCADA system and stores data for manual parameters collected in the field. This data can then be collated, analysed or graphed as required using a series of reporting templates.

Operations

Having set up the monitoring network, Council staff now perform maintenance and calibration of the monitoring sites. The automated monitoring sites have not been without their problems. Hardware and firmware issues with sensors, logger failure and flooding have required attention and resolving. However, these issues have provided the opportunity to refine maintenance procedures and systems.

Communication and management procedures for responding to trigger alarms have also been developed so that the duty water treatment plant operator can respond accordingly. There have not been any true trigger exceedances to date but several alarms have been generated, particularly in the first summer of monitoring. Most often trigger alarms are generated when maintenance is being carried out and equipment is taken out of a monitoring well or the like.

Monitoring Results

Waikanae Borefield

Abstraction from the Waikanae Borefield for water supply occurred during autumn 2015 due to low river flows, and abstraction for recharge occurred in October 2015 and mid March 2016. None of the interim alert triggers have been exceeded to date.

The introduction of water meters across the region has dropped peak day demand by 26% (2014/2015 vs. 2012/2013) which has meant less bore water into supply during the RRwGW baseline monitoring period.

The extensive water level records gathered from 27 monitoring sites are generally in line with expectations. The extended monitoring network has greater coverage than previously which provides greater insight to the hydrogeology around the Waikanae Borefield.

The data collected over the first three years will be used to update the groundwater model that was developed for the consenting of RRwGW and this will inform the ongoing monitoring regime and triggers.

Similarly electrical conductivity monitoring data is being collected from 12 sites along the coast line.

Results are generally in line with expectations and trends are being identified that will be used to set trigger levels which is the goal of current monitoring.

Small Coastal Streams

Across the seven monitored small coastal streams the measures of local fish and aquatic macroinvertebrates found that there were low number of fish present in the streams and the fish species and macroinvertebrate communities present are not generally sensitive to water depth or habitat quality changes. In-stream water depth and shallow groundwater levels adjacent to the streams are anticipated to be better indicators of effects than ecological measures. The 2014/15 monitoring also showed that two sites were not of value as indicators for future monitoring for ecological impacts as they naturally dry up during summer.

Wetlands

Water levels measured in the wetland monitoring piezometers are within expected levels and no trigger levels have been exceeded. An overall decline of water levels was observed in most sites during January to March, with levels increasing again from April. Alarm notifications that have been received and communicated to GWRC were all due to either maintenance of equipment or natural declines in shallow groundwater levels across the district.

Two vegetation monitoring plots have been established in each of the 13 monitored wetlands and these have been surveyed for species and condition measures. Aerial photography has also been undertaken of the entire wetlands to provide a baseline.

Waikanae River

Baseline monitoring of the Waikanae River is carried out during the months of December to April. This monitoring involves collection of periphyton data, macroinvertebrate samples and water quality measurements at sites upstream and downstream of the water treatment plant intake and river recharge point. One of the key concerns at the consent hearing was the effect of the groundwater discharge on algal growths in the river, so there is an interim trigger for high periphyton levels downstream of the river

recharge point when high levels of periphyton are not measured upstream of the recharge point.

At the time of writing (mid March 2016) river recharge has been used only briefly in October 2015 and March 2016, and so to date the river monitoring results are essentially just a baseline for now without any groundwater discharge present.

Reporting on Monitoring

Regulator

The key reporting requirement of the consents is three annual reports to GWRC with details of the operation and monitoring results for abstraction from the Waikanae Borefield, and for abstraction from and discharge to the Waikanae River. These reports are presented to the Adaptive Management Group (see below) as drafts prior to being finalised and submitted to GWRC. The reports are then published on Council's website for the public to access.

Communication with the regulator, GWRC, is however much more frequent than once per year. From the commencement of the consents Council has been very forthcoming and inclusive with GWRC in keeping them abreast of progress with monitoring and issues as they arise, even before a solution may be identified.

The highest compliance rating was awarded to Council by GWRC for the RRwGW consents for 2014/15 (Green four stars). The compliance assessment acknowledged Council as being proactive in meeting their consent requirements.

Stakeholders

Six key stakeholders are named in the consents. Any other person may request to be included as a stakeholder. The consents require the Council to advise the stakeholders of meetings of the Adaptive Management Group (see below) and supply them with copies of any reports or recommendations arising from the Group's activities. Council has been more inclusive with stakeholders and invited them to participate in all Adaptive Management Group meetings and supplied them with copies of the draft and final annual reports.

Public

Council uses eight production wells in the Waikanae Borefield to draw water from the 70-90m deep Waimea aquifer. One of the potential effects of groundwater abstraction from the Waikanae Borefield is the lowering of water levels in the shallow aquifer which is widely used by private well users. A public website (www.kapiticoast.govt.nz/private-bores) has been developed that enables users to access up to date graphs of Council's groundwater level monitoring data over the past 24 hours to six months. The website has a geographical interface that allows a user to enter their address and identify the nearest monitoring wells.

In accordance with the consent requirements, Council has identified approximately 150 properties that may have existing wells that are relied upon as the sole source of domestic or stock water (i.e., properties not connected to the public reticulated supply) and are located within a one kilometre radius of each of the Council's production bores. A database of these properties has been established as well as procedures for working through issues if users are not able to get water from their private wells. Council has provided guidance material to all these well owners on potential effects and actions to be taken

Adaptive Management Group

An integral and innovative part of the RRwGW scheme is the Adaptive Management Group, which was proposed by Council as part of the consent application. This group comprises representatives of GWRC, Council and Te Āti Awa ki Whakarongotai. The Adaptive Management Group (AMG) is a forum for the dissemination and collection of information and provides the opportunity to comment on consent compliance and provide recommendations for changes to operations, monitoring and adaptive management.

The AMG is guided by its Terms of Reference. The group formally meets once a year to review the draft annual monitoring reports and recommend adaptive management changes to the operations and monitoring for the RRwGW scheme for the following year. Key stakeholders are invited to these meetings also. The regular coming together of the consent holder, regulator,

iwi and stakeholders promotes the collaborative approach to managing the RRwGW scheme and adapting to what the monitoring results reveal. The AMG and stakeholders have expressed that annual updates are not frequent enough, and so interim briefings during the year have been proposed.

At the last AMG meeting prior to submission of the final annual reports for 2014/2015, the AMG agreed to:

- cessation of ongoing fish and macroinvertebrate sampling surveys and spot water quality measurements for the small coastal streams as results suggest these measures are poor indicators of effects from the RRwGW scheme
- discontinuation of two small coastal stream monitoring sites that were dry for a period over summer in the absence of groundwater abstraction
- reducing the frequency of formal reporting to GWRC on the ecological monitoring for the streams and Waikanae River from monthly to seasonally as this better matched GWRC's review periods
- extension to the submission date for the annual reports to provide adequate time for their preparation and AMG reviews
- modification to the consent to make allowance for the actual operation of the Waikanae River intake and production bore pumps at pump start-up as instantaneous pump rates exceeded pump set points while the system settled to hydraulic equilibrium,
- consideration of alternative methodologies for periphyton monitoring and fish surveys in the Waikanae River
- refinement of macroinvertebrate sampling in the Waikanae River to focus on the data gap of higher periphyton growth levels rather than continuing to gather superfluous data on macroinvertebrates with low periphyton levels.

Recommendations made by the AMG still require the approval of GWRC as consent regulator before implementation.

Changes to the Consents

Full compliance with the conditions of their consents is of the utmost importance to Council.

Through implementing the consents and their various conditions Council identified that some aspects of the conditions open to interpretation or impractical in operation. In all cases there has been upfront and regular communication with GWRC to discuss the issues and identify an appropriate way forward.

As with other major projects with suites of consents and a large number of conditions, minor amendments to the consent conditions to clarify their intent, assist with compliance and refine the monitoring framework are not unusual. Changes to the consent conditions have been sought via three applications to GWRC under Section 127 of the Resource Management Act 1991 (RMA). GWRC has approved three sets of changes to consents over the past 18 months.

The first set of condition changes were primarily related to clarifying interpretation and implementation on the ground. As an example, the consents required the setting of interim triggers for new groundwater monitoring wells one year after the commencement of the consent. The consent did not explicitly provide for a transition period to allow the new monitoring infrastructure to be put in place and for monitoring data to be gathered, and so the conditions were revised to require the setting of interim triggers after one year of data collection. It has also been agreed that triggers for groundwater drawdown do not apply during the winter months provided that the Waikanae Borefield is not being used for supply or river recharge. This removes the need to gather data from non-telemetered sites during the winter months, and offers an opportunity for maintenance activities between the monitoring seasons.

The second set of approved changes achieved an improved wetland trigger framework. The wetland interim triggers were altered to consider district-wide seasonal variations in groundwater levels, rather than a fixed reduction in water level, and these triggers are now applicable only to wetlands that are less than 2 km from Council's operable production wells. Previously the wetland triggers applied to some wetlands near to the locations of proposed future production wells that will be drilled over the next 30+ years as the community grows and the RRwGW scheme is expanded.

The most recent changes arose from a review of the 2014/15 monitoring year. Overall these

changes enhance the clarity of the conditions and facilitate monitoring that is more efficient and effective in measuring the actual effects of the RRwGW scheme on the environment. Recommendations made by the AMG are integral part of changes consent conditions applications.

Into the Future

Council expecting to be able to optimise the level of monitoring in the short to medium term, as greater certainty around the actual effects increases over time with the use of RRwGW.

The full effects of RRwGW, as presented in the consent application, will not be a reality until the groundwater abstraction and river recharge volumes are at their 50-year design capacities and there is a 1 in 50 year low flow event. In the meantime, the operation of RRwGW and associated monitoring will provide more data about the environmental responses and actual effects of the scheme. This increased understanding will enable monitoring to be more efficiently and effectively targeted to the potential effects, thereby reducing the conservatism that underpins the consents at present.

The collaborative approach applied to the scheme to date has been a key part of the success of the scheme and will continue to be a key part of the scheme's future.

Conclusion

Because RRwGW was an innovative water supply scheme, a conservative approach was taken in the consenting, resulting in a high level of monitoring. There has been much effort in setting up the monitoring network and providing associated systems to manage the data collected and to respond to monitoring alarms. The initial, 3-year period of monitoring is wide ranging across four ecosystems with the consents seeking a greater understanding of the current status of these environments to inform the development of an ongoing monitoring regime and trigger levels.

Already there have been some changes to the consents to reflect the practicalities of operating and monitoring the RRwGW scheme, and some changes to the monitoring programmes to better target indicators of effects. These changes have been identified and implemented through a collaborative approach with the regulator, the

Adaptive Management Group and key stakeholders. The Adaptive Management Group has also led to a more effective way of working together between iwi, GWRC and Council.

The degree of certainty around the actual effects of RRwGW will further increase over time as the system is used and monitored. It is Council's hope that it will be able to optimise the monitoring in line with this increase in certainty, and with the commitment to adaptive management of the scheme to safely guard the environment.

The first year of baseline monitoring has been successfully completed and GWRC have

approved river recharge of up to 20% for the following two years of baseline monitoring.

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Author Biographies

Martyn Cole is a Chartered Engineer with Engineers Ireland and has over 21 years' experience planning and delivering projects in the water industry including 9 years spent overseas in Ireland and the UK. He is passionate about making a real difference for the community he serves by continuously improving the value for money delivered and increasing the confidence in and communication of the decision making processes. Martyn is the Water and Wastewater Asset Manager for Kāpiti Coast District Council responsible for the planning and delivery of asset management and long term strategic goals for water and wastewater services in Kāpiti.

Tracy Clode is an Associate – Project Management for CH2M Beca based in Wellington. She is a Project Management Professional with a background in Civil Engineering focused on the water industry. Her 15 years plus of experience is predominantly in delivering local authority and remote community water and wastewater infrastructure, and includes working for 7 years in Scotland. Tracy is currently the Project Manager for the three-year commission for the monitoring of the RRwGW scheme.

Kirsten Fraser is an Associate – Environmental Engineering for CH2M Beca, based in Wellington. Kirsten was extensively involved in the Kāpiti Coast Water Supply project; providing senior technical support to the investigations, design and consenting work that was undertaken on that project. She is currently Technical Lead for the three-year commission for the monitoring of the RRwGW scheme.

Michael Goff is an Associate – Hydrogeology for CH2M Beca, based in Auckland. Michael has nearly 30 years of experience in hydrogeology and water resource management. He has worked in Florida, California and Nevada USA as well as Abu Dhabi, UAE and Riyadh, Saudi Arabia prior to joining CH2M Beca in New Zealand about 2 years ago. Mike is the Hydrogeology Lead for the three-year commission for the monitoring of the RRwGW scheme.

Nathan Baker is a Technical Director – Planning for CH2M Beca, based in Wellington. Nathan led the consenting for the Kāpiti Coast Water Supply project and is a strong advocate of the adaptive management approach being applied for the RRwGW scheme.