RIVER RECHARGE WITH GROUNDWATER – ADAPTIVE MANAGEMENT IN PRACTICE

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Abstract

In late 2017 Kapiti Coast District Council's award-winning River Recharge with Groundwater (RRwGW) scheme completed three years of baseline monitoring and is set to transition into ongoing mitigation monitoring. The three key points/learnings that will be explored and documented are;

- How a collaborative and pragmatic approach to monitoring has resulted in more efficient and effective data gathering, data analysis and reporting,
- how adaptive management has worked in practice and how it is programmed to continue into the future, to ensure the project can respond effectively to changes in social, economic and environmental influences, and
- because RRwGW is an innovative water supply scheme, a conservative approach was taken in the consenting, resulting in a high level of baseline monitoring. For ongoing mitigation monitoring Council has worked extensively with the regulator, Iwi partners and stakeholders to optimise the level of monitoring to achieve the intent of the consent, whilst remaining sustainable for the local community.

Key Words

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

Introduction

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

RRwGW uses groundwater, pumped from the Council's 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:

- 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 required Kāpiti Coast District Council (Council) to undertake extensive monitoring of four hydrological and eco systems:

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

The monitoring is divided into two phases by the consents: baseline and ongoing. The three years of baseline monitoring gathered additional reference information on the four ecosystems that has been used to inform the development of the ongoing monitoring programme and ongoing management triggers to identify and mitigate potential adverse effects going forward.

An integral part of the RRwGW scheme is the adaptive management approach and Adaptive Management Group. This group can make recommendations for changes to monitoring or management actions in response to monitoring results or issues raised by stakeholders

Throughout the implementation of the suite of consents there have been changes to the consent conditions required to recognise the practicalities both on-the-ground and in the monitoring framework. The Adaptive Management Group has been and is a fundamental component of these changes going forward.

The scheme has now been monitored over four summers, with reporting of the results to the regulator, stakeholders and the public.

Baseline monitoring is now complete and interim restrictions on the recharge volumes have been removed by the regulator. Council is moving into the ongoing monitoring phase of the consents.

Baseline Monitoring

Monitoring Sites

The baseline monitoring phase of work was resource intensive, despite much of it being automated.

Council's groundwater monitoring network for the Waikanae Borefield has 27 monitoring wells that were 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. These site were telemetered for continuous monitoring. Sites that were in existence at the commencement of the consent had interim triggers.

If interim triggers were exceeded, alarms were generated by Council's SCADA system and automatic notifications emailed to Council, Greater Wellington Regional Council (GWRC) and CH2M Beca (engaged by Council to assist with managing compliance with the RRwGW resource consents).

All triggers have prescribed actions to be taken based on the level of trigger: alert, action or cease. Several of the monitoring wells are operated by GWRC. GWRC's and Council's monitoring systems have been configured such that water level information is automatically transferred from GWRC to Council's SCADA.

At the commencement of baseline monitoring seven small coastal streams were 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 was 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. Manual ecological monitoring was also carried out at the stream sites. Based on results of early baseline monitoring the sites were rationalised to five in consultation with the Adaptive Management Group and key stakeholders.

Shallow groundwater levels were monitored via piezometers at thirteen wetlands in the vicinity of the Waikanae Borefield for drawdown effects. Where possible existing piezometers operated by either GWRC or the alliance that constructed the Mackays to Peka Peka Expressway were utilised. Manual ecological monitoring was 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 were visited fortnightly or weekly during the summer monitoring period by ecologists for in-river sampling as part of baseline monitoring.

Council collected over 1400 manual and 145 automated parameters from the four systems during baseline monitoring.

During baseline monitoring the consent restricted the amount of recharge that could take place to 20% of the downstream river flow. This meant that should demand have required it Council would have to put bore water into supply during

this period. Abstraction from the Waikanae Borefield for water supply occurred during autumn 2015 due to low river flows. However since 2015 no further bore water has been required to go into supply.

The introduction of water meters across the region dropped peak day demand by 26% (2014/2015 vs. 2012/2013) which has meant less bore water needed during the RRwGW baseline monitoring period even during dry summers. The 490 l/p/peak day water conservation target was also met and maintained.

Completion of Baseline Monitoring

Waikanae Borefield

The extensive water level records gathered from 27 monitoring sites was generally in line with modelled predictions and has provided greater insight to the hydrogeology of the Waikanae Borefield.

The groundwater model that was developed for the consenting of RRwGW was reviewed based on the data collected over the three years of baseline monitoring. It was found that the predicted modeled drawdown had not changed from the time of consenting. The model was used to inform the ongoing monitoring regime and triggers.

Electrical conductivity (EC) monitoring data was collected from 13 sites along the coast line. During baseline monitoring trends were identified for water level and EC that were used to set interim trigger levels for sites installed at the start of the consent. The data was reviewed again for the setting the Ongoing Trigger levels for ongoing monitoring. 17 of the 27 water level monitoring sites retained their interim triggers levels for ongoing monitoring. And three of the 13 EC sites retaining their interim trigger levels.

The sites were also rationalised based in the findings for ongoing monitoring to those that that would be effective for indicating potential adverse effects. This resulted in the removal of one EC site and four water level monitoring sites following consultation with the Adaptive Management Group and regulator.

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. The 2014/15 monitoring also showed that two sites were not of value as indicators for future monitoring for ecological impacts as they naturally dryed up during summer. The Adaptive Management Group agreed with the recommendation that monitoring cease for these two sites going forward.

Review of the baseline monitoring data showed that in-stream water depth and shallow groundwater levels adjacent to the streams were better indicators of effects than ecological, temperature and dissolved oxygen measures.

The drop in water level in the streams may not be an indicator of an effect of river recharge. A link between the borefield abstraction and shallow ground water monitoring wells needs to be established. Plus a link between the shallow groundwater water level and the instream water level.

Demand and baseline monitoring requirements prevented the borefield from been extensively pumped during baseline monitoring. Despite this baseline monitoring allowed the sites to be rationalised to the streams that would be the best indicator of a potential link and any effect from river recharge in conjunction with the predicted draw down model. Additional review triggers have been included into the ongoing monitoring programme to confirm if a link between the borefield and stream existing, once a higher level of abstraction takes place, and if monitoring needs to be rationalised further.

The Adaptive Management Group including Iwi agreed with this approach and that the monitoring should be focused on areas when indicators may be present.

Wetlands

Water levels measured in the wetland monitoring piezometers are within expected levels. An overall decline of water levels was observed in most sites during January to March, with levels increasing again from April natural declines in shallow groundwater levels across the district.

Data from the two vegetation monitoring plots

established in each of the 13 monitored wetlands and surveyed for species and condition measures were reviewed at the end of baseline monitoring along with prevalence indices Aerial photography has also been undertaken of the entire wetlands to provide a baseline for future reference.

As with the small coastal streams, the borefield has yet to be pumped sufficiently to demonstrate a link between the groundwater abstraction and wetlands. Data from baseline monitoring and the groundwater abstraction was used to rationalise the wetland monitoring going forward into Ongoing Monitoring. Also, as with the streams, a trigger to review the site for the link between shallow water levels and the borefield was introduced. The Adaptive Management Group and the regulator viewed this as a pragmatic approach.

Waikanae River

Baseline monitoring of the Waikanae River was carried out during the months of December to April over the three year period. 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 growth 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.

Analysis of the numerus parameters collected during baseline monitoring found two water quality parameters that are an indicator of a potently adverse effect. These are dissolved reactive phosphate and salinity.

The baseline monitoring provides a good understanding of the river condition and also that the river is effected by numerus factors. It also showed that periphyton, and the water quality changes, above and below the discharge point will be the most effective indicator of effects from river recharge. A pragmatic approach was taken to undertaking monitoring going forward when a sustained duration and quality of ground water was discharge to the river. The regulator requested additional fish baseline monitoring be undertaken which has been built into the ongoing monitoring.

Findings

The findings from the three years of baseline monitoring were presented and discussed with the Adaptive Management Group and key stakeholders in development on the ongoing monitoring programme.

At the time of writing (mid March 2018) river recharge has been used only briefly in October 2015 and March 2016, and was used intermittently from December 2017 to February 2018 (following completion of baseline monitoring). The AMG and key stakeholders are kept updated about river recharge activates enabling them to field question from the community if need be.

Reporting on Monitoring

The key reporting requirement of the consents is three separate 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, 2015/16 and 2016/17 (Green four stars). The compliance assessments have acknowledged Council as being proactive in meeting their consent requirements.

Adaptive Management

Adaptive Management Group and Stakeholders

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 has formally met twice 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 a collaborative approach to managing the RRwGW scheme and adapting it to what the monitoring results reveal.

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 for their comment.

Application of Adaptive Management

The AMG have provided comment and recommendations every year during baseline monitoring and will continue to do so during ongoing monitoring.

The outcomes from the process have resulted in three changes to the consent to date to align the conditions with the practicality of implementing the consent requirements. The baseline monitoring requirements were adjusted based on the findings each year to focus the monitoring on results from the past year along with changes in social, economic and environmental influences.

Changes have enhanced the clarity of the conditions and facilitated 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 an integral part of applications to change consent conditions.

The AMG and stakeholders also met at the end of baseline monitoring to provide comment on the ongoing monitoring program (Ongoing Mitigation Plans).

There is another change to the consent being prepared, following consultation with the AMG: to remove the baseline monitoring requirements from the consent as these conditions have now been met. This change was proposed by GWRC to make the consent "operational/ business as usual". This will make review of the annual reports cleaner and halve the number of conditions that need to be reviewed and confirmed are being met each year.

As part of ongoing monitoring the AMG will be provided with the draft annual reports for review and provide recommendations based in the most recent data collected at a meeting with Council. The AMG will also work with Council on any amendments to the ongoing monitoring in the future.

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

Ongoing Monitoring

In collaboration with the AMG, Council has been able to start optimising the level of monitoring required as the consents moves into the ongoing monitoring phase. This is a result of increased certainty around the indicators of actual effects increasing as a result of baseline monitoring.

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.

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.

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

Into the Future

Council is expecting to be able to optimise the level of monitoring further in the medium to long 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. The increased understanding from baseline monitoring has enabled monitoring to be more efficiently and effectively targeted to the potential effects, thereby increasing surety about the protection of the environment that has underpinned the original consent. This remains a work in progress.

A key success of the scheme to date is a result of the collaborative and practical approach taken by all parties. This will continue to be a key part of the scheme into the 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 during baseline monitoring. The three years baseline monitoring was 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.

Following analysis of the baseline monitoring data the ongoing monitoring programme was developed in consultation with the Adaptive Management Group. This led to a level of optimisation of the monitoring sites and parameters along with some changes to the consents to reflect the practicalities of operating and monitoring the RRwGW scheme as “business as usual”.

The commencement of the going monitoring phase allowed 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 lead to a more effective way of working together between iwi, GWRC and Council.

The degree of certainty around the actual effects of RRwGW has increased as a result of baseline monitoring and allowed Council to focus on locations and parameters that better indicate potential effects going forward. These parameters will be able to be refined further 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 safeguard the environment.

Baseline monitoring has been successfully completed and GWRC have approved the removal of the 20% the restriction to river recharge.

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Author Biographies

Martyn Cole is a Chartered Engineer with Engineers Ireland and has over 24 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 17 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 the Project Manager for the three-year commission for the monitoring of the RRwGW scheme.