SCIENCE & INNOVATION ACTIVITY

1 Activity Overview

Horizons' Science and Innovation team oversees delivery of monitoring and research across a broad range of Council activities including Water Quantity and Quality, Land, Biosecurity and Biodiversity, and Environmental Reporting and Air Quality Monitoring.

Programmed work for 2018/19, as set out in the Science Operational Plan, includes:

- Delivery of core monitoring programmes;
- Ongoing investigations into regional drinking water security;
- Delivery of the national groundwater pesticides survey;
- Fluvial surveying of the Pohangina and Whangaehu Rivers;
- A review of the biodiversity programme and implementation of recommended changes;
- Provision of new data on the **Land, Air, Water Aotearoa** (LAWA) website;
- Research into the impacts of climate change in the Region;
- **State of Environment** (SoE) reporting; and
- Development of a science communication strategy.

This activity report covers the reporting period from 1 April 2019 to 30 June 2019, as well as providing an annual summary of activity completed throughout the reporting year.

Performance measures, as set out in the Long-term Plan 2018-28, include the presentation of an annual report on monitoring and research activity, provision of public information via LAWA and SoE reporting, research into climate change and public drinking water security, and the development and implementation of a science communication strategy. An overview of progress against these targets is provided in Table 1 below. All 20 operational plan targets were met in the 2018/19 year. This item presents the annual report for the Science activity in the 2018/19 year.

Table 1 Year-to-date progress against performance measures set out in Horizons' Long-term Plan 2018-28.

Performance Measures for Levels of Service	Target 2018/19	Progress Update
Water Quantity and Quality		
Water quantity and water quality information is made available to the public via LAWA (www.lawa.org.nz) and Horizons' websites.	Data provided to LAWA as required	Data has been provided to LAWA and is now available on the website. Data preparation for the September 2019 refresh is also close to completion.
Annual report on water quantity and quality monitoring and research activity.	Develop an annual reporting framework and produce an annual report	An annual report on water quantity and quality activity was developed and presented to Council in August 2018.
Land Management		
Annual report on the land and fluvial monitoring and research activity.	Develop an annual reporting framework and produce an annual report	An annual report on land and fluvial activity was developed and presented to Council in August 2018.
Biodiversity and Biosecurity		
Annual report on biodiversity monitoring and research activity.	Develop an annual reporting framework and complete an annual report	An annual report on biodiversity research activity was developed and presented to Council in August 2018.
Environmental Reporting and Air Quality Monitoring		
Provide an annual summary report on the state of the environment.	Annual reporting framework is developed and a report produced	The State of Environment report was published in May 2019.
Develop and implement a science communication strategy.	Strategy and implementation plan developed	A strategy for science communication was developed.
Complete drinking water supply research with a focus on Council-operated drinking water supplies and complete an annual report on this to Council.	1	Source protection delineation and bore inspections for council-operated supplies serving 500 people (or more) were completed during 2018-19.
Investigate one aspect of climate change impact in the Region and report on this to Council.	1	A presentation by NIWA on the potential impacts of climate change on the Region was provided to Council on 14 May 2019. The report is now complete.
Air quality is monitored in Taihape and Taumarunui and reporting is made available to the public via LAWA and the annual State of Environment report.	Completed	Monitoring is ongoing and data is available to the public via the Horizons and LAWA websites. The State of Environment report was published in May 2019.
Undertake an annual public education air quality campaign.	1	A 2018 winter radio advertising campaign was completed and further information provided in the State of Environment report.

2 Water Quantity and Quality

Water is an important resource that provides for the cultural, environmental and economic needs of our Region. The Science and Innovation team serves the Water Quality and Quantity activity of Horizons' Annual Plans through a range of science monitoring and research programmes that track changes in the water resource and inform decision-making around water management.

2.1 Water Quantity

Surface Water

2.1.1 The core surface water quantity monitoring programmes continue, providing a wide range of information relating to river level, flow, rainfall, soil moisture, lake and groundwater levels and water use. This work is guided by the Catchment Data/Science Memo that describes the contents of the core hydrology programme for the year and outlines any direct requests by the Science and Innovation team for time from the Catchment Data team.

2.1.2 The water metering project (which is a fundamental component of managing water allocation and meeting Horizons' obligations under the National Regulations on Water Use Measurement and Reporting and NPS-FM) has progressed as well as possible within the current resourcing framework. With the implementation of the IRIS database has come an additional workload that was not anticipated. The team has worked with Consents Monitoring to prioritise telemetry installation and following up on water meter installations but with the IRIS reporting functionality still outstanding in this space, managing and reporting project progress has been challenging and remains a largely manual process.

2.1.3 The Accelerate25 report on water resource availability is in the final stages of completion following revision of the allocation data to May 2019 data. The reporting brief originally requested, the inclusion of draft "report cards" for surface and groundwater, summarising water availability and current use types and so on. It is recommended that these be produced as a web-based product with linkages to real-time information in addition to or as part of the SoE Annual Report cards due to the changeable nature of the data to be reported.

Groundwater and Lakes

2.1.4 Rainfall has been normal or above average in most parts of the region over the last 12 months. This has helped maintain groundwater levels over the year in most parts of the region, however water levels were lower than normal in the coastal Rangitikei area (Santoft) and some sites around Palmerston North.

2.1.5 Groundwater level trends were assessed as part of the 2019 State of Environment report recently released. It showed groundwater levels were improving at 30% of monitored bores, and declining at 14%. Those declining bores are primarily in the Santoft, Palmerston North and Rongotea areas.

2.1.6 Horizons also continues to monitor the water levels in several of our coastal lakes. This includes telemetered data on Lake Horowhenua and Lake Koitiata, and manual monthly monitoring of Lakes Poroa, Dudding, Pauri, Wiritoa, Westmere and Kohata.

2.2 Water Quality

Surface Water

2.2.1 The SoE and Discharge monitoring programme was completed, with additional water quality parameters included from April 2018 to provide essential information for our Catchment Characterisation programme.

2.2.2 Results from these programmes have been analysed for the State of Environment report. A state and trend technical report of river water quality was completed and presented to Council at the Strategy and Policy meeting in November 2018.

Fraser, C. and Snelder, T. (2018). State and Trends of River Water Quality in the Manawatu-Whanganui Region, for records to up to 30th of June 2017. Land Water People Client Report prepared for Horizons Regional Council.

Patterson M, Matthews A and Roygard J. (2018) State and Trends of River Water Quality in the Horizons Region, Report No 18-197 to the Horizons Regional Council Strategy and Policy Committee, 13 November 2018.

2.2.3 A follow-up piece of work investigating the spatial drivers of river water quality state and trends has been drafted and received by Horizons. It will be presented to Council following its completion.

Groundwater

2.2.4 Groundwater monitoring network continues to be reviewed and upgraded where possible, now consisting of 35 bores in addition to three for the National Groundwater Monitoring Programme (NGMP). These are monitored on a quarterly basis and the results of which was published in the 2019 State of Environment report. One bore to the north-east of Levin shows a slight degrading trend over five years.

Thomas, N. (2019). Report on Horizons Groundwater Monitoring Data. Pattle Delamore Partners Ltd Client report prepared for Horizons Regional Council, August 2018.

2.2.5 The four-yearly pesticides survey was undertaken in September 2018. In addition to the usual suite of pesticides we normally test for, glyphosate and a range of emerging organic contaminants were also included. Results showed pesticide and herbicide results at two bores, while no glyphosate (or its metabolites) were detected in any bores. Emerging contaminant results will be available later in 2019. The report is scheduled to be completed by ESR and provided to Horizons in October 2019.

Lakes

2.2.6 Water quality is monitored at 15 lakes in the Region. Eleven lakes have been monitored by helicopter since 2015. Lakes Dudding, Wiritoa and Pauri have been monitored quarterly by boat since 2014 and increased to monthly in late 2018 and early 2019 to further understand the in-lake processes. Lake Horowhenua has been monitored monthly by boat since 2013 and also has had a permanent monitoring buoy deployed for continuous monitoring for a range of parameters at various water depths. However, security issues since mid-2018 require the lake to be monitored by helicopter.

2.2.7 A comprehensive paper on lakes management was presented to Council at the Strategy and Policy meeting in March 2019. This included a summary of the results from the water quality monitoring programme and recommendations for further work in this area.

Kamke J., Daly E., Gilliland B., Matthews A., Brown L., and Roygard J., (2019), Lakes Management Update, Report No 19-29 to the Horizons Regional Council Strategy and Policy Committee, 12 March 2019

Swim Spots

2.2.8 Swim spot monitoring was completed at 82 popular recreation spots at lakes, rivers and beaches across the Region from early November 2018 to late April 2019. Our 'Swim Spot' public campaign was also delivered, while monitoring data was regularly published to both the Horizons and LAWA websites. A summary of results was presented in the State of Environment Report.

2.2.9 To identify potential sources of high bacteria levels in the Ototoka catchment a synoptic survey was undertaken. A report has been completed on the findings from this work and is available for councillors on the Hub. Following the investigation, flyers have been sent out to landowners in the catchment by the Freshwater Team targeting fencing and planting within the catchment.

Kamke J., Hurst I., and Patterson M. (2019). Faecal Source Tracking of the Ototoka Stream. Horizons Regional Council.

Swimmability

2.2.10 Council published swimmability targets in November 2018. A council paper presented in December 2018 provided a summary of the state of water quality in the region with respect to the swimmability targets and a detailed summary for the coastal Whanganui Streams.

Kamke J., Daly E., Gilliland B., Matthews A., Brown L., and Roygard J., (2019). Final Targets For Swimmable Lakes and Rivers, Report No 18-201 to the Horizons Regional Council Strategy and Policy Committee, 13 November 2018.

Patterson M., Matthews A., Brown L., and Roygard J., (2019). Whanganui Coastal Streams, Report No 18-233 to the Horizons Regional Council Environment Committee, 12 December 2018.

2.3 Biomonitoring

Periphyton

2.3.1 Periphyton monitoring is carried out at 65 sites in the Region and the programme has now been running for nine years, providing us with the largest – and most comprehensive – periphyton dataset in the country.

2.3.2 This dataset has been fundamental for use in a range of hearings carried out throughout this period (i.e. Pahiatua and Eketahuna Wastewater Treatment Plants), and is likely to continue being used in measures of policy effectiveness, particularly given the National Policy Statement – Freshwater Management requirements in this space.

2.3.3 Following on from a significant investigation of periphyton drivers and relationships in 2018, Horizons and DairyNZ co-funded a piece of work undertaken by NIWA to inform a review of the nutrient limits in the One Plan as relate to periphyton outcomes and to produce a series of look up tables which would inform decision making in catchments by indicating what would result from various changes to key drivers of periphyton growth. This report is currently being finalised.

Kilroy C. (2019). Using empirical relationships to develop nutrient targets for periphyton management – a case study from the Horizons region. Prepared for DairyNZ and Horizons Regional Council. NIWA client report: 2019092CH.

Macroinvertebrates

2.3.4 Macroinvertebrate communities are widely used as indicators of stream ecosystem health because they include a wide range of species, each with relatively well-known sensitivity or tolerance to stream conditions. The most common stream health indices are taxa richness, percentage of EPT taxa and the Macroinvertebrate Community Index (MCI).

2.3.5 Aquatic macroinvertebrate monitoring is undertaken annually in the Horizons Region and state and trends are reported following the analysis of samples. During the 2018-19 season 95 sites were sampled for state of the environment and discharge monitoring purposes. All results from our annual macroinvertebrate monitoring is fed into state and trend reporting identified in the State of Environment report and in the trend and drivers assessments carried out by Land Water People (identified in the water quality section).

2.3.6 Following on from the analysis carried out by NIWA on our periphyton monitoring programme, NIWA undertook analysis of our macroinvertebrate, periphyton, flow and water quality datasets, to deliver an assessment of the stressors likely responsible for changes to macroinvertebrate communities across the regional SoE network. This report increases our knowledge over drivers of macroinvertebrate community change, and was co-funded by Horizons and DairyNZ. This report is currently being finalised.

Graham, E., Stephens, T., Wright-Stow, A., Matthews, A., Brown, L., Patterson, M. E. & Patterson, M. J. (2019). Drivers of macroinvertebrate communities in the Horizons Region. Prepared for Horizons Regional Council and DairyNZ. NIWA client report: 2019136HN.

Fish

2.3.7 Fish and fish pass monitoring was undertaken across the region with one fish pass monitored and 12 state of the environment fish monitoring sites monitored, and an additional six sites surveyed for mudfish populations.

2.3.8 One of the key outputs in this space was the consolidation of data and early scoping of a project to be carried out in the 2019/20 financial year looking at prioritising Site of Significance – Aquatic sites (as defined in Schedule B of the One Plan). This would help identify sites for additional study or prioritisation for enhancement works.

2.4 Catchment Characterisation

New Zealand Water Model and Hydrological Programme

2.4.1 The NIWA-led New Zealand Water Model is a national project aimed at improving the understanding of hydrological processes to help with implementing land and water policies in New Zealand. Horizons is assisting in the development of this model by collecting age and isotope tracers from the Porewa Stream and rainfall isotopes from around the catchment. These are collected as part of the monthly water quality monitoring programme. Outputs of the programme so far are a number of geospatial layers that are necessary to feed into the model. Similarly, Horizons undertakes its own hydrological programme to characterise its catchments, most recently in the Ohau and Waikawa catchments.

Regional Physiographics

2.4.2 The Physiographic Environments of New Zealand (PENZ) is a three-year project that uses geospatial data and water quality information to characterise water quality variability in the landscape. Horizons commissioned Land and Water Science to develop the hydrological and redox Process-Attribute Layers (PAL) necessary to apply the Physiographics Method to the Horizons region. The hydrological PAL represents the landscape controls over water source, recharge mechanism and water pathway. The redox PAL represents the combined influence of soil and geological reduction potential. The PENZ project team will be looking to validate the PALs nationally over the next year using water quality data from Regional Councils.

Massey Collaborative Research Programme

2.4.3 The collaborative research programme between Massey University and Horizons is largely to do with understanding the flux and flows of farm nutrients to waterbodies in agricultural catchments. It is known that farm nutrients travel through different pathways and undergo different processes

depending on the catchment, but less is known about how and why they differ. The research programme aims to understand aspects of these questions, specific to the Horizons Region. Two PhDs and a number of Master's theses have so far been completed, and continues with an additional two PhDs started in 2019. One further PhD is still being advertised. The research undertaken as part of this programme aligns well with other projects supported by Horizons, including the physiographics work, a fluxmeter project on cropping systems (Foundation for Arable Research), and innovative drainage management technologies (Massey University).

2.5 Regional Water Resources

2.5.1 Horizons' groundwater allocation limits are undergoing a technical review with a final report soon to be finalised. Under Horizons' One Plan, groundwater allocation limits are calculated as 5% of the average annual rainfall across the area of each **Groundwater Management Zone** (GWMZ), which is generally considered a conservative approach to setting groundwater allocation limits. However, in some cases it over estimates the true volume available for abstraction. The report estimates new limits based on the rainfall recharge of the local underlying geology. It also looks at possible alternative approaches for allocation of the Rangitikei, Tararua and Horowhenua zones:

Thomas, N. (2019). Review of Groundwater Allocation Limits. Pattle Delamore Partners Ltd Client report prepared for Horizons Regional Council, July 2019.

2.6 One Plan Changes and 'Our Freshwater Future'

2.6.1 A range of work across the Science and Innovation work programme contributed to implementation and effectiveness monitoring of Horizons One Plan and National Policy Statement for Freshwater Management. In 2018/19 this included commissioning Land Water People in partnership with DairyNZ to provide an analysis and commentary on the appropriateness of different load calculation methods for translating a concentration based target into a load based limit, providing science advice and monitoring information to inform the Plan Change 3 process. This project is continuing in 2019/20 with the final report expected later in the calendar year.

2.7 Stormwater

2.7.1 Stormwater projects were delayed in the 2018/19 year due to the expanded work programme around drinking water (section 5.3) taking priority.

2.8 Lakes Research

2.8.1 The objective of Horizons' lake monitoring and research programme is to provide information that defines the current state of water quality and ecological condition of a selection of the Region's lakes, and measures changes in their health.

Lakes SPI

2.8.2 Horizons has an annual work programme in place with NIWA to learn more about the ecological condition of the Region's lakes. Lake SPI uses Submerged Plant Indicators (SPI) to assess the ecological condition of New Zealand lakes.

2.8.3 A Lake SPI index ranges from 0% (heavily impacted lakes) to 100% (pristine, unimpacted lakes) and provides five descriptive categories of condition. Lake SPI complements traditional water quality monitoring such as Trophic Level Index (TLI) by providing ecological information. Lake SPI field work for this year was completed in December 2018 with ten new lakes assessed. This brings the total number of lakes assessed for Lake SPI to 41. The Horizons Region has more than 220 lakes. Results for 2018/19 are overviewed in the State of Environment report and presented in more detail in the following report:

Burton, T. (2019). Assessment of 41 lakes in the Manawatū-Whanganui Region using LakeSPI. NIWA Client Report prepared for Horizons Regional Council, June 2019.

Lakes Prioritisation

2.8.4 A stocktake, gap identification and prioritisation for lakes in the region has been developed. The framework for the prioritisation is completed and the supporting report will be externally reviewed in August. The report will be made available to council once finalised.

Lake Dudding

2.8.5 A two day workshop was held in May after concerns were raised that water quality monitoring indicated that the lake may be in the process of flipping. The workshop involved lake experts from NIWA, Cawthron, Otago University, an iwi representative, as well as staff from Horizons, Rangitikei District Council, Public Health, and Department of Conservation. The aim of the workshop was to develop a joint witness statement outlining the issues at Lake Duding and identify possible interventions.

2.8.6 An expert conferencing statement was in the process of being finalised when grass carp were discovered at Lake Dudding. Unfortunately the discovery of grass carp in the lake has delayed the completion of the conferencing statement. Work will continue this year (FY 2019/20) to finalise the potential interventions considered suitable post grass carp discovery. Further information is available in the Freshwater team's section of this environment committee report.

2.9 Coastal and Estuarine Environments

Coast

2.9.1 Water quality monitoring is ongoing at 4 beach sites 1 on the east coast and 3 on the west coast. A summary of the results from this monitoring programme compared to the One Plan targets is presented in the 2019 State of Environment Report.

2.9.2 Envirolink funding was utilized to engage NIWA to undertake an Analysis of the marine climate of the South Taranaki coast in the Manawatū-Whanganui Region (in draft format for review) and a report on Marine Flow Patterns on the West Coast.

2.9.3 The main conclusions from the report on Marine Flow Patters on the West Coast included: material entering the CMA from rivers will have bigger impact on the CMA than material originating from the western end of Cook Strait; the coastal area south of the Whanganui River is most vulnerable to impacts from oceanic and riverine inputs; material is mainly transported downstream out of the CMA at its southern border, on occasion there is transport of material out of the northern and eastern border as well.

Collins, C., and Macdonald, H. (2019). Oceanic flow patterns and their influence on receiving and transmitting material on the west coast of the Manawatū-Whanganui Region: Ocean flow and its influence on transporting material. NIWA Client Report prepared for Horizons Regional Council, June 2019.

Estuaries

2.9.4 Estuaries are important coastal receiving environments of high ecological and recreational value. However, increased nutrient and sediment loads can degrade these important habitats. Following an initial vulnerability assessment of all the Region's estuaries for eutrophication and sedimentation in 2016, an ongoing programme is now being delivered for several estuaries in the Region.

2.9.5 Monthly monitoring of water quality is ongoing at six estuary sites across the Region (1 on the East Coast and 5 on the West Coast) the results of the monitoring programme were included in the State of Environment report.

2.9.6 During 2018/19 the Estuary habitat work programme included the completion of the 3rd year of baseline monitoring in the Manawatū Estuary; the first year of Fine Scale baseline monitoring undertaken in the Whanganui Estuary; the installation of a sediment plate and measurement report card for the Whangaehu Estuary; the second year of synoptic baseline monitoring in the Waikawa Estuary; and inaugural synoptic baseline monitoring in the Kai Iwi and Mowhanau estuaries.

2.9.7 The Manwatū Estuary saw the completion of fine scale baseline monitoring. Although it is too soon for trends to be observed the surveys saw an increase in sediment mud over the three year monitoring period and a desktop assessment to assess factors likely to explain this is recommended.

Overall the environment within the estuary appears reasonably harsh and strongly influenced by low salinity water from the Manawatū River. The report recommends continued annual sediment plate monitoring and additional fine scale monitoring in approximately 5 years.

2.9.8 The Whanganui Estuary saw the first year of fine scale and monitoring. The species found here reflect the reasonably harsh physical conditions, with the major contributors likely to be the brackish (low salinity) water inundating the tidal flats each day reflecting the mixing of the Whanganui River with the incoming tidal waters. It is recommended that baseline monitoring continue for a further two years.

2.9.9 The Whangaehu Estuary was observed to have a thick deposit of fine mud. Sites showed an increase in sediment deposition from the previous year's monitoring, although there is currently not enough data available to examine trends at this point. Deposit mud is clearly due to the input of fine-sediment from catchment run-off and not from a marine source. It is recommended that further monitoring be done here to improve understanding of the extent of habitat change due to muddy sediment and to guide catchment management decisions.

2.9.10 Synoptic monitoring of the Kai Iwi and Mowhanau estuaries revealed neither are experiencing significant symptoms of eutrophication. This finding is consistent with water quality monitoring conducted by Horizons. The recently developed Estuary Trophic Index (ETI), which describes an estuary on a eutrophication gradient, rated both estuaries in the 'good' category.

Stevens, L. (2019). Fine scale Intertidal Monitoring of Whanganui Estuary. Salt Ecology Client Report 019 prepared for Horizons Regional Council, June 2019.

Stevens, L. (2019). Whangaehu Estuary Sediment Monitoring. Salt Ecology Client Report 014 prepared for Horizons Regional Council, June 2019.

Stevens, L. (2019). Synoptic Subtidal Monitoring of the Waikawa Estuary. Salt Ecology Client Report 015 prepared for Horizons Regional Council, June 2019.

Forrest, B., and Stevens, L. (2019). Fine Scale Intertidal Monitoring of the Manawatū Estuary. Salt Ecology Client Report 016 prepared for Horizons Regional Council, June 2019.

Stevens, L. (2019). Synoptic Subtidal Monitoring of Kai Iwi and Mowhanau Estuaries. Salt Ecology Report 018 prepared for Horizons Regional Council, June 2019.

3 Land

Land Activity covers both the Land Management and Fluvial programmes and provides technical support to Horizons' main land-based initiatives: our **Sustainable Land Use Initiative** (SLUI) and River Management programme. Land Activity also informs One Plan implementation and policy development for both wastewater and nutrient management.

3.1 Gravel Use Monitoring and Reporting

3.1.1 Quarterly processing of gravel use records helps us monitor the amount of gravel being utilised and ensure that targeted rates for gravel use (gravel levies) are appropriately calculated.

3.1.2 Gravel use records collected over the 2018/19 financial year (Figure 1) show that more gravel has been taken this year than in recent years.

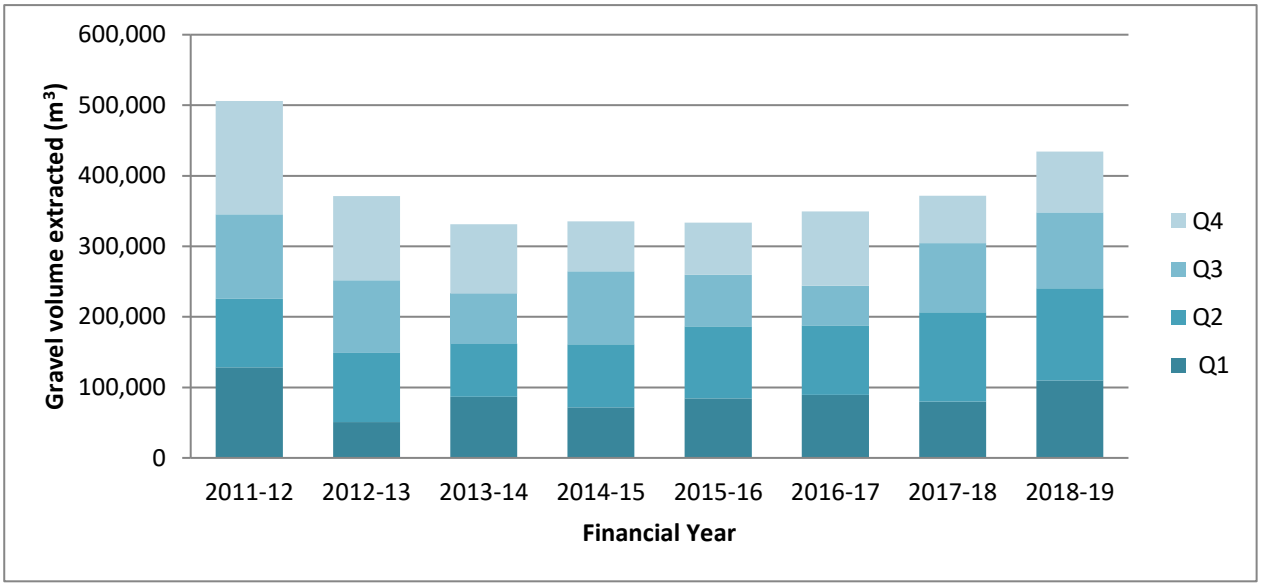

Figure 1 Plot showing the amount of gravel taken through consented takes each quarter for the last eight years. Q1 = July to September, Q2 = October to December, Q3 = January to March, Q4 = April to June.

3.2 Fluvial Surveying

3.2.1 The fluvial survey programme provides information on the changes in levels of aggradation or degradation of river channels and berms. During 2018/19, cross-sectional surveying was carried out on the Pohangina River and the South Eastern Ruahine rivers Kumeti, Tamaki, Otamarahu and Rokaiwhana. The surveying scheduled for the Whangaehu Rover has been postponed due to technical issues with appropriate survey equipment for the river.

Whale, E. & Bell, J. (2019) Manawatū and Oroua Gravel Resource Studies, Report No 19-89 to the Horizons Regional Council Catchment Operations Committee, 11 June 2019.

Whale, E., (2019). Lower Manawatū Gravel Resource Study. Horizons Regional Council.

3.3 Contaminated Land

3.3.1 An investigation in the contamination of the Bulls water supply by per- and poly-fluoroalkyl substances (PFAS), was started during the 2018/19 year. A paper was presented to council based on a draft report of the Bulls water supply investigation and is expected to be released in August 2019. Staff time was also put into the national response, with Abby Matthews being part of the All of Government National PFAS Programme which included meetings with other councils, the community and investigations at other sites (e.g. Palmerston North Airport).

Matthews A and Roygard J (2018) Per- and Polyfluoroalkyl Substances, Report No 18-234 to the Horizons Regional Council Environment Committee, 12 December 2018.

3.4 Innovative Land Use Mapping

3.4.1 This paper signalled in the operational plan was not progressed during the year with time being diverted to PFAS related response and activities.

3.5 Sediment Source and Transport

3.5.1 Building on the sediment fingerprinting and LiDAR analysis completed over 2017/18, this year Horizons undertook a project to better understand the fluvial geomorphology of the Lower Manawatū (Including the Oroua). Tonkin & Taylor were commissioned to carry out the Lower Manawatū Sedimentation Study. The objective of this project was to review all existing information, including the recent LiDAR flown over both rivers and the results of the sediment fingerprinting report, and provide recommendations about potential river management strategies that could be further investigated.

3.5.2 Tonkin & Taylor took the approach of classifying unique river types based on how they respond to different drivers of change. Thirteen river types were identified across the Manawatū and Oroua Rivers.

3.5.3 The analysis of all available data suggested that there was an overall degradation trend since the late 1800s that is disrupted by large rainfall events that cause widespread hillslope erosion. Different localized processes have taken place such as an increase in overbank deposition in the Oroua over the last ten years. Potential sediment management options included the revegetation of hillslopes (continuation of SLUI); bank regrading; two-stage channel construction; rock riffles; in-stream structures; appropriate gravel management that considers geomorphic processes; wetland creation riparian planting; floodplain engagement; and stopbank relocation.

Boyte, S., Patterson, M., Cooper, G., & Roygard, J. (2019). Hill country erosion and sediment management in the Manawatū Whanganui Region, Report No 19-94 to the Horizons Regional Council Catchment Operations Committee, 11 June 2019.

Conn, S., Quilter, B., & Groom, J. (2019). Lower Manawatū Sedimentation Study. Tonkin + Taylor Client report prepared for Horizons Regional Council.

3.6 Nutrient Management Research

3.6.1 A project to assess the water and nutrient flow pathways from intensive winter grazing on gravel soils in the Rangitikei catchment was established in 2018/19. This project is led by Massey University and funded by Horizons with the trial site located on a farm near Hunterville. Five surface water sites and one groundwater site have been sampled monthly since August 2018 and analysed for nutrients, sediment and *E. Coli.* This project will continue into the 2019-2020 year. The results will help identify likely nutrient pathways and their impact on the Rangitikei River.

3.6.2 Horizons is co-funding a three year project to measure and manage diffuse nitrogen losses from cropping systems. This project is led by the Foundation for Arable Research and was established 2018. A network of drainage fluxmeters are installed on 12 farms across the country to measure loss of phosphorus and nitrogen. These collect soil drainage at a depth of 1 m. There are three sites in our region near Levin (intensive vegetable cropping); Bulls (mixed cropping and livestock grazing); and Ohakune (mixed cropping). The results from these trials will be used to test the impact of current management practices on indicators of nutrient use efficiency.

3.7 Land Chapter State of Environment

3.7.1 The Land chapter of the State of the Environment report provided a summary of changes in farming since 1994, current land use and introduced our soil health monitoring programme established in 2015. It highlights the Sustainable Land Use Initiative through which 16 million trees have been planted over the last ten years to prevent hill country erosion. A case study on sediment demonstrated the new direction we are undertaking to understand fluvial resources better by characterising sediment sources through Manaaki Whenua's sediment fingerprinting technique as well as a LiDAR comparison analysis completed by Massey University.

4 Biosecurity and Biodiversity

Biosecurity and biodiversity management are core functions of Horizons that add significantly to the environmental, economic, social and cultural prosperity of the Region by enhancing the quality of indigenous ecosystems and reducing the impacts of pest plants and animals. This group of activities includes Horizons' species-led pest plant and pest animal control (Biosecurity function) and the protection of biodiversity though site-led approaches, including support of community biodiversity programmes (Biodiversity function).

The work programme for 2018/19 included a follow-up to the previous year's biodiversity programme review. This included the implementation of management levels and a stocktake of all managed sites. The ecosystems that would likely have been present without human intervention were mapped and this

information was used to inform a prioritisation analysis that supports our work to ensure that a representative range of ecosystems are protected on to the future.

4.1 Biodiversity Implementation Support

4.1.1 A series of projects to support the implementation of Horizons' Biodiversity Programme were initiated last year with subsequent projects scheduled for the upcoming year. The biodiversity review was overviewed in the biodiversity operation plan and updated to council via environment committee. uj

Madden, A., Smillie, R., and Roygard, J. (2018). Biodiversity Operational Plan 2018 – 19. Report No: 2018/EXT/1583. Endorsed by Council at the Environment Committee meeting on 28th August 2018.

4.1.2 Modelling and mapping of the region was commissioned to identify the full complement of ecosystems prior to human-induced land use change. Developed by the Department of Conservation and now adopted by most regional councils, this process draws on a wide range of resources available that describe both the biotic and abiotic attributes of ecosystems. The addition of this provides for a regional approach that is more nationally consistent.

Singers, N. and Lawrence, C. (2018). A Potential Ecosystem Map of the Manawatū – Whanganui Region. NZES Client Report prepared for Horizons Regional Council, December 2018.

4.1.3 To ensure that a representative range of our remaining ecosystems are managed into the future Zonation modelling was completed. Analysis was performed using internationally recognised spatial prioritisation software that maximises ecosystem representation. This process combines spatial data describing potential ecosystems (described above) and current land cover for the Horizons Region to allow identification of priority sites for indigenous biodiversity management. Analysis is supported by development of a condition layer that takes account of habitat fragmentation, distributions and any management of vertebrate pests and recognises the value of linkages between different ecosystems.

Leathwick, J. (2019). Indigenous Biodiversity Rankings for the Horizons Region. Client Report prepared for Horizons Regional Council, February 2019.

4.1.1 The State of Environment Report provides a summary of the changes to the extent of biodiversity in the region and the work that Horizons is doing to maintain and enhance remaining indigenous biodiversity. Highlighted case studies include Cape Turnagain, Te Apiti and the prioritisation ecosystem remnants across the region.

4.2 Tōtara Reserve Bird Monitoring

4.2.1 Annual bird monitoring in Totara Reserve Regional Park was completed in December 2018. This round of monitoring is the first applying an improved methodology recommended by Wildlands following a review of the monitoring protocol in 2017.

4.2.2 Nineteen indigenous and 17 introduced bird species were recorded in 2018, including kārearea (bush falcon), pōpokatea (whitehead), kererū (wood pigeon), pīpīwharauroa (shinning cuckoo), ruru (morepork); and sulphur-crested cockatoo were heard throughout all three zones. Native to Australia, these birds have established populations in Pohangina, Port Waikato and Turakina.

4.2.3 A report containing the full analysis of this data will be completed following monitoring in the 2019/20 FY.

5 Environmental Reporting and Air Quality Monitoring

Effective management of the Region's natural resources depends on accurate and timely information about the environment and its health, along with ready access to this information and having it packaged in a way that is understandable for the intended audience.

During 2018/19 our focus is on the 2019 State of Environment report; continued delivery of data to the LAWA website; responding to public enquiries and general requests for monitoring data and information; and supporting national work programmes including development and implementation of the **National Environmental Monitoring Standards** (NEMS). We will also be producing a science communication strategy and developing a framework for annual SoE reporting, following the release of our next SoE report early in 2019.

The air quality monitoring programme will continue to monitor and report on the Taihape and Taumarunui airsheds, which are designated under the **National Environmental Standard for Air Quality** (NES-AQ).

5.1 Air Quality

5.1.1 The NES-AQ requires councils to monitor and report exceedances of the short–term **World Health Organisation** (WHO) guideline values for outdoor air quality. Monitoring of air quality is undertaken by Horizons in two designated airsheds: Taihape and Taumarunui.

5.1.2 Annual pre-winter independent calibration checks of the **Beta Attenuation Monitoring** (BAM) instruments at Taihape and Taumarunui were completed by WaterCare technicians towards the end of the April 2019.

5.1.3 Monitoring over the last 14-months shows that Taihape and Taumarunui have met the NES for air quality for the 2018/19 financial year. The winter air quality in the towns is expected to improve over time as more homes switch to more efficient home heating units (attrition), resulting from

Horizons public awareness /education campaigns (burning dry wood) and from people moving to less polluting motor vehicles.

5.1.4 Staff have advised Council over the past few years that the two BAM instruments are old and their reliability and cost to keep them operational is of concern. Spare parts are not readily available, compromising the length and integrity of the record. The BAM at Taumarunui has not been operating since 15 July 2019 as a result of a failed heater element. A replacement for the faulty unit is currently being sourced and will be installed on arrival.

5.2 Climate Change

5.2.1 Over the 2018/19 year, we commissioned NIWA to provide a report analysing the implications of climate change for our region. The report looked at how climate change would impact the different areas of the region and sectors. Asset data from the Risk Scape database was used to assess exposure of buildings infrastructure, land and population to coastal inundation and flood hazard.

5.2.2 The results showed that climate change is likely to lead to increased costs in most sectors. The agricultural sector is likely to be affected by increased drought, water availability, feed preparation and pest control. The health care and social assistance sectors are likely to be affected by an increase in the risk of respiratory illness, heat-related death and water and food borne disease. It is also important to note that climate change impacts on the transport network will affect many sectors in the region.

5.2.3 Compared to other regions, the assets of the Horizons Region will be less affected by sea level rise, however the Horowhenua District will be impacted and is the most exposed area of the region. Greater parts of the region are exposed to flood hazards in the Manawatū, Rangitikei and Tararua Districts.

5.2.4 This report will be used in the development of the climate change strategy currently underway for the council.

5.2.5 The State of Environment report provides a summary of the regional scale climate change projections for the region. We can expect an increase in annual average temperatures of up to 3.1˚C by 2090, more snow and rainfall, particularly in the Ruapehu District, and up to 20 % less rainfall on the East Coast of our region. Climate change projections have also been integrated in our water quality and land programmes through the SedNetNZ model developed by Manaaki Whenua. With ongoing implementation of SLUI works at our current pace, the projected annual average sediment load decrease of 27 % by 2043 could be reduced to between 19 and 5 % depending on the climate change scenario.

Holland, P., Pearce, P., Luttrell, J & Paulik, R (2019). Climate change implications for the Manawatū-Whanganui Region. NIWA client report prepared for Horizons Regional Council, June 2019.

Boyte, S., Matthews, A., & Roygard, J. (2019). Climate Change. Report No 19-62 to the Horizons Regional Council Strategy and Policy Committee, 14 May 2019

5.3 Drinking Water

5.3.1 Ensuring the security of drinking water supplies requires collaboration between territorial authorities, water suppliers, public health offices and Horizons. A new work programme initiated during 2017/18 seeks to ensure that all parties are aware of any risk associated with each supply, that their roles and responsibilities are understood, and that there is adequate flow of information to ensure each agency is meeting its requirements.

5.3.2 Source protection zones for each drinking water supply over 500 people in the region has now been completed. Reports are being prepared for each territorial authority identifying three source protection zones around each drinking water source, including a physical assessment of well head security. This project has been co-funded by the territorial authorities and recommends various management options to protect these drinking water sources. A final report is still in progress.

Matthews A and Roygard J (2019) Drinking Water Research Annual Report, Report No 19-84 to the Horizons Regional Council Strategy and Policy Committee, 12 June 2019.

5.4 State of Environment 2019

5.4.1 Horizons' 2019 State of Environment Report was released in May 2019 including chapters on Climate, Air, Land and Water. The report (available on Horizons' website) presents a range of indicators including pressures on the environment and state as well as trends in both of these. The report also presents some information on the response to identified issues. While the information on response is not intended to be comprehensive, it does present a range of case studies, information on rates of progress and project outcomes for the region.

Matthews A and Roygard J (2019) State of Environment Report, Report No 19-73 to the Horizons Regional Council, 28 May 2019.

Horizons Regional Council (2019) 2019 State of Environment. Horizons Regional Council, May 2019.

5.5 Science Communication Strategy

5.5.1 Sound communication of science is critical to inform stakeholders, advise decision-makers and empower communities. We recognise that scientific information is often targeted to the science community and this can create difficulties in conveying this information in ways that engage the wider public. By ensuring the communication of science is purposeful and targeted to key audiences we can increase uptake and improve understanding of the issues and, in turn, empower those involved in making decisions about how natural resources can best be managed.

5.5.2 During 2018/19 we developed a strategy around the communication of our science. The objective of this strategy is to maximise science uptake, and ensure up-to-date and relevant science

information is effectively communicated to Horizons staff, councilors, iwi, the public, external agencies, and any other parties interested in aspects of natural resource management. Implementation of the strategy is planned in the coming year.

5.6 Land Air Water Aotearoa (LAWA)

5.6.1 LAWA is a regional council-driven initiative to present data and information about New Zealand's environment and natural resources to the public. Horizons provides science support for the continued evolution of the website, and data for annual refreshes. Further information can be found at www.lawa.org.nz

5.6.2 During 2018/19 Horizons contributed data to all modules, including real-time water quantity and air quality data the provision of Groundwater Quality data and an annual update for a range of water quality modules.

5.7 Public Information and RMA Advice

5.7.1 The Science and Innovation team regularly responds to data and information requests, and provides RMA advice to internal and external clients. External information sharing is an important part of Horizons' business. The purpose of this project is to communicate programme outputs, and to inform and educate resource consent holders and the public about the value of these programmes and how they contribute to the wider management of the Region's water resources.

5.7.2 The Science and Innovation team continued efforts to work closely with Horizons' Communications team to regularly produce consumable "sound bites", respond to media requests, and assist with the provision of public information.

5.7.3 Public information included contributions to a summer edition of 'Across the Region' dedicated to Swim Spot monitoring. See the State of Environment report for more details:

5.8 Community and National Engagement

5.8.1 External information sharing is an important part of Horizons' science programme, with an increasing focus on communicating science to our wider community. Opportunities to communicate information can range from data provision, over-the-phone (non-RMA) advice, site visits, and provision of guidance material, through to community workshops. During 2018/19, Horizons science team have contributed to community and national engagement through:

- Participation in a number of regional sector Special Interest Groups (SIGs) to coordinate regional sector activities at a national level;

- National leadership and project management of the National Environmental Monitoring Standards (NEMS), including contributing to the development of NEMS on Water Quality Monitoring in rivers, Lakes, Coastal Waters and Groundwater;
- Contribution to Environmental Monitoring and Reporting (EMaR) Rivers and Land Management working group;
- Conference presentations at the New Zealand Hydrological Society Conference, and the Land Use and Water Quality Conference in Denmark;
- Presentations to community and school groups including a presentation on the Manawatū Estuary was given at the biannual meeting of the Manawatū Estuary Management Trust;
- Supporting Sustainable Farming Fund projects in the region;
- Chairing and facilitating sessions at the inaugural "Pint of Science" events in Palmerston North and Whanganui;
- Participation in the AgTech Hackathon at Massey University with members from the Environmental Data team;
- Organising and hosting a workshop on Biodiversity Off-setting including stakeholders from DoC, TAs, various consultants, and environmental lawyers;
- Guest lecturing for a range of courses at Massey University;
- Hosting students as part of the ShadowTech initiative, aimed at introducing girls aged 9-11 to careers in technology;
- Judging exhibits at the Regional Science Fair and hosting prize winners on a day out with our field team;
- Participation in the Manawatu Careers expo.

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