Fonterra Kapuni

Monitoring Programme

Annual Report

2022-2023

Technical Report 2023-20

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Taranaki Regional Council

Taranaki Regional Council
Private Bag 713
Stratford

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Executive summary

Fonterra Limited (the Company) operates a lactose manufacturing factory plant located on Manaia Road at Kapuni, in the Kaupokonui catchment. The plant processes milk and whey permeate from dairy product manufacture around the North Island. There is also an inhalation grade lactose plant on the site operated by DFE Pharma (DFE plant), with stormwater discharges from the areas around this activity combined with those of the lactose plant under consents held by the Company. Wastewater from the factory site is disposed of by irrigation onto land on two nearby farms.

This report for the period July 2022 to June 2023 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

During the monitoring period, the Company demonstrated a high level of environmental performance and high level of administrative performance.

During the year under review the Company held 16 resource consents, which included a total of 141 conditions setting out the requirements that the Company must satisfy. The Company holds two consents to allow it to take and use water, five consents to discharge stormwater and/or cooling water into the Kaupokonui and Motumate Streams, four consents to discharge wastes to land, four land use consents, and one consent to discharge emissions into the air at this site.

The Council's monitoring programme for the period under review included 6 inspections, 145 water samples from groundwater, streams and discharges that were collected for physicochemical analysis, two macroinvertebrate surveys of receiving waters, one deposition gauge survey, continuous in-stream temperature monitoring at two sites downstream of the site, flow recording in the Kaupokonui Stream, evaluation of the progress of riparian plans that are eligible for funding provided by financial contributions from the Company, and review of data provided by the Company.

Cooling water discharge volume metering had been introduced at the site as per the agreement between the Council and the Company, in relation to assessment of the consumptive nature of the take and future water allocation for the Kaupokonui Stream. Telemetry of abstraction from and discharge to the stream was also installed. The provision of data was satisfactory during the year under review. Data recorded across the year under review indicated that there was little, if any, consumptive use outside the ± 10% cumulative measurement error of the metering devices. However, it is noted that this is excluding losses that may be occurring as the cooling water is discharged via the spray nozzles. The maximum daily abstraction was 76% of the permitted daily take, with the maximum abstraction rate being up to 80% of the maximum permitted take for 99% of the time

Physicochemical and ecological monitoring did not note any significant environmental effects in regard to the abstraction of water from the Kaupokonui Stream for cooling water and general purposes, from site discharges to the Kaupokonui Stream, or in the Waiokura or Motumate Streams from the discharges of wastewater to land on the Company's farms. It is noted that the removal of the Glenn Road weir is likely to result in a significant change in the fish community composition that will be able to access the potential fish barriers present in the reach of stream that influenced by the Company's activities. Consultation is on-going regarding the improvements that will need to be made to the weir and fish pass as the fish communities re-establish in the vicinity of the Company's site. At the time of writing this report, the Company had consulted Council on proposed works to repair the weir. Further refinements of the plan are required prior to implementation.

Temperature increase limits in the consent permitting cooling water discharges to the Kaupokonui Stream were complied with throughout the year under review. To aid with understanding the management of the cooling water system in the light of the pending consent replacements it is noted that the main cooling

system was replaced in August 2015 with the system designed to ensure that the temperature differential and downstream temperature limits would be complied with. From November 2018 until part way through the 2019-2020 year, the Company ran the cooling system at the maximum cooling capacity. This resulted in the discharge temperature being significantly reduced, with a measurable reduction in the instream temperature differential. The reduced discharge temperature would have also minimised the potential for a thermal barrier to fish within the mixing zone. During the 2019 to 2022 years, further structural and operational changes were made to the cooling water discharge system that ensures that the temperature differential restrictions on the consent were being met, whilst enabling the Company to operate the system in the most energy efficient and cost effective way. This more energy efficient operation of the cooling tower during the year under review has continued to result in an improvement when compared to the operation of the cooling system prior to November 2018. However, the temperature of the cooling water was increased when compared to the latter part of the 2018-2019 year, and there was loss of some of the gains that had been made in terms of the significant reduction in temperature within the mixing zone under the operating conditions adopted in the second half of the 2018-2019 year.

Irrigation of the factory wastewater and dairy shed effluent onto the farms was generally well managed during the year under review. Although there were no non-compliances related to the daily volume limits on the irrigation consents, there were nine occasions on which the irrigation event limit in the Company's irrigation management plan were exceeded. There were also three wastewater pipeline failures on the Farms notified to Council during the year under review. There was a 22% increase in the median nitrogen concentration of the factory wastewater due to an increase in the mineral concentration in the permeates being received for processing at the site. As a result, nitrogen application rates increased markedly. The nitrogen application rates ranged from 102 to 704 kg/ha/year. The average application rates, including the dairy shed effluent, were 452, 545 and 529 kg/ha/year on Farms 1, 2 and 3 respectively. No effects were found on the receiving waters from irrigation during the inspections, sampling or biological monitoring of the Kaupokonui, Motumate and Waiokura Streams. The Company is investigating options to reduce the nitrogen application rates at the Company's farms. There were three unauthorised discharges to land from the irrigation system during the year under review that were as a result of pipeline failures. No enforcement action was taken as the Company's contingency measures were effective and there were no significant adverse effects as a result of any of the discharges. It was also determined that the Company had a statutory defence.

Effects on the groundwater in the vicinity of the farms were varied, but most showed an impact on both mineral and organic component levels. This had been addressed through extension of the irrigation disposal system in 2007-2008, and by more intensive wastewater and groundwater monitoring. In the 2021-2022 and 2022-2023 years, there was a higher nitrogen load applied to the paddocks than has been the case since the extension of the irrigation system. The annual median of results for the Farm 2 impact bore GND0638 was again above the drinking water standard for nitrate-N in the year under review. Although the nitrogen loadings on the paddock in which this bore is located was below average, the two paddocks up gradient of this bore annual nitrogen loads of over 600 kg/ha/year applied. Bores GND0639 and GND0641 also had annul median nitrogen concentrations that were above the drinking water standard. Whilst GDN0639 is located in a paddock that also received an above average nitrogen application rate at 693 kgN/ha/y, the paddocks up gradient of GND0641 received below average nitrogen application rates.

The up-gradient bore on Farm 2 continued to show elevations in groundwater nitrate-N concentrations that were in excess of the drinking water standard. This is still to be explained after suitable investigation, with the anticipation that this will be a requirement of the renewed consent.

Stormwater from the site continued to be diverted to containment ponds, with the stormwater batch released after quality checks. Stormwater discharge samples were not collected during the year under review as the ponds were empty or at a low level at the time of the site inspection. However, a low flow discharge that was flowing from the southern stormwater pond at the time of one of the inspections was

sampled. It was found that the pH was outside the permitted range and that the biochemical oxygen demand was elevated. Subsequent investigations by the Company identified that the stop valve was not able to close due to debris in the valve. The debris was removed and the valve was then able to close and stem the flow. In terms of the stormwater discharges, the Company forwarded a copy of the stormwater logs to the Council and the ponds were only discharged when the quality of the stormwater was satisfactory. The Company also checked the visual quality of the Kaupokonui Stream during the discharges and no adverse effects were found.

The lactose deposition rates recorded at four of the five monitoring sites were above their respective historical medians, with the guideline exceeded at sites three of those sites. However, no complaints were received by Council in relation to deposited particulates during the year under review. Inspections also found no evidence of depositions. No odours were noted off site during the year under review. Annual isokinetic stack sampling contracted by the Company found that the particulate emission rate of the flash dryer complied with the limit on the consent.

During the year, the Company generally demonstrated a high level of environmental and high level of administrative performance with the resource consents as defined in Appendix II. However, an improvement is required in the management of the Company's activities in relation to the discharge of wastewater to land. The quantity of nitrogen and nitrogen application rates applied to land under consents 0922 and 0923 has continued to increase each year for the last four years. There were also a small number of exceedances of the irrigation event hydraulic load limits given in the Company's Whole Farm Management Plan. Monitoring indicates that there are elevations in the nitrate concentration in the groundwater at the site as a result of the irrigation activities. The Company has reviewed the management of nutrients at the site. Short term mitigation measures are being put in place, with further medium terms solutions being planned. These include the construction of a wastewater treatment plant on the Farm 1 site. Regular progress meetings are being held between the Company and the Council.

For reference, in the 2022-2023 year, consent holders were found to achieve a high level of environmental performance and compliance for 878 (87%) of a total of 1007 consents monitored through the Taranaki tailored monitoring programmes, while for another 96 (10%) of the consents a good level of environmental performance and compliance was achieved. A further 27 (3%) of consents monitored required improvement in their performance, while the remaining one (<1%) achieved a rating of poor.

This report includes recommendations for the 2023-2024 year.

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1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2022 to June 2023 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Fonterra Limited (the Company). The Company operates a lactose processing facility situated on Manaia Road at Kapuni, in the Kaupokonui catchment, along with two operational dairy farms used for wastewater irrigation (Figure 1).

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the Company that relate to abstractions and discharges of water to land and water within the Kaupokonui, Motumate and Waiokura catchments, and the air discharge permit held by the Company to cover emissions to air from the site.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the 30th combined report and 33rd water related report by the Council for the Company.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about:

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by the Company, for their Kapuni lactose plant;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company's site/catchment.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretations, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2023-2024 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

1.1.3 The Resource Management Act 1991 and monitoring

The RMA primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
b. physical effects on the locality, including landscape, amenity and visual effects;
c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and

e. risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with Section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of the performance of resource users and consent holders. Compliance monitoring, including both activity and impact monitoring, enables the Council to continually re-evaluate its approach and that of consent holders to resource management and, ultimately, through the refinement of methods and considered responsible resource utilisation, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the consent holders, this report also assigns a rating as to each Company's environmental and administrative performance during the period under review. The rating categories are high, good, improvement required and poor for both environmental and administrative performance. The interpretations for these ratings are found in Appendix II.

For reference, in the 2022-2023 year, consent holders were found to achieve a high level of environmental performance and compliance for 878 (87%) of a total of 1007 consents monitored through the Taranaki tailored monitoring programmes, while for another 96 (10%) of the consents a good level of environmental performance and compliance was achieved. A further 27 (3%) of consents monitored required improvement in their performance, while the remaining one (<1%) achieved a rating of poor.[1]

1.2 Process description

The manufacturing of lactose is based on the processing of milk and whey permeate, which is the by-product of the production of cheese and casein. Whey permeate contains typically contains 78 to 88% lactose; which is most of the lactose present in the original milk source. At this site the lactose is extracted and purified through a process that includes evaporation and crystallisation. The lactose is then dried and packed into different grades that meet a diverse range of customer needs and requirements. The plant typically operates for about 310 days per year. Approximately 50,000 tonnes of lactose is produced per annum with the peak daily processing rate being about 200 tonnes/day of lactose.

The lactose process (Figure 2) uses raw water from the Kaupokonui Stream for the evaporator condensers. Once water has passed through the condensers it is returned to the stream via the cooling tower system. In the summer, the increased stream water temperature may not be suitable for cooling the refined and edible crystallisers in the required time, so bore water may be brought into service. The cooling water systems are single pass, which do not require the use of any treatment chemicals. The cooling water from the condensers passes through a cooling tower and is discharged to the stream via spray nozzles that further reduces the temperature of the condenser cooling water so as to minimise temperature rises in the stream.

[1] The Council has used these compliance grading criteria for more than 19 years. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

Steam used for the lactose process is imported to the plant, via a 3 km pipeline, from the Todd Energy Gas Treatment Plant (Todd) at Kapuni. The first delivery of steam was in December 1997. This has reduced the use of water treatment chemicals at the lactose plant considerably, which has therefore reduced the amount of process waste discharged from the site, and reduced the potential for chemical spillages. Steam condensate is returned to Todd via a pipeline for reprocessing.

Plant washdown and other process wastes are disposed of by a land irrigation system. The wastewater is irrigated onto the Company's two farms, which are located close to the lactose plant site. There is a component of the monitoring programme in place to assess the effects of wastewater from the irrigation on groundwater and on surface water quality.

Emissions of lactose powder into the atmosphere from the driers are mitigated by the use of cyclones and a wet scrubber. The cyclones and wet scrubber remove lactose particles from the exhaust of the driers to prevent product loss to the atmosphere.

Figure 1 shows the location of the Company's Kapuni lactose factory, North, South and (extended) No. 3 farms, and the Kaupokonui, Motumate and Waiokura Streams, which are referred to throughout this report.

In the 2014-2015 dairy season, Farm 2 and Farm 3 were merged into one dairy unit and renamed by the Company as 'Kapuni Farms'. Farm 1 was renamed as 'Kapuni Farm'. Table 1 summarises the nomenclature that has been used to describe the various farms as the farming activities have changed over the years. Due to the way in which the wastewater irrigation information is provided and analysed, and for consistency, where possible the primary nomenclature used in this report is Farm 1, Farm 2 and Farm 3.

Table 1 Farm nomenclature

Primary nomenclature used in this report	Previous nomenclature	Current Farm names
Farm 1	Northern Farm	Kapuni Farm
Farm 2	Southern Farm	Kapuni Farms
Farm 3	No. 3 Farm	
	No. 3 Extension	

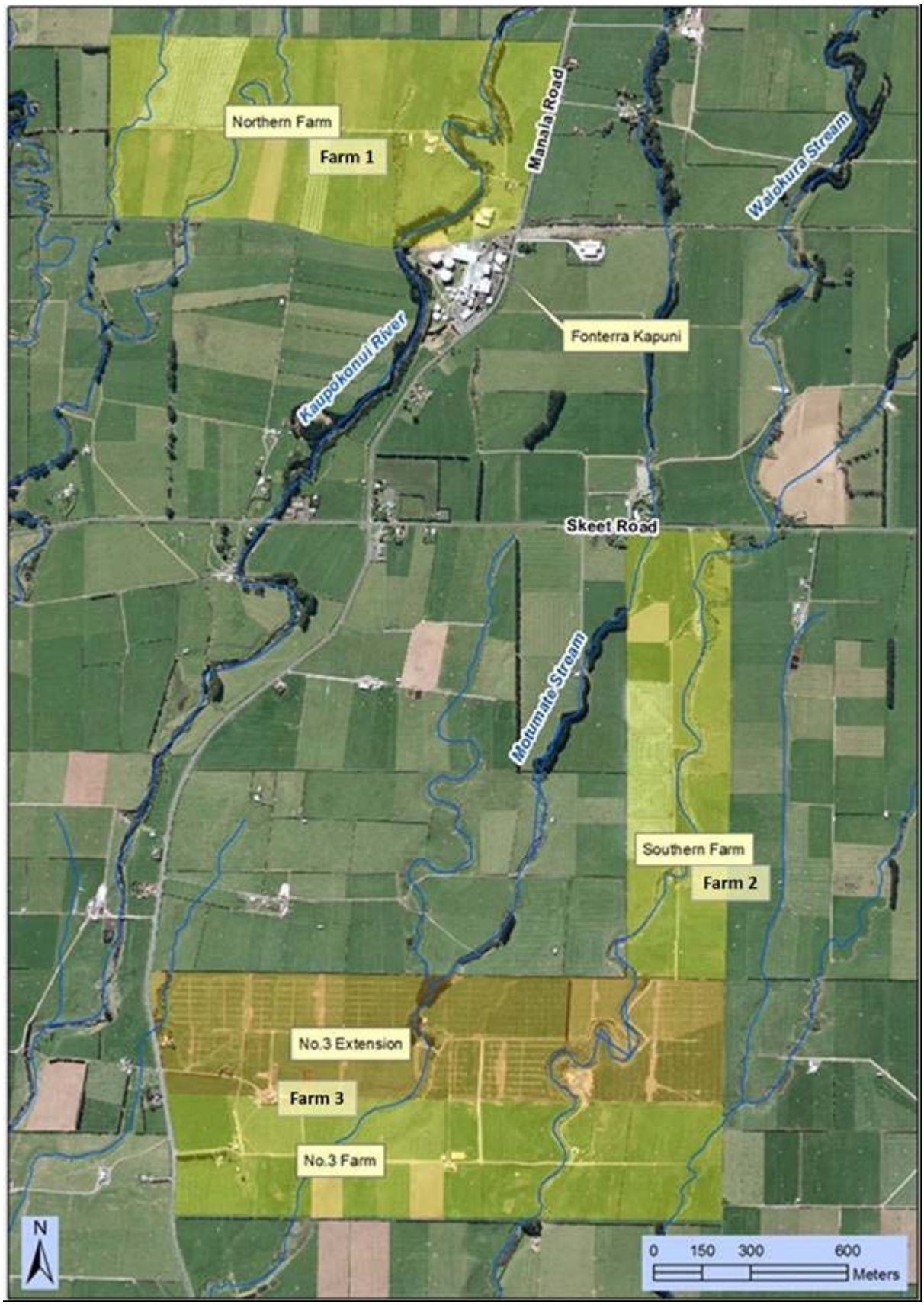

Figure 1 Location of Fonterra Ltd's lactose factory, farms and the Kaupokonui, Motumate and Waiokura Streams

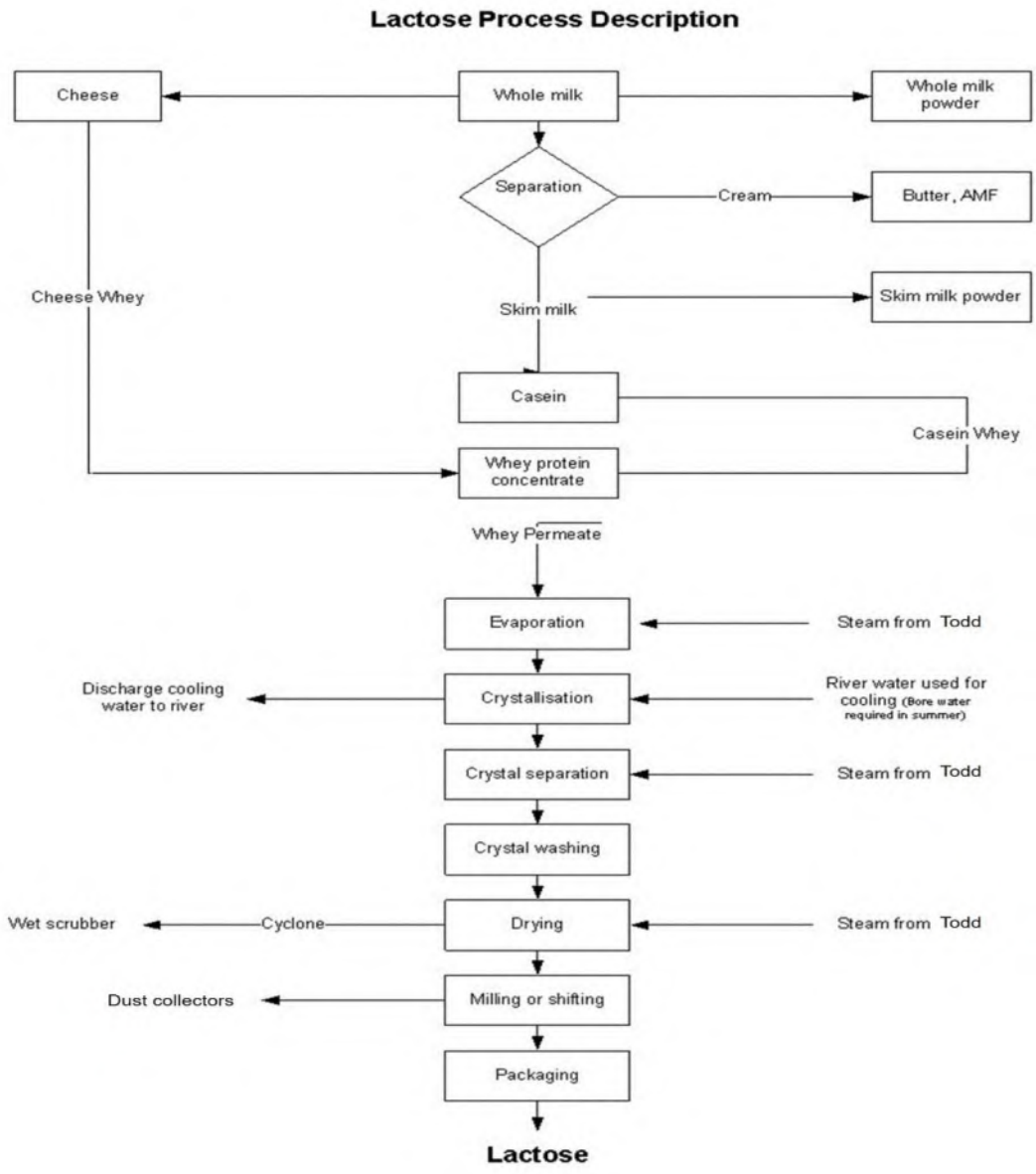

Figure 2 Lactose process diagram

1.3 Resource consents

During the year under review the Company held 16 resource consents the details of which are summarised in Table 2, along with relevant consent related activities. Summaries of the conditions attached to each permit are set out in Section 3 of this report. Consent related activities and information that is relevant to the monitoring and compliance assessment for the year under review is explained further in this section.

A summary of the various consent types issued by the Council is included in Appendix I, as are copies of all permits held by the Company during the period under review.

It is noted that the consents held in relation to the wastewater irrigation pipeline crossings over the Motumate Stream and Waiokura Streams (6948-1) and the erosion control structure in Dunns Creek (7121-1) expired on 1 June 2023. The use of these structures has been assessed as permitted under Rule 61 of the Regional Freshwater Plan.

During the year under review the Company submitted a number of applications relating to a proposed wastewater treatment plant for the factory wastewater. The applications received were to permit:

- The discharge of stormwater and sediment associated with earthworks for the construction of the plant,
- The installation, placement and use of a replacement bridge, or the modification of an existing bridge; and
- The discharge of contaminants to air, namely odour from the operation of the plant.

At the time of the application the design of the wastewater treatment plant had not been finalised and therefore the applications relating to the construction of the plant and the installation or modification of the bridge were returned as incomplete.

The application for the discharge of contaminants to air (11111-1.0) contained the necessary information and was therefore accepted. However, this was split into two applications to acknowledge the two wastewater treatment plant options detailed in the applications received, and the pending decision on whether a Lime Dissolved Air Flotation (11111-1.0) or biological treatment plant (11122-1.0) would be constructed.

1.3.1 Status of expired consents – Section 124 protection

Section 124 of the RMA provides for consent holders to continue to operate under the terms and conditions of the existing consent until a decision is made on the renewal. This applies at the Council's discretion where an application to renew the consent is made between three and six months prior to its expiry, or as a right when the application is made more than six months prior to expiry.

A number of the Company's consents expired on 1 June 2017. Applications to renew these consents were received on 1 December 2016. These applications were put on hold with the Company's agreement so that the applications for these consents could be decided upon at the same time as the consents that were due to expire on 1 June 2019. This was to allow potential cumulative effects of the activities to be considered and addressed in complementary consent conditions. The applications to renew the consents expiring in June 2019 were received on 1 February 2019.

The applications were put on hold under Section 92 of the RMA pending the provision of further information.

The further information requested was:

1. Justification/evidence to demonstrate that the existing water take is 10% consumptive;
2. Justification for retaining (and not lowering) the existing consented water take rate of 225 litres/second;
3. A Cultural Impact Assessment; and
4. With regards to the assessment of alternatives provided with the application, the Company is to provide a cost/benefit analysis of distributing cooling water over a larger area i.e. expanding the length of stream that the spray booms cover (resulting in a spray area that is less concentrated), and reasons why this option is/is not a viable alternative.

The Company asked for the standard 15 working days specified in the RMA to be extended to 19 December 2019 to allow Ngati Tu sufficient time to complete the cultural impact statement. This was agreed. A number of further extensions have been requested, with the cultural impact statement being received on 28 June 2021. Due to the release of the National Policy Statement on Freshwater Management 2000 (NPS-FM) and associated National Environmental Standards for Freshwater (NES-FW) after the applications were received, it has been agreed that further work is required to address any matters arising from the legislative

requirements associated with these documents. The Company has asked for a further extension to allow this work to be completed prior to the continuation of the processing of the applications.

1.3.2 Abstraction consents 0302-3 and 0920-3 and National Regulations

In addition to the consent requirements, the activity must also comply with the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 (the Regulations).

The Regulations require the following:

- all water permits allowing the taking of 5 L/s or more to collect and report records to a set minimum requirement;
- measurement at the point of where the water is taken from the river, lake or groundwater system (unless otherwise approved by the Council to be in another location);
- continuous records of daily volumes to be collected using an appropriate flowmeter with the data transferred to the Council on at least an annual basis;
- the flowmeter to meet an accuracy standard, and should be properly installed and calibrated independently every five years; and
- the consent holder is to be responsible for recording and transferring the data to the Council.

All abstractions captured under the Regulations were required to be compliant by 10 November 2016. The Council retains the authority to apply more stringent requirements on consent holders over and above those set out in the Regulations through the setting of consent conditions.

1.3.3 Proposed amalgamation of consents

There have been a number of changes to the site discharge methodologies in recent years namely:

- The diversion of the cooling water previously discharged under consent 0924-3 to the cooling towers, bringing it under the discharges covered by consent 0919-3; and
- The diversion of the stormwaters covered by consents 4604-2, 6423-1 and the stormwater discharged from one of the outfalls covered by consent 0924-3 to the northern stormwater pond, which has a single outfall.

This leaves the stormwater discharged from the southern stormwater pond as the only stormwater discharge originally authorised under consent 0924-3.

In the application to renew the consents for the site, it has been requested that all stormwater discharges be authorised by one consent (replacement of 0924-3, 4604-2, and 6423-3, with 6423-4) and that the discharge of wastewater from the factory and dairy shed effluents to the two farms also be amalgamated under one consent (replacement of consents 0922-3.2 and 0923-3.3 with 0922-4).

Table 2 Summary of consents held by Fonterra Ltd for the lactose plant at Kapuni

Consent number	Purpose	Commencement	Review	Expiry	Renewal application received	Consent status at 30 Jun 2022
Water abstraction permits						
0302-3	To take and use up to 19,500 cubic metres/day [225 litres/second] of water from the Kaupokonui Stream for cooling water and general purposes associated with lactose manufacturing	9 Jun 1999	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
0920-3	To take up to 700 cubic metres/day of water from a bore in the Kaupokonui Catchment for factory cooling water using plate heat exchangers	4 Feb 1999	-	1 Jun 2017	1 Dec 2016	Expired - S.124 Protection (on hold further information)
Water discharge permits						
0921-3	To discharge up to 850 cubic metres/day of cooling water from plate heat exchangers and plant cooling system into an unnamed tributary of the Motumate Stream at two different locations	4 Feb 1999	-	1 Jun 2017	1 Dec 2016	Expired - S.124 Protection (on hold further information)
0919-3	To discharge up to 19,500 cubic metres/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream	9 Jun1999	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
0924-3	To discharge up to 1,440 cubic metres/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream	9 Jun 1999	-	1 Jun 2019	1 Dec 2016. Stormwater discharge activity to be combined under 6423-4	Expired - S.124 Protection (on hold further information)
4604-2	To discharge up to 280 litres/second of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream	4 Feb 1999	-	1 Jun 2017	1 Dec 2016. Activity to be combined under 6423-4	Expired - S.124 Protection (on hold further information)
6423-1	To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream	4 Feb 1999	-	1 Jun 2017	1 Dec 2016	Expired - S.124 Protection (on hold further information)

Consent number	Purpose	Commencement	Review	Expiry	Renewal application received	Consent status at 30 Jun 2022
Air discharge permit						
4032-5	To discharge emissions into the air from the manufacture, drying, packaging and storage of lactose and associated processes and from the inhalation grade lactose plant	2 Jun 2004	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
Discharges of waste to land						
0922-3.2	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land	15 Jul 2015	-	1 Jun 2019	01 Feb 2019	Expired - S.124 Protection (on hold further information)
0923-3.3	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land	15 Jul 2015		1 Jun 2019	1 Feb 2019. Activity to be combined under 0922-4	Expired - S.124 Protection (on hold further information)
10214-1.0	To discharge solid farm dairy effluent onto and into land	5 Feb 2016	June 2023	1 Jun 2041	-	Current
10232-1.0	To discharge pond sludge from farm dairy effluent onto and into land	5 Feb 2016	June 2023	1 Jun 2041	-	Current
Land use permits						
4623-3.0	To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes	15 Dec 2017	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
6948-1	To erect, place, maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purposes of conveying irrigation wastewater	18 Sep 2006	-	1 Jun 2023	-	Expired
7121-1	To erect, place and maintain a stone lined bank on the left bank of Dunns Creek for erosion control purpose	23 May 2007	-	1 Jun 2023	-	Expired
9546-1	To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation	18 Apr 2013	June 2023	1 Jun 2029	-	Current

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations and seek information from consent holders.

The monitoring programme for the Company's Kapuni site consisted of five primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in:

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- discussion over monitoring requirements;
- preparation for any consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3 Site inspections

Six routine compliance monitoring inspections were carried out during the monitoring period. There was provision in the monitoring programme for additional targeted activity related inspections to be carried out if need arises, which may include inspection at times when the water intake is being desilted. No additional inspections were carried out during the year under review.

With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters at the factory site and at the farms used for irrigation. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions and spray drift during irrigation events. Sources of data being collected by the Company were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects. An additional annual dairy inspection was also undertaken focusing on the management of the farm dairy effluent systems.

1.4.4 Chemical sampling

The Council undertook sampling of both the discharges from the site and the water quality upstream and downstream of the discharge point and mixing zone.

A 24 hour composite or grab sample was collected of the spray cooling wastewater on five occasions. The samples were analysed for BOD_5 (total and filtered), pH, conductivity and turbidity.

The Kaupokonui Stream was sampled on six occasions at three sites. The samples were analysed for temperature, BOD_5 (total and filtered), pH, conductivity, turbidity, dissolved reactive phosphorus, nitrates, ammonia-N and total nitrogen. The Motumate Stream was sampled at four sites on six occasions. The samples were analysed for temperature, BOD_5, conductivity, dissolved reactive phosphorus, ammoniacal

nitrogen, nitrate, pH, and turbidity, on six occasions, and anion/cation balance on three occasions. The Waiokura Stream was also sampled at four sites on six occasions. The samples were analysed for temperature, BOD_5, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, pH, sodium and turbidity.

Samples are scheduled to be collected from the cooling water discharge daily composite, and the northern and southern stormwater pond outfalls. The samples are analysed for total BOD_5, conductivity, pH, turbidity, suspended solids and oil and grease. No stormwater pond samples were collected from the northern pond during the year under review as the pond levels were low and no discharges were occurring at the time of the site inspections. The discharge from the southern stormwater pond discharge structure was sampled on two occasions.

Groundwater from 12 bores on the three farms were sampled on six occasions and the samples were analysed for temperature, COD, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, total nitrogen and pH on each occasion. Additional parameters were determined on three occasions, including those necessary for the determination of the anion/cation balance.

Deposition gauges were placed at selected sites in the vicinity of the factory site on one occasion. The collected samples were analysed for COD, enabling the lactose deposition rate to be estimated.

1.4.5 Biomonitoring surveys

A biological survey of the macroinvertebrate communities was performed on two occasions in the Kaupokonui Stream to determine whether or not the discharge of stormwater and cooling water from the site has had a detrimental effect upon the communities of the stream. Two biological surveys were also performed in Dunns Creek and the Waiokura Stream to monitor the cumulative effects from irrigation of wastewater and stormwater onto land, along with the agricultural discharges, on the two dairy farms in the catchments of these two streams. During the biomonitoring surveys in the 2019-2020 year, consideration was given as to the value of adding biomonitoring in the Motumate Stream to the programme, given the extent of the irrigation area that this small stream runs through. It was found that the stream habitat in the stretch through the irrigation areas did not have suitable habitat to provide meaningful evaluation of the potential impacts of the irrigation activities at this stage. This was predominantly because any potential environmental effects resulting from the wastewater irrigation would be obscured by the elevated nitrates in the upper catchment of this stream. This was investigated by Council during the 2020-2021 year, with no point source discharges found in the upstream environment. The introduction of biomonitoring in the Motumate Stream will only be re-visited if reductions in the nitrate concentration of the Motumate Stream above the site are observed, and/or if stream habitat improves.

A fish monitoring survey was undertaken during the year under review along with observations of any fish species spotted above the weir at the time of the site inspections being noted.

Fish surveys had been scheduled to occur on a triennial basis, with the most recent survey being the fifth triennial site fish survey undertaken in the Kaupokonui Stream in March 2020.

The fish barrier presented by the Glenn Road weir was addressed by its removal in February 2021. Following the removal of the weir, Environmental DNA (eDNA) monitoring was undertaken in an attempt to assess the effectiveness of removing the barrier on the upstream fish communities. Sampling upstream of the weir indicated that inanga and torrentfish were now present, showing that the enhancement project was successful. It is now expected that these new species, and perhaps higher abundances of other species already present upstream of the Glenn Road weir, would begin to penetrate further up into the catchment, and that they may eventually reach the Fonterra spray cooling water discharges and weir. As a result, the scheduling of the fish surveys under this programme was revised in the 2021-2022 year to include annual electric fishing surveys and provision for two spotlighting surveys if required, whilst the fish communities are stabilising following the removal of the downstream fish barrier.

An electric fishing survey was undertaken over two days on 16 February and 30 March 2023. Spotlighting surveys were not undertaken.

1.4.6 Review of consent holder's data

A large amount of data is supplied by the Company in relation to stream abstraction records, cooling water discharge temperatures and rates, irrigation records, wastewater composition, soil test results, receiving water temperatures, and details on the discharges from the stormwater ponds. This data is assessed by Council staff to confirm compliance with consent conditions, as well as to assess site performance in relation to the "best practicable option" conditions, and to assess if there are any actual or potential environmental effects occurring that are not adequately addressed by the conditions of the consents.

2 Results

2.1 Water

2.1.1 Review of consent holder's data

The Company supplied various data to the Council in the form of monthly environmental reports and electronic data. The data covers information in relation to calibration of the consent holder's instream temperature monitors, stream temperature compliance data, effluent irrigation volumes, effluent composition, stream and bore extraction volumes, and cooling water discharge temperatures and rates. These data were regularly reviewed by Council in terms of compliance with consent conditions and, where necessary, the Company was immediately advised of any necessary follow-up action to be taken. A review of this data follows.

2.1.1.1 Stream abstraction records

The Company holds consent 0302-3 which allows the abstraction of up to 19,500 m^3/day (225 L/s) from the Kaupokonui Stream. Special conditions attached to the consent require the Company to undertake daily monitoring of the water abstracted from the stream, and to forward such monitoring data to the Council. The Company supplies both the daily abstraction volume and the abstraction rate. One minute data is provided, which Council processes to provide the 15 minute average data used to assess consent compliance.

Under the *Resource Management (Measurement and Reporting of Water Takes) Regulations 2010*, the Company was required by 10 November 2012 to take continuous measurements and keep daily records of volume taken, and thereafter supply the daily abstraction data by 31 July each year for the preceding 1 July to 30 June period.

Abstraction rate is measured by a magnetic flow meter on the supply line from the stream pumps to the factory. Independent verification of the accuracy of the meter was last undertaken in May 2021. Table 3 contains a summary of statistics from the daily abstraction data electronic record provided by the Company, with the abstraction rates illustrated in Figure 3 and Figure 4[2].

It is noted that during the year under review, the Company notified the Council that, due to an issue with the electronics of the abstraction measuring system and the replacement of a PLC, there were some gaps in the data for July 2022. It was noted that there was no processing occurring at the plant at this time and so any abstraction from the river would be very low in comparison to normal usage.

The daily stream abstraction data summaries in Table 3 and Figure 3 illustrate that the Company continued to take a significant volume of water from the stream during the 2022-2023 monitoring period. However, it is noted that the volumes abstracted were again significantly lower than the permitted take of 19,500 m^3/day.

[2] Earlier Annual Reports used a combination of data from the daily abstraction data provided by the Company in a monthly report, and the abstraction rates from the electronic data sent through to Council on a daily basis. In the 2019-2020 Annual Report it was confirmed that any potential reporting discrepancies or data transmission issues were negligible, following the resolution of the issues causing the more significant discrepancies that had been occurring prior to the 2018-2019 year. Therefore the data assessed here is based on the electronic record only.

Table 3 Summary of water abstraction volumes from the Kaupokonui Stream

Month	Average daily abstraction (m^3/day)	Minimum daily abstraction (m^3/day)	Maximum daily abstraction (m^3/day)	Number of days per month daily abstraction >19,500 m^3	Average abstraction rate (L/s)	Maximum abstraction rate (L/s)	Total time per month abstraction rate> 225 L/s	Missing records
Jul 22	1,069	0	4,613	0	14	67	0	11.3 days
Aug 22	5,780	1,817	9,132	0	65	156	0	No gaps
Sep 22	8,518	6,750	10,415	0	98	172	0	No gaps
Oct 22	8,732	6,650	11,118	0	101	178	0	No gaps
Nov 22	10,082	6,899	11,956	0	116	212	0	No gaps
Dec 22	11,701	8,993	14,903	0	134	207	0	No gaps
Jan 23	12,013	8,919	14,442	0	140	202	0	No gaps
Feb 23	10,304	2,109	12,678	0	119	188	0	No gaps
Mar 23	9,76	7,149	12,194	0	114	183	0	No gaps
Apr 23	7,915	6,742	9,516	0	91	155	0	No gaps
May 23	6,820	3,416	10,089	0	81	150	0	No gaps
Jun 23	3,808	0	8,525	0	65	156	0	No gaps

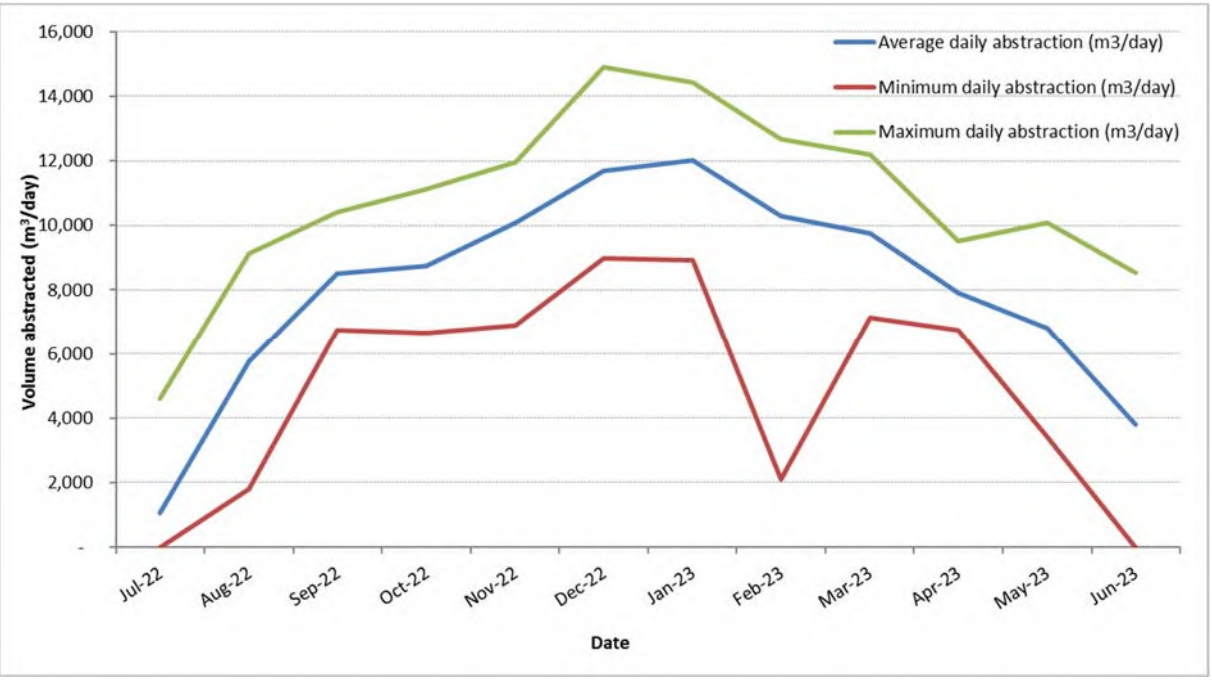

Figure 3 Monthly summary of water abstraction volumes from the Kaupokonui Stream

An approximate total volume of 2,926,718 m^3 was abstracted during the 2022-2023 year. The abstraction data provided indicates that 15% more water was abstracted during the year under review than the amount taken in 2021-2022.

The daily volume abstracted was maintained well below the 19,500 m³ daily limit. During 2022-2023, a maximum daily abstraction of 14,903 m³ was recorded on 28 December 2022, which is 76% of the consent limit.

The changes in the river abstraction volumes since the 2009-2010 year are illustrated in Figure 4, which shows a general trend of decreasing water abstraction at the site since the 2012-2013 year. It is noted that the graph below is based on the data provided in the Company's monthly reports for the 2009-2020 years and the electronic data provided by the Company for the 2020-2021 year onwards.

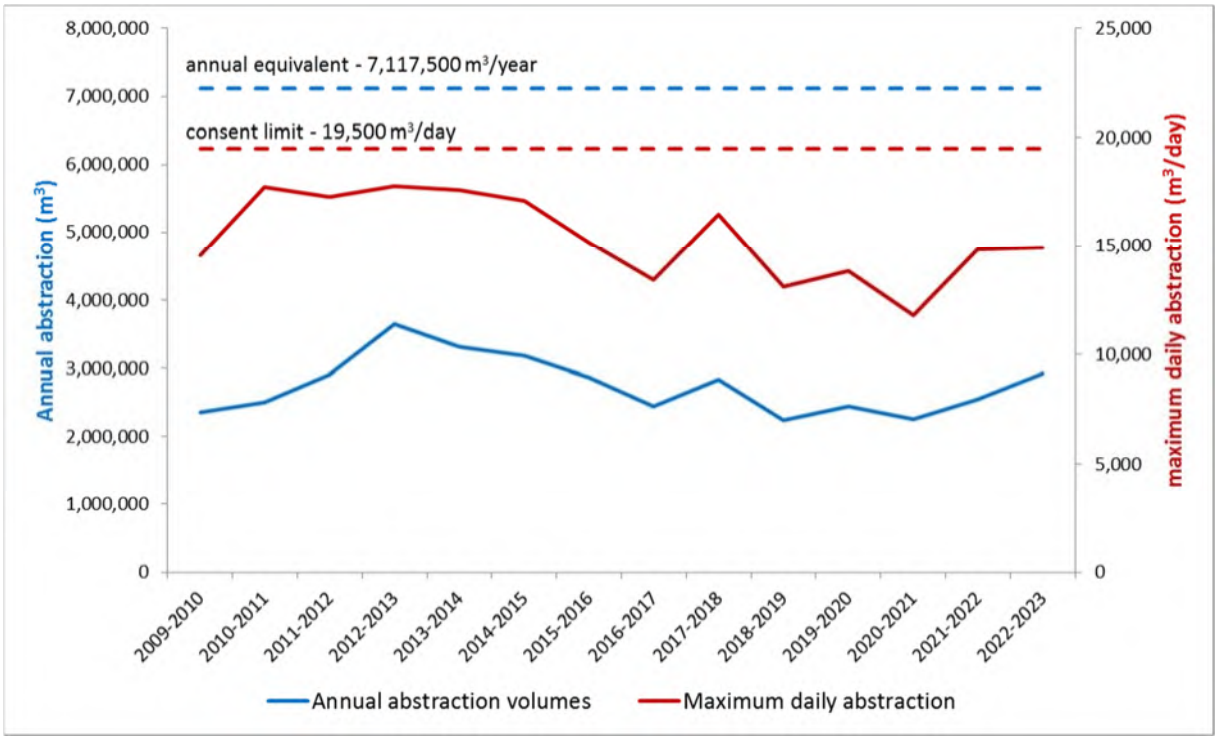

Figure 4 Daily and annual stream abstraction volumes July 2009 to June 2023

The Company's abstraction of water from the Kaupokonui Stream was undertaken in a satisfactory manner and the abstraction rates complied with consent conditions as illustrated in Table 3 and Figure 5. The abstraction rate remained at or below 180 L/s for 99% of the year. Although there was just over 11 days of missing record, this was during the winter shutdown when water usage was very low.

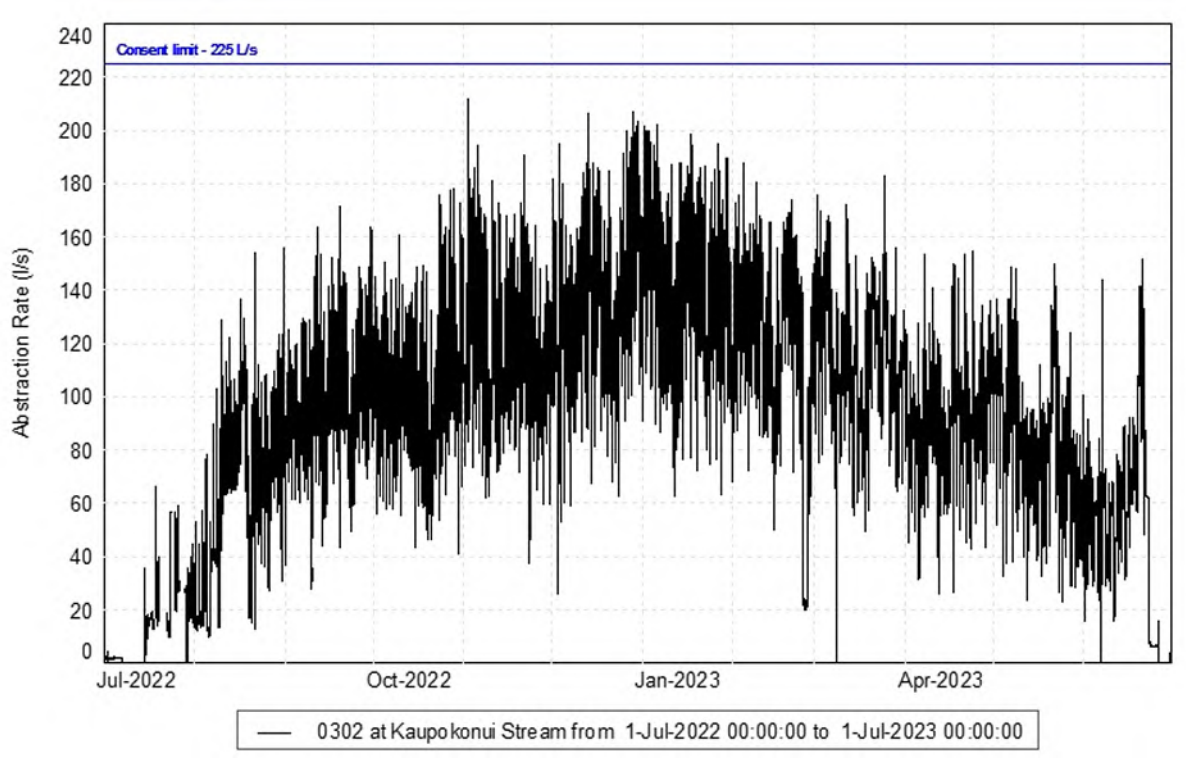

Figure 5 Abstraction rate from the Kaupokonui Stream (consent 0302-3)

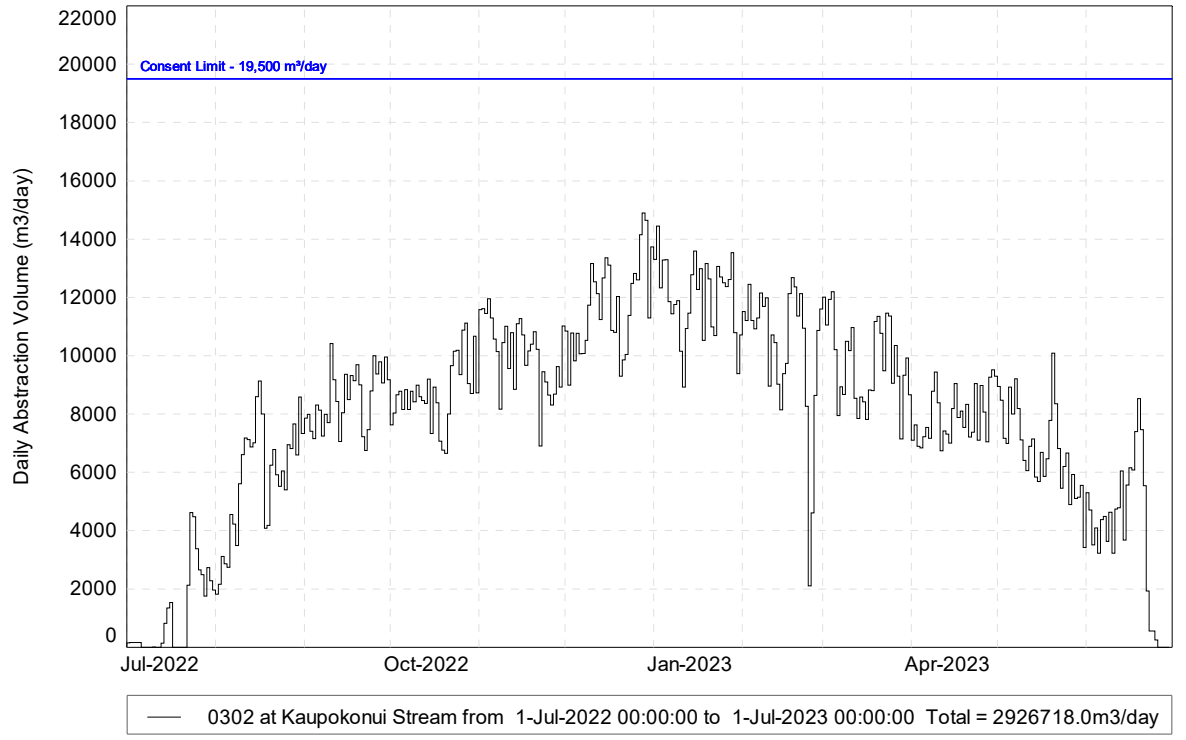

Figure 6 Daily abstraction volumes from the Kaupokonui Stream, electronic record

2.1.1.2 Bore abstraction records

In relation to the exercise of consent 0920-3, the Company supplied the Council, on a monthly basis, monitoring data on the daily volume abstracted from the bore in the Kaupokonui catchment.

At an inspection on 20 September 2019 it was noted that the bore had been closed in. During the 2022-2023 monitoring period, the bore was not used, with no further activity reported during the year under review.

2.1.1.3 Cooling water discharge rates

In June 2014, Council invoked the review of consent conditions of consents 0919-3 and 0924-3, which provide for the discharge of the abstracted cooling water back to the Kaupokonui Stream, for water allocation purposes. The notice of review was withdrawn by Council at the Company's request after an agreement was reached that the necessary monitoring information would be provided voluntarily. As condition 1 of these consents require that *"the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such physicochemical and ecological monitoring of the cooling water wastes, and the receiving waters (Kaupokonui Stream) as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991"*, this agreed monitoring is within the scope of these conditions.

In summary, the agreement related to the provision of electronic data recording the rate and volume of the cooling water discharges from both outfalls with an accuracy of ± 5%, and this was to be implemented by 31 August 2015. The implementation period was extended to 30 September 2015 following delays associated with the installation of a new cooling tower system.

As previously discussed, the purpose of the review of the consents that were initiated in 2014 were to allow conditions to be put on the consent so that sufficient data could be collected regarding the consumptive use of the abstraction to inform the water allocation decisions that need to be made at the time of the abstraction consent renewal. There were a number of issues in relation to meeting this monitoring requirement that have been discussed in previous reports, with compliance being achieved from 14 September 2019.

The details surrounding these issues are described in the 2019-2020 Annual Report, in which it was also concluded that from the above date the data was sufficiently robust to enable an estimate of the consumptive water use at the site to be determined. However, it must also be borne in mind that further evaporative and/or wind drift losses will occur to varying degrees depending on the weather conditions.

The discharge and abstraction rate record for the year under review is shown in Figure 7. During the year under review, a total of 2,838,075 m^3 (± 5%) was recorded as having discharged from the cooling tower. This is in comparison to the recorded total annual abstraction of 2,926,718 m^3 (±5%). These figures indicate that, when considered on annual basis, any usage has generally continued to be within the limits of the accuracy of the measuring devices during the year under review.

Figure 8 shows the differential between the 15 minute data provided by the Company for the discharge and abstraction rates measured during the year under review, with negative values indicating consumptive use and positive values indicating an increase return rate. The maximum permitted error on the differential between the meters is ± 10 %. The error margins, if the abstraction and discharge were approximating to the maximum take rate of 225 L/s, are also shown in Figure 7, although it is noted that the highest average daily abstraction rate was only 180 L/s. For the majority of the year under review, the measured differential in the recorded flow rates was also predominantly within the margin of error of the recording devices.

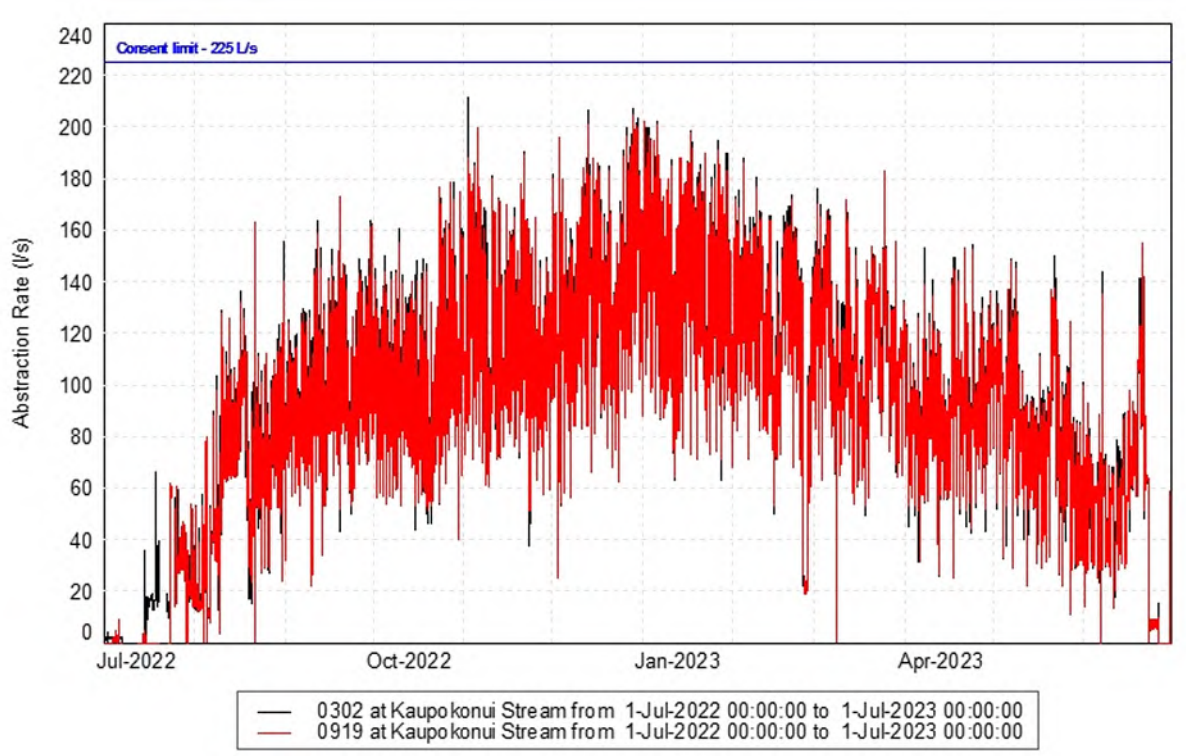

Figure 7 Discharge rates (flow from the cooling tower) for consent 0919-3, along with the abstraction rate for consent 0302-3, electronic record for the year under review

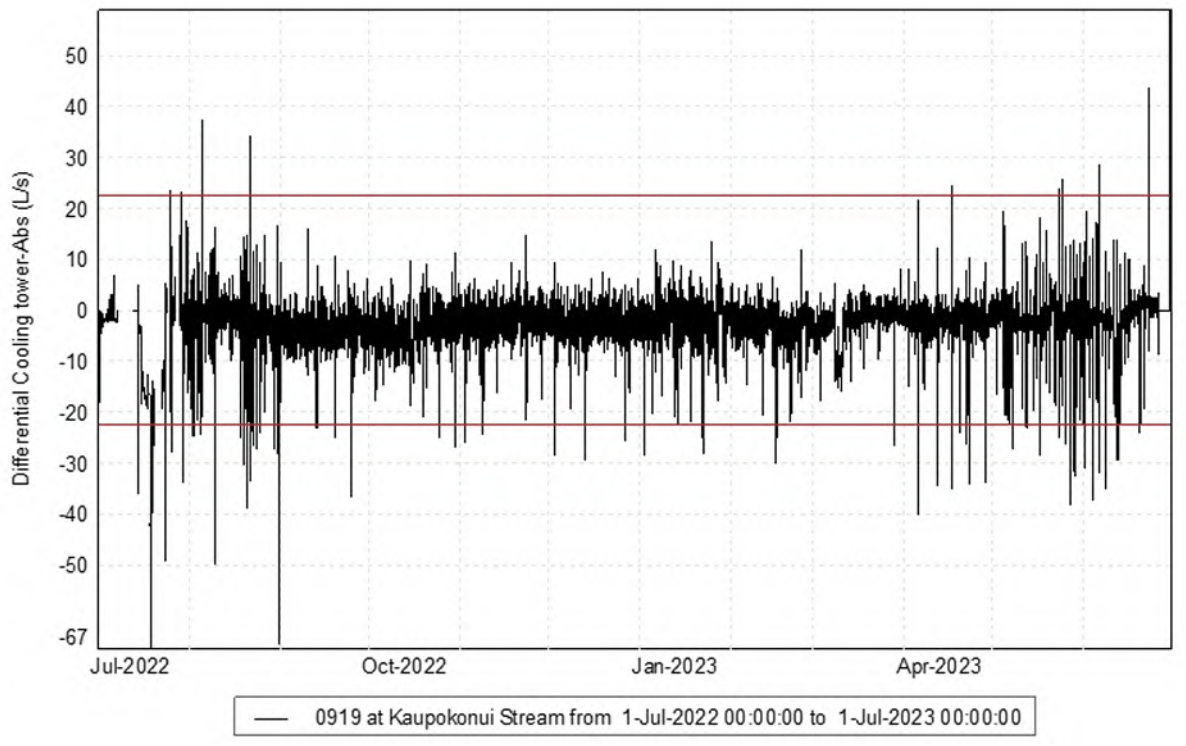

Figure 8 Differential between the rate of discharge from the cooling tower and the abstraction rate

Figure 9 show the percentage of the time that the usage or additional return is at a given rate for the year under review.

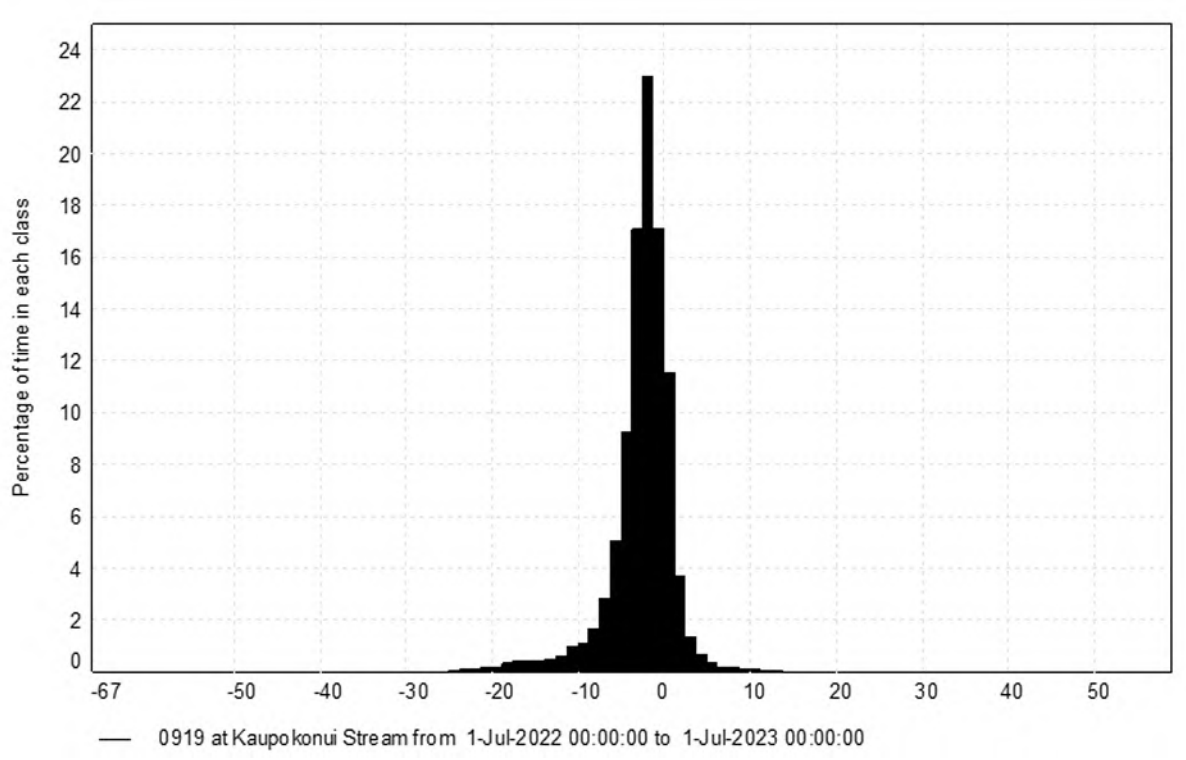

Figure 9 Probability density for the difference between the rate of flow from the cooling tower and the abstraction rate, full year's data

During the year under review, it was found that the maximum 15 minute average for water usage was 67 L/s and the maximum additional return was 58 L/s.

2.1.1.4 Cooling water discharge temperatures

In addition to providing the cooling water discharge rate monitoring data, the Company also started to voluntarily monitor the temperature of the cooling water discharged under consent 0919-3. This temperature is monitored at a point in the system that is downstream of the cooling tower but before the cooling water reaches the sprayers. The data is provided to Council electronically. Whilst this information is provided voluntarily, it is likely to be required by the replacement consent. In the meantime the data helps to inform the assessment of effects for consideration in relation to the renewal of the consent.

It must also be borne in mind that the discharge method itself (spray discharge) will provide further cooling that is not measured, prior to the cooling water entering into the stream.

The cooling water discharge temperatures for the year under review are shown in Figure 10, with a statistical summary given in Table 4.

Table 4 Cooling water temperature monthly statistical summary

Month	Monthly minimum (˚C)	Monthly maximum (˚C)	Monthly median (˚C)	Missing records
Jul 22	4.6	23.2	10.5	11 days 8 hr
Aug 22	7.3	40.7	23.2	no gaps
Sep 22	21.8	41.3	33.8	no gaps
Oct 22	17.7	39.3	32.5	no gaps
Nov 22	22.7	38.4	31.8	no gaps

Month	Monthly minimum (˚C)	Monthly maximum (˚C)	Monthly median (˚C)	Missing records
Dec 22	16.5	40.1	31.8	no gaps
Jan 23	23.4	40.2	32.0	no gaps
Feb 23	14.3	42.2	33.6	no gaps
Mar 23	14.4	39.6	28.7	no gaps
Apr 23	15.8	39.1	30.5	no gaps
May 23	13.0	40.0	33.0	no gaps
Jun 23	1.1	39.4	27.2	2 days 14 hr

As already indicated, this data is not specifically required either by the current consents or the agreement made with the Company in lieu of the consent review. However, it will be useful to compare with the stream temperatures when evaluating potential environmental effects, the Company's implementation of the "best practicable option" to minimise effects, and the requirement that the discharge does not present a thermal barrier to fish passage within the mixing zone. In the assessment of environmental effects for the pending reissue of consent 0919 it was stated that the cooling tower design parameters are such that with fluid entering at 50˚C, and the fans running at 100%, the discharge should be at 33˚C at a wet bulb temperature of 22˚C.

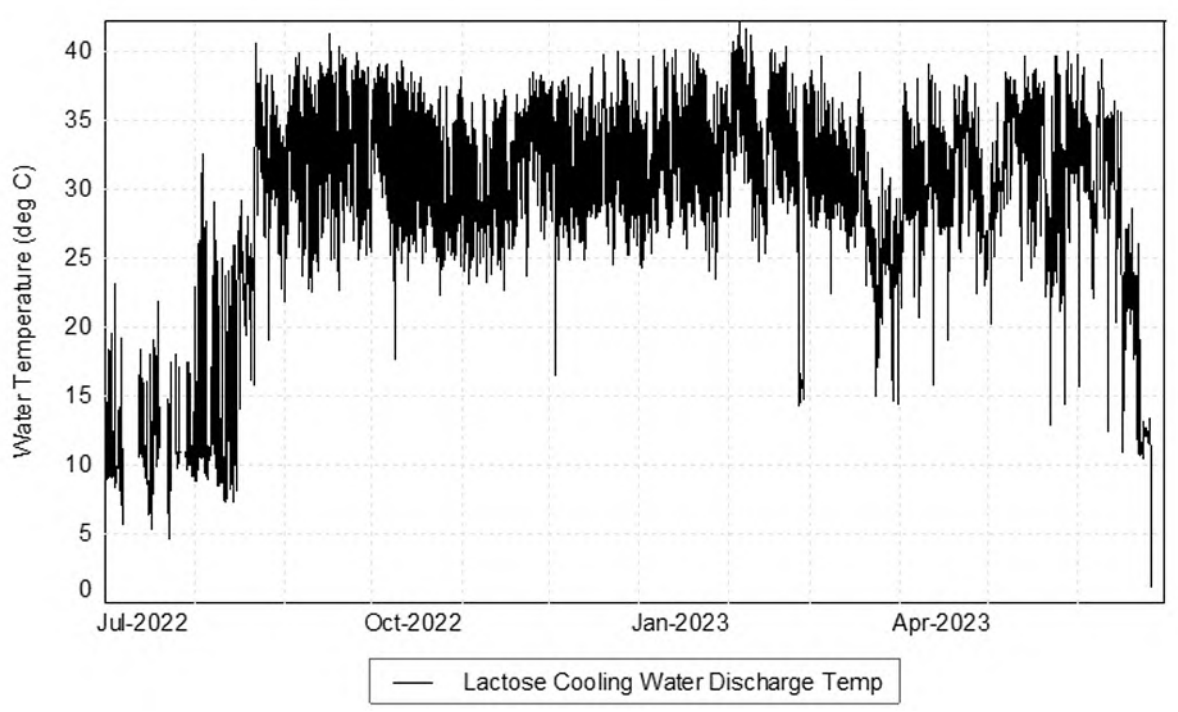

Figure 10 Temperature of the cooling water discharge permitted by consent 0919-3, 2022-2023

In November 2018, the Company identified that there was a time lag in the control system for the utilisation options available for running the cooling tower efficiently based on the upstream downstream temperature differentials to take effect. The options related to the proportion of cooling water that was passed through the cooling tower, versus passing through a bypass line, and in the operation of the fans on the cooling tower. The time lag was due to the response time between the activation of the change and the time it took for the change to have an effect on the cooling water discharge temperature. The Company has since made a number of operational changes relating to their management of the cooling system. The key changes to the

system are summarised in Table 5, along with the impact the changes have had on the measured cooling water discharge temperatures.

Table 5 Summary of cooling tower operational changes and their effects on discharge temperature

Timeframe	Change in operational management of cooling water systems	Observable effects on the monthly median discharge temperatures	Observable effects on the monthly maximum discharge temperatures	Percentage of the time that the cooling water discharge was at or above 35˚C	Percentage of the time that the cooling water discharge was at or above 33˚C during low flow*
Nov 2018-2019	Manual diversion of all flow from the cooling water flows to the cooling tower. Cooling tower operating at maximum cooling conditions at all times	Reduced from 30-37˚C to 23 -25.5˚C	Reduced from 44-54˚C to 27-43˚C	Reduced from 28% to 7%	Reduced from 48% to 1%
2019-2020	Removal of cooling tower bypass line Addition of variable speed pump to control cooling tower residence time Operation of cooling tower fans based on river temperature differential	Increased to 28-33˚C	Increased to 34-40˚C	6%	35%
2020-2021	Commencement of installation of pressure regulating nozzles at the spray discharge booms	25-28˚C	30-40˚C	11%	16%
2021-2022	Completion of installation of pressure regulating nozzles at the spray discharge booms	28-36˚C	26-44˚C	20%	50%
2022-2023	No further changes	11-34˚C	23-41˚C	20%	36%

Key *1 December to 31 March

Further analysis and comparison of cooling tower and operational performance is illustrated in Figure 11 and Figure 12. Cumulatively during the year under review the cooling water discharge was at or above 35˚C for approximately 20 % of the time. This is in comparison to 28% of the time prior to any changes to the operation of the cooling water system and 6% of the time in the 2018-2019 year.

During the period 1 December to 31 March, the time of year when typically the stream flow is low and the water temperature is higher, the cooling water temperature was at or above 33˚C for 36 % of the time, and above 35˚C for 21% of the time. This in comparison to only 1.3% of the time above both 33 and 35˚C respectively during this period for the 2018-2019 year and 48% and 39% of the time respectively for this period in the 2017-2018 year. Whilst there was a significant reduction in the heat load on the receiving environment as a result of the initial improvements in operational management of the cooling tower in the 2018-2019 year, the reduction in heat load had been lessened by the way in which the cooling water tower was operated in subsequent years, including the year under review. This does however show that there is additional cooling capacity available should this be required to prevent the cooling water discharge from presenting a barrier to fish passage.

The effects of the operational changes, as observed in the receiving waters, are discussed in Section 2.1.1.5.2.

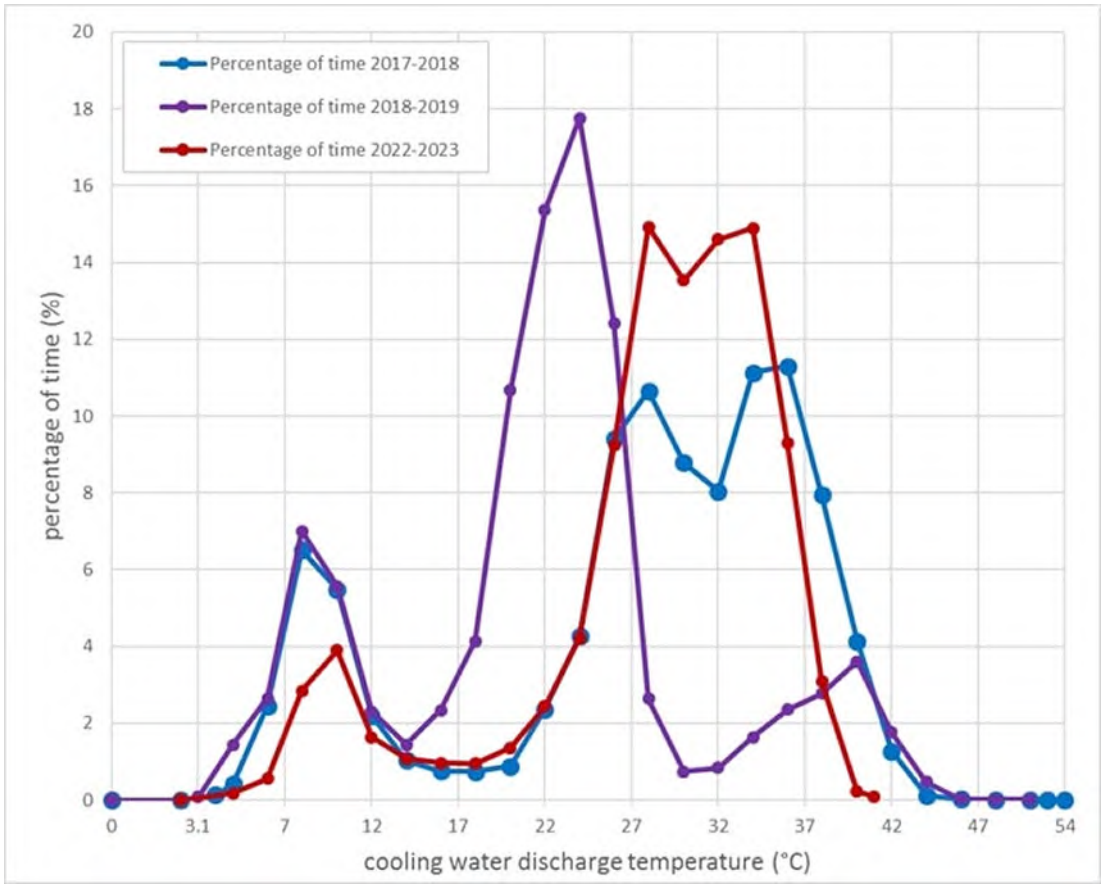

Figure 11 Cooling tower discharge temperature probability density for the year under review compared to the 2017 to 2019 years from 1 July-30 June

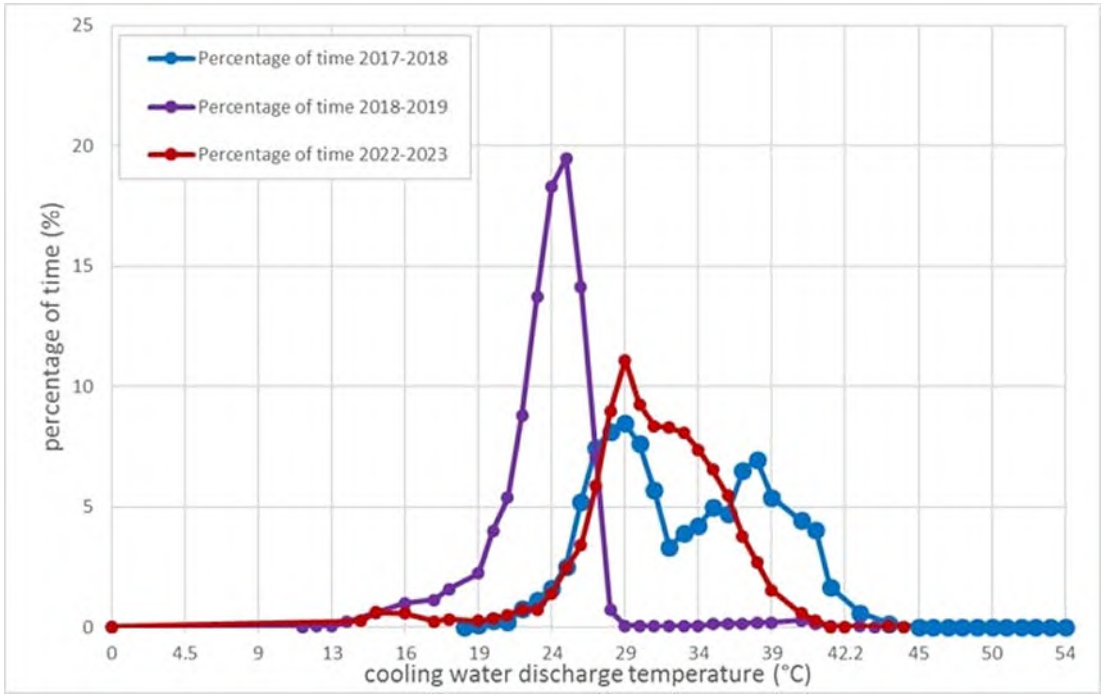

Figure 12 Cooling tower discharge temperature probability density for the year under review compared to the 2017 to 2019 years, 1 December-31 March

2.1.1.5 Receiving water temperatures

The Company maintained continuous records of Kaupokonui Stream water temperatures (upstream of the spray coolant discharge zone and at the downstream end of the designated mixing zone, see Photo 1, Photo 2 and Photo 3), and water temperature exiting the cooling tower (discussed in section 2.1.1.4). Since 19 March 2014, the upstream and downstream temperature data have been sent directly to Council by telemetry on a daily basis. During the year under review, the data was 1 minute averaged data. As per the consent conditions, compliance will continue to be assessed based on 15 minute averages. The consent holder undertakes regular checking of the recording system to ensure that compliance is achieved in terms of continuity and accuracy of the record, particularly in relation to the 3˚C maximum stream temperature increase permitted by consent conditions, and a requirement for the temperature increase not to exceed 2˚C for more than 90% of the discharge period (on an annual basis).

Photo 1 Upstream temperature probe (to May 2023) and cooling water discharge spray booms

Photo 2 Upstream temperature probe (from May 2023)

Photo 3 Downstream temperature probe

Calibration was performed at monthly intervals by Company personnel, and checks were made by Council staff during monthly receiving water sampling surveys.

Historically, Council had been advised that the accuracy of the temperature probes was ± 0.1˚C, however, calibration records forwarded to Council for the 2018-2019 year showed off-sets of up to 0.5˚C that were not being corrected for.

From October 2018, the Company introduced a reduced tolerance for allowable deviations from the reference thermometer during verifications. The allowed deviation was reduced from ± 0.5 ˚C to ± 0.2 ˚C. Up until this point, based on the maximum permitted off-sets given in NEMS[3], there was potential for error up to ± 0.8˚C deviation at each monitoring location (± 0.5˚C, with an additional off-set of ± 0.3˚C allowed for due to errors on the thermometer used to perform the calibration), and a consequent potential error of up to ± 1.6˚C on any calculated temperature differentials overall. Following implementation of the lower deviation tolerance, the potential error was reduced to between ± 0.2˚C and ± 0.5˚C at each monitoring location and therefore a temperature differential accuracy of between ± 0.4˚C and ± 1.0˚C depending on the accuracy of the thermometer used to perform the calibration.

Parallel temperature monitoring was initiated in the 2018-2019 year. The results for the year under review are discussed in Section 2.1.1.5.1. The consent holder provided data is presented in section 2.1.1.5.2.

2.1.1.5.1 Parallel temperature monitoring

Where there are cooling water discharges to waterways, it is Council policy to have continuous water temperature monitoring in place to confirm compliance with consent conditions relating to permitted instream temperature changes. The majority of this monitoring is undertaken by the Council with the installation of one upstream site and at least one downstream site. In the case of the lactose plant, this temperature information is required by the Company, as it is used to control cooling water system operating parameters. The Company is responsible for all aspects of the monitoring of the receiving water temperatures

[3] A national standard for gathering and processing environmental data

immediately upstream and downstream of their site, with any maintenance, validations and calibrations carried out internally.

The data, including any requested calibration records, are provided to the Council. It is therefore considered that the accuracy of the data and consent compliance can be confirmed by periodic parallel temperature monitoring, rather than a full duplication of effort, as would be the case if Council were to undertake monitoring of a similar scale to that which is in place for other consent holders.

The Council's temperature logger was installed alongside the Company's temperature probe at the both the upstream and downstream monitoring sites between 31 March and 2 May 2023, with the comparisons shown in Figure 13 and Figure 14.

Good agreement was observed at both monitoring sites, with the Company's data being no more than 0.2˚C higher than the Council's data at the upstream site and no more than 0.2˚C lower than the Council's data at the downstream site.

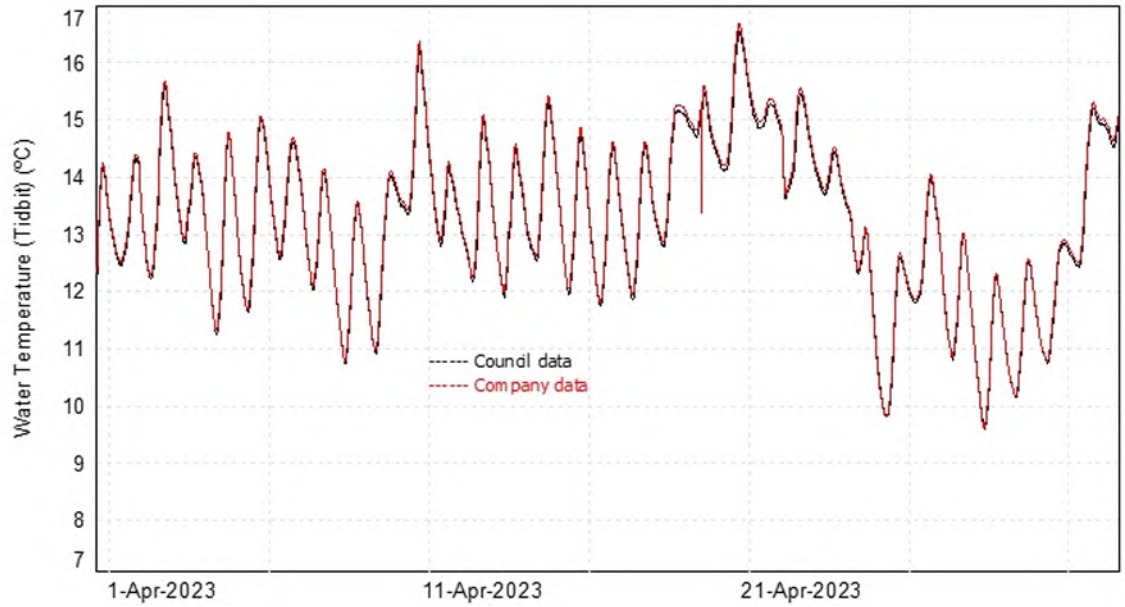

Figure 13 Parallel temperature monitoring upstream of the Company's site

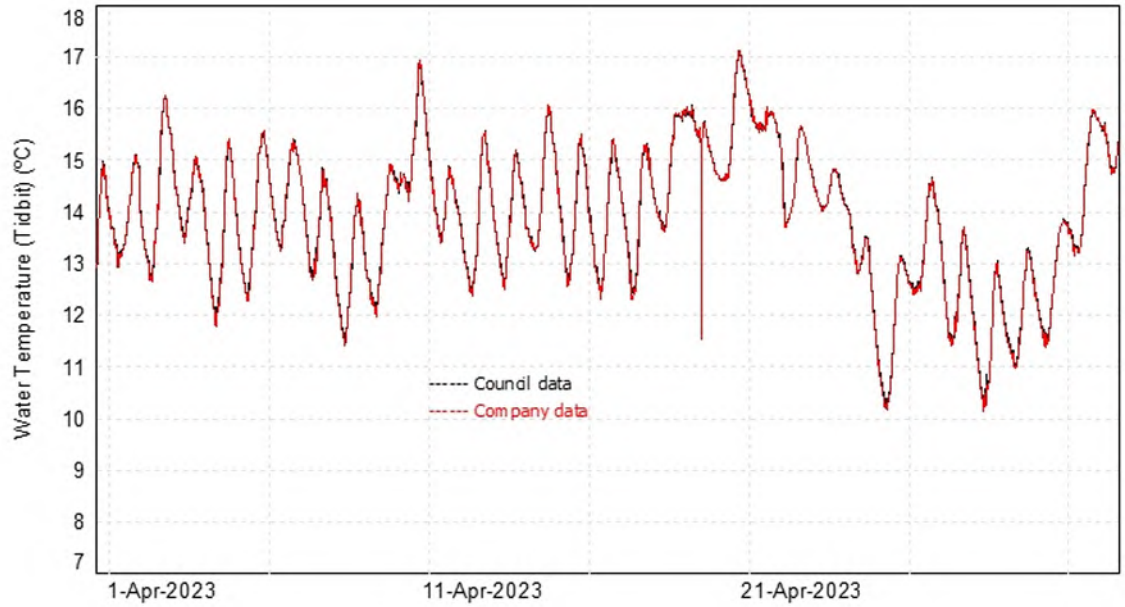

Figure 14 Parallel temperature monitoring downstream of the Company's spray cooling water discharge

2.1.1.5.2 Annual consent holder temperature data

The temperature record over the 2022-2023 reporting period for the Kaupokonui Stream upstream and downstream of the lactose plant discharge is presented in Figure 15 and Figure 16. The change in temperature is given in Figure 17.

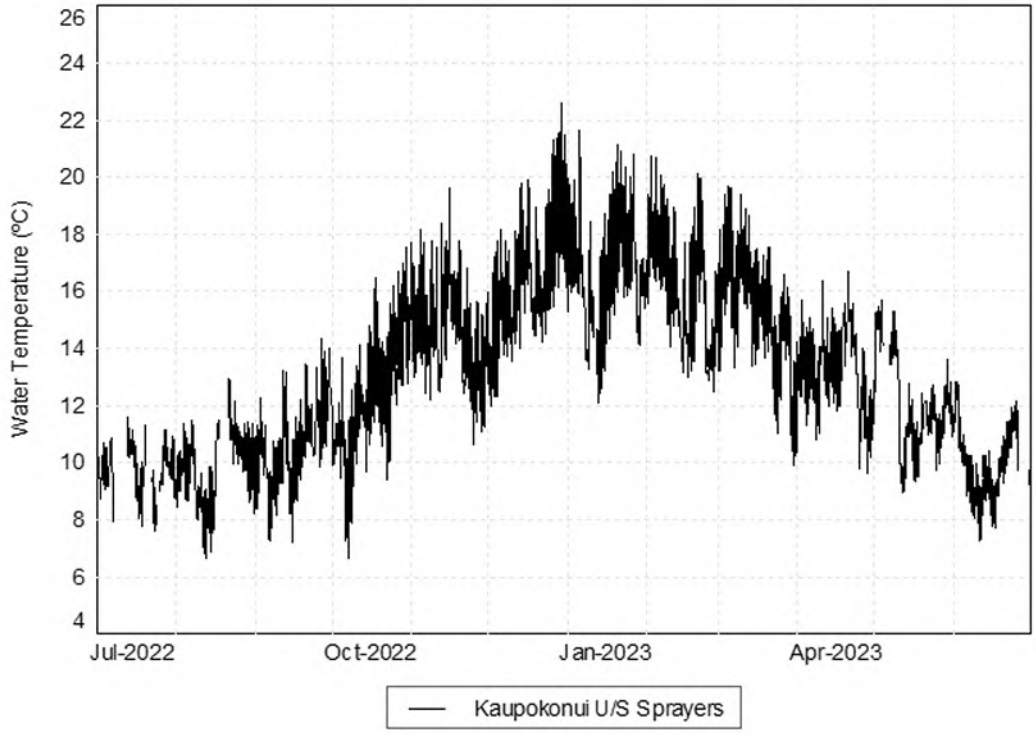

Figure 15 Water temperature (˚C) records for the Kaupokonui Stream upstream of the Lactose plant, electronic data

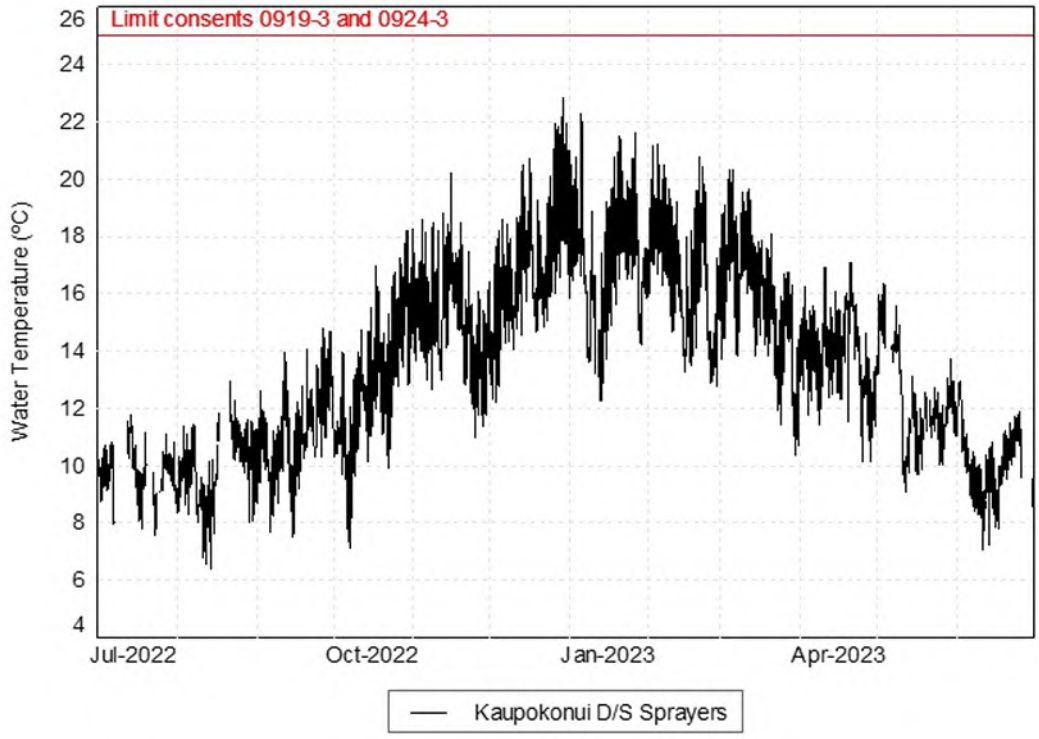

Figure 16 Water temperature (˚C) records for the Kaupokonui Stream downstream of the lactose plant, electronic data

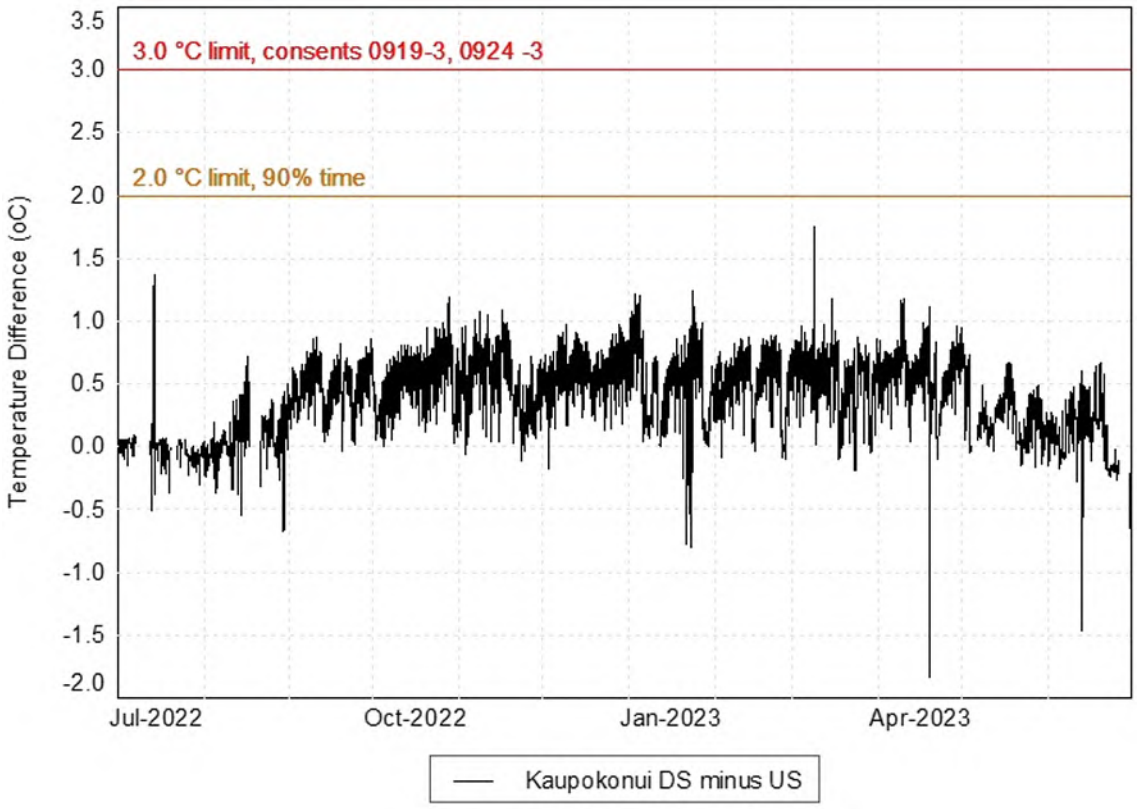

Figure 17 Kaupokonui Stream temperature change below the lactose plant, calculated from electronic data

A summary of the reported temperature change and maximum temperature data for 2022-2023 (15 minute data) is given in Table 6. On a monthly basis, the recorded percentage of time the change was below 0°C, above 2.0°C, 2.5°C and 3.0°C is given, together with the minimum and maximum reported change and the maximum downstream temperature. It is noted that during the year under review, the upstream temperature probe was relocated as a result of damage to the platform during a flood event. The new location is approximately 100 m upstream of the previous position. This location is downstream of the Company's water abstraction point, so it is still within the low flow reach. The old temperature probe was decommissioned in May 2023 following a period of parallel monitoring that showed an average difference of only 0.01°C between the two upstream monitoring locations.

Table 6 Summary of Fonterra Ltd's continuous water temperature records (˚C) from two monitoring probes in the Kaupokonui Stream

Month	Temperature change% Time*				Temperature change			Downstream temperature	
	<0˚C	>2˚C	>2.5˚C	>3˚C	Min change (d/s-u/s) (˚C)	Max change (d/s-u/s) (˚C)	Days in excess of 3˚C	Max downstream temp	Days in excess of 25˚C
Jul 22	50	0	0	0	-0.55	1.37	0	11.8	0
Aug 22	26	0	0	0	-0.68	0.72	0	12.3	0
Sep 22	0.1	0	0	0	-0.04	0.88	0	14.8	0
Oct 22	0	0	0	0	-0.01	1.19	0	18.3	0
Nov 22	1	0	0	0	-0.11	1.09	0	20.2	0

Month	Temperature change% Time*				Temperature change			Downstream temperature	
	<0˚C	>2˚C	>2.5˚C	>3˚C	Min change (d/s-u/s) (˚C)	Max change (d/s-u/s) (˚C)	Days in excess of 3˚C	Max downstream temp	Days in excess of 25˚C
Dec 22	0.2	0	0	0	-0.17	0.98	0	22.9	0
Jan 23	3	0	0	0	-0.81	1.24	0	22.3	0
Feb 23	3	0	0	0	-0.10	0.88	0	21.3	0
Mar 23	2	0	0	0	-0.19	1.76	0	20.4	0
Apr 23	1	0	0	0	-1.84	1.19	0	17.1	0
May 23	8	0	0	0	-0.17	0.93	0	16.4	0
Jun 23	33	0	0	0	-1.47	0.67	0	12.9	0
Totals for 2022-2023*	9	0	0	0	-1.8	1.7	0	22.3	0

Note:* =% of actual record (21 days 5 hrs of missing record)

Condition 4(b) of consent 0919-3 requires that the discharge does not result in an increase of more than 3˚C at any time, and does not alter the temperature of the receiving water by more than 2°C for 90% of the time (on an annual basis). There is an alarm on the system that alerts staff if there is a high differential temperature recorded and periodic testing is performed to ensure that the alarm is functioning.

The Company operates a null switch, which is activated during periods when the temperature probes are pulled out of the water for protection during high flows, or during calibration, which generally results in short periods of missing data.

This reduces the number and duration of temperature spikes recorded (it should be noted that 0.1% exceedance during any one month's operations equates to a time period of approximately 1 hour). The Company advises the Council of the reasons for any other gaps in the data. During the year under review, the probes were removed from the river for approximately 3 days during August 2022 and network issues resulted in additional data gaps in July 2022 and June 2023.

The consent limits for the permitted temperature increases in the receiving water were not exceeded during 2022-2023.

Condition 5 of consents 0919-3 requires that the discharge shall not raise the temperature of the receiving water above 25°C at the boundary of the mixing zone. Figure 16 shows that this condition was complied with during the year under review.

The data and summary provided in Figure 17 and Table 6 show that, although the temperature probes comply with the requirements of NEMS standard for the monitoring data, and significant improvements have been made to the calibration processes the Company employs, there still appears to be some occasional issues with the precision of the recording of the temperature differential between the upstream and downstream sites. During the year under review, the data reported indicated that there was a drop in stream temperature between the upstream and downstream sites for 9% of the time. A comparison of the negative temperature differentials is presented in (Table 7).

Table 7 A comparison of the historical data where a decrease in temperature of the Kaupokonui Stream has been recorded

Year	Whole year		During July		
	Percentage of the time that a negative temperature differential is recorded	Maximum negative temperature differential	Percentage of the time that a negative temperature differential is recorded	Percentage of the time that the negative temperature differential is < 0.5°C	Maximum negative temperature differential
2016-2017	23	-1.46	99	0	-0.4
2017-2018	17	-2.24	98	37	-2.24
2018-2019	3	-4.86	0.6	0.5	-3.0
2019-2020	11	-3.77	15	2.1	-2.98
2020-2021	13	-2.26	99	65	-2.14
2021-2022	7	-0.69	52	0	-0.45
2022-2023	9	-1.84	50	0	-0.55

The reductions in temperature may be due to the permitted calibration errors of the measuring devices. This continues to support the use of a 2°C temperature change limit on the consent for the majority of the time, and the need for continuation of the parallel temperature monitoring.

As discussed in Section 2.1.1.4 operational management of the cooling water discharge system had been changed in a number of ways during the 2018-2022 years. A summary of the operational changes and the notable observable effects in the receiving water are given in Table 8. The effects of the changes are illustrated in the comparison of the temperature differential probability density curves shown in Figure 18.

Table 8 Summary of cooling water system operational changes and receiving water temperature related outcomes

Timeframe	Change in operational management of cooling tower and associated in-house monitoring	Observable effects on the instream temperature	Comments
2016-2017		Negative upstream-downstream temperature differentials reported for 23% of the electronic record. Maximum negative temp differential reported -1.5°C	Errors within limits permitted by NEMS standards, resulted in potential error of ± 1.6˚C on any calculated temperature differentials. Would need to be considered in relation to the temperature increase permitted on the reissued consent. Discussions commenced on options to improve precision.
2017-2018		Negative upstream-downstream temperature differentials reported for 17% of the electronic record. Maximum negative temp differential reported -2.2°C	Discussions on-going. Council monitoring programme to include period of parallel temperature monitoring for the 2018-2019 year

Timeframe	Change in operational management of cooling tower and associated in-house monitoring	Observable effects on the instream temperature	Comments
Oct 2018	Company introduced a reduced tolerance for allowable deviations from the reference thermometer during verifications from ± 0.5 ˚C to ± 0.2 ˚C.	A significant reduction in the amount of time that a negative temperature differential was recorded to only 3.2% of the electronic record.	Time lag identified in the control loop for the utilisation options available for running the cooling tower efficiently based on the upstream downstream temperature differentials to take effect
Nov 2018	Manual diversion of all flow from the cooling water flows to the cooling tower. Cooling tower operating at maximum cooling conditions at all times	A significant reduction in the most common instream temperature differential, from 0.9 to 0.3°C A significant reduction in the percentage of the time that the temperature differential is greater than 1.0°C	
2019-2020	Removal of cooling tower bypass line Addition of variable speed pump to control cooling tower residence time Operation of cooling tower fans based on river temperature differential	A significant change in the most common instream temperature differentials, with a bimodal pattern evident in the year under review. That is two most common instream temperature differentials of 0.0 and 0.6°C, both at 17% of the time A significant increase in the amount of time that a negative temperature differential is reported (11% of record). A further reduction in the amount of time the temperature differential is above 1.0°C (17%)	Due to permitted errors inherent in any temperature measurements, actual instream temperature differentials may be up to 1.0°C higher than reported measurement. Would need to be considered in relation to the temperature increase permitted by reissued consent.
2020-2021	Commencement of installation of pressure regulating nozzles at the spray discharge booms to produce a finer spray	Most common instream (targeted) temperature differential 0.6°C at 16% of the time Further increase in the amount of time that a negative temperature differential is reported (-0.1 to -1.0°C for 13% of record). A further reduction in the amount of time the temperature differential is above 1.0°C (7%)	Due to permitted errors inherent in any temperature measurements, actual instream temperature differentials may be up to 1.0°C higher than reported measurement. Would need to be considered in relation to the temperature increase permitted by reissued consent.
2021-2022	Completion of installation of pressure regulating nozzles at the spray discharge booms	Most common instream (targeted) temperature differential 0.6°C at 14% of the time. Reduction in the amount of time that a negative temperature differential is reported (-0.1 to -1.0°C for 2% of record). Increase in the amount of time the temperature differential is above 1.0°C (11%)	Due to permitted errors inherent in any temperature measurements, actual instream temperature differentials may be up to 1.0°C higher than reported measurement. Would need to be considered in relation to the temperature increase permitted by reissued consent.

There were no further changes to the cooling water system during the year under review

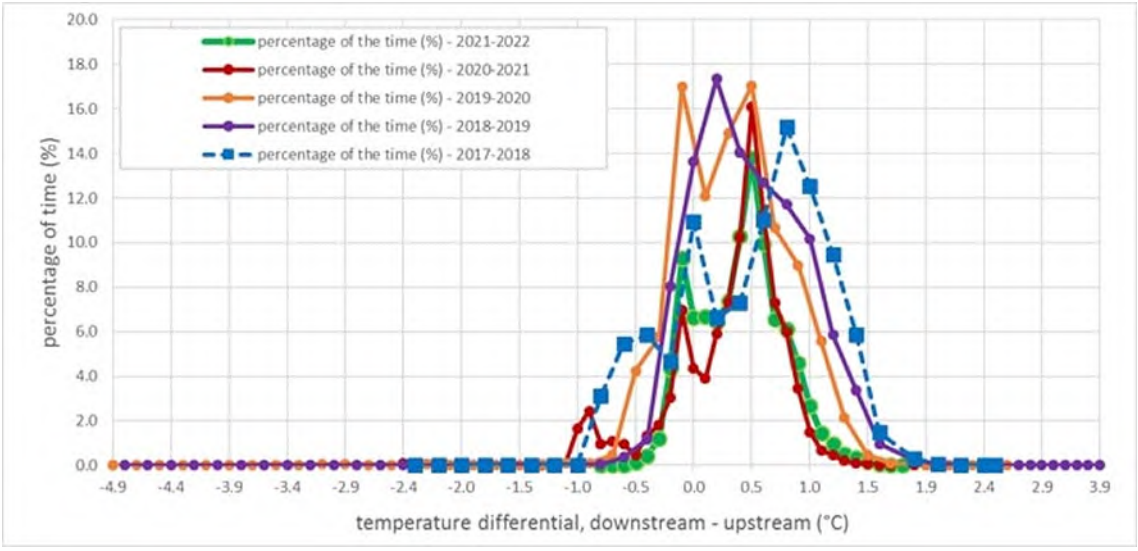

Figure 18 Instream temperature differential probability density during the 2017-2022 years from 1 July-30 June

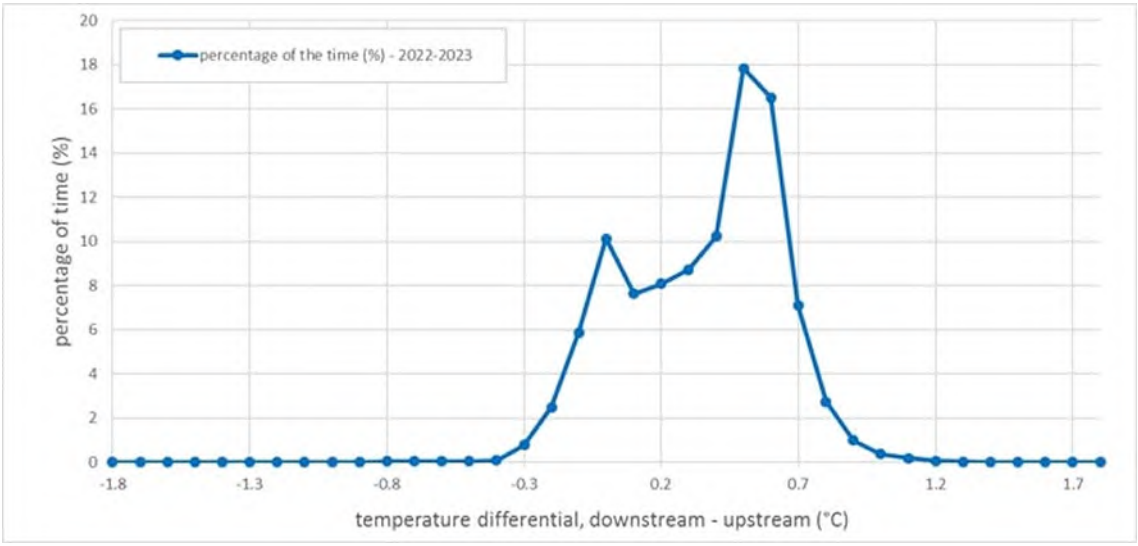

Figure 19 Instream temperature differential probability density during the year under review, 1 July-30 June

Figure 18 demonstrates that the most effective option to minimise temperature effects on the environment was achieved by running the cooling tower at maximum capacity, as was the case in the 2018-2019 year from November onwards. The reduction in the discharge temperatures would have resulted in a significant reduction in the effects occurring within the approximately 200 m discharge and mixing zone. An additional advantage is that it would improve the sustainability of the cooling water discharge system at times when the upstream receiving water temperature peaks during the summer months, whilst still ensuring compliance with the 25°C downstream temperature limit (peak upstream temperature recorded to date, 24.8°C on both 29 and 30 January 2018).

Figure 19 shows that the operational management of the cooling tower during the year under review would have resulted in a reduction in the potential effects within the discharge spray zone when compared to the 2017-2018 year, but some of this improvement would have been lost when compared to the latter part of the 2018-2019 year.

2.1.1.6 Wastewater irrigation

Well managed wastewater irrigation systems have the positive benefits of reducing the requirement for synthetic fertilisers, improving soil condition and improving pasture growth that is limited by dry conditions.

The potential for adverse effects are influenced by the total hydraulic loading (that is, the rainfall and depth of irrigation), the soil moisture at the time of the irrigation event and the contaminant concentrations of the wastewater. All these factors influence the degree of leaching of contaminants that may occur as a result of wastewater irrigation.

The Company's wastewater irrigation consents limit the potential for adverse effects from this activity primarily by:

- Setting irrigation volume limits,
- Prohibiting ponding,
- Requiring that the activity is undertaken in accordance with a management plan that addresses a number of specific matters,
- Requiring specific monitoring, with the data to be provided to Council, and
- Requiring set-back distances from streams and neighbouring properties.

The following sections (Section 2.1.1.6.1 to Section 2.1.1.6.3) contain summaries of the data provided by the Company to assess compliance with the specific consent limits and to assess the data in relation the factors that have the potential to result in adverse environmental effects.

2.1.1.6.1 Wastewater irrigation volumes

Consents 0922-3.2 and 0923-3.3 permit a maximum volume of 2,630 m^3 (Farm1) and 3,834 m^3 (Farms 2 and 3) of factory wastewater (FWW) and dairy shed effluent (DSE) combined to be spray irrigated per two consecutive days, with a maximum daily volume for DSE of 120 and 168 m^3, respectively. In addition to this, there is a limitation in that DSE can only be irrigated when in combination with factory wastewater.

In relation to the Company's monitoring and data provision for spray irrigation of wastewater onto land (that is, the exercise of 0922-3 and 0923-3) the Company supplied the Council with monitoring data relating to the daily volume of factory and DSE spray irrigated in the form of a monthly report.

The Company also provided irrigation volumes on a per paddock basis. The data used for the consent compliance assessment and analysis that follows and is based on a summation of the paddock by paddock irrigation data for each of the Farms.

Where comparisons are made with years prior to 2021-2022, it should be noted that the irrigation data provided to Council was previously based on the volumes of effluent pumped to the farms, and excluded water used to flush the pipes, which is now included in the irrigation volumes provided to Council.

The irrigation data is summarised in Table 9, with the two day totals and the associated consent limits shown in Figure 20 and Figure 21.

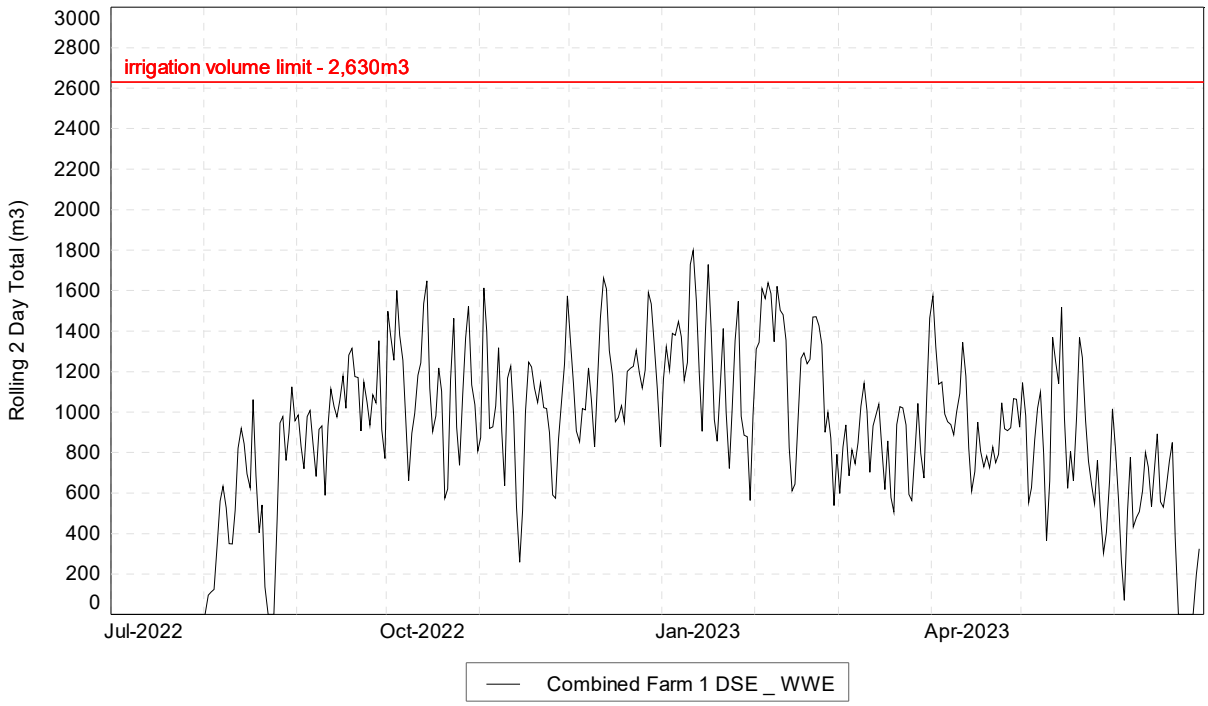

Figure 20 Irrigation volumes for Farm 1, 2 day rolling totals (FWW and DSE)

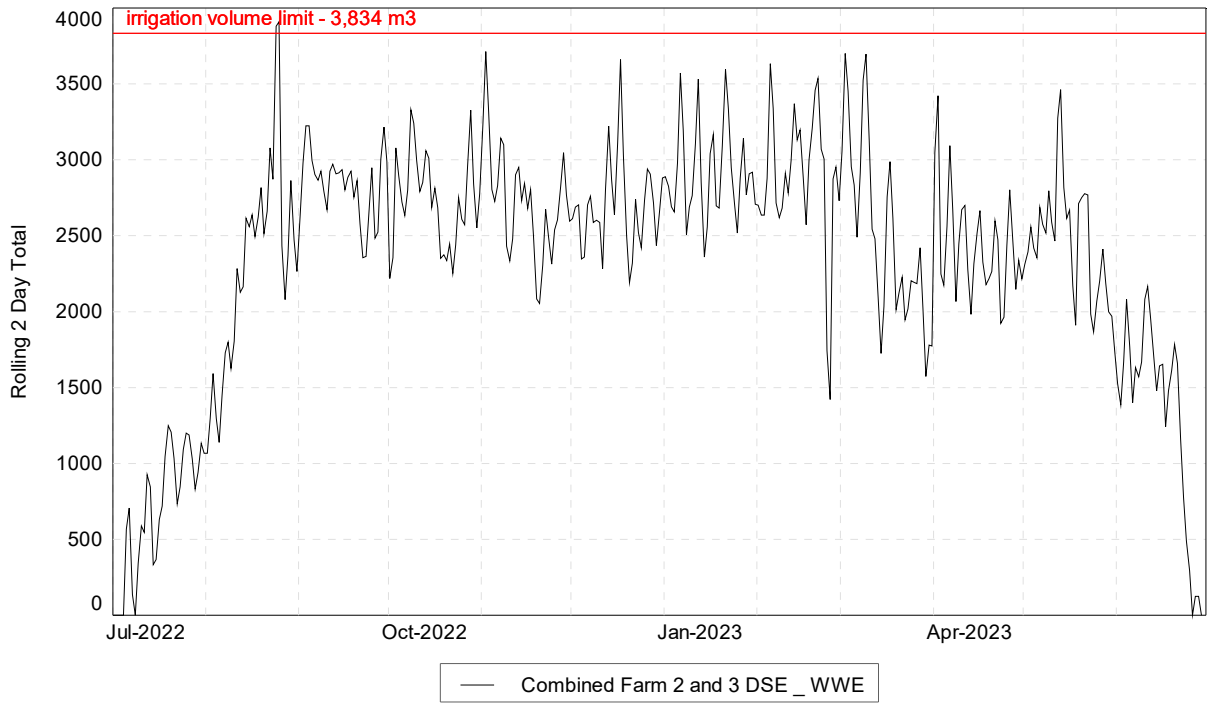

Figure 21 Irrigation volumes for Farms 2 & 3, 2 day rolling totals (FWW and DSE)

Table 9 Waste irrigation records supplied by Fonterra Ltd (volumes)

Month	Kapuni Farm 1							Farms 2 & 3						
	FWW			DSE			Days 2-day total >2,630	FWW			DSE			Days 2-day total >3,834
	Days	Volume, m^3/d		Days	Volume, m^3/d			Days	Volume, m^3/d		Days	Volume, m^3/d		
		Av.	Max		Av.	Max.			Av.	Max.		Av.	Max.	
Jul 22	0	0	0	0	0	0	0	26	319	518	26	91	167	0
Aug 22	27	264	505	25	39	81	0	31	1,078	1,955	23	80	158	2
Sep 22	30	455	641	26	50	83	0	30	1,404	1,613	16	29	39	0
Oct 22	31	507	758	30	61	90	0	31	1,309	1,664	30	60	129	0
Nov 22	30	441	717	26	61	98	0	30	1,305	1,762	27	65	103	0
Dec 22	31	534	734	29	59	98	0	31	1,298	1,760	31	50	71	0
Jan 23	31	551	852	31	57	99	0	31	1,401	1,766	30	56	114	0
Feb 23	28	575	740	16	65	99	0	28	1,403	1,744	20	53	90	0
Mar 23	31	375	613	31	54	120	0	31	1,178	1,786	31	72	167	0
Apr 23	30	431	669	20	76	119	0	30	1,169	1,545	13	117	167	0
May 23	31	398	759	26	37	62	0	31	1,226	1,732	0	0	0	0
Jun 23	23	253	398	21	31	52	0	27	706	1,083	0	0	0	0
Totals	323	142,204		281	15,349		0	357	415,190		247	16,316		2

Note: Average daily volume irrigated is calculated from days when irrigation occurred

The data provided by the Company showed Company continued to irrigate a large volume of wastewater during the year under review. The data shows that the two day irrigation volume limit was complied with on Farm 1, with the maximum volume irrigated on Farm 1 in any two consecutive days being a total of 1,798 m^3.

On Farms 2 and 3 the maximum volume irrigated in any two consecutive days was a total of 3,909 m^3. The Company contacted the Council at the time of the event to advise that there had been one exceedance. However, the apparent exceedance was not recorded as an unauthorised discharge as the volume by which the consent limit had been exceeded was within the accuracy expected by the measuring device (± 5%). This occurred on 25 August 2022 whilst the Farm 1 wastewater main line was out of action due to the pipeline failure discussed in Section 2.3.

Irrigation of effluent occurred almost daily during the monitoring year, with only 9 days when there was no irrigation. These days were during the winter shut down period, which occurs in June and July each year.

A total factory effluent volume of 557,394 m^3 was irrigated during the 2022-2023 year. This was a very similar volume when compared to the previous year (554,536 m^3).

The Company's Whole Farm Management Plan (WFMP), which covers the consents requirements for an irrigation management plan, states that an even distribution over the paddocks is ideal, however this needs to be balanced with irrigation requirements, stock rotation, calf rearing and the weather.

During the year under review, the factory wastewater irrigation distribution between the farms during the year under review was the same as the previous year with 26% on Farm 1, 17% on Farm 2 and 58% on Farm 3. Given that the Farm areas are approximately 31%, 15 % and 58 % respectively, this indicates that there were generally higher application rates of FWW on Farm 3 when compared to Farm 1.

Table 10 FWW volumes 2017-2018 to date

Year		Farm 1	Farm 2	Farm 3	Annual volume (m^3)	Percentage change from previous year
2017-2018	Volume (m^3)	145,382	95,964	334,837	576,183	-
	%	25	17	58	-	
2018-2019	Volume (m^3)	121,376	74,435	273,788	469,461	-18.5
	%	26	16	58	-	-
2019-2020	Volume (m^3)	118,402	97,585	277,624	493,611	5
	%	24	20	56	-	-
2020-2021	Volume (m^3)	118,037	94,416	299,053	511,506	4
	%	23	18	58	-	-
2021-2022	Volume (m^3)	141,893	91,709	320,934	554,536	8.4
	%	26	17	58	-	-
Area irrigated	*ha*	*57.74*	*28.4*	*98.2*	*184.34*	-
	%	*31*	*15*	*53*	-	-
2022-2023	Volume (m^3)	142,204	93,017	322,173	557,394	0.5
	%	26	17	58	-	-

Disposal of DSE from the Farm 1 and Farm 3 dairy sheds to land via the factory effluent spray irrigation system was established in 2015-2016, ending the oxidation pond discharges to the Kaupokonui and Motumate Streams.

As with the FWW, the per paddock volumes provided by the Company have been combined to determine the daily volumes of DSE discharged. These are shown in Figure 22 and Figure 23.

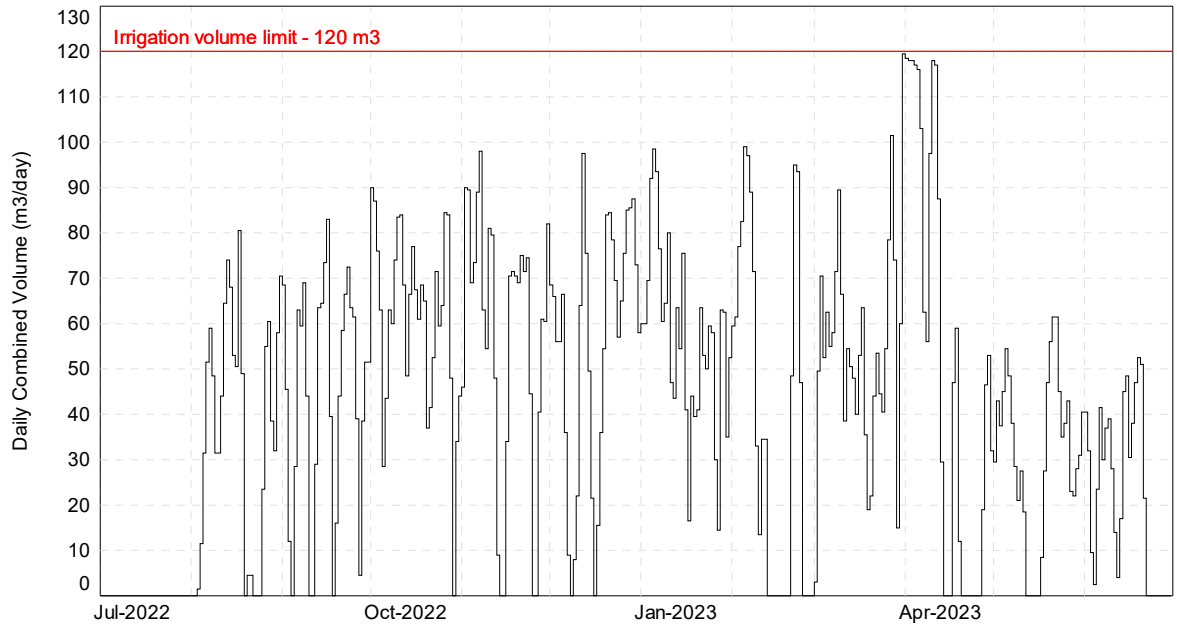

Figure 22 Daily DSE irrigation volumes for Farm1

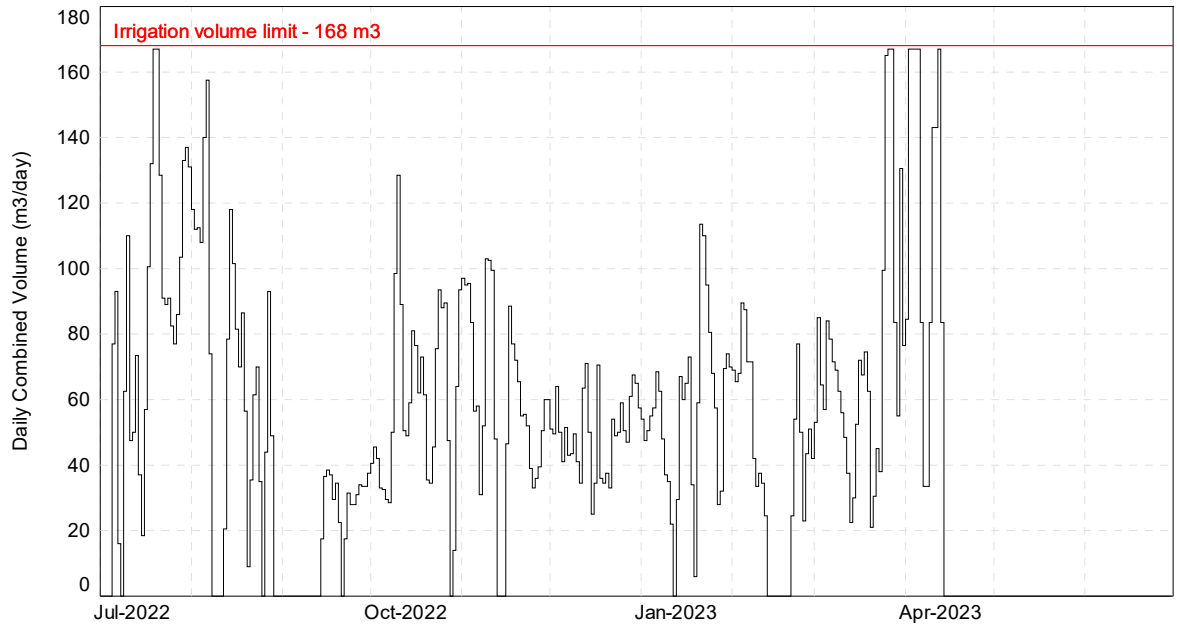

Figure 23 Daily DSE irrigation volumes for Farms 2 and 3

The maximum daily DSE volumes permitted by the Company's consents were complied with during the year under review.

It is noted that on an annual basis, there was an increase in the DSE irrigation volumes (Table 11).

Table 11 Annual DSE volumes 2017-2018 to date

Year	Farm 1 DSE volume (m^3)	Percentage change from previous year	Farm 2 DSE volume (m^3)	Farm 3[a] DSE volume (m^3)	Percentage change from previous year	Annual volume (m^3)	Percentage change from previous year
2017-2018	9,352		-	14,199		23,551	
2018-2019	12,034	29	-	13,276	9	25,310	8
2019-2020	19,229	60	-	13,972	5	33,201	31
2020-2021	18,175	-5	-	20,685	48	38,860	17
2021-2022	12,930	-29	667	14,240	-31	27,837	-28
2022-2023	15,349	19	1,658	14,658	3	31,665	14

Key a Prior to the 2021-2022 year, the DSE produced on Farm 3 could only be irrigated on Farm 3.

In general terms, there was a less than 1% increase in the volume of wastewater irrigated to the farms and an increase of 14% in the volume of DSE irrigated.

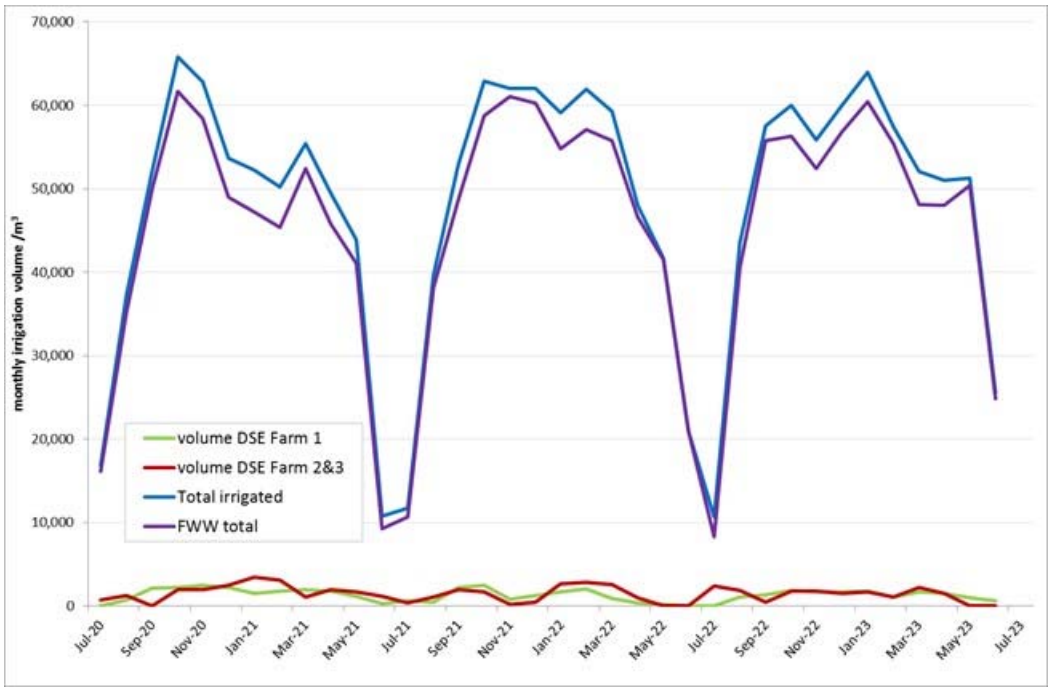

Figure 24 Relative monthly irrigation volumes during the year under review, with previous two years for comparison

As outlined, the WFMP states that, with consideration for the stated constraints, the Company is aiming to ensure that the wastewater is distributed as evenly as possible.

Given the varying areas of the paddocks, the total FWW and DSE annual irrigation load as a cumulative depth in mm equivalent have been calculated for each paddock to provide a means of comparing paddock loadings. A statistical summary for each of the farms is given in Table 12, with the individual paddock loadings depicted in Figure 25 (Farm 1) and Figure 27 to Figure 28 (Farms 2 and 3). The locations of the paddocks are shown in Figure 26 (Farm 1) and Figure 29 (Farms 2 and 3).

In the following figures orange bars represent paddocks that the WFMP states should be avoided in wet conditions and the green bar represents a paddock that can become hard in dry conditions, due to the potential for run off to occur.

Table 12 Summary of the annual irrigation on Farms 1, 2 and 3 for the year under review

	Annual application (mm equivalent)		
	Minimum	Maximum	Average
Farm 1	56	495	291
Farm 2	118	479	350
Farm 3	121	442	340

It is noted that there is a large variation in the irrigation ranges both between Farms and within paddocks on each of the Farms.

In the case of Farm 1 the lowest irrigation application rate in mm equivalent discharged during the year under review was on paddock 7 at only 56 mm/year, with the highest load applied to paddock 15 at 495 mm/year. Paddock 2, which received a load of 143 mm equivalent during the year under review is identified in the WFMP as a paddock available for the disposal of solid effluent, however the paddock was not used for this purpose at any time during the year under review.

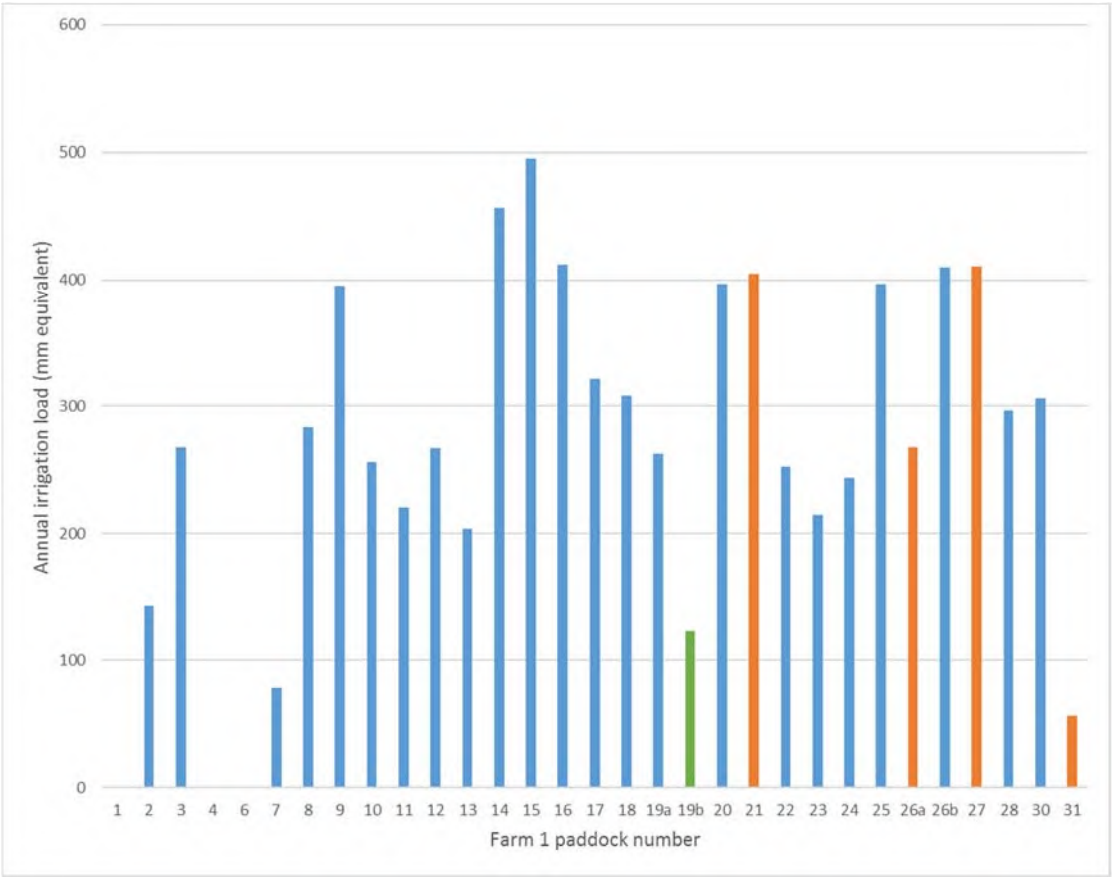

Figure 25 Farm 1 FWW and DSE irrigation load as mm per year equivalent for the year under review

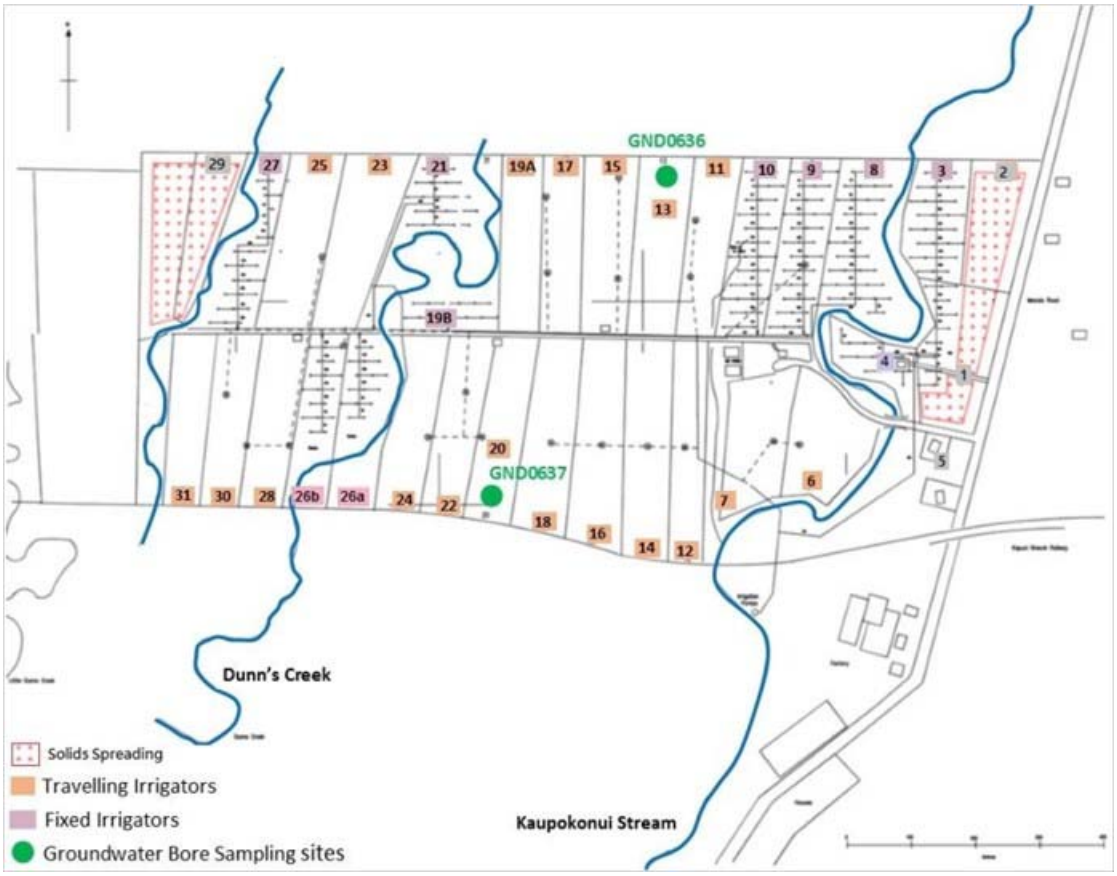

Figure 26 Paddock numbering, Farm 1

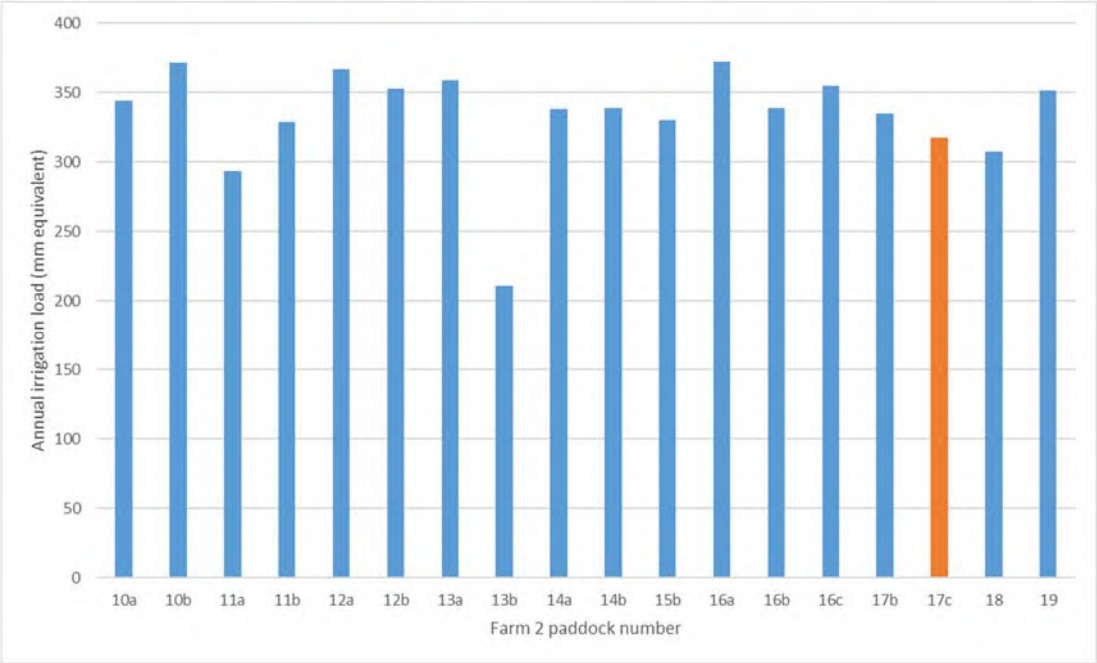

Figure 27 Farm 2 FWW and DSE irrigation load as mm per year equivalent for the year under review.

In the case of Farm 2 the lowest irrigation application rate in mm equivalent discharged during the year under review was on paddock 12a at 118 mm/year, with the highest load applied to paddock 19 at 479 mm/year.

The application rates in the Farm 3 paddocks that are equipped with fixed in ground irrigators were generally in the range 300-400 mm equivalent. The exception to this was paddock 4. Paddock 4 received the lowest load at 290 mm equivalent.

The application rates in the Farm 3 paddocks where travelling irrigators are used were generally slightly lower, being in the range 290 to 350 mm equivalent. Paddock 40, which is identified in the WFMP as a paddock that should be avoided in wet conditions due to there being a swampy area on the west side, received the lowest irrigation load on Farm 3.

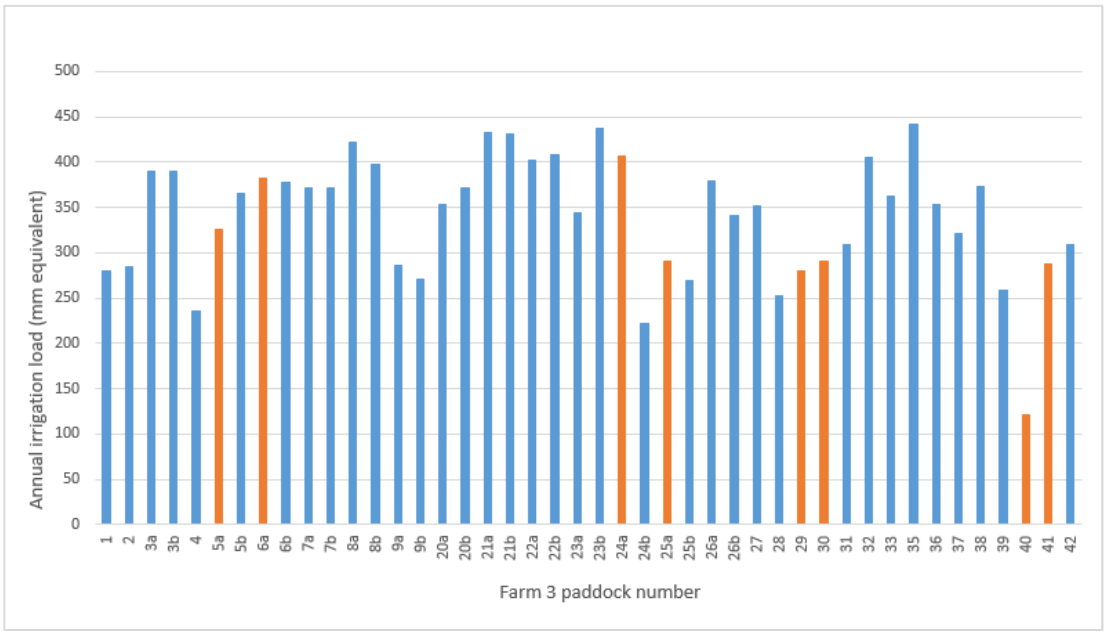

Figure 28 Farm 3 FWW and DSE irrigation load as mm per year equivalent for the year under review

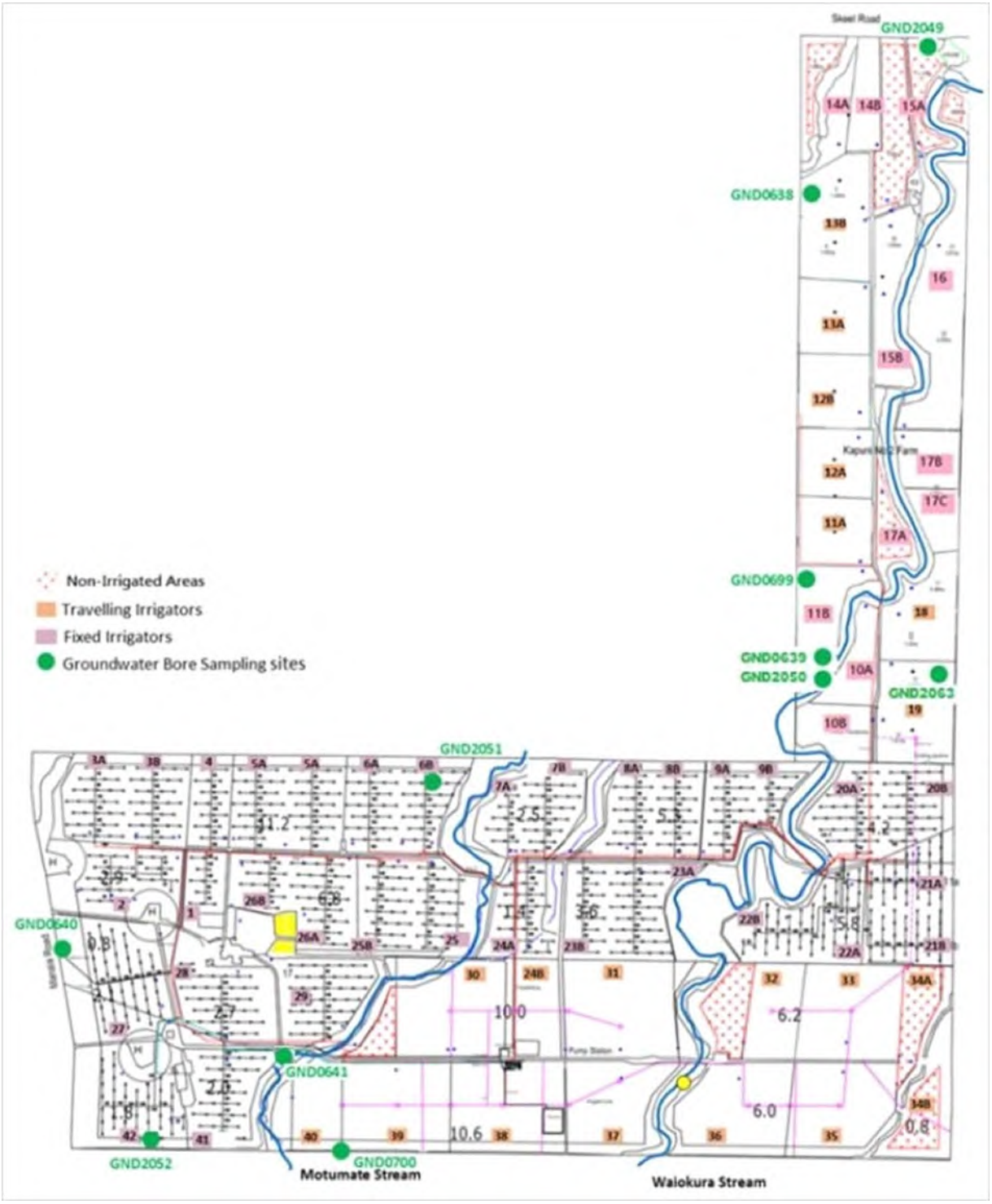

Figure 29 Paddock numbering, Farms 2 and 3

Whole Farm Management Plan irrigation loadings

The WFMP also contains limits on the irrigation loadings per application event, which is defined as one or more irrigation doses within one rotation period. The maximum loading for an irrigation event is 500 m^3/ha/event.

The irrigation loadings per event are provided to Council in the monthly reports. During the year under review the Company reported that the irrigation event loading was exceeded on five occasions on Farm 1 (paddocks

15, 21 26B and two instances on paddock 27). There were also five exceedances of the event irrigation loading on Farms 2 and 3 (paddocks 11B, 15B, 16a, 16B, and 30).

In the case of Farm 2 paddock 15B, the amount irrigated was 524 m^3/ha. This is within the ±5% accuracy limits of the flow rate metering device and so would not be considered non-compliant with the management plan. On all the other occasions, the application rate was greater than 525 m^3/ha. The highest event application rate was 655 m^3/ha.

At the time of each of these irrigation rate exceedances the nitrogen concentration of the wastewater was between 128 and 210 g/m^3 (compared to the annual median concentration of 154 g/m^3, Table 13).

There is also wastewater application rate limit of 300 m^3/ha per dose. A dose being the irrigation loading in a 24 hour period. This data has not been calculated for the year under review.

The process for recording the event data for Farms 1 and 2 currently relies on manual data entry. Therefore this is potentially subject to errors. At the time of writing this report the Company had introduced additional operational controls to improve the real time monitoring and management of the volume of wastewater irrigation doses and irrigation events. Investigations are also continuing to put process upgrades in place to enable further improvements to be made, including automation of the capture of Farm 1 and 2 dose and event data.

2.1.1.6.2 Wastewater composition

Factory wastewater

The Company commenced monthly monitoring of factory wastewater composition in May 2007. This was done at the request of the Council in order to improve calculations of loadings on irrigation areas and to characterise variation in effluent quality. The Company increased the frequency to weekly grab sampling in July 2008. The plant wastewater is now automatically sampled by the Company at the filter on the line from the plant wastewater tank. A grab sample is taken every five minutes when wastewater is being pumped to the farms. The composite of these grab samples is refrigerated and an approximately weekly composite sample is sent to an outside laboratory for analysis. Fonterra changed from using Industrial Chemical Services to Hill Laboratories during the year under review. In 2022-2023 the pH, organic strength, major mineral components, nutrients (including nitrogen species) and the metals copper and zinc were determined for 50 samples collected between 7 July 2022 and 27 June 2023. The results are summarised in Table 13.

Table 13 Results of factory wastewater monitoring by Fonterra Ltd

Parameter	Unit	2022-2023		% change in median	2021-2022		% change in median	2020-2021	
		Median N=50	Range		Median N = 46	Range		Median N = 51	Range
pH	pH	4.5	3.5 - 10.7	0	4.5	2.7 - 11.6	0.0	4.5	3.8 - 7.4
Conductivity	µS/cm @25°C	212	132 - 1,831	-89	1,886	195 - 2,510	26	1,496	228 - 2,580
Chemical oxygen demand	g/m^3	5,400	65 - 11,500	-7	5,820	46 - 10,160	13	5,140	43 - 8,630
Biochemical oxygen demand	g/m^3	3,500	80 - 8,300	9	3,200	40 - 5,600	7	3,000	20 - 4,400
Total Nitrogen	g/m^3N	154	7.2 - 290	22	126	5.0 - 171	27	99	8.9 - 167
Nitrate	g/m^3N	108	0.23 - 210	29	84	0.01 - 130	35	62	0.1 - 139
Nitrite	g/m^3N	0.52	0.01 - 33	-43	1.0	0.01 - 29	-36	1.4	0.0 - 20

Parameter	Unit	2022-2023		% change in median	2021-2022		% change in median	2020-2021	
		Median N=50	Range		Median N = 46	Range		Median N = 51	Range
Total Kjeldahl Nitrogen (TKN)	g/m^3N	46	0.1 - 166	77	26	5 - 116	-28	36	0.8 - 104
Calcium	g/m^3	147	21 - 380	6	138	7 - 252	-15	162	12.0 - 276
Calcium	meq/L	7.3	1.0 - 19.0	6	6.9	0.3 - 12.6	-15	8.1	0.6 - 13.8
Magnesium	g/m^3	15.4	2.0 - 52.0	-9	17.0	4.3 - 91.0	74	9.8	4.8 - 41
Magnesium	meq/L	1.3	0.2 - 4.3	-9	1.4	0.4 - 7.5	75	0.8	0.4 - 3.4
Sodium	g/m^3	220	20 - 480	12	196	15 - 289	89	104	15 - 228
Sodium	meq/L	9.6	0.9 - 20.9	12	8.5	0.6 - 12.6	90	4.5	0.63 - 9.9
Potassium	g/m^3	115	3 - 750	139	48	10 - 170	20	40	13 - 110
Total Phosphorus	g/m^3P	53	2 - 260	-34	80	3 - 141	36	59	0.7 - 161
Chloride	g/m^3	72	23 - 370	-12	82	12 - 160	36	60	14 - 234
Ash	g/m^3	1,385	141 - 4,100	16	1,196	123 - 1,591	33	902	77 - 1,883
Copper	g/m^3	0.315	0.050 - 1.500	103	0.156	0.020 - 0.510	-32	0.230	0.014 - 0.860
Zinc	g/m^3	0.440	0.097 - 1.270	13	0.390	0.160 - 0.730	15	0.340	0.029 - 0.750
Sodium adsorption ratio		4.7	0.7 - 7.1	13	4.2	0.6 - 19.0	89	2.2	0.54 - 4.2

The lactose plant wastewater typically has high organic strength and is acidic. A comparison can be made between results for the 2020-2021, 2021-2022 and 2022-2023 monitoring years on the basis of median values, as shown in Table 13. The wastewater organic strength in 2022-2023 was, on the whole, similar to or more concentrated when compared with the 2020-2021 and 2021-2022 years, with only the median nitrite showing successive decreases when compared to the previous year.

The total nitrogen and potassium have increased noticeably in both the 2021-2022 and 2022-2023 years. The Council has been informed that this has been due to the incoming raw products having contained a higher mineral content than in previous years. This has resulted in an increase in the amount of "cleaning in place" (CIP) required at the site. There have been successive increases in the CIP requirements in both the 2021-2022 and 2022-2023 years. This, along with the inclusion of the volume of water used for the flushing of the wastewater lines from the 2021-2022 year onwards, have contributed to the increased amount of factory wastewater irrigated during the 2021-2023 years under review as can be seen in Figure 36. The CIP chemical in use at the site is nitric acid and therefore the increases in CIP has affected both the amount of nitrogen in the FWW (Figure 36) and the contaminant loads applied to the farms, as discussed in the following sections.

It is noted that the occasional elevation in nitrite concentration that has been observed at times in recent years has continued during the year under review. However, as with previous years, the highest concentrations found in any of the groundwater monitoring bores have remained low. The maximum concentration in the year under review was 0.008 g/m^3 in two of the Farm 3 bores, which is well below the long term drinking water standard of 0.2 g/m^3.

The mineral concentrations in the year under review were generally similar to the previous year, remaining higher than in the 2020-2023 year. The exception to this was the potassium concentration, with the 2022-2023 median being over twice that of the 2021-2022 year.

The median total phosphorus concentration returned to a concentration that was similar to the 2020-2021 median. The sodium adsorption ratio (SAR) was again elevated on occasion, though well within the safe range for soil stability.

Dairy shed effluent (DSE)

The Company began weekly analysis of DSE during the 2015-2016 season upon the commencement of spray irrigation of DSE to land, together with FWW. Automatic solenoid samplers, located beside the storage pond pump at each farm, collect composite samples over 24 hours whenever DSE pumping occurs, with an approximately weekly composite being analysed for each farm's DSE. The parameters determined are similar to those for the factory wastewater, with the exception that chemical oxygen demand (COD), copper and zinc are not determined. A total of 44 samples were taken between 11 August 2022 and 27 June 2023 for Farm 1, and 38 samples were taken between 7 July 2022 and 18 April 2023 for Farms 2 and 3. The results are summarised in Table 14.

Table 14 Results of dairy shed effluent monitoring by Fonterra Ltd

Parameter	Unit	Farm 1			Farms 2 & 3		
		Median N = 44	Range	2021-2022 median (N=27)	Median N = 37	Range	2021-2022 median (N=29)
pH	pH	8.0	5.6 - 8.3	7.9	7.9	6.4 - 8.1	8.0
Biochemical oxygen demand	g/m^3	68	18 - 960	300	270	80 - 610	360
Total Nitrogen	g/m^3N	112	48 - 167	109	172	89 - 280	127
Nitrate	g/m^3N	0.10	< 0.1 - 0.64	0.2	0.10	0.02 - 0.23	0.2
Nitrite	g/m^3N	0.12	< 0.1 - 0.93	0.3	0.10	0.01 - 0.5	0.2
Total Kjeldahl Nitrogen (TKN)	g/m^3N	112	0.8 - 167	107	172	12 - 280	127
Calcium	g/m^3	61	34 - 179	72	94	24 - 125	86
Magnesium	g/m^3	28	13.7 - 41	21	36	6 - 46	28
Sodium	g/m^3	59	29 - 163	71	83	41 - 167	48
Potassium	g/m^3	300	105 - 440	335	440	10 - 640	345
Total Phosphorus	g/m^3P	52	31 - 86	48	67	32 - 95	48
Ash	g/m^3	965	500 - 1,540	1,027	1,410	810 - 2,100	1,051

Comparison of contaminant concentrations in the factory wastewater and DSE

The DSE has generally been found to have much lower organic (BOD compared to BOD and COD, Figure 30) and higher mineral strength than factory wastewater (for example potassium, Figure 33), and is slightly alkaline.

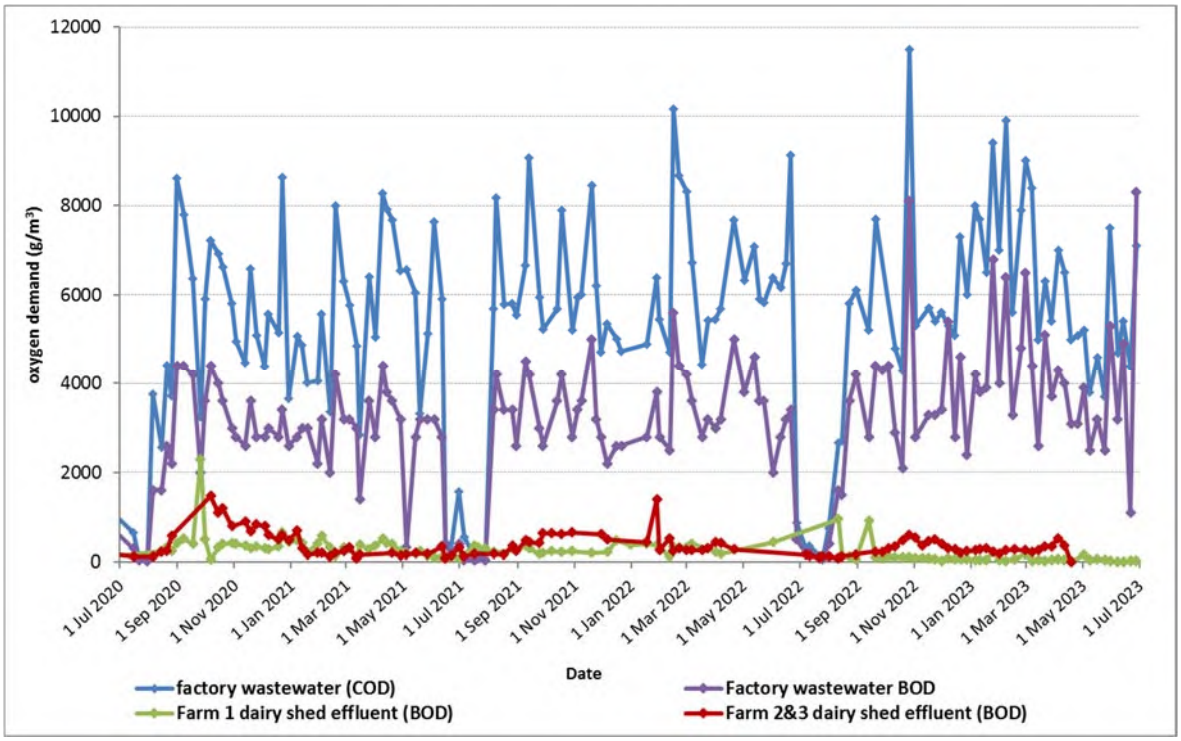

Figure 30 Oxygen demand of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

Historically, the median total nitrogen concentrations of the Farm 1 and Farm 3 DSE were generally higher than those of the FWW. During the year under review, there was less of a difference between the annual median total nitrogen concentrations of these three wastewater streams.

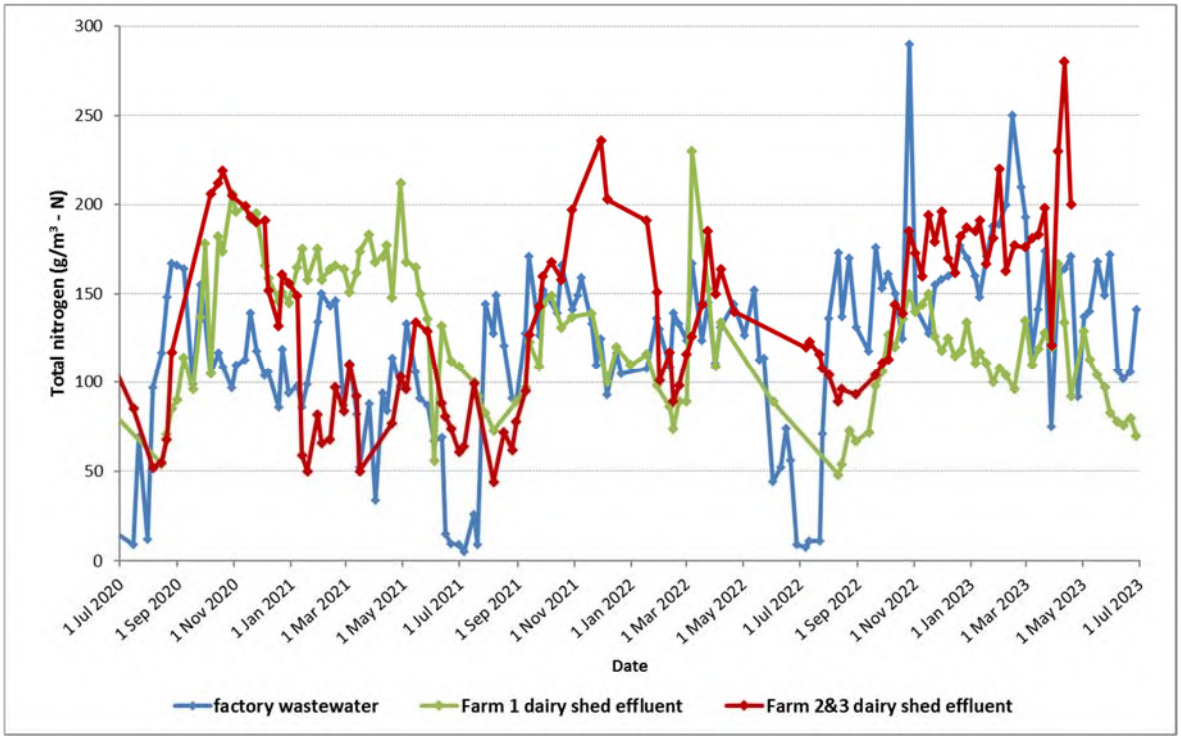

Figure 31 Nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

The predominant nitrogen species present in the DSE are generally ammoniacal nitrogen and organically bound nitrogen, whereas the factory wastewater contains much higher concentrations of nitrate and slightly more nitrite nitrogen.

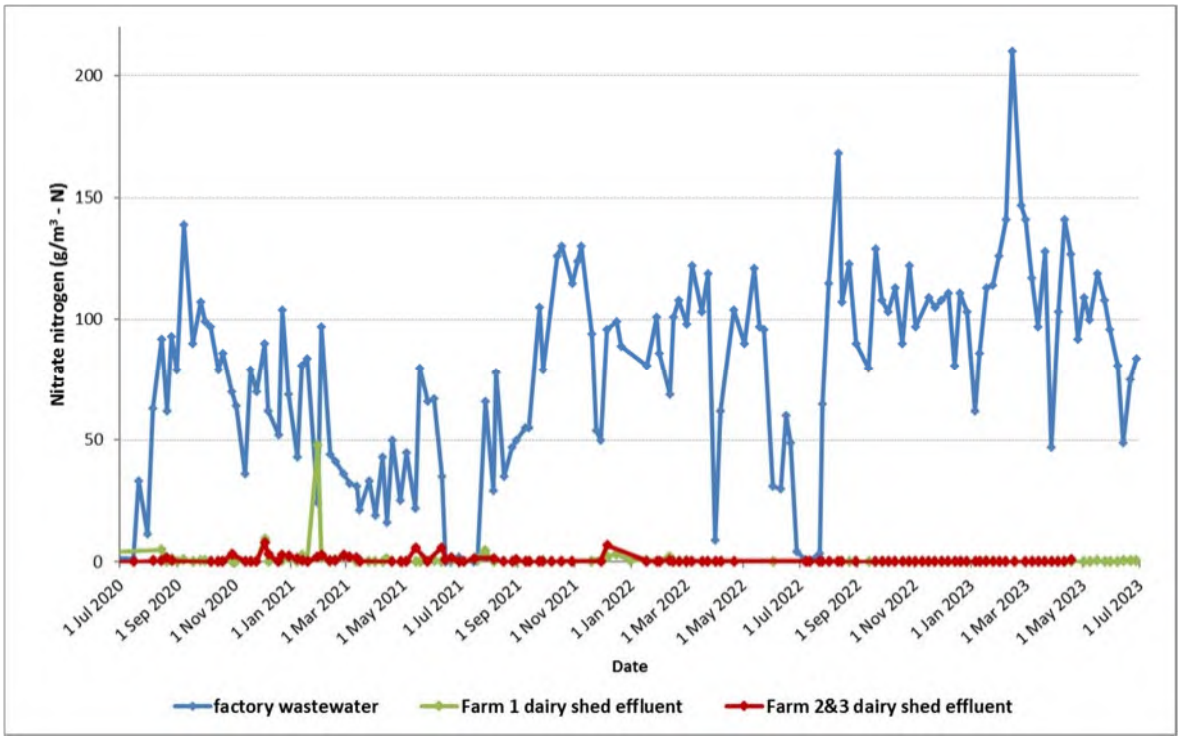

Figure 32 Nitrate nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

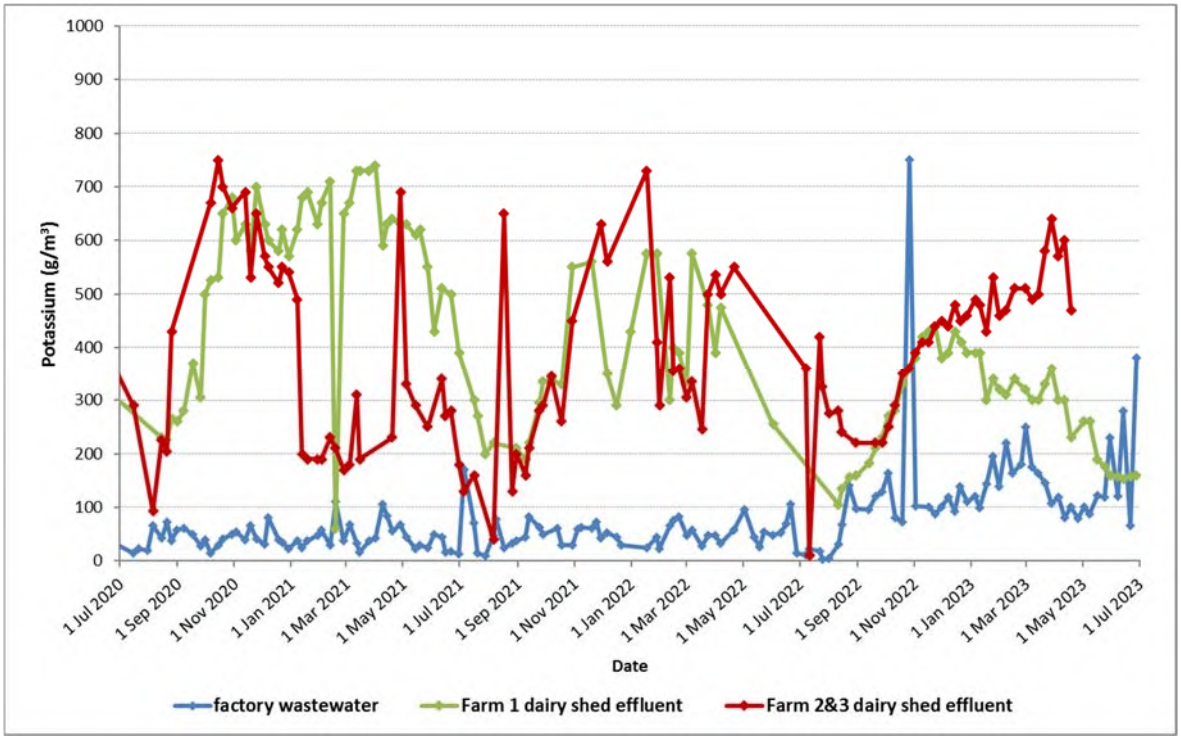

Figure 33 Potassium concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

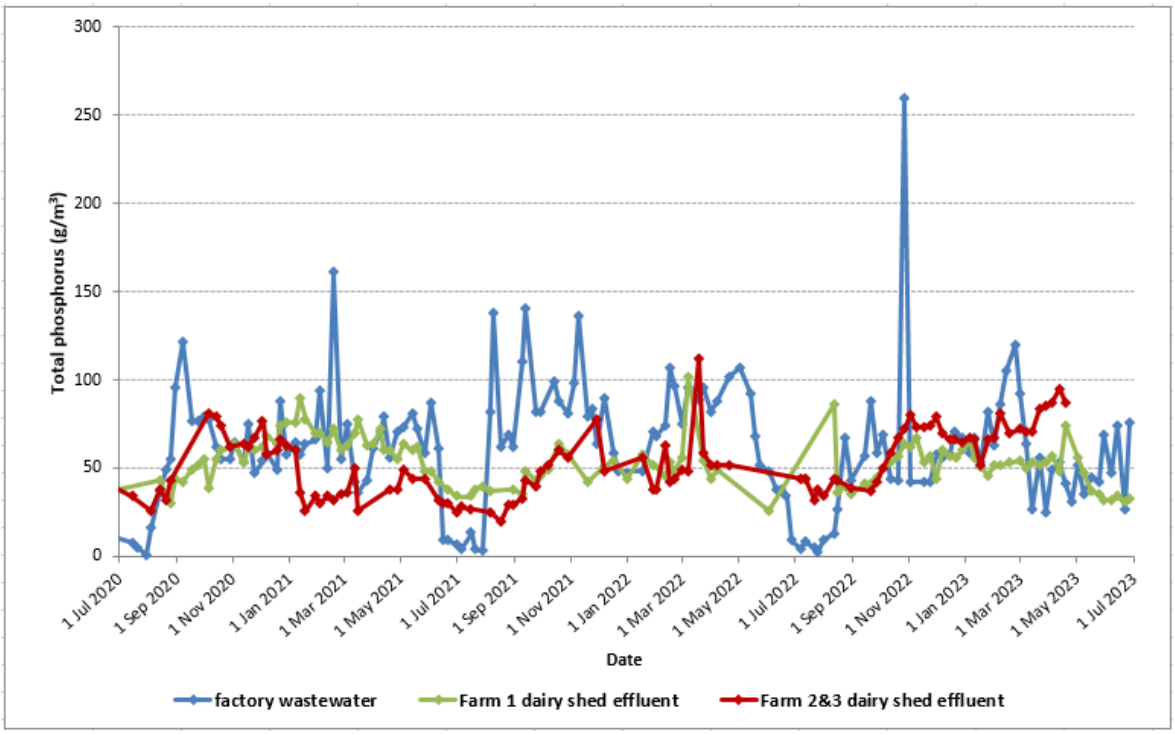

Figure 34 Phosphorus concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

2.1.1.6.3 Nitrogen and phosphorus contaminant loadings

Using data from sections 2.1.1.6.1 and 2.1.1.6.2 the approximate contaminant loadings can be estimated both in terms of the per paddock loadings and as monthly and annual totals. Prior to the 2021-2022 year, only approximate per farm monthly and annual totals were able to be calculated based on the monthly irrigation volumes on each of the farms and the average monthly nitrogen and phosphorus concentrations for each of the three wastewater streams.

A summary of the mass of nitrogen applied to the farms from the various waste streams since the assessment of environmental effects was submitted to Council in support of the application for the re-issue of the discharge to land consents is provided in Table 15. The cumulative total monthly mass of nitrogen irrigated during the year under review is summarised in Figure 35, with the loads from each waste stream applied to each of the farms also illustrated.

Table 15 Summary of the annual mass of nitrogen applied, 2016 to date

Year	Farm 1 DSE (kgN)	Farm 1 FWW (kgN)	Farm 2 DSE (kgN)	Farm 2 FWW (kgN)	Farm 3 DSE (kgN)	Farm 3 FWW (kgN)	DSE total (kgN)	FWW total (kgN)	Total applied (kgN)
2016-2017	1,624	13,072	-	9,285	3,761	29,781	5,384	52,138	57,522
2017-2018	809	10,909	-	7,564	3,177	26,170	3,986	44,644	48,630
2018-2019	1,078	11,070	-	6,750	3,273	24,245	4,352	42,066	46,417
2019-2020	2,829	11,858	-	9,555	2,243	27,392	5,072	48,805	53,877
2020-2021	2,910	13,057	-	9,957	2,416	32,224	5,326	55,238	60,564
2021-2022	1,479	17,556	108	11,515	1,925	39,673	3,512	68,744	72,256
2022-2023	1,761	22,722	177	14,393	2,447	50,118	4,385	87,233	91,619

It can be seen from Figure 35 that the relative contributions to the total nitrogen mass irrigated reflects the lower mass of nitrogen applied from the much lower volumes of DSE, and the differences in the area of land available for irrigation at each of the farms.

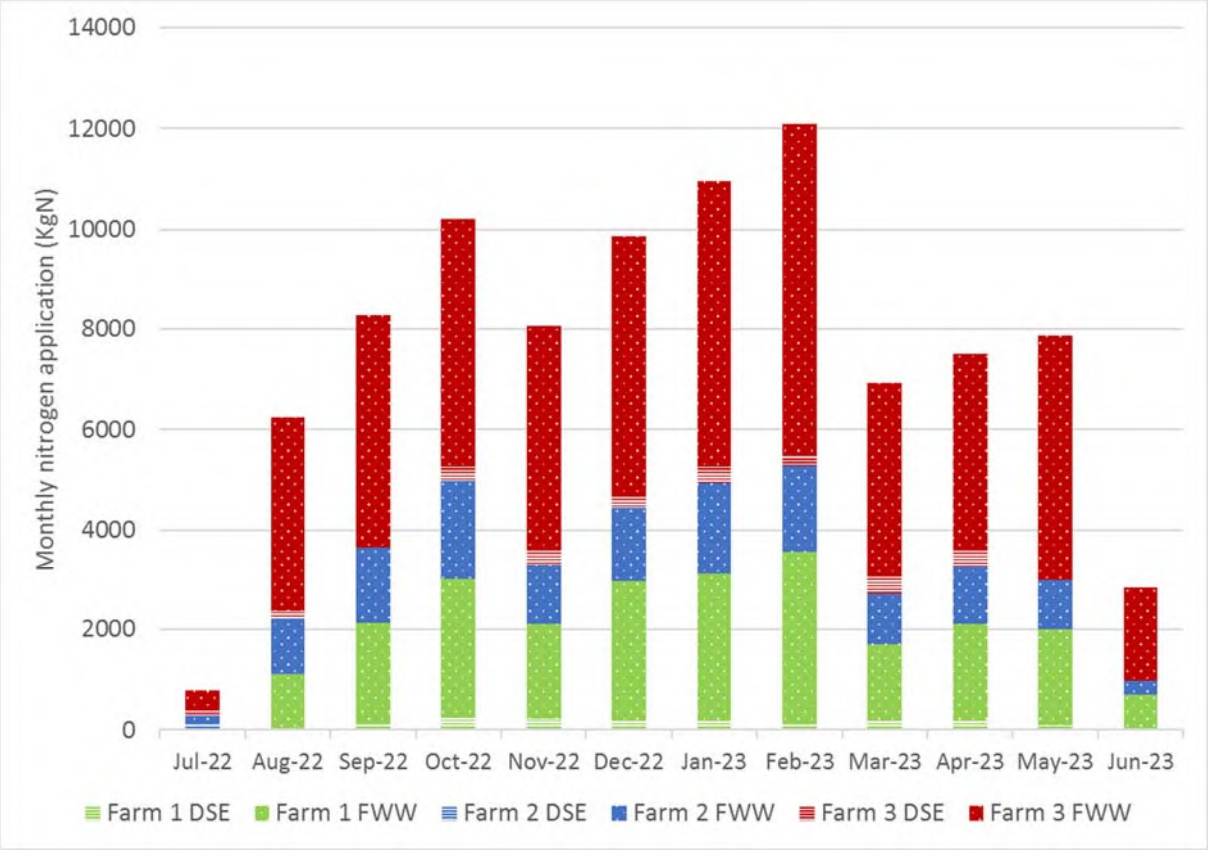

Figure 35 Cumulative monthly mass of nitrogen discharged to each farm for the year under review

The annual volume of FWW produced since 2009-2010, together with the annual mass of factory nitrogen irrigated, is presented in Figure 36. The mass discharge rate was minimised in the 2018-2019 year when there was also a relatively low volume of FWW produced. Since that time there has been a steady increase in the volume of FWW produced, however this has remained below the maximum volume that occurred in the 2017-2018 year. The total annual nitrogen mass of the FWW has increased markedly in the 2019-2023 years. In the 2019-2021 years, these changes were as a result of an increase Food Safety and Quality requirements that required an increase in the "cleaning in place" (CIP) of the factory equipment. However, as previously outlined, in the 2021-2023 years the increased CIP requirements have been due the deposition of minerals (primarily calcium phosphate and sulphate) within the plant. This is due to changes at other factory sites, which have resulted in a higher mineral content of the raw material being received at the Kapuni site from some of the Company's other sites located in Taranaki, Waikato and Manawatu. Whilst there was approximately four times the amount of nitric acid being used for CIP's at the site when compared to the 2020-2021 year, there has been more modest increases in the combined FWW discharged[4].

In the 2022-2023 year, there was an additional 18,489 kg of nitrogen discharged in the FWW when compared to the 2021-2022 year, taking the nitrogen mass from this wastewater stream to over 87,000 kg.

[4] The total FWW volume also includes out of specification stormwater and stormwater used to cool and/or dilute the wastewater prior to transfer to the farms for discharge.

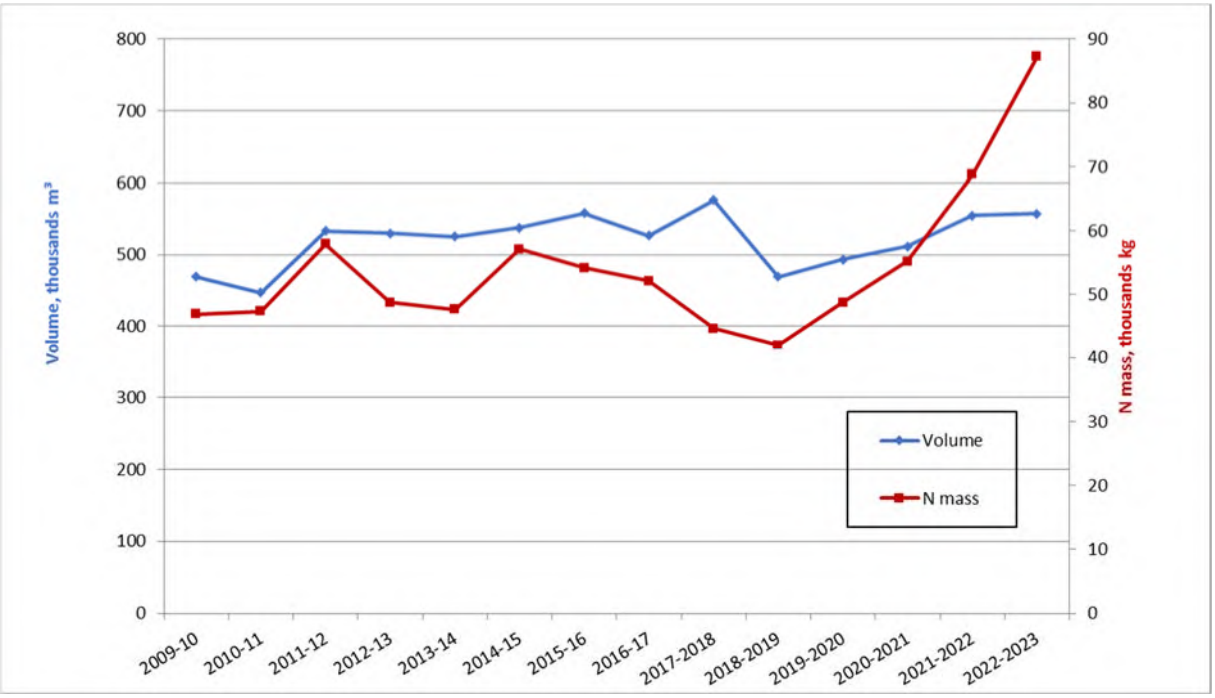

Figure 36 Annual volume of factory wastewater and estimated factory nitrogen mass irrigated, 2009-2023

In terms of the additional nitrogen load being discharged on the farms in the form of the DSE, this had represented approximately 8 or 9% of the total nitrogen mass between the 2016-2017 and 2020-2021 years, although the variation in the contribution that the Farm 1 DSE made to the total mass of nitrogen discharged on Farm 1 has varied quite considerably. The variation had been between 7 and 24% of the total mass of nitrogen discharged on this farm. During the year under review, 8% of the total nitrogen mass was from the Farm 1 DSE. In the case of the discharges to Farms 2 and 3 there had been less variation between monitoring years, with the DSE contributing between 6 to 11% of the total mass of nitrogen applied to these farms. During the 2021-2022 and 2022-2023 years, only 4% of the total nitrogen applied on these farms was from the Farm 3 DSE.

In order to make reasonable comparisons of the amount of nitrogen being discharged under consents 0922-3.2 and 0923-3.3 and any potential or actual environmental effects, the nitrogen application rates need to be evaluated in kg/ha/year. A comparison of the estimated application rates are presented in Table 16. For the 2021-2023 years, the approximate application rates for each paddock have been calculated, with the minimum, maximum and average application rates presented. Prior data has been estimated for each farm as a whole, assuming that the effluent has been evenly distributed across the available irrigation area on each of the three farms. The more data shows that the wastewater is not evenly distributed (Table 16, and Figure 37 to Figure 39).

Prior to the 2007-2008 year, the estimated annual nitrogen application rates were in the region of 523 kgN/ha/y. An expansion of the irrigation area by 49 ha in the 2007-2008 year was predicted to reduce the nitrogen load to about 371 kgN/ha/y. This increase in irrigation area was facilitated by the purchase of an additional 60 ha of land that lay between the original Farm 2 and Farm 3 areas.

On the whole, between the 2012-2013 and 2020-2021 years the nitrogen application rates, when averaged out across each of the farms, have been below or similar to this predicted application rate. During the year under review, the average nitrogen application rates increased to level that are similar to, or higher than those that were occurring prior to the extension of the irrigation area. During the year under review, paddocks received nitrogen application rates of up to approximately 700 kgN/ha/y.

It is noted that the average nitrogen loads have been consistently lower on Farm 1 than on Farms 2 and 3. However, there is a large variation in the annual application rates of the individual paddocks on all three farms.

At the time of writing this report, the Company was investigating options to reduce the amount of nitrogen irrigated under consents 0922-3.2 and 0923-3.3. This will be discussed in the 2023-2024 Annual Report.

Table 16 Farm nitrogen application rates

Monitoring year	Farm 1 nitrogen application rate (kg/ha/y)	Farms 2 and 3 nitrogen application rate (kg/ha/y)		Comments
		Farm 2	Farm 3	
2022-2023	102-704 (452)	156-693 (545)	228-698 (529)	Ranges and averages based on paddock by paddock irrigation data. Includes DSE and FWW
2021-2022	151-509 (350)	282-465 (423)	290-489 (425)	Ranges and averages based on paddock by paddock irrigation data. Includes DSE and FWW. Irrigation area for DSE expanded to some paddocks on Farm 2
2020-2021	290	356	377	This and earlier years are an average application rate, based on average monthly nitrogen concentration and monthly irrigation volumes. Includes DSE and FWW
2019-2020	267	341	322	Includes DSE and FWW
2018-2019	221	241	299	Includes DSE and FWW
2017-2018	230	326		Includes DSE and FWW
2016-2017	288	379		Factory wastewater and DSE fully implemented at Farms 1 & 3
2015-2016	283	353		Factory wastewater plus DSE (2 months only Farm 1) (9 months Farms 2 & 3)
2014-2015	270	382		Factory wastewater only, no DSE
2013-2014	259	309		Factory wastewater only, no DSE
2012-2013	244	321		Factory wastewater only, no DSE

The approximate per paddock nitrogen application rates for Farm 1 for the year under review are shown in Figure 37.

The paddocks receiving both the highest and lowest irrigation volumes (paddocks 15 and 7 respectively) also had the highest and lowest nitrogen application rates. The application rate on paddock 15 was 584 kgN/ha/y higher than the application rate on paddock 7.

It is noted that, at the time of irrigation, the nitrogen concentration of the wastewater in not known given that the composite sample is likely to be analysed up to several days after a given irrigation event. Although paddocks 20 and 25 received similar wastewater irrigation loads of approximately 397 mm equivalent during

the year under review, approximately 637 kgN/ha/y was applied to paddock 20 and 561 kgN/ha/y was applied to paddock 25.

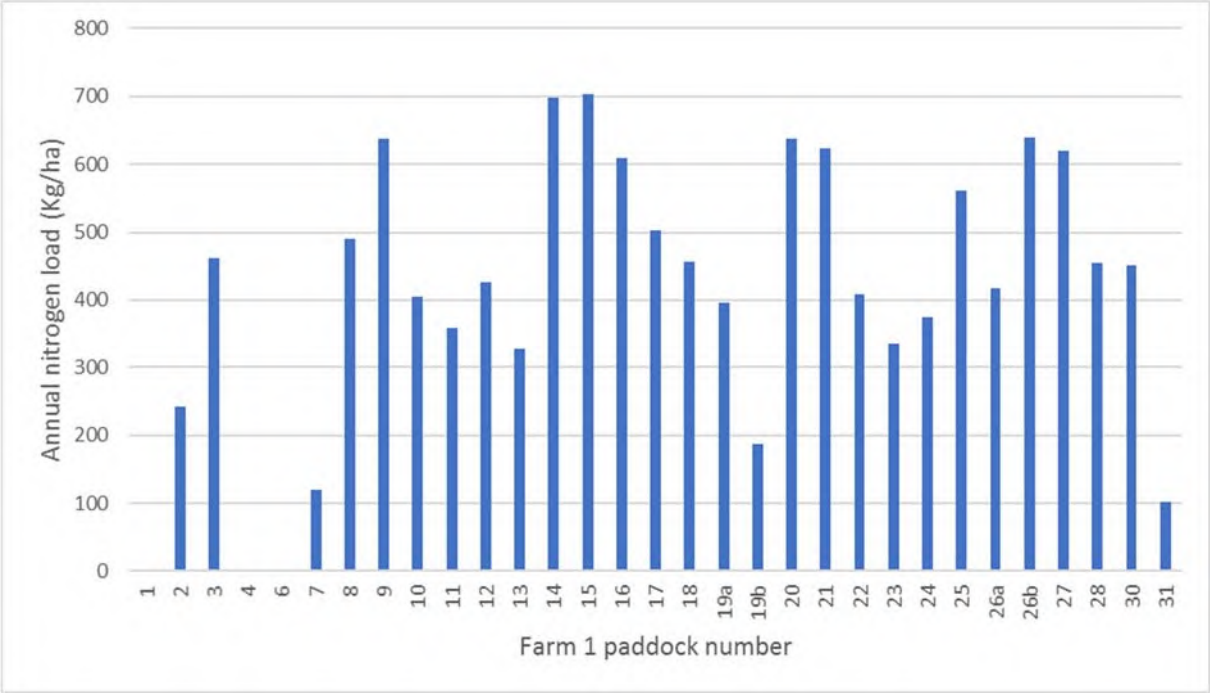

Figure 37 Paddock annual nitrogen application rates for Farm 1

It is noted that the Company also holds consent 10232-1.0 for the discharge of dairy shed pond wastes on this Farm. This consent specifies that in any 12 month period the total nitrogen applied to any hectare of land that is used for the spreading of the dairy pond sludge shall not exceed 200 kg. Although the annual nitrogen load for paddock 2 exceeded 200 kgN/ha/y, there was no disposal of waste from the dairy shed pond spread on this paddock during the year under review.

The nitrogen application rates on Farm 1 were more than 600 kgN/ha/y on eight of the 28 paddocks used for irrigation.

The approximate per paddock nitrogen application rates for Farm 2 for the year under review are shown in Figure 38.

The lowest annual nitrogen loads on Farm 2 were on paddocks 12a and 12b, where the application rates were at or below 200 kgN/ha/y. The nitrogen application rates on Farm 2 were more than 600 kgN/ha/y on 10 of the 18 paddocks used for irrigation.

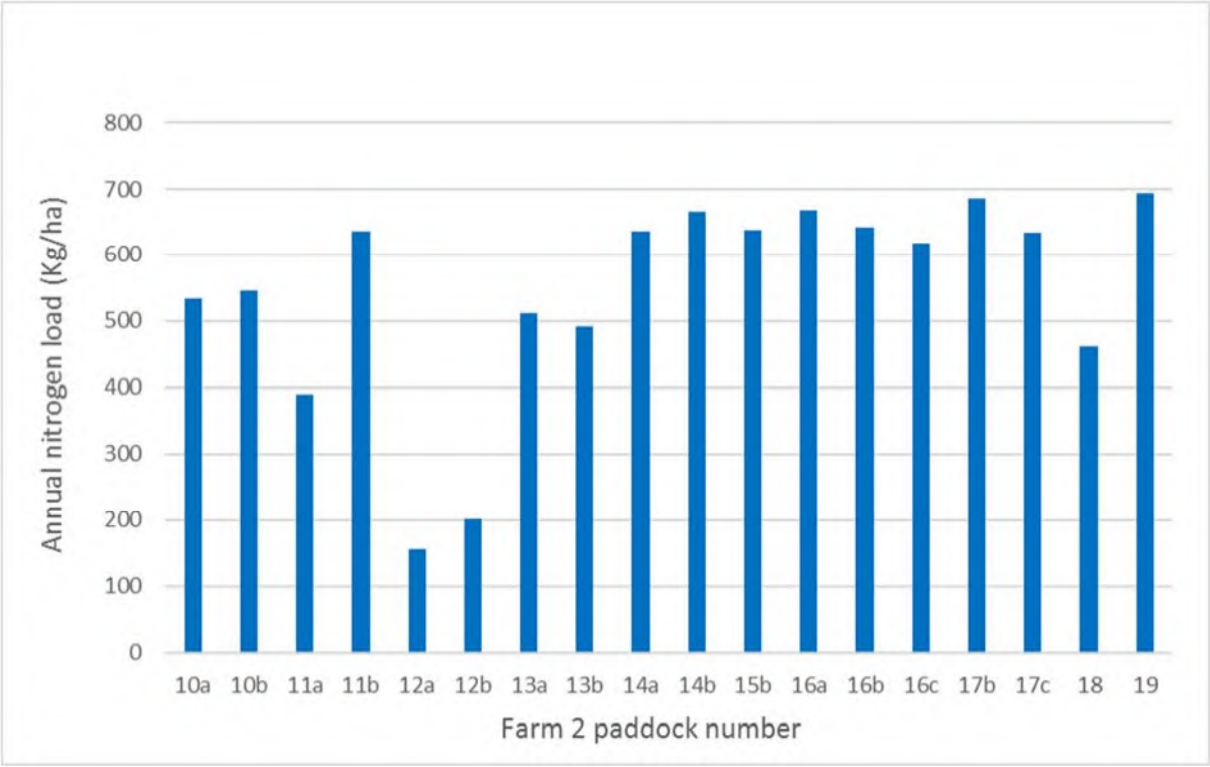

Figure 38 Paddock annual nitrogen application rates for Farm 2

The approximate per paddock nitrogen application rates for Farm 3 for the year under review are shown in Figure 39.

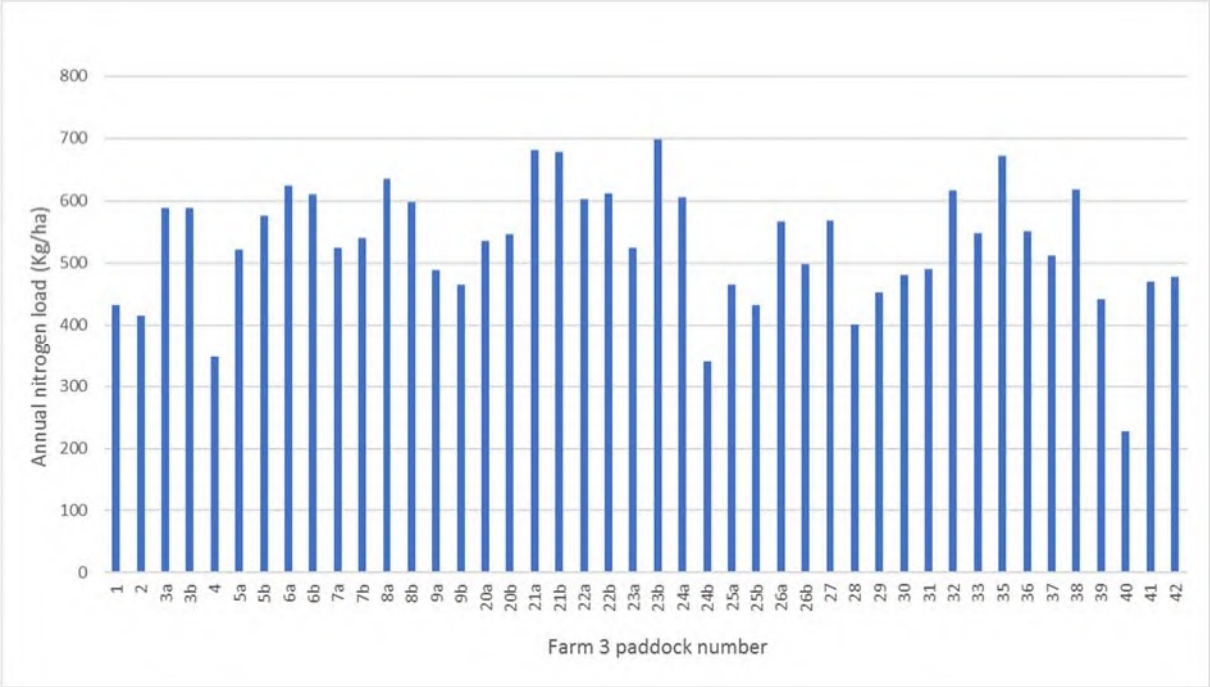

Figure 39 Paddock annual nitrogen application rates for Farm 3

On Farm 3 the lowest nitrogen load was again applied to paddock 40 at 228 kgN/ha/y. It is noted that the groundwater monitoring bore GND0700 is located on the the southern boundary of the Farm close to the fenceline between paddocks 39 and 40.

Paddocks served by the fixed irrigator system received, on average, a higher nitrogen application rate than those irrigated using travelling irrigtors. The average application rate in the paddocks with fixed irrigators was 538 kgN/ha/y, whilst the average application rate in paddocks irrigated with travelling irrigators was 500 kgN/ha/yr.

Overall, the nitrogen application rates on Farm 3 more than 600 kgN/ha/y on 12 of the 44 paddocks used for irrigation.

The Company's WFMP states that an even distribution over the paddocks is ideal, however this needs to be a balance between irrigation requirements, stock rotation and other farm needs, and the weather. It is clear that competing factors do impact on the Company's ability to achieve an approximately even distribution of nitrogen application rates from the wastewater irrigation.

As outlined previously, in addition to the contaminant application rates, factors such as rainfall and soil moisture at the time of irrigation influence the potential for leachate to enter ground and/or surface water. These factors affect the leaching from the application of both of the main contaminants of concern, namely nitrogen and phosphorus.

Currently the Company's WFMP states that the potential for the wastewater irrigation to discharge to the streams flowing through the farms during rainfall events is mitigated by avoiding irrigation on paddocks adjacent to water ways. The mitigation measures to counter the potential for adverse effects when soil moistures are high are to shorten the irrigation event or to take the paddock out of the irrigation rotation for a period of time. This may mean that the paddocks that have been affected in this way receive a higher irrigation volume during the dryer months of the year to balance this out. There are currently no formal methods used by the Company for measuring the soil moisture of the paddocks before or after irrigation events. This is assessed visually by the irrigation operators.

The estimated monthly nitrogen and phosphorus loads irrigated onto the farms are shown in Figure 40 and Figure 42 respectively. Figure 41 shows the total monthly rainfall totals and the mean daily soil moisture from the closest Council monitoring site, which is at the Glenn Road site. The Company operates a weather station located on Farm 3, and commenced providing the daily rainfall information to Council in November 2020. The monthly rainfall totals from this location are also shown in Figure 41.

During the year under review, a total of approximately 91,619 kg of nitrogen and approximately 36,301 kg of phosphorus were irrigated on to the farms. This was an increase of 27% in the approximate annual mass of nitrogen, but a reduction of 22% in the annual mass of phosphorus when compared to the 2021-2022 year. The maximum monthly mass of nitrogen irrigated onto the farms during the year under review was approximately 11,787 kg in February 2023, with over 7,000 kg of nitrogen per month discharged in September 2022 to February 2023 and in May 2023. The maximum monthly mass of phosphorus irrigated during the year under review was approximately 6,073 kg in October 2022, with over 5,000 kg of phosphorus discharged in February 2023.

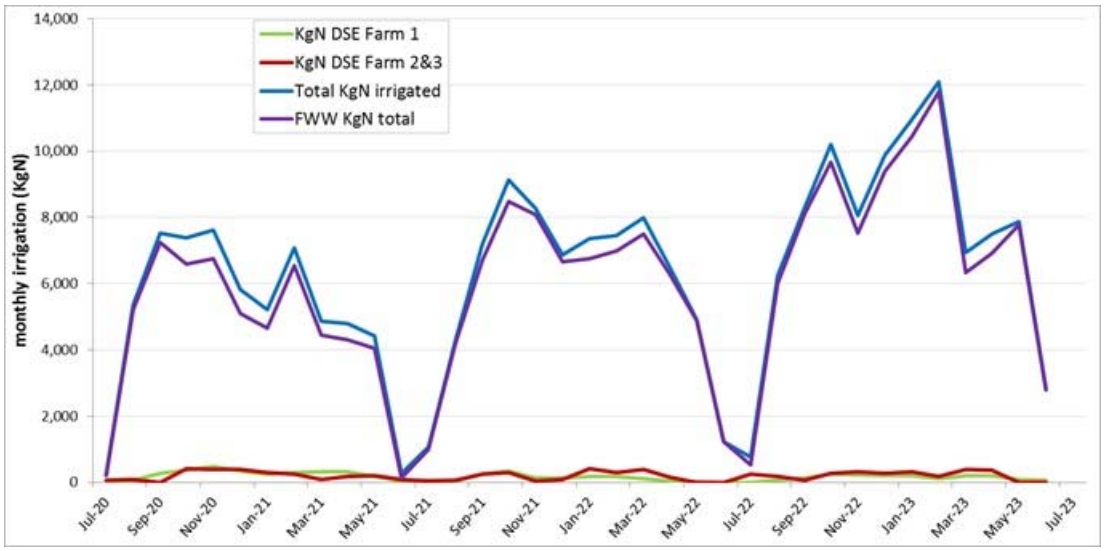

Figure 40 Monthly mass of nitrogen irrigated

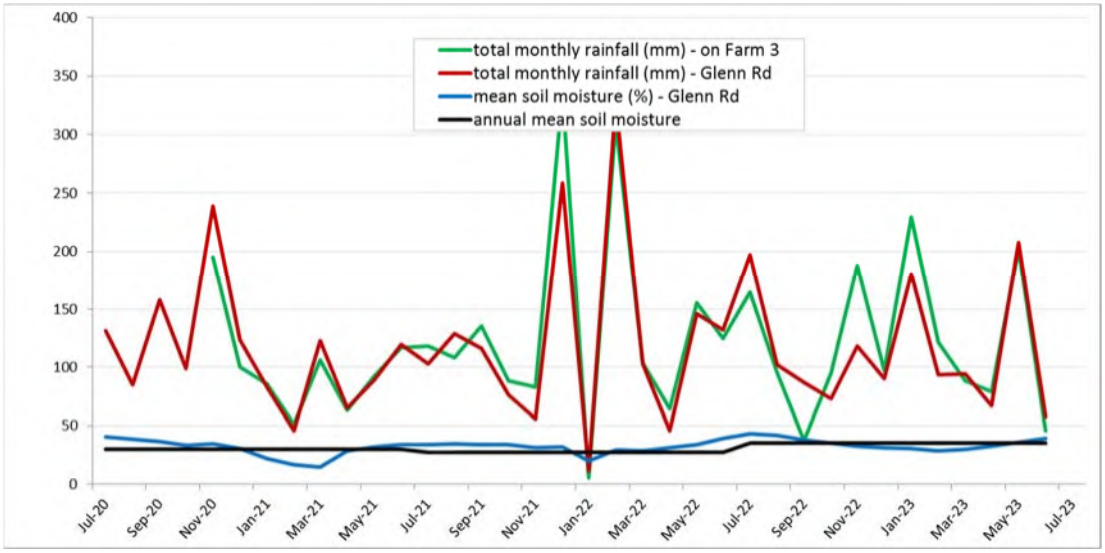

Figure 41 Monthly rainfall totals and median soil moistures

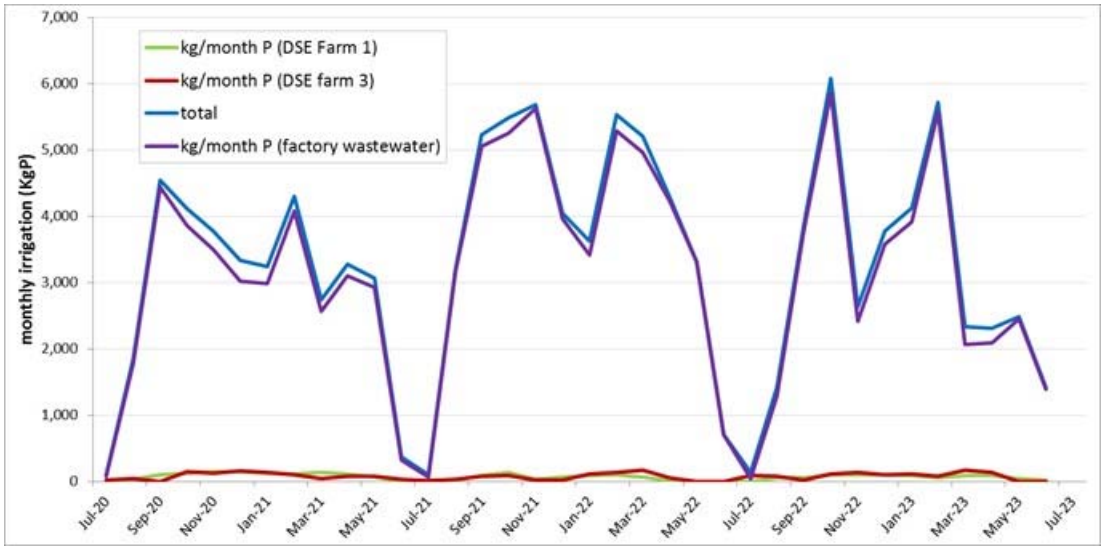

Figure 42 Estimated monthly mass of phosphorus irrigated

2.1.1.7 Soil sampling

Soil sampling and analysis was commissioned by the Company in June 2022 and a copy of the soil report was provided to Council. The depth of soil sampled was 0-75 millimetres, with 20-25 soil cores being collected along a transect through each paddock. Selected parameters from the Farm 1 results are presented in Table 17, the Farm 2 results are presented in Table 18 and the Farm 3 results are presented in Table 19. A comparison of the total nitrogen content of the soils in the various paddocks sampled is shown in Figure 43 and a comparison of the Olsen phosphorus concentrations is shown in Figure 44. The paddock numbering for Farm 1 is shown in Figure 26 and Figure 29 shows the paddock numbering for Farms 2 and 3.

Table 17 Soil sampling results Farm 1, June 2023

Paddock Number	pH	Sodium	Potassium	Magnesium	Calcium	Olsen Phosphorus	Sulphate Sulphur	Anion Storage Capacity	Exchangeable sodium percentage	Extractable Organic Sulphur	Total Nitrogen	Total Carbon	C/N ratio
	pH	MAF	MAF	MAF	MAF	mg/L	mg/kg	%	%	mg/kg	%	%	
13	7.1	34	32	60	30	339	41	32	2.5	11	1.52	14.5	9.5
14	7.0	18	24	57	26	379	21	36	1.5	5	1.27	12.2	9.6
17	7.0	22	23	43	25	278	32	36	2.0	8	1.41	13.4	9.5
18	7.1	29	24	52	26	302	23	31	2.5	7	1.55	14.8	9.6
21	7.1	19	23	48	28	345	23	39	1.6	10	1.56	14.4	9.3
29 (control)	6.3	7	6	35	10	48	21	79	0.9	8	0.77	8.2	10.6
30	7.0	23	20	43	25	330	34	43	2.1	< 2	1.17	11.2	9.6

Key: MAF – quick test units

Table 18 Soil sampling results Farm 2, June 2023

Paddock Number	pH	Sodium	Potassium	Magnesium	Calcium	Olsen Phosphorus	Sulphate Sulphur	Anion Storage Capacity	Exchangeable sodium percentage	Extractable Organic Sulphur	Total Nitrogen	Total Carbon	C/N ratio
	pH	MAF	MAF	MAF	MAF	mg/L	mg/kg	%	%	mg/kg	%	%	
12A	6.6	7	13	36	25	300	18	37	0.6	7	1.25	11.7	9.4
17A (control)	6.2	7	13	49	14	156	19	72	0.7	4	0.88	8.4	9.5
17B	7.1	33	31	56	30	413	37	42	2.5	< 2	1.49	13.2	8.8
18	7.00	35	26	46	26	308	44	34	3.0	7	1.60	14.7	9.0

Table 19 Soil sampling results Farm 3, June 2023

Paddock Number	pH	Sodium	Potassium	Magnesium	Calcium	Olsen Phosphorus	Sulphate Sulphur	Anion Storage Capacity	Exchangeable sodium percentage	Extractable Organic Sulphur	Total Nitrogen	Total Carbon	C/N ratio
	pH	MAF	MAF	MAF	MAF	mg/L	mg/kg	%	%	mg/kg	%	%	
4	7.0	31	25	60	25	310	23	55	2.6	6	1.11	9.8	8.9
21A	7.1	31	30	53	26	305	21	62	2.7	10	1.15	10.1	8.8
25A	7.2	32	25	66	28	359	22	57	2.5	8	1.22	10.8	8.8
31	7.1	41	34	54	26	345	32	52	3.3	17	1.27	10.9	8.6
US1 (control)	6.0	11	21	44	8	34	13	89	1.3	7	1.09	10.7	9.9
38	7.0	19	25	51	25	336	15	56	1.6	8	1.19	10.2	8.6
34B (control)	6.7	7	11	26	14	46	33	82	0.9	13	0.62	6.4	10.2

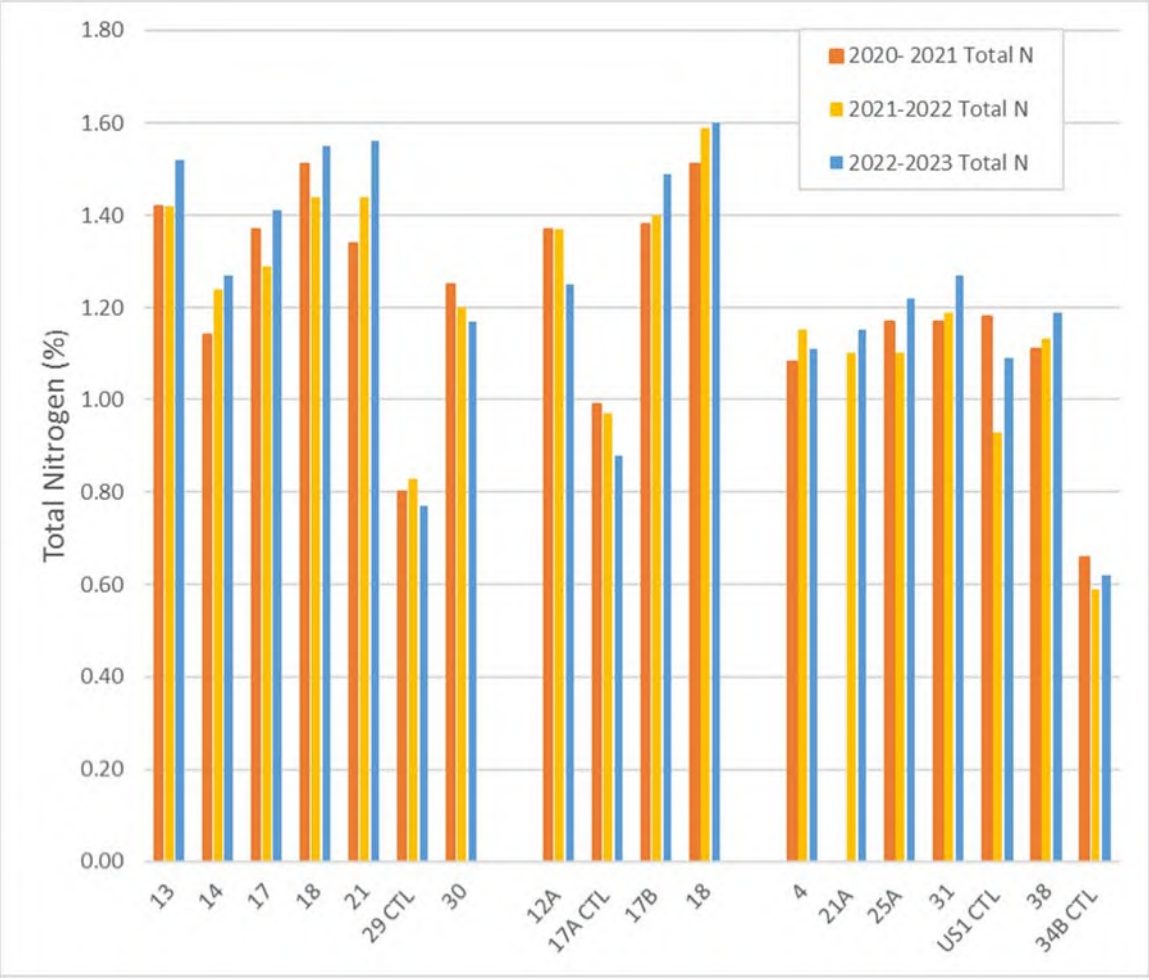

Figure 43 Total nitrogen concentration of soil samples taken from the Company's irrigation areas

It can be seen that the nitrogen concentration of the soil is up to twice that of the control paddocks. The Olsen phosphorus concentration is up to 10 times higher than the controls.

In the comparison between June 2021 and June 2023, it is noted that with the exception of the control paddocks and Farm 1 paddock 30, there has been an increase in the nitrogen content of the soil.

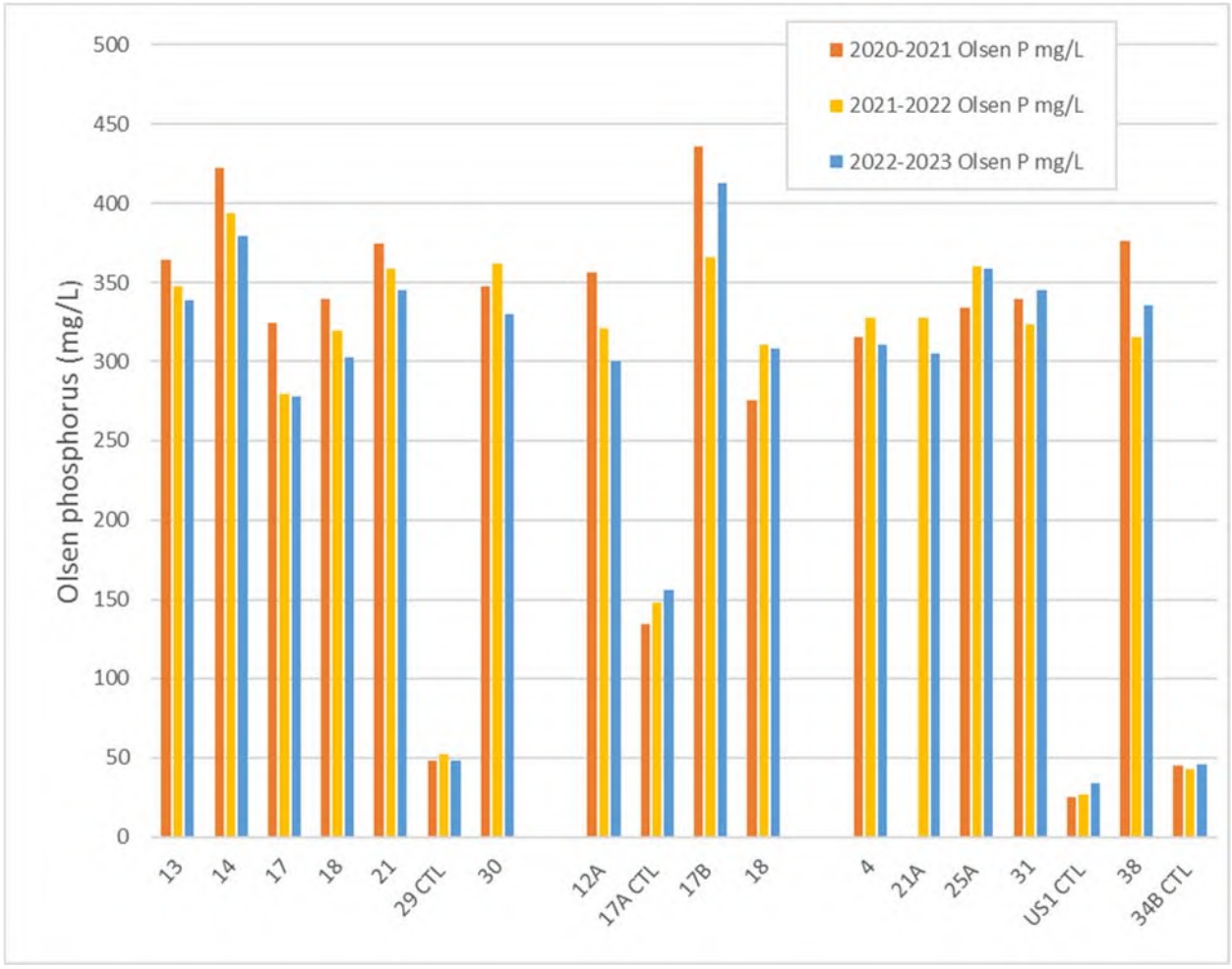

Figure 44 Olsen phosphorus of soil samples taken from the Company's irrigation areas

In the soil report it was noted that:

- Soil pH was high but stable and on irrigated paddocks and was between 6.6 and 7.2. The control paddocks remained in the pH range of 6.1 to 6.7. Soil pH's were higher than the agronomic optimum on the irrigated paddocks but are satisfactory.
- Irrigated paddocks continued to have high phosphorus levels (Olsen-P) which is usual for dairy factory wastewater farms. Trends in soil chemistry since records began at the farm show that the accumulation rate of phosphorus appears to be stable and not increasing. This likely indicates that the topsoil is saturated with Olsen-P and it is now moving deeper into the soil. Some transfer of nutrients (by stock) from irrigated to non-irrigated areas appears to be occurring as Olsen-P levels are slightly above the optimum agronomic range (35-45 mg/L) in several control paddocks.

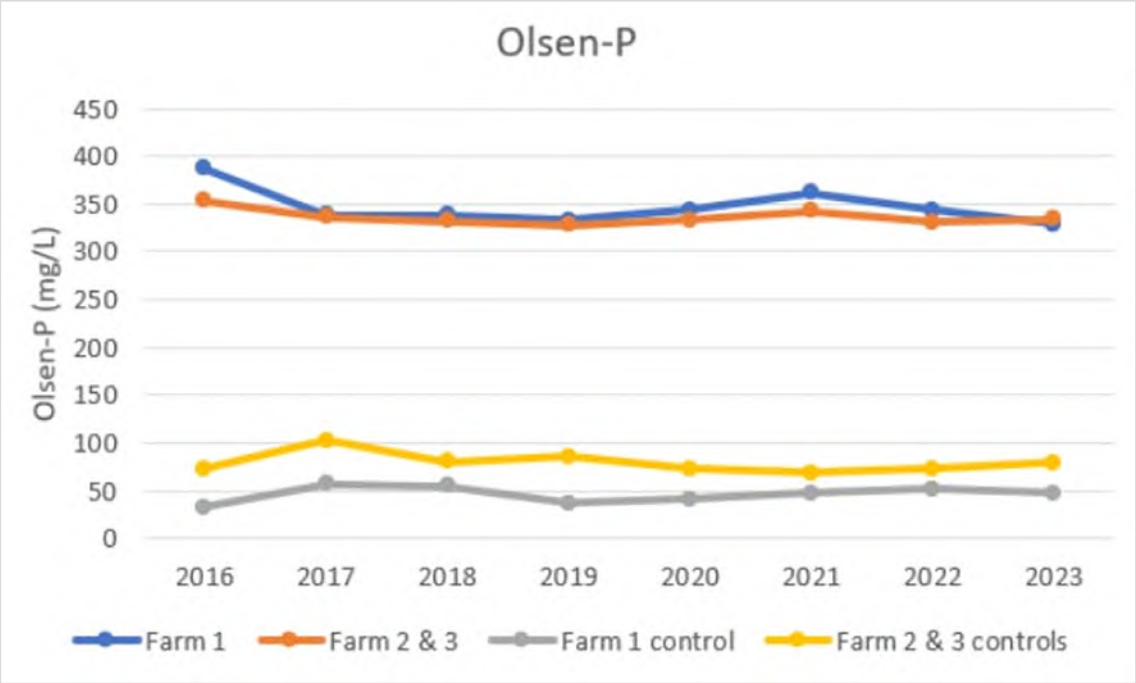

Figure 45 Trend in Olsen-P over time

- It was noted that the investigation undertaken by Lowe Environmental to support the application for the re-issue of the consents covering the discharge of wastewaters to land indicated that, due to the allophane clay in the soils, there was still capacity in the soil to retain phosphorus in the order of 9 to 15 tonnes/ha in the top soil. In an assessment of the long term impact of the phosphorus loadings undertaken by McDowell (2021) balancing P inputs with P outputs and reducing P loadings to achieve a topsoil Olsen-P of 300 mg/L or less and an eventual Olsen-P of 50 mg/L was recommended.
- Exchangeable sodium percentages (ESP) were higher than last year but still in the safe range of less than 10 %. The higher ESP (3.3 vs 1.7 % last year) was because unlike last year, wastewater was still being irrigated at the time of sampling. ESP levels were excellent and well below the critical value of 5%. Low exchangeable sodium levels showed there was no threat of soil structure collapse from any excessive build-up of salt from wastewater.
- MAF quick test potassium levels were high for the irrigated paddocks and similar to last year. These high levels are stable and typical for irrigation farms with potassium in the wastewater.
- The soil in irrigated paddocks had all, or nearly all, of the exchange sites filled with cations. Calcium was the dominant ion. Further addition of calcium will have no impact on the soil because the soils exchange sites are already full. The amounts of sodium present as a base are insignificant. The unirrigated controls were not fully saturated with bases and although Ca was still the dominant base, there was still room for other elements to occupy the soil
- The total carbon and carbon:nitrogen ratios were satisfactory and within the optimal range for pasture soil quality. The total nitrogen was higher than optimum (classified as very high in all of the irrigated paddocks sampled) but the levels were similar to the previous year.
- The soil visual assessment scores were all classified as good and the pasture soil tests have shown there are no deficiencies in the pasture. However, some paddocks had areas of surface and topsoil damage because of pugging but it was stated that these should recover quickly.
- Recommendations were made relating to aeration of the paddocks to combat surface sealing of the soil that is caused by hoof pressing and pugging. The recommendations related to annual aeration programme that should routinely occur on one third of the farm area each year, along with any damaged paddocks being aerated as required. In the June 2023 soil report it was suggested that the

Company be sure it aerate paddocks 13, 14 and 18 Farm 1; 12A, 12B and 17A Farm 2. It was also recommended that the Company should avoid pugging damage over winter to keep the soil surface and topsoil permeable.

A copy of the full soil report is available on request.

2.1.2 Council monitoring

2.1.2.1 General inspections of factory premises

Six scheduled inspections of the premises, treatment system and Kaupokonui Stream were performed during the 2022-2023 period. A standard pattern was followed by the officer of the Council with all areas of discharges and potential spillage sites inspected. The inspections were made at approximately monthly intervals. Company staff met with the Council officer and provided an update on the Company's performance on each inspection occasion. The Company also communicates regularly with the Council regarding matters at the site that relate to their in-house monitoring, environmental performance and initiatives. Additional inspections were also undertaken following notifications relating to the cleaning of the site effluent tank and desilting of the water intake area.

2.1.2.1.1 General site

The six inspections revealed no major problems with the general factory site. Generally the site was clean and tidy. The stormwater catchments were clear of spills and the hazardous material storage was secure.

Improvements in the 2022-2023 year that were discussed at the site inspections or otherwise communicated to Council included:

- Completion of the replacement of the wastewater PVC pipe crossings with stainless steel;
- annual review of wastewater transfer system alarms;
- Completion of the systems that provide the ability to transfer the wastewater to multiple farms;
- Introduction of real time monitoring of powder emissions. Although a meter was put in place, it was found that the results were not reliable. Trail of a new particulate meter commenced;
- Air Management Plan for the site in place;
- continued improvements in the Company's tracking of the nitrogen loadings applied to the irrigation areas. The year to date nitrogen loading is discussed during the weekly environmental meeting. The cumulative paddock nitrogen loading (as accessed through the irrigation browser) is monitored weekly and communicated to the Environmental team during the weekly environmental meeting;
- reviewing practices to improve the management of nutrients at the site. To this end, a number of initiative commenced, namely:
  - Upstream loss monitoring and process improvements;
  - review of CIP usage and optimisation;
  - investigation of phosphorus reduction through pilot trials;
  - review of Kapuni irrigation operations;
  - review and optimisation of interdependencies from other upstream manufacturing sites; and
  - nitrogen reduction level investigation in progress; regular meetings with the Council to update progress of work commenced in the 2023-2024 year.
- investigating options such as changes in CIP chemicals, recovery of the CIP material, and available technologies to treat the wastewater from the site to reduce the nutrient content of the irrigated factory wastewater. Available technologies were assessed with pilot trails planned for the 2023-2024 year;

- replacement of site formed bends in the wastewater transfer lines along the roadside was completed to reduce the potential for leaks; and
- Continuation of the work programmes associated with the consent renewal applications

Projects planned for the 2023-2024 year include:

- Relocation of the wastewater sampling device from the draw off from the Farm 3 wastewater tank to the factory site, ensuring that the chemical profiling of the wastewater better reflects the contaminant concentrations applied to Farm1 as well as Farms 2 and 3;
- CIP trials that include trial of an eco-acid, an AVII additive, and acid recovery via membrane filtration. At the time of writing this report some of these trials had been completed, with the Company waiting for the reports to be completed;
- review and revision of the fixed in ground irrigation network, with sprinkler take offs that are within or near the buffer areas being identified, capped or redirected;
- Site upgrades to reduce the manual data entry currently involved in recording and keeping track of irrigation hydraulic loadings; and
- increase options for areas on which the wastewater can be irrigated, specifically application to vary consent 9088, which currently provides for the discharge to land throughout the Taranaki Region, but currently only for specified dairy liquids, not factory wastewater containing inorganic nitrogen.

The irrigation management plan will be revised following completion of the above initiatives.

2.1.2.1.2 Intake from the Kaupokonui Stream

The inspections showed that both the Company's weir and intake system worked well during the period under review. The intake screens were in place and cleaned regularly during the year under review. The water intake is also cleaned regularly and compliance with permitted activity Rule 53 of the Regional Freshwater Plan is checked periodically. This was not inspected during the year under review.

It was noted that there is a hole in the weir that needs to be repaired and the Company is evaluating how to undertake this work.

2.1.2.1.3 Spray cooling water discharges to the Kaupokonui Stream

New cooling towers were constructed and commissioned in August and September 2015, designed to achieve an improved performance. Flow and temperature meters were installed on the inflow line to the towers, along with a temperature sensor on the outflow from the cooling tower that is used to provide the cooling water discharge temperature to Council. A flow meter had been placed on the line through which combined recovery condenser cooling water and stormwater was discharged directly to the stream under consent 0924-3. This was removed during the 2017-2018 year with the diversion of the cooling water to the cooling towers and stormwater to the northern stormwater pond. The installation of telemetry for the monitoring data from these meters had been delayed until December 2015, while landscaping around the towers was carried out. Accurate cooling water discharge flow monitoring commenced in September 2019.

Air actuated pressure regulating valves have been installed on the first nozzle of each discharge leg to ensure that all nozzles have a good spray discharge to maximise cooling. The Company is be able to open/close valves individually to ensure optimum spray discharge is achieved. The system was fully commissioned in December 2021.

Photo 4 Cooling water spray discharge booms looking upstream from below the discharge area

At the time of the inspections during the year under review it was found that the upstream versus downstream temperature difference was within the consented parameters. No issues were noted in relation to spray drift indicating that the well grown riparian vegetation continued to be effective at preventing spray drift of cooling water beyond the property boundary.

2.1.2.1.4 Other discharges to the Kaupokonui Stream

During October 2017 works to combine and relocate the DFE plant and factory extension stormwater pipes had occurred and for a period, the stormwater discharged via the new outfall without any treatment as the stormwater pond was yet to be completed, however a shut off valve had been installed and was functional during this period (Photo 5). All discharges from the northern area of the site occurred from this new combined outfall following this, with the first discharge from the northern pond logged by the Company as being 8 March 2018.

The Company actively manages discharges from the ponds and has the ability to divert the contents to the wastewater system, and/or to divert various parts of the stormwater catchment directly to the wastewater treatment system in the event that activities like site wash downs are occurring. Prior to discharge the quality of the water is assessed and checks are made to ensure that there are no visible effects occurring in the stream during the discharge. The stormwater discharges, receiving water checks and quality assessment information is logged, along with whether the pond has been discharged to the stream or to the effluent system for irrigation onto land at the farms. A copy of the log is provided to Council on a monthly basis and is available for checking at inspection.

Photo 5 Northern stormwater pond, stop valves and outfall to the Kaupokonui Stream

In the 2018-2019 year it was noted that the groundwater discharge from the southern pond was to be addressed in near future by contractors following the finding that low flow rate discharges were occurring periodically from the southern pond outfall. It has subsequently been identified that there is some groundwater infiltration occurring into the discharge pipe. Discharges of this nature were noted to be occurring on occasion during the year under review. No adverse effects were found in the Kaupokonui Stream as a result of these discharges.

On a number of occasions it was found that the contents of the stormwater ponds were being diverted due to potential quality issues as a result of activities on site or quality issues identified during the assessment process, thereby reducing the number of discharges that occurred to the stream.

The Company began planning to plant low growing natives around both stormwater ponds to avoid the need to spray weeds, and also minimising the potential for overland flow of sediment and debris from the pine trees into the ponds during heavy rainfall events. The planting of shrubs around both stormwater ponds was completed in June 2020.

At inspection it was noted that the stormwater catchments were clear of spills, the onsite drains appeared clear of contaminants, and hazardous material storage was secure.

During the year under review the Company consulted with the Council regarding weed spraying within the ponds. This was undertaken during a dry period and, following the spraying, the pond contents were discharged to the effluent system.

At the final inspection during the year under review it was found that although the southern stormwater pond was at a very low level and was not being discharged at the time of inspection, there was a very low flow discharge occurring from the southern stormwater pond discharge structure. It was noted that there was what appeared to be sewage fungus present where the discharge was pooling in the discharge structure. There were no visible effects noted in the Kaupokonui Stream. A sample of the discharge was collected and the results are presented in section 2.1.3.1.2.1.

2.1.2.1.5 Water bore in the Kaupokonui Catchment

The Company ceased using its groundwater bore in mid-March 2013, when an upgrade of the York Chiller removed the need for additional cooling during periods of warmer temperatures in Kaupokonui Stream. Groundwater level in the bore was last measured on 25 September 2014, at 6.17 m below the top of the upstand. The Council was advised during the 2017-2018 year that the Company intended to decommission this bore and withdraw the application to renew this consent at some point. The withdrawal application was not received by Council during the year under review. However, it was noted at the inspection on 20 September 2019 that the bore had been closed in. No abstraction occurred during the year under review.

2.1.2.1.6 Discharges to the Motumate Stream

There is no longer any discharge of heat-elevated cooling water to the unnamed tributary of the Motumate Stream, previously used by the Kapuni School to heat its swimming pool. The school is now closed and no longer has a need for this service.

Bore water, when used, was also discharged back to the Motumate catchment via a tributary immediately opposite the factory across Manaia Road. The Council was advised by the Company that, as the groundwater cooling water system has not been utilised for a number of years, the Company also intend to withdraw the application to renew this consent at some point. No discharge occurred during the year under review.

2.1.2.1.7 Spray irrigation of wastewater

In general, the inspections showed a good level of compliance in relation to the irrigation of wastewater.

The wastewater from the factory is conveyed to the Farms by transfer lines that are shown in the Company's Whole Farm Management Plan. At the time of the inspection undertaken on 19 November 2021 a wet area was found at the factory site near the southern stormwater pond on the gravel driveway. The inspecting officer was informed that this was from the wastewater transfer to Farms 2&3 that was leaking slightly, and that this would be repaired that day. The contractors were already on site to undertake the repairs.

Spray irrigation at the farms involves the use of both travelling irrigators and in-ground spray irrigators. Prior to mid-2007, approximately 95 ha was irrigated using travelling irrigators, while a further 25 ha was irrigated using in-ground irrigators. Works commenced in January 2007 on extension of the in-ground irrigation system, mainly on a parcel of land between Farm 2 and Farm 3 that had been purchased by the Company.

This extension increased the irrigated area during the 2007-2008 dairy season by 49 ha to 169 ha, of which approximately 44 ha is reticulated with in-ground irrigators. During the year under review, the total area used for irrigation was 181.5 ha. The total area farmed is 244 ha.

Care is required while irrigating near watercourses particularly during wet and/or windy conditions. Spraying is not to occur within 20 m of the streambank of a watercourse (condition 6 of consent 0923). A weather station with telemetry to the pump station on Farms 2 and 3 was installed in August 2015, allowing faster response to changes in wind direction. No spray drift across streams was observed at the time of the compliance monitoring inspections or groundwater sampling surveys during the year under review.

In previous monitoring periods some browning of grass, overland flow and minor ponding has been noted. Fonterra Research Centre was engaged to investigate the ponding/run-off issues. Subsequently, annual aeration was conducted for several years from the 2002-2003 monitoring period over a significant area of the Company's farms, which improved the capacity of these areas to receive and assimilate the irrigated wastewater. Testing undertaken in May 2010 indicated that aeration is no longer required, unless there are visible signs of ponding or damage to the pasture from pugging by stock. Some additional aeration was undertaken in February 2016. Aeration on specific paddocks continues to be undertaken on an as required basis.

The wastewater irrigation was found to be well managed during the year under review. No ponding, grass burn, or run-off were observed at the time of the inspections. No issues were noted in relation to buffer distances.

2.1.2.1.8 Riparian planting

The riparian planting on the left bank of the Kaupokonui Stream adjacent to and downstream of the cooling sprays continues to provide secondary filtering of windblown spray cooling water drift as well as aesthetically benefiting the site.

During the 2020-2021 year the Council was informed that the Company was intending to remove some of the large pine trees on the stream bank next to the northern pond to prevent the possibility of them falling into the stream or onto the wastewater pipe crossing the stream. The trees would then be replaced promptly with native trees. Some trees have been removed from this area. During the year under review, it was noted at inspection that the pine trees along the river bank next to the wastewater pipe that runs across the Kaupokonui Stream have been identified as a potential risk and are due to be removed. The inspecting officer was informed that low lying riparian planting will replace the pine trees.

The riparian planning along the streams running through the farms is now well established. All Fonterra plantings were maintained in the 2022-2023 year.

Photo 6 Riparian plantings along Waiokura Stream, Farms 2 with fixed irrigators in operation

The consent for the discharge of cooling water to the Kaupokonui Stream includes a requirement for an annual (index linked) donation of $3,000 to the Taranaki Tree Trust in accordance with condition 10 (b) of consent 0919-3. The Taranaki Tree Trust was dissolved in 2016 after which time the donations were paid directly to the Council. The financial contributions are paid upon invoicing by the Council. To 30 June 2023, a total of approximately $86,805 had been donated under the requirements of consent 0919-3, with $5,048.73 (+GST) paid to the Council in the 2022-2023 year.

At the end of the 2022-2023 year, the Council had prepared 165 Riparian Management Plans (RMP's) fully or partially located in the Kaupokonui Stream catchment (an increase of one plan). Of these, 20 plans cover the 35 km of streambank that was originally identified as requiring improvement and met the criteria for funding given in condition 10 of consent 0919-3 (that is, are located in the Kaupokonui Stream catchment above the Company's cooling water discharge). Both the plan numbers and streambank measurements are subject to change due to events such as a farms being split, improvements in mapping, reclassification of drains to streams, changes in riparian standards over time and the like.

Taking into account the riparian planting that was already existing at the time the plans were developed and changes such as those given above, the progress towards full implementation of the additional planting required is shown in Table 20 and is illustrated in Figure 46.

Subject to confirmation by audit, the riparian plantings recommended in the plans that had received funding to the end of June 2023 (12 plans) covered a total stream bank distance of 45 km, of which seven (58%) were 100% completed.

This compares to 30 plans covering a total of 33.9 km, of which 20 (67%) were 100% completed in the Kaupokonui Stream catchment downstream of the plant, and 165 plans covering a total of 776 km, of which 64 (39%) were 100% completed in the wider Kaupokonui parent catchment. The riparian planting progress for the Kaupokonui catchment as a whole is illustrated in Figure 47.

During the 2022-2023 year no farms received rebates under this scheme, as there was an alternative funding scheme available during the year under review (Jobs for Nature Fund). It is expected that uptake of the funding available under consent 0919-3 will resume in the 2023-2024 year.

Table 20 Comparison of riparian plan progress in the Kaupokonui Stream catchment and Kaupokonui catchment (subject to confirmation by audit)

	Kaupokonui Stream				Kaupokonui Catchment total
	Upstream Fonterra	Plans that have received funding	Upstream of Fonterra no funding	Downstream Fonterra	
Total length of streambank, km	95.5	45.1	50.4	33.9	776
Additional recommended planting along the stream bank, km	35.2	22.2	13.0	17.0	361
Planting implemented, km	23.6	18.8	4.8	13.0	248
Planting percentage implemented,%	67.0	82.0	36.6	76.5	68.8
Fencing implemented, km	90.2	44.3	45.9	-	-
Percentage of steam bank fenced, %	94.5	98.3	98.2	-	-

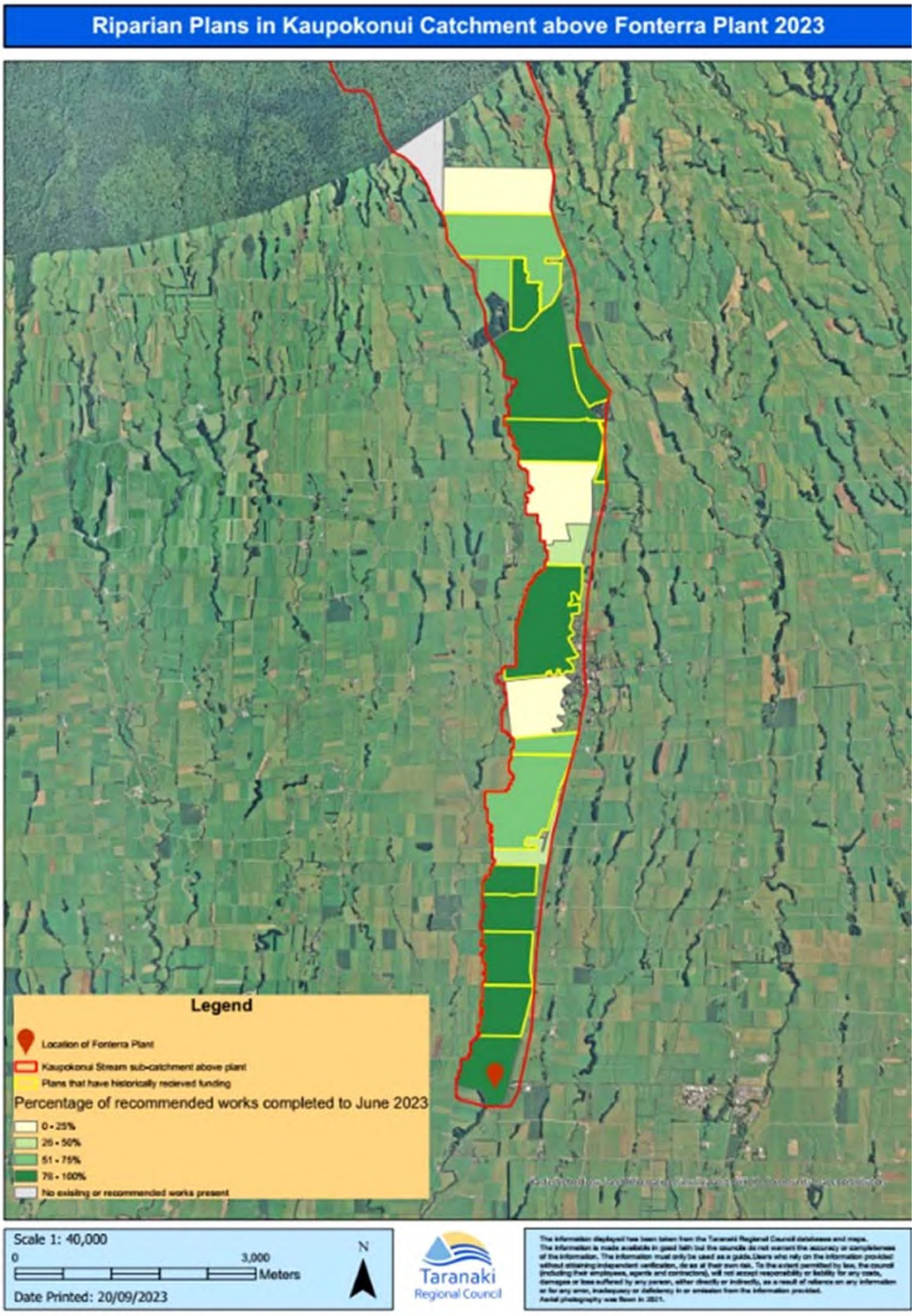

Figure 46 Riparian planting progress in the Kaupokonui Stream catchment above the lactose plant

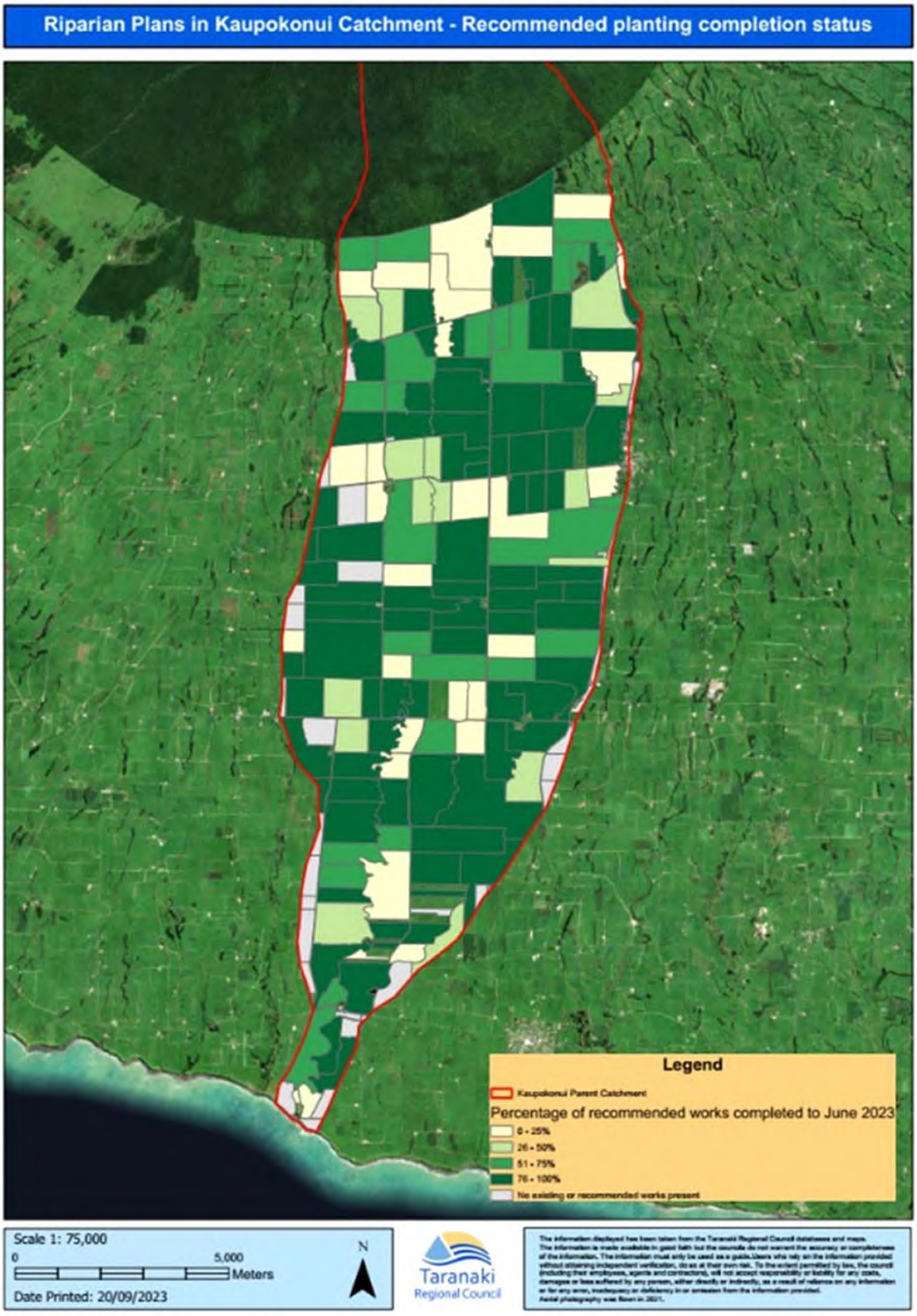

Figure 47 Riparian planting progress in the Kaupokonui Stream catchment

During the year under review, data gathered during farm visits and, improvements in data analysis tools have resulted in increases in some of the measurements for some of the total lengths of streambank and/or additional recommended planting. Significant rainfall events have also resulted in some replacement planting being necessary. This combination of factors has resulted in some apparent decreases in the reported percentage implementation rates in some instances when compared to the previous year.

It can be seen that the current data indicates that whilst there is still a moderate implementation rate of 68% in the catchment as a whole, there is a similar implementation rate upstream of the plant to 67%. As would be expected, there is a higher implementation rate on those farms that have received funding, which have reached an implementation rate of 83%, when compared to those that have not (37%).

It is important to note that, due to the fact that the Kaupokonui Stream catchment upstream of the plant has an extensive network of tributaries, there is a longer distance of stream bank above the plant than there is below it. There was also only half the amount of new planting originally recommended below the plant. This means any increases in the number of kilometres planted will have a much larger effect on the percentage completion downstream of the plant than it will upstream of the plant.

An example of riparian planting is given in Photo 6, taken along the Waiokura Stream on Farm 2, and about 1.1 km south of Skeet Road (Riparian Management Plan RMP1425). Groundwater monitoring bore GND2050 is situated down gradient of the fixed-in-place irrigators and up-gradient of the riparian plantings.

In a separate project initiated by the Company in September 2009, the Manaia Road boundaries of Farm 1 and Farm 3 were planted with native species for screening of the adjacent irrigation areas. A total of 2,142 plants were planted, over a total distance of 1,071 m, at a cost of $6,224. The roadside plantings provide visual screening and amenity value, protection of neighbours and road users from spray drift, and shelter for livestock and pasture. In addition, the Manaia Road boundary adjacent to the storm pond on the lactose plant site was planted in winter 2010. In November 2011, approximately 1,600 more plants were planted on the Manaia Road boundary of the Farm 1 run-off. Replanting was undertaken where a new crossing was installed over Waiokura Stream between Farm 2 and Farm 3 in June 2013. In June 2017, the Company purchased 4,000 native plants at a cost of $14,387. The Company supplied these to 11 upstream properties, all but one of which has a Riparian Management Plan. The Company also liaised with farmers regarding the planting. Additional fencing and planting was undertaken by the Company on Farm 3 during the 2018-2019 year, retiring some marginal farmland to a wetland.

2.1.2.1.9 Disposal of factory solid wastes

Solid wastes from annual cleaning of the waste effluent tank and lime silo had been disposed of by burial on Farms 2 and 3 during the winter maintenance shut-down for a number of years, ending in 2018. This activity was permitted under Rule 29 of the Regional Fresh Water Plan, which covers the discharge of contaminants from industrial and trade wastes premises onto and into land subject to certain conditions, including minimum distance from water courses and water supply bores. A record was kept of the volumes discharged and of the burial site locations. The disposal sites are monitored during the routine monthly inspection of the farms by Council. Compliance with the conditions of the Rule has been found on each monitoring occasion.

During the 2016-2017 year a Trommel (solids separator) was installed on site to separate the solids (diatomaceous earth and activated carbon) out of the waste stream from the filtration of the whey permeate. Following this, the solids were separated in a contained skip bin containing a mesh screen, with the liquid portion being pumped out into the factory wastewater sump. Prior to the separation techniques, the solids were either accumulated in the wastewater tank or were irrigated onto land within the wastewater. In October of the 2016-2017 year the Company advised that the current carbon burial pit was to be filled in due to operational and health and safety constraints surrounding the regular on going presence and use of open pits on the farm. For a period from January 2018 the filtered material had been removed from the site by a

composting/fertiliser company for use in their products. From August 2021, the solids were disposed of at an off-site location that holds a consent to accept this material for land stabilisation purposes.

Carbon from the wastewater tank continued to be buried on farm during the cleaning operations that occur during the shutdown period up to and including the winter 2018 shutdown. During the 2018-2019 year, the Company approached the Council for confirmation that shallow (between 25 and 50 mm) direct drilling of the waste into the pasture would still comply with Rule 29. Approval was given, and during the 2019 winter shutdown the waste was direct drilled into the paddock to the south of the southern stormwater pond on the corner of Manaia and Skeet Roads. This method and location of disposal has continued in the 2019-2023 years.

2.1.2.1.10 Bridges and culverts and pipe crossings

During the 2020-2021 year, work began on replacing PVC pipe crossings carrying the wastewater across the Kaupokonui, Waiokura and Motumate Streams following a risk assessment undertaken by the Company. The risk assessment of all stream crossings was prompted by the minor leakage that was discovered at the Farm 1 Kaupokonui Stream pipe crossing in the 2018-2019 year. The replacement of the PVC pipes with stainless steel was completed in the 2021-2022 year.

Self-notification was received regarding a leak that occurred at a pipe crossing over the Kaupokonui Stream in August 2023, as outlined in Section 2.3. This was repaired promptly.

During the routine compliance monitoring inspections it was found that the bridges, culverts and pipelines across all streams were in good repair at the time of each of the inspections.

2.1.3 Results of discharge monitoring

2.1.3.1 Physicochemical

2.1.3.1.1 Cooling water quality

Sampling of the spray cooling water discharge (authorised by discharge permit 0919-3) involved the collection by the Company of one representative 24-hour composite sample, to be analysed by the Council. The results of these analyses for year under review are presented in Table 21 (STW002017). Conditions of this consent do not place limits on individual component concentrations in the discharge, but focus on the avoidance of effects in the receiving waters.

The cooling water previously discharge via the combined stormwater/cooling water pipe discharge (STW02018, permit 0924-3) was diverted to the cooling tower and the pipework was removed in February 2018. Prior to this, a composite sample was collected from the discharge from this system by the Company, which was analysed by the Council.

A summary of the historical results for both the cooling water discharge and combined stormwater/cooling water discharge are given in Table 22 for comparative purposes.

Table 21 Results of the analysis of spray cooling water discharge during the year under review (STW002017)

Date	BOD_5		Conductivity @ 25˚C	pH	Turbidity
	Total	Filtered			
	g/m^3	g/m^3	mS/m	pH	FNU
29 Jul 2022	< 0.4	< 0.4	11.4	7.4	1.10
28 Oct 2022	< 0.4	< 3	12.3	7.4	0.39
30 Jan 2023[a]	-	-	-	-	-

Date	BOD_5		Conductivity @ 25˚C	pH	Turbidity
	Total	Filtered			
	g/m^3	g/m^3	mS/m	pH	FNU
27 Mar 2023	< 0.4	< 0.4	10.2	7.7	0.69
26 May 2023[b]	< 0.4	< 0.4	10.3	7.7	1.02
28 Jun 2023	< 3	< 0.4	11.3	7.7	0.66

Key: a no sample available due to works associated with temperature probe relocation
b grab sample

Table 22 Summary of cooling water discharge quality from the Council surveys during the period March 1992 to June 2022

Waste	Spray cooling water (STW002017)				'Stormwater/cooling' water (STW002018 – to 15 Feb 2018)		
Parameter	Unit	No. of samples	Range	Median	No. of samples	Range	Median
BOD_5 (filtered)	g/m^3	206	<0.4 - 91	1.0	216	<0.5 - 1,100	1.4
BOD_5	g/m^3	291	<0.4 - 460	1.7	233	<0.5 - 1,100	2.5
Conductivity at 25˚C	mS/m	260	3.4 - 51.7	10.8	240	5.4 - 132	10.8
Oil and grease	g/m	2	<0.5	<0.5	99	<0.5 - 4.3	<0.5
pH	pH	141	5.8 - 8.2	7.5	144	4.6 - 10.6	7.2

For the spray cooling water, there were no notable seasonal variations in the parameters monitored. The median total BOD has remained low (less than 1 g/m^3) for six successive years following the three consecutive years (2013-2014 to 2016-2017) over which it decreased significantly.

2.1.3.1.2 Stormwater quality

Discharges from stormwater pipe outlets to the stream were previously been sampled at four locations: from the northern (STW001062) and southern (STW002018) areas of the lactose plant, the DFE plant (STW001109), and the southern stormwater pond (STW002078, Photo 7), as shown in Figure 48.

The discharge from the previously combined stormwater/cooling water discharges have been addressed in Section 2.1.3.1.1 above.

During 2017-2018, stormwater from the DFE plant, factory extension (STW001109), and the southern area outside the lactose plant itself (stormwater component of STW002018) was combined with the northern discharge (STW001062) for treatment in the northern stormwater pond. The discharge location for the northern stormwater pond outfall is STW002099.

There were no stormwater discharges from the containment ponds at the time of inspection during the year under review. The water level in the stormwater ponds were also either too low at the time of the inspections to allow a sample to be collected from the ponds as an indicator of potential stormwater quality, or the inspecting officer was advised that the contents were to be discharged to the effluent system due to potential water quality issues.

A copy of the Company's stormwater discharge log is provided on a monthly basis. The logs show that the Company discharges the pond contents to the effluent system when there have been activities taking place within the stormwater catchment that may adversely impact the water quality, such as roof cleaning. The

Company tests the pH of the pond contents and undertakes a visual assessment of both the pond contents prior to discharge and the receiving water at the time the discharge commences. It is noted that on two occasions in May 2023 the stormwater discharge was stopped immediately as a result of localised visual effects, with the pond contents then being discharged to the effluent system.

2.1.3.1.2.1 Southern stormwater pond outfall

A low flow discharge was occurring from the southern stormwater pond on 30 January, 26 May and 28 June 2023. The discharge was considered to be from groundwater infiltration into the discharge pipe rather than of stormwater. Samples were collected at the time of the May and June inspections.

Conductivity values at this site have been found to vary widely in the past, tending to be higher in winter when groundwater infiltration occurs. Two sources of groundwater infiltration to the stormwater lines were found by video camera and the lines were re-grouted in July 2009, but some infiltration continued. The sample collected on 26 May 2023 returned a slightly elevated conductivity result. The sample collected on 28 June exhibited and elevated BOD and had a pH that was outside the range permitted by the consent for stormwater discharges. Samples were also collected by the Company that indicated that the pH was within the permitted range. The BOD of the discharge is not limited by the Company's consent. Sampling of the receiving water (section 2.1.4) showed that there was no effect on either the pH or the BOD of the Kaupokonui Stream. The Company was therefore asked to investigate the source of this discharge, with enforcement action to be considered if the matter is found to be on-going. It was subsequently identified that the shut off valve was not able to close completely due to debris in the valve. This was addressed.

Table 23 Results of the analysis of grab samples of the southern stormwater pond discharge during the year under review

Date	BOD_5	Conductivity @ 25˚C	Oil and grease	pH	Suspended solids	Turbidity
	g/m^3	mS/m	g/m^3		g/m^3	FNU
26 May 2023	5.4	38.9	< 4	7.1	10	14.9
28 Jun 2023	360	17.2	< 10	**5.0**	25	17.5
Consent limit (0924-3)	-	-	**15 (hydrocarbons)**	**6.0 – 8.5**	**100**	
2008-2022						
No of samples	34	44	40	42	39	4
Minimum	<0.5	3.0	<0.5	4.6	<2	7.5
Maximum	920	54.5	6	7.9	220	86
Median	1.5	40.1	<0.5	7.4	3	12

Photo 7 Outfall from the southern stormwater pond to Kaupokonui Stream (STW002078)

2.1.4 Receiving water (Kaupokonui Stream) quality

Sampling of the Kaupokonui Stream adjacent to the Company's factory and Farm 1's wastes irrigation area was performed by the Council on the approximately bi-monthly inspection visits. Three sites are located in the Kaupokonui Stream (Figure 48).

Table 24 Location of water quality sampling sites

Site code	Site	Location	Map reference, NZTM	
			Easting	Northing
KPK000655	Kaupokonui Stream	1 km upstream of rail bridge	1697963	5630770
KPK000660	Kaupokonui Stream	At water intake	1697644	5629758
KPK000679	Kaupokonui Stream	150 m downstream of spray cool discharge zone	1697607	5629399

Sampling was performed under varying flow conditions ranging from 1.72 m^3/s to approximately 15.5 m^3/s, as measured at Upper Glenn Road hydrometric station, 9.8 km downstream, where the median flow is approximately 1.89 m^3/s, and mean annual low flow (MALF) is approximately 0.67 m^3/s. The lowest flow conditions under which one of these stream surveys has been carried out is 0.52 m^3/s on 17 March 2020.

A record of flows (hydrograph) over the reporting period is presented in Figure 75. The results of this monitoring are summarised in Table 25 and a copy of the full results are available on request. Past Council sampling results from these sites are presented in summary form in Table 26 for comparative purposes. It is noted that the Council moved to using a contract laboratory for analytical work in April 2018.

Table 25 Summary of Kaupokonui Stream water quality data (ranges) from monthly monitoring for the year under review (N=6 samples)

Parameter	Unit	KPK000655		KPK000660		KPK000679	
		Range	Median	Range	Median	Range	Median
Ammoniacal-N	g/m^3 N	<0.010 - 0.017	0.013	<0.01 - 0.022	<0.010	<0.010 - 0.017	<0.01
Dissolved BOD_5	g/m^3	<0.4 - 0.7	<0.4	<0.4 - 0.5	<0.4	<0.4 - <0.4	<0.4
Total BOD_5	g/m^3	<0.4 - <3	0.5	<0.4 - <3	0.5	<0.4 - <3	0.4
Conductivity@25°C	mS/m	6.1 - 11.2	9.7	5.9 - 12.2	10.5	6.0 - 12.5	10.5
Dissolved Reactive Phosphorus	g/m^3 P	0.006 - 0.012	0.0009	0.005 - 0.015	0.010	0.007 - 0.013	0.009
Nitrate+Nitrite-N	g/m^3 N	0.23 - 0.86	0.60	0.27 - 0.96	0.65	0.27 - 0.90	0.67
pH	pH	7.3 - 7.7	7.5	7.3 - 7.7	7.5	7.3 - 7.8	7.6
Temperature	˚C	8.9 - 17.1	12.5	8.9 - 16.5	13.0	9.0 - 16.9	13.9
Total Kjeldahl Nitrogen	g/m^3	<0.10 - 0.15	0.10	<0.10 - 0.13	<0.10	<0.1 - 0.20	0.10
Total nitrogen	g/m^3	0.30 - 0.94	0.74	0.32 - 1.05	0.76	0.46 1.00	0.76
Turbidity	FNU	0.35 - 2.6	0.81	0.46 - 2.1	0.76	0.40 - 2.4	0.63
Free Ammonia	g/m^3	<0.01 - <0.01	<0.01	<0.01 - <0.01	<0.01	<0.01 - <0.01	<0.01

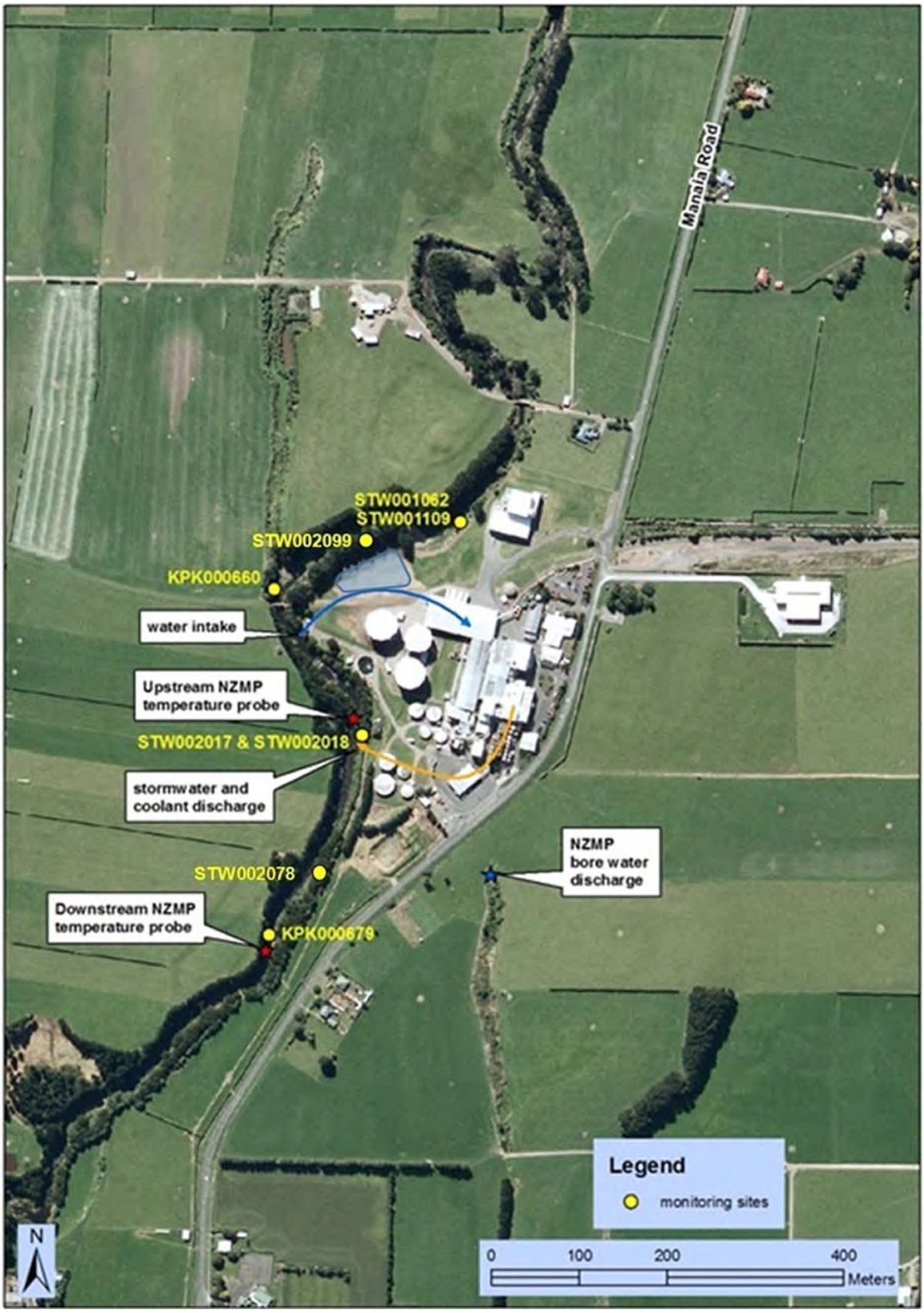

Figure 48 Section of Kaupokonui Stream for physicochemical monitoring in relation to Fonterra Ltd's waste discharges to water

Table 26 Summary of Kaupokonui Stream water quality data from the Council surveys during the period August 1994 to June 2022

Parameter	Unit	KPK000655			KPK000660			KPK000679		
		No.	Range	Median	No.	Range	Median	No.	Range	Median
Ammoniacal-N	g/m^3 N	277	<0.003 -0.869	0.022	277	0.003 - 0.147	0.016	277	<0.003 - 0.248	0.017
Dissolved BOD_5	g/m^3	231	<0.4 -2.0	0.5	233	<0.4 - 2.4	<0.5	233	<0.4 - 8.0	<0.5
Total BOD_5	g/m^3	319	<0.4 -8.3	0.6	320	<0.2 - 7.5	0.6	322	<0.4 - 8.0	0.6
Conductivity@25°C	mS/m	278	3.65 -12.3	10.1	287	3.65 - 13.0	10.6	280	3.54 - 14.6	10.8
Dissolved Reactive Phosphorus	g/m^3 P	89	0.003 -0.097	0.014	89	<0.003 - 0.101	0.014	89	<0.003 - 0.103	0.014
Nitrate+Nitrite-N	g/m^3 N	146	0.06 -1.26	0.45	146	0.07 - 1.36	0.53	146	0.06 - 1.4	0.54
pH	pH	275	6.8 -8.5	7.7	284	6.6 - 9.0	7.7	276	6.9 - 8.6	7.7
Temperature	˚C	276	4.9 -19.1	11.9	272	5.1 - 19.5	12.3	278	5.2 - 21.7	13.3
Total Kjeldahl Nitrogen	g/m^3	39	<0.10 -0.46	0.12	39	<0.1 - 0.51	0.10	39	<0.1 - 0.52	0.12
Total nitrogen	g/m^3	39	0.30 -1.17	0.66	39	0.37 - 1.25	0.72	39	0.32 - 1.37	0.73
Free Ammonia	g/m^3	50	<0.01 -0.010	<0.01	50	<0.01 - 0.013	<0.01	50	<0.01 - 0.01	<0.01

The receiving water quality results indicated that there were minimal, if any, impacts measured in the Kaupokonui Stream at time of sampling as a result of the stormwater and cooling water discharges. There was also no sewage fungus noted at any of these sampling sites over the monitoring period.

The consent limit for the maximum concentration of filtered BOD in the river at the mixing zone periphery of 2 g/m^3 was complied with on all monitoring occasions.

Total nitrogen was added to the analysis suite in September 2018 to help quantify relative influences of the instream oxidation of the reduced ammoniacal form of nitrogen and/or organic nitrogen inputs, compared to potential increases in nitrates due to additional inorganic nitrogen inputs.

Total nitrogen has generally followed similar trends to the nitrate-nitrite concentrations, which it did for the year under review.

All water temperature increases at the periphery of the mixing zone (150 m downstream of the spray system) were within the 3˚C rise permitted by consent conditions at the time of monitoring.

The summary of Kaupokonui Stream water quality data for the upstream (control) site recorded over the 28 year period prior to the 2022-2023 year (Table 26) and during this monitoring period (Table 25), shows that generally, apart from a single lapse in May 2007, there has been good water quality for the parameters measured under normal flow conditions. Only slight changes were found in the conductivity, pH and nutrient concentrations in the receiving waters downstream of the Company's activities.

2.1.5 Groundwater quality

Sampling of shallow groundwater bores was undertaken approximately every two months through the monitoring period by the Council. The monitoring frequency had been increased from bi-annual to monthly in 2006-2007 for a period of three years to gain a better understanding of the seasonal variation in groundwater quality, and was reduced to approximately every second month in 2009-2010. During the year under review up to 12 bores were sampled on the three wastewater spray irrigation farm properties, as

described in Table 27 and depicted in Figure 49. One bore ('control') on each property is sited upslope of the irrigation area and at least another one or two bores ('impact') within or down-slope of each irrigation area.

Table 27 Description of the groundwater monitoring sites

Property	Bore	Designation	Site code	Depth m	Map reference, NZTM	
					Easting	Northing
Farm 1	North	Control	GND0636	6.5	1697543	5630420
	South	Impact	GND0637	6.5	1697238	5629857
Farm 2	North	Control	GND2049	5.6	1698575	5628905
	West	Impact	GND0638	5.9	1698332	5628562
	South-west	Impact	GND0639	4.3	1698408	5627793
	South-west	Impact	GND2050	7.0	1698397	5627747
	South-east	Impact	GND2063	7.0	1698397	5627747
Farm 3	North	Control	GND2051	6.5	1697634	5627538
	West	Impact	GND0640	4.5	1696911	5627162
	Central	Impact	GND0641	3.4	1697367	5626969
	South-west	Impact	GND2052	7.0	1697216	5626790
	South-east	Impact	GND0700	4.5	1697445	5626790

Relocation and replacement of the original 'impact' bores on Farm 2 and Farm 3 was performed in April 1998 (see TRC 98-73, Southern and No. 3 farms respectively), in consultation with the consent holder and following investigations into groundwater contours and flow directions at each of these farms' monitoring sites. During the year under review, the head works on all the bores were upgraded and the bores were redeveloped by air lifting. Bore GND0640 had been damaged by farming activities in 2007. During the bore maintenance works, this bore was located and returned to a serviceable condition, with monitoring recommencing in January 2021.

It is noted that originally, bore GND0640 was a control bore for Farm 3. However, following the expansion of this farm and the incorporation of the "No. 3 extension" (Figure 1) in 2008, this became an impact bore.

A summary of selected groundwater quality data previously collected by the Council from the farm bores is presented in Table 28 for comparison with data collected during the monitoring period under review.

Nitrogen species, chloride, conductivity, and pH are determined on the samples collected at all of the surveys, with the additional parameters, including those that enable the anion/cation balance to be determined, are analysed at alternate surveys only.

The bores shaded in Table 28 are those no longer monitored.

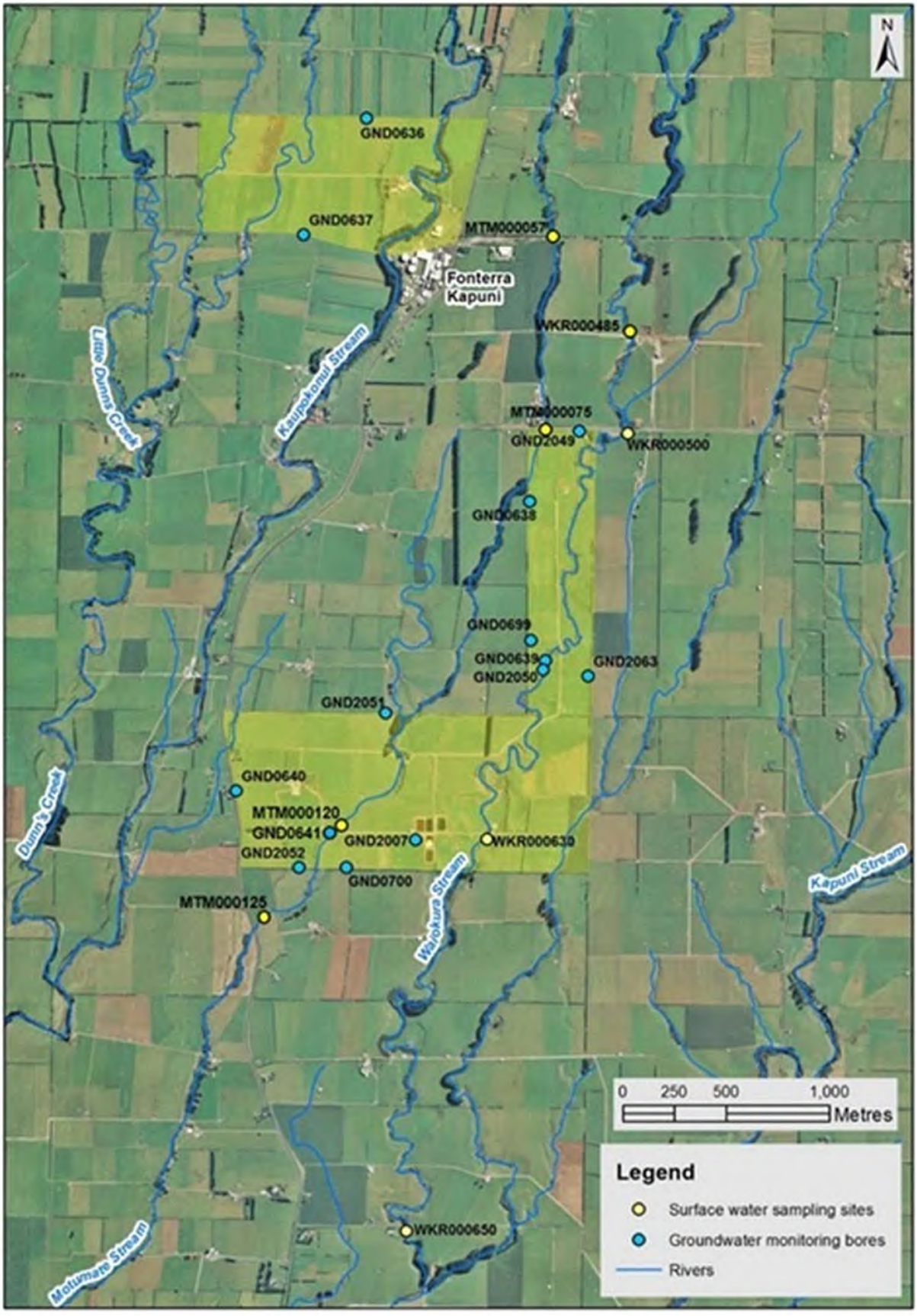

Figure 49 Groundwater monitoring bores, Motumate and Waiokura Stream sampling site locations on the three Company farms

Table 28 Summary of selected parameters from previous Council groundwater quality sampling performed during the period October 1991 to June 2022

Parameter		Level		pH		Conductivity @ 25˚C		Sodium		Nitrate/nitrite-N		COD*	
Unit		m		pH		mS/m		g/m³		g/m³N		g/m³	
Farm site	Bore	N	Range (median)	N	Range (median)	N	Range (median)	N	Range (median)	N	Range (median)	N	Range (median)
Farm 1	Control GND0636	119	1.55-4.83 (2.91)	159	6.2-7.1 (6.5)	156	27.5-66.9 (32.8)	103	12.0-56 (24.6)	178	3.0-24 (8.3)	92	<5-27 (6)
	Impact GND0637	118	2.77-6.15 (4.14)	155	6.1-7.8 (6.6)	151	36.5-91.1 (62.0)	100	40-179 (70.2)	172	1.5-33 (10.7)	88	<5-50 (6)
Farm 2	Control ('new') GND2049	90	1.36-3.80 (2.47)	91	6.2-7.2 (6.5)	91	21.4-53.4 (41.9)	49	21-38 (31)	109	1.6-27 (15.3)	49	<5-7 (<5)
	Impact ('central') GND0638	116	1.08-3.68 (2.52)	151	4.7-7.2 (6.6)	150	60.1-188 (81.8)	96	67-136 (88)	149	<0.01-71 (9.2)	90	<5-1600 (6)
	Impact ('original') GND0639	83	1.90-4.22 (2.78)	101	6.5-7.5 (6.9)	101	27.8-91.3 (70.2)	67	62-157 (115)	102	2.3-29 (10.1)	62	<5-57 (6)
	Impact ('new') GND2050	91	1.60-3.20 (2.59)	91	6.5-7.4 (6.8)	91	15.1-80.0 (62.8)	49	49-102 (64)	91	<0.01-13.4 (1.5)	49	<5-21 (6)
	Impact GND2063	88	1.55-5.00 (3.46)	88	6.3-6.9 (6.5)	88	27.9-68.0 (35.4)	48	35-59 (40)	88	0.4-18.6 (5.0)	48	<5-24 (6)
Farm 3	Control ('original') GND0640[a]	18	0.85-3.24 (1.99)	51	6.4-7.0 (6.8)	51	23.2-46.2 (28.6)	45	28-49 (29)	51	<0.01-3.4 (0.13)	42	4-30 (6)
	Control ('new") GND2051	91	1.86-4.46 (3.13)	91	6.3-7.2 (6.5)	91	28.1-67.5 (36.3)	43	21-37 (27)	91	0.03-30 (6.7)	49	<5-31 (6)
	Impact GND0640[b]	9	1.01-4.40 (2.31)	9	6.6-7.0 (6.7)	9	30.2-73.8 (33.5)	5	31-38 (32.5)	9	0.01-26 (0.81)	5	<6-42 (8)
	Impact GND0641[c]	57	1.01–3.00 (1.86)	57	6.3-7.2 (6.6)	57	27.9-70.3 (60.1)	53	30-57 (49)	57	0.87-15.6 (8.9)	50	<5-54 (7)
	Impact ('original') GND0700	115	0.40-4.60 (2.15)	127	5.6-7.3 (6.8)	127	33.5-170 (66.3)	76	39-188 (81)	128	0.02-47 (6.9)	76	<5-33 (6)
	Impact ('new') GND2052	91	1.30-4.38 (2.51)	91	6.4-7.5 (6.7)	91	20.9-49.7 (37.5)	49	35-60 (44)	91	<0.01-12.9 (2.0)	49	<5-29 (<6)
	Impact ('deep') GND2007	0	-	48	6.7-8.0 (7.7)	48	35.8-39.0 (36.9)	26	35-39 (37)	48	<0.01-0.10 (<0.01)	23	<5-44 (10)

* COD filtered prior to 2006

a GND0640 monitoring from April 1992 to April 2007 (control prior to Farm 3 extension)

b GND0640 monitoring re-commenced January 2021 (impact post Farm 3 extension)

c GND0641 not monitored between June 2013 and May 2018 due to a blockage in the bore

The groundwater quality monitored at each farm is discussed below. Wastewater irrigation occurred on each farm throughout the monitoring period (see Section 2.1.1.6).

In previous reports it has been stated that, without onsite rainfall and time series paddock by paddock irrigation data, it is difficult to gauge whether the effects found in the groundwater bores are related to periods of irrigation, rain related flushing, or a combination of these. It was signalled to the Company that paddock by paddock irrigation records are likely to be required by the reissued discharge consent. The Company provided this information voluntarily for part of the 2020-2021 year and, following discussions on how this data could be managed effectively, began providing this information on a monthly basis from the start of the 2021-2022 year. A summary of this data has been presented in Section 2.1.1.6 and, where appropriate, the more detailed data may be used to inform effects found in the groundwater.

2.1.5.1 Farm 1 groundwater

The results of groundwater monitoring on this farm during the period under review are summarised in Table 29. The full set of results is available upon request.

Table 29 Results of groundwater quality sampling on Farm 1

Waste		Control (GND0636)			Impact (GND0637)		
Parameter	**Unit**	**No.**	**Range**	**Median**	**No.**	**Range**	**Median**
Alkalinity Total	g/m^3 CO_3	3	45 - 49	48	3	150 - 155	151
Ammoniacal nitrogen	g/m^{3}N	6	<0.01 - 0.011	<0.01	6	<0.01 - <0.01	<0.01
Bicarbonate @ 25'C	g/m^3	3	54 - 59	58	3	183 - 189	184
Calcium	g/m^3	3	15.5 - 17.8	17.8	3	21.0 - 22	21.0
COD	g/m^3	3	<6 - 8	<6	3	<6 - 10	7
Chloride	g/m^3	6	23 - 51	25	6	40 - 61	55
Conductivity @ 25'C	mS/m	6	36.5 - 40.2	28.0	6	59.2 - 63.4	62
DRP	g/m^{3}P	3	0.012 - 0.013	0.012	3	0.013 - 0.024	0.019
Hardness Total	g/m^3 CO_3	3	65 - 72	69	3	82 - 89	87
Magnesium	g/m^3	3	6.0 - 6.8	6.4	3	6.8 - 8.3	8.0
Nitrite nitrogen	g/m^{3}N	3	<0.002 - <0.002	<0.002	3	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m^{3}N	6	5.6 - 7.0	6.5	6	8.1 - 10.2	9.2
pH		6	6.4 - 7.4	7.0	6	6.6 - 7.4	7.1
Potassium	g/m^3	3	6.4 - 6.9	6.7	3	68 - 73	72
Sodium	g/m^3	3	21 - 23	21	3	43 - 54	52
Sulphate	g/m^3	3	18.8 - 22	21	3	19.9 - 26	23
Sum of Anions	meq/L	3	2.5 - 2.5	2.5	3	5.4 - 5.8	5.8
Sum of Cations	meq/L	3	2.4 - 2.6	2.5	3	5.2 - 6.0	5.9
Temperature	˚C	6	13.9 - 15.1	14.3	6	14.2 - 14.9	14.6
Total Kjeldahl nitrogen	g/m^{3}N	6	0.1 - 0.21	0.11	6	0.11 - 0.25	0.215
Total nitrogen	g/m^{3}N	6	5.8 - 7.2	6.6	6	8.3 - 10.4	9.40
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	1.57 - 3.13	2.61	6	2.75 - 4.61	3.91

It is noted that the nitrate concentrations in the control bore GND0636 have remained below the drinking water standard for four consecutive years, with the annual median remaining below the historical median of 7.8 g/m^3. It is noted that during this period the groundwater levels have shown a trend of decreasing groundwater level, though still retaining the expected variation due to seasonal changes. In previous years, there has been a combination of decreasing nitrate-nitrite concentration alongside decreasing groundwater levels that is consistent with the observation that heavy rainfall tends to flush more nitrate into the groundwater and/or that increases in groundwater levels tend to "collect" nitrates stored in the surface soils. It is noted that during the year under review, the highest nitrate concentration was recorded at a time of lower groundwater levels.

Water quality at the impact bore GND0637 was found to have higher ionic strength and showed a marked elevation in alkalinity, bicarbonate, median nitrate, potassium, sodium, and conductivity levels when compared to the control bore. Monitoring of alkalinity in the groundwater commenced in the 2018-2019 year. The results obtained for this parameter in the sample collected on 16 June 2023 was the highest on record for site GND0637.

It is noted that, historically, there have generally been some large "seasonal variations" in the contaminant concentrations of the down gradient bore that are not present in the control bore. During the year under review, there was very little seasonal variation in either bore, however, the parameter concentrations were consistently higher in the down gradient bore when compared to the control bore (Figure 50 to Figure 53). These findings are consistent with the effect of leaching of wastewater from spray irrigation disposal to shallow groundwater.

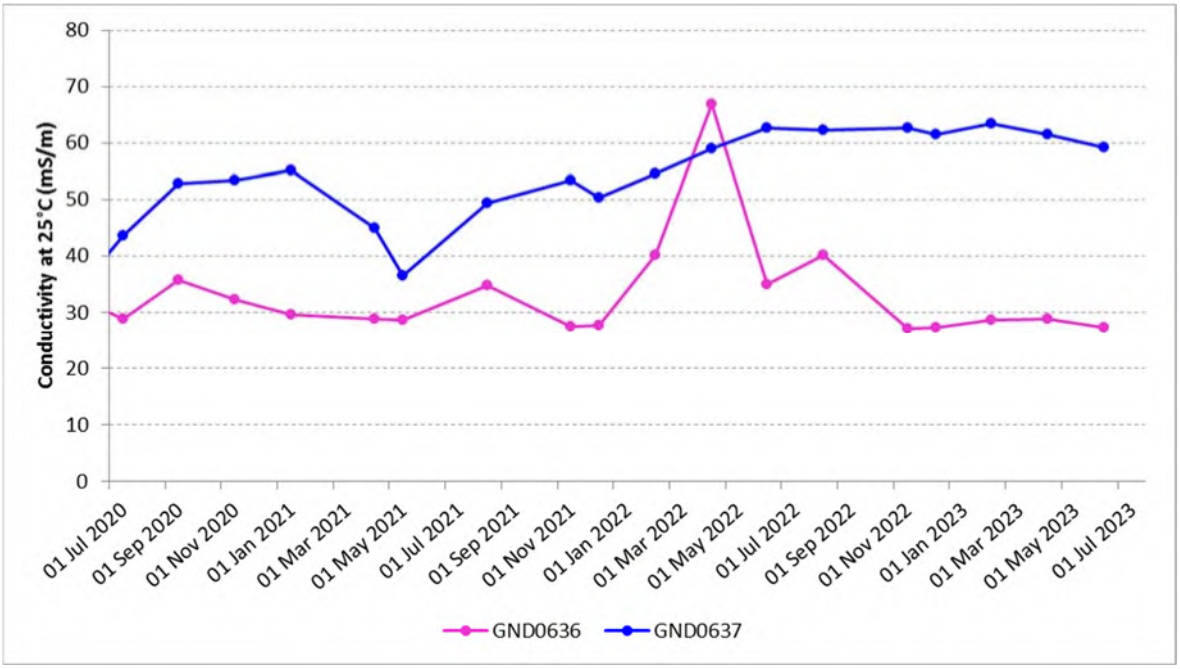

Figure 50 Three year trends in groundwater conductivity at Farm 1

During the period under review, the conductivity and chloride concentration of the control bore (GND0636) have returned to their usual lower levels. In contrast, the conductivity in the impact bore (GND0637) has remained elevated and although there has been a reduction in the chloride concentration of the impact bore, it has remained higher than in the control bore.

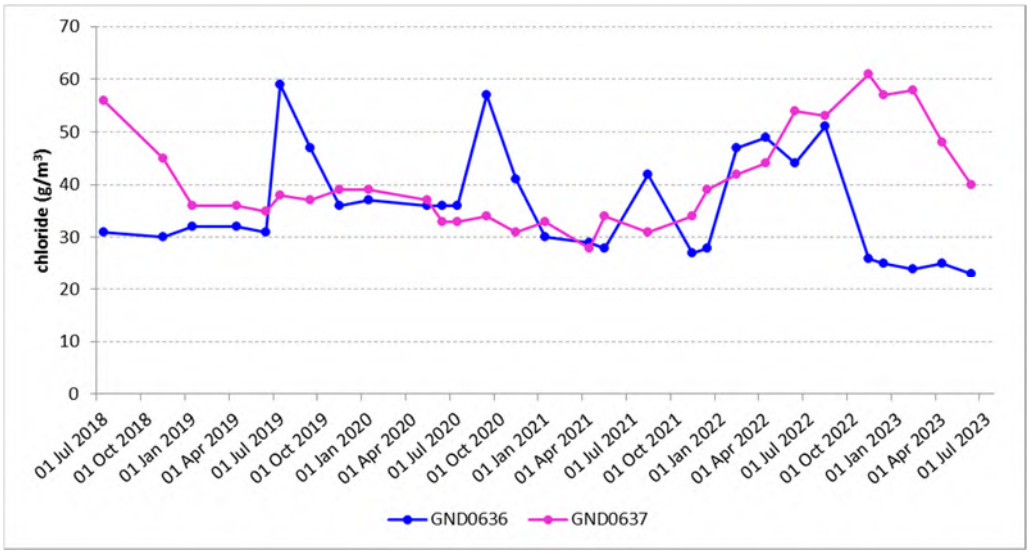

Figure 51 Trends in groundwater chloride at Farm 1

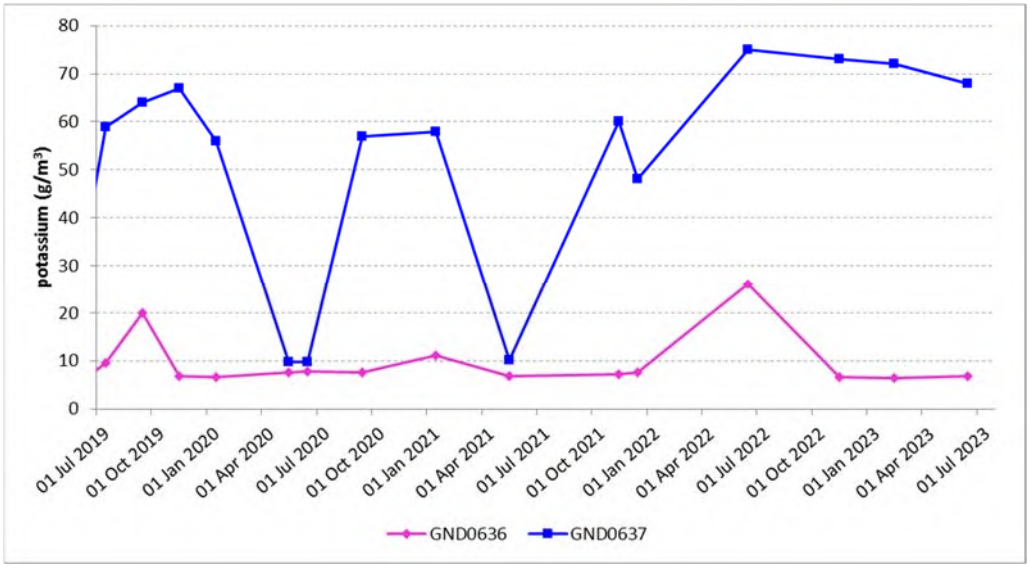

Figure 52 Four year trends in groundwater potassium at Farm 1

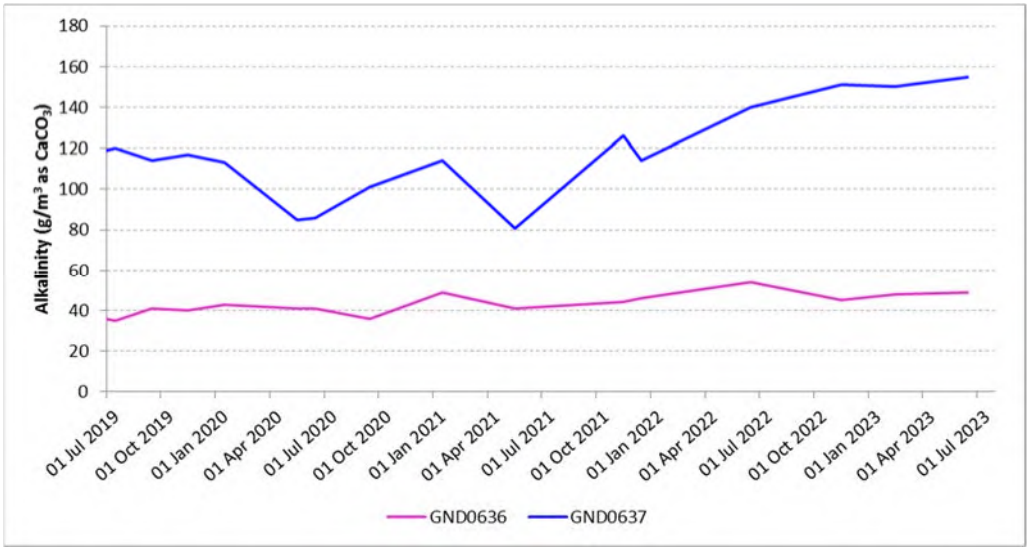

Figure 53 Four year trends in groundwater alkalinity at Farm 1

The sodium concentration again appears to be reducing overall, with all values recorded during the year under review being slightly below the historical median (refer to Figure 54 and Table 29). The COD of both bores was found to be low at each of the sampling surveys. The nitrate concentration at the impact bore was significantly higher than at the control bore. The median values for both sodium and nitrate in the 2022-2023 year, and for the historical data, are higher at the impact bore than at the control bore.

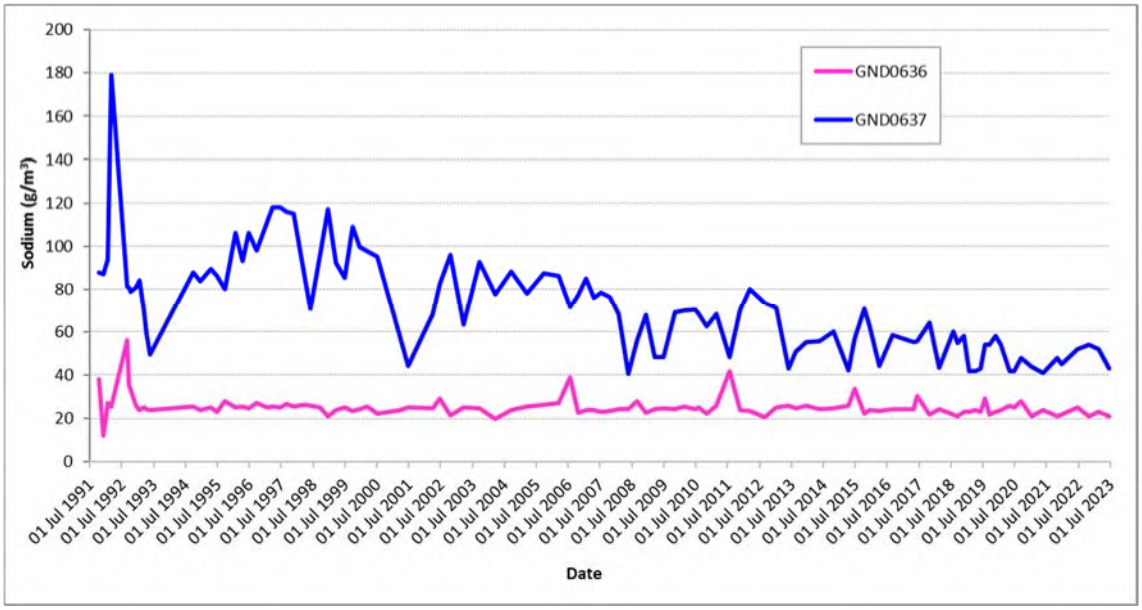

Figure 54 Long term trends in groundwater sodium concentration at Farm 1

Figure 55 compares the long term trends in groundwater nitrate-N levels at the impact bore with the control bore, 640 m up-gradient, on the northern boundary of the farm. During the year under review, only one of the samples collected was above the drinking water standard (11.3 g/m^3).

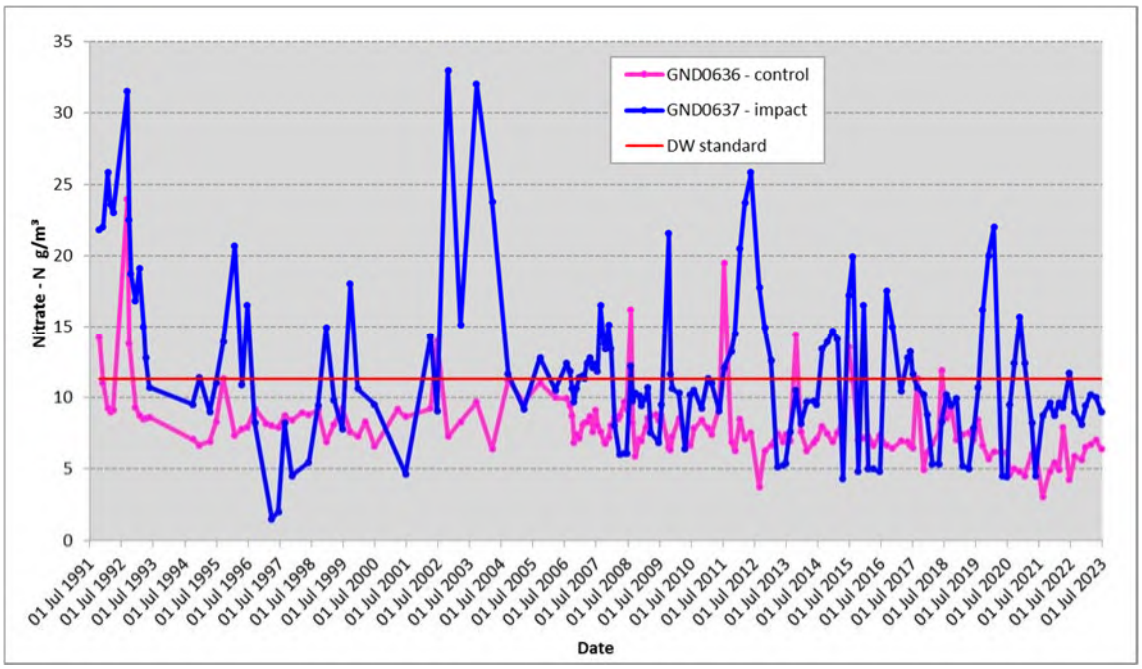

Figure 55 Long term trends in groundwater nitrate-N concentration at Farm 1

When looking at the changes in groundwater level and nitrate concentration, whilst the usual seasonal effects were apparent in the groundwater levels during the year under review, the nitrate-N concentrations were elevated at times of lower groundwater levels (Figure 56).

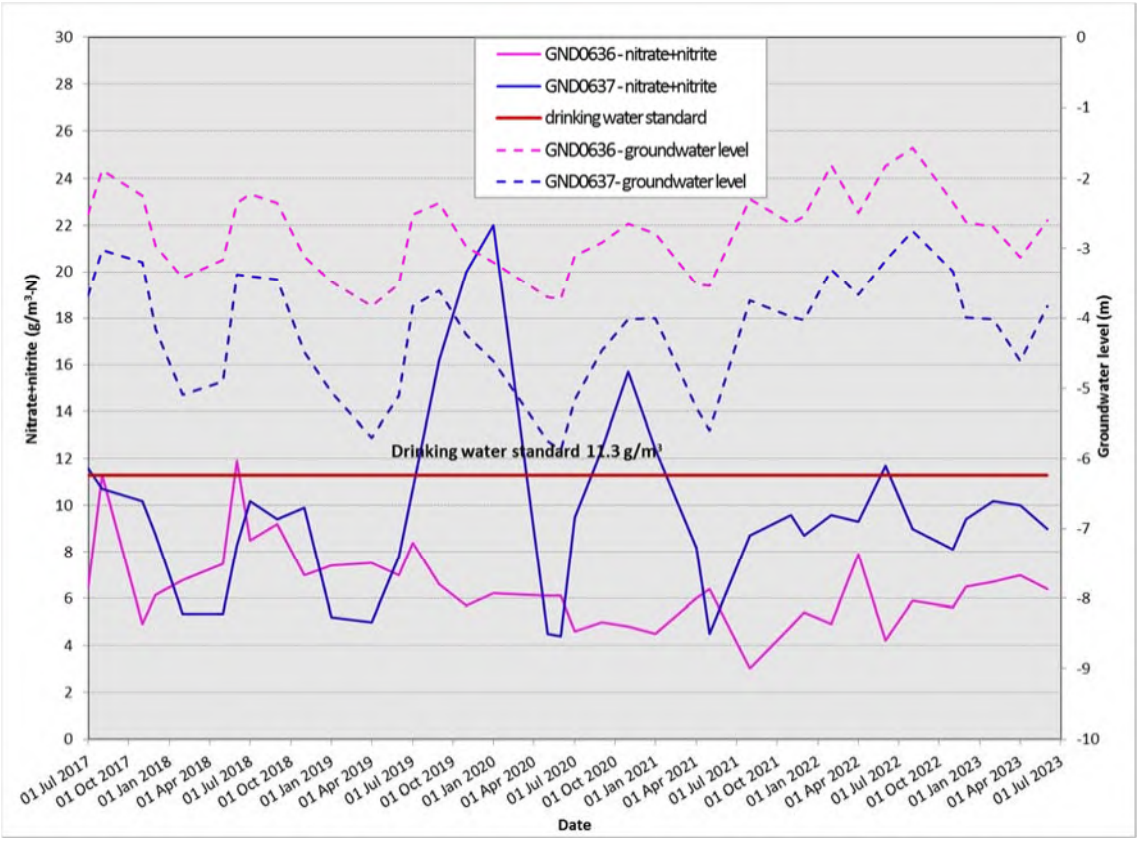

Figure 56 Farm 1 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.2 Farm 2 groundwater

The results of groundwater monitoring on this farm during the year under review are summarised in Table 30, with the relative concentrations of selected parameters, nitrate-N, conductivity, pH, sodium, chloride and potassium, shown in Figure 57 to Figure 63. The full set of results is available upon request.

The control bore for Farm 2, GND2049, was drilled in March 2008, on the northern boundary beside Skeet Road (Figure 49, page 76). This replaced the original 'control' bore, GND0638, which is situated on the western boundary with about 350 m of irrigated paddocks up-gradient. This bore was affected by ponding of effluent in spring 2006 and possibly again in spring 2007. For this reason, following this discovery, the wastewater was irrigated only in summer in the paddock immediately up-gradient (number 13B). However, this paddock was subsequently aerated, and irrigation was resumed. No further issues with ponding have been reported.

The impact monitoring bore, GND0699, some 670 m down-gradient due south of GND0638 collapsed in December 2006, following damage caused by farm activities. A replacement impact bore, GND2050, was installed above the Waiokura Stream in March 2008. This was the third impact bore drilled on Farm 2 west of the Waiokura Stream.

Figure 57 compares the long term trends in groundwater nitrate-N levels at the newer impact bores (GND2063 and GND2050), the two longer standing impact bores (GND0639 and GND0699), and the original control bore (GND0638) that is now considered to be an impact bore, with the new control bore (GND2049).

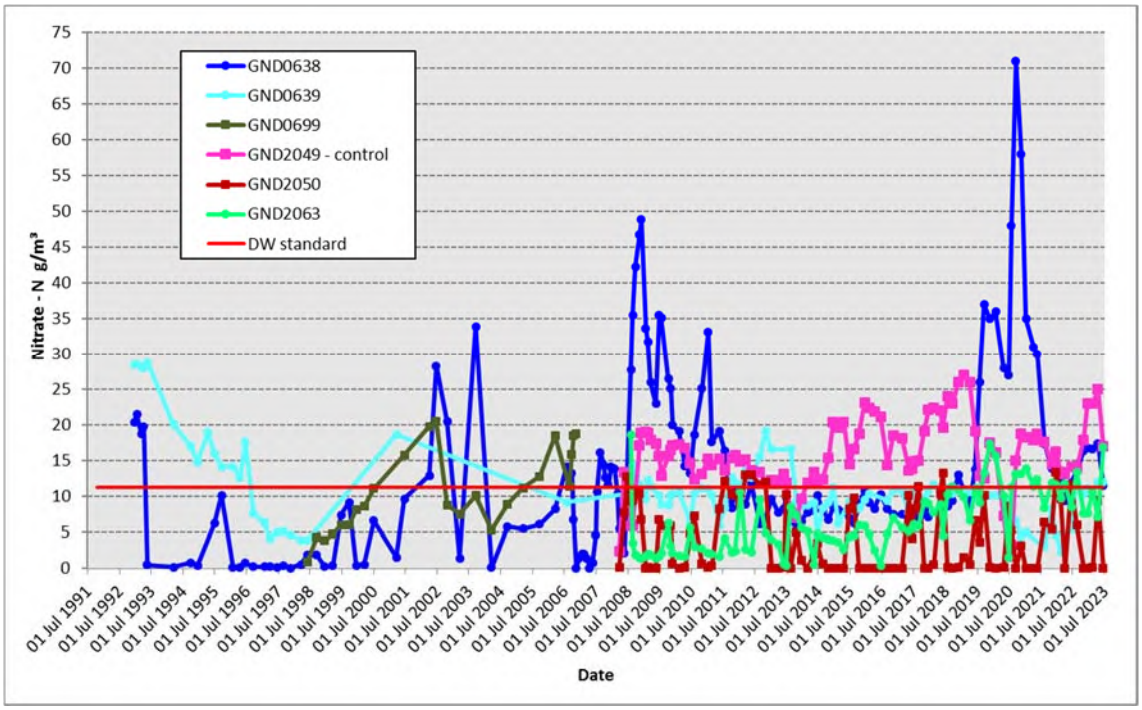

Figure 57 Long term trends in groundwater nitrate-N concentration at Farm 2

The control bore, GND2049, continued to show the influence of an unknown source during the year under review. The nitrate-N concentration in this bore ranged from 14.0 to 25.0 g/m^3 during the monitoring period, with an annual median of 20.5 g/m^3. The annual medians have been consistently above the drinking water standard since this bore was installed, with the highest annual median being found over the 2018-2019 monitoring period. All six results obtained during the year under review were above the drinking water standard. The median of the historical results has remained relatively stable for the data to the end of the four preceding monitoring periods, at 15.3 to 15.4 g/m^3 of nitrate-N. For the assessment of environmental effects to accompany the consent renewal application, the Company had been asked to investigate whether the nitrate being found in this bore originates from farming activities up-gradient across Skeet Road, from "mounding" of factory effluent applied down gradient, or by some other mechanism, noting that the nitrate level is often varying inversely with groundwater level. Although a theoretical analysis of the existing data was provided, there was no conclusive evidence supporting the theory that "upwelling" was the cause of the elevated nitrates at the control bore. It is likely that the replacement consent will require further work to be undertaken on this matter.

The conductivity, pH, sodium and chloride levels of the control bore were relatively low and within the normal ranges found in adjacent farming areas. COD and ammonia were generally low, indicating little leaching of organics into this bore.

Table 30 Results of groundwater quality sampling on Farm 2

Parameter	Unit	Control (GND2049)			Impact (GND0638)			Impact (GND0639)			Impact (GND2050)			Impact (GND2063)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Alkalinity Total	g/m³ CO_3	3	57 - 61	55	3	170 - 200	175	3	178 - 180	141	3	176 - 189	185	3	50 - 61	55
Ammoniacal nitrogen	g/m³N	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.1	6	<0.01 - <0.01	<0.01	6	<0.01 - 0.171	0.44	6	<0.01 - <0.01	<0.01
Bicarbonate @ 25'C	g/m³	3	70 - 75	71	3	210 - 250	210	3	220 - 220	220	3	176 - 230	230	3	60 - 75	67
Calcium	g/m³	3	29 - 35	34.0	3	30.0 - 35	32.0	3	14.9 - 16.2	15	3	27 - 32	29	3	7.9 - 17.4	11.9
COD	g/m³	3	<6 - <6	<6	3	<6 - 7	6	3	<6 - <6	<6	3	<6 - 7	<6	3	<6 - 10	<6
Chloride	g/m³	6	45 - 49	47	6	32 - 50	44	6	44 - 46	45	6	45 - 59	57	6	26 - 99	38
Conductivity @ 25'C	mS/m	6	45.7 - 51.7	49	6	71.0 - 79.4	73.9	6	66.1 - 68.8	67.2	6	63.7 - 77.5	65.3	6	32.3 - 64.9	38.6
DRP	g/m³P	3	0.005 - 0.009	0.008	3	0.010 - 0.014	0.011	3	0.026 - 0.028	0.026	3	0.006 - 0.012	0.011	3	0.009 - 0.014	0.01
Hardness Total	g/m³ CO_3	3	128 - 148	138	3	123 - 133	128	3	81 - 86	82	3	150 - 166	151	3	54 - 105	77
Magnesium	g/m³	3	12.6 - 15	13.8	3	11.0 - 11.7	11.5	3	10.1 - 11.8	10.6	3	19.1 - 21	20	3	8.4 - 15	11.5
Nitrite nitrogen	g/m³N	3	<0.002 - <0.002	<0.002	3	<0.002 - <0.02	<0.002	3	<0.002 - <0.002	<0.002	3	<0.002 - <0.002	<0.002	3	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m³N	6	14.0 - 25.0	20.5	6	11.5 - 17.4	16.5	6	10.3 - 12.0	11.6	6	0.019 - 9.4	0.071	6	7.1 - 16.9	9.2
pH		6	6.4 - 7.3	6.6	6	6.8 - 7.3	7.1	6	6.8 - 7.4	7.1	6	6.7 - 7.2	7.0	6	6.4 - 6.9	6.7
Potassium	g/m³	3	7.8 - 9.6	9	3	53 - 57	55	3	26 - 30	27	3	21 - 33	32	3	9.1 - 25	10
Sodium	g/m³	3	30 - 35	31	3	69 - 72	72	3	91 - 99	96	3	55 - 64	62	3	41 - 66	46
Sulphate	g/m³	3	16.4 - 18.2	17	3	48 - 57	52	3	34 - 43	40	3	51 - 59	58	3	20 - 35	30
Sum of Anions	meq/L	3	4.1 - 4.5	4.1	3	6.8 - 7.2	7.0	3	6.4 - 6.5	6.5	3	6.4 - 6.5	6.4	3	3.2 - 5.6	3.7
Sum of Cations	meq/L	3	4.1 - 4.7	4.3	3	7.0 - 7.1	7.1	3	6.3 - 6.7	6.6	6	6.3 - 6.6	6.5	3	3.1 - 5.6	3.8

Parameter	Unit	Control (GND2049)			Impact (GND0638)			Impact (GND0639)			Impact (GND2050)			Impact (GND2063)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Temperature	˚C	6	14.2 - 15.4	14.6	6	14.2 - 15.3	14.5	6	14.2 - 15.5	14.8	6	14.2 - 15.2	14.7	6	13.7 - 15.4	14.6
Total Kjeldahl nitrogen	g/m^{3}N	6	<0.1 - 0.1	<0.1	6	<0.1 - 0.19	0.18	6	0.20 - 0.28	0.26	6	<0.1 - 0.21	0.14	6	<0.1 - 0.18	0.16
Total nitrogen	g/m^{3}N	6	14.0 - 25.0	20.5	6	11.7 - 17.5	16.6	6	10.6 - 12.3	11.8	6	0.14 - 9.6	0.2	6	7.2 - 17.1	9.4
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	2.49 - 3.39	2.94	6	2.48 - 3.32	3.14	6	2.94 - 3.38	3.23	6	2.59 - 2.96	2.87	6	2.88 - 4.35	3.75

During the year under review all samples collected from GND0638 returned nitrate-N results that were above the drinking water standard, with an annual median of 16.5 g/m^3, and the maximum result obtained being 17.4 g/m^3. It is noted that the nitrate-N concentration in this bore has remained below that obtained for the up-gradient bore GND2049 from 2 November 2021. Although the nitrate-N in GND0638 is still elevated when compared to the historical median of 9.2 g/m^3, there has been a significant and relatively sustained reduction from the concentration of 71 g/m^3 recorded in September 2020 (Figure 58).

At the impact bore GND0639 it was found that the nitrate concentration varied from 10.3 to 12.0 g/m^3 during the year under review, with three of the six samples above the drinking water standard. There was very little variation in either the nitrate-N or groundwater levels at the time of the sampling surveys during the year under review when compared to previous monitoring periods (Figure 58). It is noted that this bore continues to exhibit higher sodium concentrations that in any of the other Farm 2 bores (Figure 61).

Historically, it has been found that at the newer impact bore beside the Waiokura Stream, GND2050, nitrate-N concentration appeared to fluctuate with groundwater level (Figure 58). Over the total record, the nitrate-N concentration is typically in the range of approximately 3 to 13 g/m^3 during winter and spring, falling to <1 g/m^3 in summer and autumn. Denitrification is a likely explanation, as ammonia concentration varies inversely with nitrate, reaching >0.5 g/m^{3}N, while a low oxygen level (that is, conducive to denitrification) has been recorded.

During the year under review, four of the six samples collected had a nitrate-N concentration of < 1 g/m^3, with the other samples being 6.0 and 9.4 g/m^3. It is noted that there was little change in the groundwater levels at the times that the groundwater surveys were undertaken during the year under review.

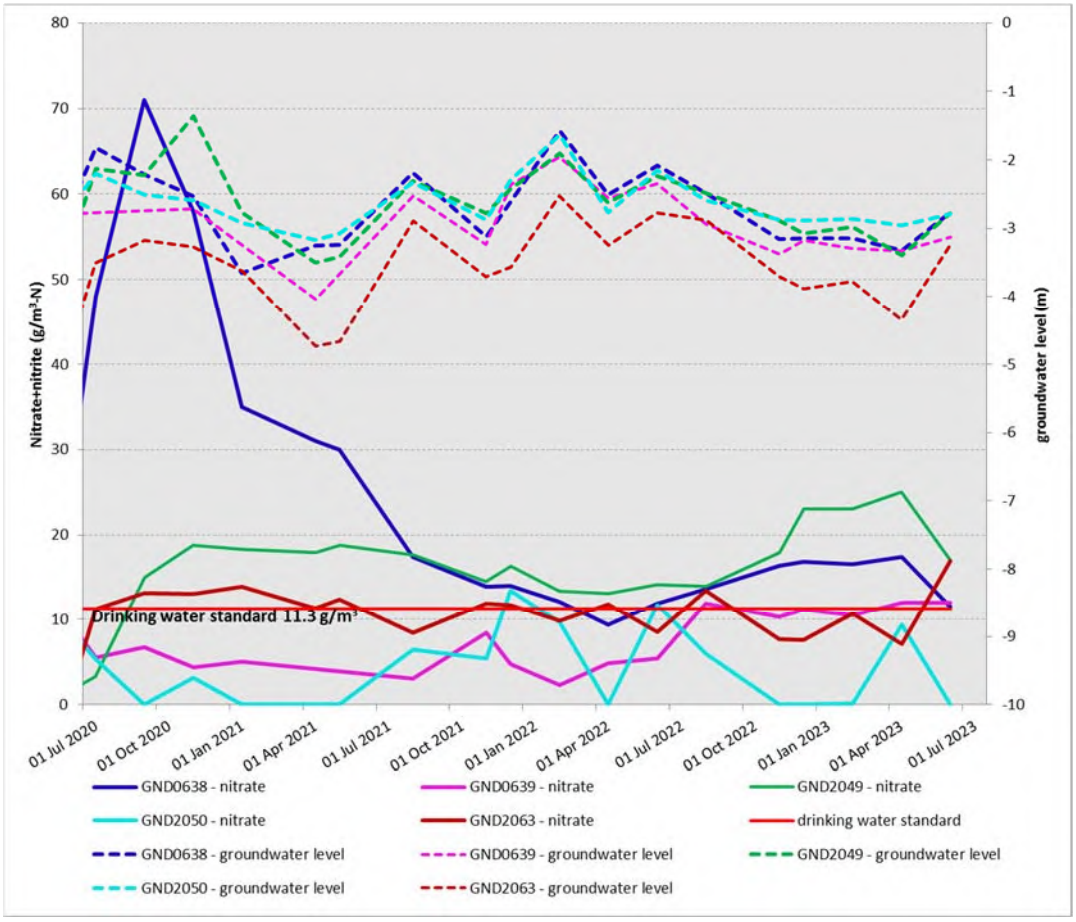

Figure 58 Farm 2 groundwater levels and nitrate + nitrite nitrogen concentrations and groundwater levels during the year under review

The nitrate-N concentrations in the impact bore GND2063 during the year under review were in the range 7.1 to 16.9 g/m³, with two of the six samples collected being above the drinking water standard. The annual median of 9.2 g/m³ is still elevated when compared to the historical median, but is less than those of the 2018 to 2022 years. At the time of the June 2023 survey there were increases in the nitrate-N, conductivity, sodium and chloride in the groundwater sample collected from this bore indicating potential minor effects from recent irrigation activities. It is noted that in contrast to previous years, the nitrate-N concentration varied with the groundwater level, which may also indicate, rising groundwater levels "collecting" accumulated nitrogen stored deeper in the soil, as well as potential minor effects from recent irrigation activities.

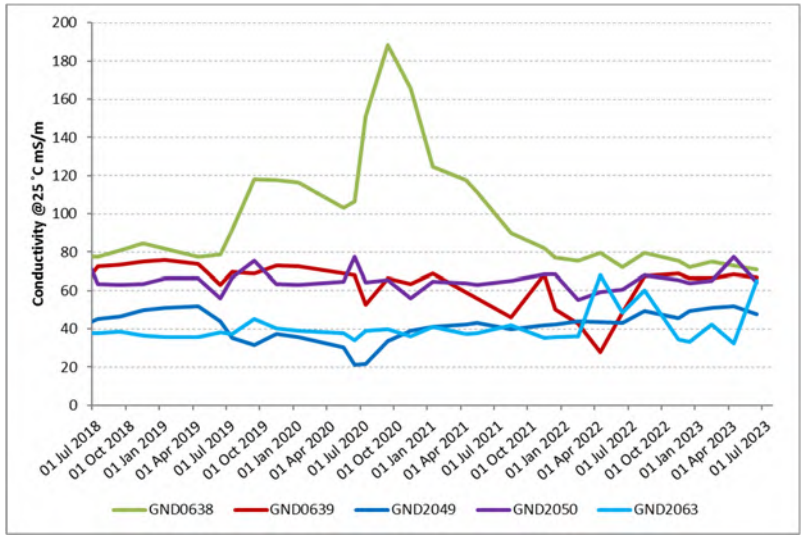

Figure 59 Groundwater conductivity at Farm 2 bores, June 2018 to date

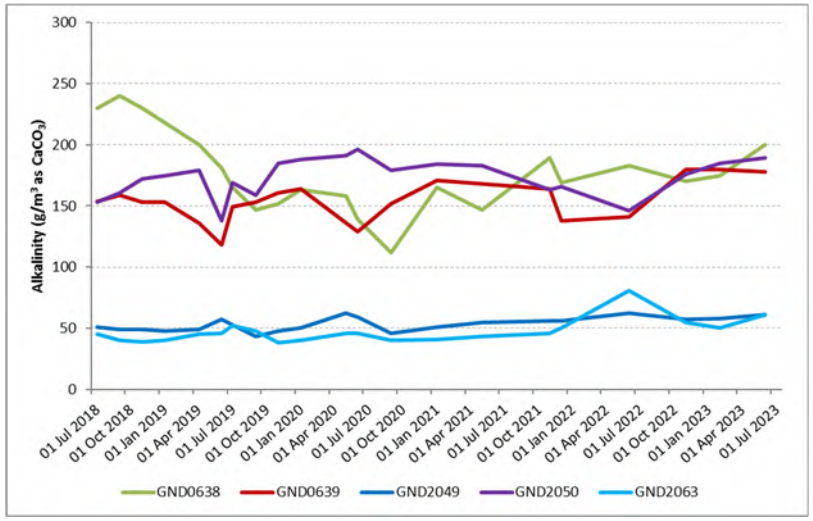

Figure 60 groundwater alkalinity at Farm 2 bores, June 2018 to date

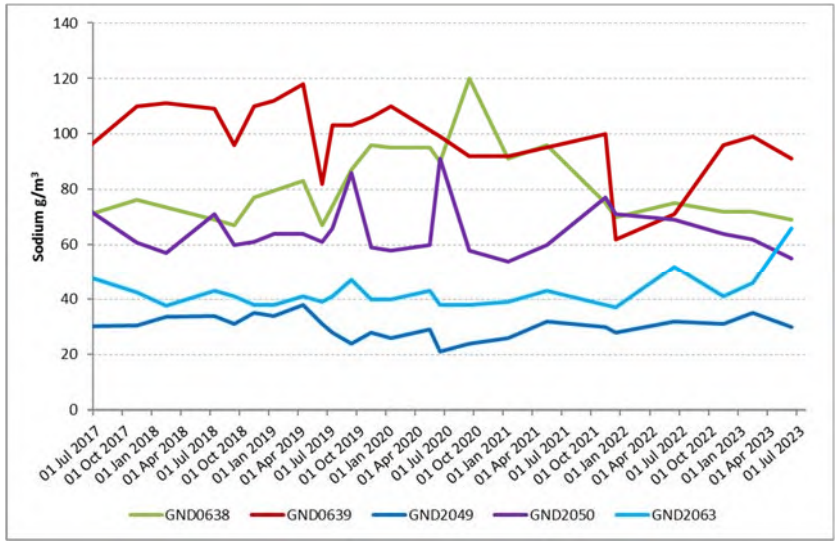

Figure 61 Groundwater sodium concentration at Farm 2, June 2017 to date

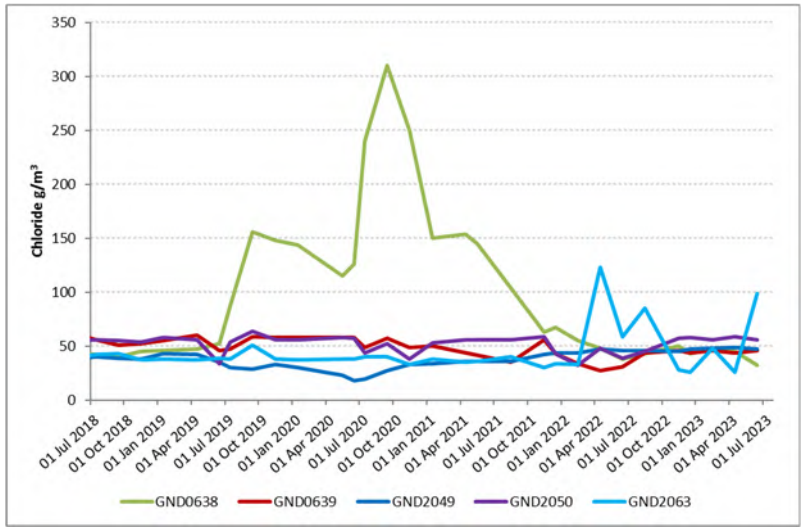

Figure 62 Groundwater chloride concentration at Farm 2, June 2018 to date

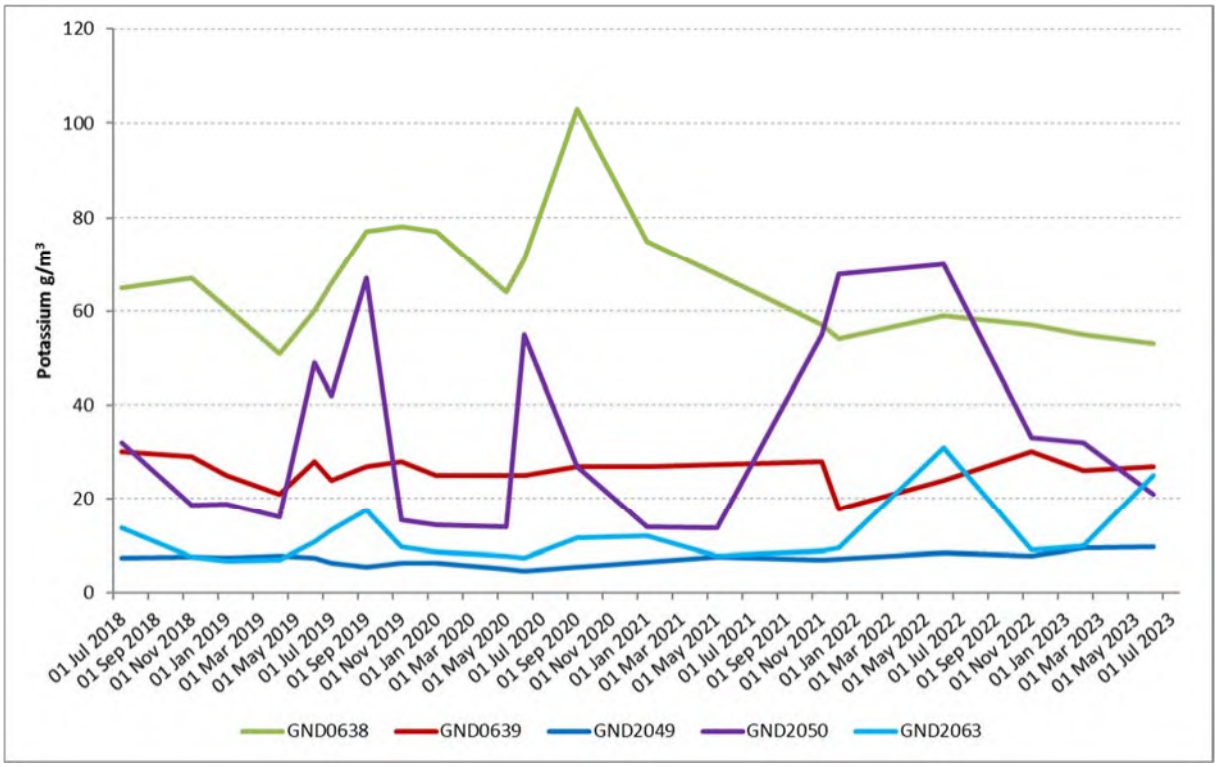

Figure 63 Groundwater potassium concentration at Farm 2 bores, June 2018 to date

2.1.5.3 Farm 3 groundwater

The results of groundwater monitoring on this farm during the period under review are summarised in Table 31. The full set of results is available upon request.

The control bore for Farm 3, GND2051, was drilled in March 2008, on the northern boundary above Motumate Stream. This replaced the original control bore, GND0640, which was situated beside Manaia Road on the western boundary down-gradient of the extended farm area, and was damaged by farm activities in May 2007.

Another impact monitoring bore (GND2052) was also drilled in March 2008, on the southern boundary to the west of Motumate Stream, immediately down-gradient of recently installed fixed in-ground irrigators. The existing impact bore, GND0700, to the east of Motumate Stream, was maintained. An old impact monitoring bore, GND0641, situated between the main access track and Motumate Stream, which had at times been dry, was reinstated in the programme in August 2008. This was not able to be sampled for a number of years due to a bailer becoming stuck inside the bore in May 2013. Sampling access to this bore was re-instated and routine monitoring recommenced in July 2018.

Table 31 Results of groundwater quality sampling on Farm 3

Parameter	Unit	Control (GND2051)			Impact (GND0640)			Impact (GND0700)			Impact (GND0641)			Impact (GND2052)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Alkalinity Total	g/m³ CO_3	3	49 - 53	49	3	72 - 76	74	3	93 - 136	99	3	132 - 148	147	3	68 - 75	75
Ammoniacal nitrogen	g/m³N	6	<0.01 - <0.01	<0.01	6	0.28 - 0.48	0.43	6	<0.01 - 0.04	<0.01	6	<0.01 - <0.01	<0.01	6	0.039 - 0.38	0.37
Bicarbonate @ 25'C	g/m³	3	60 - 65	60	3	88 - 93	90	3	113 - 165	120	3	161 - 181	179	3	82 - 92	91
Calcium	g/m³	3	13.7 - 15.0	14	3	11.4 - 12.3	12.1	3	12.5 - 15.1	14.1	3	24 - 30	28	3	14.6 - 15.5	14.6
COD	g/m³	3	<6 - <6	<6	3	<6 - 6	<6	3	<6 - 7	<6	3	<6 - 12	<6	3	<6 - 7	7
Chloride	g/m³	6	32 - 47	36	3	48 - 51	48	6	64 - 134	75	6	57 - 72	68	6	46 - 52	50
Conductivity @ 25'C	mS/m	6	30.5 - 37.8	31.3	6	30.8 - 33.1	31.5	6	43.8 - 86.7	58.5	6	66.6 - 71.1	67.7	6	36.8 - 41.8	38.9
DRP	g/m³P	3	0.008 - 0.017	0.013	3	<0.004 - <0.004	<0.004	3	0.010 - 0.024	0.019	3	<0.004 - 0.008	<0.004	3	0.004 - 0.033	0.020
Hardness Total	g/m³ CO_3	3	84 - 91	86	3	62 - 64	63	3	79 - 99	85	3	114 - 135	121	3	76 - 79	76
Magnesium	g/m³	3	11.3 - 13.7	12.3	3	7.5 - 8.6	8.0	3	10.7 - 14.8	13.1	3	12.4 - 14.6	13.1	3	9.0 - 10.4	9.5
Nitrite nitrogen	g/m³N	3	<0.002 - <0.002	<0.002	3	0.003 - 0.008	0.003	3	<0.002 - <0.002	<0.002	3	<0.002 - <0.002	<0.002	3	<0.002 - 0.008	0.004
Nitrite+nitrate	g/m³N	6	3.6 - 6.5	4.0	6	0.005 - 0.59	0.037	6	2.3 - 10.9	5.3	6	9.8 - 12.3	11.4	6	0.20 - 1.92	0.86
pH		6	6.7 - 7.2	7.0	6	6.8 - 7.5	7.0	6	6.7 - 7.6	7.1	6	6.7 - 7.1	6.9	6	6.8 - 7.7	7.0
Potassium	g/m³	3	6.9 - 7.1	7.4	3	6.9 - 7.2	7.30	3	13.1 - 29	27	3	49 - 54	51	3	10.4 - 11.9	11.4
Sodium	g/m³	3	21 - 23	23	3	31 - 35	34	3	49 - 88	80	3	52 - 59	54	3	39 - 46	41
Sulphate	g/m³	3	26 - 27	27	3	3.3 - 3.7	3.7	3	11 - 31	16.9	3	36 - 37	36	3	27 - 34	30
Sum of Anions	meq/L	3	2.8 - 2.9	2.8	3	2.9 - 3.0	2.9	3	4.1 - 6.3	4.3	3	6.1 - 6.5	6.2	3	3.4 - 3.8	3.5
Sum of Cations	meq/L	3	2.8 - 3.0	2.9	3	2.8 - 3.0	3.0	3	4.0 - 6.5	5.9	3	5.9 - 6.6	6.0	3	3.5 - 3.9	3.6

Parameter	Unit	Control (GND2051)			Impact (GND0640)			Impact (GND0700)			Impact (GND0641)			Impact (GND2052)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Temperature	˚C	6	14.2 - 15.4	14.6	6	14.2 - 15.6	15.0	6	14.2 - 15.2	14.6	6	14.2 - 15.9	14.8	6	14.5 - 15.0	14.8
Total Kjeldahl nitrogen	g/m^{3}N	6	<0.1 - 0.16	<0.1	6	0.25 - 0.59	0.46	6	0.14 - 0.19	0.17	6	0.17 - 0.31	0.214	6	<0.1 - 0.68	0.35
Total nitrogen	g/m^{3}N	6	3.6 - 6.6	4.1	6	0.46 - 0.84	0.53	6	2.5 - 11.1	5.5	6	10.0 - 12.6	11.6	6	0.54 - 2.0	1.19
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	2.34 - 3.76	3.17	6	1.64 - 2.75	2.56	6	1.47 - 2.97	2.77	6	1.69 - 2.36	2.14	6	2.43 - 3.20	2.90

The impact of wastewater irrigation was reflected in elevated alkalinity, sodium, chloride, conductivity and potassium levels at times in bores GND0700 and GND0641 (Figure 65, Figure 66, Figure 67, and Figure 68), with GND0641 appearing be showing a trend of increasing potassium.

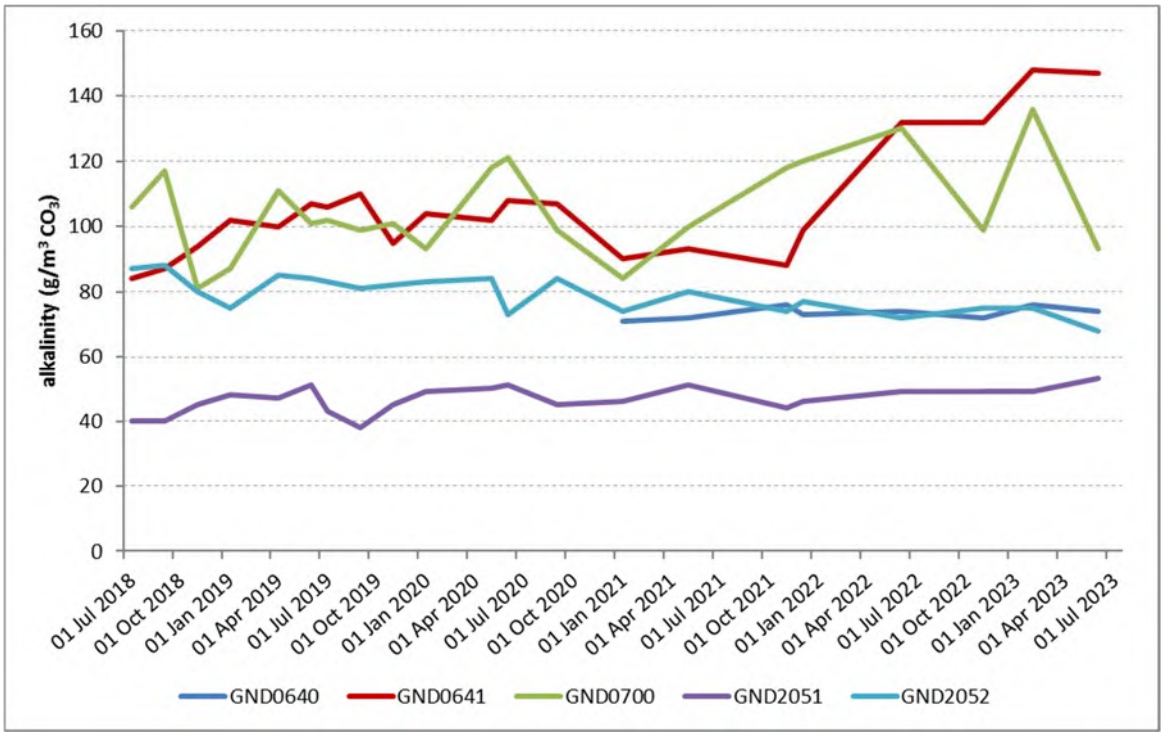

Figure 64 Groundwater alkalinity at Farm 3 bores, June 2018 to date

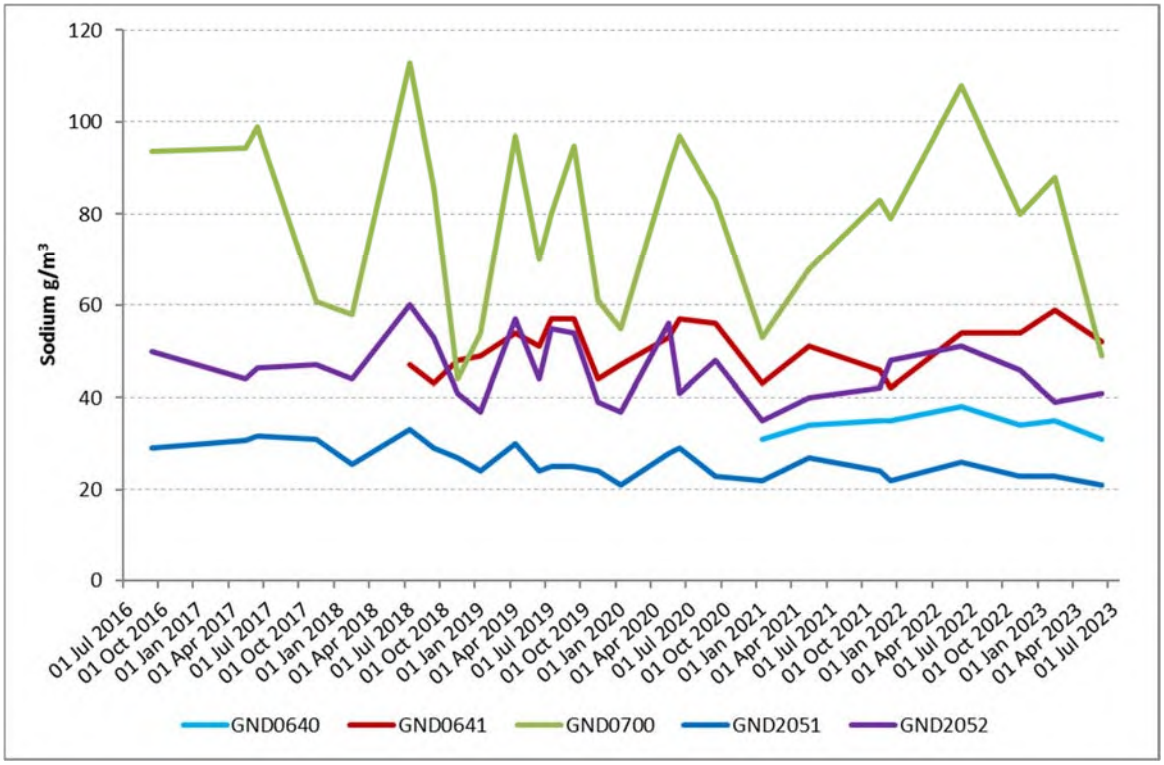

Figure 65 Groundwater sodium concentration at Farm 3 bores, June 2016 to date

It is noted that the chloride concentration and conductivity of the new control bore GND2051 had also been elevated at times in the 2015 to 2018 years. These parameters have returned to a lower level over the 2019-2023 years. Potassium can be elevated in this bore at times.

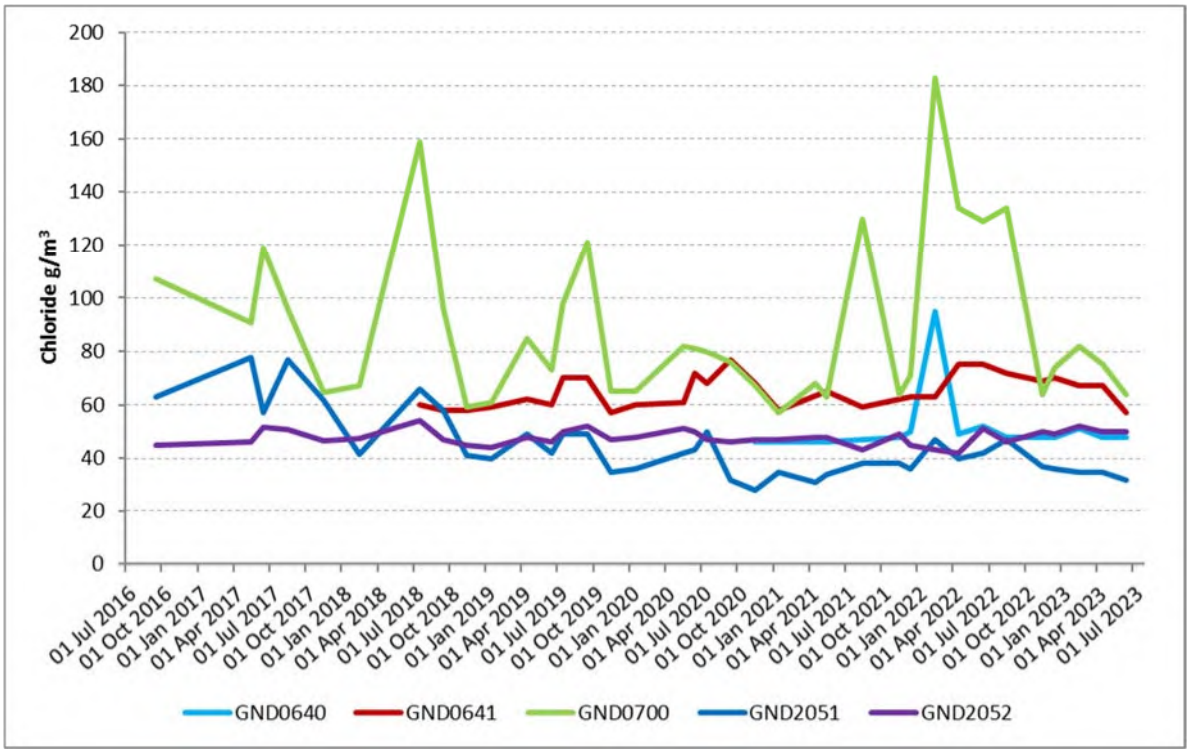

Figure 66 Groundwater chloride concentration at Farm 3 bores, June 2016 to date

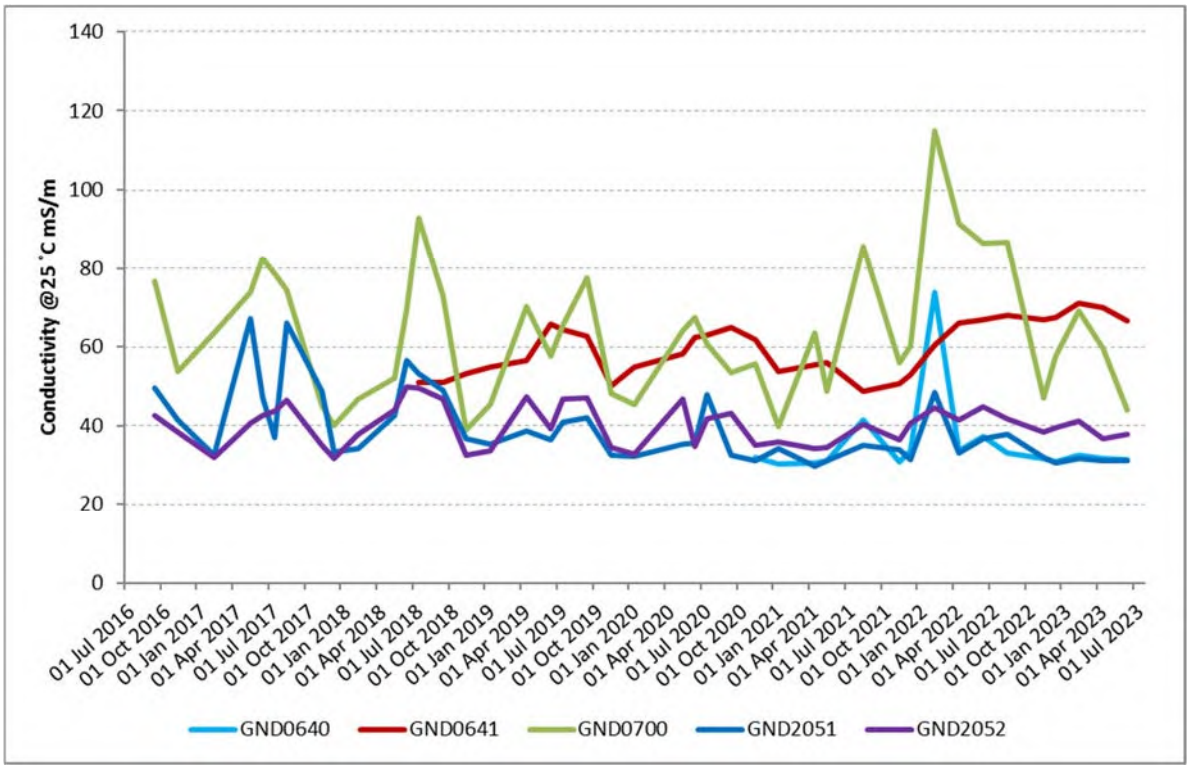

Figure 67 Groundwater conductivity at Farm 3 bores, June 2016 to date

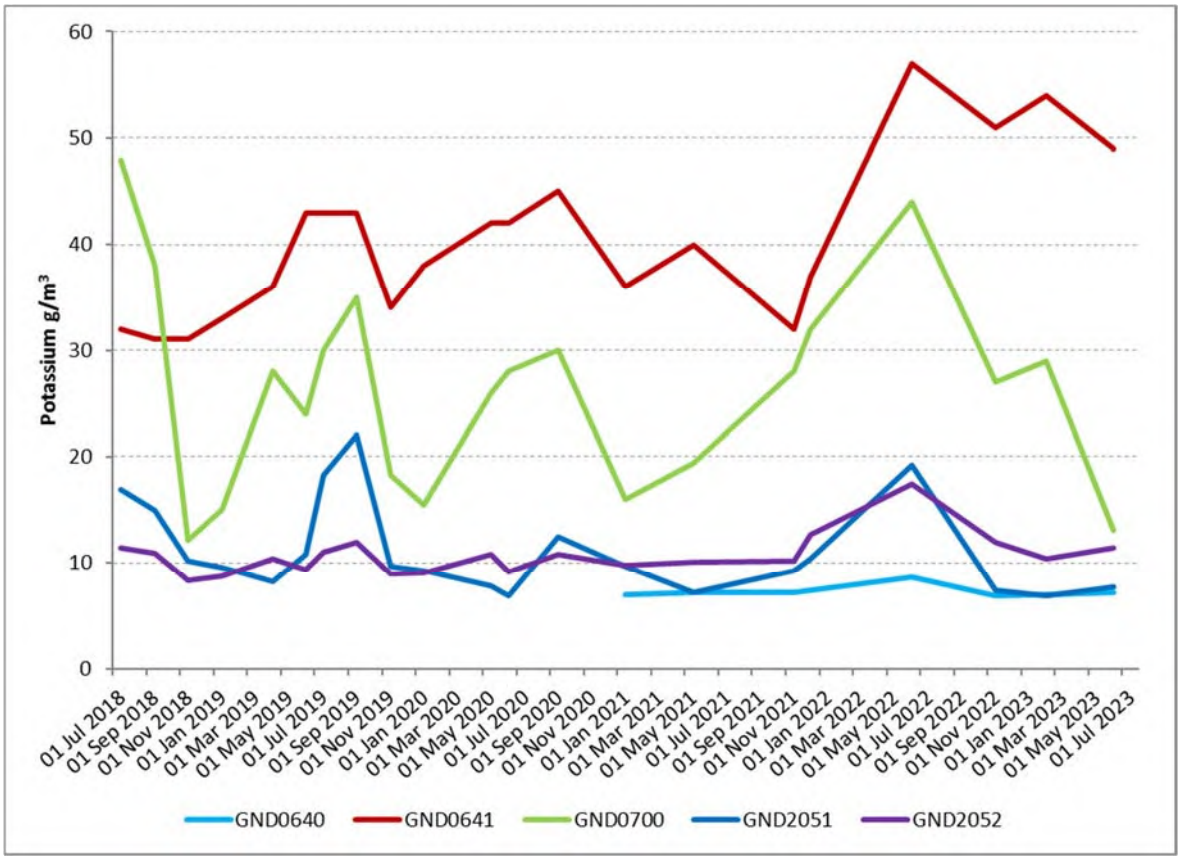

Figure 68 Groundwater potassium concentration at Farm 3 bores, June 2018 to date

Figure 69 compares trends in groundwater nitrate-N levels at the two current impact bores, GND2052 and GND0700, and the reinstated impact bore, GND0641 (between 2008-2013 and June 2018-July 2019), with the old and new control bores, GND0640 (until 2007) and GND2051.

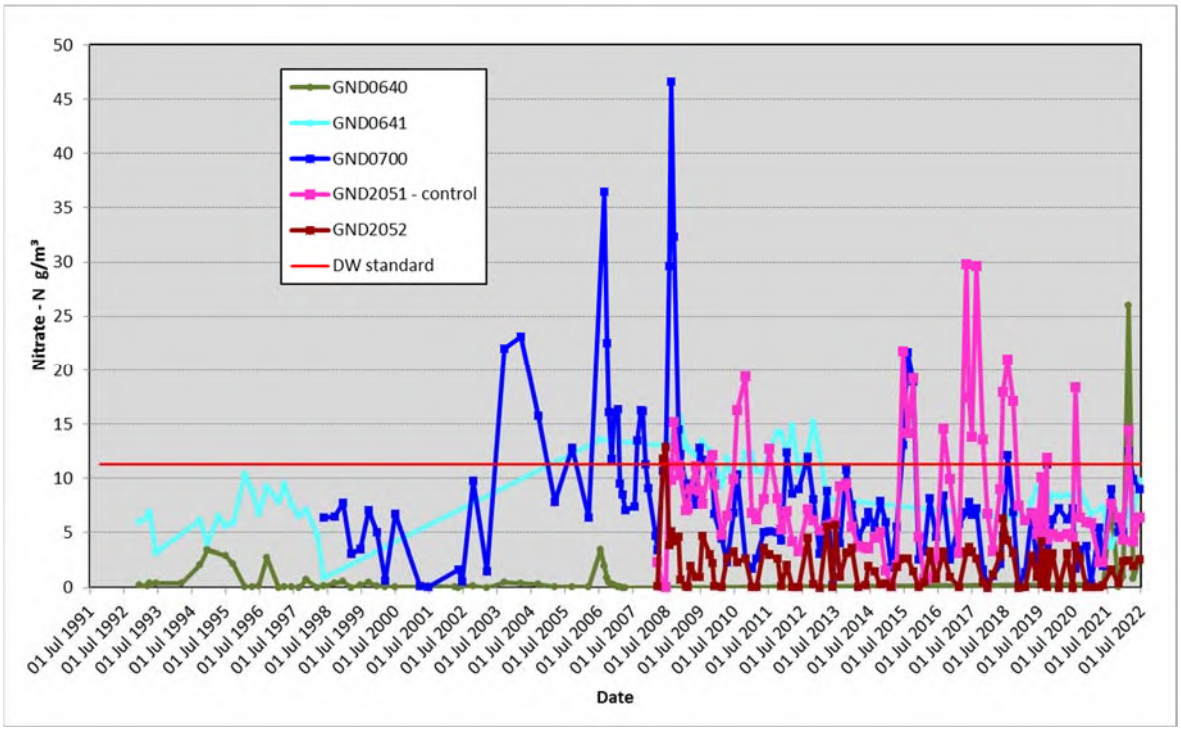

Figure 69 Trends in groundwater nitrate N concentration at Farm 3

At the new control bore (GND2051), nitrate-N were relatively low throughout the year under review. All samples returned results that were below the drinking water standard, being in the rage 3.6 to 6.5 g/m^3.The annual median of the samples collected during the year under review (4.0 g/m^3) has continued to be below the historical median of 6.7 g/m^3, as has been the case for the three previous monitoring periods.

Groundwater samples from impact bore GND0700 have generally contained relatively low levels of nitrate-N when compared to the drinking water standard, with the median of historical results being 6.9 g/m^3. The annual median for samples collected during the year under review was 5.3 g/m^3, which is a reduction from the 2021-2022 annual median of 9.0 g/m^3.

During the year under review, impact bore GND2052 continued to have a low annual median nitrate-N value (0.86 g/m^3) that is below the historical median of 2.0 g/m^3.

The nitrate-N concentration at bore GND0640 remained very low during the year under review, with an annual median of only 0.03 g/m^3. Results for this parameter ranged from 0.59 to 0.005 g/m^3. Although this is now an impact bore, the annual median for the 2022-2023 year was lower than the median of historical results collected between 1992 and 2007 (0.13 g/m^3), when this was a control bore for the southern section of Farm 3.

At the impact bore GND0641 that was re-instated in July 2018, the nitrate-N concentrations were elevated, with the annual median of 11.4 g/m^3 higher than both the historical median (8.9 g/m^3) and the 2021-2022 annual median (6.1 g/m^3). There were three of the six groundwater samples that exceeded the drinking water standard.

Overall, the results showed that the impact bores were generally experiencing only minor effects and indicated generally good management of nitrogen application rates in the vicinity of these bores.

In previous years it has been reported that the nitrate-N results obtained for the new control bore (GND2051) indicated that the groundwater on the northern boundary of Farm 3 may have been experiencing similar effects to those seen at the Farm 2 control bore (GND2049).

Historically, GND2049 and GND2051 tended to show elevations in chloride, conductivity, and to a lesser extent sodium, in the surveys in which elevations in nitrate-N occur. It is noted that the relative contaminant concentrations are different in the other impact bores. These findings highlight that this is a complex system, and the relative contaminant concentrations would depend on when irrigation was last undertaken in the vicinity of each of the bores, the component concentrations of the wastewater as these vary according to wastewater type and site activities, and the mobility of the various contaminants in the soil/groundwater. For the assessment of environmental effects to accompany the consent renewal application, the Company was asked to investigate whether the nitrate originates from farming activities up-gradient, from "mounding" of factory effluent applied down gradient, or by some other mechanism.

Although a theoretical analysis of the existing data was provided, there was no conclusive evidence supporting the conclusion that "upwelling" was the cause of the elevated nitrates at the control bores. It is likely that the reissued consent will require further work on this matter.

It is noted however, that there have only been three exceedances of the drinking water standard at GND2051 in the last four monitoring periods.

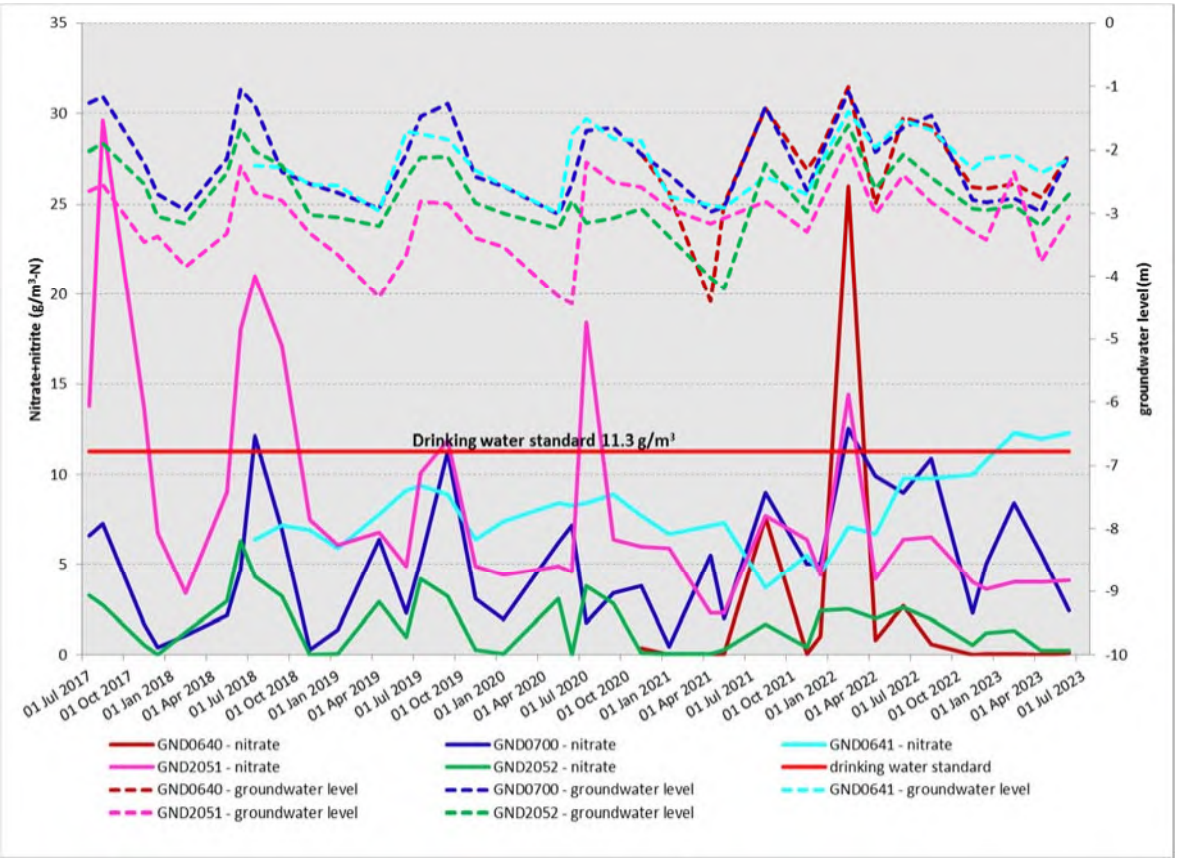

Figure 70 Farm 3 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.4 General

The use of all three farms for spray irrigation of wastewater has impacted on shallow groundwater to varying degrees, raising sodium and conductivity levels and altering nitrate levels.

The main parameter of concern is nitrate level, given the NZ Drinking Water Standard of 11.3 g/m^3 (as nitrate-N) has been exceeded on a number of occasions during this and previous monitoring periods. There are no known shallow groundwater water users in the immediate vicinity of the spray irrigation area, because of the availability and usage of the Waimate West Rural Water Supply Scheme. However, the Regional Fresh Water Plan for Taranaki (2001) does provide for the taking and use of groundwater at a scale that would enable reasonable farm use as a permitted activity. GWR Policy 4 of the Regional Policy Statement for Taranaki (2010) also states that groundwater quality will be maintained and enhanced by promoting land use practices that minimise, as far as practicable, the potential adverse effects on groundwater quality.

A summary of the groundwater nitrate monitoring results is given in Table 32.

Table 32 Summary of groundwater nitrate concentrations at monitoring bores during the year under review

Property	Site code	Bore location	Designation	Number of samples	Nitrate & Nitrite-N, g/m^3	
					Range	Median
Farm 1	GND0636	North	Control	6	5.6 - 7.0	6.5
	GND0637	South	Impact	6	8.1 - 10.2	9.2
Farm 2	GND2049	North	Control (new)	6	**14.0** - **25.0**	**20.5**
	GND0638	West	Impact	6	**11.5** - **17.4**	**16.5**
	GND0639	South-west	Impact	6	10.3 - **12.0**	**11.6**
	GND2050	South-west	Impact (new)	6	0.019 - 9.4	0.071
	GND2063	South-east	Impact	6	7.1 - **16.9**	9.2
Farm 3	GND2051	North	Control (new)	6	3.6 - 6.5	4.0
	GND0640	West	Impact	6	0.005 - 0.59	0.037
	GND0641	Central	Impact	6	9.8 - **12.3**	**11.4**
	GND2052	South-west	Impact (new)	6	0.20 - 1.92	0.86
	GND0700	South-east	Impact	6	2.3 - 10.9	5.3
New Zealand Drinking Water Standard					**11.3**	

On Farm 1 during the 2022-2023 year, it appears that, overall, there had been a slight increase in the base nitrate levels under the irrigation areas in the vicinity of the control bore (GND0636) with the levels remaining similar to the previous year in the vicinity of the impact bore (GND0637). However, the annual medians were still both below their respective historical medians of 7.8 and 10.8 g/m^3 respectively, with all samples returning results that were below the drinking water standard. The long term monitoring data has found that 43% of the samples collected from GND0637 to date have exceeded the standard. This is significantly higher than the 5% of the total dataset at the control bore (GND0636) that have been above the drinking water standard. The control bore is located in paddock 11. During the year under review, there was an annual equivalent of 221 mm and 360 kgN/ha/y applied in this paddock. This is less than the average application rates of 291 mm equivalent (Table 12) and 452 kgN/ha/y (Table 16). The impact bore is located in paddock 20. During the year under review, there was an annual equivalent of 397 mm and 637 kgN/ha/y applied in this paddock. In addition to this bore being on the down gradient boundary of the farm, the annual wastewater application rate and the nitrogen application rate in the vicinity of the impact bore were both above average during the year under review.

During the 2022-2023 year, there was an increase in the median nitrate-N concentration at impact bore GND0638 when compared to the 2021-2022 year. Although all samples were above the drinking water standard, the nitrate-N concentrations remained below those found in the up-gradient bore GND2049. However, the reasons for the elevated nitrate-N concentrations in this up-gradient bore have not been determined. Irrigation records indicate that the average nitrogen loadings on Farm 2 had increased by approximately 122 kgN/ha/y in the year under review to approximately 545 kgN/ha/y. Bores GND0639 and GND2063 both exhibited elevated nitrate-N concentrations at times during the year under review. Both of these bores are located in paddocks that received higher than the average nitrogen application rates (637 and 693 kgN/ha/y respectively).

On Farm 3, during the year under review, it was found that the annual medians for all the bores, except GND0641 were below their respective historical medians. The nitrate-N concentrations at GND0641 in the latter part of the year under review were above the drinking water standard and the highest they have been

since monitoring recommenced in July 2018. On a survey basis, it is noted that in the 2022-2023 year, the nitrate levels in the control bore (GND2051) have not continued to show the occasional elevation above the drinking water standard of 11.3 g/m^3 that had been found in previous years.

In the past, there have been spikes in groundwater nitrate concentrations that have occurred at most monitoring bores, both impact and control, that have coincided with recent heavy rainfall events and/or increases in groundwater levels. In addition to the localised effects of recent irrigation events, an additional likely mechanism that is considered to amplify any increases is the flushing of nitrate-N in the subsurface soils into the groundwater by the rainfall, combined with the groundwater "collecting" any subsurface nitrate-N in the soil as it rises. This was observed only at GND2063 during the year under review. There were additional bores that on occasion demonstrated reducing nitrate-N concentrations that occurred with reductions in the groundwater level, which is a finding that continues to be consistent with the above theory.

During the year under review, bores GND0636 and GND2063 tended to show the opposite trend, as these showed an increase in nitrate-N concentration at times of reduced groundwater levels, indicating localised effects from recent irrigation activities.

GND0639 has tended to have relatively stable nitrate concentrations irrespective of changes in groundwater levels. During the year under review both the nitrate-N concentrations and the groundwater levels were relatively stable, with nitrate-N concentrations being within ± 1.0 g/m^3 of the drinking water standard.

Historically, GND2049 (control bore) has demonstrated nitrate-N concentrations that have varied inversely with groundwater levels, as was the case during the year under review.

As discussed above, the results for the one of the two newer control bores, at the upslope boundary of Farm 2 has continued to show significant elevations in groundwater nitrate-N levels in excess of the drinking water standard at times. This may be as a result of activities on adjacent farms, or of groundwater mounding that can occur as a result of an elevated localised hydraulic loading due to irrigation. This effect had also previously been apparent in the bore on the up gradient boundary of Farm 3, however this was not evident during the year under review.

In the 2016-2020 annual reports, it had been signalled to the Company that the Assessment of Environmental Effects (AEE) for the consent renewal would need to include paddock by paddock irrigation data, continuous groundwater level and rainfall data to support the investigation and reasoning for the elevated nitrate-N levels in the bores on the up gradient boundary of Farm 2. Stock rotation should also be considered when looking at the potential for cumulative effects.

2.1.6 Motumate Stream surface water quality

In combination with groundwater monitoring, some spatial synoptic surface water monitoring was conducted at four sites on the Motumate Stream adjacent to and downstream of the Company's farms (Figure 49, Table 33). Three of these sites were previously monitored from November 2009 to April 2013, with approximately bi-monthly sampling recommencing in November 2017. A new site, MTM000057, was added further upstream in September 2018 due to the elevated level of contaminants observed in this stream and in the groundwater monitoring site at the control sites on the up gradient farm boundary.

These sites were originally chosen to monitor any possible effects on surface water from the discharge of groundwater used for cooling at the plant. The appropriateness of these locations may be re-evaluated to ensure that they are suited to the monitoring of potential effects in the stream from the spray irrigation of wastes on the Company's Farms 2 and 3, whilst also giving consideration to stream access. The results from the 2022-2023 monitoring period are presented in Table 34, and a summary of the monitoring previously performed is presented in Table 35.

Table 33 Description of the water quality monitoring sites in the Motumate Stream

Site	Site code	Description	Map reference, NZTM	
			Easting	Northing
1	MTM000057	Motumate Stream at railway line	1698475	5629820
2	MTM000075	Motumate Stream upstream of Skeet Road	1698445	5628959
3	MTM000120	Motumate Stream, Farm 3, Fonterra Kapuni	1697413	5626971
4	MTM000125	Motumate Stream at Hicks Road	1697046	5626558

The results for the 2022-2023 continue to show that the conductivity, sulphate, and dissolved magnesium measurements were generally similar at sites MTM000057 and MTM000075, with increases of varying degrees between this site and MTM000120. MTM000125 was generally similar to MTM000120 for these parameters (Table 34). Alkalinity, bicarbonate, chloride and sodium (Figure 71) were generally similar at sites MTM000057 and MTM000075, with increases of varying degrees between this site, followed by a further slight increase between MTM000120 and MTM000125. It is interesting to note that the two sites upstream of the Company's irrigation activities have comparable sodium concentrations to those recorded for all of the Waiokura Stream sites (generally in the range 17 to 25 g/m^3, Table 38), but that the two downstream sites (MTM000120 and MTM000125) have sodium concentrations that are consistently higher (generally in the range 30 to 40 g/m^3).

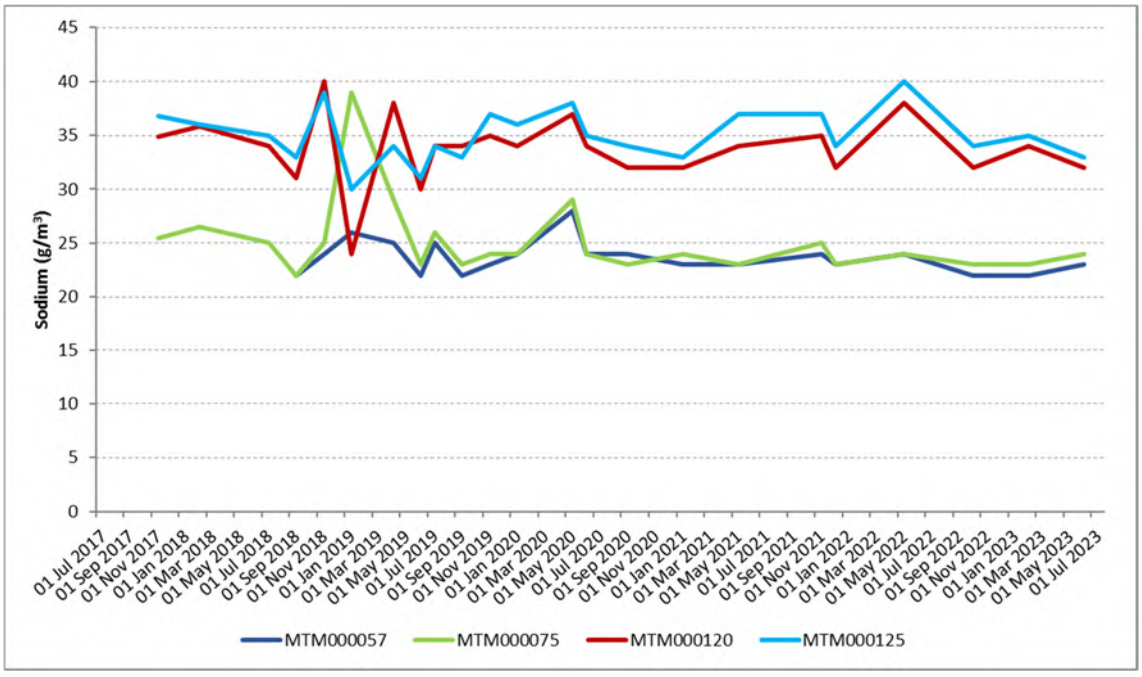

Figure 71 Sodium concentrations in the Motumate Stream 2017 to date.

None of the changes were such that they would be considered a significant adverse environmental effect.

On all occasions during the year under review the nitrate-N results increased between MTM000057 and MTM000075 and then decreased in a downstream direction (Figure 72). Historically, the nitrate-N concentration has shown a large seasonal variation, decreasing from about 6 to 8 g/m^3 during times with higher groundwater level and/or soil moisture to 2 g/m^3 during times periods with lower groundwater level and/or soil moisture. This is a larger variation than has been observed in the Waiokura Stream, which was in the range of approximately 2.7 to 4.4 g/m^3 (Table 38 and Figure 73). This is also in comparison to the NPS bottom line of 3.5 g/m^3 (annual 95th percentile). It is noted that the annual minimum has been elevated in

the 2021-2023 monitoring periods when compared to previous years. This is likely to be due to the higher rainfall, groundwater levels and soil moistures than were typical for the time of year.

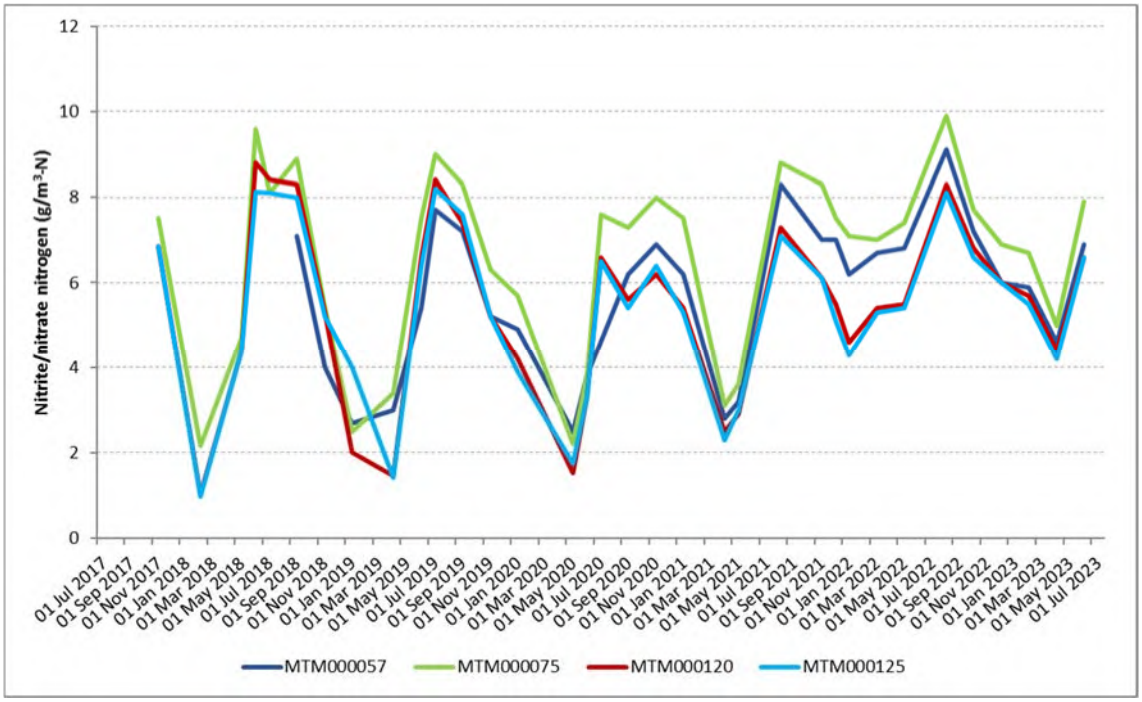

Figure 72 Nitrate/nitrite nitrogen concentrations in the Motumate Stream July 2017 to date

Continued monitoring will provide further information so that an assessment can be made regarding any possible environmental effects to surface water from the spray irrigation of wastewater on Farms 2 and 3, especially when paddock by paddock irrigation information is available. Total nitrogen was added to the analysis suite during the 2020-2021 year. Results obtained during the year under review showed that the total nitrogen concentration followed the same trends as the nitrate/nitrite-N concentration.

In terms of a comparison between the Motumate Stream and the Waiokura Stream it is noted that, in addition to the higher base nitrate-N concentrations, the conductivity and sodium were consistently higher in this water body during the year under review than in the Waiokura Stream. It is noted that there has been a shift in the range of nitrate-N concentrations observed in the Motumate Stream between monitoring undertaken in the 2009 to 2013 years (up to 5.9 g/m^3) and recent monitoring (up to 9.9 g/m^3).

In the 2018-2019 Annual Report it was proposed that if these higher levels continued in the 2019-2020 year, that consideration be given to re-establishing periodic biomonitoring in the Motumate Stream, and a recommendation to this effect was included in the report. As the high levels did continue, the stream habitat was evaluated. It was found that the habitat of the stream was such that biomonitoring results were likely to be influenced more by the habitat than any potential water quality issues through the irrigated area. Additionally it was likely that any effects from the high nitrates in the upper Motumate Stream would overshadow an effect potentially occurring through the irrigation area, if any were to be occurring.

Further investigations were initiated in the 2020-2021 year in order to identify whether there may be any unauthorised discharges occurring in the upper reaches of the catchment above the Fonterra Kapuni Farm 2 site in an attempt to identify the reasons for these elevated nitrates. Additional sampling was undertaken in December 2020. During these investigations found that the nitrate/nitrite-N concentration at the headwaters of the Motumate Stream was 2.3 g/m^3, which is similar to the concentration found in the Waiokura Stream. There were continued downstream increases in the nitrate/nitrite-N concentration, but no point source discharges were identified. These findings have been shared with the Riparian Team within the Council for their consideration.

Table 34 Results of Motumate Stream quality sampling for the year under review

Parameter	Unit	MTM000057			MTM000075			MTM000120			MTM000125		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m³ as $CaCO_3$	3	58 - 67	62	3	58 - 68	62	3	72 - 86	80	3	75 - 89	83
Ammoniacal nitrogen	g/m³-N	6	0.022 - 0.091	0.030	6	0.012 - 0.086	0.031	6	0.022 - 0.061	0.031	6	0.026 - 0.068	0.049
Bicarbonate	g/m³ at 25°C	3	70 - 81	75	3	70 - 82	75	3	87 - 104	97	3	91 - 109	101
Biochemical oxygen demand 5day	g O_2/m³	6	<0.4 - 0.9	0.7	6	0.5 - 1.6	0.8	6	0.5 - 1.1	0.7	6	<0.4 - 1.2	0.8
Calcium	g/m³	3	21 - 22	22	3	21 - 23	22	3	21 - 21	21	3	21 - 21	21
Chloride	g/m³	6	33.0 - 42	35	6	33.0 - 45	36	6	36.0 - 43	38	6	37.0 - 43	39
Conductivity @ 25'C	mS/m	6	32.7 - 38.4	34.5	6	33.7 - 40.0	35.6	6	37.5 - 41.4	39.5	6	38.9 - 41.2	40.5
Dissolved reactive phosphorus	g/m³-P	6	0.024 - 0.052	0.044	6	0.026 - 0.070	0.050	6	0.024 - 0.051	0.035	6	0.025 - 0.044	0.032
Hardness Total	g/m³ as $CaCO_3$	3	87 - 89	89	3	88 - 94	91	3	92 - 93	92	3	92 - 94	93
Magnesium	g/m³	3	8.4 - 8.4	8.4	3	8.6 - 9	8.6	3	9.5 - 9.7	9.7	3	9.5 - 9.9	9.8
Nitrite nitrogen	g/m³-N	3	0.013 - 0.053	0.013	3	0.009 - 0.061	0.011	3	0.008 - 0.038	0.018	3	0.013 - 0.036	0.019
Nitrite/nitrate nitrogen	g/m³-N	6	4.6 - 9.1	6.5	6	5.0 - 9.9	7.3	6	4.4 - 8.3	6.3	6	4.2 - 8.1	6.3
pH	pH Units	6	7.3 - 7.70	7.6	6	7.3 - 7.70	7.6	6	7.3 - 7.60	7.6	6	7.5 - 7.90	7.6
Potassium	g/m³	3	16.3 - 16.5	16.5	3	16.3 - 17.1	16.5	3	15.7 - 16.1	15.9	3	15.9 - 16.4	16
Sodium	g/m³	3	22 - 23	22	3	23 - 24	23	3	32 - 34	32	3	33 - 35	34
Sulphate	g/m³	3	19.5 - 21.0	21.0	3	19.2 - 21.0	21.0	3	22 - 24.0	24.0	3	23 - 24.0	24.0
Sum of Anions	meq/L	3	3 - 3.2	3.1	3	3.1 - 3.2	3.2	3	3.5 - 3.6	3.6	3	3.5 - 3.7	3.7
Sum of Cations	meq/L	3	3.1 - 3.2	3.2	3	3.2 - 3.3	3.2	3	3.6 - 3.7	3.6	3	3.7 - 3.8	3.7
Temperature	°C	6	11.2 - 17.6	14.0	6	11.3 - 16.7	13.1	5	11.3 - 17.2	14.0	5	11.7 - 17.1	14.3
Total Kjeldahl nitrogen	g/m³-N	6	0.25 0.49	0.34	6	0.30 0.63	0.39	6	0.25 0.56	0.36	6	0.26 0.60	0.37
Total nitrogen	g/m³-N	6	5.1 9.4	6.8	6	5.6 10.2	7.7	6	5 8.6	6.6	6	4.8 8.4	6.7
Turbidity	FNU	6	3.2 - 8.9	4.8	6	4 - 12.4	9.1	6	6.4 - 13.2	10.3	6	3.4 - 13	9.1
Un-ionised ammonia	g/m³	6	0.00016 - 0.00046	0.00030	6	0.00011 - 0.00046	0.00032	6	0.00023 - 0.00036	0.00031	6	0.00026 - 0.00124	0.00051

Table 35 Summary of Motumate Stream water quality data from the Council surveys during the period November 2009 to April 2013 and September 2018-June 2022

Parameter	Unit	MTM000057			MTM000075			MTM000120			MTM000125		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m^3 as $CaCO_3$	17	51 - 97	62	18	53 - 99	64	18	60 - 96	79	18	63 - 103	83
Ammoniacal nitrogen	g/m^3-N	22	0.012 - 0.330	0.021	34	<0.010 - 7.26	0.035	34	0.012 - 2.90	0.037	29	<0.010 - 3.38	0.059
Bicarbonate	g/m^3 at 25°C	17	62 - 118	76	18	64 - 120	77	18	73 - 116	96	18	77 - 125	100
Biochemical oxygen demand 5day	g O_2/m^3	22	<0.4 - 10	0.7	40	<0.4 - 500	1.0	39	<0.4 - 13	1.2	28	<0.4 - 3.2	0.9
Calcium	g/m^3	17	20 - 24	22	18	21 - 25	21.5	18	15 - 23	21	18	20 - 24	21
Chloride	g/m^3	22	32.0 - 47	37	24	32 - 51	38	24	28 - 52	43	24	40 - 50	43
Conductivity @ 25'C	mS/m	22	31.2 - 40.0	35.1	40	31.7 - 68.2	40.3	40	27.0 - 68.2	40.3	29	37.7 - 51.9	43.0
Dissolved reactive phosphorus	g/m^3-P	22	0.016 - 0.66	0.037	31	0.018 - 0.154	0.045	31	0.019 - 0.380	0.039	28	0.016 - 0.163	0.032
Hardness Total	g/m^3 as $CaCO_3$	17	81 - 98	89	18	87 - 102	91.5	18	64 - 105	96	18	89 - 108	96
Magnesium	g/m^3	17	7.4 - 10.2	8.7	18	8.0 - 10.7	8.9	18	6.5 - 11.4	10	18	9.0 - 12	10.4
Nitrate nitrogen	g/m^3-N	17	2.5 - 7.7	5.4	18	2.2 - 9.0	7.4	18	1.45 - 8.40	5.5	18	1.38 - 8.20	5.25
Nitrite nitrogen	g/m^3-N	17	0.005 - 0.048	0.014	18	0.008 - 0.164	0.012	18	0.008 - 0.044	0.010	18	0.012 - 0.131	0.019
Nitrite/nitrate nitrogen	g/m^3-N	22	2.5 - 8.3	5.4	37	0.95 - 9.60	6.1	37	1.02 - 8.80	5.29	28	0.98 - 8.20	5.3
pH	pH Units	22	7.2 - 7.9	7.6	40	7.1 - 7.9	7.4	39	7.0 - 8.0	7.5	29	7.3 - 7.8	7.5
Potassium	g/m^3	17	13.5 - 28	15.4	18	13.5 - 17.8	15.7	18	7.9 - 18.1	15.0	18	13.5 - 20	15.7
Sodium	g/m^3	17	22 - 28	24	27	21.9 - 39	25.0	27	24 - 40.8	34.0	20	30 - 40	35.0
Sulphate	g/m^3	17	17.3 - 260	20.0	18	17.1 - 26	20.5	18	10.1 - 32	25.5	18	16.4 - 33	26.0
Sum of Anions	meq/L	17	2.9 - 3.9	3.1	18	3.0 - 4.1	3.3	18	2.5 - 4.0	3.7	18	3.3 - 4.3	3.8
Sum of Cations	meq/L	17	2.9 - 3.8	3.2	18	3.0 - 4.1	3.3	18	2.5 - 4.3	3.8	18	3.5 - 4.4	3.9
Temperature	°C	22	10.1 - 19.0	14.2	39	1.2 - 19.9	13.8	39	10.7 - 19.7	14.0	27	11.3 - 20.0	14.4
Total Kjeldahl nitrogen	g/m^3-N	11	0.27 0.58	0.37	12	0.24 0.75	0.40	12	0.20 0.72	0.45	12	0.20 0.75	0.38
Total nitrogen	g/m^3-N	11	3.3 8.6	7.1	12	3.8 9.1	7.9	12	3.1 75	5.9	12	2.8 7.6	5.7
Turbidity	NTU	22	4.1 - 92	8.0	33	4.0 - 100	10.1	32	4.2 - 36	9.4	28	2.0 - 18.9	8.4
Un-ionised ammonia	g/m^3	22	0.00008 - 0.0032	0.00022	30	0.00008 - 0.070	0.0004	30	0.00013 - 0.0341	0.00035	28	0.00021 - 0.0137	0.00062

2.1.7 Waiokura Stream surface water quality

Some spatial synoptic surface water monitoring was conducted at three sites on the Waiokura Stream adjacent to and downstream of the Company's farms (Figure 49, Table 36). This was carried out approximately bi-monthly.

Table 36 Description of the water quality monitoring sites in the Waiokura Stream

Site	Site code	Description	Map reference, NZTM	
			Easting	Northing
0	WKR000485	Waiokura Stream approx. 400 m u/s Skeet Road	1698819	5629373
1	WKR000500	Waiokura Stream at Skeet Road	1698807	5628892
2	WKR000630	Waiokura Stream 1.5 km, u/s of Hicks Road (~ 150m upstream of Farm 3's southern boundary)	1698126	5626926
3	WKR000650	Waiokura Stream at Hicks Road	1697735	5625026

These sites were chosen to monitor any possible effects on surface water from the spray irrigation of wastes on the Company's Farms 2 and 3. The results from the 2022-2023 monitoring period are presented in Table 38, and a summary of the monitoring previously performed is presented in Table 37.

Although the medians show little change between sites during the year under review (Table 38), the results for the 2022-2023 monitoring period again indicate subtle increases in most parameters, in particular conductivity and sodium, in the samples downstream of the control site (WKR000500) during each of the surveys. However, the changes observed are not significant enough to be considered an environmental effect. Nitrate nitrite-N concentration showed a seasonal fluctuation, varying from about 4.3 g/m^3 in winter/spring to 2.7 g/m^3 in summer/early autumn. There was again much less of a fluctuation than has observed in earlier years, and particularly in the 2016-2017 year (6.8 to 2.0 g/m^3). The median nitrate-N concentration for 2022-2023 at all three long established sites were similar to the respective long-term median values, as were the median sodium concentrations.

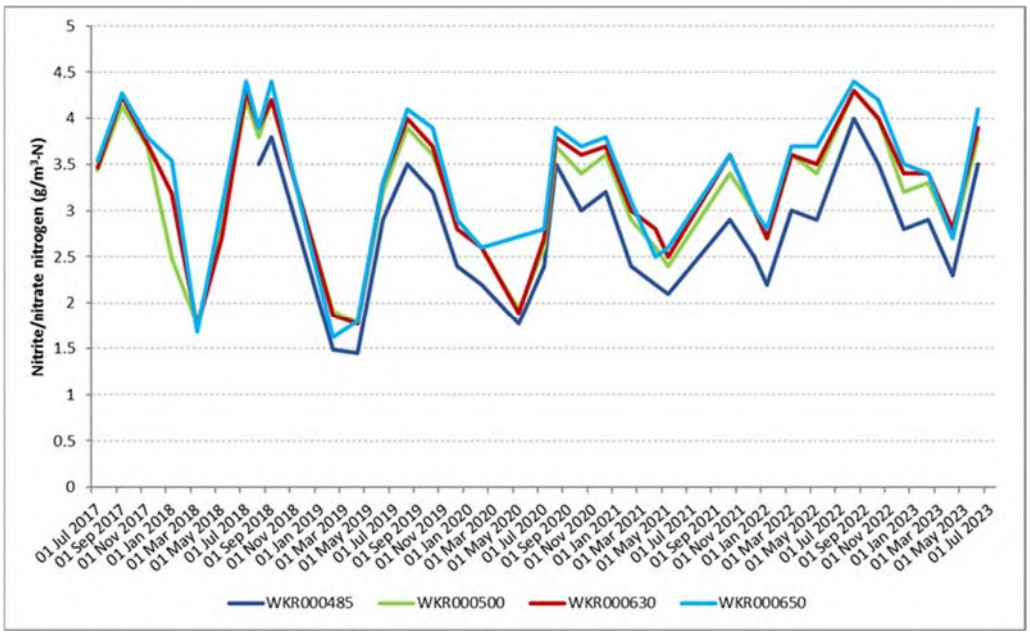

Figure 73 Nitrate/nitrite nitrogen concentrations in the Waiokura Stream July 2017 to date

Continued monitoring over future periods will provide further assessment of any possible environmental effects to surface water from the spray irrigation of wastewater on Farms 2 and 3.

Table 37 Summary of Waiokura Stream water quality data from the Council surveys during the period March 2001 to June 2022

Parameter	Unit	WKR000485			WKR000500			WKR000630			WKR000650		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Ammoniacal nitrogen	g/m^3-N	24	<0.010 - 0.4	<0.010	20	<0.010 - 0.520	0.016	24	<0.010 - 0.161	0.010	20	<0.010 - 0.123	0.010
Total BOD (5day)	g O_2/m^3	24	<0.4 - 3.0	<2	32	<0.4 - 12	1.4	31	<0.4 - 3.3	1.1	30	<0.4 - 3.4	1.1
Conductivity @ 25'C	mS/m	24	22.1 - 24.9	22.9	148	18.3 - 33.6	23.4	150	18.7 - 30.8	24.8	148	16.6 - 31.5	25.8
Dissolved reactive phosphorus	g/m^3-P	24	0.023 - 0.158	0.032	94	0.012 - 0.196	0.034	95	0.013 - 0.095	0.032	93	0.016 - 0.444	0.031
Nitrite/nitrate nitrogen	g/m^3-N	24	1.45 - 3.80	2.70	136	1.27 - 4.20	2.80	136	1.03 - 6.51	2.97	135	1.03 - 4.40	2.96
pH	pH Units	24	7.4 - 7.9	7.7	114	6.6 - 8.0	7.6	116	6.9 - 8.2	7.7	113	7.0 - 8.3	7.7
Sodium	g/m^3	24	16.6 - 22.0	19.1	146	14.8 - 25.4	19.5	147	9.4 - 24.9	21.4	145	13.9 - 62.4	22.5
Temperature	°C	23	9.6 - 17.8	13.2	144	7.1 - 18.5	12.4	151	8.3 - 20.5	12.7	149	8.1 - 20.2	12.7
Un-ionised ammonia	g/m^3	24	<0.00007 - 0.0037	0.00017	24	0.00005 - 0.0041	0.00021	24	0.00002 - 0.0021	0.00016	23	0.00004 - 0.0029	0.00017

Table 38 Results of Waiokura Stream quality sampling for the year under review

Parameter	Unit	WKR000485			WKR000500			WKR000630			WKR000650		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Ammoniacal nitrogen	g/m^3-N	6	<0.010 - 0.025	0.013	6	<0.010 - 0.023	0.017	6	<0.010 - 0.020	0.012	6	<0.010 - 0.015	0.012
Total BOD (5day)	g O_2/m^3	6	<0.4 - 1.2	0.7	6	<0.4 - 0.8	0.6	6	<0.4 - 1.1	0.6	6	<0.4 - 1.1	0.6
Conductivity @ 25'C	mS/m	6	21.8 - 26.0	23.0	6	22.6 - 26.5	23.7	6	25.2 - 27.8	26.4	6	25.2 - 27.8	26.4
Dissolved reactive phosphorus	g/m^3-P	6	0.023 - 0.057	0.031	6	0.024 - 0.057	0.032	6	0.021 - 0.060	0.029	6	0.026 - 0.055	0.029
Nitrite/nitrate nitrogen	g/m^3-N	6	2.3 - 4.0	3.2	6	2.7 - 4.3	3.6	6	2.8 - 4.3	3.7	6	2.7 - 4.4	3.8
pH	pH Units	6	7.3 - 7.8	7.7	6	7.2 - 7.8	7.7	6	7.3 - 7.9	7.8	6	7.3 - 8.0	7.8
Sodium	g/m^3	6	17.8 - 22.0	19.0	6	18.8 - 22.0	19.2	6	20 - 24	21.5	6	21 - 24	22.5
Temperature	°C	6	11.2 - 15.8	12.6	6	11.2 - 15.6	13.8	6	11.2 - 17.0	16.0	6	11.1 - 17.8	14.8
Turbidity	NTU	6	4.6 - 10.5	7.7	6	3.7 - 10.9	7.6	6	5.0 - 10.6	7.7	6	4.2 - 10.9	7.7
Un-ionised ammonia	g/m^3	6	<0.0001 - 0.00023	0.00017	6	<0.00009 - 0.0003	0.00017	6	<0.0001 - <0.0003	<0.0002	6	0.00007 - <0.0003	<0.0003

2.1.8 Biomonitoring

2.1.8.1 Fish passage temperature compliance in mixing zone

The Council installed and maintained two water temperature data loggers in the Kaupokonui Stream during the 1994-1995 monitoring period. These loggers were sited toward the left and right banks of the stream flow channel at the downstream periphery of the spray cooling water discharge zone. The purpose of these temperature recorders was to monitor compliance with condition 8 of consent 0919-3 and condition 9 of consent 0924-3 which require that these discharges shall not give rise to a thermal barrier preventing the movement of fish species within the designated mixing zone of the wastes with the Kaupokonui Stream.

The presence of a significant water temperature differential across the stream within the spray discharge zone was established during the temperature surveys of March 1993, March 1994 and January 1995. These surveys recognised that only a gradual rise in water temperature occurred toward the true right bank of the stream during spray cooling water discharges, and that this gradual increase would not be expected to present a thermal barrier preventing fish passage through the spray discharge or 150 m mixing zone of the stream. The across-stream temperature differences measured at the periphery of the spray zone were 9.5˚C, 3.7˚C, and 2.1˚C at the time of the 1993, 1994 and 1995 surveys respectively, although variation in disposal systems, weather, stream flow conditions and factory production contributed to these differences in results.

In January 2011, the Council stopped monitoring temperature differential across the width of the stream, after continuous monitoring (at 15-minute intervals with very occasional disruption) since August 1993. The record is depicted in Figure 74. The monitoring ceased for two reasons. First, there was an unacceptable risk to the safety of the personnel who climbed down the stream bank and waded to the monitoring sites. Secondly, while temperature measurement along the length of the mixing zone was continued by the Company, at the time it was considered that transverse monitoring was no longer considered necessary, as disruption to fish passage was not expected to occur. This was based on the fact that significant periods of cooler water conditions had been demonstrated towards the right bank of the stream and there was gradual mixing of the cooling water discharges with the receiving water. The assumption was made that the fish would make use of the cooler flow corridor close to the true right bank.

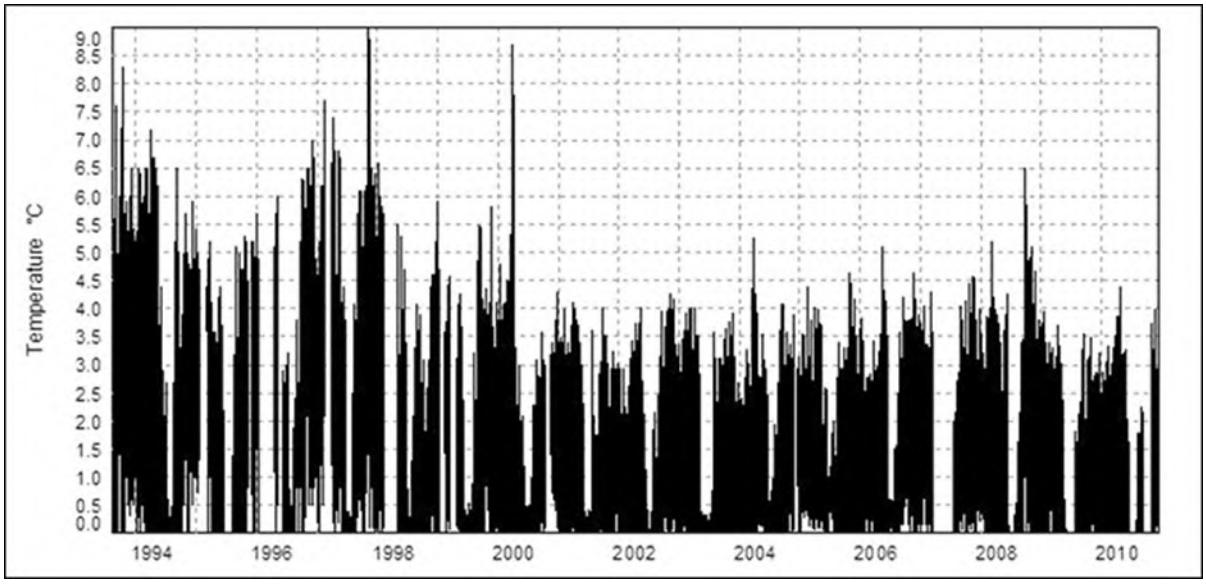

Figure 74 Kaupokonui Stream water temperature differential (LB-RB) records at the periphery of the Fonterra Ltd spray cooling water discharge zone, 1993-2010

It was requested that the current temperature conditions within the mixing zone and the validity of this assumption be investigated by the Company during the preparation of the AEE for the renewal of the cooling water discharge consent.

Work was undertaken by the Company and a report was submitted as part of the application, however it was noted that the temperature monitoring was carried out prior to the cooling water discharge temperatures reaching their maximum. The instream temperature differentials through the spray discharge area and mixing zone were measured during a period of time when the upstream temperatures in the Kaupokonui Stream were in the range 17.8˚C to 18.1˚C and the cooling water discharge temperatures were in the range of 30˚C to 32˚C. Although the report states that the cooling water discharge temperature was maximised (within operational constraints) during the survey, monitoring of the cooling water discharge temperature shows that the peak temperatures resulting from the operational changes (approximately 40˚C) were not reached until after the monitoring within this reach of the stream had been completed. As a result, the report cannot be considered representative of the worst case that may be found under normal operating conditions.

After the cross stream temperature monitoring was ceased, a programme of (triennial) fish monitoring was instituted, to assess both the influence of the cooling water discharge on fish passage, and the effectiveness of the fish pass at the water abstraction weir about 100 metres upstream. Surveys were undertaken in 2014, 2017 and 2020. The monitoring schedule was revised after the Glenn Road weir was removed in the 2020-2021 year. Surveys are now scheduled on an annual basis while the changes in the fish communities stabilise following the removal of the Glenn Road weir.

Kaupokonui Stream flow records for the monitoring period for the Upper Glenn Road recording station are presented in Figure 75.

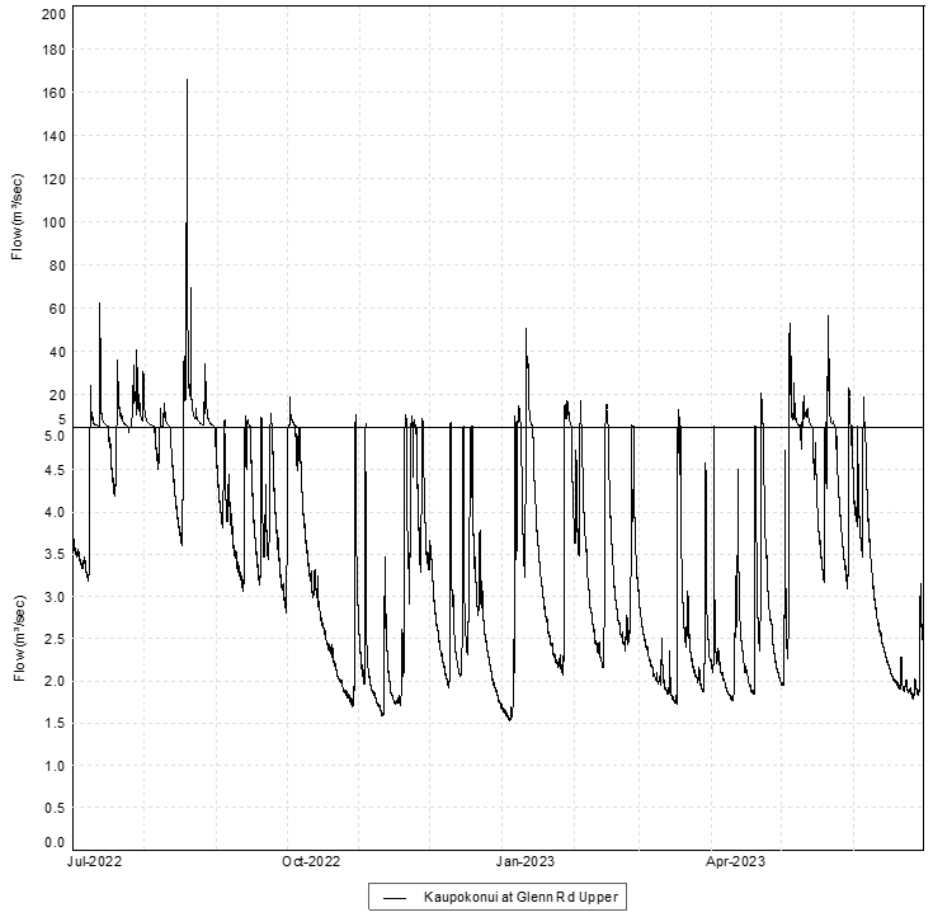

Figure 75 Kaupokonui Stream at Upper Glenn Road flow record (m^3/s) for the year under review

2.1.8.2 Lower stream water temperatures

Two additional water temperature data loggers remained in place in the lower reaches of the Kaupokonui Stream for the duration of the year under review period to provide ambient stream temperature data over the 14 km reach downstream of the factory to the coast. These loggers are sited in the stream at Upper Glenn Road, about 9.8 km downstream of the lactose plant discharge, and above the tidal influence, approximately 1.4 km upstream of the stream mouth. The loggers were installed in July 1999, with the agreement of the Company, in response to concerns expressed by submitters to consents 0919-3 and 0924-3 to discharge cooling water from the lactose plant. The original location of the Upper Glenn Road monitoring site was at the Glenn Road weir. Due to the removal of the Glenn Road weir, a new monitoring location was established in the 2020-2021 year that is approximately 500 metres upstream of the original Glenn Road temperature monitoring site.

Water temperature records for these two sites are illustrated in Figure 76 and Figure 77.

A monthly summary of these data is included in Table 39.

Stream temperatures continued to be relatively high during the year under review, with the maximum temperatures at Upper Glenn Road was 26.3˚C on 29 December 2022 and 25.1˚C at the beach, also on 29 December 2022.

On this day the maximum instream temperatures upstream and downstream of the Company's site were 22.6 and 22.9 ˚C respectively. The maximum temperature differential recorded between these two monitoring sites on 29 January 2022 was 0.9˚C, more than 5 hours earlier, when the cooling water discharge temperature was approximately 37˚C.

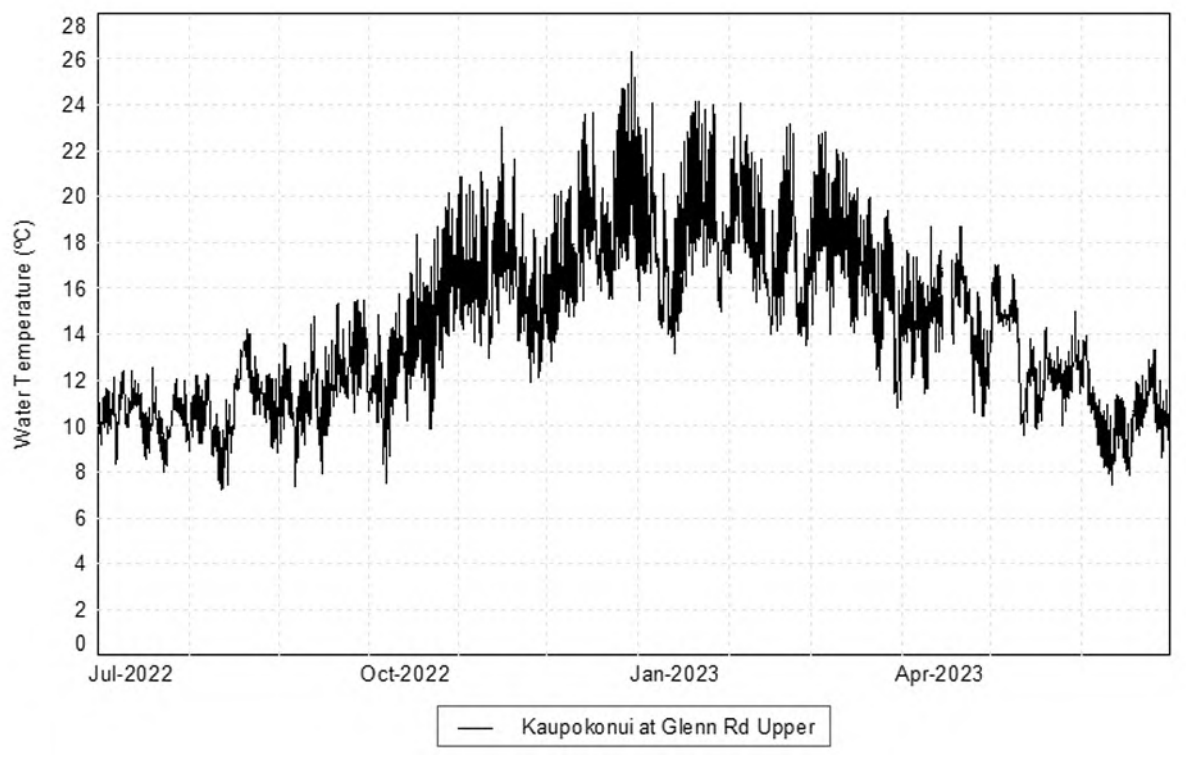

Figure 76 Water temperature (°C) records for the Kaupokonui Stream at Upper Glenn Road during the year under review

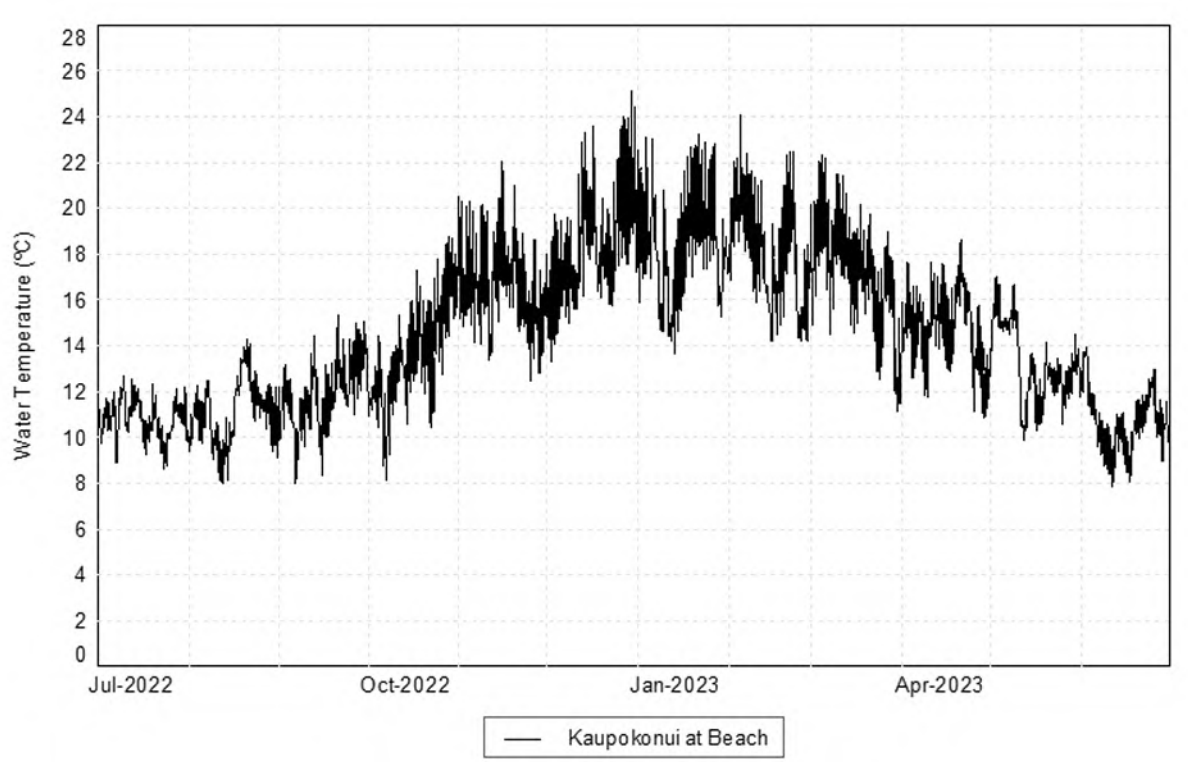

Figure 77 Water temperature (°C) records for the Kaupokonui Stream at the beach during the year under review

Table 39 Monthly Kaupokonui Stream water temperature data for Upper Glenn Road and the coast during the year under review

Site	Upper Glenn Road			Near Coast		
	Min	Max	Mean	Min	Max	Mean
Jul 22	8.0	12.5	10.5	8.6	12.7	10.8
Aug 22	7.2	14.2	10.8	8.0	14.3	11.1
Sep 22	7.3	15.5	11.8	8.0	15.4	11.9
Oct 22	7.5	20.2	13.7	8.1	20.5	13.7
Nov 22	11.9	23.1	16.3	12.5	22.1	16.6
Dec 22	12.8	26.3	18.4	13.3	25.1	18.5
Jan 23	13.2	24.2	18.3	13.7	23.3	18.4
Feb 23	13.5	24.1	17.9	14.2	24.0	18.2
Mar 23	10.8	22.8	17.0	11.1	22.4	17.1
Apr 23	10.4	18.7	14.6	10.8	18.7	14.8
May 23	9.6	17.1	13.0	9.8	17.0	13.2
Jun 23	7.4	13.9	10.4	7.8	14.0	10.7

Key missing data due to loss of the logger

An analysis of the stream water temperature data for each site over the year under review indicated that 20˚C, above which trout start to become stressed, was exceeded for approximately 8% of the year at both Upper Glenn Road and near the mouth. During the warmer months of November to March, the

temperatures exceeded 20˚C for approximately 20% of the time at Glenn Road and 21% of the time at the coast. This is a reduction in the amount of time at both sites when compared to the previous year.

The highest temperature recorded in the lower Kaupokonui River is 29.0°C, at Glenn Road on 9 January 1994 at 1500 NZST.

Instream temperatures continue to increase beyond the periphery of the mixing zone. It is not clear whether the increase in stream temperature due to the lactose plant's cooling water discharge introducing a step change that is cumulative, or whether stream temperatures below the lactose plant drop back to the upstream temperatures before natural heat fluxes take effect, and whether the reduction in flow due to water consumption at the plant contributes to this in any way. This will be a matter for further consideration during the processing of the replacement consent applications.

2.1.8.3 Evaluation of fish passage

An assessment of the effectiveness of the fishpass on the Kaupokonui Stream weir at the Company's plant (Consent 0302-3) was performed by Council staff using night spotting techniques at six sites in the Kaupokonui Stream in April 1999. These results were reported in the 1998-1999 Annual Report by Council (TRC 1999), which contained a recommendation for further fish investigations in the Kaupokonui Stream upstream of the Company's weir. The purpose of the proposed investigations was to determine the upstream extent of red-finned bully migration within the stream. This information was required to determine whether or not passage for native fish needed to be specifically addressed in the design of a replacement fish pass. However, fish data recorded in the lower section of the Kaupokonui Stream in October 1999 demonstrated that passage for native fish needed to be given specific consideration in the design of a new fish pass.

Further investigations were undertaken in the 2000-2001, along with consultation with Fish and Game. It was agreed that the construction of a new fish pass was needed at this weir to enable the passage trout and native species. Although torrent fish had been recorded in the lower section of the Kaupokonui Stream, they were not able to negotiate the hydrological control weir in the Kaupokonui Stream at Glenn Road.

A report dated May 2001 prepared by Charles Mitchell and Associates was forwarded to the Council. This report outlined two possible options for upgrading fish passage past the weir. In November 2001, the Company advised the Council of the proposed works to construct the fish pass. The Council advised that it was appropriate to undertake the works in accordance with the conditions of consent 4623, and that no change to the consent was required.

Construction of the fish pass was subsequently completed in late March 2004, and the pass was commissioned in early April 2004. Council and Fish and Game Taranaki assisted with the construction, particularly the placement of rocks within the pass. Visual inspections have indicated the pass is functioning well, and trout have been observed immediately upstream that may have used the pass. However, in November 2010, during a routine biomonitoring survey, it was noted that a cut-out had formed in the side of the lower section of the pass, through which a significant amount of the water flow was escaping. Repairs to the upper and central sections were made in May 2013. Further work on the bottom section was carried out in summer 2013-2014.

To interpret the results of a fish passage survey correctly, it is important to be aware of other barriers to fish passage downstream of the site being surveyed. Located downstream of the Kapuni Lactose factory, there was a weir known locally as the Glenn Road weir. This weir was an orphaned structure which presented a significant barrier to the passage of most fish, but was considered to have some historical significance, and therefore it had been allowed to persist. Only the best climbing species had been able to negotiate the Glenn Road weir. As a result, it was extremely unlikely that swimming species, such as common smelt, inanga, and torrentfish were able to reach the Kaupokonui Stream near the lactose factory. Climbing species were also adversely effected by this structure as was seen in 2020 when 100+ adult lamprey were found

dead surrounding the structure after failing to navigate the weir. This means that the Kapuni Lactose weir fish pass has never properly been assessed for provision of passage for swimming species, or for the full natural extent in terms of abundance for climbing species. The Glenn Road weir was removed during the summer of 2021.

Following the removal of the Glenn Road weir, the weir at Kapuni Lactose has become the first known barrier to fish passage in the catchment. However, there may be some natural barriers or behavioural restrictions that could influence fish species reaching the Kapuni Lactose weir. It is now necessary for the fish pass to be assessed and maintained at a high standard to ensure swimming and climbing species have access to the catchment upstream of the Kapuni Lactose weir. Because most swimming species have likely been excluded from the catchment since the installation of the Glenn Road weir, it is expected that the fish community of the entire Kaupokonui catchment upstream of the Glenn Road weir will drastically (but not immediately) change now that the weir has been removed. This means that swimming species, other than trout, may attempt to navigate the Kapuni Lactose weir, likely for the first time in many decades. This will require a more comprehensive assessment of the weir's fish pass.

A visual inspection of the weir during the March 2020 fish survey noted that there were areas of improvement that needed to be undertaken to ensure a higher proportion of successful fish passage attempts is achieved across all species. However, it was also noted that further improvements are also likely to be needed following the removal of the Glenn Road weir to accommodate swimming species that were not previously able to reach the Company's weir.

At the time of the 2020-2021 Annual Report, it was considered appropriate that any remedial work be delayed until the Glenn Road weir had been removed and passage reassessed in subsequent years so that premature remedial actions are not made. By this slight delay of significant works, it can be ensured that any modifications address issues for different fish communities.

Trout were observed above the weir at the time of some of the routine compliance monitoring inspections during the year under review.

2.1.8.4 Fish survey

A four-site fish survey was undertaken in the Kaupokonui Stream over two days (16 February and 30 March 2023), in order to determine whether the activities of the Kapuni Lactose factory had had any impact on the fish communities of this stream. The fish communities were surveyed using the electric fishing technique, with all fish counted and identified where possible. The sites monitored are described in Table 40 and shown in Figure 78.

Table 40 Location and description of fish monitoring sites in relation to the Kapuni Lactose factory

Site	Site code	Site description	Grid reference	Distance to coast (km)	Approximate Altitude (m)
1	KPK000652	4.3 km upstream of intake weir	E1698130 N5632654	19.68	170
2	KPK000666	Between intake weir and cooling water discharge	E1697744 N5629658	15.5	160
3	KPK000677	Downstream of cooling water discharge	E1697644 N5629458	15.3	160
4	KPK000685	Skeet Rd	E1697221 N5628986	14.51	150

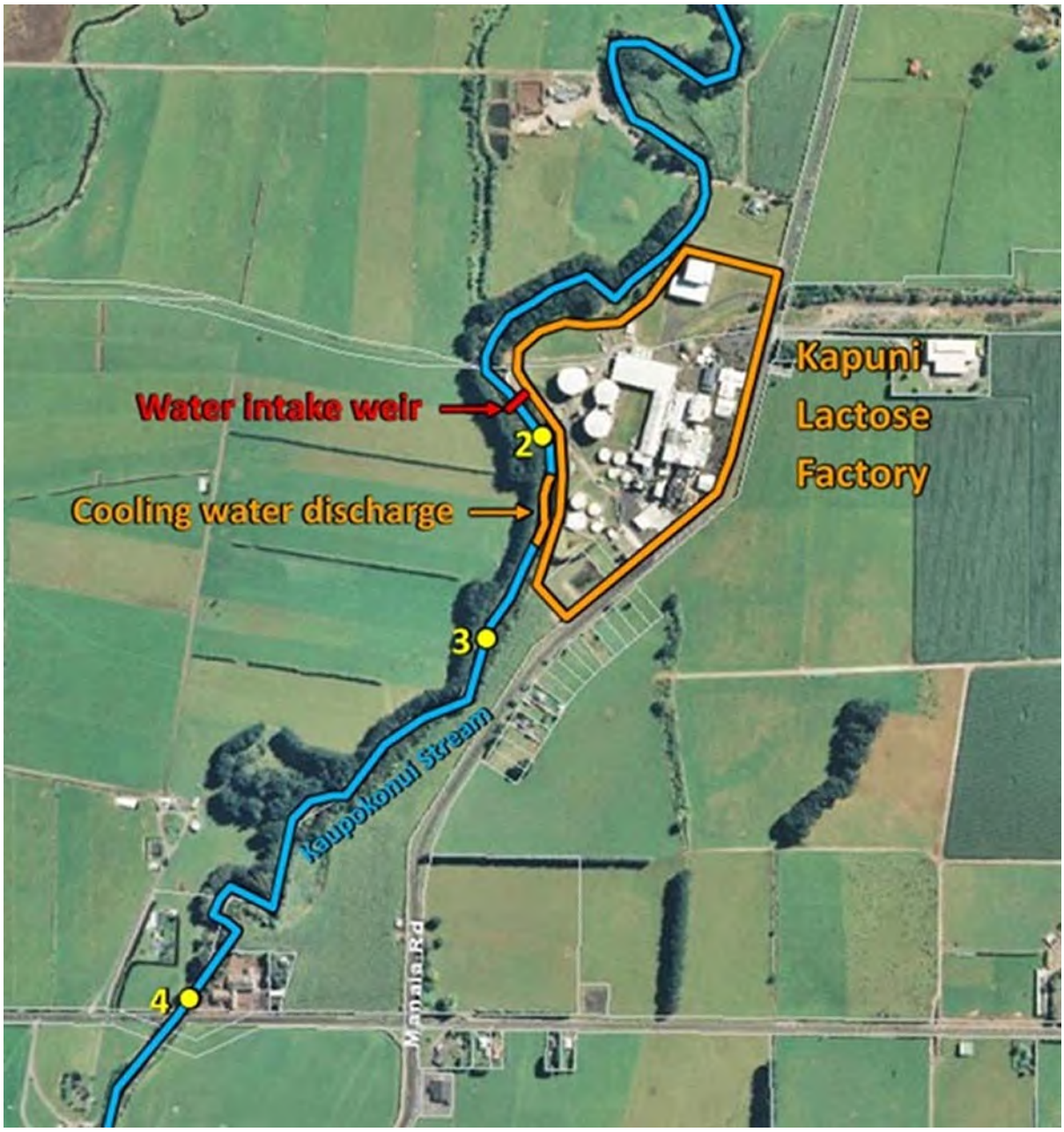

Figure 78 Fish monitoring sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory. Site 1 is located approximately 4.3 km upstream of the weir

The two main activities that could potentially impact on the fish communities are the discharge of cooling water to the Kaupokonui Stream and the water intake weir, located just upstream of the cooling water discharge. In addition, it should be noted that in February 2021 the Glenn Road weir was removed several kilometres downstream of the factory. This structure had previously been a known fish passage barrier.

A total of three fish species were recorded during the survey, being longfin eel, shortfin eel and redfin bully. Koura were also counted during the survey.

Upstream of the Kapuni Lactose weir, longfin eel were the only species recorded, indicating that the weir does not pose a significant barrier to fish passage for climbing species such as eels. The removal of the Glenn Road weir in 2021 has resulted in the detection of a singular inanga in the previous 2022 survey, located downstream of the weir, and is expected to result in further species gaining access to this section of river. Although no additional species were recorded in the current survey, future monitoring would expect to see an increase in species diversity below the weir. The ability for the current fish pass to provide access for

additional species will need to be assessed in future surveys as they begin to appear downstream of it. While no rainbow or brown trout were recorded in the survey, 2-3 rainbow trout were observed immediately above the weir outside of the survey area. The overall low abundance of fish in the current survey is believed to be due to flood events occurring during February and March prior to monitoring and relatively high flows during the survey.

While the fish pass is clearly navigable by the climbing species present in this area of the stream, there will likely need to be some improvement to the weir to allow easy fish passage to swimming species, and perhaps some improvement to increase the utilisation of the ramp by climbing species. It was noted that the weir has a large amount of attractant flow that could lead fish to the base of the weir which may result in the delay or failure of upstream passage. This could eventually lead to predation or mortality by movement to land as has been observed at a number of other similar structures. The face of the weir is not conducive to fish passage due to an overhanging perch and sharp edges. Additionally, the weir is leaking from the underside and true right side of the weir, which may further encourage fish to linger at the base of the weir. The fish pass is somewhat shallow, which would prove challenging to navigate for larger fish. The top of the fish pass is unprotected and will prove difficult for smaller fish exiting the fish pass to avoid predation. Large trout were observed loitering at the top of the fish pass, suggesting that it may be a frequent feeding spot which has been seen to occur at a number of similar structures. Addition of some form of exit cover would be beneficial in aiding smaller fish in avoiding predation while exiting the fish pass.

Overall, these survey results appear to show that the activities of the Kapuni Lactose factory are not currently significantly adversely affecting the fish communities of the Kaupokonui Stream. However, it is expected that complete fish passage is not being provided for, and that in general these survey results are unlikely to effectively portray these issues due to the survey methodologies limitations. As the riparian planting of the catchment matures, and effects of the passage remediation works at the Glenn Road weir become evident, the diversity and abundance of fish in this stretch of stream will likely improve. A more comprehensive assessment of the weir and thermal effects of the cooling operation will be required as the stream values increase. The recommendation of increasing monitoring of fish communities from every three years to every year is currently underway in order to detect expected changes. It is worthwhile delaying any remedial works until further information can be collected with respect to the changing fish community from the removal of the weir which would be used to inform remediation options. However, it is also important to recognise that there is a possibility of potentially significant effects through the lack of fish passage and thermal effects, so remediation may need to be undertaken promptly to ensure compliance. General maintenance of the current fish pass (replacing loose or missing rocks, ensure base is not undercut, surface kept clear of debris etc.) should be carried out in the meantime.

2.1.8.5 Macroinvertebrate surveys

Macroinvertebrate surveys were carried out on 7 December 2022 and 14 March 2023 in the Kaupokonui Stream, Dunns Creek and the Waiokura Stream in relation to the Company's activities. The surveys were carried out to examine the effects of the Company's consented discharges to the Kaupokonui Stream and discharges to land on the Company's two farms that are in the vicinity of these water bodies.

The Waiokura Stream sampling was expanded to include three site at the time of the February 2021 survey, as per the recommendations of the 2019-2020 Annual Report, with the survey being carried out in spring as well as summer for the first time in the 2021-2022 year.

Biomonitoring in Dunns Creek commenced in the 2021-2022 year to monitor the potential impacts of the Company's irrigation to land on Farm 1 as per the recommendations of the 2020-2021 Annual Report.

Macroinvertebrates were identified and number of different types of taxa counted (taxa richness), macroinvertebrate community index (MCI) and semi-quantitative macroinvertebrate community index (SQMCI) scores were calculated for each site. The sites monitored are described in Table 41 and shown in

Figure 79. Samples were sorted and identified to provide the number of taxa (richness), MCI and $SQMCI_s$ scores for each site. The report summaries are provided below. Copies of the full reports are available from the Council upon request.

Table 41 Biomonitoring sites in the Kaupokonui and Waiokura streams sampled in relation to Fonterra Kapuni

River	Site number	Site code	Grid reference (NZTM)	Location
Kaupokonui Stream	3b	KPK000655	E1697963 N5630770	1 km u/s of railway bridge
	4	KPK000660	E1697613 N5629791	Railway, above factory
	5	KPK000679	E1697607 N5629399	160 m below cooling water discharge zone
	6	KPK000685	E1697221 N5628986	Skeet Road
Dunn's Creek	D1	DNN000250	E1697261 N5630470	Immediately U/S Fonterra Farm 1
	D2	DNN000290	E1697044 N5629858	U/S railway bridge
Waiokura Stream	U	WKR000500	E1698807 N5628892	Skeet Road
	I	WKR000640	E1697979 N5626757	Immediately D/S Fonterra Farm 3 boundary
	D	WKR000650	E1697735 N5625026	At Hicks (Thomas) Road

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. It may be used in soft-bottomed streams to detect trends over time. The $SQMCI_s$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored and enable the overall health of the macroinvertebrate communities to be determined.

Previous surveys had recorded a substantial decline in macroinvertebrate health at site 7 in the Kaupokonui Stream. This site is a substantial distance downstream of the other monitored sites and the Company's activities. The decline has been attributed to both the influence of Dunn's Creek (a major tributary of the Kaupokonui), which was thought to have had poor water quality, and the progressive deterioration often observed in a downstream direction due to cumulative land use pressures. Consequently, this site was removed from the biomonitoring programme and two new sites established in Dunn's Creek. These sites are at the upstream and downstream boundaries of the Farm 1 irrigation area within this catchment. Monitoring at these sites will provide a better reflection of activities taking place on the Company's farm and irrigation area, than the Kaupokonui Stream site downstream of the Dunn's Creek confluence.

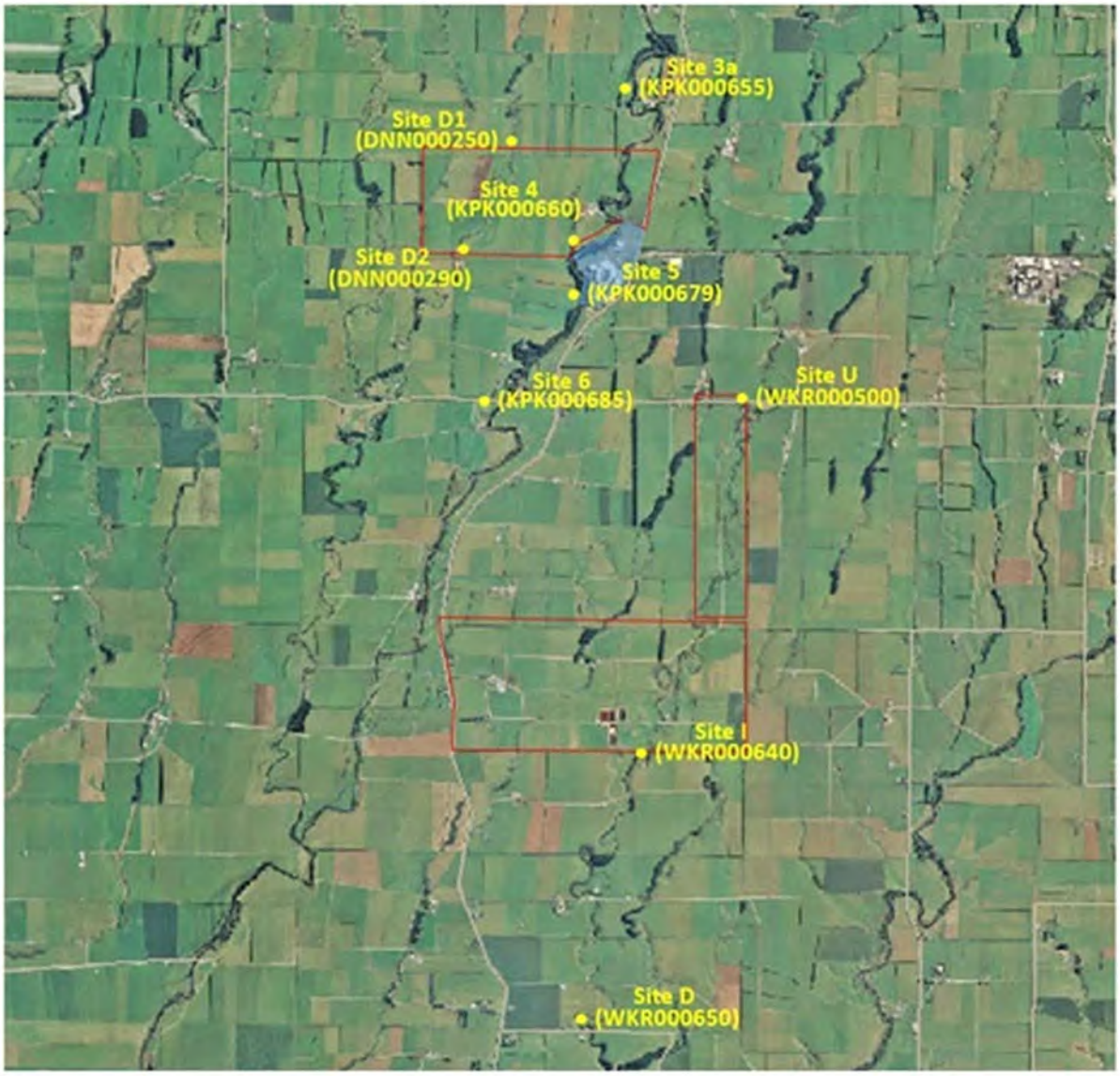

Figure 79 Biomonitoring sites in the Kaupokonui River sampled in relation to the Company's factory discharges

Kaupokonui Stream

A macroinvertebrate survey was carried out in the Kaupokonui Stream, Dunn's Creek (Figure 80) and the Waiokura Stream (Figure 81) in relation to the Fonterra Kapuni farms and factory to examine the effects of discharges to the stream and to land in the vicinity of the streams. This survey was the first of two scheduled surveys for the 2022-2023 monitoring year. Macroinvertebrates were identified and number of different types of taxa counted (taxa richness), macroinvertebrate community index (MCI) and semi-quantitative macroinvertebrate community index (SQMCI) scores were calculated for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of nutrient pollution in streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to pollution. The SQMCI takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities. Significant differences in either the MCI or SQMCI between sites indicate the degree of adverse effects (if any) of the discharges being monitored and enable the overall health of the macroinvertebrate communities to be determined.

Kaupokonui Stream

In the December 2022 survey, the four sampling sites in the Kaupokonui Stream supported taxa richness of between 17 to 19 taxa. These results are similar to that recorded in the previous survey, however all four sites recorded lower than their respective medians. MCI scores ranged from 102 to 127 units in the current survey. Site 5 recorded a MCI score that was significantly less than that recorded at site 4, but was similar to that recorded at site 3b. Site 6 recorded a MCI score significantly lower than all upstream sites scores. Site 4 and 5 recorded MCI scores significantly higher than their site medians. SQMCI scores ranged from 6.3 to 7.4 units. All four sites recorded SQMCI scores higher than that recorded in the previous survey. They were also higher than their respective medians with significant differences found at sites 3b, 5, and 6. Site 5 recorded a SQMCI score significantly more than both sites 4 and 6.

In the March 2023 survey, the four sampling sites in the Kaupokonui Stream supported taxa richness of between 18 to 20 taxa. These results are similar to that recorded previously, however all four sites recorded lower than their respective medians. MCI scores ranged from 107-127 units in the current survey. Site 4 recorded an MCI score significantly higher than the remaining Kaupokonui Stream sites.. The downstream sites 5 and 6 recorded a score similar to that recorded at site 3b but significantly lower than site 4.. There were no statistically significant differences between the current results and those recorded in the previous survey for any of the four sites. SQMCI scores ranged from 5.5-7.8 units. Site 6 recorded a score significantly lower than the three upstream sites. Site 4 recorded a significantly higher score than that recorded in the previous survey, while site 6 recorded significantly lower score. The SQMCI scores recorded at sites 3b, 4, and 5 were significantly higher than their respective site medians, while the site 6 score was higher, but not significantly.

Dunns Creek

A lower taxa richness of 15 was recorded at both sites in Dunn's Creek at the time of the December 2022 survey. This richness was less than that recorded in the previous survey for these sites, and is also less than that recorded at the four sites in the main stem of the Kaupokonui River in the same survey. Overall, the habitat was relatively similar between the Dunn's Creek and Kaupokonui Streams, although there were slightly warmer temperatures and smaller substrates in Dunn's Creek, which is a more favourable environment for 'tolerant' taxa. Nonetheless, comparison between these two nearby waterbodies in the same catchment provides context for the interpretation of the results from these new sites.

With respect to Dunn's Creek, a low taxa richness of 17 and 16 taxa was recorded at sites D1 and D2 respectively in the March 2023 survey. This richness was less than that recorded at sites in the main stem of the Kaupokonui Stream in the same survey. These scores were higher than that recorded in the previous survey, but lower than the respective site medians. MCI scores of 116 MCI units and 114 units were recorded at sites D1 and D2 respectively. The MCI scores recorded were more than that recorded in the previous survey, although not significantly and were the highest recoded for both sites to date. However, both sites recorded MCI scores significantly more than the respective site medians. The SQMCI scores recorded in Dunn's Creek were relatively high, being the highest recorded at these sites to date. Overall, the habitat was relatively similar between the Dunn's Creek and Kaupokonui Streams, although there was slightly warmer temperatures and smaller substrates at Dunn's Creek, which is a more favourable environment for 'tolerant' taxa. Nonetheless, comparison between these two nearby waterbodies in the same catchment provides context for the interpretation of the results from these new sites.

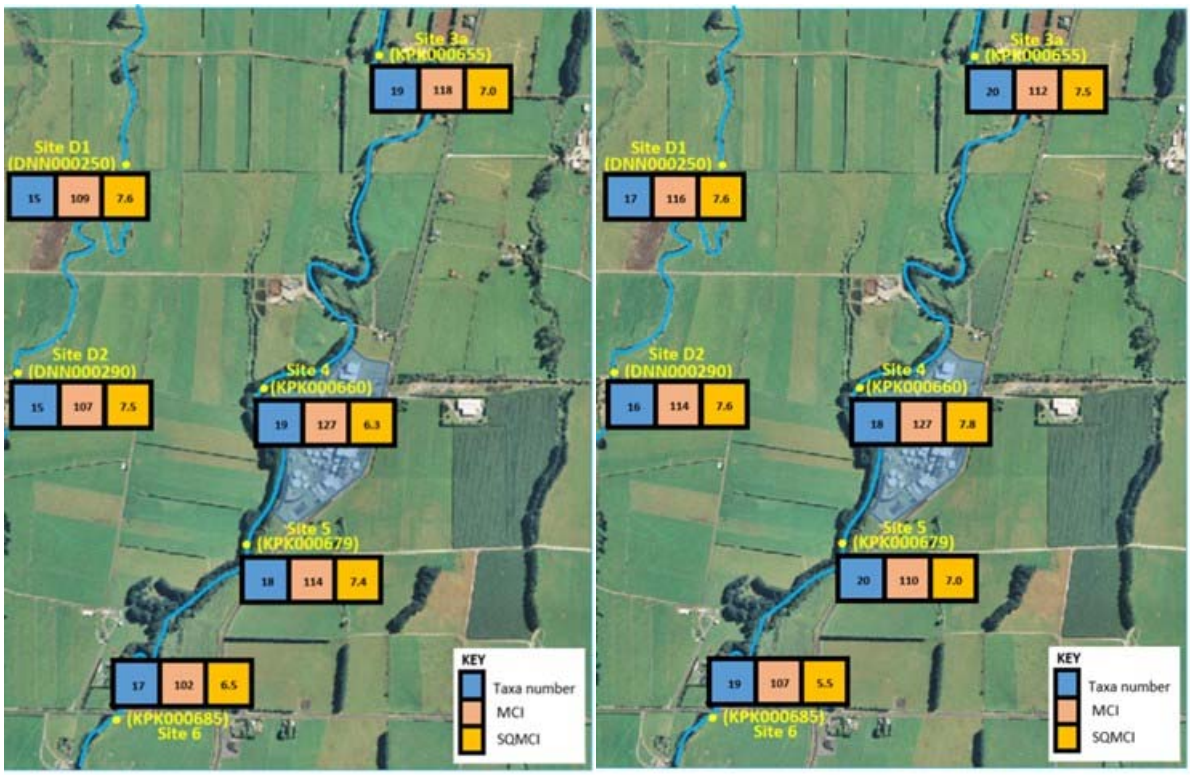

Figure 80 Macroinvertebrate indices recorded in the Kaupokonui Stream and Dunn's Creek on 7 December 2022 and 14 March 2023

Waiokura Stream

The Waiokura Stream recorded a low to moderate taxa richness ranging between 16 and 21 taxa at the three sites at the time of the December 2022 survey. All sites recorded a richness less than both the respective site medians and that recorded in the preceding survey. MCI scores ranged between 92-106 units. Sites I and D both recorded an MCI score significantly less than Site U upstream. All sites recorded scores similar to that recorded in the previous survey. SQMCI scores ranged between 4.8 and 6.6 units. Like the MCI scores, both sites I and D recorded an SQMCI score significantly less than the upstream Site U.

At the time of the March 2023 survey the Waiokura Stream recorded a low to moderate taxa richness ranging between 17-18 taxa at the three sites. All sites recorded less than their respective site medians. MCI scores ranged between 89-109 units. When compared to the previous survey, sites U and D recorded similar scores, while site I recorded a significantly higher score. All sites recorded scores similar to their respective site medians. SQMCI scores ranged between 5.3-6.4 units. The SQMCI scores were similar to those recorded in the previous survey as well as the respective site medians.

Summary

The findings of the November 2022 survey were that the results of some macroinvertebrate indices indicated a greater than expected deterioration of macroinvertebrate community health in the Kaupokonui Stream, Dunn's Creek, and Waiokura Stream. However, there is no strong evidence to support that the impacts of wastewater irrigation to land are causing this deterioration in stream health. This survey did not record the presence of heterotrophic growths, supporting a lack of impacts from the cooling water discharge.

Overall, at the time of the March 2023 survey there was no evidence that the irrigation of wastewater to land had caused any deterioration in the health of the macroinvertebrate communities of the Kaupokonui Stream, Dunn's Creek, or Waiokura Stream. The current survey did not record the presence of heterotrophic growths, supporting a lack of impacts from the cooling water discharge.

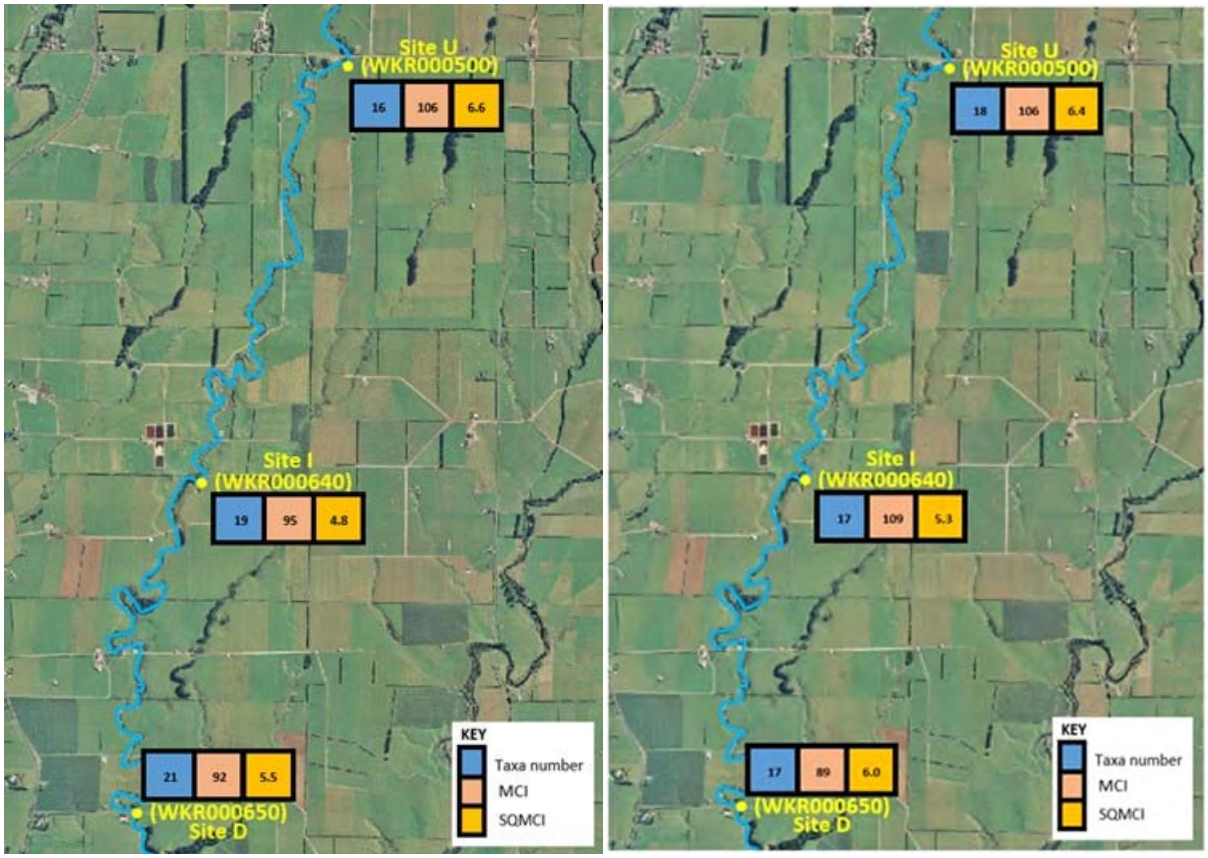

Figure 81 Macroinvertebrate indices recorded in the Waiokura Stream on 7 December 2022 and 14 March 2023

Both survey reports commented that, additionally, in both Dunn's Creek and the Waiokura Stream, there is a significant distance between monitoring sites with no direct discharges to water. While the irrigation of factory waste occurs throughout this area, farming activities may also contribute towards cumulative effects on stream communities. Therefore, should adverse impacts on the macroinvertebrate communities be detected in future surveys, further investigation would be required to positively ascertain whether these impacts can be directly attributed to the consented activities.

2.2 Air

Officers of the Council carried out inspections in relation to air emissions, of the Kapuni lactose plant, during the year under review.

From an air emissions perspective, the plant appeared to be well managed and well maintained, with a high standard of housekeeping observed at the time of each inspection. During each inspection a survey of the site boundary and the surrounding neighbourhood was carried out for odours and lactose powder fallout. No evidence of any lactose powder fallout was found during any of these surveys. No objectionable odours or visible emissions were noted beyond the site boundary during any of the inspections, with only on-site odours noted on occasion during inspections. On 26 May it was noted that there was a distinct lactose odour that was detectable only around the immediate perimeter of the wastewater tank.

2.2.1 Emission monitoring

A wet scrubber system was commissioned by the Company in October 1998. The wet scrubber system links the exhaust streams from the flash drier (pre-drier) stack and the refined fluid bed drier, with this emission source then referred to as the flash drier. Continuous particulate meters have also been installed by the

Company to give a real time indication of the powder emissions from each drier. These meters are indicators only, but do provide a warning to operators that the discharge levels have increased, enabling this to be responded to.

Table 42 is included for comparison of results prior to the installation of the wet scrubber system.

Table 42 Summary of the refined and pre-drier emission testing results prior to the installation of the wet scrubber (October 1998)

Stack	Date	Emission (mg/m^3)
Refined drier	26 November 1997	515
Refined drier	10 December 1997	215
Pre-drier	8 December 1999	158
Refined drier	21 January 1998	567

Isokinetic stack sampling and analysis of the exhaust from the flash drier stack for particulates was conducted on 11 October 2022 by Verum Group, using USEPA method 17.

The current consent does not contain any conditions specifying the methodology and reporting requirements for the stack testing required to confirm compliance with particulate emission rate limit. This will be addressed as a matter of course in the replacement consent.

The result is presented in Table 43 below, along with previous averaged CRL and Council results since 1998.

Table 43 Summary of isokinetic stack analysis of the flash drier (pre-drier) for 1998-2023

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Emission (mg/dsm^3)*	Comments
5 November 1998	-	-	<10	No visible emissions noticed
25 February 1999	-	-	<10	No visible emissions noticed
4 May 1999	-	-	<10	No visible emissions noticed
9 May 2000	-	-	<10	No visible emissions noticed
27 October 2000	-	-	<10	No visible emissions noticed
30 November 2000	-	-	21	No visible emissions noticed
29 November 2001	-	-	<10	No visible emissions noticed
21 January 2009	-	-	58	
6 February 2010	-	-	53	
20 January 2011	-	-	18	Mass emission rate 0.7 kg/hr
11 January 2012	-	-	67	Mass emission rate 3.0 kg/hr
9 January 2013	-	-	27	Mass emission rate 1.3 kg/hr
11 December 2013	-	-	18	Mass emission rate 0.9 kg/hr
17 December 2014	-	-	23	Mass emission rate 1.2 kg/hr
11 November 2015	-	-	18	Mass emission rate 0.9 kg/hr
21 September 2016	5.4	44891	17	Mass emission rate 0.8 kg/hr
25 October 2017	Not provided	46229	17.1	Mass emission rate 0.8 kg/hr

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Emission (mg/dsm^3)*	Comments
21 September 2018	Not provided	44408 to 45407	1.2	Mass emission rate 1.2 kg/hr
29 October 2019	Not provided	43305 to 44457	30	Mass emission rate 1.3 kg/hr
30 October 2020	Not provided	42383 to 45956	29	Mass emission rate 1.3 kg/hr
8 December 2021	Not provided	46636 to 48323	24	Mass emission rate 1.15 kg/hr
11 October 2022	Not provided	46517 to 46716	29	Mass emission rate 1.34 kg/hr

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas

The emission monitoring performed after the installation and commissioning of the wet scrubber system clearly shows the success of the wet scrubber in abating powder emissions from the refined drier and pre-drier at the lactose plant. In view of the consistently low particulate emissions, Council in 2002 stopped emission monitoring but continued the ambient deposition monitoring and inspections. The Company instituted its own emission testing in 2009, as part of product loss monitoring.

The consent limit for emissions from the wet scrubber system is 125 mg/m^3 of gas, adjusted to 0˚C, 1 atmosphere pressure and calculated as dry gas. Prior to the consent renewal (7 April 2000) the discharge limit was 250 mg/m^3 of gas, adjusted to 0˚C, 1 atmosphere pressure and calculated as dry gas.

The results obtained in October 2022 were again well below consent limits.

The Company commenced voluntary particulate emissions monitoring of the other three emission sources on site in 2016. The results are presented in Table 44, Table 45 and Table 46. There are currently no consent limits on these sources, however the renewed consent is likely to contain particulate emissions limits for each of these stacks. The average particulate emission rates for the small drier and the supertab north drier were below the 125 mg/m^3 limit that applies to the flash drier during the year under review, however the supertab south drier was above 125 mg/m^3. The Company is undertaking voluntary investigations into the elevated particulate emission rates from this source.

Table 44 Summary of isokinetic stack analysis of small drier, commenced in 2016

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Particulate emission (mg/dsm^3)*	Particulate emission rate (kg/hr)
21 September 2016[a]	2.5	26428	66	1.8
25 October 2017[b]	Not provided	23478	70.3	1.65
21 September 2018[c]	Not provided	22992 to 23635	104	2.4
29 October 2019[c]	Not provided	23054 to 24397	56	1.3
30 October 2020[c]	Not provided	24598 to 24851	55	1.35
8 December 2021[c]	Not provided	24042 to 25898	60	1.49
11 October 2022[c]	Not provided	24374 to 25068	56	1.39

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas

a average of three test results using USEPA method 201A

b single test result using USEPA method 17

c average of three test results using USEPA method 17

Table 45 Summary of isokinetic stack analysis of the supertab north drier, commenced in 2016

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Particulate emission (mg/dsm^3)*	Particulate emission rate (kg/hr)
21 September 2016[a]	0.629[d]	18863	93	1.7
25 October 2017[b]	Not provided	20616	24.7	0.50
21 September 2018[c]	Not provided	20553 to 23635	87	1.9
29 October 2019[c]	Not provided	17447 to 18851	110	2.0
29 October 2020[c]	Not provided	16858 to 18156	130	2.25
29 March 2022	Not provided	18280 to 19786	99	1.88
12 October 2022	Not provided	16665 to 18276	91	1.58

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas
a average of three test results using USEPA method 201A
b single test result using USEPA method 17
c average of three test results using USEPA method 17
d tested in combination with supertab south drier

Table 46 Summary of isokinetic stack analysis of the supertab south drier, commenced in 2016

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Particulate emission (mg/dsm^3)*	Particulate emission rate (kg/hr)
21 September 2016[a]	0.629[d]	21831	138	3.0
25 October 2017[b]	Not provided	20208	47.4	0.98
21 September 2018[c]	Not provided	22527 to 22927	90	2.0
29 October 2019[c]	Not provided	14204 to 14813	65	0.9
29 October 2020	Not provided	18841 to 21122	113	2.26
29 March 2022	Not provided	19541 to 20162	167	3.32
12 October 2022	Not provided	19030 to 19943	160	3.12

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas
a average of three test results using USEPA method 201A
b single test result using USEPA method 17
c average of three test results using USEPA method 17
d tested in combination with supertab north drier

2.2.2 Deposition gauging

Many industries emit dust from various sources during operational periods. In order to assess the effects of the emitted dust, industries have been monitored using deposition gauges.

Deposition gauges are basically buckets elevated on a stand to about 1.6 m. The buckets contain deionised water to ensure that any dust that settles out of the air is not re-suspended by wind. A copper sulphate solution at a concentration of 5 g/L acts as a preservative to prevent growth of algae and bacteria.

In the year under review, gauges were deployed at five sampling sites around the lactose plant for a period of approximately five weeks during summer. The contents of the gauges were analysed for COD (chemical oxygen demand). The COD results are compared with the theoretical value for lactose powder and a "total deposited powder" (TDP) value is calculated.

The descriptions and locations of the five air deposition monitoring sites are provided in Table 47 and Figure 82. A depiction of the wind conditions at the nearest wind monitoring station (Taungatara at Eltham Rd) during the deposition gauge survey are also shown in Figure 82.

The Council guideline value for total particulate deposited to cause nuisance is 130 mg/m^2/ day, but the Council does not have a specific guideline value for lactose powder deposited. The lactose deposition survey determines deposition due to lactose powder only, not total deposition.

Guideline values used by the Council for dust deposition are 4 g/m^2/30 days or 130 mg/ m^2/day deposited matter. Consideration is given to the location of the industry and the sensitivity of the surrounding community when assessing results against these values.

The deposition gauge results for the deployment period in the year under review are compared with previous results since 1997 in Figure 83 and Table 48.

Table 47 Description of the Fonterra Ltd air deposition sample sites

Site number	Description
AIR002301	east of plant, across Manaia Road adjacent to the plant
AIR002302	east of plant, opposite the tanker bay
AIR002303	south of plant
AIR002304	west of plant
AIR002305	south west of plant

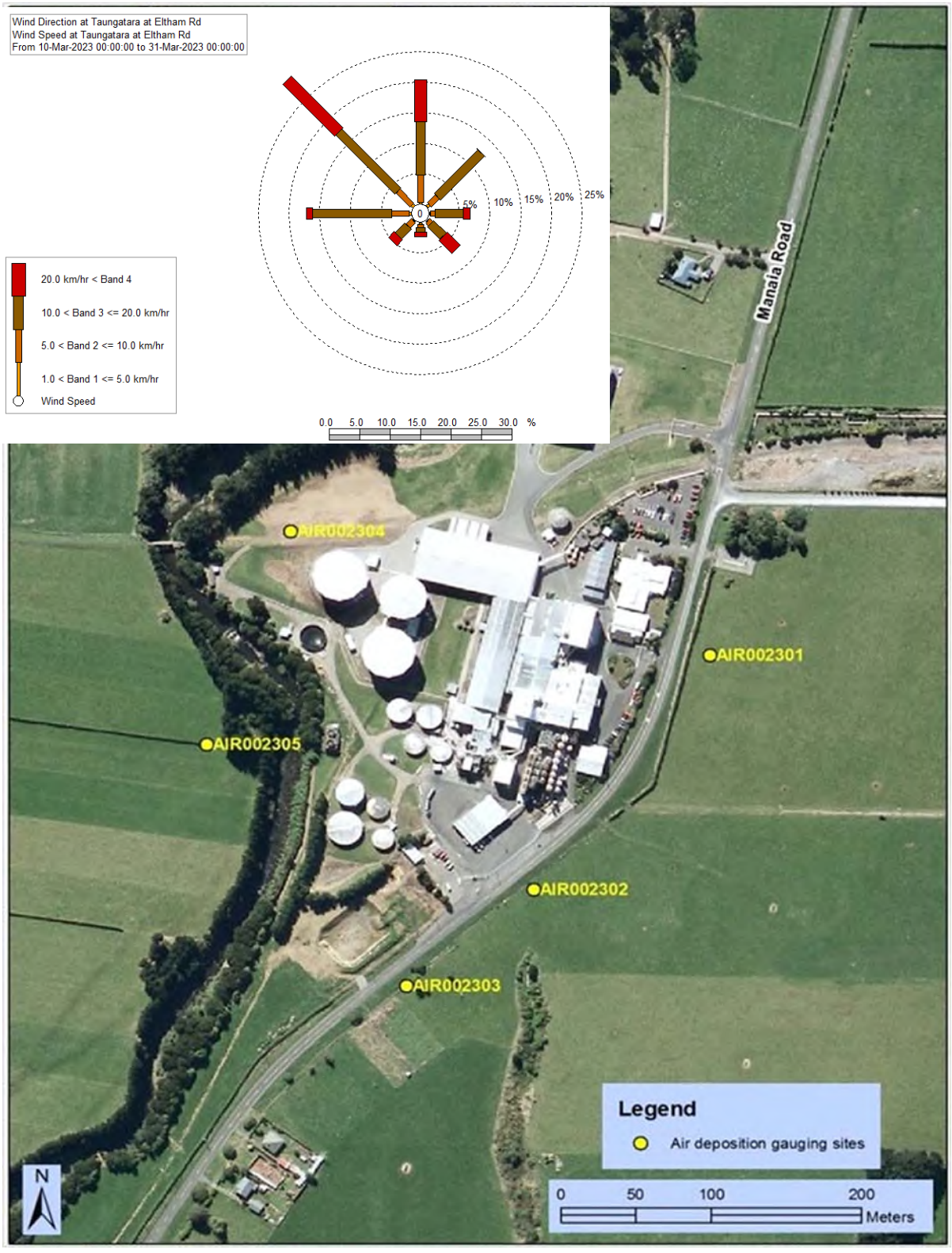

Figure 82 Location of air deposition gauging sites

The deposition rates obtained during the periods under review were elevated. The lactose deposition rates recorded at all sites except AIR002301 were above their respective historical medians and the guideline value. It is noted that the deposition rate is not limited by the Company's consent.

The highest results were at a monitoring locations AIR002302, AIR002304 and AIR0002305. In the predominantly northerly to westerly wind conditions prevailing during the survey, although AIR002302 was

predominantly downwind of the Company's activities, AIR002304 and AIR002305 were predominantly upwind. In terms of potential for adverse effects, there were no complaints received regarding particulate deposition during the deployment period of the gauges. At the time of the site inspection on 27 March 2023, there were no visible emissions or product deposition found beyond the site boundary.

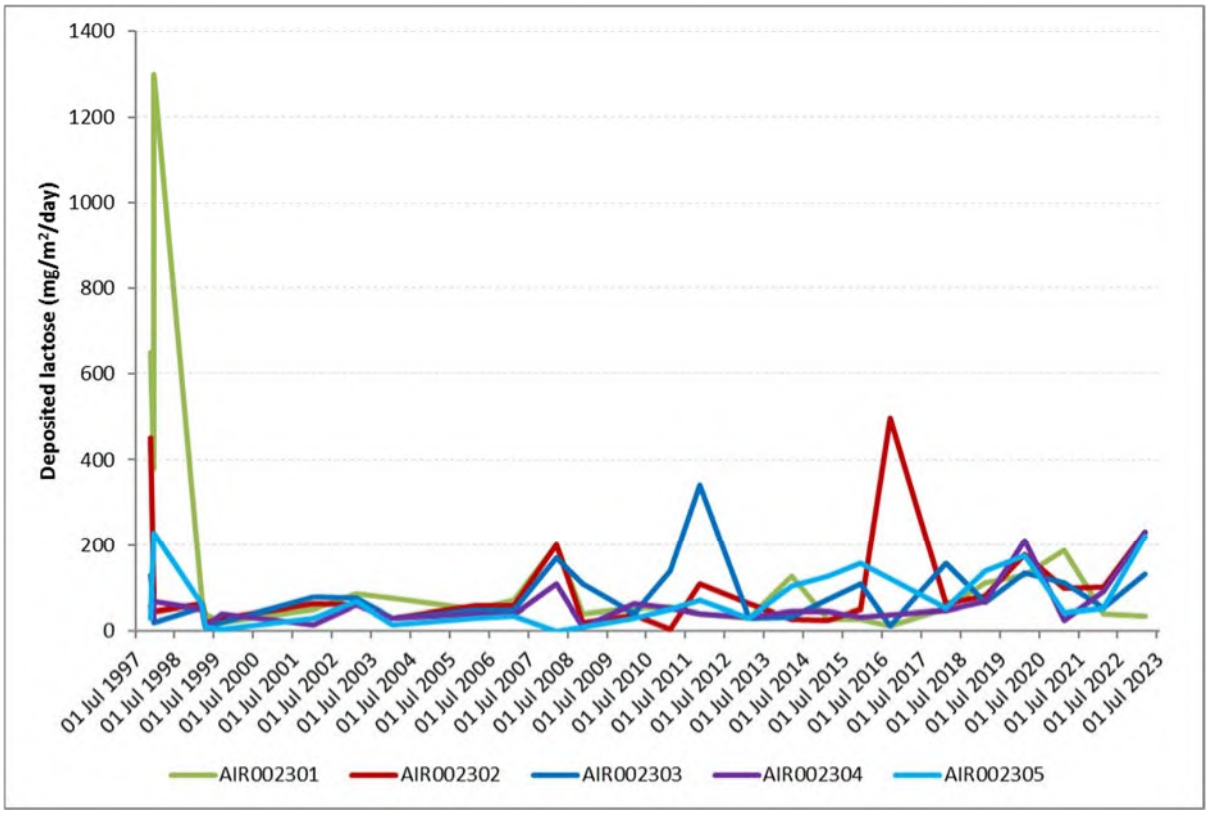

Figure 83 Deposition gauge results from 1997 to date

Table 48 Deposition gauge results from 1997 to date

Period	Number of days	Deposited lactose mg/m²/day				
		AIR002301	AIR002302	AIR002303	AIR002304	AIR002305
10 Nov to 24 Nov 1997	14	**650**	**450**	**130**	59	30
24 Nov to 9 Dec 1997	15	**380**	83	53	30	-
9 Dec to 22 Dec 1997	13	**1300**	46	20	68	**230**
4 Mar to 18 Mar 1999	14	71	63	56	50	60
12 Apr to 26 Apr 1999	14	40	20	<20	<20	<20
9 Sep to 29 Sep 1999	20	20	30	-	40	<10
9 Jan to 24 Jan 2002	16	50	63	78	<30	30
21 Jan to 3 Feb 2003	13	86	60	75	60	69
14 Jan to 29 Jan 2004	15	76	30	30	30	<30
11 Apr to 10 May 2005	29	-	-	-	-	-
10 Jan to 1 Feb 2006	22	50	59	47	40	30
11 Jan to 13 Feb 2007	33	70	59	49	37	34
15 Feb to 14 Mar 2008	28	**200**	**200**	**170**	110	-

Period	Number of days	Deposited lactose mg/m^2/day				
		AIR002301	AIR002302	AIR002303	AIR002304	AIR002305
20 Oct to 10 Nov 2008	21	40	20	110	<20	<20
12 Feb to 9 March 2010	25	52	38	39	63	30
25 Jan to 15 Feb 2011	21	21	<8	140	54	51
29 Sep to 17 Oct 2011	18	40	110	**340**	40	70
28 Jan to 15 Feb 2013	18	30	64	30	33	30
20 Feb to 17 Mar 2014	25	127	27	33	44	105
28 Jan to 18 Feb 2015	21	28	24	-	45	127
24 Nov to 15 Dec 2015	21	29	51	109	32	**159**
6 Sep to 27 Sep 2016	21	12	**498**	13	*	*
11 Jan to 2 Feb 2018	22	53	63	**158**	48	53
21 Jan to 26 Feb 2019	36	112	82	65	69	**139**
27 Jan to 17 Feb 2020	21	130	**178**	**134**	**210**	**176**
3 Feb to 23 Feb 2021	20	**187**	100	112	25	42
3 Feb to 23 Feb 2022	20	39	102	53	92	54
10 Mar to 31 Mar 2023	31	36	**232**	**131**	**232**	**222**
Historical median	-	*54*	*62*	*61*	*44*	*47*

* gauge contents contaminated by bird/bird droppings

2.3 Incidents, investigations, and interventions

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the Company. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach, that in the first instance avoids issues occurring, is favoured.

For all significant compliance issues, as well as complaints from the public, the Council maintains a database record. The record includes events where the individual/organisation concerned has itself notified the Council. Details of any investigation and corrective action taken are recorded for non-compliant events.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified individual/organisation is indeed the source of the incident (or that the allegation cannot be proven).

Table 49 below sets out details of any incidents recorded, additional investigations, or interventions required by the Council in relation to the Company's activities during the 2022-2023 period. This table presents details of all events that required further investigation or intervention regardless of whether these were found to be compliant or not.

Table 49 Incidents, investigations, and interventions summary table

Date	Details	Compliant (Y/N)	Enforcement Action Taken?	Outcome
23 Aug 2022	Self-notification was received concerning a discharge of wastewater from an unforeseen irrigation pipeline breach, into the Kaupokonui Stream at Manaia Road, Kapouni.	N	Letter of explanation received. Statutory defence	Investigation found that the river was running clear. There had been heavy rain in the previous two days. No environmental effects could be found at the time of inspection. A letter of explanation was received confirming that a mechanical failure had occurred
2 Feb 2023	Self-notification was received concerning a discharge of wastewater onto land in contravention of resource consent conditions at Fonterra Kapuni, Manaia Road, Kapuni	N	Statutory defence	Investigation found that an underground wastewater pipe had burst causing the discharge. At the time of inspection the contractors were on site with a sucker truck and had replaced the pipe. The wastewater had not discharged to any waterbody. The contingency plan for the site had been followed
10 May 2023	Self-notification was received concerning a discharge of wastewater onto land at Fonterra Kapuni, Manaia Road, Kapuni	Y	N/A	The Company indicated that there had been pooling on the surface when the rupture occurred and some wastewater may have made its way into the nearby Kaupokonui Stream. At the time of investigation the pipe had been fixed. No pooling was evident and no discharge was occurring into the stream. The Company has advised that their fail safe shut off system will be examined to make improvements to ensure that any alarms to do with their irrigation system will result in automated switch offs, should flow detection indicate any anomalies in the future

3 Discussion

3.1 Discussion of plant performance

General site management

Generally the onsite management and operation of the Kapuni lactose plant site was undertaken in a satisfactory manner. Continual liaison between the Company's staff and the Council has contributed to this performance. A number of improvements were made at the site during the year under review that primarily related to the tracking and management of the nutrient loadings associated with the discharge of wastewater on the farms.

Work identified for the 2023-2024 year included:

- Relocation of the wastewater sampling device from the draw off from the Farm 3 wastewater tank to the factory site, ensuring that the chemical profiling of the wastewater better reflects the contaminant concentrations applied to Farm1 as well as Farms 2 and 3;
- CIP trials that include trial of an eco-acid, an AVII additive, and acid recovery via membrane filtration. At the time of writing this report some of these trials had been completed, with the Company waiting for the reports to be completed;
- Review and revision of the fixed in ground irrigation network, with sprinkler take offs that are within or near the buffer areas being identified, capped or redirected;
- Site upgrades to reduce the manual data entry currently involved in recording and keeping track of irrigation hydraulic loadings; and
- Increase options for areas on which the wastewater can be irrigated, specifically application to vary consent 9088, which currently provides for the discharge to land throughout the Taranaki Region, but currently only for specified dairy liquids, not factory wastewater containing inorganic nitrogen.

Management plans

Contingency planning is in place in the form of the Site Stormwater Management Plan. It is a requirement of the consent that the plan is reviewed and updated (if required) annually. In the 2022-2023 monitoring year, the latest plan on record at the Council was issued in April 2022. A Spray Irrigation Plan is required by consents 0922-3.2 and 0923-3. The consent requires that this is updated annually with the updated plan to be provided to Council by 1 July each year. Council has been informed that the irrigation practices at the site have not changed substantially, but the irrigation management plan was updated to a whole farm management plan in June 2019. The whole farm management plan covers both the irrigation management and the farm management practices to ensure that the operation of these two activities is well integrated. The plan was updated in April 2023.

Data provision

Data was collected by the Company and forwarded to the Council regarding the abstraction of water from the Kaupokonui Stream, temperature of the Kaupokonui Stream above and below the discharge of cooling wastes, cooling water discharge rates and temperatures, stormwater pond discharge records, and volume and composition of effluent sprayed to pasture on the two farms. Daily volumes, temperature maxima, and stormwater discharges were reported monthly. Historically, this was all provided in the form of monthly reports, with the upstream and downstream temperatures being provided electronically on a daily basis and irrigation waste composition records forwarded annually upon request. More recently the flow data for the abstraction and cooling water discharge and the cooling water discharge temperature has been provided to Council in the form of electronic data, that was initially also provided on a daily basis. This data is now provided every two hours. This change was made because there is an upstream consent that requires the consent holder to cease abstraction when the temperature of the Kaupokonui Stream, at the monitoring site

operated by the Company upstream of their spray cooling water discharge, reaches 22°C. More frequent provision of the Company's monitoring data enables better adherence to this requirement, which was included in the consent at Fonterra's request as an affected party.

In terms of irrigation data, historically total daily data was provided that gave separate volumes for the factory wastewater and DSE volumes irrigated onto each of the farms, along with the two day rolling totals for Farm 1 and for Farms 2 & 3 to enable confirmation of compliance with the discharge rates permitted by the consents. The wastewater composition data was provided annually at the end of each year under review. It had been highlighted for several years that, although not a specific requirement of the current consents, more frequent provision of data in the form of paddock by paddock irrigation volumes, localised rainfall and the nitrogen content of the irrigated wastes would enable more effective evaluation of the actual and potential environmental effects of the wastewater irrigation to be made. Provision of this data commenced in the 2020-2021 year. Records were provided on a monthly basis for the year under review.

The Company's data collection and provision was satisfactory during the year under review. There were some short instances of missing record due to systems maintenance activities and these were communicated to Council. Overall, the improved accuracy and precision of the various datasets were maintained and gaps in the data were minimal.

Parallel temperature monitoring in the Kaupokonui Stream found very little difference between the data collected by the Company and by the Council.

Compliance with consent conditions was demonstrated for abstraction rates, stream temperatures and wastewater/effluent irrigation volumes data provision.

Water abstraction and cooling water discharge volumes

It is noted that there had been a general trend of decreasing abstraction since the 2012-2013 year. This has been evident in terms of maximum daily abstraction and annual volume taken. During the year under review, there was an estimated 15% increase in the annual abstraction volume when compared to the previous year. However, the maximum daily abstraction was 76% of the permitted daily take, with the maximum abstraction rate being up to 80% of the maximum permitted take for 99% of the time.

A comparison of the abstraction and discharge data (excluding the months affected by the abstraction rate reporting error), indicates minimal water usage (within the ± 10 % accuracy of the two measuring devices used to determine this differential), though the water losses through evaporation and spray drift at the spray discharge booms is not accounted for here. Losses at the spray discharge booms may have been increased by the addition of the pressure regulated nozzles. Although these provide benefits in terms of reduced temperature effects, they may reduce the volume of water returned to the stream.

Cooling water discharges

The main cooling system was replaced in August 2015. There is a continuously monitored system (conductivity) on the crystallising condensers, which will enable detection of contaminants for informing the discharge to the cooling water system and stream and/or diversion to wastewater irrigation. The Company's operation of the cooling tower and associated systems during the year under review resulted in monthly median temperatures in the range of 11-34˚C and monthly maximums in the range 23-41˚C. The cooling water discharge was at or above 35˚C for 20% of the year and at or above 33˚C for 36% of the time during the times of lower stream flows. Council monitoring found that the cooling water discharge complied with the contaminant concentrations limited by the consent. The operational changes introduced in recent years will have increased the Company's ability to reduce the temperature of the cooling water discharge. However, as the automation of the system is based on aiming for a temperature differential of approximately 0.6°C, the cooling water discharge temperature could be further reduced. Whilst the current operation has the benefit of better energy efficiency, it is not known what impact the higher median cooling water temperatures may have on the stream temperatures within the low flow reach.

Wastewater irrigation

The consent holder complied with the prescribed limits on the wastewater irrigation volumes with the exception of a minor exceedance that was notified to Council. This occurred on Farms 2 and 3 at a time when the Farm 1 wastewater main line was out of action due to a pipeline failure. The minor exceedance of the wastewater irrigation volume was not considered to be non-compliant as the irrigation volume did not exceed the margin allowed for due to the permitted measurement error of the metering device. The volume of FWW irrigated during the year under review was similar to the 2021-2022 year (less than 1% increase), but the volume of DSE increased by 14%.

The WFMP states that an even distribution over the paddocks is ideal, however this needs to be balanced with irrigation requirements, stock rotation and the weather. During the year under review it was found that annual application rates in mm/year equivalent ranged from 56 mm/year to 495 mm/year. Showing that from a volume and hydraulic loading perspective, the wastewater is not applied evenly across the available farm area. The plan also set a limit of 500 m^3/ha per irrigation event. This was exceeded by more than 5% on nine occasions. At the time of writing this report the Company had introduced additional operational controls to improve the real time monitoring and management of the volume of wastewater irrigation doses and irrigation events. Investigations are also continuing to put process upgrades in place to enable further improvements to be made.

Across the whole season, the median measured strength of wastewater irrigated onto land increased for nitrogen species for the fifth successive year. There was again also less consistency in the strength of the wastewater when compared to the 2017-2018 year. The concentration varied from 7.2 to 290 g/m^3.During the year under review, there was a combination of a very slight increase in the wastewater volume, but a 22% increase in the median nitrogen concentration of the FWW when compared to recent years. This resulted in an additional 18,489 kgN being discharged in the FWW when compared to the 2021-2022 year. It is noted that there was a decrease of 10,101 kg in the mass of phosphorus discharged. As with the wastewater volumes, there was a wide range of nitrogen application rates across the various paddocks that would not be wholly explained by the need to avoid irrigation in the paddocks specified in the WFMP under certain weather conditions. During the year under review, the nitrogen application rates ranged from 102 to 704 kg/ha/y. The average nitrogen application rates on each of the Farms increased by between 100 and 120 kg/ha/y.

There also continues to be high nitrogen (and phosphorus) loads applied to the paddocks during months that have a high total rainfall and above mean soil moisture.

Stormwater discharges

The stormwater system to contain and control stormwater from the southern catchment of the factory site, designed to capture a 1 in 100 year flood volume, has provided additional security for the area where road tankers operate and process materials are stored. A similar system (northern pond) was put in place for the remainder of the site during the 2017-2018 year. These continued to be well managed during the year under review. However, at the time of one inspection there was a very low flow discharge from the southern stormwater pond discharge structure, at a time when the pond was at a very low level and was not discharging, that exhibited an elevated BOD and a pH that was outside the permitted range for the stormwater discharge. Receiving water samples showed that there was no effect in the receiving water, however the Company was asked to investigate the source of this discharge. Investigation found that the lower valve in the pond was not completely shut due to sediment and debris caught in the valve. The valve was been cleaned and this has stopped the discharge.

Riparian

Riparian planting was maintained on the factory site. The financial contributions were paid for the 2022-2023 year.

Incidents and investigations

There were three matters arising where additional investigations, or interventions were required by the Council in relation to the Company's activities during the 2022-2023 period. On each occasion self-notification was received regarding discharges of wastewater from unseen irrigation pipeline breaches. Repairs were undertaken promptly, and at the time of investigation, no evidence of discharges to surface water were found. The Company has advised that their fail safe shut off system will be examined to make improvements to ensure that any alarms to do with their irrigation system will result in automated switch offs, should flow detection indicate any anomalies in the future.

3.2 Environmental effects of exercise of consents

Water consumption

When looking at the water allocation of the Kaupokonui Stream, Council had made the assumption that the water take was approximately 30% consumptive. In the AEE, based on water balance calculations, Fonterra estimated that approximately 10% of the water take was consumptive. Following the resolution of the issues that affected the cooling water discharge rates provided for the 2016-2019 years, it was found that the data being supplied meet the agreed standards both in terms of completeness and accuracy of ± 5% from September 2019. As a result, a better estimate of the consumptive nature of the water take, and potential effects on the stream could be assessed from a water allocation perspective. However, it is noted that this would account only for the consumptive use within the factory and losses from the cooling tower, and would not account for the losses from evaporation and spray drift at the cooling water discharge booms. Data recorded across the year under review indicated that there was little, if any, consumptive use outside the ± 10% cumulative measurement error of the metering devices. Changes were made at the spray discharge booms over the 2020-2022 years to decrease the droplet size to aid with cooling. It is noted that this is likely to have increased the potential for evaporative and spray drift losses that are not currently measured.

Receiving water effects, general

Inspections and sampling did not find any adverse effects in the receiving waters during the monitoring period, and there was generally good compliance with discharge permit conditions.

Receiving water effects, temperature

Temperature data supplied by the Company showed that the ambient temperature of the receiving water during the monitoring period was not increased by more than the amounts prescribed on consents 0919-3 and 0921-3, that is, by less than 2˚C for 90% of the time with an upper limit of 3˚C. With the improvement in the measurement error of the Company's instream monitoring that were implemented in the 2018-2019 year, there was improved confidence in the accuracy and precision of the data provided. This has been maintained during the year under review. In the 2017-2018 year, due to the measurement error of the temperature probes, temperature reductions were measured for approximately 16% of the time, with a maximum temperature drop of 2.2˚C reported to Council, resulting in a reduction in the tolerance applied during the Company's calibration of the temperature sensors. In the 2018-2022 years temperature reductions of between 0.01 and 1.0˚C have been recorded for between 2 and 13% of the time. During the year under review, a negative temperature differential of up to 1.0°C was reported for 9% of the record. This indicates that the actual instream temperature differentials may be up to 1.0°C higher than measurement reported by the Company due to permitted measurement errors. This needs to be considered in relation to the temperature increase permitted by the reissued consent.

During the year under review, operation of the cooling tower and associated systems resulted in the reported increase in temperature below the cooling water discharge being well below the consented limit,

being at or below 1.0˚C for 90% of the time, with the temperature differential most commonly being between 0.5 and 0.6˚C (18% of the time).

In terms of the potential effects within the relatively long 200 m cooling water discharge mixing zone, there is the potential for there to be elevated temperatures that could present a barrier to fish passage. Based on historical monitoring, the assumption has been made that fish would make use of a cooler flow corridor close to the true right bank in order to negotiate this stretch of the stream. It was requested that the current temperature conditions within the mixing zone and the validity of this assumption be investigated by the Company during the preparation of the AEE for the renewal of the cooling water discharge consent. Although work was undertaken in February 2018, the temperature measurements within the mixing zone were not conducted during worst case conditions within normal operational parameters as cooling water discharges were in the range of 30˚C to 32˚C. From November 2018 to the end of that monitoring year, the Company manually diverted all cooling water through the cooling tower and ran the cooling tower at the maximum cooling capacity. Monitoring from 1 December to 30 June 2019 showed that this reduced the cooling water discharge temperature (15 minute average) to below 29˚C for 99% of the time. In comparison, the more energy efficient operation of the cooling tower and associated systems that was in place during the year under review (outlined in Table 5) resulted in the cooling water discharge temperature (15 minute average) being above 29˚C for 63% of the time and above 32˚C for 45% of the time during December to March inclusive. The lower cooling water discharge temperatures that were achieved whilst the cooling tower system operated in a way that achieved the maximum cooling capacity would also have resulted in a significant reduction in the temperature effects occurring within the relatively long approximately 200 m mixing zone. However, the cooling water discharge temperatures during the year under review were higher than those prevailing at the time the investigations of the temperature conditions within the mixing zone were undertaken for the AEE for the consent replacement. The potential temperature effects within the low flow reach are therefore difficult to assess.

The cooling water discharge consent also prohibits temperatures in excess of 25˚C downstream of the plant as a result of the cooling water discharges. This limit was complied with.

Incidents and investigations

There were no significant adverse effects found as a result of the three self-notified unauthorised discharges to land that occurred on the farms due to pipeline failures.

Effects relating to wastewater irrigation, soil

In general, soil quality was good, with most measures being within the optimum range for pasture growth. There were no deficiencies in the pasture. There was no threat of soil structure collapse from potential accumulation of the salts from the wastewater irrigation activities. Where the optimal agronomic concentrations were exceeded (potassium, calcium and total nitrogen), these were unlikely to cause any issues with plant or animal health.

With respect to total nitrogen it was noted that the concentrations were classified as very high in irrigated paddocks. The nitrogen concentration of the soil increase in 11 of the 14 irrigated paddocks that were tested previously.

With respect to phosphorus it was reported that trends in soil chemistry since records began at the farm show that the accumulation rate of phosphorus appears to be stable and not increasing. This likely indicates that the topsoil is saturated with Olsen-P and it is now moving deeper into the soil. Some transfer of nutrients (by stock) from irrigated to non-irrigated areas appear to be occurring as Olsen-P levels are slightly above the optimum agronomic range (35-45 mg/L) in several control paddocks. In an assessment of the long term impact of the phosphorus loadings undertaken by McDowell (2021) balancing P inputs with P outputs and reducing P loadings to achieve a topsoil Olsen-P of 300 mg/L or less and an eventual Olsen-P of 50 mg/L was recommended. It is noted however that the soil Olsen P concentration had reduced slightly

in all of the Farm 1 paddocks, one of the Farm 2 paddocks and two of the Farm 3 paddocks when compared to the June 2021 and 2022 data.

With respect to calcium it was noted that the soil in irrigated paddocks had all, or nearly all, of the exchange sites filled with cations. Calcium was the dominant ion. Further addition of calcium will have no impact on soil quality because the soils exchange sites are already full.

Effects relating to wastewater irrigation, groundwater

Effects on the groundwater in the vicinity of the farms were varied, but most showed that there was an adverse impact on both mineral and organic component levels. Between the 2014 and 2018 years there were successive decreases in the amount of total nitrogen discharged to the farms. Since then the amount of nitrogen discharged had increased year on year. The average nitrogen application rates during the year under review were the highest since they have been since prior to the irrigation area expansion in the 2007-2008 monitoring year[5]. The average application rates during the year under review being 452 kgN/ha/y on Farm 1; 545 kgN/ha/y on Farm 2; and 529 kgN/ha/y on Farm 3.

In terms of the effects on groundwater, during the year under review, there was only one bore that was consistently above the drinking water standard. This was the up gradient bore at the northern boundary of Farm 2 (GND2049). The reason for the reasonably consistent elevation in this control bore and the occasional elevation in the control bore for Farm 3 (GND2051) is still to be fully investigated.

In terms of the impact bores, there were three bores where the annual median was above the drinking water standard. This is in comparison to the 2021-2022 year when the Farm 2 impact bore GND0638 was the only bore that had an annual median above the standard. The Impacted bores were the Farm 2 bores GND0638 and GND0639 and the Farm 3 bore GND0641. The annual median nitrogen concentrations of these bores were 16.5 g/m^3 (with all results above the standard) at GND0638; 11.6 g/m^3 at GND0639; and 11.4 g/m^3 at GND0641. It is noted that, with the exception of paddock 13b, the nitrogen application rates on the paddocks up gradient of GND0638 and GND0639 all received nitrogen application rates that were above average, being in the range of 635 to 667 kgN/ha/y. On Farm 3, the nitrogen application rates on the paddocks immediately up gradient of GND0641 were in the range 401 to 452 kgN/ha/y, with paddock 41, in which GND0641 is located receiving 469 kgN/ha/y.

The nitrogen concentration of the Farm 2 bore GND2063 at the time of the survey on 19 June 2023 was 16.9 g/m^3, which is the third highest concentration to date for this bore. Although there was very little nitrogen applied to the paddocks up gradient of this bore in the week preceding this survey, there was a total of 556 kgN discharged in the vicinity of this bore since the preceding groundwater survey. Thus indicating likely effects from the irrigation activities.

Groundwater data indicated that another contributing effect at some of the bores was occurring on occasion. This is the "collecting" of any subsurface nitrate-N in the soil in the groundwater as the level rises after rainfall and irrigation. This was evident in GND2063 and GND0641 tended to have nitrogen concentrations that increased with increasing groundwater level throughout the year under review. Conversely, the nitrogen concentrations in these bores decreased as the groundwater levels receded.

During the year under review (with the exception of GND0637 on 22 August 2022) both of the Farm 1 bores varied inversely with groundwater levels. The Farm 2 bores GND0638, GND2050 and GND2049 also had nitrogen concentrations that varied inversely with respect to groundwater levels. This would potentially indicate minor effects from the discharge of wastes to land and/or on site agricultural activities. In the case of GND2063, this is also supported by the notable increases in conductivity, chloride, sodium and potassium

[5] Estimated average nitrogen application rate of 523 kgN/ha/y based on the averaged irrigation data over the preceding 6 years and the nitrogen concentration determined based on the November/December wastewater study.

concentrations in this bore at sampling surveys that followed the same trend as the total nitrogen concentration.

As discussed in Section 2.1.5.4, there are no known shallow groundwater water users in the immediate vicinity of the spray irrigation area, because of the availability and usage of the Waimate West Rural Water Supply Scheme. However, the Regional Fresh Water Plan for Taranaki (2001) does provide for the taking and use of groundwater at a scale that would enable reasonable farm use as a permitted activity. GWR Policy 4 of the Regional Freshwater Plan for Taranaki (2010) also states that groundwater quality will be maintained and enhanced by promoting land use practices that minimise, as far as practicable, the potential adverse effects on groundwater quality. In the 2019-2020 Annual Report it was stated that consideration should therefore be given to changes that could be made to the management of the wastewater irrigation management to reduce the nitrate concentration, initially, at least in the bores that are on the boundary of the site, or that are close to waterways. During the year under review the Company continued to track the nitrogen loadings applied to the irrigation areas from all sources. It is however noted that the primary means of control is with respect to the volumes applied, with the nitrogen concentration varying widely and the results for the nitrogen concentration of the approximately weekly composited wastewater samples not being available for several days after the sample has been dispatched to the laboratory. This does make it difficult to control the year to date nitrogen application rates on a real time basis.

At the end of the year under review, the Council was advised that the Company was reviewing practices to improve the management of nutrients at the site, some of which will take time to initiate. In the meantime the Company has provided irrigation operators with further guidance and tools to improve their ability to ensure that the irrigation dose and event volume limits in the WFMP are complied with and have applied for a variation to the global dairy products discharge to land consent (9908) as short term solutions. The final solutions planned being the ability to control the irrigation hydraulic loads by use of a PLC systems and to treat the wastewater in a treatment facility that is to be constructed on Farm 1. Regular progress meetings are being held between Council and the Company.

Macroinvertebrate monitoring

The findings of the November 2022 survey were that the results of some macroinvertebrate indices indicated a greater than expected deterioration of macroinvertebrate community health in the Kaupokonui Stream, Dunn's Creek, and Waiokura Stream. However, there is no strong evidence to support that the impacts of wastewater irrigation to land are causing this deterioration in stream health.

Overall, at the time of the March 2023 survey there was no evidence that the irrigation of wastewater to land had caused any deterioration in the health of the macroinvertebrate communities of the Kaupokonui Stream, Dunn's Creek, or Waiokura Stream.

There were no heterotroph[hic grows found at the time of either survey, supporting a lack of effects from the site discharges. Both survey reports commented that, additionally, in both Dunn's Creek and the Waiokura Stream, there is a significant distance between monitoring sites with no direct discharges to water. While the irrigation of factory waste occurs throughout this area, farming activities may also contribute towards cumulative effects on stream communities. Therefore, should adverse impacts on the macroinvertebrate communities be detected in future surveys, further investigation would be required to positively ascertain whether these impacts can be directly attributed to the consented activities.

Fish passage

Following the 2023 fish survey and associated evaluation of the fish passage, overall, it was considered that the activities of the Kapuni Lactose factory were not having a significant adverse effect on the fish communities of the Kaupokonui Stream. However, due to fugitive attractant flows and a lack of a deeper channel catering to larger fish, it is likely that there was currently incomplete passage provision, but that this would be challenging to confirm in practice. In general these survey results are unlikely to effectively portray

these issues due to the survey methodologies' own limitations. As the riparian planting of the catchment matures, and effects of the passage remediation works at the Glenn Road weir become evident, the diversity and abundance of fish in this stretch of stream will likely improve.

A more comprehensive assessment of the weir and thermal effects of the cooling operation will be required as the stream values increase, and a shift to annual monitoring is recommended as opposed to the current three yearly survey in order to detect the expected changes. It is worthwhile delaying any remedial works until further information can be collected with respect to the changing fish community from the removal of the weir which would be used to inform remediation options. However, it is also important to recognise that there is a possibility of potentially significant effects through the lack of fish passage and thermal effects, so remediation may need to be undertaken promptly to ensure compliance.

General maintenance of the current fish pass (replacing loose or missing rocks, ensure base is not undercut, surface kept clear of debris etc.) should be carried out in the meantime, as well as potentially positioning large boulders near the top of the fish pass to provide protection from predation for small fish.

Discharges to air

With respect to the Company's discharges to air, the results of the emissions monitoring undertaken on the flash dryer was again well below consent limit of 125 mg/dsm^3 that applies to this discharge only. The Company voluntarily monitors the particulate emissions from the other three stacks. During the year under review the average particulate emission rates for two of the three stacks were below the 125 mg/dsm^3 limit that applies to the flash dryer, with the supertab south dryer emission rate being above this at 160 mg/dsm^3. The Company is undertaking voluntary investigations into the elevated particulate emission rates from this source.

The lactose deposition rates recorded during the year under review were above their respective historical medians and the guideline value of 130 mg/ m^2/day at all sites except for AIR002301. It must be borne in mind that this is a guideline only and the particulate deposition rate is not limited by the Company's consent. No complaints were received by Council in relation to deposited particulates and inspections found no evidence of depositions. No odours were noted off site during the year under review.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 50 to Table 65.

Table 50 Summary of performance for Consent 0302-3

Purpose: ***To take and use up to 19,500 m^3 /day (225 L/s) of water from the Kaupokonui Stream for cooling and general purposes associated with lactose manufacturing***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Undertake ecological monitoring	Biomonitoring surveys	Yes
2. Record daily rates of abstraction	Records received from the Company	Yes
3. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 51 Summary of performance for Consent 0919-3

Purpose: *To discharge up to 19,500 m^3/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Physicochemical and ecological monitoring of wastes and stream	Collection of samples and review of Company supplied data	Yes
2. Prohibited effects on receiving water	Site inspections, collection of samples, biological surveys	Yes
3. Limits on BOD level in receiving water	Collection of samples	Yes
4. Limits on temperature increase of receiving water	Temperature information supplied by the Company	Yes
5. Limit on downstream temperature of receiving water	Temperature data supplied by the Company and parallel temperature monitoring	Yes
6. Continuous monitoring of temperature of receiving water required	Temperature information supplied by the Company	Yes
7. Review of conditions 4 and 5	No further provision for review	N/A
8. No thermal barrier or growths as a result of discharge within the mixing zone	Temperature information, site inspections	Yes
9. No anti-corrosion agents, biocides, anti-flocculants or other chemicals added to cooling water	Site inspections, sample collection	Yes
10. Maintenance of riparian zone and annual donation to Taranaki Tree Trust	Site inspections. Review of contributions paid to Council	Yes
11. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 52 Summary of performance for agreed monitoring additional to consent 0919-3

Purpose: ***Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014***		
Agreed monitoring	**Means of monitoring during period under review**	**Agreed monitoring standards met**
1. Installation and maintenance of a tamper-proof recording device measuring cooling water discharge rate and flow to accuracy of ± 5% by 31 August 2015	Issues resolved September 2019. Review of Company provided data	Yes
2. Installation and maintenance of a tamper proof data logger recording cooling water discharge rate and flow at 15 minute intervals (NZST) by 31 August 2015	Issues resolved September 2019. Review of Company provided data	Yes
3. Provision document from qualified person certifying installation and maintenance is as per manufacturers' instructions, and is operating to an accuracy of ± 5% within 30 days, and at Council's request	As found and after re-installation calibration data and certification will be required to meet the intent of this agreed monitoring standard. . Review of Company provided data	Yes
4. Flow recording devices accessible to Council for inspection, data retrieval and verification of accuracy	Inspection and review of Company provided data	Yes
5. By 31 August 2015, agreed measurements to be transmitted to Council to maintain a real time record in a format suitable for auditing and registering "zero" when no discharge occurring	Issues resolved September 2019. Review of Company provided data	Yes
Overall assessment of consent compliance and environmental performance in respect of this agreement		**High**
Overall assessment of administrative performance in respect of this agreement		**High**

N/A = not applicable

Table 53 Summary of performance for Consent 0920-3

Purpose: ***To take up to 700 m^3/day from a bore in the Kaupokonui catchment for factory cooling water using plate heat exchangers***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Records of abstractions kept and supplied to Council	Records received – consent not exercised during monitoring period	Yes
2. Access to bore to be provided		Yes

Purpose: *To take up to 700 m^3/day from a bore in the Kaupokonui catchment for factory cooling water using plate heat exchangers*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
3. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 54 Summary of performance for Consent 0921-3

Purpose: *To discharge up to 850 m^3/day of cooling water from plate heat exchangers and plant cooling system into an unnamed tributary of the Motumate Stream at two different locations*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effects discharge must not have on receiving water below mixing zone	Site inspections – consent not exercised during monitoring period	N/A
2. Consent holder to monitor daily volume, temperature of discharge	Consent not exercised during monitoring period	N/A
3. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

N/A = not applicable

Table 55 Summary of performance for Consent 0922-3.2

Purpose: *To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Maintenance of effluent spray irrigation plan, with specific matters to be covered in plan	Whole farm plan provided dated March 2021	Yes
2. Limit on maximum two day volumes	Records received	Yes
3. Consent exercised in accordance with procedures set out in effluent spray irrigation plan	Site and farm inspections. Review of self-monitoring data	No. Five exceedances of irrigation event hydraulic loading

Purpose: *To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Provision for initiation of spray irrigation plan review, with plan reviewed plan by 1 July each year or upon two months' notice by Council	Plan reviewed and updated March 2023. Minor amendments requested. Included in revised plan issued July 2023	Yes
5. Operation of spray irrigation systems according to plan required by condition 1, staff training	Site and farm inspections	No. As per condition 3
6. No direct discharges of effluent into any watercourse	Farm inspections	Yes
7. No ponding	Farm inspections	Yes
8. 20 m 'buffer zone' to watercourse	Farm inspections	Yes
9. Records available to Council on request of effluent produced, volume irrigated, area and hours pumped	Records viewed at inspection. Volumes irrigated daily provided to Council	Yes
10. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Good**
Overall assessment of administrative performance in respect of this consent		**Good**

N/A = not applicable

Table 56 Summary of performance for Consent 0923-3.3

Purpose: *To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to adopt BPO to prevent or minimise adverse effects	Site and farm inspections, review of Company data, receiving environment monitoring	No. Elevated nitrogen concentrations in groundwater. Improvements being implemented
2. Maintenance of effluent spray irrigation plan	Plan reviewed and updated March 2021	Yes
3. Limit on maximum two day volumes	Records received. 2 day rolling total exceeded on two days, however was within 5% accuracy of measuring equipment	Yes

Purpose: *To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Consent exercised in accordance with procedures set out in plan	Site and farm inspections. Review of self-monitoring data	No. Irrigation event limits exceeded on four occasions
5. Provision for initiation of spray irrigation plan review, with plan reviewed plan by 1 July each year and upon two months' notice by Council	Plan reviewed and updated April 2023. Minor amendments requested. Included in revised plan issued July 2023	Yes
6. Operation of spray irrigation systems according to plan required by condition 1, staff training	Site and farm inspections	No as per condition 4
7. No offensive or objectionable odour	Farm inspections	Yes
8. No spray drift beyond boundaries	Farm inspections	Yes
9. No direct discharge to watercourses	Farm inspections	Yes
10. No ponding	Farm inspections	Yes
11. Spray 'buffer zone' limits	Farm inspections	Yes
12. Remediation in case of contamination of groundwater or roof water supply	Review of monitoring data and liaison with Company. Remedial actions being put in place with short term solutions being implemented and medium terms solutions scheduled	Yes. However, further reduction in groundwater nitrogen concentrations desirable
13. Installation and maintenance of monitoring bores	Farm inspections	Yes
14. Records provided to Council of effluent produced, volume irrigated, area and hours pumped	Records received	Yes
15. Change of consent conditions	Not sought	N/A
16. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Good**
Overall assessment of administrative performance in respect of this consent		**Good**

N/A = not applicable

Table 57 Summary of performance for Consent 0924-3

Purpose: *To discharge up to 1,440 m^3/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to undertake physicochemical and ecological monitoring	Consent holder and Council sampling. Old pipeline decommissioned and subsequently removed	Yes
2. Effects discharge must not have on receiving water below mixing zone	Site inspections	Yes
3. BOD of receiving water not to rise above 2 g/m^3	Samples collected	Yes
4. Temperature of receiving water not altered by more 2°C for 90% of time and not rise by more than 3°C	Consent holder data	Yes
5. Temperature of receiving water shall not increase above 25 degrees at the periphery of the mixing zone	Council data logger information, temperature information supplied by the Company. Parallel temperature monitoring	Yes
6. Consent holder to constantly monitor the temperature of the receiving waters	Consent holder maintains temperature probes instream, data forwarded to Council	Yes
7. Review of consent in June 2001 to evaluate performance of cooling system		N/A
8. Limits upon levels of contaminants in discharge	Collection of very low flow samples from the stormwater discharge pipe	Mostly. One of two samples outside consented pH range. No environmental effect
9. Discharge not to create barrier for fish, or undesirable growths within the mixing zone	Site inspections	Yes
10. No anti-corrosion agents, biocides, anti-flocculants or other chemicals added to cooling water	Site inspections, sample collection	Yes
11. Maintenance of contingency plan. Review and update (if required) annually	Review of Council records. Contained in Stormwater Management Plan. Latest plan on record April 2021	Yes
12. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

*The consent specifies an average daily limit- i.e. a composite sample
N/A = not applicable

Table 58 Summary of performance for Consent 4032-5

Purpose: ***To discharge emissions to the air from the manufacture, drying, packaging and storage of lactose and associated processes and from the inhalation grade lactose plant***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to adopt BPO to prevent or minimise emissions	Site inspections	Yes
2. Consent holder to fulfil obligations under the RMA	Site inspections	Yes
3. Limits of particulate from wet scrubber	Stack testing in October 2020	Yes
4. No alterations to plant or processes without prior consultation with Council	Site inspections	Yes
5. Discharge not to result in dangerous levels of airborne contaminants at or beyond the boundary	Not monitored during period under review	N/A
6. Discharge not to result in offensive or objectionable dust or odour at or beyond boundary	Site inspections	Yes
7. Change or cancellation of conditions		N/A
8. Discharge not to result in noxious or toxic levels of airborne contaminants at or beyond boundary	Not monitored during period under review	N/A
9. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 59 Summary of performance for Consent 4604-2

Purpose: ***To discharge up to 280 L/s of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effects which must not arise below the 50 m mixing zone	Site inspections, samples, biomonitoring	Yes
2. Limits on oil & grease, pH and suspended solids in discharge	Sample collection	Yes
3. Contingency planning	Review of Council records. Contained in Stormwater Management Plan. Latest plan on record April 2021	Yes

Purpose: *To discharge up to 280 L/s of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 60 Summary of performance for Consent 4623-3

Purpose: *To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. States consent is for on-going use of existing structure. Changes to the structure may need further authorisation under RMA	Inspection. No changes found	N/A
2. Structure to be maintained so it is safe and functions effectively	Inspection. Minor fugitive flows found at the weir. To be addressed along with any fish pass improvements that may be needed following the removal of the Glenn Road weir	Yes
3. Required prior notice of commencement of maintenance work	Inspection, no works found or notified during the period under review. Council consulted re: works proposed to be undertaken on weir in 2023-2024 year	N/A
4. The weir shall not restrict the passage of fish	Inspection and fish survey	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 61 Summary of performance for Consent 6423-1

Purpose: *To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Contingency planning	Review of Council records. Contained in Stormwater Management Plan. Latest plan on record April 2021	Yes
2. Exercise of consent in accordance with application	Site inspections	Yes
3. Best practicable option to minimise environmental impacts	Site inspections	Yes

Purpose: *To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Limits on pH, suspended solids and hydrocarbons in the discharge	Sample collection	Yes
5. Effects which must not arise below the 50 mixing zone	Site inspections, stream sample collection, biomonitoring	Yes
6. Lapse of consent		N/A
7. Review of consent conditions	Expired - S.124 Protection. Re-consenting in progress	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 62 Summary of performance of Consent 6948-1

Purpose: *To erect, place, maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purposes of conveying irrigation wastewater*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option on adverse effects	Inspection by Council	Yes
2. Exercise in accordance with application	Inspection by Council	Yes
3. Notification prior to installation		N/A
4. Best practicable option to minimise contaminant discharge	Inspection by Council	Yes
5. Minimise disturbance of riverbed	Inspection by Council	Yes
6. Works resulting in downstream discolouration to be undertaken between November and April	Inspection by Council	Yes
7. Reinstatement of structure when no longer required		N/A
8. Lapse of consent		N/A
9. Review of consent conditions	No further opportunities for review. Consent expired 1 June 2023	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 63 Summary of performance of Consent 9546-1

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification prior to commencement of works	Liaison with Council. Work last undertaken June 2013	N/A
2. Culverts dimensions defined		N/A
3. Maximum depth of fill over culverts		N/A
4. Shaping of stream banks		N/A
5. Placement of rock rip-rap on upstream and downstream batters		N/A
6. Gradient of rock rip-rap in condition 5		N/A
7. Thickness of rock rip-rap on fill batters		N/A
8. Gradient of rock rip-rap in condition 7		N/A
9. Separation of concrete work from stream		N/A
10. Minimum period for curing of concrete in channel		N/A
11. No instream works between 1 June and 31 October	No maintenance undertaken during review period	N/A
12. Streambed disturbance minimised and reinstated		N/A
13. Fish passage not to be restricted	Inspection by Council	Yes
14. Pipes invert depth set		N/A
15. Gradient of culvert pipes not to exceed that of natural stream bed		N/A
16. Minimisation and mitigation of sediment discharged to stream	No maintenance undertaken during review period	N/A
17. Earthworks stabilisation to be as soon as practicable		N/A
18. Prevention of blockage and erosion responsibility of consent holder	Inspection by Council. No erosion or scour occurring	Yes
19. Procedure on discovery of archaeological remains		N/A

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
20. Removal of structure when no longer required		N/A
21. Lapse of consent on 20 June 2018 if not exercised	Consent exercised	N/A
22. Optional review provision for environmental effects	No further opportunities for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 64 Summary of performance of Consent 10214-1

Purpose: *To discharge solid farm dairy effluent onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effluent and farm dairy definition		N/A
2. Maximum volume of discharge		N/A
3. Notification upon volume exceedance	Check of Council records. No notifications received	N/A
4. Best practicable option on adverse effects	No disposals observed at inspection but no evidence of effects found	N/A
5. Diversion of stormwater		N/A
6. Maintenance of buffer distances	No disposals observed at inspection	N/A
7. Limit on Nitrogen application rate	Not assessed	N/A
8. Keeping of records	Not assessed	N/A
9. Actions following unauthorised discharge	No effects observed at inspection	N/A
10. Optional review provision for environmental effects	Next opportunity for review June 2029	N/A
11. Optional review provision for Regional Plan	Within 12 months of a Regional Plan becoming active	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

N/A = not applicable

Table 65 Summary of performance of Consent 10232-1

Purpose: *To discharge pond sludge from farm dairy effluent onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effluent and farm dairy definition		N/A
2. Maximum volume of discharge	Checking of records. No information provided to Council	N/A
3. Notification upon volume exceedance	Checking of records. No information provided to Council	N/A
4. Best practicable option on adverse effects	No disposals observed at inspection	N/A
5. Diversion of stormwater	Assessment by Council Officers	Yes
6. Maintenance of buffer distances	No disposals observed at inspection	N/A
7. Limit on Nitrogen application rate	Not assessed	N/A
8. Keeping of records	Not assessed	N/A
9. Actions following unauthorised discharge	Check of Council records for notifications received by Council. No notifications received	N/A
10. Optional review provision for environmental effects	Next opportunity for review June 2029	N/A
11. Optional review provision for Regional Plan	Within 12 months of a Regional Plan becoming active	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

During the year, the Company generally demonstrated a high level of environmental and high level of administrative performance with the resource consents as defined in Appendix II. However, an improvement is required in the management of the Company's activities in relation to the discharge of wastewater to land. The quantity of nitrogen and nitrogen application rates applied to land under consents 0922 and 0923 has continued to increase each year for the last four years. There were also a small number of exceedances of the irrigation event hydraulic load limits given in the Company's Whole Farm Management Plan. Monitoring indicates that there are elevations in the nitrate concentration in the groundwater at the site as a result of the irrigation activities. The Company has reviewed the management of nutrients at the site. Short term mitigation measures are being put in place, with further medium terms solutions being planned. These include the construction of a wastewater treatment plant on the Farm 1 site. Regular progress meetings are being held between the Company and the Council.

3.4 Recommendations from the 2021-2022 Annual Report

In the 2021-2022 Annual Report, it was recommended:

1. THAT in the first instance, monitoring of consented activities at the Company's Kapuni site in the 2022-2023 year, continue at the same level as in 2021-2022.
2. THAT consultation continue between the Council and the consent holder during the 2022-2023 year to establish what improvements may need to be made to the weir to rectify identified issues, and what improvements need to be made to the fish passage to address both the current potential issues and those likely to occur following the removal of the Glenn Road weir.
3. THAT the option for a review of resource consents 10214-1.0, 10232-1.0, and 9546-1 in June 2023, as set out in condition 10, 10, and 22 of the consents, not be exercised, on the grounds that the current conditions of the consent are adequate.
4. THAT consent 10412-1.0 be removed from the 2022-2023 monitoring programme as this consent lapsed on 31 March 2022.
5. THAT should there be issues with environmental or administrative performance in 2022-2023, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
6. THAT the Company investigate the reason for the elevated nitrate nitrogen concentrations in the Farm 2 and Farm 3 control bores.
7. THAT the Company investigate the environmental significance of the discrepancy between the sum of anions and sum of cations in the irrigated wastewater.

Recommendations 1, 2, 3, and 4 were implemented. With respect to recommendation 2, it is noted that the fish communities are continuing to re-establish following the removal of the Glenn Road weir and therefore consultation is likely to be on-going in the 2023-2024 year. Recommendation 5 did not require implementation. In relation to recommendation 6, a report has previously been provide detailing a theoretical explanation for these elevated levels, however the Council considered that the matter still needs to be further investigated. No information was received from Fonterra regarding investigations related to recommendation 7 during the year under review.

3.5 Alterations to monitoring programmes for 2023-2024

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for 2023-2024, the monitoring remains unchanged.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any

time during 2023-2024, a change is made to the activities taking place, or a change is made to any of the consents in place for those activities.

4 Recommendations

1. THAT in the first instance, monitoring of consented activities at the Company's Kapuni site in the 2023-2024 year, continue at the same level as in 2022-2023.
2. THAT consultation continue between the Council and the consent holder during the 2023-2024 year to establish what improvements may need to be made to the weir to rectify identified issues, and what improvements need to be made to the fish passage to address both the current potential issues and those likely to occur following the removal of the Glenn Road weir.
3. THAT should there be issues with environmental or administrative performance in 2023-2024, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
4. THAT the Company investigate the reason for the elevated nitrate nitrogen concentrations in the Farm control bore.
5. THAT the Company investigate the environmental significance of the discrepancy between the sum of anions and sum of cations in the irrigated wastewater.

Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
Cl	Chloride.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 25˚C and expressed in mS/m or µS/cm.
DSE	Dairy shed effluent.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Ha	Hectare. A unit of land area.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
K	Potassium.
kg/ha/y	Kilograms per hectare per year.
kg/hr	Kilograms per hour.
L/s	Litres per second.
m^3	Cubic metres, a measure of volume.
MALF	Mean annual low flow. A statistic that describes the average amount of water in a river during times of low flow.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
Mg	Magnesium.
mg/dsm^3	Milligrams per cubic meter as measured at (or converted to) 0˚C and 1 atmosphere of pressure.

$mg/m^2/day$	Milligrams per square meter per day.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
Na	Sodium.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia.
NO_2	Nitrite, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of the environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	Resource Management Act 1991 and including all subsequent amendments.
SAR	Sodium adsorption ratio is a ratio of the concentration of sodium ions to the concentration of calcium plus magnesium ions. It is used to assess the likelihood that the amount of sodium present in irrigation water will cause permeability problems. An SAR greater than 10 to 15 can cause permeability problems in some soil types.
SIMP	Spray irrigation management plan.
SS	Suspended solids.
Temp	Temperature, measured in ˚C (degrees Celsius).
t/hr	Tonnes per hour.
TKN	Total Kjeldahl Nitrogen. A measure of the total concentration of organic nitrogen and ammonia, normally expressed in terms of the mass of nitrogen (N).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

For further information on analytical methods, contact an Environment Quality Manager.

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Appendix I

Resource consents held by Fonterra Limited

(For a copy of the signed resource consent
please contact the TRC consent department)

Water Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	9 June 1999
Commencement Date:	9 June 1999

Conditions of Consent

Consent Granted:	To take and use up to 19,500 cubic metres/day [225 litres/second] of water from the Kaupokonui Stream for cooling water and general purposes associated with lactose manufacturing
Expiry Date:	1 June 2019
Site Location:	Kaupokonui Stream, Manaia Road, Kapuni Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697840E-5629660N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such ecological monitoring associated with the abstraction of water from the Kaupokonui Stream as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.

2. That the consent holder shall operate and maintain a measuring device capable of accurately recording daily rates of abstraction and shall measure, record and make such records available to the Chief Executive, Taranaki Regional Council, on a monthly basis.

3. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004, June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	9 June 1999
Commencement Date:	9 June 1999

Conditions of Consent

Consent Granted:	To discharge up to 19,500 cubic metres/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream
Expiry Date:	1 June 2019
Site Location:	Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629660N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such physicochemical and ecological monitoring of the cooling water wastes, and the receiving waters (Kaupokonui Stream) as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.

2. That allowing for a mixing zone of 150 metres extending downstream of the periphery of the spray discharge zone, the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to all or any of the following effects in the receiving water:

(a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(b) any conspicuous change in the colour or visual clarity;
(c) any emission of objectionable odour;
(d) the rendering of fresh water unsuitable for consumption by farm animals;
(e) any significant adverse effects on aquatic life, habitats, or ecology;
(f) any visible bacterial and/or fungal growths in the receiving water.

3. That the discharge (in conjunction with any other discharges pertaining to the same site) shall not raise the average daily GFC (glass fibre) filtered five day biochemical oxygen demand of the receiving water above 2 gm^{-3} when measured at a site 150 metres downstream of the periphery of the spray discharge zone.

4. That the discharge (in conjunction with any discharges pertaining to the same site) shall not:

   a) alter the ambient temperature of the receiving water by more than 2 degrees Celsius for 90% of the time that the discharge is occurring on an annual basis; and

   b) alter the ambient temperature of the receiving water by more than 3 degrees Celsius at all times;

   when measured simultaneously immediately upstream and 150 metres downstream of the periphery of the spray discharge zone.

5. That the discharge shall not increase the temperature of the receiving water above 25 degrees Celsius at the periphery of the mixing zone defined in condition 2.

6. That the consent holder shall continuously monitor the temperature of the receiving waters in compliance with conditions 4 and 5, and forward the results of this monitoring to the Chief Executive, Taranaki Regional Council, at monthly intervals.

7. That the Taranaki Regional Council may review conditions 4 and 5 of this consent in June 2001, for the purpose of evaluating the performance of the cooling system in achieving compliance with these conditions.

8. That within the designated mixing zone, and including those waters of the Kaupokonui Stream directly receiving the cooling water discharge, the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to:

   a) a thermal barrier preventing the movement of fish species; and/or
   b) any visible bacterial and/or fungal slime growths.

9. That no anti-corrosion agents, biocides, anti-flocculants or other chemicals shall be added to the cooling water without the written permission of the Chief Executive, Taranaki Regional Council.

10. That by the agreement of the consent holder, the consent holder shall mitigate the effects of the discharge by:

    a) the maintenance of existing riparian planting; and

    b) by donating annually to the Taranaki Tree Trust $3,000 (goods and services tax exclusive) for the purpose of providing long term riparian management in the Kaupokonui Stream catchment above the discharge. The amount shall be adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation.

11. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice or review during the month of June 2004, June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Water Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	4 February 1999
Commencement Date:	4 February 1999

Conditions of Consent

Consent Granted:	To take up to 700 cubic metres/day of water from a bore in the Kaupokonui catchment for factory cooling water using plate heat exchangers
Expiry Date:	1 June 2017
Site Location:	Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629660N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall operate, to the satisfaction of the Chief Executive, Taranaki Regional Council, a measuring device capable of recording groundwater levels and daily and continuous rates of abstraction and shall make records available to the Chief Executive, Taranaki Regional Council.

2. That the consent holder shall allow the Taranaki Regional Council, its employees or agents, access to the bore at all reasonable times, for the purpose of inspecting the bore and/or taking samples of water or other material for analytical purposes.

3. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which either were not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	4 February 1999
Commencement Date:	4 February 1999

Conditions of Consent

Consent Granted:	To discharge up to 850 cubic metres/day of cooling water from plate heat exchangers and plant cooling system into an unnamed tributary of the Motumate Stream at two different locations
Expiry Date:	1 June 2017
Site Location:	Manaia Road Kapuni
Legal Description:	Pt Sec 14 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697930E-5629670N
Catchment:	Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That beyond a reasonable mixing zone extending to the confluence of the unnamed tributary and the Motumate Stream, the discharges shall not give rise to all or any of the following effects in the receiving water:

(i) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(ii) any conspicuous change in the colour or visual clarity;
(iii) any emission of objectionable odour;
(iv) the rendering of freshwater unsuitable for consumption by farm animals, and;
(v) any significant adverse effects on aquatic life, habitats, or ecology.

2. That the consent holder shall monitor the daily volume and temperature of the discharge, to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall make such records available to the Chief Executive, Taranaki Regional Council, on a monthly basis.

3. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which either were not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date (Change):	15 July 2015
Commencement Date (Change):	15 July 2015 (Granted Date: 9 June 1999)

Conditions of Consent

Consent Granted:	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land
Expiry Date:	1 June 2019
Site Location:	893-911 Manaia Road, Kapuni
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697240E-5630126N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

    i) the administration, monitoring and supervision of this consent; and
    ii) charges authorised by regulations.

Special conditions

1. The consent holder shall maintain an effluent spray irrigation management plan, to the satisfaction of the Chief Executive, Taranaki Regional Council, which shall address the following matters:

    a) control of effluent application rate;
    b) monitoring of the effluent (physicochemical);
    c) monitoring of groundwater beneath the irrigated area (physicochemical);
    d) monitoring of drainage water downslope of the irrigated area (physicochemical);
    e) monitoring of the Kaupokonui Stream (physicochemical and biological);
    f) livestock management;
    g) irrigator maintenance and rotation;
    h) farm management and operator training;
    i) contingency events;
    j) the dairy industry guidelines;
    k) riparian planting and management; and
    l) the inclusion of dairy effluent.

2. The maximum volume of discharge shall not exceed 2,630 cubic metres over two consecutive days, including a maximum 120 cubic metres per day of dairy effluent.

3. The consent shall be exercised in accordance with the procedures set out in the effluent spray irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and all other matters specified in the effluent spray irrigation management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the effluent spray irrigation management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.

4. The spray irrigation management plan described in special condition 1 of this consent shall be subject to review upon two months' notice by either the consent holder or the Taranaki Regional Council. Further, the consent holder shall review the spray irrigation management plan annually and shall provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 1 July each year.

5. The consent holder shall ensure that:

   a) the operation of the spray irrigation system shall be carried out at all times in accordance with the requirements of the effluent spray irrigation management plan required in special condition 1 or subsequent version of that document which does not lessen environmental protection standards;

   b) all relevant site staff are to be regularly trained on the content and implementation of the effluent spray irrigation management plan, the maximum period between training sessions being 12 months. Relevant new staff are to be trained on recruitment and the training record made available to the Chief Executive, Taranaki Regional Council, upon request; and

   c) all relevant site staff are advised immediately of any revision or additions to the effluent spray irrigation management plan.

6. There shall be no direct discharge of effluent into any watercourse.

7. The spray irrigation system shall not be operated in a manner that causes ponding.

8. From the edge of the spray zone there shall be at least 20 metres to the bank of any watercourse.

9. The consent holder shall monitor and record on a daily basis the volume of effluent produced, the volume of effluent spray irrigated, the area spray irrigated and the hours the irrigation pumps are working; and shall make such records, together with groundwater monitoring data, available to the Chief Executive, Taranaki Regional Council, upon request.

10. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004 and/or June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 15 July 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date (Change):	15 July 2015
Commencement Date (Change):	15 July 2015 (Granted Date: 9 June 1999)

Conditions of Consent

Consent Granted:	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land
Expiry Date:	1 June 2019
Site Location:	560A & 586 Manaia Road & 1319 Skeet Road, Kapuni
Legal Description:	Lot 2 DP 5897 Lots 1 & 2 6039 Lot 6 DP 2903 Lot 3 DP 3601 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697811E-5627168N
Catchment:	Waiokura Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

    i) the administration, monitoring and supervision of this consent; and
    ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The consent holder shall maintain an effluent spray irrigation management plan, to the satisfaction of the Chief Executive, Taranaki Regional Council, which shall address the following matters:

    a) control of effluent application rate and duration;
    b) application frequency
    c) designated application areas;
    d) prevention of runoff and ponding
    e) monitoring of the effluent (physicochemical);
    f) monitoring of groundwater beneath the irrigated area (physicochemical);
    g) monitoring of drainage water downslope of the irrigated area (physicochemical);
    h) monitoring of the Waiokura and Motumate Streams (physicochemical and biological);
    i) monitoring of soils and herbage (physicochemical);
    j) minimisation and control of odour effects offsite;
    k) livestock management;
    l) soil and herbage management;
    m) irrigator maintenance and rotation;
    n) farm management and operator training;
    o) contingency events;
    p) reporting monitoring data;
    q) notification to the council of non-compliance with conditions of this consent;
    r) the dairy industry guidelines;
    s) riparian planting and management; and
    t) the inclusion of dairy effluent.

3. The maximum volume of discharge shall not exceed 3,834 cubic metres over two consecutive days, including a maximum 168 cubic metres per day of dairy effluent.

4. The consent shall be exercised in accordance with the procedures set out in the effluent spray irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and all other matters specified in the effluent spray irrigation management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the effluent spray irrigation management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.

5. The spray irrigation management plan described in special condition 2 of this consent shall be subject to review upon two months' notice by either the consent holder or the Taranaki Regional Council. Further, the consent holder shall review the spray irrigation management plan annually and shall provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 1 July each year.

6. The consent holder shall ensure that:

   a) the operation of the spray irrigation system shall be carried out at all times in accordance with the requirements of the effluent spray irrigation management plan required in special condition 2 or subsequent version of that document which does not lessen environmental protection standards;

   b) all relevant site staff are to be regularly trained on the content and implementation of the effluent spray irrigation management plan, the maximum period between training sessions being 12 months. Relevant new staff are to be trained on recruitment and the training record made available to the Chief Executive, Taranaki Regional Council, upon request; and

   c) all relevant site staff are advised immediately of any revision or additions to the effluent spray irrigation management plan.

7. There shall be no offensive or objectionable odour as a result of the exercise of this consent at or beyond the boundary of the property or properties on which spray irrigation is occurring.

8. There shall be no spray drift as a result of the exercise of this consent at or beyond the boundary of the property or properties on which spray irrigation is occurring.

9. There shall be no direct discharge of any type of effluent into any watercourse.

10. The spray irrigation system shall not be operated in a manner that causes ponding.

11. The edge of the spray zone shall be at least:

   (a) 20 metres from the bank of any watercourse;
   (b) 10 metres from any property boundary, except as detailed in c);
   (c) 20 metres from the boundary with the property described as Lot 1 DP3601, Blk XV, Kaupokonui SD, unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance.

12. Should monitoring of the discharge under conditions 13 and 14 indicate, in the opinion of the Chief Executive, Taranaki Regional Council, contamination of local groundwater or a water supply from the roof of a dwelling house as a result of the exercise of this consent the consent holder shall:

    (a) undertake appropriate remedial action as soon as practicable as described in the wastewater irrigation management plan prepared under condition 2, or other such action reasonably required by the Chief Executive, Taranaki Regional Council;

    (b) shall review the wastewater irrigation management plan and incorporate such reasonable modifications as are considered necessary by the Chief Executive, Taranaki Regional Council; and

    (c) where water supplies are significantly affected immediately provide alternative supplies as reasonably required by the Chief Executive, Taranaki Regional Council.

13. The consent holder shall site, install and maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge.

14. The consent holder shall monitor and record on a daily basis the volume of effluent produced, the volume of effluent spray irrigated, the area spray irrigated and the hours the irrigation pumps are working; and shall make such records, together with groundwater monitoring data, available to the Chief Executive, Taranaki Regional Council, upon request.

15. The consent holder may apply to the Taranaki Regional Council for a change or cancellation of the conditions of this consent, in accordance with section 127(1)(a) of the Resource Management Act 1991, to take into account of operational requirements, the results of monitoring, or irrigation scheme expansion.

16. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 15 July 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	9 June 1999
Commencement Date:	9 June 1999

Conditions of Consent

Consent Granted:	To discharge up to 1,440 cubic metres/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream
Expiry Date:	1 June 2019
Site Location:	Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629560N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such physicochemical and ecological monitoring of the stormwater and cooling water discharges, and the receiving waters (Kaupokonui Stream) as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.

2. That allowing for a mixing zone of 150 metres extending downstream of the periphery of the spray discharge zone, the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to all or any of the following effects in the receiving water:

a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;

b) any conspicuous change in the colour or visual clarity;

c) any emission of objectionable odour;

d) the rendering of fresh water unsuitable for consumption by farm animals;

e) any significant adverse effects on aquatic life, habitats, or ecology;

f) any visible biological and/or fungal growths in the receiving water.

3. That the discharge (in conjunction with any other discharges pertaining to the same site) shall not raise the average daily GFC (glass fibre) filtered five day biochemical oxygen demand (BOD(5)) of the receiving water above 2 gm^{-3} when measured at a site 150 metres downstream of the periphery of the spray discharge zone.

4. That the discharge (in conjunction with any other discharges pertaining to the same site) shall not:

   a) alter the ambient temperature of the receiving water by more than 2 degrees Celsius for 90% of the time that the discharge is occurring on an annual basis; and

   b) alter the ambient temperature of the receiving water by more than 3 degrees Celsius at all times;

   when measured simultaneously immediately upstream and 150 metres downstream of the periphery of the spray discharge zone.

5. That the discharge shall not increase the temperature of the receiving water above 25 degrees Celsius at the periphery of the mixing zone defined in condition 2.

6. That the consent holder shall continuously monitor the temperature of the receiving waters in compliance with conditions 4 and 5, and forward the results of this monitoring to the Chief Executive, Taranaki Regional Council, at monthly intervals.

7. That the Taranaki Regional Council may review conditions 4 and 5 of this consent in June 2001, for the purpose of evaluating the performance of the cooling system in achieving compliance with these conditions.

8. That the discharge shall comply with the following limits at all times:

a)	oil and grease (Freon extractable)	<15 gm^{-3}
b)	pH (within the range)	6.0 - 8.5
c)	suspended solids	<100 gm^{-3}

9. That within the designated mixing zone, and including those waters of the Kaupokonui Stream directly receiving the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to:

   i) a barrier preventing the movement of fish species and/or;
   ii) any visible bacterial and/or fungal slime growths.

10. That no anti-corrosion agents, biocides, anti-flocculants or other chemicals shall be added to the cooling water without the written permission of the Chief Executive, Taranaki Regional Council.

11. That the consent holder shall maintain a contingency plan, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent, and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge. This contingency plan shall be reviewed and updated (if necessary) on an annual basis.

12. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004, June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date (Change):	2 June 2004
Commencement Date (Change):	2 June 2004 (Granted Date: 17 April 2000)

Conditions of Consent

Consent Granted:	To discharge emissions into the air from the manufacture, drying, packaging and storage of lactose and associated processes and from the inhalation grade lactose plant
Expiry Date:	1 June 2019
Site Location:	Manaia Road, Kapuni
Legal Description:	Pt Lot 1 DP 6157 Lots 1-9 DP 6588 Lot 1 DP 9769 Blk XV Kaupokonui SD Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697840E-5629860N

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any emissions of particulate matter during loading, processing, unloading, packaging, drying, transport or any other site operation.

2. Nothing in these conditions shall remove from the consent holder the obligations, liabilities, duties and/or responsibilities specified in section 17 of the Resource Management Act 1991 or any other part of the Act.

3. The particulate from the wet scrubber system, which treats the exhaust streams from the pre-drier stack and the refined fluid bed drier, shall not exceed 125 milligrams per cubic metre of air, adjusted to 0 degrees Celsius, 1 atmosphere pressure and calculated as a dry gas.

4. No alteration shall be made to plant or process which may substantially change the nature or quality of contaminants emitted without prior consultation with the Chief Executive, Taranaki Regional Council.

5. The discharge shall not result in dangerous levels of airborne contaminants at or beyond the boundary of the property, including but not limited to any risk of fire or explosion.

6. The discharge shall not result in offensive or objectionable dust or odour at or beyond the boundary of the property.

7. The consent holder may apply to the Council for a change or cancellation of any of the conditions of this consent in accordance with section 127(1)(a) of the Resource Management Act 1991 to take account of operational requirements or the results of monitoring.

8. The discharge shall not result in noxious or toxic levels of airborne contaminants at or beyond the boundary of the property.

9. Subject to the provisions of this condition, the Taranaki Regional Council may in June 2004 and/or June 2009 and/or June 2014, serve notice that it intends to review any condition of the resource consent, in accordance with section 128(1)(a) of the Resource Management Act 1991, for the purpose of:

   a) dealing with any significant adverse effect on the environment arising from the exercise of this consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; or

   b) further specifying the best practicable option to remove or reduce any adverse effect on the environment caused by any discharge to air; or

   c) to add limits on discharge or ambient concentration of any contaminant or contaminants.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	4 February 1999
Commencement Date:	4 February 1999

Conditions of Consent

Consent Granted:	To discharge up to 280 litres/second of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream
Expiry Date:	1 June 2017
Site Location:	Factory Extension Site, Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629860N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That allowing for a reasonable mixing zone of 50 metres extending downstream of the discharge point, the discharge shall not give rise to all or any of the following effects in the receiving water:

(i) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(ii) any conspicuous change in the colour or visual clarity;
(iii) any emission of objectionable odour;
(iv) the rendering of fresh water unsuitable for consumption by farm animals; and
(v) any significant adverse effects on aquatic life, habitats or ecology.

2. That the discharge shall not exceed the following parameters:

(i)	oil and grease	<15 g/m^3
(ii)	pH [within the range]	6.0 - 8.5
(iii)	suspended solids	100 gm^3

3. That prior to the exercise of this consent, the consent holder shall prepare a contingency plan to be approved by the Chief Executive, Taranaki Regional Council, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.

4. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which either were not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	14 December 2017
Commencement Date:	14 December 2017

Conditions of Consent

Consent Granted:	To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes
Expiry Date:	1 June 2019
Site Location:	879 Manaia Road, Kapuni
Grid Reference (NZTM)	1697665E-5629707N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. This consent authorises the ongoing use of the weir existing at the time the application for this consent was lodged, and as described in the application. Any change to the nature or scale of the structure may therefore need to be authorised by a formal process in accordance with the Resource Management Act, 1991.

2. The consent holder shall maintain the structure in a safe and sound condition such that it continues to function effectively.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to commencement of maintenance work that involves disturbance of, or deposition to the stream bed, or discharges to water. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

4. The weir shall not restrict the passage of fish.

Signed at Stratford on 14 December 2017

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	13 July 2004
Commencement Date:	13 July 2004

Conditions of Consent

Consent Granted:	To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream
Expiry Date:	1 June 2017
Site Location:	Manaia Road, Kapuni
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697810E-5629840N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. Prior to the exercise of this consent, the consent holder shall prepare a contingency plan to be approved by the Chief Executive, Taranaki Regional Council, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.

2. The exercise of this consent shall be conducted in general accordance with the information submitted in support of application 3198, and to ensure that the conditions of this consent are met at all times. In the case of any contradiction between the documentation submitted in support of application 3198 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on any water body.

4. The following concentrations shall not be exceeded in the discharge:

Component	**Concentration**
pH (range)	6.5 - 8.5
suspended solids	100 gm^{-3}
total recoverable hydrocarbons [infrared spectroscopic technique]	15 gm^{-3}

This condition shall apply prior to the entry of the stormwater into the Kaupokonui Stream at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

5. After allowing for reasonable mixing, within a mixing zone extending 50 metres downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving waters of the Kaupokonui Stream:

   a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
   b) any conspicuous change in the colour or visual clarity;
   c) any emission of objectionable odour;
   d) the rendering of fresh water unsuitable for consumption by farm animals;
   e) any significant adverse effects on aquatic life.

6. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	18 September 2006
Commencement Date:	18 September 2006

Conditions of Consent

Consent Granted:	To erect, place, maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purposes of conveying irrigation wastewater
Expiry Date:	01 June 2023
Review Date(s):	June 2017
Site Location:	Skeet and Manaia Roads, Kapuni
Legal Description:	Lot 6 DP 2903 Lot 3 DP 3601 Blk XV Kaupokonui SD, Lots 1 & 2 DP 6039 Blk III Waimate SD, Lot 2 DP 5897 Pt Secs 25 & 26 Blk III Waimate SD
Grid Reference (NZTM)	1697950E-5627960N
Catchment:	Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4339. In the case of any contradiction between the documentation submitted in support of application 4339 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least seven days prior to the exercise of this consent.

4. The consent holder shall adopt the best practicable option to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.

6. Any disturbance of parts of the river bed covered by water and/or any maintenance works which may result in downstream discolouration of water shall be undertaken only between 1 November and 30 April except where this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.

7. The structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

8. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

9. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and/or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	23 May 2007
Commencement Date:	23 May 2007

Conditions of Consent

Consent Granted:	To erect, place and maintain a stone lined bank on the left bank of Dunns Creek for erosion control purpose
Expiry Date:	1 June 2023
Review Date(s):	June 2017
Site Location:	901 Manaia Road, Kapuni - Fonterra Kapuni No 1 Farn
Legal Description:	Lot 1 DP 45096 Sec 1 SO 11967 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697230E-5630180N
Catchment:	Kaupokonui
Tributary:	Dunns Creek

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4650. In the case of any contradiction between the documentation submitted in support of application 4650 and the conditions of this consent, the conditions of this consent shall prevail.

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least seven days prior to the exercise of this consent. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable only if the consent holder does not have access to email.

3. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

4. Except with the written agreement of the Chief Executive, Taranaki Regional Council, the structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

5. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

6. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and/or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	18 April 2013
Commencement Date:	18 April 2013

Conditions of Consent

Consent Granted:	To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation
Expiry Date:	1 June 2029
Review Date(s):	June 2017, June 2023
Site Location:	586 Manaia Road, Kapuni
Legal Description:	Lot 1 DP 6039 Blk III Waimate SD (Site of structure)
Grid Reference (NZTM)	1698317E-5627432N
Catchment:	Waiokura

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 2 working days prior to the commencement of work. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

2. Installation shall include two culvert pipes with a diameter no less than 1.35 metres, and a total length no greater than 17.5 metres.

3. The fill over the top of the twin culvert pipes shall be no deeper than 3 metres.

4. The stream banks shall be shaped both upstream and downstream of the twin culvert to form a gradual transition between the existing channel width and the twin culvert.

5. The consent holder shall ensure that rock rip rap armouring is placed on the reshaped channel batters and the streambed, for at least 5 metres, both upstream and downstream of the culvert.

6. The rock rip rap required by condition 5 shall be placed at a slope no steeper than 1.5 horizontal to 1 vertical, and shall have the following grading:

    - 100% less than 800 mm diameter
    - 50% greater than 600 mm diameter
    - 90% greater than 350 mm diameter

7. The consent holder shall ensure that a layer of rock rip rap, at least 500 mm thick, is placed on the batters of the fill embankment.

8. The rock rip rap required by condition 7 shall be placed at a slope no steeper than 1.5 horizontal to 1 vertical, and shall have the following grading:

    - 100% less than 450 mm diameter
    - 50% greater than 300 mm diameter
    - 90% greater than 310 mm diameter

9. Any concrete work carried out in the river bed shall be completely separated from running water, by a temporary coffer-dam and/or diversion using sand bags or some other form of contained of fill.

10. The consent holder shall ensure that any concrete placed in the channel is not exposed to flowing water for a period of 48 hours after it has been placed.

11. No instream works shall take place between 1 June and 31 October inclusive.

12. The consent holder shall ensure that the area and volume of stream bed disturbance is, as far as practicable, minimised and any areas that are disturbed are, as far as practicable, reinstated.

13. The culvert shall not obstruct fish passage.

14. The invert of each culvert pipe shall be set 300 mm below the natural streambed.

15. The gradient of each culvert pipe shall be no steeper than the natural gradient of the stream bed at the site.

16. The consent holder shall take all reasonable steps to:

    a. minimise the amount of sediment discharged to the stream;
    b. minimise the amount of sediment that becomes suspended in the stream; and
    c. mitigate the effects of any sediment in the stream.

    Undertaking work in accordance with *Guidelines for Earthworks in the Taranaki region,* by the Taranaki Regional Council, will achieve compliance with this condition.

17. All earthwork areas shall be stabilised as soon as is practicable immediately following completion of soil disturbance activities.

    Note: For the purpose of this condition "stabilised" in relation to any site or area means inherently resistant to erosion or rendered resistant, such as by using indurated rock or by the application of basecourse, colluvium, grassing, mulch, or another method to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council and as specified in Taranaki Regional Council's Guidelines for Earthworks in the Taranaki Region, 2006. Where seeding or grassing is used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once, on reasonable visual inspection by an Investigating Officer, Taranaki Regional Council, an 80% vegetative cover has been established.

18. The works shall remain the responsibility of the consent holder and be maintained so that:

    a. it does not become blocked and at all times allows the free flow of water through it;
    b. any erosion, scour or instability of the stream bed or banks that is attributable to the works carried out as part of this consent is remedied by the consent holder.

19. In the event that any archaeological remains are discovered as a result of works authorised by this consent, the works shall cease immediately at the affected site and tangata whenua and the Chief Executive, Taranaki Regional Council, shall be notified within one working day. Works may recommence at the affected area when advised to do so by the Chief Executive, Taranaki Regional Council. Such advice shall be given after the Chief Executive has considered: tangata whenua interest and values, the consent holder's interests, the interests of the public generally, and any archaeological or scientific evidence. The New Zealand Police, Coroner, and Historic Places Trust shall also be contacted as appropriate, and the work shall not recommence in the affected area until any necessary statutory authorisations or consents have been obtained.

20. Except with the written agreement of the Chief Executive, Taranaki Regional Council, the culvert shall be removed and the area reinstated, if and when it is no longer required. A further resource consent may be required to authorise the removal of the structure, and the consent holder is advised to seek advice from the Council on this matter.

21. This consent shall lapse on 30 June 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

22. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2017 and/or June 2023, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	5 February 2016
Commencement Date:	5 February 2016

Conditions of Consent

Consent Granted:	To discharge solid farm dairy effluent onto and into land
Expiry Date:	1 June 2041
Review Date(s):	June 2023, June 2029, June 2035 and in accordance with special condition 11
Site Location:	1291 Skeet Road; 560 A & B, 586 and 594 Manaia Road, Kapuni (Kapuni Farms)
Legal Description:	Lot 2 DP 5897 Lot 2 DP 6039 Blk III Waimate SD, Lot 6 DP 2903 Lot 3 DP 3601 Blk XV Kaupokonui SD (Discharge source & site)
Grid Reference (NZTM)	1698545E–5626837N; 1698551E–5627075N 1698184E–5627034N; 1697499E–5626999N 1698510E–5627964N; 1698564E–5628854N
Catchment:	Waiokura Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent authorises the discharge of pond sludge from farm dairy effluent onto land. For the purposes of this consent:

   a) Farm dairy includes every area of the dairy cow milking process and includes covered and uncovered areas where cows reside for longer than five minutes for the purpose of milking (including a stand-off pad or yard) but does not include raceways; and

   b) 'Effluent' includes slurry and solid forms. It also includes sand trap cleanings.

2. A maximum of 500 m^3/year of dried solid effluent shall be discharged to 9.23 ha of land.

3. The consent holder shall advise the Taranaki Regional Council by sending an email to consents@trc.govt.nz if the volume of dairy farm exceeds the amount authorised in condition 2. The email shall include the consent number or dairy supply number.

4. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on the environment.

5. A stormwater diversion system and a sand trap system shall be installed, maintained and operated at the farm dairy. The diversion system shall prevent, as far as practicable, uncontaminated stormwater entering the effluent disposal system.

   Note. Farm dairy includes any stand-off pad or yard (see condition 1(a)).

6. No contaminants shall be discharged within:

   (a) 25 metres of any surface water body; or
   (b) 25 metres of any fenced urupa (burial ground) without the written approval of the relevant Iwi; or
   (c) 50 metres of any bore, well or spring used for water supply purposes; or
   (d) 150 metres of any dwelling that is not owned by the consent holder, or any marae, unless the written approval of the owner and occupier has been obtained to allow the discharge at a closer distance.

7. Over any 12 month period the Total Nitrogen applied to any hectare of land as a result of the discharge shall be no more than 200 kg.

   Advice Note: Any Nitrogen applied within effluent should be taken into account in the nutrient budget for that land.

8. The consent holder shall keep accurate records of effluent discharged including, but not necessarily limited to the:

   (a) effluent type (e.g. liquid, slurry, solid);
   (b) source of any solid effluent (e.g. anaerobic pond sludge, sand trap);
   (c) paddock and area (ha) that effluent was applied to; and
   (d) date the paddock received effluent.

   This information shall be provided to the Taranaki Regional Council upon request.

9. Where, for any cause (accidental or otherwise), effluent enters surface water or a subsurface drainage system, the consent holder shall:

   (a) immediately notify the Taranaki Regional Council on Ph. 0800 736 222 (notification must include either the consent number or farm dairy number); and
   (b) stop the discharge and immediately take steps to control and stop the escape of effluent to surface water; and
   (c) immediately take steps to ensure that a recurrence of the escape of effluent to surface water is prevented; and
   (d) report in writing to the Chief Executive, Taranaki Regional Council, describing the manner and cause of the escape and the steps taken to control it and to prevent it reoccurring. The report shall be provided to the Chief Executive within seven days of the occurrence.

10. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2023 and/or June 2029 and/or June 2035, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

11. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review within a period of 12-months immediately following a Regional Plan, that includes rules relating to discharges of farm dairy effluent, becoming operative. Any such review would be for the purposes of ensuring that the consent conditions have appropriate regard to that plan.

Signed at Stratford on 5 February 2016

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	5 February 2016
Commencement Date:	5 February 2016

Conditions of Consent

Consent Granted:	To discharge pond sludge from farm dairy effluent onto and into land
Expiry Date:	1 June 2041
Review Date(s):	June 2023, June 2029, June 2035 and in accordance with special condition 11
Site Location:	893, 901, 911 Manaia Road, Kapuni (Kapuni 1)
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD, Lot 6 Pt Lot 5 DP 4509 Pt Lot 2 DP 6157 Secs 51 & 55 Blk XV Kaupokonui SD (Discharge source & site)
Grid Reference (NZTM)	1697477E–5629140N 1696786E–5630300N 1697978E–5630246N
Catchment:	Kaupokonui
Tributary:	Dunns Creek

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent authorises the discharge of solid farm dairy effluent onto land. For the purposes of this consent:

   a) Farm dairy includes every area of the dairy cow milking process and includes covered and uncovered areas where cows reside for longer than five minutes for the purpose of milking (including a stand-off pad or yard) but does not include raceways; and

   b) 'Effluent' includes slurry and solid forms. It also includes sand trap cleanings.

2. A maximum of 1000 m^3/year of the solid farm dairy effluent shall be discharged to 14.1 ha of land.

3. The consent holder shall advise the Taranaki Regional Council by sending an email to consents@trc.govt.nz if the volume of dairy farm exceeds the amount authorised in condition 2. The email shall include the consent number or dairy supply number.

4. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on the environment.

5. A stormwater diversion system and a sand trap system shall be installed, maintained and operated at the farm dairy. The diversion system shall prevent, as far as practicable, uncontaminated stormwater entering the effluent disposal system.

   Note. Farm dairy includes any stand-off pad or yard (see condition 1(a)).

6. No contaminants shall be discharged within:

   (a) 25 metres of any surface water body; or
   (b) 25 metres of any fenced urupa (burial ground) without the written approval of the relevant Iwi; or
   (c) 50 metres of any bore, well or spring used for water supply purposes; or
   (d) 150 metres of any dwelling that is not owned by the consent holder, or any marae, unless the written approval of the owner and occupier has been obtained to allow the discharge at a closer distance.

7. Over any 12 month period the Total Nitrogen applied to any hectare of land as a result of the discharge shall be no more than 200 kg.

   Advice Note: Any Nitrogen applied within effluent should be taken into account in the nutrient budget for that land.

8. The consent holder shall keep accurate records of effluent discharged including, but not necessarily limited to the:

   (a) effluent type (e.g. liquid, slurry, solid);
   (b) source of any solid effluent (e.g. anaerobic pond sludge, sand trap);
   (c) paddock and area (ha) that effluent was applied to; and
   (d) date the paddock received effluent.

   This information shall be provided to the Taranaki Regional Council upon request.

9. Where, for any cause (accidental or otherwise), effluent enters surface water or a subsurface drainage system, the consent holder shall:

   (a) immediately notify the Taranaki Regional Council on Ph. 0800 736 222 (notification must include either the consent number or farm dairy number); and
   (b) stop the discharge and immediately take steps to control and stop the escape of effluent to surface water; and
   (c) immediately take steps to ensure that a recurrence of the escape of effluent to surface water is prevented; and
   (d) report in writing to the Chief Executive, Taranaki Regional Council, describing the manner and cause of the escape and the steps taken to control it and to prevent it reoccurring. The report shall be provided to the Chief Executive within seven days of the occurrence.

10. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2023 and/or June 2029 and/or June 2035, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

11. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review within a period of 12-months immediately following a Regional Plan, that includes rules relating to discharges of farm dairy effluent, becoming operative. Any such review would be for the purposes of ensuring that the consent conditions have appropriate regard to that plan.

Signed at Stratford on 05 February 2016

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	10 March 2017
Commencement Date:	10 March 2017

Conditions of Consent

Consent Granted:	To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed
Expiry Date:	01 June 2035
Review Date(s):	June 2023, June 2029
Site Location:	1319 Skeet Road, Kapuni
Grid Reference (NZTM)	1698599E - 5628827N
Catchment:	Waiokura

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The culvert pipe shall be made up of 2 pipes with diameters of no less than 1350 mm each and be no longer than 12 metres.

2. The fill over the top of the culvert pipe shall be no deeper than 1.5 metres.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 2 working days prior to the commencement of work. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

4. Between 1 May and 31 October no work shall be undertaken on any part of the stream bed that is covered by water.

5. The consent holder shall take all practicable steps to minimise stream bed disturbance, sedimentation and increased turbidity during installation of the culvert, including by:
   a) completing all works in the minimum time practicable;
   b) avoiding placement of excavated material in the flowing channel;
   c) keeping machinery out of the actively flowing channel, as far as practicable; and
   d) reinstating any disturbed areas as far as practicable.

6. A layer of rock riprap 1200 mm thick shall be installed in the stream bed. The riprap shall extend 5 metres downstream of the culvert outlet and 5 metres upstream of the culvert inlet, 1.5 metres up the banks on both sides of the stream and on the batter slope of the fill on both sides of the culvert. The batter shall be no steeper than 1.5 horizontal and 1 vertical. The rock shall have the following grading:
   - 100% less than 800 mm diameter;
   - 50% greater than 600 mm diameter;
   - 90% greater than 350 mm diameter.

7. The culvert shall not restrict fish passage.

8. The invert of the culvert shall be set below the existing stream bed by 250 mm so that it fills with bed material and simulates the natural bed.

9. The gradient of the culvert shall be no steeper than the natural gradient of the stream bed at the site.

10. On completion of works, the banks of the channel upstream and downstream of the culvert installation shall be no steeper than the existing natural banks. Where the bank consists of fill, the fill must be well compacted with batter slopes no steeper than 2 horizontal to 1 vertical.

11. The culvert shall remain the responsibility of the consent holder and be maintained so that:
    a) it does not become blocked, and at all times allows the free flow of water through both pipes; and
    b) the consent holder repairs any erosion, scour or instability of the stream bed or banks that the culvert causes.

12. In the event that any archaeological remains are discovered as a result of works authorised by this consent, the works shall cease immediately at the affected site and tangata whenua and the Chief Executive, Taranaki Regional Council, shall be notified within one working day. Works may recommence at the affected area when advised to do so by the Chief Executive, Taranaki Regional Council. Such advice shall be given after the Chief Executive has considered: tangata whenua interest and values, the consent holder's interests, the interests of the public generally, and any archaeological or scientific evidence. The New Zealand Police, Coroner, and Historic Places Trust shall also be contacted as appropriate, and the work shall not recommence in the affected area until any necessary statutory authorisations or consents have been obtained.

13. This consent shall lapse on 31 March 2022, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

14. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2023 and/or June 2029, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 10 March 2017

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management