Fonterra Kapuni
Air and Water
Monitoring Programme
Annual Report
2019-2020

Technical Report 2020-63

Taranaki Regional Council
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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 (IGL) plant on the site operated by another entity, with stormwater discharges from the areas around this activity combined with those of the lactose plant under consents held by the Company. This report for the period July 2019 to June 2020 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 year under review the Company held 17 resource consents, which included a total of 155 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, five land use consents, and one consent to discharge emissions into the air at this site. Two of the consents, to discharge factory wastewater to land, were varied in July 2015 to include dairy shed effluent which previously had been discharged to surface water. Another two of the consents were granted in February 2016 to provide for the discharge of farm dairy solids and pond sludge to land. One of the land use consents was granted in March 2017 for the installation of a dual culvert in the Waiokura Stream to allow the reinstatement of a farm track across the stream. The replacement consent for the use of the weir associated with the water abstraction consent was granted in December 2017 for a period until June 2019. Four of the Company's consents expired in June 2017, with the applications put on hold so that the effects of these activities could be considered in combination with the effects of the seven further activities for which the consents expired in June 2019. Applications to renew these consents were received on 1 February 2019 and were put on hold until 19 December 2019 awaiting further information. There have been a number of further extensions to the timeframe by which the further information will be provided, most recently extended to 31 August 2020. There are a total of 11 consented activities where the Company is operating under the expired consents until a decision is made on the renewal, as provided for by Section 124 of the *Resource Management Act 1991* (RMA). The applications indicate that the Company wishes to amalgamate activities under single consents where appropriate.

During the monitoring period, the Company demonstrated an overall high level of environmental performance.

The Council's monitoring programmes for the period under review included 12 inspections, 167 water samples collected for physicochemical analysis, one fish survey, two macroinvertebrate surveys of receiving waters, five ambient air quality analyses, 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 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 installed. However, the ongoing transmission and validity of the data have resulted in the full terms of the agreement not being met within the agreed timeframe. The problems with data transmission were addressed during the 2017-2019 years. However the Council was advised that the location in which the equipment was installed has resulted in the agreed accuracy and validation not being achievable. As the written agreement brought this monitoring within the scope of condition 1 of consent 0919, this was recorded as a consent non-compliance This was resolved during the year under review, with the installation of a new flow metering system in a location that allowed all the data quality objectives to be met. The data

provided indicates that for the most part, the consumptive use is low at between 1 and 21 L/s for 76% of the time excluding losses that may be occurring as the cooling water is discharged via the spray nozzles.

Ecological monitoring did not note any problems 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 from the discharges of wastewater to land on the farms. However, in the macroinvertebrate survey reports it was noted that the sites used for the monitoring of the discharges of wastewater to land on the farms are still appropriate and in the fish survey report it was 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 reach of stream that is monitored under this programme.

Temperature increase limits on cooling water discharged to the Kaupokonui Stream were complied with throughout the review period. 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 year under review, 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 year under review, further structural and operational changes were made to the cooling water discharge system that ensure that the temperature differential restrictions on the consent were being met, whilst enabling the Company to operate the system in the most cost effective way. This resulted in the temperature of the cooling water being increased and a loss of some of the gains that would have been made in terms of the reduction in temperature within the mixing zone when compared to the 2018-2019 year.

Irrigation onto the two dairy farms was, in general, well managed, including the new dairy shed effluent. No effect from irrigation was found during inspection, sampling or biological monitoring of the Kaupokonui and Waiokura Streams. A 20 m buffer to the bank of water courses was maintained during irrigation activities observed at inspection.

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. During the year under review, there was a higher nitrogen load applied to the paddocks than in the 2017-2019 years. The nitrogen application rates increased by about 14% on Farm 1 and 20% on Farms 2 and 3. There was only one bore that was consistently above the drinking water standard, but there were four bores having an annual median above the standard, one of which was the control bore at the northern boundary of Farm 2. The trend of increasing nitrates at the bore that was consistently over the drinking water standard continued at the start of the 2020-2021 year. Therefore the Council requested that Company investigate and mitigate as per consent conditions and the Company's Whole Farm Management Plan. The outcomes of this will be discussed in the 2020-2021 Annual Report.

Two of the control bores (Farm 2 and Farm 3 control bores) continued to show significant increases in groundwater nitrate concentrations that are, at times, in excess of drinking water standards. 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. Sample results for the discharge samples collected by the Council were within those prescribed by consent conditions. The lactose deposition rates recorded at all sites were above their respective historical medians and all sites except AIR002031 were above the guideline value. However, this is not limited by the Company's consent and no complaints were received by Council in relation to deposited

particulates. Inspections also found no evidence of depositions. No odours were noted off site during the year under review

There was one consent non-compliance recorded during the year under review in relation to an unforeseen failure with the electronics associated with the recording of the water take abstraction. It could be demonstrated that there were no breaches of the abstraction limits in the period of time it took to undertake the repairs. In addition to this matter, there was the on-going non-compliance registered in the 2018-2019 year that was a contravention of the monitoring condition in relation to the cooling water discharge rate monitoring as outlined above. This non-compliance was resolved in September 2019.

The Company demonstrated a high level of environmental performance and compliance with resource consents as defined in Section 1.1.4.

With respect to the administrative performance, there were still ongoing issues with provision of accurate real time monitoring data that was due by 30 September 2015. A further agreement was made to resolve this issue by 30 September 2019 following the recording of this matter as a consent non-compliance in the 2018-2019. This was resolved in September 2019 therefore the Company's demonstrated a good level of administrative performance and compliance with resource consents as defined in Section 1.1.4.

For reference, in the 2019-2020 year, consent holders were found to achieve a high level of environmental performance and compliance for 81% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 17% of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations for the 2020-2021 year, and an indication of any matters that may need to be accommodated in the 2021-2022 year where possible.

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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 2019 to June 2020 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 whey 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 28th combined report and 31st 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 2020-2021 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 Company, this report also assigns them a rating for their environmental and administrative performance during the period under review.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or during investigations of incidents reported to the Council by a third party but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or during investigations of incidents reported to the Council by a third party. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or during investigations of incidents reported to the Council by a third party. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2019-2020 year, consent holders were found to achieve a high level of environmental performance and compliance for 81% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 17% of the consents, a good level of environmental performance and compliance was achieved. [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 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

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

condensers is discharged to the stream via spray nozzles that reduce the temperature of the condenser cooling water so as to minimise temperature rises in the stream.

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 Vector 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 a wet scrubber. The scrubber removes any fine 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 "Kapuni Farms". The name of the other farm remained "Farm 1". 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	

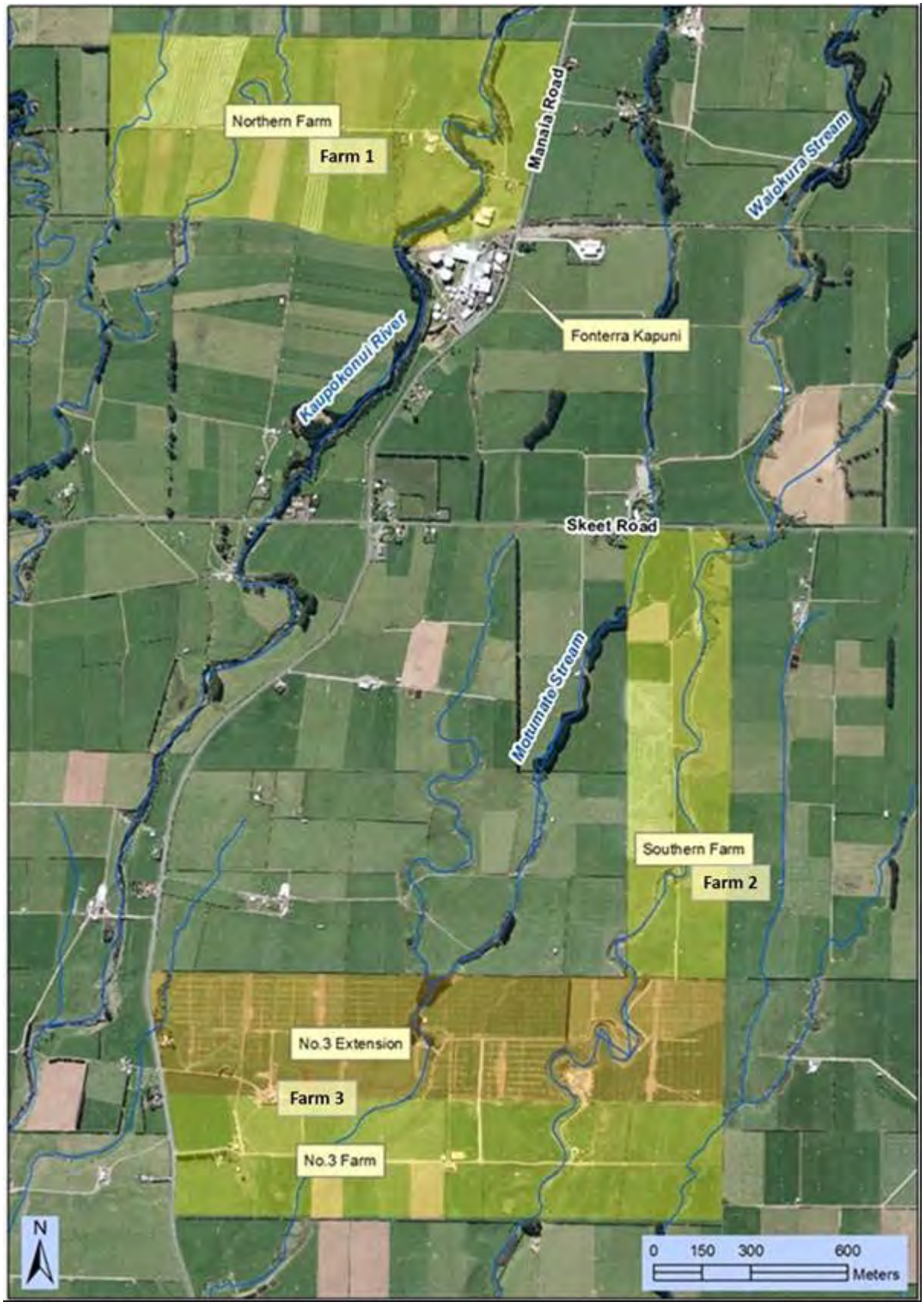

Figure 1 Location of Fonterra Ltd's lactose factory, farms and the Kaupokonui, Motumate and Waiokura Streams

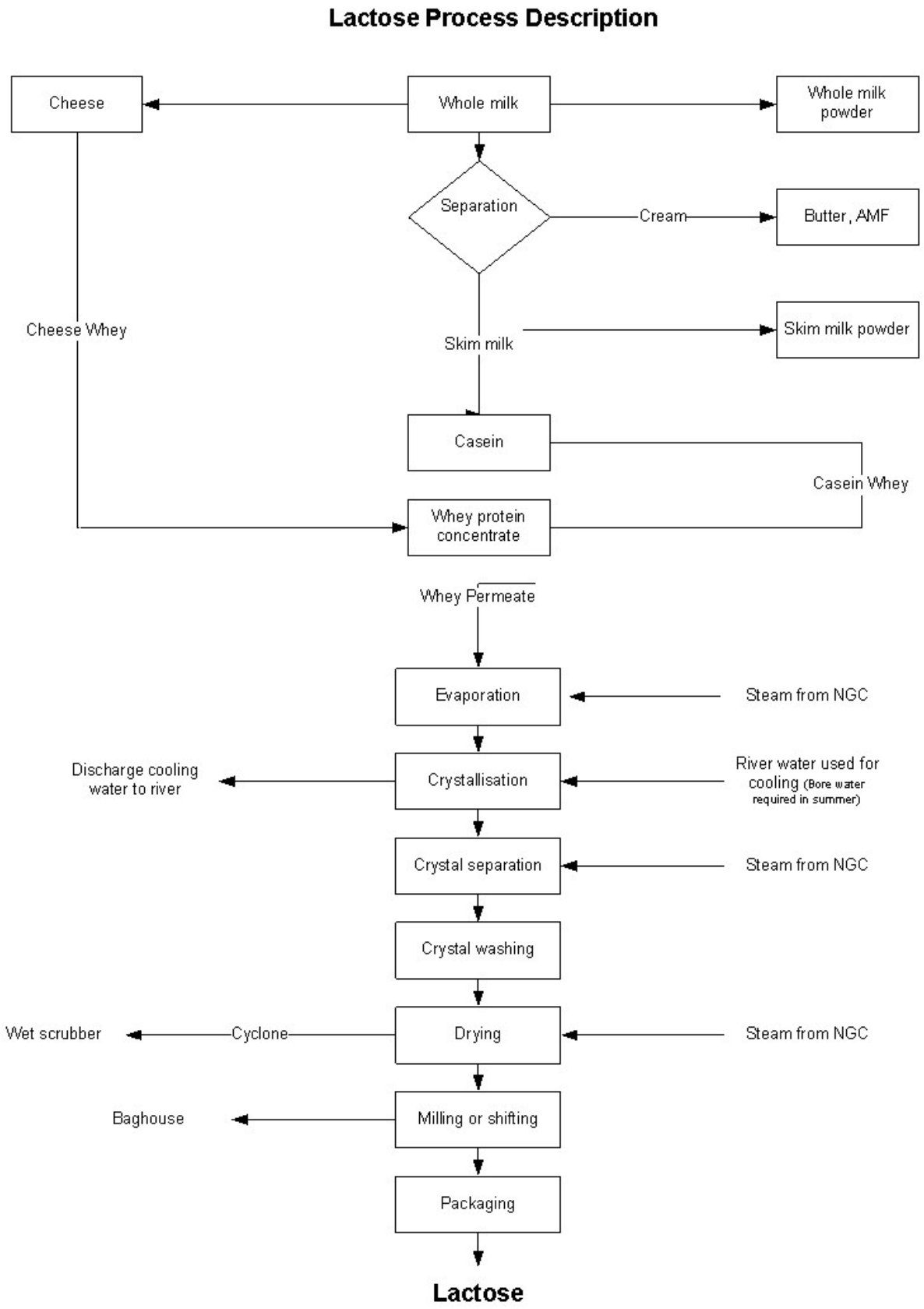

Figure 2 Lactose process diagram

1.3 Resource consents

The Company holds 17 resource consents the details of which, along with relevant consent related activities are summarised in Table 2. Summaries of the conditions attached to each permit are set out in Section 3 of this report, with consent related activities and information that is relevant to the monitoring and compliance assessment for the year under review 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.

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 Councils 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 is:

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;

Council staff have recently put together some data which suggests that in the last couple of years, the rate of take was less than ~150 litres/second 95% of the time.

3. A Cultural Impact Assessment;
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 now expected by 31 March 2021.

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 Notice to review consents 0919-3 and 0924-3

On 27 June 2014, Council invoked the review conditions on consents 0919-3 and 0924-3, which provide for discharge back to Kaupokonui Stream of cooling water taken under consent 0302-3. The reason for review was to impose five new monitoring conditions on both consents to obtain information on the amount of water that is returned to the stream, for water allocation purposes, and for assessment of the effects of the abstraction on the stream. The data gathered was also necessary for the preparation of an assessment of environmental effects in the consents replacement process due to be carried out in 2019.

After consultation, the Company requested that, upon agreement to implement the required monitoring measures by 31 August 2015, Council withdraw the notice of review. The notice of review was withdrawn on basis of the agreement outlined below, with the monitoring being within the scope of condition 1 of both consents.

The agreed monitoring measures related to (1) installation and maintenance of flow recording devices and (2) dataloggers, (3) certification of and (4) access to equipment, and (5) transmission to Council of a real time record of discharge volumes.

Specifically, the agreed monitoring measures are as follows:

1. "By 31 August 2015 the consent holder shall install, and thereafter maintain a flow recording device(s). The device shall be tamper-proof and shall measure and record the rate and volume of cooling water discharge to an accuracy of ±5%.
   Note: flow recording devices must be installed, and regularly maintained, in accordance with manufacturer's specifications in order to ensure that they meet the required accuracy. Even with proper maintenance flow recording devices have a limited lifespan.
2. By 31 August 2015, the consent holder shall install, and thereafter maintain a datalogger to automatically record discharge volumes from the flow recording devices(s). The datalogger shall be tamper-proof and shall record the date, the time (in New Zealand Standard Time) and the rate and volume of water discharge at intervals not exceeding 15 minutes.
   Note: dataloggers must be installed, and regularly maintained, in accordance with manufacturer's specifications in order to ensure that they meet the required accuracy. Even with proper maintenance flow recording devices and dataloggers have a limited lifespan.
3. Within 30 days of the installation of a flow recording device or datalogger, and at other times when reasonable notice is given, the consent holder shall provide the Chief Executive, Taranaki Regional Council with a document from a suitably qualified person certifying that:
   a. water measuring or recording equipment required by the conditions of this consent has been installed and/or maintained in accordance with the manufactures specifications; and/or

b. water measuring or recording equipment required by the conditions of this consent has been tested and shown to be operating to an accuracy of ±5%.

4. The flow recording device(s) shall be accessible to Taranaki Regional Council officers at all reasonable times for inspection and/or data retrieval. In addition the data logger shall be designed and installed so that Council officers can readily verify that it is accurately recording the required information.
5. From a date no later than 31 August 2015, the measurements made in accordance with condition 1 of this consent, shall be transmitted to the Taranaki Regional Council's computer system, in a format to be advised by the Chief Executive, Taranaki Regional Council, to maintain 'real time' record of the discharge volumes. The records shall:
   a. be in a format that, in the opinion of the Chief Executive, Taranaki Regional Council, is suitable for auditing; and
   b. specifically record the water discharged as 'zero' when no discharge(s) occurs."

In August 2015, the implementation period was extended to 30 September 2015, following delays associated with the installation of a new cooling tower system.

During the 2018-2019 year, Council was informed that the Company did not intend to undertake the work necessary to comply with the terms of this agreement. The Company was informed that this was a contravention of condition 1 of consent 0919 and the matter was logged as a consent non-compliance on Council's incidents register. As outlined in Section 2.3 this was closed out during the year under review following the Company having undertaken to carry out the works by 30 September 2019. The new metering arrangement became operational on 14 September 2019, with data deemed to be satisfactory following review in the 2019-2020 year.

1.3.4 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 to the cooling towers, bringing it under the discharges covered by consent 0919; and
- The diversion of the stormwaters covered by consents 4604, 6423 and the stormwater discharged from one of the outfalls covered by consent 0924 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.

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 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 2019
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 2019
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	-	Current
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	-	Current
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
10412-1.0	To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed	10 Mar 2017	June 2023	1 Jun 2035	-	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

The Company's site was visited 12 times during the monitoring period. 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. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. 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.

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 eleven occasions. The samples were analysed for BOD_5 (total and filtered), pH, conductivity and turbidity.

The Kaupokonui Stream was sampled on 12 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 6 occasions. The samples were analysed for temperature, BOD_5, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, pH, turbidity, and anion/cation balance. The Waiokura Stream was sampled at four sites on five occasions, with the fifth survey delayed until early July due to COVID-19 restrictions. This survey will be reported on in the 2020-2021 Annual Report. The Waiokura Stream samples were analysed for temperature, BOD_5, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, pH, turbidity and anion/cation balance.

Three sample was collected from the northern stormwater pond or outfall and three samples were collected from the southern stormwater pond or discharge outfall. These samples were analysed for total BOD_5, conductivity, pH, turbidity, suspended solids and oil and grease.

Groundwater from 11 bores on the three farms was sampled on six occasions and the samples were analysed for temperature, COD, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, pH and anion/cation balance. However, in the case of one bore (GND0639) only 5 samples were obtained as the bore was dry at the time of the May survey.

Deposition gauges were placed at selected sites in the vicinity 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 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. A biological survey was also performed in the Waiokura Stream to monitor the effects from irrigation of wastewater and stormwater onto land in the Waiokura catchment. During the biomonitoring surveys in the year under review, 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 is 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 is to be investigated by Council during the 2020-2021 year. Therefore, the introduction of biomonitoring will be re-visited following investigation of activities in the upstream environment.

The triennial fifth site fish survey was undertaken in the Kaupokonui Stream in March 2020 and, under the current schedule, is due next in the 2022-2023 monitoring year. However, due to the expectation that the fish barrier presented by the Glenn Road weir will be addressed in the summer of 2021, this scheduling is likely to need changing.

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, irrigation records, receiving water and coolant temperatures, and wastewater composition. 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.

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 production, stream and bore extraction volumes, and cooling water discharge 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 these 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 that was commissioned on 24 December 2008. Independent verification of the accuracy of the meter was undertaken on 27 August 2014, and was therefore due again in August 2019. The meter was verified in April 2019, with a copy of the verification report provided to Council. Table 3 contains a summary of statistics 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. Figure 3 and Figure 4 are based on the daily data provided in the monthly reports. During the year under review, a PLC failure affecting the flow meter recording occurred on 8 April 2020. The Company notified Council on the morning that the event occurred. The electronics were replaced on 16 April, and the meter was verified as soon as was practicable after the reduction in COVID restrictions allowed this external verification to be carried out (5 May 2020). The meter failure and inability to report accurate water abstraction data was recorded as a non-compliance on the Council's incidents register. No enforcement action was undertaken as the Company reinstated the monitoring system promptly and had a statutory defence with regard to the unforeseen failure of the meter. The abstraction rate data provided from 1 to16 April was an estimate based on the cooling water return flow rate and the approximate correlation between the two flows.

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 2019-2020 monitoring period. However, it is noted that the volumes abstracted are significantly lower than the permitted take of 19,500 m^3/day.

Table 3 Summary of water abstraction volumes from the Kaupokonui Stream

Month	Average daily abstraction[a] (m^3/day)	Minimum daily abstraction[a] (m^3/day)	Maximum daily abstraction[a] (m^3/day)	Number of days per month daily abstraction[a] >19,500 m^3	Average abstraction rate[b] (L/s)	Maximum abstraction rate[b] (L/s)	Total time per month abstraction rate[b]> 225 L/s	Missing records[b]
Jul 2019	759.2	0.0	2,954.4	0	9	80	0	No gaps
Aug 2019	3,830.0	1,384.7	9,762.2	0	44	164	0	No gaps
Sep 2019	8,137.0	5,778.3	11,665.9	0	94	169	0	No gaps
Oct 2019	10,027.7	8,320.7	11,427.4	0	116	187	0	No gaps
Nov 2019	10,222.7	7,605.2	13,563.3	0	118	186	0	No gaps
Dec 2019	7,643.9	5,934.7	11,000.7	0	88	182	0	No gaps
Jan 2020	8,592.1	5,906.6	13,251.5	0	99	183	0	No gaps
Feb 2020	10,594.7	6,378.9	13,815.8	0	123	216	0	No gaps
Mar 2020	7,917.9	4,414.2	10,944.2	0	92	173	0	No gaps
Apr 2020	6,716.4	4,584.0	11,622.4	0	78	250	4.5 hours	No gaps
May 2020	5,010.8	3,104.2	6,897.3	0	58	138	0	No gaps
Jun 2020	1,115.3	0.0	5,291.5	0	13	91	0	No gaps

a. From the Company's monthly reports

b. from the electronic records forwarded to Council

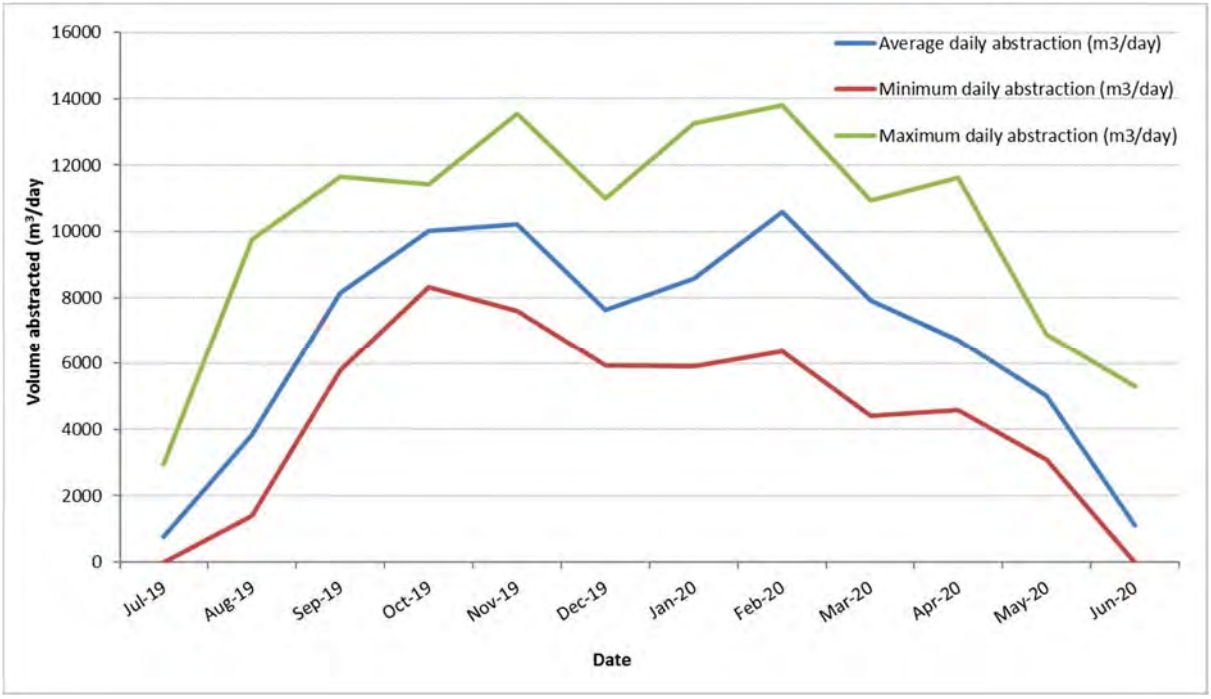

Figure 3 Monthly summary of water abstraction volumes from the Kaupokonui Stream from the Company's monthly reports

The abstraction rate from the daily electronic data showed that the authorised abstraction rate was exceeded for a total of 4.5 hours during April. This was during the initial period of the discovery of the fault, when erroneous data was still being recorded and supplied to Council.

The total volume of 2,450,216 m³ abstracted during 2019-2020 was 9% more than the amount taken in 2018-2019, but 14% less than the median annual amount taken during the 2009 to 2019 periods (2,849,299 m³/year). The daily volume abstracted was maintained well below the 19,500 m³ daily limit. During 2019-2020, a maximum daily abstraction of 13,816 m³ was recorded on 13 February 2020, which is 70% of the consent limit. The changes in the river abstraction volumes since the 2009-2010 year are illustrated in Figure 4.

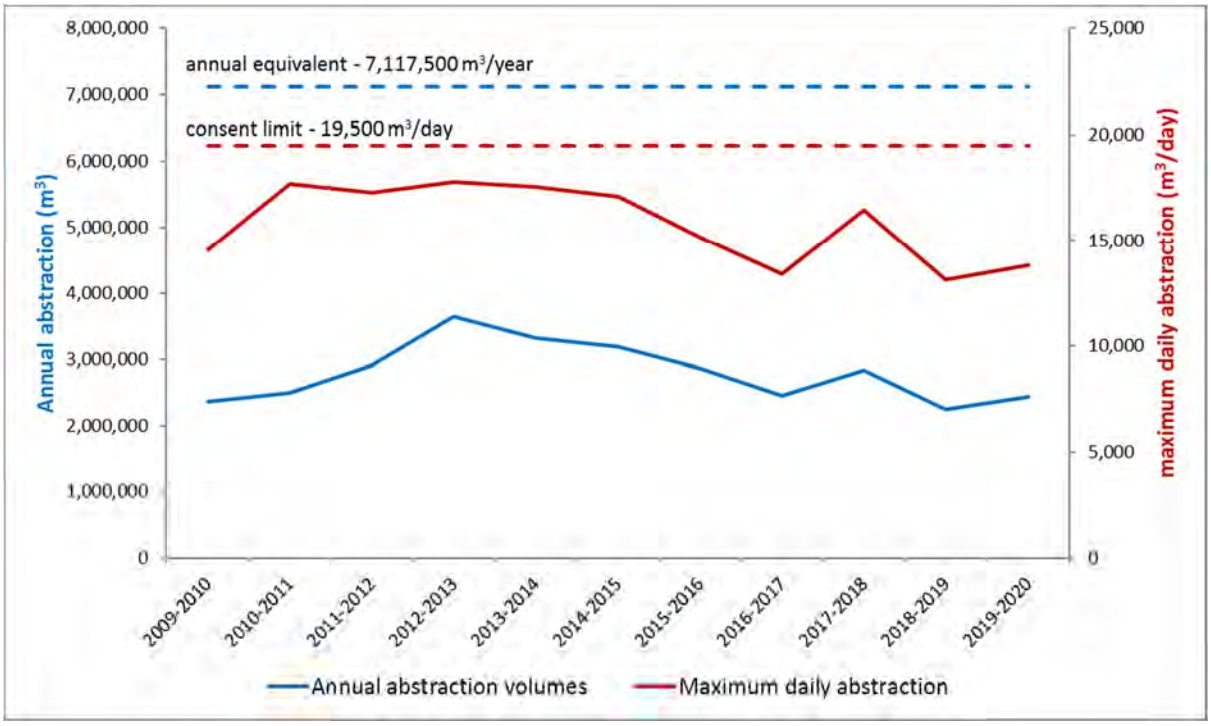

Figure 4 Daily and annual stream abstraction volumes July 2009 to June 2020 from the Company's monthly reports

The Company's abstraction of water from the Kaupokonui Stream was generally undertaken in a satisfactory manner and the abstraction rates complied with consent conditions. There was one short instance where the data reported indicated that the consent limit was exceeded as previously discussed and illustrated in Table 3 and Figure 5. However, this was due to a data recording issue rather than abstraction limit exceedance. This was a minor non-compliance with the data recording conditions of consent 0302-1 and the Resource Management Regulations, 2010. It was recorded on the Council's incidents register and is included in the summary given in Section 2.3 (Table 41).

The abstraction rate remained below 172 L/s for 99% of the year, with no missing records.

In comparison to the daily abstraction volumes provided in the monthly reports, the electronic data record (Figure 6) indicated that the total annual abstraction was 2,449,392 m³, which is only 824 m³ less than monthly report record. The maximum daily abstraction volume on the electronic record is 13,762 m³ on 13 February 2020 (a difference of only 54 m³ or 0.4%). These cross checks show that any potential reporting discrepancies or data transmission issues continue to be negligible following the resolution of the issues causing the more significant issue that had been occurring prior to the 2018-2019 year.

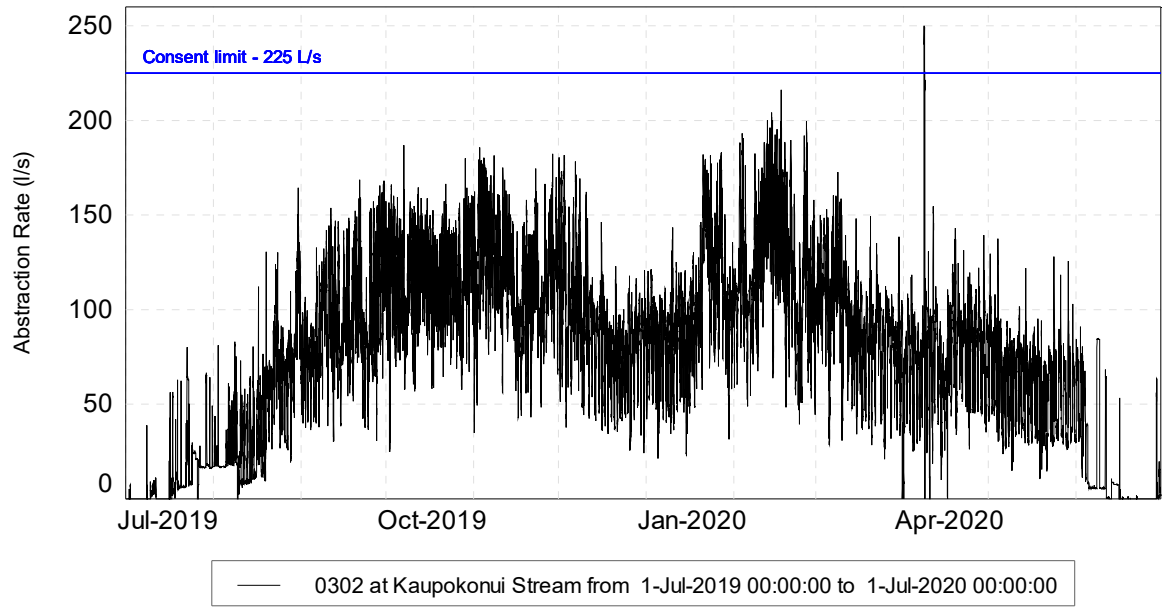

Figure 5 Abstraction rate from the Kaupokonui Stream (consent 0302-3), electronic record

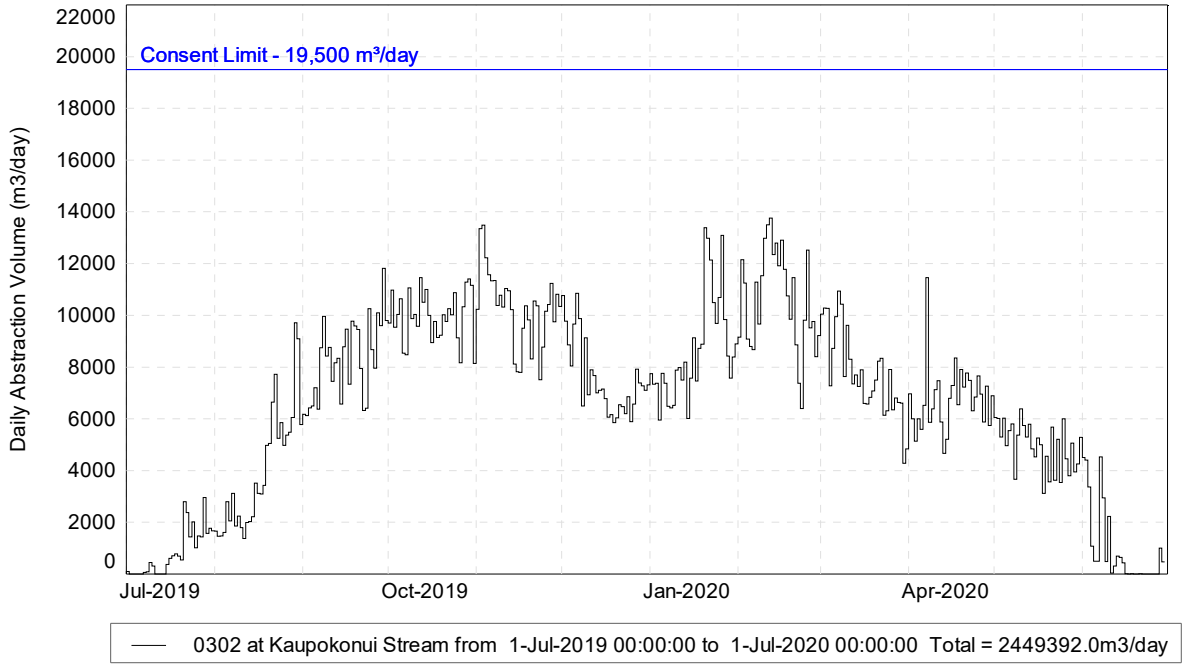

Figure 6 Daily abstraction volumes from the Kaupokonui Stream, electronic record

2.1.1.2 Bore abstraction records

In relation to the exercise of resource 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.

During the 2019-2020 monitoring period, the bore was not used. At the inspection on 20 September 2019 it was noted that the bore had been closed in.

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, as discussed in section 1.3.3. 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.

Provision of an electronic record did not commence until 14 January 2016 following a meeting (3 December 2015) and follow-up correspondence. Since this time there were frequent gaps in the telemetered record, for example about 25% of the time in February 2016. The Company was informed in March 2016 that these were simultaneous across all parameters measured, suggesting a system fault. Although the data was being recorded by the Company and could be back-filled on request, this did not meet the agreed requirement of the data being transmitted to the Council computer system, enabling a "real time" record to be maintained by Council. This was followed up periodically by Council Officers, with the Council advised that the cause of this issue was identified by the Company during the 2017-2018 year. The actions put in place to resolve the issue enabled a substantial reduction in the missing discharge record for the 2017-2018 year, which amounted to a total of approximately 3% of what would be expected for a full dataset. This reduction continued through the 2018-2019 year, with the missing record being only 2.8% of a full year's data.

The more reliable provision of data enabled it to be determined that the consumptive use was being overestimated due to the fouling of the flow meter with solids from the untreated Kaupokonui Stream water. This resulted in the Company cleaning the affected parts on a monthly basis. Due to the agreed requirements around verification, the flow metering should be verified on each occasion, with records provided showing the as found and post maintenance accuracy of the flow measurement. During discussions around this requirement, it was identified that the meter had been installed in a way that would not allow either accurate flow recording or verification. The measuring device (and any verification device) needs to be placed in/on a pipe that is full. The Company's measuring device has been placed in a section of pipe that is not full, and it is therefore not capable of meeting the terms of the agreement. An example of the underestimates of the flow found due to fouling of the measuring device and/or overestimates due to the partially filled pipe are shown in Figure 7. This matter was resolved during the year under review following pipework modifications that provided a suitable monitoring location on the discharge from the cooling tower, enabling the required measurement accuracy and verification to be undertaken. The data from the new meter was provided to Council beginning on 16 September 2019. A comparison between Figure 7 and Figure 8 illustrates that the data is now 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 the further evaporative and/or wind drift losses will occur to varying degrees depending on the weather conditions.

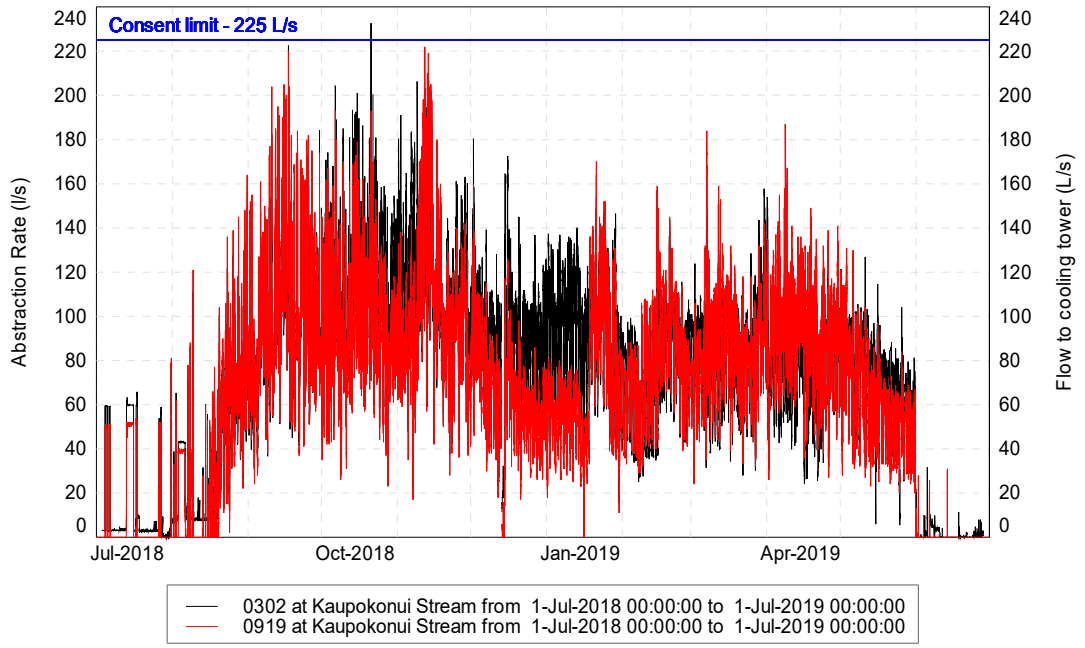

Figure 7 Discharge rates (flow to the cooling tower) for consent 0919-3, along with the abstraction rate for consent 0302-3, electronic record, 2018-2019

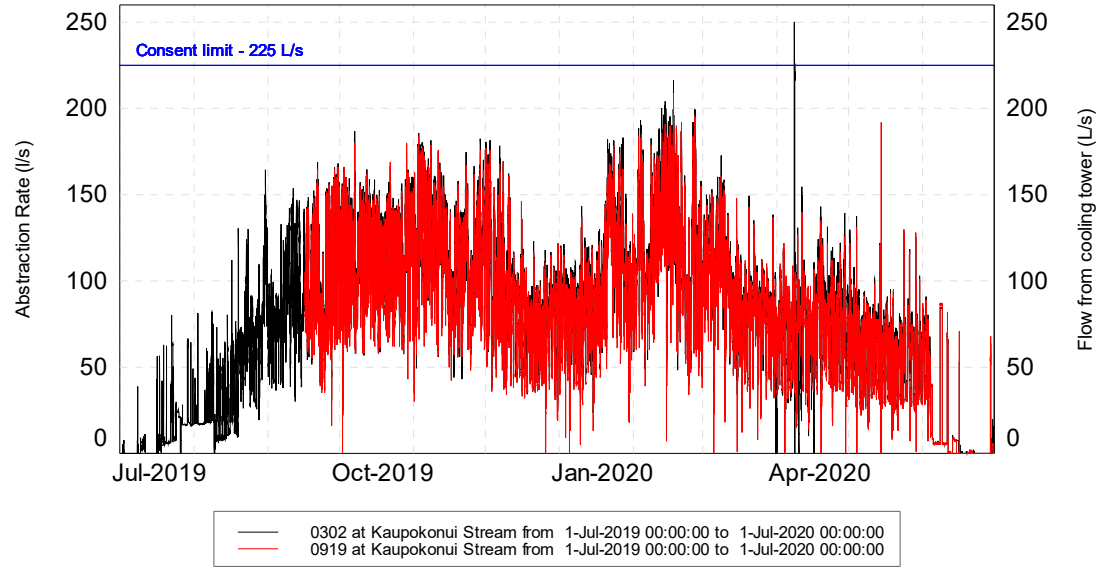

Figure 8 Discharge rates (flow from the cooling tower) for consent 0919-3, along with the abstraction rate for consent 0302-3, electronic record, September 2019 – June 2020

During the year under review, a total of 2,274, 439 m^3 was recorded as having been returned to and/or discharged from the cooling tower. Although this is 175,777 m^3 less than the electronically provided abstraction volume, it is also noted that prior to 14 September 2019, there had been issues with the accuracy of the meter measuring the return flow.

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. For the reasons already discussed, the discharge flow measuring system the Company installed to honour that agreement did not provide data suitable for this decision making, as

illustrated in Figure 7. Figure 9 shows the variability in the differential between the discharge and the abstraction rates for the 2018-2019 year, with negative valued indicating consumptive use and positive values indicating an increased rate of return. The periods of increasing usage indicate fouling of the meter, with the periods when there was more water returned to the stream than was abstracted are likely to be due to overestimate of the discharge flow rate due to the pipe not being full.

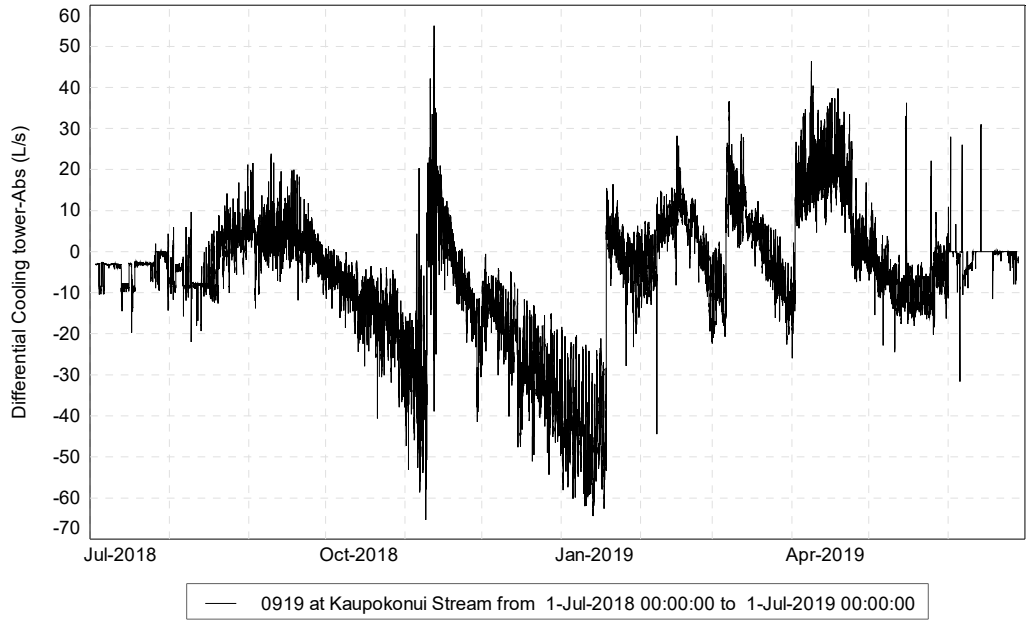

Figure 9 Differential between the rate of discharge to the cooling tower and the abstraction rate, 2018-2019

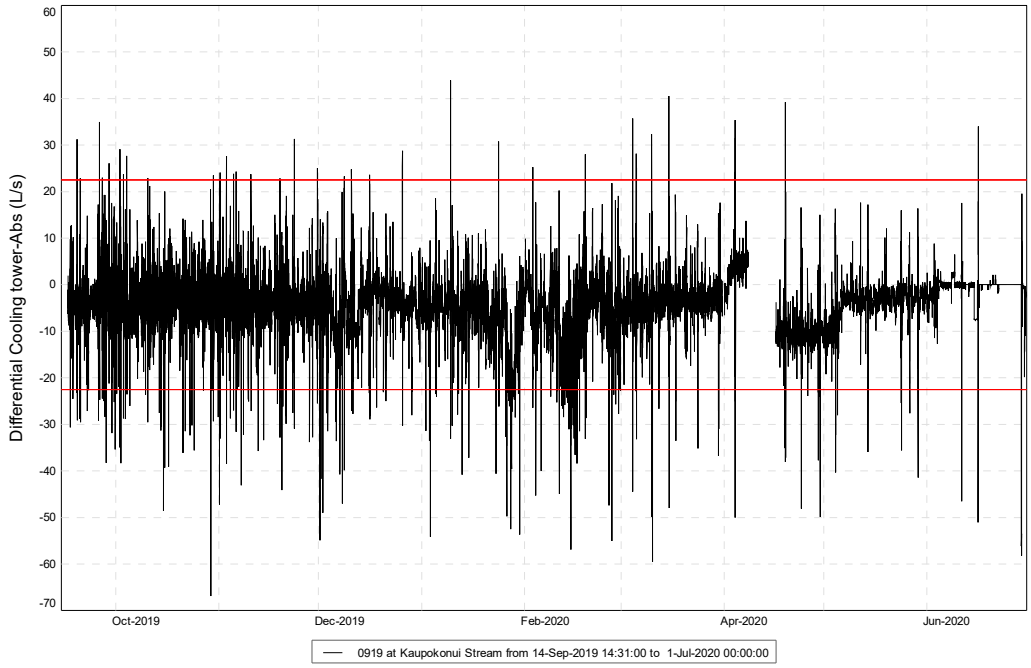

Figure 10 Differential between the rate of discharge from the cooling tower and the abstraction rate, 14 September 2019 to 30 June 2020

Figure 10 shows the differential between the discharge and abstraction rates for the year under review, following the installation of the systems allowing the discharge from the cooling water tower to be recorded. The maximum permitted error on the differential between the meters would be ±10 %. The error

margins if the abstraction and discharge were approximating to the maximum take rate of 225 L/s are shown in Figure 10, although it is noted that the highest average monthly abstraction rate was only 123 L/s. For the majority of the year under review for which accurate data was provided, the measured differential was within the margin of error of the recording devices.

Figure 11 and Figure 12 show the percentage of the time that the usage or additional return is at a given rate for the 2018-2019 year and for the 2019-2020 year following the installation of the system accurately measuring the discharge rate from the cooling tower. Again, the difference between these two graphs illustrates the effect that the inaccuracies of the measuring system had on the spread of the data received.

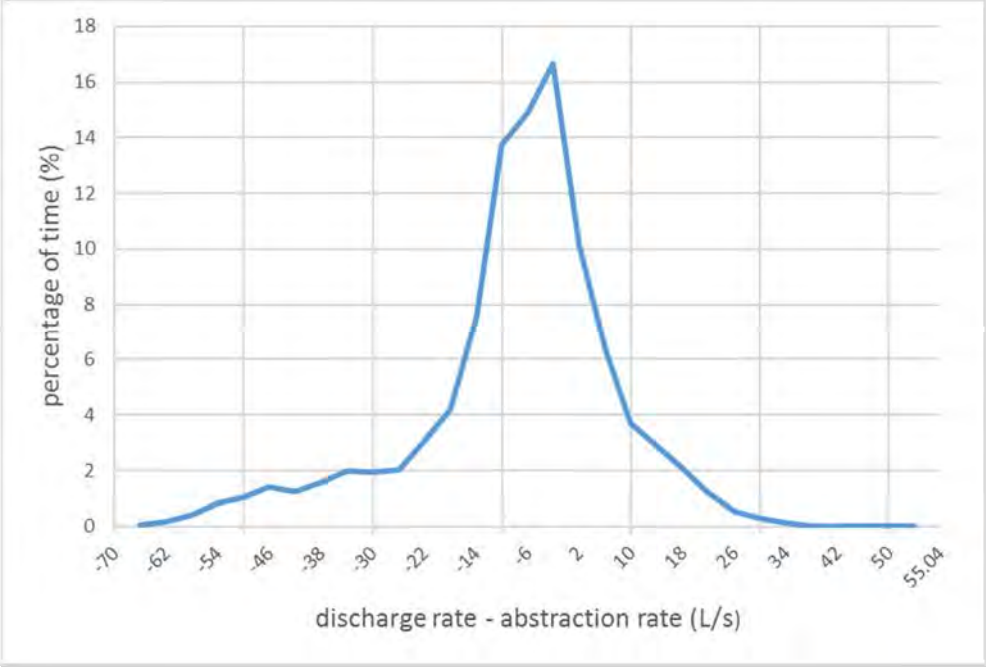

Figure 11 Probability density for the difference between the rate of flow to the cooling tower and the abstraction rate, 2018-2019

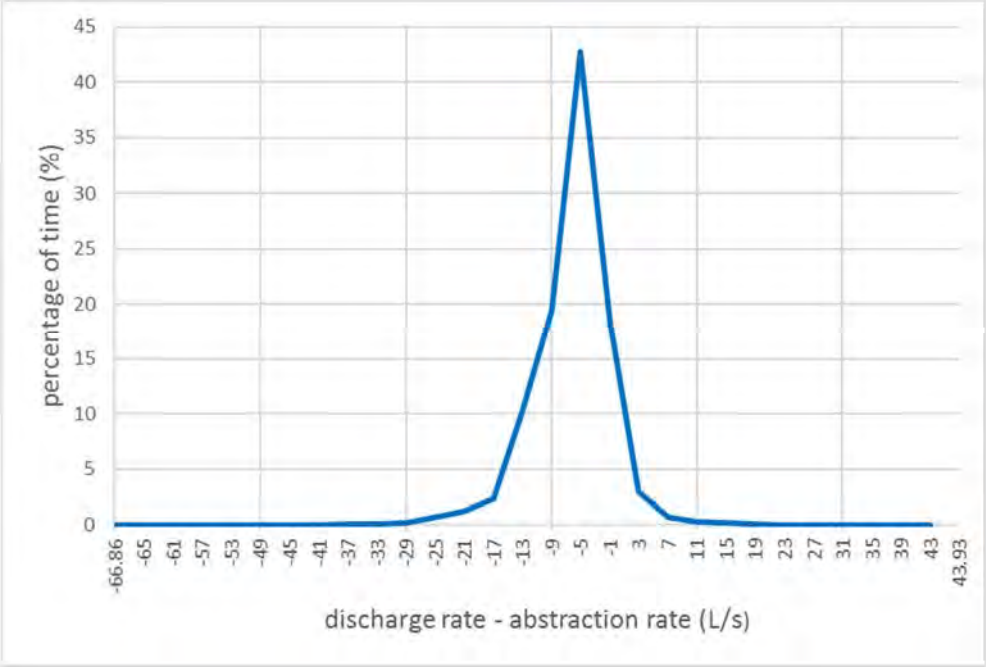

Figure 12 Probability density for the difference between the rate of flow from the cooling tower and the abstraction rate, September 2019 to 30 June 2020

During the year under review, it was found that the maximum 15 minute average for water usage was 66 L/s and the maximum additional return was 44 L/s

It is noted that any of the evaporative losses and/or wind drift at the spray discharge will also not be accounted for, however these are generally expected to be minor.

2.1.1.4 Cooling water discharge temperature

In addition to providing the new cooling water discharge rate monitoring data, the Company also started to voluntarily monitor the temperature of the cooling water discharged under consent 0919-3 downstream of the cooling water tower, upstream of the sprayers. This monitoring is likely to be required by the renewed consent, and in the meantime informs the assessment of effects prepared by the Company for 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 temperature data has been provided to Council electronically on a daily basis for the year under review. One minute data is provided by the Company that the Council then processes to provide the 15 minute average temperature (Figure 13) so it is comparable to the data used to assess consent compliance in the receiving water as per the conditions of the consent. The median monthly discharge temperatures are 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 2019	4.7	24.0	10.2	no gaps
Aug 2019	2.1	35.7	18.1	no gaps
Sep 2019	12.3	38.1	22.0	no gaps
Oct 2019	11.8	34.3	30.1	no gaps
Nov 2019	17.8	34.3	28.0	no gaps
Dec 2019	18.4	39.5	31.6	no gaps
Jan 2020	15.6	39.7	32.7	no gaps
Feb 2020	21.9	39.2	31.3	no gaps
Mar 2020	17.0	37.3	28.4	no gaps
Apr 2020	14.0	35.6	28.4	no gaps
May 2020	11.2	38.5	31.1	3.5 hours
Jun 2020	6.1	37.2	11.2	no gaps

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 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 takes for the change to have an effect on the cooling water discharge temperature. A decision was made to manually override the control systems such that all cooling water was directed through the cooling tower and that the cooling tower would be run at 100% capacity at all times, irrespective of the instream temperature differential. These changes in operational management of the cooling tower system resulted in median discharge temperatures in the range 23 to 25.5˚C in the 2018-2019 year following this change.

Further operational changes were made progressively during the year under review, which included removing the cooling water tower bypass line so that all the cooling water continued to be directed through the cooling tower and the addition of a variable speed pump so that that the flow rate can be controlled allowing the residence time of the cooling water in the cooling tower to be increased. However the Company returned to controlling the operation of the cooling fans based on the upstream/downstream temperature differential.

The monitoring during the year under review shows that the median monthly discharge temperature, as measured downstream of the cooling towers, was generally in the range of 28 to 33˚C, including during the warmer, lower stream flow months of the year (Table 4). This is a significant increase when compared to the 2018-2019 year following changes in the operational management of the cooling system.

Although this represented an increase over the 2018-2019, it was still a notable reduction when compared to the start of the 2018-2019 year (and previous years) when the temperature had generally been in the range 30-37˚C during those months. The effect of these changes in operational management of the cooling tower system in terms of both the temperature of the cooling water discharge, and the variability of the temperature pre and post November 2018 in the year under review is illustrated by the comparison between Figure 13 and Figure 14.

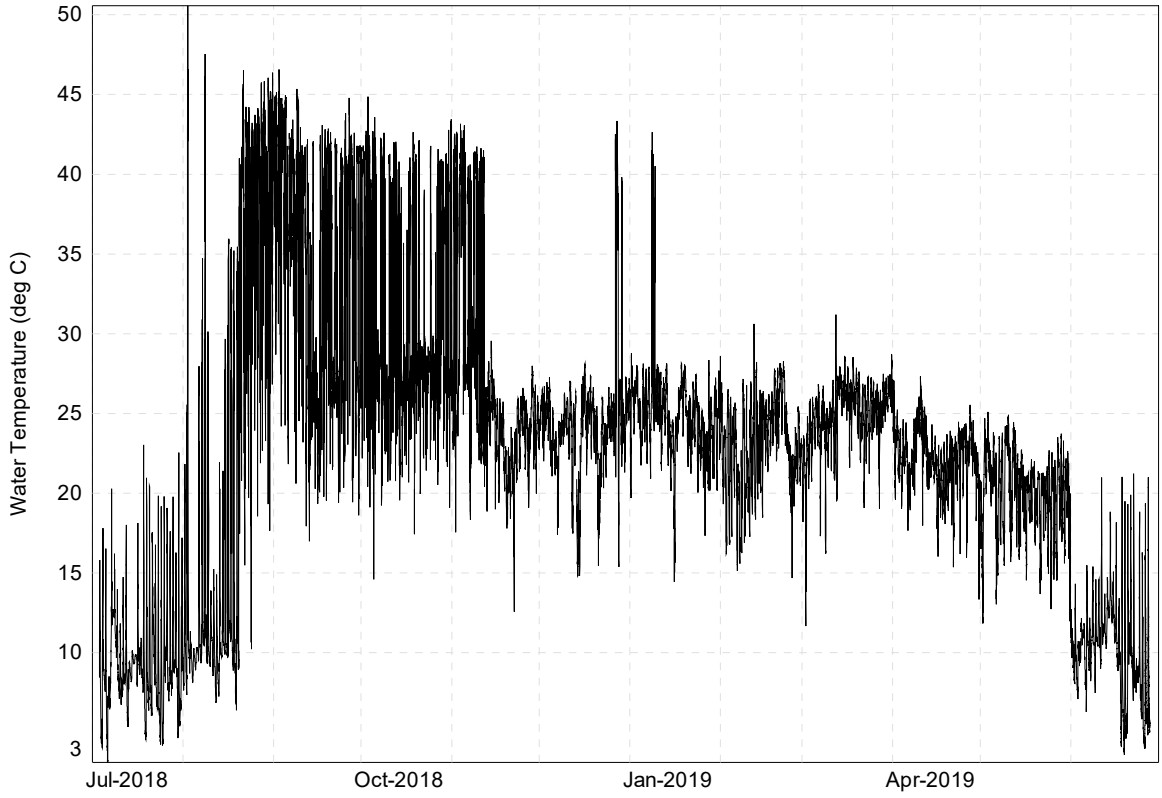

Figure 13 Temperature of the cooling water discharge permitted by consent 0919-3, 2018-2019 electronic record

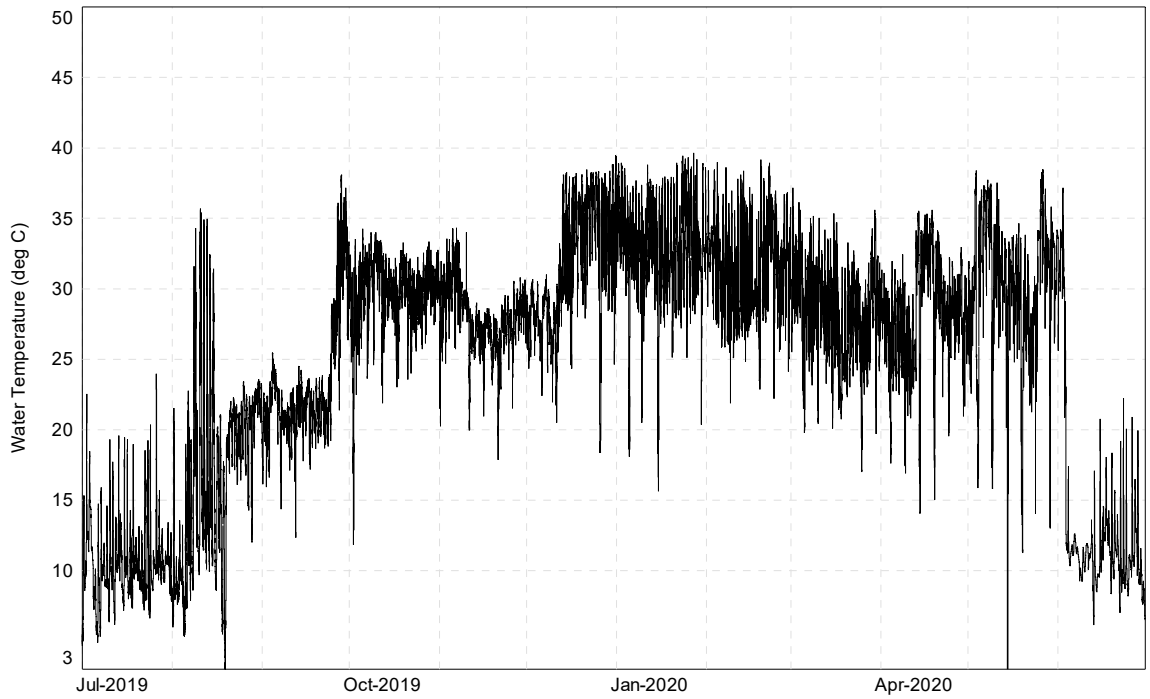

Figure 14 Temperature of the cooling water discharge permitted by consent 0919-3, 2019-2020 electronic record

Further analysis and comparison of cooling water tower and operational performance is illustrated in Figure 15 and Figure 16. Council understands that the cooling water 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. Cumulatively during the year under review the cooling water discharge was at or above 35˚C for approximately 7% of the time. This is in comparison to 28% of the time prior to the operational changes made in November 2018, 1% of the time between December 2018 and the end of the 2018-2019 monitoring year and 35% of the time in the 2017-2018 year.

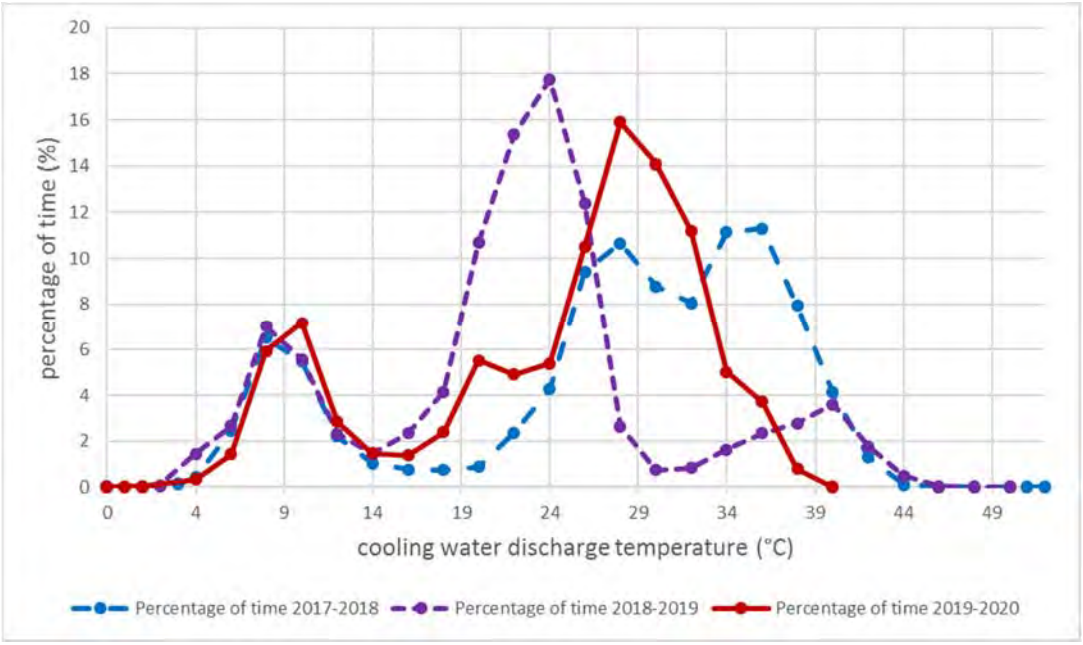

Figure 15 Cooling water tower discharge temperature probability density during the 2017 to 2020 years from 1 July-30 June

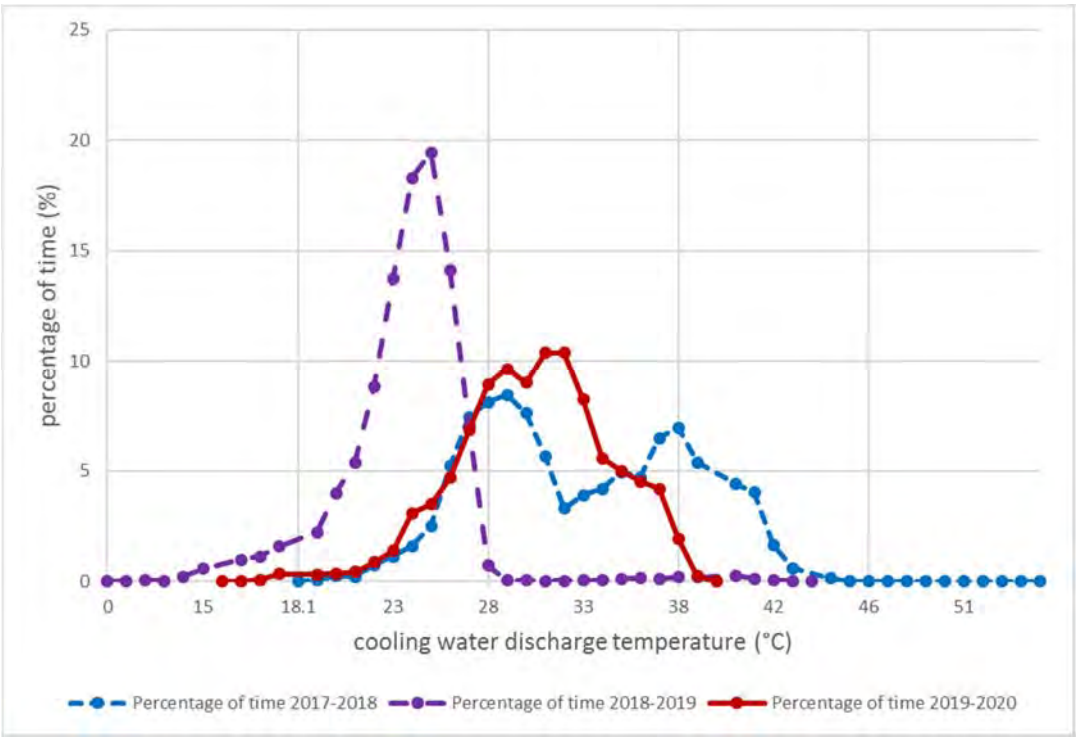

Figure 16 Cooling water tower discharge temperature probability density during the 2017 to 2020 years, 1 December-31 March

During the period 1 December to 30 March, the time of year when typically the stream flow is low and the water temperature is higher, the cooling water temperature is at or above 33˚C for 35% of the time, and above 35˚C for 16% 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 further operational changes in the year under review, as illustrated in Figure 16.

The effects of these changes, as observed in the receiving waters, are discussed in Section 2.1.1.6.2.

2.1.1.5 Irrigation records

In relation to the Company's 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 dairy shed effluent (DSE) spray irrigated. This information is summarised in Table 5.

Table 5 Wastes irrigation records supplied by Fonterra Ltd

Month	Kapuni Farm 1							Farms 2 & 3						
	Factory			DSE			Total	Factory			DSE			Total
	Days	Volume, m^3/d		Days	Volume, m^3/d		Days 2-day volume >2630	Days	Volume, m^3/d		Days	Volume, m^3/d		Days 2-day volume >3834
		Av.	Max		Av.	Max.			Av.	Max.		Av.	Max.	
Jul 19	0	0.0	0.0	0	0.0	0	0	31	136	558.2	0	0.0	0	208.2
Aug 19	22	175.5	608.6	19	39.5	120	0	31	668	1,429.9	3	7.7	80	895.1
Sep 19	29	421.9	703.1	23	72.0	120	0	30	1,274	1,753.5	0	0.0	0	1,230.5
Oct 19	29	462.0	822.0	23	78.7	120	0	31	1,267	1,933.5	19	80.9	167	1,409.4
Nov 19	30	487.6	853.7	25	80.8	120	0	30	1,280	1,632.9	6	23.5	167	1,342.4
Dec 19	31	382.6	591.9	31	81.6	120	0	31	1,127	1,677.9	17	57.5	167	1,167.7
Jan 20	31	432.5	778.2	29	53.3	96	0	31	1,217	1,698.3	20	78.9	167	1,302.9
Feb 20	28	525.6	948.4	28	64.3	97	0	28	1,033	1,807.5	10	22.6	116	1,423.8
Mar 20	31	353.1	752.0	27	42.5	94	0	31	1,257	1,719.9	16	79.3	167	1,118.6
Apr 20	30	352.5	595.7	28	74.2	119	0	30	1,224	1,211.4	7	27.7	167	839.3
May 20	29	243.6	455.3	29	38.0	117	0	31	937	1,540.3	7	16.3	167	980.3
Jun 20	7	59.1	642.1	7	7.1	50	0	23	153	1,123.7	18	61.4	167	235.4

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

The Company continued to irrigate a large volume of wastewater during the year under review. Consents 0922 and 0923 permit a maximum volume of 2,630 m^3 (Farm1) and 3,834 m^3 (Farms 2 and 3) of factory effluent and dairy effluent combined to be spray irrigated per two consecutive days, with a maximum daily volume for dairy shed effluent of 120 and 168 m^3, respectively.

With the exception of the winter shut down period that occurs in June and July each year, irrigation of factory effluent occurred almost daily during the monitoring year. A total factory effluent volume of 493,611 m^3 was irrigated during the 2019-2020 year, with a distribution between farms of 24%, 20% and 56% for Farm 1, Farm 2 and Farm 3, respectively. This was an increase of 5% from the volume of 469,461 m^3 irrigated in the 2018-2019 year. The factory wastewater irrigation distribution between the farms during the year under review saw an increased percentage of the factory waste water applied to Farm 2 when compared to the previous year (26%, 16% and 58%). An additional 23,165 m^3 of factory wastewater was irrigated onto Farm 2 when compared to the previous year. The changes in the volume irrigated on Farms 1 and 3 were less pronounced (approximately 3,000m^3 less on Farm 1 and 4,000 m^3 more on Farm 3 in 2019-2020).

Disposal of dairy shed effluent from the Farm 3 dairy shed to land via the factory effluent spray irrigation system was established in 2015-2016, replacing the oxidation pond treatment systems which had previously discharged to Kaupokonui and Motumate Streams. During the year under review, Farm 3 irrigation commenced for the season on 19 August 2019 (although regular irrigation did not commence until early October). A total volume of 13,972 m^3 was discharged on these farms during the year, which was very similar to the previous year. On Farm 1, where irrigation commenced on 6 August 2020, a total volume of 19,229 m^3 was discharged, with 5 days irrigation at the maximum limit of 120 m^3/day. This is in comparison to the 12,034 m^3 discharged in the 2018-2019 year, which represents an increase of 60%.

The record shows that the volume limits on both consents were complied with throughout the 2019-2020 monitoring period.

2.1.1.6 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), 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 predominantly consisted of 15 minute average values at all three monitoring points. At the end of the monitoring period (26 June 2019), the Company began sending 1 minute averaged data every two hours. It is however noted that, 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 10% of the discharge period (on an annual basis).

Calibration was performed at monthly intervals by Company personnel, and checks were made by Council staff during monthly receiving water sampling surveys. Although Council had previously been advised that the accuracy of the temperature probes was ± 0.1˚C, 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, 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 reduces to between ± 0.2˚C and ± 0.5˚C at each monitoring location and 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.

2.1.1.6.1 Parallel temperature monitoring (one month)

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 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 on 17 March 2020. The logger could not be removed in April as scheduled due to government COVID-19 restrictions. When retrieval was attempted on 21 May 2020, it was found that the loggers were no longer in place and had been lost.

2.1.1.6.2 Annual consent holder data

The temperature record over the 2019-2020 reporting period for the Kaupokonui Stream upstream and downstream of the lactose plant discharge is presented in Figure 17 and Figure 18. The change in temperature is given in Figure 19.

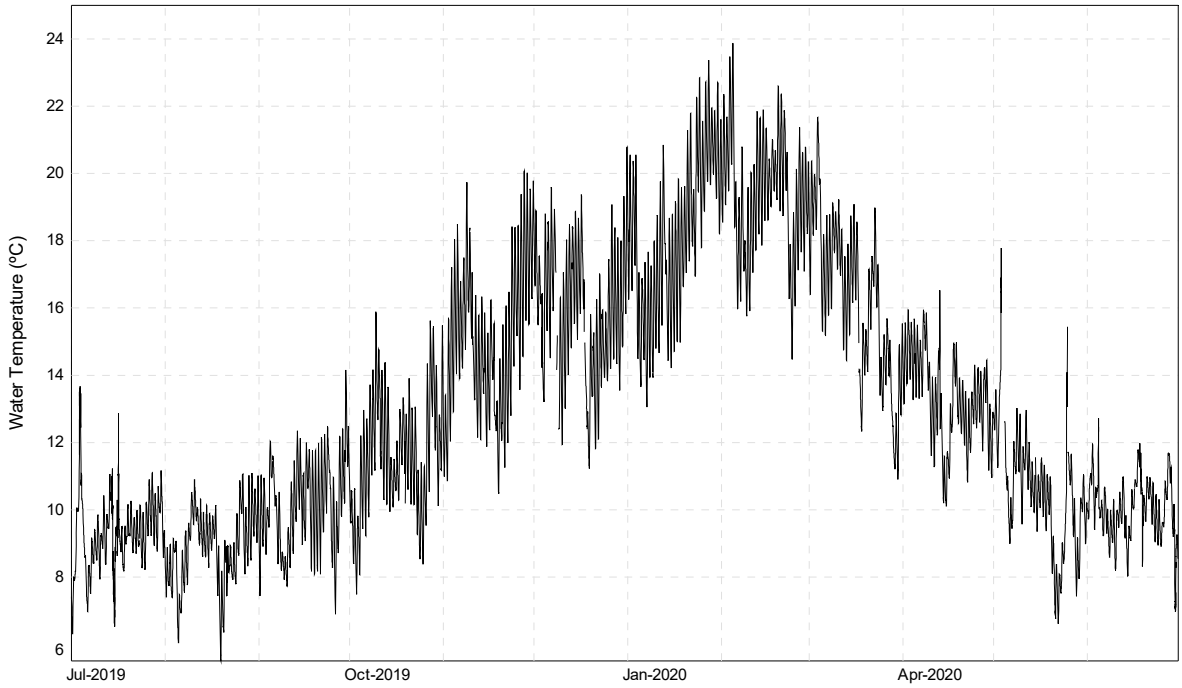

Figure 17 Water temperature (˚C) records for the Kaupokonui Stream upstream of the Lactose plant, electronic data

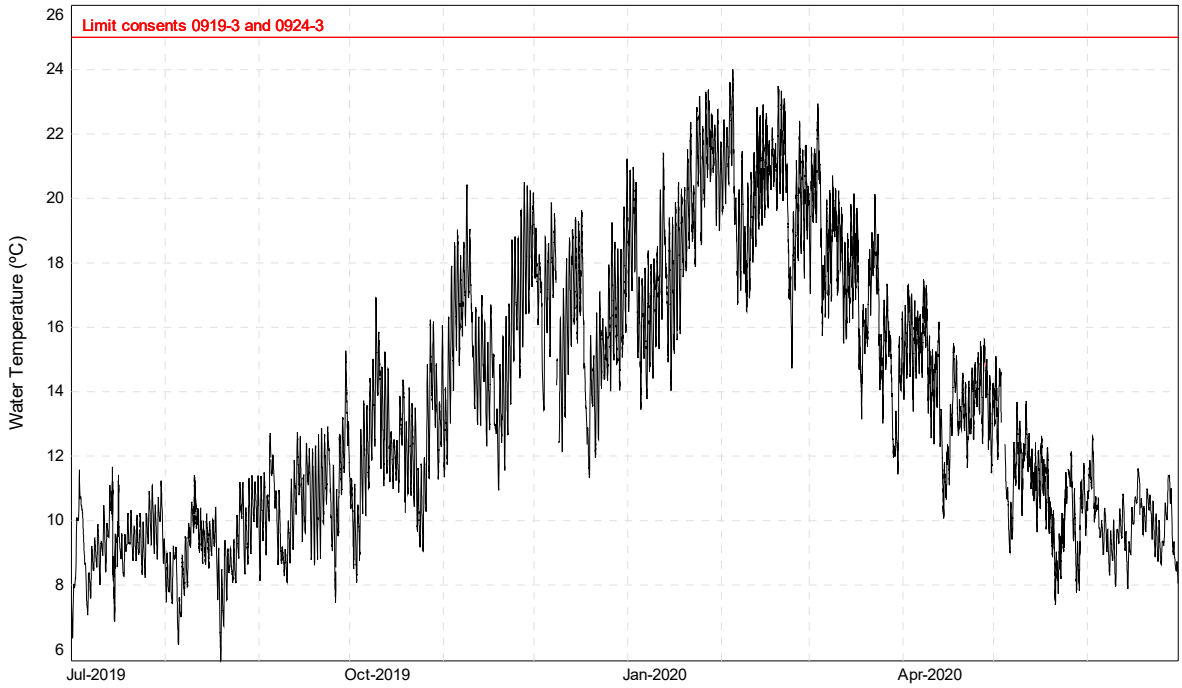

Figure 18 Water temperature (˚C) records for the Kaupokonui Stream downstream of the lactose plant, electronic data

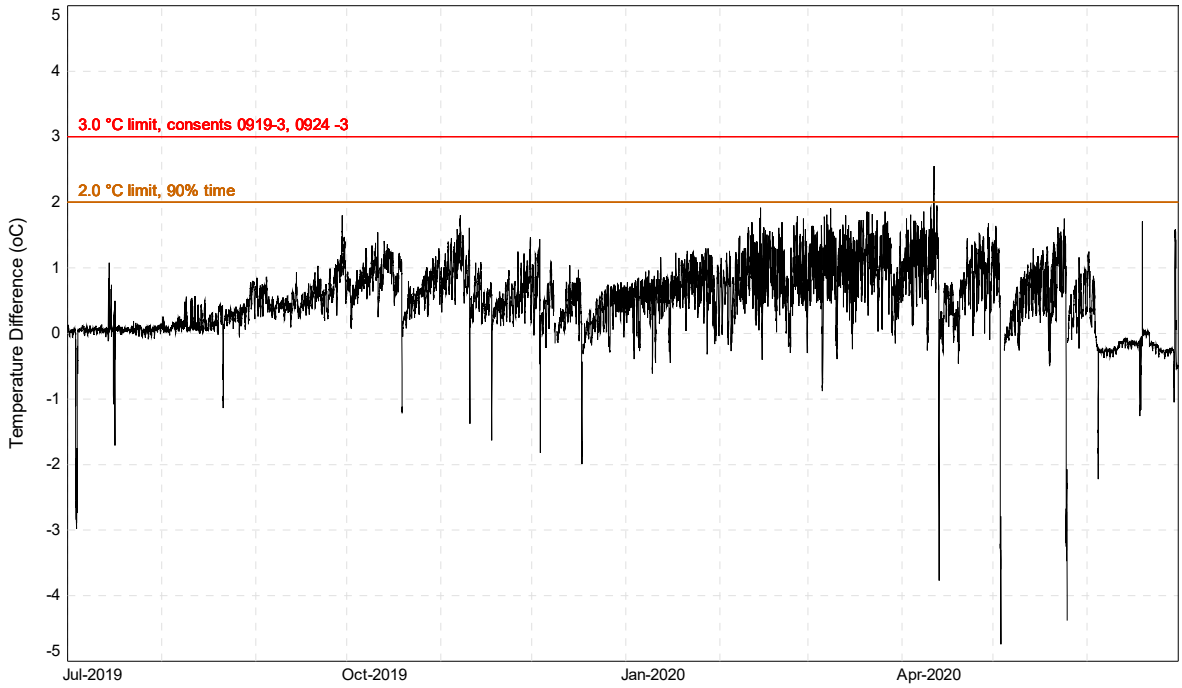

Figure 19 Kaupokonui Stream temperature change below the lactose plant, calculated from electronic data

A summary of the reported temperature change and maximum temperature data for 2019-2020 (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.

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

Month	Temperature change% Time*				Downstream temperature				
	<0˚C	>2˚C	>2.5˚C	>3˚C	Min reported change (d/s-u/s) (˚C)	Max reported change (d/s-u/s) (˚C)	Days in excess of 3˚C	Max downstream temp	Days in excess of 25˚C
Jul 2019	11	0	0	0	-3.0	1.8	0	11.6	0
Aug 2019	1.2	0	0	0	-1.1	0.8	0	11.4	0
Sep 2019	0	0	0	0	0.09	1.8	0	15.3	0
Oct 2019	0.2	0	0	0	-1.2	1.5	0	16.9	0
Nov 2019	0.04	0	0	0	-1.6	1.8	0	20.5	0
Dec 2019	10.5	0	0	0	-2.0	1.44	0	21.2	0
Jan 2020	5.4	0	0	0	-0.6	1.3	0	23.3	0
Feb 2020	2.9	0	0	0	-0.4	1.9	0	24.0	0
Mar 2020	2.2	0	0	0	-0.9	1.9	0	23.0	0
Apr 2020	5	0.5	0	0	-3.8	2.6	0	17.5	0
May 2020	11	0	0	0	-4.7	1.8	0	15.0	0
Jun 2020	83	0	0	0	-2.2	1.7	0	12.6	0
Totals for 2019-2020*	11	0.04	0	0	-4.7	2.55	0	24.0	0

Note:* =% of actual record (3 days 1 hr and 30 min 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).

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. 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).

There was an occasion when temperature difference exceeded 2˚C, during a period of low flow in Kaupokonui Stream. The month in which this occurred was in April 2020, but this was for only 0.5% of the month with no missing record.

Therefore these consent limits were not exceeded during 2019-2020.

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 18 shows that this condition was complied with during the year under review.

The data and summary provided in Figure 19 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 11% of the time. This is in comparison to 3% of the time in 2018-2019, 16% of the time in 2017-2018 and 23% of the time in the 2016-2017 year.

It is also noted that during the month of June in the year under review, 83 % of the data provided for the upstream and downstream temperatures resulted in a negative temperature differential. 81% of June temperature differentials were less than -0.5°C. This is due to the permitted calibration errors of the measuring devices, but 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 was changed during the 2018-2019 year and again during the year under review. The effects of these changes can be seen in a comparison of the temperature differential probability density curves for the 2017-2018, 2018-2019 years and 2019-2020 years (Figure 20).

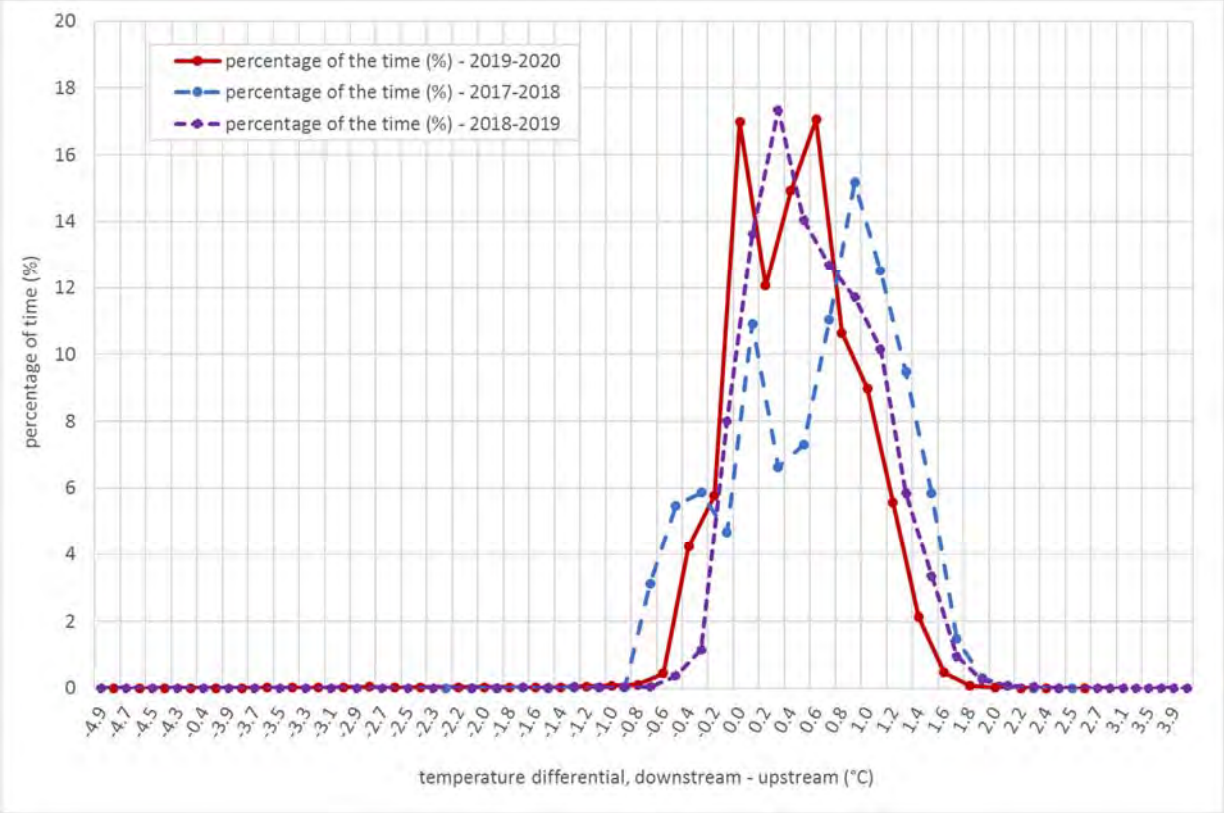

Figure 20 Instream temperature differential probability density during the 2017-2019 years from 1 July-30 June

The most notable changes between the 2017-2018 and 2018-2019 years were:

- A significant reduction in the amount of time that a negative temperature differential is reported;
- 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.

The most notable changes between the 2018-2019 and the 2019-2020 years are:

- 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, which means that the actual instream temperature variations may be up to 0.5°C higher due to permitted measurement errors;
- A further reduction in the amount of time the temperature differential is above 1.0°C.

This illustrates the most effective option to minimise effects on the environment was 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).

The changes in operational management of the cooling water tower in the 2019-2020 year would have resulted in an improvement in the effects occurring 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 2018-2019 year.

2.1.1.7 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 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 a weekly composite sample is sent to an outside laboratory (Industrial Chemistry Services Ltd) for analysis. In 2019-2020 the pH, organic strength, major mineral components, nutrients (including nitrogen species) and the metals copper and zinc were determined for 49 samples collected between 2 August 2017 and 25 June 2020. It is noted that the number of analyses performed has been steadily increasing since the 2017-2018 year. The results are summarised in Table 7.

Table 7 Results of factory wastewater monitoring by Fonterra Ltd

Parameter	Unit	2019-2020		% change	2018-2019		% change	2017-2018	
		Median N = 49	Range		Median N = 46	Range		Median N=42	Range
pH	pH	4.4	4.0 - 8.0	0	4.4	3.8 - 7.4	0	4.4	4.0 - 11.6
Chemical oxygen demand	g/m^3	5,300	82 - 9,480	-7	5,685	308 - 17,760	-16	6,760	592 - 13,720
Biochemical oxygen demand	g/m^3	3,200	30 - 4,800	7	3,000	140 - 6,000	-6	3,200	360 - 6,300
Total Nitrogen	g/m^3N	102	5 - 166	24	82	9.4 - 174	13	72.5	45- 147
Nitrate	g/m^3N	61	0.8 - 130	3	59	0.13 - 149	37	43	14.5 - 87
Nitrite	g/m^3N	2.4	0.01 - 30.0	100	1.2	0.01 - 13.5	64	0.7	0.1 - 16
Total Kjeldahl Nitrogen (TKN)	g/m^3N	25	1 - 96	67	15.0	1.4 -65.0	-46	28.0	5.0 - 118

Parameter	Unit	2019-2020		% change	2018-2019		% change	2017-2018	
		Median N = 49	Range		Median N = 46	Range		Median N=42	Range
Calcium	g/m^3	183	12 - 259	20	153	50 - 306	-16	182	98 - 298
Magnesium	g/m^3	12	4.9 - 46	0	12.0	5 - 97	-43	21	4.8 - 96
Sodium	g/m^3	107	22 - 235	8	99	54 - 164	-3	102	58 - 227
Potassium	g/m^3	48	10 - 265	-13	55	12 - 150	-50	110	40 - 340
Total Phosphorus	g/m^3P	85	4.2 - 144	67	51	6 - 260	-42	88	4.8 - 262
Ash	g/m^3	976	93 - 1,816	14	855	328 - 1,868	-9	941	469 - 2,112
Sodium adsorption ratio		3.0	0.8 - 5.9	4	2.9	1.9 - 5.4	6	2.7	1.5 - 5.6
Copper	g/m^3	0.270	0.042 - 0.850	-29	0.38	0.07 - 0.98	23	0.310	0.13 - 0.67
Zinc	g/m^3	0.330	0.028 - 0.770	-93	4.4	0.26 - 0.93	17	0.410	0.13 - 0.66

The lactose plant wastewater typically has high organic strength and is acidic. A comparison can be made between results for the 2017-2018, 2018-2019 and 2019-2020 monitoring years on the basis of median values, as shown in Table 7. Wastewater organic strength in 2019-2020, was, on the whole similar to or more concentrated when compared with the 2018-2019 year, with the changes being from -7% (a slight reduction of chemical oxygen demand) to 100 % (a doubling of nitrite). Although there was a 67% increase in the median Kjeldahl nitrogen, the increase in the total nitrogen median was less than this, at 25%. It is also noted that the total nitrogen concentration continued to agree reasonably well with the sum of the individual nitrogen species in the 2016-2020 years, unlike the 2013-2015 seasons. It is noted that although the nitrite concentration has become more elevated in recent years, the concentrations found in the groundwater monitoring bores remained below the detection limit of the test method used (<0.002 g/m^3), which is well below the long term drinking water standard of 0.2 g/m^3. The mineral concentrations were generally similar in the year under review, with the exception of calcium, which had an increase in the median of 20%. The median total phosphorus concentration also increased by 67%. The sodium adsorption ratio was again elevated on occasion, though well within the safe range for soil stability.

The annual volume of factory wastewater produced since 2009-2010, together with the annual mass of factory nitrogen irrigated, is presented in Figure 21. With respect to the mass discharge rate of wastewater components, factory wastewater volume had generally changed little between the 2011-2012 and 2016-2017 years. Therefore, during this period, the estimated mass discharge rate of the wastewater components increased or reduced by about the same proportion as their respective concentrations. However, since the 2017-2018 year there has been much more variability in the annual volume discharged and/or the concentration of the components in the discharge. This has resulted in what was at the time, a maximum volume discharged, with a minimum total nitrogen mass discharge in the 2017-2018 year. A further reduction in the mass discharge rate of total nitrogen was achieved in the 2018-2019 year, however an additional 6,739 kg of nitrogen was discharged onto the farms during the irrigation of the factory wastewater in the 2019-2020 year.

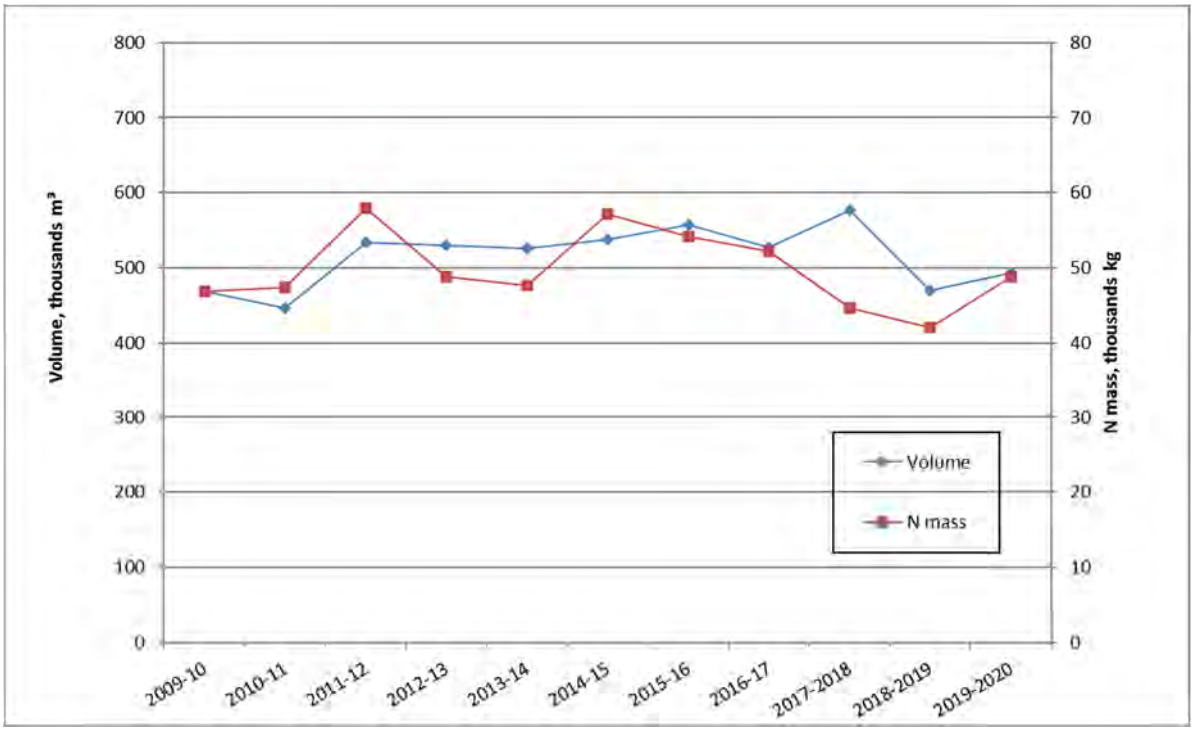

Figure 21 Annual volume of factory wastewater and estimated factory nitrogen mass irrigated, 2009-2020

Both the factory wastewater and dairy shed effluent (DSE) strengths vary through the season. A comparison of the relative strengths of these different wastewater streams is discussed following the DSE section.

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 factory wastewater. Automatic solenoid samplers, located beside the storage pond pump at each farm, collect composite samples over 24 hours whenever DSE pumping occurs, with a 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 42 samples were taken between 9 August 2019 and 10 June 2020 for Kapuni Farm 1, and 31 samples were taken between 21 August 2019 and 25 June 2020 for Farms 2 and 3. The results are summarised in Table 8.

Table 8 Results of dairy shed effluent monitoring by Fonterra Ltd

Parameter	Unit	Farm 1			Farms 2 & 3		
		Median N = 42	Range	2018-2019 median (N=39)	Median N = 31	Range	2018-2019 median (N=29)
pH	pH	7.9	7.5 - 8.2	7.8	8.0	7.7 - 8.2	7.9
Biochemical oxygen demand	g/m^3	400	100 - 640	340	280	42 - 880	800
Total Nitrogen	g/m^3N	153	36 - 191	78	127	59 - 352	214
Nitrate	g/m^3N	0.43	0.010 - 3.59	1.3	0.100	0.010 - 0.830	0.16
Nitrite	g/m^3N	0.10	0.010 - 0.44	0.1	0.030	0.010 - 0.230	0.08
Total Kjeldahl Nitrogen (TKN)	g/m^3N	153	35 - 190	77.0	126	59 - 352	214

Parameter	Unit	Farm 1			Farms 2 & 3		
		Median N = 42	Range	2018-2019 median (N=39)	Median N = 31	Range	2018-2019 median (N=29)
Calcium	g/m^3	100	58 - 156	78	82	55 - 120	102
Magnesium	g/m^3	29	5 - 59	17	29	9.5 - 59	26
Sodium	g/m^3	86	18 - 105	47	67	22 - 112	87
Potassium	g/m^3	580	150 - 860	275	450	180 - 850	840
Total Phosphorus	g/m^{3}P	62	14 - 91	40	55	20 - 84	74
Ash	g/m^3	1,505	277 - 3,153	769	1,130	372 - 1,937	1,895

Comparison of contaminant loadings from the factory wastewater and DSE

The DSE has generally been found to have lower organic (BOD compared to BOD and COD, Figure 23) and higher mineral strength than factory wastewater (for example potassium, Figure 29), and is slightly alkaline (Figure 24). During the 2018-2019 year it was found that the organic strength of the DSE from Farm 3 exceeded that of the factory wastewater through February and March due to a breakdown of the separator which allowed more solids through to the DSE irrigation pond. This trend was not repeated in the year under review (Figure 23). In the 2018-2019 year it was found that the Farm 3 DSE had an oxygen demand, total nitrogen (Figure 22), calcium (Figure 28), potassium (Figure 29) and phosphorus concentrations (Figure 30) that were between two and three times higher than in the previous year. The elevated concentrations occurred during the period January to April. Again this did not reoccur during the year under review. In the 2019-2020 year it was found that the effluent from Farm 1 had higher median component concentrations than that of Farms 2 and 3, which is in contrast to the previous year. The change is a result of both a substantial increase in the median strength of the Farm 1 effluent and a substantial reduction in the median strength of the Farm 3 effluent when compared to the previous year. The reduction in the strength of the Farm 3 effluent is likely to be as a result of the separator functioning correctly during the entire year. It is noted in the graphs presented below that the Farm 3 effluent component concentrations were much lower during February and March 2020 than in previous years. The median total nitrogen concentration in the Farms 3 effluent was 127 g/m^3 (down from 214 g/m^3 in 2018-2019), which was less that the Farm 1 effluent at 153 g/m^3 (up from 78 g/m^3 in 2018-2019) and the factory wastewater at 102 g/m^3 (up from 82 g/m^3 in the 2018-2019 year). The predominant nitrogen species present in the dairy shed effluent are generally ammoniacal nitrogen and organically bound nitrogen, whereas the factory wastewater contains much higher concentrations of nitrate and nitrite nitrogen. The additional nitrogen load applied to the paddocks during the year under review from the Farm 1 and Farm 2 and 3 DSE was about 5,072 kg (compared to 4,352 kg in 2018-2019), that is, about 9% of the total nitrogen load.

Within the production season, during the year under review the measured organic strength of the factory wastewater strength (BOD) was no longer significantly higher at the start of the season (Figure 23), as was the case for this parameter in the 2017-2018 year along with the minerals (for example potassium as shown in Figure 29) and total phosphorus (Figure 30).

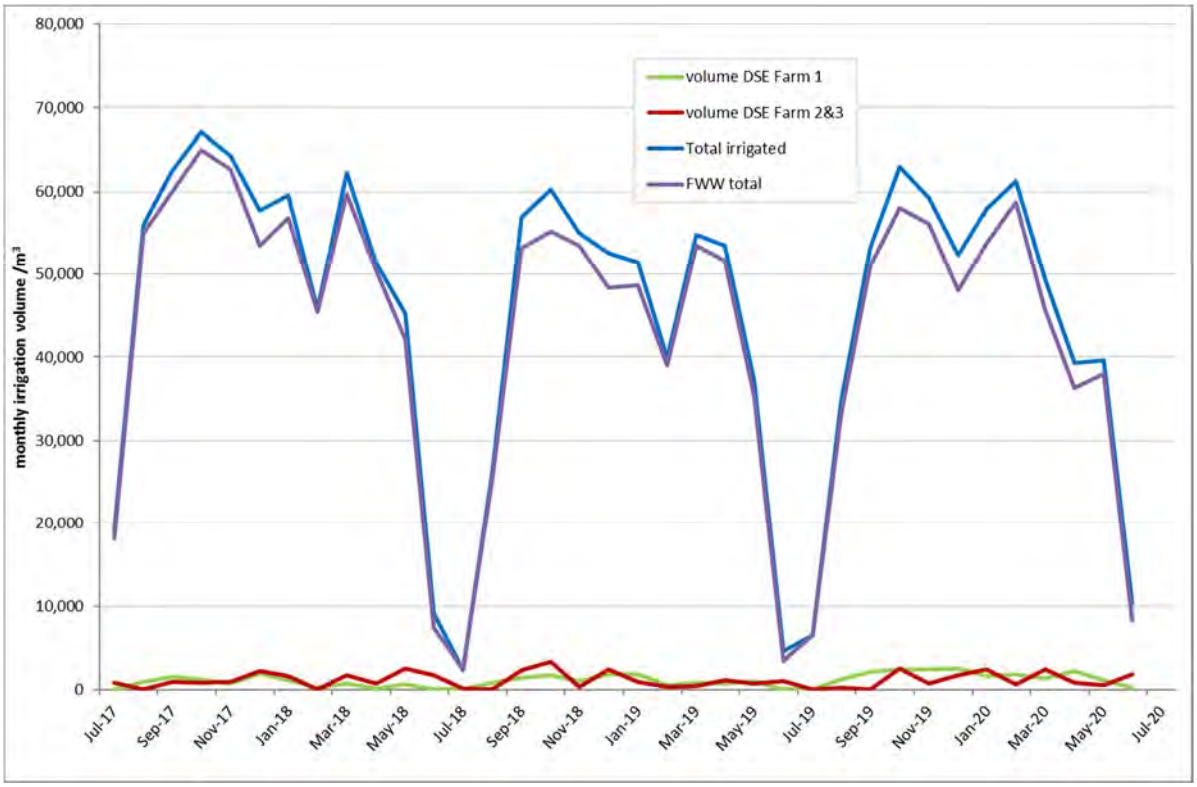

Figure 22 Relative irrigation volumes during the year under review, with previous two years for comparison

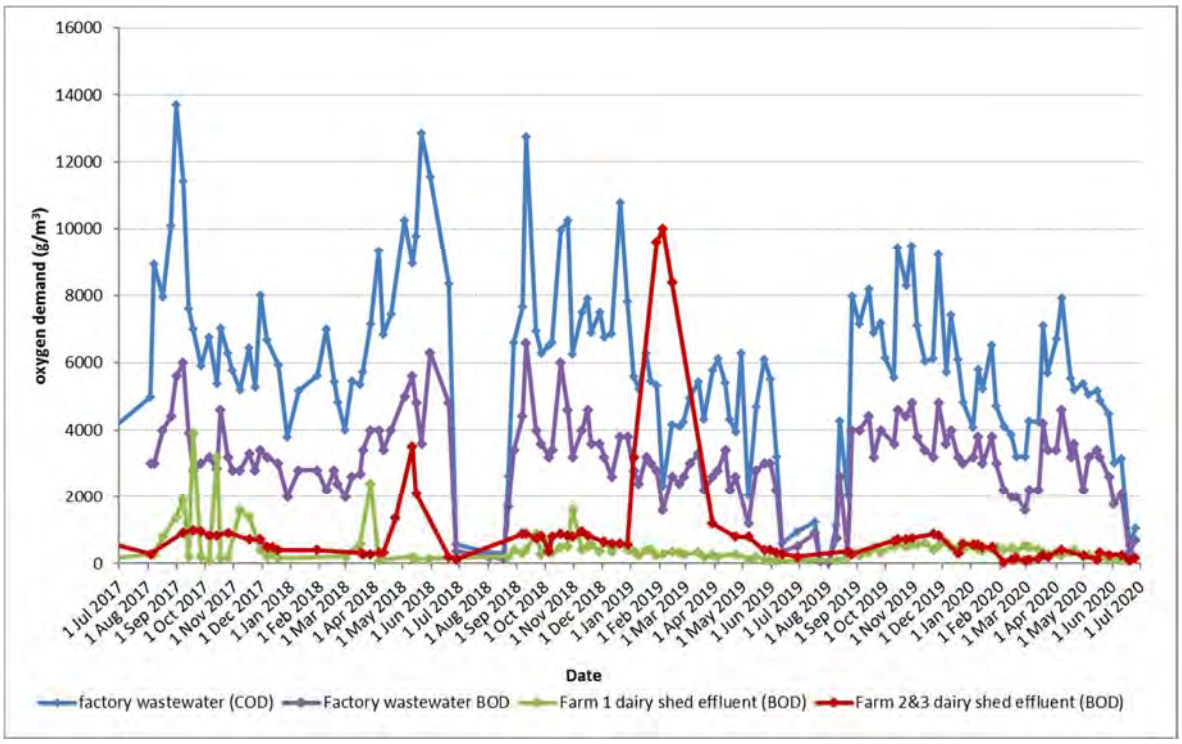

Figure 23 Oxygen demand of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

Figure 24 pH of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

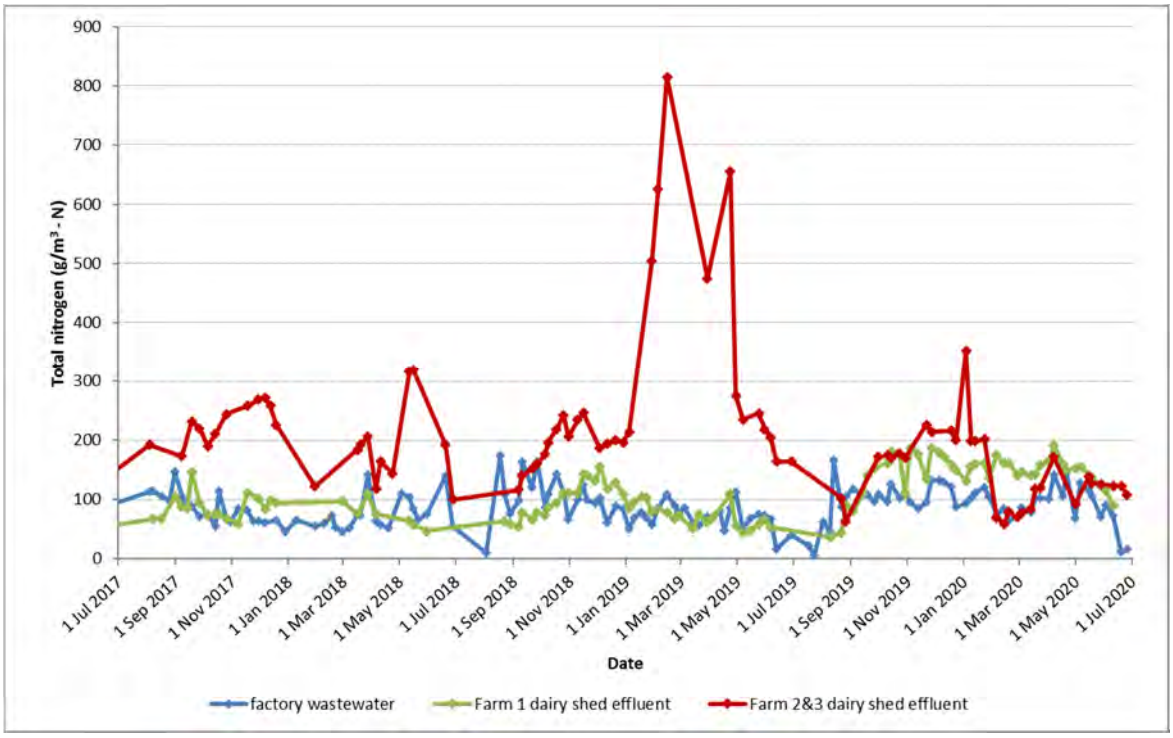

Figure 25 Nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

It is noted that the seasonal profile for the total nitrogen of the Farm 3 dairy shed effluent is quite different when compared to the previous monitoring period (Figure 25) and the factory wastewater has continued to have much higher total nitrogen and nitrate levels on the whole during the year under review when compared to the 2017-2018 year (Figure 26). It is also noted that during the last three years, the nitrite concentration of the Farm 3 DSE has reduced and remained low for the 2018-2020 years, but that there has

been a change in the nitrite concentration of the factory wastewater, with this showing a progressive increase season on season (Figure 27).

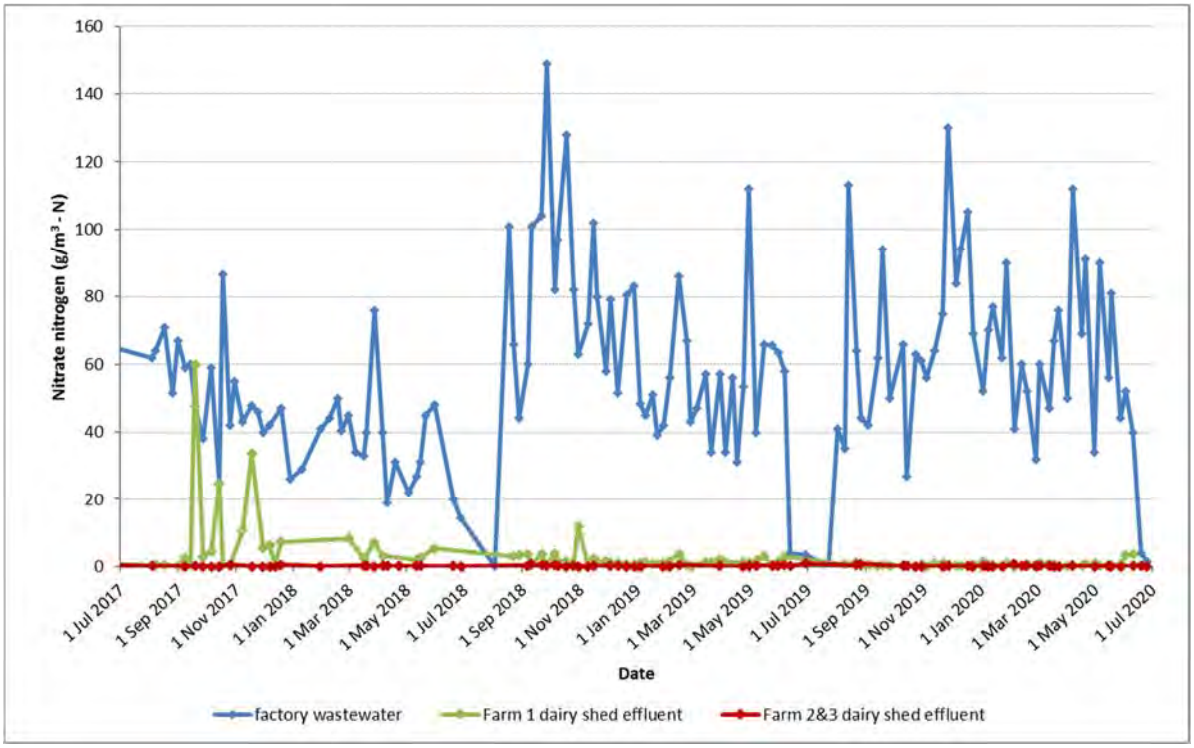

Figure 26 Nitrate nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

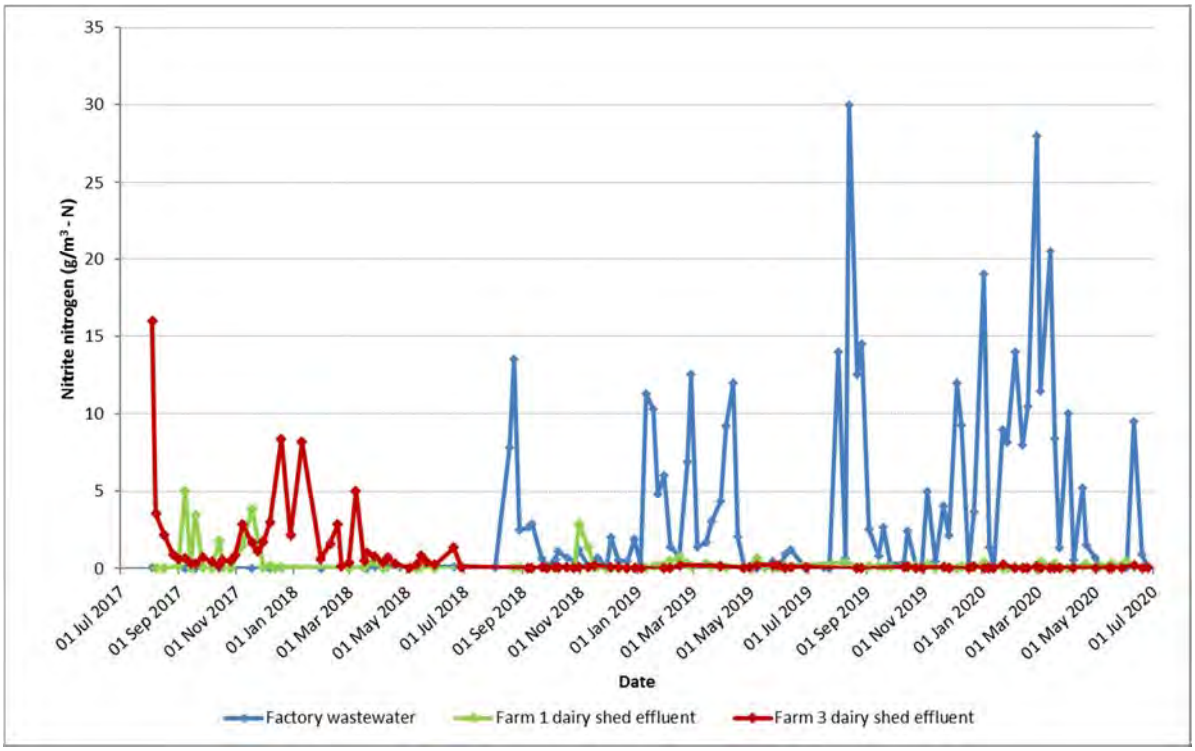

Figure 27 Nitrite nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

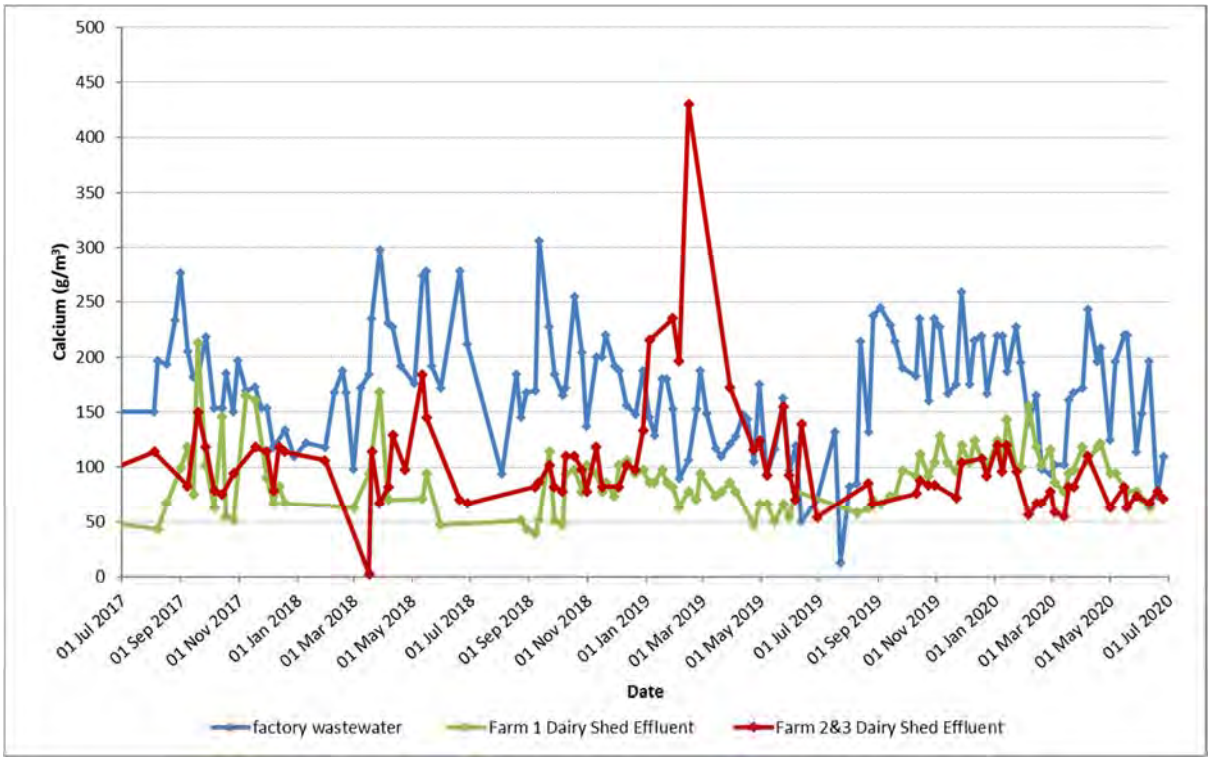

Figure 28 Calcium concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

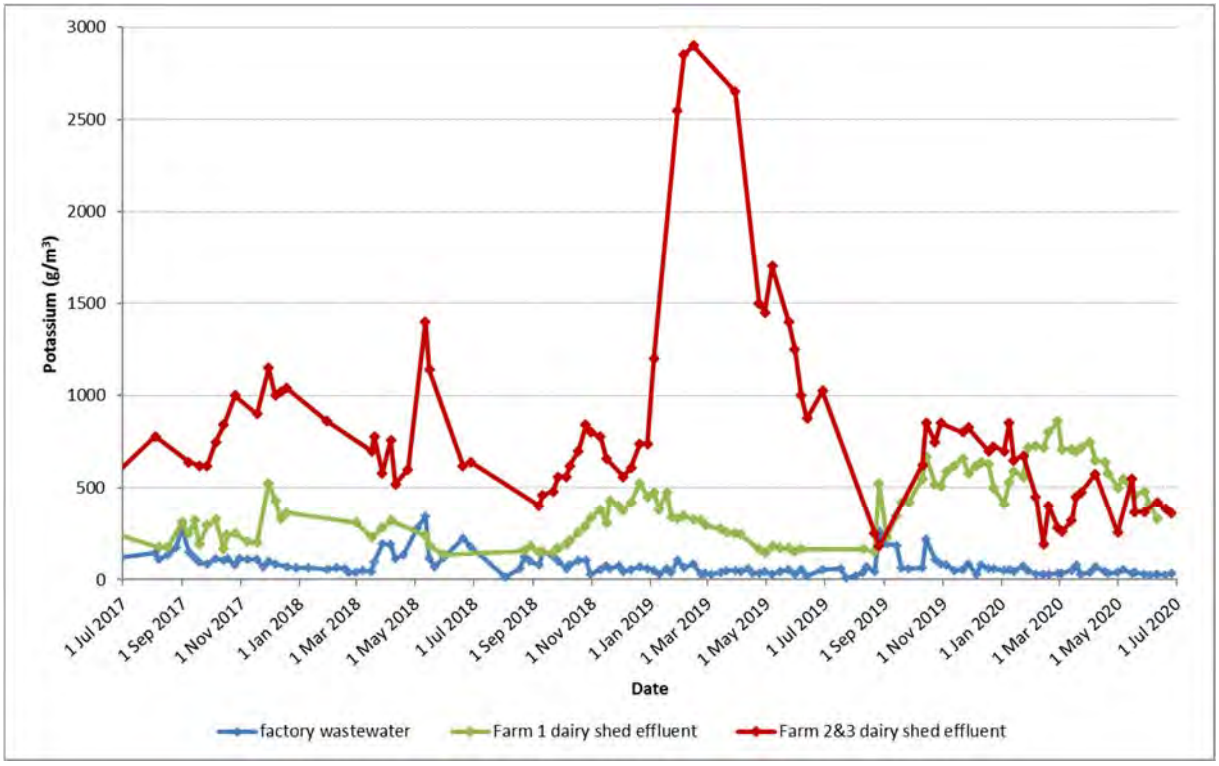

Figure 29 Potassium concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

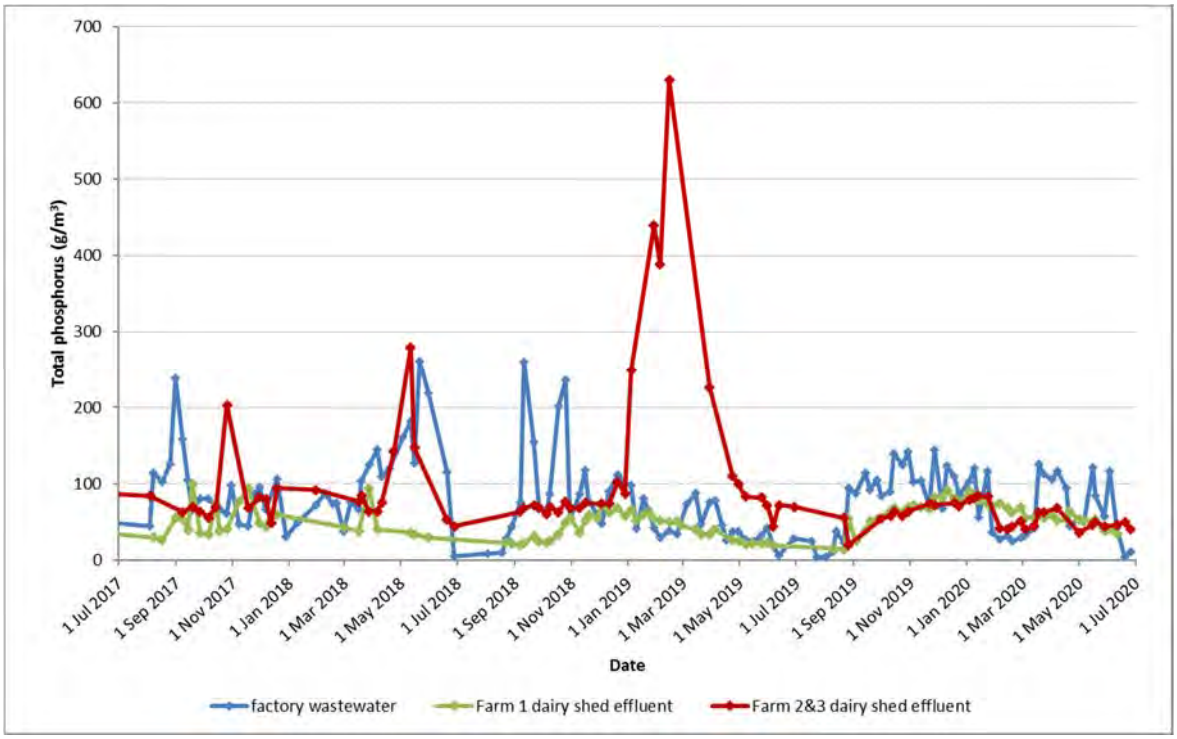

Figure 30 Phosphorus concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

Interlaboratory comparison

An interlaboratory comparison exercise was carried out on 11 November 2019 on weekly composite of the 24-hour composite samples taken of factory wastewater and farms DSE by the Company. The results are given in Table 9.

Table 9 Results of interlaboratory comparison on factory and dairy effluents, 11 November 2019

Parameter	Unit	Factory wastewater		Dairy shed effluent (Farm 1)		Dairy shed effluent (Farms 2 & 3)	
		Fonterra (ICS)	TRC	Fonterra (ICS)	TRC	Fonterra (ICS)	TRC
Sum of cations	meq/L		18.5		30		34
Sum of anions	meq/L		7.6		30		30
Alkalinity, total to pH 4.5	g/m³ $CaCO_3$	-	<1.0	-	1,060	-	1,050
Biochemical oxygen demand (BOD)	g/m³	3,200	2,600	420	210	880	500
Calcium	g/m³	175	165	96	90	72	73
Chloride	g/m³	-	66	-	210	-	350
Chemical oxygen demand (COD)	g/m³	6,121	5,700	-	-	-	-
Conductivity, 25°C	mS/m	-	164	-	313	-	351
Bicarbonate	g/m³ HCO_3	-	<1.0	-	1,290	-	1,270
Potassium	g/m³	52	82	660	500	800	580
Potassium adsorption ratio		-	1	-	7	-	8

Parameter	Unit	Factory wastewater		Dairy shed effluent (Farm 1)		Dairy shed effluent (Farms 2 & 3)	
		Fonterra (ICS)	TRC	Fonterra (ICS)	TRC	Fonterra (ICS)	TRC
Magnesium	g/m^3	24	13.7	32	32	32	35
Sodium	g/m^3	129	128	76	74	100	95
Ammoniacal nitrogen	g/m^{3}N	-	2.8	-	101	-	125
Nitrate + nitrite	g/m^{3}N	-	76	-	0.04	-	0.03
Oil and grease	g/m^3	-	21	-	16	-	77
pH	pH	4.3	4.2	7.9	7.8	7.9	7.8
Sodium adsorption ratio		3.4	2.5	-	1.7	-	2.3
Suspended solids	g/m^3	-	310	-	560	-	720
Total Kjeldahl Nitrogen (TKN)	g/m^{3}N	16	38	133	174	226	197
Total Nitrogen	g/m^{3}N	95	114	134	175	226	197
Total Phosphorus	g/m^{3}P	71	75	67	76	74	82
Ash	g/m^3	1,059	-	1,545	-	1,715	-
Nitrate	g/m^{3}N	75	73	1.00	<0.02	0.08	<0.02
Nitrite	g/m^{3}N	4.0	3.4	0.12	0.06	0.10	0.04

In the 2015-2016 year, agreement between laboratories was poor, apart from on pH, which led to a revision of the methods of sample compositing, splitting and identification. During the year under review, the only parameters that were found to have good agreement (within ± 5%) for all three effluent sources were again pH and sodium. COD agreed well for the factory wastewater, with reasonably good agreement (about ± 10% or less) for calcium and total phosphorous, however the Fonterra values for this parameter were consistently under estimates when compared to the Council's contract laboratory. In the 2017-2018 year, the other parameters were generally found to have been overestimated by the Company for all waste streams when compared to the Council determinations, however during the 2018-2019 year and the year under review there were almost equal numbers of over and under estimates. Getting good agreement for the dairy shed effluents can be particularly problematic due to the nature of the waste. The first area of focus would be to ensure that the samples are split in an effective manner, which is difficult to achieve. Again, BOD, potassium and nitrogen were the parameters showing particularly poor agreement across all of the wastewater streams. In the case of total nitrogen, there was underestimation of between 17 and 60%, in the total nitrogen and Kjeldahl nitrogen results for the factory wastewater and Farm 1 dairy shed effluent, but a 14% overestimation of these components in the Farm 3 dairy shed effluent results reported by the Company. This is the fifth series of interlaboratory comparisons that have been undertaken, and these are scheduled to continue.

A wide range of parameters were tested by Council, for future reference. Historically, for nitrogen species, it has been determined that nitrate was the major single component in the factory wastewater, whereas the dairy shed effluent was almost exclusively ammonia and organics (which are the components that are measured by TKN analysis). During the 2017-2019 years, both the Council laboratory and Council's contract laboratory obtained atypical results for the nitrate-N and the TKN of the factory wastewater. This continues to support the indications that the factory wastewater has been containing an increased amount of organic nitrogen than would be expected for this waste stream since the 2017-2018 year.

The discrepancy between the sum of anions and sum of cations, and conductivity in the factory wastewater also indicates the presence of other anions (from organic acids) that have not been quantified in the parameters determined. It is recommended that the Company investigate the potential environmental significance of the presence of these organic acids in the irrigated wastewater.

2.1.2 Council monitoring

2.1.2.1 General inspections of factory premises

Twelve scheduled inspections of the premises, treatment system and Kaupokonui Stream were performed during the 2019-2020 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. An additional inspection was undertaken to observe the cleaning of the water intake.

2.1.2.1.1 General site

The monthly inspections revealed no major problems with the general factory site. Generally the site was clean, tidy and orderly.

Improvements discussed at the site inspections included:

- Approval was granted for a medium term plan to move to a fixed irrigator system that will eventually replace all travelling irrigators on the farms. Detailed planning will commence following replacement of the consent.
- The construction of a new bunded proliq tank on the factory site that would be replacing the open proliq ponds on Farm 3.
- Surveys of all pipe crossings had been undertaken, which five high risk crossing where the construction material of the pipelines did not comply with new Company standards. It was outlined the five pipes are to be progressively replaced with stainless steel.

At inspection on 13 February 2020 it was noted that hydro testing of the new proliq tank was still in progress and the tank was being slowly re-filled. However, the process was about to be put on hold. Although within their take consent limits, the Company wanted to minimise the consumptive use on site due to the low flows in the Kaupokonui Stream. The DFE Pharma (IGL)) plant had been sold and agreement had been reached that the new owners would ensure compliance with consent conditions under Fonterra's direction.

2.1.2.1.2 Intake from the Kaupokonui Stream

The monthly 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 was inspected during cleaning on 8 July 2019. Visual clarity measurements found no decrease in clarity downstream, and that the activity was being performed in compliance with permitted activity Rule 53 of the Regional Freshwater Plan. Cleaning activities also commenced a week prior to the inspection undertaken on 9 June 2020. The silt was being pumped to an earth bund and a sand bund was located next to the stream for the silt to be filtered out prior to entering the Kaupokonui Stream. There appeared to be no visual adverse effects in the receiving water at the time of discharge.

The fish pass installed by the Company under the guidance of the Council in March 2004, contained an adequate level of water during all inspections. Trout were observed above the weir at the August and October 2019 and February, March and both June 2020 inspections.

2.1.2.1.3 Spray cooling wastes 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.

The cooling water discharge system had variable performance during the monitoring year. The Company's recording system generally worked well during the year under review. However there were issues with accuracy of the flow data that continued from the 2018-2019 year until it was resolved in September 2019. These matters are covered in Sections 2.1.1.3, 2.3 and 3.1.

Historically, the most common cause of missing data was due to a third party server going off line temporarily, which then did not accept data until the link was reset. Alerts have now been put in place so that the link can be re-established by Fonterra staff in a more timely fashion. This continued to work well during the year under review. The only remaining missing data tends to be when the probes have been removed during flood conditions, the null switch has been activated during calibrations, or rarely there are faults or electrical problems at the site. The missing data rate had been reduced to about 3% for the previous two years, and was less than 1% for the year under review.

At the inspection on 20 September 2019 it was confirmed that the new flow meter on the cooling water discharge line had been verified and the data was being transmitted to Council.

At the inspection undertaken on 13 February 2020 the inspecting officer was informed that the initiative to install air actuated pressure regulating valves on the first nozzle of each discharge leg was progressing. It was observed that all but three nozzles had a good spray discharge to maximise cooling. The inspecting officer was advised that once all valves had been installed, the Company would be able to open/close valves individually to ensure optimum spray discharge is achieved. During the deployment of the parallel temperature loggers at the March inspection, the change in temperature differential due to the removal of the upstream logger triggered the alarm in the factory and a staff member attended to investigate. This confirmed that the alert and follow-up procedures were functioning well.

The growth in riparian vegetation continued to be effective at preventing spray drift of cooling water beyond the property.

2.1.2.1.4 Other discharges to the Kaupokonui Stream

During October 2017 works to combine and relocate the IGL 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 1). All discharges from the norther area of the site occurred from this new combined outfall following this with the first discharge from the new 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 waste water system, and/or to divert various parts of the stormwater catchment directly to the waste water treatment system in the event that activities like site wash downs are occurring. Prior to discharge the quality of the water is assessed.

An example of the active management is that on one occasion when the ponds were almost dry and no discharge had occurred for a period of time, the inspecting officer was informed that it was likely that in the event that the pond needed emptying, then this would probably be sent to the irrigation system as it had been sitting in the pond for a long time.

During the year under review a whey spill occurred that was contained on site. The bulk of the material was recovered using sucker trucks and disposed of at a composting facility. The remaining material/gravel was to be recovered and buried in the paddock at the corner of Skeet and Manaia Road. Any potential run off from the area drains into a bunded area. The inspecting officer was informed that, to prevent a future occurrence, it was likely that the Company would install welded flanges.

Photo 1 Northern stormwater pond, stop valves and outfall to the Kaupokonui Stream

At the August 2018 inspection it was noted that the groundwater discharge from southern pond was to be addressed in near future by contractors. However, at inspection in August 2019, it was noted that ground water ingress into the southern pond outlet pipeline was occurring at the time of inspection. The discharge was clear and no deleterious effects were occurring in the receiving waters.

On a number of occasions it was found that the contents of the stormwater pond were being used to cool the waste water, and as such reduced the number of discharges that occurred to the stream.

The Company began planning to plant low growing natives around the northern stormwater pond 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. It was confirmed at a subsequent inspection that shrubs were being planted around both stormwater ponds.

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.

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.

2.1.2.1.7 Spray irrigation of wastewater

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

Spray irrigation 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 44 ha is reticulated with in-ground irrigators. The total area farmed is 244 ha.

No spray drift across streams was observed. Care is required while irrigating near watercourses particularly during wet and/or windy conditions. Spraying is not to occur within 20 m 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.

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. Some additional aeration was undertaken in February 2016.

On the whole, the general wastewater irrigation was found to be well managed. The pasture receiving irrigation appeared to be healthy, with no ponding, grass burn, or run-off observed during the inspections. Buffer distances were being adhered to at the time of all inspections.

During the year under review, 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.

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. New planting was undertaken on the riverbank upstream of the factory in the 2001-2002 monitoring period. The gully areas in the vicinity of the Farm 1 cowshed to the downstream farm boundary, which were planted during the 1997 and 1998 winter periods, continued to be maintained during the 2019-2020 monitoring period. During the year, the inspecting officer was informed that some of the riparian planting would need to be removed to allow access for the replacement of the PVC wastewater pipes over the stream during their replacement with lower risk stainless steel pipes. The extent of this was still to be assessed, but it would be minimised and replanted.

The Company has continued to invest in planting and fencing of waterways around the factory and Company farms, with a significant riparian programme of approximately $77,000 value over about 12 km of the Kaupokonui Stream. This also includes an annual (index linked) donation of $3,000 to the Taranaki Tree Trust in accordance with condition 10 (b) of consent 0919. The Taranaki Tree Trust was dissolved in 2016

after which time the donations were paid directly to the Council. To the end of the 2019-2020 monitoring year, a total of $74,520 had been donated under the requirements of consent 0919. In the 2018-2019 Annual Report it was noted that there was no contribution received during the 2018-2019 year (and no funding allocated to plan holders). The contribution is normally paid upon invoice from the Council. Due to the consent expiring, Council omitted to send out an invoice. The Council systems have now been updated to cater to activities operating under Section 124 protection. Therefore two invoices were issued in the 2019-2020 year ($4,593.36+GST and $4,650.00+GST), both of which were paid.

At the end of the 2019-2020 year, the Council had prepared 164 Riparian Management Plans (RMP's) fully or partially located in the Kaupokonui Stream catchment (an increase of four plans). Of these, 20 plans cover the 31 km of streambank that was originally identified as requiring improvement and meet 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 10 and is illustrated in Figure 31.

Subject to confirmation by audit, the riparian plantings recommended in the plans that had received funding to the end of June 2020 (nine plans) covered a total stream bank distance of 42 km, of which eight (44%) were 100% completed.

This compares to 29 plans covering a total of 33.3 km, of which four (14%) were 100% completed in the Kaupokonui Stream catchment downstream of the plant, and 164 plans covering a total of 772 km, of which 24 (15%) were 100% completed in the wider Kaupokonui parent catchment. The riparian planting progress for the Kaupokonui catchment as a whole is illustrated in Figure 32.

During the 2019-2020 year six farms received rebates under this scheme totalling $6,527.64, which equated to 4,390 plants.

Table 10 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	93.9	42	51.9	30.3	772
Original additional recommended planting, km	32.6	12.9	19.7	14.7	347
Planting implemented, km	15.2	11.2	4.0	9.8	210
Planting percentage implemented,%	46	86.6	20.3	67	60.3
Fencing implemented, km	84.6	38.3	46.3	-	-
Percentage of steam bank fenced, %	91.3	91.1	77.0	-	-

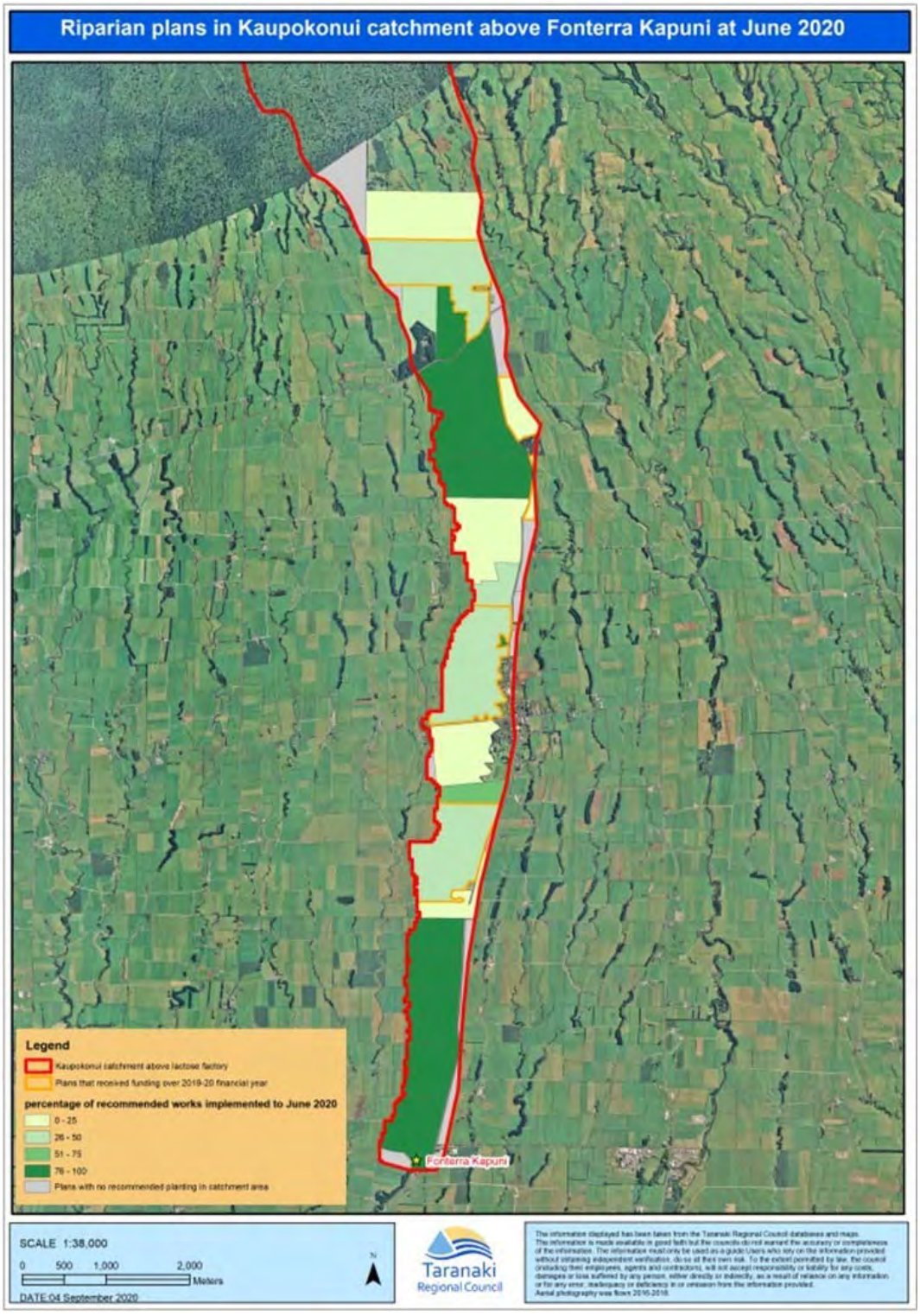

Figure 31 Riparian planting progress in the Kaupokonui Stream catchment above the lactose plant

It can be seen that the current data indicates that although there is a moderate implementation rate in the catchment as a whole (60.3%), there is a low implementation rate upstream of the plant (46%). As would be expected, there is a higher implementation rate on those farms that have received funding (86.6%) when compared to those that have not (20%).

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.

The data shows that progress continues to be made with the riparian planting in the Kaupokonui Stream and wider Kaupokonui catchment. The plan percentages implemented have increase by between 1 and 15% when compared to the data available at the end of the 2018-2019 year.

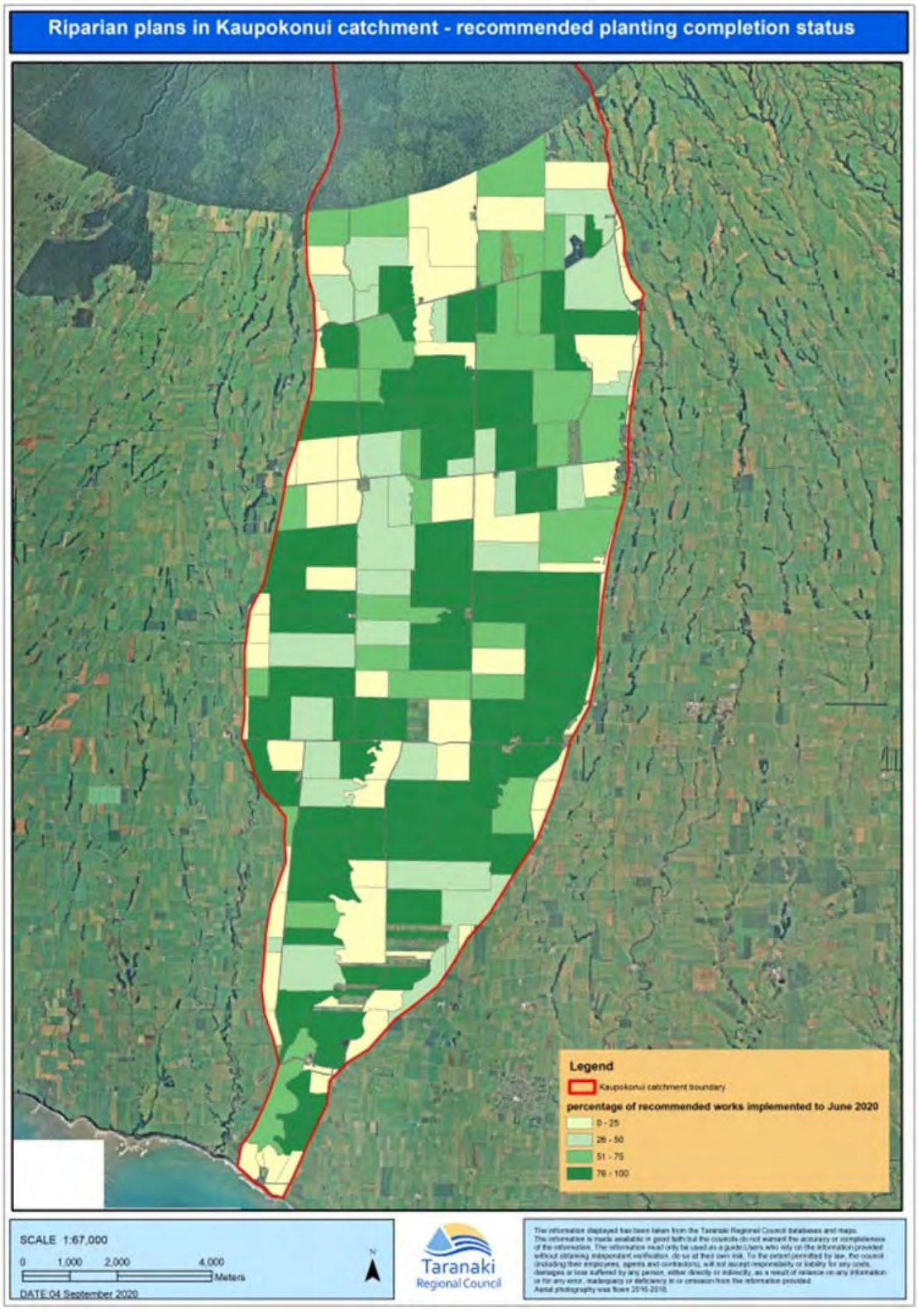

Figure 32 Riparian planting progress in the Kaupokonui Stream catchment

An example of riparian planting is given in Photo 2, 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 metres, 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.

All Fonterra plantings were maintained in the 2019-2020 year. Although some small sections needed to be removed to allow the replacement of the wastewater pipe crossings, the plantings were replaced as soon as possible following completion of the work.

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

2.1.2.1.9 Disposal of solid wastes

Solid wastes from annual cleaning of the waste effluent tank and lime silo have been disposed of by burial on Farms 2 and 3 during the winter maintenance shut-down for a number of years. This activity is permitted under Rule 29 of the Regional Freshwater 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 is 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. Prior to the installation the Trommel, these solids were either accumulated in the wastewater tank or were irrigated onto land within the wastewater. In October of that 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. From January 2018 the filtered material has been removed from the site by a composting/fertiliser company for use in their products.

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 was again used in the 2019-2020 year.

An additional disposal of site surface material (gravel) that was contaminated with condensed whey from a spillage that was contained on site occurred in September 2019. The disposal site used was the paddock on the corner of Manaia and Skeet Roads. This disposal was carried out after confirmation from Council that the activity was acceptable under Rule 29 as a permitted activity.

2.1.3 Results of discharge monitoring

2.1.3.1 Physicochemical

2.1.3.1.1 Cooling waters' quality

Monthly 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 of each waste, to be analysed by the Council. The results of these analyses for year under review are presented in Table 11 (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 12 for comparative purposes.

Nine of the ten samples collected during the year under review were composite samples, however there was one occasion on which there was no discharge and occasions when a composite sample was not available at the time of inspection.

Table 11 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
19 Jul 2019[a]	-	-	-		-
15 Aug 2019	0.4	0.5	11.1	7.5	0.74
20 Sep 2019	0.9	1.1	11.6	7.6	0.44
15 Oct 2019	0.4	0.6	10.7	7.7	0.48
21 Nov 2019	0.9	1.2	9.4	7.5	0.46
18 Dec 2019	<0.4	<0.4	5.8	7.1	2.9
17 Jan 2020	0.4	0.7	12.0	7.7	0.54
13 Feb 2020	<0.4	0.4	12.4	7.6	1.9
17 Mar 2020	0.4	0.6	12.1	7.6	0.46
21 May 2020	<0.4	<0.4	11.0	7.6	0.28
09 Jun 2020	0.6	0.5	9.4	7.5	0.44
24 Jun 2020	0.4	0.8	10.2	7.2	0.98
Range	<0.4 – 0.9	<0.4 – 1.2	5.8 – 12.4	7.1 – 7.7	0.3 – 2.9
Median	0.4	0.6	11.0	7.6	0.48

a. No discharge

Table 12 Summary of cooling water discharge quality from the Council surveys during the period march 1992 to June 2018

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	g/m^3	228	<0.5 - 460	2.1	233	<0.5 - 1,100	2.5
BOD_5 (filtered)	g/m^3	217	<0.4 - 91	1.0	216	<0.5 - 1,100	1.4
Conductivity at 20˚C	mS/m	234	3.4 - 46.8	9.8	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	115	5.8 - 8.2	7.4	144	4.6 - 10.6	7.2
Turbidity	NTU	231	0.35 - 450	3.5	125	0.26 - 110	4.2

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 three successive years following the three consecutive years over which it decreased significantly (2016-2017 annual median of 0.5 g/m^3 down from 1.2 g/m^3 in 2015-2016, 4.7 g/m^3 in 2014-2015 and 7.2 g/m^3 in 2013-2014).

2.1.3.1.2 Stormwater quality

Discharges from stormwater pipe outlets to the stream have previously been sampled at four locations: from the northern (STW001062) and southern (STW002018) areas of the lactose plant, the IGL plant (STW001109), and the southern stormwater pond (STW002078), as shown in Figure 33.

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 IGL 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.

Stormwater discharges from the containment ponds were found to be occurring very rarely at the time of inspection during the year under review.

2.1.3.1.2.1 Northern stormwater pond outfall

A sample was collected of the discharge from the northern stormwater pond outfall (site STW002099, Table 13) once during the period under review.

Table 13 Results of the analysis of a grab sample of the northern stormwater pond during year under review (STW002099)

Date	BOD_5	Conductivity @ 25˚C	Oil and grease	pH	Suspended solids	Turbidity
	g/m³	mS/m	g/m³		g/m³	FNU
19 Jul 2019*	1.3	2.6	4	6.8	<3	3.4
15 Oct 2019	4.4	1.7	<5	6.8	40	30
18 Dec 2019*	7.0	9.0	<4	6.0	20	5.7
Consent limit	**-**	**-**	**15 (hydrocarbons)**	**6.0 – 8.5**	**100**	
2017-2019						
No of samples	5	5	5	5	5	5
Minimum	1.7	5.3	<0.5	6.0	2	0.91
Maximum	290	55.9	0.6	8.2	27	10
Median	5.2	11.4	<4	7.0	9	4.8

* Sample collected from pond, no discharge

The limits prescribed by consent conditions for hydrocarbons, pH and suspended solids were complied with at the time of the sampling. The BOD was elevated above the guideline value given in the Regional Freshwater Plan 5.0 g/m^3) on one occasion, however, the sample was collected from the inflow to the pond as an indicator of likely stormwater quality. The pond was not discharging at the time of the survey.

2.1.3.1.2.2 Southern stormwater pond outfall

A sample was collected from the outlet of the stormwater pond (Site STW002078, Table 14 and Photo 3) on only one occasion during the year under review (18 December 2019). At the time of two of the other surveys samples were collected from within the pond as an indicator of the stormwater quality at that time.

Sampling showed that the BOD continues to be elevated to varying degrees in the stormwater from this area of the site.

Stormwater discharge records provided by the Company, which showed that the next discharge following 19 July sample was on 21 July. It was reported that the condition of the water at that time was visually excellent and the pH was within consent limits at the time of discharge. The next discharge from the southern pond following the October sample was recorded as being to the wastewater system, to enable cooling of the site effluent.

The sample collected from the pond on 18 December was found to be compliant with consent conditions, The sample had a slightly elevated BOD. There were no observable effects in the receiving water at the time of this survey.

Table 14 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
19 Jul 2019*	14	10.1	<4	6.6	16	10.4
15 Oct 2019*	32	13.8	<4	6.8	19	13.1
18 Dec 2019	6.3	3.0	<4	6.3	19	7.5
Consent limit (0924-3)	**-**	**-**	**15 (hydrocarbons)**	**6.0 – 8.5**	**100**	
2008-2019^						
No of samples	34	40	35	39	36	39
Minimum	<0.5	5.0	<0.5	4.6	<2	0.05
Maximum	920	53.9	5	7.9	150	31
Median	1.5	40.6	<0.5	7.4	3	1.7

* Sample collected from pond, no discharge

^ Turbidity measured in NTU

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 re-grouted in July 2009, but some infiltration continued).

Photo 3 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 monthly inspection visits. Three sites are located in the Kaupokonui Stream (Figure 33).

Table 15 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	Immediately upstream of rail bridge	1697613	5629791
KPK000679	Kaupokonui Stream	150 m downstream of spray cool discharge zone	1697607	5629399

Sampling was performed under varying flow conditions ranging from 0.53 m^3/s to about 7.71 m^3/s, as measured at Upper Glenn Road hydrometric station, 9.8 km downstream, where the median flow is 2.0 m^3/s, and mean annual low flow (MALF) is 0.74 m^3/s. The flow rate of 0.52 m^3/s is the lowest flow conditions under which one of these stream surveys has been carried out. This was on 17 March 2020. A record of flows (hydrograph) over the reporting period is presented in Figure 61. Samples were taken in the mornings. The results of this monitoring are summarised in Table 16 and a copy of the full results are available on request. Past Council sampling results from these sites are presented in summary form in for comparative purposes Table 17. It is noted that the Council moved to using a contract laboratory for analytical work in April 2018.

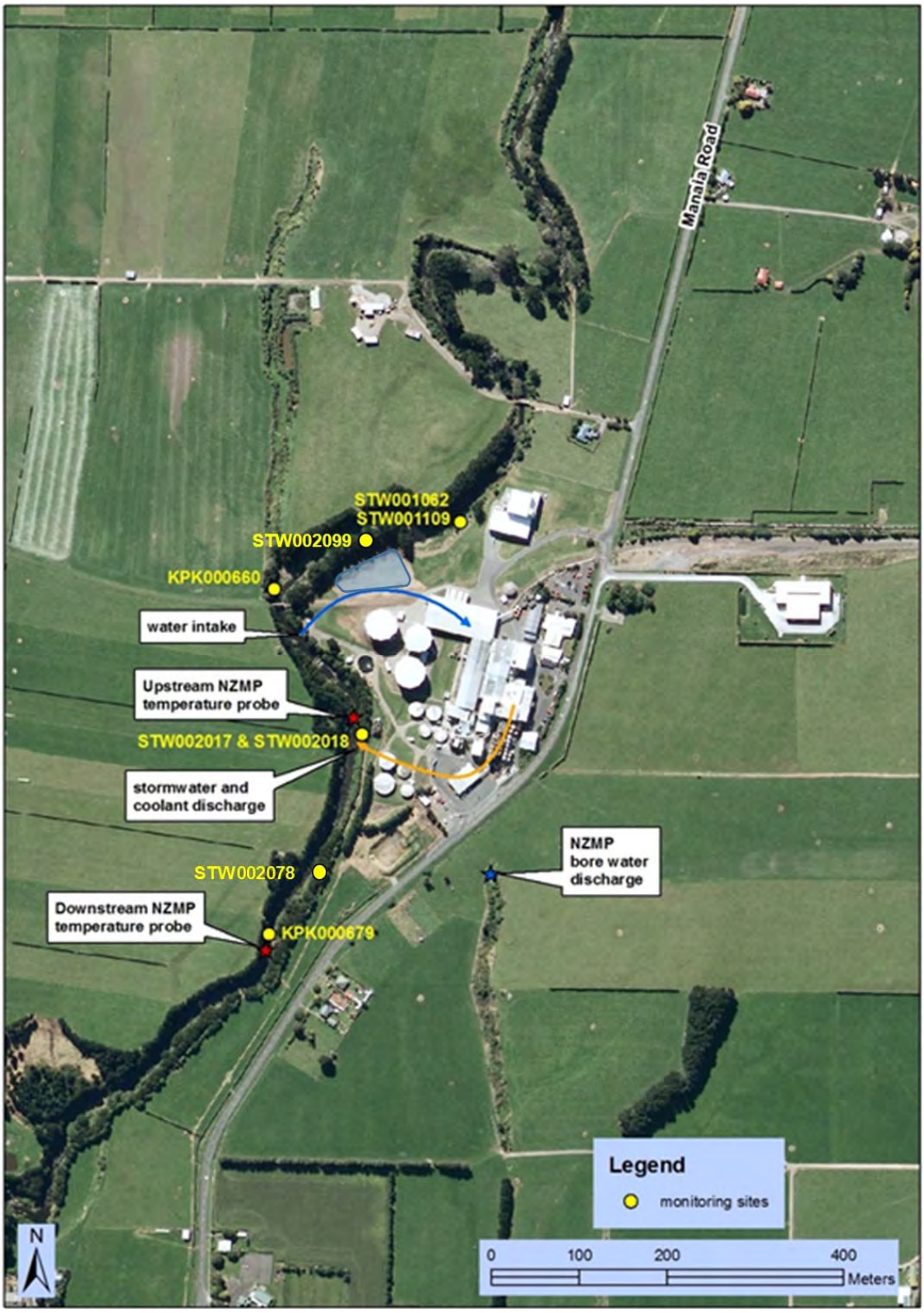

Figure 33 Section of Kaupokonui Stream for physicochemical monitoring in relation to Fonterra Ltd's waste discharges to water

Table 16 Summary of Kaupokonui Stream water quality data (ranges) from monthly monitoring for the year under review (N=12 samples)

Parameter	Unit	KPK000655		KPK000660		KPK000679	
		Range	Median	Range	Median	Range	Median
Dissolved Reactive Phosphorus	g/m^3 P	0.004 - 0.022	0.011	0.005- 0.019	0.010	0.005- 0.019	0.010
Dissolved BOD_5	g/m^3	<0.4 - 0.6	<0.4	<0.4- 0.5	<0.4	<0.4- 0.5	<0.4
Conductivity	mS/m	6.3 - 11.5	10.25	6.3- 13.9	11.0	6.5- 13.9	11.6
Free Ammonia	g/m^3	<0.01 - <0.01	<0.01	<0.01- <0.01	<0.01	<0.01- <0.01	<0.01
Nitrate+Nitrite-N	g/m^3 N	0.22 - 0.89	0.445	0.24- 1.00	0.53	0.25- 1.00	0.53
pH	pH	7.0 - 7.7	7.5	7.0- 7.8	7.6	7.2- 7.9	7.5
Temperature	˚C	6.2 - 17.3	10.9	6.5- 17.5	10.2	7.6- 19.3	10.7
Ammoniacal-N	g/m^3 N	<0.010 - 0.040	0.013	<0.01- 0.045	0.013	<0.01- 0.038	<0.01
Total BOD_5	g/m^3	<0.4 - 0.8	<0.4	<0.4- 0.9	0.5	<0.4- 0.8	0.5
Total Kjeldahl Nitrogen	g/m^3	<0.10 - 0.22	0.10	<0.10- 0.20	<0.10	<0.10- 0.21	<0.10
Total nitrogen	g/m^3	0.35 - 1.02	0.55	0.38- 1.16	0.61	0.37- 1.16	0.67
Turbidity	FNU	0.31 - 2.3	0.715	0.33- 2.3	0.74	0.28- 2.8	0.90

Table 17 Summary of Kaupokonui Stream water quality data from the Council surveys during the period August 1994 to June 2019

Parameter	Unit	KPK000655			KPK000660			KPK000679		
		No.	Range	Median	No.	Range	Median	No.	Range	Median
Dissolved Reactive Phosphorus	g/m^3 P	60	0.003 - 0.097	0.015	60	0.003 - 0.101	0.016	60	<0.003 - 0.103	0.017
Dissolved BOD_5	g/m^3	231	<0.4 - 1.8	0.5	233	<0.4 - 2.4	0.5	233	<0.4 - 8	0.5
Conductivity	mS/m	249	3.65 - 12.3	10.1	258	3.6 - 13	10.6	251	3.54 - 14.6	10.8
Free Ammonia	g/m^3	21	<0.01 - 0.01	<0.01	21	<0.01 - <0.01	<0.01	21	<0.01 - 0.01	<0.01
Nitrate+Nitrite-N	g/m^3 N	117	0.06 - 1.26	0.43	117	0.07 - 1.36	0.5	117	0.06 - 1.4	0.52
pH	pH	246	6.8 - 8.5	7.7	255	6.6 - 9.9	7.7	247	6.9 - 8.6	7.7
Temperature	˚C	247	4.9 - 19.1	12.1	265	5.1 - 19.5	12.4	250	5.2 - 21.7	13.5
Ammoniacal-N	g/m^3 N	248	<0.003 - 0.869	0.022	248	0.003 - 0.147	0.017	248	<0.003 - 0.248	0.018
Total BOD_5	g/m^3	261	<0.4 - 8.3	0.6	282	<0.2 - 7.5	0.6	264	<0.4 - 8	0.7
Total Kjeldahl Nitrogen	g/m^3	10	<0.10 - 0.46	0.16	10	<0.1 - 0.51	0.135	10	<0.1 - 0.52	0.17
Total nitrogen	g/m^3	10	0.37 - 0.97	0.69	10	0.4 - 1.05	0.75	10	0.46 - 1.16	0.78
Turbidity	FNU	248	0.39 - 120	1.00	251	0.4 - 130	0.96	250	0.42 - 160	0.93

The receiving water quality results indicated that there were minimal impacts from the stormwater and cooling water discharges measured in the Kaupokonui Stream, at time of sampling, with no sewage fungus noted over the monitoring period. The biggest pH change was from 7.1 at site KPK000655 to 7.5 at KPK000660 on 24 June 2019. At the time of this survey there were no discharges occurring from the stormwater ponds to the stream, and this change is less than the ± 0.5 pH units that is considered to present a barrier to the passage of fish.

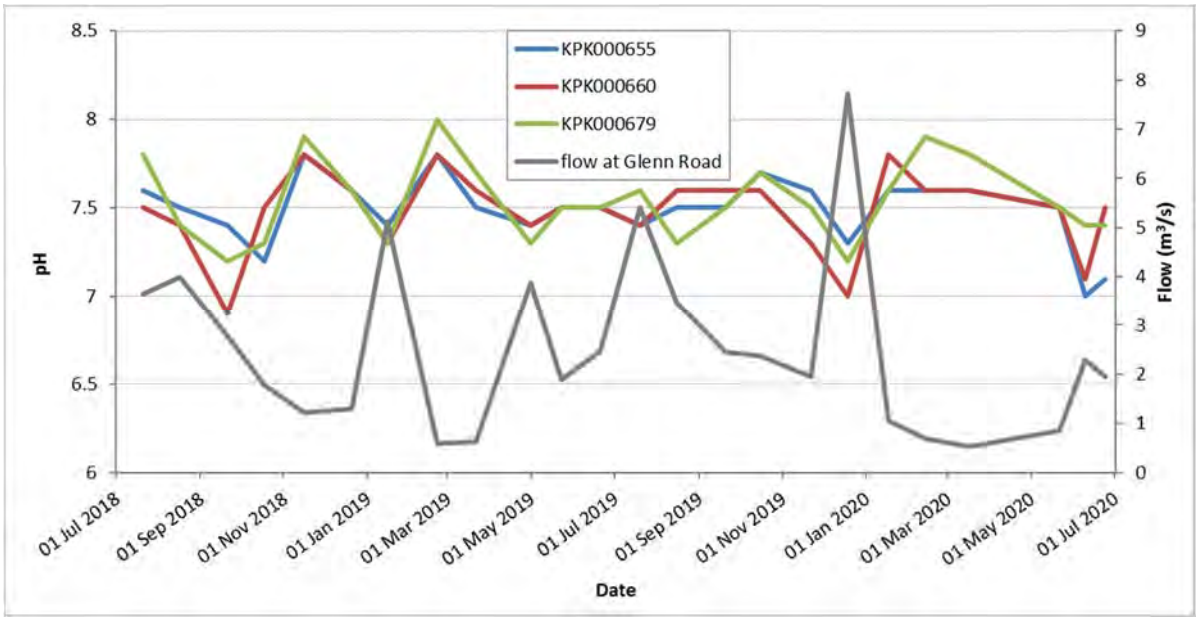

Figure 34 Downstream pH changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

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

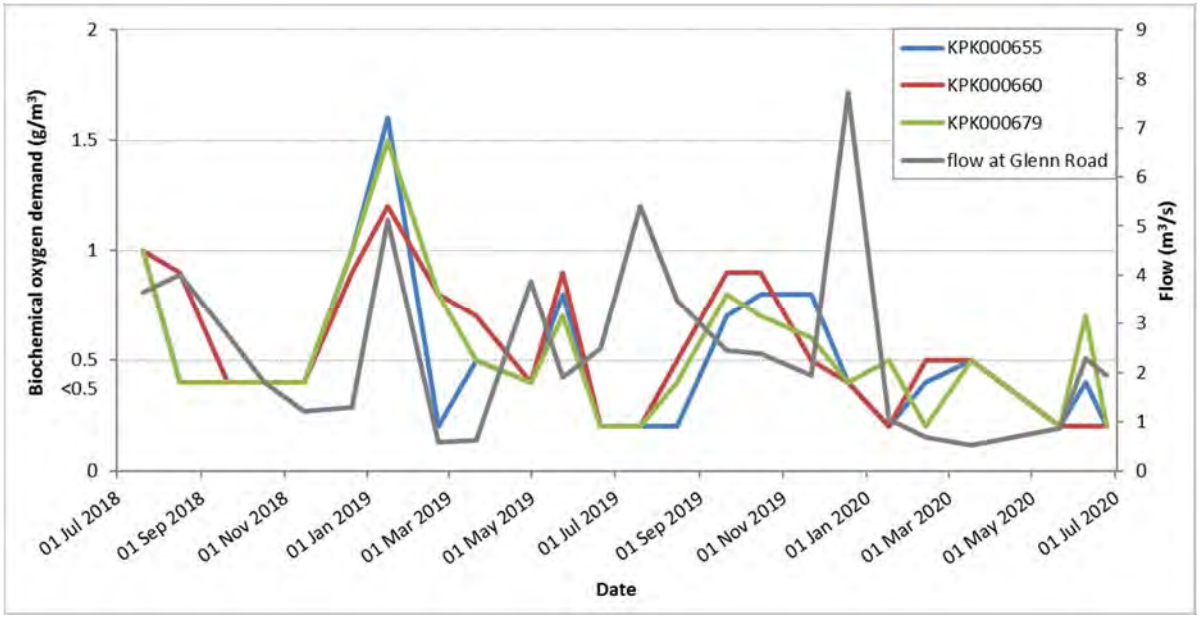

Figure 35 Downstream biochemical oxygen demand changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

Ammoniacal nitrogen generally decreased in a downstream direction, as one would expect where there are no additional ammoniacal nitrogen inputs. An increase was observed between sites KPK000655 and

KPK000660 on 20 September 2019, however the increase was not of degree that would cause environmental concern.

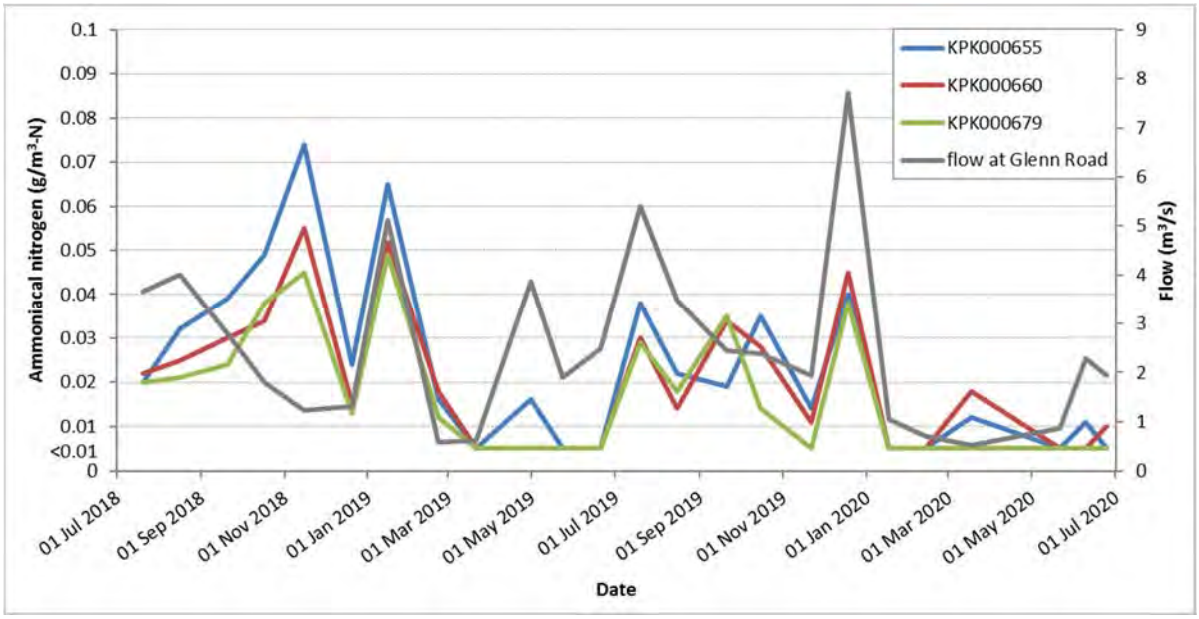

Figure 36 downstream ammoniacal nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

Conductivity increased slightly in a downstream direction. The largest increase recorded was at site KPK000679 on 20 September 2019. There were no discharges occurring from the stormwater ponds at the time of the survey, and the change in the receiving water was not one that would cause significant adverse effects.

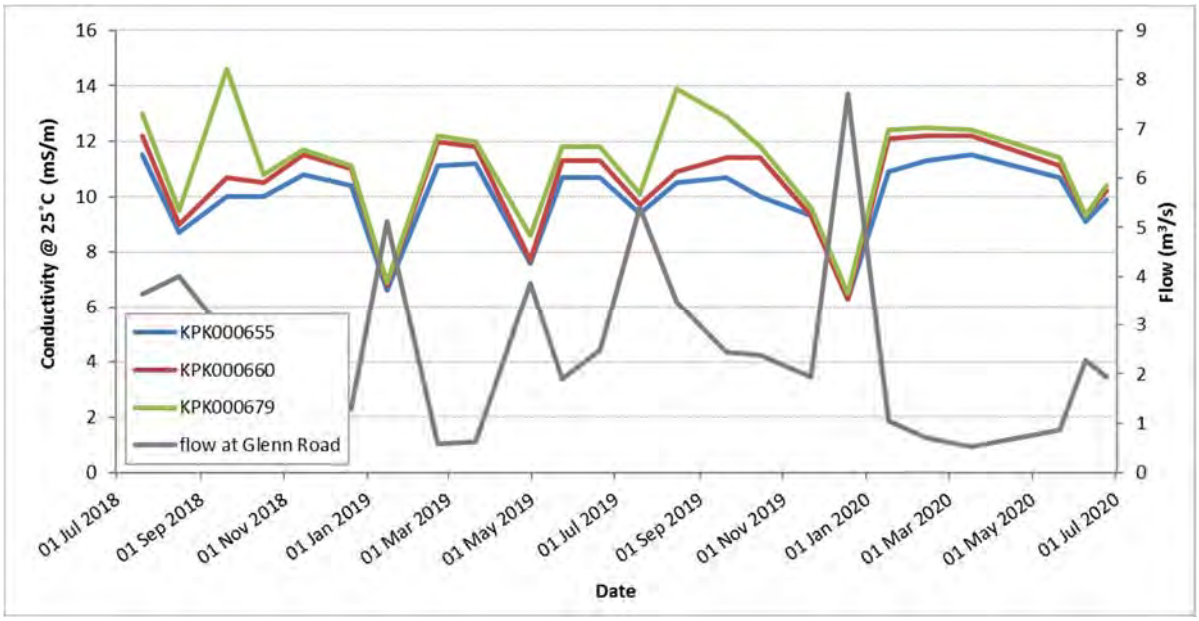

Figure 37 Downstream conductivity changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

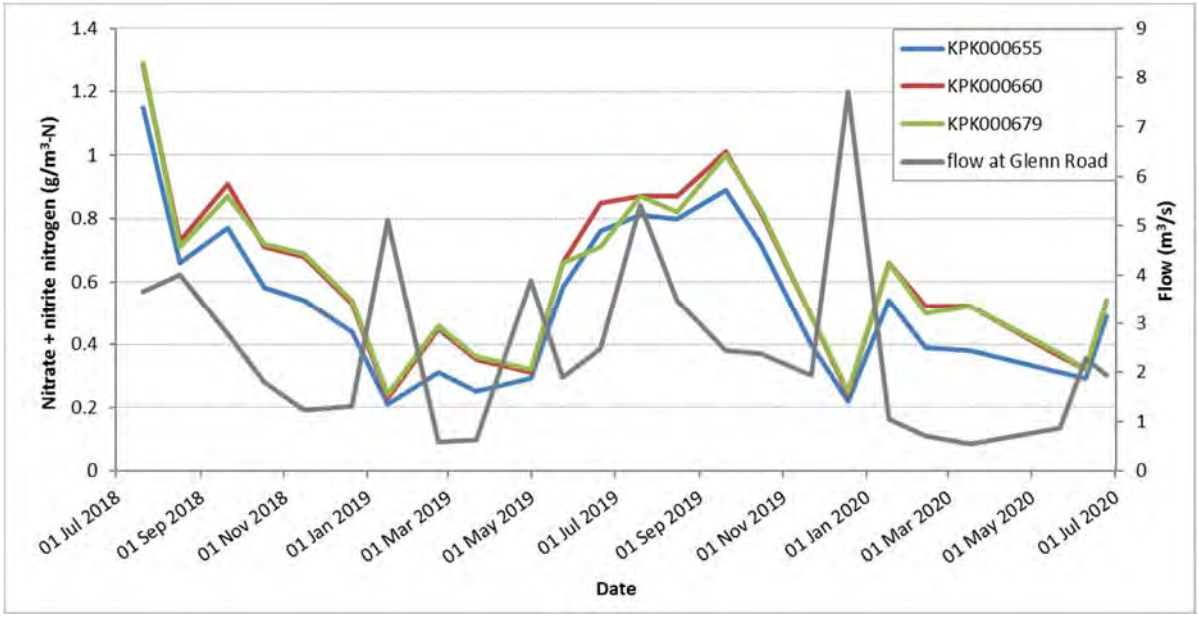

Figure 38 Downstream nitrate-nitrite nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

Nitrate-nitrite nitrogen increases slightly between the top site (KPK000655) and the site downstream of Farm 1 and the northern pond (KPK000660), whilst ammoniacal nitrogen is relatively low and generally decreases. The nitrate-nitrite nitrogen concentrations are well below the drinking water standards (11.3 g/m^3), and the National Policy Statement for Freshwater Management, Guide to Attributes (draft for comment)[2] (NPS) bottom line values of 9.8 g/m^3 (annual 95th percentile) and 6.9 g/m^3 (annual median). Total nitrogen was added to the analysis suite in September 2018 to help quantify relative influences of the

[2] Ministry for the Environment. 2018*: A Guide to Attributes in Appendix 2 of the National Policy Statement for Freshwater Management (as amended 2017)*. Wellington: Ministry for the Environment.

instream oxidation of the reduced ammoniacal form of nitrogen and/or organic nitrogen inputs, compared to increased nitrates due to additional inorganic nitrogen inputs.

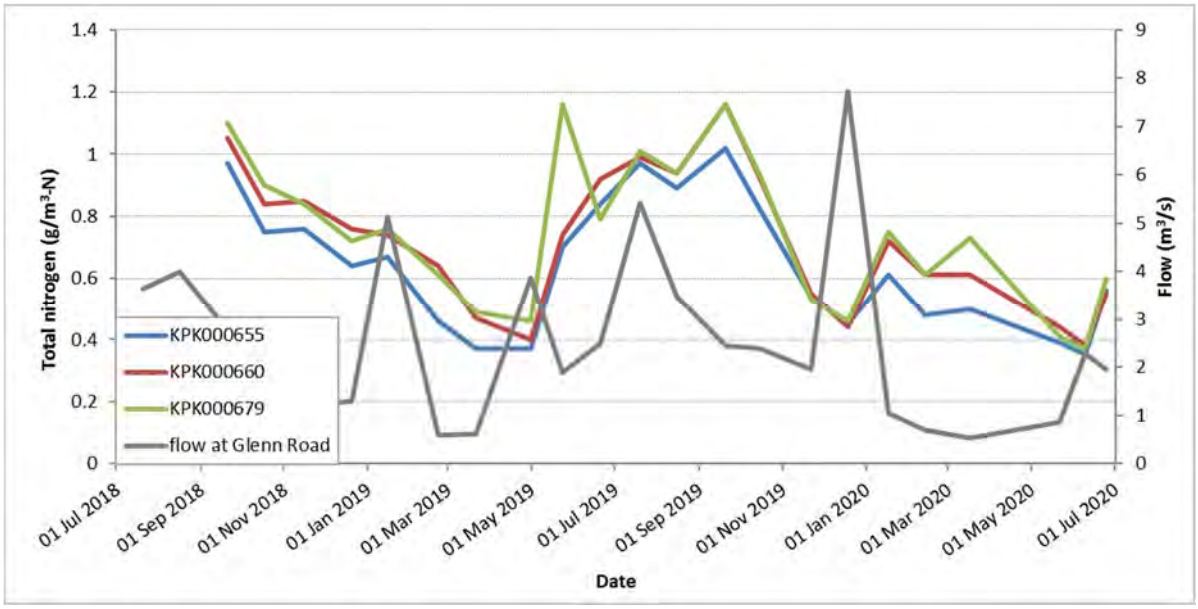

Figure 39 Downstream total nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

Total nitrogen generally follows similar trends to the nitrate-nitrite concentrations, with the exception of the sample collected at KPK000679 on 17 March 2020. On this occasion the ammoniacal nitrogen remained low, but there was an increase in the total Kjeldahl nitrogen TKN, indicating the presence of organic nitrogen species. During this dry and low flow condition survey, the TKN's presence was most noticeable in the KPK000679 sample only.

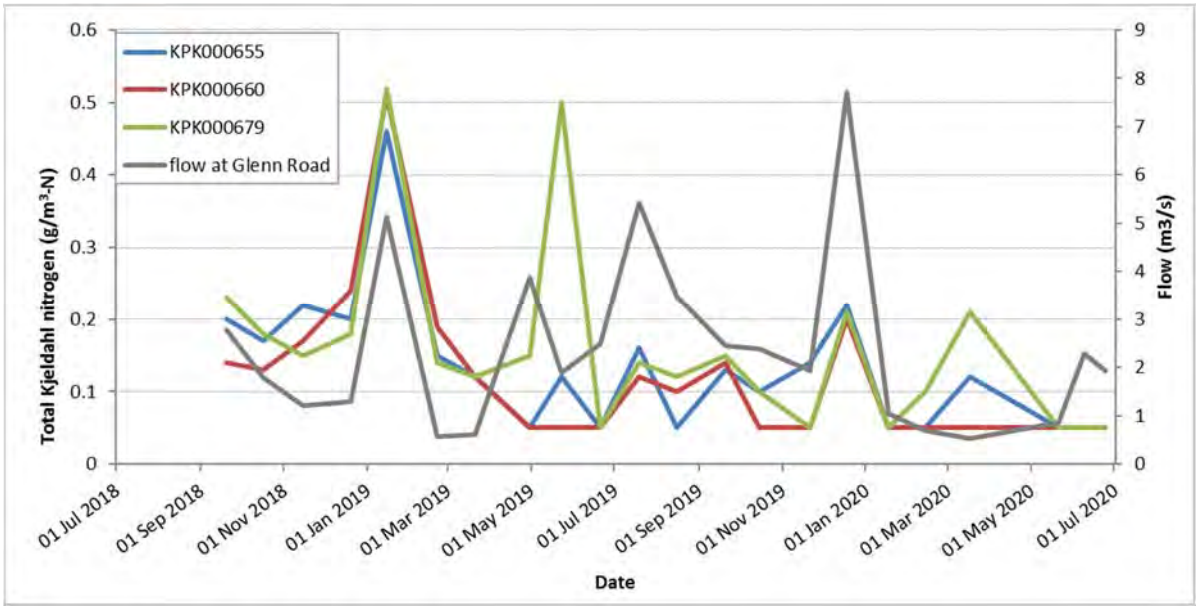

Figure 40 Downstream total Kjeldahl nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

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 (Figure 41).

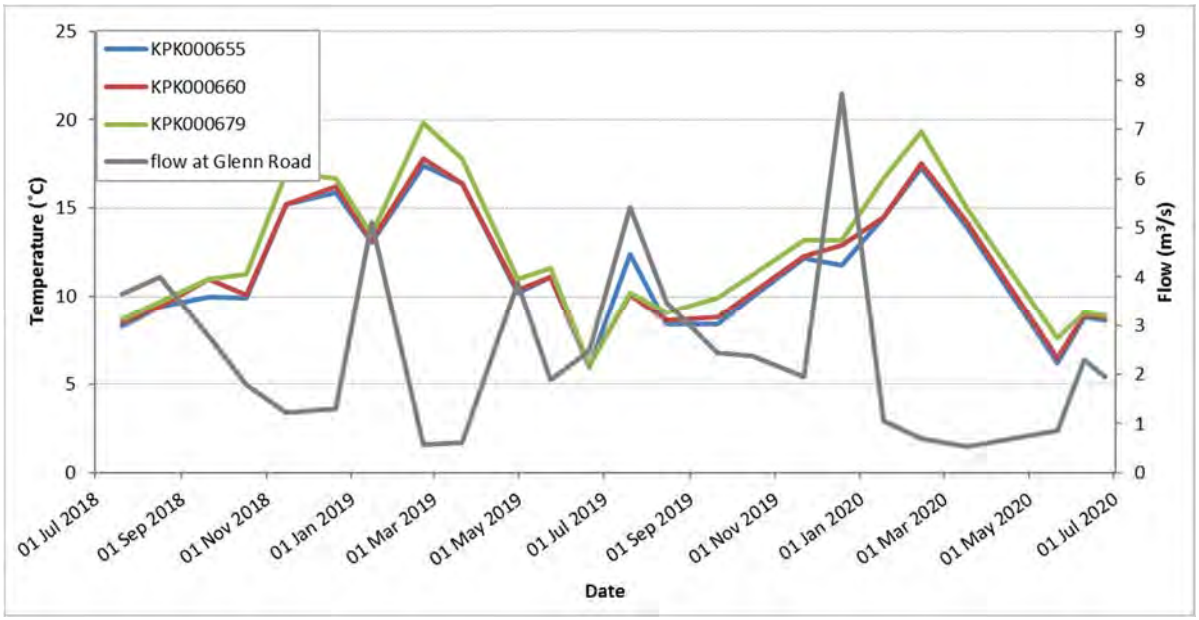

Figure 41 downstream temperature changes in the Kaupokonui Stream from the monthly stream surveys, with the previous year for comparison

It is noted that, as expected, the larger temperature increases are observed at lower stream flows, particularly during the summer months, when there are also warmer air temperatures and higher humidity.

There were no significant changes in clarity, as indicated by turbidity measurements and field comments. Natural variation in clarity was observed, in relation to stream flow and rainfall.

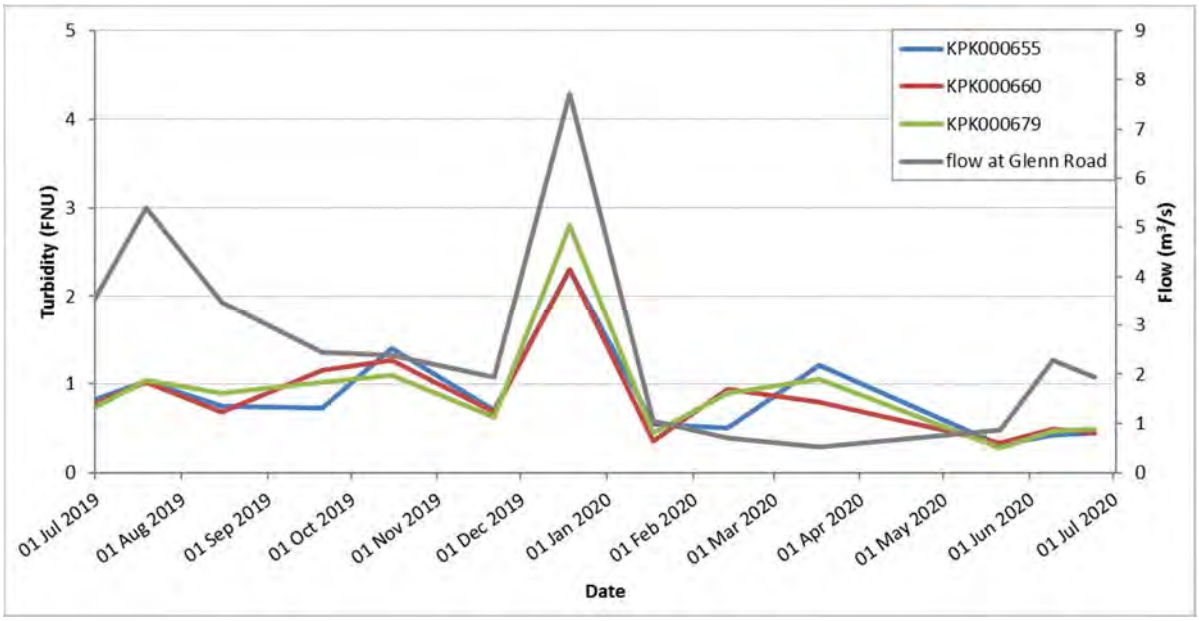

Figure 42 Downstream turbidity changes in the Kaupokonui Stream from the monthly stream surveys

The summary of Kaupokonui Stream water quality data for the upstream (control) site recorded over the 24 year period prior to the 2019-2020 year (Table 17) and during this monitoring period (Table 16), 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.

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. Eleven bores were sampled on the three wastewater spray irrigation farm properties, as described in Table 18 and depicted in Figure 43. 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 18 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 (new)	GND2049	5.6	1698575	5628905
	West	Impact	GND0638	5.9	1698332	5628562
	South-west	Impact	GND0639	4.3	1698408	5627793
	South-west	Impact (new)	GND2050	7.0	1698397	5627747
	South-east	Impact	GND2063	7.0	1698397	5627747
Farm 3	North	Control (new)	GND2051	6.5	1697634	5627538
	Central	Impact	GND0641	3.4	1697367	5626969
	South-west	Impact (new)	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.

A summary of selected groundwater quality data previously collected by the Council from the farm bores is presented in Table 19 for comparison with data collected during the monitoring period under review. The bores shaded in Table 19 are those no longer monitored.

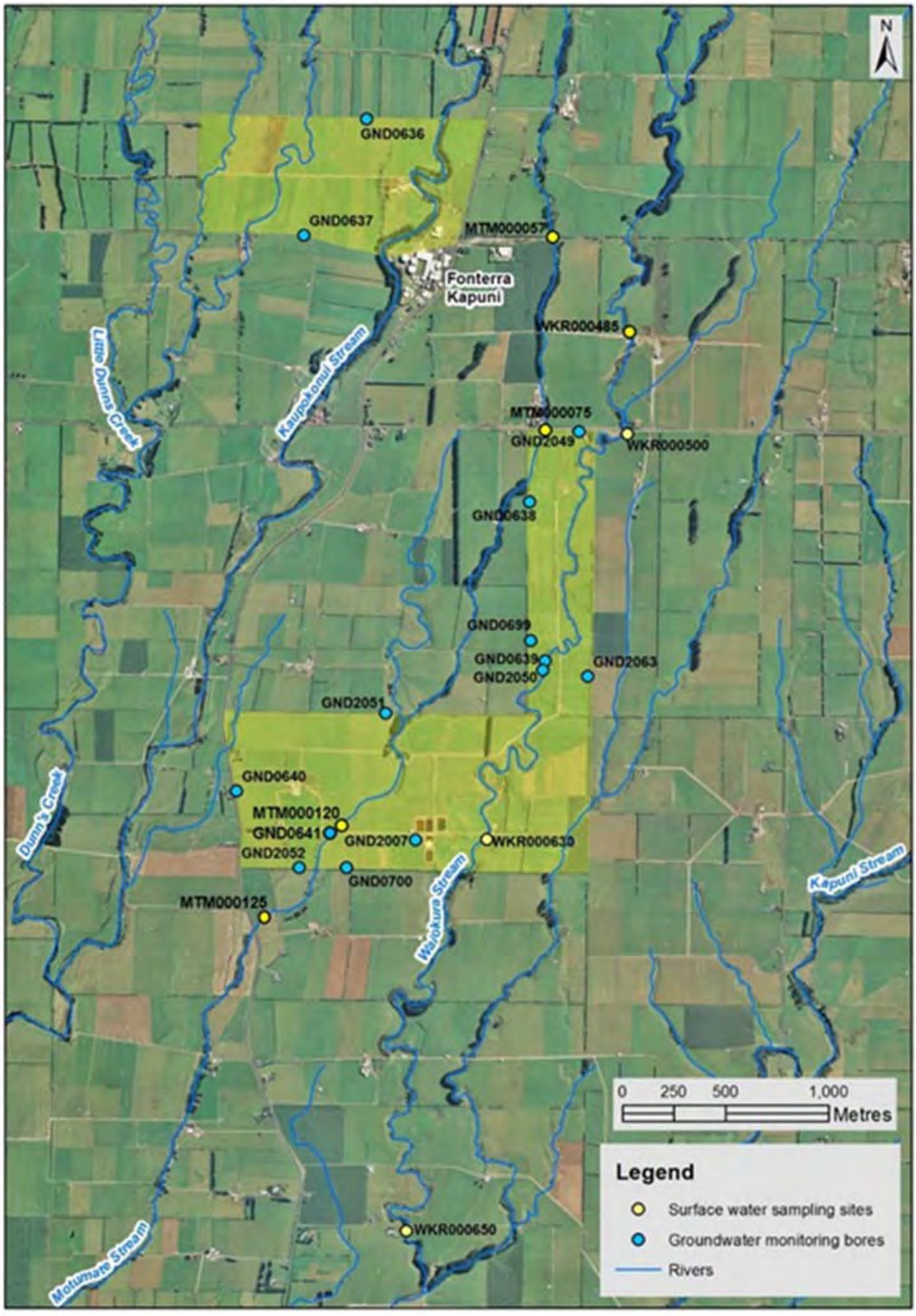

Figure 43 Groundwater monitoring bores, Motumate and Waiokura Stream sampling site locations on the three Company farms

Table 19 Summary of selected parameters from previous Council groundwater quality sampling performed during the period October 1991 to June 2019

Parameter		Level		pH		Conductivity @ 25˚C		Sodium		Nitrate/nitrite-N		COD*	
Unit		m		pH		mS/m		g/m^3		g/m^{3}N		g/m^3	
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	101	1.55-4.83 (2.90)	141	6.2-7.1 (6.5)	138	29.2 -63.8 (32.9)	91	12.0-56 (24.6)	148	3.7-24 (8.2)	80	<5-27 (6)
	Impact GND0637	100	2.77-6.15 (4.14)	137	6.1-7.8 (6.5)	133	37.6-91.1 (62.9)	88	40-179 (73)	142	1.5-33 (12.1)	76	<5-50 (6)
Farm 2	Control ('new') GND2049	72	1.73-3.80 (2.46)	73	6.2-7.2 (6.4)	73	23.4-53.4 (42.2)	37	26-38 (31)	79	2.4-27 (15.4)	37	<5-7 (<5)
	Impact ('central') GND0638	98	1.08-3.68 (2.51)	133	4.7-6.9 (6.5)	132	60.1-165 (81.0)	84	67-136 (87)	137	<0.01-49 (8.7)	78	<5-1600 (13)
	Impact ('original') GND0639	68	1.90-4.22 (2.86)	86	6.5-7.5 (6.9)	86	48.3-91.3 (71.1)	57	73-157 (117)	92	3.8-29 (12.3)	52	<5-57 (13)
	Impact ('new') GND2050	73	1.60-3.20 (2.58)	73	6.5-7.0 (6.8)	73	15.1-80.0 (61.7)	37	49-102 (64)	79	<0.01-13.3 (0.86)	37	<5-21 (6)
	Impact GND2063	70	1.55-5.22 (3.42)	70	6.3-6.9 (6.5)	70	27.9-54.3 (34.0)	36	35-59 (41)	76	0.4-18.6 (4.2)	36	<5-24 (5)
Farm 3	Control ('original') GND0640	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	73	1.86-4.46 (3.13)	73	6.3-7.2 (6.5)	73	28.1-67.5 (36.8)	37	24-37 (29)	79	0.03-30 (7.2)	37	<5-31 (5)
	Impact GND0641[a]	40	1.01–2.96 (1.73)	58	6.3-7.1 (6.5)	59	27.9-70.3 (61.5)	41	30-57 (47)	65	0.87-15.6 (10.7)	38	<5-34 (8)
	Impact ('original') GND0700	97	0.40-4.60 (2.17)	109	5.6-7.2 (6.7)	109	33.5170 (66.9)	64	39-188 (81)	116	0.02-47 (7.1)	64	<5-33 (6)
	Impact ('new') GND2052	73	1.30-4.38 (2.47)	73	6.4-7.3 (6.6)	73	20.9-49.7 (37.5)	37	35-60 (44)	79	<0.01-12.9 (1.9)	37	<5-29 (<5)
	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 GND0641 not monitored between June 2013 and May 2018 due to a blockage that has now been cleared

The groundwater quality monitored at each farm is discussed below. Wastewater irrigation occurred on each farm throughout the monitoring period (see Section 2.1.1.5).

2.1.5.1 Farm 1 groundwater

The results of groundwater monitoring on this farm during the period under review are summarised in Table 20. The full set of results is available upon request.

Table 20 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	6	35 - 43	41	6	85 - 120	114
Ammoniacal nitrogen	g/m^{3}N	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Bicarbonate @ 25'C	g/m^3	6	43 - 53	50.0	6	103 - 146	139
Calcium	g/m^3	6	18.5 - 27.0	20.3	6	16.1 - 23.0	18.3
COD	g/m^3	6	<6 - <6	<6	<6	<6 - <6	<6
Chloride	g/m^3	6	36 - 59	36.5	6	33 - 39	37
Conductivity @ 25'C	µS/cm	6	289 - 312	307	6	379 - 629	483
DRP	g/m^{3}P	6	0.006 - 0.02	0.015	6	0.017 - 0.092	0.024
Hardness Total	g/m^3 CO_3	6	79 - 106	83	6	69 - 100	84
Magnesium	g/m^3	6	5.6 - 9.3	8.1	6	6.3 - 10.5	9.1
Nitrate nitrogen	g/m^{3}N	6	5.7 - 8.4	6.2	6	4.4 - 22	13.5
Nitrite nitrogen	g/m^{3}N	6	<0.002 - <0.002	<0.002	6	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m^{3}N	6	5.7 - 8.4	6.2	6	4.4 - 22	13.5
pH		6	6.5 - 6.9	6.7	6	6.6 - 6.9	6.8
Potassium	g/m^3	6	6.6 - 20	7.6	6	9.7 - 67	58
Sodium	g/m^3	6	22 - 29	25	6	42 - 58	54
Sulphate	g/m^3	6	21 - 24	22	6	28 - 46	37
Sum of Anions	g/m^{3}N	6	2.7 - 3.5	2.8	6	3.6 - 5.7	5.3
Sum of Cations	g/m^{3}N	6	2.9 - 3.6	2.9	6	3.7 - 6.0	5.4
Temperature	˚C	6	14.0 - 14.8	14.3	6	14.6 - 14.9	14.6
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	2.35 - 3.72	3.08	6	3.61 - 5.88	4.43

At the end of the 2016-2017 year it was considered that the water quality of the control bore GND0636 groundwater appeared to be improving slightly in terms of nitrate. Based on the 2017- 2018 data, it appeared that this had stabilised somewhat, but then was followed by an increased median during the 2018-2019 year. The median nitrate-N concentration of 6.2 g/m^3 for the 2019-2020 year is lower than the 2018-2019, 2017-2018 and 2016-2017 medians (7.45 g/m^3, 6.8 g/m^3 and 6.6 g/m^3 respectively), and the historical median of 8.2 g/m^3. The highest concentration recorded in this bore during the year under review (8.4 g/m^3), which is lower than the peaks of 9.2 and 11.9 g/m^3 obtained in the 2018-2019 and 2017-2018 years, but higher than the peak concentrations of 6.9 g/m^3 in the 2016-2017 year. It is noted that the nitrate concentration have remained below the drinking water standard for two consecutive years but also that for

the second year, groundwater levels were generally lower than the previous year. This 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.

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, sulphate and conductivity levels when compared to the control bore, consistent with the effect of leaching of wastewater from spray irrigation disposal to shallow groundwater. The sodium concentration again appears to be reducing overall, with all values recorded during the year under review being below the historical median (refer to Figure 44 and Table 20). The COD of both bores was found to be low at each of the sampling surveys. For the most part, the nitrate concentration at the impact bore was significantly higher than at the control bore. Although the nitrate concentration was slightly lower at this site than the control bore on two of the monitoring occasions, it is noted that this bore had significantly lower groundwater levels at these times (approximately 2 metres), and that the median values for both of these parameters in the 2019-2020 year, and for the historical data, are higher at the impact bore than at the control bore.

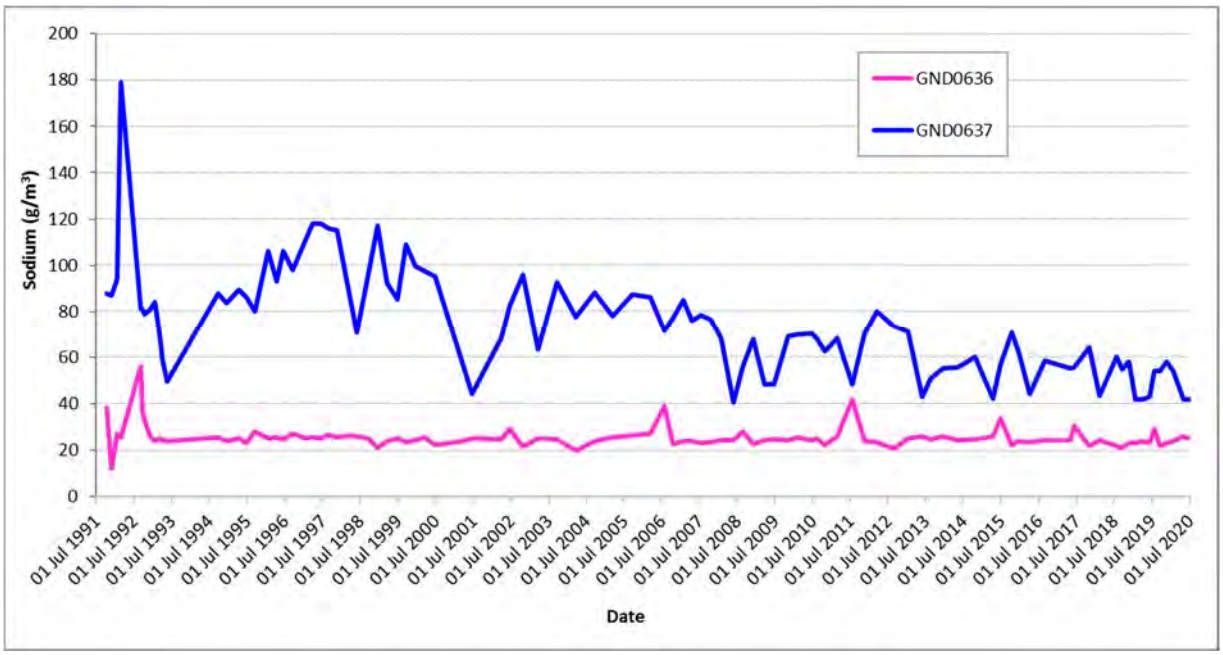

Figure 44 Long term trends in groundwater sodium concentration at Farm 1

Figure 45 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. In contrast to previous years, levels of nitrate-N in the impact bore were much higher in spring and summer than they were in winter and spring, which is the usual trend observed. The three samples collected during this period were all above the drinking water standard (11.3 g/m^3), with the sample collected in January almost double the standard and three and a half times higher than the concentration at the control bore. It was also the highest concentration recorded in the impact bore since May 2012.

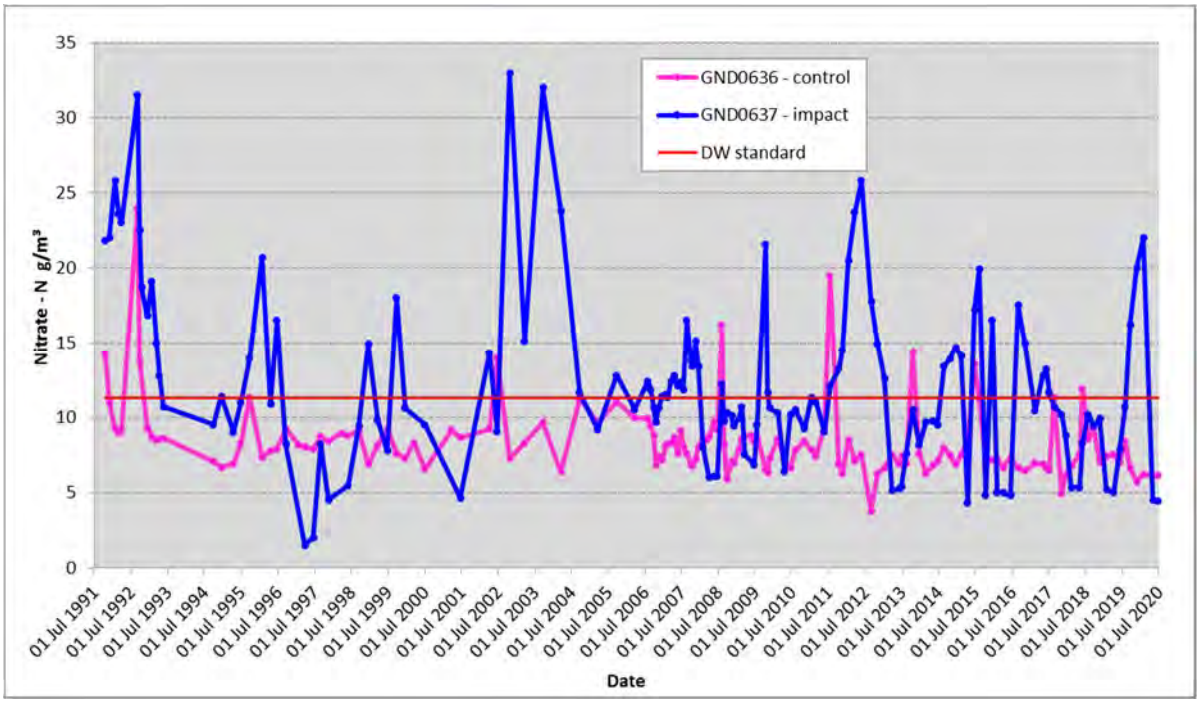

Figure 45 Long term trends in groundwater Nitrate-N concentration at Farm 1

When looking at the changes in groundwater level and nitrate concentration at the time of the November 2019 and January 2020 (Figure 46), it is likely that the effects of irrigation are evident in the impact bore. Although the groundwater levels at the two sites were consistent with each other, the nitrate-N concentration was significantly higher on the down gradient farm boundary than at the control bore. Without onsite rainfall and time series paddock by paddock irrigation data, it is difficult to gauge whether the effects are related to periods of irrigation, rain related flushing, or a combination of these. It has been signalled to the Company that paddock by paddock irrigation records are likely to be required by the renewed discharge consent.

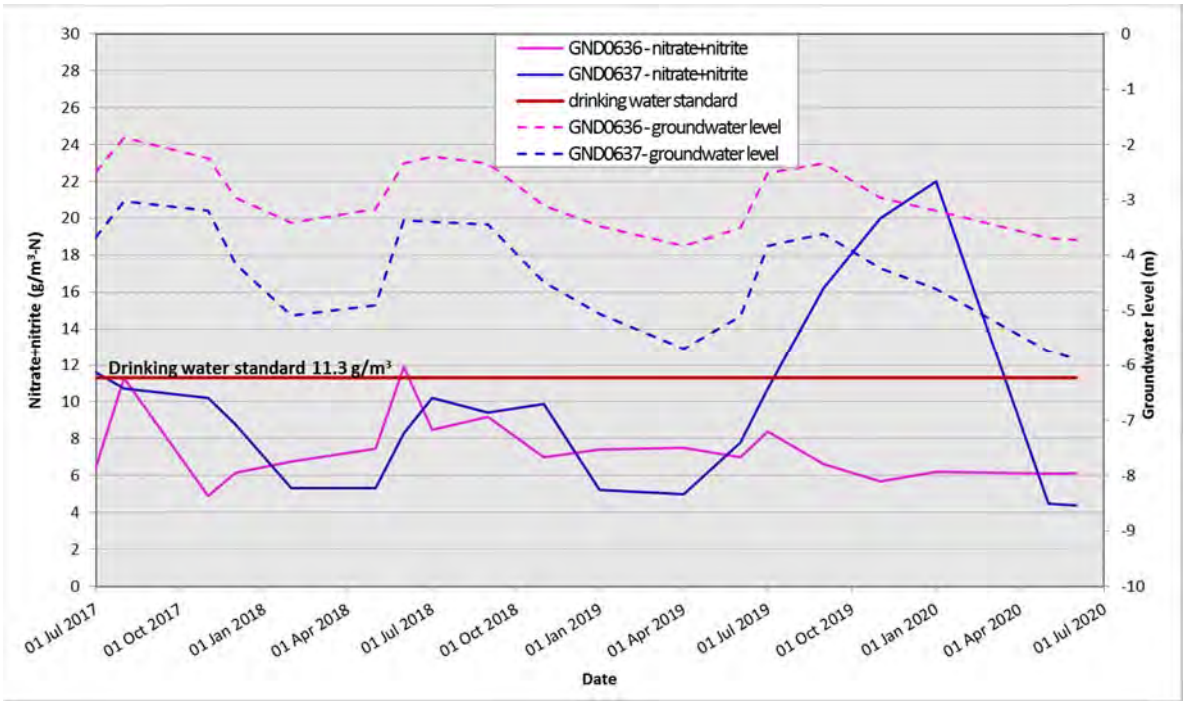

Figure 46 Farm 1 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.2 Farm 2 groundwater

The results of groundwater monitoring on this farm during the year under review are summarised in Table 21. The full set of results is given in Appendix III. Site GND0638 could not be sampled in the January 2019 survey as maize was being grown in this paddock.

The control bore for Farm 2, GND2049, was drilled in March 2008, on the northern boundary beside Skeet Road (Figure 43). This replaced the original 'control' bore, GND0638, which is situated on the western boundary with about 350 m of irrigated paddocks up-gradient, and 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, with irrigation resuming. 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 47 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, but impacted control bore (GND0638) with the new control bore (GND2049).

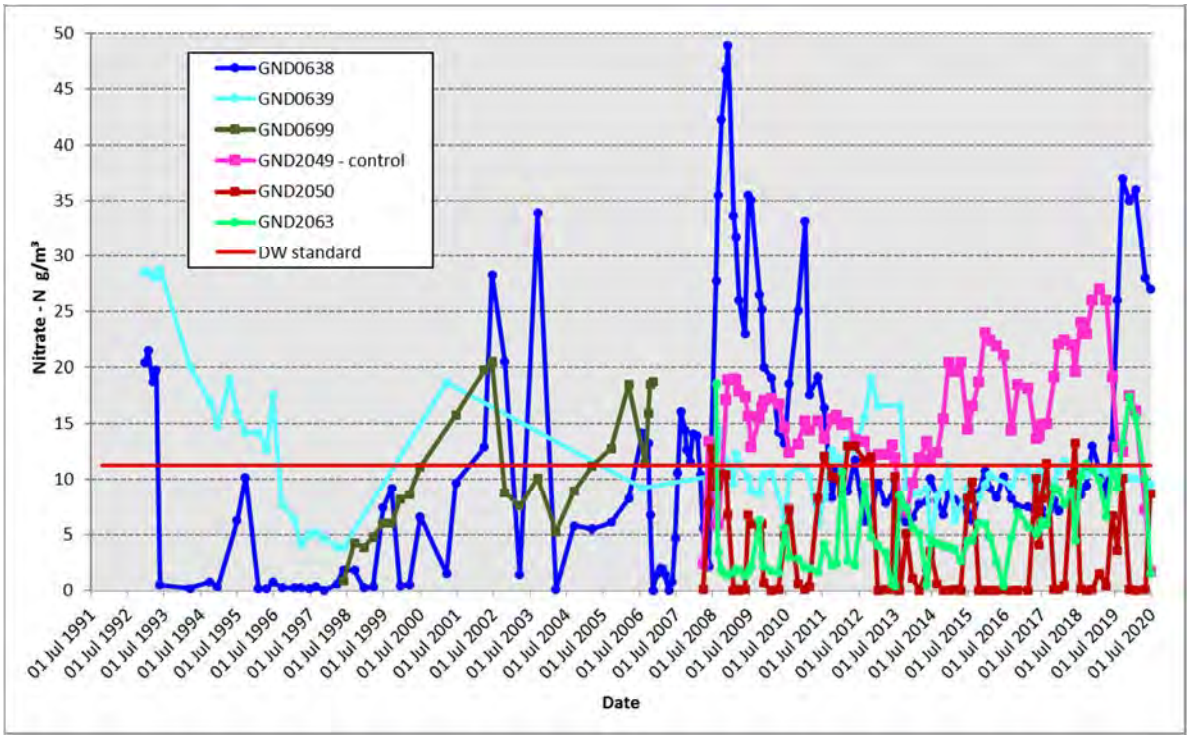

Figure 47 Long term trends in groundwater Nitrate-N concentration at Farm 2

The control bore, GND2049, continued to show the influence of an unknown source in the first seven months of the monitoring period, with the nitrate-N concentration ranging from 12.5 to 17.5 g/m^3 during the monitoring period, with an annual median of 12.7 g/m^3. This follows annual medians of 13.0 g/m^3 in 2013-2015 and 25 g/m^3 in 2018-2019, which had been the third consecutive year in which the annual median had increased. Four of the six results obtained during the year under review were above the drinking water standard. The historical median continued to increase slightly for the third consecutive year, with a change from 14.9 to 15.1 and then to 15.4 g/m^3. For the assessment of environmental effects to accompany the consent renewal application, the Company had been asked to investigate whether the nitrate comes from farming activities up-gradient across Manaia 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. The conductivity, pH, sodium and chloride levels of the control bore were within the normal ranges found in adjacent farming areas. COD and ammonia were low, indicating little leaching of organics into this bore.

Table 21 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	6	43 - 62	52	6	139 - 165	155	5	129 - 164	153	6	159 - 196	187	6	38 - 52	46
Ammoniacal nitrogen	g/m³N	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	5	<0.01 - 0.011	<0.01	6	<0.01 - 0.48	0.15	6	<0.01 - <0.01	<0.01
Bicarbonate @ 25'C	g/m³	6	53 - 75	63	6	170 - 200	190	5	157 - 200	187	6	193 - 240	230	6	46 - 64	56
Calcium	g/m³	6	12.2 - 25	20.9	6	48 - 65	57.5	5	13.8 - 19.1	16.8	6	21 - 36	31	6	10 - 13.8	13
COD	g/m³	6	<6 - <6	<6	6	<6 - 22	<6	5	<6 - <6	<6	6	<6 - 8	<6	6	<6 - <6	<6
Chloride	g/m³	6	17.6 - 33	29.5	6	87 - 156	135	5	47 - 59	58	6	54 - 64	56.5	6	37 - 51	38
Conductivity @ 25'C	µS/cm	10	214 - 373	331	6	1030 - 1174	1114	5	618 - 730	725	6	628 - 775	639	10	341 - 403	384
DRP	g/m³P	6	0.005 - 0.012	0.006	6	0.007 - 0.034	0.012	5	0.022 - 0.036	0.025	6	0.004 - 0.011	0.0075	6	0.007 - 0.026	0.01
Hardness Total	g/m³ CO_3	6	56 - 111	92	6	187 - 260	235	5	77 - 103	90	6	87 - 200	163	6	63 - 89	77
Magnesium	g/m³	6	6.3 - 11.9	10.1	6	16.6 - 23	22	5	10.4 - 13.5	11.7	6	8.3 - 28	20.6	6	9.3 - 13.3	11.1
Nitrate nitrogen	g/m³N	6	1.64 - 17.5	12.7	6	26 - 37	31.5	5	9.5 - 11.2	10.1	6	0.032 - 10.1	1.85	6	1.52 - 17.4	117
Nitrite nitrogen	g/m³N	6	<0.002 - <0.002	<0.002	6	<0.002 - <0.002	<0.002	5	<0.002 - <0.002	<0.002	6	<0.002 - 0.018	<0.002	6	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m³N	6	1.64 - 17.5	12.7	6	26 - 37	31.5	5	9.5 - 11.2	10.1	6	0.034 - 10.1	1.86	6	1.52 - 17.4	11.7
pH		6	6.4 - 6.7	6.7	6	6.6 - 6.9	6.7	5	6.9 - 7.1	7.0	6	6.8 - 7	6.9	6	6.4 - 6.7	6.5
Potassium	g/m³	6	4.5 - 6.3	6	6	64 - 78	74	5	24 - 28	25	6	14 - 67	29	6	7.4 - 17.6	9
Sodium	g/m³	6	21 - 29	27	6	74 - 96	93	5	99 - 110	103	6	58 - 91	63	6	38 - 47	41
Sulphate	g/m³	6	12.6 - 21	14.0	6	39 - 48	45	5	68 - 75	71	6	57 - 69	61	6	24 - 46	29

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
Sum of Anions	meq/L	6	2.1 - 3.4	3.0	6	8.6 - 10.8	10.0	5	6.4 - 7.1	6.9	6	6.5 - 7.5	6.6	6	3.1 - 4.0	3.5
Sum of Cations	meq/L	6	2.2 - 3.6	3.2	6	8.7 - 11.2	10.5	5	6.5 - 7.4	7.0	6	6.6 - 7.5	6.9	6	3.2 - 4.0	3.6
Temperature	˚C	6	14.2 - 15.6	15.0	6	14.2 - 15.2	14.7	5	14.3 - 15.0	14.7	6	14.3 - 14.9	14.7	6	14.2 - 14.9	14.5
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	5	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	2.07 - 3.58	2.81	6	1.94 - 3.39	2.74	5	2.49 - 3.14	2.78	6	2.35 - 2.97	2.68	6	2.80 - 4.88	3.91

At the bore inside the irrigation area, GND0638, nitrate-N concentration had reduced from the peak of 49 g/m³ recorded during 2008-2009 down to 8 g/m^3 in 2012. For the five years from June 2012 to June 2018 it had been fluctuating between 6 to 11 g/m³, remaining just below the drinking water standard of 11.3 g/m^3. During the 2018-2019 year the fluctuations were more pronounced and higher than in the previous year with the range being 8.6 to 13.8 g/m^3. The annual median of 9.4 g/m^3 was also higher when compared to the previous two years (7.7 g/m^3 in 2017-2018 and 7.5 g/m^3 in 2016-2017). Two nitrate-N results were recorded that exceeded the drinking water standard. In the year under review the annual median increased to 31.5 g/m^3, with results in the range 26 to 37 g/m^3. All results were between about two and three times the drinking water standard, and were up to four times the historical median for this monitoring location. For further discussion on this refer to Sections 2.1.5.4 and 3.2.

The ionic strengths of the samples from this bore were significantly higher than both the other bores monitored in the year under review and at this bore in the 2018-2019 year. There were also differences between the sum of anions and sum of cations that was considered to possibly be as a result of the presence of an inorganic acid. Conductivity, sodium, potassium and chloride values were elevated, as might be expected underneath such a wastewater irrigation area, though COD (with the exception of the sample collected on 29 July 2019) and ammonia levels were low. It is noted that the conductivity and chloride concentrations followed similar trends to the nitrate-N results (Figure 48, Figure 49 and Figure 52).

At the impact bore GND0639 it was found that the nitrate concentration varied from 9.5 to 11.2 g/m^3 during the year under review, remaining just below the drinking water standard. In contrast to the 2017-2018 year, there appeared to be little influence from changes in ground water levels in both the 2019-2020 and 2018-2019 years (Figure 48). It is noted that this bore continues to exhibit higher sodium concentrations that in any of the other Farm 2 bores (Figure 51).

Historically, it has been found that at the newer impact bore beside the Waiokura Stream, GND2050, nitrate-N concentration appears to fluctuate with groundwater level (Figure 48). Over the total record, the nitrate-N concentration is typically in the range 3 to 13 g/m³ during winter and spring, falling to <1 g/m³ in summer and autumn. Denitrification is a likely explanation, as ammonia concentration varies inversely with nitrate, reaching >0.5 g/m³N, while a low oxygen level (that is, conducive to denitrification) has been recorded. In the 2018-2019 Annual Report, it was recommended that consideration should be given to the addition of total nitrogen and ammoniacal nitrogen to the analysis suite if this finding continues. As this trend has continued during the year under review, it is recommended that this monitoring be incorporated into the 2021-2022 monitoring programme should this occur again in the 2020-2021 year. It is noted that the conductivity, sodium, potassium and chloride values were elevated at GND2050 when compared to the control bore.

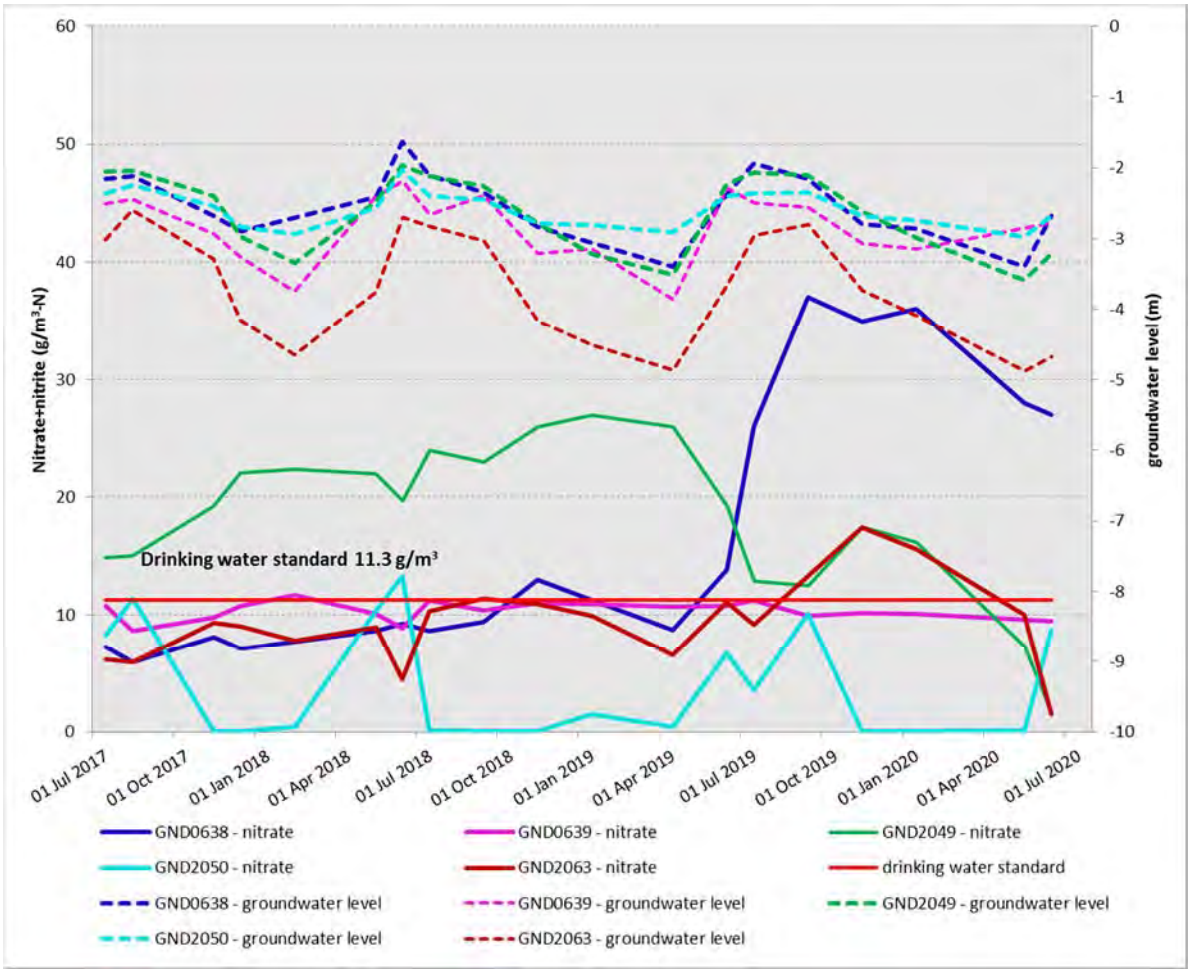

Figure 48 Farm 2 groundwater levels and nitrate + nitrite nitrogen concentrations and groundwater levels during the year under review

The relative concentrations of selected parameters, conductivity, pH, sodium, chloride and potassium, are shown in Figure 49 to Figure 53.

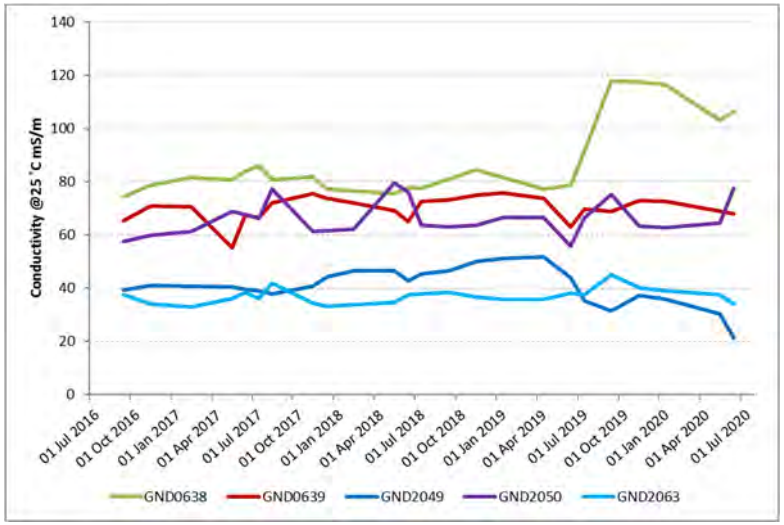

Figure 49 Groundwater conductivity at Farm 2 bores, June 2016 to date

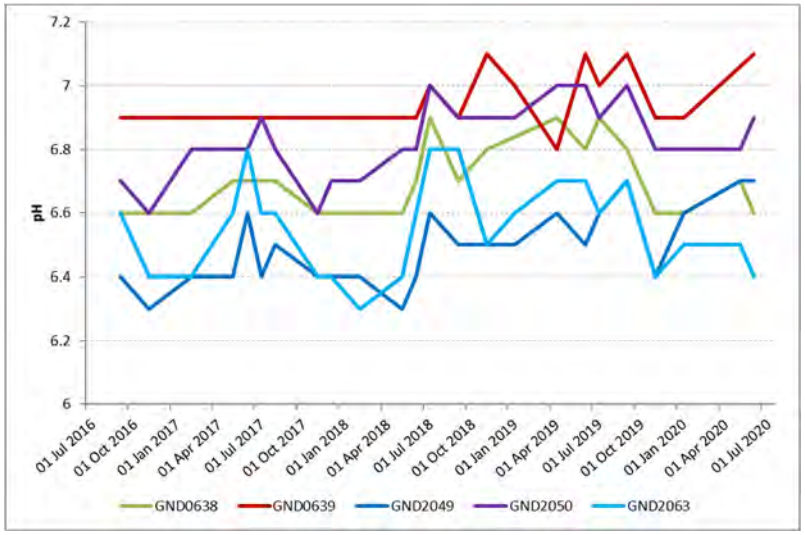

Figure 50 groundwater pH at Farm 2 bores, June 2016 to date

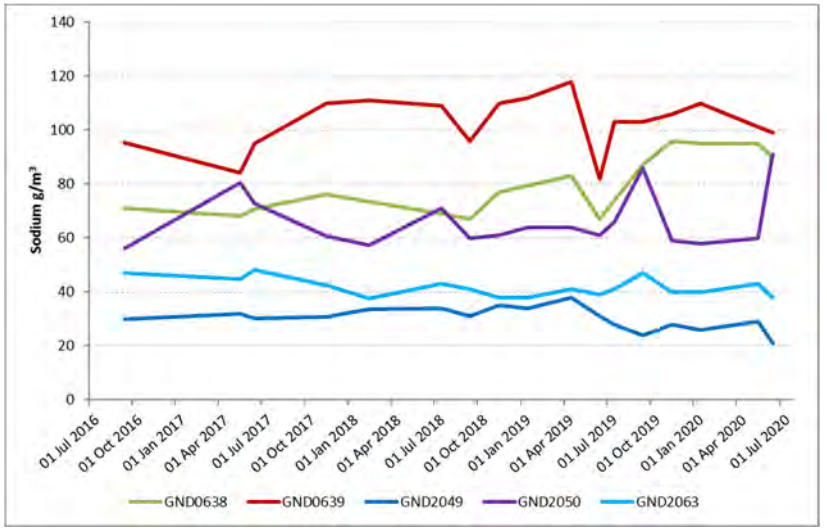

Figure 51 Groundwater sodium concentration at Farm 2, June 2016 to date

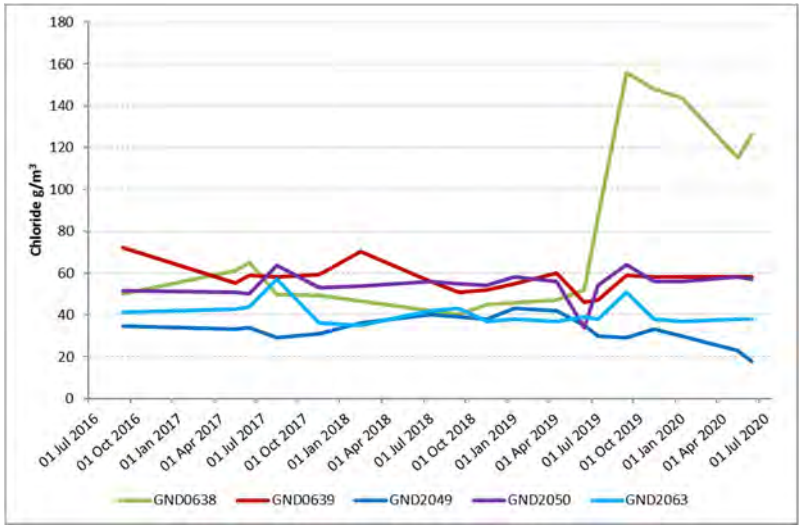

Figure 52 Groundwater chloride concentration at Farm 2 bores, June 2016 to date

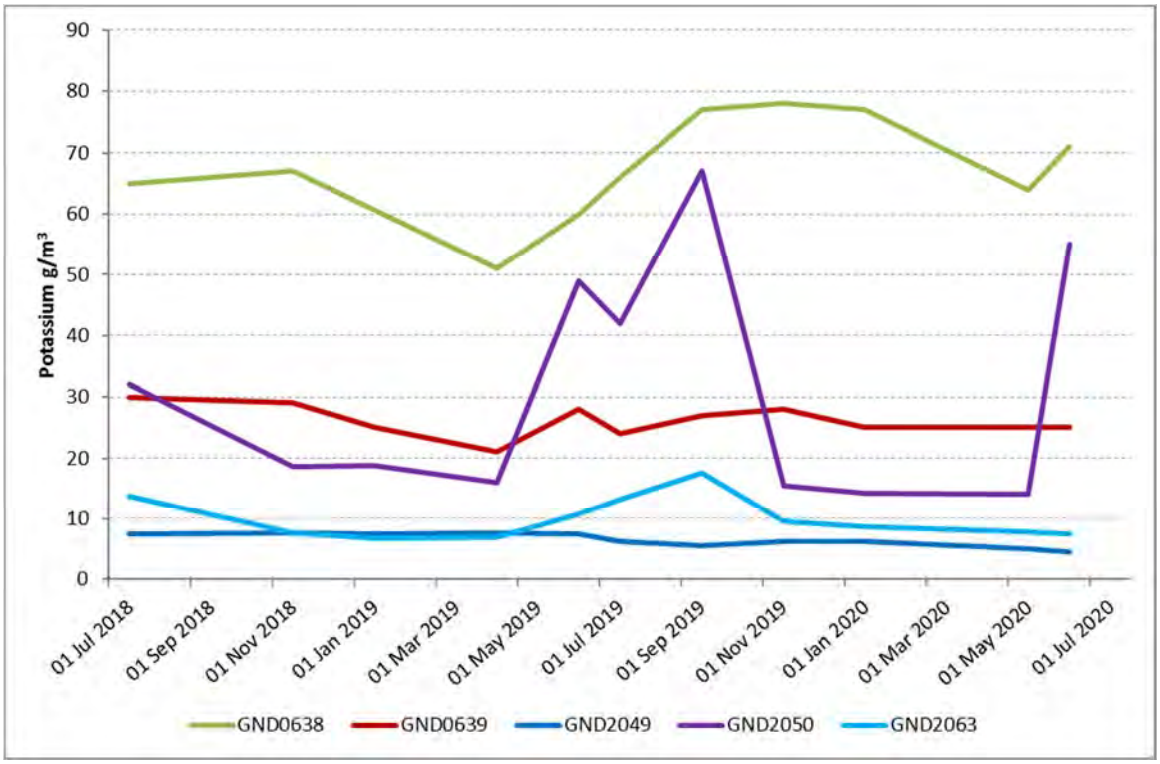

Figure 53 Groundwater potassium concentration at Farm 2 bores, June 2018 to date

2.1.5.3 Farm 3 groundwater

The results of groundwater monitoring on this farm during the period under review are summarised in Table 22. 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. Given that:

- the location of this bore is close to the banks of the Motumate Stream, and
- the historical data shows that the nitrate concentrations in the groundwater at this monitoring location were fluctuating between 8 and 15.5 g/m^3, and the results were often above both the drinking water guideline (11.3 g/m^3) and the National Objective Frameworks bottom line (9.8 g/m^3 annual 95 percentile and 6.9 g/m^3 annual median),

further successful attempts were made to re-instate this bore and routine sampling recommenced in July 2018.

Monitoring of the Motumate Stream, provisionally provided for in the programme to monitor potential effects from the discharge of cooling water, was also initiated in November 2018 to monitor for potential effects on the stream from irrigation activities given the extension in the irrigation area that had occurred after the increase in the area of Farm 3.

Table 22 Results of groundwater quality sampling on Farm 3

Parameter	Unit	Control (GND2051)			Impact (GND0700)			Impact (GND0641)			Impact (GND2052)		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m³ CO_3	6	38 - 51	47	6	93 - 121	102	6	95 - 110	105	6	73 - 84	83
Ammoniacal nitrogen	g/m³N	6	<0.01 - <0.01	<0.01	6	<0.01 - 0.02	<0.01	6	<0.01 - 0.012	<0.01	6	<0.01 - 0.131	0.02
Bicarbonate @ 25'C	g/m³	6	46 - 63	58	6	114 - 147	123.5	6	116 - 134	128	6	89 - 103	100.5
Calcium	g/m³	6	12.5 - 17.2	16.0	6	12.9 - 17.4	14	6	22 - 27	24	6	12.9 - 18.1	15
COD	g/m³	6	<6 - <6	<6	6	<6 - 32	<6	6	<6 - 20	<6	6	<6 - 8	<6
Chloride	g/m³	6	35 - 49	43	6	65 - 121	81.5	6	57 - 72	64.5	6	47 - 52	50
Conductivity @ 25'C	µS/cm	6	321 - 355	340	6	453 - 675	561	6	502 - 625	565	6	328 - 467	345
DRP	g/m³P	6	0.005 - 0.020	0.011	6	0.009 - 0.027	0.020	6	0.004 - 0.030	0.007	6	0.018 - 0.054	0.038
Hardness Total	g/m³ CO_3	6	85 - 112	98	6	76 - 112	90	6	102 - 124	112	6	69 - 96	79
Magnesium	g/m³	6	13.0 - 17.6	13.7	6	10.6 - 16.7	13.2	6	11.5 - 14.1	12.4	6	8.6 - 12.3	9.9
Nitrate nitrogen	g/m³N	6	4.4 - 11.9	4.9	6	1.93 - 11.3	5.7	6	6.4 - 9.4	8.4	6	0.011 - 4.2	1.7
Nitrite nitrogen	g/m³N	6	<0.002 - <0.002	<0.002	6	<0.002 - <0.002	<0.002	6	<0.002 - <0.002	<0.002	6	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m³N	6	4.4 - 11.9	4.9	6	1.93 - 11.3	5.7	6	6.4 - 9.4	8.4	6	0.011 - 4.2	1.7
pH		6	6.5 - 6.7	6.7	6	6.8 - 7.0	7.0	6	6.8 - 6.9	6.9	6	6.7 - 6.9	6.8
Potassium	g/m³	6	6.9 - 22	9.0	6	15.5 - 35	27	6	34 - 43	42	6	8.9 - 11.9	10
Sodium	g/m³	6	21 - 29	25	6	55 - 97	85	6	44 - 57	55	6	37 - 56	48
Sulphate	g/m³	6	31 - 38	32	6	18.8 - 52	41	6	36 - 48	44	6	5.9 - 50	32
Sum of Anions	meq/L	6	2.9 - 3.8	3.2	6	4.2 - 7.1	6.1	6	4.7 - 5.8	5.5	6	3.1 - 4.4	3.8
Sum of Cations	meq/L	6	2.9 - 3.9	3.4	6	4.3 - 7.3	6.2	6	4.8 - 6.0	5.7	6	3.2 - 4.6	3.9
Temperature	˚C	6	14.4 - 15.1	14.7	6	14.1 - 15.8	14.7	6	14.7 - 16.0	15.0	6	14.5 - 15.2	14.9
Un-ionised ammonia	g/m³	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	2.81 - 4.44	3.46	6	1.28 - 3.01	2.48	6	1.75 - 3.00	2.08	6	2.10 - 3.24	2.82

The impact of wastewater irrigation upon the old impact bores (GND0700 and GND0641) was reflected in elevated sodium, chloride, conductivity and potassium levels (Figure 54, Figure 55, Figure 56, and Figure 57).

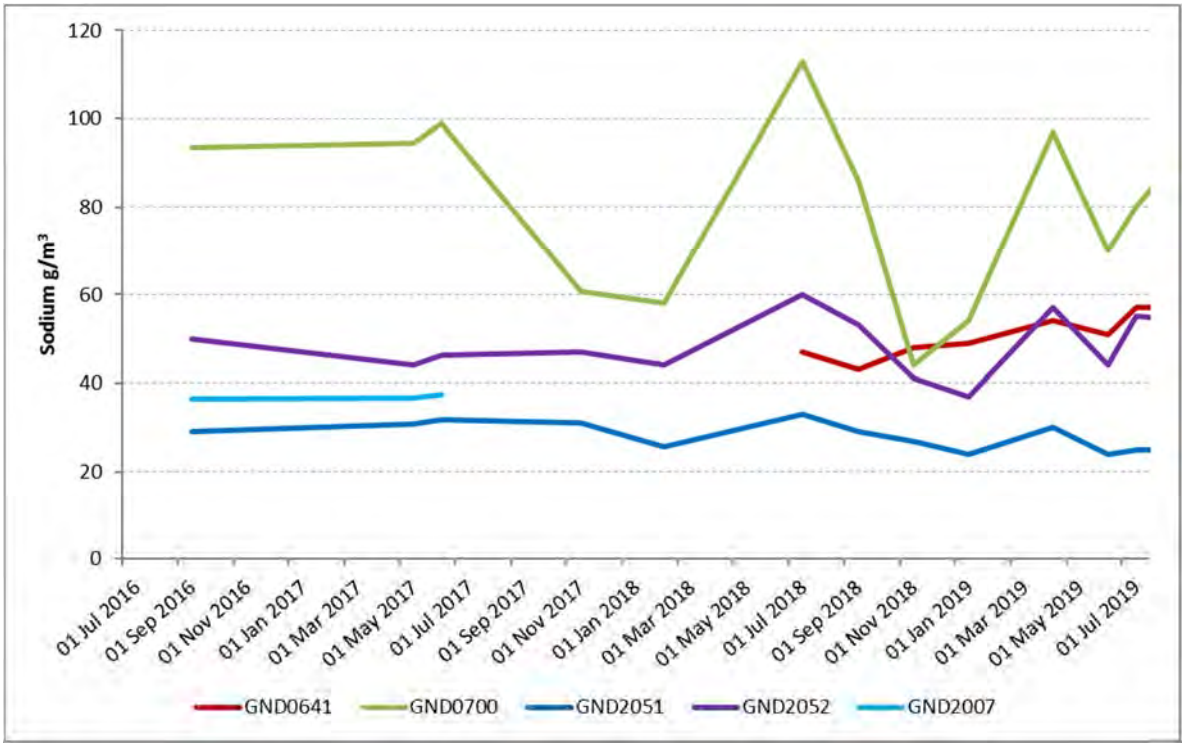

Figure 54 Groundwater sodium concentration at Farm 3 bores, June 2016 to date

It is noted that the chloride concentration and conductivity of the new control bore GND2051 has also been elevated at times, although not during the year under review. Potassium was found to be elevated in this bore at the start of the 2019-2020 year.

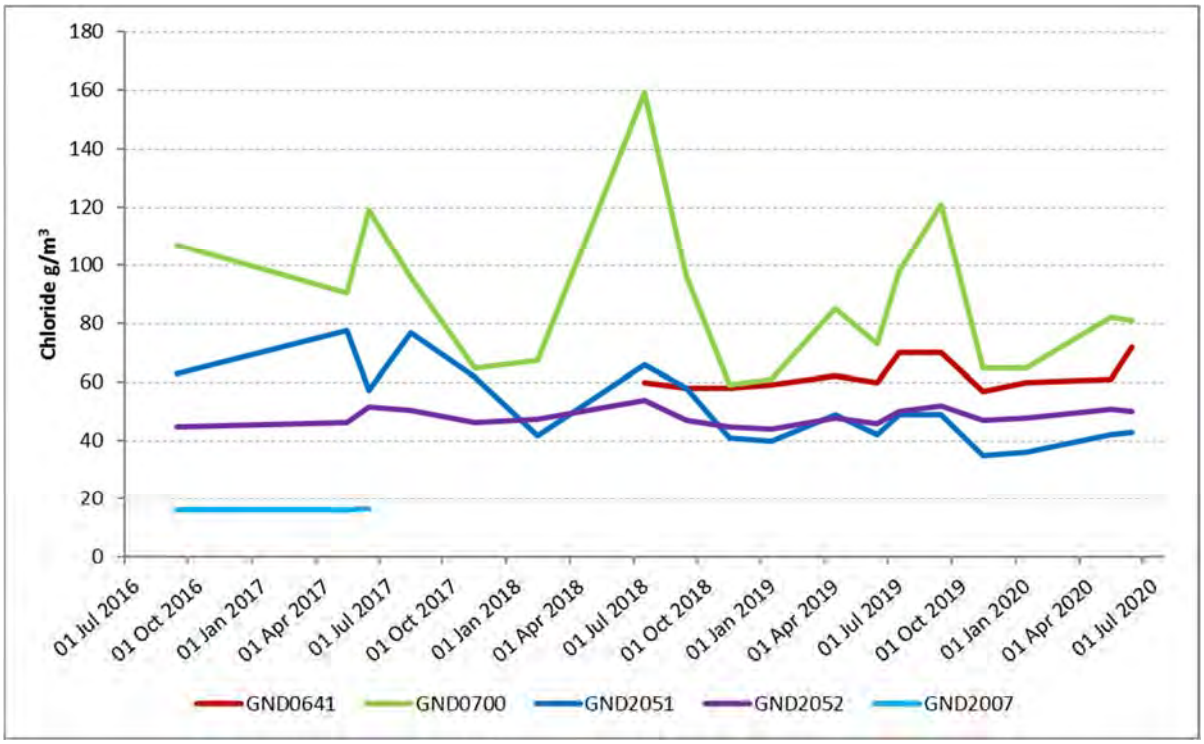

Figure 55 Groundwater chloride concentration at Farm 3 bores, June 2016 to date

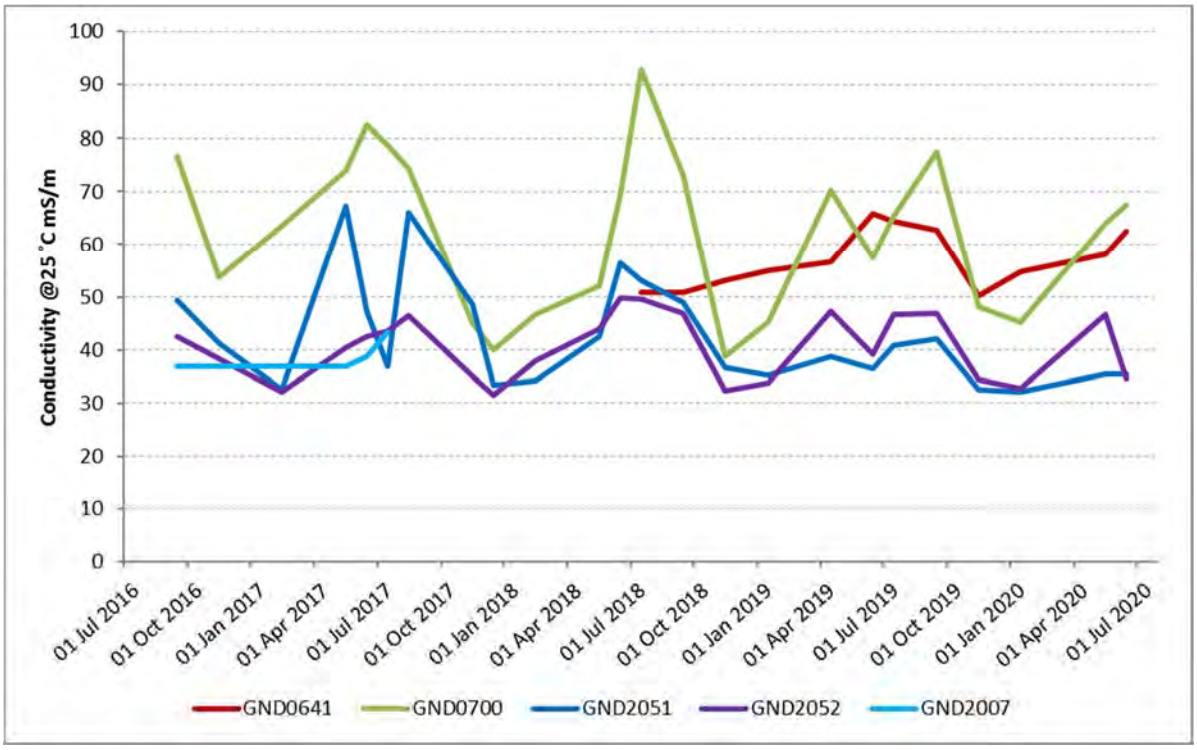

Figure 56 Groundwater conductivity at Farm 3 bores, June 2016 to date

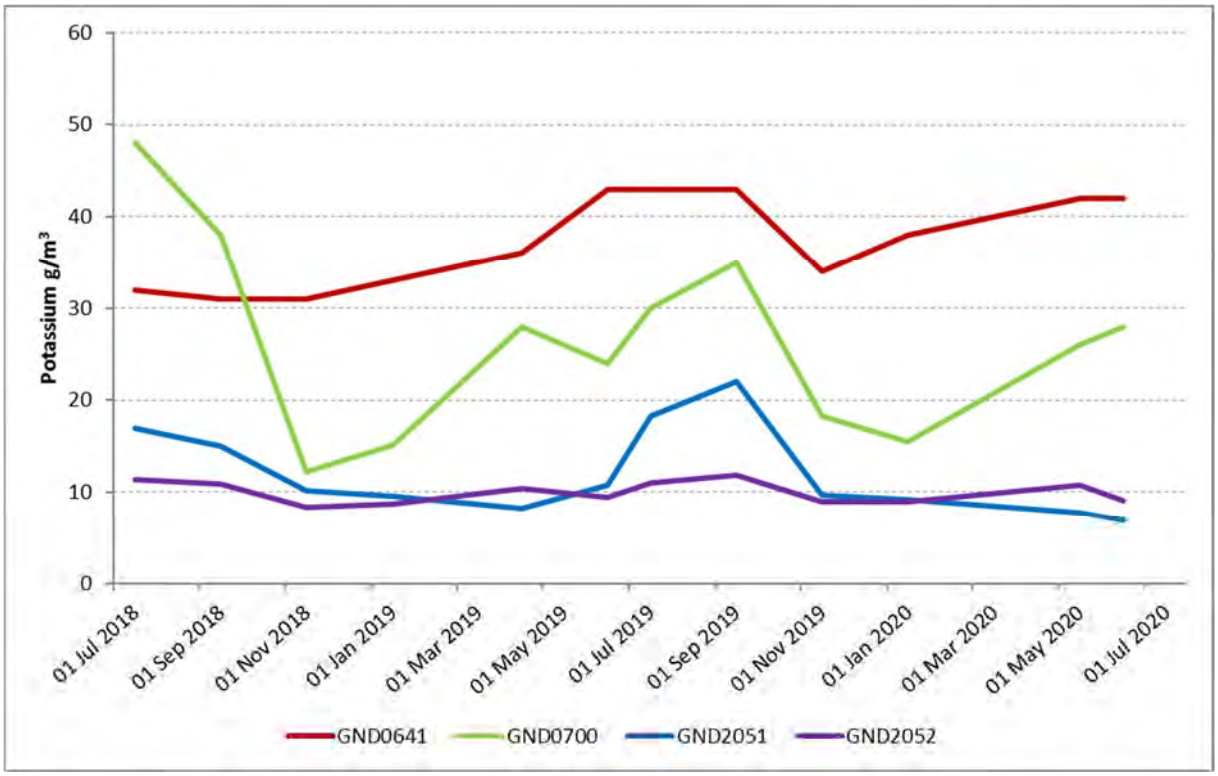

Figure 57 Groundwater potassium concentration at Farm 3 bores, June 2018 to date

Figure 58 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.

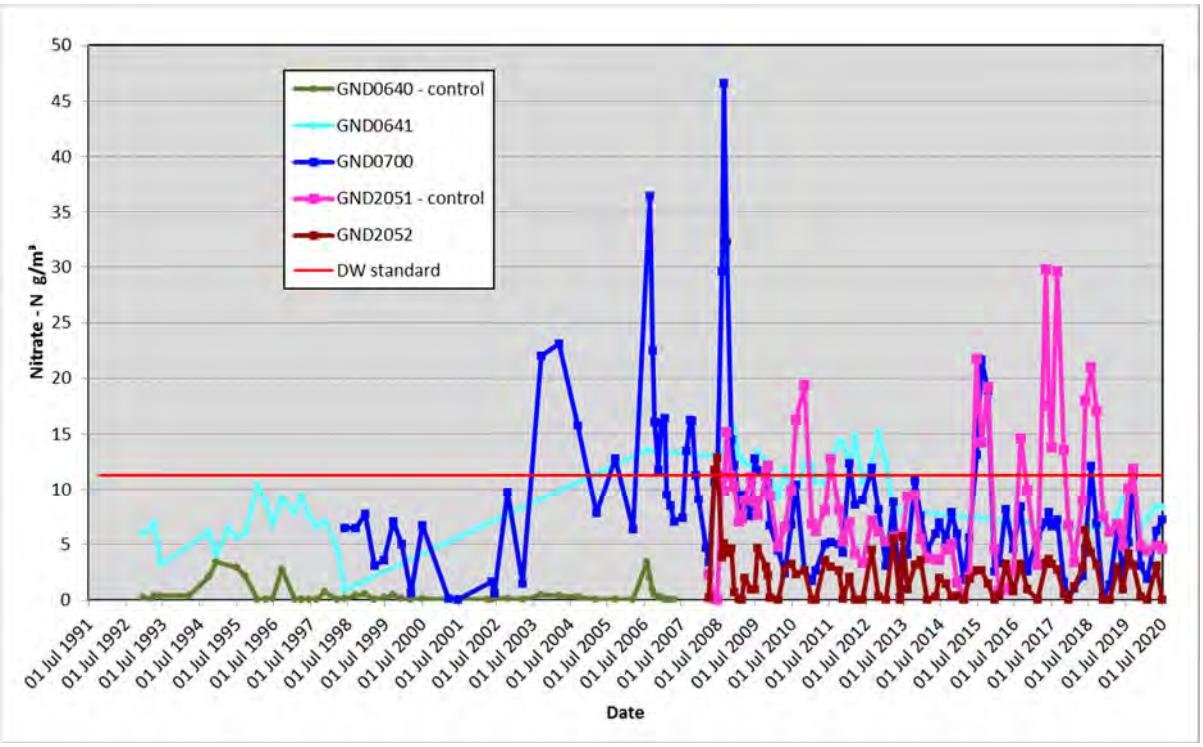

Figure 58 Trends in groundwater Nitrate N concentration at Farm 3

At the new control bore (GND2051), nitrate-N values were still elevated at times, but to a lesser extent than in the preceding three years, with a reduced median value of 4.9 g/m³ (compared to 7.2 g/m³ in 2018-2019, 13.6 g/m³ in 2017-2018, 14.6 g/m³ in 2016-2017 and 3.6 g/m³ in 2015-2016). The maximum nitrate-N concentration during the year under review was still high (11.9 g/m³) coinciding with higher groundwater levels found at the time of the sampling survey in September 2019. This maximum nitrate-N concentration much lower than the maximum obtained in the 2018-2019 year, which at 21.0 g/m³, was the fourth highest on record for this monitoring location. The older impact bore GND0700 generally yielded higher levels of nitrate-N, with a median value of 5.7 g/m³. The maximum concentration obtained was in this bore was 11.3 g/m³, also in the September 2019 survey, which coincided with an increase in groundwater level at this site.

For the second consecutive year the new impact bore GND2052 had a much lower median nitrate-N value (1.67 g/m³) during the year under review when compared to the 2017-2018 and 2016-2017 year (2.71 g/m³ and 6.94 g/m³ respectively).

At the re-instated impact bore GND0641 the nitrate-N concentrations were elevated, however the annual median of 8.35 g/m³ was lower than the historical median (10.7 g/m³), with no results exceeding the drinking water standard.

Overall, the results showed that the impact bores were experiencing only minor effects and indicate generally good management of nitrogen application rates in the vicinity of these three bores. However, the nitrate-N results obtained for the new control bore (GND2051) indicate that the groundwater on the northern boundary of Farm 3 may be experiencing similar effects to those seen at the Farm 2 control bore (GND2049). Again, for the assessment of environmental effects to accompany the consent renewal application, the Company was asked to investigate whether the nitrate comes from farming activities up-gradient, from "mounding" of factory effluent applied down (the ground surface) gradient, or by some other mechanism. Although a theoretical explanation was provided, it is likely that the renewed consent will require further work on this matter.

Historically, GND2049 and GND2051 tend to show elevations in chloride, conductivity, and to a lesser extent sodium, in the surveys in which elevations in nitrate-N occur.

However, the relative contaminant concentrations are different in the other impact bores. It is noted 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.

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 renewed consent will require further work on this matter.

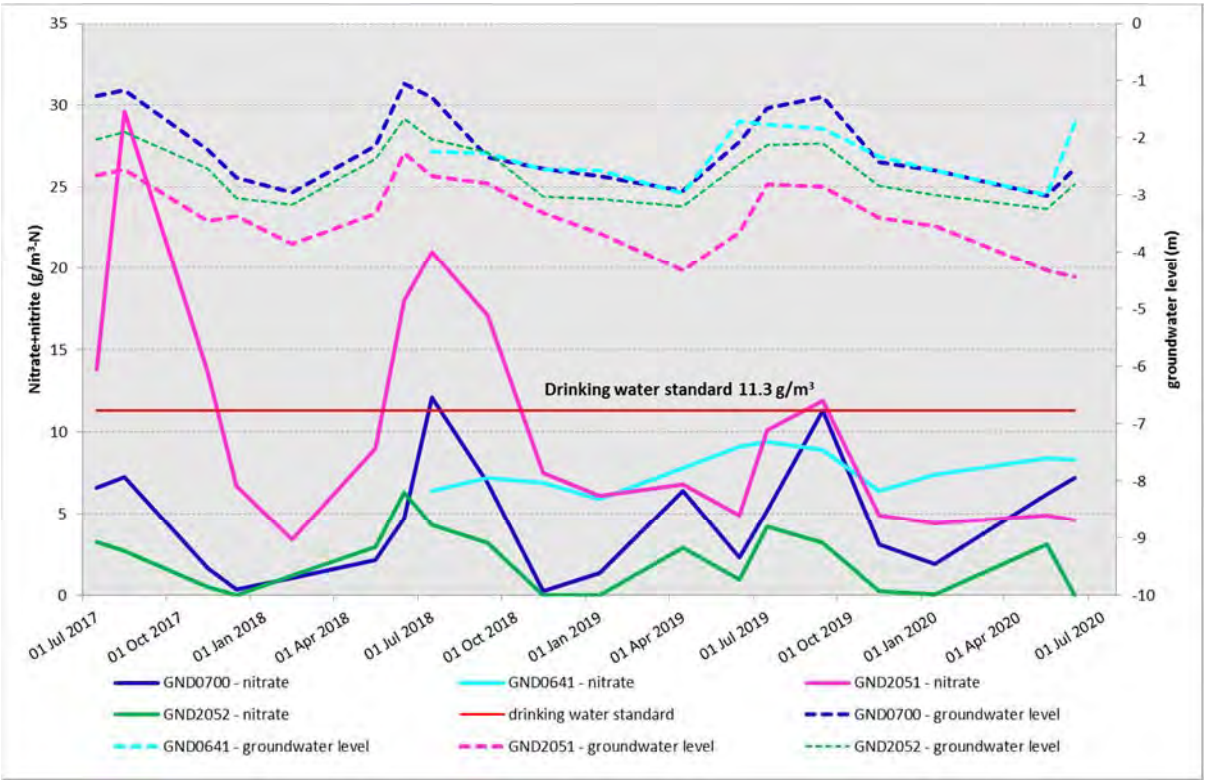

Figure 59 Farm 3 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

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 frequently 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 Freshwater 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 23. It is noted that during the year under review, the minimum, maximum and median values obtained for GND0638 increased to their highest levels since 2007-2008 year.

Table 23 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/m³	
					Range	Median
Farm 1	GND0636	North	Control	6	5.7 - 8.4	6.2
	GND0637	South	Impact	6	4.4 - **22**	**13.5**
Farm 2	GND2049	North	Control (new)	6	1.64 - **17.5**	**12.7**
	GND0638	West	Impact	5	**26 - 37**	**31.5**
	GND0639	South-west	Impact	6	9.5 - 11.2	10.1
	GND2050	South-west	Impact (new)	6	0.034 - 10.1	1.86
	GND2063	South-east	Impact	6	1.52 - **17.4**	**11.7**
Farm 3	GND2051	North	Control (new)	6	4.4 - **11.9**	4.9
	GND0641	Central	Impact	6	6.4 - 9.4	8.4
	GND2052	South-west	Impact (new)	6	0.011 - 4.2	1.7
	GND0700	South-east	Impact	6	1.93 - 11.3	5.7
New Zealand Drinking Water Standard					**11.3**	

In recognition of the potential for adverse effects on soil and groundwater quality, and in order to enable better combination of wastewater disposal and farming operations, the Company in 2006 purchased an additional 60 ha of land between Farm 2 and Farm 3, bringing the total farmed area to 244 ha. Consent 0923-3 was varied to provide for a planned 41% increase in spray irrigation area, from 120 to 169 ha (5 ha on original Farm 3). Work started in January 2007 on the extension, which comprised a 4.1 km pipeline from the factory to a storage and control facility on Farm 3, and the installation of fixed in-ground irrigators. The new system was commissioned in time for the 2007-2008 processing season.

The effect of the additional irrigation area on groundwater nitrate level was predicted, using the AgResearch Overseer model in combination with the water balance for the site. The annual average nitrogen loading used in the model was 523 kgN/ha/y (average over the previous 6 years, based on the November/December 2005 wastewater composition study) for the existing area. Assuming average rainfall of 1,200 mm, evapo-transpiration of 450 mm, and wastewater application of 383 mm, the drainage was estimated at 1,133 mm. The concentration of nitrate-N in the leaching water was predicted to be about 25 g/m^3. This value is similar to the levels that were found in some of the impact monitoring bores in previous monitoring periods. The introduction of the new farm was predicted to reduce the nitrogen load to about 371 kgN/ha/y. The concentration of percolate (leaching water) was predicted to reduce to 17 g/m^3, a factor of 39%.

It is noted that there has been a slight increase in the recognised areas irrigated on each of the farms of between 3 and 5 ha, increasing the total area irrigated from 164 to 171 ha across all three farms. This was as a result of more accurate mapping of the area.

In 2019-2020, a total metered volume of 493,611 m^3 of factory effluent was generated, which had a (time-based) average total nitrogen concentration of 61 g/m^3 (49 samples, range 0.8-130 g/m^3), giving a total nitrogen mass of 48,805 kg. When applied to 175 ha, at an average depth of 282 mm, this amounted to an overall annual nitrogen application rate of 279 kg/ha. The calculated annual nitrogen application rates for

Farm 1 (55 ha), Farm 2 (28 ha) and Farm 3 (92 ha) are 215, 341 and 298 kg/ha, respectively, assuming that the effluent has been evenly distributed across the available irrigation area on all three farms. The average rate for Farms 2 and 3 was 320 kg/ha.

For dairy shed effluent, on Farm 1, a total metered volume of 19,229 m^3 was irrigated over 12 months, which had an average total nitrogen concentration of 144 g/m^3 (42 samples, range 36-191 g/m^3), giving a total mass of 2,892 kg (more than double the 2018-2019 total). When applied to 55 ha, at an average depth of 35 mm, this amounted to an overall annual nitrogen application rate of 51 kg/ha.

For dairy shed effluent, on Farms 2 and 3, a total metered volume of 13,972 m^3 was irrigated over 11 months, which had an average total nitrogen concentration of 144 g/m^3 (31 samples, range 59–352 g/m^3), giving a total mass of 2,243 kg. When applied to 120 ha, at an average depth of 12 mm, this amounted to an overall annual nitrogen application rate of 19 kg/ha.

The total mass of nitrogen from DSE irrigated increased from 4,352 kg in 2018-2019 to 5,072 kg in 2019-2020; an increase of 721 kg. The factory wastewater annual nitrogen mass increase by 6,739 kg. The DSE total nitrogen amounted to 9.4% of nitrogen mass irrigated.

The combined nitrogen loading rate for 2019-2020 from irrigation of factory wastewater and DSE was 267 kg/ha on Farm 1 and 327 kg/ha on Farms 2 and 3. A comparison of the nitrogen application rates in recent years are given in Table 24.

Table 24 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
2019-2020	267	327	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3
2018-2019	221	286	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3
2017-2018	230	326	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3
2016-2017	288	379	Factory wastewater and DSE fully implemented at Farms 1, 2 & 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

In comparison, the respective loadings in 2014-2015 from factory wastewater alone were 270 and 382 kg/ha. Although the nitrogen loading rates had increased between that year and 2016-2017, with successive reductions in the loading rates on both farms during the periods 2017-2019, the Farm 1 loading rates returned to 2014-2015 levels and Farm 3 to 2017-2018 levels during the year under review. However, based on these calculations the addition of the DSE has not had a significant effect on the loadings and they are still considerably less than the average value of 523 kg/ha/y estimated for the period before the irrigation area was extended (2006-2007 processing season).

The calculated nitrogen mass and annual loadings need to be treated with caution as there can be significant discrepancies in the median wastewater and DSE analysis data between individual nitrogen species and total nitrogen (refer Table 7 and Table 8), along with relying on the assumption that the waste has been irrigated uniformly across all paddocks. In addition, there continued to be large variations in the total nitrogen concentrations of the wastewaters throughout the year under review.

Four additional groundwater monitoring bores were drilled in March 2008 to provide for the new irrigation area; to replace the two bores damaged during the 2006-2007 monitoring period; and to install a proper control for Farm 2.

On Farm 1 during the 2019-2020 year, it appears that, overall, the base nitrate levels under the irrigation areas have increased, with the annual median of the impact bore (GND0637) increasing from 8.6 to 13.5 g/m^3. In 2018-2019 it was found that they may have decreased for the second consecutive year, following the increase observed in the 2016-2017 year. During the year under review three of the nitrate-N concentrations in GND0637 were found to be above the drinking water standard. This compares to 46% of the total dataset for this bore and to only 6% of the total dataset at the control bore. At the control site (GND0636) none of the six samples collected during the year under review contained nitrate-N concentrations at or above the drinking water standard. In contrast to the 2018-2019 year, there were no occasions on which higher nitrate-N levels were found at the control bore than at the impact bore. The annual median at the control bore reduced from 7.5 g/m^3 in 2018-2019 to 6.2 g/m^3 for the year under review. During the year under review, the median value obtained for the control bore was lower than the historical median. However the median value obtained for the impact bore was higher than the historical median.

During the 2019-2020 year, the findings on Farm 2 differed from those of the previous three monitoring years. In 2016-2019 years it appeared that the nitrogen loadings had been better managed since the beginning of the 2013-2014 year, with low numbers of impact bore samples being at, or above, the drinking water standard. During the year under review all samples from impact bore GND0639 and three samples from impact bore GND2063 were above the drinking water standard. This is likely to be attributable to the irrigation volume and increased nitrogen loading on Farm 2 from the wastewater disposal activities during the year under review (341 kg/ha compared to 241 kg/ha in the 2018-2019 year).

The annual median nitrate-N concentration at GND0638 has continued to increase from 7.71 g/m^3 in 2017-2018 to 9.40 g/m^3 in the 2018-2019 year and then to 31.5 g/m^3 in the 2019-2020 year. Continued increases were also observed in the annual median at GND2063 from 7.78 g/m^3 in 2017-2018 to 10.6 g/m^3 in the 2018-2019 year and then to 11.7 g/m^3 in the 2019-2020 year. Concentrations at the control bore (GND2049) were elevated, but lower at the start of the 2019-2020 year when compared to the early part of the 2018-2019 year, with marked reductions being observed in the May and June 2020 samples from about 13 to 17 g/m^3 in the earlier part of the year down to 1.6 g/m^3 in June 2020. The first four samples collected were again above the drinking water standard. A decrease in the annual median was observed, down to 12.7 g/m^3, following three years of consecutive increases in annual median (from 14.4 g/m^3 in 2016-2017 to 19.7 g/m^3 in 2017-2018 and then to 25.0 g/m^3 in the 2018-2019 year).

On Farm 3, it had appeared that nitrate levels under the irrigation areas had decreased and were stabilising in response to the 2007-2008 increase in irrigated area. Again, during the year under review, it was found that the annual medians were all similar to or lower than the historical medians, with the 2019-2020 annual medians also lower than the 2018-2019 annual medians in bore GND2051 and similar to the annual median in bore GND2052. In bore GND0700, the 2019-2020 annual median had again increased, following the finding in the 2018-2019 that the annual median had approximately doubled when compared to 2017-2018. On a survey basis, it is noted that that the nitrate levels in the control bore (GND2051) have continued be elevated (above the drinking water standard of 11.3 g/m^3) on occasion in the 2019-2020 year. This was greatly reduced though, with only one sample (September 2019) being above the drinking water standard.

The maximum value obtained (11.9 g/m^3) was also much lower than the previous three years, which were in the range 21.0 g/m^3 to 29.8 g/m^3.

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 increased groundwater levels. The likely mechanism considered for these occurrences was 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. There were again spikes in nitrate level observed during the year under review and or bores with noticeable increases in nitrate-N concentrations with increasing groundwater levels. These trends were observed at both of the Farm 1 bores, however, in the case of GND0637 (Farm 1 impact bore) further increases were observed as the groundwater levels reduced. All Farm 2 bores also demonstrated this trend, with the exception of GND2049 (control bore) and GND0639 (impact bore). As in previous years the nitrate-N concentrations at GND2049 continued to vary inversely with groundwater level. GND0639 had relatively stable nitrate concentrations irrespective of changes in groundwater level. All Farm 3 bores had increases in the nitrate-N that coincided with the higher groundwater levels that were apparent in all of the bores in the winter and/or spring surveys. It is noted that the effects were again not as pronounced as in the 2016-2018 monitoring periods, however it is also noted that the changes in groundwater levels were also less pronounced and remained generally lower during the year under review. This continues to be consistent with the above theory.

It is noted that although GND2052 (Farm 3 impact bore) generally followed this trend, there was a noticeable increase in the (relatively low) nitrate-N concentration at this bore as the time of the lowest groundwater level recorded for the bore during the year under review.

The results for the two relatively new control bores, at the upslope boundaries of Farm 2 and Farm 3, have continued to show significant elevations in groundwater nitrate-N levels in excess of the drinking water standard. During the year under review, all results obtained at the site on the Farm 2 up gradient boundary (GND2049) were below the lowest concentration recorded in the previous year, however the concentrations found were still higher than the drinking water standard on all but two surveys. 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. In the case of the bore on the up gradient boundary of Farm 3, the nitrate-N concentration was lower than the previous year's median concentration and the maximum value was approximately half of the previous year maximum. As stated in the 2016-2019 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 boundaries of Farms 2 and 3. This information was not provided in detail, but the above continuous and daily data will be required by the replacement consents.

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 43, Table 25). 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 2019-2020 monitoring period are presented in Table 26, and a summary of the monitoring previously performed is presented in Table 27.

Table 25 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 2019-2020 conductivity, chloride, dissolved magnesium, potassium and sodium and sulphate 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 26). There was an exception to this for chloride in the sampling survey undertaken in May 2020, when there was an increase between sites MTM000057 and MTM000075, a reduction between MTM000075 and MTM000120, followed by another increase at MTM000125, where the highest conductivity of the year was recorded (41.9 ms/m). A similar trend was observed in the magnesium concentrations at the time of this survey. Potassium was generally fairly stable through the length of the stream monitored, with the exception of the May 2020 survey, when an increase was observed between sites MTM000120 and MTM000125. None of the changes were such that they would be considered a significant adverse environmental effect.

The nitrate-N concentration continued to show a large seasonal variation, increasing from about 2 g/m^3 in summer to 9 g/m^3 in winter. This is a larger variation than was observed in the Waiokura Stream, which was in the range of approximately 1.7 to 3.9 g/m^3. This is also in comparison to the NPS bottom line of 9.8 g/m^3 (annual 95th percentile). On all occasions the nitrate-N results increased between MTM000057 and MTM000075 and then generally decreased in a downstream direction. There were two surveys when the increase between sites MTM000057 and MTM000075 was minor rather than the larger increase usually observed. On these occasions the nitrate-N at these sites were still higher than at MTM000120 and MTM000075. During the year under review, there were no obvious trends in the ammoniacal nitrogen or unionised ammonia concentrations. At the time of the survey in May 2020, there was an increase in ammoniacal nitrogen between sites MTM000120 and MTM000125, but the ammonia concentration was significantly lower than the concentration considered to be toxic to aquatic ecosystems. 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. Adding total nitrogen to the analysis suite would help ascertain whether there are any nitrogen inputs or uptakes occurring through the stretch of the stream monitored.

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 minerals 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 9.6 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 have been 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.

Table 26 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/m^3 as $CaCO_3$	6	54 - 81	60	6	54 - 84	61	6	54 - 84	77	6	67 - 103	80
Ammoniacal nitrogen	g/m^3-N	6	0.016 - 0.032	0.018	6	0.028 - 0.043	0.034	6	0.028 - 0.043	0.032	6	0.025 - 0.580	0.069
Bicarbonate	g/m^3 at 25°C	6	66 - 99	73	6	66 - 102	75	6	66 - 102	94	6	82 - 125	97
Biochemical oxygen demand 5day	g O_2/m^3	6	0.4 - 3.6	0.8	6	0.5 - 1.4	0.8	6	0.5 - 1.4	0.7	6	0.7 - 3.2	0.9
Calcium	g/m^3	6	21 - 23	22	6	21 - 24	22	6	21 - 24	22	6	20 - 23	22
Chloride	g/m^3	6	32 - 39	36	6	33 - 40	37	6	33 - 40	44	6	42 - 48	45
Conductivity @ 25'C	mS/m	6	32.6 - 36.1	33.3	6	33.6 - 40.2	34.9	6	38.3 - 41.9	39.2	6	38.9 - 42.3	40.2
Dissolved reactive phosphorus	g/m^3-P	6	0.017 - 0.049	0.029	6	0.022 - 0.068	0.035	6	0.022 - 0.068	0.033	6	0.017 - 0.163	0.025
Hardness Total	g/m^3 as $CaCO_3$	6	87 - 94	92	5	89 - 98	94	6	89 - 98	99	6	96 - 101	100
Magnesium	g/m^3	6	8.1 - 10.2	9	6	8.7 - 10.6	9.5	6	8.7 - 10.6	10.8	6	9.7 - 11.7	10.9
Nitrate nitrogen	g/m^3-N	6	2.5 - 7.7	5.1	6	2.2 - 9.0	6.0	6	2.2 - 9.0	4.7	6	1.62 - 8.2	4.6
Nitrite nitrogen	g/m^3-N	6	0.009 - 0.014	0.014	6	0.009 - 0.013	0.012	6	0.009 - 0.013	0.014	6	0.014 - 0.131	0.019
Nitrite/nitrate nitrogen	g/m^3-N	6	2.5 - 7.7	5.1	6	2.2 - 9.0	6.0	6	2.2 - 9.0	4.7	6	1.75 - 8.2	4.6
pH	pH Units	6	7.2 - 7.7	7.6	6	7.4 - 7.7	7.6	6	7.4 - 7.7	7.6	6	7.3 - 7.7	7.5
Potassium	g/m^3	6	13.5 - 16.2	14.3	6	13.5 - 16.6	14.4	6	13.5 - 16.6	14.8	6	13.5 - 19.4	15.1
Sodium	g/m^3	6	22 - 28	24	6	23 - 29	24	6	23 - 29	34	6	33 - 38	36
Sulphate	g/m^3	6	17.9 - 26	20.5	5	18 - 26	21	6	18 - 26	26	6	20 - 33	26
Sum of Anions	meq/L	6	2.9 - 3.3	3.1	6	3.0 - 3.4	3.2	6	3.0 - 3.4	3.7	6	3.7 - 4.0	3.8
Sum of Cations	meq/L	6	3.1 - 3.5	3.3	6	3.2 - 3.6	3.3	6	3.2 - 3.6	3.9	6	3.7 - 4.2	4.0
Temperature	°C	6	10.1 - 18.1	13.4	5	1.2 - 17.8	13.4	6	1.2 - 17.8	13.6	6	11.4 - 17.6	13.4
Turbidity	FNU	6	6.7 - 15.5	9.1	6	9.1 - 19.8	13.6	6	9.1 - 19.8	11.6	6	3.0 - 18.3	9.6
Un-ionised ammonia	g/m^3	6	0.00008 - 0.00023	0.00017	6	0.0002 - 0.0006	0.000335	6	0.0002 - 0.0006	0.000245	6	0.00021 - 0.0043	0.00054

Table 27 Summary of Motumate Stream water quality data from the council surveys during the period November 2009 to April 2013 and September 2018-June 2019

Parameter	Unit	MTM000057			MTM000075			MTM000120			MTM000125		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m^3 as $CaCO_3$	5	51 - 97	65	6	53 - 99	68	6	60 - 86	69	6	63 - 97	76
Ammoniacal nitrogen	g/m^3-N	5	0.019 - 0.330	0.032	16	<0.010 - 7.3	0.048	16	0.012 - 2.900	0.048	11	0.054 - 3.38	0.102
Bicarbonate	g/m^3 at 25°C	5	62 - 118	79	6	64 - 120	83	6	73 - 104	83.5	6	77 - 118	92
Biochemical oxygen demand 5day	g O_2/m^3	5	0.8 - 10	0.9	22	<0.4 - 500	1.5	21	<0.4 - 13	2.0	10	0.7 - 2.7	1.5
Calcium	g/m^3	5	20 - 23	21	6	21 - 23	21	6	15 - 23	21.5	6	20 - 24	21
Chloride	g/m^3	5	34 - 47	36	6	36 - 51	38	6	28 - 52	46	6	40 - 50	46
Conductivity @ 25'C	mS/m	5	33.4 - 40.0	35.5	22	31.7 - 70.8	35.6	21	27.0 - 68.2	41.4	11	38.4 - 51.9	44.4
Dissolved reactive phosphorus	g/m^3-P	5	0.026 - 0.66	0.048	13	0.026 - 0.154	0.059	13	0.020 - 0.38	0.1	10	0.032 - 0.134	0.060
Hardness Total	g/m^3 as $CaCO_3$	5	81 - 98	88	6	87 - 97	90	6	64 - 105	93	6	90 - 108	93
Magnesium	g/m^3	5	7.4 - 9.8	8.4	6	8 - 10.7	9	6	6.5 - 11.4	10	6	9 - 12	9
Nitrate nitrogen	g/m^3-N	5	2.7 - 7.1	4.0	6	2.4 - 8.9	6.5	6	1.45 - 8.3	6	6	1.38 - 8.1	5.75
Nitrite nitrogen	g/m^3-N	5	0.005 - 0.048	0.014	6	0.008 - 0.164	0.025	6	0.008 - 0.044	0.0	6	0.013 - 0.12	0.024
Nitrite/nitrate nitrogen	g/m^3-N	5	2.7 - 7.1	4.0	19	0.95 - 9.6	4.87	19	1.02 - 8.8	4.70	10	0.98 - 8.12	5.80
pH	pH Units	5	7.5 - 7.7	7.6	22	7.4 - 7.8	7.5	21	7.1 - 8.0	7.4	11	7.4 - 7.7	7.5
Potassium	g/m^3	5	13.9 - 28	15.7	6	14.3 - 17.8	16.2	6	7.9 - 18.1	15.6	6	14.4 - 20	16.3
Sodium	g/m^3	5	22 - 26	24	15	21.9 - 39	25.4	15	24 - 40.8	34.3	8	30 - 39	35
Sulphate	g/m^3	5	17.3 - 23	19.4	6	17.1 - 23	20.5	6	10.1 - 26	25	6	16.4 - 26	25.5
Sum of Anions	meq/L	5	2.9 - 3.9	3.1	6	3.1 - 4.1	3.3	6	2.5 - 4	3.65	6	3.3 - 4.3	3.6
Sum of Cations	meq/L	5	2.9 - 3.8	3.2	6	3.1 - 4.1	3.3	6	2.5 - 4.3	3.7	6	3.5 - 4.4	3.7
Temperature	°C	5	11.2 - 19.0	13.1	21	10.8 - 19.9	13.3	21	11.3 - 19.7	14.0	11	11.4 - 20.0	14.2
Turbidity	NTU	5	5.8 - 92	6.2	15	4 - 100	10	14	4.2 - 36	9.2	10	5.2 - 10.9	8.2
Un-ionised ammonia	g/m^3	5	0.0002 - 0.0032	0.00027	12	<0.010 - 0.0704	0.00058	12	<0.010 - 0.03407	0.00038	10	0.00044 - 0.0137	0.00129

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 43, Table 28). This was carried out approximately bi-monthly.

Table 28 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 2019-2020 monitoring period are presented in Table 29, and a summary of the monitoring previously performed is presented in Table 30.

Although the medians show little change between sites during the year under review (Table 29), the results for the 2019-2020 monitoring period again indicate subtle increases in most parameters, in particular conductivity and the 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-N concentration showed a seasonal fluctuation, varying from about 3.9 g/m^3 in spring to 1.6 g/m^3 in summer. This was again much less of a fluctuation than was observed in the 2016-2017 year (6.8 to 2.0 g/m^3). The median nitrate-N concentration for 2019-2020 at all three long established sites were similar to the respective long-term median values, as were the median sodium concentrations.

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, especially when paddock by paddock irrigation information is available.

Table 29 Summary of Waiokura Stream water quality data from the Council surveys during the period March 2001 to June 2019

Parameter	Unit	WKR000485			WKR000500			WKR000630			WKR000650		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m^3 as $CaCO_3$	6	44 - 67	57	6	44 - 66	58	6	47 - 68	58	6	48 - 70	57
Ammoniacal nitrogen	g/m^3-N	6	<0.010 - 0.400	0.013	7	0.015 - 0.520	0.019	6	<0.010 - 0.023	0.013	6	<0.010 - 0.026	0.013
Bicarbonate	g/m^3 at 25°C	6	53 - 81	69	6	54 - 80	70	6	57 - 83	70	6	58 - 85	69
Biochemical oxygen demand 5day	g O_2/m^3	6	<2 - <2	<2	14	<0.5 - 12	2	13	0.7 - 3.3	2	13	<0.5 - 3.4	2
Calcium	g/m^3	6	12.4 - 15.3	14.4	6	13.1 - 15.8	14.7	6	13.2 - 15.9	14.9	6	13.4 - 16	14.6
Chloride	g/m^3	6	24 - 26	24	7	23 - 27	25	6	26 - 28	26	6	27 - 29	28
Conductivity @ 25'C	mS/m	6	22.3 - 24.9	24	130	18.3 - 33.6	23.3	132	18.8 - 28.0	24.8	131	16.6 - 31.5	25.6
Dissolved reactive phosphorus	g/m^3-P	6	0.027 - 0.158	0.051	76	0.012 - 0.196	0.0	77	0.013 - 0.095	0.033	76	0.016 - 0.444	0.033
Hardness Total	g/m^3 as $CaCO_3$	6	51 - 66	60.	6	54 - 68	62.5	6	55 - 70	64	6	57 - 71	64
Magnesium	g/m^3	6	4.9 - 6.8	5.9	6	5.2 - 6.9	6.15	6	5.4 - 7.3	6.4	6	5.8 - 7.5	6.4
Nitrate nitrogen	g/m^3-N	6	1.44 - 3.70	2.60	6	1.77 - 4.20	3.00	6	1.76 - 4.20	3.00	6	1.61 - 4.40	3.00
Nitrite nitrogen	g/m^3-N	6	0.003 - 0.016	0.008	6	0.004 - 0.015	0.0	6	0.006 - 0.013	0.006	6	0.005 - 0.011	0.009
Nitrite/nitrate nitrogen	g/m^3-N	6	1.45 - 3.8	2.65	118	1.27 - 4.2	2.8	118	1.03 - 6.51	2.95	118	1.03 - 4.40	2.90
pH	pH Units	6	7.6 - 7.8	7.7	96	6.6 - 8.0	7.6	98	6.9 - 8.2	7.7	96	7.0 - 8.3	7.7
Potassium	g/m^3	6	5.7 - 7.6	6.5	6	5.7 - 8.2	6.7	6	6.4 - 8	7.0	6	6.5 - 9	7.1
Sodium	g/m^3	6	16.6 - 22	19.6	128	14.8 - 25.4	20	129	9.4 - 24.9	21.4	128	13.9 - 62.4	22.6
Sulphate	g/m^3	6	7.2 - 10.3	8.8	6	7.1 - 10.6	9.2	6	8.9 - 12.2	11	6	10.7 - 12.8	11
Sum of Anions	meq/L	6	2.0 - 2.3	2.0	6	2.1 - 2.4	2.2	6	2.2 - 2.4	2.4	6	2.2 - 2.6	2.4
Sum of Cations	meq/L	6	1.9 - 2.4	2.3	6	2.0 - 2.5	2.4	6	2.1 - 2.6	2.4	6	2.1 - 2.8	2.5
Temperature	°C	5	11.1 - 17.3	15.2	132	7.1 - 18.0	12.3	133	8.3 - 20.2	12.7	132	8.1 - 19.6	12.7
Turbidity	NTU	6	4.4 - 12.8	7.6	6	4.0 - 15.4	7.8	6	3.0 - 13.4	7.2	6	3.1 - 17.3	8.3
Un-ionised ammonia	g/m^3	6	0.00008 - 0.0037	0.00021	6	0.00011 - 0.0041	0.000255	6	<0.00009 - 0.0005	0.00021	6	<0.00007 - 0.0007	0.00024

Table 30 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
Alkalinity Total	g/m^3 as $CaCO_3$	5	46 - 57	48	5	47 - 57	49	5	48 - 59	50	5	48 - 60	53
Ammoniacal nitrogen	g/m^3-N	5	0.01 - 0.070	0.014	5	<0.01 - 0.066	0.012	5	<0.010 - 0.110	0.012	5	<0.010 - 0.123	0.032
Bicarbonate	g/m^3 at 25°C	5	56 - 69	58	5	57 - 69	60	5	58 - 72	61	5	59 - 73	64
Biochemical oxygen demand 5day	g O_2/m^3	5	<2 - 3	<2	5	<2 - 3	<2.0	5	<2 - 3	<2	5	<2 - 3	<2
Calcium	g/m^3	5	12.8 - 13.9	13	5	13 - 14.5	14	5	13.5 - 14.7	14.0	5	12.7 - 15.1	14.0
Chloride	g/m^3	5	23 - 28	24	5	24 - 29	25	5	25 - 30	26	5	26 - 30	26
Conductivity @ 25'C	mS/m	5	22.1 - 23.6	23	5	23 - 23.6	24	5	24.5 - 26.7	24.8	5	24.6 - 26.1	25.7
Dissolved reactive phosphorus	g/m^3-P	5	0.023 - 0.070	0.032	5	0.02 - 0.070	0.033	5	0.02 - 0.074	0.035	5	0.021 - 0.053	0.030
Hardness Total	g/m^3 as $CaCO_3$	5	56 - 61	58	5	58 - 65	61	5	60 - 66	62	5	57 - 67	62
Magnesium	g/m^3	5	5.8 - 6.5	6.1	5	6.1 - 7	6.4	5	6.2 - 7.1	6.5	5	6.2 - 7.3	6.6
Nitrate nitrogen	g/m^3-N	5	1.75 - 3.5	2.4	5	1.9 - 3.9	2.9	5	1.87 - 4.00	2.80	5	1.7 - 4.00	2.90
Nitrite nitrogen	g/m^3-N	5	0.003 - 0.019	0.005	5	0.003 - 0.019	0.004	5	0.004 - 0.017	0.005	5	0.004 - 0.014	0.005
Nitrite/nitrate nitrogen	g/m^3-N	5	1.77 - 3.5	2.4	5	1.92 - 3.9	2.9	5	1.89 - 4.00	2.80	5	1.71 - 4.10	2.90
pH	pH Units	5	7.4 - 7.8	7.7	5	7.4 - 7.8	7.7	5	7.4 - 7.9	7.8	5	7.6 - 7.9	7.8
Potassium	g/m^3	5	5.3 - 9.8	5.4	5	5.4 - 10	5.6	5	5.8 - 10.2	6.3	5	6 - 9.9	6.5
Sodium	g/m^3	5	18.4 - 22	19	5	19.1 - 22	19	5	20 - 23	21	5	22 - 24	22
Sulphate	g/m^3	5	8.1 - 10.3	9.3	5	8.5 - 10.7	9.7	5	9.6 - 11.8	10.9	5	9.5 - 12.2	11.6
Sum of Anions	meq/L	5	2.0 - 2.2	2.1	5	2.1 - 2.2	2.2	5	2.2 - 2.3	2.2	5	2.1 - 2.4	2.3
Sum of Cations	meq/L	5	2.1 - 2.4	2.2	5	2.2 - 2.4	2.2	5	2.2 - 2.5	2.4	5	2.3 - 2.5	2.4
Temperature	°C	5	9.6 - 17.8	14.1	5	9.7 - 18.5	14.1	5	9.7 - 20.5	14.5	5	9.5 - 20.2	14.6
Turbidity	NTU	5	1.7 - 13.4	7.8	5	1.6 - 13.2	7.6	5	4.6 - 14.9	8.6	5	1.6 - 11.6	9.9
Un-ionised ammonia	g/m^3	5	<0.00017 - 0.0007	0.00018	5	0.00012 - 0.00053	0.00021	5	0.00013 - 0.0010	0.00019	5	<0.00017 - 0.0029	0.00035

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 Special Condition 8 of consent 0919-3 and 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 60. 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. 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(s).

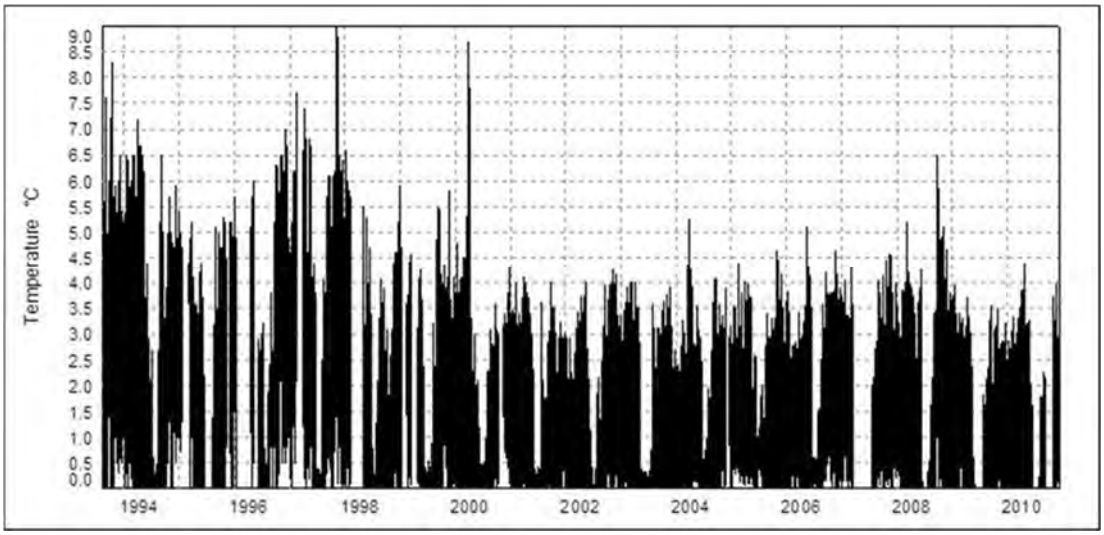

Figure 60 Kaupokonui Stream water temperature differential (LB-RB) records at the periphery of the Fonterra Ltd spray cooling water discharge zone, 1993-2010

Instead, 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. The first fish monitoring survey was conducted in January 2014. A second survey was carried out in June 2017 and was undertaken again in the 2019-2020 year. The results of the 2019-2020 survey is discussed below in section 2.1.8.3. The next survey is due in the 2022-2023 year.

Kaupokonui Stream flow records for the monitoring period for the Glenn Road recording station are presented in Figure 61.

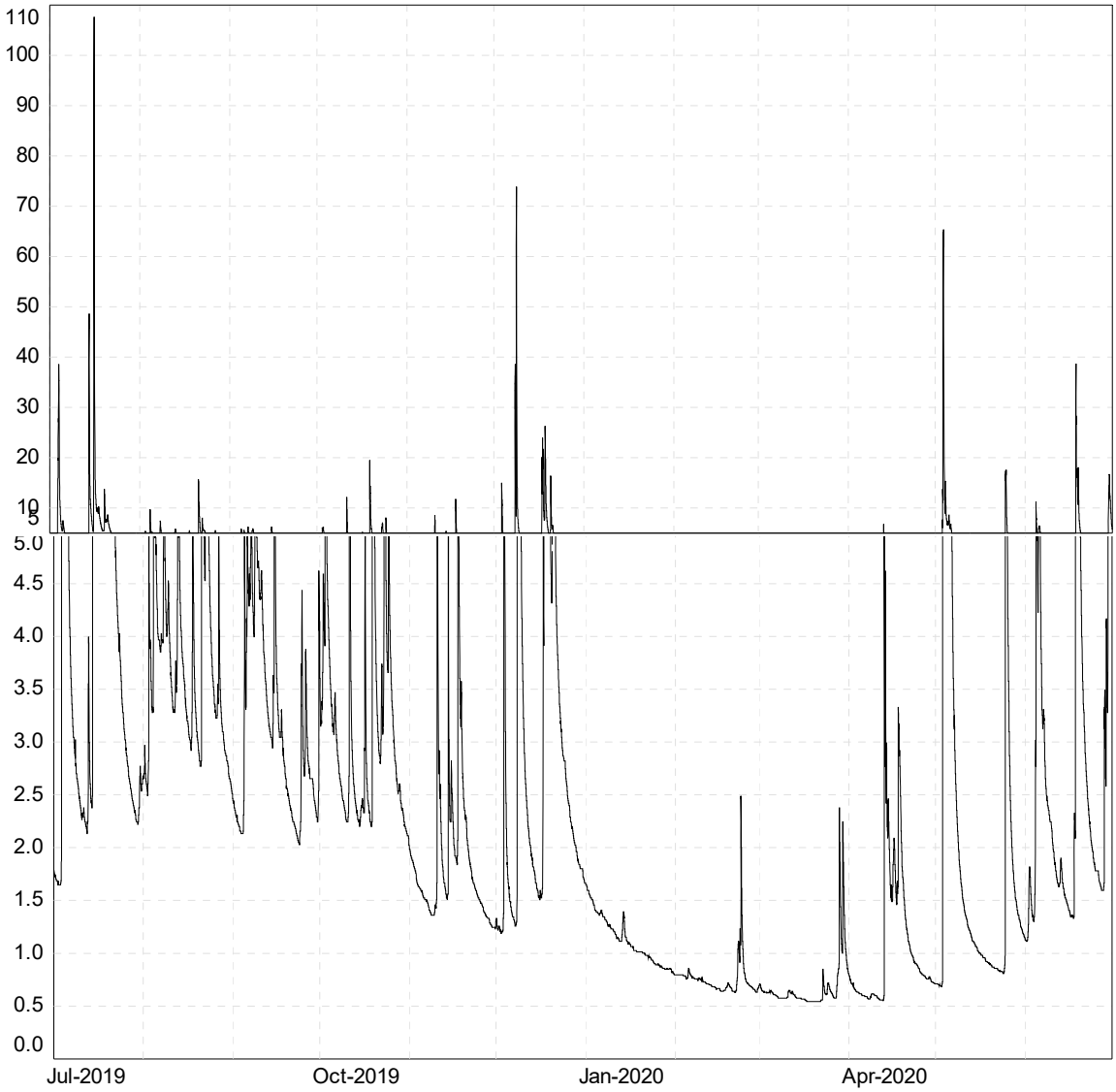

Figure 61 Kaupokonui Stream at Glenn Road flow record (m^3/s) for the year under review

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.

Water temperature records for these two sites are illustrated in Figure 62 and Figure 63.

A monthly summary of these data is included in Table 31.

During the year under review, the stream temperature at Glenn Road reached a maximum of 26.0˚C on 4 February 2020 from 15:30 to 17:00 NZDT. The temperature at the Beach site at this time was approximately 25˚C. The maximum temperature at the beach was 25.6˚C on 4 February 2020 from 15:15 to 15:45 NZDT. These temperatures are very similar to the maximum temperatures observed during the 2018-2019 year.

On 4 February the temperature of the Kaupokonui Stream upstream of the Company's site peaked at 23.9˚C, however this was much later in the day, between 17:45 and 18:30. The temperatures prior to 15:30 reached a maximum of 23.3˚C upstream of the sprayers. The temperature downstream of the sprayers peaked at 24.0˚C between 17:45 and 18:00. The temperature prior to 15:30 reached a maximum of 23.6˚C. It is noted that the stream temperature at Glenn Road and the coast often peaks somewhere between approximately two to three and a half hours earlier than in the vicinity of the lactose plant. In the hours leading up to the peak Glenn Road and beach temperatures, the maximum cooling water discharge temperature was approximately 35˚C at an approximate discharge rate of 120 L/s relative to a flow rate of 780 L/s in the stream at Glenn Road.

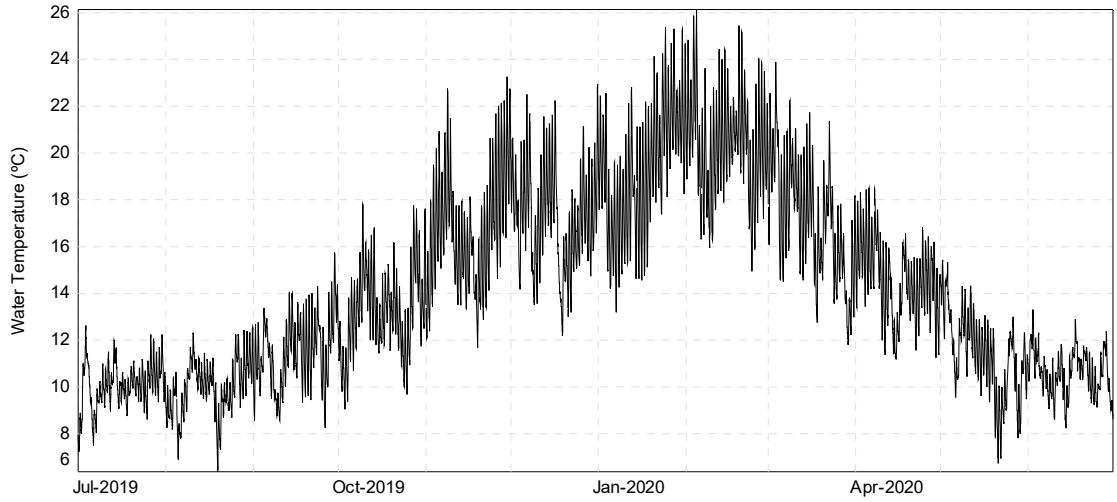

Figure 62 Water temperature (°C) records for the Kaupokonui Stream at Glenn Road during the year under review

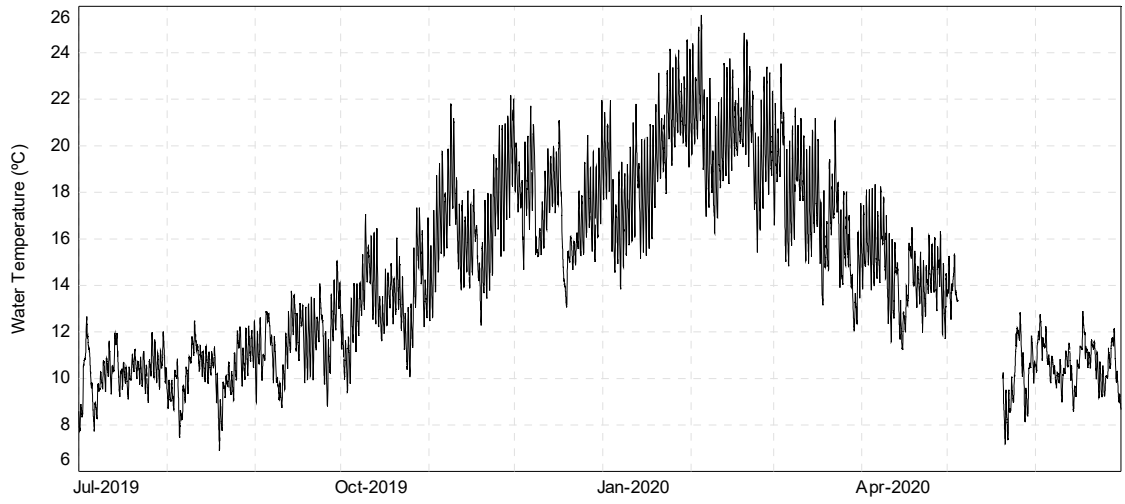

Figure 63 Water temperature (°C) records for the Kaupokonui Stream at beach during the year under review

Table 31 Monthly Kaupokonui Stream water temperature data for Glenn Road and the coast during the year under review

Site	Upper Glenn Road			Near Coast		
	Min	Max	Mean	Min	Max	Mean
July 2019	7.3	10.1	12.6	7.7	10.3	12.7
August 2019	6.4	10.0	12.6	6.9	10.3	12.5
September 2019	8.3	11.5	15.8	8.7	11.6	15.1
October 2019	9.1	13.2	17.8	9.4	13.3	17.4
November 2019	11.7	16.8	23.3	12.3	16.8	22.2
December 2019	12.2	17.3	22.9	13.1	17.3	22.0
January 2020	13.2	19.3	25.4	13.8	19.2	24.6
February 2020	14.9	20.4	26.1	15.4	20.4	25.6
March 2020	11.8	17.2	23.9	12.0	17.1	23.5
April 2020	11.2	14.6	18.5	11.2	14.5	18.3
May 2020[a]	6.8	11.4	15.4	7.2	15.3	10.4
June 2020	8.3	10.6	13.3	8.6	10.6	12.9

Key a – approximately 16 days affected by missing data due to logger being buried after a fresh

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 7% of the year at Glenn Road and 11% of the year near the mouth (with approximately 16 days affected by missing data), while the annual median water temperatures were 13.7˚C at Glenn Road and 14.1˚C near the mouth. During the warmer months of November to March, the temperatures exceeded 20˚C for approximately 27% of the time at Glenn Road and 13% of the time at the coast, which is a reduction in the amount of time at both sites when compared to the previous year that is particularly significant at the beach site (30% in 2018-2019). The median temperature during this period was 18.1˚C at both sites.

The highest recorded temperature in the lower Kaupokonui River is 29.0°C, for 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 the water consumption at the plant contributes to this in any way. This will be a matter for further investigation 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 new fish pass. However, new 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.

In October 2000 the Council recorded torrentfish in the lower section of the Kaupokonui Stream. Torrentfish migrate up and down waterways several times throughout the year and have been recorded in Taranaki streams up to an altitude of 440 m. However, they are poor climbers and are not currently able to negotiate the hydrological control weir in the Kaupokonui Stream at Glenn Road, at an altitude of 50 m. With the construction of a new fish pass at this weir to enable the passage of torrentfish and other native species over the weir, torrentfish are expected to migrate upstream to the Company's site, at an altitude of 160 m.

In September 2000, Fish and Game Taranaki wrote to the Council recommending that a 'constructed stream' type fish pass be built over the Company's Kapuni weir, similar to the one recently built on Cold Creek for South Taranaki District Council. Such a pass would allow for the passage of both trout and native fish. A deep channel in the centre of the pass would allow for the passage of trout. Rough, shallow zones on the edge of the pass would allow for the passage of native fish. It was suggested that a local engineering firm develop a design, and that a recognised fish pass expert evaluate the design. The Council concurred with this proposal.

In December 2000, the Council's Freshwater Biologist met onsite with Company and Fish and Game Taranaki staff, and Mr Charles Mitchell, a fish pass consultant. The weir was visited and options for the fish pass to provide passage for native fish (targeting torrentfish), and trout were discussed.

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 is a weir known locally as the Glenn Road weir. This weir is an orphaned structure which presents a significant barrier to the passage of most fish, but is considered to have some historical significance, and therefore it has been allowed to persist. Only the best climbing species have been able to negotiate the Glenn Road weir. As a result, it is extremely unlikely that swimming species, such as common smelt, inanga, and torrentfish are able to reach the Kaupokonui Stream near the lactose factory. Climbing species are 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 as well as the full natural extent in terms of abundance for climbing species. The Glenn Road weir is consented to be removed from the stream with works beginning when conditions are favourable. It is anticipated that this is likely to be during the summer of 2021.

After the Glenn Road weir is removed, the weir at Kapuni Lactose will become the first known barrier to fish passage in the catchment, although there may be some natural barriers or behavioural restrictions that could influence fish species reaching the Kapuni Lactose weir. Therefore, it is imperative the fish pass is

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 Glen Road weir, it is expected that the fish community of the entire Kaupokonui catchment upstream of the Glen Road weir will drastically (but not immediately) change upon removal of the weir. 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 survey noted areas of improvement that need to be undertaken to ensure a higher proportion of successful fish passage attempts across all species is achieved. However, further improvements are also likely to be needed following the removal of the weir to accommodate swimming species. It is considered appropriate the any remedial work is delayed until the Glen Road weir has been removed and passage is reassessed in 2021-2022 (and potentially further years ahead) so that premature remedial actions are not made addressing issues for different fish communities.

2.1.8.4 Fish survey

Fish surveys are scheduled to take place every third year. A survey was carried out in March 2020, with the next survey currently scheduled for the 2022-2023. A discussion of the results of the survey carried out during the year under review is presented below.

A four-site fish survey was undertaken in the Kaupokonui Stream on 13 and 17 March 2020, 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 identified where possible, counted, and lengths estimated. The sites monitored are described in Table 32 and shown in Figure 64.

Table 32 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

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 some kilometres downstream of the factory is an orphaned structure, the Glenn Road weir, which currently does not have adequate fish passage provision.

Five fish species were recorded during this survey, being longfin and shortfin eel, redfin bully, and brown and rainbow trout. A single redfin bully was recorded, reflecting the impact of the Glenn Road weir.

Upstream of the Kapuni Lactose weir, longfin and shortfin eels were recorded, indicating that this weir is not posing a significant barrier to fish passage for these climbing species. The weir has yet to be assessed for all swimming species such as inanga, smelt, and torrent fish due to the Glenn road weir. While redfin bully was not recorded at site one, it has been recorded in the past above the weir. Lack of detection of the redfin

bully during the current survey is likely due to low abundance rather than there being a complete barrier to fish passage for the species presented by the Kapuni Lactose weir.

While the fish pass is clearly navigable by the species present (climbers) 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.

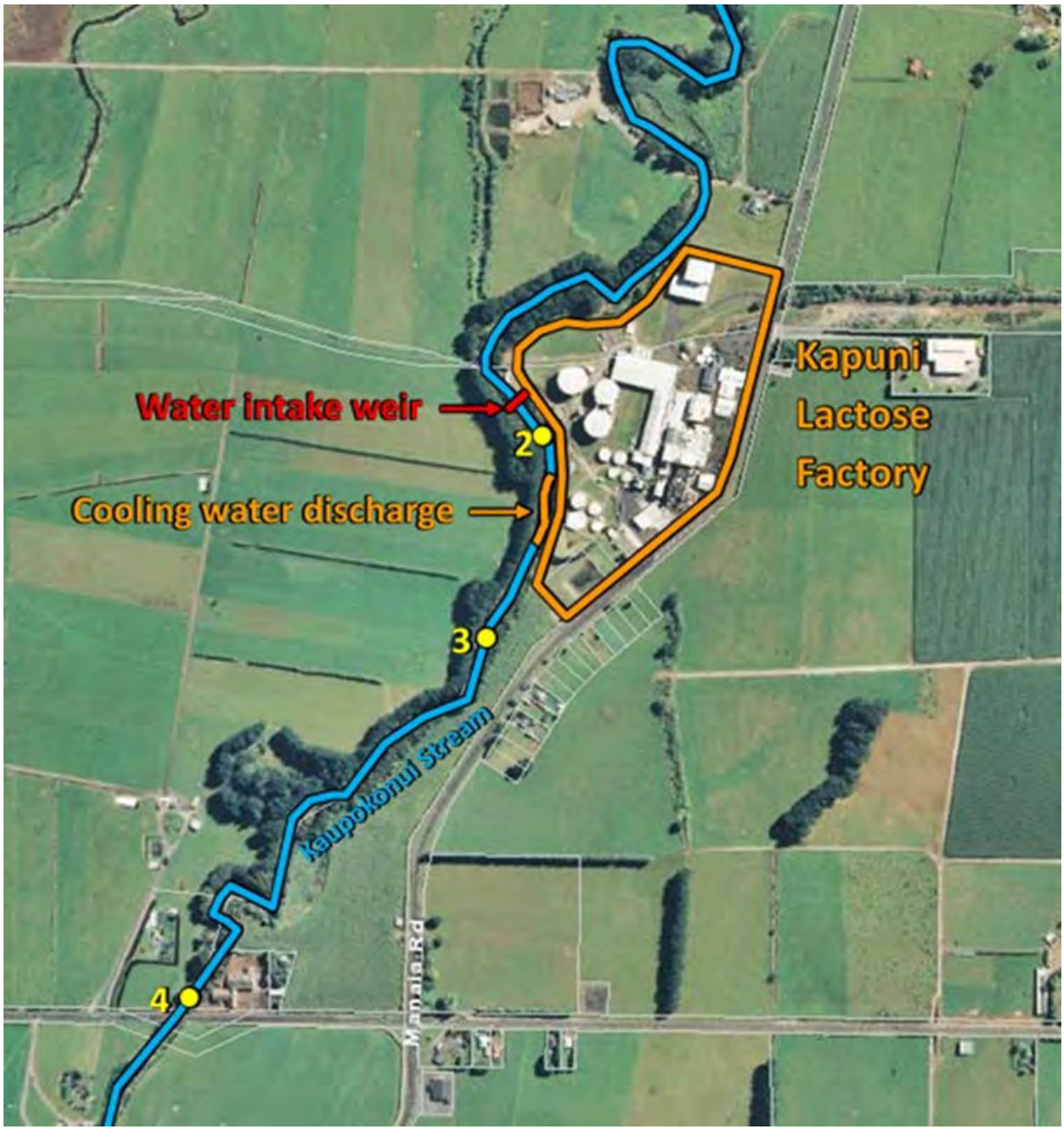

Figure 64 Fish monitoring sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory. Site 1 is located approximately 4.3 km upstream of the weir.

Additionally, the weir is leaching 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, such as boulders, would aid smaller fish in avoiding predation while exiting the fish pass.

Overall, these surveys results appear to show that the activities of the Kapuni Lactose factory are not currently significantly adversely affected the fish communities of the Kaupokonui Stream. However, it is expected that complete passage is not being provided for due to the reasons outlined earlier, and that in general these survey results are unlikely to effectively portray these issues due inherent limitations in the survey methodologies. As the riparian planting of the catchment matures, and passage remediation works at the Glenn Road weir are undertaken, 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. 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 any remediation required may need to be undertaken promptly to ensure continued consent compliance.

2.1.8.5 Macroinvertebrate surveys – replace image only

Macroinvertebrate surveys were carried out in the Kaupokonui Stream in relation to the Fonterra Kapuni farm and factory to examine the effects of discharges to the stream and to land in the vicinity of the stream on 25 November 2019 and 28 February. Two sites in the Waiokura Stream were also sampled in February 2020. 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 33 and shown in Figure 65. 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 33 Biomonitoring sites in the Kaupokonui River and Waiokura Stream

Stream	Site No.	Site Code	Location
Kaupokonui River	3b	KPK000655	1 km u/s of railway bridge
	4	KPK000660	Railway, above factory
	5	KPK000679	160m below cooling water discharge zone
	6	KPK000685	Skeet Road
	7	KPK000880	Glenn Road
Waiokura Stream	U	WKR000500	Skeet Road
	D	WKR000650	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.

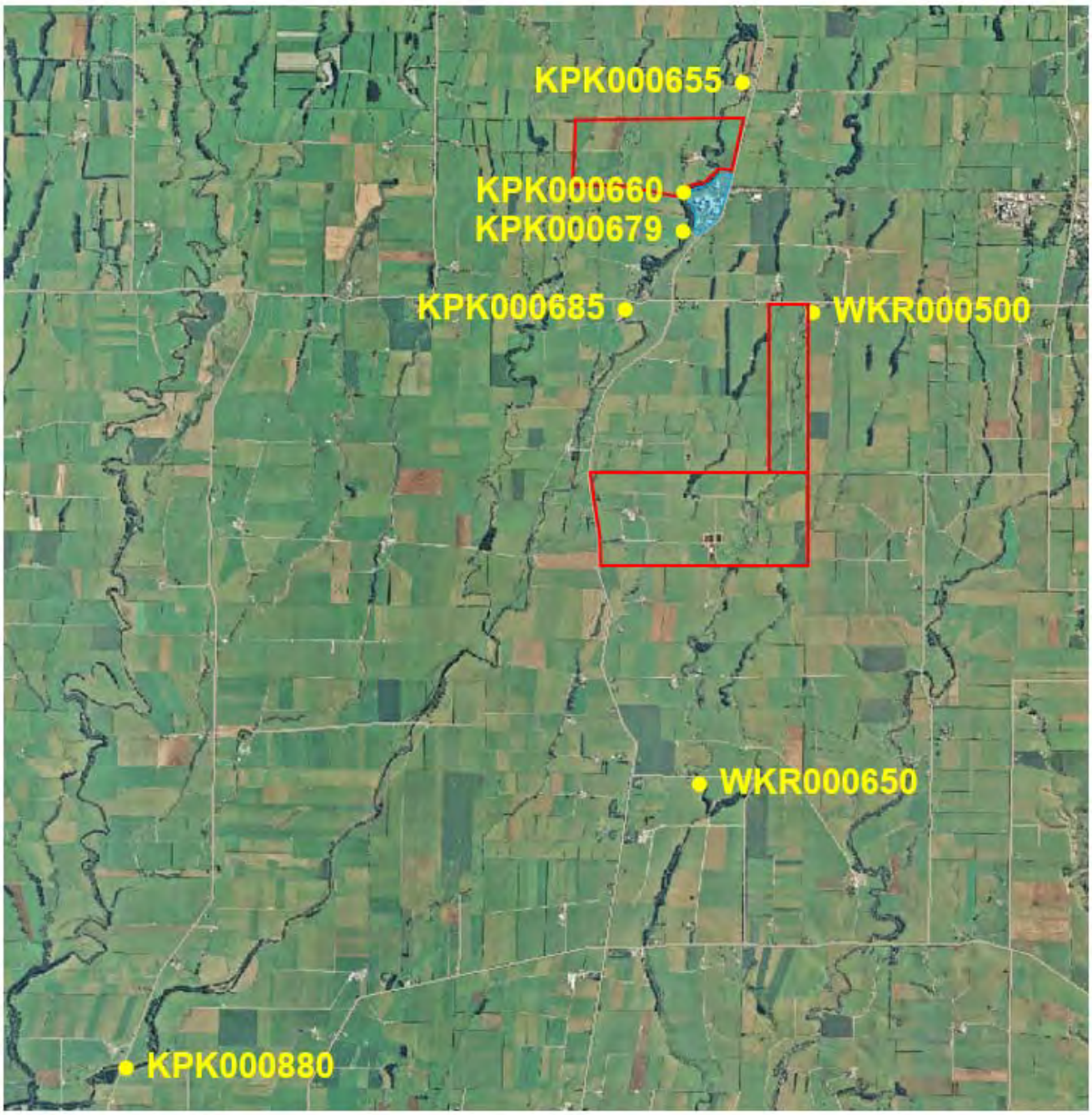

Figure 65 Biomonitoring sites in the Kaupokonui River sampled in relation to the Company's factory discharges

25 November 2019

In this November 2019 survey, the five sampling sites supported taxa richness of between 13 and 26 taxa. The sites supported equal or fewer taxa than recorded in the preceding survey, by up to seven taxa. Taxa richness was generally relatively similar between sites, with the exception of site 7, which recorded the lowest richness of 25 taxa, a substantial seven taxa less than any other site in this survey.

MCI scores ranged from 89 to 121 units in the current survey, indicating 'very good' to 'fair' macroinvertebrate community health throughout the surveyed reach. The highest score in the current survey was recorded at site 5, although this was not significantly higher than sites 3b and 4. Site 6 recorded a score significantly lower than site 5, but similar to sites 3b and 4. SQMCI scores ranged from 6.3 to 3.0, with scores being similar at sites 3b, 4 and 5, while site 6 had a score significantly lower than these three sites. Site 7 had MCI and SQMCI scores significantly lower than any other site in this survey.

In some previous surveys, a decline in macroinvertebrate community health has been noted between sites 3b and 4, which may be attributable to the discharge of treated dairy shed effluent to an inflowing tributary a short distance upstream of site 4. No such deterioration was recorded in the current survey. Site 5 historically has had a lowered median MCI score, with some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Most surveys in more recent years had found no sign of the heterotrophic growths (mats of filamentous bacteria and protozoa) recorded by several surveys at this site in the 1980s and early 1990s. However, an extensive outbreak of heterotrophic growths occurred in this reach of the river during the autumn-winter months of 2007. Heterotrophic growths were again recorded in summer 2008, spring 2010 and spring 2014. An obvious deterioration in the macroinvertebrate community occurred in conjunction with the outbreak in 2008, and a more subtle deterioration occurred in 2010. This indicated that a poor quality cooling water discharge had been occurring, but that it was not resulting in the same degree of deterioration in water quality as the discharges that occurred in the early 1990s. The current survey did not record any heterotrophic growths; neither did it indicate any change in macroinvertebrate communities caused by the cooling water discharge. Site 7 typically records the poorest macroinvertebrate communities, and this was the case in the current survey. This is owing in part to the influence of the Dunns Creek tributary, which joins the river between the two sites, and also to the large distance between the two sites. It is common to observe progressive downstream deterioration in ringplain rivers and streams. Occasionally, there had been little difference between sites 6 and 7, due to site 6 showing impacts from the cooling water discharge. However, in the current survey, there was no significant evidence of cooling water discharge influencing the macroinvertebrate community at site 6.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, and that the communities were largely in average condition. Community composition showed similarities between all sites, with the largest change being between sites 6 and 7. The current survey did not record the presence of heterotrophic growths, supporting a lack of impacts from the cooling water discharge. Further, the trend of improvement in communities adjacent to the factory observed in more recent years has continued to be recorded by this survey.

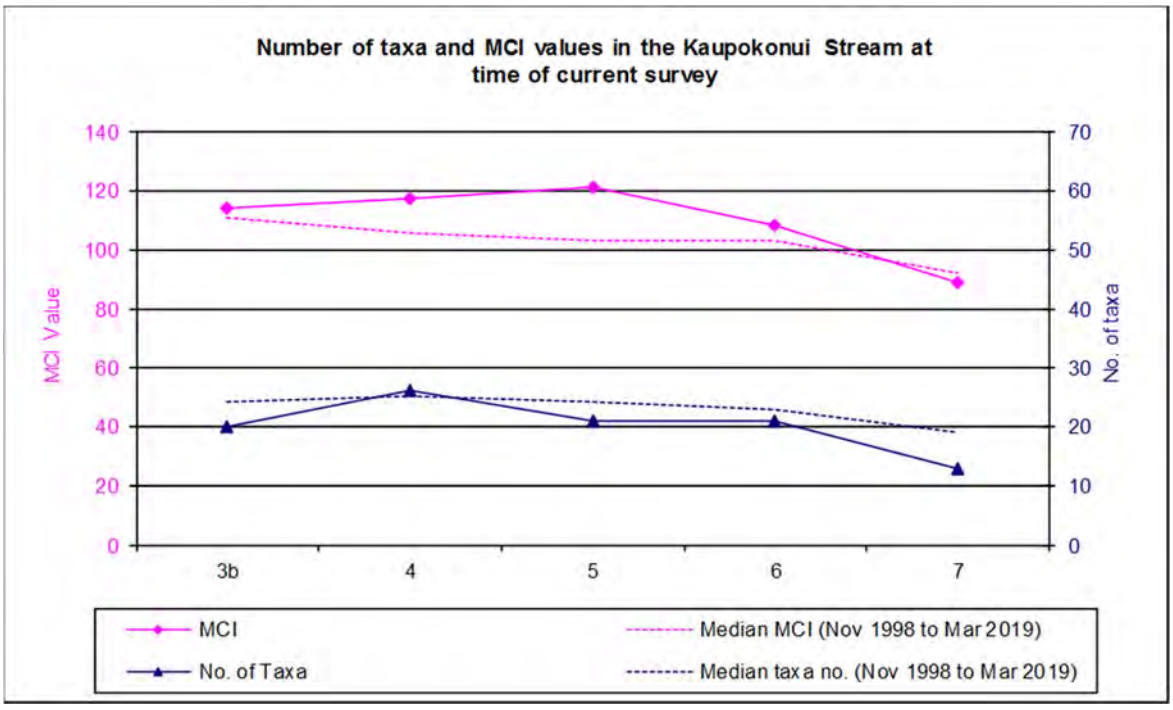

Figure 66 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

28 February 2020

In the February 2020 survey, the five sampling sites in the Kaupokonui Stream supported taxa richness of between 13 and 21 taxa. Richness was similar but low at sites 3b, 4 and 7, while sites 5 and 6 supported moderate richness. Compared to the preceding survey, the richness at individual sites was either the same (sites 5 and 7), or lower. This difference was a substantial twelve taxa at site 4. The richness was lower than the median richness since 1998 at all sites, with this difference being substantial at sites 3b, 4 and 7.

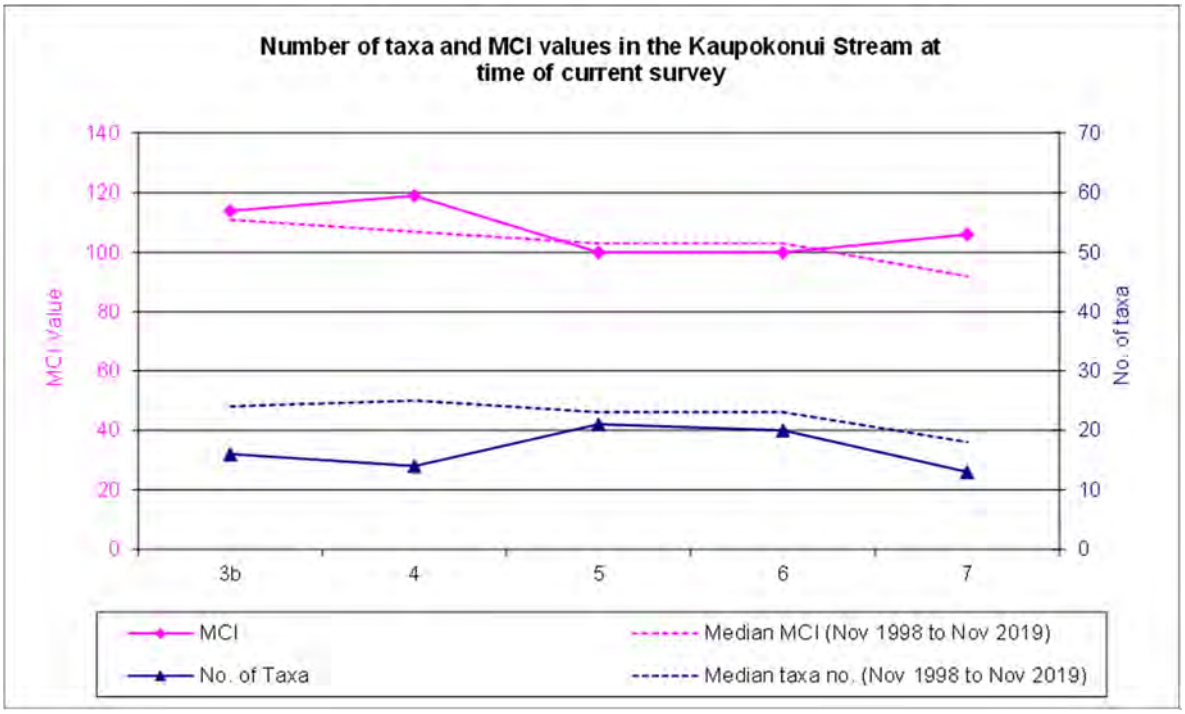

Figure 67 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

MCI scores ranged from 100 to 119 units in the current survey, indicating 'good' macroinvertebrate community health throughout the surveyed reach. Overall, and as is typical, MCI scores generally decreased in a downstream direction although there were non-significant increases between sites 3b and 4, and site 6 and 7. Sites 3b and 4 had significantly higher MCI scores than sites 5 and 6, and the score at site 4 was also significantly higher than that at site 7.

In some previous surveys, a decline in macroinvertebrate community health has been noted between sites 3b and 4, which may have been attributable to the discharge of treated dairy shed effluent to an inflowing tributary a short distance upstream of site 4. No such deterioration was recorded in the current survey, with no significant changes in taxa richness or SQMCI and an increase in MCI scores between these two sites.

Site 5 historically has had a lowered median MCI score, with some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Most surveys in more recent years had found no sign of the heterotrophic growths (mats of filamentous bacteria and protozoa) recorded by several surveys at this site in the 1980s and early 1990s. However, an extensive outbreak of heterotrophic growths occurred in this reach of the river during the autumn-winter months of 2007. Heterotrophic growths were found on the substrate by the late summer survey of 2008, coincident with the deterioration in the macroinvertebrate community at this site at that time. In the spring 2010 survey bacterial growths were again recorded, although there was no significant deterioration in the macroinvertebrate community. At that time subtle impacts on the macroinvertebrate community, such as the appearance of the bloodworm midge (*Chironomus*), suggested that the degree of impact was potentially approaching a 'tipping point' after which deterioration in the macroinvertebrate community was more likely, provided the poor quality discharge

continued. In spring 2014, the survey again recorded the presence of heterotrophic growths, but in that case, there was no obvious impact on the macroinvertebrate communities. This indicated that a poor quality cooling water discharge had been occurring, but that it was not resulting in the same degree of deterioration in water quality as the discharges that occurred in the early 1990s. No heterotrophic growths were recorded in the current survey. The current survey provided no evidence that there was any change in the macroinvertebrate communities as a result of the cooling water discharge.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities of the Kaupokonui Stream, and that the communities were largely in average condition, although taxa richness was lower than is typical. Community composition showed similarities between all sites, with the largest change being between sites 4 and 5.

The current survey did not record the presence of heterotrophic growths, supporting a lack of impacts from the cooling water discharge. Further, the trend of improvement in communities adjacent to the factory observed in more recent years has continued to be recorded by this survey.

The Waiokura Stream recorded moderate taxa richness of 18 taxa at site U, and 16 taxa at site D. These numbers were slightly lower (by up to six taxa) than the historic medians and the preceding results for the two sites. MCI scores of 110 and 83 units were recorded at the two sites, showing a significant deterioration in a downstream direction. The scores categorised site U as having 'good' and site D as having ' fair' macroinvertebrate community health. These scores were not significantly different from historic medians, although at both sites the score diverged from the median by nine units (higher at site U and lower at site D). The score was also significantly lower than the preceding survey results at site D. SQMCI scores of 6.0 and 4.6 were recorded at the two sites, showing a significant decrease in a downstream direction. These scores were not significantly different from the preceding result at either site, but was significantly lower than the historical median at site D only.

Taxa richness in the Waiokura Stream was lower than has been typical when compared to previous surveys at these two sites, with the richness equal to or only one taxon higher than the lowest recorded richness to date for each site. The stream exhibited a greater than usual deterioration in MCI score, with a significant 27 unit decrease between the two sites. The SQMCI scores also indicated that there was some deterioration in a downstream direction with a significantly lower score recorded downstream compared to upstream. It is noteworthy that this survey was the second consecutive survey to record the lowest SQMCI score to date at site D.

Often the difference between sites in the Waiokura Stream is largely attributable to the distance between the sites (approximately six kilometres), and the marked habitat differences between sites (especially the predominance of macrophytes at site D), rather than to any effects of the application of wastes to land from the Fonterra factory. There were some subtle changes in macroinvertebrate community composition between the sites, which largely were associated with differences in habitat (principally an increase in macrophytes at the downstream site).

Overall, and given the large distance between the two sites, there is insufficient evidence to conclude that the observed deterioration in the Waiokura Stream is related to the impacts of wastewater irrigation within the Waiokura catchment. However, on the basis of the available data, this cannot be ruled out either. Therefore it is recommended that if continuation of the deterioration occurring at site D is detected in the next scheduled survey, then increasing the monitoring frequency in the Waiokura Stream to spring and summer macroinvertebrate surveys should be considered. Furthermore, at this time it should be considered whether these two sites are suitable to detect the impacts of land irrigation on the Fonterra Kapuni farms, or whether intermediate site(s) are also required.

2.2 Air

Officers of the Council carried out inspections in relation to air emissions, of the Kapuni lactose plant, during the 2018-2019 monitoring period. These inspections are an important part of the monitoring programme, and are incorporated as part of the monthly inspections and water sampling, allowing for discussion of air discharge management issues.

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.

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 pre-drier stack and the refined fluid bed drier, with this emission source then referred to as the flash drier.

Table 34 is included for comparison of results prior to the installation of the wet scrubber system.

Table 34 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 21 September 2018 by CRL Energy, using USEPA method 17. During the year under review, there was again a slight change in the methodology of the emissions monitoring. In the 2019-2020 year the determination was an average of three tests performed over a period of about 60 minutes for the Flash dryer and the small dryer, but 50 minutes for the North and South Supertab. In 2018-2019, the determination had returned to being an average result from three tests each conducted over approximately 60 minute periods, rather than the one approximately 60 minute period used during the 2017-2018 year. Again, no information was included in the report regarding the production rate at the time the test was undertaken. 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 in the replacement consent.

The result is presented in Table 35 below, along with previous averaged CRL and Council results since 1998.

Table 35 Summary of isokinetic stack analysis of the flash drier for 1998-2018

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

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Emission (mg/dsm^3)*	Comments
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
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

Key * mg/dsm3 = 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 2019 were 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 36, Table 37 and Table 38. There are currently no consent limits on these sources, however the renewed consent will contain particulate emissions limits for each of these stacks. All average particulate emission rates during the year under review were below the 125 mg/m^3 limit that applies to the flash dryer.

Table 36 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

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 37 Summary of isokinetic stack analysis of the supertab north dryer, 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 (combined with south)	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

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 38 Summary of isokinetic stack analysis of the supertab south dryer, 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 (combined with north)	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

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

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 39 and Figure 68.

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 69 and Table 40.

Prior to the commissioning of the wet scrubber in October 1998, deposition rates of up to 1,300 milligrams per square metre were reported from surveys carried out surrounding the lactose factory site. There has been a significant reduction in deposition since the wet scrubber began operating. This is consistent with the decrease in stack emission concentrations measured (see section 2.2.2).

Table 39 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

A review of the monitoring data from the nearest wind monitoring station (Taungatara at Eltham Rd) indicated that it was likely that winds were predominantly from the NW (approximately 54% of the time) to W (approximately 22% of the time) during the gauge deployment. Northerly components were present for approximately 9% of the time, whilst all other components were each for only 2 to 4 % of the time.

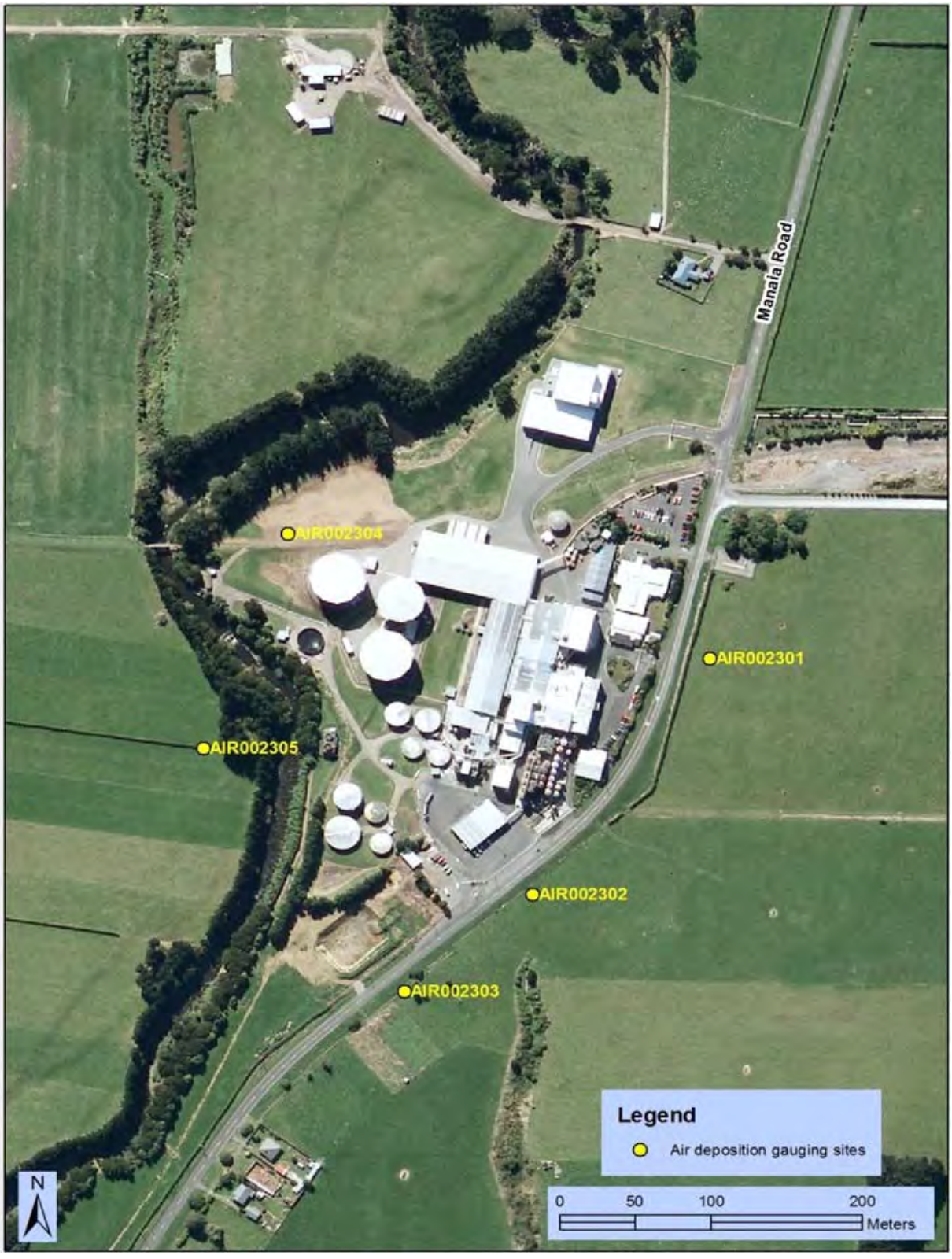

Figure 68 Location of air deposition gauging sites

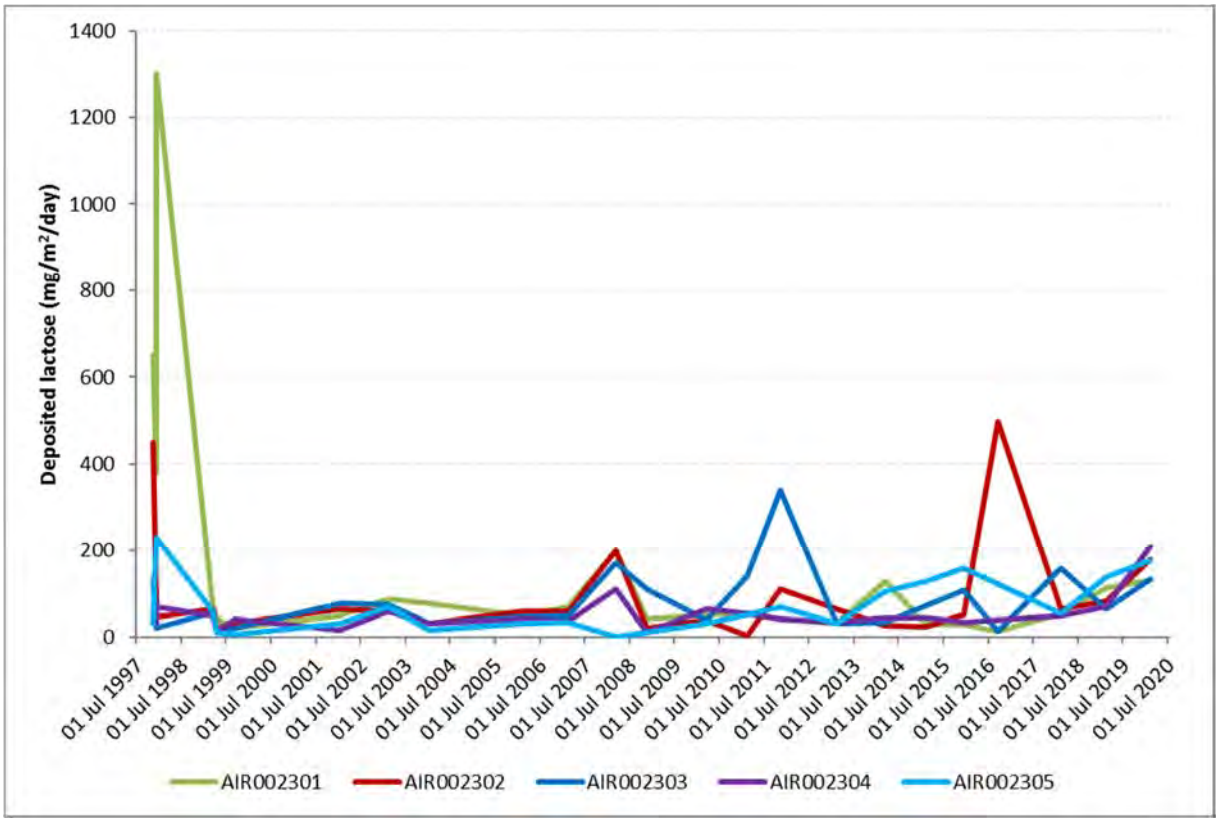

Figure 69 Deposition gauge results from 1997 to date

Table 40 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	-
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

Period	Number of days	Deposited lactose mg/m^2/day				
		AIR002301	AIR002302	AIR002303	AIR002304	AIR002305
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**

* gauge contents contaminated by bird/bird droppings

The deposition rates obtained during the periods under review were elevated. The lactose deposition rates recorded at all sites were above their respective historical medians and all sites except AIR002031 were above the guideline value. It is noted that the highest result was at a monitoring location that was at AIR002304, which is no longer surrounded by exposed earthworks as the area around the constructed stormwater pond has been stabilised for some time. In the predominantly NW wind conditions prevailing during the survey, this monitoring location was predominantly upwind of the Company's activities, indicating a short lived event. The monitoring locations downwind of the factory site during the survey (AIR002301 and AIR002302) were at or above the guideline, but to a lesser extent than AIR002305. It is noted that there were no complaints received regarding particulate deposition during the deployment period of the gauges, and the deposition rate is not limited by the Company's consent.

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 41 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 2019-2020 period. It also includes matters that commenced and were reported on in previous monitoring periods, only where additional activity by the Council continued during the monitoring period under review. 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 41 Incidents, investigations, and interventions summary table

Date	Details	Compliant (Y/N)	Enforcement Action Taken?	Outcome
16-Nov-2018	An email was received confirming that the cooling water discharge flow recording device is not capable of achieving the accuracy required by agreement reached on 28 August 2015.	N	N	During analysis of data it was found that the location in which the equipment for recording the cooling water discharge flow rate was installed, resulted in the agreed accuracy and validation not being achievable, at the Fonterra site in Kapuni. As a written agreement with Fonterra brought this monitoring within the scope of condition 1 of consent 0919, this consent conditions was deemed to been contravened. A meeting was held with the Company. The Company undertook to install a suitable system by 30 September 2019, which has been done. Data review in the 2019-2020 year deemed the data provided complied with the agreement and therefore consent conditions.
28-Oct-2019	Council was notified that the Company had identified a very minor leak from the Farm 1 pipe crossing over the Kaupokonui Stream.	Y	N	The leak was very minor and at one end of the pipe crossing. No evidence was found indicating that there was a discharge to the stream as a result of the leak. The Company logged this as an internal non-compliance. The outcome of their investigation was that the Company undertook to replace this, and all other PVC pipe crossings, with stainless steel to mitigate the risk of a non-compliant discharge occurring in the future.
8-Apr-2020	Self-notification was received concerning a failure with a PLC card associated with the water take flow meter, which stopped the data being recorded accurately, at the Fonterra Kapuni Plant.	N	N	The Company advised that they could prove that the water abstraction rate and daily total of abstraction were in fact compliant, just the meter was not recording the data accurately as required by the consent. The Company immediately undertook temporary repairs to the meter, however this was not successful. A new part for the meter was ordered, replaced and verified promptly. The Company had a statutory defence with regard to the unforeseen failure of the meter.

3 Discussion

3.1 Discussion of plant performance

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, including further modifications to the cooling water system in the interest of energy efficiency (although this did result in higher cooling water discharge temperatures when compared to the 2018-2019 year), commencement of a programme to replace all of the PVC pipe crossings conveying wastewater over streams with stainless steel pipes, and improving accuracy and precision of the instream temperature monitoring and electronic data provision, with data gaps now down to less than 1% for the whole year.

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. The latest plan on record at the Council was issued in June 2020. The whole document was reviewed with updates and/or clarifications added throughout the plan. 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, but the irrigation management plan having been updated to a whole farm management plan in June 2019, was reviewed again in June 2020. The most significant change to the plan was the addition of a section covering the actions that the Company would take to address the contamination of local groundwater contamination should this become necessary. The plan integrates the irrigation management and the farm management practices to ensure that the operation of these two activities are themselves well integrated, with the priority being afforded to the wastewater disposal activities rather than the farming operations.

Data were 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, 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 additional electronic data has been provided to Council for the water abstraction and discharge flow rates, and for the cooling water discharge temperature, also provided on a daily basis. Discussions are continuing around the more frequent provision of electronic data. Compliance with consent conditions was demonstrated for stream temperature and dairy effluent volume. However, following review of the electronic 2016-2017 data and temperature probe calibration records, it became apparent that although the level of accuracy of the probe advised to Council in February 2016 was unchanged, the observed deviation allowed to go uncorrected by the Company during verification had increased. As discussed previously, in the absence of any specific consent requirements the monitoring should, and does, meet the requirements of the NEMS standard. During the year under review, the verification tolerances were reduced, with adjustments being made to the calibration if the probe is found to be out by more than ± 0.2°C, reducing potential errors of measurement on the temperature differential from ± 1.6°C to ±1.0°C. Data collected in the 2019-2020 year showed a marked reduction in the degree and frequency of temperature decreases recorded for the stretch of water flowing through the cooling water discharge area, indicating that the previous bias introduced by recording errors were significantly reduced as a result of these changes in practice. As with other thermal dischargers that undertaken their own temperature monitoring, a period of parallel temperature monitoring was undertaken. However, the Council temperature loggers were no longer in place when retrieval was attempted following a longer than scheduled deployment due to COVID-19 restrictions.

Electronic transmission to Council of cooling water discharge volume data was instituted during the 2015-2016 year following an agreement by Council in July 2014 not to review the discharge consents, but to have this information provided by agreement, in order to have the information available to Council for water allocation purposes. This monitoring, which is within the scope of condition 1 of consents 0919 and 0924, required the installation of new flow monitoring equipment on the cooling water and cooling water/stormwater discharge lines. The provision of this data (originally due by 31 August 2015 and rescheduled to 30 September 2015) was delayed by more than three months (until January 2016), while landscaping was completed around new cooling towers, and data transmission processes were established. Transmission of electronic abstraction data already collected by the Company was established at the same time. (Electronic transmission of water temperature upstream and downstream in the Kaupokonui had been in place since March 2014). During the 2015-2016 and 2016-2017 and start of the 2017-2018 years there were ongoing problems with transmission of the data, in terms of missing record and of accuracy. In the interim, the daily values that were supplied by the Company in its monthly report were used to determine consent compliance retrospectively on volumes and temperatures. Investigations in the 2017-2018 year allowed most of the missing data to be backfilled, and corrupt data to be corrected for the 2016-2017 year. However, further assessment of the data during the 2018-2019 year identified that there remained an issue with the accuracy of the flow meter for the cooling water discharge covered by consent 0919-3 during the year under review. Council was informed that the Company incorrectly installed the flow meter in a location that means it will not be capable of delivering, nor being certified as delivering, data of the agreed accuracy without significant further capital investment. The location also results in the discharge flow rate not capturing any losses at the cooling tower, which was thought to be the major source of water "usage" at the site. This was recorded as a non-compliance and the Company undertook to install an appropriate system by the end of September 2019. This was done. A review of the data gathered following installation and verification of the new meter found that the data now provided was satisfactorily robust and indicated that the consumptive use was generally between 1 and 25 L/s.

The main cooling system was replaced in August 2015, in order to reduce the temperature of the discharge and ensure compliance with the temperature limit on consent 0919. During the year under review, the use of the pipe that can be used to divert a proportion of the cooling water around the cooling tower was discontinued and the cooling tower was run at maximum cooling capacity. This resulted in a reduction in the monthly median cooling water temperature upstream of the spray discharge system during the year under review to 20.5 to 25.3°C, down from the previous years 29 to 37°C. The effect of this on the instream temperature differential was a significant reduction the amount of time that the temperature differential exceeded 1°C, from 37% of the time to only 26% of the time, with the temperature differential exceeding 2°C for less than 1% of the time. The reduced cooling water discharge temperature would also have also resulted in a significant reduction in the temperature effects occurring within the approximately 200 m mixing zone. During the year under review, refinements were made to the cooling water system so that the automated control systems could ensure that the temperature differential restrictions on the consent were being met, whilst enabling the Company to operate the system in the most cost effective way. This resulted in the temperature of the cooling water being in the increased temperature range of 28-33°C and a loss of the reduction in temperature within the mixing zone that was achieved during the 2018-2019 year's operational changes. There is no temperature monitoring undertaken of the cooling water entering the stream or of the stream itself at the point of discharge, however a degree of further evaporative cooling is expected due to the discharge mechanism. 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.

One new incident was recorded; self-notification of a PLC failure that prevented accurate abstraction data from being recorded. The discharge rate and known approximate correlation between the abstraction and discharge rate was used to confirm compliance with the abstraction rate limit on the consent. The metering was re-instated within an acceptable timeframe.

Recorded annual abstraction volume from Kaupokonui Stream, although increased from the 2018-2019 year, remained relatively low. The abstraction rate remained below 172 L/s for 99% of the time, which is well below the maximum permitted rate of 225 L/s.

Across the whole season, the median measured strength of wastewater irrigated onto land increased for nitrogen species for the third successive year. There was again also less consistency in the strength of the wastewater when compared to the 2017-2018 year. Although there was a relatively minor increase in the wastewater volume irrigated in the year under review when compared to the previous year, there was an increase in the estimated total mass of nitrogen calculated on a kilogramme per hectare per year basis.

Disposal of DSE to land via the factory effluent spray irrigation system was established in 2015-2016, replacing the oxidation pond treatment systems which had discharged to a Kaupokonui tributary and Motumate Stream. This is in line with Council's policy of promoting discharges of DSE to land. The calculated estimate for the nitrogen application rate of the combined factory wastewater and DSE in the 2019-2020 year was 20% more than the previous year on Farm 1 and 14% more than the previous year on Farms 2 and 3. However, caution needs to be applied to these calculated estimates given the variability observed in the wastewater compositions (factory and DSE) throughout the year and the assumption that the application is uniform across all paddocks.

Two major projects had been completed during the 2007-2008 reporting period which have had long-term beneficial effects on environmental performance: extension of the wastewater irrigation system, and construction of a stormwater detention system.

The 41% extension of irrigation area, from 120 to 169 ha in 2006, with little change in effluent volume and nitrogen mass has significantly reduced loading rates on soil and groundwater, and the use of automated in-ground irrigators has greatly improved the management of the combined waste disposal and farming operation.

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, with samples compliant with consent conditions.

Riparian planting was maintained on the factory site. The financial contributions were not invoiced during the year under review due to the expiry of the consent. Council systems have now been adjusted to ensure that consents under Section 124 protection are captured for invoicing financial contributions. Both the 2018-2019 and 2019-2020 contributions were invoiced and paid in the 2019-2020 year.

3.2 Environmental effects of exercise of consents

An assumption had previously been made that the abstraction for the cooling water was close to being non-consumptive. Following the resolution of the issues that affected the cooling water discharge rates provided for the 2016-2017 year, it was stated in the 2016-2017 Annual Report that assessment of the consumptive nature of the abstraction, and the impact this may be having on the flow of the Kaupokonui Stream could now be made once sufficient data was available, noting that any losses due to evaporation or wind drift at the point of discharge is additional to any measured water consumption through the plant. During the 2018-2019 year, with more data at hand it was found that the data being supplied did not meet the agreed standards as far as accuracy was concerned. Council was also informed that the flow meter was positioned upstream of the cooling towers, considered to be the main consumptive use at the site. As a result the consumptive nature of the water take, and potential effects on the stream cannot be reliably assessed from a water allocation perspective, and additionally was a non-compliance with condition 1 of consent 0919 for which a resolution and been planned during that year, to be implemented in the year under review. This

time frame was considered acceptable due to the significant investment required, and because ecological monitoring had not found any significant adverse effects in regard to the abstraction of water from the Kaupokonui Stream for cooling water and general purposes.

The discharge of cooling water did not have a visible effect on receiving waters during the monitoring period, and there was good compliance with discharge permit conditions.

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 is improved confidence in the accuracy and precision of the data provided. 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. In the 2018-2019 year temperature reductions of between 0.01 and 0.9˚C were recorded for only 3% of the time. A reduction in the instream temperature differential was also found during the year under review due to the Company running the cooling tower at the maximum cooling capacity. Monitoring at this time therefore showed this was effective at minimising effects, with a reduction of the temperature differential recorded most frequently of 0.6˚C. The lower cooling water discharge temperatures would also have resulted in a significant reduction in the temperature effects occurring within the approximately 200 m mixing zone. In the 2019-2020 year, these beneficial effects were less pronounced. Temperature reductions of between 0.01 and 1˚C were recorded for 11% of the time due to the measurement error of the temperature probes. This was better than in 2017-2019, but not as good as in 2018-2019. In addition to this the structural and operational changes made to the cooling water system in the interest of cost and energy efficiency resulted in higher cooling water discharge temperatures during the year under review when compared to the previous year, as discussed in section 3.1. Although control of the upstream/downstream temperature differentials was good, the increase in the monthly median cooling water discharge temperatures from 23 to 25.5˚C in 2018-2019 to 28 to 33˚C in 2019-2020 would result in the potential for increased temperature effects within this relatively long mixing zone.

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

At inspection it was found that the irrigation of wastewaters onto the dairy farms was, in general, well managed. At inspection it was found that a 20 m buffer to the bank of water courses was maintained. No ponding, spray drift or patches of dead grass were noted at inspection.

Effects on the groundwater in the vicinity of the farms were varied, but most showed an adverse impact on both mineral and organic component levels. This was previously addressed through extension of the irrigation disposal system and by more intensive wastewater and groundwater monitoring. The monitoring results show that, since 2011-2012, total volume of factory wastewater irrigated had remained relatively stable, although there was an increase in volume in the 2017-2018 year and a decreased volume during the year under review. There was a reduction in total nitrogen loading in 2012-2013, which increased back to the previous levels in 2014-2015, possibly as the result of a change in cleaning procedures. Since that year, there had been successive declines in the total nitrogen loading each year, up to and including the 2018-2019 year. During the year under review, there was a higher nitrogen load applied to the paddocks than in the 2017-2019 years. The nitrogen application rates increased by about 14% on Farm 1 and 20% on Farms 2 and 3. There was only one bore that was consistently above the drinking water standard (GND0638), but there were four bores having an annual median above the standard, one of which was the control bore at the northern boundary of Farm 2 (GND2049). The reason for the elevation in this control bore and the control bore for Farm 3 (GND2051) is still to be fully investigated. The Farm 1 impact bore returned an annual median that was above the drinking water standard and also the highest result observed at this site

since 2012. The Farm 2 impact bores where the drinking water standard was exceeded in some or all of the samples collected during the year under review were one of the sites near the Motumate Stream (GND0638 – all) and the site on the eastern boundary (GND2063 – three of six samples). Site GND0638 returned a result that was the highest since 2008 and GND2063 returned a result that was the highest since 2012. 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 Freshwater 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. Therefore consideration should 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 are close to waterways. It is also noted that the trend of increasing nitrates at GND0638 was continuing at the start of the 2020-2021 year. Therefore the Council requested that Company investigate and mitigate as per consent conditions and the Company's Whole Farm Management Plan. The outcomes of this will be discussed in the 2020-2021 Annual Report.

Biological surveys found no significant adverse effects on the stream communities of Kaupokonui Stream in relation to the discharges from the factory site and the presence of the weir, or in the Motumate and Waiokura Streams in relation to land irrigation.

Overall, it is considered that the activities of the Kapuni Lactose factory have not had 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 is currently incomplete passage provision, but that would be challenging to confirm in practice. It is noted that additional issues may arise due the changes in the downstream environment when the Glenn Road weir is removed. At this time, it is predicted that the full range of swimming species, that will be able to access this part of the stream following the removal of the Glenn Road weir, may not be able to negotiate the Company's weir in sufficient numbers. As this is because the fish passage was designed and constructed to cater only to those fish that could successfully navigate the Glenn Road weir, it is considered that the extent to which this is true will need to be evaluated post weir removal. On this basis it is recommended that this evaluation is allowed to occur prior to assessing the full extent of the improvements and/or modifications that will be needed to the weir and fish passage to provide for the range of species required. However, as stated in the fish survey report, it is important to recognise that there is a possibility of potentially significant effects through the lack of fish passage and thermal effects within the cooling water tower mixing zone, so any remediation required may need to be undertaken promptly to ensure continued consent compliance.

Macroinvertebrate monitoring of the Kaupokonui Stream during spring 2019 and summer 2020 did not show any significant adverse effect of the cooling or stormwater discharges to the stream on streambed communities. However, it was noted in the report that the site furthest downstream typically records the poorest macroinvertebrate communities, which was again the case in the surveys during the year under review. This has been attributed in part to the influence of the Dunns Creek tributary, which joins the stream above this site, and also to the large distance between the two relevant sites. It is therefore considered that the biomonitoring sites used to monitoring the Company's activities (Farm 1 irrigations as well as the activities at the factory site) that may influence macroinvertebrate communities in Dunns Creek and therefore the Kaupokonui Stream be re-evaluated. A recommendation to this effect is included in this report.

In the Waiokura Stream there was only a slight difference in the number of taxa between the upstream and downstream sites. However, there were significant differences in both the MCI and SQMCI, with upstream site being categorised as 'good' and the downstream site categorised as' fair' in terms of macroinvertebrate community health. It is also noteworthy that there have now been two consecutive surveys recording the

lowest SQMCI score to date at the downstream site. Often the difference between sites in the Waiokura Stream has been largely attributed to the distance between the sites (approximately six kilometres), and the marked habitat differences between sites (with predominant macrophytes noted at the downstream site), rather than to any effects of the application of wastes to land from the Fonterra factory. This can be supported by subtle changes observed in the macroinvertebrate community composition between the sites, which largely were associated with differences in habitat (principally an increase in macrophytes at the downstream site). It was concluded that overall, and given the large distance between the two sites, there is insufficient evidence to conclude that the observed deterioration in the Waiokura Stream is related to the impacts of wastewater irrigation within the Waiokura catchment. However, on the basis of the available data, this cannot be ruled out either. Therefore it is recommended that if the deterioration occurring at the downstream site is continued in the next scheduled survey, then increasing the monitoring frequency in the Waiokura Stream to spring and summer macroinvertebrate surveys should be considered. Furthermore, the sampling sites should also be re-evaluated in terms of what intermediate site(s) are also required.

Discharges from both the southern and northern ponds complied with the conditions of their respective consents.

The lactose deposition rates recorded at all sites were above their respective historical medians and all sites except AIR002031 were above the guideline value. However, this is not limited by the Company's consent and no complaints were received by Council in relation to deposited particulates. Inspections also 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 42 to Table 59.

Table 42 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	No further provision 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 43 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	**No. See Table 45. However this was a pre-existing non-compliance that was resolved in the year under review**
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, fish survey in 2020	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	No further provision 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		**Good**

N/A = not applicable

Table 44 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	**Status**	**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	Deferred to 30 September 2015. First data provided 14 January 2016, but is upstream of cooling tower and continues to be affected by errors	**Data not to required standard of accuracy for the whole of the year under review. Agreement reached to resolve by 30 September 2019. This was done**
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	Deferred to 30 September 2015. First data provided 14 January 2016. Accuracy issues continuing	**Data not to required standard of accuracy for the whole of the year under review. Agreement reached to resolve by 30 September 2019. This was done**
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	**No certification received covering early part of monitoring period. Agreement reached to resolve by 30 September 2019. This was done**
4. Flow recording devices accessible to Council for inspection, data retrieval and verification of accuracy	Council advised that verification is not possible	Not assessed
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	Deferred to 30 September 2015. First data provided 14 January 2016	**Daily data not auditable during the entire year under review due to errors. Agreement reached to resolve by 30 September 2019. This was done**

Purpose: *Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014*		
Agreed monitoring	**Status**	**Agreed monitoring standards met**
Overall assessment of consent compliance and environmental performance in respect of this agreement		**N/A**
Overall assessment of administrative performance in respect of this agreement		**Good**

N/A = not applicable

Table 45 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
3. Review of consent conditions	No further provision 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 46 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	No further provision for review	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 47 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	New whole farm plan provided dated June 2020. Awaiting review by Council	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	Yes
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 June 2020	Yes
5. Operation of spray irrigation plan, staff training	Site and farm inspections	Yes
6. No direct discharges of effluent into any watercourse	Farm inspections	Yes
7. No ponding	Farm inspections	Yes
8. 20 metre '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	No further provision 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 48 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	Yes
2. Maintenance of effluent spray irrigation plan	New whole farm plan provided dated June 2020.	Yes
3. Limit on maximum two day volumes	Records received	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	Yes
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 June 2019	Yes
6. Operation of system in accordance with plan. Staff training	Site and farm inspections	Yes
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		N/A
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	No further provision 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 49 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, with minor loss of record
7. Review of consent in June 2001 to evaluate performance of cooling system		N/A
8. Limits upon levels of contaminants in discharge	Sample collection	Yes
9. Discharge not to create barrier for fish, or undesirable growths within the mixing zone	Site inspections and fish survey	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. Latest plan on record April 2018.	Yes
12. Review of consent conditions	No further provision 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**

*The consent specifies an average daily limit- ie a composite sample

N/A = not applicable

Table 50 Summary of performance for agreed monitoring additional to consent 0924-3

Purpose: ***Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014***		
Agreed monitoring	**Status**	**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	Cooling water discharge licenced under this consent has ceased	N/A
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		N/A
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		N/A
4. Flow recording devices accessible to Council for inspection, data retrieval and verification of accuracy		N/A
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		N/A
Overall assessment of consent compliance and environmental performance in respect of this agreement		**N/A**
Overall assessment of administrative performance in respect of this agreement		**N/A**

N/A = not applicable

Table 51 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 2021	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	No further provision 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 52 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	Latest plan on record June 2020	Yes
4. Review of consent conditions	No further provision for review prior to expiry	N/A

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?**
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 53 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 the consent was in effect	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 54 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	Latest plan on record June 2020	Yes
2. Exercise of consent in accordance with application	Site inspections	Yes
3. Best practicable option to minimise environmental impacts	Site inspections	Yes
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

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?**
6. Lapse of consent		N/A
7. Review of consent conditions	No further provision 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 55 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	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 56 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	Next review date available 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 57 Summary of performance of Consent 10215-1

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 review date available 1 June 2023	N/A
11. Optional review provision for Regional Plan		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 58 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 review date available 1 June 2023	N/A
11. Optional review provision for Regional Plan		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 of Consent 10412-1

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Specifies culvert dimensions		N/A
2. Specifies depth of fill over		N/A
3. Notification required 2 days prior to commencement of works	Checking of records and observation at inspection. Works not started	N/A
4. Prohibits work on under water stream bed between 1 May and 31 October		N/A

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
5. All practicable steps to be taken to minimise streambed disturbance and effects, including specified measures		N/A
6. Gives rock riprap requirements including dimensions, batter and rock grading		N/A
7. Prohibits the restriction of fish passage		N/A
8. Specifies culvert invert		N/A
9. Specifies culvert gradient requirements		N/A
10. Specifies requirements for upstream and downstream stream banks		N/A
11. Specifies culvert maintenance requirements		N/A
12. Notification requirements if archaeological remains are found		N/A
13. Consent lases 31 March 2022 if not given effect to		N/A
14. Provisions for review of consent conditions	Next review opportunity June 2023	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

The Company demonstrated a high level of environmental performance and compliance with resource consents as defined in Section 1.1.4.

With respect to the administrative performance, the ongoing issues with provision of accurate real time monitoring data that was due by 30 September 2015 was resolved part way through the year under review, therefore it is considered that the Company's demonstrated a good level of administrative performance during the year under review, as defined in Section 1.1.4.

3.4 Recommendations from the 2018-2019 Annual Report

In the 2018-2019 Annual Report, it was recommended:

1. THAT in the first instance, monitoring of consented activities at the Company's Kapuni site in the 2019-2020 year continue at the same level as in 2018-2019.

2. THAT if the higher nitrate nitrogen levels in the Motumate Stream continue in the 2019-2020 year, that consideration is given to re-establishing periodic biomonitoring in the Motumate Stream in the 2020-2021 year.
3. THAT should there be issues with environmental or administrative performance in 2019-2020, 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 2 and Farm 3 control bores.

Recommendations 1 and 2 were implemented. Recommendation 3 was not necessary. In relation to recommendation 4, a report has previously been provide detailing a theoretical explanation for these elevated levels, however the matter is still to be further investigated.

3.5 Alterations to monitoring programmes for 2020-2021

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 2020-2021, the monitoring be amended as per the recommendations below, with consideration also being given to matters that may need to be accommodated in the 2021-2022 monitoring year where possible.

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 2019-2020, 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 2020-2021 year, be amended from that undertaken in the 2019-2020 year by the inclusion of total nitrogen and ammoniacal nitrogen in the analysis suite for the groundwater monitoring survey.
2. THAT, due to the elevated nitrates in the upper catchment of the Motumate Stream, the re-establishment of periodic biomonitoring in the Motumate Stream be re-evaluated only after this issue has been investigated and resolved.
3. THAT, based on the findings of the biomonitoring surveys undertaken during the year under review, the locations of the biomonitoring sites be re-evaluated with the inclusion of up to three additional Waiokura biomonitoring sites during the 2020-2021 year
4. THAT the Waiokura Stream biomonitoring surveys are undertaken in both spring and summer in the 2021-2022 if the deterioration occurring at the downstream site continues in the 2020-2021 survey.
5. THAT the biomonitoring sites used to monitoring the Company's activities that may influence macroinvertebrate communities in Dunns Creek and the Kaupokonui Stream be re-evaluated in the 2020-2021 year.
6. THAT consultation occur between the Council and the consent holder during the 2020-2021 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.
7. THAT provision be made in the 2021-2022 monitoring programme for the work required to re-evaluate the effectiveness of the fish pass following the removal of the Glenn Road weir.
8. THAT should there be issues with environmental or administrative performance in 2020-2021, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
9. THAT the Company investigate the reason for the elevated nitrate nitrogen concentrations in the Farm 2 and Farm 3 control bores.
10. 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.
IGL	Inhalation grade lactose.
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 a Science Services 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 Consents department)

Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

Air discharge permits

Section 15(1)(c) of the RMA stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) of the RMA.

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

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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 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 Co-operative Group Limited P O Box 444 HAWERA
Consent Granted 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 at or about GR: P20:072-919
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	901 Manaia Road, Kapuni – Fonterra Kapuni No 1 Farm
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
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.

Signed at Stratford on 23 May 2007

For and on behalf of
Taranaki Regional Council

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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