

Fonterra Kapuni
Air and Water
Monitoring Programme
Biennial Report
2013-2015
Technical Report 2015–111

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Executive summary

Fonterra Limited (the Company) operates a lactose manufacturing factory and inhalation grade lactose plant located on Manaia Road at Kapuni, in the Kaipokonui catchment. The plant processes whey and permeate from dairy product manufacture around the North Island. This report for the period July 2013-June 2015 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds a total of 18 resource consents, which include a total of 145 conditions setting out the requirements that the Company must satisfy. The Company holds two consents to allow it to take and use water, six consents to discharge stormwater and/or cooling water into the Kaipokonui and Motumate Streams, three consents to discharge wastes to land, six land use consents, and one consent to discharge emissions into the air at this site.

During the monitoring period, Fonterra Limited demonstrated an overall good level of environmental performance.

The Council's monitoring programmes for the period under review together included 24 inspections, 306 water samples collected for physico-chemical analysis, four bio-monitoring surveys of receiving waters, one fish survey and nine ambient air quality analyses.

Ecological monitoring did not note any problems in regard to the abstraction of water from the Kaipokonui Stream for cooling water and general purposes.

Temperature increase limits on cooling water discharged to the Kaipokonui Stream were complied with throughout the review period. Riparian planting was maintained on the factory site and a donation was received by the Taranaki Tree Trust as per consent conditions.

Irrigation onto the three dairy farms was, in general, well managed. No effect from irrigation was found from biological monitoring of the Kaipokonui and Waiokura Streams. A 20-metre buffer to the bank of water courses was maintained during irrigation.

Effects on the groundwater in the vicinity of the farms were varied, but most showed some impact on both mineral and organic component levels. This has been addressed through extension of the irrigation disposal system in 2007-2008, and by more intensive wastewater and groundwater monitoring. The monitoring results in some areas continue to show an increase in total nitrogen loading on irrigation areas, although with the increase in the area utilised, concentrations are showing no increase overall.

For the two-year period covered by this report, no long-term or significant effects were noted on the Kaipokonui Stream as a result of the stormwater discharges from the northern and stormwater outfalls, Inhalable Grade Lactose plant, and stormwater detention pond, although sewage fungus was observed in the stream on two of four occasions, associated with excessive biochemical oxygen demand in the discharge, in breach of consents. Sample results were generally within those prescribed by consent conditions, although on one occasion pH and

suspended solids limits in the discharge breached the relevant consents. The Company subsequently undertook remedial works to seek to eliminate or reduce such discharges.

Levels of suspended solids in the septic tank discharge continued to be higher than consent conditions allow, however these were not high in regard to a discharge of this nature. Fonterra surrendered the consent in March 2015, as the discharge meets the standards of Rule 22 of the Regional Freshwater Plan, and as such is classed as a permitted activity.

Particulate deposition from air emissions was similar to the previous monitoring periods. Visual inspections found no evidence of depositions, and odour surveys continued to note low levels of odour off site, with some odour observed around the effluent tank and in the vicinity of this depending on the direction of the wind.

Overall, during the period under review, the Company demonstrated a good level of environmental performance and compliance with the resource consents. There were two unauthorised incidents during the period under review, with no significant effects.

For reference, in the 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents. In the 2014-2015 year, 75% of consent holders achieved a high level of environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance.

This report includes recommendations for the 2015-2016 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the combined Annual Reports for the period July 2013-June 2015 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents formerly held by Fonterra Cooperative Group Limited, Kapuni (Fonterra). The consents were all transferred to Fonterra Limited on 13 April 2015. The Company operates a whey processing facility situated on Manaia Road at Kapuni, in the Kaupokonui catchment (Figure 1).

This report covers 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 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 twenty-third combined report and twenty-seventh 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 compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Fonterra, 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.

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

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

Section 4 presents recommendations to be implemented in the 2015-2016 monitoring year.

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

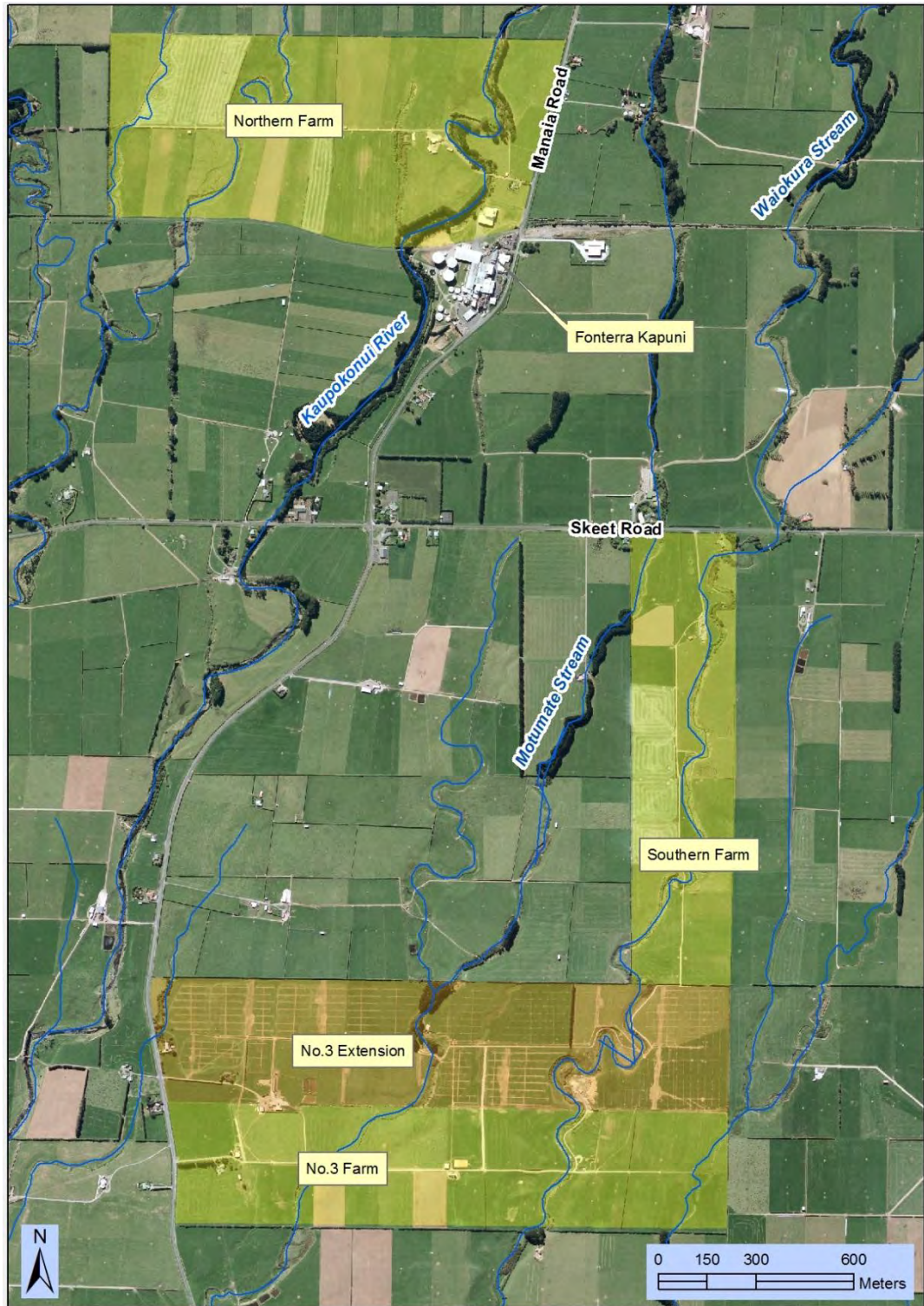


Figure 1 Fonterra Kapuni lactose factory, North, South and (extended) No 3 farms and the Kaupokonui, Motumate and Waiokura Streams

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 a discharger, and may include cultural and socio-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);
- (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 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 performance

Besides discussing the various details of the performance and extent of compliance by the consent holder during the period under review, this report also assigns a rating as to the Company's environmental and administrative performance.

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 significant 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 in response to unauthorised incident reports, 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 in response to unauthorised incident reports. 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 in response to unauthorised incident reports. 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 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents. In the 2014-2015 year, 75% of consent holders achieved a high level of environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance.

1.2 Process description

The manufacturing of lactose is based on the processing of whey permeate, the by-product of the production of cheese and casein. Whey permeate contains most of the lactose present in the original milk source, and, through a process which includes evaporation and crystallization, lactose is extracted out and purified. 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 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 Vector Gas Treatment Plant (Vector) 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.

Lactose Process Description

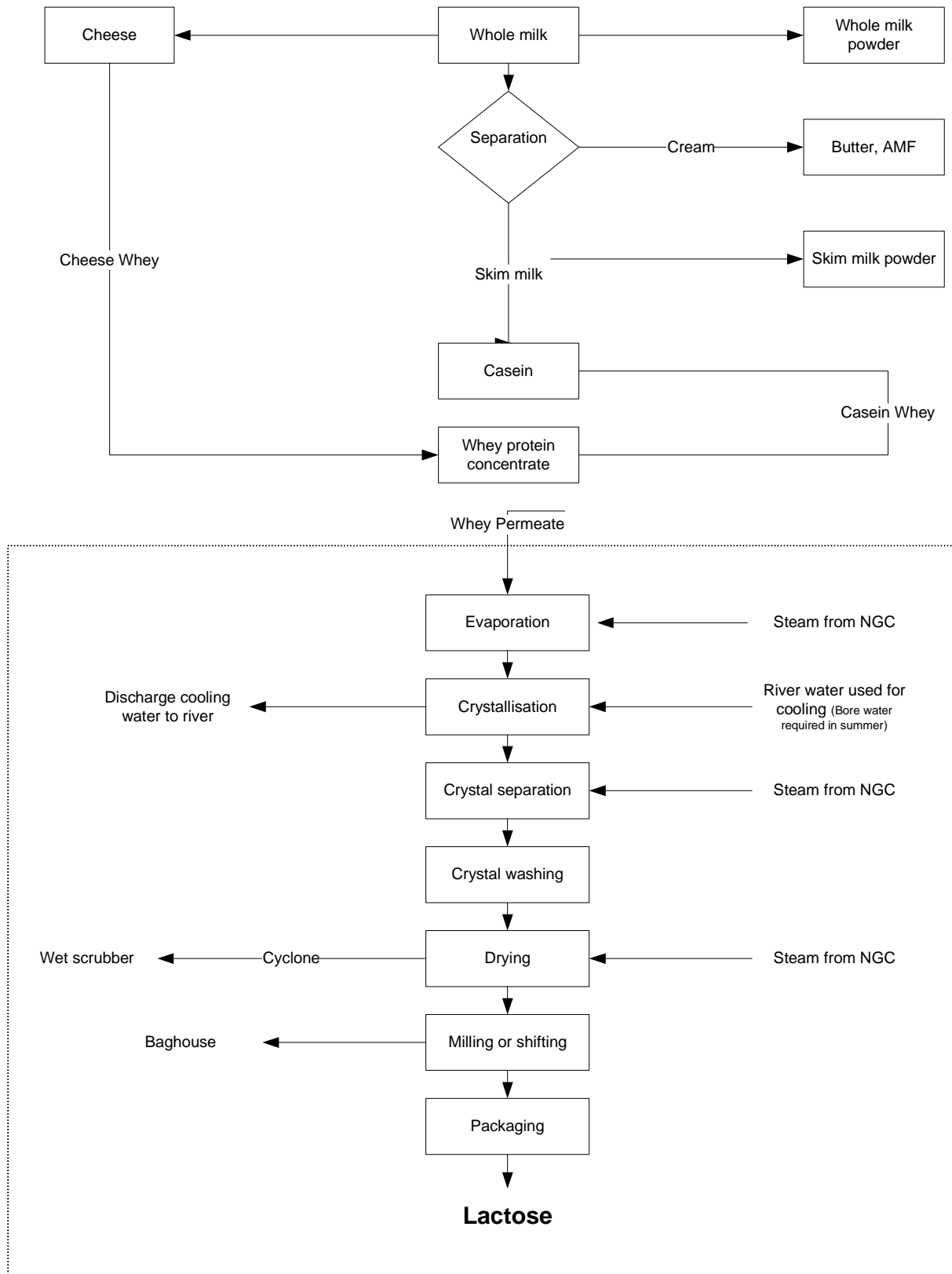


Figure 2 Lactose process diagram

Plant washdown and other process wastes are disposed of by a land irrigation system, that is, the wastewater is irrigated onto the Company's three farms, in the vicinity of the Fonterra site. There is a 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 Fonterra Kapuni lactose factory, North, South and (extended) No. 3 farms, and the Kaipokonui, Motumate and Waiokura Streams, which are referred to throughout this report.

1.3 Resource consents

A summary of the consents held by Fonterra in relation to activities at its Kapuni plant is given in Table 1 below, and the consents are discussed in Sections 1.3.1 to 1.3.5. A copy of each of the consents can be found in Appendix I.

Table 1 Summary of resource consents held by Fonterra Limited for the lactose plant at Kapuni

Consent number	Purpose	Volume	Next review date	Expiry date
0302-3	Take from Kaipokonui	19,500 m ³ /day (225 L/s)	-	2019
0919-3	Discharge cooling water to Kaipokonui	19,500 m ³ /day	-	2019
0920-3	Take from bore	700 m ³ /day	-	2017
0921-3	Discharge cooling water to trib. of Motumate Stream	850 m ³ /day	-	2017
0922-3	Discharge processing wastes, etc to land (North)	2,600 m ³ /2 days	-	2019
0923-3	Discharge processing wastes, etc to land (South)	3,750 m ³ /2 days	-	2019
0924-3	Discharge storm & cooling water to Kaipokonui	1,440 m ³ /day	-	2019
4032-5	Discharge emissions to air		-	2019
4235-2	Discharge stormwater during factory shutdown periods	240 m ³ /day	-	2017
4604-2	Discharge stormwater from extension to Kaipokonui	280 L/s	-	2017
4623-2	Structures for spray, stormwater, irrigation and take		-	2017
5368-1	Structure over Little Dunn's Creek		-	2017
5629-1	Discharge treated domestic effluent into land	7.5 m ³ /day	Surrendered 30 March 2015	
6422-1	Structure for stormwater outlet (IGL plant)		-	2017
6423-1	Discharge stormwater to Kaipokonui (IGL plant)		-	2017
6885-1	Structure for stormwater (pond) outlet		-	2017
6948-1	Structure for pipeline over Motumate and Waiokura		2017	2023
9546-1	Install culvert in Waiokura Stream		2017	2029

m³/day = cubic metres per day; L/s = litres per second

1.3.1 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.

Fonterra Limited holds water permit **0302-3** to take and use up to 19,500 m³/day (225 litres/second) of water from the Kaupokonui Stream for cooling water and general purposes associated with lactose manufacturing. This permit was issued by the Council on 9 June 1999 under Section 87(d) of the RMA. It is due to expire on 1 June 2019.

There are three special conditions attached to the consent.

Condition 1 requires that the consent holder, in conjunction with the Council, undertake ecological monitoring associated with the abstraction.

Condition 2 stipulates that the consent holder records the daily rates of abstraction and make these records available to the Council.

Condition 3 deals with review procedures.

Fonterra Limited also holds water permit **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. This permit was issued by the Council on 4 February 1999 under Section 87(d) of the RMA. It is due to expire on 1 June 2017.

There are three special conditions attached to the consent.

Condition 1 requires the consent holder to record groundwater levels and rates of abstraction and make these records available to the Council.

Condition 2 stipulates that the consent holder allows the Council access to the bore for inspection or sampling purposes.

Condition 3 deals with review procedures.

1.3.2 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.

Fonterra Limited holds water discharge permit **0919-3** to cover the discharge of up to 19,500 m³/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream. This permit was issued by the Council on 9 June 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

There are eleven special conditions attached to the consent.

Condition 1 requires the consent holder to undertake physicochemical and ecological monitoring of the wastes and receiving waters.

Condition 2 describes effects which the discharge shall not give rise to in the receiving waters.

Condition 3 stipulates that the biochemical oxygen demand (BOD) shall not rise above 2 g/m³ below the discharge.

Condition 4 requires that the discharge does not alter the temperature of the receiving water by more than 2 degrees Celsius for 90% of the time, and by more than 3 degrees at all times.

Condition 5 stipulates that the temperature of the receiving water shall not increase above 25 degrees.

Condition 6 requires the consent holder to continuously monitor the temperature of the receiving waters, and to forward this information to the Council.

Condition 7 allowed the Council to review conditions 4 and 5 of the consent in June 2001 for the purpose of evaluating the performance of the cooling system.

Condition 8 stipulates that the discharge not give rise to a thermal barrier to fish or any visible bacterial and/or fungal slime growths.

Condition 9 requires that no anti-corrosion agents, biocides, anti-flocculants or other chemicals be added to the cooling water without permission of the Council.

Condition 10 requires mitigation of the effects of the discharge by maintenance of existing riparian planting, and an annual donation to the Taranaki Tree Trust of \$3000.

Condition 11 deals with review of the conditions of the consent.

Fonterra Limited holds water discharge permit **0921-3** to cover the discharge of up to 850 m³/day of cooling water from plate heat exchangers and plant cooling system into an unnamed tributary of the Motumate Stream at two different locations. This permit was issued by the Council on 4 February 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2017.

There are three special conditions attached to the consent.

Condition 1 describes effects which must not arise below the mixing zone in the receiving waters.

Condition 2 requires that the consent holder monitor the daily volume and temperature of the discharge.

Condition 3 deals with review of the conditions of the consent.

Fonterra Limited holds water discharge permit **0924-3** to cover the discharge of up to 1,440 m³/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream. This permit was issued by the Council on 9 June 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

There are twelve special conditions attached to the consent.

Condition 1 requires the consent holder to undertake physicochemical and ecological monitoring of the wastes and receiving waters.

Condition 2 describes effects which the discharge shall not give rise to in the receiving water.

Condition 3 stipulates that the filtered BOD shall not rise above 2 g/m³ below the discharge.

Condition 4 requires that the discharge does not alter the temperature of the receiving water by more than 2 degrees Celsius for 90% of the time and by more than 3 degrees at all times.

Condition 5 stipulates that the temperature of the receiving water not increase above 25 degrees.

Condition 6 requires the consent holder to continuously monitor the temperature of the receiving waters, and to forward this information to the Council.

Condition 7 allowed the Council to review conditions 4 and 5 of the consent in June 2001 for the purpose of evaluating the performance of the cooling system.

Condition 8 sets limits on levels of oil and grease, pH and suspended solids in the discharge.

Condition 9 stipulates that the discharge not give rise to a thermal barrier to fish or any visible bacterial and/or fungal slime growths.

Condition 10 requires that no anti-corrosion agents, biocides, anti-flocculants or other chemicals be added to the cooling water without the permission of the Council.

Condition 11 requires the consent holder to maintain a contingency plan outlining measures and procedures to prevent spillage and remedy or mitigate effects of such a spillage.

Condition 12 deals with review of the conditions of the consent.

Fonterra Limited holds water discharge permit **4235-2** to cover the discharge of up to 240 m³/day of stormwater from the factory site via the existing stormwater system into the Kaupokonui Stream only during factory shutdown periods. This permit was issued by the Council on 4 February 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2017.

There are five special conditions attached to the consent.

Condition 1 describes effects which must not arise below the mixing zone.

Condition 2 sets limits on levels of oil and grease, pH and suspended solids in the discharge.

Condition 3 requires the consent holder to prepare and maintain a contingency plan outlining measures and procedures to be undertaken to prevent a spillage and measures to remedy or mitigate environmental effects of such a discharge.

Condition 4 defines factory shut down as being when no whey is being processed.

Condition 5 deals with review of the conditions of the consent.

Fonterra Limited holds water discharge permit **4604-2** to cover the discharge of up to 280 litres/second of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream. This permit was issued by the Council on 4 February 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2017.

There are four special conditions attached to the consent.

Condition 1 describes effects which must not arise below the mixing zone.

Condition 2 sets limits on levels of oil and grease, pH and suspended solids in the discharge.

Condition 3 requires the consent holder to prepare and maintain a contingency plan outlining measures and procedures to be undertaken to prevent a spillage and measures to remedy or mitigate environmental effects of such a discharge.

Condition 4 deals with review of the consent conditions.

Fonterra holds water discharge permit **6423-1** to cover the discharge of stormwater from an inhalation grade lactose plant (IGL) site into the Kaupokonui Stream. This permit was issued by the Council on 13 July 2004 under Section 87(e) of the RMA. It is due to expire on 1 June 2017.

Condition 1 requires the consent holder to prepare and maintain a contingency plan outlining measures and procedures to be undertaken to prevent a spillage and measures to remedy or mitigate environmental effects of such a discharge.

Condition 2 stipulates that the consent be conducted in accordance with the information submitted in support of the application.

Condition 3 requires that the consent holder adopt the best practicable option to prevent or minimise any adverse effects of the discharge on any water body.

Condition 4 sets limits on the levels of pH, suspended solids, and hydrocarbons in the discharge.

Condition 5 describes effects which must not arise below the mixing zone.

Conditions 6 and 7 deal with lapse of consent and review of consent conditions.

1.3.3 Air discharge permit

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.

Fonterra Limited holds air discharge permit **4032-5** to cover the discharge of emissions to air from the manufacture, drying, packing and storage of lactose and associated processes and from an inhalation grade lactose plant. This permit was issued by the Council on 17 April 2000 under Section 87(e) of the RMA. It is due to expire on 1 June 2019. A change to the conditions of consent 4032-5 was made on 2 June 2004 to include the IGL plant.

There are nine special conditions attached to the consent.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise emissions of particulate matter.

Condition 2 emphasises that the consent holder is bound by the obligations and duties specified in the RMA.

Condition 3 stipulates that particulate from the wet scrubber system not exceed 125 mg/m³ of air.

Condition 4 requires that the consent holder consult with the Council prior to making alterations to the plant.

Conditions 5, 6 and 8 stipulate that the discharge not give rise to dangerous levels of airborne contaminants, offensive or objectionable dust or odour, or noxious levels of airborne contaminants at or beyond the boundary of the property.

Condition 7 allows the consent holder to apply for a change or cancellation to any of the conditions of the consent.

Condition 9 deals with review provisions.

1.3.4 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.

Fonterra Limited holds discharge permits **0922-3** and **0923-3** to cover the discharge of evaporator condensate, washings, processing wastes and stormwater from a lactose manufacturing plant by spray irrigation onto pasture. Consent **0922-3** covers up to 2,600 m³/two consecutive days and refers to the Kaupokonui catchment, while **0923-**

3 covers the discharge of up to 3750 m³/two consecutive days and refers to the Waiokura and Motumate catchments. Both permits were issued by the Council on 9 June 1999 under Section 87(e) of the RMA. They are due to expire on 1 June 2019. A change to the conditions of consent 0923-3 was made on 21 August 2006 to provide for extension of the land disposal area.

There are nine special conditions attached to consent **0922-3**.

Condition 1 requires the consent holder to maintain an effluent spray irrigation management plan (SIMP), and matters which it should address are listed.

Condition 2 stipulates that the consent be exercised in accordance with the procedures set out in the SIMP.

Condition 3 allows the SIMP to be reviewed on two months' notice, either by the consent holder or Council. This condition also stipulates that the SIMP is reviewed annually by the consent holder.

Condition 4 requires that the operation of the spray irrigation system is carried out in accordance with the SIMP, that relevant staff are regularly trained on the content and implementation of the plan and staff are advised immediately of revisions or additions to the SIMP.

Condition 5 stipulates that there be no direct discharge of effluent to any watercourse.

Condition 6 requires that the system be operated in a manner which does not cause ponding.

Condition 7 stipulates that there be at least 20 metres from the edge of the spray zone to the bank of any watercourse.

Condition 8 requires the consent holder to monitor and collect various data on the spray irrigation system, with this is to be made available to the Council.

Condition 9 deals with review provisions.

There are fifteen special conditions attached to consent **0923-3**, nine of which were the same as those on consent **0922-3**, when the two consents were issued. The change of consent on 21 August 2006 added six conditions, that address: adoption of the best practicable option to minimise adverse effects (condition 1); prohibition of offensive or objectionable odour (condition 6); control of spray drift (condition 7); contamination of water supplies (condition 11); groundwater monitoring (condition 12); and change or cancellation of conditions (condition 14).

Fonterra Limited held discharge permit **5629-1** to cover the discharge of up to 7.5 m³/day (114 litres/second) of treated domestic effluent from the Lactose New Zealand processing plant into land. This permit was issued by the Council on 23 May 2000 under Section 87(e) of the RMA. It was due to expire on 1 June 2017. Changes to consent conditions were made on 28 July 2000 to correct an ultra vires condition. The consent was surrendered on 30 March 2015 as the discharge meets the standards of Rule 22 of the Regional Freshwater Plan, and as such is classed as a permitted activity.

There were six special conditions attached to the consent.

Condition 1 required that the treatment system be installed according to the plans submitted in the application.

Condition 2 required that the treatment system is maintained.

Condition 3 stipulated that the disposal field be located within the boundaries of the subject property, and that it does not adversely affect groundwater.

Condition 4 required that the consent holder establish an access point for sampling of the discharge.

Condition 5 stipulated that an average of four samples in any 12 month period not exceed 33 g/m³ total suspended solids.

Condition 6 dealt with review provisions.

1.3.5 Land use consents

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 by a rule in a regional plan or by a resource consent.

Fonterra Limited holds land use consent **4623-2** to erect, place, use and maintain various spray, stormwater, irrigation and intake structures in the bed of the Kaupokonui Stream. This permit was issued by the Council on 4 February 1999 under Section 87(a) of the RMA. It is due to expire on 1 June 2017.

There are seven special conditions attached to the consent.

Condition 1 requires the consent holder to notify the Council at least 48 hours prior to undertaking significant maintenance works. Condition 5 stipulates that such works be carried out only between 1 November and 30 April.

Condition 2 stipulates that the structures are constructed generally in accordance with the application.

Condition 3 requires the consent holder adopt the best practicable option to minimise adverse effects on water quality.

Condition 4 stipulates that fish passage is not obstructed.

Condition 6 requires that if the structures are no longer required they are removed and the area reinstated.

Condition 7 deals with provisions for review.

Fonterra Limited holds land use consent **5368-1** to erect, place, use and maintain a bridge over Little Dunn's Creek a tributary of Dunn's Creek in the Kaupokonui

catchment for access purposes. This permit was issued by the Council on 21 July 1998 under Section 87(a) of the RMA. It is due to expire on 1 June 2017.

There are six conditions attached to the consent.

Condition 1 addresses notification of works.

Condition 2 stipulates that construction and maintenance be according to the documentation submitted.

Condition 3 covers measures to prevent contamination of the watercourse.

Condition 4 requires that the structure is removed and the area reinstated, if and when it is no longer required.

Condition 5 prohibits the discharge of contaminated stormwater from the bridge or its approaches to the water course.

Condition 6 is a review provision.

Fonterra Limited holds land use consent **6422-1** to erect, place, and maintain a stormwater outlet structure in the bed of the Kaupokonui Stream. This permit was issued by the Council on 13 July 2004 under Section 87(a) of the RMA. It is due to expire on 1 June 2017.

There are seven special conditions attached to the consent.

Conditions 1 to 4 deal with construction and maintenance of the structure.

Condition 5 requires that the structure is removed and the area reinstated, if and when it is no longer required.

Conditions 6 and 7 deal with lapse and expiry of consent.

Fonterra Limited holds land use consent **6885-1** to erect, place, use and maintain an outlet structure in the Kaupokonui Stream for stormwater discharge purposes. This permit was issued by the Council on 12 May 2006 under Section 87(a) of the RMA. It is due to expire on 1 June 2017.

There are seven special conditions attached to the consent.

Condition 1 requires the consent holder to adopt the best practicable option to minimise effects on water quality.

Condition 2 stipulates that the consent is undertaken in accordance with documentation submitted in support of the application.

Condition 3 requires the consent holder to notify the Council prior to commencing installation.

Condition 4 stipulates that riverbed disturbance be kept to a minimum.

Condition 5 requires the structure(s) be removed when no longer required.

Condition 6 and 7 deal with expiry and review of the consent.

Fonterra Limited holds land use consent **6948-1** to erect, place, use and maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purpose of conveying irrigation wastewater. This permit was issued by the Council on 18 September 2006 under Section 87(a) of the RMA. It is due to expire on 1 June 2023.

There are nine special conditions attached to the consent.

Condition 1 requires the consent holder to adopt the best practicable option to minimise effects on water quality.

Condition 2 stipulates that the consent is undertaken in accordance with documentation submitted in support of the application.

Condition 3 requires the consent holder to notify the Council prior to commencing installation.

Condition 4 requires the adoption of the best practicable option to minimise discharge of silt and other contaminants, and to minimise riverbed disturbance.

Condition 5 deals with riverbed disturbance and reinstatement.

Conditions 6 and 7 relate to the timing and notification of works.

Conditions 8 and 9 relate to lapse and review of consent.

Fonterra Limited holds land use consent **9546-1** to install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation. This permit was issued by the Council on 18 April 2013 under Section 87(a) of the RMA. It is due to expire on 1 June 2029.

There are 22 conditions attached to the consent.

Condition 1 addresses notification of works.

Conditions 2 to 10, 14, 15, and 18 address the design, construction and maintenance of works.

Condition 11 prohibits works between 1 June and 31 October.

Condition 12 deals with riverbed disturbance and reinstatement.

Condition 13 prohibits the obstruction of fish passage.

Conditions 16 and 17 address the minimisation of sedimentation in the stream, and stabilisation of earthworks.

Condition 19 addresses the discovery of archaeological remains.

Condition 20 deals with removal of the structure.

Conditions 21 and 22 relate to lapse and review of the consent.

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets out an obligation for the Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region and report upon these.

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 Fonterra Limited 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 reviews;
- renewals;
- new consents;
- 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 twelve times during each monitoring year. 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 and land, including contaminated stormwater and process wastewaters. Air inspections focussed 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 consent holder 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.

Over the two-year period, 24-hour composite or grab sample was collected of the spray cooling waste water on 23 occasions and of the combined stormwater/cooling water discharge on 21 occasions, and the samples analysed for BOD₅ (total and filtered), pH, conductivity and turbidity. The stormwater discharge was also analysed for suspended solids, pH and oil and grease.

The Kaupokonui Stream was sampled on 22 occasions at three sites, and the samples analysed for temperature, BOD₅ (total and filtered), pH, conductivity, turbidity and ammonia-N. The Waiokura Stream was sampled at three sites on 22 occasions, and the samples analysed for temperature, conductivity, nitrate and sodium.

Nineteen samples were collected from the stormwater outfall from the factory extensions, three samples were collected from the stormwater outfall from the IGL plant and another six were collected from the outlet of the stormwater pond. Stormwater samples were analysed for total BOD₅, conductivity, pH, turbidity, suspended solids and oil and grease.

Samples were collected from the septic tank on six occasions and analysed for suspended solids.

Groundwater from eight bores on the three farms was sampled on 12 occasions and analysed for temperature, conductivity, pH, and nitrate. In addition, filtered COD, ammonia, sodium and chloride were tested for on six of the occasions.

Deposition gauges were placed at selected sites in the vicinity on two occasions. The collected samples analysed for COD.

1.4.5 Biomonitoring surveys

A biological survey was performed on two occasions each year in the Kaupokonui Stream to determine whether or not the discharge of stormwater, evaporator condensate, washings, processing and cooling wastes from the site has had a detrimental effect upon the communities of the stream. A biological survey was also performed each year in the Waiokura Stream to monitor the effects from irrigation of wastewater and stormwater onto land in the Waiokura catchment.

A four-site fish survey was undertaken in the Kaupokonui Stream on one occasion, 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 fish communities were surveyed using the electric fishing technique, with all fish identified where possible, counted, and lengths estimated.

1.4.6 Review of consent holder's data

A large amount of data are supplied by the Company in relation to stream abstraction records, irrigation records, receiving water and coolant temperatures, and wastewater composition. These data are assessed by Council staff to confirm compliance with consent conditions.

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. These reports cover 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 rainfall levels. 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 m³/day (225 L/s average) 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.

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 by 31 July each year the record 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. Previously, flow volumes were calculated based on crystalliser use.

Table 2 Summary of water abstraction volumes from the Kaupokonui Stream, 2013-2014

Month	Average daily abstraction (m ³ /day)	Minimum daily abstraction (m ³ /day)	Maximum daily abstraction (m ³ /day)	Number of days per month daily abstraction >19 500 m ³
July 2013	379	0	1,568	0
August 2013	4,971	317	13,861	0
September 2013	13,334	10,174	16,803	0
October 2013	13,656	10,619	17,568	0
November 2013	13,830	9,260	16,126	0
December 2013	12,639	9,897	14,849	0
January 2014	10,779	6,217	15,115	0
February 2014	12,186	7,881	14,999	0
March 2014	10,656	6,842	13,024	0
April 2014	7,667	5,649	10,089	0
May 2014	5,992	4,186	7,088	0
June 2014	3,302	9	5,805	0

Table 3 Summary of water abstraction volumes from the Kaupokonui Stream, 2014-2015

Month	Average daily abstraction (m ³ /day)	Minimum daily abstraction (m ³ /day)	Maximum daily abstraction (m ³ /day)	Number of days per month daily abstraction >19 500 m ³
July 2014	276	8	4,118	0
August 2014	5,620	851	8,714	0
September 2014	11,386	8,793	13,589	0
October 2014	13,981	10,355	16,673	0
November 2014	15,760	13,846	17,077	0
December 2014	13,958	12,013	15,473	0
January 2015	12,566	8,173	16,947	0
February 2015	8,990	7,007	12,894	0
March 2015	8,322	6,644	11,252	0
April 2015	6,277	3,652	11,974	0
May 2015	4,506	2,968	5,388	0
June 2015	2,987	511	5,604	0

The daily stream abstraction data summary in Table 2 and Table 3 illustrates that the Company continued to take a significant volume of water from the stream during the 2013-2015 monitoring period.

The total volume of 3,314,401 m³ abstracted during 2013-2014 was 9% less than the amount taken in 2012-2013. All abstractions were within the consent limits, with the monthly average daily volume abstracted maintained well below the 19,500 m³ daily limit. During 2013-2014, a maximum daily abstraction of 17,568 m³ was recorded, on 7 October 2013.

During 2014-2015, the total volume of 3,181,379 m³ abstracted was 4% less than the amount taken in 2013-2014. All abstractions were within the consent limits, with the monthly average daily volume abstracted maintained well below the 19,500 m³ daily limit. In 2014-2015, a maximum daily abstraction of 17,077 m³ was recorded, on 9 November 2014.

Fonterra's abstraction of water from the Kaupokonui Stream was undertaken in a satisfactory manner and there were no obvious problems. The abstraction information supplied by the Company complied with the conditions of consent **0302-1** and the Resource Management Regulations, 2010. Telemetry of the abstraction data, directly to Council, is being arranged.

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 2013-2015 monitoring period, the bore was not used.

2.1.1.3 Irrigation records

In relation to the Company's spray irrigation of wastewater onto land (that is, the exercise of consents 0922-3 and 0923-3) the Company supplied the Council with monitoring data relating to the daily volume of effluent produced, and the volume of wastes spray irrigated. This information is summarised in Table 4 and Table 5.

Table 4 Wastes irrigation records supplied by Fonterra, 2013-2014

Month	Northern Farm				Southern Farms			
	Days irrigated	Average daily volume irrigated (m ³ /day)	Maximum daily volume irrigation (m ³ /day)	Number of times 2-day irrigation >2600m ³	Days irrigated	Average daily volume irrigated (m ³ /day)	Maximum daily volume irrigated (m ³ /day)	Number of times 2-day irrigation >3750 m ³
July 2013	11	144	324	0	26	29	260	0
August 2013	27	288	576	0	31	775	1,541	0
September 2013	30	506	717	0	30	1,456	1,718	0
October 2013	31	539	908	0	31	1,511	1,959	0
November 2013	30	615	881	0	30	1,549	1,789	0
December 2013	31	468	941	0	31	1,415	1,870	0
January 2014	31	401	850	0	31	1,201	1,814	0
February 2014	28	487	750	0	28	1,230	1,489	0
March 2014	31	419	718	0	31	1,177	1,455	0
April 2014	30	407	804	0	30	906	1,300	0
May 2014	31	330	638	0	31	805	1,048	0
June 2014	30	329	532	0	30	471	886	0

Table 5 Wastes irrigation records supplied by Fonterra, 2014-2015

Month	Northern Farm				Southern Farms			
	Days irrigated	Average daily volume irrigated (m ³ /day)	Maximum daily volume irrigation (m ³ /day)	Number of times 2-day irrigation >2600m ³	Days irrigated	Average daily volume irrigated (m ³ /day)	Maximum daily volume irrigated (m ³ /day)	Number of times 2-day irrigation >3750 m ³
July 2014	17	131	484	0	28	102	468	0
August 2014	31	312	551	0	31	886	1,193	0
September 2014	30	533	827	0	30	1,451	1,771	0
October 2014	31	579	1,000	0	31	1,552	1,813	0
November 2014	30	568	807	0	30	1,632	1,866	0
December 2014	31	446	884	0	31	1,322	1,699	0
January 2015	31	462	774	0	31	1,080	1,534	0
February 2015	28	449	875	0	28	1,104	1,394	0
March 2015	31	517	734	0	31	1,246	1,509	0
April 2015	29	287	611	0	30	1,069	1,639	0
May 2015	21	67	303	0	31	1,137	1,414	0
June 2015	10	16	94	0	30	870	1771	0

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

The Company continued to irrigate a large volume of wastewater during the 2013-2015 monitoring period. Consents **0922** and **0923** permit a maximum volume of 2,600 m³ (Northern farm) and 3,750 m³ (Southern farms) to be spray irrigated onto land per two consecutive days. Irrigation occurred almost daily during both monitoring years. A total volume of 525,638 m³ was irrigated during 2013-2014, with a distribution between farms of 28%, 14% and 58% for Farm 1, Farm 2 and Farm 3, respectively. This was a decrease of 0.9% from the volume of 530,225 m³ irrigated in 2012-2013, with similar distribution between farms.

During 2014-2015 a total of 538,074 m³ was irrigated, with a similar distribution between farms of 24%, 17% and 59% for Farm 1, Farm 2 and Farm 3, respectively. This was an increase of 2.4% from the volume irrigated during 2013-2014.

The record shows that the volume limits on both consents were complied with throughout the 2013-2015 monitoring period.

2.1.1.4 Receiving water and coolant temperatures

The Company maintained continuous records of Kaipokonui Stream water temperatures (upstream of the spray coolant discharge zone and at the downstream end of the designated mixing zone), and spray coolant water temperature. These records have been examined by the Council and a summary of performance and compliance in 2013-2015 is presented in Table 6 and Table 7. 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 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. Calibration was generally performed at weekly intervals by Company personnel, and checks were made by Council staff during monthly receiving water sampling surveys. From 19 March 2014, the upstream and downstream temperature data were sent directly to Council by telemetry, on a daily basis, of 15-minute average values. Previous temperature data in the same format, back to 31 December 2010 with some gaps, were forwarded in electronic form.

The temperature record over the 2013-2015 reporting period for the Kaipokonui Stream upstream and downstream of the lactose plant discharge are presented in Figure 3 and Figure 4. The increase in temperature is given in Figure 5.

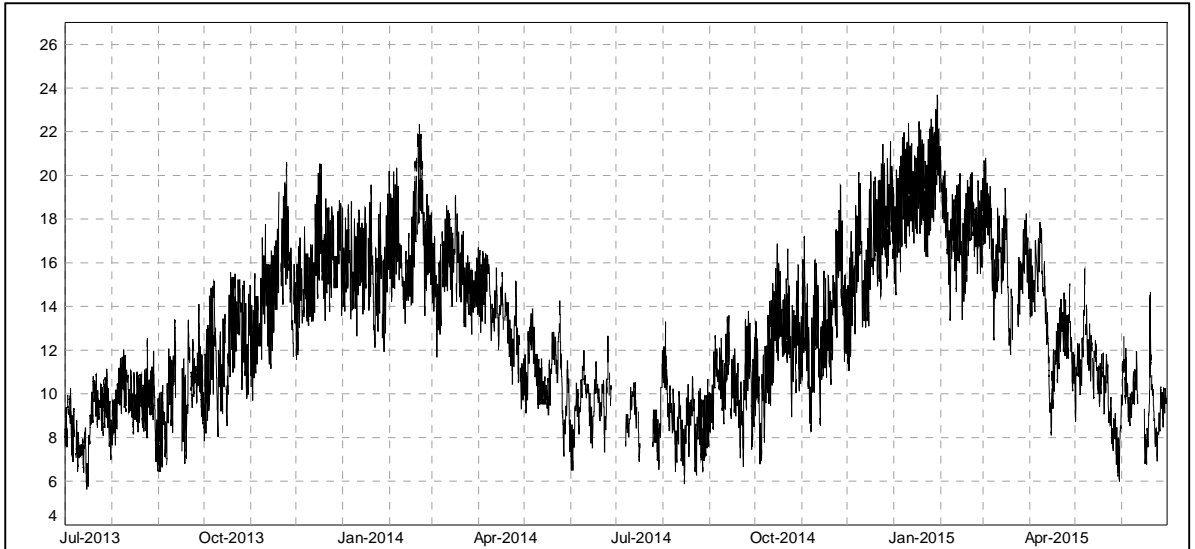


Figure 3 Water temperature (°C) records for the Kaipokonui Stream upstream of lactose plant during the period 1 July 2013 to 30 June 2015

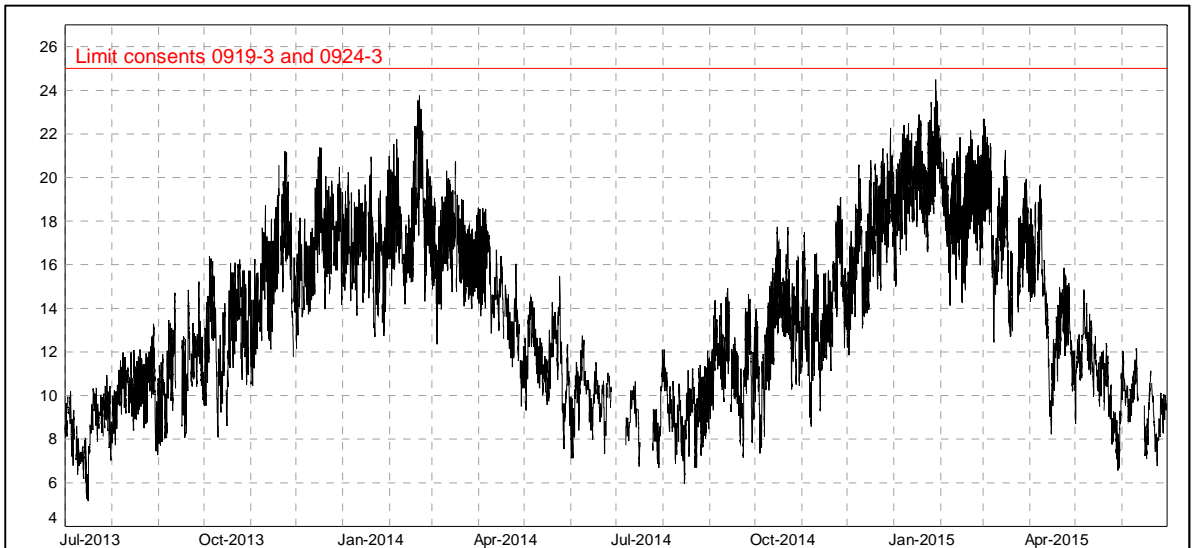


Figure 4 Water temperature (°C) records for the Kaipokonui Stream downstream of lactose plant during the period 1 July 2013 to 30 June 2015

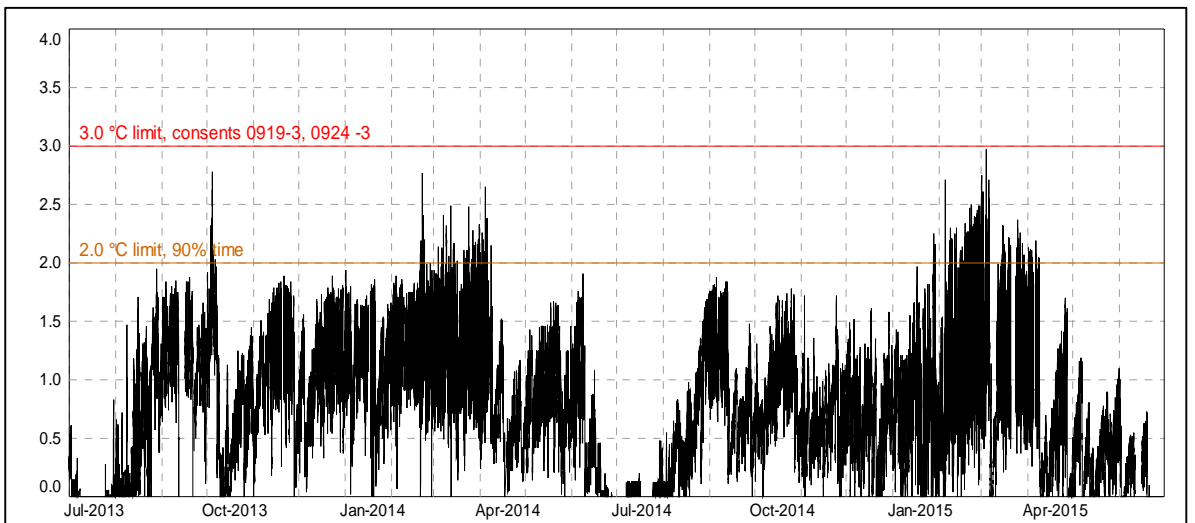


Figure 5 Kaupokonui Stream temperature increase below lactose plant for period 1 July 2013 to 30 June 2015

Table 6 Summary of Fonterra continuous temperature records (°C) from two monitoring probes in the Kaupokonui Stream, July 2013 to June 2014

Month	% Time* Increase			Downstream temperature			
	>2°C	>2.5°C	>3°C	Max Increase (°C)	Days in excess of 3°C	Max downstream temp	Days in excess of 25°C
July 2013	0.0	0.0	0.0	0.8	0	10.9	0
August 2013	0.0	0.0	0.0	2.0	0	13.4	0
September 2013	0.0	0.0	0.0	1.9	0	15.2	0
October 2013	1.4	0.10	0.0	2.8	0	20.0	0
November 2013	0.0	0.0	0.0	1.9	0	21.8	0
December 2013	0.0	0.0	0.0	1.9	0	21.4	0
January 2014	0.0	0.0	0.0	1.9	0	21.2	0
February 2014	0.06	0.05	0.0	2.8	0	24.1	0
March 2014	1.9	0.0	0.0	2.5	0	20.9	0
April 2014	0.88	0.02	0.0	2.6	0	18.8	0
May 2014	0.0	0.0	0.0	1.7	0	15.5	0
June 2014	0.0	0.0	0.0	1.9	0	12.8	0
Total 2013-2014	0.42	0.01	0.00				

Note:* = % of actual record

Table 7 Summary of Fonterra continuous water temperature records (°C) from two monitoring probes in the Kaupokonui Stream, July 2014 to June 2015

Month	% Time* Increase			Downstream temperature			
	>2°C	>2.5°C	>3°C	Max Increase (°C)	Days in excess of 3°C	Max downstream temp	Days in excess of 25°C
July 2014	0.0	0.0	0.0	0.5		10.7	0
August 2014	0.0	0.0	0.0	1.7	0	12.2	0
September 2014	0.0	0.0	0.0	1.9	0	15.1	0
October 2014	0.0	0.0	0.0	1.8	0	17.8	0
November 2014	0.29	0.08	0.0	2.7	0	19.2	0
December 2014	0.0	0.0	0.0	1.6	0	22.3	0
January 2015	0.21	0.0	0.0	2.2	0	24.8	0
February 2015	3.9	0.03	0.0	2.7	0	22.4	0
March 2015	5.2	0.22	0.0	3.0	0	22.8	0
April 2015	0.37	0.0	0.0	2.2	0	19.8	0
May 2015	0.0	0.0	0.0	1.2	0	14.9	0
June 2015	0.0	0.0	0.0	1.0	0	12.2	0
Total 2014-2015	0.82	0.03	0.00				

Note:* = % of actual record

A summary of the temperature increase and maximum temperature data for 2013-2014 and 2014-2015 is given in Table 6 and Table 7. On a monthly basis, recorded percentage of time the increase was above 2.0°C, 2.5°C and 3.0°C is given, together with the maximum increase and the maximum downstream temperature.

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). During 2013-2015, there were brief periods before the null switch was activated during which temperature spikes exceeded the 3°C increase limit. These temperature values, while the probes were out of the water, were not included in the data analysis.

There were occasions when temperature differences reached or exceeded 2°C, during periods of low flow in Kaupokonui Stream.

Condition 4(b) of consents **0919-3** and **0924-3** 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. These limits were not exceeded during the 2013-2015 monitoring period.

Condition 5 of consents 0919-3 and 0924-3 requires that the discharge shall not raise the temperature of the receiving water above 25°C at the boundary of the mixing zone. Figure 4 shows that this was not found to have been exceeded at any time. (Temperatures further downstream reached levels up to 26.7 °C).

2.1.1.5 Wastewater composition

The Company commenced monthly monitoring of 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 in July 2008. Grab samples are taken at the filter on the line from the plant wastewater tank and sent to an outside laboratory (Industrial Chemistry Services Ltd) for analysis of pH, organic strength, major mineral components, and nutrients, including nitrogen species. The results for the 46 samples taken between 13 August 2013 and 26 June 2014, and the 46 samples taken between 13 August 2014 and 24 June 2015 are summarised in Table 8.

Table 8 Results of wastewater monitoring by Fonterra 2013-2015

Parameter	Unit	2014-2015		% change	2013-2014		% change	2012-2013	
		Median N = 46	Range		Median N = 46	Range		Median N = 45	Range
pH	pH	4.4	4.1 – 4.7	-	4.5	4.3 – 5.4	-	4.4	4.2 – 5.3
Chemical oxygen demand	g/m ³	8,435	5,150 – 14,106	- 4	8,747	5,218 – 19,926	+20	7,273	2,475 – 13,905
Lactose	%	0.57	0.32 – 14.5	+19	0.48	0.00 – 1.37	+17	0.41	0.00 – 0.77
Nitrate	g/m ³	48	5 – 130	+37	35	6 - 83	-15	41	11 - 86
Nitrite	g/m ³	1.3	0.1 – 8.8	-64	3.7	0.6 – 14.8	+19	3.1	0.6 - 11
Total Kjeldahl Nitrogen (TKN)	g/m ³	41	5 – 130	-11	46	22 - 110	+15	40	12 - 73
Total Nitrogen	g/m ³	107	41 – 176	+23	87	41 - 143	-3	90	52 - 148
Total Phosphorus	g/m ³	93	25 – 278	-28	129	41 - 275	+7	121	18 - 267
Sodium	g/m ³	112	57 – 189	- 8	122	51 - 176	+24	98	37 - 142
Potassium	g/m ³	145	54 – 320	- 3	150	60 - 245	0	150	45 - 300
Calcium	g/m ³	196	137 – 352	- 17	235	143 - 392	+12	209	100 - 519
Magnesium	g/m ³	21	5 – 183	0	21	5 - 90	0	21	1 - 191
Sodium adsorption ratio		2.7	1.7 – 4.2	0	2.7	1.2 – 4.2	+17	2.3	0.8 – 3.6

The lactose plant wastewater typically has high organic strength and is acidic. A comparison can be made between results for the 2012-2013, 2013-2014 and 2014-2015 monitoring years on the basis of median values, as described in Table 8. Wastewater strength in 2012-2013 was the lowest on record, most parameters reducing by 20-40% as the result of a strong focus by the Company on loss minimisation, with no change in wastewater volume.

During 2013-2014 and 2014-2015, some parameters changed in concentration, though this may not be significant when the variability that results from grab sampling is taken into account. Median lactose concentration increased by 41% over the two-year period, back to the level (0.54%) of 2011-2012. COD fluctuated, below pre-2012-13 levels.

The concentration of total nitrogen increased, by 23% in 2014-2015. Again, there is a discrepancy in the data between individual nitrogen species and total nitrogen values, (in theory, nitrate-N + nitrite-N + TKN = total nitrogen), which makes comparison between years difficult. Variation in use of nitric acid, which Fonterra reports was increased in 2014-2015 to improve the effectiveness of the clean-in-place (CIP) system, may explain the 37% increase in nitrate concentration from 2013-2014. Total phosphorus decreased significantly in 2014-15, by 28%, to the lowest annual median value recorded. Cation concentrations did not change.

With respect to mass discharge rate of wastewater components, wastewater volume in 2014-2015 and 2013-2014 was similar to that produced in 2012-2013. Therefore, the mass discharge rate of the wastewater components increased or reduced by the same proportion as their respective concentrations. Thus, it appears that the total mass of nitrogen applied to irrigation increased in 2014/2015.

Within the production season, measured wastewater strength was significantly higher from mid-August to early/mid-December, in terms of COD, total nitrogen, and minerals. This coincided with peak production periods.

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 both the 2013-2014 and 2013-2014 monitoring periods. 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 made liaison with the Council officer and provided an update on the Company's performance on each inspection occasion.

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.

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 fish pass installed by the Company under the guidance of the Council in March 2004, contained an adequate level of water during all inspections. Some repairs to the side of the pass, that were begun in May 2013, were completed during summer 2013-2014.

2.1.2.1.3 Spray cooling wastes discharges to the Kaupokonui Stream

The cooling water discharge system had variable performance during the monitoring year. The Company's recording system had some malfunctions, resulting in periods of missing records with regard to stream temperatures.

In general, the main cooling tower system worked well.

The most common cause of missing (or inaccurate) data in the temperature record was due to one or both instream temperature probes being removed from the stream during fresh conditions to prevent damage, or during calibration exercises. During these times a null switch is activated to avoid recording inaccurate data.

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

The stormwater outfalls, from the IGL plant installed upstream of the old rail bridge and the detention pond downstream of the cooling water sprayers, did not cause concern during the monitoring period, due to either very low discharge rates or limited contamination of the discharge.



Photo 1 Valve on northern storm drain, and Reno mattresses laid out below storm drains to Kaupokonui Stream

A valve is installed on this stormwater outfall, in case of accidental spillage of chemicals, and Reno mattresses for erosion control were laid below both northern stormwater outlets, as shown in Photo 1. The valve was not required to be used in the 2013-2015 review period.

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 measured on 25 September 2014, at 6.17 m below the top of the upstand.

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 is also discharged back to the Motumate catchment via a tributary immediately opposite the factory across Manaia Road.

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 (Figure 1), of which 44 ha is reticulated with in-ground irrigators. The total area farmed is 244 ha.

For the 2014-2015 dairy season, Farm 2 and Farm 3 were merged into one dairy unit and renamed “Kapuni Farm”. The name of the other farm remained “Farm 1”. For the purposes of describing the wastewater system the old farm designations are occasionally used in this report.

The majority of inspections noted spraying of wastewater onto paddocks well away from stock. No spray drift across streams was observed. Care is required while irrigating near watercourses particularly during windy conditions. Spraying is not to occur within 20 m of a watercourse (condition 6 of consent **0923**).

No leakage of wastewater/stormwater from the underground transfer and distribution pipelines to surface water was recorded. A set of standard operating procedures is in place for monitoring of the system. Pumping is stopped automatically, and restarts must be made manually, when the pressure set point is exceeded.

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 Fonterra farms, which improved the performance of these areas in their ability to receive and assimilate the irrigated wastewater. Testing undertaken in May 2010 indicated that aeration is no longer required, unless there is visible sign of ponding. Some aeration was undertaken in autumn 2015.

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 North Farm cowshed to the lower farm boundary, which were planted during the 1997 and 1998 winter periods, continued to be maintained during the 2013-2015 monitoring period.

The Company is currently investing around \$20,000 a year in planting and fencing of waterways around the factory and Company farms, and a further \$2,000 a year on maintenance of these areas, such as spraying. This includes an annual donation of \$3000 to the Taranaki Tree Trust in accordance with condition 10 (b) of consent **0919**. At the end of the review period, a total of \$49,077.66 had been donated to the Trust.

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



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

In a separate project initiated by Fonterra 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 will 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 Kapuni 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. All plantings were maintained in 2013-2015.

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**) and the combined stormwater/cooling water pipe discharge (permit **0924-3**) 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 2013-2014 and 2014-2015 are presented in Table 9 and Table 10.

Table 9 Results of the analysis of stormwater/cooling water and spray cooling water discharge, 2013-2014

Waste	Spray cooling water					'Stormwater/cooling water'						
Site code	STW 002017					STW 002018						
Date	BOD ₅		Condy @ 20°C	Turbidity	pH	BOD ₅		Condy @ 20°C	Turbidity	Suspended solids	pH	O&G
	Total	Filtered				Total	Filtered					
	g/m ³	g/m ³	mS/m	NTU	g/m ³	g/m ³	mS/m	NTU	g/m ³	pH	g/m ³	
29-Aug-13	7.2	4.9	9.9	12	-	6.2	6.0	9.4	2.1	4	7.1	<0.5
23-Sep-13 ^{^^}	0.7	0.7	5.6	2.5	7.4	0.9	0.9	7.6	4.2	5	6.8	<0.5
17-Oct-13	1.8	1.4	8.0	1.2	7.5	2.8	1.8	9.6	2.8	5	7.1	<0.5
21-Nov-13 ^{^^}	30	24	10.6	0.94	7.9	1.7	0.9	10.7	1.2	<2	6.9	<0.5
9-Jan-14	30	26	9.8	14	7.4	16	9	14.7	54	63	7.3	<0.5
30-Jan-14 ^{^^}	<0.5	<0.5	8.9	1.2	7.8	34	34	22.9	18	20	6.6	<0.5
20-Feb-14 [*]	0.9	0.6	9.9	1.8	7.9	150	100	19.6	58	100	6.8	4.3
20-Mar-14	13	9.0	9.2	4.9	7.4	52	39	26.9	20	50	5.9	<0.5
17-Apr-14	18	>8.0	6.4	22	7.1	10	6.2	8.0	10	18	7.0	<0.5
15-May-14 [*]	18	7.6	9.9	78	7.3	24	19	12.9	25	52	6.9	<0.5
26-Jun-14	-	-	-	-	-	5.8	5.0	34.5	5.0	9	7.4	<0.5
Range	<0.5- 30	<0.5- 26	5.6 - 10.6	0.94 - 78	7.1 - 7.9	0.9 - 150	0.9 - 100	7.6-34.5	1.2 - 58	<2 -100	5.9 -7.4	<0.5-4.3
Median	7.2	4.9	9.7	2.5	7.5	10	6.2	12.9	10	18	6.9	<0.5

* Grab sample of spray cooling water collected due to absent or insufficient composite

[^] Grab sample of stormwater/cooling water collected due to absent or insufficient composite

Table 10 Results of the analysis of stormwater/cooling water and spray cooling water discharge, 2014-2015

Waste	Spray cooling water					'Stormwater/cooling water'						
Site code	STW 002017					STW 002018						
Date	BOD ₅		Condy @ 20°C	Turbidity	pH	BOD ₅		Condy @ 20°C	Turbidity	Suspended solids	pH	O&G
	Total	Filtered				Total	Filtered					
	g/m ³	g/m ³	mS/m	NTU		g/m ³	g/m ³	mS/m	NTU	g/m ³	pH	g/m ³
15-Jul-14 [^]	-	-	-	-	-	5.5	1	67	6.4	3	7.3	<0.5
21-Aug-14 ^{^^}	<0.5	<0.5	9.2	2.5	7.6	10	8.7	11.3	3.5	8	7.2	<0.5
25-Sep-14	1.8	1.0	9.9	12	7.4	2.1	0.5	12	3.5	7	7.3	<0.5
16-Oct-14	4.9	3.6	10.7	7.1	7.5	73	63	16	9.0	24	6.5	<0.5
20-Nov-14	4.6	3.3	9.4	16	7.4	16	16	12	4.8	8	7.3	<0.5
16-Dec-14	19	14	10.3	5.6	7.2	2.4	1	10.8	2.4	4	7.1	<0.5
22-Jan-15	44	>24	10.7	5.0	7.4	7.0	4.6	10.8	5.2	23	7.3	<0.5
25-Feb-15	6.6	3.3	11.0	18	7.5	-	-	-	-	-	-	-
19-Mar-15	4.9	2	9.6	5.6	7.4	-	-	-	-	-	-	-
23-Apr-15	4.7	1.4	10.0	2.4	7.2	3.7	-	9.4	3.0		7.4	
21-May-15	3.7	1.6	9.8	2.8	7.2	7.6	5.6	14.3	3.9	8	7.0	<0.5
25-Jun-15	2.0	1.2	11.8	4.1	7.5	0.6	0.5	55.3	9.3	4	7.4	<0.5
Range	<0.5 -44	<0.5- >24	9.2 – 11.8	2.4 - 18	7.2 - 7.6	0.6 – 73	0.5 – 63	9.4-67	2.4– 9.3	3 – 24	6.5– 7.4	<0.5
Median	4.7	2.0	10.0	5.6	7.4	6.3	4.6	12	4.4	8	7.3	<0.5

* Grab sample of spray cooling water collected due to absent or insufficient composite

[^] Grab sample of stormwater/cooling water collected due to absent or insufficient composite

Composite samples of the spray cooling water discharge were either not collected or of insufficient volume on five out of 10 monitoring occasions in 2013-2014, and on one out of 11 monitoring occasions in 2014-2015, because the samplers had either not been set up properly or failed, in which cases a grab sample was taken. Similarly, for stormwater/cooling water, grab instead of composite samples were taken on three occasions in 2013-2014, and on two occasions in 2014-2015.

Both discharges have been sampled (mainly as 24-hour composites) and analysed by the Council during previous monitoring periods. A summary of these results is presented in Table 11.

Table 11 Summary of cooling water discharge quality from the Council surveys during the period March 1992 to June 2013

Waste	Spray cooling water				'Stormwater/cooling' water		
	Parameter	Unit	No. of samples	Range	Median	No. of samples	Range
Conductivity at 20°C	mS/m	171	3.1 – 46.8	9.8	191	5.4 - 132	10.7
Turbidity	NTU	168	0.4 - 450	1.7	185	0.3- 110	2.5
BOD ₅	g/m ³	170	0.4 - 460	2.5	186	<0.5 - 1100	2.3
BOD ₅ (filtered)	g/m ³	156	0.4 - 91	1.1	168	<0.5 - 1100	1.3
pH	pH	54	5.8 – 8.2	7.4	95	4.6 – 8.0	7.2
Oil and grease	g/m	2	<0.5	<0.5	62	<0.5 – 2.3	<0.5

For the main cooling water, the seasonal increase in total and filtered BOD in spring/summer that was noted in 2012-2013 was repeated in 2013-2014 and 2014-2015.

For the stormwater/cooling water, elevated BOD and conductivity was found in the samples taken in January, February and March 2014. An additional, grab sample was taken on 20 March 2014 at 0955 NZST which returned a total BOD of 190 g/m³, conductivity 106 mS/m (20°C), a pH of 10.6 (outside of the pH range limit of 6.0 – 8.5 set on consent 0924-3), and a suspended solids concentration of 160 g/m³ (above the consent limit of 100 g/m³). Elevated BOD was also recorded for the composite discharge samples taken on 16 October 2014 and 20 November, during a period when a sewage fungus plume was detected below the outfall. The BOD discharge of February 2014 resulted in an excessive BOD level within the stream itself. Refer to section 2.3 for a discussion of both incidents.

Normally, contaminated 'stormwater/cooling water' is dealt with by diversion to the effluent irrigation system (by means of Fonterra's internal conductivity/turbidity-based alarm system) or by the location and elimination of a major contamination source.

In comparison with historical data, the 'stormwater/cooling water' discharge results were within ranges previously recorded, except the high pH on 20 March 2014, as detailed in section 2.3.

2.1.3.1.2 Stormwater quality

Discharges from stormwater pipe outlets to the stream were sampled at four locations: from the northern (STW001062) and southern (STW002018) areas of the lactose plant, the IGL plant (STW001109), and the stormwater pond (STW002078), as shown in Figure 6. The discharge from the southern area of the lactose plant is combined with cooling water and has been addressed in section 2.1.3.1.1 above.

Discharges were found to be occurring on most inspections, however some of these were very small volumes.

2.1.3.1.2.1 Northern outfall

A grab sample was collected from the discharge (STW001062, see Table 12) on 10 occasions during both 2013-2014 and 2014-2015 and analysed by the Council's laboratory. These results are presented in Table 12 below. Rain was falling or had recently occurred on five occasions. There was typically a small discharge.

Table 12 Results of the analysis of grab samples of the stormwater from the northern factory extensions outfall discharge during the 2013-2015 monitoring period

Date	Flow rate (estimated)	BOD ₅	Conductivity at 20°C	Turbidity	O&G	pH	Suspended solids
	L/s	g/m ³	mS/m	NTU	g/m ³		g/m ³
29-Aug-13	7	18	1.8	6.1	<0.5	6.5	8
23-Sep-13	1	3.7	11.1	0.7	<0.5	6.7	3
17-Oct-13	-	6.0	11.8	2.6	<0.5	6.9	<2
21-Nov-13	-	0.9	10.5	1.0	<0.5	7.7	<2
09-Jan-14	0.5	11	6.6	5.3	<0.5	6.6	<2
30-Jan-14	<0.1	5.8	13.8	1.5	<0.5	7.1	<2
20-Feb-14	<0.1	4.0	11.6	1.5	<0.5	7.1	2
17-Apr-14	3	4.7	0.9	4.5	-	6.8	6
15-May-14	0.1	21	4.9	5.8	<0.5	6.7	7
26-Jun-14	<0.1	9.4	9.8	1.1	<0.5	7.1	<2
21-Aug-14	0.1	110	15.9	12	<0.5	6.9	19
25-Sep-14	0.1	8.6	28.8	1.4	0.5	7.1	4
16-Oct-14	0.1	4.9	15.4	0.96	<0.5	7.2	<2
20-Nov-14	0.1	4.5	11.5	1.8	<0.5	6.2	3
16-Dec-14	0.1	110	14.6	9.6	0.7	6.6	20
25-Feb-15	<0.1	5.1	11.1	0.64	<0.5	7.6	<2
19-Mar-15	0.1	4.0	10.9	2.0	<0.5	7.3	3
23-Apr-15	<0.1	20	10.0	0.99	<0.5	7.2	2
21-May-15	0.3	3.5	10.0	3.0	<0.5	7.0	<2
26-Jun-15	0.2	<0.5	21.8	0.2	<0.5	6.9	<2
Consent limit					15	6.0 – 8.5	100
1995-2013							
No of samples		80	82	76	44	71	53
Range		<0.5 – 1400	0.6 – 38.4	0.20 – 29	<0.5 – 2.2	3.8 – 8.7	<2 – 32
Median		6.6	10.5	3.5	<0.5	7.0	4

BOD₅ was high on several monitoring occasions indicating more organic contamination. This may have been a result of lactose powder deposition within the stormwater catchment. A slight organic odour was noticed on several occasions.

The limits on pH, oil and grease, and suspended solids prescribed by conditions on consent **4604-2** were complied with.

2.1.3.1.2.2 IGL plant outfall

The IGL plant stormwater outfall (STW001109, Table 13) was discharging during three inspections in the 2013-2015 monitoring period. The results of the grab samples collected are presented in Table 13 below.

Table 13 Results of the analysis of grab sample of the stormwater from the IGL outfall discharge during the 2013-2015 monitoring period

Date	Flow rate (estimated)	BOD ₅	Conductivity at 20°C	Turbidity	O&G	pH	Suspended solids
	L/s	g/m ³	mS/m	NTU	g/m ³		g/m ³
29-Aug-13	2	1.4	2.4	5.8	<0.5	6.5	3
17-Apr-14	5	0.8	0.6	2.2	<0.5	6.8	3
21-May-15	0.1	41	14.0	230	<0.5	7.7	29
Consent limit		-	-	-	15	6.5 – 8.5	100
2005-2013							
No of samples		18	19	19	11	19	17
Range		<0.5 – 30	0.9 – 22.6	1.1 – 21	<0.5 – 0.8	6.5 – 8.0	<2 – 62
Median		4.5	7.3	6.4	<0.5	7.1	6

The sample collected on 21 May 2015 was influenced by alkaline lichen removal solution that had been applied to the roof of the IGL plant, increasing the pH to above normal, within the consent range limit.

There was no sign of undesirable biological growths in the receiving waters below the discharge point.

Limits prescribed by conditions of consent **6423-1** were complied with.

2.1.3.1.2.3 Stormwater pond outfall

Samples were also collected from the outlet of the stormwater pond (Site STW002078, Table 14 and Photo 3) on six occasions during 2013-2015. The results of the grab samples collected are presented in Table 14. There had been no, or very little, recent rain prior to the collection of samples. The stormwater pond outlet valve was closed on all sampling occasions, suggesting groundwater seepage.



Photo 3 Outfall from stormwater pond to Kaipokonui Stream

Table 14 Results of the analysis of grab samples of the stormwater pond during the 2013-2015 monitoring period

Date	Flow rate (estimated)	BOD ₅	Conductivity at 20°C	Turbidity	Hydrocarbons	pH	Suspended solids
	L/s	g/m ³	mS/m	NTU	g/m ³		g/m ³
17-Oct-13	-	<0.5	34.4	0.32	<0.5	7.4	<2
26-Jun-14	<0.1	<0.5	35.8	0.05	<0.5	7.5	<2
21-Aug-14	0.1	0.6	39.8	0.36	<0.5	7.6	-
25-Sep-14	<0.1	2.6	45.2	0.08	<0.5	7.6	<2
16-Oct-14	<0.1	<0.5	42.0	0.12	<0.5	7.6	<2
21-May-15	0.1	0.6	36.0	0.6	<0.5	7.5	<2
Consent limit		-	-	-	15	6.5 – 8.5	100
2008-2013							
No of samples		11	12	12	8	11	9
Range		<0.5 – 28	4.6 – 43.8	0.3 – 31	<0.5	6.6 – 7.6	<2 - 35
Median		1.5	39.7	1.4	<0.5	7.1	2

Conductivity values at this site have been found to vary widely, 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 regouted in July 2009, but some infiltration continued). Limits prescribed by conditions on consent **0924-3** were complied with.

2.1.3.1.3 Receiving water (Kaipokonui Stream) quality

Sampling of the Kaipokonui Stream adjacent to the Company's factory and Northern Farm wastes irrigation area was performed by the Council on the monthly inspection visits. Ten samples were collected in 2013-2014, during lactose production; for the 2014-2015 period, this was increased to monthly sampling throughout the

year at the request of the consent holder. Three sites were located in the Kaipokonui Stream (Figure 6 and Table 15) as follows:

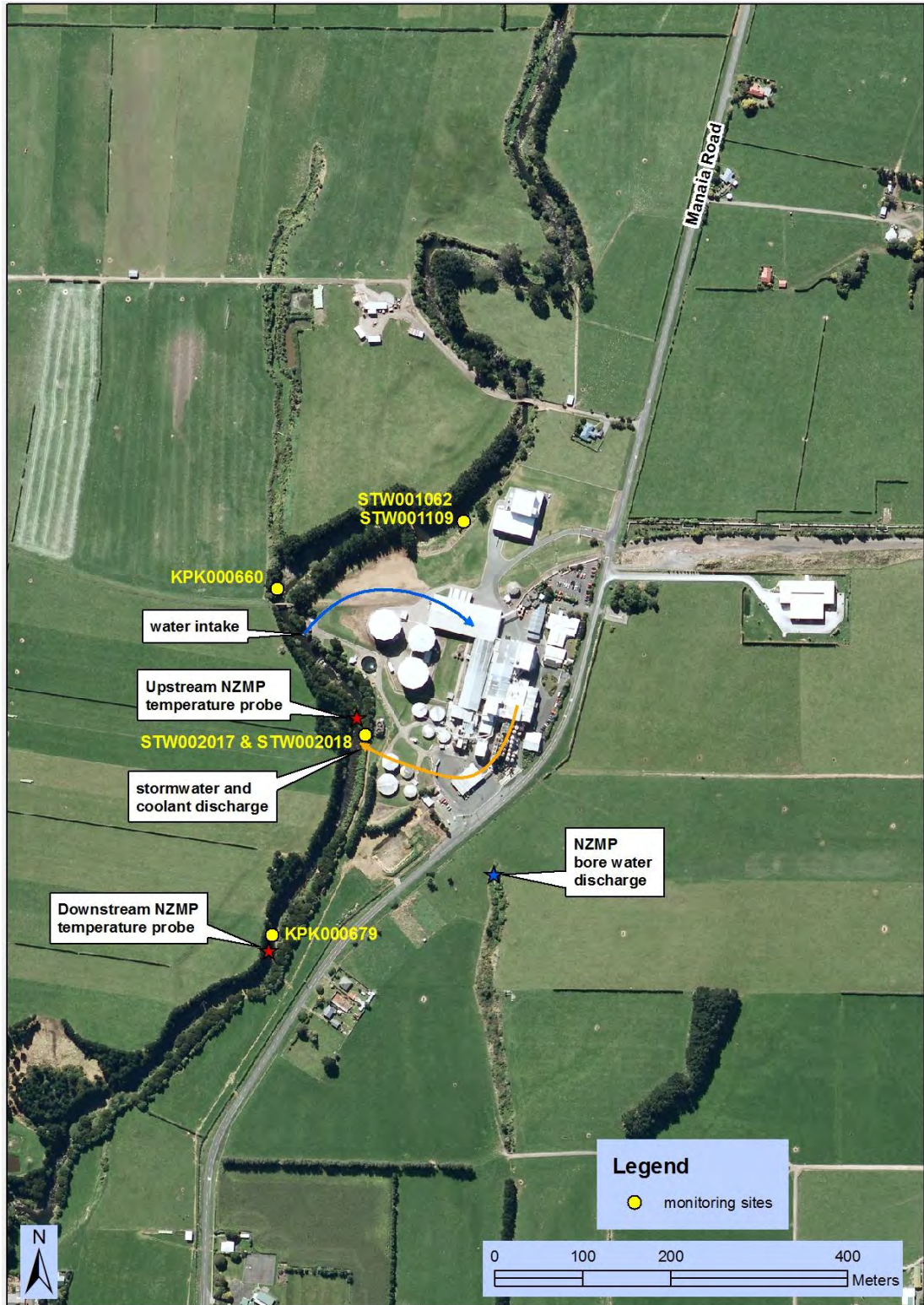


Figure 6 Section of Kaipokonui Stream for physicochemical monitoring in relation to Fonterra Kapuni's waste discharges to water

Table 15 Location of water quality sampling sites

Site	Location	Map reference, NZTM		Site code
		Easting	Northing	
Kaupokonui Stream	1km upstream of rail bridge	1697963	5630770	KPK000655
Kaupokonui Stream	Immediately upstream of rail bridge	1697613	5629791	KPK000660
Kaupokonui Stream	150m downstream of spray cool discharge zone	1697607	5629399	KPK000679

Sampling was performed under varying flow conditions ranging from 0.69 m³/s to 31.4 m³/s, as measured at Upper Glenn Road hydrometric station, 9.8 km downstream, where the median flow is 2.0 m³/s, and mean annual low flow (MALF) is 0.75 m³/s. A record of flows (hydrograph) over the reporting period is presented in Figure 12. Samples were taken in mid to late morning. The results of this monitoring are contained in Appendix II and summarised in Table 16 and Table 17.

Table 16 Summary of Kaupokonui Stream water quality data (ranges) from monthly monitoring for the period August 2013 to June 2014 (N=10 samples)

Site	Unit	KPK000655		KPK000660		KPK000679	
		Range	Median	Range	Median	Range	Median
Temperature	°C	9.5 – 17.3	13.6	9.6 – 18.0	13.2	10.6 – 19.6	13.8
Conductivity @ 20°C	mS/m	5.4 – 9.7	8.6	4.9 – 10.3	9.0	4.4 – 10.5	9.3
Turbidity	NTU	0.91 - 110	1.1	0.93 - 120	1.1	0.96 - 96	1.3
pH	pH	7.4 – 7.8	7.6	7.4 – 7.9	7.7	7.3 – 8.3	7.8
Total BOD ₅	g/m ³	<0.5 – 7.6	0.6	<0.5 – 7.5	0.7	<0.5 – 7.2	0.6
Filtered BOD ₅	g/m ³	<0.5 – 1.2	<0.5	<0.5 – 1.4	<0.5	<0.5 – 4.2	0.6
Ammonia-N	g/m ³ N	0.016 – 0.100	0.041	0.010 – 0.085	0.026	0.005 – 0.081	0.022
Nitrate+Nitrite	g/m ³ N	0.12 – 0.66	0.32	0.12 – 0.79	0.40	0.11 – 1.04	0.46

Table 17 Summary of Kaupokonui Stream water quality data (ranges) from monthly monitoring for the period July 2014 to June 2015 (N=12 samples)

Site	Unit	KPK000655		KPK000660		KPK000679	
		Range	Median	Range	Median	Range	Median
Temperature	°C	8.1 – 15.8	10.8	8.2 – 16.7	11.5	8.4 – 18.4	12.6
Conductivity @ 20°C	mS/m	8.6 – 10.7	9.3	9.1 – 11.3	10.0	9.2 – 11.5	10.0
Turbidity	NTU	0.65 – 1.2	1.2	0.65 - 48	0.96	0.58 – 2.4	1.0
pH	pH	7.4 – 8.0	7.6	7.5 – 8.0	7.7	7.6 - 8.1	7.8
Total BOD ₅	g/m ³	<0.5 – 0.6	<0.5	<0.5 – 3.1	0.5	<0.5 – 1.0	0.6
Filtered BOD ₅	g/m ³	<0.5	<0.5	<0.5	<0.5	<0.5 – 0.8	<0.5
Ammonia-N	g/m ³ N	0.005 – 0.156	0.025	0.003 – 0.133	0.023	0.009 – 0.109	0.020
Nitrate+Nitrite	g/m ³ N	0.22 – 1.26	0.62	0.37 – 1.36	0.72	0.35 – 1.40	0.74
DRP	g/m ³ P	0.011 - 0.097	0.020	0.012 – 0.101	0.021	0.014 – 0.103	0.024

Past Council sampling results from these sites are presented in summary form in Table 18.

Table 18 Summary of Kaupokonui Stream water quality data from the Council surveys during the period August 1994 to June 2013

Site	Unit	KPK000655			KPK000660			KPK000679		
		No.	Range	Median	No.	Range	Median	No.	Range	Median
Temperature	°C	176	4.9 – 19.1	12.2	180	5.1 – 19.4	12.5	180	5.2 – 21.7	13.8
Conductivity	mS/m	179	3.3 – 11.1	9.0	181	3.3 – 11.8	9.5	181	3.2 – 11.9	9.7
Turbidity	NTU	178	0.39 – 120	0.97	180	0.4 – 130	0.9	180	0.4 – 160	0.88
pH	pH	176	6.9 – 8.5	7.7	178	7.0 – 8.6	7.7	177	7.0 – 8.5	7.8
Total BOD ₅	g/m ³	176	<0.5 – >8.3	0.6	179	<0.5 – 5.0	0.6	179	<0.5 – >8	0.7
Filtered BOD ₅	g/m ³	176	<0.5 – 1.8	<0.5	179	<0.5 – 1.7	<0.5	156	<0.5 – >8	<0.5
Ammonia-N	g/m ³ N	178	<0.003 – 0.87	0.022	177	<0.003– 0.147	0.017	178	<0.003 –0.248	0.018
Nitrate+Nitrite	g/m ³ N	48	0.13 – 0.81	0.35	48	0.14 – 1.06	0.42	48	0.13 – 1.01	0.42

The receiving water quality sampling results (Table 16, Table 17 and Appendix II) indicated that minimal impacts of the two cooling waters' discharges were measured in the Kaupokonui Stream, at time of sampling, except for February and March 2014, when substantial increases in total and filtered BOD were recorded under low flow conditions. These in-stream results were co-incident with excessive levels of contaminants in the discharge from the site. Filtered BOD values of 4.2 and 2.0 g/m³, respectively, were recorded for the mixing zone boundary (the limit on consents 0919-3 and 0924-3 is 2.0 g/m³), representing instream increases of 3.4 and 1.4 g/m³. A thin film of sewage fungus had appeared at the time of the March 2014 sampling. Investigation by the Company found the cause to be contamination of the combined stormwater/cooling water discharge, which was subsequently remedied(refer to section 2.3).

In July 2014 total BOD downstream was elevated (3.1 g/m³), the highest concentration reached in the 2014/2015 year, but on this occasion the filtered BOD remained below 0.5 g/m³ and the consent limit was therefore not breached.

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.

No conspicuous changes in clarity, as indicated by turbidity measurements and field comments, were attributed to discharges of cooling or storm water. Natural variation in clarity was observed, in relation to rainfall. On 15 July 2014, the sampling was undertaken while the water intake structure was being cleaned. There was increase in turbidity in the immediate vicinity of the works, which had mostly dissipated at the mixing zone boundary for cooling water discharges, about 470 metres downstream. This activity may have been the cause of the elevated total BOD found in the sample collected on the visit and referenced above.

The summary of Kaupokonui Stream water quality data for the upstream (control) site recorded over the 19-year period prior to the 2013-2015 monitoring period (Table 18) and during this period (Table 16 and Table 17), shows that, apart from a single lapse in May 2007, there has been very good water quality for the parameters measured under normal flow conditions.

2.1.3.1.4 Groundwater quality

Sampling of shallow groundwater bores was undertaken approximately two-monthly 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 in seasonal variation in groundwater quality, and was reduced to two-monthly in 2009-2010. Eight bores were sampled on the three wastewater spray irrigation farm properties, as described in Table 19 and depicted in Figure 7. One bore ('control') on each property is sited upslope of the irrigation area and another one or two bores ('impact') within or down-slope of each irrigation area.

Table 19 Groundwater monitoring sites

Property	Bore	Designation	Site code	Depth m	Map reference, NZTM	
					Easting	Northing
'Northern' (No 1) Farm	North	Control	GND0636	6.5	1697543	2630420
	South	Impact	GND0637	6.5	1697238	5629857
'Southern' (No 2) Farm	North	Control (new)	GND2049	5.6	1698575	2628905
	West	Impact	GND0638	5.9	1698332	2628562
	South-west	Impact (new)	GND2050	7.0	1698397	5627747
No 3 Farm	North	Control (new)	GND2051	6.5	1697634	5627538
	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 the Southern and No. 2 farms was performed in April 1998 (see TRC 98-73), in consultation with the consent holder and following investigations into groundwater contours and flow directions at each of these farms' monitoring sites.

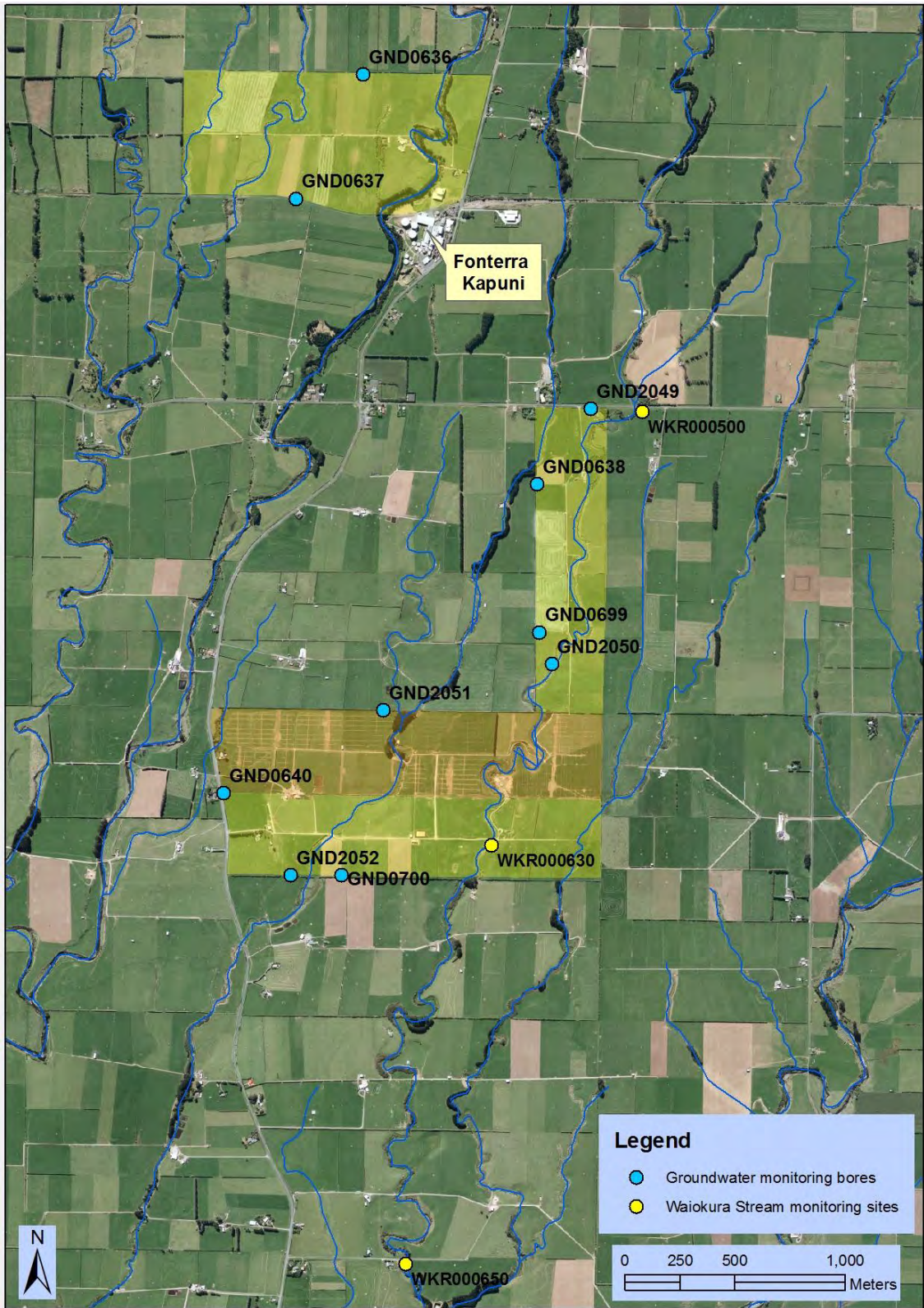


Figure 7 Groundwater monitoring bores and Waiokura Stream sampling site locations on the three Company farms

A summary of groundwater quality data previously collected by the Council from these farm bores is presented in Table 20 for comparison with data collected during the recent monitoring period.

Table 20 Summary of previous Council groundwater quality sampling performed during the period October 1991 to June 2013

Parameter		Level		pH		Conductivity @ 20°C		Sodium		Nitrate-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)
Northern	Control GND0636	65	1.55-4.83 (2.90)	106	6.2-7.1 (6.5)	105	26.4-57.7 (30.0)	72	12.0-56 (25)	106	3.7-24 (8.3)	60	<5-27 (5)
	Impact GND0637	64	2.77-6.15 (4.13)	102	6.1-7.8 (6.5)	100	34.8-82.4 (58.6)	69	40-179 (81)	101	1.5-33 (11.4)	56	<5-42 (7)
Southern (No 2)	Control (New) GND2049	36	1.73-3.80 (2.63)	37	6.2-7.2 (6.4)	37	21.2-48.3 (38.3)	17	26-36 (31)	37	2.4-19 (14.7)	17	<5-7 (<5)
	Impact ('central') GND0638	64	1.08-3.68 (2.64)	99	4.7-6.9 (6.5)	98	54.4-149 (74.9)	66	67-136 (92)	98	<0.01-49 (9.5)	60	<5-1600 (10)
	Impact ('original') GND0639	33	1.99-4.22 (2.90)	53	6.5-7.5 (6.9)	53	45.5-82.6 (64.5)	39	88-157 (120)	53	3.8-29 (11.4)	34	<5-57 (10)
	Impact ('new') GND2050	37	1.65-3.20 (2.62)	37	6.5-7.0 (6.8)	37	13.7-71.1 (58.6)	17	49-102 (87)	37	0.02-13.0 (6.8)	17	<5-21 (<5)
No 3	Control original GND0640	18	0.85-3.24 (1.99)	51	6.4-7.0 (6.8)	51	21.0-41.8 (25.9)	45	28-49 (31)	51	<0.01-3.4 (0.13)	42	4-30 (6)
	Control new GND2051	37	1.98-4.46 (3.13)	37	6.4-7.2 (6.5)	37	25.4-46.4 (33.8)	17	24-37 (30)	37	0.03-19.4 (7.3)	17	<5-31 (<5)
	Impact GND0641	34	1.01-2.94 (1.57)	52	6.3-6.8 (6.5)	53	25.2-63.6 (55.9)	35	30-57 (42)	53	0.87-15.6 (10.7)	32	<5-34 (8)
	Impact ('original') GND0700	61	0.40-4.60 (2.25)	73	5.6-7.2 (6.7)	73	30.3-154 (62.8)	44	39-188 (80)	74	0.02-47 (8.4)	44	<5-33 (6)
	Impact ('new') GND2052	37	1.30-4.38 (2.51)	37	6.4-7.3 (6.6)	37	18.9-42.6 (31.2)	17	35-55 (41)	36	0.02-12.9 (2.3)	17	<5-29 (<5)

* COD = filtered prior to 2006

The groundwater quality monitored at each farm is discussed below. Wastewater irrigation occurred on each farm throughout the monitoring period (see Section 2.1.1.3).

2.1.3.1.4.1 'Northern' Farm groundwater

The results of groundwater monitoring on this farm during the 2013-2015 period are summarised in Table 21. The full set of results is given in Appendix IV.

Table 21 Results of groundwater quality sampling on 'Northern' Farm, 2013-2015

Parameter	Unit	Control (GND0636)			Impact (GND0637)		
		N	Range	Median	N	Range	Median
Water level	m	12	1.89 – 3.55	2.91	12	3.34 – 5.61	4.35
Temperature	°C	12	12.8 – 16.7	13.8	12	13.8 – 15.3	14.2
Conductivity, 20°C	mS/m	12	28.7 – 51.9	29.9	12	34.0 – 60.2	55.8
pH	pH	12	6.2 – 6.9	6.5	12	6.4 – 6.8	6.6
Nitrate+nitrite	g/m ³ N	12	6.3– 14.4	7.5	12	4.28 – 17.2	10.1
Ammonia	g/m ³ N	6	<0.003 – 0.009	<0.003	6	<0.003 – 0.017	<0.003
Sodium	g/m ³	6	24 – 34	25	6	42 – 60	55
Chloride	g/m ³	6	34 – 78	37	6	36 – 64	53
COD	g/m ³	6	<5 - 6	<5	6	<5 - 27	11

The water quality of the control bore GND0636 groundwater continued to be relatively stable in terms of nitrate. The median nitrate-N concentration of 7.5 g/m³ was lower than the historical median of 8.3 g/m³. Two peaks were recorded, of 14.4 g/m³ in July 2013 and 13.6 g/m³ in June 2015, both when groundwater level was high (this is consistent with the observation that heavy rainfall tends to flush more nitrate into groundwater). Water quality at the impact bore GND0637 showed a marked elevation in sodium (and chloride) and conductivity levels when compared with the control bore, consistent with the effect of leaching of wastewater from spray irrigation disposal to shallow groundwater. Sodium concentration appears to be reducing, overall (refer to Table 20). COD at the impact bore fluctuated, within previously recorded values, increasing when groundwater level fell.

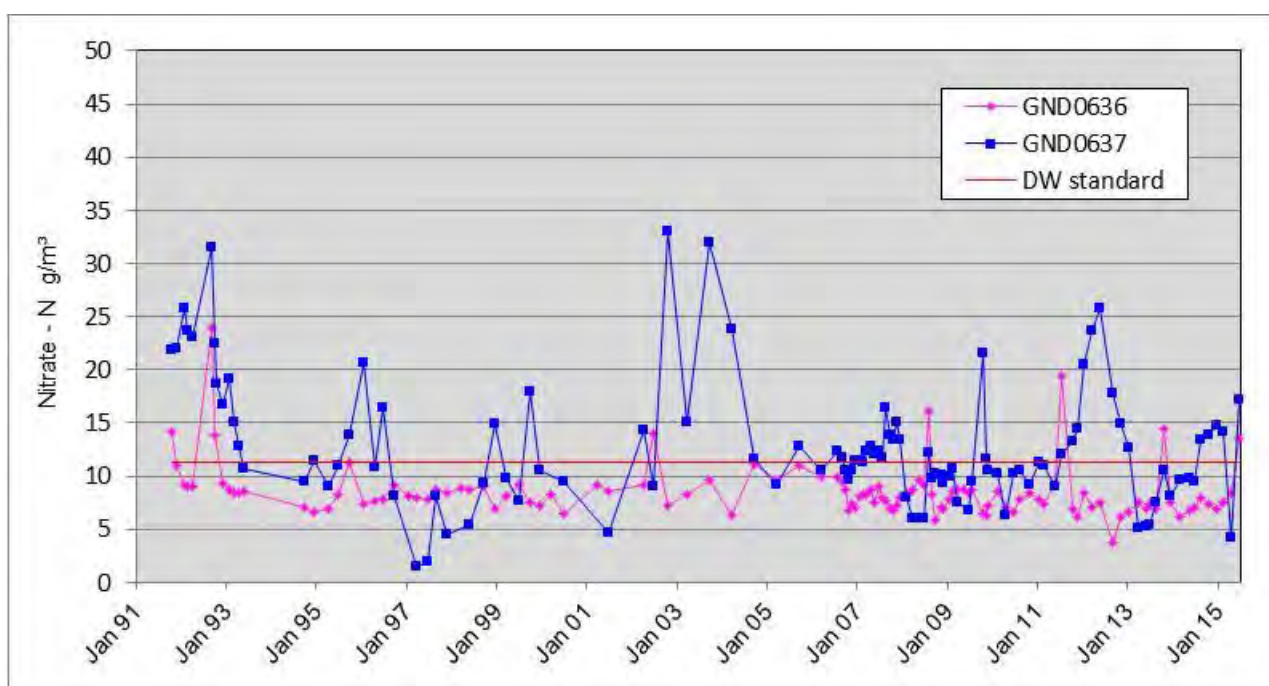


Figure 8 Trends in groundwater Nitrate-N concentration at Farm 1

Figure 8 compares trends in groundwater nitrate-N levels at the impact bore with the control bore, 640 m up-gradient. Levels of nitrate-N in the impact bore rose steadily throughout the 2013-2015 period, from 5 to 17 g/m³, except for a dip in autumn 2015 when groundwater level was low.

2.1.3.1.4.2 'Southern' Farm groundwater

The results of groundwater monitoring on this farm during the 2013-2015 period are summarised in Table 22. The full set of results is given in Appendix III.

Table 22 Results of groundwater quality sampling on 'Southern' ('No 2') farm, 2013-2015

Parameter	Unit	Control (GND2049)			Impact (GND0638)			Impact (GND2050)		
		N	Range	Median	N	Range	Median	N	Range	Median
Water level	m	12	1.73 – 3.35	2.30	12	1.13 – 3.19	2.37	12	1.60 – 2.93	2.54
Temperature	°C	12	13.3 – 14.9	14.3	12	13.9 – 15.3	14.9	12	13.2 – 14.9	14.2
Conductivity, 20°C	mS/m	12	30.3 – 39.8	34.3	12	61.0 – 74.6	71.5	12	52.3 – 61.5	54.2
pH	pH	12	6.4 – 7.2	6.5	12	6.5 – 6.9	6.7	12	6.6 – 7.0	6.8
Nitrate+nitrite	g/m ³ N	12	7.0 – 20.4	12.9	12	6.1 – 10.1	7.8	12	<0.01 – 8.24	0.33
Ammonia	g/m ³ N	6	<0.003 – 0.015	0.007	6	<0.003-0.006	0.003	6	0.011 – 0.655	0.395
Sodium	g/m ³	6	28 – 32	30	6	69 – 80	78	6	52 – 82	58
Chloride	g/m ³	6	33 – 41	38	6	51 – 67	59	6	48 – 81	51
COD	g/m ³	6	<5	<5	6	<5	<5	6	<5 - 13	<5

A new control bore for Farm 2, GND2049, was drilled in March 2008, on the northern boundary beside Skeet Road. (Refer to Figure 7). 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. For this reason, wastewater is now irrigated only in summer in the paddock (number 5) immediately up-gradient.

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 9 compares trends in groundwater nitrate-N levels at the new impact bore, the previous two impact bores, GND0639 and GND0699, and the original control bore, GND0638, with the new control bore GND2049.

The control bore, GND2049, showed the (likely) influence of farming activity up-gradient across Skeet Road, the nitrate-N concentration ranging from 7.0 to 20.4 g/m³ during the monitoring period, with a median value of 12.9 g/m³. Conductivity, pH, sodium and chloride levels were within the normal range that is found in adjacent dairy farming areas. COD and ammonia were low, indicating little leaching of organics.

At the bore inside the irrigation area, GND0638, nitrate-N concentration continued to reduce throughout the review period, to about 8 g/m³, from the peak (49 g/m³) recorded during 2008-2009. Conductivity, sodium and chloride values were elevated,

as might be expected underneath such a wastewater irrigation area, though COD and ammonia levels were low.

At the new impact bore beside the Waiokura Stream, GND2050, nitrate-N concentration appears to fluctuate with groundwater level, being in the range 3 to 13 g/m³ during winter and spring over the total record, and falling to <1 g/m³ in summer and autumn. Mineral levels were significantly higher than at the control bore.

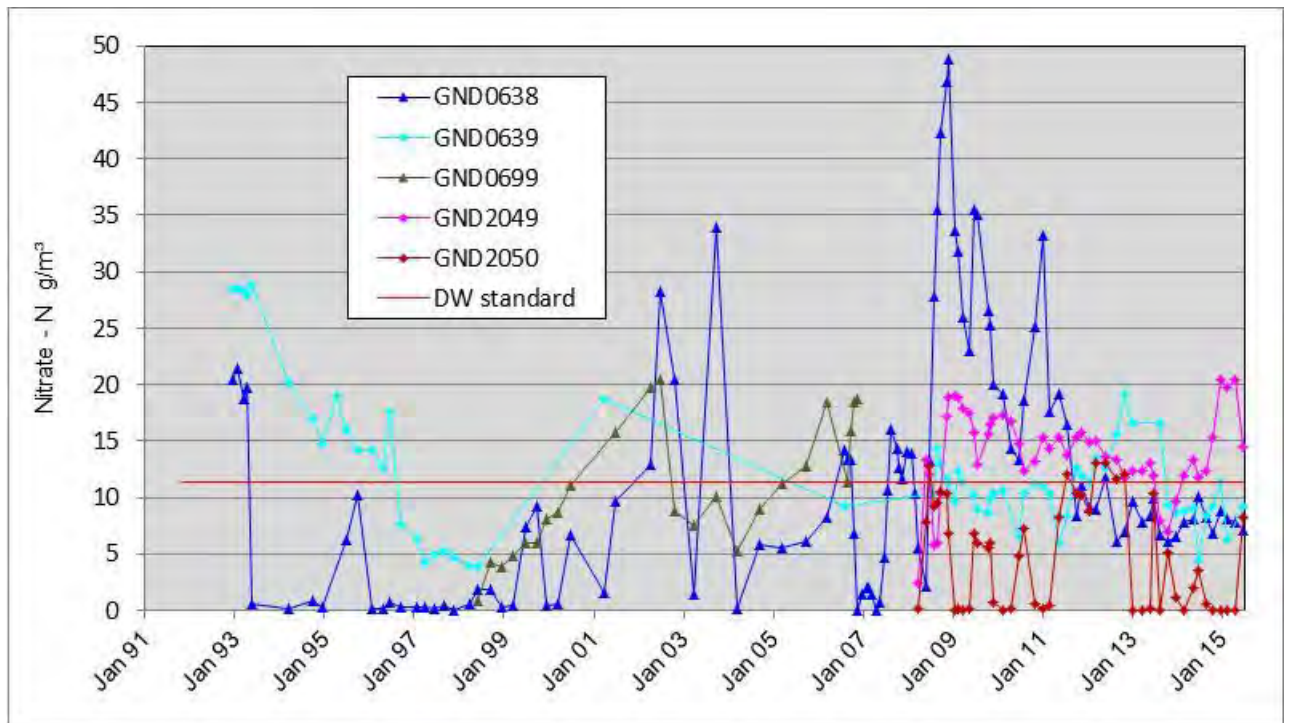


Figure 9 Trends in groundwater Nitrate-N concentration at Farm 2

2.1.3.1.4.3 'No 3' Farm groundwater

The results of groundwater monitoring on this farm during the 2013-2015 period are summarised in Table 23. The full set of results is given in Appendix III.

Table 23 Results of groundwater quality sampling on 'No 3' Farm, 2013-2015

Parameter	Unit	Control (GND2051)			Impact (GND2052)			Impact (GND0700)		
		N	Range	Median	N	Range	Median	N	Range	Median
Water level	m	12	1.86 – 4.02	3.01	12	1.35 – 3.05	2.39	12	0.53 – 2.75	1.99
Temperature	°C	12	13.4 – 15.2	14.1	12	13.5 – 15.3	14.5	12	13.6 – 16.5	14.6
Conductivity, 20°C	mS/m	12	26.2 – 56.9	29.2	12	27.2 – 37.8	31.3	12	39.0 – 73.1	55.9
pH	pH	12	6.4 – 6.7	6.5	12	6.5 – 6.8	6.7	12	6.6 – 7.1	6.8
Nitrate+nitrite	g/m ³ N	12	0.18 – 21.8	4.2	12	0.02 – 3.59	1.3	12	1.86 – 13.1	6.0
Ammonia	g/m ³ N	6	<0.003 – 0.025	0.006	6	<0.003 – 0.194	0.014	6	<0.003 – 0.012	0.004
Sodium	g/m ³	6	25 – 35	26	6	37 – 49	43	6	67 – 94	82
Chloride	g/m ³	6	35 – 88	36	6	43 – 53	45	6	68 – 117	73
COD	g/m ³	6	<5 - 11	<5	6	<5 - 10	<5	6	<5 - 24	6

A new 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.

A new impact monitoring bore was also drilled, 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 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 during the 2013-2015 period due to the bailer becoming stuck inside the bore in May 2013. The bore was not able to be unblocked and is no longer used.

The impact of wastewater irrigation upon the old impact bore (GND0700, Table 23) was reflected in elevated sodium, chloride, and conductivity levels.

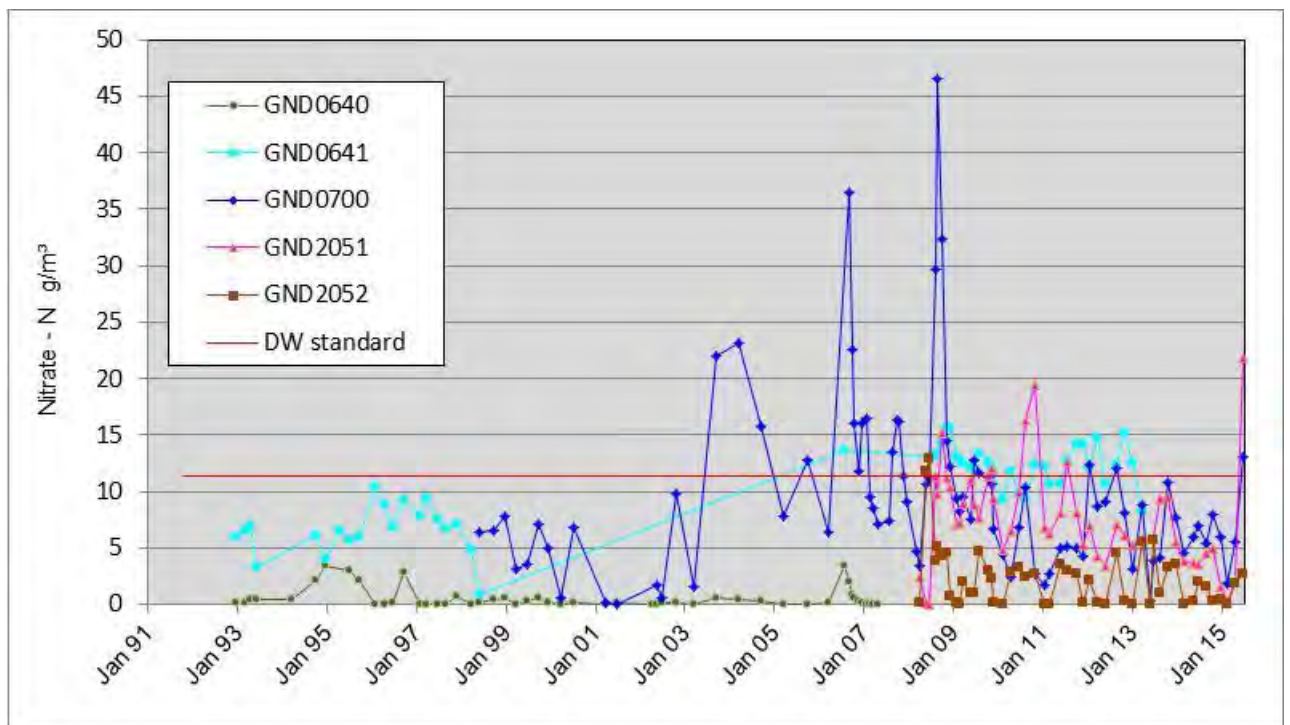


Figure 10 Trends in groundwater Nitrate-N concentration at Farm 3

Figure 10 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), with the old and new control bores, GND0640 (until 2007) and GND2051. At the new control bore, nitrate-N values were moderate, with a median value of 4.2 g/m³; a spike to 22 g/m³ occurred after the large rainfall event on 20 June 2015. The older impact bore GND0700 yielded a similar level of nitrate-N, with a median value of 6.0 g/m³; an increase also followed the rainfall event of June 2015. The new impact bore GND2052 had a low median nitrate-N value of 1.3 g/m³. Results overall show good management of nitrogen application rates.

2.1.3.1.4.4 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/m³ (as nitrate-N) has been exceeded frequently during previous monitoring periods. There are no 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. A summary of the groundwater nitrate monitoring results is given in Table 24.

Table 24 Summary of groundwater nitrate concentrations at monitoring bores, 2013-2015

Property	Bore location	Designation	Nitrate & Nitrite-N, g/m ³		No. samples	Site code
			Median	Range		
'Northern' (No 1) Farm	North South	Control Impact	7.5	6.3 – 14.4	12	GND0636
			10.1	4.3 – 17.2	12	GND0637
'Southern' (No 2) Farm	North West South-west	Control (new)	12.9	7.0 – 20.4	12	GND2049
		Impact	7.8	6.1 – 10.1	12	GND0638
		Impact (new)	0.3	<0.01 – 8.2	12	GND2050
'No 3' Farm	North South-west South-east	Control (new)	4.2	0.18 – 21.8	12	GND2051
		Impact (new)	1.3	0.02 – 3.6	12	GND2052
		Impact	6.0	1.9 – 13.1	12	GND0700
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 has been 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/m³ – 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/m³, a factor of 39%.

In 2013-2014, based on the data provided by the Company, a total metered volume of 525,638 m³ of effluent was generated, which had a (time-based) average total nitrogen concentration of 90.8 g/m³ (46 samples, range 41 - 143 g/m³), giving a total nitrogen mass of 47,707 kg. When applied to 164 ha, at an average depth of 321 mm, this amounted to an overall annual nitrogen application rate of 291 kg/ha. The calculated annual nitrogen application rates for Farm 1 (51 ha), Farm 2 (26 ha) and Farm 3 (87 ha) are 259, 267 and 321 kg/ha, respectively.

In 2014-2015, a total metered volume of 538,699 m³ of effluent was generated, which had a (time-based) average total nitrogen concentration of 106 g/m³ (46 samples, range 41 - 176 g/m³), giving a total nitrogen mass of 57,102 kg. When applied to 164 ha, at an average depth of 323 mm, this amounted to an overall annual nitrogen application rate of 348 kg/ha. The calculated annual nitrogen application rates for Farm 1 (51 ha), Farm 2 (26 ha) and Farm 3 (87 ha) are 270, 361 and 388 kg/ha, respectively.

This measured increase in total nitrogen mass should be treated with caution, as there is a significant discrepancy in the median weekly wastewater analysis data between individual nitrogen species and total nitrogen values (refer to Table 8 in section 2.1.1.5). The nitrogen loading rates for both years under review are considerably less than the average value of 523 kg/ha/y estimated for the period before the irrigation area was extended. The overall increase in nitrogen irrigated since 2012/2013 is discussed in Section 2.1.1.5.

Four new 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. Overall, it appears that nitrate levels under the irrigation areas have decreased and are stabilising in response to the increase in irrigated area. There was a spike in nitrate level at most monitoring bores, both impact and control, at the end of the review period, most likely as the result of a heavy rainfall event. The results for the two relatively new control bores, at the upslope boundaries of Farm 2 and Farm 3, indicate a significant influence on groundwater nitrate-N levels probably as a result of activities on adjacent farms.

2.1.3.2 Waiokura Stream surface water quality

In combination with groundwater monitoring, 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 7, Table 25). This was carried out approximately monthly at the following sites in conjunction with the groundwater sampling.

Table 25 Water quality monitoring sites in the Waiokura Stream

Site	Description	Map reference, NZTM		Site code
		Easting	Northing	
1	Waiokura Stream at Skeet Road	1698807	5628892	WKR000500
2	Waiokura Stream 1.5 l, u/s of Hicks Road (No. 3 Farm)	1698126	5626926	WKR000630
3	Waiokura Stream at Hicks Road	1697735	5625026	WKR000650

These sites were chosen to monitor any possible effects on surface water from the spray irrigation of wastes on the Company's Southern Farms. The results of analytical work performed by the Council's laboratory in the 2013-2015 monitoring period are presented in Table 26 and Table 27, and a summary of the monitoring previously performed is presented in Table 28.

Table 26 Results of Waiokura Stream quality sampling for the 2013-2014 monitoring period

Site		Site 1(WKR000500)			Site 2 (WKR000630)			Site 3 (WKR000650)		
Parameter	Unit	N	Range	Median	N	Range	Median	N	Range	Median
Temperature	°C	12	8.2 – 15.7	12.8	12	8.4 – 15.5	13.3	12	8.7 – 16.1	13.4
Conductivity	mS/m	12	20.1 – 21.4	20.6	12	21.5 – 23.1	22.0	12	22.3 – 24.6	22.8
Nitrate + nitrite	g/m ³ N	12	1.8 – 3.0	2.5	12	1.8 – 3.1	2.6	12	1.7 – 3.1	2.6
Sodium	g/m ³	12	18.9 – 23.4	19.4	12	9.4 – 23.0	21.0	12	21.3 – 24.8	22.2

Table 27 Results of Waiokura Stream quality sampling for the 2014-2015 monitoring period

Site		Site 1(WKR000500)			Site 2 (WKR000630)			Site 3 (WKR000650)		
Parameter	Unit	N	Range	Median	N	Range	Median	N	Range	Median
Temperature	°C	10	10.1 – 16.8	12.4	10	10.0 – 17.6	12.6	10	10.0 – 17.8	12.4
Conductivity	mS/m	10	20.0 – 22.8	20.8	10	21.3 – 25.1	22.4	10	22.0 – 26.3	23.2
Nitrate + nitrite	g/m ³ N	10	1.7 – 3.4	3.0	10	1.7 – 3.5	3.1	10	1.7 – 3.6	3.1
Sodium	g/m ³	10	18.6 – 21.5	20.4	10	20.7 – 24.9	21.6	10	21.5 – 25.6	22.9

Table 28 Summary of Waiokura Stream water quality data from the Council surveys during the period March 2001 to June 2013

Site		Site 1(WKR000500)			Site 2 (WKR000630)			Site 3 (WKR000650)		
Parameter	Unit	N	Range	Median	N	Range	Median	N	Range	Median
Temperature	°C	79	7.1 – 18.0	12.1	79	8.5 – 20.2	12.3	78	8.1 – 19.6	12.5
Conductivity	mS/m	77	16.6 – 30.4	21.2	78	17.0 – 25.3	22.4	77	15.0 – 27.4	23.2
Nitrate + nitrite	g/m ³ N	65	1.3 – 4.0	2.7	64	1.0 – 4.0	3.0	64	1.0 – 4.2	2.9
Sodium	g/m ³	76	14.8 – 24.1	19.5	76	9.7 – 24.6	21.5	75	13.9 – 26.5	22.5

The results for the 2013-2015 monitoring period indicate a slight increase in sodium in the samples downstream of the control site (site 1) on all survey occasions (Table 26 and Table 27), but not significant enough to be considered an environmental effect. Nitrate-N concentration showed a large seasonal fluctuation, varying from about 1.7 g/m³ in autumn to 3.4 g/m³ in winter. The ranges of all parameters were similar to those recorded in previous monitoring periods (Table 28). Continued monitoring over future periods will provide further assessment of any possible environmental effects to surface water from the spray irrigation of wastewater on the Southern Farms.

2.1.3.3 Fish passage temperature compliance in mixing zone

The Taranaki Regional 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 Kaipokonui 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 11. 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, transverse monitoring was no longer considered necessary, as disruption to fish passage was not expected to occur because 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.

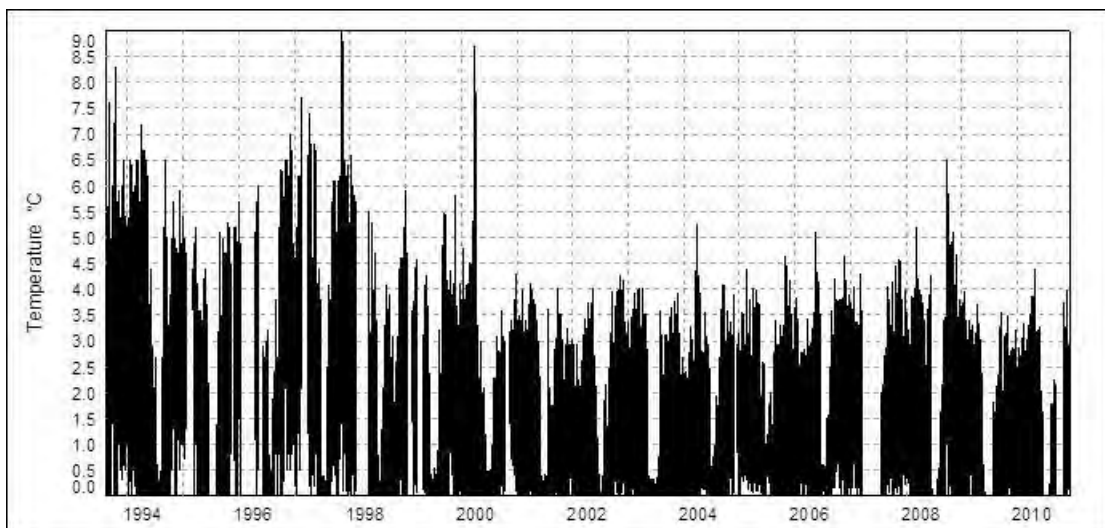


Figure 11 Kaupokonui Stream water temperature differential (LB-RB) records at the periphery of the Fonterra Kapuni spray cooling water discharge zone, 1993-2010

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 is discussed below in section 2.1.3.5.

Kaupokonui Stream flow records for the monitoring period for the Glenn Road recording station are presented in Figure 12.

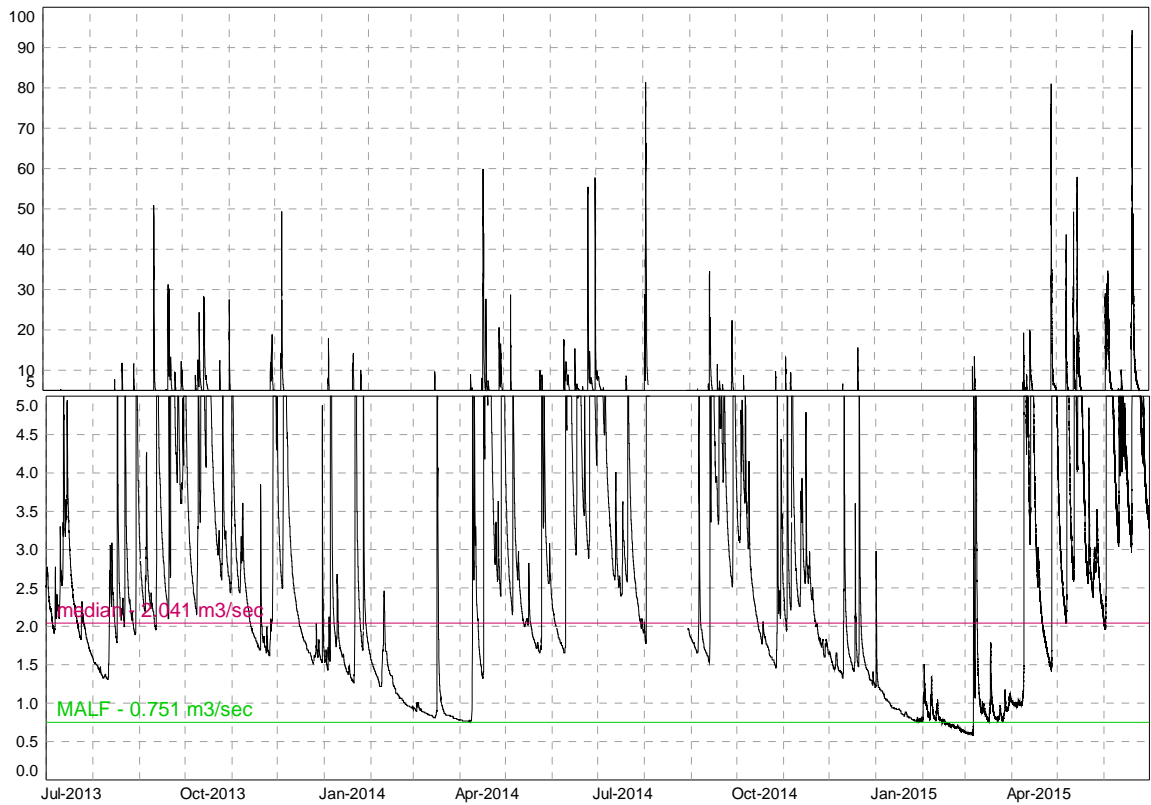


Figure 12 Kaupokonui Stream at Glenn Road flow record (m³/s) for period 1 July 2013 to 30 June 2015

2.1.3.4 Lower stream water temperatures

Two additional water temperature data loggers were installed in the lower reaches of the Kaupokonui Stream for the duration of the 2013-2015 period to provide ambient stream temperature data over the 14 km reach downstream of the factory to the coast. These loggers were 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 13 and Figure 14.

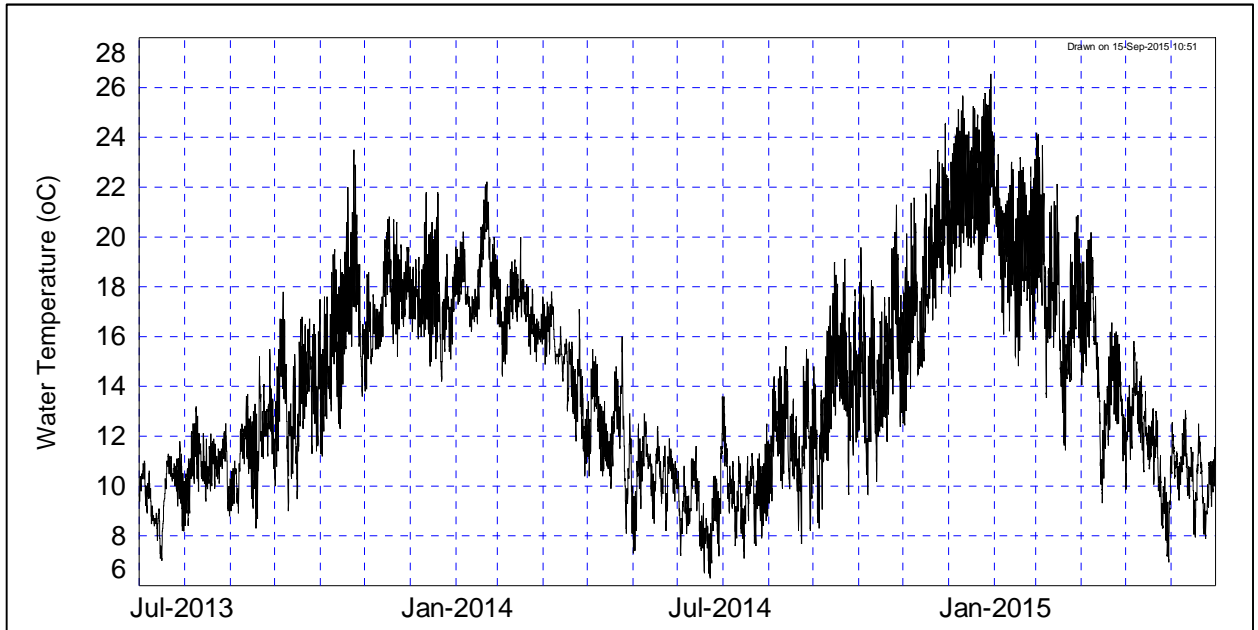


Figure 13 Water temperature (°C) records for the Kaupokonui Stream at Glenn Rd during the period 1 July 2013 to 30 June 2015

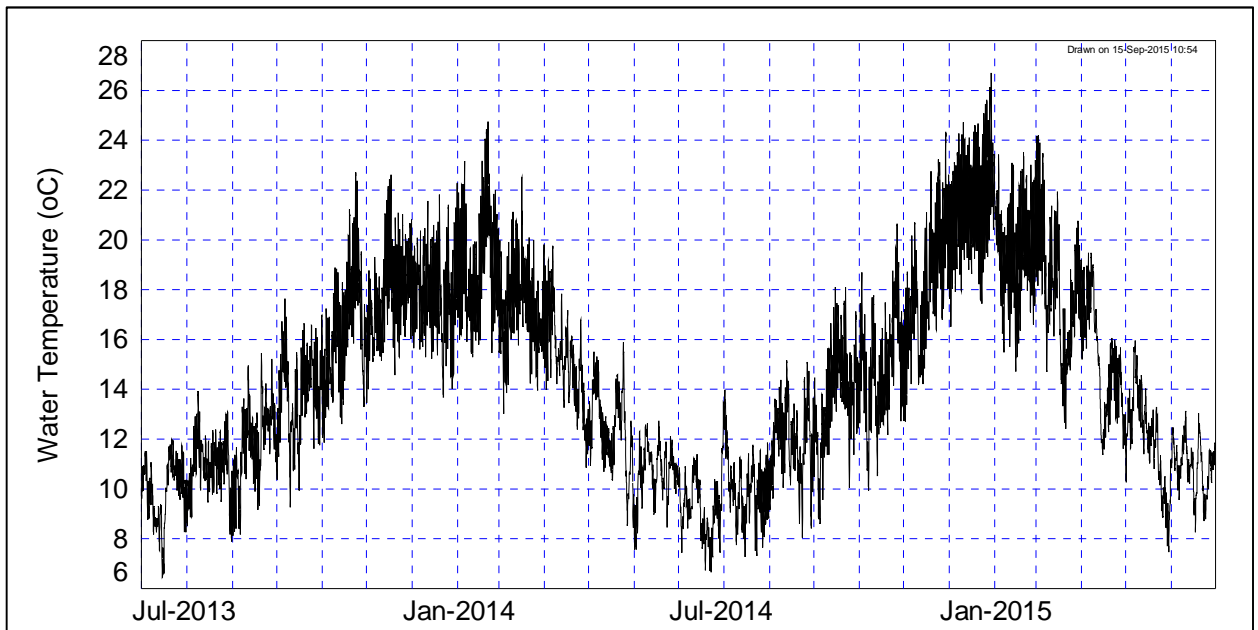


Figure 14 Water temperature (°C) records for the Kaupokonui Stream at beach during the period 1 July 2013 to 30 June 2015

A monthly summary of these data is included in Table 29 and Table 30.

Table 29 Monthly Kaipokonui Stream water temperature data for two sites from July 2013 to June 2014

Site	Upper Glenn Road			Near Coast		
	Min	Max	Mean	Min	Max	Mean
July 2013	7.0	11.8	9.7	6.5	12.0	9.8
August 2013	8.4	13.2	10.8	7.9	13.9	10.9
September 2013	8.3	15.5	11.6	8.1	15.5	11.8
October 2013	9.0	17.8	13.6	9.3	17.6	13.8
November 2013	11.2	23.5	16.4	11.9	22.7	16.4
December 2013	13.8	20.8	17.4	13.5	22.6	17.8
January 2014	14.2	21.8	17.5	13.7	22.3	17.8
February 2014	16.2	22.2	18.6	15.3	24.8	19.1
March 2014	14.4	20.0	17.0	13.0	22.5	17.2
April 2014	10.4	17.8	14.9	10.9	19.8	15.1
May 2014	8.1	16.0	12.2	8.4	15.9	12.4
June 2014	7.3	12.9	10.5	7.6	12.7	10.7

Table 30 Monthly Kaipokonui Stream water temperature data for two sites from July 2014 to June 2015

Site	Upper Glenn Road			Near Coast		
	Min	Max	Mean	Min	Max	Mean
July 2014	6.3	13.6	9.1	6.7	13.5	9.3
August 2014	7.1	13.6	9.9	7.3	14.0	10.0
September 2014	7.7	15.6	11.8	8.1	15.2	11.9
October 2014	8.3	19.1	13.7	8.6	18.1	13.7
November 2014	9.7	21.3	14.8	10.0	20.7	14.9
December 2014	12.4	24.5	18.4	12.7	24.3	18.1
January 2015	17.6	26.6	22.1	16.5	26.7	21.3
February 2015	14.8	23.3	19.6	-	-	-
March 2015	11.4	24.2	17.6	12.4	24.2	17.9
April 2015	9.3	20.2	14.6	11.4	19.5	15.0
May 2015	6.9	15.8	11.6	-	-	-
June 2015	7.9	13.1	10.4	8.3	13.1	11.0

In 2013-2014, stream temperatures reached an instantaneous maximum of 24.8°C on 21 February 2014 at 1530 NZST at the site near the coast (Figure 14). An analysis of the stream water temperature data for each site indicated that 20°C (above which temperature trout start to become stressed) was exceeded for approximately 2% and 5% of the year at Glenn Road and near the mouth, respectively, while the median water temperatures were 14.2°C at Glenn Road and 14.3°C near the mouth.

In 2014-2015, stream temperatures reached an instantaneous maximum of 26.7°C on 21 January 2015 at 1530 NZST at the site near the coast. An analysis of the stream water temperature data for each site indicated that 20°C was exceeded for approximately 15% of the year at Glenn Road and 12% near the mouth, while the median water temperatures were 13.6°C at Glenn Road and 13.8°C near the mouth.

In-stream temperatures continue to increase beyond the periphery of the mixing zone. Given this natural increase and the distances involved, it is not clear whether the increase in stream temperature due to the lactose plant's cooling water discharge introduces 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. This will be a matter for further investigation prior to consent renewal (2019).

2.1.3.5 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 metres. 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 metres. 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 metres.

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.

Electric fishing survey, 30 January 2014

A four site fish survey was undertaken in the Kaupokonui Stream on 30 January 2014, 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 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.

Four fish species were recorded during the survey, being longfin and shortfin eel, redfin bully and rainbow trout. Redfin bully were recorded in very low abundance, reflecting the impact of the Glenn Road weir.

Although only two species were recorded upstream of the Kapuni Lactose weir, longfin and shortfin eels, there is no indication that this weir is posing a significant barrier to fish passage. There were good numbers of juvenile eels recorded upstream of the weir, and no evidence of fish accrual immediately downstream of the weir.

The presence of rainbow trout downstream of the cooling water discharge is an indication that this discharge had not adversely affected the fish communities, as rainbow trout are considered to be one of the more 'sensitive' species with regards to water quality, including temperature. The higher abundance of eels between 250mm and 450mm is considered to be a reflection of the greater proportion of boulders in the substrate, which provide good cover for these fish.

Overall, it was considered that the activities of the Kapuni lactose factory have not adversely affected the fish communities of the Kaupokonui Stream. It is hoped that as the riparian planting of the catchment matures, and passage remediation works at the Glenn Road weir are undertaken, that the diversity and abundance of fish in this stretch of stream will improve.

The full fish survey report is included in Appendix IV.

2.1.3.6 Biomonitoring

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui Stream in October 2013, February 2014, 14 October 2014 and 19 February 2015. Two sites in the Waiokura

Stream were sampled in February 2014 and 2015. Samples were sorted and identified to provide the number of taxa (richness), MCI and SQMCI_s scores for each site. The reports are included as Appendix V. The report summaries are provided below.

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.

8 October 2013

In the Kaupokonui Stream, taxa richnesses were relatively similar or better than historical median richnesses, while MCI scores indicated 'good' community health at all sites except the furthest downstream site. The MCI scores at all five sites were higher than their historical median scores, with four sites recording significantly higher scores. Sites showed little if any improvement from those recorded by the (previous) February 2013 survey, which was an atypical trend for a spring survey. The survey continued to show that the Kaupokonui Stream generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community found at site 7 was indicative of probable influence of the Dunn's Creek tributary through the reach between sites 6 and 7.

It may be concluded that the factory's cooling water discharges did not result in a significant adverse effect on the macroinvertebrate communities, which indicated continued recovery from the situation recorded by the 2010 spring survey. That survey recorded the presence of 'sewage fungus' and *Chironomus* blood worm midge, both indicative of significant enrichment, at sites 5 and 6, at least 800 metres downstream of the site. Neither was recorded by the following five surveys, nor by the October 2013 survey, indicating that the discharge that caused the spring 2010 result had either ceased, improved in quality, or was adequately diluted by the receiving water. In addition, there was no deterioration in the macroinvertebrate community between sites upstream and downstream of spray irrigation of wastes onto land (but upstream of the cooling water discharge) from the Kapuni lactose factory in the current survey.

MCI values continued to indicate in general that macroinvertebrate communities were in 'good' health, being above or very similar to median MCI scores from surveys conducted since 1998 for all sites. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, with some exceptions at site 7. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was statistically significant and greater than usually recorded in this stream, over and above the typical deterioration in communities in a downstream direction in Taranaki ringplain rivers and streams. In the current survey, this deterioration was more related to the poorer community health recorded at site 7 although the result was relatively typical of historical data. This deterioration at site 7 was emphasised by a significant decrease in the SQMCI_s score through this reach, a typical result.

The trend of improvement in communities noted in recent years adjacent to the factory has generally been maintained (from the results of this survey), following a break in the trend recorded by the February 2008 survey, which also recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts were recorded on the macroinvertebrate communities. No such undesirable heterotrophic growths were recorded in the October 2013 survey.

3 February 2014

In the Kaupokonui Stream, taxa richnesses were similar to or better than historical median richnesses, while MCI scores indicated 'good' to 'fair' community health at all sites. The MCI scores at four sites were higher than their historical median scores while the score at the furthest downstream site was slightly below its historical median. Three sites (downstream of the cooling water discharges) showed some reduction in community health from those recorded by the previous spring survey, which is a fairly typical trend for a summer survey. The survey continued to show that the Kaupokonui Stream generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community found at site 7 was indicative of some influence from the Dunns Creek tributary within the reach between sites 6 and 7.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities although there was an indication of some deterioration in biological health but not to the degree compared with conditions recorded by the 2010 spring survey, (as described earlier in this section). Also, there was no deterioration in the macroinvertebrate communities between sites upstream and downstream of spray irrigation of wastes onto land (but upstream of the cooling water discharge) from the Fonterra Kapuni factory recorded by the current survey.

MCI values continued to indicate in general that macroinvertebrate communities were mainly in 'good' health, being above median MCI scores from surveys conducted since 1998 for three sites and within 5 units of medians for the two furthest downstream sites. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, although there was some exceptions at site 7. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was not a statistically significant result, but was a result commonly recorded in this stream, often due to progressive deterioration in communities in a downstream direction, typical of Taranaki ringplain rivers and streams. In the current survey, this deterioration was more related to the poorer 'health' recorded at site 7 which also was emphasised by the significant decrease in SQMCI_s score through this reach and downstream of the Dunns Creek tributary.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which also recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. No such growths were recorded in the February 2014 survey which also found subtle impacts on the macroinvertebrate communities at these sites.

The Waiokura Stream communities indicated that conditions during this survey were better than during most of the relatively limited number of previous surveys at these two sites to date. The MCI value recorded at the downstream site was less than that recorded upstream (but not significantly so given the more subtle loss of rare 'highly sensitive' taxa at the downstream site and habitat variability between sites), and both values were above their respective historical medians. There were some subtle changes in macroinvertebrate community compositions between the sites which were associated with differences in habitat, principally an increase in macrophytes and absence of boulders at the downstream site. These community differences were insignificant and not indicative of recent impacts of wastewater irrigation within the Waiokura Stream catchment.

14 October 2014

In the Kaupokonui Stream, taxa richnesses were similar to or higher than historical median richnesses (with the exception of site 5), while MCI scores indicated 'good' to 'fair' community health at all sites. MCI scores declined in a downstream direction, but only to the degree expected, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. The MCI scores at all five sites were higher than their historical median scores, and the three sites downstream of the cooling water discharges showed some improvement in community health from that recorded by the previous summer survey, which is a fairly typical result for a spring survey. The survey continued to show that the Kaupokonui Stream generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 7, was indicative of some influence from the Dunns Creek tributary within the reach between sites 6 and 7.

Of concern was the presence of sewage fungus on the bed of the stream at the first site downstream of the cooling water discharge (site 5) and also at Skeet Road (site 6). This sewage fungus was visible at site 5, where a thin film was observed covering much of the stream bed. At site 6 it was only confirmed through microscopic examination of the sample. The results of the current survey indicated that the deterioration in water quality that had resulted in the sewage fungus outbreak was not sufficiently severe to cause a deterioration in macroinvertebrate health.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, with the communities appearing healthier than that recorded in the previous summer survey, a relatively typical result. Although the presence of sewage fungus at sites 5 and 6 indicated some deterioration in biological health, it was not to the degree recorded by the 2010 spring survey (as described earlier in this section). The current survey did not record the presence of blood worm midges, indicating that a poor quality cooling water discharge was (or had recently been) occurring, but that it had not resulted in the same degree of deterioration in water quality as that recorded in spring 2010. In addition, there was no deterioration in the macroinvertebrate communities between sites upstream and downstream of spray irrigation of wastes onto land (but upstream of the cooling water discharge) from the Fonterra Kapuni factory recorded by the current survey.

MCI values continued to indicate in general that macroinvertebrate communities were mainly in 'good' health, being above median MCI scores from surveys

conducted since 1998. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, although there were some exceptions at site 5. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was not a statistically significant result, but was a result commonly recorded in this stream, often due to progressive deterioration in communities in a downstream direction, typical of Taranaki ringplain rivers and streams.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which also recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. Such growths were again recorded in the October 2014 survey, but there were only subtle impacts on the macroinvertebrate communities recorded at these sites.

19 February 2015

In the Kaupokonui Stream, taxa richnesses were similar to or higher than historical median richnesses, while MCI scores indicated 'good' to 'fair' community health at all sites. MCI scores declined in a downstream direction, but largely to the degree expected, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. In the case of the current survey however, this progressive deterioration had been exacerbated by the extremely long period of stable flows that preceded this survey. The MCI scores at the upper four of the five sites were higher than their historical median scores, while site 7 had the lowest MCI score, six units less than its historical median. However, the other two sites downstream of the cooling water discharges (sites 5 & 6) showed little deterioration in community health from that recorded by the previous summer survey, which is a better than typical result for a summer survey. The survey continued to show that the Kaupokonui Stream generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 7, was indicative of some influence from the Dunns Creek tributary within the reach between sites 6 and 7. A positive result was that there was no evidence of the sewage fungus recorded during the previous (spring 2014) survey.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, although the communities appeared in slightly worse condition than that recorded in the previous spring survey, a relatively typical result. The current survey did not record the presence of sewage fungus or blood worm midges, indicating that the poor quality cooling water discharge that had been occurring prior to the spring 2014 survey had ceased.

MCI values continued to indicate in general that macroinvertebrate communities were mainly in 'good' health, being above median MCI scores from surveys conducted since 1998, despite the extended period of low flow that preceded this survey, and the related algal proliferation. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, although there were some additions at sites 6 and 7, further downstream. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was a statistically

significant result, and was greater than is commonly recorded in this stream. As with the previous surveys, it is considered that this is due to progressive deterioration in communities in a downstream direction, typical of Taranaki ringplain rivers and streams, but in this case was exacerbated by the preceding low flows.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. Such growths were again recorded in the spring 2014 survey, but not in the February 2015 survey.

The Waiokura Stream communities indicated that conditions during this survey were fairly typical when compared with the relatively limited number of previous surveys at these two sites to date. The MCI value recorded at the downstream site was significantly less than that recorded upstream, although this can be attributed largely to the distance between the sites and the marked habitat differences between sites, especially the predominance of macrophytes at site D, rather than to any effects from the application of wastes to land from the Fonterra factory. This conclusion is supported by the SQMCI_s scores, which were similar. There were some subtle changes in macroinvertebrate community compositions between the sites which were associated with differences in habitat, principally an increase in macrophytes and absence of boulders at the downstream site. These community differences were insignificant and not indicative of recent impacts of wastewater irrigation within the Waiokura Stream catchment.

2.2 Air

2.2.1 Inspections

Officers of the Council carried out inspections in relation to air emissions, of the Kapuni lactose plant, during the 2013-2015 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.

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. On-site odours were noted during inspections, particularly in the vicinity of the effluent tank, and occasional slight odours were noted at the southern plant entrance under northerly wind conditions.

The plant appeared to be well managed and well maintained, with a high standard of housekeeping observed at the time of each inspection. Any on-site spills were responded to and cleaned up promptly.

2.2.2 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. Table 31 is included for comparison of results prior to the installation of the wet scrubber system. **Table 31** Summary of the refined and pre-drier emission testing results prior to the installation of the wet scrubber (October 1998)

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

Isokinetic stack sampling and analysis of the exhaust from the flash drier stack for particulates was conducted on 11 December 2013 and 17 December 2014 by CRL Energy, using USEPA Method 17 over a 64 minute period. Average production rate was 5 t/h. These results are presented in Table 32 below, along with previous CRL and Council results since 1998.

Table 32 Summary of isokinetic stack analysis for 1998-2015

Date	Emission (mg/dsm ³)*	Comments
5 November 1998	<10	No visible emissions noticed
25 February 1999	<10	No visible emissions noticed
4 May 1999	<10	No visible emissions noticed
9 May 2000	<10	No visible emissions noticed
27 October 2000	<10	No visible emissions noticed
30 November 2000	21	No visible emissions noticed
29 November 2001	<10	No visible emissions noticed
21 January 2009	58	
6 February 2010	53	
20 January 2011	18	Mass emission rate 0.7 kg/h
11 January 2012	67	Mass emission rate 3.0 kg/h
9 January 2013	27	Mass emission rate 1.3 kg/h
11 December 2013	18	Mass emission rate 0.9 kg/hr
17 December 2014	23	Mass emission rate 1.2 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/m³ 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/m³ of gas, adjusted to 0°C, 1 atmosphere pressure and calculated as dry gas.

The result obtained in December 2013 and December 2014 were both below consent limits.

2.2.3 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 1.6m. 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.

Gauges were deployed at five sampling sites around the lactose plant for a period of approximately three weeks over summer/autumn in 2013-2014 and 2014-2015. 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 33 and Figure 15 below.

Table 33 Description of the Fonterra 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

The Council guideline value for total particulate deposited to cause nuisance is 130 mg/m²/ 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/m²/30 days or 0.13 g/ m²/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.

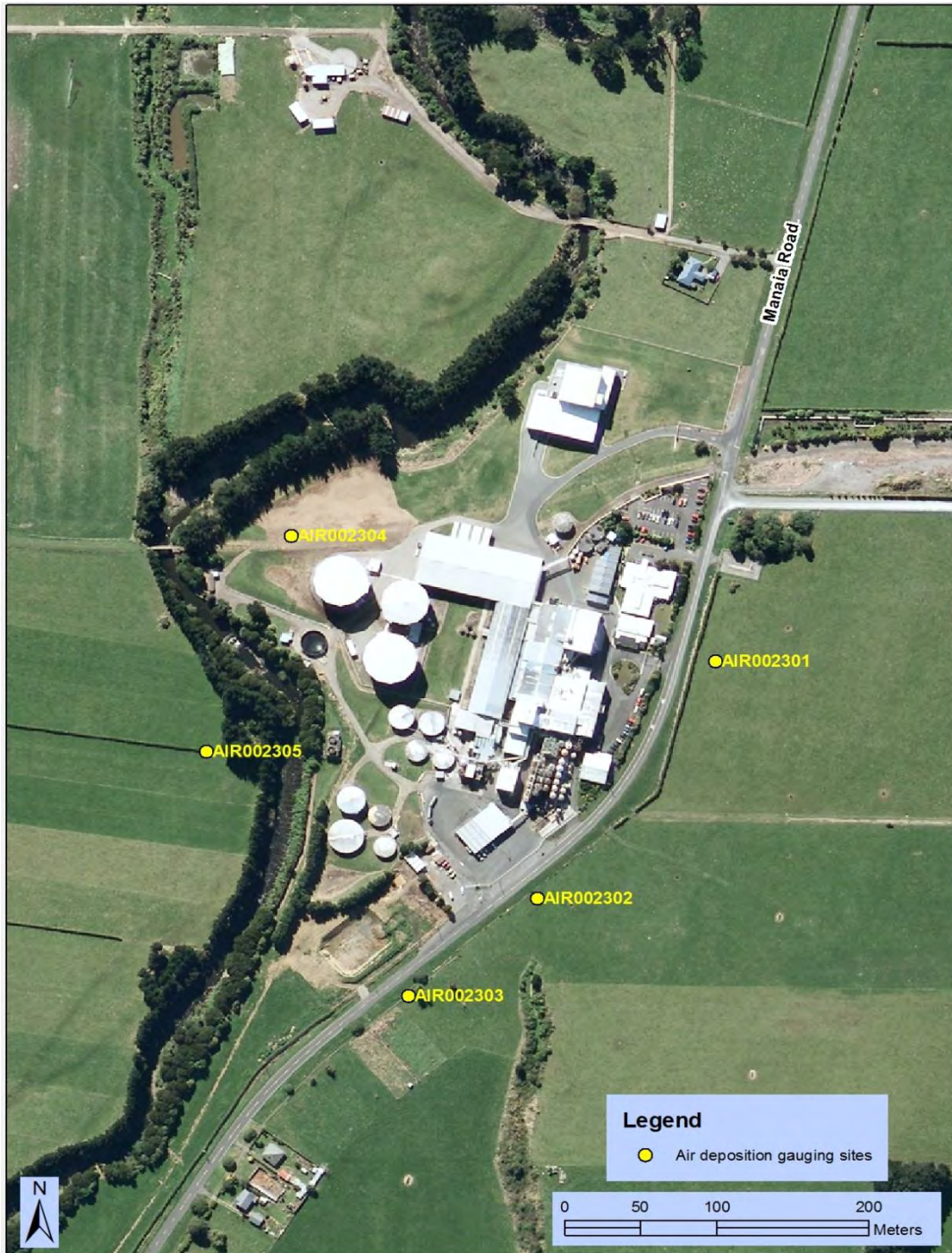


Figure 15 Location of air deposition gauging sites

The deposition gauge results for the 2013-2014 and 2014-2015 deployment periods are compared with previous results since 1997 in Table 34.

Prior to the commissioning of the wet scrubber in October 1998, deposition rates of up to 1300 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 34 Deposition gauge results from 1997-2015 monitoring periods

Period	Number of days	TDP mg/m ² /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
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

Westerly winds predominated during the 2014 gauge deployment, with northerly and southeasterly components. Westerly and southeasterly winds, and large calm periods, predominated in 2015. During the 2015 monitoring period, the gauge at site AIR002303, the southern site across Manaia Road from the lactose plant, was interfered with, being emptied of water and having dirt put in it.

The deposition rates obtained during the periods under review were generally similar to the most recent monitoring periods (Table 34). There was no visible evidence of lactose powder deposition.

2.3 Investigations, interventions and incidents

The monitoring programme for each year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the monitoring period 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.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-

compliance with consents, which may damage the environment. The Incident Register (IR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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 company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2013-2015 period, the Council was required to undertake additional investigations and interventions, and record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans on two occasions, one in 2013-2014 and one in 2014-2015.

BOD exceedance in Kaupokonui Stream, 20 February 2014 (Incident 30444)

Following routine monitoring on 20 February 2014, it was found that the limit on average daily filtered BOD (5-day test) in Kaupokonui Stream below the lactose plant was exceeded, on the basis of a grab sample. Fluctuations in pH and suspended solids concentration in the discharge, beyond the respective consent limits was also recorded.

The BOD limit set in consents 0919-3 and 0924-3, to allow the discharge of cooling water, are established to prevent the establishment of undesirable biological growths, such as 'sewage fungus'. The consents also prohibit visible such growths.

Investigation by the Company found that the discharge from the combined stormwater/cooling water line (consent **0924-3**) was contaminated by inflow from a damaged sump in the underground wastewater drainage network. Wastewater was diverted temporarily from the damaged area while the sump was relined, and inspection frequency of the stream was increased. A video camera was used to find out the extent of wastewater ingress to the cooling water line for subsequent repairs.

As the BOD breach was from one grab sample only, and the consent limit states that the discharge shall not raise the *average daily* filtered BOD in the receiving waters above 2 g/m³, there was not sufficient information to establish conclusively whether the Company was non-compliant. While no visible growth was observed at the time of the February sampling, a thin film was just observed during the 20 March sampling. An observable film of sewage fungus is itself a breach of a condition within each of the consents.

As no significant adverse effect was found in the receiving water, no further action was taken.

Sewage fungus in the Kaupokonui Stream, 14 October 2014 (Incident 31137)

During a routine biomonitoring survey on 14 October 2014, a thin film of sewage fungus was found on the bed of Kaupokonui Stream at the site immediately below the lactose plant. Sampling by the Council on 16 October found that the filtered BOD in the stream was at the limit allowed (2.0 g/m³). Investigation by the Company, through chemical analysis and visual and video camera inspection, found that the discharge from the combined stormwater/cooling water line (consent **0924-3**) was

again contaminated, via damaged underground parts of both the wastewater and cooling water systems. The leak was repaired and the sewage fungus dispersed. This incident highlighted a section of the underground pipeline network where the Company's drawings were not accurate, and a contractor was engaged to remap the entire drainage network and to carry out a full video survey of all drains through 2015. The damaged drains were repaired in major works.

As the biological survey found no significant adverse effect on macroinvertebrate communities of Kaupokonui Stream (refer section 2.1.3.6, page 55), and in view of the action taken by the Company to improve its underground drainage system, no further action was taken.

3. Discussion

3.1 Discussion of plant performance

Generally the on-site 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.

Contingency planning is in place in the form of the Environmental Management System manual (this included the Spray Irrigation Plan). The plan is updated annually, with the most recent edition received in August 2015.

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, and volume and composition of effluent sprayed to pasture on the three farms.

Two unauthorised incidents were recorded, one concerning a high BOD in the Kaupokonui Stream, and one involving sewage fungus in the Kaupokonui Stream. Remedial action was taken through major works to prevent contamination of the cooling and stormwater drainage systems.

There was also a breach of suspended solids and pH discharge limits found on one occasion.

Temperature conditions identified in condition 4(b) and 5 of consents **0919-3** and **0924-3**, were not breached over the two year monitoring period.

Recorded annual abstraction volume from Kaupokonui Stream decreased in 2013-2014, by a factor of about 9% over 2012-2013, and reduced a further 4% in the 2014-2015 year. The measured strength of wastewater irrigated onto land increased in terms of lactose concentration and nitrogen concentration, while volume remained constant. As the volume abstracted decreased while the volume discharged to land changed little, it is assumed that the volume returned to Kaupokonui Stream as cooling water decreased correspondingly.

Two major projects were 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, with no increase in effluent volume 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 new stormwater system to contain and control stormwater from the southern catchment of the factory site has provided additional security for the area where road tankers operate and process materials are stored.

Riparian planting was maintained on the factory site and a donation was received by the Taranaki Tree Trust as per consent conditions.

3.2 Environmental effects of exercise of consents

Ecological monitoring did not note any problems 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, with one exception on a pH limit and suspended solids limit. Biological monitoring of the Kaupokonui Stream during spring 2013 and 2014, and in summer 2014 and 2015, did not show any significant adverse effect of the cooling and storm water discharges to the stream on streambed communities, though the beginnings of sewage fungus growth were detected in two of the four surveys, in February and October 2014.

A fish survey carried out in summer 2014 found no indication that the weir was posing a significant barrier to fish passage, or that cooling water had adversely affected the fish communities.

Temperature data supplied by the Company showed that the ambient temperature of the receiving water during the two year monitoring period was not increased by more than the amounts prescribed on consents **0921** and **0924**, that is, by less than 2 °C for 90% of the time with an upper limit of 3 °C.

Irrigation onto the three dairy farms was, in general, well managed. A 20 m buffer was maintained to the bank of water courses. 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 has been 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 irrigated has remained stable. 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, which was reversed for 2015-2016.

No effect on stream communities of Kaupokonui Stream or Waiokura Stream was noted in relation to land irrigation.

Stormwater discharged from the northern outfall complied with the conditions of consent **4604**.

Results from monitoring of the stormwater discharged from the IGL plant showed that the discharge was complying with conditions of consent **6423**.

Results from monitoring of the stormwater discharged from the southern stormwater outlet showed that the discharge was complying with the conditions of consent **0924-3**.

Levels of suspended solids in the septic tank discharge continued to be higher than consent conditions allowed, however these were not high in regard to a discharge of this nature. The Company surrendered the consent in March 2015 as the discharge

meets the standards of Rule 22 of the Regional Freshwater Plan, and as such is classed as a permitted activity.

Particulate deposition from air emissions were similar to the previous monitoring periods, with all sites within the guideline target value set by the Council. Visual inspections found no evidence of depositions, and odour surveys continued to note low level of odour off site, with some odour observed around the effluent tank and in the vicinity of this depending on the direction of the wind.

3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Table 35 to Table 52.

Table 35 Summary of performance for Consent 0302-3

Purpose: To take and use up to 19,500 cubic metres/day (225 litres/second) of water from the Kaipokonui 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	Review not considered necessary in June 2014, 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

Table 36 Summary of performance for Consent 0919-3

Purpose: 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 Kaipokonui Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Physicochemical and ecological monitoring of wastes	Collection of samples	Yes
2. Effects on receiving water	Site inspections, collection of samples, biological surveys	No. Visible sewage fungus on two occasions, extending at least 800 metres downstream on one occasion
3. BOD level	Collection of samples	Yes
4. Limits on temperature increase of receiving water	Council data logger information, temperature information supplied by Fonterra	Yes
5. Limit on temperature of receiving water	Temperature data supplied by the Company	Yes

Purpose: 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		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
6. Monitoring of temperature of receiving water	Temperature information supplied by the Company	Yes, with minor loss of record
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	Temperature information, site inspections, fish survey	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, donation received	Yes
11. Review of consent conditions	Review invoked in June 2014 for water allocation purposes, then withdrawn upon agreement by Fonterra to install flow meters by 31 August 2015	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Good
Overall assessment of administrative performance in respect of this consent		High

Table 37 Summary of performance for Consent 0920-3

Purpose: To take up to 700 cubic metres/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 – no abstraction during monitoring period	Yes
2. Access to bore 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

Table 38 Summary of performance for Consent 0921-3

Purpose: 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		
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 and biological surveys	Yes
2. Consent holder to monitor daily volume, temperature of discharge	Information supplied by the Company	Yes

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		High
Overall assessment of administrative performance in respect of this consent		High

Table 39 Summary of performance for Consent 0922-3

Purpose: To discharge up to 2,600 cubic metres/two consecutive days of evaporator condensate, washings, processing wastes and stormwater from a lactose manufacturing plant by spray irrigation onto pasture via spray irrigation in Kaupokonui catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Maintenance of effluent spray irrigation plan		Yes
2. Consent exercised in accordance with procedures set out in effluent spray irrigation plan	Site and farm inspections	Yes
3. Review of spray irrigation plan	Document received, October 2012	Yes
4. Operation of spray irrigation plan, staff training	Site and farm inspections	Yes
5. No direct discharges of effluent into any watercourse	Farm inspections	Yes
6. No ponding	Farm inspections	Yes
7. 20 metre 'buffer zone' to watercourse	Farm inspections	Yes
8. Records provided to Council of effluent produced, volume irrigated, area and hours pumped	Records received	Yes
9. Review of consent conditions	Not scheduled during period under 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

Table 40 Summary of performance for Consent 0923-3

Purpose: To discharge up to 3,750 cubic metres/two consecutive days of evaporator condensate, washings, processing wastes and stormwater from a lactose manufacturing plant by spray irrigation in the Waiohura and Motumate catchments		
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		Yes
3. Consent exercised in accordance with procedures set out in plan	Site and farm inspections	Yes
4. Review of spray irrigation plan	Document received, October 2012	Yes

Purpose: To discharge up to 3,750 cubic metres/two consecutive days of evaporator condensate, washings, processing wastes and stormwater from a lactose manufacturing plant by spray irrigation in the Waiokura and Motumate catchments		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
5. Operation of system in accordance with plan. Staff training	Site and farm inspections	Yes
6. No offensive or objectionable odour	Farm inspections	Yes
7. No spray drift beyond boundaries	Farm inspections	Yes
8. No direct discharge to watercourses	Farm inspections	Yes
9. No ponding	Farm inspections	Yes
10. Spray 'buffer zone' limits	Farm inspections	Yes
11. Remediation in case of contamination of groundwater or roof water supply		N/A
12. Installation and maintenance of monitoring bores	Farm inspections	Yes
13. Records provided to Council of effluent produced, volume irrigated, area and hours pumped	Records received	Yes
14. Change of consent conditions	Not sought	N/A
15. Review of consent conditions	Not scheduled during period under 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

Table 41 Summary of performance for Consent 0924-3

Purpose: To discharge up to 1,440 cubic metres/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaipokonui 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	Yes
2. Effects discharge must not have on receiving water below mixing zone	Site inspections	Visible undesirable biological growths on two occasions, on one occasion at least to 800 metres downstream
3. BOD of receiving water not to rise above 2 g/m ³	Samples collected	No – (exceedance only based on one grab sample*)
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

Purpose: To discharge up to 1,440 cubic metres/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaipokonui Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
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	Yes
6. Consent holder to constantly monitor the temperature of the receiving waters	Consent holder maintains temperature probes in stream, data forwarded to Council	Yes
7. Review of consent in June 2001 to evaluate performance of cooling system		N/A
8. Limits upon levels of contaminants in discharge	Sample collection	No. pH and suspended solids limits breached once
9. Discharge not to create barrier for fish, or undesirable growths	Temperature monitoring and site inspections	Yes
10. No anti-corrosion agents, biocides, anti-flocculants or other chemicals added to cooling water	Site inspections, sample collection	Yes
11. Maintenance of contingency plan	Plan approved April 2013	Yes
12. Review of consent conditions	Review invoked in June 2014 for water allocation purposes, then withdrawn upon agreement by Fonterra to install flow meters by 31 August 2015	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Improvement required
Overall assessment of administrative performance in respect of this consent		High

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

Table 42 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 December 2013 and 2014	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

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?
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	Review not considered necessary in June 2014, 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

Table 43 Summary of performance for Consent 4235-2

Purpose: To discharge up to 240 cubic metres/day of stormwater from the factory site via the existing stormwater system into the Kaipokonui Stream only during factory shutdown periods		
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	Yes
2. Levels of contaminants not to be exceeded in discharge	No sampling was undertaken during period under review	N/A
3. Contingency plan	Approved August 2015	Yes
4. Factory shut down when no whey is being processed		N/A
5. Review of consent	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

Table 44 Summary of performance for Consent 4604-2

Purpose: To discharge up to 280 litres/second of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaipokonui Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Effects which must not arise below the mixing zone	Site inspections, samples, biomonitoring	Yes
2. Levels of oil & grease, pH and suspended solids in discharge	Sample collection	Yes
3. Contingency planning	Approved August 2015	Yes

4. 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

Table 45 Summary of performance for Consent 4623-2

Purpose: To erect, place and maintain various spray, stormwater, irrigation and intake structures in the bed of the Kaupokonui Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Notification of maintenance works	Receipt of notification of works in July 2013	Yes
2. Construction in accordance with application		N/A
3. Best practicable option to minimise environmental effects	Consent holder monitored maintenance activity	Yes
4. Structures not to restrict fish passage	Site inspections	Yes
5. Works to be undertaken between November and April	Works did not result in downstream discolouration, therefore fell outside date restrictions	Yes
6. Structure to be removed and area reinstated when no longer required		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

Table 46 Summary of performance for Consent 5368-1

Purpose: To erect, place, use and maintain a bridge over Little Dunn's Creek a tributary of Dunns Creek in the Kaupokonui catchment for access purposes		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Notification of works	No maintenance carried out during period under review	N/A
2. Construction in accordance with application	No maintenance carried out during period under review	N/A
3. Practicable measures to prevent contamination of watercourse	No maintenance carried out during period under review	N/A
4. Removal and reinstatement when no longer required		N/A
5. No discharge of contaminated stormwater	No maintenance carried out during period under review	N/A
6. 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		N/A
Overall assessment of administrative performance in respect of this consent		N/A

Table 47 Summary of performance for Consent 5629-1, surrendered March 2015

Purpose: To discharge up to 7.5 cubic metres/day (114 litres/second) of treated domestic effluent from the Lactose New Zealand processing plant into land		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Treatment system installed in accordance with application	Site inspections	Yes
2. Maintenance of treatment system	Sample collection	See 5 below
3. Disposal field within subject boundary		N/A
4. Consent holder to establish sampling point	Sampling point established	Yes
5. Average suspended solids of 12 month period not exceed 33 g/m ³	Sample collection	No. Suspended solids above this level.
6. Review of consent conditions	Consent surrendered in March 2015	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Good
Overall assessment of administrative performance in respect of this consent		High

Table 48 Summary of performance for Consent 6422-1

Purpose: To erect, place and maintain a stormwater outlet structure in the bed of the Kaipokonui Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Notification prior to maintenance	No maintenance undertaken	N/A
2. Exercise of consent in accordance with application	Site inspections	Yes
3. Best practicable option to minimise environmental effects		N/A
4. Disturbance to be minimised		N/A
5. Structure to be removed and area reinstated if no longer required		N/A
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

Table 49 Summary of performance for Consent 6423-1

Purpose: To discharge stormwater from an inhalation grade lactose plant site into the Kaipokonui Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Contingency planning	Approved August 2015	Yes

Purpose: To discharge stormwater from an inhalation grade lactose plant site into the Kaipokonui Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
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 levels of pH, suspended solids and hydrocarbons in the discharge	Sample collection	Yes
5. Effects which must not arise below the mixing zone	Site inspections, stream sample collection, biomonitoring	Yes
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

Table 50 Summary of performance for Consent 6885-1

Purpose: To erect, place and maintain an outlet structure in the Kaipokonui Stream for stormwater discharge purposes		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Best practicable option		N/A
2. Exercise of consent in accordance with application		N/A
3. Notification prior to installation		N/A
4. Minimise disturbance of stream bed		N/A
5. Reinstatement when structure no longer needed		N/A
6. Lapse of consent		N/A
7. Review of consent conditions		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

Table 51 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		N/A
2. Exercise in accordance with application	Inspection by Council	Yes
3. Notification prior to installation		N/A
4. Best practicable option to minimise contaminant		N/A
5. Minimise disturbance of riverbed		N/A
6. Works resulting in downstream discolouration to be undertaken between November and April		N/A
7. Reinstatement of structure when no longer required		N/A
8. Lapse of consent		N/A
9. Review of consent conditions	Not scheduled during period under 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

Table 52 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 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

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?
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	Yes
19. Procedure on discovery of archaeological remains		N/A
20. Removal of structure when no longer required		N/A
21. Lapse of consent if not exercised		N/A
22. Optional review provision for environmental effects	Next review date available 1 June 2017	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

During the two years under review, the Company demonstrated a good level of environmental and a high level of administrative performance with the resource consents as defined in Section 1.1.4. While there were instances of non-compliance for the discharges to and effects in the Kaupokonui Stream, they were few in number and minor in environmental consequence, with the Company undertaking prompt remedial action.

3.4 Recommendations from the 2012-2013 Annual Report

In the 2012-2013 Annual Report, it was recommended:

1. THAT monitoring of air emissions from the Fonterra Kapuni site in the 2012-2013 year continue at the same level as in 2010-2011 and 2011-2012.
2. THAT monitoring of discharges from the Fonterra Kapuni site in the 2012-2013 year continue to be exercised as in 2010-2011 and 2011-2012, with the addition of an appropriate triennial fish survey to assess the performance of the abstraction weir fish pass and effect of cooling water discharges on fish passage.
3. THAT the option for a review of resource consent **0302-3** (abstraction from surface water) in June 2014, as set out in condition 3 on consent **0302-3** not be exercised, on the ground that current conditions are adequate to deal with any potential adverse effects.
4. THAT the option for a review of resource consent **0919-3** (discharge cooling water) in June 2014, as set out in condition 11 on consent **0919-3** not be exercised, on the ground that current conditions are adequate to deal with any potential adverse effects.
5. THAT the option for a review of resource consent **0922-3** (discharge north farm) in June 2014, as set out in condition 9 on consent **0922-3** not be exercised, on the ground that current conditions are adequate to deal with any potential adverse effects.
6. THAT the option for a review of resource consent **0923-3** (discharge south farms) in June 2014, as set out in condition 15 on consent **0923-3** not be exercised, on the ground that current conditions are adequate to deal with any potential adverse effects.
7. THAT the option for a review of resource consent **0924-3** (discharge storm/cooling water) in June 2014, as set out in condition 12 on consent **0924-3** not be exercised, on the ground that current conditions are adequate to deal with any potential adverse effects.
8. THAT the option for a review of resource consent **4032-5** (discharge to air) in June 2014, as set out in condition 3 on consent **4032-5** not be exercised, on the ground that current conditions are adequate to deal with any potential adverse effects.

These recommendations were followed.

3.5 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for air and water discharges in the region, the Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA, the obligations of the Act in terms of monitoring emissions and discharges and effects, and subsequently reporting to the regional community, 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 emitting to the atmosphere and discharging to the environment.

In the case of Fonterra Limited, the programme for 2013-2014 was the same as that for 2012-2013, with the addition of a triennial fish survey to assess the performance of the abstraction weir fish pass to assess the performance of the abstraction weir fish pass and effect of cooling water discharges on fish passage. During 2014-2015 the number of samples of coolant and other wastes was increased from ten per year to 12 at the request of the consent holder. The number of surface water samples collected from three sites in the Kaupokonui Stream also increased from ten to 12, again at the request of the consent holder. It is now proposed that for 2015-2016, the programme remain the same as that for 2014-2015.

3.6 Exercise of optional review of consent

None of the consents provide for an optional review in June 2015 or June 2016.

4. Recommendations

1. THAT monitoring of air emissions from the Fonterra Kapuni site in the 2015-2016 year continue at the same level as in 2014-2015.
2. THAT monitoring of discharges from the Fonterra Kapuni site in the 2015-2016 year continue to be exercised as in 2014-2015.

Glossary of common terms and abbreviations

The following abbreviations and terms are 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.
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 20°C and expressed in mS/m.
Fresh g/m ³	Elevated flow in a stream, such as after heavy rainfall. Grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
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.
IR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
l/s	Litres per second
m ³	Cubic metres, a measure of volume.
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
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.
NH ₄	Ammonium, normally expressed in terms of the mass of nitrogen(N).
NH ₃	Unionised ammonia, 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 subsequent amendments.
SS	Suspended solids.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

For further information on analytical methods, contact the Council's laboratory.

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Appendix I

Resource consents held by Fonterra Limited

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

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

Name of
Consent Holder: Fonterra Limited
PO Box 424
Hawera 4640

Decision Date: 9 June 1999

Commencement Date: 9 June 1999

Conditions of Consent

Consent Granted: To take and use up to 19,500 cubic metres/day [225 litres/second] of water from the Kaupokonui Stream for cooling water and general purposes associated with lactose manufacturing

Expiry Date: 1 June 2019

Site Location: Kaupokonui Stream, Manaia Road, Kapuni Kapuni

Legal Description: Lot 1 DP 6157 Blk XV Kaupokonui SD

Grid Reference (NZTM) 1697840E-5629660N

Catchment: Kaupokonui

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

General conditions

- a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
 - i) the administration, monitoring and supervision of this consent; and
 - ii) charges authorised by regulations.

Special conditions

- 1. That the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such ecological monitoring associated with the abstraction of water from the Kaupokonui Stream as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.
- 2. That the consent holder shall operate and maintain a measuring device capable of accurately recording daily rates of abstraction and shall measure, record and make such records available to the Chief Executive, Taranaki Regional Council, on a monthly basis.
- 3. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004, June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

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

Name of
Consent Holder: Fonterra Limited
PO Box 424
Hawera 4640

Decision Date: 9 June 1999

Commencement Date: 9 June 1999

Conditions of Consent

Consent Granted: To discharge up to 19,500 cubic metres/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaipokonui Stream

Expiry Date: 1 June 2019

Site Location: Manaia Road Kapuni

Legal Description: Lot 1 DP 6157 Blk XV Kaipokonui SD

Grid Reference (NZTM) 1697740E-5629660N

Catchment: Kaipokonui

*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.

Consent 0919-3

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.

Consent 0919-3

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

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

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

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): 8 February 2005

Commencement Date
(Change): 8 February 2005 (Granted: 9 June 1999)

Conditions of Consent

Consent Granted: To discharge up to 2,600 cubic metres/two consecutive days of evaporator condensate, washings, processing wastes and stormwater from a lactose manufacturing plant by spray irrigation onto pasture in the Kaupokonui catchment

Expiry Date: 1 June 2019

Site Location: Lactose Farm 1, Manaia Road, Kapuni

Legal Description: Lot 1 DP 4509 Blk XV Kaupokonui SD

Grid Reference (NZTM) 1697840E-5630160N

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; and
 - k) riparian planting and management.
2. 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.
3. 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.

Consent 0922-3

4. 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.
5. There shall be no direct discharge of effluent into any watercourse.
6. The spray irrigation system shall not be operated in a manner that causes ponding.
7. From the edge of the spray zone there shall be at least 20 metres to the bank of any watercourse.
8. 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.
9. 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.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

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

Name of
Consent Holder: Fonterra Limited
PO Box 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.

Consent 0922-3.2

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

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 Co-operative Group Limited, Kapuni
P O Box 424
HAWERA

Change To Conditions Date: 21 August 2006 [Granted: 9 June 1999]

Conditions of Consent

Consent Granted: To discharge up to 3,750 cubic metres/two consecutive days of evaporator condensate, washings, processing wastes and stormwater from a lactose manufacturing plant by spray irrigation onto pasture in the Waiokura and Motumate catchments at or about GR: P21:080-894

Expiry Date: 1 June 2019

Review Date(s): June 2009, June 2014

Site Location: Lactose Farms 2 & 3 and Gibson, Skeet / Manaia Roads, Kapuni

Legal Description: Lot 6 DP 2903 Lot 3 DP 3601 Blk XV Kaupokonui SD Lot 2 DP 5897 Lot 2 DP 6039 Blk III Waimate SD Lot 1 DP 6039 Blk III Waimate SD

Catchment: Waiokura

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

Best practicable option

Condition 1 - additional

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.

Management Plan

Condition 2 [previously condition 1] - changed

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 Kaupokonui Stream [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;

Consent 0923-3

- p) reporting monitoring data;
- q) notification to the council of non-compliance with conditions of this consent;
- r) the dairy industry guidelines; and
- s) riparian planting and management.

Conditions 3 to 5 [previously conditions 2 to 4] - unchanged

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 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.
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 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.

Odour and spray effects

Condition 6 - additional

6. 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.

Condition 7 - additional

7. 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.

Land effects

Condition 8 [previously condition 5] - unchanged

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

Condition 9 [previously condition 6] - unchanged

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

Condition 10 [previously condition 7] - changed

10. 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.

Mitigation

Condition 11 - additional

11. Should monitoring of the discharge under conditions 12 and 13 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.

Monitoring

Condition 12 - additional

12. 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.

Condition 13 [previously condition 8] - unchanged

13. 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.

Review

Condition 14 - additional

14. 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.

Condition 15 [previously condition 9] - unchanged

15. 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 21 August 2006

For and on behalf of
Taranaki Regional Council

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.

Consent 0923-3.3

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.

Consent 0923-3.3

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

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.

Consent 0924-3

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) <math><15 \text{ gm}^{-3}</math>
 - b) pH (within the range) 6.0 - 8.5
 - c) suspended solids <math><100 \text{ gm}^{-3}</math>
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.

Consent 0924-3

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

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.

Consent 4032-5

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

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 240 cubic metres/day of stormwater from the factory site via the existing stormwater system into the Kaupokonui Stream only during factory shutdown periods

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 allowing for a mixing zone of 150 metres extending downstream of the periphery of the spray discharge zone, 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 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 g/m ³
3. That the consent holder shall prepare and 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.
4. That the purpose of this consent the factory shall be deemed to be shut down when no whey is being processed.

Consent 4235-2

5. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during 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

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.

Consent 4604-2

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

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: 4 February 1999

Commencement Date: 4 February 1999

Conditions of Consent

Consent Granted: To erect, place, use and maintain various spray, stormwater, irrigation and intake structures in the bed of the Kaupokonui Stream

Expiry Date: 1 June 2017

Site Location: Manaia Road Kapuni Kaponga

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 notify the Taranaki Regional Council at least 48 hours prior to undertaking any maintenance works that would involve disturbance of, or deposition to the river bed or discharges to water.
2. That the structure[s] authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.
3. That the consent holder shall adopt the best practicable option [as defined in the Resource Management Act] to avoid or minimise the discharge of silt or other contaminants into water or onto the river bed and to avoid or minimise the disturbance of the river bed and any adverse effects on water quality.
4. That structures which are the subject of this consent shall not obstruct the passage of eels, mature fish, juveniles and adult trout.
5. That 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 by the written approval of the Chief Executive, Taranaki Regional Council.
6. That 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.

Consent 4623-2

7. 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 it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

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: 21 July 1998

Commencement Date: 21 July 1998

Conditions of Consent

Consent Granted: To erect, place, use and maintain a bridge over Little Dunns Creek a tributary of Dunns Creek in the Kaipokonui catchment for access purposes

Expiry Date: 1 June 2017

Site Location: Little Dunns Creek, Manaia Road, Kapuni

Legal Description: Road Reserve Blk XV Kaipokonui SD

Grid Reference (NZTM) 1696440E-5630060N

Catchment: Kaipokonui

*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 notify the Taranaki Regional Council at least 48 hours prior to commencement, and upon completion of the initial construction, and again prior to, and upon completion of, any subsequent maintenance works which might involve disturbance of the streambed or discharges to the watercourse.
2. That the structure licenced by this consent shall be constructed and maintained in accordance with the documentation submitted in support of application 401.
3. That during the construction, and any subsequent maintenance of the bridge and its approaches, the consent holder shall observe every practicable measure to prevent the discharge or placement of silt and/or organics and/or cement products and/or any other contaminants into the watercourse.
4. That the structure covered by this consent shall be removed and the area reinstated, if and when it is no longer required.
5. That the consent holder shall ensure that there is not discharge of contaminated stormwater to the watercourse from the bridge or its approaches.

Consent 5368-1

6. 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 adequately deal with the environmental effects arising from the exercise of this consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

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

Name of Consent Holder: Fonterra Co-operative Group Limited, Kapuni
P O Box 424
HAWERA

Change To Conditions Date: 28 July 2000 [Granted: 23 May 2000]

Conditions of Consent

Consent Granted: To discharge up to 7.5 cubic metres/day [114 litres/second] of treated domestic effluent from the Lactose New Zealand processing plant into land at or about GR: P20:080-914

Expiry Date: 1 June 2017

Review Date(s): June 2005, June 2011

Site Location: Manaia Road South, Kapuni

Legal Description: Lots 1-9 DP 6588 Pt Secs 34 & 54 Lots 1-4 DP 7211 Pt Secs 14816 Blk XV Kaupokonui SD

Catchment: Kaupokonui

Consent 5629-1

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. The treatment system shall be installed according to the plans submitted with application 935.
2. The consent holder shall maintain the treatment system to ensure the conditions of this consent are met.
3. The disposal field shall be located within the boundaries of the subject property, and as far as is reasonably practicable the discharge shall be contained within the boundaries of the subject property and not adversely affect groundwater quality.
4. The consent holder shall establish an access point for sampling of the discharge prior to discharge to the disposal field.
5. The average of four samples in any 12 month period shall not exceed 33 gm^{-3} total suspended solids.
6. 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 20011, 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 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 4 November 2003

For and on behalf of
Taranaki Regional Council

Chief Executive

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: 13 July 2004

Commencement Date: 13 July 2004

Conditions of Consent

Consent Granted: To erect, place and maintain a stormwater outlet structure in the bed of 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. The consent holder shall notify the Chief Executive, Taranaki Regional Council in writing at least 48 hours prior to the commencement and upon completion of the initial installation and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the river bed or discharges to water.
2. The structure authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of application 3197 and shall be maintained to ensure the conditions of this consent are met. In the case of any contradiction between the documentation submitted in support of application 3197 and the conditions of this consent, the conditions of this consent shall prevail.
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. 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.
5. 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.
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.

Consent 6422-1

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

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 Kaipokonui Stream

Expiry Date: 1 June 2017

Site Location: Manaia Road, Kapuni

Legal Description: Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaipokonui SD

Grid Reference (NZTM) 1697810E-5629840N

Catchment: Kaipokonui

*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.

Consent 6423-1

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

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, Kapuni
P O Box 424
HAWERA

Consent Granted
Date: 12 May 2006

Conditions of Consent

Consent Granted: To erect, place and maintain an outlet structure in the
Kaupokonui Stream for stormwater discharge purposes at
or about GR: P20:077-912

Expiry Date: 1 June 2017

Review Date(s): June 2011

Site Location: Manaia Road, Kapuni

Legal Description: Lot 6 Pt Lot 5 DP 4509 Pt Lot 2 DP 6157 Secs 51 & 55 Blk
XV Kaupokonui SD

Catchment: Kaupokonui

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 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.
2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4214. In the case of any contradiction between the documentation submitted in support of application 4214 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 48 hours prior to the commencement and upon completion of the initial installation and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.
4. 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.
5. 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.
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.

Consent 6885-1

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 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.

Signed at Stratford on 12 May 2006

For and on behalf of
Taranaki Regional Council

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: 12 May 2006

Commencement Date: 12 May 2006

Conditions of Consent

Consent Granted: To erect, place and maintain an outlet structure in the
Kaupokonui Stream for stormwater discharge purposes

Expiry Date: 1 June 2017

Site Location: Manaia Road, Kapuni

Legal Description: Lot 6 Pt Lot 5 DP 4509 Pt Lot 2 DP 6157 Secs 51 & 55 Blk
XV Kaupokonui SD

Grid Reference (NZTM) 1697690E-5629540N

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 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.
2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4214. In the case of any contradiction between the documentation submitted in support of application 4214 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 48 hours prior to the commencement and upon completion of the initial installation and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.
4. 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.
5. 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.
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.

Consent 6885-1

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 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

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 424
HAWERA

Consent Granted
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: 1 June 2023

Review Date(s): June 2011, 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

Catchment: Motumate
Waiokura

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.

Consent 6948-1

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.

Signed at Stratford on 18 September 2006

For and on behalf of
Taranaki Regional Council

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.

Consent 9546-1

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.

Consent 9546-1

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

A D McLay
Director - Resource Management

Appendix II

**Monthly analytical monitoring results
for the Kaupokonui Stream
(sites KPK000655, KPK000660, KPK000679)**

Sample date: 29 August 2013 (flow at Glenn Road – 2.28 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0910	1015	1045	Beginning of fresh. Turbid. No algae visible.
Temperature	°C	9.5	9.6	10.6	
Conductivity	mS/m	9.2	9.5	9.6	
Turbidity	NTU	2.4	2.7	2.7	
pH	pH	7.6	7.6	7.6	
Total BOD	g/m ³	0.9	1.3	1.2	
Filtered BOD	g/m ³	0.7	1.0	0.9	
Ammonia-N	g/m ³ N	0.035	0.032	0.054	
Nitrate-N	g/m ³ N	0.46	0.53	0.54	

Sample date: 23 September 2013 (flow at Glenn Road – 10.80 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0900	1005	1045	Stream in fresh. Swift, highly turbid brown. No algae visible
Temperature	°C	10.0	10.6	11.1	
Conductivity	mS/m	5.4	5.5	5.6	
Turbidity	NTU	2.4	2.4	2.2	
pH	pH	7.6	7.5	7.4	
Total BOD	g/m ³	0.6	<0.5	0.6	
Filtered BOD	g/m ³	<0.5	<0.5	0.5	
Ammonia-N	g/m ³ N	0.076	0.05	0.039	
Nitrate-N	g/m ³ N	0.20	0.22	0.23	

Sample date: 17 October 2013 (flow at Glenn Road – 6.22 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0800	0845	0920	
Temperature	°C	10.2	10.7	11.1	
Conductivity	mS/m	8.1	8.3	8.5	
Turbidity	NTU	1.1	1.3	1.3	
pH	pH	7.7	7.7	7.8	
Total BOD	g/m ³	0.6	0.5	0.5	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ N	0.047	0.048	0.046	
Nitrate-N	g/m ³ N	0.65	0.72	0.75	

Sample date: 21 November 2013 (flow at Glenn Road - 1.83 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0805	0900	0940	Near calm after small fresh No algae visible.
Temperature	°C	14.6	15.2	16.4	
Conductivity	mS/m	9.7	10.3	10.5	
Turbidity	NTU	1.1	1.1	1.0	
pH	pH	7.6	7.7	7.7	
Total BOD	g/m ³	0.7	0.7	0.6	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ N	0.052	0.02	0.015	
Nitrate-N	g/m ³ N	0.66	0.79	0.82	

Sample date: 9 January 2014 (flow at Glenn Road - 1.83 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0815	0925	1005	Slightly milky turbidity. No algae visible
Temperature	°C	13.6	14.1	15.1	
Conductivity	mS/m	8.1	8.7	8.6	
Turbidity	NTU	0.91	0.93	1.3	
pH	pH	7.8	7.8	7.9	
Total BOD	g/m ³	0.6	0.7	0.7	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ N	0.05	0.045	0.028	
Nitrate-N	g/m ³ N	0.31	0.4	0.37	

Sample date: 30 January 2014 (flow at Glenn Road - 1.73 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0810	0850	0935	Stream clear, low flow
Temperature	°C	14.2	14.8	16.1	
Conductivity	mS/m	8.4	8.8	9.0	
Turbidity	NTU	1.0	0.96	0.96	
pH	pH	7.7	7.8	7.9	
Total BOD	g/m ³	0.6	0.5	0.6	
Filtered BOD	g/m ³	0.6	0.5	0.6	
Ammonia-N	g/m ³ N	0.028	0.01	0.008	
Nitrate-N	g/m ³ N	0.29	0.36	0.39	

Sample date: 20 February 2014 (flow at Glenn Road – 1.06 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0815	0930	1005	Clear, slow flow
Temperature	°C	17.3	18.0	19.6	
Conductivity	mS/m	9.2	9.7	10.0	
Turbidity	NTU	1.1	1.0	1.2	
pH	pH	7.7	7.9	7.8	
Total BOD	g/m ³	0.7	0.8	5.2	
Filtered BOD	g/m ³	<0.5	<0.5	4.2	
Ammonia-N	g/m ³ /N	0.018	0.016	0.005	
Nitrate-N	g/m ³ N	0.25	0.27	0.38	

Sample date: 20 March 2014 (flow at Glenn Road – 0.95 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0825	0930	1020	Low flow. Slight milky turbidity
Temperature	°C	14.0	14.6	15.8	
Conductivity	mS/m	8.8	9.2	10.4	
Turbidity	NTU	1.1	1.1	1.6	
pH	pH	7.6	7.8	8.3	
Total BOD	g/m ³	0.6	0.6	2.2	
Filtered BOD	g/m ³	0.6	0.5	2.0	
Ammonia-N	g/m ³ /N	0.016	0.012	0.007	
Nitrate-N	g/m ³ N	0.34	0.39	1.04	

Sample date: 17 April 2014 (flow at Glenn Road – 31.4 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0925	1015	1045	Stream in fresh. Highly turbid brown
Temperature	°C	12.4	12.4	12.4	
Conductivity	mS/m	5.7	4.9	4.4	
Turbidity	NTU	110	120	96	
pH	pH	7.4	7.4	7.3	
Total BOD	g/m ³	7.6	7.5	7.2	
Filtered BOD	g/m ³	1.2	1.4	1.9	
Ammonia-N	g/m ³ /N	0.1	0.085	0.081	
Nitrate-N	g/m ³ N	0.12	0.12	0.11	

Sample date: 15 May 2014 (flow at Glenn Road – 2.10 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0905	1010	1050	Moderate level. Clear, slow flow
Temperature	°C	-	9.9	11.0	
Conductivity	mS/m	9.2	9.6	9.7	
Turbidity	NTU	1.0	1.0	1.0	
pH	pH	7.5	7.7	7.8	
Total BOD	g/m ³	0.5	0.8	0.6	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ N	0.03	0.011	0.006	
Nitrate-N	g/m ³ N	0.52	0.6	0.61	

Sample date: 15 July 2014 (flow at Glenn Road – 2.63 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	1235	1250	1320	Moderate flow. Turbid.
Temperature	°C	9.0	9.1	9.1	
Conductivity	mS/m	9.2	9.8	9.8	
Turbidity	NTU	0.88	4.1	2.4	
pH	pH	7.7	7.5	7.6	
Total BOD	g/m ³	<0.5	3.1	0.6	
Filtered BOD	g/m ³	<0.5	<0.5	0.7	
Ammonia-N	g/m ³ N	0.015	0.024	0.01	
Nitrate-N	g/m ³ N	0.73	0.86	0.89	
DRP	g/m ³ P	0.015	0.015	0.014	

Sample date: 21 August 2014 (flow at Glenn Road – 2.71 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0910	1015	1110	Moderate to high. Slightly milky turbidity
Temperature	°C	9.0	9.1	9.7	
Conductivity	mS/m	8.7	9.1	9.2	
Turbidity	NTU	1.2	1.1	1.1	
pH	pH	7.4	7.5	7.8	
Total BOD	g/m ³	<0.5	<0.5	<0.5	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ N	0.03	0.031	0.021	
Nitrate-N	g/m ³ N	0.75	0.86	0.88	
DRP	g/m ³ P	0.025	0.026	0.028	

Sample date: 25 September 2014 (flow at Glenn Road – 3.11 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0855	0955	1040	Moderate, slow flow. Slightly milky turbidity
Temperature	°C	9.1	9.8	11.0	
Conductivity	mS/m	9.2	9.6	9.7	
Turbidity	NTU	0.96	0.95	0.9	
pH	pH	7.8	7.8	7.8	
Total BOD	g/m ³	<0.5	<0.5	<0.5	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ N	0.097	0.061	0.044	
Nitrate-N	g/m ³ N	0.83	0.92	0.92	
DRP	g/m ³ P	0.026	0.027	0.025	

Sample date: 16 October 2014 (flow at Glenn Road – 1.91 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0805	0905	1000	Moderate flow. Slight milky turbidity
Temperature	°C	11.2	12.0	13.5	
Conductivity	mS/m	9.9	10.7	10.8	
Turbidity	NTU	1.0	1.0	1.1	
pH	pH	7.7	7.8	7.9	
Total BOD	g/m ³	<0.5	0.5	1.0	
Filtered BOD	g/m ³	<0.5	<0.5	0.8	
Ammonia-N	g/m ³ N	0.038	0.026	0.018	
Nitrate-N	g/m ³ N	0.84	0.98	1.02	
DRP	g/m ³ P	0.019	0.022	0.029	

Sample date: 20 November 2014 (flow at Glenn Road – 2.42 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0810	0930	1010	Moderate flow, slightly turbid
Temperature	°C	10.3	11.0	12.0	
Conductivity	mS/m	8.6	9.1	9.2	
Turbidity	NTU	1.1	0.96	1.1	
pH	pH	8.0	8.0	8.0	
Total BOD	g/m ³	<0.5	<0.5	<0.5	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ N	0.02	0.018	0.012	
Nitrate-N	g/m ³ N	0.51	0.64	0.66	
DRP	g/m ³ P	0.014	0.017	0.018	

Sample date: 16 December 2014 (flow at Glenn Road - 1.48 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	1015	1105	1135	Moderate-low flow. Slightly turbid
Temperature	°C	15.6	16.7	18.3	
Conductivity	mS/m	9.3	10.1	10.2	
Turbidity	NTU	1.1	0.76	0.58	
pH	pH	7.4	7.8	7.9	
Total BOD	g/m ³	0.6	0.6	0.7	
Filtered BOD	g/m ³	<0.5	<0.5	0.6	
Ammonia-N	g/m ³ /N	0.02	0.02	0.017	
Nitrate-N	g/m ³ N	0.43	0.58	0.58	
DRP	g/m ³ P	0.024	0.025	0.026	

Sample date: 22 January 2015 (flow at Glenn Road - 0.83 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0820	0915	1005	Low flow. Slightly turbid
Temperature	°C	15.8	16.7	17.6	
Conductivity	mS/m	9.5	10.2	10.4	
Turbidity	NTU	0.82	0.8	0.72	
pH	pH	7.7	7.8	8.0	
Total BOD	g/m ³	0.5	0.6	0.7	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ /N	0.018	0.013	0.01	
Nitrate-N	g/m ³ N	0.3	0.48	0.44	
DRP	g/m ³ P	0.011	0.014	0.014	

Sample date: 25 February 2015 (flow at Glenn Road - 0.69 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0930	1005	1055	Low flow, slightly turbid. Small amount of periphyton
Temperature	°C	15.8	16.4	18.4	
Conductivity	mS/m	9.9	10.7	11.0	
Turbidity	NTU	0.84	1.3	1.3	
pH	pH	7.8	7.9	8.1	
Total BOD	g/m ³	0.6	0.8	0.8	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ /N	0.014	0.008	0.009	
Nitrate-N	g/m ³ N	0.22	0.37	0.35	
DRP	g/m ³ P	0.028	0.036	0.036	

Sample date: 19 March 2015 (flow at Glenn Road – 1.00 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0815	0920	1000	Low-moderate flow. Relatively clear
Temperature	°C	11.6	12.0	13.2	
Conductivity	mS/m	10.0	10.0	10.1	
Turbidity	NTU	1.1	1.2	1.2	
pH	pH	7.5	7.6	7.6	
Total BOD	g/m ³	0.6	0.7	0.6	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ /N	0.156	0.133	0.109	
Nitrate-N	g/m ³ N	0.29	0.41	0.41	
DRP	g/m ³ P	0.097	0.101	0.103	

Sample date: 23 April 2015 (flow at Glenn Road – 1.44 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0930	1030	1125	Moderate, clear flow
Temperature	°C	11.8	12.2	14.2	
Conductivity	mS/m	9.1	9.5	9.5	
Turbidity	NTU	0.65	0.65	0.72	
pH	pH	7.4	7.6	7.7	
Total BOD	g/m ³	<0.5	<0.5	<0.5	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ /N	0.005	0.003	0.021	
Nitrate-N	g/m ³ N	0.37	0.44	0.43	
DRP	g/m ³ P	0.013	0.012	0.015	

Sample date: 21 May 2015 (flow at Glenn Road – 2.51 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	0920	1055	1145	Moderate-high flow
Temperature	°C	10.0	10.6	11.6	
Conductivity	mS/m	9.3	9.6	9.8	
Turbidity	NTU	0.81	0.91	0.68	
pH	pH	7.6	7.6	7.6	
Total BOD	g/m ³	<0.5	<0.5	<0.5	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ /N	0.049	0.034	0.024	
Nitrate-N	g/m ³ N	0.75	0.8	0.81	
DRP	g/m ³ P	0.014	0.015	0.015	

Sample date: 25 June 2015 (flow at Glenn Road - 5.10 m³/s)

Parameter	Unit	Site			Conditions
		1	2	3	
Time	NZST	09:15	10:30	11:30	Recession after large flood five days previous. Swift and clear. Some brown film present
Temperature	°C	8.1	8.2	8.4	
Conductivity	mS/m	10.7	11.3	11.5	
Turbidity	NTU	0.96	0.91	0.76	
pH	pH	7.5	7.5	7.6	
Total BOD	g/m ³	<0.5	<0.5	<0.5	
Filtered BOD	g/m ³	<0.5	<0.5	<0.5	
Ammonia-N	g/m ³ /N	0.032	0.022	0.034	
Nitrate-N	g/m ³ N	1.26	1.36	1.40	
DRP	g/m ³ P	0.020	0.020	0.022	

Appendix III

Groundwater monitoring data

SITE	DATE	TIME	LEVEL	TEMP	CONDY	pH	NNN	CL	NA	NH4	COD
		NZST	m	°C	mS/m@20C		g/m ³ N	g/m ³	g/m ³	g/m ³ N	g/m ³
Farm 1											
GND0636	15-Aug-13	12:50	3.27	13.8	28.7	6.6	6.94	35.1	24.8	<0.003	<5
GND0636	21-Oct-13	11:50	2.40	13.3	45.2	6.5	14.4			<0.003	
GND0636	17-Dec-13	11:05	2.71	13.9	30.4	6.5	7.6	34.4	25.8	0.009	<5
GND0636	24-Feb-14	12:00	3.40	15.9	29.0	6.6	6.25				
GND0636	12-May-14	13:35	3.20	13.9	28.8	6.5	6.8	37.4	24.4	<0.003	<5
GND0636	19-Jun-14	14:00	2.94	13.8	29.7	6.6	7.06				
GND0636	21-Aug-14	10:00	2.52	12.8	38.2	6.7	7.96				
GND0636	23-Oct-14	13:25	2.61	13.4	30.0	6.5	7.43	37.2	24.8	<0.003	<5
GND0636	17-Dec-14	12:00	2.88	13.6	29.4	6.2	6.88				
GND0636	12-Feb-15	12:20	3.41	16.7	29.8	6.5	7.49				
GND0636	16-Apr-15	13:15	3.55	13.9	30.1	6.5	8.49	37.8	26.0	0.004	<5
GND0636	24-Jun-15	12:45	1.89	13.1	51.9	6.9	13.5	78.3	33.5	0.004	6
GND0637	15-Aug-13	12:30	4.81	14.0	46.5	6.7	7.56	41.5	50.9	<0.003	13
GND0637	21-Oct-13	11:35	3.61	14.4	56.3	6.5	10.5				
GND0637	17-Dec-13	10:55	3.81	14.2	55.4	6.6	8.12	58.7	55.1	0.004	9
GND0637	24-Feb-14	11:40	4.86	14.6	55.7	6.6	9.67				
GND0637	12-May-14	13:15	5.00	14.1	52.3	6.4	9.75	50.8	55.8	<0.003	18
GND0637	19-Jun-14	13:40	4.56	14.2	56.0	6.6	9.48				
GND0637	21-Aug-14	10:15	3.80	14.4	60.1	6.8	13.4				
GND0637	23-Oct-14	12:35	3.87	13.8	59.1	6.5	13.9	63.7	60.0	<0.003	<5
GND0637	17-Dec-14	11:50	4.14	14.1	60.2	6.5	14.7				
GND0637	12-Feb-15	11:55	4.89	14.4	50.6	6.5	14.1				
GND0637	16-Apr-15	12:50	5.61	15.3	34.0	6.8	4.28	35.9	42.2	0.017	27
GND0637	24-Jun-15	12:20	3.34	14.1	56.9	6.7	17.2	54.9	56.7	<0.003	<5
Farm 2											
GND2049	15-Aug-13	10:20	2.27	14	31.6	6.5	7.88	36.0	28.0	0.015	<5
GND2049	21-Oct-13	08:55	1.97	14.4	30.3	6.5	7.01				

SITE	DATE	TIME	LEVEL	TEMP	CONDY	pH	NNN	CL	NA	NH4	COD
		NZST	m	°C	mS/m@20C		g/m ³ N	g/m ³	g/m ³	g/m ³ N	g/m ³
GND2049	17-Dec-13	08:55	2.17	14.2	30.7	6.4	9.64	32.7	28.6	0.006	<5
GND2049	24-Feb-14	08:30	3.09	14.7	34.0	6.6	11.9				
GND2049	12-May-14	10:55	2.92	14.9	33.6	6.4	13.4	35.2	28.9	<0.003	<5
GND2049	19-Jun-14	11:15	2.26	14.6	34.5	6.5	11.8				
GND2049	21-Aug-14	11:05	2.08	13.3	34.0	6.5	12.4				
GND2049	23-Oct-14	09:30	2.33	13.4	36.3	6.4	15.4	39.6	30.5	0.007	<5
GND2049	17-Dec-14	09:45	2.56	13.6	39.4	6.4	20.4				
GND2049	12-Feb-15	09:20	3.27	14.6	39.8	6.4	19.7				
GND2049	16-Apr-15	09:30	3.35	14.8	39.5	6.5	20.4	41.4	32.3	<0.003	<5
GND2049	24-Jun-15	09:30	1.73	14.2	36.4	7.2	14.5	40.4	31.6	0.013	<5
GND0638	15-Aug-13	11:10	2.35	14.7	61.0	6.7	6.61	51.1	69	<0.003	<5
GND0638	21-Oct-13	09:10	1.77	14.9	66.0	6.6	6.08				
GND0638	17-Dec-13	09:00	2.39	14.0	71.5	6.7	6.54	61.3	79.8	0.005	<5
GND0638	24-Feb-14	08:50	2.9	15.1	74.2	6.8	7.77				
GND0638	12-May-14	11:10	2.33	15.3	69.0	6.6	8.02	66.9	78	<0.003	<5
GND0638	19-Jun-14	11:35	2.21	15.2	71.7	6.7	10.1				
GND0638	21-Aug-14	11:15	2.14	13.9	74.2	6.8	8.19				
GND0638	23-Oct-14	09:50	2.47	14.2	71.4	6.6	6.75	55.7	77.5	0.003	<5
GND0638	17-Dec-14	09:50	2.72	14.4	74.6	6.5	8.75				
GND0638	12-Feb-15	09:35	2.99	14.8	71.5	6.6	8.14				
GND0638	16-Apr-15	10:00	3.19	15.1	68.3	6.5	7.77	60.9	79.4	0.006	<5
GND0638	24-Jun-15	09:50	1.13	14.9	65.4	6.9	7.03	57.2	69.2	0.003	<5
GND2050	15-Aug-13	10:45	2.67	14.0	52.3	6.8	0.02	48.2	52.0	0.508	13
GND2050	21-Oct-13	09:35	2.18	13.7	61.5	6.7	5.06				
GND2050	17-Dec-13	09:20	2.50	14.3	53.1	6.7	1.08	52.0	58.6	0.248	8
GND2050	24-Feb-14	09:20	2.93	14.7	53.2	7.0	0.02				
GND2050	12-May-14	11:25	2.58	14.3	55.5	6.6	2.00	58.2	68.8	0.282	<5
GND2050	19-Jun-14	12:00	2.34	14.1	54.3	6.9	3.48				

SITE	DATE	TIME	LEVEL	TEMP	CONDY	pH	NNN	CL	NA	NH4	COD
		NZST	m	°C	mS/m@20C		g/m ³ N	g/m ³	g/m ³	g/m ³ N	g/m ³
GND2050	21-Aug-14	11:45	2.36	13.2	54.4	6.9	0.60				
GND2050	23-Oct-14	10:40	2.46	14.0	53.3	6.7	<0.01	50.5	55.6	0.58	<5
GND2050	17-Dec-14	10:10	2.66	13.8	54.0	6.8	<0.01				
GND2050	12-Feb-15	10:00	2.83	14.9	55.3	6.7	0.06				
GND2050	16-Apr-15	10:40	2.84	14.2	54.0	6.8	<0.01	50.6	56.4	0.655	6
GND2050	24-Jun-15	10:20	1.60	14.2	58.4	6.9	8.24	81.2	81.9	0.011	<5
Farm 3											
GND2051	15-Aug-13	12:00	3.05	13.9	32.9	6.5	9.3	37.4	26.4	<0.003	<5
GND2051	21-Oct-13	10:00	2.43	14.4	33.3	6.5	9.53				
GND2051	17-Dec-13	09:45	2.87	14.0	29.5	6.6	5.55	36.8	26.3	0.011	<5
GND2051	24-Feb-14	10:20	3.48	14.7	28.2	6.6	3.76				
GND2051	12-May-14	12:10	3.13	14.5	28.6	6.4	3.71	36.1	24.9	0.025	<5
GND2051	19-Jun-14	12:45	2.63	14.0	29.4	6.6	3.59				
GND2051	21-Aug-14	12:05	2.65	13.4	29.3	6.7	4.56				
GND2051	23-Oct-14	11:25	2.96	13.9	29.0	6.5	5.01	34.8	25.2	<0.003	<5
GND2051	17-Dec-14	11:00	3.19	13.8	26.9	6.5	1.58				
GND2051	12-Feb-15	10:45	3.52	14.2	26.2	6.5	0.18				
GND2051	16-Apr-15	11:45	4.02	15.2	27.4	6.5	2.11	34.9	26.4	<0.003	11
GND2051	24-Jun-15	11:00	1.86	14.2	56.9	6.6	21.8	88.3	35.2	0.012	<5
GND2052	15-Aug-13	11:30	2.3	14.1	33.2	6.6	1.00	43.5	42.6	<0.003	<5
GND2052	21-Oct-13	11:00	1.73	15.2	36.8	6.5	3.21				
GND2052	17-Dec-13	10:00	2.16	14.0	35.1	6.5	3.59	43.1	45.8	0.012	<5
GND2052	24-Feb-14	10:40	3.03	14.6	27.2	6.8	0.02				
GND2052	12-May-14	12:25	2.47	14.6	28.5	6.6	0.26	44.8	37.1	0.109	<5
GND2052	19-Jun-14	13:00	2.15	14.6	30.4	6.7	2.01				
GND2052	21-Aug-14	12:25	2.19	13.5	32.2	6.8	1.52				
GND2052	23-Oct-14	10:45	2.52	13.9	29.6	6.6	0.28	45.4	38.1	0.194	<5
GND2052	17-Dec-14	11:10	2.51	13.9	30.4	6.7	0.42				

SITE	DATE	TIME	LEVEL	TEMP	CONDY	pH	NNN	CL	NA	NH4	COD
		NZST	m	°C	mS/m@20C		g/m ³ N	g/m ³	g/m ³	g/m ³ N	g/m ³
GND2052	12-Feb-15	11:05	3.05	14.6	29.2	6.6	0.02				
GND2052	16-Apr-15	12:10	2.59	15.3	35.5	6.8	1.91	52.9	42.8	0.016	10
GND2052	24-Jun-15	11:30	1.35	14.4	37.8	6.8	2.64	49.2	48.5	0.005	<5
GND0700	15-Aug-13	11:45	1.95	14.3	49.0	6.9	4.07	68.0	67.4	0.006	6
GND0700	21-Oct-13	10:20	1.10	14.6	70.0	6.7	10.8				
GND0700	17-Dec-13	10:20	1.97	14.6	56.2	6.8	7.60	69.6	81.8	0.012	24
GND0700	24-Feb-14	10:55	2.70	14.7	48.0	6.8	4.56				
GND0700	12-May-14	12:40	2.00	14.5	60.0	6.7	6.00	79.2	87.8	<0.003	6
GND0700	19-Jun-14	13:05	1.61	14.7	56.9	6.8	6.94				
GND0700	21-Aug-14	12:40	1.54	13.6	55.1	7.1	5.46				
GND0700	23-Oct-14	12:05	2.03	13.9	57.6	6.7	7.91	75.7	81.3	<0.003	<5
GND0700	17-Dec-14	11:30	2.25	13.9	54.3	6.6	5.98				
GND0700	12-Feb-15	11:30	2.75	16.5	39.0	6.7	1.86				
GND0700	16-Apr-15	12:30	2.40	15.2	55.5	6.7	5.59	71.1	80.9	0.01	10
GND0700	24-Jun-15	11:30	0.53	14.4	73.1	7.0	13.1	117	93.6	<0.003	6

Appendix IV

Report on fish survey of Kaupokonui Stream

30 January 2014

Memorandum

To James Kitto, Job Manager
From Bart Jansma, Scientific Officer
Report No. BJ247
Doc No. 1458187
Date 19 January 2015

Fish survey in the Kaupokonui Stream in relation to the Fonterra Kapuni lactose factory and weir, January 2014

Introduction

The Fonterra Kapuni lactose factory, located on Manaia Road, Kapuni, sits alongside the Kaupokonui Stream. There are numerous consents held in relation to this factory, a number of which have the potential to impact on the fish communities of the Kaupokonui Stream. For example, the discharge of cooling water could potentially increase the water temperature of the stream, beyond the tolerance limits of those fish species inhabiting it, and the weir associated with the water intake (Figure 1), could pose a barrier to the passage of migrant fish.

There has been no regular fish monitoring undertaken in the Kaupokonui Stream to date, although some sites have been monitored on an ad hoc basis. The current survey is the first undertaken in relation to the Kapuni Lactose factory since April 1999, and is to be repeated on a three yearly basis.

Before any results are interpreted, it is necessary to provide some context. Located downstream of the Kapuni Lactose factory, there is a weir, known as the Glenn Road weir. This weir is an orphaned structure, but is considered to have historical significance. It also presents a significant barrier to the passage of most fish, with only the best climbers being able to negotiate it. It is considered highly unlikely that swimming species, such as common smelt, inanga and torrentfish, could negotiate this weir, and as such they are not expected to be in the Kaupokonui River near the lactose factory.



Figure 1 Kaupokonui Stream, Kapuni Lactose weir and fish pass

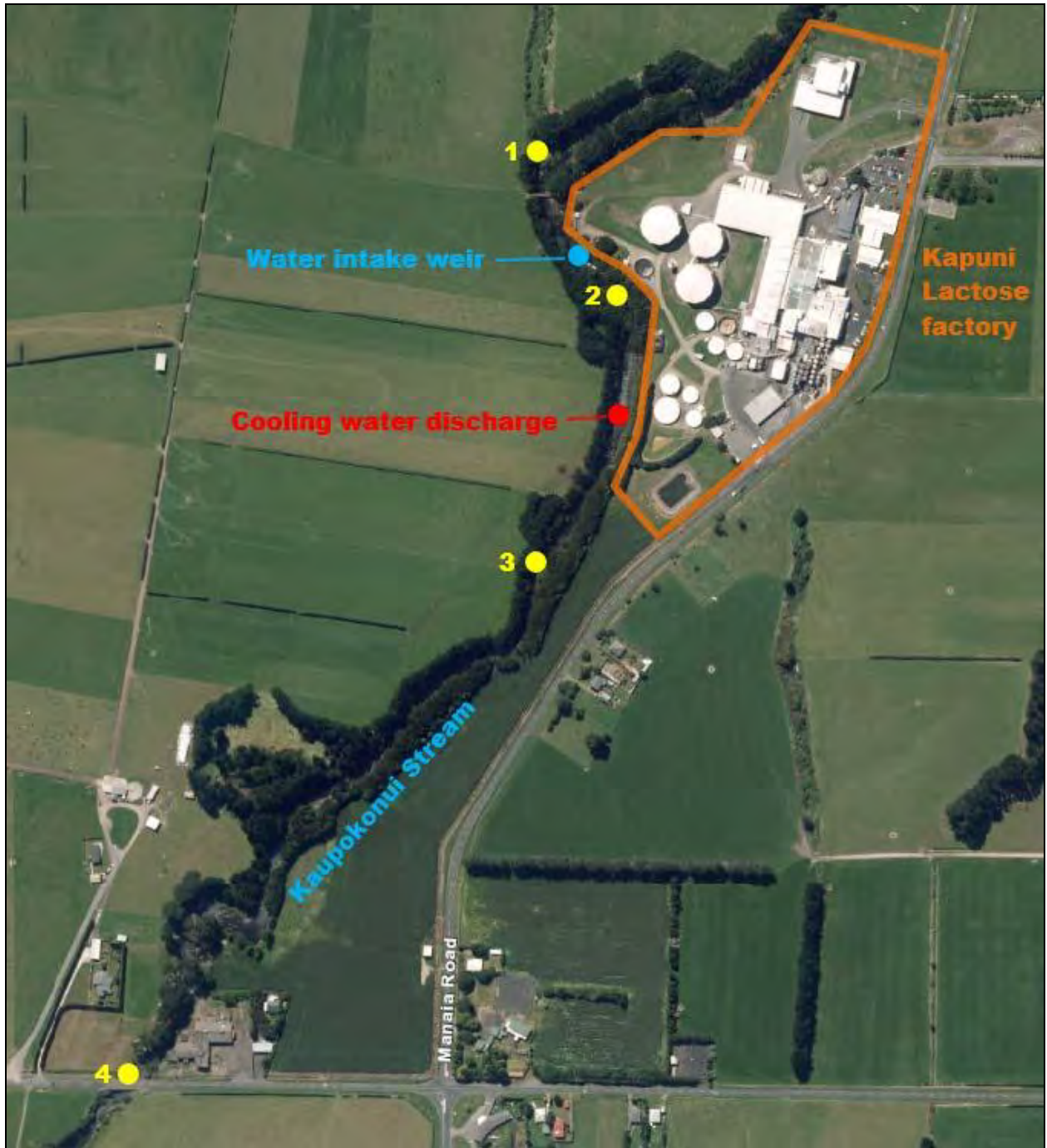


Figure 2 Sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory

Methods

The current survey was performed at four sites in the Kaupokonui Stream on 30 January 2014. Details of the sites surveyed in the current survey are presented in Table 1, and their locations are shown in Figure 2.

Table 1 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	KPK000660	Upstream of intake weir	1697613-5629791	15.98	170
2	KPK000666	Between intake weir and cooling water discharge	1697744-5629658	15.5	160
3	KPK000677	Downstream of cooling water discharge	1697644-5629458	15.3	160
4	KPK000685	Skeet Rd	1697221-5628986	14.51	150

The sites were surveyed using the electric fishing method, which employed a Kainga EFM machine. Those fish captured were identified and counted, where possible. Inevitably some fish eluded capture, although some were identified before reaching cover. The length of each fish was estimated, following which they were released. The results of this survey are presented in Table 2 together with the results of previous surveys.

In addition, the area surveyed was estimated, and some observations made regarding the habitat present at the sites surveyed.

Results

The sites surveyed all included similar habitat, with the substrate comprising predominantly boulders and cobbles, with lesser proportions of gravels and sand. With the exception of site 4, all sites enjoyed partial shading, while only site 1 had any undercut bank. Overhanging vegetation was observed at site 2, 3 and 4. Water clarity was good during this survey, with uncoloured and clear flow at all sites.

The results for each site are summarised in Table 2.

Table 2 Fish species and abundance recorded during the current survey.

Site:		Site 1	Site 2	Site 3	Site 4
Area fished (m ²):		36	72	80	84
Longfin eel (<i>Anguilla dieffenbachii</i>)	Number	13	9	9	6
	Length range (mm)	100-200	100-150	100-400	150-400
Shortfin eel (<i>Anguilla australis</i>)	Number	7	1	-	9
	Length range (mm)	100-200	130	-	100-400
Unidentified eel	Number	-	2	2	2
	Length range (mm)	-	200-600	100-100	200-350
Redfin bully	Number	-	-	1	1
	Length range (mm)	-	-	40	40
Unidentified bully	Number	-	-	-	1
	Length range (mm)	-	-	-	80
Rainbow trout	Number	-	-	1	
	Length range (mm)	-	-	120	
Unidentified trout	Number	-	-	-	1
	Length range (mm)	-	-	-	100
Crayfish	Number	3	10	1	2
Total number of species		2	2	3	4
Total number of fish		20	12	13	20

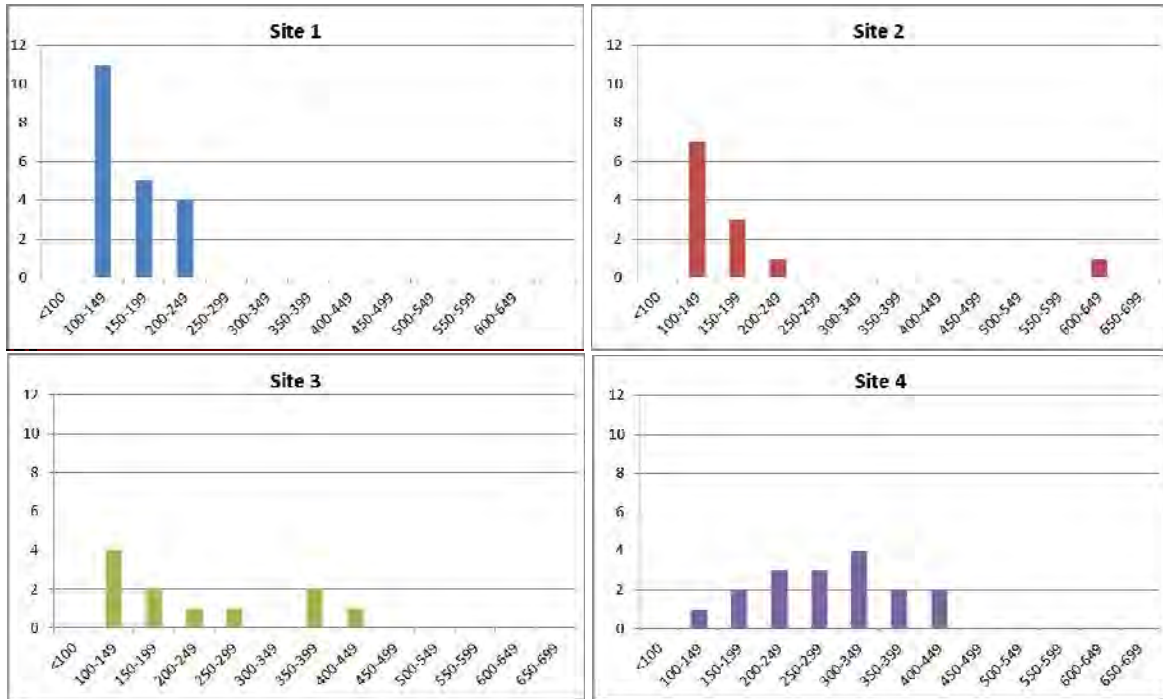


Figure 3 The size of range of eels recorded at each site

Length distribution data for all eels recorded are presented in Figure 3, while the number of fish recorded per square metre is presented in Figure 4.

Only two species were recorded at sites 1 and 2, while site 3 recorded three species, and four species were recorded at site 4. Longfin eel and shortfin eel were recorded both upstream and downstream of the weir, while redfin bully were only recorded downstream of the weir, and in very low abundance. A juvenile rainbow trout was recorded at site 3, and freshwater crayfish were recorded at all sites, being most abundant at site 2. This low species abundance, and also low redfin bully abundance is an indication that the Glenn Road weir is still having a significant deleterious effect on upstream fish migration. Although only two species were recorded upstream of the Kapuni Lactose weir, there is no indication that this weir is posing a significant barrier to fish passage. There were good numbers of juvenile eels recorded upstream of the weir (Figure 3), and no evidence of fish accrual immediately downstream of the weir (Figure 4). This would have been evident by higher fish abundance per square metre at site 2 than any other site, especially site 1.

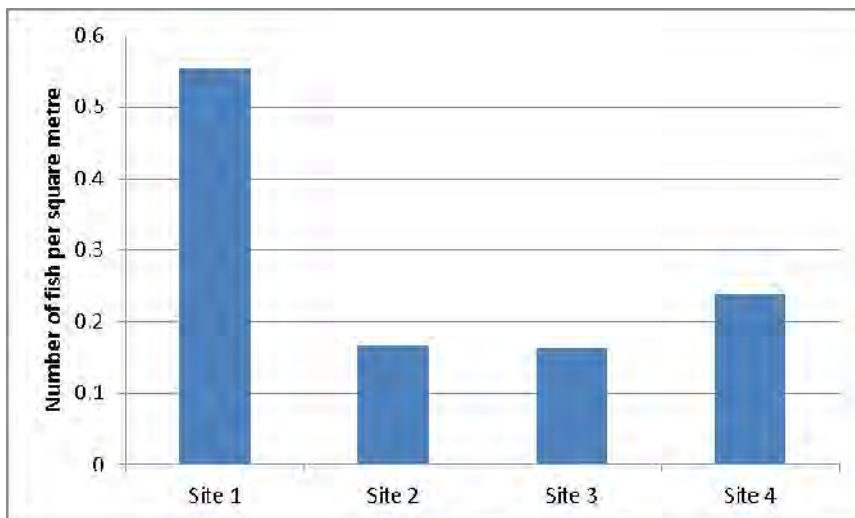


Figure 4 The average number of fish recorded per square metre sampled at each site

There is also no evidence that the discharge of cooling water to the Kaupokonui Stream has had a significant impact on the fish communities. Rainbow trout are considered to be one of the more 'sensitive' species, with regards to water quality, and the presence of a rainbow trout at site 3 is an indication of good preceding water quality (including water temperature). However, there were some differences in small eel distribution, with sites 3 and 4 having higher numbers of eels longer than 250mm. Only one eel longer than 250mm was recorded upstream of the cooling water discharge, compared with a total of fifteen eels at sites 3 and 4. This could be an indication that the cooling water discharge has caused an increase in food supply downstream, for example through nutrients contamination of the discharge. However, it is also likely to be related to the increased boulder habitat observed at sites 3 and 4, which provides ideal habitat for these small eels. This observation, coupled with the findings of the macroinvertebrate survey undertaken in February 2014 (Fowles & Jansma, 2015), indicates that there is little evidence of a cooling water impact. Although it is possible that a subtle impact has occurred, it is not possible to differentiate this from the changes caused by habitat variation.

Summary and Conclusions

A four site fish survey was undertaken in the Kaupokonui Stream on 30 January 2014, 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 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.

Four fish species were recorded during this survey, being longfin and shortfin eel, redfin bully and rainbow trout. Redfin bully were recorded in very low abundance, reflecting the impact of the Glenn Road weir.

Although only two species were recorded upstream of the Kapuni Lactose weir, longfin and shortfin eels, there is no indication that this weir is posing a significant barrier to fish passage. There were good numbers of juvenile eels recorded upstream of the weir, and no evidence of fish accrual immediately downstream of the weir.

The presence of rainbow trout downstream of the cooling water discharge is an indication that this discharge had not adversely affected the fish communities, as rainbow trout are considered to be one of the more 'sensitive' species with regards to water quality, including temperature. The higher abundance of eels between 250mm and 450mm is considered to be a reflection of the greater proportion of boulders in the substrate, which provide good cover for these fish.

Overall, it is considered that the activities of the Kapuni Lactose factory have not adversely affected the fish communities of the Kaupokonui Stream. It is hoped that as the riparian planting of the catchment matures, and passage remediation works at the Glenn Road weir are undertaken, that the diversity and abundance of fish in this stretch of stream will improve.

References

Jansma, B and Fowles, C: Biomonitoring of the Kaipokonui River and Waiokura Stream in relation to the Fonterra Kapuni farm and factory, February 2014. Report No. CF628.

Taranaki Regional Council, 1999: Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1998-1999. Technical Report 99-52, Taranaki Regional Council, Stratford.

Appendix V

Biomonitoring reports

To Job Manager, James Kitto
 From Scientific Officer, B Jansma
 Report No BJ256
 Doc No 1539920
 Date 15 July 2015

Biomonitoring of the Kaupokonui River in relation to the Fonterra Kapuni farm and factory, October 2014

Introduction

This biological survey was the first of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2014-2015 monitoring year. The results from surveys performed since the 2001-2002 monitoring year are discussed in reports listed in the references section of this report.

This survey relates to the following consents held by Fonterra Kapuni Ltd:

- 0919 to discharge cooling water to the Kaupokonui River;
- 0922 to spray irrigate wastewater and stormwater to land in the Kaupokonui catchment;
- 0923 to spray irrigate wastewater and stormwater to land in the Waiokura and Motumate catchments;
- 0924 to discharge stormwater and cooling water to the Kaupokonui River;
- 4235 to discharge stormwater to the Kaupokonui River during factory shutdown periods;
- 4604 to discharge stormwater to the Kaupokonui River from the factory extension;
- 6423 to discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui River

Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River in relation to discharges to the river and on to land in the catchment (Table 1, Figure 1) on 14 October 2014. The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Table 1 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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001).

Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20, produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways.

A semi-quantitative MCI value (SQMCI_s) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI_s is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

When necessary, sub-samples of periphyton (algae and other microflora) taken from the macroinvertebrate samples were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths") at a microscopic level. The presence of masses of these organisms can be an indicator of organic enrichment within a stream.



Figure 1 Biomonitoring sites in the Kaipokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a short period of receding flows in the Kaipokonui River, and followed 8 and 15 days after flow events in excess of three and seven times median flow respectively. The Kaipokonui River had a moderate, clear, uncoloured, and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 2.1 m³/sec, just above the median flow (2.04 m³/sec) for the Kaipokonui River.

At the time of this morning survey, water temperatures in the Kaipokonui River ranged from 12.8°C to 13.9°C. Periphyton mats and algal filaments were patchy all sites, with the exception of site 3b, which did not support any filaments. It was noted during this survey that site 7 was relatively clean, as this site usually supports widespread mats and long filaments. This is probably related to the high flows that preceded this survey, with flows exceeding seven times median twice, and three times median seven times in the preceding month. Cobbles, gravel and boulders were the predominant substrate at all sites in the river.

Of concern was the observation of undesirable heterotrophic growths (sewage fungus) on the bed of the stream at site 5, the first site downstream of the cooling water discharge. This sewage fungus was present as a thin film over much of the stream bed, but in smaller areas was quite thick. Observations at site 6 indicated that it was also present there, although to a lesser degree. The presence of sewage fungus at these sites was confirmed through microscopic examination of the sample, and identified as growths of filamentous bacteria.

Macroinvertebrate communities

Kaipokonui River

Historically the mid to lower reaches of the Kaipokonui River have shown the effects of nutrient enrichment from the surrounding farmland, and in past years (mainly prior to 2000) there have been a number of surveys showing detectable impacts of discharges from the lactose factory on the riverbed fauna. On many past sampling occasions, the sites immediately upstream and downstream of the Fonterra Kapuni factory supported moderate numbers of taxa, with relatively low proportions of 'sensitive' taxa (such as mayflies and stoneflies), resulting in median MCI values in the low 80s (Table 2). Since 1998 however, macroinvertebrate communities have improved throughout the reach and have shown higher numbers of taxa and MCI scores on most occasions. Median values for both the total data set and the results since 1998 are included in Table 2. Faunal results from the current survey are presented in full in Table 3.

Table 2 Numbers of taxa and MCI values recorded previously in the Kaipokonui River (since 1985), together with current results

Site	Number of previous surveys	Numbers of taxa				MCI values			
		Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey	Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey
3b	47	24	13-28	24	27	105	68-125	110	117
4	61	22	8-32	25	22	94	65-128	104	109
5	42	23	11-28	24	17	98	65-121	100	107
6	61	20	4-30	23	20	90	40-125	102	103
7	52	17	7-31	19	21	90	57-110	92	95

Generally the summer (February to March) surveys have found lower proportions of 'sensitive' taxa resulting in lower MCI values than the spring (October to November) surveys (see Figures 3, 4, 5, 6 and 7).

In this October 2014 survey, all sampling sites supported between 17 and 27 taxa. These results were all within 3 taxa of the site medians from data since 1998, with the exception of site 7, which recorded a richness seven taxa less than this median. MCI scores at all sites were above their respective median values for surveys since November 1998. The MCI scores at all sites also were well in excess of their respective median values for the entire record with the exception of the score at site 7 which was only five units above its historical median (Table 2, Figure 2). Four sites had very similar numbers of taxa, with site 5 recording the lowest richness of 17 taxa. MCI scores generally decreased steadily in a downstream direction, with the highest scores recorded at the 'control site'. MCI scores ranged from 97 to 117 units, reflecting relatively fair to good physicochemical water quality, indicating that land irrigation of wastewater had not adversely affected the Kaipokonui River macroinvertebrate communities in the months prior to this survey but that there were some impacts of the cooling water discharges in the mid-reaches of the river as indicated by the presence of sewage fungus at sites 5 and 6. Similar to results frequently recorded by most previous surveys, there was an eight unit decrease in scores between sites 6 and 7, indicating further impacts on the macroinvertebrate communities at site 7. In most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the natural decrease in MCI with distance downstream in the lower mid-reaches of the Taranaki ringplain, over a stream distance of about 9 km (of 5 units (Stark and Fowles, 2009)) should also be taken into account.

The 'fair' to 'good' MCI scores did not reflect the results of the microscopic scan for undesirable biological growths, which recorded such growths at sites 5 and 6. This indicates that although the cooling water discharge was facilitating the growth of sewage fungus, it either had not been occurring for very long, and/or was not causing sufficient deterioration in water quality that caused a reduction in macroinvertebrate community health. The last time such growths were noted in the Kaipokonui River was during the spring 2010 survey, which found dense growths of filamentous bacteria at two sites.

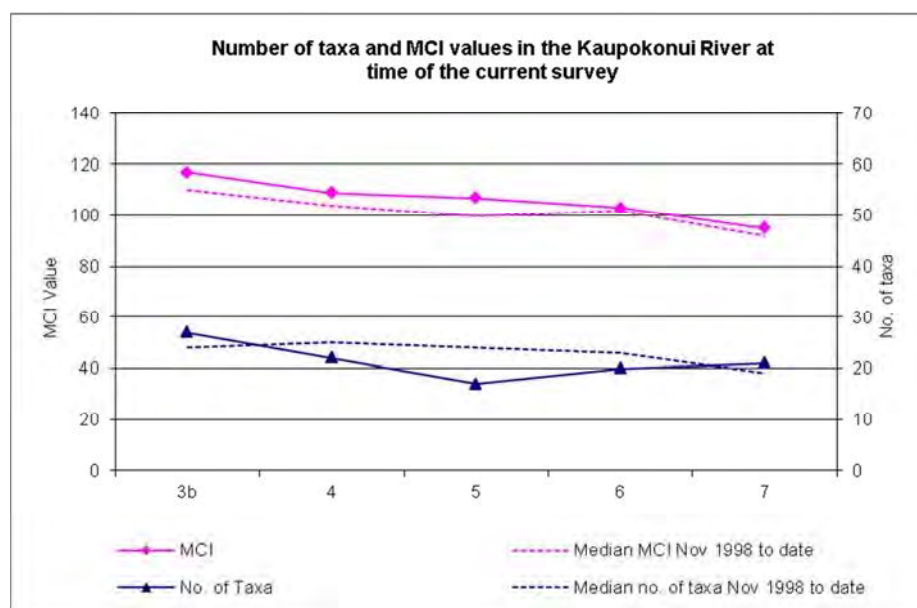


Figure 2 Numbers of taxa and MCI values recorded in the Kaipokonui River in this survey, together with median values from previous surveys (November 1998 to date)

Table 3 Macroinvertebrate fauna of the Kaipokonui River in relation to Fonterra Kapuni samples on 14 October 2014

Taxa List	Site Number	MCI score	3b	4	5	6	7
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880
	Sample Number		FWB14261	FWB14262	FWB14263	FWB14264	FWB14265
PLATYHELMINTHES	<i>Cura</i>	3	-	-	-	-	R
NEMATODA	Nematoda	3	-	-	C	R	R
ANNELIDA	Oligochaeta	1	C	A	R	C	A
	Lumbricidae	5	-	-	-	-	R
MOLLUSCA	<i>Potamopyrgus</i>	4	C	C	R	-	C
CRUSTACEA	<i>Paracaliope</i>	5	-	-	-	-	R
EPHEMEROPTERA	<i>Acanthophlebia</i>	9	R	-	-	-	-
	<i>Austroclima</i>	7	C	C	R	R	-
	<i>Coloburiscus</i>	7	VA	VA	A	A	R
	<i>Deleatidium</i>	8	XA	VA	VA	XA	VA
	<i>Nesameletus</i>	9	C	-	R	-	-
	<i>Zephlebia group</i>	7	-	-	-	-	R
PLECOPTERA	<i>Acroperla</i>	5	C	R	-	R	C
	<i>Megaleptoperla</i>	9	R	R	-	-	-
	<i>Zelandobius</i>	5	C	R	-	-	R
	<i>Zelandoperla</i>	8	R	-	-	-	-
COLEOPTERA	Elmidae	6	A	VA	C	A	C
	Hydraenidae	8	R	-	-	R	-
MEGALOPTERA	<i>Archichauliodes</i>	7	A	A	C	C	C
TRICHOPTERA	<i>Hydropsyche (Aoteapsyche)</i>	4	VA	VA	C	A	R
	<i>Costachorema</i>	7	A	A	C	C	C
	<i>Hydrobiosis</i>	5	R	R	R	C	A
	<i>Neurochorema</i>	6	R	-	-	-	-
	<i>Psilochorema</i>	6	-	-	-	R	-
	<i>Beraeoptera</i>	8	A	R	R	R	-
	<i>Olinga</i>	9	R	R	-	-	-
	<i>Pycnocentroides</i>	5	VA	C	R	A	VA
DIPTERA	<i>Aphrophila</i>	5	A	VA	C	A	C
	<i>Maoridiamesa</i>	3	A	VA	A	A	VA
	Orthoclaadiinae	2	VA	VA	VA	VA	A
	Tanypodinae	5	R	R	-	-	-
	Tanytarsini	3	R	-	-	R	-
	<i>Austrosimulium</i>	3	-	-	-	-	R
	Tabanidae	3	R	R	-	R	-
ACARINA	Acarina	5	-	R	-	-	-
No of taxa			27	22	17	20	21
MCI			117	109	107	103	95
SQMCIs			6.4	5.0	5.1	6.6	4.9
EPT (taxa)			16	12	9	10	9
%EPT (taxa)			59	55	53	50	43
'Tolerant' taxa	'Moderately sensitive' taxa			'Highly sensitive' taxa			

R = Rare

C = Common

A = Abundant

VA = Very Abundant

XA = Extremely Abundant

Site 3b (KPK000655)

A moderately high richness of twenty-seven taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was slightly higher than the long term median number of taxa recorded at this site to date (Table 3) and the median richness of more recent records (since 1998). The community was characterised by eleven taxa including two 'highly sensitive' taxa [mayfly (*Deleatidium*) and caddisfly (*Beraeoptera*)]; six 'moderately sensitive' taxa [*Coloburiscus* mayfly, elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisflies (*Costachorema*), stony-cased caddisfly (*Pycnocentroides*), and crane-fly (*Aphrophila*)]; and three 'tolerant' taxa [net-spinning caddisfly (*Aoteapsyche*) and extremely abundant midges (orthoclads and *Maoridiamesa*)]. This dominance represented an increase in the relative proportions of 'highly sensitive' to 'tolerant' taxa dominating the community, in comparison with the characteristic taxa found by the previous summer (2014) survey.

The moderate proportion of 'tolerant' taxa in the community (26% of taxa richness) was reflected in the MCI score (117) which was similar to the previous summer (2014) survey score and six units higher than the previous spring score at this site (Figure 3). The presence of eight 'highly sensitive' taxa indicated good preceding physicochemical water quality at this control site, above all Fonterra activities in the Kaupokonui River catchment.

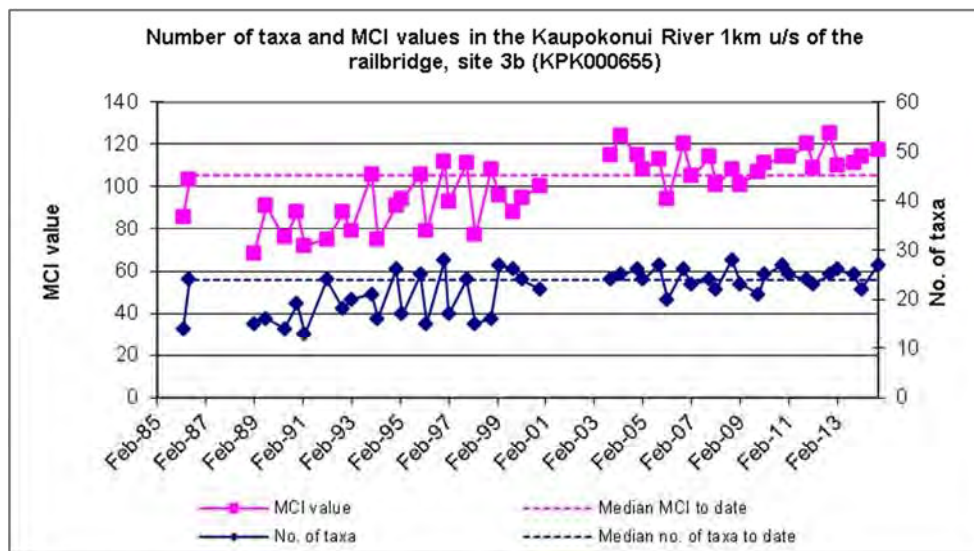


Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaupokonui River since 1985

The MCI score of 117 units was well within the range recorded in recent surveys (Figure 3). It was seven units higher than the median score for surveys since 1998 and twelve units higher than the median from all surveys conducted to date (Figure 2, Table 3). The numerical dominance by 'sensitive' taxa, in particular the extremely abundant 'highly sensitive' mayfly *Deleatidium* resulted in the SQMCI_s value of 6.4 units, a significant 2.7 units higher than the SQMCI_s value found at this site by the previous summer (2014) survey.

Site 4 (KPK000660)

A moderate richness of twenty-two macroinvertebrate taxa was recorded in the community at site 4, upstream of the Fonterra Kapuni weir and rail bridge, and downstream of the area of land irrigated by wastes from Fonterra Kapuni. This taxa richness was slightly less than the numbers of taxa recorded in recent monitoring years (Figure 4), and five less than that recorded at site 3b by this current survey (Table 3).

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisflies (*Costachorema*), and crane fly (*Aphrophila*)]; and four 'tolerant' taxa [oligochaete worms, net-spinning caddisfly (*Aoteapsyche*), and midges (orthoclads and *Maoridiamesa*)]. Only three taxa showed a significant change in abundances between sites 3b and 4 (Table 3).

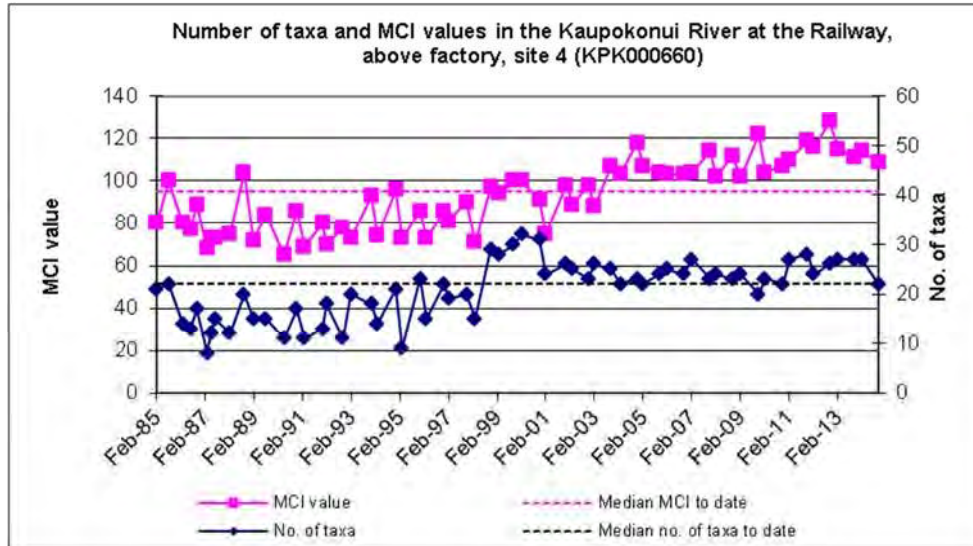


Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaipokonui River since February 1985

The MCI score at site 4 was eight units less than the score recorded upstream at site 3b (Stark, 1998), reflecting a slightly less sensitive community composition (Table 3). The MCI score was significantly higher (Stark, 1998) than the historic median recorded to date and five units above the median of values since 1998 (Table 3, Figure 4), continuing a trend of higher than average values over the last twenty-three surveys. This indicated 'good' generic health (TRC, 2013) and that this site had good physicochemical water quality preceding this survey.

The SQMCI_s value for this (5.0 units) was 1.4 units lower than that at site 3b (Table 3), primarily due to decreased abundance of two 'highly sensitive' taxa, in particular *Deleatidium* mayfly. This score indicated that the community was dominated by similar proportions of 'sensitive' and 'tolerant' taxa and this was further confirmation that the community had not been recently adversely affected by land irrigation upstream of this site.

In prior surveys some of the deterioration in biological 'health' between sites 3b and 4 had been attributed to the impacts of dairy shed wastes assimilation in the receiving waters of the inflowing tributary a short distance upstream of site 4. No such deterioration was indicated by the results of this survey.

Site 5 (KPK000679)

A reduced richness of seventeen macroinvertebrate taxa was found at site 5, downstream of the cooling water discharges from Fonterra Kapuni. This was seven taxa less than the median number of taxa recorded at this site since 1998 (Table 3, Figure 2). This richness was also five taxa fewer than recorded at site 4 located upstream of the cooling water discharges.

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; one 'moderately sensitive' taxon [mayfly (*Coloburiscus*)]; and two 'tolerant' taxa [midges (*Maoridiamesa* and orthoclads)] (Table 3). This represents a reduction in the number of abundant taxa from that recorded in the previous (summer 2014) survey.

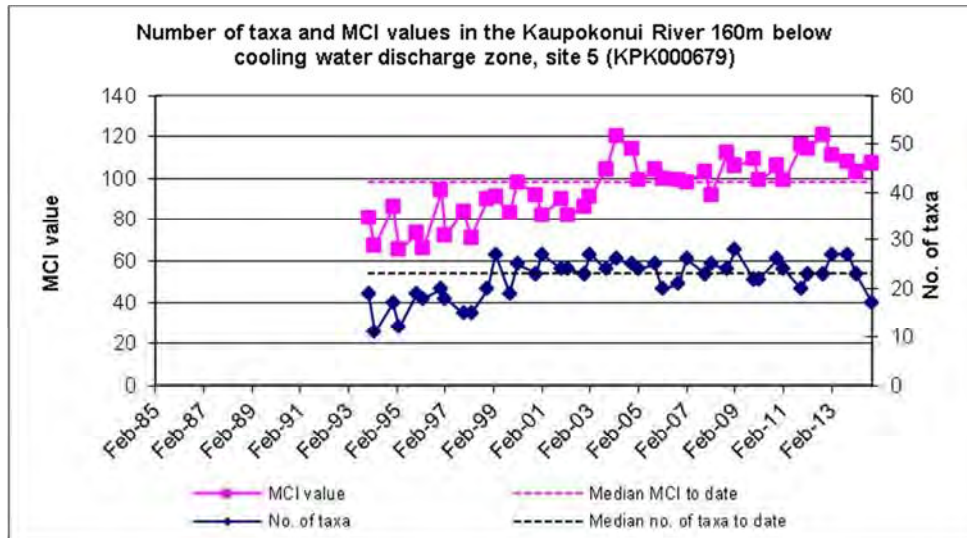


Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaipokonui River

The MCI score (107 units) was higher than most of the earlier surveys' scores, especially those prior to 2003 (Figure 5) and nine units above the median of scores from all surveys to date (Figure 2, Table 2). This MCI score was similar to that recorded at site 4 upstream of the cooling water spray discharge, despite the widespread growth of sewage fungus. This indicates that the deterioration in water quality that has resulted in the sewage fungus outbreak was not sufficiently bad enough to cause a deterioration in macroinvertebrate health. This was further reinforced by the absence of taxa indicative of severe organic enrichment (e.g. blood worm midge (*Chironomus*)).

The SQMCI_s value (5.1 units) was similar to that recorded at site 4, but 1.3 units lower than that recorded at site 3b. As with sites 3b and 4, the community at this site was dominated by *Deleatidium* mayfly, which was very abundant. This explained the similarity in SQMCI_s values between these sites, and overall was not indicative of significant impacts from the cooling water discharge.

It should be noted that the historical MCI median at this site was lowered by some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Most surveys in recent years had found no sign of the 'sewage fungus' growths that were recorded at site 5 in several of the 1980s and early 1990s surveys. However, an extensive 'sewage fungus' outbreak occurred in this reach of the river during the autumn-winter months of 2007. Mats of filamentous bacteria and protozoa ('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, and 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, such as the appearance of the blood worm 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. The current

survey again recorded the presence of 'sewage fungus' growth, but not the presence of blood worm midges, indicating that a poor quality cooling water discharge was (or had recently 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.

Site 6 (KPK000685)

An increased richness of twenty taxa was recorded at site 6, at Skeet Road, a further 700 m below the cooling water discharges. This was three taxa fewer than the median number of taxa since 1998 for this site but equal to the historical median. It was however three taxa more than found at the nearest upstream site 5 (Table 2, Figure 2 and Figure 6).

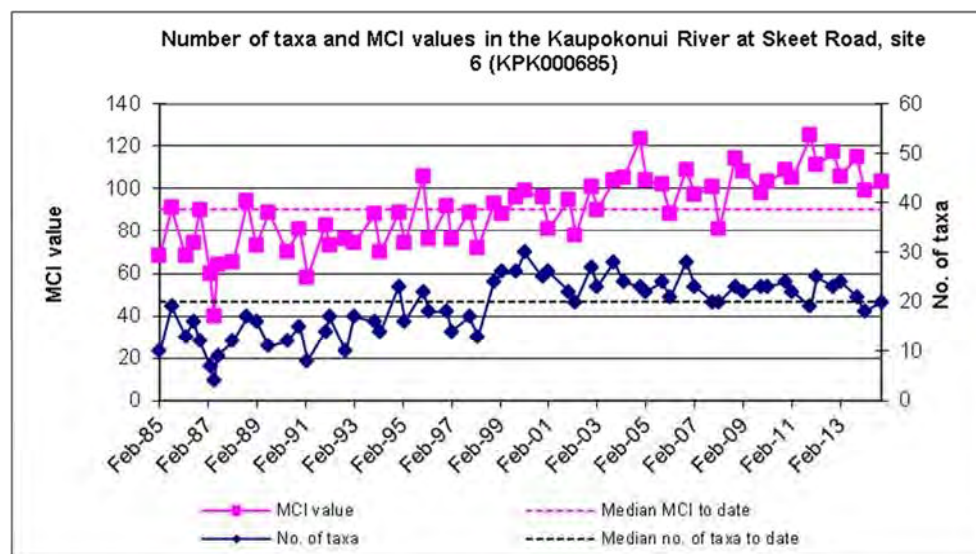


Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaipokonui River, at Skeet Road, since February 1985

This community was characterised by more taxa than at site 5, with one 'highly sensitive' taxon (extremely abundant *Deleatidium* mayfly); four 'moderately sensitive' taxa [*Coloburiscus* mayfly, elmids beetles, caddisfly (*Pycnocentroides*) and crane fly (*Aphrophila*)]; and three 'tolerant' taxa [(net-spinning caddisfly (*Aoteapsyche*) and midges (orthoclads, and *Maoridiamesa*)] (Table 3). This represented an increase in the number of abundant 'sensitive' taxa from that recorded at site 5.

The MCI score of 103 units was thirteen units higher than the historical median for this site but only one unit higher than the median of scores recorded since 1998. Although this result was lower than that recorded by most recent surveys, it was still higher than the majority of previous surveys undertaken to date (Figure 2, Table 2). The MCI score at this site can be variable (Figure 6), and as the current result was much higher than the long-term median score and only six units below the score recorded at site 4 (upstream of the cooling water discharges), there was no indication of marked deterioration in community health at this site at the time of the current survey. This is despite the presence of sewage fungus growths recorded on the substrate.

The SQMCI_s (6.6 units) was 1.5 units higher than that recorded at site 5, suggesting an improvement in the health of the community structure. It was also the highest SQMCI_s score recorded in this survey. Only one taxon changed significantly in abundance at this site (from site 5), but the increased abundance of 'highly sensitive' *Deleatidium* mayfly, which was recorded in extreme abundance, was the primary driver behind the improved SQMCI_s score.

This indicated that the subtle effects recorded by some past surveys were minimal at the time of the current survey and not considered to be significant in terms of impacts on the macroinvertebrate communities recorded at this site. As with site 5 upstream, although sewage fungus was recorded as present at this site, the degree of deterioration in water quality that resulted in this growth was not sufficient to cause deterioration in macroinvertebrate community health.

Site 7 (KPK000880)

A moderate richness of twenty-one taxa was recorded at site 7, at Upper Glenn Road (Table 2), above both the long term median and the median richness of surveys since 1998. One 'highly sensitive' taxon was present in this community, being the very abundant *Deleatidium* mayfly; fewer than that found at the four upstream sites, but typical of the number recorded by most previous surveys. Characteristic taxa included the one aforementioned 'highly sensitive' mayfly; two 'moderately sensitive' taxa [free-living caddisfly (*Hydrobiosis*) and stony-cased caddisfly (*Pycnocentroides*)]; and three 'tolerant' taxa [oligochaete worms, and midges (orthoclads and *Maoridiamesa*)]. Despite the distance between sites 6 and 7 and a degree of natural deterioration in macroinvertebrate communities normally found in a downstream direction over such a distance, the community compositions were more dissimilar than usual between the two sites with only fourteen (of 27) taxa common to both communities.

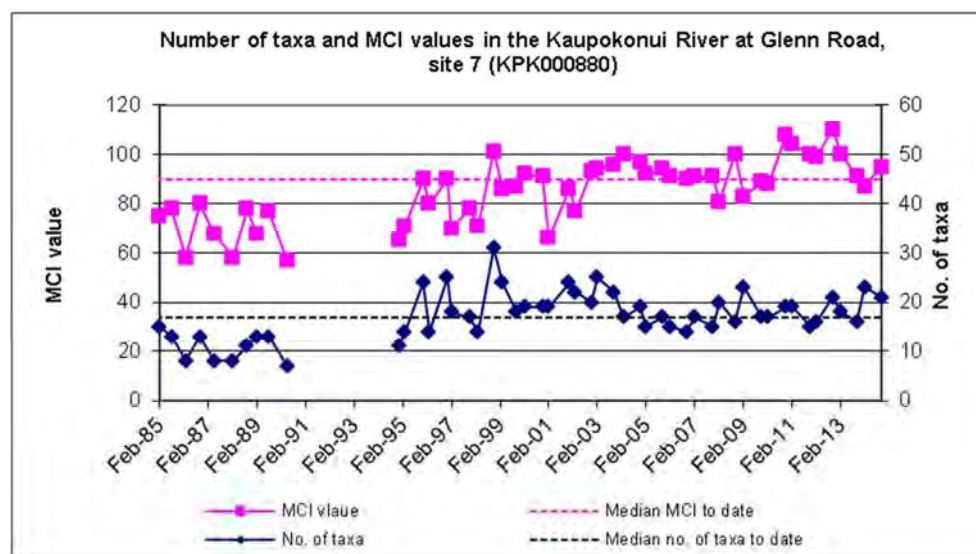


Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaipokonui River, since February 1985

The proportion of 'tolerant' taxa (38% of taxa number) reduced from that recorded in the previous summer (2014) survey resulted in an increased MCI score of 95 units. This score was three units higher than the median of scores since 1998, and five units higher than the historic median at this site (Table 2, Figure 7), neither of which was a statistically significant difference (Stark, 1998). This indicated some recovery from that recorded in the previous two surveys, and is a return to the above-median health normally recorded since 2010 (Figure 7). The current MCI score was eight units less than that recorded at site 6, some 9 km upstream. This was a relatively typical trend though this reach, and an improvement on that recorded in the previous two surveys. It also reflects the natural downstream deterioration typical of ringplain streams and rivers, with streams and rivers at this altitude and distance from the National Park boundary typically seeing a reduction in MCI score of approximately 0.6 MCI unit/km (Stark and Fowles, 2009).

The SQMCI_s score (4.9) showed a significant decrease, being 1.7 units lower than the score at the nearest upstream site (Table 3). This change was principally due to an increased abundance of 'very tolerant' oligochaete worms and decreased abundances of two 'sensitive' mayfly taxa (*Coloburiscus* and *Deleatidium*). Generally, there has been a decreasing trend in SQMCI_s scores between sites 6 and 7, (especially in the summer surveys). This was usually due to the distance between the sites and the influence of the Dunns Creek tributary, which joins the river between the two sites. Occasionally, there has been little difference, due to site 6 showing impacts from the cooling water discharge. In the current survey, there was minor evidence of some cooling water discharge influence at site 6, indicating that the deterioration in community health at site 7 may be largely attributed to some typical downstream deterioration and the additional influence of the Dunns Creek tributary.

Summary and Conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River on 14 October 2014. Samples were sorted and identified to provide the number of taxa (richness), MCI and SQMCI_s scores for each site. The samples were also microscopically scanned to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths").

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.

In the Kaupokonui River, taxa richnesses were similar to or higher than historical median richnesses (with the exception of site 5), while MCI scores indicated 'good' to 'fair' community health at all sites. MCI scores declined in a downstream direction, but only to the degree expected, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. The MCI scores at all five sites were higher than their historical median scores, and the three sites downstream of the cooling water discharges showed some improvement in community health from that recorded by the previous summer survey, which is a fairly typical result for a spring survey. The survey continued to show that the Kaupokonui River generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 7, was indicative of some influence from the Dunns Creek tributary within the reach between sites 6 and 7.

Of concern was the presence of sewage fungus on the bed of the River at the first site downstream of the cooling water discharge (site 5) and also at Skeet Rd (site 6). This sewage fungus was visible at site 5, where a thin film was observed covering much of the stream bed. At site 6 it was only confirmed through microscopic examination of the sample. The results of the current survey indicated that the deterioration in water quality that had resulted in the sewage fungus outbreak was not sufficiently severe to cause a deterioration in macroinvertebrate health.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, with the communities appearing healthier than that recorded in the previous summer survey, a relatively typical result. Although the presence of sewage fungus at sites 5 and 6 indicated some deterioration in biological health, it was not to the degree recorded by the 2010 spring survey. At that time subtle impacts, such as the appearance of the blood worm 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. The current survey did not record the presence of blood worm midges, indicating that a poor quality cooling water discharge was (or had recently been) occurring, but that it had not resulted in the same degree of deterioration in water quality as that recorded in spring 2010. In addition, there was no deterioration in the macroinvertebrate communities between sites upstream and downstream of spray irrigation of wastes onto land (but upstream of the cooling water discharge) from the Fonterra Kapuni factory recorded by the current survey.

MCI values continued to indicate in general that macroinvertebrate communities were mainly in 'good' health, being above median MCI scores from surveys conducted since 1998. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, although there were some exceptions at site 5. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was not a statistically significant result, but was a result commonly recorded in this river, often due to progressive deterioration in communities in a downstream direction, typical of Taranaki ringplain rivers and streams.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which also recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. Such growths were again recorded by the current survey, but there were only subtle impacts on the macroinvertebrate communities recorded at these sites.

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To Job Manager, James Kitto
From Scientific Officer, B Jansma
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Doc No 1542459
Date 20 July 2015

Biomonitoring of the Kaipokonui River and Waiokura Stream in relation to the Fonterra Kapuni farm and factory, February 2015

Introduction

This biological survey was the second of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2014-2015 monitoring year. The results from surveys performed since the 2001-2002 monitoring year are discussed in reports listed in the references section of this report.

This survey relates to the following consents held by Fonterra Kapuni Ltd:

- 0919 to discharge cooling water to the Kaipokonui River;
- 0922 to spray irrigate wastewater and stormwater to land in the Kaipokonui catchment;
- 0923 to spray irrigate wastewater and stormwater to land in the Waiokura and Motumate catchments;
- 0924 to discharge stormwater and cooling water to the Kaipokonui River;
- 4235 to discharge stormwater to the Kaipokonui River during factory shutdown periods;
- 4604 to discharge stormwater to the Kaipokonui River from the factory extension;
- 6423 to discharge stormwater from an inhalation grade lactose plant site into the Kaipokonui River

Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from seven sites in the Kaipokonui River and Waiokura Stream in relation to discharges to the river and on to land in the catchment (Table 1, Figure 1) on 19 February 2015. The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Table 1 Biomonitoring sites in the Kaipokonui River and Waiokura Stream

Stream	Site No.	Site Code	Location
Kaipokonui 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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001).

Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20, produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways.

A semi-quantitative MCI value (SQMCI_s) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI_s is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

When necessary, sub-samples of periphyton (algae and other microflora) taken from the macroinvertebrate samples were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths") at a microscopic level. The presence of masses of these organisms can be an indicator of organic enrichment within a stream.



Figure 1 Biomonitoring sites in the Kaipokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a long period of receding flows in the Kaupokonui River, and followed 60 and 143 days after flow events in excess of three and seven times median flow respectively. The Kaupokonui River had a very low, clear, uncoloured, and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 0.703 m³/sec, just below the mean annual low flow (0.755 m³/sec), and well below median flow (2.04 m³/sec) for the Kaupokonui River.

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 18.7°C to 17.2°C. Periphyton mats and algal filaments were patchy to widespread at all sites, a direct reflection of the lack of preceding scouring flows. Cobbles, gravel and boulders were the predominant substrate at all sites in the river. The Waiokura Stream sites had a finer substrate with the bed primarily composed of gravels and cobbles, with slightly higher proportions of sand and silt than in the Kaupokonui River and some boulders at site U. Aquatic vegetation grew throughout the stream at site D, with *Myriophyllum* the dominant macrophyte. Algae were noted only as slippery films on the substrate at site U, while site D supported patches of algal mats and filaments. Water temperatures ranged from 14.4°C to 15.6°C at the time of this early-morning component of the survey. The Waiokura Stream had also recorded an extended period of stable flows, with this survey performed 144 and 158 days after flow events in excess of three and seven times median flow respectively.

Macroinvertebrate communities

Kaupokonui River

Historically the mid to lower reaches of the Kaupokonui River have shown the effects of nutrient enrichment from the surrounding farmland, and in past years (mainly prior to 2000) there have been a number of surveys showing detectable impacts of discharges from the lactose factory on the riverbed fauna. On many past sampling occasions, the sites immediately upstream and downstream of the Fonterra Kapuni factory supported moderate numbers of taxa, with relatively low proportions of 'sensitive' taxa (such as mayflies and stoneflies), resulting in median MCI values in the low 80s (Table 2). Since 1998 however, macroinvertebrate communities have improved throughout the reach and have shown higher numbers of taxa and MCI scores on most occasions. Median values for both the total data set and the results since 1998 are included in Table 2. Faunal results from the current survey are presented in full in Table 3.

Generally the summer (February to March) surveys have found lower proportions of 'sensitive' taxa resulting in lower MCI values than the spring (October to November) surveys (see Figures 3, 4, 5, 6 and 7).

Table 2 Numbers of taxa and MCI values recorded previously in the Kaupokonui River (since 1985), together with current results

Site	Number of previous surveys	Numbers of taxa				MCI values			
		Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey	Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey
3b	48	24	13-28	25	22	106	68-125	111	107
4	62	22	8-32	25	27	95	65-128	104	100
5	43	23	11-28	24	26	98	65-121	100	102
6	62	20	4-30	23	27	91	40-125	102	104
7	51	17	7-31	19	18	89	57-110	92	84

In this February 2015 survey, all sampling sites supported between 18 and 27 taxa. These results were all within four taxa of the site medians from data since 1998. MCI scores at all sites were similar to their respective median values for surveys since November 1998, with the exception of site 7, which recorded a score eight units less than this median. The MCI scores at sites 3b, 4, 5 and 6 were slightly higher than their respective median values for the entire record with site 7 being the exception, with a score which was six units below its historical median (Table 2, Figure 2). Four sites had very similar numbers of taxa, with site 7 recording the lowest richness of 18 taxa. MCI scores were relatively stable in a downstream direction, although the highest score was recorded at the 'control site' (site 3b), and the lowest (by twenty units) was recorded at site 7. MCI scores ranged from 84 to 107 units, reflecting relatively 'fair' to 'good' physicochemical water quality, indicating that land irrigation of wastewater had not adversely affected the Kaipokonui River macroinvertebrate communities in the months prior to this survey. There was also no obvious impact of the cooling water discharges in the mid-reaches of the river as indicated by the lack of sewage fungus at the downstream sites. Worse than that frequently recorded by most previous surveys, there was a twenty unit decrease in scores between sites 6 and 7, indicating further impacts on the macroinvertebrate communities at site 7. In most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the natural decrease in MCI with distance downstream in the lower mid-reaches of the Taranaki ringplain, over a stream distance of about 9 km (of 5 units (Stark and Fowles, 2009)) should also be taken into account. In this case this is considered to still be the case, but amplified by the extremely long period of stable flows that preceded this survey.

The 'fair' to 'good' MCI scores were also reflected by the results of the microscopic scan for undesirable biological growths, which recorded no such growths at any site. This is an improvement from that recorded in the previous survey, which recorded sewage fungus at sites 5 and 6. This indicates that the cooling water discharge had either improved in quality, or was being better assimilated. Considering the low flows noted during this survey, the former is most likely to be the case.

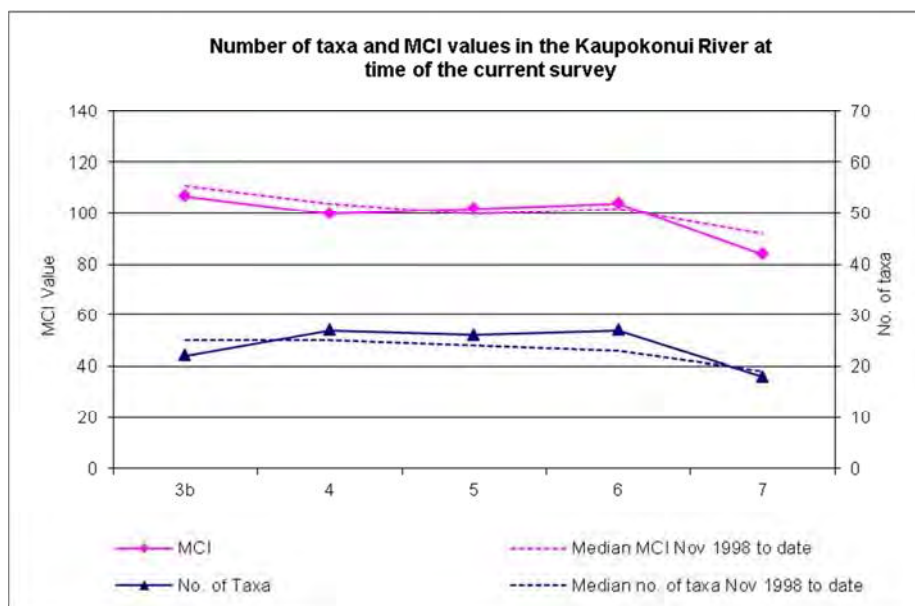


Figure 2 Numbers of taxa and MCI values recorded in the Kaipokonui River in this survey, together with median values from previous surveys (November 1998 to date)

Table 3 Macroinvertebrate fauna of the Kaipokonui River in relation to Fonterra Kapuni samples on 19 February 2015

Taxa List	Site Number	MCI score	3b	4	5	6	7
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880
	Sample Number		FWB15151	FWB15152	FWB15153	FWB15154	FWB15155
PLATYHELMINTHES	<i>Cura</i>	3	-	R	-	-	R
NEMERTEA	Nemertea	3	-	-	R	C	C
NEMATODA	Nematoda	3	-	R	-	C	-
ANNELIDA	Oligochaeta	1	C	C	C	R	A
	Lumbricidae	5	-	-	C	R	-
MOLLUSCA	<i>Ferrissia</i>	3	-	R	-	-	-
	<i>Potamopyrgus</i>	4	C	A	A	VA	VA
CRUSTACEA	<i>Paracalliope</i>	5	-	-	-	R	-
EPHEMEROPTERA	<i>Austroclima</i>	7	A	A	C	C	R
	<i>Coloburiscus</i>	7	C	A	A	A	R
	<i>Deleatidium</i>	8	VA	VA	A	VA	C
	<i>Nesameletus</i>	9	R	R	R	-	-
PLECOPTERA	<i>Stenoperla</i>	10	-	-	-	R	-
COLEOPTERA	Elmidae	6	VA	VA	A	VA	C
	Hydraenidae	8	-	R	R	R	-
	Staphylinidae	5	-	R	-	-	-
MEGALOPTERA	<i>Archichauliodes</i>	7	A	A	C	A	A
TRICHOPTERA	<i>Hydropsyche (Aoteapsyche)</i>	4	VA	XA	VA	XA	C
	<i>Costachorema</i>	7	R	A	R	R	-
	<i>Hydrobiosis</i>	5	A	A	A	VA	A
	<i>Neurochorema</i>	6	R	-	R	R	-
	<i>Psilochorema</i>	6	R	-	-	-	-
	<i>Beraeoptera</i>	8	R	R	-	R	-
	<i>Olinga</i>	9	R	R	R	R	-
	<i>Oxyethira</i>	2	R	C	R	A	A
	<i>Pycnocentroides</i>	5	C	R	C	A	VA
DIPTERA	<i>Aphrophila</i>	5	R	R	C	R	-
	<i>Limonia</i>	6	-	-	R	-	-
	<i>Maoridiamesa</i>	3	-	R	C	-	C
	Orthocladinae	2	XA	VA	A	A	VA
	Tanytarsini	3	C	A	VA	XA	A
	Empididae	3	-	C	-	C	-
	Ephydriidae	4	R	-	R	-	-
	Muscidae	3	C	C	C	-	C
	<i>Austrosimulium</i>	3	-	-	R	R	C
	Tanyderidae	4	-	-	-	R	-
ACARINA	Acarina	5	-	R	-	-	-
No of taxa			22	27	26	27	18
MCI			107	100	102	104	84
SQMCI			3.7	4.6	4.3	4.2	3.7
EPT (taxa)			12	10	10	11	6
%EPT (taxa)			55	37	38	41	33
'Tolerant' taxa	'Moderately sensitive' taxa			'Highly sensitive' taxa			

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 3b (KPK000655)

A moderate richness of twenty-two taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was slightly less than the long term median number of taxa recorded at this site to date (Table 3) and the median richness of more recent records (since 1998). The community was characterised by seven taxa including one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; four 'moderately sensitive' taxa [*Austroclima* mayfly, elmids beetles, dobsonfly (*Archichauliodes*) and the free-living caddisflies (*Hydrobiosis*)]; and two 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and extremely abundant orthoclad midges. This dominance represented an decrease in the relative proportions of 'highly sensitive' to 'tolerant' taxa dominating the community, in comparison with the characteristic taxa found by the previous spring (2014) survey.

The moderate proportion of 'tolerant' taxa in the community (36% of taxa richness) was reflected in the MCI score (107) which was lower than most recent surveys, and reflective of the long period of stable flows and relatively prolific periphyton growths observed. This score was ten units less than that recorded in the previous spring survey (Figure 3). The presence of four 'highly sensitive' taxa indicated good preceding physicochemical water quality at this control site, above all Fonterra activities in the Kaipokonui River catchment.

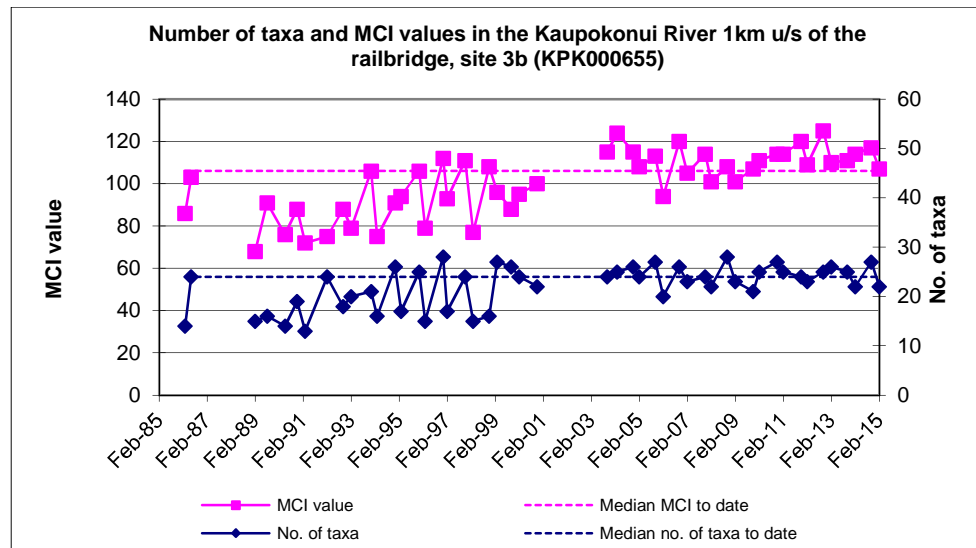


Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaipokonui River since 1985

The MCI score of 107 units was well within the range recorded in recent surveys (Figure 3). It was four units lower than the median score for surveys since 1998 and only one unit higher than the median from all surveys conducted to date (Figure 2, Table 3). Although there were more 'sensitive' taxa recorded in abundance than 'tolerant' taxa, the extremely abundant 'tolerant' orthoclad midges resulted in the SQMCI_s value of 2.7 units, a significant 2.7 units lower than the SQMCI_s value found at this site by the previous spring (2014) survey.

Site 4 (KPK000660)

A moderate richness of twenty-seven macroinvertebrate taxa was recorded in the community at site 4, upstream of the Fonterra Kapuni weir and rail bridge, and downstream of the area of land irrigated by wastes from Fonterra Kapuni. This taxa richness was slightly more than the numbers of taxa recorded in recent monitoring years (Figure 4), and five more than that recorded at site 3b by this current survey (Table 3).

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; six 'moderately sensitive' taxa [mayflies (*Austroclima* and *Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*) and free-living caddisflies (*Costachorema* and *Hydrobiosis*); and four 'tolerant' taxa [*Potamopyrgus* snails, net-spinning caddisfly (*Hydropsyche-Aoteapsyche*), and midges (orthoclads and tanytarsids)]. Only one taxon showed a significant change in abundance between sites 3b and 4 (Table 3).

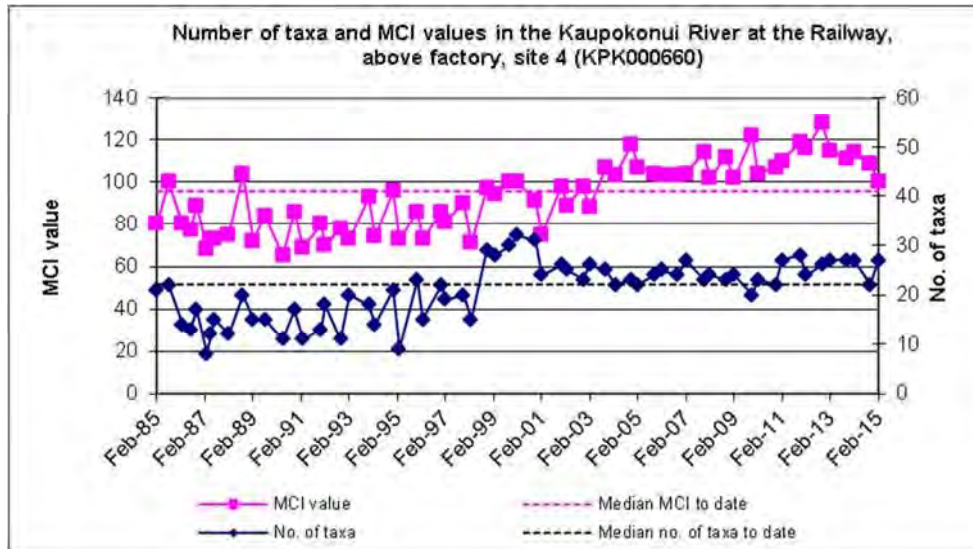


Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaipokonui River since February 1985

The MCI score at site 4 was seven units less than the score recorded upstream at site 3b, reflecting a slightly less sensitive community composition (Table 3). The MCI score was four units below the median of values since 1998 but slightly higher than the historic median recorded to date (Table 3, Figure 4), continuing a trend of higher than average values over the last twenty-four surveys. This indicated 'good' generic health (TRC, 2015) and that this site had good physicochemical water quality preceding this survey.

The SQMCI_s value for this (4.6 units) was 0.9 unit higher than that at site 3b (Table 3), primarily due to decreased abundance of 'tolerant' orthoclad midge larvae, coupled with an increased abundance of the less 'tolerant' net-spinning caddisfly *Hydropsyche-Aoteapsyche*. This score indicated that the community was dominated by similar proportions of 'sensitive' and 'tolerant' taxa and this was further confirmation that the community had not been recently adversely affected by land irrigation upstream of this site.

In prior surveys some of the deterioration in biological 'health' between sites 3b and 4 had been attributed to the impacts of dairy shed wastes assimilation in the receiving waters of the inflowing tributary a short distance upstream of site 4. No such deterioration was indicated by the results of this survey.

Site 5 (KPK000679)

A moderate richness of twenty-six macroinvertebrate taxa was found at site 5, downstream of the cooling water discharges from Fonterra Kapuni. This was three taxa more than the median number of taxa recorded at this site since 1998, and nine more than that recorded in the previous survey (Table 3, Figure 2)). This richness was only one taxon fewer than recorded at site 4 located upstream of the cooling water discharges.

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; three 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles and free swimming caddisfly (*Hydrobiosis*)]; and four 'tolerant' taxa [snail (*Potamopyrgus*), net spinning caddisfly (*Hydropsyche-Aoteapsyche*) and midges (orthoclads and tanytarsids)] (Table 3). This represents an increase in the number of abundant taxa from that recorded in the previous (spring 2014) survey.

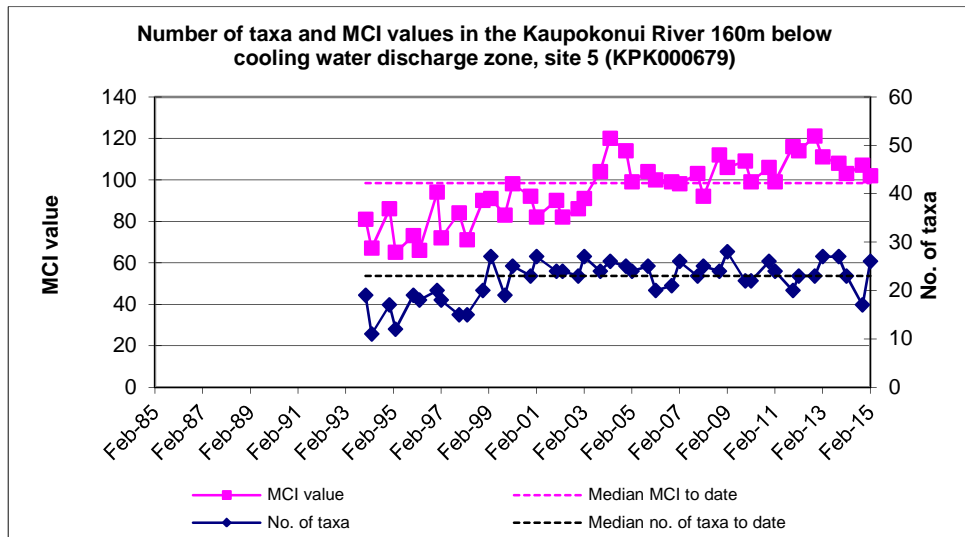


Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaipokonui River

The MCI score (102 units) was higher than most of the earlier surveys' scores, especially those prior to 2003 (Figure 5) and four units above the median of scores from all surveys to date (Figure 2, Table 2). This MCI score was similar to that recorded at site 4 upstream of the cooling water spray discharge, despite the differences in community composition, with only twenty taxa common to both sites, of the thirty-three taxa recorded across both sites. There was no evidence of the sewage fungus recorded at this site in the previous survey.

The SQMCI₅ value (4.3 units) was similar to that recorded at site 4, and 0.6 unit higher than that recorded at site 3b. The communities at sites 3b, 4 and 5 were dominated by similar taxa, including *Deleatidium* mayfly, *Hydropsyche-Aoteapsyche* caddisflies and orthoclad midge larvae. This explained the similarity in SQMCI₅ values between these sites, and overall was not indicative of significant impacts from the cooling water discharge.

It should be noted that the historical MCI median at this site was lowered by some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Most surveys in recent years had found no sign of the 'sewage fungus' growths that were recorded at site 5 in several of the 1980s and early 1990s surveys. However, an extensive 'sewage fungus' outbreak occurred in this reach of the river during the autumn-winter months of 2007. Mats of filamentous bacteria and protozoa ('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, and 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, such as the appearance of the blood worm 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. The spring

2014 survey again recorded the presence of sewage fungus, but in that case, there was no obvious impact on the macroinvertebrate communities, with blood worm midges being absent and no decline in MCI or SQMCI_s scores. 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 sewage fungus; neither did it indicate any change in macroinvertebrate communities caused by the cooling water discharge.

Site 6 (KPK000685)

A similar richness of twenty-seven taxa was recorded at site 6, at Skeet Road, a further 700 m below the cooling water discharges. This was four taxa more than the median number of taxa since 1998 for this site, seven more than the historical median, and similar to that recorded at sites 4 and 5 upstream (Table 2, Figure 2 and Figure 6).

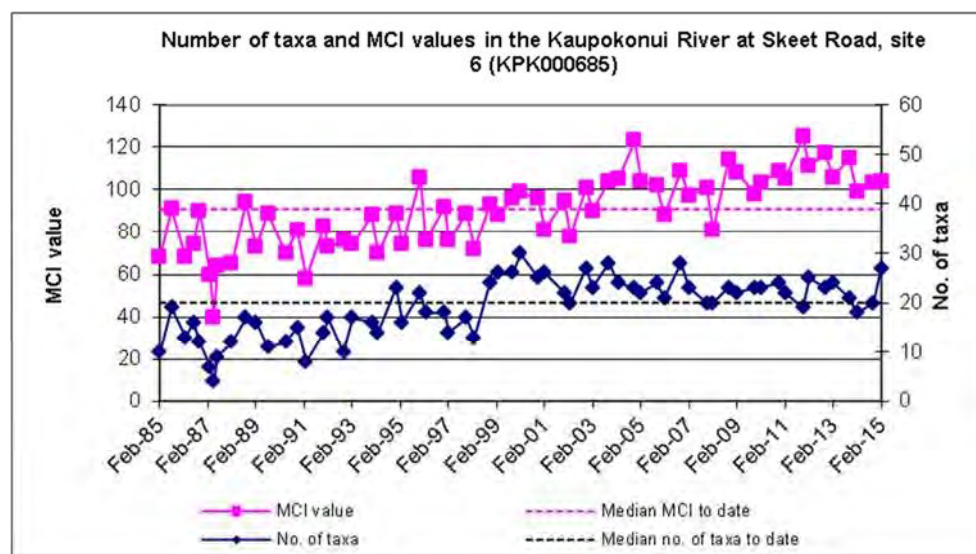


Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaipokonui River, at Skeet Road, since February 1985

This community was characterised by more taxa than at site 5 with one 'highly sensitive' taxon (very abundant *Deleatidium* mayfly); five 'moderately sensitive' taxa [*Coloburiscus* mayfly, elmid beetles, dobsonfly (*Archichauliodes*), free swimming caddisfly (*Hydrobiosis*) and stony cased caddisfly (*Pycnocentroides*)]; and five 'tolerant' taxa [snail (*Potamopyrgus*), net-spinning caddisfly (*Hydropsyche-Aoteapsyche*), algal piercing caddisfly (*Oxyethira*) and midges (orthoclads and tanytarsids)] (Table 3). This represented an increase in the number of abundant taxa from that recorded at site 5, although this increase was spread between 'tolerant' and 'sensitive' taxa.

The MCI score of 104 units was thirteen units higher than the historical median for this site but only two units higher than the median of scores recorded since 1998. Although this result was lower than that recorded by most recent surveys, it was still higher than the majority of previous surveys undertaken to date (Figure 2, Table 2). The MCI score at this site can be variable (Figure 6) and, as the current result was much higher than the long-term median score and four units above the score recorded at site 4 (upstream of the cooling water discharges), there was no indication of marked deterioration in community health at this site at the time of the current survey.

The SQMCI_s score (4.2 units) was only 0.1 unit less than that recorded at site 5, a very insignificant difference, suggesting little change in the health of the community structure.

Five taxa changed significantly in abundance at this site (from site 5), all related to increases or decreases in 'tolerant' taxa. This indicated that the subtle effects recorded by some past surveys were minimal at the time of the current survey and not considered to be significant in terms of impacts on the macroinvertebrate communities recorded at this site.

Site 7 (KPK000880)

A moderate richness of eighteen taxa was recorded at site 7, at Upper Glenn Road (Table 2), similar to both the long term median and the median richness of surveys since 1998. One 'highly sensitive' taxon was present in this community, being the common *Deleatidium* mayfly; fewer than that found at the four upstream sites, but typical of the number recorded by most previous surveys. Characteristic taxa included the no 'highly sensitive' taxa; three 'moderately sensitive' taxa [dobsonfly (*Archichauliodes*), free-living caddisfly (*Hydrobiosis*) and stony-cased caddisfly (*Pycnocentroides*)]; and five 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), algal piercing caddisfly (*Oxyethira*) and midges (orthoclads and tanytarsids)]. Despite the distance between sites 6 and 7 and a degree of natural deterioration in macroinvertebrate communities normally found in a downstream direction, over such a distance, the community compositions were more dissimilar than usual between the two sites with only fifteen (of 30) taxa common to both communities. The main change in composition between the two sites was the loss of nine 'sensitive' taxa that were recorded at site 6, but not at site 7.

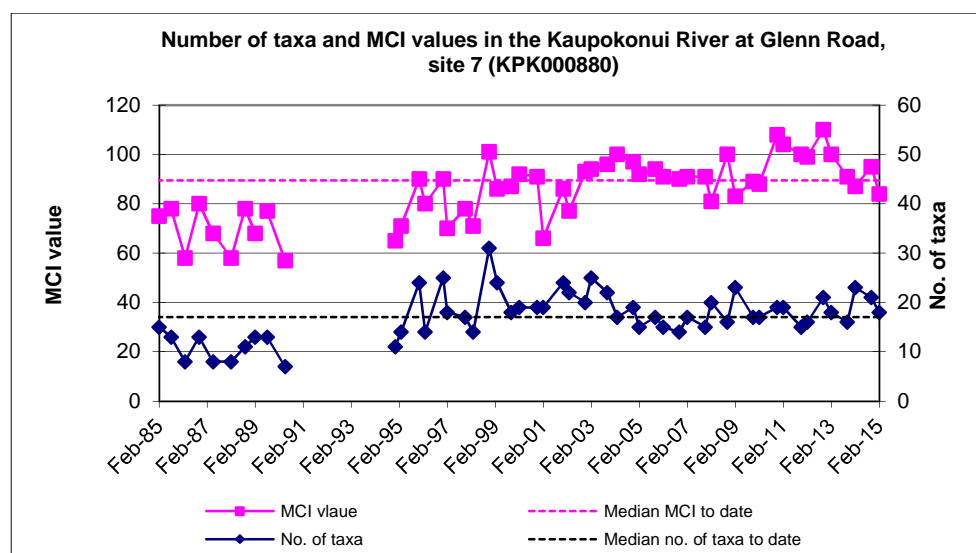


Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaipokonui River, since February 1985

As a result of these changes in community composition, the proportion of 'tolerant' taxa (61% of taxa number) increased markedly from that recorded in the previous spring (2014) survey, resulting in a reduced MCI score of 84 units. This score was eight units lower than the median of scores since 1998, and five units lower than the historic median at this site (Table 2, Figure 7), neither of which was a statistically significant difference (Stark, 1998). However, this indicates some deterioration in community health, being the lowest score recorded over the last twelve surveys (Figure 7). This is likely to be a direct reflection of the long period of low flows that preceded this survey, accompanied with warm water temperatures. Just downstream of this site, water temperatures as warm as 26.9°C were recorded in the month prior to this survey. The current MCI score was twenty units less than that recorded at site 6, some 9 km upstream, a statistically significant result (Stark, 1998). This was a larger reduction than the trend typically recorded though this reach, and a

deterioration on that recorded in the previous survey. It in part reflects the natural downstream deterioration typical of ringplain streams and rivers, with streams and rivers at this altitude and distance from the National Park boundary typically seeing a reduction in MCI score of approximately 0.6 MCI unit/km (Stark and Fowles, 2009), but this downstream deterioration appears to have been exacerbated by the low flows.

The SQMCI_S score (3.7) showed a lesser decrease, being 0.5 unit lower than the score at the nearest upstream site (Table 3). This change was principally due to an increased abundance of 'very tolerant' oligochaete worms and decreased abundances of numerous 'sensitive' taxa including *Deleatidium* mayfly. Generally, there has been a decreasing trend in SQMCI_S scores between sites 6 and 7, (especially in the summer surveys). This was usually due to the distance between the sites and the influence of the Dunns Creek tributary, which joins the river between the two sites. Occasionally, there has been little difference, due to site 6 showing impacts from the cooling water discharge. In the current survey, there was little evidence of some cooling water discharge influence at site 6, indicating that the deterioration in community health at site 7 may be largely attributed to some typical downstream deterioration and the additional influence of the Dunns Creek tributary.

Waiokura Stream

The Waiokura Stream was included in the biological monitoring programme for the first time in the 2002-2003 monitoring year, to monitor effects from irrigation of wastewater and stormwater from the Fonterra Kapuni site onto land in the Waiokura Stream catchment. The location of the irrigation areas in relation to the biological (and water quality) monitoring sites is shown in Figure 8. This was the fourteenth biological survey related to this monitoring programme conducted at the two sites in this stream and results from this survey are summarised in

Figure 8 Waiokura Stream biomonitoring site (U and D) locations in relation to Fonterra Kapuni wastes irrigation

Table 4, with full results provided in Table 5. No 'heterotrophic growths' were seen on the bed of the stream nor were any found

microscopically (during sample processing) by this survey at either of the two sites.

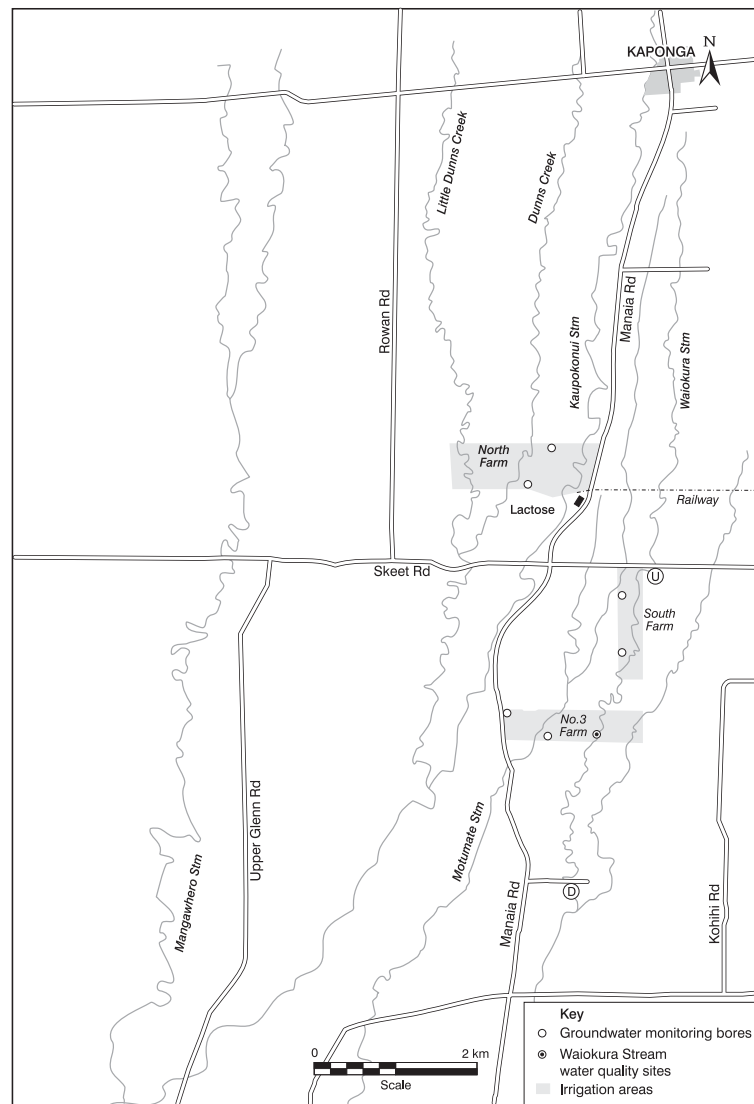


Figure 8 Waiokura Stream biomonitoring site (U and D) locations in relation to Fonterra Kapuni wastes irrigation**Table 4** Numbers of taxa and MCI values recorded previously in the Waiokura Stream, together with current results

Site	Number of previous surveys	Numbers of taxa			MCI values		
		Median	Range	Feb 2015	Median	Range	Feb 2015
U	19	23	18-29	19	99	88-114	106
D	13	24	15-27	21	92	81-103	91

Table 5 Macroinvertebrate fauna of the Waiokura Stream in relation to Fonterra, Kapuni land irrigation of wastes, sampled on 19 February 2015

Taxa List	Site Number	MCI score	U	D
	Site Code		WKR000500	WKR000650
	Sample Number		FWB15156	FWB15157
NEMATODA	Nematoda	3	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	R
	Lumbricidae	5	R	-
MOLLUSCA	<i>Potamopyrgus</i>	4	C	XA
CRUSTACEA	Ostracoda	1	-	A
	<i>Paracalliope</i>	5	-	A
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	VA	XA
	<i>Coloburiscus</i>	7	A	R
	<i>Deleatidium</i>	8	C	VA
	<i>Zephlebia group</i>	7	VA	R
PLECOPTERA (STONEFLIES)	<i>Zelandobius</i>	5	-	C
COLEOPTERA (BEETLES)	Elmidae	6	A	VA
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	A	A
TRICHOPTERA (CADDISFLIES)	<i>Hydropsyche (Aoteapsyche)</i>	4	VA	A
	<i>Hydrobiosis</i>	5	C	C
	<i>Neurochorema</i>	6	R	-
	<i>Psilochorema</i>	6	-	C
	<i>Beraeoptera</i>	8	R	-
	<i>Oxyethira</i>	2	-	R
	<i>Pycnocentria</i>	7	C	-
	<i>Pycnocentroides</i>	5	-	A
DIPTERA (TRUE FLIES)	<i>Harrisius</i>	6	R	-
	<i>Maoridamesa</i>	3	-	R
	Orthoclaadiinae	2	-	R
	Tanytarsini	3	R	C
	<i>Austrosimulium</i>	3	C	R
	Tanyderidae	4	C	-
ACARINA (MITES)	Acarina	5	-	R
No of taxa			19	21
MCI			106	91
SQMCI			6.0	5.6
EPT (taxa)			9	9
%EPT (taxa)			47	43
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa	

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site U (WKR000500)

A moderate richness of nineteen taxa was recorded at site U, upstream of the Fonterra wastes irrigation areas. This number of taxa was four taxa fewer than the median richness of the previous surveys undertaken at this site (Table 4). The community was characterised by no 'highly sensitive' taxa; five 'moderately sensitive' taxa (mayflies (very abundant *Austroclima*, *Coloburiscus*; and *Zephlebia* group), elmid beetles and dobsonfly (*Archichauliodes*)); and one 'tolerant' taxon [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*)] (Table 5). Most of these taxa have been characteristic of communities at this site to date (TRC, 2015).

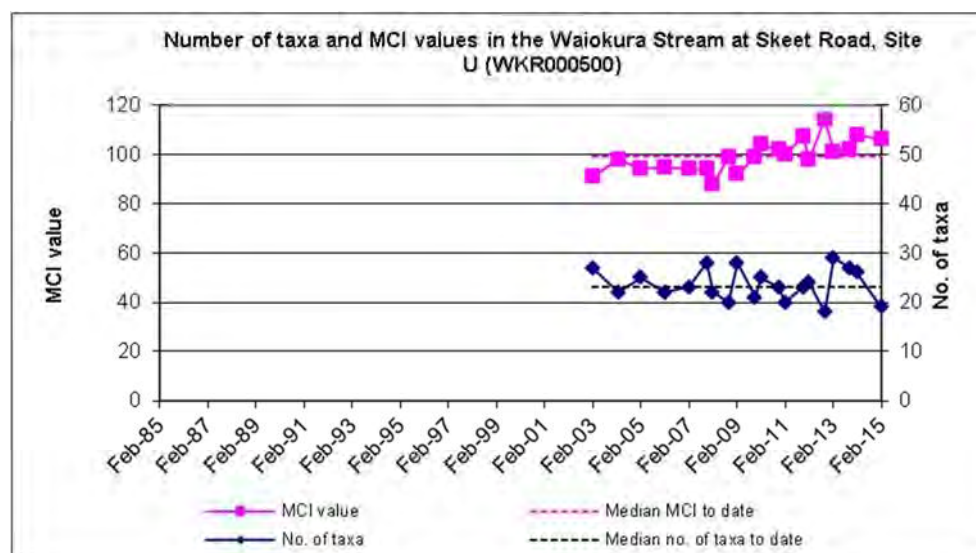


Figure 9 Numbers of taxa and MCI values recorded at site U in the Waiokura Stream since February 1985

The MCI value of 106 units was two units lower than that recorded by the previous summer (2014) survey, but seven units above the median of previous values recorded from the nineteen previous surveys at this site (Table 5, Figure 9). This score reflected the moderate proportion of 'tolerant' taxa (37% of taxa richness) in the community (Table 5). The Waiokura Stream rises below the National Park boundary and the site at Skeet Road (site U) is in the mid-reaches at an altitude of 150 m asl. A relationship for ringplain streams developed between MCI and site altitude (Stark and Fowles, 2009), predicts a MCI value of 100 units for this site. The historical site median (99 units) is one unit below this altitude prediction while the current summer score (106 units) was 6 units (above) the predictive value. The SQMCI_s score of 6.0 units was near the maximum of the range of previously recorded values at this site, and reflected the dominance of several 'sensitive' taxa and two mayflies in particular (Table 5).

Site D (WKR000650)

A moderate richness of twenty-one taxa was recorded at this site downstream of the wastes irrigation areas in the Waiokura Stream catchment. This was relatively similar to that recorded at site U and the median taxa number previously recorded at this downstream site (Table 2). Four of the taxa that dominated the community at site U were also dominant at this site, with the addition of one 'highly sensitive' mayfly (*Deleatidium*), two 'moderately sensitive' taxa [*Paracalliope* amphipods and stony-cased caddisfly (*Pycnocentroides*)] and two one 'tolerant' taxa (snail (*Potamopyrgus*) and ostracod seed shrimps) (Table 5). This was coincident with a significant change in habitat with macrophytes, which were absent at site U, being present throughout the stream and loss of bouldery substrate at this site.

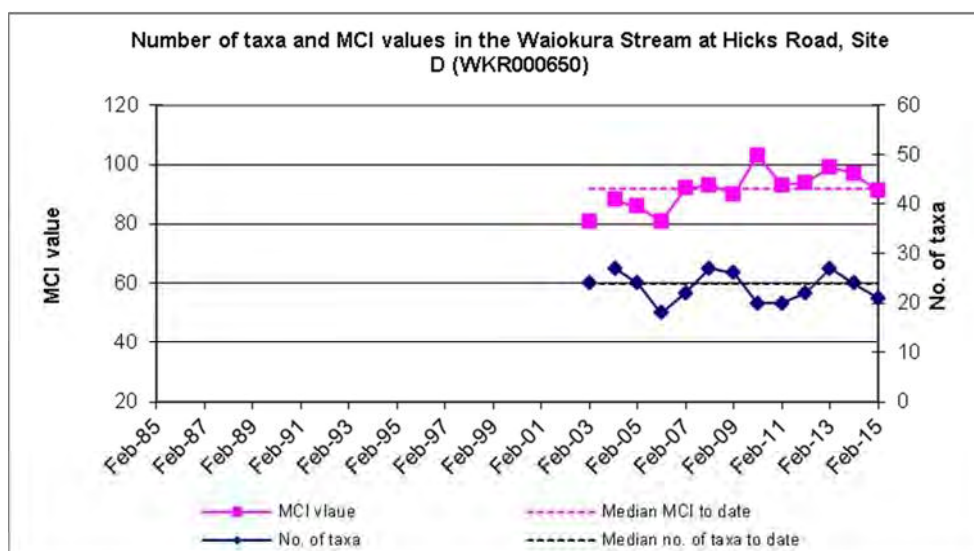


Figure 10 Numbers of taxa and MCI values recorded at site D in the Waiokura Stream since February 1985

A moderate proportion of 'tolerant' taxa (43% of taxa richness) was present at this site, which was reflected in the MCI value of 91 units. This score was six units lower than that recorded by the previous summer (2014) survey, but similar to the median of the twelve previous surveys performed at this site (Table 5, Figure 8). The MCI score was fifteen units less than that recorded upstream at site U, which is a statistically significant difference (Stark, 1998). Although this indicates that the communities were different to each other, with the community at site D being more 'tolerant' to organic enrichment, in this case it is not considered to be due to the irrigation of wastes from the Fonterra factory. The primary drivers behind this drop in MCI score are considered to be the distance between sites U and D and the marked habitat differences between sites, especially the predominance of macrophytes at site D.

Despite eleven significant changes in individual taxon abundances between the sites, the SQMCI_s score remained within 0.4 unit of the score at site U, upstream of the irrigation areas (Table 5). As the main change in MCI scores was attributable to differences in habitat between the two sites, the relative similarity in community structure indicated that wastes discharged from the Fonterra Kapuni site on to land in the Waiokura Stream catchment had not had a recent detrimental effect on the biological health of this stream.

Summary and Conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River and two sites in the Waiokura Stream on 19 February 2015. Samples were sorted and identified to provide the number of taxa (richness), MCI and SQMCI_s scores for each site. The samples were also microscopically scanned to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths").

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.

In the Kaupokonui River, taxa richnesses were similar to or higher than historical median richnesses, while MCI scores indicated 'good' to 'fair' community health at all sites. MCI scores declined in a downstream direction, but largely to the degree expected, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. In the case of the current survey however, this progressive deterioration had been exacerbated by the extremely long period of stable flows that preceded this survey. The MCI scores at the upper four of the five sites were higher than their historical median scores, while site 7 had the lowest MCI score, six units less than its historical median. However, the other two sites downstream of the cooling water discharges (sites 5 & 6) showed little deterioration in community health from that recorded by the previous summer survey, which is a better than typical result for a summer survey. The survey continued to show that the Kaupokonui River generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 7, was indicative of some influence from the Dunns Creek tributary within the reach between sites 6 and 7. A positive result was that there was no evidence of the sewage fungus recorded during the previous (spring 2014) survey.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, although the communities appeared in slightly worse condition than that recorded in the previous spring survey, a relatively typical result. The current survey did not record the presence of sewage fungus or blood worm midges, indicating that the poor quality cooling water discharge that had been occurring prior to the spring 2014 survey had ceased.

MCI values continued to indicate in general that macroinvertebrate communities were mainly in 'good' health, being above median MCI scores from surveys conducted since 1998, despite the extended period of low flow that preceded this survey, and the related algal proliferation. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, although there were some additions at sites 6 and 7, further downstream. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was a statistically significant result, and was greater than is commonly recorded in this river. As with the previous surveys, it is considered that this is due to progressive deterioration in communities in a downstream direction, typical of Taranaki ringplain rivers and streams, but in this case was exacerbated by the preceding low flows.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. Such growths were again recorded in the spring 2014 survey, but not in the current survey.

The Waiokura Stream communities indicated that conditions during this survey were fairly typical when compared with the relatively limited number of previous surveys at these two sites to date. The MCI value recorded at the downstream site was significantly less than that recorded upstream, although this can be attributed largely to the distance between the sites

and the marked habitat differences between sites, especially the predominance of macrophytes at site D, rather than to any effects from the application of wastes to land from the Fonterra factory. This conclusion is supported by the SQMCI_s scores, which were similar. There were some subtle changes in macroinvertebrate community compositions between the sites which were associated with differences in habitat, principally an increase in macrophytes and absence of boulders at the downstream site. These community differences were insignificant and not indicative of recent impacts of wastewater irrigation within the Waiokura Stream catchment.

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To Job Manager, James Kitto
 From Scientific Officers, B Jansma and CR Fowles
 Report No CF627
 Doc No 1424668
 Date 30 October 2014

Biomonitoring of the Kaupokonui River in relation to the Fonterra Kapuni farm and factory, October 2013

Introduction

This biological survey was the first of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2013-2014 monitoring year. The results from surveys performed since the 2001-2002 monitoring year are discussed in reports listed in the references section of this report. The Waiokura Stream is monitored on an annual basis in the summer, and therefore was not included in this spring survey.

This survey relates to the following consents held by Fonterra Kapuni Ltd:

- 0919 to discharge cooling water to the Kaupokonui River;
- 0922 to spray irrigate wastewater and stormwater to land in the Kaupokonui catchment;
- 0923 to spray irrigate wastewater and stormwater to land in the Kaupokonui (Waiokura) catchment;
- 0924 to discharge stormwater and cooling water to the Kaupokonui River;
- 4235 to discharge stormwater to the Kaupokonui River;
- 4604 to discharge stormwater to the Kaupokonui River
- 6423 to discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui River

Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River in relation to discharges to the river and on to land in the catchment (Table 1, Figure 1) on 8 October 2013. The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Table 1 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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001).

Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20, produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways.

A semi-quantitative MCI value (SQMCI_s) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI_s is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

When necessary, sub-samples of periphyton (algae and other microflora) taken from the macroinvertebrate samples were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths") at a microscopic level. The presence of masses of these organisms can be an indicator of organic enrichment within a stream.



Figure 1 Biomonitoring sites in the Kaipokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a short period of receding flows in the Kaupokonui River, and followed 7 and 16 days after flow events in excess of three and seven times median flow respectively. The Kaupokonui River had a moderate, clear, uncoloured, and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 1.62 m³/sec, which was below the median flow (2.04 m³/sec) for the Kaupokonui River.

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 12.2°C to 13.7°C. Periphyton mats were thin to patchy at all sites, with algal filaments patchy at sites 5 and 7. Cobbles, gravel and boulders were the predominant substrate in the river, with the exception of site 4 where no boulders were recorded.

Macroinvertebrate communities

Kaupokonui River

Historically the mid to lower reaches of the Kaupokonui River have shown the effects of nutrient enrichment from the surrounding farmland, and in past years (mainly prior to 2000) there have been a number of surveys showing detectable impacts of discharges from the lactose factory on the riverbed fauna. On many past sampling occasions, the sites immediately upstream and downstream of the Fonterra Kapuni factory supported moderate numbers of taxa, with relatively low proportions of 'sensitive' taxa (such as mayflies and stoneflies), resulting in median MCI values in the low 80s (Table 2). Since 1998 however, macroinvertebrate communities have improved throughout the reach and have shown higher numbers of taxa and MCI scores on most occasions. Median values for both the total data set and the results since 1998 (25 to 30 surveys) are included in Table 2. Faunal results from the current survey are presented in full in Table 3.

Table 2 Numbers of taxa and MCI values recorded previously in the Kaupokonui River (since 1985), together with current results

Site	Number of previous surveys	Numbers of taxa				MCI values			
		Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey	Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey
3b	45	24	13-28	24	25	103	68-125	109	111
4	59	22	8-32	25	27	93	65-128	104	111
5	40	23	11-28	24	27	96	65-121	99	108
6	59	20	4-30	23	21	90	40-125	102	115
7	48	17	7-31	19	16	89	57-110	92	91

Generally the summer (February to March) surveys have found lower proportions of 'sensitive' taxa resulting in lower MCI values than the spring (October to November) surveys (see Figures 3, 4, 5, 6 and 7).

In this October 2013 survey, all sampling sites supported between 16 and 27 taxa. These results were all within three taxa of the site medians from data since 1998. MCI scores at most sites were higher than their median values for surveys since November 1998 with the site 7 score only one MCI unit lower than the median. Therefore the MCI scores at all sites also exceeded their respective median values for the entire record some (e.g. sites 4, 5, and 6) significantly in excess (Stark, 1998) (Table 2, Figure 2). MCI scores generally decreased in a downstream direction, although the highest scores were recorded at the upstream ('control')

site and at site 4, located just upstream of the railway bridge. MCI scores ranged from 'fair' to 'good' in terms of generic categories of biological health (TRC, 2013), indicating that land irrigation of wastewater and cooling waters discharges to the River had not adversely affected the Kaupokonui River macroinvertebrate community in the months prior to this survey. Similar to that recorded by most previous surveys, there was a 14 unit decrease in scores between sites 6 and 7, indicating further impacts on the macroinvertebrate community at site 7. In most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the natural decrease in MCI with distance downstream in the lower mid-reaches of the Taranaki ringplain over a stream distance of about 9 km (of 5 units (Stark and Fowles, 2009)) should also be taken into account.

Table 3 Macroinvertebrate fauna of the Kaupokonui River in relation to Fonterra Kapuni sampled on 8 October 2013

Taxa List	Site Number	MCI score	3b	4	5	6	7		
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880		
	Sample Number		FWB13249	FWB13250	FWB13251	FWB13252	FWB13253		
NEMERTEA	Nemertea	3	-	-	R	-	-		
NEMATODA	Nematoda	3	-	-	R	-	R		
ANNELIDA (WORMS)	Oligochaeta	1	R	C	C	-	A		
	Lumbricidae	5	-	R	-	R	R		
MOLLUSCA	<i>Potamopyrgus</i>	4	C	A	C	A	C		
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	A	C	R	-	-		
	<i>Coloburiscus</i>	7	XA	VA	VA	VA	-		
	<i>Deleatidium</i>	8	XA	VA	XA	XA	A		
	<i>Ichthybotus</i>	8	-	-	R	-	-		
	<i>Nesameletus</i>	9	A	C	C	R	-		
PLECOPTERA (STONEFLIES)	<i>Acroperla</i>	5	C	R	-	-	R		
	<i>Zelandobius</i>	5	C	R	R	R	-		
	<i>Zelandoperla</i>	8	R	-	R	-	-		
COLEOPTERA (BEETLES)	Elmidae	6	A	VA	A	A	C		
	Hydraenidae	8	R	R	-	-	-		
	Hydrophilidae	5	-	-	R	-	-		
	Ptilodactylidae	8	-	R	-	-	-		
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	R	A	A	C	C		
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	VA	VA	VA	VA	A		
	<i>Costachorema</i>	7	A	C	C	C	R		
	<i>Hydrobiosis</i>	5	C	C	C	C	A		
	<i>Neurochorema</i>	6	-	R	-	-	-		
	<i>Beraeoptera</i>	8	VA	A	C	C	-		
	<i>Confluens</i>	5	R	R	R	R	-		
	<i>Helicopsyche</i>	10	-	-	-	R	-		
	<i>Olinga</i>	9	R	R	R	R	-		
	<i>Pycnocentroides</i>	5	VA	A	A	VA	VA		
	<i>Aphrophila</i>	5	C	A	A	C	R		
DIPTERA (TRUE FLIES)	Eriopterini	5	R	R	R	-	-		
	<i>Maoridiamesa</i>	3	VA	A	VA	VA	VA		
	Orthoclaadiinae	2	C	C	A	A	A		
	<i>Polypedilum</i>	3	R	-	-	-	-		
	Tanytarsini	3	R	C	C	R	C		
	Tabanidae	3	-	R	-	-	-		
	Tanyderidae	4	-	-	R	R	-		
No of taxa			25	27	27	21	16		
MCI			111	111	108	115	91		
SQMCIs			6.8	6.0	6.5	6.4	4.1		
EPT (taxa)			14	14	14	12	6		
%EPT (taxa)			56	52	52	57	38		
'Tolerant taxa'		'Moderately sensitive' taxa			'Highly sensitive' taxa				
R = Rare		C = Common		A = Abundant		VA = Very Abundant		XA = Extremely Abundant	

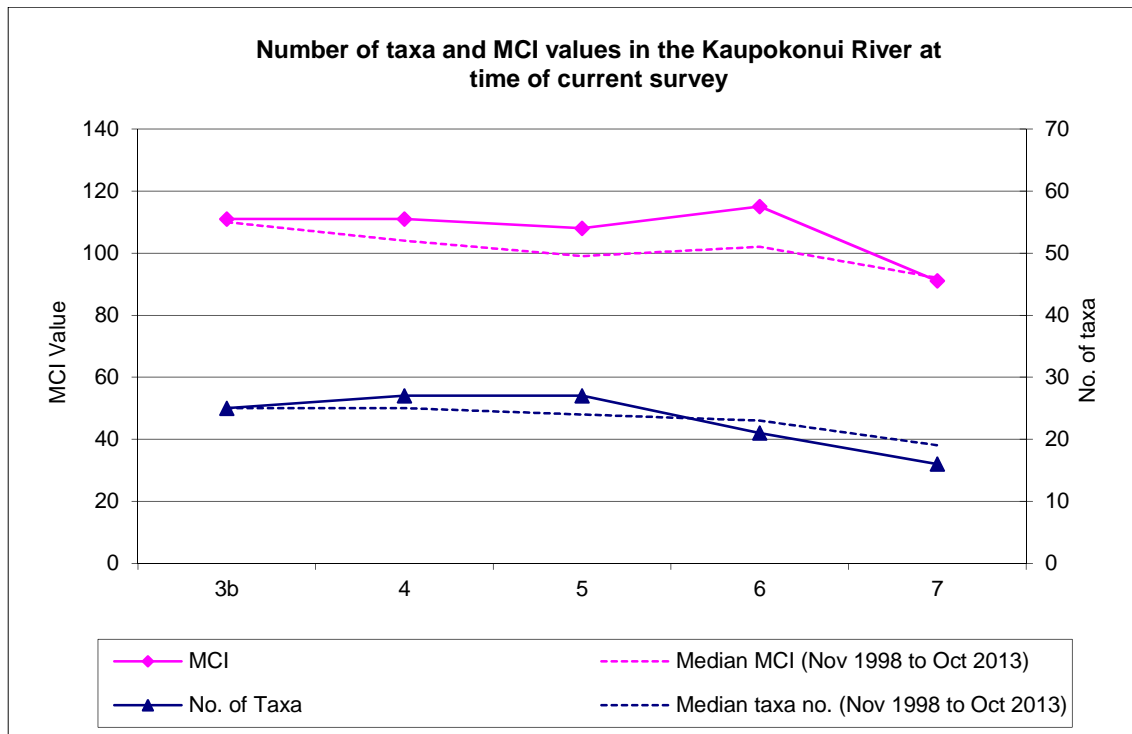


Figure 2 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

The 'fair' to 'good' MCI scores are reinforced by the results of the scan for undesirable biological growths which found no such growths at any site. The last time such growths were recorded was during the spring 2010 survey, which found dense growths of filamentous bacteria at two sites.

Site 3b (KPK000655)

A moderate richness of twenty-five taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was very similar to the long term median number of taxa recorded at this site to date (Table 3) and equivalent with the median richness of more recent records (since 1998). The community was characterised by ten taxa which included three 'highly sensitive' taxa [mayflies (*Deleatidium* (extremely abundant) and *Nesameletus*) and caddisfly (*Beraeoptera*)]; five 'moderately sensitive' taxa [mayflies (*Austroclima* and *Coloburiscus*), elmids beetles, caddisflies (*Pycnocentroides* and *Costachorema*)]; and two 'tolerant' taxa [net-spinning caddisfly (*Aoteapsyche*) and midge (*Maoridiamesa*)]. This dominance represented a slight increase in the relative proportions of 'sensitive' to 'tolerant' taxa dominating the community, in comparison with the characteristic taxa found by the previous summer (2012) survey.

The relatively low proportion of 'tolerant' taxa in the community (28% of taxa richness) was reflected in the MCI score (111) which was only slightly higher than the previous summer survey score but significantly lower (Stark, 1998) than the previous spring score at this site (Figure 3). The presence of six 'highly sensitive' taxa indicated good preceding physicochemical water quality at this control site, above all Fonterra activities in the Kaupokonui River catchment.

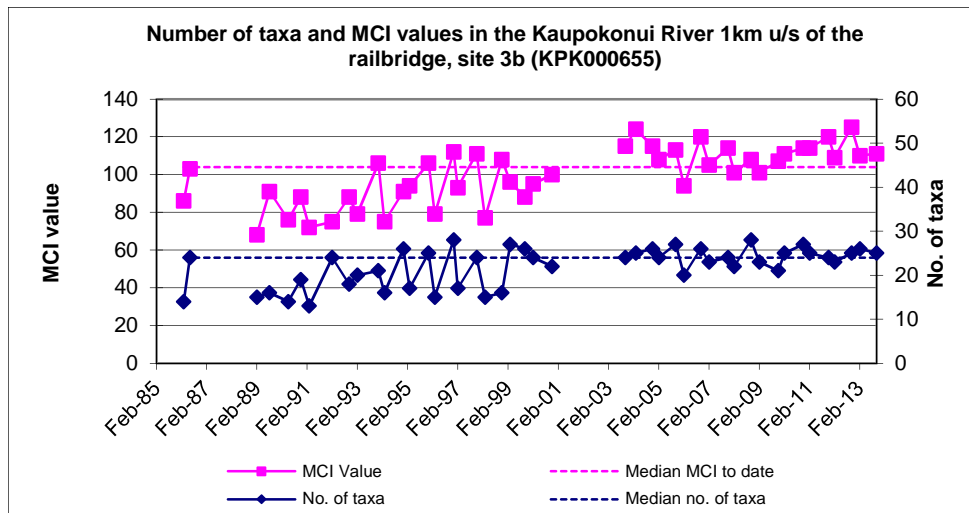


Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaupokonui River since 1985

The MCI score of 111 units was a significant 14 units below the previous spring survey score, which had been one unit higher than the maximum of all surveys previously undertaken at this site (Figure 3). It was also two units higher than the median score for surveys since 1998 and eight units higher than the median from all surveys conducted to date (Figure 2, Table 3). The numerical dominance by four 'sensitive' taxa in particular resulted in the relatively high SQMCI_s value of 6.8 units, 1.2 units higher than the SQMCI_s value found at this site by the previous summer (2013) survey.

Site 4 (KPK000660)

A moderate richness of twenty-seven macroinvertebrate taxa was recorded in the community at site 4, upstream of the Fonterra Kapuni weir and rail bridge, and downstream of the area of land irrigated by wastes from Fonterra Kapuni. Taxa richness was similar to the numbers of taxa recorded in recent monitoring years (Figure 4), and two more than that recorded at site 3b by this current survey (Table 3).

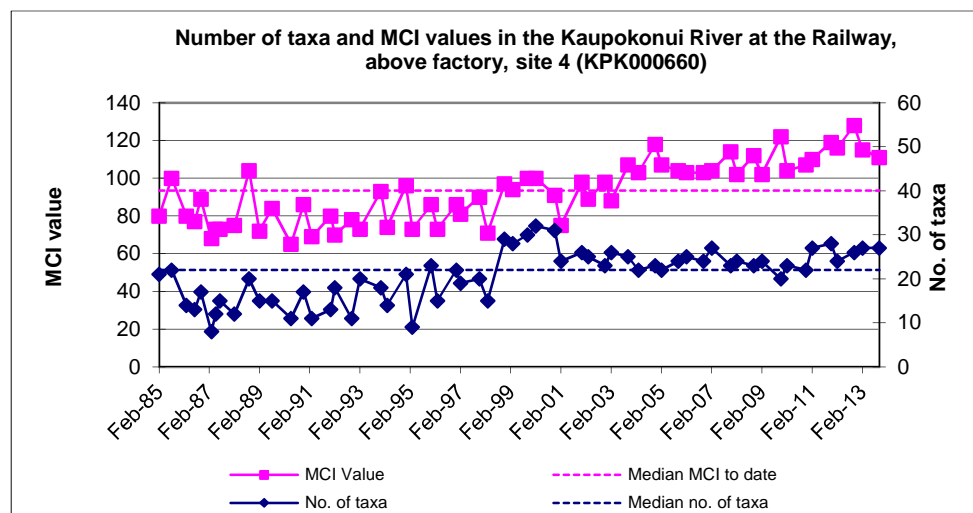


Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaupokonui River since February 1985

The community was characterised by two 'highly sensitive' taxa [mayfly (*Deleatidium*) and flare-cased caddisfly (*Beraeoptera*)]; five 'moderately sensitive' taxa (mayfly (*Coloburiscus*),

elmid beetles, dobsonfly (*Archichauliodes*), caddisfly (*Pycnocentroides*), and crane fly (*Aphrophila*); and three 'tolerant' taxa [snail (*Potamopyrgus*), net-spinning caddisfly (*Aoteapsyche*), and midge (*Maoridiamesa*)]. Only one 'moderately sensitive' taxon showed a significant change in abundance between site 3a and site 4 (Table 3).

The MCI score at site 4 was identical with than the score recorded upstream at site 3b, reflecting the similarities in community composition (Table 3). The MCI score was significantly higher (Stark, 1998) than the historic median recorded to date and 7 units above the median of values since 1998 (Table 3, Figure 4), continuing a trend of higher than median values over the last twenty-one surveys. This score was indicative of 'good' generic health (TRC, 2013) and reflective of good preceding physicochemical water quality at this site

The SQMCI_s value for this (6.0 units) was 0.8 unit lower than that at site 3b (Table 3), primarily due to a decrease in abundance of the 'highly sensitive' mayfly (*Deleatidium*). This score indicated that the community was dominated by 'sensitive' taxa which was further confirmation that the community had not been recently adversely affected by land irrigation upstream of this site.

In prior surveys some of the deterioration in biological health between sites 3b and 4 had been attributed to the impacts of dairy shed wastes assimilation in the receiving waters of the inflowing tributary a short distance upstream of site 4. No such deterioration was indicated by the results of this survey.

Site 5 (KPK000679)

A moderate richness of twenty-seven macroinvertebrate taxa was found at site 5, downstream of the cooling water discharges from Fonterra Kapuni. This was three taxa more than the median number of taxa recorded at this site since 1998 (Table 3, Figure 2). This richness was also equal with that recorded at site 4 located upstream of the cooling water discharges.

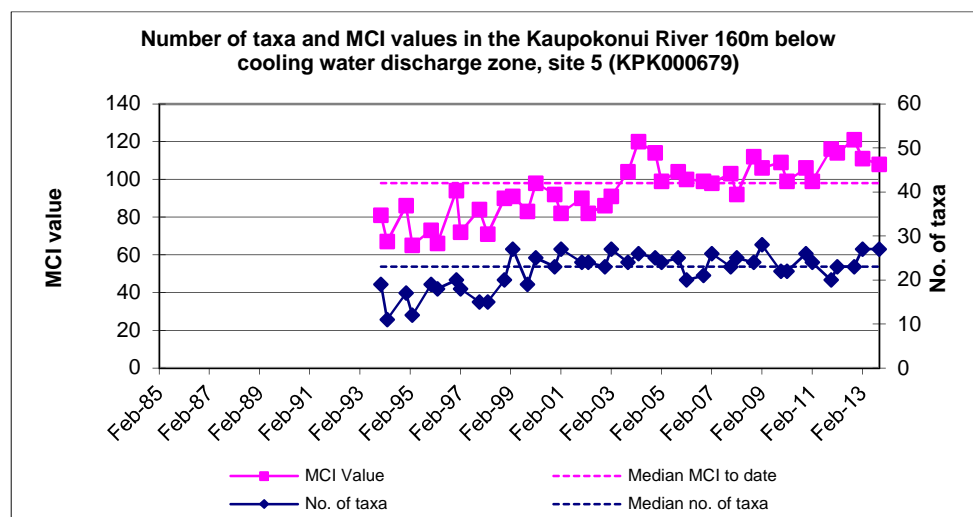


Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaipokonui River

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), stony-cased caddisfly (*Pycnocentroides*), and crane fly (*Aphrophila*)]; and three 'tolerant' taxa [net-spinning caddisfly (*Aoteapsyche*) and midges (orthoclads and *Maoridiamesa*)] (Table 3).

The MCI score (108 units) was slightly lower than that recorded by the previous summer survey, but higher than many of the preceding surveys' scores, especially all of those prior to 2003 (Figure 5). It was also significantly higher than the median of scores from all surveys to date (Figure 2, Table 2). The MCI score was an insignificant three units less than that recorded at site 4 upstream of the cooling water spray discharge, which represented an insignificant change in biological health. This was further reinforced by the absence of 'sewage fungus' and taxa indicative of marked enrichment (e.g. blood worm midge (*Chironomus*)).

The SQMCI_S value (6.5 units) was an insignificant 0.5 unit higher than that recorded at site 4, and more similar to that recorded at site 3b. This increase from site 4 was primarily due to the increased abundance of the 'highly sensitive' mayfly, which changed from very abundant at site 4 to extremely abundant at site 5. These minor differences were not indicative of deteriorating impacts from the cooling water discharge.

It should be noted that the historical MCI median at this site was lowered by some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Surveys in recent years had found no sign of the 'sewage fungus' growths that were recorded at site 5 in several of the 1980s and early 1990s surveys. However, an extensive 'sewage fungus' outbreak occurred in this reach of the river during the autumn-winter months of 2007. Mats of filamentous bacteria and protozoa ('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, and 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, such as the appearance of the blood worm 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. The current survey did not record either 'sewage fungus' growths or the presence of blood worm midges, indicating that this poor quality cooling water discharge had either ceased or was extensively diluted by the receiving waters of the stream.

Site 6 (KPK000685)

A moderate richness of twenty-one taxa was recorded at site 6, at Skeet Road, a further 700 m below the cooling water discharges. This was slightly fewer than the median number of taxa since 1998 for this site and similar to the historical median. It was also six taxa fewer than found at the nearest upstream site 5 (Table 2, Figure 2, and Figure 6)

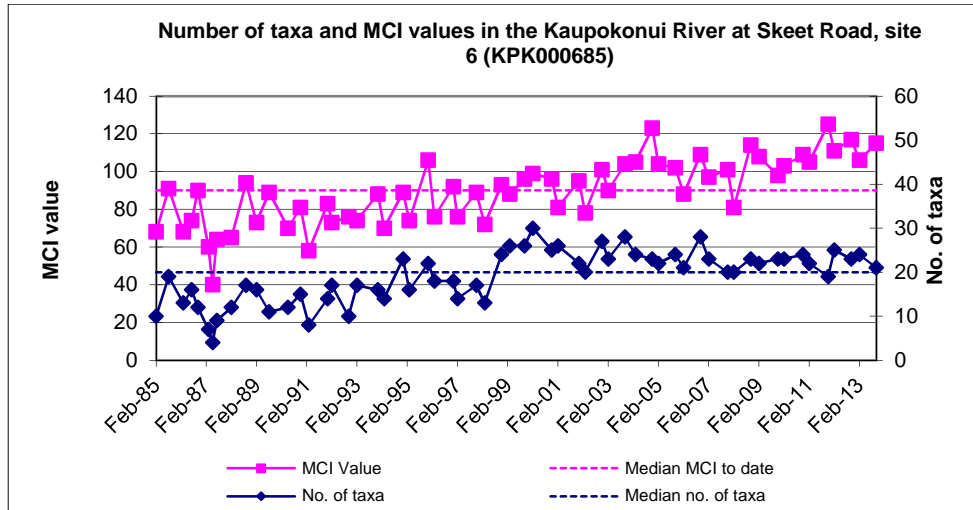


Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaipokonui River, at Skeet Road, since February 1985

This community was characterised by similar taxa to those at site 5 with two fewer 'moderately sensitive' taxa and one additional 'tolerant' taxon [snail (*Potamopyrgus*)].

The MCI score of 115 was 25 units higher than the historical median for this site and 13 units higher than the median of scores recorded since 1998 (both statistically significant differences (Stark, 1998)). This followed the previous spring (2012) survey which recorded the highest MCI score of the 60 surveys undertaken to date (Figure, Table 2). The MCI score at this site can be variable (Figure 6), and as the current result was significantly higher than the median score, and seven units above that at site 5 (upstream of the cooling water discharges), there was no indication of deterioration in community health at this site at the time of the current survey.

The SQMCI_s (6.4 units) was very similar to that recorded at site 5, suggesting minimal difference in characteristic community taxa structure. Only one taxon changed significantly in abundance at this site (loss of 'tolerant' worms), which resulted in minimal change in SQMCI_s score. This was dissimilar to in the spring 2010 survey when *Chironomus* blood worm midges and 'sewage fungus' were recorded at the Skeet Road site, indicative of subtle effects caused by the discharge(s) from the Fonterra Kapuni site at that time. Therefore the current results indicated no significant adverse effects of cooling water discharges on the macroinvertebrate communities recorded at this site.

Site 7 (KPK000880)

A poorer richness of sixteen macroinvertebrate taxa was recorded at site 7, at Upper Glenn Road (Table 2), 9 km downstream of site 6 and below the Dunn's Creek confluence. This richness was very similar to the long term median and three taxa fewer than the median richness of surveys since 1998. Only one 'highly sensitive' taxon was present in this community, fewer than numbers found at the other four upstream sites, and typical of the number recorded by most previous surveys. Characteristic taxa included the one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; two 'moderately sensitive' taxa [caddisflies (*Pycnocentroides* and *Hydrobiosis*)] and four 'tolerant' taxa [(oligochaete worms, net-spinning caddisfly (*Aoteapsyche*), and (midges *Maoridiamesa* and orthoclads)]. Despite the distance between these sites (6 and 7) and the natural deterioration in macroinvertebrate communities normally found in a downstream direction over such a distance, the community compositions were less similar than usual between sites 6 and 7, with only 13

(of 24) taxa common to both communities survey, with eighteen taxa being common to both communities.

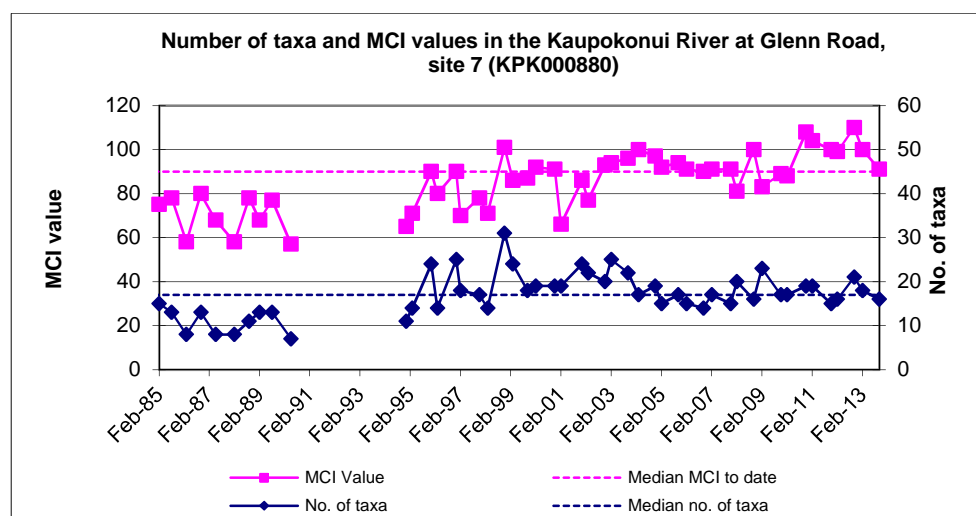


Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaupokonui River, since February 1985

The increase in proportion of 'tolerant' taxa (44% of taxa number) in this community resulted in a MCI score at this site of 91 units. This score was one unit lower than the median of scores recorded since 1998, and two units higher than the historic median at this site (Table 2, Figure 7), both statistically insignificant differences (Stark, 1998). This indicated some more recent deterioration in the normally above median health recorded since 2010 (Figure 7). The current MCI score was a significant 24 units less than that recorded at site 6, some 9 km upstream. This was greater than the typical trend though this reach, which would be expected to show a decrease of approximately 0.6 MCI unit/km, attributable to the natural downstream deterioration in macroinvertebrate communities found in most ring plain streams and rivers at this altitude and distance from the National park boundary (Stark and Fowles 2009).

The SQMCI_s score (4.1 units) also showed a significant decrease of 2.3 units below the score at the nearest upstream site (Table 3). This change was due principally to a marked drop in abundance of the 'highly sensitive' mayfly (*Deleatidium*) and 'moderately sensitive' mayfly (*Coloburiscus*) which dominated the community at site 6, and to a lesser extent, an increase in abundance of 'very tolerant' oligochaete worms. Generally, there is decreasing trend in SQMCI_s score between sites 6 and 7, (especially in the summer surveys). This is usually due to the distance between the sites and the influence of the Dunns Creek, which joins between the two sites. Occasionally, there is little difference, due to site 6 showing impacts from the cooling water discharges. In the current survey, the magnitude of the difference appeared to have been coincident with poorer community health at site 7 downstream of the Dunn's Creek confluence.

Summary and Conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River on 8 October 2013. Samples were sorted and identified to provide the number of taxa (richness), MCI and SQMCI_s scores for each site. The samples were also scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths") at a microscopic level.

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.

In the Kaupokonui River, taxa richnesses were relatively similar or better than historical median richnesses, while MCI scores indicated 'good' community health at all sites except the furthest downstream site. The MCI scores at all five sites were higher than their historical median scores, with four sites recording significantly higher scores. Sites showed little if any improvement from those recorded by the (previous) February 2013 survey, which was an atypical trend for a spring survey. The survey continued to show that the Kaupokonui River generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community found at site 7 was indicative of probable influence of the Dunn's Creek tributary through the reach between sites 6 and 7.

It may be concluded that the factory's cooling water discharges did not result in a significant adverse effect on the macroinvertebrate communities, which indicated continued recovery from the situation recorded by the 2010 spring survey. (That survey recorded the presence of 'sewage fungus' and *Chironomus* blood worm midge, both indicative of significant enrichment, at sites 5 and 6, at least 800 metres downstream of the site. Neither was recorded by the following five surveys, nor by the current survey, indicating that the discharge that caused the spring 2010 result had either ceased, improved in quality, or was adequately diluted by the receiving waters). In addition, there was no deterioration in the macroinvertebrate community between sites upstream and downstream of spray irrigation of wastes onto land (but upstream of the cooling water discharge) from the Fonterra Kapuni factory in the current survey.

MCI values continued to indicate in general that macroinvertebrate communities were in 'good' health, being above or very similar to median MCI scores from surveys conducted since 1998 for all sites. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, with some exceptions at site 7. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was statistically significant and greater than usually recorded in this stream, over and above the typical deterioration in communities in a downstream direction in Taranaki ringplain rivers and streams. In the current survey, this deterioration was more related to the poorer community health recorded at site 7 although the result was relatively typical of historical data. This deterioration at site 7 was emphasised by a significant decrease in the SQMCI_s score through this reach, a typical result.

The trend of improvement in communities noted in recent years adjacent to the factory has generally been maintained (from the results of this survey), following a break in the trend recorded by the February 2008 survey, which also recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts were recorded on the macroinvertebrate communities. No such undesirable heterotrophic growths were recorded by the current survey.

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To Job Manager, James Kitto
From Scientific Officers, B Jansma and CR Fowles
Report No CF628
Doc No 1426912
Date November 2014

Biomonitoring of the Kaipokonui River and Waiokura Stream in relation to the Fonterra Kapuni farm and factory, February 2014

Introduction

This biological survey was the second of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2013-2014 monitoring year. The results from surveys performed since the 2001-2002 monitoring year are discussed in reports listed in the references section of this report.

This survey relates to the following consents held by Fonterra Kapuni Ltd:

- 0919 to discharge cooling water to the Kaipokonui River;
- 0922 to spray irrigate wastewater and stormwater to land in the Kaipokonui catchment;
- 0923 to spray irrigate wastewater and stormwater to land in the Kaipokonui (Waiokura) catchment;
- 0924 to discharge stormwater and cooling water to the Kaipokonui River;
- 4235 to discharge stormwater to the Kaipokonui River;
- 4604 to discharge stormwater to the Kaipokonui River
- 6423 to discharge stormwater from an inhalation grade lactose plant site into the Kaipokonui River

Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from seven sites in the Kaipokonui River and Waiokura Stream in relation to discharges to the river and on to land in the catchment (Table 1, Figure 1) on 3 February 2014. The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Table 1 Biomonitoring sites in the Kaipokonui River and Waiokura Stream

Stream	Site No.	Site Code	Location
Kaipokonui 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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001).

Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20, produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways.

A semi-quantitative MCI value (SQMCI_s) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI_s is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

When necessary, sub-samples of periphyton (algae and other microflora) taken from the macroinvertebrate samples were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths") at a microscopic level. The presence of masses of these organisms can be an indicator of organic enrichment within a stream.



Figure 1 Biomonitoring sites in the Kaipokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a short period of receding flows in the Kaupokonui River, and followed 7 and 13 days after flow events in excess of three and seven times median flow respectively. The Kaupokonui River had a moderate, clear, uncoloured, and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 1.42 m³/sec, below the median flow (2.04 m³/sec) for the Kaupokonui River.

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 17.1°C to 18.4°C. Periphyton mats and algal filaments were thin to patchy to widespread at all sites. Site 7 had widespread mats, and filaments which were very thick. Cobbles, gravel and boulders were the predominant substrate at all sites in the river. The Waiokura Stream sites had a finer substrate with the bed primarily composed of gravels and cobbles, with slightly higher proportions of sand and silt than in the Kaupokonui River and some boulders at site 4. Aquatic vegetation grew throughout the stream at site D, with *Myriophyllum* the dominant macrophyte. Algae were noted only as slippery films on the substrate at sites U and D, while site D also supported patches of algal filaments. Water temperatures ranged from 13.0°C to 14.7°C at the time of this mid-morning component of the survey.

Macroinvertebrate communities

Kaupokonui River

Historically the mid to lower reaches of the Kaupokonui River have shown the effects of nutrient enrichment from the surrounding farmland, and in past years (mainly prior to 2000) there have been a number of surveys showing detectable impacts of discharges from the lactose factory on the riverbed fauna. On many past sampling occasions, the sites immediately upstream and downstream of the Fonterra Kapuni factory supported moderate numbers of taxa, with relatively low proportions of 'sensitive' taxa (such as mayflies and stoneflies), resulting in median MCI values in the low 80s (Table 2). Since 1998 however, macroinvertebrate communities have improved throughout the reach and have shown higher numbers of taxa and MCI scores on most occasions. Median values for both the total data set and the results since 1998 (26 to 31 surveys) are included in Table 2. Faunal results from the current survey are presented in full in Table 3.

Table 2 Numbers of taxa and MCI values recorded previously in the Kaupokonui River (since 1985), together with current results

Site	Number of previous surveys	Numbers of taxa				MCI values			
		Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey	Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey
3b	46	24	13-28	25	22	104	68-125	110	114
4	60	22	8-32	25	27	94	65-128	104	114
5	41	23	11-28	24	23	98	65-121	99	103
6	60	20	4-30	23	18	90	40-125	102	99
7	49	17	7-31	19	23	89	57-110	92	87

Generally the summer (February to March) surveys have found lower proportions of 'sensitive' taxa resulting in lower MCI values than the spring (October to November) surveys (see Figures 3, 4, 5, 6 and 7).

In this February 2014 survey, all sampling sites supported between 18 and 27 taxa. These results were all within 5 taxa of the site medians from data since 1998. MCI scores at all sites were above or within 5 units of their respective median values for surveys since November 1998. The MCI scores at all sites also were well in excess of their respective median values for the entire record with the exception of the score at site 7 which was within 2 units of its historical median (Table 2, Figure 2). Four sites had very similar numbers of taxa, with site 6 recording the lowest richness of 18 taxa. MCI scores generally decreased steadily in a downstream direction, although the highest scores were recorded at the 'control site' and at site 4, located just upstream of the railway bridge. MCI scores ranged from 87 to 114 units, reflecting relatively good to moderate physicochemical water quality, indicating that land irrigation of wastewater had not adversely affected the Kaupokonui River macroinvertebrate communities in the months prior to this survey but that there may have been some impacts of the cooling water discharges in the mid-reaches of the river. Similar to results frequently recorded by most previous surveys, there was only a 12 unit decrease in scores between sites 6 and 7, indicating further impacts on the macroinvertebrate communities at site 7. In most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the natural decrease in MCI with distance downstream in the lower mid-reaches of the Taranaki ringplain, over a stream distance of about 9 km (of 5 units (Stark and Fowles, 2009)) should also be taken into account.

The 'fair' to 'good' MCI scores were supported by the results of the microscopic scan for undesirable biological growths which found no such growths at any site indicative of less severe impacts of cooling water discharges than recorded by the spring 2010 survey, which found dense growths of filamentous bacteria at two sites.

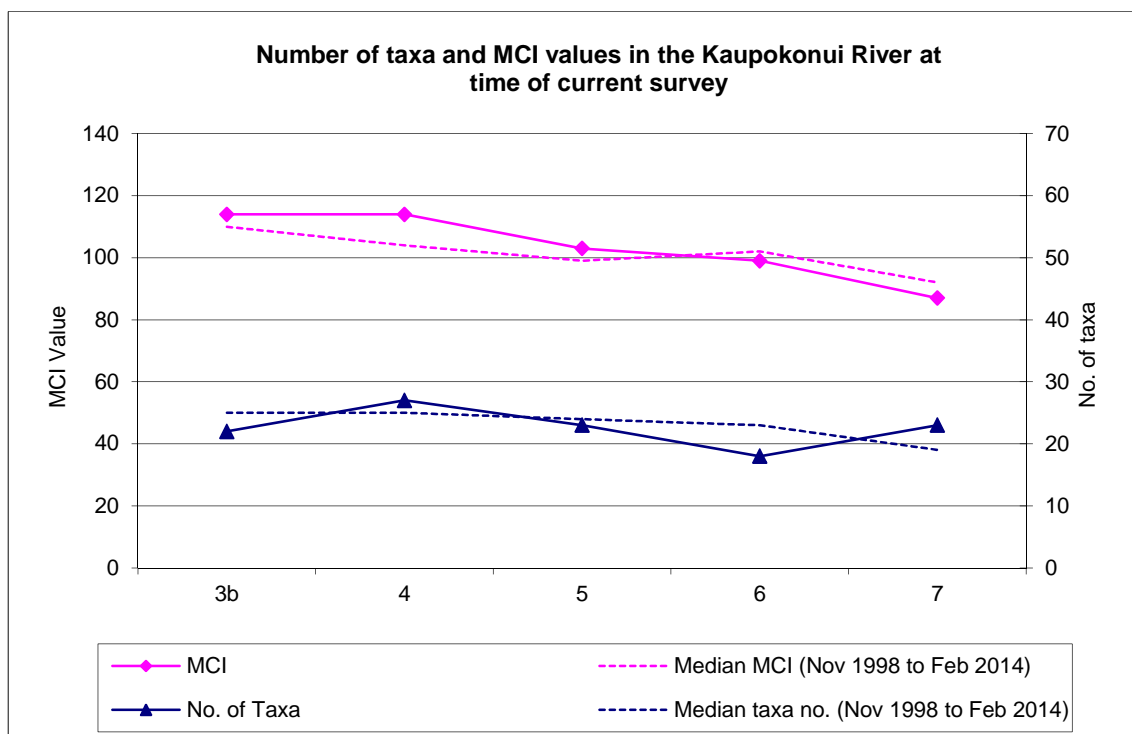


Figure 2 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

Table 3 Macroinvertebrate fauna of the Kaupokonui River in relation to Fonterra Kapuni samples on 3 February 2014

Taxa List	Site Number	MCI score	3b	4	5	6	7
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880
	Sample Number		FWB14027	FWB14028	FWB14029	FWB14030	FWB14031
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	-	-	-	-	R
NEMERTEA	Nemertea	3	-	-	R	C	C
NEMATODA	Nematoda	3	-	-	-	-	R
ANNELIDA (WORMS)	Oligochaeta	1	C	C	A	A	VA
	Lumbricidae	5	R	R	-	-	-
MOLLUSCA	<i>Ferrissia</i>	3	R	-	-	R	R
	<i>Physa</i>	3	-	-	-	-	R
	<i>Potamopyrgus</i>	4	A	VA	A	A	A
EPHEMEROPTERA (MAYFLIES)	<i>Ameletopsis</i>	10	-	R	-	-	-
	<i>Austroclima</i>	7	C	C	A	C	C
	<i>Coloburiscus</i>	7	C	A	C	C	-
	<i>Deleatidium</i>	8	VA	VA	A	C	R
	<i>Nesameletus</i>	9	C	R	C	R	-
PLECOPTERA (STONEFLIES)	<i>Megaleptoperla</i>	9	R	R	-	-	-
	<i>Zelandoperla</i>	8	-	R	-	-	-
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA	VA	VA	C
	Hydraenidae	8	R	C	R	-	-
	Hydrophilidae	5	-	-	-	-	R
	Ptilodactylidae	8	-	-	R	-	R
	Staphylinidae	5	-	-	R	-	-
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	A	A	A	A	C
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	XA	XA	XA	VA	C
	<i>Costachorema</i>	7	A	A	A	C	R
	<i>Hydrobiosis</i>	5	A	A	A	C	A
	<i>Neurochorema</i>	6	-	-	C	-	-
	<i>Beraeoptera</i>	8	C	R	-	-	-
	<i>Olinga</i>	9	R	R	-	-	-
	<i>Oxyethira</i>	2	-	-	-	-	C
	<i>Pycnocentroides</i>	5	A	C	C	C	A
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	A	VA	VA	A	A
	<i>Maoridiamesa</i>	3	XA	VA	VA	A	A
	Orthocladiinae	2	XA	A	A	VA	VA
	Tanypodinae	5	-	R	-	-	-
	Tanytarsini	3	-	C	C	A	C
	Empididae	3	-	R	-	-	-
	Muscidae	3	R	R	R	-	C
	<i>Austrosimulium</i>	3	-	R	-	-	-
	Tabanidae	3	-	-	R	-	-
No of taxa			22	27	23	18	23
MCI			114	114	103	99	87
SQMCIs			3.7	4.7	4.4	4.1	2.7
EPT (taxa)			11	13	9	8	6
%EPT (taxa)			50	48	39	44	26
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa				

R = Rare

C = Common

A = Abundant

VA = Very Abundant

XA = Extremely Abundant

Site 3b (KPK000655)

A moderate richness of twenty-two taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was slightly lower than the long term median number of taxa recorded at this site to date (Table 3) and the median richness of more recent records (since 1998). The community was characterised by eleven taxa including one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; six 'moderately sensitive' taxa [elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisflies (*Hydrobiosis* and *Costachorema*), stony-cased caddisfly (*Pycnocentroides*), and crane fly (*Aphrophila*)]; and four 'tolerant' taxa [snail (*Potamopyrgus*), net-spinning caddisfly (*Aoteapsyche*) and extremely abundant midges (orthoclads and *Maoridiamesa*)]. This dominance represented a decrease in the relative proportions of 'highly sensitive' to 'tolerant' taxa dominating the community, in comparison with the characteristic taxa found by the previous spring (2013) survey.

The moderate proportion of 'tolerant' taxa in the community (32% of taxa richness) was reflected in the MCI score (114) which was similar to the previous spring (2013) survey score and the previous summer score at this site (Figure 3). The presence of six 'highly sensitive' taxa indicated good preceding physicochemical water quality at this control site, above all Fonterra activities in the Kaipokonui River catchment.

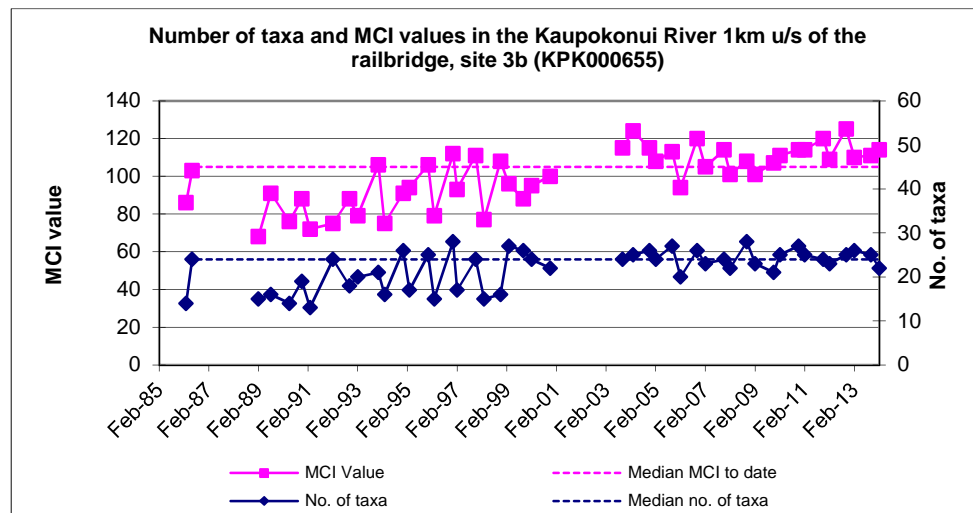


Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaipokonui River since 1985

The MCI score of 114 units was well within the range recorded in recent surveys (Figure 3). It was four units higher than the median score for surveys since 1998 and 10 units higher than the median from all surveys conducted to date (Figure 2, Table 3). The numerical dominance by three 'tolerant' taxa in particular resulted in the SQMCI_s value of 3.7 units, a significant 3.1 units lower than the SQMCI_s value found at this site by the previous spring (2013) survey.

Site 4 (KPK000660)

A moderate richness of twenty-seven macroinvertebrate taxa was recorded in the community at site 4, upstream of the Fonterra Kapuni weir and rail bridge, and downstream of the area of land irrigated by wastes from Fonterra Kapuni. Taxa richness was similar to the numbers of taxa recorded in recent monitoring years (Figure 4), but five more than that recorded at site 3b by this current survey (Table 3).

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; six 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisflies (*Hydrobiosis* and *Costachorema*), and crane fly (*Aphrophila*); and four 'tolerant' taxa [snail (*Potamopyrgus*), extremely abundant net-spinning caddisfly (*Aoteapsyche*), and midges (orthoclads and *Maoridiamesa*)]. Only two taxa showed a significant changes in abundances, between sites 3a and 4 (Table 3).

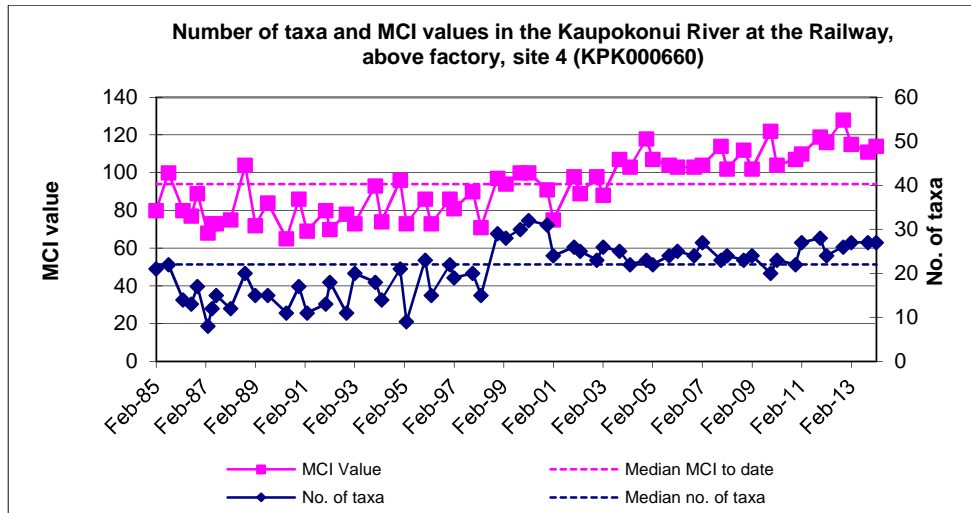


Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaipokonui River since February 1985

The MCI score at site 4 was identical with the score recorded upstream at site 3b, reflecting the similarities in community composition (Table 3). The MCI score was significantly higher (Stark, 1998) than the historic median recorded to date and 10 units above the median of values since 1998 (Table 3, Figure 4), continuing a trend of higher than average values over the last twenty-two surveys. This indicated 'good' generic health (TRC, 2013) and that this site had good physicochemical water quality preceding this survey.

The SQMCI_s value for this (4.7 units) was one unit higher than that at site 3b (Table 3), primarily due to decreases in abundances of both 'tolerant' midge taxa. This score indicated that the community was dominated by similar proportions of 'sensitive' and 'tolerant' taxa and this was further confirmation that the community had not been recently adversely affected by land irrigation upstream of this site.

In prior surveys some of the deterioration in biological 'health' between sites 3b and 4 had been attributed to the impacts of dairy shed wastes assimilation in the receiving waters of the inflowing tributary a short distance upstream of site 4. No such deterioration was indicated by the results of this survey.

Site 5 (KPK000679)

A moderate richness of twenty-three macroinvertebrate taxa was found at site 5, downstream of the cooling water discharges from Fonterra Kapuni. This was very similar to the median number of taxa recorded at this site since 1998 (Table 3, Figure 2)). This richness was four taxa fewer than recorded at site 4 located upstream of the cooling water discharges.

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; six 'moderately sensitive' taxa [mayfly (*Austroclima*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisflies (*Hydrobiosis* and *Costachorema*), and crane fly (*Aphrophila*); and five

'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), extremely abundant net-spinning caddisfly (*Aoteapsyche*) and midges (*Maoridiamesa* and orthoclads)] (Table 3).

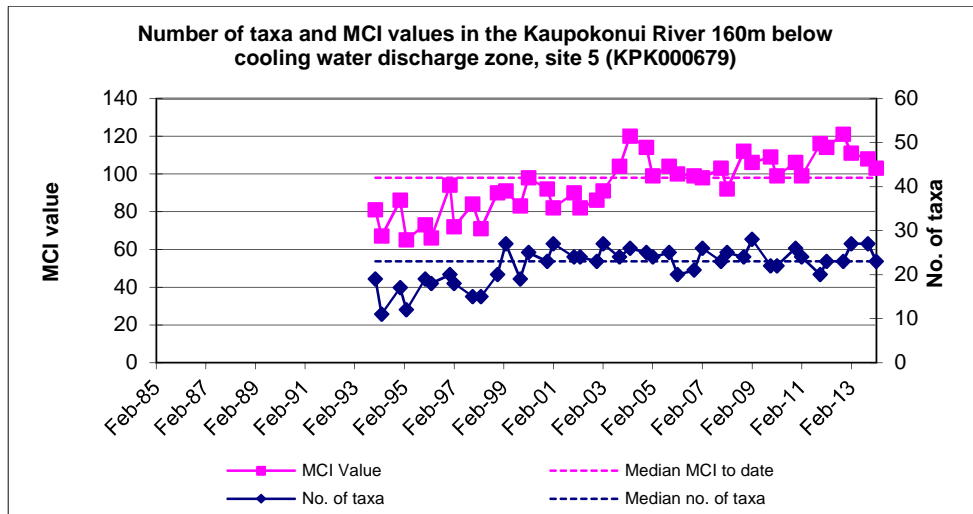


Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaipokonui River

The MCI score (103 units) was higher than most of the earlier surveys' scores, especially those prior to 2003 (Figure 5) and five units above the median of scores from all surveys to date (Figure 2, Table 2). However, this MCI score was a significant 11 units less (Stark, 1998) than that recorded at site 4 upstream of the cooling water spray discharge, although this decrease in MCI score was due almost entirely to a loss of four 'highly sensitive' taxa present only as rarities (less than 5 individuals per taxon) rather than any significant changes in community composition between sites. This was further reinforced by the absence of 'sewage fungus' and taxa indicative of severe organic enrichment (e.g. blood worm midge (*Chironomus*)).

The SQMCI_s value (4.4 units) was only slightly lower than that recorded at site 4, and higher than that recorded at site 3b. As with sites 3b and 4, the community at this site was dominated by the net-spinning caddisfly (*Aoteapsyche*), which was extremely abundant. This explained the similarity in SQMCI_s values between these sites, and overall was not indicative of significant impacts from the cooling water discharge.

It should be noted that the historical MCI median at this site was lowered by some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Surveys in recent years had found no sign of the 'sewage fungus' growths that were recorded at site 5 in several of the 1980s and early 1990s surveys. However, an extensive 'sewage fungus' outbreak occurred in this reach of the river during the autumn-winter months of 2007. Mats of filamentous bacteria and protozoa ('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, and 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, such as the appearance of the blood worm 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. The current survey did not record either 'sewage fungus' growth or the presence of blood worm midges,

indicating that poor quality cooling water discharges had either improved or were relatively adequately diluted by the receiving waters of the river.

Site 6 (KPK000685)

A poorer richness of eighteen taxa was recorded at site 6, at Skeet Road, a further 700 m below the cooling water discharges. This was five taxa fewer than the median number of taxa since 1998 for this site but more similar to the historical median. It was also five taxa fewer than found at the nearest upstream site 5 (Table 2, Figure 2 and Figure 6).

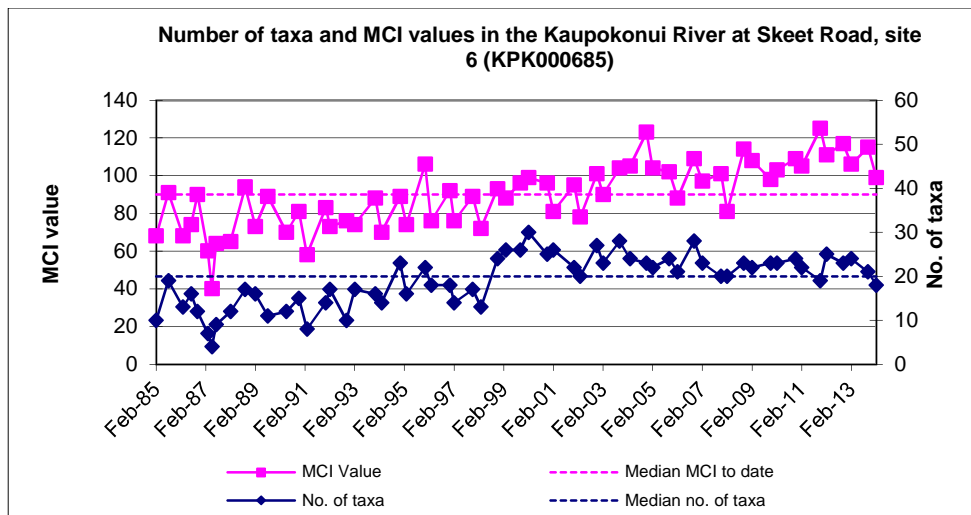


Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaipokonui River, at Skeet Road, since February 1985

This community was characterised by fewer taxa than at site 5 (no 'highly sensitive' taxa); three 'moderately sensitive' taxa [elmid beetles, dobsonfly (*Archichauliodes*), and crane fly (*Aphrophila*)]; and six 'tolerant' taxa [(oligochaete worms, snail (*Potamopyrgus*), net-spinning caddisfly (*Aoteapsyche*) and midges (tanytarsids, orthoclads, and *Maoridiamesa*)] (Table 3). This represented a marked change in the abundance of 'tolerant' taxa.

The MCI score of 99 units was nine units higher than the historical median for this site but three units lower than the median of scores recorded since 1998. Although this result was lower than that recorded by the previous eight surveys, it was still higher than the majority of previous surveys undertaken to date (Figure 2 Table 2) The MCI score at this site can be variable (Figure 6), and as the current result was much higher than the long-term median score and only 4 units below the score recorded at site 5 (upstream of the cooling water discharges) there was no indication of marked deterioration in community health at this site at the time of the current survey.

The SQMCI_s (4.1 units) was 0.7 unit lower than that recorded at site 5, suggesting minimal difference in community structure. Only one taxon changed significantly in abundance at this site (from site 5), which resulted in the minimal change in SQMCI_s score. This indicated that the subtle effects caused by the discharge(s) from the Fonterra Kapuni site by some past surveys were minimal at the time of the current survey and not considered to be significant in terms of impacts on the macroinvertebrate communities recorded at this site.

Site 7 (KPK000880)

A moderate richness of twenty-three taxa was recorded at site 7, at Upper Glenn Road (Table 2), above both the long term median and the median richness of surveys since 1998. Two 'highly sensitive' taxa were present in this community (although only as rarities); fewer than found at three of the four upstream sites, but typical of the number recorded by most previous surveys. Characteristic taxa included no 'highly sensitive' taxa; three 'moderately sensitive' taxa [free-living caddisfly (*Hydrobiosis*), stony-cased caddisfly (*Pycnocentroides*), and cranefly (*Aphrophila*)]; and four 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), and midges (orthoclads and *Maoridiamesa*)]. Despite the distance between sites 6 and 7 and a degree of natural deterioration in macroinvertebrate communities normally found in a downstream direction, over such a distance, the community compositions were more dissimilar than usual between the two sites with only sixteen (of 25) taxa common to both communities.

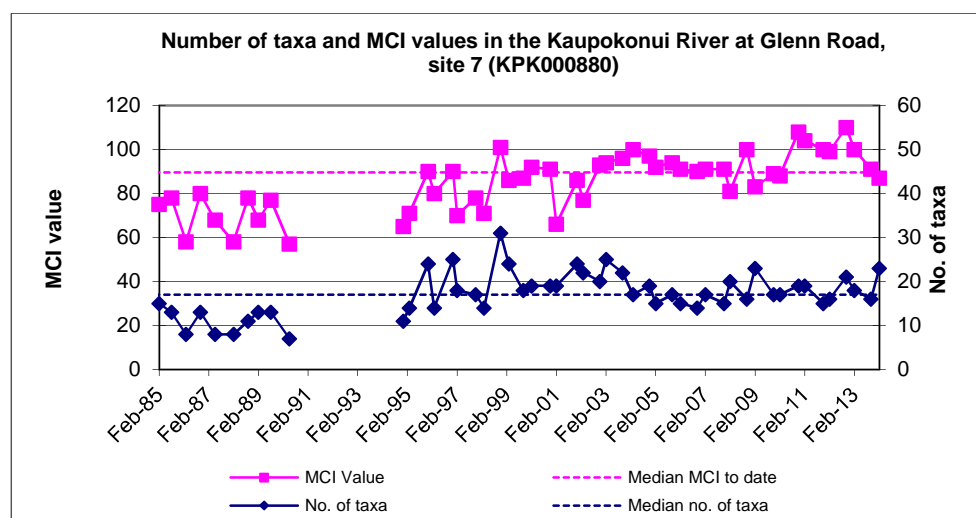


Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaipokonui River, since February 1985

In particular the relatively high proportion of 'tolerant' taxa (57% of taxa number) in this community resulted in a MCI score at this site of 87 units. This score was five units lower than the median of scores since 1998, and two units lower than the historic median at this site (Table 2, Figure 7), neither of which was a statistically significant difference (Stark, 1998). This indicated some more recent deterioration in the above median health normally recorded since 2010 (Figure 7). The current MCI score was 12 units less than that recorded at site 6, some 9 km upstream. This was greater than the typical trend though this reach (although not as great as the 24 unit decrease found by the spring 2013 survey) which would be expected to show a decrease of approximately 0.6 MCI unit/km, attributable to the natural downstream deterioration in macroinvertebrate communities found in most ring plain streams and rivers at this altitude and distance from the National Park boundary (Stark and Fowles, 2009).

The SQMCI_s score (2.7) also showed a significant decrease, being 1.1 units lower than the score at the nearest upstream site (Table 3). This change was principally due to an increased abundance of 'very tolerant' oligochaete worms and decreased abundances of the 'less tolerant' net-spinning caddisfly and 'sensitive' elmids beetles. Generally, there has been a decreasing trend in SQMCI_s scores between sites 6 and 7, (especially in the summer surveys). This was usually due to the distance between the sites and the influence of the Dunns Creek tributary, which joins the river between the two sites. Occasionally, there has

been little difference, due to site 6 showing impacts from the cooling water discharge. In the current survey, there was minor evidence of some cooling water discharge influence, indicating that the deterioration in community health at site 7 may be largely attributed to some typical downstream deterioration and the additional influence of the Dunns Creek tributary.

Waiokura Stream

The Waiokura Stream was included in the biological monitoring programme for the first time in the 2002-2003 monitoring year, to monitor effects from irrigation of wastewater and stormwater from the Fonterra Kapuni site onto land in the Waiokura Stream catchment. The location of the irrigation areas in relation to the biological (and water quality) monitoring sites is shown in Figure 8. This was the thirteenth biological survey related to this monitoring

programme conducted at the two sites in this stream and results from this survey are summarised in Table 4, with full results provided in Table 5. No 'heterotrophic growths' were seen on the bed of the stream nor were any found microscopically (during sample processing) by this survey at either of the two sites.

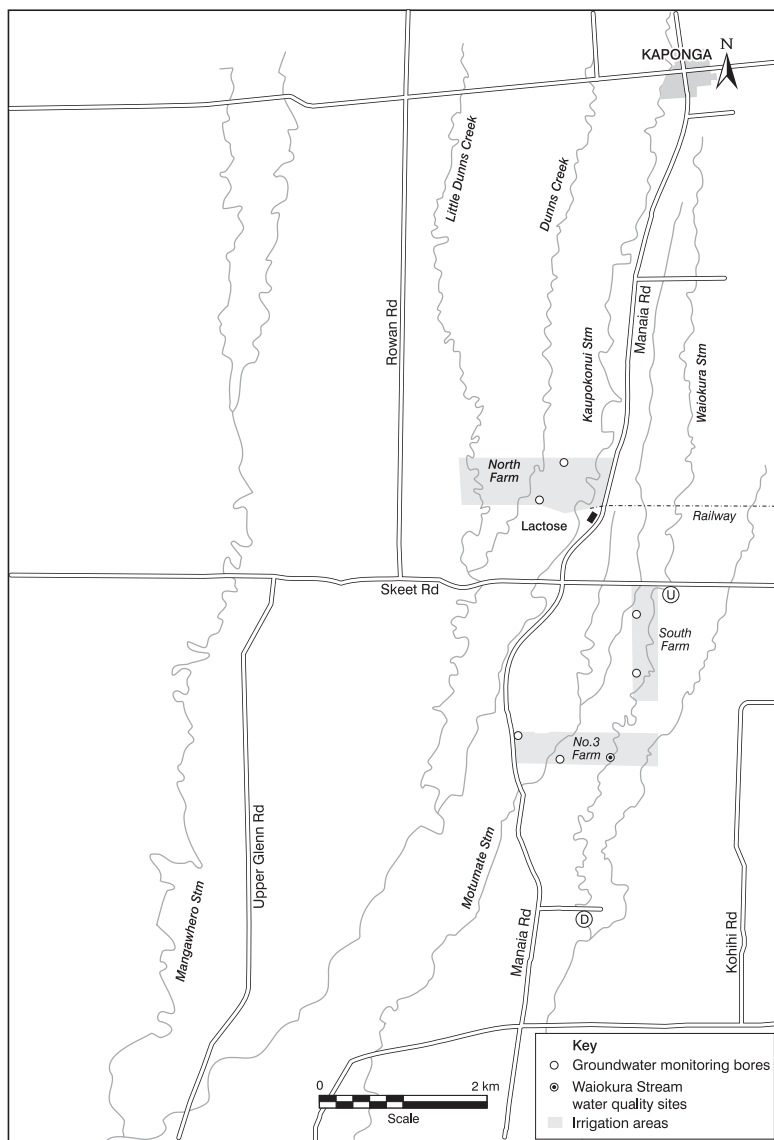


Figure 8 Waiokura Stream biomonitoring site (U and D) locations in relation to Fonterra Kapuni wastes irrigation

Table 4 Numbers of taxa and MCI values recorded previously in the Waikura Stream, together with current results

Site	Number of previous surveys	Numbers of taxa			MCI values		
		Median	Range	Feb 2014	Median	Range	Feb 2014
U	18	23	18-29	26	99	88-114	108
D	12	23	15-27	24	91	81-103	97

Table 5 Macroinvertebrate fauna of the Waikura Stream in relation to Fonterra, Kapuni land irrigation of wastes, sampled on 13 February 2014

Taxa List	Site Number	MCI score	U	D	
	Site Code		WKR000500	WKR000650	
	Sample Number		FWB14024	FWB14025	
NEMERTEA	Nemertea	3	-	R	
ANNELIDA (WORMS)	Oligochaeta	1	C	C	
MOLLUSCA	<i>Potamopyrgus</i>	4	C	C	
CRUSTACEA	<i>Paracalliope</i>	5	-	C	
	Paraleptamphopidae	5	R	R	
	<i>Paranephrops</i>	5	R	R	
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	XA	VA	
	<i>Coloburiscus</i>	7	A	C	
	<i>Deleatidium</i>	8	A	VA	
	<i>Zephlebia</i> group	7	VA	C	
PLECOPTERA (STONEFLIES)	<i>Megaleptoperla</i>	9	R	-	
	<i>Zelandobius</i>	5	R	C	
HEMIPTERA (BUGS)	<i>Microvelia</i>	3	R	-	
COLEOPTERA (BEETLES)	Elmidae	6	VA	XA	
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	A	A	
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	VA	A	
	<i>Costachorema</i>	7	R	R	
	<i>Hydrobiosis</i>	5	C	C	
	<i>Orthopsyche</i>	9	R	-	
	<i>Psilochorema</i>	6	R	C	
	<i>Pycnocentria</i>	7	C	-	
	<i>Pycnocentroides</i>	5	-	A	
	<i>Zelolessica</i>	7	R	-	
	DIPTERA (TRUE FLIES)	<i>Harrisius</i>	6	R	-
		<i>Maoridiamesa</i>	3	-	R
Orthoclaadiinae		2	R	R	
<i>Polypedilum</i>		3	R	R	
Tanytarsini		3	R	C	
<i>Austrosimulium</i>		3	VA	R	
Tanyderidae	4	R	-		
ACARINA (MITES)	Acarina	5	-	R	
No of taxa			26	24	
MCI			108	97	
SQMCIs			6.1	6.2	
EPT (taxa)			13	10	
%EPT (taxa)			50	42	
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa		

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site U (WKR000500)

A moderately high richness of twenty-six taxa was recorded at site U, upstream of the Fonterra wastes irrigation areas. This number of taxa was three taxa higher than the median richness of the previous surveys undertaken at this site (Table 4). The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa (mayflies (extremely abundant *Austroclima*; *Coloburiscus*, and *Zephlebia* group), elmid beetles and dobsonfly (*Archichauliodes*)); and two 'tolerant' taxa [net-spinning caddisfly (*Aoteapsyche*) and sandfly (*Austrosimulium*)] (Table 5). Most of these taxa have been characteristic of communities at this site to date (TRC, 2013).

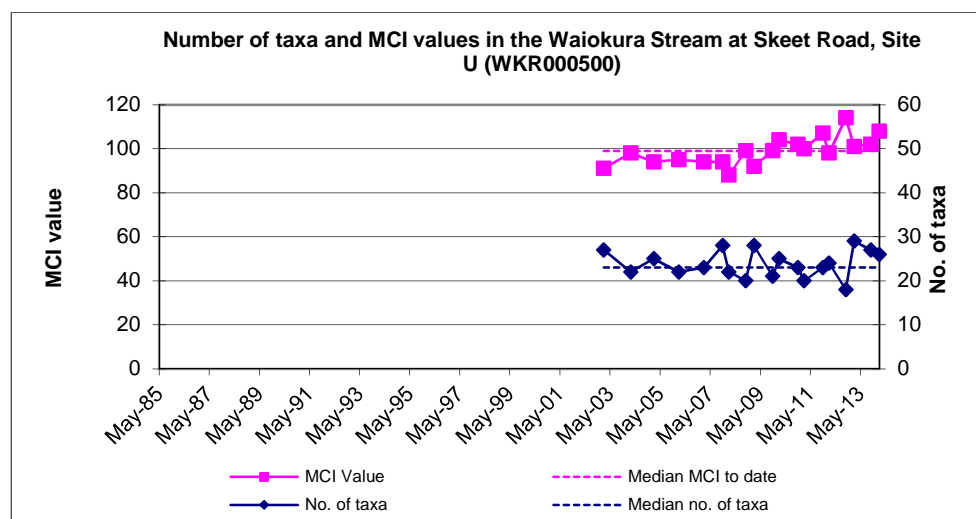


Figure 9 Numbers of taxa and MCI values recorded at site U in the Waiokura Stream since February 1985

The MCI value of 108 units was seven units higher than that recorded by the previous summer (2013) survey, and nine units above the median of previous values recorded from the eighteen previous surveys at this site (Table 5, Figure 9). This score reflected the moderate proportion of 'tolerant' taxa (35% of taxa richness) in the community (Table 5). The Waiokura Stream rises below the National Park boundary and the site at Skeet Road (site U) is in the mid-reaches at an altitude of 150 m asl. A relationship for ringplain streams developed between MCI and site altitude (Stark and Fowles, 2009), predicts a MCI value of 100 units for this site. The historical site median (98 units) is one unit below this altitude prediction while the current summer score (108 units) was 9 units (above) the predictive value. The SQMCI_s score of 6.1 units was near the maximum of the range of previously recorded values at this site, and reflected the dominance of several 'sensitive' taxa and one mayfly in particular (Table 5).

Site D (WKR000650)

A moderate richness of twenty-four taxa was recorded at this site downstream of the wastes irrigation areas in the Waiokura Stream catchment. This was relatively similar to that recorded at site U and the median taxa number previously recorded at this downstream site (Table 2). Five of the taxa that dominated the community at site U were also dominant at this site, with the addition of one 'moderately sensitive' taxon [stony-cased caddisfly (*Pycnocentroides*)] and loss of two 'moderately sensitive' and one 'tolerant' taxa (Table 5). This was coincident with a significant change in habitat with macrophytes, which were absent at site U, being present throughout the stream and loss of bouldery substrate at this site.

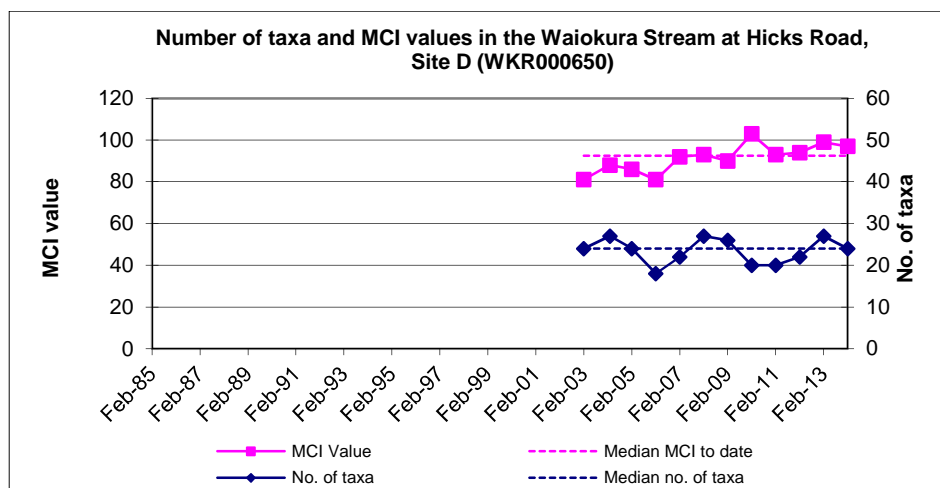


Figure 10 Numbers of taxa and MCI values recorded at site D in the Waiokura Stream since February 1985

A moderate proportion of ‘tolerant’ taxa (38% of taxa richness) was present at this site, which was reflected in the MCI value of 97 units. This score was two units lower than that recorded by the previous summer (2013) survey, the third highest MCI score recorded to date at this site, and six units above the median of the twelve previous surveys performed at this site (Table 5, Figure 8). The MCI score was eleven units less than that recorded upstream at site U, which was not considered to be significant given the distance between sites U and D, the marked habitat differences between sites and that the absence of two ‘highly sensitive’ taxa (at site D) present only as rarities upstream, contributed to half of the decrease in MCI scores.

Despite five significant changes in individual taxon abundances between the sites, the SQMCI_s remained within 0.1 unit of the score at site U, upstream of the irrigation areas (Table 5). As the main change in MCI scores was attributable to differences in habitat between the two sites, the relative similarity in community structure indicated that wastes discharged from the Fonterra Kapuni site on to land in the Waiokura Stream catchment had not had a recent detrimental effect on the biological health of this stream.

Summary and Conclusions

The Council’s standard ‘kick-sampling’ technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River and two sites in the Waiokura Stream on 3 February 2014. Samples were sorted and identified to provide the number of taxa (richness), MCI and SQMCI_s scores for each site. The samples were also microscopically scanned to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa (“undesirable biological growths”).

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.

In the Kaupokonui River, taxa richnesses were similar to or better than historical median richnesses, while MCI scores indicated 'good' to 'fair' community health at all sites. The MCI scores at four sites were higher than their historical median scores while the score at the furthest downstream site was slightly below its historical median. Three sites (downstream of the cooling water discharges) showed some reduction in community health from those recorded by the previous spring survey, which is a fairly typical trend for a summer survey. The survey continued to show that the Kaupokonui River generally has macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community found at site 7 was indicative of some influence from the Dunns Creek tributary within the reach between sites 6 and 7.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities although there was an indication of some deterioration in biological health but not to the degree compared with conditions recorded by the 2010 spring survey. (That survey recorded the presence of sewage fungus and *Chironomus* blood worm midges, both indicative of enrichment, at sites 5 and 6, at least 800 metres downstream of the site. Neither was recorded by the following six surveys, nor by the current survey, indicating that the discharge that caused the spring 2010 result had either ceased, improved in quality, or been more adequately diluted). Also there was no deterioration in the macroinvertebrate communities between sites upstream and downstream of spray irrigation of wastes onto land (but upstream of the cooling water discharge) from the Fonterra Kapuni factory recorded by the current survey.

MCI values continued to indicate in general that macroinvertebrate communities were mainly in 'good' health, being above median MCI scores from surveys conducted since 1998 for three sites and within 5 units of medians for the two furthest downstream sites. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites, although there was some exceptions at site 7. The deterioration in MCI score recorded between sites 6 and 7 (in the lower reaches), was not a statistically significant result, but was a result commonly recorded in this river, often due to progressive deterioration in communities in a downstream direction, typical of Taranaki ringplain rivers and streams. In the current survey, this deterioration was more related to the poorer 'health' recorded at site 7 which also was emphasised by the significant decrease in SQMCI_s score through this reach and downstream of the Dunns Creek tributary.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. No such growths were recorded by the current survey which also found subtle impacts on the macroinvertebrate communities at these sites.

The Waiokura Stream communities indicated that conditions during this survey were better than during most of the relatively limited number of previous surveys at these two sites to date. The MCI value recorded at the downstream site was less than that recorded upstream (but not significantly so given the more subtle loss of rare 'highly sensitive' taxa at the downstream site and habitat variability between sites), and both values were above their respective historical medians. There were some subtle changes in macroinvertebrate community compositions between the sites which were associated with differences in habitat, principally an increase in macrophytes and absence of boulders at the downstream site. These community differences were insignificant and not indicative of recent impacts of wastewater irrigation within the Waiokura Stream catchment.

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