Taranaki By-Products Ltd Monitoring Programme Biennial Report 2013-2015

Technical Report 2015–65

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Executive summary

Taranaki By-Products Limited (the Company, TBP) runs an animal rendering operation located on Kohiti Road at Okaiawa, in the Inaha Stream catchment. Two rendering plants operate on the site, an inedibles plant owned by Taranaki By-Products Limited, and a food-grade plant owned by Taranaki Bio-Extracts Limited (TBE). A trucking firm, Jackson Transport Limited, operates from the site also. This report for the two-year period from July 2013-June 2015 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

Taranaki By-Products Limited holds 13 resource consents for all of the operations associated with the site, which include a total of 166 conditions setting out the requirements that the Company must satisfy. The Company holds two resource consents to allow it to take and use water, one consent for structures in a watercourse, one consent to realign a watercourse, four consents to discharge to the Inaha Stream and a tributary, three consents to discharge to land, and two consents to discharge emissions into the air at the site. Two of the consents were granted during the review period, one in February 2014 to take groundwater, the other in January 2015 to discharge emissions to air from burning of wood waste.

During the period under review, Taranaki By-Products demonstrated overall improvement required level of environmental performance.

Monitoring is carried out by both the Company and the Council. The Company monitors water abstraction rates, wastewater volume and composition, effluent loadings on irrigation areas, bio-filter performance and weather conditions. The Council undertakes inspections of the plants' site and irrigation and burial areas; water quality and biological monitoring in the Inaha Stream and its tributaries; and groundwater surveys.

The Council's annual monitoring programmes for the two years under review together included 24 inspections, 343 water samples collected for physico-chemical analysis, and four bio-monitoring surveys of receiving waters. In addition, continuous monitoring of the temperature of cooling water discharged and of the Inaha Stream was undertaken, and a staff gauge rating was maintained for measurement of flow in the stream.

There was a fire at the inedibles plant on 12 January 2014, which affected the operation of the plant and the monitoring undertaken for about 12 weeks.

The abstraction of water from the Inaha Stream was not found to have any adverse effect on the stream. Compliance with volume limits was demonstrated. The water permit was changed in January 2015, to allow measurement of flow in Inaha Stream by visual reading of the existing staff gauge rather than by a continuous water level recorder.

Abstraction of groundwater commenced in February 2014, to supplement the surface supply with water more suited to use in steam systems. Measurement of abstraction rate with telemetry to the Council was implemented in March 2014. An infringement notice was issued for not installing this and water level monitoring equipment before the consent was exercised. In 2014-2015, groundwater comprised 47% of water used from the two sources. (Water is also drawn from Waimate West rural water supply).

The discharge of cooling water to the Inaha Stream was not found to have any adverse effect on the stream's ecology. The cooling system was upgraded in April 2014, in response to an abatement notice issued upon exceedance of the limit on receiving water temperature increase in summer 2013. The temperature limit was complied with throughout 2013-2014 and 2014-2015, except for a short period while the additional cooling system was being installed.

The Company operates a 'dual' wastewater disposal system, in which discharge may be either to the Inaha Stream directly or to the Company's dairy farm by spray irrigation. In 2006-2007, a significant improvement in water quality of the stream was brought about by a change in management of the system so that disposal to land was maximised. The results of stream bio-monitoring in 2013-2015 show that this improvement was maintained, to the extent that there was little difference in health of stream-bed communities above and below the rendering plants' site or the irrigation areas, until the February 2015 survey, which showed some deterioration occurred at the two sites immediately downstream**.** This deterioration may be related to a proliferation of periphyton growth that followed the removal of shading willow trees adjacent to the plants' site, and possibly to discharges from the site. The affected riparian margins were planted with native species in winter 2015**.**

The total area of land utilised for wastewater irrigation decreased, from 291 ha in 2012-2013 to 252 ha in 2013-2014, and further to 226 ha in 2014-2015. There was a corresponding increase in area on which nitrogen fertiliser was applied, primarily by injection of Zeal Grow (stickwater, a by-product of the rendering process), from 95 ha in 2013-2014 to 276 ha in 2014-2015. This occurred largely as a result of change in treatment/disposal of stickwater from the TBE plant after the fire. Over the two-year period, reported annual nitrogen loading from wastewater reduced from about 64 to 31 tonnes, while reported fertiliser nitrogen application increased from about 17 to 44 tonnes, mainly as Zeal Grow.

The reported average annual nitrogen loading from wastewater irrigation where 300 kg/ha is allowed reduced from 75% of the limit in 2012-2013 to 60% in 2013-2014, and further to 43% in 2014-2015. Where 200 kg/ha is allowed, the successive annual loadings were 19% and 42% of the limit. Distribution of wastewater over the TBP farm was uneven in 2013-2014, with improvement shown in 2014-2015. In 2013-2014, nine paddocks, or 11% of the relevant area, exceeded the limit where 300 kg/ha is allowed, to a maximum of 523 kg/ha. In 2014-2015, a similar area exceeded the limit, with a much reduced maximum of 324 kg/ha.

Groundwater monitoring continued to show significant effects of irrigation. Nitrate levels were elevated at several bores situated down-gradient of long disposal areas, with all either being stable or showing a reducing trend, as indicated by the median. However, nitrate ranges observed show elevated levels which require further investigation. An increase in nitrate concentration was found in the tributary that runs through western irrigation area. Nitrogen application to adjacent areas was reduced, and the response is being monitored.

The spring used for supply of local residents downslope of the irrigation block south of Normanby Road was well within the guideline for nitrate concentration, but continued to show an increasing trend.

There was no complaint recorded in 2013-2015 in relation to wastewater disposal.

Management of the solid waste disposal area was satisfactory. The narrow plume, containing a high concentration of ammonia and organics, of low volume yield, that has been detected downslope of the disposal area, is being monitored to determine if any remedial action is

needed. Following the fire, rubble from the burned building, and raw material that could not be diverted during the repairs, was buried. A monitoring bore was installed downgradient of the new pit.

The wastewater treatment system continued to be upgraded in stages. In 2013, the pH adjustment system at the dissolved air floatation (DAF) unit was refined, improving removal of soluble fat and protein. In June 2014, a second settling pond (5A) was commissioned beside the first to enable it to be desludged.

The stormwater system has discharged significantly lower amounts of sediment and grease to the Inaha tributary since improvements began in 2006-2007 that include diversion of first flushes of stormwater to the wastewater system, placement of additional sediment traps, and sealing of much of the catchment. Some breaches of the suspended solids and oil and grease limits were recorded, with no apparent adverse effect in the Inaha Stream.

Fencing and planting of riparian margins of the Inaha Stream above Kohiti Road was maintained, in compliance with the consent to install culverts. A donation was made to the Taranaki Tree Trust for riparian planting in the Inaha catchment, as agreed in the consent to discharge wastewater.

Substantial works were undertaken on the bio-filters for treatment of odorous emissions from the rendering plants. In January 2014, a new bio-filter was completed which was dedicated to the treatment of concentrated sources streams from the inedibles plant. Comprehensive repairs and maintenance was carried out on the existing bio-filters, replacing pipework and bark.

Other works to control odorous emissions from the inedibles plant included the construction of an enclosed blood unloading area with a dedicated air scrubbing system, and a new offal reception area. Two air-cooled vacuum condensers were installed to improve air extraction and bio-filter efficiency, increase odorous condensibles removal, and reduce heat load on the water cooling system.

An audit of the odour control system was carried out in May 2015 by Golder Associates, independent air quality engineers. The (Golder) report concluded that the system and associated equipment appear to be maintained and operated in sound engineering state. Recommendations on improvements were made, to which the Company has agreed.

Air quality remained a concerning environmental issue. In 2013-2014, out of the 13 incidents registered in total for all of the Company's activities, nine related to complaints about emissions to air causing odour, and in 2014-2015 all seven incidents related to odour. Over the two year period, one odour complaint was substantiated, in January 2014, for which there was reasonable defence as provided for within the Resource Management Act. This may be compared against 37 odour complaints in 2012-2013, six of which were substantiated, and 13 odour complaints in 2011-2012, none of which was substantiated. The complaints related to either cooking, wastewater treatment, or partially treated emissions during the repair, maintenance and upgrade of the bio-filters. No odour was associated with the edibles plant, irrigation of wastewater, or burial of solid waste.

Investigation of complaints by Council found noticeable, but not objectionable, odour beyond the plant boundary on 76% of occasions.

During the 2013-2014 and 2014-2015 years, TBP demonstrated a variable level of environmental performance overall. Of the nine consents for which compliance and environmental performance could be categorised, four were rated 'improvement required, three 'good' and two 'high'.

For the abstraction of water from Inaha Stream and from groundwater, during the period under review, the Company's overall level of environmental performance was high.

For the discharge of wastewater to Inaha Stream, during the period under review, the Company's overall level of environmental performance required improvement. This relates to incidents where insufficient dilution occurred, and notification of recommencement of discharge to the stream was not given, for which infringement notices were issued. No adverse effect was found in the stream, however although within guidelines groundwater has increasing nitrate downstream of the plant and biodiversity has seen a decline.

For the discharge of cooling water to Inaha Stream, during the period under review, the Company's overall level of environmental performance was good.

For the discharge of stormwater to Inaha Stream, during the period under review, the Company's overall level of environmental performance required improvement, in respect of the amount of solids and oils in the discharge despite the improvements to the wastewater treatment plant. No adverse effect was noted for the receiving water.

For the discharge of wastewater to land, during the period under review, the Company's overall level of environmental performance required improvement. More even application of wastewater could be achieved. Nitrate concentration increased substantially in the western Inaha Stream tributary where it runs through the irrigation area.

For the burial of solid wastes, during the period under review, the Company's overall level of environmental performance was good.

For the maintenance of culverts in the Inaha Stream, during the period under review, the company's overall level of environmental performance was good. The timing of works to maintain the culverts could be better to avoid fish spawning periods.

For the discharge of emissions to air, during the period under review, the Company's overall level of environmental performance required improvement. Substantial works were undertaken, at a cost of about $400,000, towards improvement in odour control.

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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1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the combined Annual Report for the periods July 2013-June 2014 and July 2014-June 2015 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Taranaki By-Products Limited (TBP). The Company runs an animal rendering operation situated on Kohiti Road at Okaiawa, in the Inaha catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by TBP that relate to abstractions and discharges of water within the Inaha catchment, and the air discharge permit held by TBP 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 TBP's use of water, land, and air, and is the nineteenth and twentieth combined annual report by the Council for Taranaki By-Products.

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 TBP in the Inaha catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Inaha catchment.

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.

1.1.3 The Resource Management Act (1991) and monitoring

The *Resource Management Act 1991* (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 (e.g. 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 Company in the Inaha catchment during the period under review, this report also assigns an overall 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 TBP plant on Kohiti Road, Okaiawa is the major animal rendering plant in Taranaki. It was established in 1936. About 60 persons are employed. Raw material comes largely from meat and poultry processing plants in central and southern North Island. The Company also runs a dead stock collection service in Taranaki and adjacent regions. Transport of raw materials to and products from the site is undertaken by a trucking firm that operates from the site, Jackson Transport Limited.

The site is located beside Inaha Stream in mid-catchment, about 13 km from sea, and less than 1 km from Okaiawa, a village of about 50 dwellings. Intensive pastoral farming, mainly dairy, occurs around the site (Figure 1).

Inedible products are manufactured, including meat and bone, poultry, feather, and blood meals, as well as tallow and chicken oil. There are three separate processing lines – a mixed abattoir material line [processing beef and mutton, hard and soft offal, and fallen stock], a poultry line [processing soft poultry offal and feathers], and a blood line. The plant is able to process up to 26 tonnes per hour of raw material [18 t/h through the mixed abattoir material line and 6-8 t/h through the poultry feather and offal line]. Up to 100,000 litres/day of blood can be processed.

The plant operates 24 hours/day, seven days/week throughout the year, with weekly maintenance shutdowns on Sunday/Monday. There is some seasonal variation in beef offal processing, the peak occurring between January and May, being earlier in dry seasons, when the availability of stock feed is reduced. Processing of fallen stock peaks in July and August, during the calving season. Poultry processing is relatively steady throughout the year, with a slight increase before Christmas and over the summer months.

Animal rendering is essentially a two-stage process, involving separation of fat and drying of the residual solids. The TBP process is largely continuous low temperature [below 100˚C] dry rendering with mechanical de-watering by screw press, and some thermal de-watering. Indirect (Rotadisc) steam-heated driers are employed. The dried product is milled, sieved and stored in bulk.

The mechanical de-watering of the raw material creates large quantities of stickwater, essentially the pressed-out meat juices. Waste heat exchangers dry the stickwater under vacuum to a stage where it can be incorporated back into the meal product. Washings and waste products from the stickwater system have been registered as a fertiliser (Zeal Grow) and are applied to an adjacent dairy farm owned by TBP. Solid wastes are buried in a designated area on the farm.

1.2.1 Wastewater treatment system

Wastewater from TBP's plant comprises equipment and floor washings, condensates from treatment of gas emissions, and blood decanter liquids. There is potential for stickwater and blood losses to the treatment system.

The wastewater treatment system comprises a contra-shear screen, a dissolved air flotation (DAF) unit, three anaerobic ponds (ponds 1-3), an aeration pond (pond 4), a settling pond (pond 5), and a large aerobic pond (pond 6).

All wastewater from the plant (except condensate wastewater from the waste heat exchanger) is pumped through the rotary screen, then a 100 m^3/h DAF unit to which flocculent is added to assist in recovery of solids. The wastewater then moves sequentially through ponds 1-3, with a total volume of about 15,000 m^3, where anaerobic activity breaks it down. The condensate wastewater from the plant is pumped directly to pond 1. Ponds 1 and 2, on the northern side of the plant, may be operated in parallel, depending on loadings. The wastewater from pond 2 enters wet well pump station 1, from where it is pumped to pond 3, at a higher level on the southern side of the plant.

From pond 3, the wastewater discharges to an aerated lagoon (pond 4) with a volume of 8000 m^3. Aerators of about 315kW total capacity assist in the reduction of biochemical oxygen demand (BOD) and of ammonia concentration. The wastewater finally passes, via a small settling pond (5), into a large aerobic pond (6), with an area of 1.04 hectares and a nominal volume of 30,000 m^3, with four brush aerators each of 17.5 kW capacity. The purpose of the aerobic pond is to allow further treatment of the effluent, and to provide for storage of treated wastewater. Pond 6 is also used as a source of scrubbing water in the odour control system.

The treated wastewater is discharged either to Inaha Stream directly or to adjacent land by spray irrigation. This 'dual' wastewater disposal system addresses the limited capacity of Inaha Stream to assimilate the treated wastewater, while promoting grass growth for dairy production on land that is well suited to irrigation. The total area utilised for irrigation increased from 269 ha in 2011-2012 to 291 ha in 2012-2013.

1.2.2 Odour management

The rendering operations have potential to generate offensive odour. Sources include the raw materials, rendering processes, wastewater treatment and disposal systems, odour control system, and solid waste burial areas. The generation of odour is controlled through the quality and preservation of raw materials, design and operation of the rendering processes, maintenance of the buildings, treatment of odorous emissions, and management of the wastewater treatment and disposal systems and burial areas.

Odour extraction, cooling and bio-filters are the main components of the odour control systems that are operated at the TBP and TBE plants. There are four extraction systems, one each for concentrated odour sources in the two plants, and two independent building air systems (Factory Air 1 and 2) at the TBP plant to capture fugitive emissions that are not collected by the concentrated sources system.

Concentrated odorous gases from the TBP bovine, poultry and feather rendering (but not blood) lines are collected at source, then cooled and scrubbed in two water spray condenser towers before being discharged to the concentrated sources (CS) bio-filter. Hot exhaust gases, from pre-cookers and driers, are passed through three waste heat evaporators to concentrate stick liquor, then a vertical condenser, before going to the spray towers with the other concentrated emissions.

The Factory Air 1 (FA1) ventilation system extracts air from above the mixed abattoir and poultry rendering lines in the northern part of the TBP building. Factory Air 2 (FA2) system collects air from the dead stock pre-breaker, blood drying processes within the blood room, meal mill exhausts and the poultry dryer room, in the southern part of the building, and passes the air through a wet scrubber.

At the TBE plant, humid odorous air streams from the concentrated sources are extracted, and cooled and scrubbed, before being ducted to the concentrated sources bio-filter. TBE building air is ventilated directly to atmosphere as it contains no significant odour.

There are three bio-filter systems, comprising two factory air bio-filters, and a concentrated sources bio-filter. FA1 bio-filter is of coarse bark set in the ground, with three parallel zones that are each 30m x 40m x 1.5m (total volume of 5,400m^3). FA2 bio-filter is also formed of coarse bark, set above ground over pea gravel with two zones 25m x 30m x 1m (1,500 m^3). The CS bio-filter has two parallel beds 25m x 20m x 0.7m (700m^3) of coarse bark overlaid with fine bark compost. The locations of the bio-filters are given in Figure 2.

The CS bio-filter was repaired in November 2010, when two sides of both beds were replaced. Bed 3 of FA1 bio-filter was reconstructed between July and December 2011, improving the pipework for air distribution and for drainage of liquids. The remainder of FA1 bio-filter was reconstructed between October 2012 and April 2013, the corrosion-prone corrugated iron manifolds being replaced with concrete pipes, and bark replacement being delayed by problems with supply.

Upon upgrade of FA1 bio-filter, the concentrated sources air flow from the TBP plant was redirected to it temporarily, reducing heat load on the designated CS bio-filter,

now dedicated to the TBE plant. At the end of the 2012-2013 review period, construction had begun of a fourth zone for FA1 bio-filter, intended to receive the TBP plant concentrated sources streams.

1.3 Bio-extracts plant

In April 2003, an edible (food grade) tallow and gelatine bone chip recovery plant was commissioned adjacent to the existing rendering plant at Okaiawa. A new company, Taranaki Bio Extracts Limited (TBE), was established for the venture that is owned by Taranaki By-Products Limited and Riverlands Eltham Limited in equal partnership.

The TBE operation involves the processing of boning-room waste that has been separated from other raw offal at meat processing plants. No increase in raw material input has occurred. The rendering and drying is carried out at lower temperatures than at the inedibles plant, resulting in less odour generation and heat emission. Total wastewater volume and concentration at the site has not changed. Certain utilities are shared between the two plants, including the steam generators, the wastewater treatment plant, and bio-filters for treatment of air emissions.

The (gas-fired) Duske drier, previously used on the chicken line with occasional smoking problems, was transferred to the new plant and operated at lower temperature, and replaced with indirect steam driers, resulting in lower loading on the biofilter odour control system. Surfaces of surrounding areas were sealed, leading to improved stormwater quality and reduction in background odour levels.

1.4 Resource consents

A summary of the consents held by Taranaki By-Products Limited in relation to activities at its Okaiawa plant is given in Table 1 below, and the consents are discussed in Sections 1.4.1 to 1.4.5. A copy of each of the consents can be found in Appendix I.

Table 1 Summary of resource consents held by Taranaki By-Products Limited

Consent number	Purpose	Volume	Next review date	Expiry date
2049-4	Discharge treated wastewater to Inaha Stream	940 m^3/day	2017	2019
2050-4	Discharge cooling/backwash water to Inaha Stream	2,160m^3/day	2017	2019
2051-4	Take from Inaha Stream	2,160m^3/day(50L/s)	2017	2019
3941-2	Discharge treated wastewater to land and air	1,400m^3/day	2014	2019
4058-4	Discharge emissions to air from rendering operations		2015	2024
5426-1	Discharge stormwater to Inaha tributary	1,025L/s	2017	2019
5495-1	Discharge meat wastes by burial into land	200 tonne/day	2017	2019
5560-1	Discharge waste cheese by burial, and emit to air	100 tonne	-	2017
6431-1	Place culverts in Inaha Stream		2017	2023
7234-1	Disturb to realign Inaha Stream		2017	2023
7329-1	Discharge sediment during Inaha Stream realignment		2017	2023
9756-1	Take groundwater	22.8L/s(1,970m^3/d)	2017	2029
10054-1	Discharge emissions to air from burning		2017	2029

In addition, TBP holds consents **2446** and **3117** to discharge untreated farm dairy effluent by irrigation to land. Consent **2446** was exercised until the 2004-2005 dairy season, when dairy operations were consolidated at a new shed on Kohiti Road from which wastewater is transferred to the treatment system for the nearby rendering operations. Consent **3117** now applies to a small shed used for sick cows on Katotauru Road.

1.4.1 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 rule in a regional plan, or it falls within some particular categories set out in Section 14.

TBP Ltd holds two water permits that provide for abstraction of water, one from Inaha Stream and one from groundwater.

1.4.1.1 Inaha Stream

Taranaki By-Products Ltd (TBP Ltd) holds water permit **2051-4** to cover the abstraction of up to 50 litres/second of water from the Inaha Stream for a rendering operation. This permit was issued by the Taranaki Regional Council on 31 May 1999 under Section 87(d) of the RMA. It is due to expire on 1 June 2019.

There are six conditions imposed on consent **2051-4**.

Condition 1 requires the means of taking water to be satisfactory to Council.

Condition 2 imposes a minimum flow of 25 litres/second be maintained in the stream and condition 3 requires installation of a measuring device and records to be kept of daily abstraction and condition 4 requires the flow of Inaha Stream to be measured and recorded.

Condition 5 required the consent holder to investigate and report on the use of wastewater for cooling water.

Condition 6 sets out provision for review of the consent.

Condition 4 was changed on 21 January 2015 to remove the requirement to install a flow recorder, but preserve the requirement to visually record the stream height daily, and keep records of the flows within Inaha Stream.

1.4.1.2 Groundwater

TBP Ltd holds water permit **9756-1** to cover the take and use of groundwater for industrial water supply. This permit was issued by the Taranaki Regional Council on 3 February 2014 under section 87(d) of the RMA. It is due to expire on 1 June 2029.

There are 12 conditions imposed on consent **9756-1**.

Condition 1 imposes a limit on maximum abstraction rate.

Condition 2 requires the bore to be permanently labelled for identification.

Conditions 3 and 6 address water level monitoring.

Conditions 4 and 5 address metering and logging of water use, and certification.

Condition 7 deals with the telemetry of monitoring data to Council.

Conditions 8 and 9 relate to access to and failure of monitoring equipment.

Condition 10 requires adoption of the best practicable option.

Conditions 11 and 12 relate to lapse and review of consent.

1.4.2 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.

TBP Ltd holds four discharge permits that provide for discharge to surface water, one of wastewater, one of cooling water, and two of stormwater.

1.4.2.1 Wastewater discharge

TBP Ltd holds water discharge permit **2049-4** to cover discharge of up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream. This permit was issued by the Taranaki Regional Council on 31 May 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

The consent was changed on 4 October 2006, following a review of conditions invoked by Council to deal with adverse effects resulting from exercise of the consent, and an application by TBP to include provision for farm dairy wastewater.

There are 19 special conditions imposed on consent **2049-4.**

Conditions 1 and 2 relate to the location and area of the mixing zone and Condition 3 relates to the point of discharge into the Inaha Stream.

Condition 4 requires the consent holder to give notice of changes in process which may affect the nature of the discharge.

Condition 5 requires the consent holder to monitor consent conditions as deemed reasonably necessary by Council.

Condition 6 sets a minimum dilution rate on the discharge.

Condition 7 prohibits the discharge of stickwater, and deals with increase in dairy herd size.

Condition 8 requires cessation of discharge into the stream at the specified minimum flow rate.

Condition 9 prohibits the discharge from giving rise to specific adverse effects in the receiving waters.

Condition 10 sets a limit on the level of ammonia in the receiving waters.

Condition 11 requires controls on discharge and records of discharge rate.

Condition 12 requires the consent holder to maintain a stream flow gauge.

Conditions 13 and 14 relate to the requirement for a wastewater disposal management plan.

Conditions 15 and 16 require notice of changes to the management plan, provide for review of the plan, and require a designated manager of the wastewater system.

Condition 17 requires the wastewater management plan be adhered to, and that site staff are trained in implementation and advised of any changes to the plan.

Condition 18 relates to a consent holder donation to Taranaki Tree Trust and commitment to riparian planting.

Condition 19 is a provision for review of consent conditions.

The changes of conditions from the review were a requirement to operate the dual wastewater disposal system so as to minimise discharge to Inaha Stream, increasing the minimum dilution of treated wastewater in the stream, prohibition of discharge of stickwater, and annual review of the wastewater management plan.

The changes of conditions in relation to the inclusion of farm dairy wastewater were an increase in discharge volume, a limit on the number of cows provided for, and an additional review date.

1.4.2.2 Cooling water discharge

TBP Ltd holds water discharge permit **2050-4** to cover discharge of up to 2160 cubic metres/day of cooling water and backwash water into the Inaha Stream. This permit was issued by the Taranaki Regional Council on 31 May 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

There are 7 special conditions imposed on consent **2050-4.**

Condition 1 requires the consent holder to monitor consent conditions as deemed reasonable and necessary by Council.

Condition 2 prohibits the increase in concentration of pollutants in the discharge.

Conditions 3 and 4 place a temperature and suspended solids limit on the cooling water discharge.

Condition 5 prohibits specific adverse effects in the receiving waters of the Inaha Stream.

Condition 6 requires the consent holder to measure and keep record of discharge temperature, to make available on request.

Condition 7 sets out provision for review of the consent.

1.4.2.3 Stormwater discharges

Rendering plants' site
TBP Ltd holds water discharge permit **5426-1** to cover discharge of up to 1095 litres/second of stormwater into an unnamed tributary of the Inaha Stream. This permit was issued by the Taranaki Regional Council on 31 May 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

There are five special conditions imposed on consent **5426-1.**

Condition 1 requires the consent holder to give notice of changes in process which may alter the nature of the discharge.

Condition 2 sets chemical limits on the discharge.

Condition 3 prohibits specific adverse effects in the receiving waters of the Inaha Stream.

Condition 4 requires the consent holder to provide Council with a contingency plan and condition 5 sets out provision for review of the consent.

Land re-contouring
TBP Ltd holds water discharge permit **7329-1** to cover the discharge of stormwater and sediment into the Inaha Stream from earthworks associated with the re-contouring of land and the re-alignment of a section of the Inaha Stream. This permit was issued by the Taranaki Regional Council on 30 June 2008 under Section 87(e) of the RMA. It is due to expire on 1 June 2023.

There are 10 conditions imposed under consent **7329-1**.

Condition 1 requires the consent to be exercised in accordance with documentation submitted.

Conditions 2 and 3 limit the area and volume of soil disturbed.

Conditions 4 and 5 address sediment control measures and mitigation of effects in the stream.

Condition 6 requires notification and a programme of works.

Condition 7 deals with stabilisation of completed earthwork areas.

Condition 8 lays down procedure in case an archaeological site is encountered.

Conditions 9 and 10 relate to lapse and review of consent.

1.4.3 Air discharge permits

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

TBP Ltd holds two discharge permits that provide for emissions to air, on from rendering operations and one from burning waste wooden material.

1.4.3.1 Rendering operations

TBP Ltd holds discharge permit **4058-4** to cover the discharge to air of emissions from rendering operations and associated processes including wastewater treatment and burial of material. This permit was issued by the Taranaki Regional Council under Section 87(e) if the RMA on 11 October 2011. It expires on 1 June 2024,

There are 12 special conditions imposed on consent **4058-4**.

Condition 1 requires the consent holder to adopt best options to minimise adverse effects of discharge on the environment.

Condition 2 prohibit offensive or objectionable odour beyond the property boundaries at any time, and Condition 3 defines such odour.

Condition 4 requires the employment of a suitable person to ensure compliance with consent conditions.

Condition 5 prohibits fish processing,

Condition 6 requires certification of the works, processes and equipment by a suitable independent engineer biennially.

Conditions 7 to 9 relate to an Air Discharge Management Plan.

Condition 10 deals with dust.

Condition 11 deals with community consultation.

Condition 12 is a review condition, applicable in June 2013 and biennially thereafter.

1.4.3.2 Burning

TBP Ltd holds discharge permit **10054-1** to cover the discharge to air of emissions from the burning of pallets, paper and cardboard. This permit was issued by the Taranaki Regional Council under Section 87(e) if the RMA on 21 January 2015. It expires on 1 June 2029,

There are nine special conditions imposed on consent **10054-1**.

Condition 1 requires the consent holder to adopt best options to minimise adverse effects of discharge on the environment.

Condition 2 restricts the type of material combusted.

Condition 3 prohibits objectionable or offensive odour beyond the property boundaries.

Condition 4 requires burning to be supervised at all times.

Conditions 5 to 7 deal with dust and other contaminants.

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

1.4.4 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.

TBP Ltd holds two discharge permits that provide for disposal of untreated farm dairy effluent on land.

Discharge permit **2446-2** to cover the discharge of untreated farm dairy effluent by honey wagon onto and into land was issued by the Taranaki Regional Council on 18 November 2004 under Section 87(e) of the RMA. It is due to expire on 1 December 2023.

Discharge permit **3117-2** to cover the discharge of untreated farm dairy effluent by spray irrigation onto and into land was issued by the Taranaki Regional Council on 13 July 2004 under Section 87(e) of the RMA. It is due to expire on 1 December 2023.

The two consents have essentially the same nine conditions, relating to volume, location, control of effects, system maintenance, and review of conditions. Consents **2446-2** and **3117-2** provide for up to 1,000 and 250 cows, respectively.

Consent **2446-2** is no longer exercised, but has been retained by TBP in case it is needed in future. Consent **3117-2** applies to a small shed used for sick cows on Katotauru Road.

1.4.4.1 Spray irrigation

Taranaki By-Products holds discharge permit **3941-2** to cover the discharge of up to 1400 cubic metres/day of treated wastewater by irrigation onto and into land. This permit was issued by the Taranaki Regional Council on 15 December 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

The consent was changed on 21 December 2005, following a review of conditions invoked by Council to deal with adverse effects resulting from exercise of the consent, and an application by TBP to extend the irrigation area and include the discharge of farm dairy effluent. The consent was changed again on 9 November 2009 to allow a further extension of the irrigation area.

Condition 1 outlines the requirement to provide a spray irrigation management plan and specific matters it must address.

Condition 2 requires adherence to the plan and states that consent conditions prevail over any contradictory aspects.

Condition 3 provides for review of the management plan and Condition 4 requires a designated manager to implement the management plan.

Condition 5 requires adoption of the best practicable option to deal with adverse effects, with particular reference to minimisation of nitrogen in the effluent.

Condition 6 requires notification to Council when irrigation is not possible and discharge to the stream will cause dilution limits to be exceeded.

Condition 7 places a minimum limit on the level of dissolved oxygen in the discharge.

Conditions 8 and 9 stipulate there shall be no objectionable odour or spray drift as a result of irrigation.

Condition 10 limits the sodium adsorption ratio.

Condition 11 prohibits ponding of wastewater or direct discharge.

Conditions 12 and 13 specify the area of the irrigation spray zone and limit the rate of nitrogen loading.

Condition 14 requires the consent holder to investigate and report on options for reducing ammonia concentrations in wastewater prior to discharge.

Conditions 15 and 16 restrict the average application rate and specify the return period between effluent applications.

Conditions 17 and 18 require the consent holder to monitor groundwater bores and to monitor consent activities deemed necessary by Council.

Condition 19 relates to liaison meetings with interested submitters to the consent, and condition 20 addresses notification of Ngai Manuhiakai hapu of discharge to Inaha Stream.

Condition 21 relates to mitigating effects in the case of contamination of groundwater.

Condition 19 allows for the consent holder to apply for change of conditions.

Conditions 20, 21 and 22 all set out provisions for review of specific conditions and the consent in general.

The changes of conditions from the review were a requirement to operate the dual wastewater disposal system so as to minimise discharge to Inaha Stream, adoption of

the best practicable technology to minimise wastewater nitrogen concentration, and an annual review of the spray irrigation management plan.

The changes of conditions in relation to first extension of the irrigation area were increased wastewater volume, increased safety buffer zones, and greater liaison with neighbours and interested parties. The second change of consent simply increased the irrigation area with no other change of condition.

1.4.4.2 Waste burial

TBP holds two discharge permits that provide for burial of wastes into land.

TBP Ltd holds water discharge permit **5495-1** to cover discharge of up to 200 tonnes/day of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream.

This permit was issued by the Taranaki Regional Council on 30 March 2000 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

There are 18 conditions imposed on consent **5495-1**.

Condition 1 requires the Consent holder to provide a waste burial management plan addressing specific matters.

Conditions 2, 3 and 4 relate to the implementation and exercise of the management plan and provide for a review with notice from either party.

Condition 5 prohibits disposal pits from intercepting shallow groundwater.

Conditions 6 and 7 relate to the construction of the disposal pits and Condition 8 requires inspection by Council prior to disposal.

Condition 9 relates to the timing of conditions 1-4.

Condition 10 imposes a time limit on the covering of discharged material.

Conditions 11 and 12 impose a certain quality of cover material and suitable stormwater contouring.

Condition 13 requires the disposal site be reinstated satisfactorily.

Conditions 14 and 15 prohibit irrigation of effluent onto disposal area or direct discharge of contaminants to surface water.

Condition 16 requires a minimum of eight monitoring bores to monitor groundwater quality.

Condition 17 allows the consent holder to apply for change to consent conditions.

Condition 18 sets out provision for review of the consent.

TBP Ltd holds water discharge permit **5560-1** to discharge waste cheese and associated packaging by burial into land and discharge emissions into air in the vicinity of the Inaha Stream. This permit was issued by the Taranaki Regional Council on 15 October 1999 under Section 87(e) of the RMA. It is due to expire on 1 February 2000 for the air discharge and 1 June 2017 for the land discharge.

There are 23 conditions imposed on consent **5560-1**.

Condition 1 requires notification by the consent holder prior to operations.

Condition 2 requires the consent holder to house affected parties for the period of removal and disposal.

Condition 3 places a limit on tonnage and Condition 4 ensures access to Council employees for inspection and monitoring.

Condition 5 requires the consent holder to maintain a photographic record of disposal operation.

Conditions 6, 7 and 8 impose a time period on disposal operations and provide for an interim measure if the time frame is exceeded.

Conditions 9 and 10 prescribe the nature of cover at completion and prohibit the disposal of other wastes.

Condition 11 requires the consent holder to minimise odour and other effects arising from discharge.

Conditions 12, 13 and 14 relate to air discharge and require transported waste is covered and only transported in southerly wind conditions.

Condition 15 prohibits odours after February 2000.

Condition 16 relates to the construction of the disposal pit and Condition 17 prohibits the pit from intercepting groundwater.

Conditions 18 and 19 require the cover material be contoured away from disposal area and that the site be rehabilitated.

Condition 20 prohibits irrigation of effluent over the disposal area.

Condition 21 requires that the cover material remain intact and Condition 22 prohibits direct discharge of contaminants to a water body.

Condition 23 sets out provision for review of the consent.

1.4.5 Land use consents

1.4.5.1 Stream culverts

Section 13(1)(a) of the RMA stipulates that no person may use, erect, reconstruct, place, alter, extend, remove or demolish any structure or part of any structure in, or under, or over the bed of any lake or river, unless the activity is expressly allowed for by a resource consent, or rule in a regional plan and in any relevant proposed regional plan.

TBP Ltd holds land use permit **6431-1** to erect and maintain two culverts in the Inaha Stream for farm access. This permit was issued by the Taranaki Regional Council on 4 October 2004 under Section 87(e) of the RMA. It is due to expire on 1 June 2023.

There are 12 conditions imposed on consent **6431-1**.

Conditions 1 and 2 require the consent holder to adopt best option to minimise adverse environmental effects and establishes that consent conditions prevail over conflicting information.

Condition 3 requires notice of initial construction and subsequent maintenance of the culverts.

Condition 4 stipulates dates within which maintenance must occur.

Conditions 5 and 6 require the consent holder to minimise adverse effects on the water quality and riverbed disturbance.

Condition 7 requires removal and reinstatement of area when structures are no longer needed.

Condition 8 prohibits the structure from preventing fish passage.

Conditions 9 and 10 set out requirements for the establishment and maintenance of fenced riparian margins.

Condition 11 specifies the placement of culverts and structures to prevent erosion.

Condition 12 relates to lapse of consent and Condition 13 provides for review of consent conditions.

1.4.5.2 Stream diversion

Section 13(2)(b) of the RMA stipulates that no person may disturb, remove, damage, or destroy any plant or part of any plant or habitats of any such plants or of animals in, or under, or over the bed of any lake or river, unless the activity is expressly allowed for by a resource consent, or rule in a regional plan and in any relevant proposed regional plan.

TBP Ltd holds land use permit **7234-1** to realign a section of approximately 350 metres of the Inaha Stream for land improvement purposes. This permit was issued

by the Taranaki Regional Council on 12 March 2008 under Section 87(a) of the RMA. It is due to expire on 1 June 2023.

There are 11 conditions imposed on consent **7234-1**.

Condition 1 requires the consent to be exercised in accordance with documentation submitted.

Conditions 2 and 4 relate to notification and timing of works.

Condition 3 specifies the construction of a rock wall for bank protection.

Conditions 5 and 6 address the control and mitigation of riverbed disturbance and sediment effects.

Conditions 7 and 8 address the removal of fish from the old channel and future fish passage.

Condition 9 prohibits the burial of the removed vegetation near the stream.

Conditions 10 and 11 relate to lapse and review of consent.

1.5 Monitoring programme: water

1.5.1 Introduction

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

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

The monitoring programme for the TBP site consisted of five primary components.

1.5.2 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:

- in discussion over monitoring requirements,
- preparation for any reviews
- renewals
- new consents
- advice on the Council's environmental management strategies and the content of regional plans, and
- consultation on associated matters.

1.5.3 Site inspections

The TBP site was visited on 12 occasions each year during the 2013-2014 and 2014-2015 monitoring periods. With regard to consents for the abstraction of water and for the discharge of wastes to water and land, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. 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.

1.5.4 Water take

The water take was checked during site inspections. A rating curve for the stage board at Kohiti Road has been developed and maintained by the Council and updates provided to TBP since April 2001.

1.5.5 Chemical sampling

The Council undertook sampling of the discharges from the site, of surface waters upstream and downstream of the discharge points and irrigation areas, and of groundwaters around the irrigation and waste burial areas.

The final discharge from the wastewater treatment system (the discharge from the aerobic pond, Pond 6) was sampled on four occasions in 2013-2014 and in 2014-2015. The samples were analysed for both mineral and organic components, and general water quality parameters, to enable determination of compliance with consent conditions, and to calculate loadings on both Inaha Stream and land irrigation areas. The cooling water discharge and the receiving Inaha tributary were sampled concurrently with the wastewater. The stormwater discharge point was sampled when it was found to be discharging.

Monitoring of up to 10 sites in Inaha Stream and its tributaries was carried out to determine compliance with consent conditions, and to assess the impact of discharges to water and land.

In addition, three temperature recorders (one installed in the cooling water tributary and one each upstream and downstream of the confluence of the tributary with Inaha Stream) were run continuously and downloaded as required. TBP took responsibility for this monitoring in July 2010, and forwarded the data to Council monthly. (Council took back responsibility in September 2013, at the request of TBP).

Groundwater sampling was undertaken as part of monitoring of the irrigation of wastewater under consent **3941**, and of the burial of unprocessable material under consent **5495**. Nine monitoring bores and a spring were sampled every two months in connection with the irrigation areas. Up to five monitoring bores around the waste burial area were sampled, including a new bore that was established in April 2015 to replace two damaged bores.

1.5.6 Biomonitoring surveys

Two surveys of biological communities at up to eight sites in Inaha Stream and a major tributary were scheduled each year. These surveys assessed the effects of TBP's discharges (point source discharges and any diffuse source discharges as a result of spray irrigation) on benthic invertebrate communities of the stream.

1.5.7 Monitoring by Taranaki By-Products Limited

The Company measures and records rate of abstraction from Inaha Stream and, since March 2015, from groundwater.

The Company monitors Inaha Stream, and wastewater discharged to the stream and to land, as an integral part of the management of its wastewater disposal system.

The flow rate of Inaha Stream (at Kohiti Road staff gauge) and of the wastewater discharge to the stream are measured daily in order to control dilution of the wastewater. The stream is sampled and analysed weekly to determine compliance with the consent limit on ammonia concentration. The wastewater is analysed weekly for nitrogen species to enable calculation of allowable ammonia discharge rate to the stream, and of the nitrogen loading on irrigation areas.

The results of this stream and effluent monitoring were forwarded to the Regional Council monthly.

1.6 Monitoring programme: air

1.6.1 Introduction

The air quality monitoring programme for the TBP site consisted of three primary components.

1.6.2 Programme liaison and management

This part of the monitoring programme was combined with that for the water monitoring programme, and involved discussion and liaison with TBP staff, both on site during regular inspections and at the Regional Council's and TBP's offices.

1.6.3 Site inspections

The TBP site was visited on a total of 24 occasions during the 2013-2014 and 2014-2015 monitoring periods as part of the annual monitoring programme. An additional number of inspections were undertaken in response to complaints received – this is addressed further in section 2.3.3.

The main points of interest were plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, and noxious or offensive emissions.

As far as was practicable, inspections in relation to air emissions were integrated with inspections undertaken for other purposes e.g. water monitoring or in response

to complaints. A list of incidents which led to complaints is summarised in section 2.3.3 of this report.

1.6.4 Monitoring by Taranaki By-Products Limited

From 2 February 2012, the Company was required under the new air discharge permit 4058-4 to operate in accordance with an Air Discharge Management Plan. In respect of monitoring, the Plan includes production of a daily activities log, conduct of ambient odour surveys, and maintenance of a register of complaints. The monitoring components of the Plan had been in place for several years.

The daily activities log presents a checklist of operational monitoring items that must be recorded on a routine daily basis, such as climatic data, condition of the wastewater and odour treatment systems, cleaning and maintenance of plant, and various process records such as temperature in the driers and blood coagulator.

The results of bio-filter and weather monitoring, and comment from the daily activities log on events affecting environment quality, were forwarded to the Regional Council monthly. Odour survey reports and the complaints register are made available during site inspections.

2. Results

2.1 Water

2.1.1 Inspections

Compliance monitoring inspections were undertaken at approximately monthly intervals throughout the monitoring period. Inspections pertaining to water-related matters were undertaken in conjunction with air quality inspections. In addition, physico-chemical sampling was stipulated as part of the Tailored Compliance Monitoring Programmes for 2013-2014 and 2014-2015.

Water samples were collected according to the Tailored Compliance Monitoring Programme. All components of the programme were carried out, with samples taken of the following on four scheduled occasions in 2013-2014 and 2014-2015:

1. Samples of the aerobic pond discharge to Inaha Stream were taken and analysed for the following constituents: temperature, dissolved oxygen, total and filtered carbonaceous BOD_5, COD (chemical oxygen demand), total sulphide, conductivity, pH, alkalinity, turbidity, suspended solids, total grease, ammonia, nitrite, nitrate and total nitrogen, total and dissolved reactive phosphorus, sodium, potassium, calcium, magnesium, chloride, sulphate and faecal coliforms (Table 4).

2. Cooling water from the discharge point to the fire-water reservoir was sampled and analysed for temperature, turbidity, conductivity, pH, total BOD_5 and ammonia (Table 5).

3. Samples were taken from the stormwater discharge point, when it was discharging, and analysed for temperature, turbidity, conductivity, pH, suspended solids, total BOD_5, ammonia, oil and grease, and faecal coliforms (Table 6).

4. Samples from the tributary which receives the stormwater, cooling water and fire-water reservoir discharges were taken at the confluence of the tributary with Inaha Stream, and analysed for temperature, turbidity, dissolved oxygen, total BOD_5, pH, alkalinity, chloride, ammonia, nitrate/nitrite, dissolved reactive phosphorus, suspended solids, oil and grease, and faecal coliforms (Table 7).

5. Water quality in the Inaha Stream and its tributaries was sampled at up to 10 sites and analysed for temperature, turbidity, conductivity, pH, dissolved oxygen, total and filtered carbonaceous BOD_5, ammonia, nitrate, nitrite, dissolved reactive phosphorus, chloride and faecal coliforms (Table 8).

For groundwater, up to nine monitoring bores and a spring were sampled on six occasions and analysed for temperature, conductivity, pH, ammonia, nitrite/nitrate and chloride. On one occasion, in Winter/Spring, the samples were also analysed for calcium, magnesium, sodium, potassium, total alkalinity and sulphate, to enable an ion balance, and for COD. The water level in each of the bores was also measured (Figure 11).

In-stream temperature sensors (in Inaha Stream and the tributary that receives the cooling water discharge) were employed and the data downloaded and reset as required (Figure and Figure 8).

The stream physico-chemical water quality sampling sites are illustrated in Figure 1 and described in Table 3. The aerial photograph was taken on 7 March 2012.

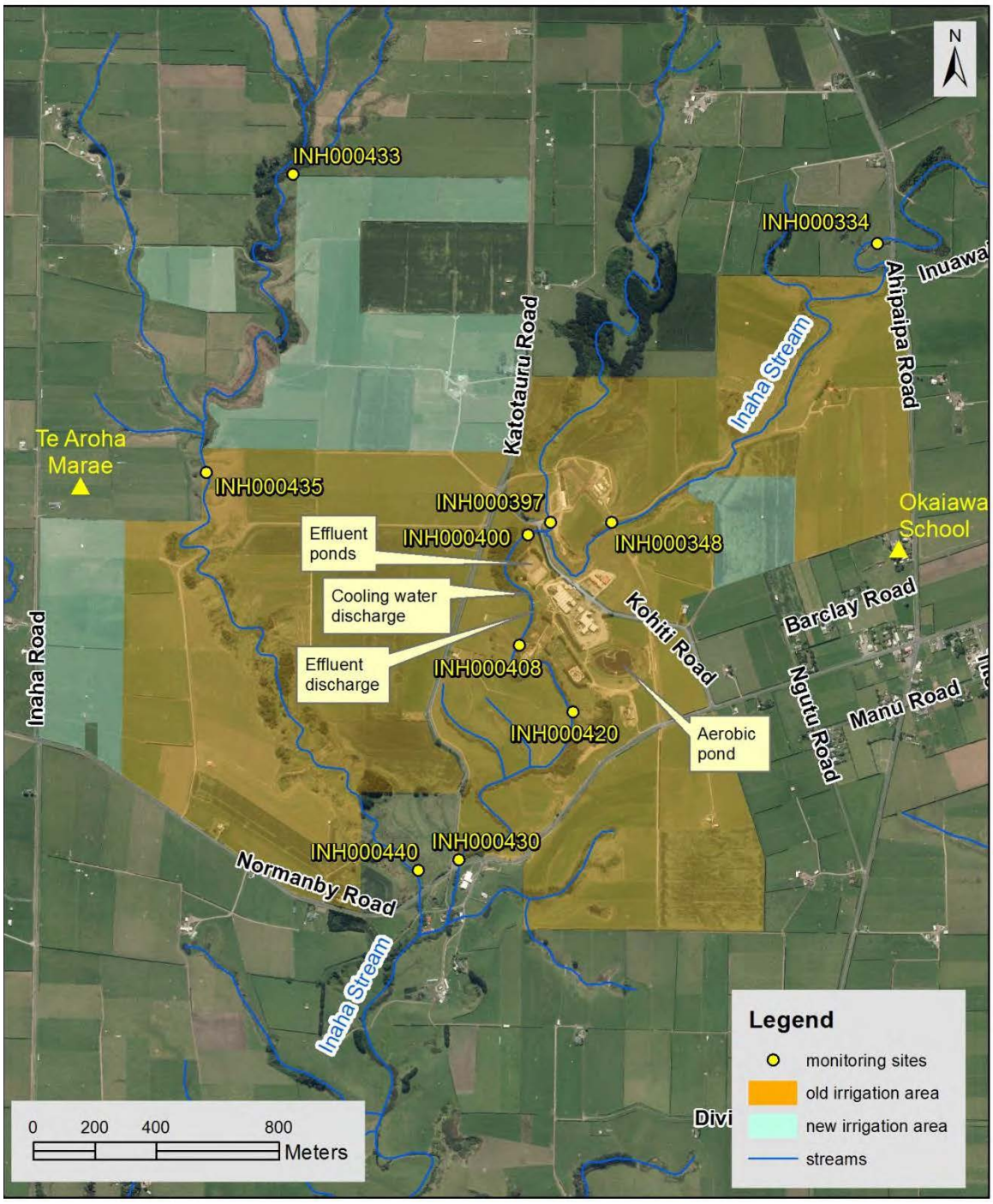

Figure 1 Chemical water quality monitoring sites for surface waters

The point-source sampling sites for the rendering operations area are illustrated in Figure 2 and described in Table 2.

Figure 2 Chemical monitoring sites for rendering operations area

Table 2 Sampling points for point-source discharges

Site	Description	Map reference, NZTM		Site code
		Easting	Northing	
A	Aerobic pond effluent	1703086	5623907	IND004004
B	Cooling water discharge	1702015	5623991	IND002004
C	Stormwater, firewater, coolant and groundwater seepage from reservoir	1701968	5624052	IND001014
D	Stormwater, firewater, coolant and groundwater seepage to Inaha	1701894	5624084	IND001015
E	No 1 stormwater: main reception, garage and yard to firewater reservoir	1702022	5623983	STW001075

Table 3 Sampling points for receiving water

Site	Description	Map reference, NZTM		Site code
		Easting	Northing	
1	Ahipaipa Road	1703013	5625271	INH000334
3	Bridge, 420 m u/s Kohiti Road	1702138	5624345	INH000348
4	Unnamed northern tributary at Inaha confluence	1701947	5624362	INH000397
5	Kohiti Road	1701874	5624322	INH000400
6	110 m d/s cooling water discharge and 30 m d/s pond 6 discharge	1701861	5623980	INH000408
7	500 m d/s pond waste discharge	1702021	5623745	INH000420
8	Normanby Road bridge, 1,450 m d/s discharges	1701650	5623262	INH000430
9a	Unnamed western tributary, 3,500m u/s Inaha confluence	1701109	5625496	INH000433
9	Unnamed western tributary 2,550m u/s Inaha confluence	1700816	5624558	INH000435
9b	Unnames western tributary ~2,000m u/s Inaha confluence	1700818	5624175	
9c	Unnames western tributary ~1,450m u/s Inaha confluence	1701183	5623577	
9d	Unnames western tributary ~900m u/s Inaha confluence	1701013	5623963	
10	Unnamed western tributary 250m u/s Inaha confluence	1701518	5623227	INH000440
11	State Highway 45	1700393	5620330	INH000470

A total of 12 routine inspections were undertaken during both the 2013-2014 and 2014-2015 periods. Council holds a record of detailed inspection notes which are available by request. Additional inspections were carried out in response to public complaints. Inspections were also carried out at the times of effluent and receiving water chemistry monitoring. During or immediately after each inspection by an officer of the Council contact was made with a Company representative to discuss the findings.

Particular attention is given to the following items:

- rendering processes
- air emission control systems
- load-in and load-out areas
- workshops
- truck depot
- chemical and oil/fuel storage areas
- stormwater system
- wastewater treatment system
- land irrigation system
- waste burial areas

2.1.2 Water abstraction

At the start of the review period, all water for processing at TBP's inedibles rendering plant was drawn from Inaha Stream at a point beside the plant under consent **2051-4**. Water for the adjacent edibles plant, and potable water for both plants, came from Waimate West rural water supply. In February 2014, following surface water quality problems experienced with new high pressure boilers and with other processes, the Company started to use groundwater taken under consent **9756-1** from a 151.2 m bore that had been sunk beside the old cowshed on Katotauru Road, about 800 m north-west of the inedibles plant.

2.1.2.1 Surface water

The water take from Inaha Stream resulted in no compliance issues with regard to the maintenance of the minimum flow (25 L/s downstream of the abstraction point) required under special condition 2 on consent **2051-4**.

With regard to the limit on abstraction rate, consent **2051-4** allows 2,160 m³/day, or 25 L/s on average, and an instantaneous maximum of 50 litres/second. TBP continuously operates one of two pumps rated at 33 and 25 L/s, the larger of which is normally the duty pump.

Under the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010, TBP has been required since 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. The Company installed a flow measurement and recording system as required. Verification of the accuracy of the system was carried out by an approved certifier.

Abstraction data for the 2013-2014 and 2014-2015 monitoring periods, recorded at 10-second intervals, were supplied on 21 August 2015. The daily abstraction record for the period from July 2013 to June 2015 is presented in Figure 3.

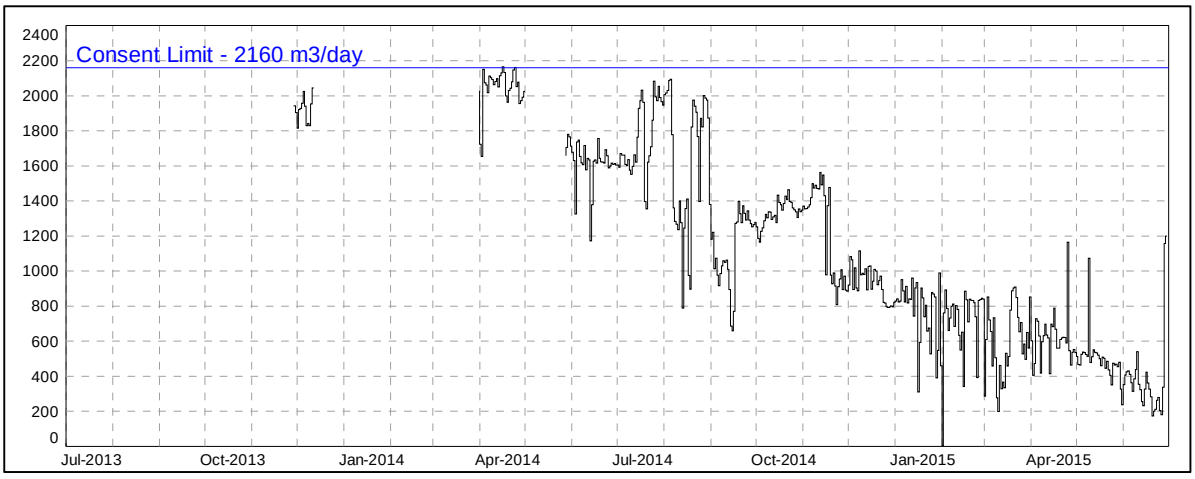

Figure 3 Daily surface water abstraction by Taranaki By-Products, July 2013–June 2015, m³/day

There are large gaps in the 2013-2014 data, which is attributed by TBP to data storage problems. (Continuous data had previously been supplied, for the period 1 March to 30 June 2013).

The record shows that the limit of 2,160 m³/day on maximum daily abstraction volume was complied with throughout the period monitored, when the allowable error of ± 5% is taken into account. In 2013-2014, the maximum daily volume exceeded the limit on two days, 17 and 24 April 2014, by factors of up to 0.2% (2,165 m³/day).

In 2014-2015, the maximum recorded daily volume was 2,094 m³, or 97% of the limit, on 5 August 2014. The maximum recorded abstraction rate over a 15-minute period was 43.4 litres/second, on 29 July 2014 until 0728 NZST, which is less than the maximum absolute rate of 50 litres/second that is allowed. The recorded annual volume abstracted from Inaha Stream for 2014-2015 was 352,455 m³.

2.1.2.2 Groundwater

Consent **9756-1** allows abstraction at a rate not exceeding 22.8 litres/second (1,970 m³/day). The consent was first exercised in February 2014, before the required installation of a flow measurement, recording and telemetry system, for which abatement and infringement notices were issued. (Refer section 2.3.1). Telemetry to Council's computer system was established on 27 March 2014. Verification of the accuracy of the measurement system was undertaken by a The telemetered record for the period ending 30 June 2015 is presented in Figure 4.

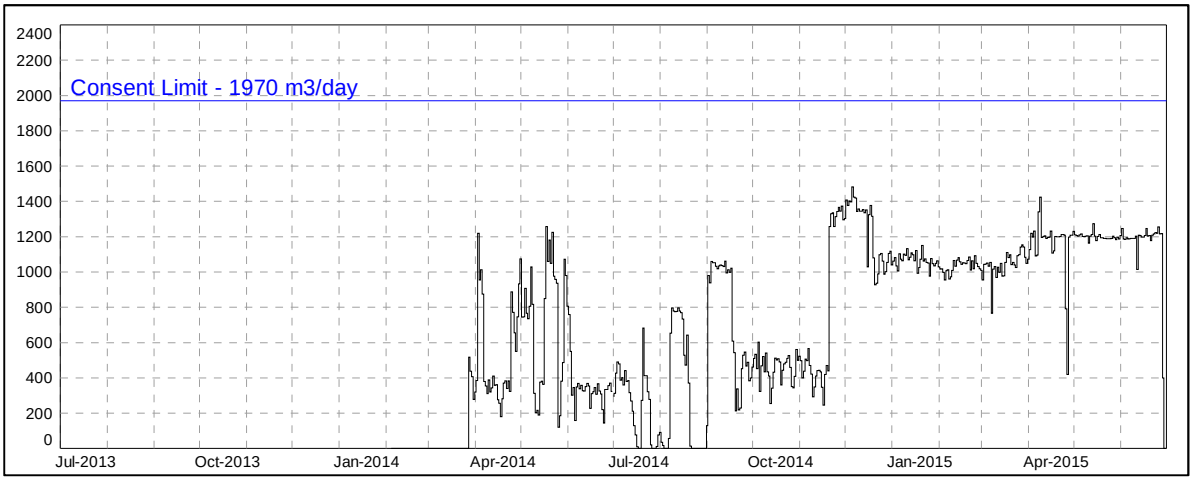

Figure 4 Daily ground water abstraction by Taranaki By-Products, July 2013–June 2015, m³/day

In 2013-2014, the maximum recorded abstraction rate over a 5-minute period was 19.3 litres/second, or 85% of the limit, on 19 June 2014 at 0715 NZST. The maximum recorded daily volume was 1198 m³ on 17 May 2014. The recorded volume abstracted between 27 March and 30 June 2014 was 50,180 m³.

In 2014-2015, the maximum recorded abstraction rate over a 5-minute period was 21.0 litres/second, or 92% of the limit, on 14 November 2014 at 1605 and 1620 NZST, and 27 November 2014 at 0255 NZST. The maximum recorded daily volume was 1,486 m³ on 6 December 2014. The recorded annual volume of groundwater abstracted for 2014-2015 was 313,034 m³. This equated to 47% of the annual total water volume abstracted by TBP.

2.1.3 Discharges to water and land

2.1.3.1 Wastewater

The results of analysis of the discharge of wastewater by the Regional Council are outlined in Table 4, together with a summary of previous results since the last major upgrade of the wastewater treatment system, in 1997. Samples were typically taken between about 9 am and about 10 am.

The effluent from the final pond contained levels of components that reflected the variation in wastewater composition, strength and flow, and the changes in treatment, that occurred during the 2013-2015 period. As in the years since the 1997 upgrade, the mineral strength was always high, notably in nitrogen species, though there was a reduction in both mineral strength and nitrogen concentration.

Dissolved oxygen concentration, measured by probe at 0.3 to 4.2 g/m^3, was above the minimum limit of 1 g/m^3 in condition 6 on consent **3941-2** for irrigation of wastewater on five of six monitoring occasions. Mechanical aerators were operating in both Pond 4 and Pond 6. No sulphide was detected, indicating low potential for malodour.

The recorded temperature range was 18.3 to 32.8°C. The highest value, measured on 29 January 2015 at 1010 NZST, exceeded the highest previously recorded by 1.7°C. Recirculation of cooling water through pond 6 continued (since commencement in February 2002).

Total nitrogen concentration decreased markedly during the 2013-2015 period, from a high of around 400 g/m^{3}N to around 250 g/m^{3}N, largely as a decrease in ammonia, while oxidised nitrogen remained relatively stable. In 2013-2015, the measured total nitrogen concentration was in the range 196-410 g/m^3, largely in solution as ammonia (44-340 g/m^{3}N) and in oxidised form (nitrite/nitrate 55-168 g/m^{3}N).

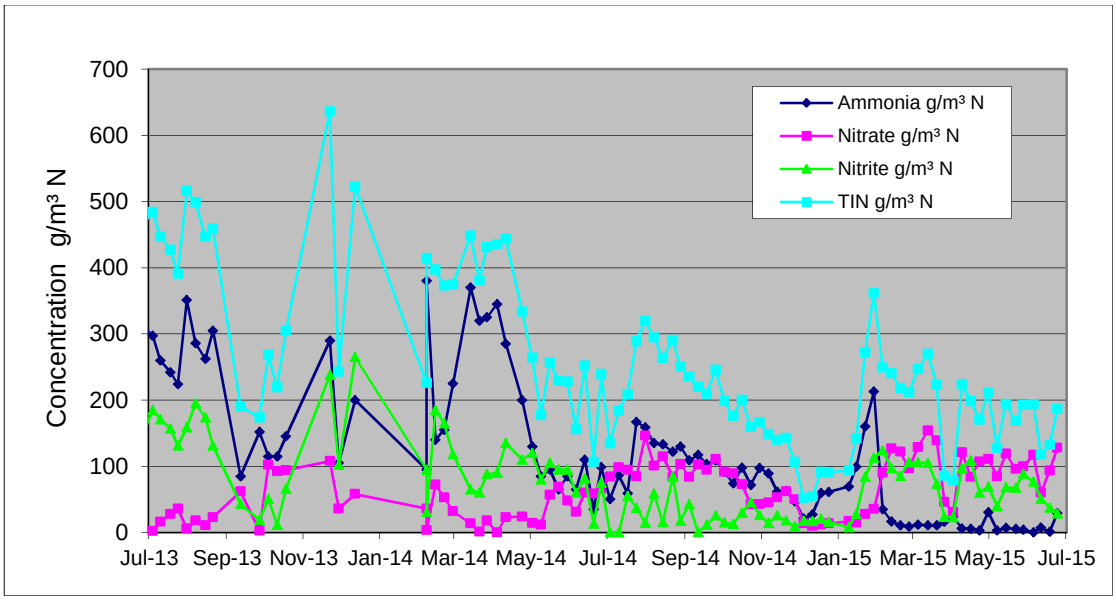

Figure 5 Results of treated wastewater monitoring for inorganic nitrogen species reported by TBP 2013-2015 (TIN = total inorganic nitrogen)

Table 4 Chemical monitoring results for effluent discharged from TBP's wastewater treatment system, with summary of previous monitoring data since July 1997. TRC site IND004004

Date	Flow	Temp	DO	Cond	pH	ALKT	SS	O&G	BOD_5	$fcBOD_5$	COD	TN	NH_4	NNN	DRP	Cl	SO_4	TS	Na	K	Ca	Mg	SAR	FC
Number		106	83	111	117	98	85	38	86	53	77	77	123	101	78	57	55	74	80	59	62	62	59	73
Maximum		31.1	12.6	561	8.5	2260	580	51	480	79	7200	810	570	189	54	339	260	2.4	366	188	68	20	14.0	20000
Minimum		7.4	<0.1	170	6.8	25	36	<0.5	14	1.0	100	110	40	0.03	21	129	64	<0.05	136	74	6.4	7.6	5.1	7
Median		20.8	0.2	283	8.0	568	130	<0.5	92	4.8	340	330	208	86	34	240	124	<0.05	220	118	17	11	9.8	400
03.10.13		18.4	3.2	281	7.3	210	200	-	77	-	450	360	160	168	42	280	200	-	236	159	21	12	10.1	260
25.03.14	0	28.9	0.3	385	8.3	1330	180	20	240	6.3	500	410	340	55	46	304	114	-	293	172	24	14	11.7	150
30.06.14	0	15.4	1.7	216	7.3	175	120	-	72	43	270	230	86	102	38	250	112	-	208	114	18	14	9.1	390
10.07.14	1.4	17.8	4.2	223	7.3	145	310	-	69	32	640	205	44	120	37	241	121	-	209	119	23	16	8.3	64
24.09.14	<0.1	16.4	1.4	250	7.6	345	55	-	120	19	220	280	142	128	31	204	95	-	182	130	29	18	6.5	5800
28.01.15	0	32.8		305	8.2	540	130	-	110	4.0	380	330	200	126	30	280	140	-	225	170	23	7.7	10.3	-
24.06.15	1.9	18.3	2.3	182	7.4	157	410	8	83	27	610	196	74	90	19	184	110	-	192	80	32	16	6.9	200
24.07.15	2.2	19.8	1.5	224	7.4	210	130	13	150	21	320	250	122	121	20	182	74	--	173	76	2525	17	6.56.5	300

ALKT = alkalinity to pH 4.5 as $CaCO_2$
BOD_5 = total 5-day biochemical oxygen demand, g/m^3
Ca = calcium, g/m^3
C1 = chloride, g/m^3
COD = chemical oxygen demand g/m^3
Cond = conductivity, mS/m at 20˚610C
DO = dissolved oxygen, g/m^3
DRP = dissolved reactive phosphorus, g/m^3P
FC = faecal coliforms, cfu/100 ml
Flow = flow rate, L/s
K = potassium, g/m^3
Mg = magnesium, g/m^3
Na = sodium, g/m^3
NH = ammonia, g/m^3N
NNN = nitrite/nitrate nitrogen, g/m^3N
O&G = oil & grease, g/m^3
pH
SAR = sodium adsorption ratio
SO_4 = sulphate, g/m^3
SS = suspended solids, g/m^3
Temp = temperature, ˚C
TG = total grease, g/m^3
TN = total nitrogen, g/m^3
TS = total sulphide, g/m^3

In comparison, from 56 samples collected in 2013-2014 and 51 samples in 2014-2015, TBP recorded ammonia-nitrogen, nitrite-nitrogen and nitrate-nitrogen concentration ranges of 0.4-380 g/m^3, 1-238 g/m^3 and 0.1-146 g/m^3, respectively. The TBP data, as presented in Figure 5, were produced from internal monitoring by TBP, and agreed reasonably well with the Council results on total nitrogen calculation, with some differences on individual nitrogen species. The total inorganic nitrogen (TIN) values plus an estimated 15 g/m^3 organic nitrogen concentration were used by TBP in calculating total nitrogen loadings on effluent irrigation areas. Overall, TIN values reduced from a peak of around 500 g/m^3 in February 2013 to around 200 g/m^3 in June 2015.

Several parameters indicate the loading on and performance of the aerated Pond 4. Large variations in pH, alkalinity and nitrogen species, suspended solids and COD relate to this.

Fat levels were higher than the average of previous values. Faecal bacteria levels were similar to the average of previous values, except in September 2014, when a higher count was recorded.

Sodium adsorption ratio ranged from 6.5 to 11.7, below the consent limit of 15. The values in 2014-2015 were lower than the average previously recorded.

2.1.3.2 Cooling water

During each sampling run, the cooling water discharge (to the firewater pond) is monitored to keep a check on its quality. The results of this sampling are shown in Table 5 together with a summary of results since cooling water was diverted to the head of the firewater pond in February 1998.

Table 5 Chemical monitoring results for cooling water discharged from TBP's plant, with summary of previous monitoring data since February 1998. TRC site code IND002004

Date	Temp	Cond	pH	Turb*	BOD_5	NH_4
Number	68	70	69	37	70	69
Maximum	65.1	28.4	8.2	31	2.7	1.89
Minimum	6.0	17.8	6.6	1.2	<0.5	0.023
Median	27.4	22.0	7.7	7.5	0.9	0.099
03.10.13	36.9	20.0	7.6	10	1.8	0.044
25.03.14	40.2	25.7	7.9	1.7	0.7	0.092
30.06.14	11.5	18.8	7.6	20	2.3	0.030
10.07.14	11.8	20.1	7.5	16	1.7	0.034
24.09.14	13.0	20.2	7.7	9.3	1.4	0.039
28.01.15	62.7	29.6	7.7	6.4	<0.5	1.91
24.06.15	11.2	21.2	7.4	31	2.7	0.113
24.07.15	13.3	29.1	7.3	3.6	1.3	1.64

* Turbidity instrument changed after February 2005, from Hach 2001A to WTW turbo 550, giving higher results

BOD_5 = total 5-day biochemical oxygen demand, g/m^3
Cond = conductivity, mS/m at 20˚C
NH_4 = ammonia, g/m^{3}N
pH
Temp = temperature, ˚C
Turb – turbidity, NTU

Cooling water quality was within acceptable ranges. There was large variation in temperature, from 11.2 to 62.7°C. On two occasions, in January and July 2015, some ammonia showed.

2.1.3.3 Stormwater

During the 2009-2010 reporting period, there were two point-source discharges of stormwater from the rendering plants' site. Stormwater from the main yard, garage and raw materials reception area flowed via a drain that runs from Kohiti Road into the firewater pond (STW001075), through which the tributary flows. The other discharge, from the meal load-out area and the main building roof, entered Inaha Stream through a pipe drain that exits immediately below the firewater reservoir outlet, via a settling pit, as overflow from the first-flush diversion system to the treatment ponds (STW001076). The overflow pipe inlet was capped in May 2010, to establish a manual release control system. (A third stormwater discharge (STW0001077), from the odour control and primary wastewater treatment area, was diverted to the treatment ponds prior to the reporting period). These discharge points were first sampled in the 1999-2000 monitoring period, following the issue of consent 5426 in May 1999.

The sampling results for the 2013-2015 reporting period are shown in Table 6, together with a summary of previous results. The samplings were all undertaken in dry weather.

Table 6 Chemical monitoring results for stormwater discharged from TBP's plant, with summary of previous monitoring data, since October 1999

Date	Flow	Temp	Cond	pH	Turb	SS	BOD_5	TG	O&G	HC	NH_4	FC
Number		53	58	57	34	57	47	13	39	21	57	51
Maximum		21.7	895	11.2	1400	6000	1600	630	180	180	340	12000000
Minimum		8.7	5.2	6.8	0.32	<2	<0.5	<5	<0.5	<0.5	0.036	46
Median		14.7	42.0	7.2	48	100	42	12	2.3	0.9	3.5	72000
03.10.13	<0.1	12.7	61.5	7.0	1.1	4	4.6		-		0.96	11000
25.03.14	0.5	17.4	46.3	7.6	22	**150**	38		5.5		1.22	10000
30.06.14		13.3	38.6	7.1	170	**330**	49		**57**		9.2	150000
10.07.14		15.4	61.0	7.0	0.96	<2	0.7		<0.5		0.138	1700
24.09.14	1	13.8	58.8	6.89	0.68	4	3.6		-		0.42	2700
28.01.15	?	17.6	66.1	7.0	1.7	5	4.4		0.6		0.71	52000
24.06.15		12.9	68.1	7.2	110	**200**	100		4.2		4.2	140000
24.07.15		13.5	60.8	7.0	2.1	<2	3.5				0.28	2400

BOD_5 = total 5-day biochemical oxygen demand, g/m^3
Cond = conductivity, mS/m at 20˚C
FC = faecal coliforms, cfu/100 ml
Flow = flow, L/s
HC = total recoverable hydrocarbons, g/m^3
NH4 = ammonia, g/m^3N
pH
O&G = oil & grease, g/m^3
SS = suspended solids, g/m^3
Temp = temperature, ˚C
TG = total grease, g/m^3
Turb = turbidity, NTU

Consent 5426 places limits on pH range (6-9) and on maximum concentration of suspended solids (100 g/m^3) and oil and grease (15 g/m^3). For a total of 8 samples taken over the 2013-2015 period, the limit on suspended solids was breached thrice, and the limit on grease once. Both limits were breached on 30 June 2014, when

suspended solids and oil and grease concentrations of 330 g/m³ and 59 g/m³, respectively, were recorded. The suspended solids limit was also breached on 25 March 2014 and 24 June 2015, when concentrations of 150 and 200 g/m³, respectively, were recorded. There were corresponding increases in BOD and ammonia concentration, and in faecal coliforms on two occasions, indicating an organic component.
It is noted that the stormwater drain sampled discharges to the large fire-water reservoir, where solids settle and floating material is trapped before discharge to Inaha Stream.

2.1.3.4 Inaha tributary at plant site

In addition to the aerobic pond effluent, and the cooling water and stormwater discharges, the tributary that flows through the fire-water reservoir was sampled on a regular basis. This sampling monitors the combined discharges of stormwater and cooling water from the plant, as well as any seepage from the ring drain around the aerobic pond under fine weather conditions. Until 2010-2011, two points (Sites C and D, (Figure 2)) were monitored to distinguish the effect of any inflow downstream of the reservoir. In 2010-2011, the reservoir outlet site (IND001014) was removed from the monitoring programme because the tributary had been piped to the Inaha Stream, and as stormwater could no longer overflow to the tributary below the reservoir unless released manually. The site at the Inaha confluence (IND001015) was retained. The sampling results are contained in Table 7.

Table 7 Chemical monitoring results for combined tributary and cooling, storm and fire water discharges from TBP plant, with summary of previous data since February 1998

Site	Date	Temp	DO	Cond	pH	Alk	Turb	BOD_5	O&G	NH_4	NNN	DRP	Cl	FC
Tributary at Inaha confluence IND001015	Number	71	68	74	75	70	36	63	54	75	51	67	49	67
	Maximum	33.6	9.2	44.8	8.0	84	20	13	1.3	8.0	10.8	0.26	52	45000
	Minimum	9.9	2.9	19.5	7.1	44	1.5	<0.5	<0.5	0.074	1.13	0.010	30	<23
	Median	22.8	7.0	25.6	7.4	61	4.2	3.1	<0.5	0.72	3.8	0.042	36	1100
	03.10.13	22.2	6.4	23.2	7.2	51	2.9	1.7	3.2	1.01	3.2	0.035	30	400
	20.03.14	21.5		37.5	7.8		2.2	2.8		6.1			44	
	25.03.14	24.1	7.9	37.4	7.7	103	2.0	3.7	0.6	6.8	4.8	0.62	44	1800
	30.06.14	11.9	7.3	23.3	7.2	54	5.7	1.7	<0.5	0.67	3.6	0.069	31	210
	10.07.14	13.8	8.4	23.8	7.3	51	6.8	2.7	<0.5	0.47	4.0	0.036	32	1000
	24.09.14	13.5	7.8	30.5	7.3	61	5.5	2.2	-	3.0	6.7	0.41	35	430
	28.01.15	26.1	4.2	38.5	7.4	110	19	>24	3.6	6.7	5.1	0.74	43	3300
	24.06.15	11.5	3.4	46.4	7.3	118	44	120		3.4	5.0	0.031	60	6700
	24.07.15	10.9	2.2	35.7	7.2	210	11	2.8		3.0	3.0	0.081	40	370

ALKT = alkalinity to pH 4.5
BOD_5 = total 5-day biochemical oxygen demand, g/m³
Cond = conductivity, mS/m at 20˚C
FC = faecal coliforms, cfu/100 ml
DO = dissolved oxygen, g/m³
DRP = dissolved reactive phosphorus, g/m³
NH4 = ammonia, g/m³N lkalinity to pH 4.5 as pH
O&G = oil & grease, g/m³
Temp = temperature, ˚C
TS = total sulphide, g/m³
Turb = turbidity, NTU

During 2013-2015, the level of contaminants in the Inaha tributary increased. Ammonia concentration was above the previous median value on six of the eight monitoring occasions, by factors of up to almost ten. On 28 January and 24 June 2015, the BOD was excessive, being 120 g/m³ in the June sample. By 24 July (and subsequently), the BOD had fallen to normal level. The reason for the deterioration in water quality was not determined, but may relate to leachate from the odour control system situated adjacent to the fire pond.

Faecal coliform counts varied widely under dry weather conditions. Temperatures complied with the maximum limit of 35˚ C set on consent 2050-1.

2.1.4 Results of receiving environment monitoring

2.1.4.1 Inaha Stream flows

The flow rate of Inaha Stream is measured for the purpose of managing the dilution of TBP's treated wastewater in the stream, and also the rate of abstraction. A water level staff gauge is installed at Kohiti Road bridge, about 300 metres upstream of the TBP discharge point. Stream flow rate is calculated from a rating curve developed from manual stream gaugings taken at the staff gauge site. The Regional Council took 14 stream gaugings in the 2013-2015 reporting period, more than are normally required to maintain the staff gauge rating, because the rating had to be re-established after willow removal from the stream in 17 January 2014 affected water level at the bridge. A new rating curve was produced on 29 July 2014, from three gaugings. The last 10 gaugings, taken between December 2014 and June 2015, recorded flows ranging from 60 litres/second (staff gauge 3.06 m, 3 March 2015) to 1,610 litres/second (staff gauge 3.55 m, 4 June 2015). An updated rating curve was produced on 8 June 2015.

TBP has regularly recorded staff gauge readings since May 2008. Previously, readings were taken less frequently, usually when wastewater was discharging to the stream, and during Council inspections.

The hydrographs for 2013-2014 and 2014-2015, drawn from the staff gauge readings at Kohiti Road, are given in Figure 6, together with a plot of the rate of wastewater discharge to the stream as measured at the v-notch weir at the outlet of Pond 6. The rate of discharge to the stream for 2013-2014 and 2014-2015 is compared against the rate for the monitoring periods since 2008-2009 in Figure 7.

Special condition 6 on consent 2049 requires that minimum dilution rate of 1:300 for effluent discharged to the stream be maintained at all times, and special condition 8 requires that the discharge cease when flows in the stream, as measured at Kohiti Road bridge, decrease to below 100 litres/second. Special condition 2 on consent 2051 requires that a minimum flow of 25 litres/second be maintained in the stream at the point of abstraction.

The results from the monitoring of wastewater and receiving water discharge rates by TBP show that the limit on minimum dilution rate of 300-fold were achieved throughout 2013-2014. However, on 30 April 2014, it was found that a breach of the limit had occurred that day, as the dilution calculated by Council was only 68:1. An infringement notice was issued, and TBP staff were retrained in discharge control. (Refer section 2.3.1).

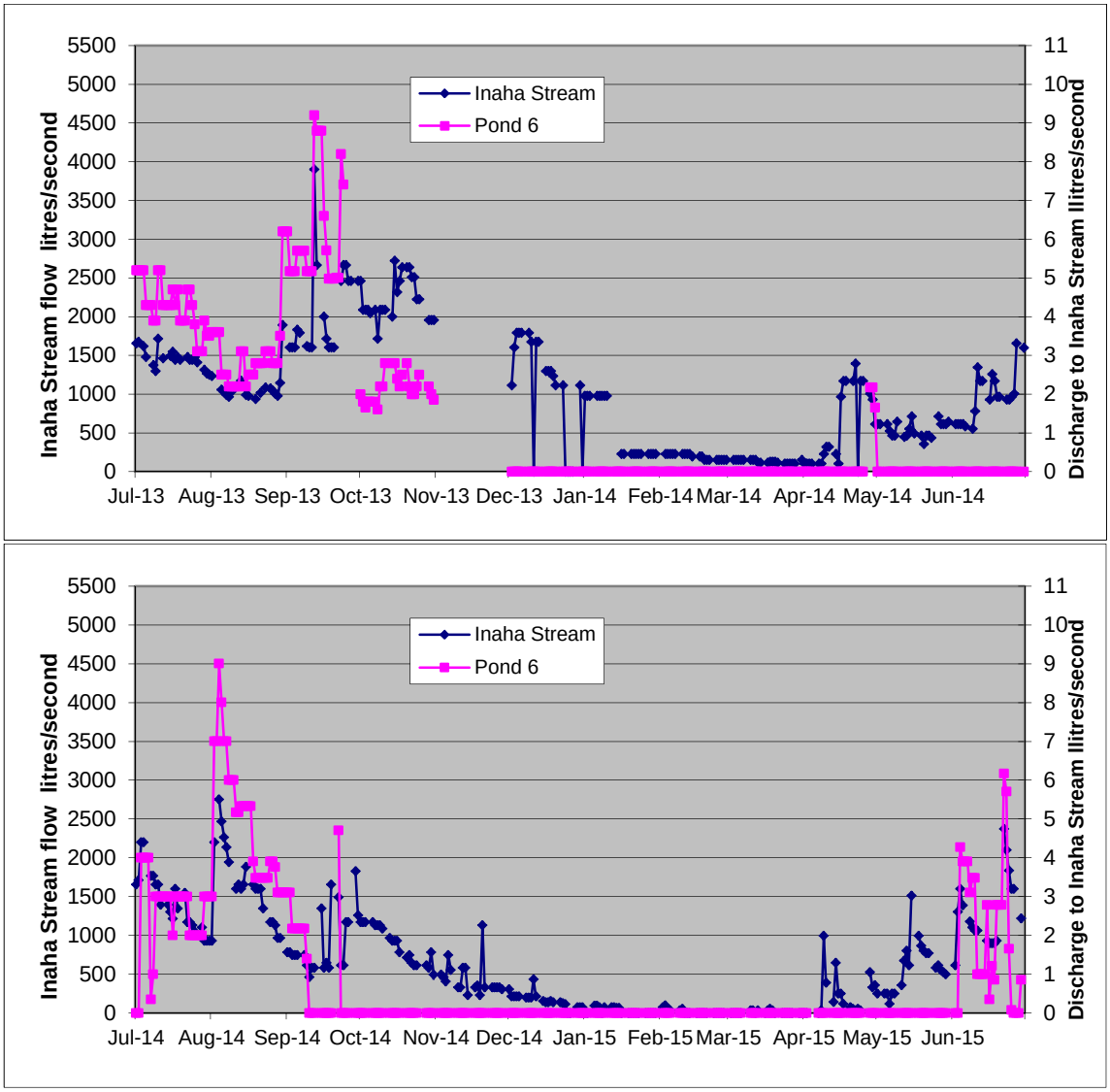

Figure 6 Hydrograph for Inaha Stream at Kohiti Road, July 2013 to June 2014 and July 2014 to June 2015, from daily staff gauge readings, with TBP discharge rate, litres/second

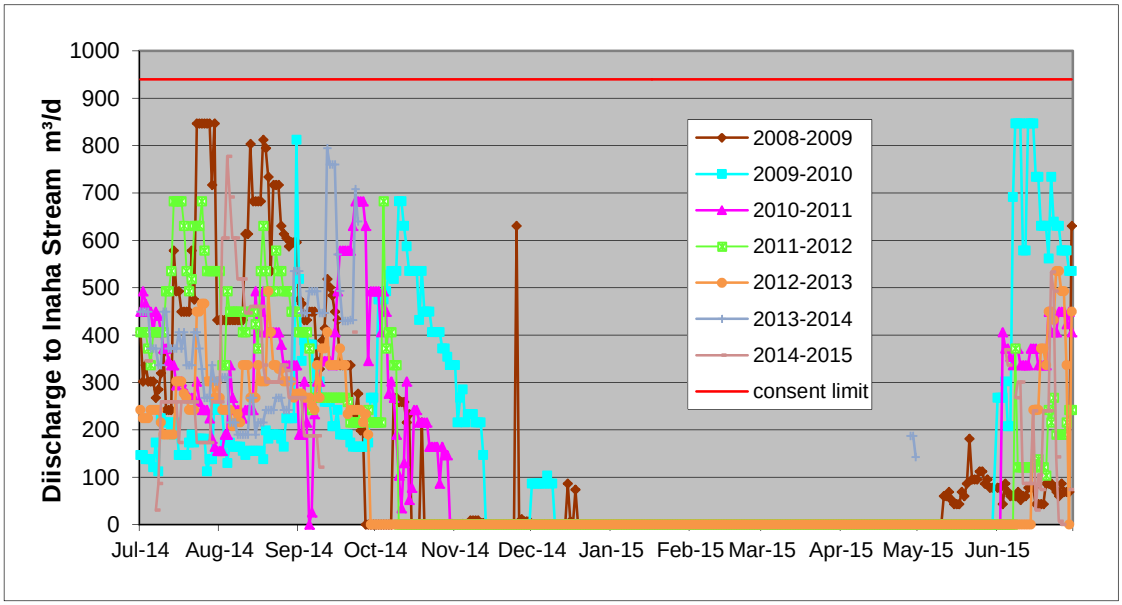

Figure 7 TBP discharge rate to Inaha Stream, July 2013 to June 2014 and July 2014 to June 2015, with previous five years' rates for comparison, m³/day

The lowest recorded flow in Inaha Stream was about 103 litres/second, on 1-8 and 15 April 2014. In 2014-2015, the TBP record (using updated ratings for Kohiti Road staff gauge) shows that the minimum dilution rate was not achieved on two days, 1-2 September 2014, when a minimum dilution of 238:1 was calculated. The record shows that the stream flow was below 100 litres/second for about 105 days, over the period between 26 December 2014 and 9 April 2015, however, there is some question as to the accuracy of staff qauge readings during this period.

In comparison, for 2012-2013, the flow was below 100 litres/second on about 75 days. The lowest flow recorded at Kohiti Road is 52 litres/second, from a gauging performed on 13 March 2001.

The TBP record shows that no wastewater was discharged to Inaha Stream when stream flows were below 100 litres/second, in accordance with condition 8 on consent 2049-4.

The TBP record shows that wastewater from the rendering plant was not discharged to Inaha Stream on 226 days in 2013-2014, between 4 November 2013 and 2 July 2014 during periods of low flow in the stream. The maximum recorded discharge rate of 9.2 litres/second, which is equivalent to 795 m^3/day or 85% of the consent limit of 940 m^3/day, was recorded for 12 September 2013.

The TBP record shows that wastewater from the rendering plant was not discharged to Inaha Stream on a total of 269 days in 2014-2015, between 10 September 2014 and 4 June 2015, and between 26 and 29 June 2015 during periods of low flow in the stream. The maximum recorded discharge rate of 9 litres/second, which is equivalent to 778 m^3/day or 83% of the consent limit of 940 m^3/day, was recorded for 4 August 2014.

In comparison, for 2012-2013, wastewater was not discharged on 257 days between 28 September 2012 and 14 June 2013. The maximum recorded discharge rate was 6.2 litres/second.

2.1.4.2 Instream temperature

The in-stream temperature recorders were operated throughout the monitoring period. These monitors are located within the unnamed tributary which receives the cooling water discharge, and in the Inaha Stream upstream of the confluence with the tributary, and downstream of the confluence at the end of the mixing zone. In September 2013, the Council over the temperature monitoring again from TBP, at the Company's request.

The record over the 2013-2014 and 2014-2015 monitoring periods for the temperature of cooling water discharged, and the increase in Inaha Stream temperature, is given in Figure 8 and Figure 9.The error on the cooling water temperature is ± 0.2˚C, and the error on the in-stream temperature increase is ±0.4˚C.

Special condition 3 on Consent 2050 requires that the temperature of the cooling water discharge not exceed 35˚C. In 2013-2014 and 2014-2015, the limit was complied with fully, for the third and fourth years in succession.

Special condition 9c on Consent 2049 and special condition 5g on Consent 2050 require that there be no more than a 3.0 degree Celsius temperature differential in the receiving waters below the mixing zone as a result of the wastewater and cooling water discharges, respectively.

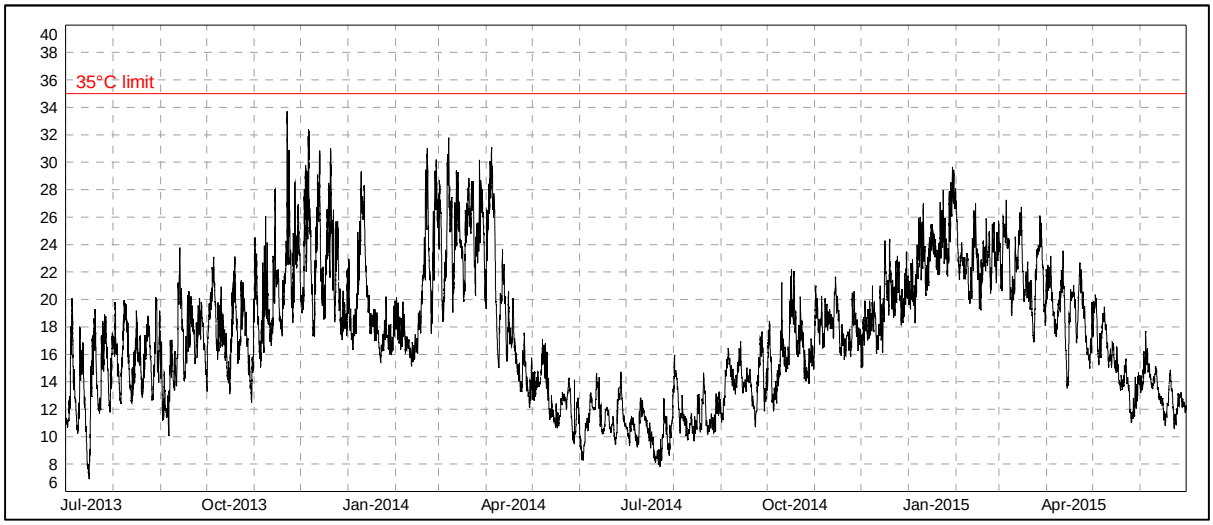

Figure Cooling water temperature for period 1 July 2013 to 30 June 2015, ˚C

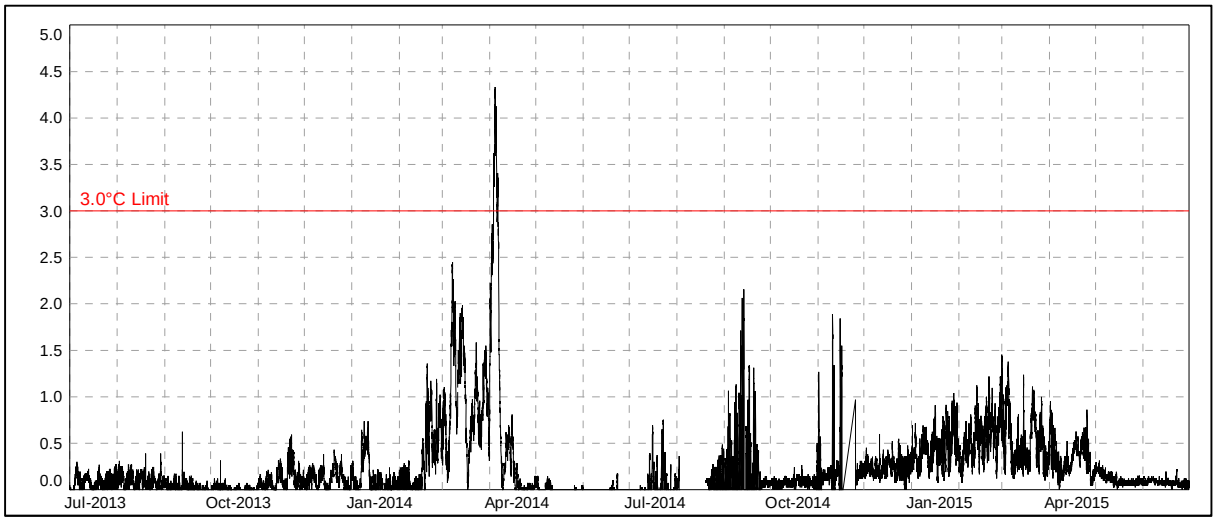

Figure 8 Inaha Stream temperature increase for period 1 July 2013 to 30 June 2015, ˚C

In the 2012-2013 reporting period, the maximum allowable temperature increase was exceeded by at least 0.5°C on 25 days between 13 February and 13 April, with a maximum increase of 5.6°C on Friday 15 March at 1515 NZST during the longest continuous period of 4.5 days, from 12 to 17 March. The limit had not been breached since April 2008, a period of five years. An abatement notice was issued in respect of this incident. TBP took action by installing two vacuum air condensers in April 2014 which reduced the heat loading on the cooling water system, as well as increasing the removal of odorous condensibles and improving bio-filter performance. The temperature increase limit was breached over three days, from 3 to 6 April 2014, while the cooling system was installed, with a maximum increase of 4.3°C. The maximum stream temperature during this period was 20.2°C, well below the limit of 25°C.

Subsequently, full compliance with the temperature differential limit was achieved, for the remainder of the 2013-2014 and throughout the 2014-2015 reporting periods.

The highest recorded temperature downstream of the discharge point in 2013-2014 was 23.0˚C, on 21 February 2014 at 1530 NZST. In 2014-2015, the highest recorded downstream temperature was 26.6°C, on 29 January 2015 at 1430 NZST. In comparison, the highest temperature ever recorded at this site is 30.9˚C, on 29 February 2008.

The temperature was above 25°C on 2 days, 28 and 29 January 2015, the longer continuous period being 5.5 hours.

The highest temperature recorded at the upstream site in 2013-2014 was 22.1°C, on 20 February 2013 between 1500 and 1530 NZST. In 2014-2015, the highest recorded upstream temperature was 25.7°C, on 29 January 2015 between 1415 and 1430 NZST. This was a significant increase of 1.0°C over the highest temperature previously recorded for the site, being 24.7˚C on 29 January 2013 at 1530 NZST. This exceptionally high temperature may, in part, have been the result of the removal of shading willow trees from the banks upstream in November 2014.

2.1.4.3 Water chemistry

Four sampling runs on Inaha Stream were scheduled for both the 2013-2014 and the 2014-2015 monitoring periods. Site locations are given in Figure 1 and Table 3. Each year, two 'full' runs of all 11 stream monitoring sites were carried out when wastewater was discharging directly to the stream, and two 'reduced' runs of 8 sites under lower stream flows when all wastewater was discharged to land. In both years, the last run was delayed until July by limited opportunity to sample during periods of discharge directly to the stream at times when the stream was not in fresh. The results of the sampling and estimated flows for the main stem of Inaha Stream are presented in Table 8. The full set of results for each sampling run is given in Appendix II. Discharge permit 2049, which allows the discharge of treated wastewater from TBP's rendering plant to Inaha Stream, places specific limits on the combined effect of all discharges from the plant on dissolved oxygen, biochemical oxygen demand and total ammonia and pH levels in the stream beyond the boundary of a 30-metre mixing zone. The effect that the discharge has on the receiving environment is a function of the relative flow rates of the stream and effluent, the strength of the effluent, and the quality of the stream above the discharge point. Results for individual parameters are discussed separately below.

It is noted that TBP was not discharging treated wastewater during four of the eight monitoring runs in 2013-2015, as all wastewater was being discharged to land during relatively low stream flows. This allowed assessment of the effects of leaching from the rendering plants' site, and of the minor discharges, such as cooling water, via the tributary that flows through the site.

Table 8 Water quality in the Inaha Stream 2013-2015

Site	Date	Temp	DO	%Sat	BOD_5	$fcBOD_5$	Turb	Cond	pH	NH_4	NNN	DRP	FC
1	3.10.13	11.7	10.3		1.8		7.4	17.9	7.6	0.007	2.6	0.042	390
3		11.7	10.6		1.8		8.7	18.0	7.6	0.009	2.6	0.040	720
5	Inaha flow	11.6	10.6		1.7	<0.5	10	19.3	7.6	0.011	2.5	0.037	420
6	2,088 L/s	12.1	10.5		1.8	<0.5	12	20.0	7.6	0.22	2.8	0.068	300
7		12.2	10.6		2.7	0.5	9.7	20.0	7.6	0.198	2.9	0.068	450
8	TBP	12.5	10.3		2.6	<0.5	11	20.1	7.6	0.113	2.8	0.070	280
11	x.x L/s	13.3	10.5		2.2		10	22.1	7.7	0.027	3.1	0.065	240
1	25.03.14	13.7	7.9	78	0.8		2.0	22.4	7.7	0.056	1.04	0.048	950
3													
5	Inaha flow	14.7	9.7	97	0.6	<0.5	1.4	24.8	7.8	0.041	1.86	0.022	320
6	506 L/s	15.2	9.2	97	2.9	0.5	1.9	27.0	7.7	0.66	3.0	0.085	280
7		15.0	8.2	88	3.8	0.6	3.8	27.1	7.6	0.28	3.4	0.075	220
8	TBP	15.0	9.2	90	2.6	0.5	3.3	27.8	7.7	0.084	3.9	0.074	340
11	0.0 L/s	15.0	10.3	103	1.0		2.3	32.6	8.0	0.019	3.6	0.056	870
1	30.06.14	11.1	10.3	96	2.1		19	17.0	7.7	0.017	2.6	0.030	550
3		11.1	10.6	98	2.0		18	17.3	7.7	0.016	2.6	0.031	200
5	Inaha flow	11.0	10.6	98	2.1	0.8	19	18.4	7.7	0.016	2.8	0.030	600
6	1,548 L/s	11.2	10.4	97	2.0	0.5	16	18.8	7.6	0.048	2.8	0.034	450
7		11.3	10.4	97	2.0	<0.5	16	19.0	7.5	0.039	2.8	0.032	520
8	TBP	11.2	10.4	97	2.0	<0.5	21	19.0	7.6	0.050	3.0	0.032	620
11	x.x L/s	11.1	10.3	98	2.0		22	21.2	7.6	0.036	3.6	0.037	520
1	10.07.14	10.6	10.6	96	1.6		15	18.4	7.7	0.011	2.8	0.029	350
3		10.7	10.7	98	1.4		17	18.7	7.7	0.010	2.9	0.027	180
5	Inaha flow	10.7			1.7	<0.5	16	19.6	7.7	0.015	3.2	0.027	210
6	1,656 L/s	11.1	10.8	99	2.1	<0.5	16	20.4	7.6	0.145	3.2	0.062	210
7		11.2	10.7	99	2.2	<0.5	18	20.4	7.6	0.173	3.5	0.074	200
8	TBP	11.3	10.7	98	2.1	<0.5	16	20.6	7.6	0.148	3.6	0.076	210
11	1.4 L/s	10.9	10.8	99	2.0		18	22.7	7.7	0.056	3.7	0.066	140
1	24.09.14	11.4	10.9	100	1.2		10	18.1	7.6	0.103	2.8	0.86	510
3		11.9	11.0	102	1.1		8.8	18.5	7.7	0.020	3.0	0.051	520
5	Inaha flow	12.0	11.0	103	0.8	<0.5	13	19.7	7.7	0.021	3.0	0.043	600
6	1,348 L/s	12.7	10.8	102	1.1	<0.5	10	20.2	7.6	0.069	3.2	0.047	520
7		12.8	10.0	97	1.3	<0.5	10	20.2	7.6	0.064	3.0	0.042	440
8	TBP	13.2	10.6	101	1.3	<0.5	8.8	20.4	7.6	0.057	3.2	0.045	460
11	0.0 L/s	14.0	10.6	101	1.6		10	22.8	7.7	0.052	3.5	0.044	360
1	28.01.15	18.0	8.4	90	<0.5		1.4	20.8	7.7	0.48	0.63	0.032	730
3													
5	Inaha flow	19.0	9.2	99	<0.5	<0.5	2.4	23.4	7.8	0.131	1.70	0.020	1200
6	86 L/s	21.0	10.0	112	2.0	0.7	2.0	25.8	7.9	0.66	3.0	0.093	1200
7		21.2	11.3	130	2.8	0.9	2.1	25.7	8.2	0.39	3.1	0.077	1200
8	TBP	21.8	11.4	132	-	0.9	2.9	25.7	8.8	0.062	3.2	0.047	310
11	0.0 L/s	19.6	9.6	105	0.7		2.0	31.7	7.9	0.171	3.3	0.045	840
1	24.06.15	`9.2	11.0	96	1.5		11	18.9	7.5	0.021	3.4	0.029	310
3		9.3	11.3	98	1.4		12	19.3	7.5	0.032	3.5	0.028	300
5	Inaha flow	9.2	11.3	98	1.5	<0.5	14	20.9	7.6	0.036	3.5	0.025	250
6	2,044 L/s	9.4	11.2	98	1.8	<0.5	16	21.1	7.4	0.080	3.7	0.040	290
7		9.4	11.2	98	1.8	<0.5	18	21.4	7.4	0.117	3.6	0.040	380
8	TBP	9.7	11.2	98	1.8	<0.5	15	21.5	7.6	0.110	3.6	0.041	250
11	1.9 L/s	9.9	10.9	96	1.7		14	23.6	7.4	0.088	3.8	0.040	200

Site	Date	Temp	DO	%Sat	BOD_5	$fcBOD_5$	Turb	Cond	pH	NH_4	NNN	DRP	FC
1	24.07.15	10.1	11.0	97	1.5		12	19.0	7.7	0.014	3.3	0.026	200
3		10.2	11.2	100	1.4		12	19.3	7.7	0.019	3.3	0.025	170
5	Inaha flow	10.2	11.2	99	1.4	<0.5	12	20.6	7.6	0.021	3.4	0.025	330
6	xxx L/s	10.5	11.2	100	2.1	<0.5	18	21.4	7.5	0.134	3.7	0.037	290
7		10.6	11.2	100	2.0	<0.5	16	21.7	7.5	0.22	3.8	0.052	340
8	TBP	10.9	11.2	100	2.0	<0.5	17	21.8	7.6	0.21	4.0	0.052	170
11	x.x L/s	10.4	11.0	99	2.5		16	24.3	7.6	0.128	4.5	0.048	280

BOD_5 = total 5-day biochemical oxygen demand, g/m^3
$fcBOD_5$= filtered carbonaceous 5-day biochemical demand, g/m^3
Cond = conductivity, mS/m at 20˚C
DO = dissolved oxygen, g/m^3
DRP = dissolved reactive phosphorus, g/m^3P
FC = faecal coliforms, cfu/100 ml
NH4 = ammonia, g/m^3N
NNN = nitrate + nitrite, g/m^3N
O&G = oil & grease, g/m^3
pH
Temp = temperature, ˚C
Turb = turbidity, NTU
%Sat = percentage oxygen saturation

Dissolved oxygen

Consent 2049 requires that the discharge shall not reduce the concentration of dissolved oxygen of the receiving water to below 80% of saturation concentration, that is, about 6-9 g/m^3 in the case of Inaha Stream, depending on stream temperature. This limit is set for the protection of fish populations. Sampling runs were timed to take place when dissolved oxygen concentration is lowest, in early to mid-morning.

Dissolved oxygen was monitored on eight occasions in 2013-2015. The results show compliance with the minimum limit on all of those occasions.

In comparison, the lowest oxygen saturation value recorded since the wastewater treatment system upgrade in 1997 is 36%, at the second site downstream, on 28 February 2001 during extreme low flow conditions.

The profile of dissolved oxygen with distance down the catchment relates largely to channel and flow characteristics, with licensed discharges from TBP having less effect. Oxygen levels reduce where the water is slow, and distant from riffles or falls, as occurs in the deeper reaches during periods of low flow, notably at the three sites below TBP, and the uppermost site at Ahipaipa Road where a low of 78% of saturation was measured in March 2014.

Monitoring in recent years has shown that, during lower flows, there tends to be a slight increase in dissolved oxygen between Ahipaipa Road and Kohiti Road, and a slight decrease below the rendering plants at the second and third sites downstream, 500 metres downstream and at Normanby Road. During winter and spring flows, when TBP wastewater is being discharged, there tends to be a slight decrease at the first site downstream.

Unusually high dissolved oxygen levels were recorded in January 2015 at the three sites immediately below the rendering plants, coincident with high pH, possibly as the result of increased algal activity following removal of willows that had shaded the stream before they were removed in November 2014.

Biochemical oxygen demand
Consent 2049 requires that the discharge shall not raise the filtered carbonaceous biochemical oxygen demand (filtered cBOD) above 2g/m^3. This limit is set to control excessive bacterial or fungal slime growths. The Regional Council monitored for both total and filtered cBOD on eight occasions in 2013-2015. Total BOD is monitored to assess the potential for dissolved oxygen sag.

The limit was complied with on each monitoring occasions, the maximum downstream filtered cBOD value ranging from <0.5 g/m^3, when there was no (licensed) wastewater discharge, to 0.7 g/m^3, at a time of low stream flow when the tributary that carries cooling water from the site was contaminated .

Total BOD concentration increased significantly below the TBP discharge points during lower flows and when wastewater was being discharged, to a maximum of 2.8 g/m^3.

BOD determinations with and without nitrifier inhibition (carbonaceous and total BOD) showed that oxygen demand exerted by TBP's effluent was largely nitrogenous. This is supported by the observed conversion of ammonia to nitrate (nitrification) and concurrent slight dissolved oxygen sag in the stream, and is consistent with the discharge of wastewater containing active nitrifying bacteria together with a significant amount of ammonia.

Total ammonia and pH
Consent 2049 requires that the discharge shall not raise the total ammonia concentration (as NH_3) in the receiving water above 1.5 g/m^3 if the pH of the receiving water is below 7.75, or above 0.7 g/m^3 if the pH lies between 7.75 and 8.0, or above 0.4 g/m^3 if the pH is above 8.0. The permit also requires that the discharge not cause a fall of more than 0.5 pH units in the receiving water. These limits are set for the protection of fish populations.

In 2013-2015, with one exception, the pH at sites near the discharge point was between 7.4 and 7.7: therefore the total ammonia limit was 1.5 g/m^3. Had samples been taken later in the day, when algal photosynthesis has increased stream pH (rather than in early to mid-morning to monitor dissolved oxygen sag), the pH values recorded may have exceeded 8.0 below the discharge point. (The highest previously recorded pH of 8.1 was for a sample taken at the mixing zone boundary at 1330 NZST on 22 October 2002).

On 28 January 2015, between 0950 and 1015 NZST, the pH values recorded for the three sites below the mixing zone, located 30, 500 and 1,450 metres below the (unused) TBP wastewater outlet, were 7.9, 8.2 and 8.8. The stream flow was low, estimated as 86 litres/second, and there was prolific filamentous algzl growth on the bed. The cooling water was discharging at pH 7.4. These high pH values are ascribed to algal activity, following the removal of shading willows along the stream in November 2014.

The maximum pH change recorded in 2013-2015 while wastewater was being discharged was a reduction of 0.2 units, which is within the consent limit.

Table 9 Results of ammonia monitoring immediately below TBP wastewater discharge point

Date	Time	Inaha flow	TBP flow	Temperature	pH	Ammonia	
		L/s	L/s	˚C		g/m³	% limit
03.10.13	0945	2,088	x.x	12.1	7.6	0.27	18
20.03.14	0833		0	17.3	7.7	0.59	39
25.03.14	1045	506	0	15.2	7.7	0.80	53
30.06.14	1145	1,548	x.x	11.2	7.6	0.058	4
10.07.14	1156	1,656	1.4	11.1	7.6	0.176	12
24.09.14	1138	1,348	0	12.7	7.6	0.084	6
28.01.15	0950	86	0	21.0	7.9	0.66	94
24.06.15	1126	2,044	1.9	11.2	7.4	0.097	6
24.07.15	1026	1,179	2.2	10.5	7.5	0.163	11

The results of total ammonia monitoring at the mixing zone boundary during eight routine compliance monitoring runs in 2013-2015 are presented in Table 9 above.

The total ammonia limit was complied with on all eight monitoring occasions, for the sixth and seventh years in succession.

In previous monitoring periods, there has often been a slight reduction in stream pH below the mixing zone, so compliance with the total ammonia limit has not been an issue further downstream, as ammonia tends to be assimilated rapidly through plant uptake and microbial transformation. In summer 2015, pH increased significantly below the mixing zone, lowering the total ammonia limit. On 28 January, there was an increase in ammonia in the stream, from sources both upstream above pH 8.0beyond the TBP farm and around the TBP plant. At the site 500 metres downstream (Site 7) the total ammonia concentration of 0.39 g/m³, or 98% of the limit of 0.4 g/m³ above pH 8.0.

Also, in previous monitoring periods, a slight increase in ammonia concentration was recorded between the first and second monitoring sites below the TBP discharge point, indicating either incomplete mixing, variation in discharge composition, or an intermediate input. Leachate from the bio-filters is a possible source, which has been addressed through a collection drain and pumping system.

Tributaries in irrigation areas

Physico-chemical monitoring of the two tributaries which run through irrigated areas on the western side of Inaha Stream is carried out to determine the effects of wastewater irrigation. The locations and descriptions of the monitoring sites are given in Figure 1and Table 3, respectively.

The water quality of the two tributaries is more mineralised (having higher conductivity) than the main stem, reflecting the closer proximity of their catchment to the sea. Nitrate concentration is the factor most likely to be affected by irrigation.

Northern tributary

The northern tributary joins Inaha Stream immediately above Kohiti Road, It runs a distance of about 0.64 km through the Kohiti block of TBP's farm, about 0.42 km adjacent to potentially irrigated areas. The tributary is monitored at its confluence with the main stream at Site 4 (INH000397).

The results of physico-chemical monitoring of the northern tributary are presented in Table 10.

Table 10 Water quality in northern Inaha Stream tributary in irrigation areas (Site 4), 2013-2015

Date	Temp	DO	%Sat	BOD_5	Turb	Cond	pH	NH_4	NNN	Cl	DRP	FC
3.10.13	11.3	10.3		0.9	10	25.6	7.5	0.020	2.3	33.8	0.006	470
25.03.14												
30.06.14	10.8	10.4	95	1.7	13	25.0	7.6	0.026	2.4	32.9	0.022	240
10.07.14	10.3	10.5	94	1.4	13	24.8	7.6	0.029	3.0	34.6	0.021	120
24.09.14	11.8	10.7	99	0.8	16	25.3	7.6	0.019	3.3	32.5	0.028	1200
28.01.15	16.6	7.7	80	<0.5	2.0	27.7	7.6	0.45	2.2	35.1	0.013	760
24.06.15	8.5	11.1	95	1.1	9.5	27.8	7.5	0.046	3.8	39.7	0.017	230
24.07.15	10.1	11.0	97	1.7	16	26.1	7.6	0.036	3.9	33.4	0.022	250

There was no obvious effect on the northern tributary of irrigation carried out by TBP. Nitrate has remained at similar levels to those in Inaha Stream above the TBP farm, between about 0.5 and 3.5 g/m³N, since monitoring started in 1999, though in recent years, the seasonal variation appears to have reduced, summer troughs being lesser.

Western tributary

The western tributary joins Inaha Stream immediately below Normanby Road. It runs a distance of about 3.5 km through land that is irrigated on one or both sides with TBP wastewater. The distance of the stream in its valley to the irrigated areas on the plateaux above is about 50 to 100 m. The tributary is monitored at three points: Site 9a (INH000433) is above the TBP farm; Site 9 (INH000435) was the original upstream site, 2.5 km above the Inaha confluence, before the irrigation area was extended; Site 10 is the downstream site, immediately above Normanby Road, about 0.22 km above the confluence.

The results of physico-chemical monitoring of the northern tributary are presented in Table 11.

Between 2006 and 2010, nitrate concentration increased, both upstream and downstream of the irrigation area, with seasonal peaks in winter/spring that rose from about 1.5 to 4 g/m³N. In 2014, after a relatively stable period, the time of the seasonal peak at the downstream site changed to summer/autumn. Peak values of 7.1 and 10.7 g/m³N were recorded in January 2014 and May 2015, respectively.

In February 2015, Council carried out investigations to trace the location of nitrate inflow to the tributary. Three additional sites, 9b, 9c and 9d, spaced approximately 500 m apart, were surveyed between Site 9 and Site 10. The nitrate inflow was found to be between about 1.5 and 2.0 km above Normanby Road (between Site 9b and Site 9c). This is an area where springs enter the tributary from both sides, above which wastewater irrigation and nitrogen fertiliser application has occurred. The Company was required to reduce nitrogen application in these areas. Monitoring frequency of the tributary by the Council was increased to monthly. In July 2015, TBP commenced weekly monitoring of the tributary for nitrogen species.

Table 11 Water quality in western Inaha Stream tributary in irrigation areas, 2013-2015

Site	Date	Temp	DO	%Sat	BOD_5	Turb	Cond	pH	NH_4	NNN	Cl	DRP	FC
9a	3.10.13	13.8	10.0		1.6	5.4	29.1	7.2	0.016	2.1	39.7	0.006	150
9		13.4	10.8		0.6	0.90	28.9	7.3	0.020	2.2	39.1	0.007	140
10		12.9	10.4		0.5	10	32.0	7.6	0.012	4.1	51.4	0.009	310
10	25.03.14	15.2	7.8	79	<0.5	2.4	41.1	7.4	0.006	7.1	73.1	0.004	610
9a	30.06.14	11.0	9.6	91	1.7	13	28.3	7.5	0.021	2.6	39.5	0.012	300
9*		10.8	8.6	79	<0.5	2.5	30.8	7.3	<0.003	4.1	46.2	0.007	120
10		10.7	8.9	87	<0.5	2.1	30.9	7.3	0.018	4.0	47.2	0.007	50
9a	10.07.14	11.1	10.7	99	<0.5	2.1	28.6	7.6	0.019	3.3	38.6	0.014	69
9*		9.9	9.6	86	<0.5	3.6	31.8	7.4	0.009	5.5	47.5	0.010	71
10		9.7	9.4	87	<0.5	3.7	31.8	7.4	0.007	5.5	47.0	0.011	74
9a	24.09.14	13.3	9.8	94	0.6	9.1	27.8	7.6	0.011	2.9	35.6	0.022	800
9		13.7	10.0	97	<0.5	3.2	28.8	7.6	0.010	3.7	39.1	0.015	460
10		13.9	10.2	100	0.7	15	31.0	7.6	0.018	5.3	43.2	0.019	640
10	28.01.15	16.9	7.5	78	<0.5	2.6	39.4	7.5	0.108	8.1	61.1	0.008	530
9a	05.02.15	17.5				14	28.2	7.7		1.49	35.4		
9		18.7				8.2	32.5	7.6		1.94	44.8		
10		17.0				2.2	39.3	7.6		7.1	63.8		
9b	18.02.15	15.2				3.2	35.2	7.6		5.0	53.6		
9c		15.4				5.6	38.4	7.7		8.5	58.3		
9d		16.0				4.5	39.7	7.6		8.4	63.5		
10		14.7				2.5	40.7	7.5		8.0	68.2		
9	06.05.15	15.5				6.1	31.6	7.4	0.026	2.5	45.6	0.020	
10						10	40.4	7.2	0.010	10.7	62.5	0.010	
10	16.06.15	9.7				17	33.4	7.5	0.123	5.3	51.4		
9a	24.06.15	9.6	10.6	93	0.7	7.7	30.2	7.5	0.014	3.8	41.8	0.014	110
9		9.5	10.5	92	<0.5	1.5	31.1	7.5	0.018	4.6	44.1	0.012	85
10		9.5	10.8	94	<0.5	6.9	32.7	7.5	0.012	6.4	51.2	0.014	270
9a	24.07.15	10.5	10.6	95	0.6	7.2	29.3	7.6	0.012	3.9	38.5	0.006	100
9		9.9	10.7	95	0.6	2.4	30.5	7.6	0.008	4.8	42.5	0.003	80
10		9.9	11.1	97	0.6	9.6	33.0	7.5	0.026	6.7	47.0	0.003	140

Key: refer to Table 8, page 33.

* Site 9 was sampled 450m further downstream on 30 June and 10 July 2014 owing to access difficulties

2.1.4.4 Biomonitoring

In accordance with condition 9 on consent 2049, biological surveys were undertaken in the 2013-2014 and 2014-2015 monitoring periods to assess the effects of point and diffuse source discharges from the TBP operation on the biological communities of Inaha Stream. Given the decreasing period of wastewater discharge to Inaha Stream, and demonstrated improvement in the health of benthic communities below the discharge point by previous surveys, the frequency of biomonitoring was reduced from triannual to biannual for 2011-2012. The four surveys were conducted on 3 October 2013, 12 February and 20 October 2014, and 17 February 2015. Sites for biomonitoring are listed in Table 12, and depicted in Figure 7. The full reports of the two surveys are given in Appendix IV.

Table 12 Biomonitoring sites

Stream	Site	Sitecode	Map reference, NZTM		Location	Date established
			Easting	Northing		
Inaha	U	INH000334	170313	5625271	Upstream of irrigation area, near Ahipaipa Road	20.05.2004
	1	INH000400	1701874	5624322	Upstream of treatment ponds, Kohiti Road	01.09.1987
	2d	INH000420	1702021	5623745	500 m downstream of cooling water discharge	20.01.1995
	3	INH000430	1701650	5623262	Upstream of Normanby Road	06.08.1981
	4	INH000450	1701454	5622948	100m downstream of 'irrigation' tributary	01.02.2005
Unnamed tributary	UT	INH000433	1701109	5625496	Upstream of irrigation area	18.03.2010
	MT	INH000435	1700827	5624524	Within irrigation area	20.05.2004
	DT	INH000440	1700393	5620330	Upstream of Normanby Road and Inaha Stream	20.05.2004

A new control site (UT) was established on the unnamed tributary during the March 2010 survey, as the existing control site (renamed MT) lies within the extension of the irrigation area that was licensed by variation of consent 3941 on 9 November 2009, and where irrigation commenced in December 2009.

The Council's standard 'kick-net' and/or 'vegetation sweep' sampling techniques were used at eight sites to collect streambed macroinvertebrate from the Inaha Stream, and an unnamed tributary of the Inaha Stream, to assess whether discharges (via point source and irrigation to land) have had any adverse effects on the macroinvertebrate communities of the stream. Samples were processed to provide number of taxa (richness), MCI and $SQMCI_s$ scores for each site.

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. The $SQMCI_s$ takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the $SQMCI_s$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The conclusions of the reports on the four biomonitoring surveys conducted in 2013-2015 are presented below, each prefaced with a comment on preceding stream and wastewater flows.

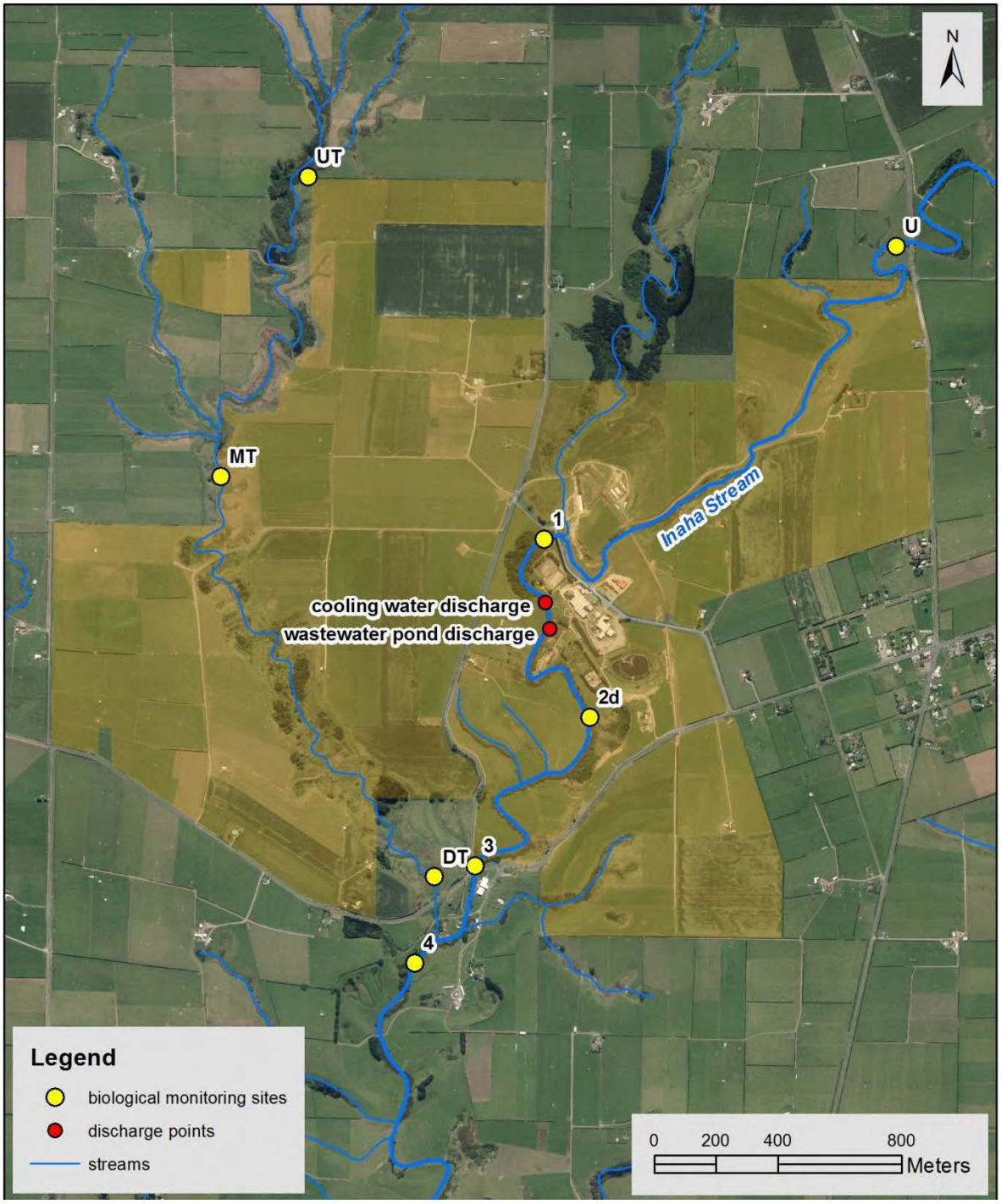

Figure 9 Biological monitoring sites

3 October 2013 survey

This October 2013 survey followed a period of 21 days since a fresh in excess of three times median flow in the nearby Waiokura Stream (the nearest appropriate water level recorder). This was the only flood in the month prior to the survey, although flows were above mean annual low flow (MALF) in the month leading up to the survey due to a number of small freshes that occurred over this period.

Freshes and floods would likely scour a proportion of the fine organic matter and filamentous periphyton growths from the streambed, which could impact upon macroinvertebrate community compositions. The fact that there was only one major fresh event in the month leading up to the survey suggests that flooding is unlikely to have influenced the community, therefore the community should be reflective of preceding water quality conditions.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream began on 14 June 2013 and continued, almost without cessation, until and after the biosurvey of 3 October 2013. That is, discharge of Taranaki By-products wastewater to Inaha Stream had been occurring for a period of 111 days immediately prior to this biological survey. The record shows that the minimum dilution of wastewater of 1:300 that is required under consent 2049-1 was maintained throughout this period. This means that this biological survey was preceded by an extended period during which discharge occurred, indicating that the macroinvertebrate communities would reflect any changes caused by this discharge if present.

The results of this October 2013 biological survey indicated that the Inaha Stream was in fair health, with all four sites recording MCI and $SQMCI_S$ scores similar to or higher than their long term medians. In this survey, the MCI scores recorded at site 2d, immediately downstream of the discharges from the rendering plant was 15 units higher than its long term median. Site 3, just downstream, was 3 units higher than its long term median. This shows that the MCI scores at both sites continue to show improvement from the low scores recorded in 2009. In addition, the $SQMCI_S$ scores at both sites were both significantly higher than their long term medians. Overall, these results indicated that the degree of impact from the wastewater discharge was much less evident than that recorded in previous surveys, which frequently recorded significant enrichment of the stream, and a consequent deterioration of the streambed macroinvertebrate communities. However the improvement noted in the most recent survey was not as evident with sites 2d and 3, which showed a deteriorating trend, and thus a short term reduction in health.

Usually, the sampling sites located upstream of the Taranaki By-Products plant supported macroinvertebrate communities with higher MCI and $SQMCI_S$ values compared to the three sites downstream of the factory discharges. In the current survey there were no statistically significant differences in MCI scores between sites. However, a significant decrease in $SQMCI_S$ scores was recorded between the upstream control site U and the downstream sites, 2d, 3 and 4. This does not indicate deterioration at these sites though, as the results for site U was exceptionally high for this stream, being the highest $SQMCI_S$ score recorded to date. The extreme abundance of the 'highly sensitive' *Deleatidium* mayfly and the abundance of five 'moderately sensitive' taxa supported the high $SQMCI_S$ score found at site U.

Macroinvertebrate richnesses recorded at the three unnamed tributary sites (UT, MT and DT) were very similar to the historical medians for these sites. Community composition was similar between sites, particularly between UT and MT. *Potamopyrgus* snails were common to all sites, as were Talitrid amphipods. Amphipods (*Paracalliope)* and black sandfly larvae (*Austrosimulium*) were common to both UT and MT whereas the mayfly (*Zephlebia*) was common to both UT and DT. The similarities between UT and MT reflected the instream habitat which consisted of willow roots and/or fine sediment. In contrast, the communities at DT also included the very abundant mayfly *Austroclima* and abundant oligochaete worms, a reflection of the stony-bottom rather than fine sediment habitat.

The MCI scores recorded at all unnamed tributary sites were indicative of 'fair' health. There were no significant differences in MCI score between any of the three sites. The upstream site recorded a slightly lower MCI score to that recorded at site DT, supporting the conclusion that the low score recorded at site MT was due to differences in habitat type rather than the result of the discharge of wastewater irrigation to land in the vicinity of the unnamed tributary.

Overall, the macroinvertebrate communities downstream of the Taranaki By-Products discharges in both the Inaha Stream and the unnamed tributary were of 'fair' health. The results of this survey gave no indication that the discharges (to land and to water) from the rendering plant were having any significant adverse effect on the macroinvertebrate communities in either the Inaha Stream or the unnamed tributary. However some results indicate a possible return to less healthy conditions, and wastewater management needs more attention, particularly in relation to the discharge to the Inaha Stream.

12 February 2014 survey

This February 2014 survey followed a period of 68 days since a fresh in excess of three times median flow in the nearby Waiokura Stream (the nearest appropriate water level recorder). Freshes and floods would likely scour a proportion of the fine organic matter and filamentous periphyton growths from the streambed, which could impact upon macroinvertebrate community compositions. The fact that there were no major fresh events in the two months leading up to the survey suggests that flooding is unlikely to have influenced the macroinvertebrate community; therefore the community should be reflective of preceding water quality conditions.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream ceased on 2 December 2013, and recommenced on 3 July 2014. That is, discharge of Taranaki By-Products wastewater to Inaha Stream had not been occurring for a period of 74 days immediately prior to this biological survey of 12 February 2014.This means that this biological survey was preceded by an extended period after discharge occurred.

The results of this February 2014 biological survey indicated that the Inaha Stream was in fair health, with four out of five sites recording MCI and $SQMCI_S$ scores that were not significantly different to their long term medians. Of the five sites surveyed in the Inaha Stream, two sites recorded MCI scores higher than their long term medians (2d and 3) and two sites recorded MCI scores lower than their long term medians (U and 1). Site 4 recorded an MCI equal to its long term median. Only site 2d (located

immediately downstream of the discharges from the rendering plant) recorded an $SQMCI_S$ score higher than its long term median (although this result was not significant). Site 1 (located upstream of the wastewater and cooling water discharge points but downstream of part of the treated wastewater irrigation area) recorded MCI and $SQMCI_S$ scores significantly lower than their historical medians for this site. This can be attributed to a disruption of habitat at this site caused by the removal of a debris dam prior to the survey. Overall, these results indicated that the degree of impact from the wastewater discharge was much less evident than that recorded in earlier surveys, which frequently recorded significant enrichment of the stream, and a consequent deterioration of the streambed macroinvertebrate communities.

Usually, the sampling sites located upstream of the Taranaki By-Products plant supported macroinvertebrate communities with higher MCI and $SQMCI_S$ values compared to the three sites downstream of the factory discharges. In the current survey there were no statistically significant differences in MCI scores between sites. However, a significant decrease in $SQMCI_S$ scores was recorded between the upstream control site U and downstream sites 2d and 3, (although not site 4). The $SQMCI_S$ score recorded at site 4 was however significantly lower than that recorded in the previous two surveys, indicating a possible deterioration in biological health at this site. The significant decreases in $SQMCI_S$ scores at sites 2d and 3 may be indicative of long term impacts from the rendering plant discharges but also to the very low flows recorded at the time of this survey.

Macroinvertebrate richnesses recorded at the three unnamed tributary sites (UT, MT and DT) were very similar to the historical medians for these sites. Community composition was similar between sites, with four out of the eight dominant taxa found at all three sites. *Potamopyrgus* snails were abundant to extremely abundant to all sites, as were Talitrid and *Paracalliope* amphipods and mayfly *Zephlebia* group. The similarities in macroinvertebrate community composition between sites reflected similarities in the instream habitat, with proportions of roots and/or fine sediment and instream macrophytes common to all three sites. The communities at DT also included the abundant mayfly *Austroclima*, a reflection of the predominantly stony-bottom rather than fine sediment habitat.

The MCI scores recorded at all unnamed tributary sites were indicative of 'fair' health. There were no significant differences in MCI score between any of the three sites. Sites UT and MT recorded slightly lower MCI scores to that recorded at site DT, which can be attributed to differences in habitat type. Site UT recorded an $SQMCI_S$ score significantly lower than its long term median and significantly lower than that recorded at site MT. This is mainly a reflection of the habitat conditions which were impacted by very low and very slow flows at the time of this survey. Results suggest no long term impact from the discharge of wastewater irrigation to land in the vicinity of the unnamed tributary.

Overall, the macroinvertebrate communities downstream of the Taranaki By-Products discharges in both the Inaha Stream and the unnamed tributary were of 'fair' health. The results of this survey gave no clear indication that the discharges (to land and to water) from the rendering plant were having any significant long term adverse effect on the macroinvertebrate communities in either the Inaha Stream or the unnamed tributary. However, some results indicate a possible return to less healthy conditions, although low flows are likely to have also affected the results.

20 October 2014 survey

This October 2014 survey followed a period of 22 days since a fresh in excess of three times median flow in the nearby Waiokura Stream at No. 3 Fairway (the nearest appropriate water level recorder) and 36 days since a fresh in excess of seven times median flow. In the month prior to this survey, there had been three fresh events of which one exceeded three times median flow. Freshes would likely scour a proportion of the fine organic matter and filamentous periphyton growths from the streambed, which could alter macroinvertebrate community compositions.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream began on 3 July 2014 and continued without cessation until 23 September 2014. Therefore, there was a moderate period of 27 days when no discharges occurred prior to this biological survey.

A spring macroinvertebrate survey was performed at four sites in the Inaha Stream and at three sites in an unnamed tributary of the Inaha Stream in relation to discharges by Taranaki By-Products. Taxa richnesses were moderate at all seven sites and similar to median values calculated from previous surveys and to the median value calculated from similar sites.

MCI scores at the 'potentially impacted' sites showed that macroinvertebrate communities were in 'fair' health which was typical for sites at that altitude in Taranaki ring plain streams.The three 'potentially impacted' sites (sites 1, 2d and 3) in the Inaha Stream had MCI scores which were not significantly different (Stark, 1998) to each other or to the 'control' site (site U) indicating that there was no impact from discharges associated with Taranaki By-Products. As expected, $SQMCI_s$ scores showed greater variability than MCI scores, with some sites in the Inaha Stream having markedly different scores, which was probably indicative of habitat variation among sites rather than water quality.

There were no significant differences (Stark, 1998) among the three sites sampled in the unnamed tributary of the Inaha Stream for any of the macroinvertebrate indices examined (MCI, $SQMCI_S$ and taxa richness), indicating that discharges from land under irrigation from Taranaki By-Products were not having an impact on macroinvertebrate communities.

No 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

Overall, the macroinvertebrate communities downstream of the Taranaki By-Products discharges in both the Inaha Stream and the unnamed tributary were of 'fair' health. The results of this survey gave no clear indication that the discharges (to land and to water) from the rendering plant were having any significant long term adverse effect on the macroinvertebrate communities in either the Inaha Stream or the unnamed tributary since the previous survey.

17 February 2015 survey

This February 2015 survey followed a period of 142 days since a fresh in excess of three times median flow in the nearby Waiokura Stream at No. 3 Fairway (the nearest appropriate water level recorder) and 156 days since a fresh in excess of seven times median flow. In the month prior to this survey, there had been two very small fresh events, both of which did not exceed median flow. An absence of significant freshes would likely result in increased levels of filamentous periphyton and fine sediment accumulating on the streambed.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream began on the 3 July 2014 and continued without cessation until 23 September 2014. Therefore, there was a long period of 147 days when no discharges occurred prior to this biological survey.

A summer macroinvertebrate survey was performed at five sites in the Inaha Stream and at three sites in an unnamed tributary of the Inaha Stream in relation to discharges by Taranaki By-Products. Taxa richnesses were generally moderate and slightly higher than the previous survey values and that of the median values calculated from all previous surveys.

MCI scores showed that macroinvertebrate communities were generally in 'fair' health. However, there was a significant decline in macroinvertebrate community health in Inaha Stream between sites 1 and 3. No such deterioration was observed in the previous spring survey (Sutherland and Thomas, 2015). A chemical survey on the 28 January 2015 found some organic contamination of the unnamed tributary that runs through the rendering plant site, causing a slight increase in filtered carbonaceous BOD_5 in Inaha Stream, which might be a contributing factor to the observed declines. At site 2d, the willows had been removed from the stream banks between the spring and summer surveys; the reduced shading had resulted in increased periphyton growth, which would explain the deterioration in macroinvertebrate community health at the site. There was also a significant decline in macroinvertebrate community health between sites UT and MT in the unnamed tributary of the Inaha Stream which was likely due to habitat variation.

$SQMCI_s$ scores were largely congruent with MCI scores at the Inaha Stream sites indicating less healthy macroinvertebrate communities at sites 2d and 3 but did not show any substantial differences among sites in the unnamed tributary of the Inaha Stream.

No 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

Overall, there was some evidence that discharges from Taranaki By-Products had impacted on the freshwater macroinvertebrate communities present in the Inaha Stream. However, changes in habitat and habitat variation between sites make drawing strong conclusions from the data difficult.

2.1.5 Irrigation and groundwater monitoring

Irrigation

The exercise of consent 3941-2 to spray irrigate wastewater onto land is monitored by both TBP and Council. TBP measures and records wastewater volumes discharged on each paddock daily, and analyses nitrogen constituents of the wastewater at approximately weekly intervals. Some soil testing has been carried out.

Monitoring by Council includes inspection of irrigation areas, effluent analysis, chemical and biological survey of Inaha Stream, and sampling from groundwater bores drilled around the irrigation areas and of a spring situated near an irrigation area that is used to supply several households.

The spray irrigation system employs low-medium pressure travelling irrigators with a 30-metre or 50-metre swath. Use of a 'Rotorainer' irrigator with a 100-metre boom, that requires less maintenance, commenced in May 2008. A second Rotorainer was employed from January 2009.

The area irrigated has progressively been increased as TBP has purchased or leased more land around the rendering plants. Prior to 2006, irrigation occurred on four blocks, three owned by TBP on Kohiti Road (38.83 ha), Normanby Road (37.95 ha) and Katotauru Road (20.15 ha), and a block owned by Mr and Mrs Shearer on Katotauru Road (19.27 ha).

An extension followed the change of consent 3941 in December 2005, which provided for two additional blocks to be irrigated, one leased on Katotauru/Normanby Roads (about 110 ha), the other purchased on Ahipaipa Road (about 48 ha). The blocks were developed in stages by re-fencing and reticulation in 2006 and 2007.

TBP bought or leased further parcels adjacent to the existing irrigation areas, and in November 2009 was granted a change of consent 3941-2 to provide for irrigation on them. Part of this additional land, adjacent to the Katotauru Road block, 17.4 ha area in total, was irrigated from December 2009. Irrigation of "Maori Trust land", 20.6 ha in area beside Upper Inaha Road, started in December 2010. A further area of about 19.1 ha, in the "Kingi Block" to the north, that spans the Inaha Stream tributary between Katotauru and Upper Inaha Roads, was reticulated in December 2010 and irrigated from October 2011, after a groundwater monitoring bore (BH9) was installed down-gradient.

In the 2013-2014 season, approximately 319 ha was available (licensed, including Shearers' property) for irrigation, of which 252 ha was utilised. A total area of 75 ha was planted in maize and beet, 15 ha of which was irrigated with wastewater before the growing season.

For 2013-2014, records produced by TBP show that, on the basis of weekly effluent tests for ammonia-nitrogen, nitrate nitrogen and nitrite-nitrogen, and assuming 15 g/m^3 organic nitrogen, the total mass of nitrogen discharged to land was 44,355 kg. This represents a reduction of 31% from the previous year, which is attributed by TBP to improved wastewater treatment and housekeeping. The 246 ha area utilised on the TBP farm received effluent nitrogen loading of 180 kgN/ha, and the 6.7 ha on Shearers' farm received 38 kgN/ha.

Recorded loadings on the 61 individual paddocks irrigated on the TBP farm ranged from 18 to 523 kgN/ha/y, with an area of 23 ha (9 paddocks) exceeding 300 kgN/ha/y and an area of 14 ha (6 paddocks) exceeding 400 kg/ha/y. On Shearers' Farm, nitrogen loadings ranged from 34 to 44 kgN/ha/y.

In the 2014-2015 season, the paddocks on the TBP farm continued to be restructured, enlarging them from 3.0 to about 7.4 ha on average and reducing their number from 113 to 46. An area of approximately 319 ha again was available for irrigation, of which an estimated 226 ha was utilised. A total area of 61 ha was planted in maize, beet or oats, or a combination of two of these, 19 ha of which was irrigated before planting.

For 2014-2015, the TBP records show that the total mass of nitrogen discharged to land was 31,122 kg. The 216 ha area utilised on the TBP farm received effluent nitrogen loading of 140 kgN/ha, and the 9.8 ha on Shearers' farm received 83 kgN/ha. This significant reduction in nitrogen loading has been ascribed by TBP to further improvement in wastewater treatment and housekeeping.

Loadings on the 46 individual paddocks irrigated on the TBP farm ranged from 15 to 324 kgN/ha/y, with an area of 23 ha (3 paddocks) exceeding 300 kgN/ha/y. On Shearers' farm, nitrogen loadings ranged from 41 to 209 kgN/ha/y.

A summary of annual nitrogen application rates since 2001-2002 is given in Table 13.

Table 13 Irrigation periods and annual nitrogen application rates

Year	Nitrogen applied	300 kgN/ha areas		200 kgN/ha area	
		ha	kgN/ha/y	ha	kgN/ha/y
2001-02	9,409	62.7	150		
2002-03	18,513	65.8	253	11	168
2003-04	18,129	82.3	198	13	144
2004-05	17,911	93.2	177	15	94
2005-06	32,067*	163	197		
2006-07	27,719*	198	140		
2007-08	25,889	180	140	4.4	145
2008-09	22,737	148	154	1.9	31
2009-10	38,856	215	181	0	0
2010-11	44,732	233	188	10	76
2011-12	56,970	258	218	11	69
2012-13	64,058	278	226	14	102
2013-14	44,355	246	180	6.7	38
2014-15	31,122	216	140	9.8	83

* does not include Shearers'

The limit on consent 3941-2 for annual nitrogen loading is 300 kgN/ha, except for the Shearer block, where the limit is 200 kgN/ha.

Overall, during the 2013-2014 period, compliance with the annual nitrogen loading limits was achieved, the average nitrogen loadings being 60% of the 300 kg/ha limit,

and 19% of the 200 kg/ha limit, respectively. For individual paddocks, compliance was recorded for 91% of the irrigated area where the limit is 300 kgN/ha, and 100% of the area where the limit is 200 kgN/ha.

During the 2014-2015 period, compliance with the annual nitrogen loading limits was achieved, the average nitrogen loadings being 47% of the 300 kg/ha limit, and 42% of the 200 kg/ha limit, respectively. For individual paddocks, compliance was recorded for 90% of the irrigated area where the limit is 300 kgN/ha, and 93% of the area where the limit is 200 kgN/ha.

Fertilisers
In August 2011, the Company produced its first annual "fertiliser budget", the outcome of a procedure TBP had developed for recording of nitrogen fertiliser application, including Zeal Grow (stickwater), urea and other chemical fertilisers used on crops and new grass, and soil conditioners such as dairy and rendering plant wastewater treatment pond solids. In 2013-2014 and 2014-2015, the recording of fertiliser nitrogen application rate was complicated by the restructuring of paddocks, first on the western side of Katotauru Road, and then on the eastern side.

For 2013-2014, estimated nitrogen application from fertilisers and soil conditioners, in addition to wastewater irrigation, amounted to around 17,000 kg, comprising about 8,000 kg from Zeal Grow (assuming nitrogen concentration of 3,900 g/m^3, based on previous measurement), about 8,640 kg in chemical fertiliser, with the remainder in dairy solids. Zeal Grow was disked into the ground over an area of about 95 ha at an estimated rate ranging from 29 to 230 kg/ha/y. Urea was applied over an area of about 24 ha that was cropped in maize at a rate of 357 kg/ha. The fertiliser was applied largely on paddocks that had not recently been irrigated.

For 2014-2015, the reported nitrogen application from fertilisers and waste solids increased significantly, by a factor of over 150% to about 44,000 kg. This is attributed to increased application of Zeal Grow (stickwater), by a factor of about 450% over an area of 276 ha, equating to an average application of 160 kgN/ha/y. Application rate was high in some areas, notably near the corner of Normanby and Upper Inaha Roads, and adjacent to Ahipaipa Road, Reported application rate exceeded 300 kgN/ha/y in four paddocks, over a total area of 30 ha, with a maximum of 536 kgN/ha/y.

In 2014-2015, the combined annual nitrogen application rate of wastewater and fertiliser exceeded 300 kg/ha/y in most of the paddocks along the middle reaches of the western tributary that joins Inaha Stream below Normanby Road, with a maximum combined rate of 520 kg/ha/y. The maximum recorded combined nitrogen application rate on the farm was 701 kg/ha/y, adjacent to Upper Inaha Road (new P29).

Groundwater
Groundwater sampling of the irrigation areas commenced in February 2000 and was undertaken on a monthly basis until June 2006, when the frequency was reduced to two-monthly. Initially, four bores on Kohiti and Normanby Road blocks and a spring on Shearers' property were monitored. In September 2001, two bores were commissioned on Katotauru block, four months before irrigation started there. In January 2005, two bores were drilled in proposed new irrigation areas, at least one year before irrigation commenced, and two existing bores were replaced because of access difficulty. In October 2011, two further bores were drilled, at the downslope

boundaries of the "Kingi" and Inaha Road blocks at the northern and western extents, respectively, of the irrigation area.

The locations of the groundwater monitoring bores and spring are described in Table 14 and shown in Figure 10. The results of the sampling are given in Appendix III.

Table 14 Groundwater monitoring sites

Site name	Site code	Depth m	Grid reference, NZMP	
			Easting	Northing
BH1	GND1054	13.5	1702469	5624829
BH2	GND1055	6.8	1702001	5624440
BH3	GND1056	12.8	1702359	5623913
BH4	GND1057	11.0	1702308	5623294
Shearers' Spring	GND1058		1701770	5623022
BH5	GND1171	9.5	1701358	5624353
BH5B	GND1346	8.6	1701352	5624536
BH6	GND1172	11.8	1701575	5623867
BH6B	GND1347	12.2	1701586	5623914
BH7	GND1348	13.5	1702671	5624594
BH8	GND1349	13.6	1701013	5623526
BH9	GND2225	11.5	1701186	5624945
BH10	GND2226	10.4	1700548	5623806

Bore 1 and Bore 5 were installed as control sites, situated at the (then) upslope boundaries of Kohiti and Katotauru blocks, respectively. Bore 5B was placed up-gradient of Bore 5 after a new farm track covered it in September 2004. Bore 2 was on the flat beside an unnamed tributary of Inaha Stream, at the bottom of Kohiti block. (A farm dairy was constructed over this site in April 2004). Bore 3 is beside Kohiti Road on the south-eastern plateau above TBP's plant. Bore 4 is in the centre of Normanby block. Bore 6 is in a swale beside the road at the downslope boundary of Katotauru block. Bore 6B was emplaced on the flat above Bore 6 after a series of floodings by ponded rainfall and wastewater. Bore 7 is downgradient of the southern side of the Ahipaipa block. Bore 8 is downgradient of the western side of the Katotauru/Normanby Roads block. Bore 9 is downgradient of the eastern side of Kingi block. Bore 10 is downgradient of the "Maori Trustee" block beside Upper Inaha Road.

The spring on Shearers' property is used as a water supply for a number of households. It is therefore monitored to ensure that it meets Drinking Water Standards as well as to assess any off-site effects of effluent irrigation at TBP. The spring is relatively close to the boundary with Normanby block, though there is a shallow gully in between. Maize was grown in the nearest TBP irrigated paddock (old 95), about 100 m away up-gradient from the spring, in 2013-2014. The New Zealand health standard for nitrate-nitrogen concentration in drinking water for domestic supply is 11.3g/m^3N. Monitoring shows that nitrate levels in the spring, while remaining moderate, increased from 1.4 to 5.2g/m^3N over a period of about fifteen years to June 2015.

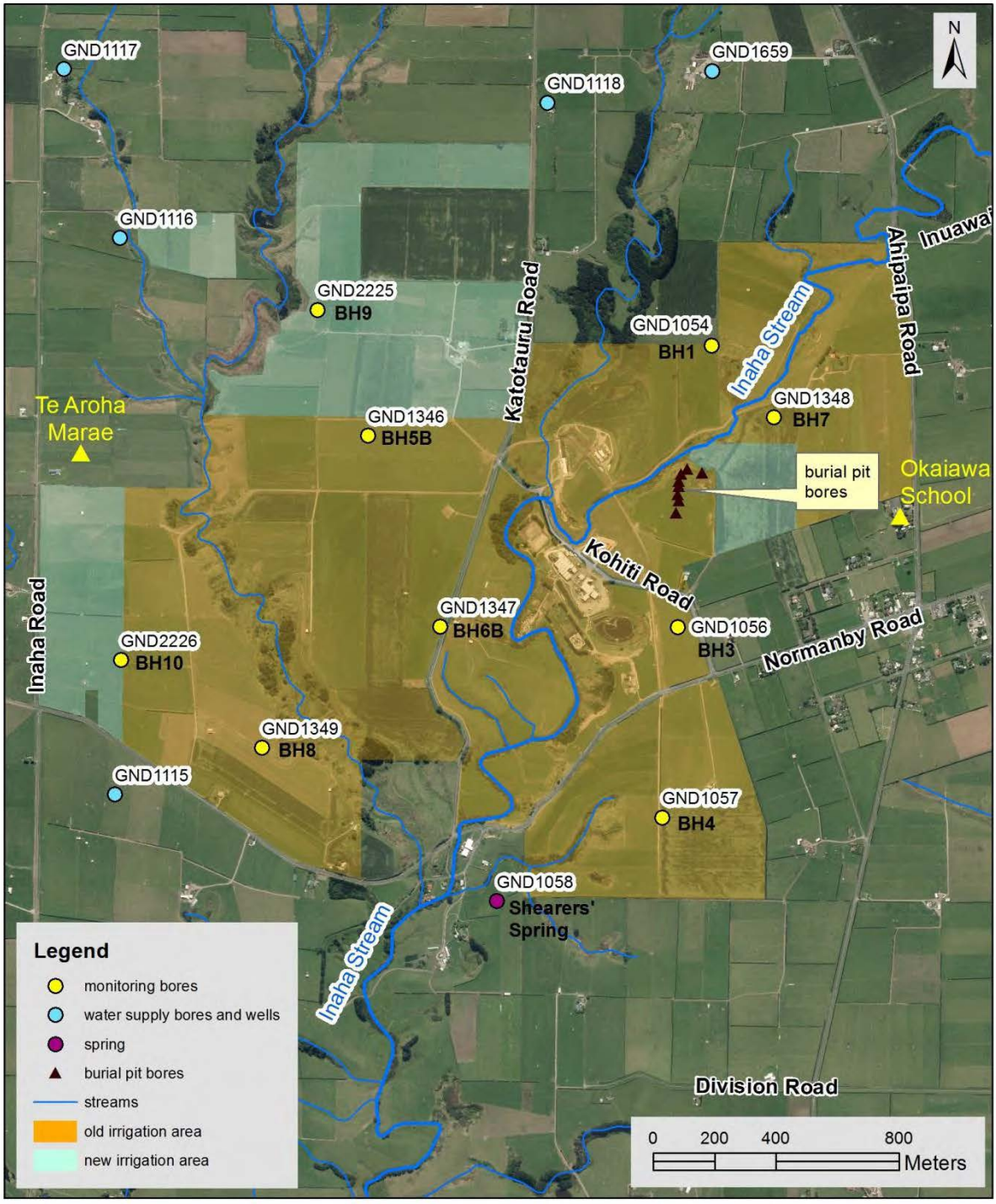

Figure 10 Pasture irrigation areas and groundwater monitoring sites

The parameters of most interest with regard to operation of the wastewater irrigation system are the groundwater level, mineral strength (conductivity) and nitrate concentration. Figure 11 shows how these parameters have varied through time for groundwater at the ten monitoring points.

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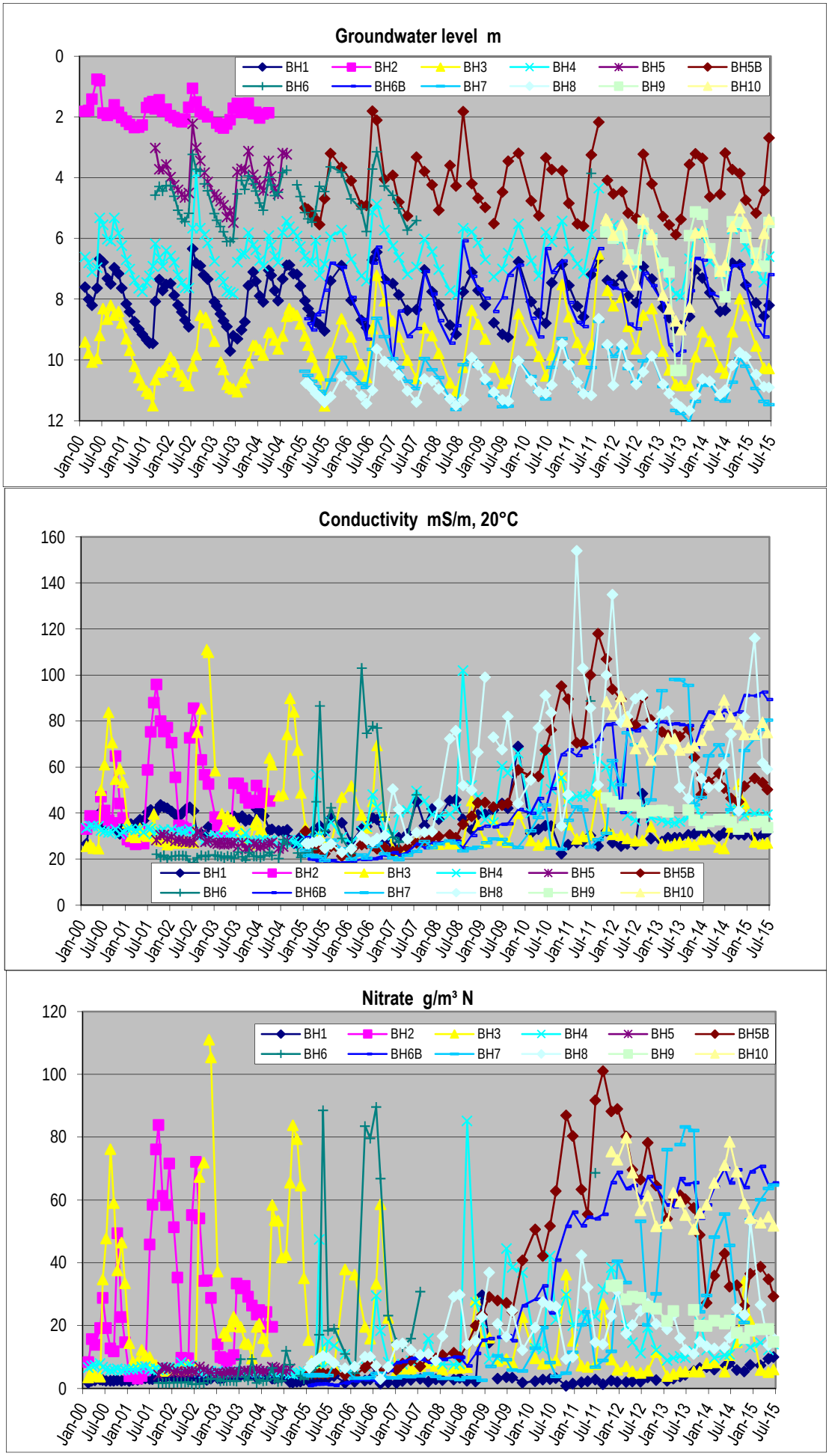

Figure 11 Water level, conductivity and nitrate concentration at irrigation monitoring bores 2000-2015

Groundwater level fluctuations show correlation with increases in nitrate concentration and conductivity. From this it can be inferred that rainfall is mobilising irrigated effluent or applied fertiliser components through the soil into the shallow groundwater. Nitrate concentration appears to rise and fall quickly, which is consistent with the application of relatively low volumes of high strength wastewater.

A summary of the nitrate concentrations for each monitoring site, comparing the 2013-2015 values with those from the previous two-year monitoring period, is given in Table 15.

Table 15 Summary of groundwater nitrate data, 2011–2013 versus 2013-2015

Site name	Site code	2011-2013		2013-2015	
		Median	Range	Median	Range
BH1 (control)	GND1054	2.5	1.35 – 2.4	6.8	5.4 – 10.0
BH3	GND1056	5.6	3.9 – 27	7.0	5.2 – 34
BH4	GND1057	13.4	9.0 – 38	12.7	9.7 – 21
Shearers' Spring	GND1058	3.6	2.8 – 4.0	4.5	3.4 – 5.5
BH5B	GND1346	68	54 – 101	35	26 – 58
BH6B	GND1347	64	55 – 69	65	54 – 71
BH7	GND1348	40	8.9 – 83	51	21 – 82
BH8	GND1349	20	12.3 – 31	15.4	11.0 – 53
BH9	GND2225	28	22 – 33	19.4	14.8 – 25
BH10	GND2226	61	52 - 80	57	51 – 78

Overall, at the end of the 2013-2015 review period, nitrate concentration was stable or showing a reducing trend at all impact monitoring sites, as indicated by the median values of the 12 samples taken in each two-year period. (At Bore 7, nitrate rose sharply in 2013, then fell, resulting in the elevated median).

Bore 1 (GND1054) - Control

Background nitrate concentration, as found at control bores 1 and 5, and at bores 4, 6 and 5B before application of effluent, is typically 2 to 6 g/m^{3}N. At bore 1 on the northern boundary of the Kohiti Block, a spike in nitrate, to 30 g/m^{3}N, was recorded in December 2008. Between June 2013 and June 2015, nitrate concentration at control bore 1 increased from 4.4 to 10 g/m^3. Due to extension of irrigation areas the suitability of these bores as control bores needs to be reviewed.

Bore 3 (GND1056)

In Kohiti block (Bore 3), where effluent irrigation began in the 1990s at high application rates, large seasonal swings in nitrate concentration have occurred, with peaks in spring and troughs in autumn as groundwater level rises and falls. As effluent application rate has reduced, the peaks have reduced, from about 110 g/m^{3}N in 2002 to 27 g/m^{3}N in 2011 and 34 g/m^3 in October 2014. For most of the time, measured nitrate concentrations during 2013-2015 were below about 8 g/m^{3}N. Reported annual nitrogen loading around bore 3 (old paddock 87) was 84 kg/ha in 2013-2014, applied entirely in July/August 2013, with no nitrogen fertiliser. In 2014-2015, effluent was applied monthly from July to November to a total of 96 kgN/ha, and Zeal Grow was applied in June 2015 at 47 kgN/ha.

Bore 4 (GND1057)

At bore 4, in Normanby block, nitrate concentration was typically 7-13 g/m^{3}N, with spikes in winter of up to about 50 g/m^{3}N, until 2009-2010, when the winter increase lasted longer than before, and in 2010-2011 the baseline lifted to about 20 g/m^{3}N. There was a reduction, to 11 g/m^{3}N, in June 2012, following a hiatus in irrigation in 2011-2012, which remained in 2012-2013, although reported effluent application rates around the bore site (paddocks 90, 91 and 97) were relatively high, at 329 to 404 kgN/ha. In 2013-2014, effluent application rate around bore 4 continued to be high, at 369 to 419 kgN/ha, mostly in February/March, though this was not reflected in the groundwater monitoring results, nitrate-N rising slightly, to about 15 g/m^3. There was no application of Zeal Grow. In 2014-2015, a low level of effluent nitrogen was applied nearby in March/April, with no Zeal Grow fertiliser

Bore 5B (GND1346) – Control then Impact

Bore 5B was initially a control bore in Katotauru block, before effluent irrigation was authorised up-gradient in November 2009, though an unknown amount of stickwater (ZealGrow) application and some effluent irrigation had occurred before then. Maize was grown immediately up-gradient in 2009-2010, and around the bore in 2011-2012. Nitrate concentration increased from <5 g/m^{3}N in 2006 to a peak of 101 g/m^{3}N in winter 2011, then reduced to 29 g/m^{3}N in June 2015. The peak nitrate concentration followed six, monthly applications of effluent on the paddock (old 55) immediately upgradient during a wet autumn and winter. In 2013-2014, reported annual effluent nitrogen loading was 191 kgN/ha in the immediate vicinity (new paddock 35), applied evenly through the year, with no application of Zeal Grow. In 2014-2015, reported total nitrogen loading was 349 kgN/ha, comprising 76 kgN/ha effluent and 273 kgN/ha Zealgrow, applied alternately and evenly throughout the year.

Bore 6B (GND1346)

At the replacement impact bore 6B in Katotauru block, nitrate concentration increased from about 3 to 17 g/m^{3}N between 2006 and winter 2009, then increased more rapidly to about 65 to 70 g/m^3 in October 2011 and stabilised. This is likely to be the accumulative effect of the application of treated wastewater and stickwater over a distance of several hundreds of metres up-gradient of bore 6B. Maize was grown around the bore in 2013-2014.

Bore 7 (GND1348)

At bore 7, in the Ahipaipa block, nitrate levels remained at 3-5 g/m^{3}N, until autumn 2009, when the level increased to about 10 g/m^{3}N. In the following six autumn periods, the (measured) seasonal peak increased, reaching 83 g/m^{3}N in 2013, 55 g/m^3 in 2014 and 65 g/m^3 in 2015, with troughs in winter/spring of around 20 g/m^{3}N (except in 2013, when groundwater levels were unusually low). The surrounding paddock (old 82) was used for maize cropping in 2008-2009, 2011-2012 and 2012-2013. In 2013-2014, reported annual effluent nitrogen loading was 294 kg/ha, applied in spring and summer, with no Zeal Grow fertiliser. Up-gradient (old 81 and 80), reported effluent loading was higher, at 457 and 395 kgN/ha. In 2014-2015, the reported effluent loading reduced greatly to 28 kgN/ha, applied in June.

Bore 8 (GND1349)

At bore 8, on the western side of the Katotauru/Normanby block, nitrate levels have fluctuated between 3 and 53 g/m^{3}N over periods of several months, unrelated to season. Other dissolved constituents, notably chloride and the major cations, have

followed similar cycles. Maize was grown in the paddock (old 19) up-gradient in 2013-2014, and within the bore paddock (new 26) in 2014-2015. In 2013-2014, nitrate levels were stable, at 13 to 16 g/m^{3}N, while groundwater level remained low. Reported annual effluent nitrogen loading was 173 kg/ha, applied in September/October. Zeal Grow application was recorded, for August and May, at an estimated nitrogen application rate of 165 kg/ha. In 2014-2015, the reported effluent loading was 31 kgN/ha in July/August, with Zeal Grow applied at 150kgN/ha in March/April 2015. The spike of 53 gN/m^3 in nitrate recorded for December 2014 occurred upon a rise in groundwater level following a two-year period of low levels.

Bore 9 (GND2225)

At bore 9, downgradient of the eastern side of the newly irrigated Kingi block, the initial nitrate level in October 2011 was quite high, at 33 g/m^{3}N, and had reduced to 15 g/m^{3}N by June 2015. Maize was grown around the bore in 2013-2014. In 2013-2014, no effluent was discharged in the vicinity, nor was nitrogen fertiliser applied. In 2014-2015, only Zeal Grow was applied, at a rate of 25 kg/ha, in August 2014.

Bore 10 (GND2226)

Bore 10 is placed at the edge of the 200-metre buffer zone along Normanby Road (as is bore 8), about 270 metres from Upper Inaha Road, near to the boundary of the existing Katotauru/Normanby Roads block. Measured nitrate level has fluctuated annually between about 50 and 80 g/m^{3}N. It is likely that previous irrigation on the adjacent block has affected this monitoring site. In 2012-2013, 2013-2014 and 2014-2015, reported effluent nitrogen loading in the adjacent paddock (old 29) up-gradient was 277, 250 and 299 kgN/ha, respectively, applied evenly through the year. For 2013-2014, application of 101 kgN/ha of Zeal Grow was reported, in early spring and late autumn, making a combined nitrogen loading of 378 kgN/ha. In 2014-2015, application of 402 kgN/ha of Zeal Grow was reported, in spring and autumn, making a combined nitrogen loading of 701 kgN/ha.

2.1.6 Solid waste disposal

The disposal of solid wastes from meat rendering operations under consent **5495-1** is undertaken in accordance with a management plan that has been approved by Council. Raw material that cannot be processed is buried on the Kohiti Road property opposite the rendering plant (Figure 10). Pits must be dug to certain specifications after notification of Council; material placed in the pits must be covered with soil within four hours to control odour; and stormwater must be diverted away.

Monitoring by Council consists of monthly inspection, and sampling of groundwater from bores placed around the disposal area.

In the 2013-2015 period, the first recorded burial followed the fire at the plant on 12 January 2014, to allow disposal of rubble from the burned building and of raw material that could not be diverted to other rendering plants. A pit was excavated at the southern end of the existing burial area in preparation for large volumes of solid waste, and a stockpile of lime was laid for odour control. The volumes buried were less than expected, owing to the large proportion of material diverted, and the rapid repair of the plant. The Company reported that about 40 tonne of material was buried as a result of the fire, mainly home kill product and some waste from the bio-extracts plant. Initially, daily inspections were carried out by Council. The burial area was

covered with earth each day, no exposed materials were found, and there was little odour beyond the immediate vicinity of the pit.

From December 2014 to April 2015, material from the DAF unit at a chicken processing plant was buried at times when it was found to be unprocessible. A new pit was dug. TBP reported that 119.72 tonnes of "product" was buried in February. The Company stopped taking the DAF unit wastes on 4 April. The burial pit was filled in.

No complaint was received about odour associated with solid waste burial in the 2013-2015 period, at the time of burial. One complaint was made in May 2015, about odour and flies associated with the burial in February and March 2015, which could not be substantiated.

Groundwater monitoring at seven bores immediately down-gradient of the burial area has shown the formation of a plume approximately 150 metres in width. In 2013-2015, maximum (individual bore) nitrate concentrations ranged from <1 to 78 g/m^{3}N. Since 2001, nitrate concentration in the control bore up-gradient has fluctuated over a ten-year cycle between 2 and 8 g/m^{3}N, peaking in 2006, and was rising past 6 g/m^{3}N in June 2015.

A new monitoring bore (BP10, code GND2506) to replace damaged bores BP8 and BP9 was drilled on 11 May 2015, down-gradient of the pits dug in 2014 for disposal of solid waste after the fire and of the unprocessible chicken wastes. New wellheads (concrete pads and riser pipes) were installed for two of the older bores in March 2014.

Since 2010, there has been a notable increase in ammonia concentration at two bores, BP4 and BP7, both down-gradient of relatively newly-used burial or farm solids storage areas. BP4, at the north-western corner, reached 97 g/m^{3}N in March 2015, and BP7 peaked at 84 g/m^{3}N in May 2012. Both bores had elevated COD values, of up to 56 g/m^3, and some organic odour.

As the bores that contained elevated concentrations of nitrogen yielded low volumes on pumping, indicating slow movement of groundwater with little dilution, and as the plume is relatively narrow with no potential groundwater usage down-gradient, a watching brief is being maintained.

Should nitrogen contamination levels increase markedly, to the extent that Inaha Stream, 50 metres away, may be affected, remedial measures such as a denitrification trench may need to be considered.

2.2 Air

No emission monitoring or deposition gauging is undertaken as part of the air quality monitoring for TBP. Instead, an odour survey of the surrounding area is carried out at each of the monthly air quality inspections. These inspections identify any issues that need to be addressed.

Consent 4058 has as its main effects criterion a requirement that the odour is not to be noxious or offensive or objectionable, at or past the legal boundaries of the property. Further details of air-related incidents can be found in the Register of Incidents in section 2.3.

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 year matters may arise which require additional activity by the Council, for example, provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Taranaki Regional 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 significant additional investigations and interventions, or record incidents, in association with TBP's conditions in resource consents or provisions in Regional Plans in relation to the Company's activities at its Okaiawa site on 41 occasions. The incidents are summarised in Table 16. In the case of odour complaint, it is noted whether the level of offensiveness was substantiated.

Table 16 Unauthorised incidents reported from 1 July 2013 to 30 June 2015

Water

Date	Incident	Description/Finding	Action
27 February 2014	Groundwater abstraction monitoring equipment not installed	Water level meter, and level and take telemetry, not installed before consent 9756-1 exercised	Infringement Notice, $500 fine. Monitoring equipment installed
3-6 April 2014	Breach of temperature increase limit for Inaha Stream	TBP record showed breaches by up to 1.3°C over 3 days	
30 April 2014	Non-notification of discharge to Inaha Str. and insufficient dilution	TRC and Ngatimanuhiakai not notified of recommencement of discharge; dilution	Infringement Notice, $750 fine. Discharge procedure amended.

Land

Date	Incident	Description/Finding	Action
19 March 2014	Discharge of untreated waste causing ponding adjacent to bio-filters.	Leakage to ground from factory air extraction ducting, a bio-filter, and a burst water line.	Ponded liquid recovered by suction tanker. Ducting repaired.

Air

Date	Incident	Description/Finding	Action
1 January 2014 1350; 2245 NZDT	Odour complaints (2)	Slight intermittent odour in daytime, then objectionable odour at night, on-site source not identified	Letter of explanation accepted. Second DAF product separator installed to avoid any overflow.
3 January 2014	Odour complaint	Noticeable intermittent odour beyond boundary	Continued surveillance
12 January 2014	Fire at plant	Damage to building roof, wiring and some process equipment. Douse water directed to WWTP.	Management meeting, diversion of raw product elsewhere and/or burial while repairs made.
31 January 2014	Odour complaint	Noticeable odour on Skeet Road	Continued surveillance
25 March 2014	Odour complaint	Noticeable cooking odour on Division Road	Continued surveillance
12 April 2014	Odour complaint	Noticeable odour at corner of Normanby and Kohiti Roads	Continued surveillance
21 April 2014	Odour complaint	Noticeable variable odour during weekly maintenance shutdown.	Continued surveillance
31 May 2014	Odour complaint	No odour beyond boundary	Continued surveillance
13 June 2014	Odour complaint	Noticeable odour from cooking,/ponds/bio-filter under variable winds along Ahipaipa and Katotauru Roads	Continued surveillance
23 December 2014	Odour complaint	No odour beyond boundary	Continued surveillance
12 January 2015	Odour complaint	No odour beyond boundary	Continued surveillance
24 Jan 2015	Odour complaint	Noticeable variable odour at Ngutu/Barclay Roads corner	Continued surveillance
8 March 2015	Odour complaint	Slight intermittent odour at complainant's house	Continued surveillance
5 May 2015	Odour complaint	Strong factory odour at Katotauru/Normanby Roads corner. Vacuum pump broken temporarily.	Meetings with complainant and TBP on odour control and reporting
11 May 2015	Odour complaint	Noticeable odour at complainant's house	Continued surveillance
18 May 2015	Odour complaint	Noticeable odours beyond plant boundary following temporary plant breakdown.	Continued surveillance

A summary of the incidents registered in 2013-2014 and 2014-2015 is presented in Table 17, with those for the years since 2000 included for comparison. Incidents are described as relating to water, land or air. Odour complaint numbers, both total received and those substantiated, are distinguished in the air category.

Table 17 Summary of registered incidents relating to Taranaki By-Products Limited, 2000-2015

Year	Total	Water	Land	Air		
				Total	Odour	Substantiated odour
2000-2001	55	3	0	52	49	3
2001-2002	20	1	0	19	16	5
2002-2003	22	4	5	13	12	5
2003-2004	26	6	2	18	18	3
2004-2005	36	4	2	30	30	5
2005-2006	28	5	4	19	19	2
2006-2007	34	8	3	23	23	5
2007-2008	55	6	3	46	45	8
2008-2009	28	1	2	25	25	2
2009-2010	11	1	0	10	10	0
2010-2011	19	1	1	17	17	0
2011-2012	13	0	0	13	13	0
2012-2013	41	2	1	38	37	6
2013-2014	14	3	1	10	9	1
2014-2015	7	0	0	7	7	0

Over the 2013-2014 period, a total of three incidents were registered in relation to water, one in relation to land, and 10 in relation to air.

Over the 2014-2015 period, no incident was registered in relation to water or land, and seven in relation to air.

2.3.1 Water

The three incidents registered about effects on water in the 2013-2014 period all resulted from resource consent compliance monitoring by Council. No complaint was received about effect on water.

Conditions on three consents were breached: consent **9756-1** to take and use groundwater, consent **2049-1** to discharge treated wastewater to Inaha Stream, and consent **2050-4** to discharge cooling water to Inaha Stream.

On 25 February 2014, during a routine groundwater monitoring survey by Council, it was found that water was being abstracted from a new groundwater bore ("Bore 3", Site Code GND2380, beside the old cowshed) without the infrastructure required under conditions of consent **9756-1**, namely equipment to measure and record the water level of the bore, and equipment to transmit data on water level and water taken to Council's computer system. An infringement notice ($500 fine) was issued for this offence. Abstraction from the bore was allowed to continue, as the flow of Inaha Stream, the alternative water source for the rendering plants, was very low. The

required equipment was then installed, telemetry to Council of abstraction data starting on 27 March, and of water level on 6 June 2014.

Consent **2050-4** (cooling water) was breached on one occasion, over about three days from 3 to 6 April 2014, during a period of low flows in Inaha Stream. The (monthly) monitoring record downloaded by Council on 23 April showed that the 3°C limit on maximum temperature increase was breached, with a maximum increase of 4.3°C. Breaches of the limit had occurred over the previous summer, and an Abatement Notice had been issued, requiring works to be undertaken by 31 October 2013 to improve the effectiveness of the cooling system before summer 2013-2014. Delays in delivery of equipment on order, and a severe fire in the rendering plant in January 2014, held up the installation of the equipment (two vacuum air condensers) until early April 2014. The breach occurred while the new cooling system was being installed. Under the circumstances, that the breach was not discovered until after the remedial equipment was installed, and that maximum downstream temperature during this period was, at 20.2°C, well below the limit of 25°C, no further action was taken.

On 30 April 2014, during a routine site inspection, it was found that discharge of treated wastewater to Inaha Stream had recommenced without notification of Council and Ngatimanuhiakai, as required under consent **3941-2**, and that the required dilution of effluent in the receiving water under consent **2049-4** was not being achieved. The Company stated that discharge to the stream had recommenced two days before, after high rainfall. On the basis of calculated flow at the v-notch weir for the effluent, and the calibrated staff gauge at Kohiti Road for the stream, the effluent dilution was 68:1, compared to the minimum of 300:1 required. An infringement notice ($750 fine) was issued. Ngatimanuhiakai were informed and a liaison meeting arranged. Discharge to the stream ceased two days later, when conditions for effluent disposal to land had improved. Staff retraining on control of discharge rate was implemented.

2.3.2 Land

On 19 March 2014, during a routine visit to the rendering plant site, a Council officer found that liquid was leaking from rusted factory air extraction ducting to the ground beside the bio-filters. Investigation found that the condensate, together with overflow from the condensate collection sump and discharge from a burst water line, had been ponding for some time above Inaha Stream. A sample taken of the stream below the ponded area showed some elevation of ammonia concentration, possibly from the leakage area, within the limit on the consent (**2049-4**) for discharge of treated wastewater. A sucker truck was employed to transfer the leakage to the wastewater treatment ponds until the next weekly plant maintenance shutdown, when the ducting was repaired. No further action was taken.

2.3.3 Air

2013-2014

Over the 2013-2014 period, a total of 10 incidents were registered in connection with emissions to air from the rendering plants' operation. All but one of the incidents related to complaints by members of the public about odour. There were five complainants, one of whom made five complaints. All of the complaints were

investigated by officers of the Council as soon as practicable after each complaint was laid, through inspection of the rendering plants and surrounding area.
One of the nine odour complaints was substantiated, in that offensive or objectionable odour was found beyond the boundary of property covered by consent **4058-4** at the time of inspection, and the odour affected someone.

The substantiated complaint occurred on the night of 1 January 2014. The odour source was ascribed by the Company to emissions that resulted from failure of equipment, being the separator for sludge from the DAF (dissolved air floatation) unit in the wastewater treatment system. The Company's written explanation was accepted. A second separator was installed to reduce the likelihood of a recurrence.

On seven occasions, that is, on 78% of investigations, Council officers found odour from the TBP site to be noticeable but not objectionable beyond the plants' boundary, four times at the location of complaint. The source of odour detected was attributed to either cooking, wastewater treatment or the bio-filters. No odour was associated with the edibles plant, irrigation of wastewater, or burial of solid waste.

On one occasion that complaint was made, no noticeable odour was found upon inspection. It is noted that odorous emissions from a rendering plant site can be sporadic and of variable intensity.

The other incident in 2013-2014 related to a fire that occurred in the inedibles plant on 12 January 2014.

2014-2015
Over the 2014-2015 period, a total of seven incidents were registered in connection with emissions to air from the rendering plants' operation. All of the incidents related to complaints by members of the public about odour. There were seven complainants, one for each complaint. All of the complaints were investigated by officers of the Council as soon as practicable after each complaint was laid, through inspection of the rendering plants and surrounding area. None of the complaints was substantiated, in that offensive of objection able odour was found beyond the boundary of property covered by consent **4058-4** at the time of inspection, and the odour affected someone.

On five occasions, that is, on 71% of investigations, Council officers found odour from the TBP site to be noticeable but not objectionable beyond the plants' boundary, four times at the location of complaint. The source of odour was largely attributed to cooking. No odour was associated with the edibles plant, irrigation of wastewater, or burial of solid waste.

On two occasions that complaint was made, no noticeable odour was found upon inspection.

2.4 Community consultation

A community liaison group was set up in July 2000. Its purpose is to facilitate communication between TBP, the Okaiawa community and the Council regarding resource consent matters. The group members are the Okaiawa Community Liaison Officer, representatives from TBP (Managing Director and Plant Manager), staff of the Council (Director - Resource Management, Compliance Manager, and Inspecting Officer), and site neighbours. Initially meetings were held monthly, then on an 'as required' basis.

It is noted that the Council in June 2003 initiated reviews of the consents (2049, 3941 and 4058, respectively) for discharges to water, land and air partly in response to concerns raised by members of the community. The consent reviews that ensued were instrumental in installation of additional odour control equipment, upgrade of the wastewater treatment system, and extension of the land disposal system.

The reviewed consents for discharge to land by spray irrigation and for discharge of emissions to air both had a condition inserted that requires liaison with interested parties on exercise of the consent.

Special condition 19 on discharge permit 3941-2 to discharge treated wastewater onto or into land by spray irrigation, imposed on 21 December 2005, reads:

The consent holder and staff of the Regional Council shall meet as appropriate, quarterly or at such other frequency as the parties may agree, with representatives of Ngati Manuhiakai Hapu and other interested submitters to the consent, and any other interested party at the discretion of the Chief Executive, Taranaki Regional Council, to discuss any matter relating to the exercise of the resource consent, in order to facilitate ongoing consultation.

Special condition 4 on the replacement discharge permit 4058-4 to discharge emissions to air, issued on 11 October 2011, reads:

The consent holder shall consult and inform the local community about activities on the site, specifically those relating to the exercise of this consent, by:

a. Four times per year, providing a newsletter to all land owners and/or occupiers of properties within 3 kilometres of the site; and
b. Convening a meeting with the Director – Resource Management, Taranaki Regional Council (or their delegate), and the local community annually or at such other frequency as the parties may agree.

A meeting under consent **3941-2** was held at Te Aroha marae on 7 June 2014, during the monthly hapu meeting. About 21 members of Ngati Manuhiakai attended, together with representatives of the Company (1) and the Council (2).

Some of the topics discussed included:

- Plant operation, raw material sources, and local employment
- Wastewater treatment
- Licensed irrigation areas
- Buffer zones
- Effects on Inaha Stream and bio-monitoring
- Areas of particular importance to the hapu
- Riparian planting

- Communications, via newsletters and meetings
- Sponsorship of local activities

A meeting under consent **4058-4** was held at Okaiawa Rugby Club rooms on 14 November 2013. A newsletter with an invitation to the meeting was hand delivered to local residents, and mailed to a number of community organisations and groups. Five persons attended, including a representative of the rugby club, together with Company (1) and Council (2) staff.

Matters covered included

- Plant operation, performance and events with regard to odour
- Recent, planned and considered improvements for odour control
- Installation of equipment for lowering cooling water temperature
- Licensed irrigation areas and buffer zones
- Community events
- Community newsletters
- Devolvement of Environmental Manager duties to Plant Manager
- Appointment of a new Community Liaison Officer

Two community newsletters were produced during the 2013-2014 reporting period, in October 2013 and May 2014, and one newsletter during the 2014-2015 period, in August 2014.

No community meeting was held during the 2014-2015 reporting period.

2.5 Riparian management

Conditions on two consents held by TBP relate to the management of riparian margins of Inaha Stream, in connection with the discharge of wastewater to and the emplacement of culverts in the stream.

Donation to Taranaki Tree Trust
To mitigate any effect of its discharge of wastewater to Inaha Stream, TBP has since 1999 donated to the Taranaki Tree Trust $2,100 per year for the purpose of riparian planting and management in the Inaha catchment (GST exclusive and adjusted according to the consumer price index).

This agreement is written into special condition 18 on discharge permit **2049-4**.

These donations have been used to subsidise riparian planting along the main stream and its tributaries. The effect of these measures will be to increase shading, with consequent decrease in water temperature and in nuisance algal growth; to reduce stock access and bank erosion; to reduce nutrient and sediment input to watercourses; and to enhance the appearance of the riparian margins.

At the end of 2014-2015, a total of $32,378.04 of TBP funding had been spent on or was committed to riparian management covering planting of stream margins. The works were carried out throughout the catchment, mainly along reaches above the Okaiawa plant. Funding was granted to landholders at a rate of 50% on plants as a rebate.

Fencing and planting above Kohiti Road
Land use consent **6431-1**, that allows the emplacement of two culverts in Inaha Stream for farm access above Kohiti Road, requires TBP to prevent stock access to the stream and adjacent wetlands throughout the property by fencing or other means (condition 9), and to plant and maintain the controlled riparian areas (condition 10) within four years of granting. This requirement applies to a section approximately 2 km in length between Ahipaipa and Kokiri Roads. Consent **6431-1** was granted on 4 October 2004.

It is noted that Council produced two riparian management plans (RMP938 and RMP921) for TBP in September 2004, relating to the Inaha stem between Ahipaipa and Normanby Roads and to the western tributary that runs through the Katotauru/Upper Inaha Roads irrigation area, respectively. Two other riparian plans relating to the western tributary (RMP014 and RMP1363), have become associated with the irrigation area as it has been extended up the catchment.

Prior to the 2007-2008 reporting period, some work was done on riparian margins of Inaha Stream above Kohiti Road, involving aerial spraying and removal of willows.

Following the realignment of Inaha Stream in April 2008, a length of approximately 1,200 metres extending downstream from Ahipaipa Road that spans the new channel section was fenced on both sides. Planting of the fenced areas with appropriate native species was completed in June 2008.

Fencing and planting of the remaining section of about 900 metres of riparian margin immediately above Kohiti Road was completed at the end of the 2008-2009 reporting period. Willows along this section were aerially sprayed in the 2009-2010 reporting period and removed in April 2011 (with some effect on the water level monitoring site below the bridge). Planting of the cleared section occurred in winter 2011, and replanting/blanking of areas further upstream.

In June 2015, dead trees and associated debris were removed from the banks and bed of the stream over a distance of about 800 metres above the upper culvert as a maintenance measure to protect the culverts from blockage. A waiver was granted to allow the instream works to occur outside the permitted November to April work period.

2.6 Provision of reports, management plans, and certification

2.6.1 Reports and plans

TBP is required to provide to Council various management plans, contingency procedures, certifications and monitoring reports under five consents, as summarised in Table 18.

Table 18 Requirements for reports and plans imposed by special conditions

Requirement	Consent Number (and Condition Numbers)	Date(s) required	Compliance achieved?
Emissions to Air			
Certification that works, processes and equipment are operated according to good engineering practice	4058-4 (6)	Biennially from 30 April 2013	Certification received 31 July 2015, 3 months late
Air discharge management plan.	4058-4 (7)(9)	2 February 2012, annual review by 31 May, including contingency procedures	Initial plan received 3 July 2012. Annual reviews received 14 May 2014 and 23 April 2015
Monthly report under section 3.2 of management plan on daily activities log, weather, bio-filter performance	4058-4 (7)	Monthly	Reports received, with some delays of up to 6 months
Wastewater to Inaha Stream			
Wastewater disposal management plan	2049-4 (13)(15)	31 December 2000, annual review from 31 May 2007	Plan received and approved Dec 2000. Annual review received 28 May 2014 and 20 April 2015
Monthly report under section 5.2 of management plan on wastewater characteristics, flows and irrigated areas	2049-4 (13)(15)	Monthly	Reports received, with some delays of up to 6 months
Wastewater to land			
Spray irrigation management plan	3941-2 (1)(3)	31 December 2000 annual review from 31 May 2006	Plan received and approved Dec. 2000. Annual review received 27 May 2014 and 23 April 2015
Annual report under section 4.3 of management plan on wastewater characteristics, flows and irrigated areas	3941-2 (1)(3)	Annually	Nitrogen budget received 4 August 2014, then supplied monthly
Burial pits			
(Solid) Waste burial management plan	5495-1 (1)(3)	1 November 2000, subject to review on two months notice	Plan received and approved Oct. 2000. Review received 2 May 2014
Stormwater to Inaha Stream			
Contingency plan for spillage or accidental discharge	5426-1 (4)	31 August 1999	Plan received and approved Nov 2000. Review received 28 May 2014

Management plans (4) are required for the disposal of wastewater to Inaha Stream and to land by spray irrigation, for the burial of solid wastes, and for the discharge of emissions to air. TBP is required to undertake an annual review of both wastewater management plans and the air management plan, the reviewed plans to be provided by 31 May each year.

Certification by a suitably qualified independent person that the works, processes and equipment relevant to all discharges to air from the site are operational in accordance with good engineering practice is required biennially.

Contingency plans (2) are required that address situations which could result in a discharge to air of odorous emissions that are offensive or objectionable beyond the boundary of the site, and spillage or accidental discharge to the stormwater catchment.

The air management plan that is required under the new air discharge permit incorporates the operations and maintenance manual and the contingency plan on loss of processing capacity that were required under the old permit.

Monthly monitoring reports are required from TBP under the wastewater management plan on various aspects of wastewater quality and disposal, and under the air consent/management plan about weather and bio-filter performance. An annual report is required under the spray irrigation management plan.

The required management and contingency plans and certification were all produced in 2000, except the air management plan, which was not required until 2012. For the period from 2000-2001 to 2008-2009, none of the required revision or certification documents were received by Council. The TBE plant was constructed in the interim. (It is noted that annual reviews of plans have only been required since wastewater and air discharge consents were changed in 2005 and 2007, respectively upon consent reviews invoked by Council).

In 2013-2014 and 2014-2015, TBP was required to review by 31 May the management plans for wastewater disposal to Inaha Stream and to land by spray irrigation, and for discharge of emissions to air. The reviews were undertaken in time. In conjunction, a review of the solid waste burial management plan was also undertaken in 2013-2014. The reviewed plans were satisfactory.

With regard to monthly and annual monitoring reports, TBP did provide reports as required, mostly on time, but with some delays of up to six months. The longest delay followed the fire at the rendering plant in January 2014. From July 2014, the required monitoring reports were supplied largely on time.

2.6.2 Air discharge engineering practice certification

The second biennial engineering practice audit under permit **4058-4**, in respect of the works, processes and equipment relevant to all discharges to air from the site, was undertaken by air quality engineers Golder Associates on 20 to 22 May 2015. The audit focussed on aspects that contribute to the status of existing 'engineering practice':

- Physical condition of equipment: the state of odour control components, including consideration of materials used for construction

- Instrumentation review: the accuracy of selected instrumentation and the adequacy of instrument for monitoring the odour control system
- Design aspects: the current engineering design with respect to the air extraction, air cooling and bio-filter systems

The report on the evaluation is attached as Appendix V.

The report concludes:

Following Golder's audit of the TBP and TBE odour control system, it is concluded that the associated equipment, including ducts, fans, cooling system and biofilters, appear to be operated in a sound engineering state.

The existing cooling systems are generally achieving inlet airstreams to the biofilters [that] are normally 40°C or lower, which represents good practice. Future upgrades to the cooling systems, and a new WHE plant (as being considered by TBP) is likely to be necessary given the expansion to the bovine rendering systems.

It is concluded that an increased level of temperature and pressure gauge monitoring at various positions along the extraction, cooling and biofilter system would ensure standard engineering practice is achieved. Currently regular manual measurements are undertaken.

The existing biofilters and extraction systems are generally working effectively however most will require some maintenance or remedial actions as follows:

- *The Factory Air 2 biofilter requires a new air distribution and lateral system that can be cleaned.*
- *The Factor Air 2 air extraction from the blood room requires pre-cleaning of this air stream to remove blood dust and blocking up of the biofilter.*
- *The TBP concentrated sources biofilter has excessive water levels and the source and remediation measures need further investigation.*
- *The TBE concentrated sources biofilter has signs of air channelling around its central concrete manifolds that will in time require remediation by re-sealing its connections to the Novaflo laterals.*

The site has comprehensively documented management systems for ensuring reliable operation of process equipment and achieving processing goals. An expansion of the documentation to odour control system temperatures and pressures as well as some additional WHE operational information is recommended.

Finally it is recommended that the TBP concentrated source system is reviewed and upgraded in conjunction with the design and installation of a system that targets an expanded bovine rendering line. The opportunity exists for installing a system that manages emissions from both the new and existing bovine rendering equipment.

3. Discussion

3.1 Discussion of plant performance

By providing a service that utilises offal, fallen stock, and other by-products of the meat and poultry processing industry, TBP's activities play a role in the sustainable management of natural and physical resources in Taranaki, as expressed in the RMA. The various matters of importance in sections 6 and 7 of the RMA, as well as the minimum water quality standards in section 107, are important considerations in this regard.

During 2013-2015, there was frequent contact between TBP staff and officers of Council at the Okaiawa rendering plants as part of routine monthly and any follow-up inspections, and the investigation of 21 incidents over that period. In addition, some 343 water samples were taken, 4 biomonitoring surveys conducted, temperature data processed monthly, and the stream gauged periodically in the vicinity of the plants.

This intensity of monitoring was the result of on-going concern about the performance of the plant, particularly with regard to generation of odour, but also to past adverse effects on Inaha Stream and, potentially, on groundwater.

Generally, the on-site management and operation of TBP's facility over 2013-2015 could be described as fair, with improvement in most aspects and deterioration in some.

The management and contingency plans, and compliance monitoring reports that were required under four consents for the 2013-2015 period were all provided in reasonable time, with the exception of some monitoring reports, which were up to 6 months late. (See Table 18).

Data required under the Measurement and Reporting of Water Takes Regulations, 2010 for the abstraction from Inaha Stream were provided for both years, showing full compliance on daily volumes, though there were large gaps in the record for 2013-2014. Flow and water level measurement, with telemetry to Council, for the new groundwater take were installed in 2015, though late, incurring an infringement notice.

The wastewater treatment system continued to be upgraded in stages. In 2013, the pH adjustment system for wastewater entering the DAF unit was refined improving removal of soluble fat and protein. In June 2014, a second settling pond (5A) was commissioned beside the first to enable it to be desludged.

Control of wastewater discharge so as to maximise application to land was very good, with no discharge to Inaha Stream occurring for 226 days in 2013-2014, between 4 November and 2 July, and 269 (non-contiguous) days in 2014-2015, between 10 September 2014 and 29 June 2015). In comparison, discharges of wastewater to water occurred on 257 days in 2012-2013, and 186 days in 2007-2008. The Company is endeavouring to extend this period. When discharge to Inaha Stream did occur, the Company record shows compliance with the limits on minimum dilution throughout 2013-2015, with the exception of two days in September 2014. However, inspection by Council found a breach of the limit on another occasion, on 30 April 2014, for which an

infringement notice was issued and staff retraining was undertaken. The maximum ammonia concentration in the receiving water was complied with on each monitoring occasion.

The cooling water discharge breached the 3˚C limit on stream temperature increase on 3 days between 3 and 6 April 2014, with a maximum increase of 4.3°C. This occurred while an additional cooling system was being installed to comply with an abatement notice. The installation was delayed about five months by late delivery on the import order for the equipment, and the fire in January. The 35˚C limit on maximum temperature of the receiving tributary was complied with.

The stormwater system continued to discharge significantly lower concentrations of sediment and grease to the Inaha tributary, although breaches of the suspended solids and oil and grease limits were recorded for the point where stormwater enters the firewater pond. This improvement is attributed to diversion of the first flush to the wastewater treatment system, and to the placement of sediment traps in the catchment around the two rendering plants and transport depot. Work on sealing the entire catchment continued, thus removing a potential odour source and enabling better housekeeping.

The irrigation system was managed so as to produce an average nitrogen loading that easily complied with consent limits. The reported average annual nitrogen loading from wastewater irrigation where 300 kg/ha is allowed reduced from 75% of the limit in 2012-2013 to 60% in 2013-2014, and further to 43% in 2014-2015. Where 200 kg/ha is allowed, the successive annual loadings were 19% and 42% of the limit. Distribution of wastewater over the TBP farm was uneven in 2013-2014, with improvement shown in 2014-2015. In 2013-2014, nine paddocks, or 11% of the relevant area, exceeded the limit where 300 kg/ha is allowed, to a maximum of 523 kg/ha. In 2014-2015, a similar area exceeded the limit, with a much reduced maximum of 324 kg/ha.

The total area of land utilised for wastewater irrigation decreased, from 291 ha in 2012-2013 to 252 ha in 2013-2014, and further to 226 ha in 2014-2015. There was a corresponding increase in area on which nitrogen fertiliser was applied, primarily by injection of Zeal Grow (stickwater, a by-product of the rendering process), from 95 ha in 2013-2014 to 276 ha in 2014-2015. This occurred largely as a result of change in treatment/disposal of stickwater from the TBE plant after the fire in January 2014. Over the two-year period, reported annual nitrogen loading from wastewater reduced from about 64 to 31 tonnes, while reported fertiliser nitrogen application increased from about 17 to 44 tonnes, mainly as Zeal Grow.

There was no complaint about irrigation.

Management of the solid waste disposal area was satisfactory, in general. Following the fire, rubble from the burned building, and raw material that could not be diverted during the repairs, was buried. A monitoring bore was installed downgradient of the new pit.

Fencing and planting of riparian margins of the Inaha Stream above Kohiti Road was maintained, in compliance with the consent to install culverts. Dead willows and debris were removed from the stream bank and bed above the culverts in June 2015 to prevent

blockage. A donation was made to the Taranaki Tree Trust for riparian planting in the Inaha catchment, as agreed in the consent to discharge wastewater.

With respect to operation of the rendering plants, a biennial site audit of odour control systems, carried out by air quality engineers Golder Associates in May 2015, concluded that the systems and associated equipment appeared to be maintained and operated in a sound engineering state. A review of the design philosophy of the inedibles plant odour control system was promoted, to make the concentrated sources system the primary means of containing odour. The report noted that the construction of a dedicated bio-filter for concentrated sources from the TBP plant was an improvement. It was recommended that the Company take the opportunity to review and further upgrade the concentrated sources system in conjunction with the design and installation of a system for a proposed expansion of the bovine rendering line. Recommendations were also made on maintenance and remedial actions for the existing biofilters, and on improvements to the waste heat evaporator control system. The Company has undertaken to follow the recommendations of the report, with minor modifications.

3.2 Environmental effects of exercise of consents

The abstraction of water from Inaha Stream was not found to have any adverse effect on the stream.

The discharge of cooling water raised Inaha Stream temperature by more than the consent limit for a period of 3 days in April 2014. This was not found to have any adverse effect on the stream.

In 2006-2007, a significant improvement in water quality of the stream was brought about by a change in management of the 'dual' wastewater disposal system, in which discharge may be either to the Inaha Stream directly or to land by spray irrigation so that disposal to land was maximised. The results of the four stream biomonitoring surveys conducted in 2013-2015 show that improvement was sustained, to the extent that there was no significant difference in benthic invertebrate communities above and below the wastewater discharge point until the February 2015 survey, which showed some deterioration occurred at the two sites immediately downstream**.**

This deterioration may be related to a proliferation of periphyton growth that followed the removal of shading willow trees adjacent to the plants' site, and/or also related to discharges from the site. The highest temperature ever measured upstream of the rendering plant, at 25.7°C, was recorded for 29 January 2015, possibly as a result of the recent removal of the willow trees, as stream flows were not exceptionally low. The affected riparian margins were planted with native species in winter 2015**.**

With regard to discharge of wastewater to land, groundwater monitoring showed significant effects of irrigation, overall. Nitrate levels were elevated at several bores, situated within and down-gradient of disposal areas, with all either being stable or showing a reducing trend, as indicated by the mean. However, the upper ranges observed showed elevated levels which require further investigation.

The spring used for supply of local residents downslope of the irrigation block south of Normanby Road was well within the guideline for nitrate concentration, but continued to display an increasing trend.

No effect on stream communities was noted in relation to land irrigation. An increasing level of nitrate concentration was found in the western tributary that runs through the irrigation areas, which is being investigated.

For the solid waste disposal area, no complaint about odour was received. A narrow plume containing high concentration of nitrate, detected downslope of the disposal area, is being monitored to determine if any remedial action is needed.

Over the 2013-2015 reporting period, the effect on the environment as a result of emissions to air was demonstrably reduced. In terms of substantiated unauthorised incidents (which are the primary measure of the adverse effect that TBP has), there was a decrease in odour incidents to one (1) for 2013-2014 and zero (0) for 2014-2015, compared to six (6) in 2012-2013.

Noticeable, but not objectionable, odour was found beyond the plant boundary on 78% of the 9 incident investigations by Council in 2013-2014, and 71% of the 7 investigations in 2014-2015. The source of odour was attributed entirely to the inedibles plant and its odour control system, particularly cooking odour, and to the wastewater treatment system. No odour complaint was associated with the edibles plant, irrigation of wastewater, or burial of solid waste.

3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the 2013-2015 monitoring period is set out in Table 19 to Table 31.

Table 19 Summary of performance for Consent **2051-4**

Purpose ***To take water from the Inaha Stream for a rendering operation***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Means of take satisfactory to Council	Inspection and monitoring	Yes
2. Minimum flow of 25L/s downstream of point of abstraction	Monitoring of flow	Yes
3. Operation of an abstraction measurement device, maintain records	Site inspection. Fixed rate pumps. Meters installed September 2012. Data provided for period since March 2013, with some large gaps in 2013-2014.	No
4. Operation of a flow recorder at Kohiti Road, level gauge from Jan 2015	Staff gauge in stream, rated by Council. Daily level record and monthly report by Company	Yes
5. Report on use of treated wastewater as cooling water by 31 March 2000	Report produced 13 October 2000 and recommendations implemented	N/A
6. Provision for review	Next review date available 1 June 2017	N/A

Purpose *To take water from the Inaha Stream for a rendering operation*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		High Improvement required

N/A = applicable

Table 20 Summary of performance for Consent **2049-4**

Purpose: *To discharge treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream*			
Condition requirement	**Means of monitoring during period under review**		**Compliance achieved?**
1. Mixing zone 30m downstream of discharge	Site inspection and monitoring results		Yes
2. Boundaries of mixing zone to be determined by Council	Site inspection		N/A
3. Point of discharge to enter channel directly to ensure mixing	Site inspection		Yes
4. Advise Council before making changes to alter nature of discharge	Site inspection, monitoring results and liaison		Yes
5. Company to undertake self monitoring	Review and compare results. Some monitoring in management plan undertaken by Council		Yes
6. Minimum discharge dilution rate	Monitoring results.	No. Breach on 30 April 2014. **Infringement Notice** ($750 fine)**.**	
7. No discharge of stickwater, and consult with Council before increasing cow herd	Site inspection, monitoring results and liaison		Yes
8. Discharge to cease when flows in the Inaha drop below 100L/s	Monitoring of Kohiti Rd flow gauge results		Yes
9. Control on effect of discharge in receiving water	Inspection, chemical sampling and bio-monitoring		Yes
10. Limits on receiving water ammonia concentration	Chemical sampling		Yes
11. Recording and reporting of discharge rate	Inspection and review of records		Yes
12. Inaha Stream flow measurement device	Inspection, gaugings by Council		Yes
13. Provision of wastewater disposal plan	Plan received by Council and approved December 2000		Yes
14. Plan to be implemented	Inspections and liaison and receipt of Company reports		Some reports late
15. Optional and annual reviews of wastewater plan	Liaison. Annual reviews by Company submitted 28 May 2014 and 20 April 2015		Yes
16. Designated staff member	Part of Company Environmental Manager's job description, also Plant and Operations Manager's		Yes
17. Training of staff on wastewater disposal	Liaison and inspection		Yes

Purpose: ***To discharge treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
18. Donation to Taranaki Tree Trust	Confirmation with Council finance department that donation received	Yes
19. Optional review provision	Next review date available June 2017	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		Improvement required Good

N/A = applicable

Table 21 Summary of performance for Consent **2050-4**

Purpose: ***To discharge cooling water to Inaha tributary***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Activity monitoring by Company as required	Continuous temperature monitoring taken over by Council in September 2013, at Company's request	Yes
2. Composition not to be different to Inaha Stream, other than heat and solids	Chemical sampling by Council	Yes
3. Maximum temperature limit on discharge	Continuous temperature recording by Council	Yes
4. Limit on suspended solids in discharge	Sampling by Council	Yes
5. Controls on effect of discharge in receiving water	Continuous temperature monitoring , and chemical and biological sampling, by Council. Refer section 2.1.4.2	No. Maximum temperature increase breach 3-6 April 2014, while new cooling equipment installed
6. Discharge temperature measurement and recording	Monitoring carried out by Council	Yes
7. Optional review provision	Next review date available June 2017	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		Good High

N/A = applicable

Table 22 Summary of performance for Consent **5426-1**

Purpose: ***To discharge stormwater to Inaha tributary***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification prior to changing processes that may significantly alter discharge	Inspection by Council	Yes
2. Limits on discharge composition	Chemical sampling by Council	Three breaches of suspended solids limit, and one breach of oil and grease limit
3. Controls on effect of discharge in receiving water	Chemical and biological sampling by Council	Yes

Purpose: ***To discharge stormwater to Inaha tributary***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Provision of spillage contingency plan by 31 August 1999	Plan produced in November 2000	N/A
5. Optional review provision	Next review date available June 2017	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

N/A = applicable

Table 23 Summary of performance for Consent **4058-4**

Purpose: ***To discharge emissions to air***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practicable option (bpo) to prevent or minimise adverse effects	Checking that standard operating procedures to achieve compliance with consent conditions are followed Liaison with Company and inspection by Council	BPO generally achieved
2. No offensive or objectionable odour beyond boundary	Odour surveys by Council and Company, and investigation and recording of complaints.	One substantiated complaint, after equipment failure
3. Definition of noxious, offensive or objectionable odour		N/A
4. Designated staff member for emissions management	Part of Company Environmental Manager's job description. Also Plant and Operations Managers	Yes
5. Prohibition of fish rendering	Inspection by Council	Yes
6. Certification processes and equipment operated according to good engineering practice biennially from 30 April 2013	Biennial certification by suitably qualified independent person. Initial review of TBP and TBE plant operations conducted 20-22 April 2015, report received 31 July 2015	Report received, 3 months late
7. Preparation of Air Discharge Management Plan	Submission of Plan, on 3 July 2012	N/A
8. Operation in accordance with Air Discharge Management Plan	Inspection by Council	Yes
9. Annual review of Air Discharge Management Plan by 31 May	Liaison. Reviews by Company submitted 14 May 2014 and 23 April 2015	Yes
10. Limits on dust deposition rate	Inspection	Yes
11. Newsletter production, and community liaison meetings	Three newsletters produced. Community liaison meeting held 14 November 2013	Newsletter frequency less than required

Purpose: ***To discharge emissions to air***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
12. Optional review provision to deal with significant adverse effects	Next review date available June 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		Improvement required

N/A = applicable

Table 24 Summary of performance for Consent **3941-2**

Purpose: ***To discharge treated wastewater to land***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Irrigation to defined area	Inspection by Council	Yes
2. Provision and maintenance of spray irrigation management plan	Plan received by Council and approved in October 2000	Yes
3. Plan to be followed	Liaison, inspection and provision of monitoring reports	Yes
4. Optional, and mandatory annual reviews of management plan	Liaison. Change to plan to maximise discharge to land, and mandatory annual reviews, required under review of consent 21 December 2005. Revisions submitted 27 May 2014 and 23 April 2015.	Yes
5. Designated staff member	Part of Company Environmental Manager's job description. Also Plant and Operations Manager's	Yes
6. Adopt best practicable option to minimise adverse effects, including total nitrogen minimisation	Liaison and inspection. DAF unit installed October 2004 and enlarged October 2008. Flocculant addition for solids (including nitrogen) removal from November 2007, and pH adjustment from March 2013	Upgraded system still being assessed
7. Seek permission for Inaha discharge when cannot irrigate, and Inaha low	Liaison and inspection	N/A
8. Limit on dissolved oxygen in final pond	Chemical sampling.	No, though no adverse effect
9. No offensive or objectionable odour beyond boundary	Inspection and complaint register	Yes
10. No spray drift beyond boundary	Inspection and complaint register	Yes
11. Limit on sodium absorption ratio	Chemical sampling	Yes
12. Prohibition of ponding and run-off	Inspection and complaint register	Yes
13. Spray buffer zones	Inspection and complaint register	Yes

Purpose: ***To discharge treated wastewater to land***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
14. Limit on nitrogen application rate	Monitoring by Company and review of irrigation records. Record also kept of N fertiliser application to establish total nitrogen loading	No. Llimit exceeded for 11% of area irrigated
15. Report on reducing ammonia concentration by 15 December 2000	Report received by Council on 2 April 2001	N/A
16. Limit on application rate	Inspection and field measurement	Yes
17. Limit on return period	Inspection and provision of records	Yes
18. Installation and maintenance of monitoring bores	Liaison and inspection. Further maintenance required	Yes
19. Baseline and operational monitoring by Company	Results of wastewater, irrigation and soil monitoring by/for Company reviewed by Council	Yes
20. Consultation meetings with interested parties	Imposed by review of 21 December 2005. Meeting held at Te Aroha marae on 7 June 2014	Yes
21. Notification prior to Inaha discharge	Imposed by review of 21 December 2005. Liaison with Company and Ngati Manuhiakai	No. Breach on 28 April 2014. **Infringement Notice** ($750 fine)**.**
22. Provisions for contamination of groundwater or water supply	Groundwater monitoring by Council and complaint register	N/A
23. Optional review provision for operational requirements	Not sought by Company	N/A
24. Optional review provision upon receipt of ammonia reduction report	Not sought by Council	N/A
25. Optional review provision for nitrogen treatment and disposal	Not sought by Council	N/A
26. Optional review provision for environmental effects	Not invoked in June 2014. Next review date available June 2017	`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		Improvement required

N/A = applicable

Table 25 Summary of performance for Consent **5495-1**

Purpose: ***To discharge wastes from meat rendering by burial***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Provision of waste burial management plan by 1 November 2000	Plan received by Council and approved in October 2000	N/A

Purpose: ***To discharge wastes from meat rendering by burial***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
2. Waste burial management plan to be followed	Inspection by Council, and review of Company records.	Yes
3. Optional provision for review of waste burial management plan	Not sought by Company or Council. Revision undertaken by Company in May 2014	N/A
4. Designated staff member	Part of Company Environmental Manager's job description. Also Plant and Operations Managers'	Yes
5. Disposal pits not to intercept groundwater	Inspection by Council	Yes
6. Disposal pits to be constructed as undertaken in consent application	Inspection by Council	Yes
7. Notification of commencement of pit construction outside nominated area	Inspection by Council	N/A
8. All constructed disposal pits to be inspected by Council prior to use	Inspection by Council	Yes
9. Conditions 1-4 to apply to new disposal pits	Inspection by Council	Yes
10. Discharged material to be covered within 4 hours	Inspection by Council	Yes
11. Soil cover requirements upon completion of each disposal operation	Inspection by Council	Yes
12. Cover material and surrounding land to be contoured to direct stormwater away	Inspection by Council	Yes
13. Site rehabilitation and pasture re-establishment	Inspection by Council	N/A
14. No irrigation of effluent onto disposal area	Inspection by Council	Yes
15. No direct discharge of contaminants to surface water	Inspection and chemical/biological survey by Council	Yes
16. Installation of monitoring bores	Inspection and sampling by Council. New bore installed 11 May 2015, replacing two bores damaged	Yes
17. Optional review provision for operational requirements	Not sought by Company	N/A
18. 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		Good
Overall assessment of administrative performance in respect of this consent		Good

N/A = applicable

Table 26 Summary of performance for Consent **5560-1**

Purpose: ***To discharge waste cheese by burial***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification prior to commencement of operations to plan monitoring	No operation during review period	N/A
2. Removal of affected parties during operations	No operation during review period	N/A
3. Discharge in accordance with information submitted, and limit on tonnage	No operation during review period	N/A
4. Site access to Council for inspection and monitoring	Inspection by Council	N/A
5. Keeping photographic record of disposal operation	No operation during review period	N/A
6. Timeframe for operation	No operation during review period	N/A
7. Interim covering of wastes with soil if timeframe not met	No operation during review period	N/A
8. Immediate covering of wastes with treatment material	No operation during review period	N/A
9. Covering with clean soil upon completion	No operation during review period	N/A
10. No other wastes to be buried	Inspection by Council	N/A
11. Adopt best practicable option to minimise effects on the environment	Liaison and inspection	N/A
12. Covering of material during transportation	No operation during review period	N/A
13. Immediate covering of material discharged during transit	No operation during review period	N/A
14. Discharge only under certain wind conditions	No operation during review period	N/A
15. No emission of odours after 1 Feb 2000	Inspection by Council	N/A
16. Disposal pit liner to be as specified	No operation during review period	N/A
17. Pit not to intercept groundwater	Inspection by Council	N/A
18. Surface contour to direct away stormwater	Inspection by Council	N/A
19. Site rehabilitation and pasture re-establishment	Inspection by Council	N/A
20. No irrigation over disposal area	Inspection by Council	N/A
21. Cover material integrity to be maintained	Inspection by Council	N/A

Purpose: ***To discharge waste cheese by burial***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
22. No direct discharge to surface water	Inspection by Council	N/A
23. 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		Not exercised
Overall assessment of administrative performance in respect of this consent		Not exercised

N/A = applicable

Table 27 Summary of performance for Consent **6431-1**

Purpose: ***To place culverts in Inaha Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adoption of best practicable option to minimise adverse environmental effects	Liaison, and inspection by Council	Yes
2. Consent to be exercised in accordance with documentation submitted	Inspection by Council	N/A
3. Notification prior to commencement and upon completion of works	Liaison with Council. No work undertaken	N/A
4. Subsequent works prohibited between May and October, without permission	Inspection by Council. Permission for dead willow removal given 4 June 2015	Yes
5. Adoption of best practicable option to minimise discharges, bed disturbance and water quality effects	Liaison, inspection and bio-monitoring by Council	Yes
6. Minimisation of bed disturbance	Inspection by Council	Yes
7. Structure removal and area reinstatement upon redundancy		N/A
8. Fish passage not to be restricted	Inspection by Council	Yes
9. Erection of stock-proof riparian fences on consent holders property above Kohiti Road	Implementation of riparian plan RMP938 and inspection by Council	Fencing completed June 2009
10. Planting of riparian margins within 4 years from 4 October 2004	Implementation of riparian plan RMP938 and inspection by Council. Some replanting/blanking undertaken in winter 2011 and 2015	Planting completed June 2009
11. Placement of culvert inverts and headwall protection structures	Inspection by Council	Yes
12. Lapse of consent if not exercised	Consent was exercised	N/A

Purpose: ***To place culverts in Inaha Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
13. 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		Good
Overall assessment of administrative performance in respect of this consent		Good

N/A = applicable

Table 28 Summary of performance for Consent **7234-1**

Purpose: ***To disturb and realign Inaha Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent to be exercised in accordance with documentation submitted	Inspection by Council. Sedimentation controls required in April – June 2008	N/A
2. Notification prior to commencement of works	Notification given 17 March 2008	N/A
3. Placement and design of rock wall for bank protection	Inspection by Council	N/A
4. Works prohibited between May and October, without permission	Inspection by Council	N/A
5. Riverbed disturbance to be minimised	Inspection by Council	N/A
6. Sediment discharge and effects to be minimised	Inspection by Council	N/A
7. Fish salvage from old channel immediately upon diversion	Council carried out fish salvage on 18 April 2008	N/A
8. Fish passage not be obstructed	Inspection by Council	N/A
9. Vegetation removed not to be buried near stream	Inspection by Council	N/A
10. Lapse of consent if not exercised	Consent was exercised	N/A
11. Optional review provision for environmental effects	Next review date available June 2017	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Not exercised
Overall assessment of administrative performance in respect of this consent		Not exercised

N/A = applicable

Table 29 Summary of performance for Consent **7329-1**

Purpose: ***To discharge stormwater and sediment from re-contouring land and realigning Inaha Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent to be exercised in accordance with documentation	Inspection by Council. An erosion and sediment control management plan was provided with the application. (Sediment controls initially inadequate)	N/A
2. Limit on maximum soil area disturbed	Inspection by Council	N/A
3. Limit on maximum soil volume disturbed	Inspection by Council	N/A
4. Design criteria for run-off sediments traps to be followed	Inspection by Council.	N/A
5. Sediment discharge and effects to be minimised	Inspection by Council.	N/A
6. Provision of programme of works prior to exercise of consent	An erosion and sediment control management plan was provided with the application	N/A
7. Stabilization of earthwork areas upon completion of soil disturbance activities	Inspection by Council	N/A
8. Procedure to be followed upon discovery of archaeological site	Liaison with Council (Retrospective)	N/A
9. Lapse of consent if not exercised	Consent was exercised	N/A
10. Optional review provision for environmental effects	Next review date available June 2017	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Not exercised
Overall assessment of administrative performance in respect of this consent		Not exerrcised

N/A = applicable

Table 30 Summary of performance for Consent **9756-1**

Purpose: ***To take and use groundwater for industrial water supply***			
Condition requirement	**Means of monitoring during period under review**		**Compliance achieved?**
1. Limit on maximum take	Water measuring and recording required by consent conditions		Yes
2. Labelling of bore	Inspection by Council		Yes
3. Access to bore for manual measurement of water levels	Inspection by Council		Yes
4. Installation of metering and logging equipment	Inspection by Council and certification under condition 5	No. Water taken before metering infrastructure installed. **Infringement Notice** ($500 fine)	

Purpose: ***To take and use groundwater for industrial water supply***			
Condition requirement	**Means of monitoring during period under review**		**Compliance achieved?**
5. Certification of water measuring equipment	Provision of certificate. Supplied 29 May 2014.	No. Not provided within 30 days of installation	
6. Installation of water level measuring equipment	Inspection by Council	No. Water taken before metering infrastructure installed. **Infringement Notice** ($500 fine)	
7. Telemetry of monitoring data to	Inspection by Council and receipt of data. Water take from 27 March 2014; water level from 6 June 2014		No. Not installed when consent first exercised.
8. Access to monitoring equipment	Inspection by Council		Yes
9. Notification of equipment failure	Inspection by Council and checking of records		N/A
10. Adoption of best practicable option	Liaison and inspection		Yes
11. Lapse of consent if not exercised	Consent was exercised		N/A
12. Optional review provision for environmental effects	Next review date available 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			Improvement required

Table 31 Summary of performance for Consent **10054-1**

Purpose: ***To discharge emissions into the air from the burning of pallets, paper and cardboard***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adoption of best practicable option to minimise adverse environmental effects	Liaison, and inspection by Council	N/A
2. Restrict on materials combusted	Inspection by Council	N/A
3. Prohibition of objectionable odour	Inspection by Council	N/A
4. Supervision of burning	Inspection by Council.	N/A
5. Limit on dust deposition rate	Inspection by Council.	N/A
6. Control of airborne dust components and particulate concentration	Inspection by Council	N/A
7. Prohibition of toxic components beyond boundary	Inspection by Council	N/A
8. Lapse of consent if not exercised	Consent was exercised	N/A

Purpose: *To discharge emissions into the air from the burning of pallets, paper and cardboard*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
9. Optional review provision for environmental effects	Next review date available June 2017	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Not exercised
Overall assessment of administrative performance in respect of this consent		Not exercised

During the 2013-2014 and 2014-2015 years, TBP demonstrated a variable level of environmental performance overall. Of the nine consents for which compliance and environmental performance could be categorised, four were rated 'improvement required, three 'good' and two 'high'.

The number of incidents reduced from 14 in 2013-2014 to seven in 2014-2015, with land and water incidents going from four to zero, and substantiated odour complaints going from one to zero, which suggests that there was improvement in 2014-2015, as unsubstantiated (though possibly valid) odour complaints were the only incidents.

Water abstraction from the Inaha Stream and from groundwater was within the volume limits. There were gaps in the monitoring record for the surface take in 2013-2014. The flow measurement and telemetry system for the new groundwater take was installed late, incurring an abatement notice and an infringement notice.

Wastewater discharged to the Inaha Stream complied with consent conditions, except for dilution on two occasions, and non-notification of discharge on another. Infringement notices were issued for one low dilution event and for the non-notification.

Cooling water discharged to the Inaha Stream complied with consent conditions, except for a short period while the cooling system water was upgraded.

Stormwater discharged to the Inaha tributary/fire pond breached the suspended solids and/or grease limits on three occasions. No visible effect was noted in the Inaha Stream.

The results of monitoring by TBP indicated that wastewater spray irrigated onto land easily complied with the annual nitrogen loading limits, on average over the farm, though application was uneven, particularly in 2013-2014, when there was significant exceedance of the limit in several paddocks. No ponding, run-off or complaint about odour was recorded.

The burial of solid wastes was found through inspection to be compliant with consent conditions throughout the review period.

The results from chemical monitoring of the Inaha Stream complied with all consent conditions. Chemical monitoring of the tributary that runs through the western wastewater irrigation areas found increasing levels of nitrate. This is likely to be the strong groundwater /surfacewater interaction, whereby groundwater is contaminated

by the wastewater and nitrogen fertiliser applied. Subsequently groundwater provides a pathway for the contaminants to migrate down gradient to the stream.

Biological monitoring undertaken in the Inaha Stream and its western tributary indicated that any preceding abstraction from the stream or discharges to the stream and adjacent land had not had a significant adverse effect on the macroinvertebrate communities of the streams.

Emissions to air from the rendering plants' site were the cause of a number of complaints about odour, one of which was substantiated, in January 2014.

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 rendering operations of Taranaki By-Products Limited in the 2013-2014 year continue at the same level as in 2012-2013.

2. THAT monitoring of water abstraction and of wastewater, cooling water, stormwater and solids discharges from the rendering operations of Taranaki By-Products Limited in the 2013-2014 year continue at the same level as in 2012-2013 with the appropriate adjustments to reflect changes, in wastewater treatment and disposal, and in environmental effects.

3. THAT the option for a review of resource consent 3941-2 (discharge of wastewater to land) in June 2014, as set out in condition 25 on consent 3941-2 not be exercised, on the ground that current conditions are adequate to deal with any potential adverse effects.

These recommendations were implemented, with some adjustments agreed between Council and consent holder.

The monitoring programmes for water abstraction and discharges and for air emission were continued essentially unchanged during the 2013-2015 monitoring period.

3.5 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for air/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/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/discharging to the environment.

In the case of TBP, the programme for 2013-2015 was essentially unchanged from that for 2012-2013 in respect of air monitoring, but was changed in respect of water monitoring. In February 2015, additional samples were taken of the western Inaha

tributary to investigate the cause of rising nitrate levels and, in May 2015, monthly monitoring of the tributary was instituted to monitor nitrate levels.

It is proposed that for 2015-2016, the air quality monitoring programme, being monthly inspection, be maintained.

With regard to the water quality monitoring programme for 2015-2016, it is proposed that the existing programme be maintained as in 2014-2015, with an additional component to investigate the cause of increased nitrate levels in the western tributary of Inaha Stream that runs through the wastewater irrigation areas. This may involve additional investigation of the site to allow an assessment of groundwater and its interaction with surface water to be made. This may involve but is not limited to sampling of the stream and contributing springs for chemical analysis, including "aging" by tritium determination, and levelling in and pump testing of groundwater monitoring bores in order to establish groundwater flow characteristics. This will enable a site specific environmental management plan to be developed to assist in the reduction of the environmental effects observed.

The suitability of the current control bores to provide background data should also be reviewed.

Recommendations to this effect are attached to this report.

3.6 Exercise of optional review of consents

Resource consent **4058-4** (discharge to air) provides for an optional review of the consent in June 2015. Condition 12 allows the Council to review the consent, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects of the discharge on the environment.

Based on the results of monitoring in 2013-2014, and in previous years as set out in earlier annual compliance monitoring reports, it was considered that there were no grounds that required a review to be pursued or grounds to exercise the review option.

None of the thirteen consents associated with the rendering plants at Okaiawa provides for review in June 2016.

4. Recommendations

1. THAT monitoring of air emissions from the rendering operations of Taranaki By-Products Limited in the 2015-2016 year continue at the same level as in 2014-2015.

2. THAT monitoring of water abstraction and of wastewater, cooling water, stormwater and solids discharges from the rendering operations of Taranaki By-Products Limited in the 2015-2016 year continue at the same level as in 2014-2015 with the appropriate adjustments to reflect changes, in wastewater treatment and disposal, and in environmental effects.

3. THAT Taranaki By-Products Limited undertake a detailed investigation at the site to allow an updated site specific environmental management plan to be developed that controls the effects on surface water and groundwater from their wastewater disposal.

4. THAT the Council notes that the option for review of consent **4058-4** (discharge to air) in June 2015, as set out in condition 12 of the consent, was not exercised on the grounds that the current conditions were adequate to deal with any potential environmental effects.

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
CBOD	carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate
cfu	colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample
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
CS	concentrated sources, in relation to the origin of air streams for treatment of odour
DO	dissolved oxygen
DRP	dissolved reactive phosphorus
FA	factory air, in relation to the origin of air streams for treatment of odour
FC	faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
fresh	elevated flow in a stream, such as after heavy rainfall
g/m^3	grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
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
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
	ammonium, normally expressed in terms of the mass of nitrogen (N)
NH4	ammonium, 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 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 an 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
TBE	Taranaki Bio-Extracts Limited
TBP	Taranaki By-Products Limited
Temp	temperature, measured in ˚C (degrees Celsius)
Turb	turbidity, expressed in NTU
UIR	Unauthorised Incident Register entry – an event recorded by the Council on the basis that it had potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan
WHE	Waste heat evaporator – equipment that uses waste heat from dryer or feather hydrolyser exhausts to evaporate liquid streams

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

Bibliography and references

Golder Associates, 2015: Site visit report – Consent 4058-4 certification. Golder Project No. 1530864.

Golder Associates, 2013: Site visit report – Consent 4058-4 certification. Golder Project No. 1378104138.

Golder Associates, 2010: Evaluation of the air discharge control operations, Golder Document No. 1078104234.

Stark JD, 1999: An evaluation of TRC's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No 472.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research 32(1):55-66*

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No.87.

Stark, JD and Fowles, C R, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant using artificial substrate, January to March 2003. TRC report.

Taranaki Regional Council, 2013: Taranaki By-Products Ltd Monitoring Programmes Biennial Report 2012-2013. Technical report 2013-101.

Taranaki Regional Council, 2012: Taranaki By-Products Ltd Monitoring Programmes Biennial Report 2010-2012. Technical report 2012-94.

Taranaki Regional Council, 2010: Taranaki By-Products Ltd Monitoring Programmes Annual Report 2009-2010. Technical report 2010-38.

Taranaki Regional Council, 2009: Taranaki By-Products Ltd Monitoring Programmes Annual Report 2008-2009. Technical report 2009-108.

Taranaki Regional Council, 2008: Taranaki By-Products Ltd Monitoring Programmes Annual Report 2007-2008. Technical report 2008-77.

Taranaki Regional Council, 2007: Taranaki By-Products Ltd Monitoring Programme Triennial Report 2004-2007. Technical Report 2008-08.

Taranaki Regional Council, 2004: Taranaki By-Products Ltd Monitoring Programmes Annual Report 2003-2004. Technical report 2004-67.

Taranaki Regional Council, 2003: Taranaki By-Products Ltd Monitoring Programmes Annual Report 2002-2003. Technical report 2003-81.

Taranaki Regional Council, 2002: Taranaki By-Products Ltd Monitoring Programmes Annual Report 2001-2002. Technical report 2002-73.

Taranaki Regional Council, 2001: Taranaki By-Products Ltd Monitoring Programmes Annual Report 2000-2001. Technical report 2001-88.

Taranaki Regional Council, 2000: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1999-2000. Technical report 2000-25.

Taranaki Regional Council, 1999: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1998-99. Technical report 99-48.

Taranaki Regional Council, 1998: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1997-98. Technical report 98-87.

Taranaki Regional Council, 1997: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1996-97. Technical report 97-59.

Taranaki Regional Council, 1996: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1995-96. Technical report 96-70.

Taranaki Regional Council, 1995: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1994-95. Technical report 95-38.

Taranaki Regional Council, 1994: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1993-94. Technical report 94-72.

Taranaki Regional Council, 1993: Taranaki By-Products Ltd Resource Consents Monitoring Programmes Annual Report 1992-93. Technical report 93-59.

Appendix I

Resource consents held by Taranaki By-Products Limited

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

Discharge Permit

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

Name of Consent Holder:	Taranaki By-Products Limited P O Box 172 HAWERA
Change to Conditions/Review Completed Date:	4 October 2006 [Granted: 31 May 1999]

Conditions of Consent

Consent Granted:	To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream at or about GR: Q21:118-858
Expiry Date:	1 June 2019
Review Date(s):	June 2001, June 2003, June 2005, June 2007, June 2011, June 2017
Site Location:	Kohiti Road, Okaiawa
Legal Description:	Lots 1 & 2 DP 6457 Blk IV Waimate SD
Catchment:	Inaha

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

Special conditions 1 – 5 (unchanged]

1. The mixing zone in each condition of this consent shall extend for a distance of 30 metres downstream of the point of discharge of treated wastewater.

2. The boundaries of the mixing zone and site of discharge shall be as physically determined by the Chief Executive, Taranaki Regional Council.

3. The point of discharge into the Inaha Stream shall be such that the discharge enters directly into a channel of the Inaha Stream in order to ensure that complete mixing occurs.

4. The consent holder shall advise the Taranaki Regional Council prior to making any change in the processes undertaken at the site which could significantly alter the nature of the discharge.

5. The consent holder shall undertake such monitoring of the activities licensed by this consent, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991. This monitoring information is to be forwarded to the Chief Executive, Taranaki Regional Council, upon request.

Special condition 6 [amended]

6. A minimum dilution rate of 1:300 shall be maintained at the point of discharge to the Inaha Stream at all times.

Special condition 7 [replaced]

7. a) No stick-water shall be discharged under this consent. Stick-water is defined as juices squeezed out of products that are rendered.

   b) This consent allows the discharge of wastewater from up to 1,200 cows. Prior to this number being increased the consent holder must demonstrate, in writing, to the satisfaction of the Chief Executive Officer, Taranaki Regional Council, that the wastewater treatment system can treat the wastewater without breaching condition 9 of this consent.

Special conditions 8- 12 [unchanged]

8. The discharge shall cease when flows decrease in the Inaha Stream, as measured at the Kohiti Road gauging site, to below 100 litres/second.

9. The discharge [in conjunction with any other discharges pertaining to the same property], shall not cause or give rise to any of the following effects, at any point in the receiving waters below the mixing zone:

   (a) a fall of more than 0.5 pH units;
   (b) an increase in filtered carbonaceous biochemical oxygen demand [20 degrees Celsius, 5-day test] to above 2.00 gm^{-3};
   (c) a temperature rise of more than 3.0 degrees Celsius;
   (d) a reduction in the dissolved oxygen concentration to below 80% of saturation concentration;
   (e) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
   (f) any conspicuous change in the colour or visual clarity;
   (g) any emission of objectionable odour;
   (h) the rendering of fresh water unsuitable for consumption by farm animals;
   (i) any significant adverse effects on aquatic life, habitats or ecology;
   (j) any visible bacterial and/or fungal growths in the receiving water.

10. The discharge, in conjunction with any other discharges pertaining to the same property, shall not raise the total ammonia concentration [expressed as NH_3] in the receiving waters at any point below the mixing zone above 1.5 gm^{-3} if the pH of the receiving water is below 7.75, or above 0.7 gm^{-3} if the pH of the receiving water lies between 7.75 and 8.00, or above 0.4 gm^{-3} if the pH of the receiving water is above 8.00.

11. The consent holder shall install a metal control gate on the discharge outlet, and install and operate a v-notch weir and stage board on the outlet, to the satisfaction of the Chief Executive, Taranaki Regional Council; and shall keep records of the discharge rate during the exercise of this consent; such records to be made available to the Chief Executive, Taranaki Regional Council, upon request.

12. The consent holder shall install and maintain a stage board on the Kohiti Road Bridge and shall gauge the site for the purpose of providing a stream flow monitoring site, to the satisfaction of the Chief Executive, Taranaki Regional Council.

Special condition 13 [amended)

13. The consent holder shall maintain a wastewater disposal management plan [the management plan] for the wastewater treatment system, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, particularly the use of the spray irrigation system in combination with the pond discharge, which shall demonstrate the ability to comply with consent conditions and shall address the following matters:

    (a) monitoring of the discharge wastewater;
    (b) monitoring of the receiving water;
    (c) management of the wastewater treatment system;
    (d) minimisation of nutrients in the discharge wastewater;
    (e) treatment and disposal of stickwater;
    (f) mitigation of the effects of the discharge;
    (g) guidelines for use of spray irrigation or discharge to surface water; and
    (h) reporting on the exercise of the consent.

    An objective of the plan shall be to minimise discharges to surface water and to maximise discharges to land under consent 3941.

Special condition 14 [unchanged]

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

Special condition 15 [amended]

15. The consent holder shall advise the Taranaki Regional Council two months prior to any changes being made to the wastewater disposal management plan. Should the Taranaki Regional Council wish to review the wastewater disposal management plan, two months notice shall be provided to the consent holder. The consent holder shall review the plan annually and shall provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 31 May each year.

Special conditions 16-18 [unchanged]

16. The consent holder shall designate an officer with the necessary qualifications and/or experience to manage the wastewater treatment system.

17. The consent holder shall ensure that:

    (a) the operation of the wastewater treatment system shall be carried out at all times in accordance with the requirements of the wastewater disposal management plan prepared as required in condition (13) above 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 wastewater disposal management plan, the maximum period between training sessions being 12 months. 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 wastewater disposal management plan.

18. By the agreement of the consent holder, the consent holder shall mitigate the effects of the discharge by donating annually to the Taranaki Tree Trust $2100 [goods and services tax exclusive] for the purpose of providing riparian planting and management in the Inaha Stream catchment. The amount shall be adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation.

Special condition 19 [amended]

19. 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 2007, June 2011, and/or June 2017, 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 4 October 2006

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

TRK992050

DISCHARGE PERMIT

Pursuant to the RESOURCE MANAGEMENT ACT 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	TARANAKI BY-PRODUCTS LIMITED PO BOX 172 HAWERA
Renewal Granted Date:	31 May 1999

CONDITIONS OF CONSENT

Consent Granted:	TO DISCHARGE UP TO 2,160 CUBIC METRES/DAY OF COOLING WATER AND BACKWASH WATER FROM A RENDERING OPERATION INTO AN UNNAMED TRIBUTARY OF THE INAHA STREAM AT OR ABOUT GR: Q21:118-858
Expiry Date:	1 June 2019
Review Date[s]:	June 2001, June 2003, June 2005, June 2011 and June 2017
Site Location:	KOHITI ROAD OKAIAWA
Legal Description:	LOTS 1 & 2 DP6457 BLK IV WAIMATE SD
Catchment:	INAHA 351.000
Tributary:	UNNAMED TRIBUTARY

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

TRK992050

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), 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 undertake such monitoring of the activities licensed by this consent, as deemed reasonably necessary by the General Manager, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991. This monitoring information is to be forwarded to the General Manager, Taranaki Regional Council, upon request.

2. THAT the discharge shall not contain concentrations of any chemical, biological or physical contaminant [other than heat and suspended solids] greater than those found in the water abstracted from the Inaha Stream.

3. THAT the cooling water discharge to the Inaha Stream shall not exceed 35.0 degrees Celsius in temperature at the point of the discharge to the unnamed tributary of the Inaha Stream.

4. THAT the cooling water discharge to the Inaha Stream shall not contain a concentration of suspended solids in excess of 100 gm^{-3}

5. THAT after allowing for a mixing zone of 45 metres extending downstream of the confluence of the unnamed tributary with the Inaha Stream, the discharge [in conjunction with any other discharge pertaining to the same property], shall not give rise to any of the following effects in the receiving waters:

(a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material;
(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; and
(g) an increase in temperature of more than 3.0 degrees Celsius.

6. THAT the consent holder shall operate and maintain, to the satisfaction of the General Manager, Taranaki Regional Council, a discharge temperature measuring device and shall keep records of the discharge temperature during the exercise of this consent; such records to be made available to the General Manager, Taranaki Regional Council, upon request.

TRK992050

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 2001, June 2003, June 2005, June 2011 and/or June 2017, 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 31 May 1999

For and on behalf of
TARANAKI REGIONAL COUNCIL

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DIRECTOR—RESOURCE MANAGEMENT

TRK992051

WATER PERMIT

Pursuant to the RESOURCE MANAGEMENT ACT 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	TARANAKI BY-PRODUCTS LIMITED PO BOX 172 HAWERA
Renewal Granted Date:	31 May 1999

CONDITIONS OF CONSENT

Consent Granted:	TO TAKE UP TO 2,160 CUBIC METRES/DAY [50 LITRES/SECOND] OF WATER FROM THE INAHA STREAM FOR A RENDERING OPERATION AT OR ABOUT GR: Q21:118-858
Expiry Date:	1 June 2019
Review Date[s]:	June 2001, June 2003, June 2005, June 2011 and June 2017
Site Location:	KOHITI ROAD OKAIAWA
Legal Description:	LOTS 1 & 2 DP6457 BLK IV WAIMATE SD
Catchment:	INAHA 351.000

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

TRK992051

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), 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 means of taking water shall be maintained to the satisfaction of the General Manager, Taranaki Regional Council.

2. THAT a minimum flow of at least 25 litres/second shall be maintained in the stream at all times downstream of the point of abstraction.

3. THAT the consent holder shall install and operate to the satisfaction of the General Manager, Taranaki Regional Council, an abstraction rate measuring device and shall keep records of the dates and daily quantities of water abstracted during the exercise of this consent; such records to be made available to the General Manager, Taranaki Regional Council, upon request.

4. THAT the consent holder shall install and operate to the satisfaction of the General Manager, Taranaki Regional Council, a flow recorder at Kohiti Road, and shall keep records of the flows in the Inaha Stream; such records to be made available to the General Manager, Taranaki Regional Council, upon request.

5. THAT the consent holder shall investigate and report on the use of treated wastewater as cooling water; the report to be received by the General Manager, Taranaki Regional Council, not later than ten months from the date the consent is granted.

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 2001, June 2003, June 2005, June 2011 and/or June 2017, 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 31 May 1999

For and on behalf of
TARANAKI REGIONAL COUNCIL

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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:	Taranaki By-Products Limited P O Box 172 HAWERA 4640
Change To Conditions Date:	9 November 2009 [Granted: 15 December 1999]

Conditions of Consent

Consent Granted:	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries
Expiry Date:	1 June 2019
Review Date(s):	June 2011, June 2014, June 2017
Site Location:	Kohiti Road, Okaiawa
Legal Description:	Existing areas: Lot 1 DP 6457 Pt Sec 93 Blk IV Waimate SD [factory site], Lot 1 DP 378038, Pt Sec 93 Lots 2 & 3 DP 6457 Ngatimanuhiakai 17B2 17A2 17A3 Sec 88 Pt Sec 90 Lot 1 DP 10174 Lot 1 DP 11864 Pt Secs 90 & 94 DP SO219 Pt Sec 8 Sec 9 Pt Sec 154 Pt Sec 87 & Sec 89 Lot 2 DP 10412 Sec 92 Ngatimanuhiakai 3B Pt Sec 149 Ngatimanuhiakai 17B1 Lots 1 & 2 DP 4415 Sec 151 Blk IV Waimate SD New areas: Ngatimanuhiakai 3A Blk IV Waimate SD, Ngatimanuhiakai 2A & 2B Blk, Ngatimanuhiakai 4A Blk IV Waimate SD, Ngatimanuhiakai 10A2 Blk IV Waimate SD, Lot 1 DP 5153 Sec 86 Blk Waimate SD, Lot 1 DP 10412 Lot 2 DP 11864 Pt Sec 94 Blk IV Waimate SD, Ngatimanuhiakai 7C1 Blk IV Waimate SD [between the following points; NW (1700589E-5625245N), NE (1700909E-5625245N), SW (1700631E-5625092N), SE (1700921E-5625046N)
Catchment:	Inaha

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

Condition 1 – new

1. The discharge authorised by this consent shall only occur on the land shown in the map labelled Figure 1 attached.

Conditions 2 to 12 [previously conditions 1 to 11] – unchanged

Management plan

2. Prior to the exercise of the consent, the consent holder shall provide, and subsequently shall maintain, a spray irrigation management plan, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters:

a) designated application areas;
b) selection of appropriate irrigation methods for different types of terrain;
c) application rate and duration;
d) application frequency;
e) farm management and operator training;
f) soil and herbage management;
g) prevention of runoff and ponding;
h) minimisation and control of odour effects offsite;
i) operational control and maintenance of the spray irrigation system;
j) monitoring of the effluent [physicochemical];
k) monitoring of soils and herbage [physicochemical];
l) monitoring of groundwater beneath the irrigated area [physicochemical];
m) monitoring of drainage water downslope of the irrigated area [physicochemical];
n) monitoring of Inaha Stream and relevant tributaries;
o) remediation measures;
p) liaison with submitters to the consent, and interested parties;
q) reporting monitoring data;
r) procedures for responding to complaints; and
s) notification to the Council of non-compliance with the conditions of this consent.

An objective of the plan shall be to maximise discharges to land and to minimise discharges to surface water under consent 2049.

3. The consent shall be exercised in accordance with the procedures set out in the spray irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the 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 31 May each year.

5. The consent holder shall designate an officer with the necessary qualifications and/or experience to manage the spray irrigation system. The officer shall be regularly trained on the content and implementation of the spray irrigation management plan, and shall be advised immediately of any revision or additions to the spray irrigation management plan.

6. The consent holder shall at all times adopt the best practicable option or options, as defined in Section 2 of the Resource Management Act 1991, to prevent or minimise the adverse effects of the discharges on the environment. This shall include, but not be limited to the minimisation of total nitrogen concentration in the treated effluent.

7. In circumstances where spray irrigation of wastewater is not possible, and where a dilution rate of 1:200 in the Inaha Stream cannot be maintained, the consent holder shall seek the permission of the Chief Executive, Taranaki Regional Council, prior to discharging wastewater to the Inaha Stream.

Odour and spray effects

8. The level of dissolved oxygen within the wastewater pond from which irrigation water is drawn shall be maintained above 1.0 gm^{-3} at all times.

9. There shall be no offensive or objectionable odour as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.

10. There shall be no spray drift as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.

Land effects

11. The sodium adsorption ratio [SAR] of the wastewater shall not exceed 15.

12. There shall be no ponding of wastewater, and/or any direct discharge to a watercourse due to the exercise of this consent.

Condition 13 [previously condition 12 - changed]

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

    a) 25 metres from the banks of any watercourse;
    b) 50 metres from any bore, well or spring used for water supply purposes;
    c) 20 metres from any public road, except as detailed in f) and g) of this condition;
    d) 20 metres from any property boundary;
    e) 150 metres from any dwellinghouse or place of public assembly unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance;
    f) 200 metres from Normanby Road adjacent to the property described as Lots 3 & 4, Pt Lot 1 DP 2707, Lot 1 DP 3731, Blk IV, Waimate SD, unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance; and
    g) 50 metres from Ahipaipa Road adjacent to the properties described as Pt Lot 1 and Lot 2 DP 3322, Lot 2 DP12129, Blk IV, Waimate SD.

Conditions 14 to 26 [previously conditions 13 to 25] – unchanged

14. The effluent application rate shall not exceed 300 kg nitrogen/hectare/year except on land described as Pt Sec 154 Blk IV Waimate SD, where the effluent application rate shall not exceed 200 kg/nitrogen/hectare/year.

15. The consent holder shall investigate, and report in writing on, options for upgrading the wastewater treatment system to reduce the concentration of ammonia in the wastewater prior to discharge; the report to be received by the Chief Executive, Taranaki Regional Council, not later than twelve months from the date the consent is granted. Any necessary works associated with the report on reduction of ammonia concentrations shall be completed within twelve months after the receipt of the report.

16. The average application rate shall not exceed 5 mm/hour.

17. The return period between applications shall be at least seven days and the application depth shall not exceed 25 mm at each application.

Monitoring and liaison

18. The consent holder shall site, install and maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, a minimum of nine monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge. The bores are to be sited in the following locations: upslope of the Kohiti Road and Katotauru Road irrigation areas (2), at the southern boundary of the western Normanby Road irrigation area (2), within the Normanby Road, Kohiti Road and Katotauru Road irrigation areas (3), at the southern boundary of the Katotauru irrigation area, and at the southern boundary of the Ahipaipa Road irrigation area. The spring downslope of the Normanby Road irrigation area, and three bores in the vicinity of Inuawai Road shall also be monitored.

19. The consent holder shall undertake such baseline and operational monitoring of the activities licensed by this consent, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council.

20. The consent holder and staff of the Regional Council shall meet as appropriate, quarterly or at such other frequency as the parties may agree, with representatives of Ngati Manuhiakai Hapu and other interested submitters to the consent, and any other interested party at the discretion of the Chief Executive, Taranaki Regional Council, to discuss any matter relating to the exercise of the resource consent, in order to facilitate ongoing consultation.

21. The consent holder shall, where practicable, advise the Chief Executive, Taranaki Regional Council, and representatives of Ngati Manuhiakai Hapu, prior to discharge to Inaha Stream under consent 2049.

Mitigation

22. Should monitoring of the discharge under conditions 14 and 18 indicate contamination of local groundwater 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 spray irrigation management plan prepared under condition 2, or such action reasonably required by the Chief Executive, Taranaki Regional Council;
    b) shall review the spray 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.

Review

23. 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.

24. The Taranaki Regional Council may review conditions 7 and 14 of this consent within two weeks after the completion of works to be investigated under condition 15 of this consent, for the purpose of evaluating the appropriateness of the required dilution rate and application rate, and the effects of the discharge on the Inaha Stream and soil.

25. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, and/or June 2007, for the purpose of assessing the need to increase the land area for wastewater disposal, reduce nitrogen loading to land and/or increase treatment at the wastewater treatment system to reduce the nitrogen concentration of the effluent.

26. The Taranaki Regional Council may, pursuant to section 128 of the Resource Management Act 1991, review any or all of the conditions of this consent by giving notice of review during June 2001, June 2003, June 2005, June 2007, June 2009, June 2011, June 2014 and/or June 2017, 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 that time.

Signed at Stratford on 9 November 2009

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

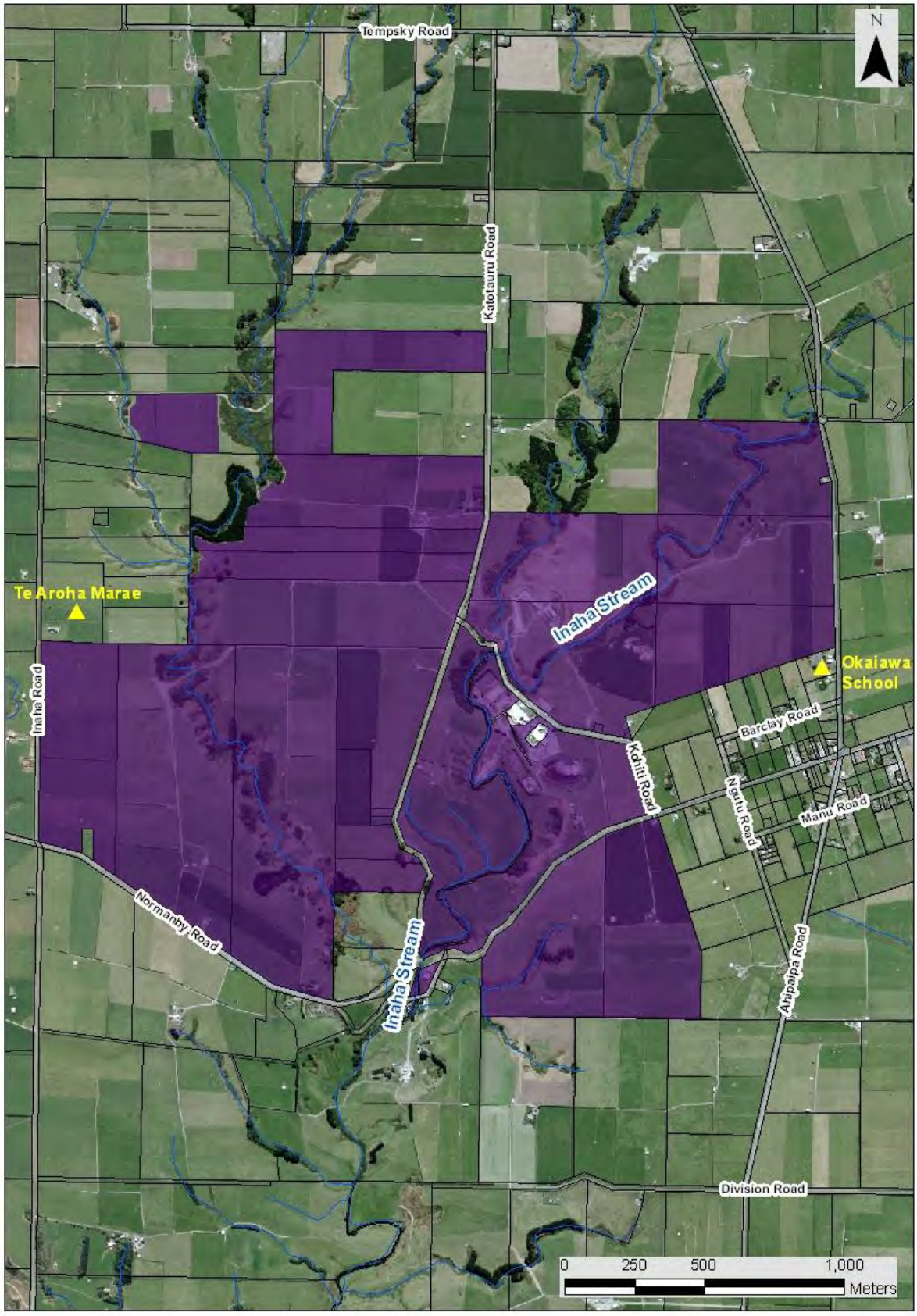

Figure 1 Location of the authorised area to receive wastewater, via spray irrigation, onto and into land

Discharge Permit

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

Name of Consent Holder:	Taranaki By-Products Limited P O Box 172 HAWERA 4640
Decision Date:	11 October 2011
Commencement Date:	11 October 2011

Conditions of Consent

Consent Granted:	To discharge emissions into the air from rendering operations and associated processes including wastewater treatment at or about (NZTM) 1701965E-5624119N and burial of material at or about (NZTM) 1702416E-5624339N
Expiry Date:	1 June 2024
Review Date(s):	June 2013, June 2015, June 2017, June 2019, June 2021, June 2023
Site Location:	Kohiti Road, Okaiawa
Legal Description:	Lot 3 DP 378038 Lot 2 DP 410593 Lots 2-3 DP 6457, Lot 1 DP 6457 Blk IV Waimate SD, Lot 1 DP 410593 [TBE], Lot 1 DP 10174 Lot 1 DP 11864 Sec 88 Pt Sec 90 Blk IV Waimate SD

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 to section 36 of the Resource Management Act.

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 actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.

2. The discharge authorised by this consent shall not give rise to an odour at or beyond the boundary of the site that is offensive or objectionable.

   Note: With respect to this condition, the consent holder's site is defined as the areas shown in the map attached.

3. For the purposes of condition 2, an odour shall be deemed to be offensive or objectionable if:

   a. it is held to be so in the opinion of an enforcement officer of the Taranaki Regional Council, having regard to the duration, frequency, intensity and nature of the odour; and/or
   b. an officer of the Taranaki Regional Council observes that an odour is noticeable, and either it lasts longer than two (2) hours continuously, or it occurs frequently during a single period of more than four (4) hours; and/or
   c. no less than two individuals from at least two different properties, each declare in writing that an objectionable or offensive odour was detected beyond the boundary of the site, provided the Council is satisfied that the declarations are not vexatious and that the objectionable or offensive odour was emitted from the site at the frequency and duration specified in (b). Each declaration shall be signed and dated and include:

      1. the individuals' names and addresses;
      2. the date and time the objectionable or offensive odour was detected;
      3. details of the duration, frequency, intensity and nature of the odour that cause it to be considered offensive or objectionable;
      4. the location of the individual when it was detected; and
      5. the prevailing weather conditions during the event.

4. The consent holder shall continue to employ a suitably qualified and experienced person in the role of Environmental Manager, whose responsibilities shall include ensuring compliance with the conditions of this consent.

5. No fish or fish parts shall be received or processed on the premises.

6. By 30 April 2013, and every two years thereafter, the consent holder shall provide certification by a suitably qualified independent person that the works , processes and equipment relevant to all discharges to air from the site are operational in accordance with good engineering practice.

7. Before 2 February 2012, the consent holder shall prepare an Air Discharge Management Plan for the site that, to the satisfaction of the Chief Executive of the Taranaki Regional Council, details how discharges to air from the site will be managed to ensure compliance with conditions of this consent. The plan shall include but not necessarily be limited to;

    a. A description of the air quality objectives sought by the plan;

    b. The identification of key personnel responsible for managing air discharges and implementing the Management Plan;

    c. A description of the activities on the site and the main potential sources of odour emissions;

    d. A description of storage and treatment procedures (including specification of storage times and preservative dosing concentrations) for ensuring that only high quality raw material is processed;

    e. The identification and description of the odour and dust mitigation measures in place;

    f. The identification and description of relevant operating procedures and parameters that need to be controlled to minimise emissions;

    g. A description of contingency procedures for addressing situations, such as equipment failure or spillage of raw material or chemicals, which could result in a discharge to air of odorous emissions that are offensive or objectionable beyond the boundary of the plant;

    h. A description of monitoring and maintenance procedures for managing the odour mitigation measures including record keeping of control parameters and maintenance checks; and

    i. Details of staff training proposed to enable staff to appropriately manage the odour mitigation measures.

8. Operations on site shall be undertaken in accordance with the Air Discharge Management Plan, required by condition 7 above.

9. The Air Discharge Management Plan described in special condition 7 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 management plan annually and provide the reviewed plan to the Taranaki Regional Council, by 31 May each year.

10. The discharges authorised by this consent shall not give rise to suspended or deposited dust at or beyond the boundary of the site that, in the opinion of at least one enforcement officer of the Taranaki Regional Council, is offensive or objectionable. For the purpose of this condition, discharges in excess of the following limits are deemed to be offensive or objectionable:

    a. dust deposition rate 0.13 g/m^2/day; and/or

    b. suspended dust level 3 mg/m^3.

11. The consent holder shall consult and inform the local community about activities on the site, specifically those relating to the exercise of this consent, by:

    a. Four times per year, providing a newsletter to all landowners and/or occupiers of properties within 3 kilometres of the site; and

    b. Convening a meeting with the Director - Resource Management, Taranaki Regional Council (or their delegate), and the local community annually or at such other frequency as the parties may agree.

12. 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 2013 and/or every two years thereafter. The purpose of any review would be to ensure 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. When determining if any review is required the Council will take into account any expressed views of the Okaiawa community.

Signed at Stratford on 11 October 2011

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

TRK995426

DISCHARGE PERMIT

Pursuant to the RESOURCE MANAGEMENT ACT 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	TARANAKI BY-PRODUCTS LIMITED PO BOX 172 HAWERA
Consent Granted Date:	31 May 1999

CONDITIONS OF CONSENT

Consent Granted:	TO DISCHARGE UP TO 1,095 LITRES/SECOND OF STORMWATER FROM AN ANIMAL RENDERING SITE INTO AN UNNAMED TRIBUTARY OF THE INAHA STREAM AT OR ABOUT GR: Q21:119-858, Q21:120-858 AND Q21:121-858
Expiry Date:	1 June 2019
Review Date[s]:	June 2001, June 2003, June 2005, June 2011 and June 2017
Site Location:	KOHITI ROAD OKAIAWA
Legal Description:	LOTS 1 & 2 DP6457 BLK IV WAIMATE SD
Catchment:	INAHA 351.000
Tributary:	UNNAMED TRIBUTARY

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

TRK995426

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), 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 advise the Taranaki Regional Council prior to making any change in the processes undertaken at the site which could significantly alter the nature of the discharge.

2. THAT the discharge shall not exceed the following parameters:

Component	Concentration
pH range	6-9
oil and grease	15 gm^{-3}
suspended solids	100 gm^{-3}

This condition shall apply prior to the entry of the discharge into the receiving water at designated sampling point[s] approved by the General Manager, Taranaki Regional Council.

3. THAT after allowing for reasonable mixing, within a mixing zone extending 45 metres from the confluence of the unnamed tributary with the Inaha Stream, the discharge [in conjunction with any other discharges pertaining to the same property], shall not give rise to any of the following effects in the receiving waters:

(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 freshwater unsuitable for consumption by farm animals;

(e) any significant adverse effects on aquatic life, habitats or ecology; and

(f) any visible bacterial and/or fungal growths.

4. THAT within three months of the granting of this consent, the consent holder shall prepare 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.

5. 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 2001, June 2003, June 2005, June 2011 and/or June 2017, 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 31 May 1999

For and on behalf of
TARANAKI REGIONAL COUNCIL

_____
DIRECTOR—RESOURCE MANAGEMENT

Consent 5495-1

TARANAKI
REGIONAL
COUNCIL

PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

Discharge Permit

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

Name of Consent Holder:	Taranaki By-Products Limited P O Box 172 HAWERA
Change To Conditions Date:	4 August 2000 [Granted: 30 March 2000]

Conditions of Consent

Consent Granted:	To discharge up to 200 tonnes/day of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream at or about GR: Q21:121-859
Expiry Date:	1 June 2019
Review Date(s):	June 2001, June 2003, June 2005, June 2011, June 2017
Site Location:	Kohiti Road, Okaiawa
Legal Description:	Lot 1 DP 10174 Lot 1 DP 11864 Sec 88 Pt Sec 90 SO 268 Blk IV Waimate SD
Catchment:	Inaha

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 General Manager, Taranaki Regional Council (hereinafter the General Manager), 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

special condition 1 [amended]

1. THAT by 1 November 2000, the consent holder shall provide a waste burial management plan, to the approval of the General Manager, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters:

a) nature of wastes discharged;
b) discharge control;
c) waste cover;
d) addition of hydrated lime to stabilise the wastes;
e) minimisation and control of odour effects offsite;
f) stormwater control;
g) leachate management;
h) monitoring of groundwater beneath the burial area [physicochemical];
i) site re-instatement and after care (including maintaining the integrity of the cover material);
j) site contouring;
k) reporting monitoring data;
l) procedures for responding to complaints; and
m) notification to the Council of non-compliance with the conditions of this consent.

special conditions 2-5 [unchanged]

2. THAT the consent shall be exercised in accordance with the procedures set out in the waste burial management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the General Manager, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.

3. THAT the waste burial management plan described in special condition 1 of this consent shall be subject to review upon two months notice by either holder the Taranaki Regional Council.

4. THAT the consent holder shall designate an officer with the necessary qualifications and/or experience to manage the waste burial site. The officer shall be regularly trained on the content and implementation of the burial management plan, and shall be advised immediately of any revision or additions to the burial management plan.

5. THAT the disposal pit[s] shall not intercept shallow groundwater.

special conditions 6 – 7 [amended]

6. THAT the disposal pits shall be constructed when required in general accordance with the information supplied by the applicant in support of application 1084.

7. THAT the consent holder shall notify the Council of the commencement to construct additional disposal pits outside of the disposal area indicated in the map supporting the application.

special condition 8 [unchanged]

8. THAT an officer of the Council is to inspect all constructed disposal pits prior to disposal operations.

special condition 9 [amended]

9. THAT special conditions 1 to 4 shall apply after 1 November 2000 when the disposal pit required by special condition 6 is constructed and also for all subsequent disposal pits.

special conditions 10 – 15 [unchanged]

10. THAT the discharged material shall be covered within a period of four hours or less so as to avoid the generation of offensive offsite odours.

11. THAT at the completion of the disposal operation a low permeability, clean, compacted soil cover with a minimum thickness of 1.0m be placed over the discharged wastes.

12. THAT the cover material and surrounding land shall be contoured such that all stormwater is directed away from the disposal area to the satisfaction of the General Manager, Taranaki Regional Council.

13. THAT the disposal site shall be rehabilitated and pasture re-established to the satisfaction of the General Manager, Taranaki Regional Council.

14. THAT there shall not be any irrigation of effluent under resource consent 3941 or resource consent 2466 onto the disposal area.

15. THAT the exercise of this consent shall not lead, or be liable to lead, to a direct discharge of contaminants to a surface water body.

special condition 16 [amended]

16. THAT the consent holder shall install and maintain, to the satisfaction of the General Manager, Taranaki Regional Council, a minimum of eight monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge.

special condition 17-18 [unchanged]

17. THAT 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 resources of monitoring.

18. 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 2001, June 2003, June 2005, 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 consent, which was 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 4 August 2000

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:	Taranaki By-Products P O Box 172 HAWERA
Consent Granted Date:	15 October 1999

Conditions of Consent

Consent Granted:	To discharge waste cheese and associated packaging by burial into land and to discharge emissions into air from the removal and disposal operation at or about GR: Q21:116-854	
Expiry Date:	1 February 2000 1 June 2017	[for air discharge] [for land discharge]
Review Date(s):	June 2005, June 2011	[for land discharge]
Site Location:	Katotauru Road, Okaiawa	
Legal Description:	Ngatimanuhiakai 17B2 Block Blk IV Waimate SD	

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), 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

Air discharge and land discharge

1. THAT the consent holder shall notify the Taranaki Regional Council at least 24 hours prior to commencement of the removal and disposal operations to plan monitoring.

2. THAT the consent holder, at the consent holder's reasonable expense, shall undertake to remove all affected parties from the discharge area for the duration of the removal and disposal operations or to otherwise mitigate the effects, to the satisfaction of the General Manager, Taranaki Regional Council.

3. THAT the consent holder shall ensure that the discharge licensed by this consent takes place in general accordance with the information submitted in support of application 774 and does not exceed 100 tonnes.

4. THAT the consent holder shall allow the Taranaki Regional Council, its employees or agent access to the discharge site at all reasonable times for the purpose of inspecting the site and/or taking samples of water or other material for analytical purposes.

5. THAT the consent holder shall keep a photographic record of the disposal operation and shall forward a copy of the photographic record to the Taranaki Regional Council upon request.

6. THAT the disposal operation shall be completed as far as practicable within one 15 hour period.

7. THAT if Condition 6 is not achieved the discharged wastes shall be covered with at least 0.5 m of clean soil as an interim measure.

8. THAT the discharged material shall be immediately covered upon placement in the disposal pit with hydrated lime and agricultural lime (dolomite) as an interim cover.

9. THAT at the completion of the disposal operation a low permeability compacted clean soil cover with a minimum thickness of 1.0 m shall be placed over the discharged wastes.

10. THAT the site shall not be used for simultaneous disposal, or re-opened for subsequent disposal, of any other wastes.

11. THAT 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 odour and to remedy or mitigate any actual or potential effects on the environment arising from the discharge.

Air discharge only

12. THAT during transportation all waste material shall be covered.

13. THAT any material discharged during transit shall be recovered immediately.

14. THAT the discharge shall only be undertaken when the prevailing wind is from the southerly quarter (ie. south-east to south-west).

15. THAT there shall be no emission of odours from the removal and disposal operation after 1 February 2000.

Land discharge only

16. THAT the disposal pit shall be constructed with a low permeability compacted soil liner with a minimum thickness of 0.6 m.

17. THAT the disposal pit shall not intercept groundwater (the water table).

18. THAT the cover material and surrounding land shall be contoured such that all stormwater is directed away from the disposal area.

19. THAT the disposal site shall be rehabilitated and pasture re-established.

20. THAT there shall not be any irrigation of effluent from the Taranaki By-Products wastewater disposal system over the disposal area.

21. THAT the integrity of the cover material shall be maintained after the completion of the discharge.

22. THAT the exercise of this consent shall not lead, or be liable to lead, to a direct discharge of contaminants to a surface waterbody.

23. 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 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 October 1999

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Consent 6431-1

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:	Taranaki By-Products Limited P O Box 172 HAWERA
Consent Granted Date:	4 October 2004

Conditions of Consent

Consent Granted:	To erect, place and maintain two culverts in the Inaha Stream for farm access purposes at or about GR: Q21:121-860 and Q21:125-863
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	Kohiti Road, Hawera
Legal Description:	Secs 89 & 90 Blk IV Waimate SD
Catchment:	Inaha

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 resource consent.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 3271. In the case of any contradiction between the documentation submitted in support of application 3271 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 river bed or discharges to water.

4. Once initial work is complete, any further instream works shall take place only between 1 November and 30 April inclusive, except where this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.

5. 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.

6. The consent holder shall ensure the area and volume of riverbed disturbance shall, so far as practicable, be minimised and any areas which are disturbed shall, so far as practicable, be reinstated.

7. The structures authorised by this consent shall be removed and the area reinstated, if and when the structures are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to removal and reinstatement.

8. The structures which are the subject of this consent shall not restrict the passage of fish.

9. The consent holder shall prevent stock at all times from accessing all water bodies, including wetlands, on or bordering the consent holder's property, upstream of Kohete Road bridge, by constructing and maintaining fences or other controls, located to provide for the establishment of riparian margins; such means of prevention to be established within four years of the granting of this consent.

10. The consent holder shall undertake planting and subsequent maintenance of the riparian margins of the water bodies within the fenced or controlled area(s) as required by special condition 9, to the satisfaction of the Chief Executive, Taranaki Regional Council, within four years of the granting of this consent, for the purpose of enhancing water quality and aquatic habitat.

11. The invert of the culverts shall be not less than 50 mm below the bed of the stream. Appropriate headwall structures shall be constructed to protect the intake and outlet of the culverts from erosion.

12. 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.

13. 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 4 October 2004

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Land Use Consent

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

Name of Consent Holder:	Taranaki By-Products Limited P O Box 172 HAWERA
Consent Granted Date:	12 March 2008

Conditions of Consent

Consent Granted:	To realign a section of approximately 350 metres of the Inaha Stream for land improvement purposes at or about 2612637E-6186381N
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	533 Ahipaipa Road, Okaiawa
Legal Description:	Sec 89 Blk IV Waimate SD Lot 2 DP 10412 Pt Sec 87 Blk IV Waimate SD
Catchment:	Inaha

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

General conditions

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

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

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

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

Special conditions

1. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4881. In the case of any contradiction between the documentation submitted in support of application 4881 and the conditions of this consent, the conditions of this consent shall prevail.

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least seven days prior to the exercise of this consent. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable only if the consent holder does not have access to email.

3. A rock wall consisting of interlocking boulders of an average diameter of at least 1 metre shall be constructed on the outside of the bend at the downstream end of the realignment to protect that bank from erosion. The rock wall and bank over this reach shall be no steeper than 2 horizontal to 1 vertical.

4. Any instream works shall take place only between 1 November and 30 April inclusive, except where this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.

6. 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.

7. Immediately before water is diverted away from the existing stream channel the consent holder shall ensure that fish are removed from the channel to be dewatered and released to a reach with suitable habitat. Fish to be removed shall be captured using electric fishing, or other accepted fish capture techniques that achieve similar results.

8. The stream realignment shall not obstruct fish passage.

9. Any vegetation removed during the realignment shall not be buried within 25 metres of the Inaha Stream.

10. 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.

11. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review 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 12 March 2008

For and on behalf of
Taranaki Regional Council

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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:	Taranaki By-Products Limited P O Box 172 HAWERA
Consent Granted Date:	30 June 2008

Conditions of Consent

Consent Granted:	To discharge stormwater and sediment from earthworks associated with the re-contouring of land and the re-aligning of a section of the Inaha Stream onto and into land and into the Inaha Stream at or about (NZTM) 1702455E-5624812N
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	533 Ahipaipa Road, Okaiawa
Legal Description:	Sec 89 & Lot 2 DP 10412 Pt Sec 87 Blk IV Waimate SD
Catchment:	Inaha

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

General conditions

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

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

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

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

Special conditions

1. The exercise of this consent shall be undertaken in accordance with the documentation submitted in support of application 6022. If there is any conflict between the documentation submitted in support of application 6022 and the conditions of this consent, the conditions of this consent shall prevail.

2. The discharge shall not derive from an area of soil disturbance greater than 8 hectares.

3. The discharge shall not derive from a volume of soil disturbance greater than 24, 000 cubic metres.

4. While any area of soil is exposed, all run off from that area shall pass through settlement ponds or sediment traps with a minimum total capacity of 200 cubic metres for every hectare of exposed, unless other sediment control measures that achieve an equivalent standard are agreed to by the Chief Executive of the Taranaki Regional Council.

5. 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.

   Subject to condition 2, undertaking work in accordance with *Guidelines for Earthworks in the Taranaki region,* by the Taranaki Regional Council, will achieve compliance with this condition.

6. At least 7 working days prior to the commencement of works the consent holder shall provide the Taranaki Regional Council with a programme for the proposed works, including: a schedule of proposed start dates and an estimation of the duration of the works, and details of the contractor including contact information for the project manager. The programme shall be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable if the consent holder does not have access to email.

7. All earthwork areas shall be stabilised vegetatively or otherwise as soon as is practicable immediately following completion of soil disturbance activities.

8. In the event of any archaeological site or koiwi being encountered during the exercise of this consent, activities in the vicinity of the discovery shall cease. The consent holder shall contact the Chief Executive, Taranaki Regional Council, to obtain details of the relevant iwi authority. The consent holder shall then consult with the relevant local iwi, the New Zealand Historic Places Trust and the New Zealand Police and shall not recommence works in the area of the discovery until the relevant Historic Places Trust approvals or other approvals to damage, destroy or modify such sites have been obtained, where necessary.

9. This consent shall lapse 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.

10. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 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 30 June 2008

For and on behalf of
Taranaki Regional Council

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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:	Taranaki By-Products Limited P O Box 172 HAWERA 4640
Decision Date:	3 February 2014
Commencement Date:	3 February 2014

Conditions of Consent

Consent Granted:	To take and use groundwater for industrial water supply purposes
Expiry Date:	1 June 2029
Review Date(s):	June 2017, June 2023
Site Location:	179 Katotauru Road, Okaiawa
Legal Description:	Ngatimanuhiakai 2B (Site of take & use)
Grid Reference (NZTM)	1701636E-5624804N
Catchment:	Inaha

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 to section 36 of the Resource Management Act 1991.

Special conditions

1. The total volume of water taken from the 'Bore 3' (GND2380) at a rate not exceeding 22.8 litres per second (1,970 cubic metres per day)

2. The bore shall be easily identifiable by a permanent label, which may be welded or engraved on the casing, or on the equivalent fixed part of the well construction or associated building. The bore shall be labelled with the bore number assigned by Taranaki Regional Council - GND2380.

3. The consent holder shall ensure that there is access into the well that enables the manual measurement of static and pumping water levels.

4. Before exercising this consent the consent holder shall install, and thereafter maintain a water meter and a datalogger at the site of taking (or a nearby site in accordance with Regulation 10 of the *Resource Management (Measurement and Reporting of Water Takes) Regulations 2010*. The water meter and datalogger shall be tamper-proof and shall measure and record the rate and volume of water taken to an accuracy of ± 5%. Records of the date, the time (in New Zealand Standard Time) and the rate and volume of water taken at intervals not exceeding 15 minutes, shall be made available to the Chief Executive, Taranaki Regional Council at all reasonable times.

   Note: Water meters and dataloggers must be installed, and regularly maintained, in accordance with manufacturer's specifications in order to ensure that they meet the required accuracy. Even with proper maintenance water meters and dataloggers have a limited lifespan.

5. The consent holder shall provide the Chief Executive, Taranaki Regional Council with a document from a suitably qualified person certifying that water measuring and recording equipment required by the conditions of this consent ('the equipment'):

   (a) has been installed and/or maintained in accordance with the manufacturer's specifications; and/or

   (b) has been tested and shown to be operating to an accuracy of ± 5%.

   The documentation shall be provided:

   (i) within 30 days of the installation of a water meter or datalogger;

   (ii) at other times when reasonable notice is given and the Chief Executive, Taranaki Regional Council has reasonable evidence that the equipment may not be functioning as required by this consent; and

   (iii) no less frequently than once every five years.

6. Before exercising this consent, the consent holder shall install and subsequently maintain equipment to measure and record the water level within Bore 3 to an accuracy of ± 0.05 metres at intervals not exceeding 15 minutes.

7. The measurements made in accordance with condition 4 and 6 of this consent, shall be transmitted to the Taranaki Regional Council's computer system, in a format to be advised by the Chief Executive, Taranaki Regional Council, to maintain a 'real time' record of the water taken and bore water levels.The records of water taken and the water level within each bore shall:

   (a) be in a format that, in the opinion of the Chief Executive, Taranaki Regional Council, is suitable for auditing; and

   (b) specifically record the water taken as 'zero' when no water is taken.

8. The water meter, level monitoring device and datalogger shall be accessible to Taranaki Regional Council officer's at all reasonable times for inspection and/or data retrieval. The data logger shall be designed and installed so that Council officers can readily verify that it is accurately recording the required information.

9. If any measuring or recording equipment breaks down, or for any reason is not operational, the consent holder shall advise the Chief Executive, Taranaki Regional Council immediately. Any repairs or maintenance to this equipment must be undertaken by a suitably qualified person.

10. At all times the consent holder shall adopt the best practicable option (BPO) to prevent or minimise any actual or likely adverse effect on the environment associated with the abstraction of groundwater, including, but not limited to, the efficient and conservative use of water.

11. This consent shall lapse on 31 March 2019, 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.

12. 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.

Signed at Stratford on 3 February 2014

For and on behalf of
Taranaki Regional Council

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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:	Taranaki By-Products Limited PO Box 172 Hawera 4640
Decision Date:	21 January 2015
Commencement Date:	21 January 2015

Conditions of Consent

Consent Granted:	To discharge emissions into the air from the burning of pallets, paper and cardboard
Expiry Date:	01 June 2029
Review Date(s):	June 2017, June 2023
Site Location:	Kohiti Road, Okaiawa
Legal Description:	Lot 3 DP 378038 Lot 2 DP 410593 Lots 2-3 DP 6457 (Discharge source & site)
Grid Reference (NZTM)	1701917E-5623971N

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 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 and shall include as a minimum:
    - having regard to the prevailing and predicted wind speed and direction at the time of burning in order to minimise offsite effects;
    - allowing the waste material to dry before burning;
    - starting a small fire with the driest material and adding further material once it is blazing, as opposed to igniting a large stack and leaving it unattended.

2. The materials for combustion are restricted to untreated wood or sawdust, paper and cardboard.

3. There shall be no objectionable or offensive odour to the extent that it causes an adverse effect at or beyond the boundary of the site.

    Note: For the purposes of this condition:

    - The site is defined as Lot 3 DP 378038 Lot 2 DP 410593 Lots 2-3 DP 6457; and
    - Assessment under this condition shall be in accordance with the *Good Practice Guide for Assessing and Managing Odour in New Zealand, Air Quality Report 36, Ministry for the Environment, 2003.*

4. The consent holder, or an authorised agent, shall supervise burning at all times.

5. The dust deposition rate beyond the property boundary arising from the discharge shall be less than 0.13 $g/m^2/day$ or 4.0 $g/m^2/30$ days.

6. Any discharge to air from the site shall not give rise to any offensive, objectionable, noxious or toxic levels of dust at or beyond the boundary of the property, and in any case, suspended particulate matter shall not exceed 3 mg/m^3 (measured under ambient conditions) beyond the boundary of the site.

7. The discharges authorised by this consent shall not give rise to a level of a contaminant or contaminants at or beyond the boundary of the site that is noxious or toxic.

8. This consent shall lapse on 31 March 2020, 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 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.

Signed at Stratford on 21 January 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Appendix II

Inaha Stream chemistry monitoring data

Taranaki By-Products water quality monitoring survey **Date:** 3 October 2013 **Flows:** Kapuni: 2,440 L / s
Waiokura 654 L / s
Inaha: 2,088 L / s SG: 3.87 m Rating date: 7 / 03 / 13
TBP: x.x L / s

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	137189	0820	11.7	10.3		17.9	7.6	*7.4*			1.8		0.007	0.009	2.6	0.042	22.4	390
Above Kohiti Rd	INH000348	137190	0833	11.7	10.6		18.0	7.6	*8.7*			1.8		0.009	0.008	2.6	0.040	24.0	720
Kohiti Road	INH000400	137192	0852	11.6	10.6		19.3	7.6	*10*			1.7	<0.5	0.011	0.007	2.5	0.037	25.3	420
Mixing zone	INH000408	137197	0945	12.1	10.5		20.0	7.6	*12*			1.8	<0.5	0.22	0.051	2.8	0.068	25.9	300
500m d/s	INH000420	137198	1000	12.2	10.6		20.0	7.6	*9.7*			2.7	0.5	0.198	0.055	2.9	0.068	26.2	450
Normanby Rd	INH000430	137202	1101	12.5	10.3		20.1	7.6	*11*			2.6	<0.5	0.113	0.054	2.8	0.070	23.8	280
SH45	INH000470	137203	1125	13.3	10.5		22.1	7.7	*10*			2.2		0.027	0.033	3.1	0.065	29.6	240
Trib. Kohiti	INH000397	137191	0843	11.3	10.3		25.6	7.5	*10*			0.9		0.020	0.004	2.3	0.029	33.8	470
Trib. Normanby u/s	INH000433	137199	1030	13.8	10.0		29.1	7.2	*5.4*			1.6		0.016	0.005	2.1	0.006	39.7	150
Trib. Normanby mid	INH000435	137200	1045	13.4	10.8		28.9	7.3	*0.90*			0.6		0.020	0.006	2.2	0.007	39.1	140
Trib. Normanby d/s	INH000440	137201	1052	12.9	10.4		32.0	*7.6*	***10***			0.5		0.012	0.001	**4.1**	0.009	**51.4**	310
Discharge	IND004004	137193	0859	18.4	3.2		281	7.3	*120*	200	-	77	-	160	56	112	41.8	280	260
Pond 4	IND004005	137206	1014	29.8			309	**6.0**						183	140	80		258	
Pond 3	IND004006	137205	1010	30.1			502	7.4						570					
Pond 2	IND004007	137204	1020	32.6			497	6.8						590					
C/w tributary	IND001015	137196	0935	22.2	6.4		23.2	7.2	*2.9*	3	3.2	1.7		1.01	0.069	3.1	0.035	30.4	400
Up c/w tributary	IND001014																		
Cooling water	IND002004	137195	0919	36.9			20.0	7.6	*10*			1.8		0.044					
Stormwater No 1	STW001075	137194	0916	12.7			61.5	7.0	*1.1*	4	?	4.6		0.96					11000

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	137193	212	450	360	43	-	200	236	159	21	12	10.1	4.0
Pond 4	IND004005	137206	49	710	450									
Pond 3	IND004006	137205	2190	1500	580									
Pond 2	IND004007	137204	1820	4900	680									
C/w tributary	IND001015	137196	51											

Notes: Inaha Stream appeared “clear, no odour. CW trib discharge clear, no odour, slight HC sheen upstream. Stormwater flow v. minor, clear, organic odour.

Taranaki By-Products water quality monitoring survey **Date:** 25 March 2014 **Flows:** Kapuni: 506 L / s
Waiokura 175 L / s
Inaha: 93 L / s SG: 3.10 m Rating date: 17 / 01 / 14
TBP: 0.0 L / s

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	149580	0928	13.7	7.9	78	22.4	7.7	*2.0*			0.8		0.056	0.004	1.04	0.048	28.3	950
Above Kohiti Rd	INH000348																		
Kohiti Road	INH000400	149581	0950	14.7	9.7	96	24.8	7.8	*1.4*			0.6	<0.5	0.041	0.004	1.86	0.022	32.6	320
Mixing zone	INH000408	149586	1045	15.2	9.2	92	27.0	7.7	*1.9*			2.9	0.5	**0.66**	0.113	**2.9**	0.085	33.8	280
500m d/s	INH000420	149587	1100	15.0	8.2	88	27.1	7.6	***3.8***			3.8	0.6	0.28	0.144	3.3	0.075	35.4	220
Normanby Rd	INH000430	149589	1215	15.0	9.2	90	27.8	7.7	*3.3*			2.6	0.5	0.084	0.088	3.8	0.074	35.6	340
SH45	INH000470	149590	1245	15.0	10.3	103	32.6	8.0	*2.3*			1.0		0.019	0.014	3.6	0.056	49.6	870
Trib. Kohiti	INH000397																		
Trib. Normanby u/s	INH000433																		
Trib. Normanby mid	INH000435																		
Trib. Normanby d/s	INH000440	149588	1220	15.2	7.8	79	41.1	*7.4*	*2.4*			<0.5		0.006	0.001	**7.1**	0.004	73.1	610
Discharge	IND004004	149582	1123	28.9	0.3	4	385	8.3	*82*	180	20	240	6.3	340	55	0.0	46	304	150
Pond 4	IND004005	149593	1118	35.5	0.3	**33**	434	7.7						350	148			303	
Pond 3	IND004006	149592	1113	33.6			623	7.9						710					
Pond 2	IND004007	149591	1020	36.4			610	7.5						750					
C/w tributary	IND001015	149585	1030	24.1	7.9	83	37.4	7.7	*2.0*	10	0.6	3.7		**6.8**	0.74	4.0			1800
Up c/w tributary	IND001014																		
Cooling water	IND002004	149584	1137	40.2			25.7	7.9	*1.7*			0.7		0.092					
Stormwater No 1	STW001075	149583	1145	17.4			46.3	7.6	*22*	**150**	5.5	38		1.22					10000

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	149582	1330	500	410	48	-	114	293	172	24	13.9	11.7	4.0
Pond 4	IND004005	149593	1200	990	570									
Pond 3	IND004006	148592	3160	1300	810									
Pond 2	IND004007	148591	2520	6400	800									
C/w tributary	IND001015	149585	**103**											

Notes: Inaha Stream flow low, clear. Tributary had slight pungent odour, ~8 L/s. Cooling water discharging though alkathene pipe only. Storm drain discharge " clear", ~0.5 L/s, slight pungent odour.
Tributary: NH4 high, relative to BOD; conductivity and pH high; alkalinity highest recorded.

Taranaki By-Products water quality monitoring survey **Date:** 30 June 2014

Flows: Kapuni: 2,861 L / s
Waiokura 692 L / s
Inaha: 1,548 L / s SG: 3.58 m Rating date: 17 / 01 / 14
TBP: 0.0 L / s SG: 0.36 m

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	1410526	1000	11.1	10.3	96	17.0	7.7	*19*			2.1		0.017	0.022	2.6	0.030	23.2	550
Above Kohiti Rd	INH000348	1410527	1015	11.1	10.6	98	17.3	7.7	*18*			2.0		0.016	0.009	2.6	0.031	23.6	200
Kohiti Road	INH000400	1410529	1030	11.0	10.6	98	18.4	7.7	*19*			2.1	0.8	0.016	0.010	2.8	0.030	24.5	600
Mixing zone	INH000408	1410534	1145	11.2	10.4	97	18.8	7.6	*16*			2.0	0.5	0.048	0.012	2.8	0.034	23.9	450
500m d/s	INH000420	1410535	1200	11.3	10.4	97	19.0	7.5	*16*			2.0	<0.5	0.039	0.013	2.8	0.032	25.8	520
Normanby Rd	INH000430	1410539	1220	11.2	10.4	97	19.0	7.6	*21*			2.0	<0.5	0.050	0.013	3.0	0.032	25.9	620
SH45	INH000470	1410540	1340	11.1	10.3	98	21.2	7.6	*22*			2.0		0.036	0.017	3.6	0.037	30.0	520
Trib. Kohiti	INH000397	1410528	1025	10.8	10.4	95	25.0	7.6	*13*			1.7		0.026	0.014	2.4	0.022	32.9	240
Trib. Normanby u/s	INH000433	1410536	1230	11.0	9.6	91	28.3	7.5	*13*			1.7		0.021	0.006	2.6	0.012	39.5	300
Trib. Normanby mid	SSM000051	1410537	1245	10.8	8.6	79	30.8	7.3	*2.5*			<0.5		<0.003	0.002	4.1	0.007	46.2	120
Trib. Normanby d/s	INH000440	1410538	1300	10.7	8.9	87	30.9	*7.3*	*2.1*			<0.5		0.018	0.003	4.0	0.007	47.2	50
Discharge	IND004004	1410530	1105	15.4	1.7	18	216	7.3	*70*	120		72	43	86	56	46	38	250	390
Pond 4	IND004005	1410542	1310	25.0	4.6	?	276	6.4						147	16	174		420	
Pond 3	IND004006																		
Pond 2	IND004007	1410541	1210	27.0			428	7.5						380					
C/w tributary	IND001015	1410533	1138	11.9	7.3	68	23.3	7.2	*5.7*	5	<0.5	1.7		0.67	0.110	3.4	0.069	31.1	210
Up c/w tributary	IND001014																		
Cooling water	IND002004	1410532	1125	11.5			18.8	7.6	*20*			2.3		0.030					
Stormwater No 1	STW001075	1410531	1115	13.3			38.6	7.1	*170*	**330**	**57**	49		9.2					150000

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	1410530	175	270	230	40	-	112	208	114	14	14	8.9	2.9
Pond 4	IND004005	1410542	80	550	410									
Pond 3	IND004006													
Pond 2	IND004007	1410541	1740	3300	600									
C/w tributary	IND001015	1410533	54											

Notes: Stormwater had meaty odour, turbid, feathers. Tributary middle site ~450 m below normal, as access difficult.

Taranaki By-Products water quality monitoring survey **Date:** 10 July 2014 **Flows:** Kapuni: 1,902 L/s
Waiokura 873 L/s
Inaha: 1,656 L/s SG: 3.60 m Rating date: 17/01/14
TBP: 1.4 L/s SG: 0.08 m

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	1410600	0930	10.6	10.6	96	18.4	7.7	*15*			1.6		0.011	0.007	2.8	0.029	24.0	350
Above Kohiti Rd	INH000348	1410601	0943	10.7	10.7	98	18.7	7.7	*17*			1.4		0.010	0.007	2.9	0.027	24.3	180
Kohiti Road	INH000400	1410603	1007	10.7	-	-	19.6	7.7	*16*			1.7	<0.5	0.015	0.008	3.2	0.027	26.5	210
Mixing zone	INH000408	1410608	1156	11.1	10.8	99	20.4	7.6	*16*			2.1	<0.5	0.145	0.050	3.2	0.062	27.1	210
500m d/s	INH000420	1410609	1211	11.2	10.7	99	20.4	7.6	*18*			2.2	<0.5	0.173	0.063	3.4	0.074	27.1	200
Normanby Rd	INH000430	1410613	1247	11.3	10.7	98	20.6	7.6	*16*			2.1	<0.5	0.148	0.064	3.5	0.076	27.6	210
SH45	INH000470	1410614	1310	10.9	10.8	99	22.7	7.7	*18*			2.0		0.095	0.056	3.6	0.066	31.9	140
Trib. Kohiti	INH000397	1410602	0957	10.3	10.5	94	24.8	7.6	*13*			1.4		0.029	0.014	3.0	0.021	34.6	120
Trib. Normanby u/s	INH000433	1410610	1230	11.1	10.7	99	28.6	7.6	*2.1*			<0.5		0.019	0.006	3.3	0.014	38.6	69
Trib. Normanby mid	SSM000051	1410611	1258	9.9	9.6	86	31.8	7.4	*3.6*			<0.5		0.009	0.003	**5.5**	0.010	47.5	71
Trib. Normanby d/s	INH000440	1410612	1252	9.7	9.4	87	31.8	*7.4*	*3.7*			<0.5		0.007	0.003	**5.5**	0.011	47.0	74
Discharge	IND004004	1410604	1105	17.8	4.2	46	223	7.3	*160*	310		69	32	44	31	89	37	241	64
Pond 4	IND004005	1410617	1120	27.8	4.2	51	267	6.6						138	128	34		244	
Pond 3	IND004006	1410616	1123	28.8			456	7.4						480					
Pond 2	IND004007	1410615	1035	29.6			454	7.5						470					
C/w tributary	IND001015	1410607	1149	13.8	8.4	83	23.8	7.3	*6.8*	7	<0.5	2.7		0.47	0.044	4.0	0.036	31.9	1000
Up c/w tributary	IND001014																		
Cooling water	IND002004	1410606	1132	11.8			20.1	7.5	*16*			1.7		0.034					
Stormwater No 1	STW001075	1410605	1136	15.4			61.0	7.0	*0.96*	<2	<0.5	0.7		0.138					1700

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	1410604	143	640	215	48		121	209	119	16	16	8.3	2.8
Pond 4	IND004005	1410605	98	540	325									
Pond 3	IND004006	1410616	2100	1500	485									
Pond 2	IND004007	1410615	1980	2200	500									
C/w tributary	IND001015	1410607	51											

Notes: Stormwater clear, no odour. Tributary middle site ~450 m below normal, as access difficult.

Taranaki By-Products water quality monitoring survey **Date:** 24 September 2014 **Flows:** Kapuni: 1,935 L/s
Waiokura 700 L/s
Inaha: 1,348 L/s SG: 3.54 m Rating date: 17/01/14
TBP: 0.03 L/s SG: 0.20 m

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	1411259	0927	11.4	10.9	100	18.1	7.6	*10*			1.2		**0.103**	0.013	2.8	**0.86**	22.1	510
Above Kohiti Rd	INH000348	1411260	0941	11.9	11.0	102	18.5	7.7	*8.8*			1.1		0.022	0.013	3.0	0.051	22.4	520
Kohiti Road	INH000400	1411262	1008	12.0	11.0	103	19.7	7.7	*13*			0.8	<0.5	0.021	0.012	3.0	0.043	22.8	600
Mixing zone	INH000408	1411267	1138	12.7	10.8	102	20.2	7.6	*10*			1.1	<0.5	0.069	0.015	3.2	0.047	23.4	520
500m d/s	INH000420	1411268	1155	12.8	10.0	97	20.2	7.6	*10*			1.3	<0.5	0.064	0.014	3.0	0.042	24.7	440
Normanby Rd	INH000430	1411272	1205	13.2	10.6	101	20.4	7.6	*8.8*			1.3	<0.5	0.057	0.016	3.2	0.045	25.9	460
SH45	INH000470	1411273	1317	14.0	10.6	101	22.8	7.7	*10*			1.6		0.052	0.020	3.5	0.048	30.6	360
Trib. Kohiti	INH000397	1411261	0956	11.8	10.7	99	25.3	7.6	*16*			0.8		0.019	0.007	3.3	0.028	32.5	1200
Trib. Normanby u/s	INH000433	1411269	1215	13.3	9.8	94	27.8	7.6	*9.1*			0.6		0.011	0.002	2.9	0.022	35.6	800
Trib. Normanby mid	SSM000051	1411270	1225	13.7	10.0	97	28.8	7.6	*3.2*			<0.5		0.010	0.001	3.7	0.015	39.1	460
Trib. Normanby d/s	INH000440	1411271	1243	13.9	10.2	100	31.0	*7.6*	*15*			0.7		0.018	0.002	5.3	0.019	43.2	640
Discharge	IND004004	1411263	1020	16.4	1.4	14	250	7.6	*24*	55	-	120	19	142	19.4	109	31	204	5800
Pond 4	IND004005	1411276	1035	25.9	2.5	30	264	6.8						158	102	65		216	
Pond 3	IND004006	1411275	1045	27.0			406	7.3						400					
Pond 2	IND004007	1411274	1140	29.2			396	7.5						400					
C/w tributary	IND001015	1411266	1125	13.5	7.8	77	30.5	7.3	*5.5*	9	-	2.2		**3.0**	0.23	**6.5**	**0.41**	35.0	430
Up c/w tributary	IND001014																		
Cooling water	IND002004	14112465	1106	13.0			20.2	7.7	*9.3*			1.4		0.039					
Stormwater No 1	STW001075	1411264	1110	13.8			58.8	6.9	*0.68*	4		3.6		0.42					2700

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	1411263	345	220	280	31	-	95	182	130	29	18	6.5	2.7
Pond 4	IND004005	1411276	163	370	645									
Pond 3	IND004006	1411275	1860	550	390									
Pond 2	IND004007	1411274	1740	1300	425									
C/w tributary	IND001015	1411266	61											

Notes: Stormwater clear, “pipe” odour, wastewater discharge rate ~ 2L/min or 0.02 L/s.

Taranaki By-Products water quality monitoring survey **Date:** 28 January 2015 **Flows:** Kapuni: 239 L/s
Waiokura 206 L/s
Inaha: 86 L/s SG: 3.075 m Rating date: 8/06/15
TBP: 0.0 L/s SG: 0.20 m

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	150419	0820	18.0	8.4	90	20.8	7.7	*1.4*			<0.5		**0.48**	0.002	0.63	0.032	25.9	730
Above Kohiti Rd	INH000348																		
Kohiti Road	INH000400	150421	0845	19.0	9.2	99	23.4	7.8	*2.4*			<0.5	<0.5	0.131	0.004	1.70	0.020	30.0	1200
Mixing zone	INH000408	150426	0950	21.0	10.0	112	25.8	7.9	*2.0*			2.0	0.7	0.66	0.28	2.7	0.093	32.4	1200
500m d/s	INH000420	150427	1000	21.2	11.3	130	25.7	**8.2**	*2.1*			2.8	0.9	0.39	0.31	2.8	0.077	32.6	1200
Normanby Rd	INH000430	150429	1015	21.8	11.4	132	25.7	**8.8**	*2.9*			-	0.9	0.062	0.20	3.0	0.047	34.4	310
SH45	INH000470	150430	1040	19.6	9.6	105	31.7	7.9	*2.0*			0.7		0.171	0.028	3.3	0.045	**61.1**	840
Trib. Kohiti	INH000397	150420	0840	16.6	7.7	80	27.7	7.6	*2.0*			<0.5		**0.45**	0.003	2.2	0.013	35.1	760
Trib. Normanby u/s	INH000433																		
Trib. Normanby mid	SSM000051																		
Trib. Normanby d/s	INH000440	140428	1025	16.9	7.5	78	39.4	*7.5*	*2.6*			<0.5		0.108	0.005	8.1	0.008	61.1	530
Discharge	IND004004	150422	1010	32.8			305	8.2	*66*	130	-	110	4.0	200	126	0	30	280	
Pond 4	IND004005	150433	0910	32.5			425	6.0						290	330	14		306	
Pond 3	IND004006	150432	0905	33.5			649	7.8						880					
Pond 2	IND004007	150431	0930	37.7			666	7.6						890					
C/w tributary	IND001015	150425	0940	26.1	4.2	52	38.5	7.4	***19***	**140**	**3.6**	**>24**		**6.7**	**2.6**	2.5	**0.74**	42.9	3300
Up c/w tributary	IND001014																		
Disch to fire pond	SSM000051	150418	0915	21.1			24.4	7.7	*1.4*										
Cooling water	IND002004	150424	0915	62.7			29.6	7.7	*6.4*			<0.5		**1.91**					
Stormwater No 1	STW001075	150423	0920	17.6			66.1	7.0	*1.7*	5	0.6	4.4		0.71					52,000

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	150422	540	380	330	37	-	140	225	170	23	7.7	10.3	4.6
Pond 4	IND004005	150433	73	900	640									
Pond 3	IND004006	150432	3200	930	970									
Pond 2	IND004007	150431	2540	4300	1070									
C/w tributary	IND001015	150425	110											

Notes: Low stream flow. Willows removed. Massive filamentous algae growth. New discharge to fire pond ~ 5 L/s. Firepond outlet sampled among macrophytes, raising SS/turbidity, BOD/NO_2/DRP/O&G also elevated..

Taranaki By-Products water quality monitoring survey **Date:** 24 June 2015 **Flows:** Kapuni: 4,900 L/s
Waiokura 2,500 L/s
Inaha: 2,044 L/s SG: 3.64 m Rating date: 8/06/15
TBP: 1.9 L/s SG: 0.09 m

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	152088	0927	9.2	11.0	96	18.9	7.5	*11*			1.5		0.021	0.012	3.4	0.029	25.5	310
Above Kohiti Rd	INH000348	152089	0952	9.3	11.3	98	19.3	7.5	*12*			1.4		0.032	0.012	3.5	0.028	26.3	300
Kohiti Road	INH000400	152091	1010	9.2	11.3	98	20.9	7.6	*14*			1.5	<0.5	0.036	0.013	3.5	0.025	29.1	250
Mixing zone	INH000408	152096	1126	9.4	11.2	98	21.1	7.4	*16*			1.8	<0.5	0.080	0.020	3.7	0.040	29.0	290
500m d/s	INH000420	152097	1138	9.4	11.2	98	21.4	7.4	*18*			1.8	<0.5	0.117	0.034	3.6	0.040	30.0	380
Normanby Rd	INH000430	152101	1305	9.7	11.2	98	21.5	7.6	*15*			1.8	<0.5	0.110	0.033	3.6	0.041	30.0	250
SH45	INH000470	152102	1330	9.9	10.9	96	23.6	7.4	*14*			1.7		0.088	0.030	3.8	0.040	33.6	200
Trib. Kohiti	INH000397	152090	1004	8.5	11.1	95	27.8	7.5	*9.5*			1.1		0.046	0.017	3.6	0.017	39.7	230
Trib. Normanby u/s	INH000433	152098	1228	9.6	10.6	93	30.2	7.5	*7.7*			0.7		0.014	0.007	3.8	0.014	41.8	110
Trib. Normanby mid	SSM000051	152099	1245	9.5	10.5	92	31.1	7.5	***1.5***			<0.5		0.018	0.006	4.6	0.012	44.1	85
Trib. Normanby d/s	INH000440	152100	1255	9.5	10.8	94	32.7	*7.5*	*6.9*			<0.5		0.012	0.005	6.4	0.014	51.2	270
Discharge	IND004004	152092	1042	18.3	2.3	24	182	7.4	*220*	410	8	83		74	26	64	19.4	184	200
Pond 4	IND004005	152105	1154	23.7	4.6		254	6.6						140	164	0.00		250	
Pond 3	IND004006	152104	1150	27.1			356	7.4						410					
Pond 2	IND004007	152103	1052	37.5			346	7.6						340					
C/w tributary	IND001015	152095	1112	11.5	**3.4**	**32**	**46.4**	7.3	***44***	**110**		**120**		3.4	0.53	4.5	0.031	**59.5**	**6700**
Up c/w tributary	IND001014																		
Disch to fire pond	SSM000051																		
Cooling water	IND002004	152094	1104	11.2			21.2	7.4	*31*			2.7		0.113					
Stormwater No 1	STW001075	152093	1100	12.9			68.1	7.2	***110***	**200**	4.2	100		4.2					140000

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	152092	157	610	**196**	26	-	110	192	80	32	16	6.9	1.7
Pond 4	IND004005	152105	86	630	310									
Pond 3	IND004006	152104	1540	720	380									
Pond 2	IND004007	152103	1360	2000	390									
C/w tributary	IND001015	152095	**118**											

Notes: High stream flow, 4 days after large flood. Fire pond outlet sampled among macrophytes, raising SS/turbidity; conductivity/BOD highly elevated and ammonia/coliforms up, unexplained.. Stormwater SS over limit, meaty odour.

Taranaki By-Products water quality monitoring survey **Date:** 24 July 2015

Flows: Kapuni: 2,482 L/s
Waiokura 1,236 L/s
Inaha: 1,179 L/s SG: 3.45 m Rating date: 8/06/15
TBP: 2.2 L/s SG: x.xx m

Site	Code	Lab ID	Time	Temp	DO	DO sat.	Cond	pH	Turb	TSS	TG/O&G	BOD	fcBOD	NH4	NO_2	NO_3	DRP	Cl	FC
			NZST	°C	gm^{-3}	%	mSm^{-1}	pH	NTU	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	cfu/100ml
Ahipaipa Road	INH000334	152307	0815	10.1	11.0	97	19.0	7.7	*12*			1.5		0.014	0.007	3.3	0.026	22.7	200
Above Kohiti Rd	INH000348	152308	0825	10.2	11.2	100	19.3	7.7	*12*			1.4		0.019	0.007	3.3	0.025	23.4	170
Kohiti Road	INH000400	152310	0840	10.2	11.2	99	20.6	7.6	*12*			1.4	<0.5	0.021	0.009	3.4	0.025	26.1	330
Mixing zone	INH000408	152315	1026	10.5	11.2	100	21.4	7.5	*18*			2.1	<0.5	0.134	0.026	3.7	0.037	27.0	290
500m d/s	INH000420	152316	1035	10.6	11.2	100	21.7	7.5	*16*			2.0	<0.5	0.22	0.048	3.8	0.052	27.3	340
Normanby Rd	INH000430	152320	1137	10.9	11.2	100	21.8	7.6	*17*			2.0	<0.5	0.21	0.049	4.0	0.052	27.1	170
SH45	INH000470	152321	1159	10.4	11.0	99	24.3	7.5	*16*			2.5		0.128	0.048	4.5	0.048	31.9	280
Trib. Kohiti	INH000397	152309	0835	10.1	11.0	97	26.1	7.6	*16*			1.7		0.036	0.017	3.9	0.022	33.4	250
Trib. Normanby u/s	INH000433	152317	1102	10.5	10.6	95	29.3	7.6	*7.2*			0.6		0.012	0.006	3.9	0.020	38.5	100
Trib. Normanby mid	SSM000051	152318	1120	9.9	10.7	95	30.5	7.6	*2.4*			0.6		0.008	0.003	4.8	0.013	42.5	80
Trib. Normanby d/s	INH000440	152319	1129	9.9	11.1	97	33.0	*7.5*	*9.8*			0.6		0.026	0.003	6.7	0.015	47.0	140
Discharge	IND004004	152311	0945	19.8	1.5	20	224	7.4	*120*	130	11	150	21	122	23	98	20	182	300
Pond 4	IND004005	152324	0925	20.2	7.1	78	289	7.1						200	116	9		228	
Pond 3	IND004006	152323	0920	24.5			354	7.4						350					
Pond 2	IND004007	152322	0905	28.1			337	7.5						330					
C/w tributary	IND001015	152314	1010	10.9	**2.2**	**20**	35.7	7.2	*11*	8		2.8		3.0	0.081	3.0	0.050	40.4	370
Up c/w tributary	IND001014																		
Disch to fire pond	SSM000051																		
Cooling water	IND002004	152313	0959	13.3			29.1	7.3	*3.6*			1.3		1.64					
Stormwater No 1	STW001075	152312	0955	13.5			60.8	7.0	*2.1*	<2		3.5		0.28					2400

Site	Code	Lab ID	Alk	COD	TN	TP	TS	SO4	Na	K	Ca	Mg	SAR	KAR
			gm^{-3} $CaCO_3$	gm^{-3}	$gm^{-3}N$	$gm^{-3}P$	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}	gm^{-3}		
Discharge	IND004004	152311	210	320	250	22	-	74	173	76		17		
Pond 4	IND004005	152324	485	350	340									
Pond 3	IND004006	152323	1490	410	360									
Pond 2	IND004007	152322	1380	950	360									
C/w tributary	IND001015	152314	110											

Notes: 5 days after a fresh. Fire pond outlet slight sweet organic odour.Stormwater drain flow minor, clear, slight sweet fragrant odour. C/w flow from southern of 2 pipes.

Appendix III

Groundwater monitoring data

Site name	Site code	Description	Grid reference, NZTM	
			Easting	Northing
Irrigation bores				
BH1	GND1054	Control, NE Kohiti Road block	1702469	5624829
BH2	GND1055	Kohiti Road block, near Inaha Stream	1702001	5624440
BH3	GND1056	Kohiti Road block, above TBP plant	1702359	5623913
BH4	GND1057	East Normanby Road block	1702308	5623294
Shearer	GND1058	Shearers' spring	1701770	5624284
BH5B	GND1346	Control, NW Katotauru Road block	1701352	5624536
BH6 B	GND1347	Katotauru Road block, beside road	1701586	5623914
BH7	GND1348	Ahipaipa Road block	1702671	5624595
BH8	GND1349	West Normanby Road block	1701013	5623526
BH9	GND2225	Kingi block east, above Inaha trib	1701186	5624945
BH10	GND2226	Inaha Road block	1700548	5623806
Burial pit bores				
BP1	GND1063	Control, upslope	1702475	5624400
BP2	GND1064		1702439	5624414
BP3	GND1065		1702390	5624425
BP4	GND1066		1702370	5624409
BP5	GND1067		1702363	5624386
BP6	GND1068		1702362	5624370
BP7	GND1069		1702359	5624342
BP8	GND1350		1702362	5624323
BP9	GND1356		1702353	5624284

Site	Date	LEVEL	TEMP	CONDY	PH	NNN	NH4	CL	ALKT	SO4	NA	K	CA	MG	COD
		m	Deg.C	mS/m @ 20C	pH	g/m3 N	g/m3 N	g/m3	g/m3 CaCO3	g/m3	g/m3	g/m3	g/m3	g/m3	g/m3
BH1															
GND1054	3-Sep-13	8.57	13.8	30.6	6.3	5.55	0.011	50							
GND1054	22-Oct-13	7.03	14.3	30.9	6.5	6.52	0.003	55.4	40	19.3	26.7	3.3	19.6	11.4	6
GND1054	18-Dec-13	7.30	14.2	31.7	6.4	6.77	0.021	50.7							
GND1054	18-Feb-14	7.78	15.4	30.6	6.6	6.02	<0.003	49.7							
GND1054	13-May-14	8.4	13.8	30.1	6.4	6.92	<0.003	45.1							
GND1054	23-Jun-14	8.36	13.6	31.4	6.4	8.10	<0.003	48.4							
GND1054	20-Aug-14	6.81	13.6	31.0	6.7	5.84	<0.003	49.5							
GND1054	21-Oct-14	6.86	14.1	30.8	6.6	5.42	0.007	51.6	47	15.1	36.2	3.6	15.6	8.4	<5
GND1054	8-Dec-14	7.53	14.2	30.6	6.4	7.47	0.004	47.4							
GND1054	2-Mar-15	8.12	14.5	29.4	6.4	7.34	0.005	46.3							
GND1054	6-May-15	8.56	14.1	30.5	6.4	9.44	<0.003	44.0							
GND1054	16-Jun-15	8.20	13.7	31.9	6.4	10.0	<0.003	46.7							
BH3															
GND1056	3-Sep-13	10.84	14.4	27.5	6.4	5.39	0.004	46							
GND1056	22-Oct-13	9.89	14.3	26.2	6.4	5.36	<0.003	51.0	41	6.1	32.8	3.2	12.8	7.3	<5
GND1056	18-Dec-13	9.07	14.3	28.6	6.4	8.04	<0.003	47.8							
GND1056	18-Feb-14	9.38	14.7	28.9	6.5	8.29	<0.003	50.7							
GND1056	13-May-14	10.23	14.2	25.3	6.4	5.36	<0.003	44.1							
GND1056	23-Jun-14	10.43	14.2	24.7	6.5	10.6	0.004	43.7							
GND1056	20-Aug-14	9.07	14.0	34.0	6.5	14.7	<0.003	45.2							
GND1056	21-Oct-14	7.98	14.6	52.7	6.2	34.0	0.019	78.6	32	4.4	47.3	4.5	32.4	16.1	<5
GND1056	8-Dec-14	8.54	14.5	44.3	6.4	21.4	0.010	75.0							
GND1056	2-Mar-15	9.54	15.3	27.5	6.4	5.86	<0.003	48.4							
GND1056	6-May-15	10.26	14.5	26.7	6.4	5.18	0.003	43.2							
GND1056	16-Jun-15	10.28	14.3	27.1	6.4	6.03	<0.003	45.9							
BH4															
GND1057	3-Sep-13	6.67	14.8	38.1	6.3	11.8	0.008	59							
GND1057	22-Oct-13	5.87	14.4	43.6	6.4	21.1	<0.003	57.4	48	18.3	48.3	4.6	22.2	14.7	<5
GND1057	18-Dec-13	5.84	14.2	38.5	6.4	12.3	<0.003	59.2							
GND1057	18-Feb-14	6.76	14.7	36.6	6.6	9.72	<0.003	62.2							
GND1057	13-May-14	7.16	14.3	37.0	6.4	10.6	<0.003	62.5							
GND1057	23-Jun-14	7.10	14.2	37.4	6.4	10.8	0.003	62.3							
GND1057	20-Aug-14	5.69	11.1	41.9	6.6	17.2	<0.003	61.4							
GND1057	21-Oct-14	5.64	14.1	41.2	6.3	14.9	<0.003	62.7	46	19.4	47.2	4.3	20.0	12.0	<5
GND1057	8-Dec-14	6.27	14.5	39.0	6.5	13.1	0.005	54.0							
GND1057	2-Mar-15	6.97	14.7	39.9	6.3	14.6	<0.003	64.4							
GND1057	6-May-15	7.44	14.3	38.7	6.3	12.3	<0.003	61.1							
GND1057	16-Jun-15	6.60	14.0	39.3	6.4	14.1	<0.003	68.0							

Site	Date	LEVEL	TEMP	CONDY	PH	NNN	NH4	CL	ALKT	SO4	NA	K	CA	MG	COD
		m	Deg.C	mS/m @ 20C	pH	g/m3 N	g/m3 N	g/m3	g/m3 CaCO3	g/m3	g/m3	g/m3	g/m3	g/m3	g/m3
BH5B															
GND1346	3-Sep-13	3.56	13.9	76.5	6.1	57.5	0.004	87							
GND1346	22-Oct-13	3.21	14.2	64.3	6.3	48.9	<0.003	81.4	32	7.9	47.0	6.8	48.0	24.7	6
GND1346	18-Dec-13	3.36	13.9	48.1	6.4	27.2	0.009	66.3							
GND1346	18-Feb-14	4.63	14.9	53.6	6.5	35.9	<0.003	62.3							
GND1346	13-May-14	4.54	13.8	57.2	6.3	42.9	<0.003	64.8							
GND1346	23-Jun-14	3.18	13.8	50.9	6.3	32.4	0.003	60.5							
GND1346	20-Aug-14	3.73	14.0	46.4	6.5	32.9	<0.003	55.4							
GND1346	21-Oct-14	3.86	14.0	45.0	6.4	26.3	<0.003	53.0	42	11.6	36.5	5.2	31.8	14.5	<5
GND1346	8-Dec-14	4.74	14.1	51.7	6.3	36.5	<0.003	55.7							
GND1346	2-Mar-15	5.16	14.4	55.2	6.3	38.7	0.004	64.0							
GND1346	6-May-15	4.42	14.2	53.3	6.3	34.8	0.004	58.1							
GND1346	16-Jun-15	2.69	13.9	50.3	6.4	29.3	<0.003	55.7							
BH6B															
GND1347	3-Sep-13	7.72	14.0	78.1	6.0	65.5	0.004	90							
GND1347	22-Oct-13	6.65	14.4	68.5	6.4	54.2	<0.003	86.4	23	2.3	49.8	5.3	46.7	27.7	<5
GND1347	18-Dec-13	6.71	14.2	77.6	6.2	58.4	0.023	93.5							
GND1347	18-Feb-14	7.81	14.9	84.0	6.3	64.1	<0.003	101							
GND1347	13-May-14	7.93	13.7	82.2	6.2	70.0	0.022	96.2							
GND1347	23-Jun-14	7.97	13.8	84.7	6.2	65.4	0.006	99.8							
GND1347	20-Aug-14	6.90	13.8	82.8	6.3	69.6	<0.003	107							
GND1347	21-Oct-14	6.86	14.1	84.0	6.1	64.0	0.197	112	23	2.7	54.0	5.3	61.2	32.6	<5
GND1347	8-Dec-14	7.54	14.1	91.2	6.1	68.9	0.010	116							
GND1347	2-Mar-15	8.85	14.5	91.0	6.2	70.7	<0.003	119							
GND1347	6-May-15	9.24	14.3	92.6	6.0	64.8	<0.003	116							
GND1347	16-Jun-15	7.19	14.1	89.4	6.3	65.4	<0.003	128							
BH7															
GND1348	3-Sep-13	12.05	13.9	95.5	6.1	82.1	0.040	94							
GND1348	22-Oct-13	11.36	14.6	43.6	6.5	24.4	0.003	59.2	35	4.9	37.0	5.3	25.6	16.5	<5
GND1348	18-Dec-13	10.83	14.5	46.8	6.4	29.6	<0.003	61.0							
GND1348	18-Feb-14	10.83	14.3	64.9	6.6	48.2	<0.003	74.0							
GND1348	13-May-14	11.29	14.1	69.7	6.4	55.5	<0.003	74.7							
GND1348	23-Jun-14	11.35	13.8	65.2	6.4	45.5	0.006	71.0							
GND1348	20-Aug-14	10.73	13.8	41.5	6.7	23.2	0.009	55.8							
GND1348	21-Oct-14	9.96	14.4	40.0	6.5	21.0	0.088	53.5	37	9.7	35.4	4.8	23.4	13.8	<5
GND1348	8-Dec-14	10.20	14.2	67.2	6.3	53.7	0.005	72.0							
GND1348	2-Mar-15	10.93	15.4	72.2	6.4	60.1	0.007	77.8							
GND1348	6-May-15	11.36	15.4	76.4	6.3	63.7	0.004	81.3							
GND1348	16-Jun-15	11.47	13.8	80.4	6.4	64.7	0.049	84.7							

Site	Date	LEVEL	TEMP	CONDY	PH	NNN	NH4	CL	ALKT	SO4	NA	K	CA	MG	COD
		m	Deg.C	mS/m @ 20C	pH	g/m3 N	g/m3 N	g/m3	g/m3 CaCO3	g/m3	g/m3	g/m3	g/m3	g/m3	g/m3
BH8															
GND1349	3-Sep-13	11.67	14.1	46.4	6.3	11.0	0.006	86							
GND1349	22-Oct-13	11.15	14.3	60.2	6.3	14.9	0.004	124	49	7.2	43.6	4.7	42.4	25.1	5
GND1349	18-Dec-13	10.63	14.1	55.1	6.2	13.4	<0.003	117							
GND1349	18-Feb-14	10.70	14.6	51.2	6.5	12.7	<0.003	104							
GND1349	13-May-14	11.13	14.0	51.6	6.2	13.1	<0.003	102							
GND1349	23-Jun-14	10.99	14.0	61.0	6.3	16.2	0.004	129							
GND1349	20-Aug-14	10.18	14.1	74.3	6.5	25.4	<0.003	158							
GND1349	21-Oct-14	9.75	14.2	41.0	6.4	23.4	0.022	53.5	42	8.8	34.2	3.7	26.4	14.6	<5
GND1349	8-Dec-14	9.89	14.2	81.8	6.3	53.4	0.004	120							
GND1349	5-Mar-15	10.48	14.7	116	6.3	26.6	0.009	291							
GND1349	6-May-15	10.88	14.5	61.8	6.2	13.7	<0.003	125							
GND1349	16-Jun-15	10.90	13.8	59.1	6.4	16.0	<0.003	119							
BH9															
GND2225	3-Sep-13	5.90	14.3	41.4	6.2	25.0	0.004	56							
GND2226	3-Sep-13	8.25	14.1	68.5	6.2	50.7	0.009	79							
GND2225	22-Oct-13	5.12	14.5	37.0	6.5	20.0	0.003	48.2	37	3.9	33.6	3.3	21.7	14.2	8
GND2225	18-Dec-13	5.20	14.4	34.9	6.4	19.9	<0.003	47.1							
GND2225	18-Feb-14	6.34	14.5	36.4	6.5	21.6	<0.003	48.5							
GND2225	13-May-14	7.07	14.0	37.2	6.4	20.7	<0.003	53.6							
GND2225	23-Jun-14	7.92	14.0	37.3	6.3	21.6	0.014	53.4							
GND2225	20-Aug-14	5.45	14.1	36.1	6.6	17.7	<0.003	51.3							
GND2225	21-Oct-14	5.47	14.5	33.1	6.4	16.0	0.022	45.9	37	4.8	31.0	2.8	18.0	12.5	<5
GND2225	8-Dec-14	5.97	14.1	34.0	6.4	18.4	0.005	44.9							
GND2225	2-Mar-15	6.48	14.4	35.9	6.4	18.8	0.005	52.9							
GND2225	6-May-15	6.91	14.6	36.4	6.3	18.9	0.006	50.7							
GND2225	16-Jun-15	5.47	13.9	33.7	6.4	14.8	<0.003	49.8							
BH10															
GND2226	22-Oct-13	5.82	14.5	69.3	6.3	55.8	0.003	78.4	27	3.3	50.3	4.7	48.1	31.1	<5
GND2226	18-Dec-13	5.77	14.3	71.7	6.2	58.5	0.025	82.8							
GND2226	18-Feb-14	6.47	15.3	78.4	6.4	65.4	0.069	85.2							
GND2226	13-May-14	7.08	14.1	83.1	6.2	71.1	<0.003	86.9							
GND2226	23-Jun-14	6.87	14.0	89.2	6.2	78.5	0.089	97.6							
GND2226	20-Aug-14	5.6	13.9	81.8	6.4	69.0	0.003	96.0							
GND2226	21-Oct-14	4.99	14.1	78.7	6.2	58.9	0.051	95.7	28	3.4	51.3	4.6	53.8	33.7	<5
GND2226	8-Dec-14	5.50	14.2	74.2	6.2	54.3	0.006	88.7							
GND2226	2-Mar-15	6.88	14.7	74.2	6.2	52.8	0.003	101							
GND2226	6-May-15	5.83	14.2	79.5	6.2	54.7	0.004	104							
GND2226	16-Jun-15	5.37	13.8	75.0	6.4	51.8	<0.003	103							

Site	Date	LEVEL	TEMP	CONDY	PH	NNN	NH4	CL	ALKT	SO4	NA	K	CA	MG	COD
		m	Deg.C	mS/m @ 20C	pH	g/m3 N	g/m3 N	g/m3	g/m3 CaCO3	g/m3	g/m3	g/m3	g/m3	g/m3	g/m3
Shearers' spring															
GND1058	3-Sep-13		15.1	30.7	6.6	3.42	<0.003	60							
GND1058	22-Oct-13		15.3	30.1	6.6	3.83	0.004	64.5	42	7.8	29.8	3.0	16.8	11.3	<5
GND1058	18-Dec-13		15.2	30.7	6.6	4.05	<0.003	61.8							
GND1058	18-Feb-14		16.7	31.5	6.8	4.11	<0.003	63.4							
GND1058	13-May-14		14.5	31.1	6.6	4.21	<0.003	64.0							
GND1058	23-Jun-14		14.8	31.2	6.6	4.27	<0.003	62.2							
GND1058	20-Aug-14		13.9	31.2	6.8	4.81	<0.003	65.0							
GND1058	21-Oct-14		15.0	32.1	6.5	4.97	0.007	64.7	41	8.5	29.1	2.8	18.0	11.2	<5
GND1058	8-Dec-14		15.4	32.8	6.6	5.53	<0.003	64.6							
GND1058	2-Mar-15		16.3	32.8	6.5	5.24	<0.003	64.8							
GND1058	6-May-15		15.4	32.5	6.5	4.73	<0.003	63.0							
GND1058	16-Jun-15		14.8	32.4	6.6	5.18	<0.003	67.0							
BP1															
GND1063	2-Sep-13	9.49	14.2	20.9	6.4	2.93	0.027								<5
GND1063	29-Nov-13	7.70	14.2	20.4	6.7	3.40	<0.003								23
GND1063	25-Feb-14	8.31	15.3	22.1	6.6	4.00	0.057								77
GND1063	28-May-14	9.09	14.0	21.5	6.5	4.00	0.006								10
GND1063	19-Aug-14	7.83	14.3	21.7	6.5	4.06	<0.003								<5
GND1063	17-Nov-14	7.54	14.1	22.4	6.4	4.46	0.005								<5
GND1063	16-Mar-15	8.71	17.3	23.4	6.6	5.86	0.025								10
GND1063	25-Jun-15	7.99	13.9	23.6	6.4	6.17	0.013								<5
BP3															
GND1065	2-Sep-13	9.13	15.2	157	6.4	24.4	0.006								14
GND1065	29-Nov-13	8.10	15.6	148	6.6	32.2	<0.003								12
BP4															
GND1066	2-Sep-13	5.80	14.9	239	6.7	39.2	38.6								24
GND1066	29-Nov-13	5.78	14.8	200	6.6	70.8	24.0								28
GND1066	25-Feb-14	6.02	15.4	224	6.9	31.0	48.8								28
GND1066	28-May-14	5.90	14.4	220	6.9	43.8	44.8								28
GND1066	19-Aug-14	5.62	14.4	163	6.5	77.9	16.0								17
GND1066	17-Nov-14	5.71	14.5	207	6.6	31.2	56.4								26
GND1066	16-Mar-15	6.04	15.1	244	6.8	5.93	97.1								34
GND1066	25-Jun-15	4.65	14.5	249	6.6	58.6	93.4								29
BP5															
GND1067	2-Sep-13	5.90	14.7	72.0	6.5	28.4	0.017								5
GND1067	29-Nov-13	5.66	14.6	30.6	6.7	12.0	<0.003								<5
GND1067	25-Feb-14	5.03	17.7	76.6	6.4	24.3	0.023								16
GND1067	28-May-14	6.02	14.4	76.6	6.5	26.1	0.120								17
GND1067	19-Aug-14	5.47	14.1	63.7	6.2	24.8	0.052								5
GND1067	17-Nov-14	5.71	14.4	80.7	6.2	27.6	0.014								10

Site	Date	LEVEL	TEMP	CONDY	PH	NNN	NH4	CL	ALKT	SO4	NA	K	CA	MG	COD
		m	Deg.C	mS/m @ 20C	pH	g/m3 N	g/m3 N	g/m3	g/m3 CaCO3	g/m3	g/m3	g/m3	g/m3	g/m3	g/m3
GND1067	16-Mar-15	6.26													
GND1067	25-Jun-15	4.43	14.3	50.4	6.2	12.7	<0.003								<5
BP7															
GND1069	2-Sep-13	5.98	15.1	156	6.5	36.8	45.2								13
GND1069	29-Nov-13	5.54	15.0	118	6.4	70.4	8.79								56
GND1069	25-Feb-14	6.06	15.3	130	6.7	23.9	18.9								52
GND1069	28-May-14	6.23	14.0	126	6.5	61.0	9.60								46
GND1069	19-Aug-14	5.43	14.6	106	6.6	37.6	15.2								16
GND1069	17-Nov-14	5.81	14.8	114	6.4	11.6	15.1								6
GND1069	16-Mar-15	6.41	15.2	155	6.6	2.72	40.8								24
GND1069	25-Jun-15	4.33	14.6	73.9	6.2	28.3	3.36								9
BP10															
GND2506	25-Jun-15	3.54	14.2	47.4	6.4	20.1	0.010								98

Appendix IV

Biological monitoring reports

To James Kitto, Job Manager
From Brooke Thomas, Scientific Officer
Report No. BT010
Date 6 March 2014
Doc number 1296618

Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, October 2013.

Introduction

Taranaki By-Products Limited holds a number of consents for discharges to land and to water associated with the operation of a rendering plant and a neighbouring farm owned and operated by the Company. The discharge consents most relevant to this biomonitoring survey are summarised in Table 1 below:

Table 1 Summary of discharge consents held by Taranaki By-Products Limited which are of most relevance to this biological survey.

Consent no.	Purpose
2049-4	To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream
2050-4	To discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream
3941-2	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries...between 1700909E-5625245N, 1700631E-5625092N and 1700921E-5625046N
5426-1	To discharge up 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha Stream

Biomonitoring has been undertaken at some sites in relation to the discharges from the rendering plant and associated activities since the mid-1980s. Some of the sites used for the biomonitoring of these discharges have changed over time and these changes have been documented in previous reports (Jansma, 2012 a, b, c).

This spring biological survey was the first of two scheduled in the Inaha Stream catchment in the 2013-2014 monitoring year in relation to discharges from the Taranaki By-Products plant. Results from previous surveys are also referred to in this report (see references).

Methods

This biomonitoring survey was undertaken at only seven sites on 3 October 2013 (Table 2 and Figure 1). Four of the seven sites surveyed were in the Inaha Stream and the remaining sites were in an unnamed tributary of the Inaha Stream (Figure 1). The locations of sampling sites in relation to the discharges from the rendering plant are discussed below.

Site U (INH000334) was established in the 2003-2004 monitoring period as an appropriate control site on the Inaha Stream above the rendering plant discharges and irrigation areas. Site 1 (INH000400) is located upstream of the wastewater and cooling water discharge points but downstream of part of the treated wastewater irrigation area. Sites 2d and 3 (INH000420 and INH000430) are located downstream of these two discharges and above the confluence with the unnamed tributary of the Inaha Stream which drains land upon which wastewater is irrigated.

The area of land authorised to be irrigated onto under consent 3941-2 has increased on several occasions since the consent was granted in December 1999. Sites UT, MT and DT (INH000433, INH000435 and INH000440) were established to monitor the effects of the expanded irrigation area on an unnamed tributary of the Inaha Stream. Site UT was established as a 'control site' for the expanded irrigation area. Site MT is located within the authorised irrigation area and site DT is situated downstream of the irrigation area but upstream of the unnamed tributary's confluence with the Inaha Stream.

Site 4 (INH000450) on the Inaha Stream is situated approximately 100 metres downstream of the convergence point between the Inaha Stream and the unnamed tributary.

Table 2 Bio-monitoring sites in the Inaha Stream and in an unnamed tributary relating to the Taranaki By-Products plant

Stream	Site No.	Site code	Location	Sampling method used
Inaha Stream	U	INH000334	Upstream of irrigation area, near Ahipaipa Road	Streambed kick
	1	INH000400	Upstream of treatment ponds, Kohiti Road	Not sampled
	2d	INH000420	500 m downstream of cooling water discharge	Streambed kick
	3	INH000430	Upstream of Normanby Road	Streambed kick
	4	INH000450	100 m downstream of 'irrigation' tributary confluence	Streambed kick
Unnamed tributary of Inaha Stream	UT	INH000433	Upstream of irrigation area	Kick-sweep
	MT	INH000435	Middle site within the new irrigation area	Vegetation sweep
	DT	INH000440	50m upstream Normanby Road	Streambed kick

A debris dam at site 1 (INH000400) impounded the Inaha Stream, which meant this site was unable to be sampled on this occasion due to high water levels.

Two different sampling techniques were used to collect streambed macroinvertebrates in this survey. The Council's standard '400ml kick-sampling' technique was used at sites U, 2d, 3, 4 and DT, and the 'vegetation sweep' technique was used at site MT. A combination of the 'kick-sampling' and 'vegetation sweep' sampling techniques was used at site UT (Table 2). The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

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) = 20-99 individuals;
VA (very abundant) = 100-499 individuals;
XA (extremely abundant) = 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 from a list of taxa taken from one site and multiplying by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

Sub-samples of algal and detrital material 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 these organisms is an indicator of organic enrichment within a stream. Such heterotrophic growths have been recorded on numerous past occasions at sites downstream of the Taranaki By-Products plant as a result of organic nutrient enrichment from the wastewater discharge.

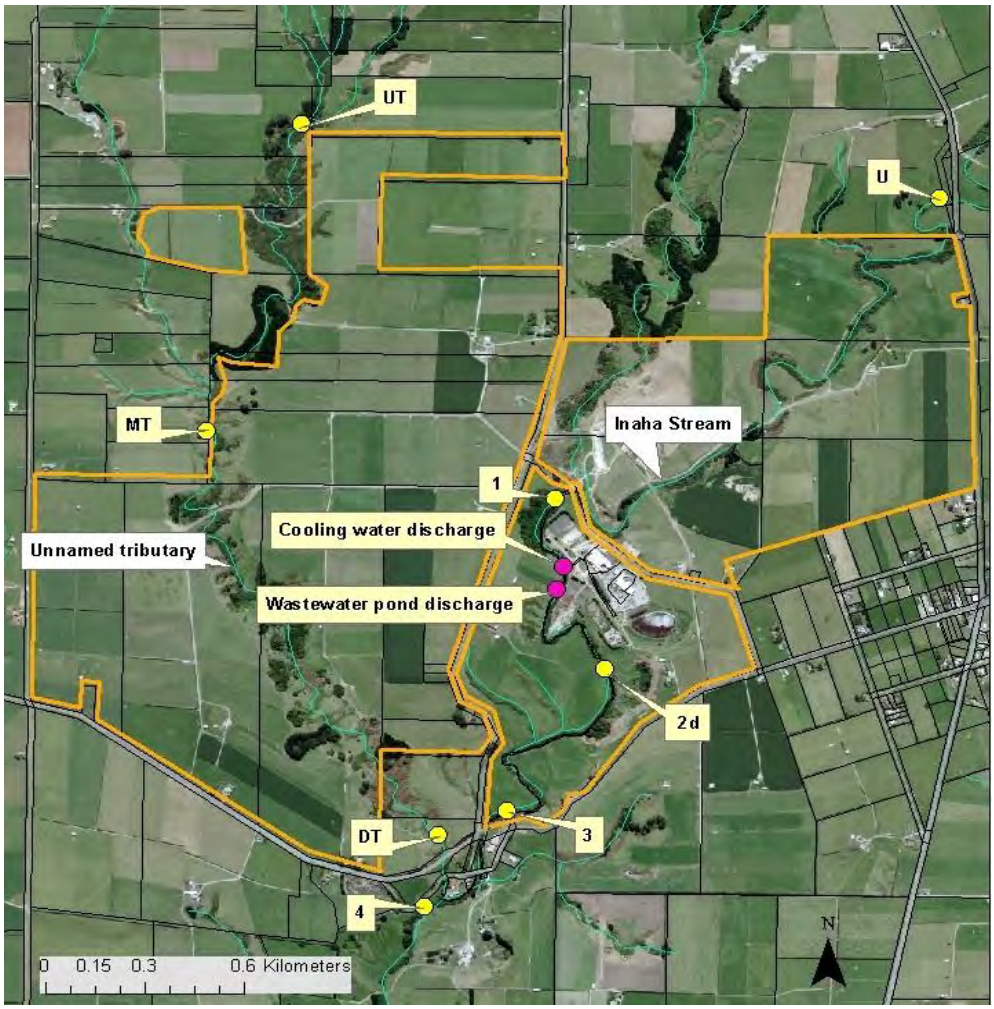

Figure 1 Aerial photo showing biomonitoring sites in the Inaha Stream and an unnamed tributary stream relating to discharges from the Taranaki By-Products plant. The orange line outlines the irrigation areas around the rendering plant.

Results and discussion

This October 2013 survey followed a period of 21 days since a fresh in excess of three times median flow in the nearby Waiokura Stream (the nearest appropriate water level recorder). This was the only flood in the month prior to the survey, although flows were above mean annual low flow (MALF) in the month leading up to the survey due to a number of small freshes that occurred over this period.

Freshes and floods would likely scour a proportion of the fine organic matter and filamentous periphyton growths from the streambed, which could impact upon macroinvertebrate community compositions. The fact that there was only one major fresh event in the month leading up to the survey suggests that flooding is unlikely to have influenced the community, therefore the community should be reflective of preceding water quality conditions.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream began on 14 June 2013 and continued, almost without cessation, until and after the biosurvey of 3 October 2013. That is, discharge of Taranaki By-products wastewater to Inaha Stream had been occurring for a period of 111 days immediately prior to this biological survey. The record shows that the minimum dilution of wastewater of 1:300 that is required under consent 2049-1 was maintained throughout this period. This means that this biological survey was preceded by an extended period during which discharge occurred, indicating that the macroinvertebrate communities would reflect any changes caused by this discharge if present.

There was a swift to steady, moderate flow at all sites of the unnamed tributary of the Inaha Stream (DT, UT and MT). The flow was uncoloured and clear at UT and MT and uncoloured and cloudy at DT. Stream temperatures ranged from 11.7 °C to 13.0 °C.

Site U in the Inaha Stream was unshaded, while sites 2d, 3 and 4 were partially shaded. The substrate at all sites along the Inaha Stream consisted mainly of cobbles with fine and coarse gravels, boulders, and some sand and silt. Slippery algal mats were recorded at all sites. Macrophytes were recorded on the banks and on the streambed at sites U, 2d, and 4. No macrophytes were recorded at site 3.

There was a swift to steady, moderate flow at all Inaha Stream sites (U, 2d, 3 and 4). The flow was brown and cloudy at these sites, and water temperatures ranged between 12.7°C and 13.3°C.

In the unnamed tributary of the Inaha Stream, site DT was unshaded and had a substrate that consisted mainly of cobbles, fine and coarse gravels with some sand and silt. Patchy algal mats and filaments were noted at this site, and macrophytes were observed growing on the banks and streambed of this site. Sites UT and MT were both partially shaded. Substrate at MT comprised 100% silt, and UT comprised mainly willow root with some silt and sand. No algae was recorded at either UT or MT. Macrophytes were widespread at both UT and MT, growing both on the banks and on the streambed.

Streambed microflora

A microscopic inspection of material collected from the bed of the Inaha Stream found no evidence of 'heterotrophic growths '(protozoa or fungi) at any of the sites sampled. This was

the ninth consecutive survey to record a lack of such growths, continuing the improvement following the late summer 2008 and spring 2009 surveys, which both recorded such growths. This is an important result, as such growth is often associated with 'sewage fungus', and an indication of an abundant supply of organic matter and nutrient enrichment to the stream, and such growths have been recorded (often in abundance) on many previous sampling occasions, particularly downstream of the plant discharges at site 2d. The absence of such growths is evidence that the degree of enrichment is not as severe as that recorded previously.

Macroinvertebrate communities

Results of previous macroinvertebrate surveys performed in the Inaha Stream and the unnamed tributary are summarised and presented together with current results in Table 3. The full results from this current survey are given in Table 4 and Table 5.

Table 3 Summary of previous numbers of macroinvertebrate taxa and MCI and $SQMCI_S$ values together with current results recorded in the Inaha Stream and an unnamed tributary in relation to Taranaki By-Products between September 1987 and October 2013

	Number of taxa				MCI values			$SQMCI_S$ values			
	No. samples	Range	Median	Current survey	Range	Median	Current Survey	No. of samples	Range	Median	Current survey
U	25	18-32	23	23	83-102	95	93	25	4.3-6.5	5.3	6.9
1	66	15-31	22	-	82-104	95	-	42	3.6-6.3	5.1	-
2d	53	10-29	21	23	52-106	78	93	42	1.2-6.5	2.0	4.2
3	66	6-35	21	24	43-99	80	83	42	1.3-5.8	2.4	3.4
4	23	17-31	26	27	77-104	90	93	23	2.0-6.6	4.2	5.7
UT	5	13-19	16	21	97-109	103	91	5	5.3-6.3	5.5	4.2
MT	18	12-29	20	23	71-94	82	81	18	3.1-5.7	4.5	4.1
DT	19	12-25	22	18	80-105	88	93	19	3.5-4.9	4.6	5.3

Inaha Stream

Site U

A moderate community richness of 23 taxa was recorded at site U, the 'control' site on the Inaha Stream. This richness was the same as the median for this site (Table 3). The community (Table 4) was characterised by six 'sensitive' taxa (mayfly (*Deleatidium*), elmid beetles, dobson fly larvae (*Archichauliodes*), stonefly (*Zelandobius*) and caddisflies (*Pycnocentria* and *Pycnocentrodes*)), and one 'tolerant' taxon (snail (*Potamopyrgus*)). The extreme abundance of one 'highly sensitive' taxon and abundance of numerous 'moderately sensitive' taxa together with the absence of any 'heterotrophic growths' on the streambed, indicated good preceding water quality conditions at this control site.

A moderate proportion of 'sensitive' taxa (61%) resulted in an MCI score of 93 units which is slightly lower than median MCI score recorded at this site to date (Table 3 and Figure 2). The $SQMCI_S$ score of 6.9 units was significantly higher than the median for this site and reflected the numerical dominance of several 'sensitive' taxa especially the extremely abundant mayfly *Deleatidium*. These results are reflective of good preceding water quality conditions.

Table 4 Macroinvertebrate fauna of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 3 October 2013

Taxa List	Site Number	MCI score	U	2d	3	4
	Site Code		INH000334	INH000420	INH000430	INH000450
	Sample Number		FWB13241	FWB13243	FWB13244	FWB13245
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	R	R	R
NEMATODA	Nematoda	3	-	R	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	VA	VA	C
	Lumbricidae	5	C	C	-	R
MOLLUSCA	*Ferrissia*	3	-	-	R	-
	Physa	3	-	-	R	R
	Potamopyrgus	4	VA	C	R	A
	Sphaeriidae	3	-	R	C	-
CRUSTACEA	Cladocera	5	-	R	C	-
	Ostracoda	1	R	R	A	C
	Paracalliope	5	R	-	R	R
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	R	-	R
	Coloburiscus	7	R	C	-	C
	Deleatidium	8	XA	A	A	A
	Zephlebia group	7	-	R	R	C
PLECOPTERA (STONEFLIES)	*Acroperla*	5	R	-	-	-
	Zelandobius	5	A	C	C	R
COLEOPTERA (BEETLES)	Elmidae	6	A	VA	A	VA
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	C	C	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	R	R	C	C
	Hydrobiosis	5	C	C	R	C
	Neurochorema	6	R	-	-	R
	Oecetis	4	-	-	C	R
	Olinga	9	-	-	-	R
	Oxyethira	2	-	-	-	R
	Pycnocentria	7	A	C	A	A
	Pycnocentrodes	5	A	A	A	A
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	R	-	-
	Maoridiamesa	3	C	-	-	-
	Orthocladiinae	2	C	-	R	R
	Polypedilum	3	R	R	R	R
	Tanytarsini	3	-	R	R	C
	Empididae	3	R	-	-	R
	Austrosimulium	3	C	R	R	R
		No of taxa	23	23	24	27
		MCI	93	93	83	93
		SQMCIs	6.9	4.2	3.4	5.7
		EPT (taxa)	10	9	8	12
		%EPT (taxa)	43	39	33	44

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

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

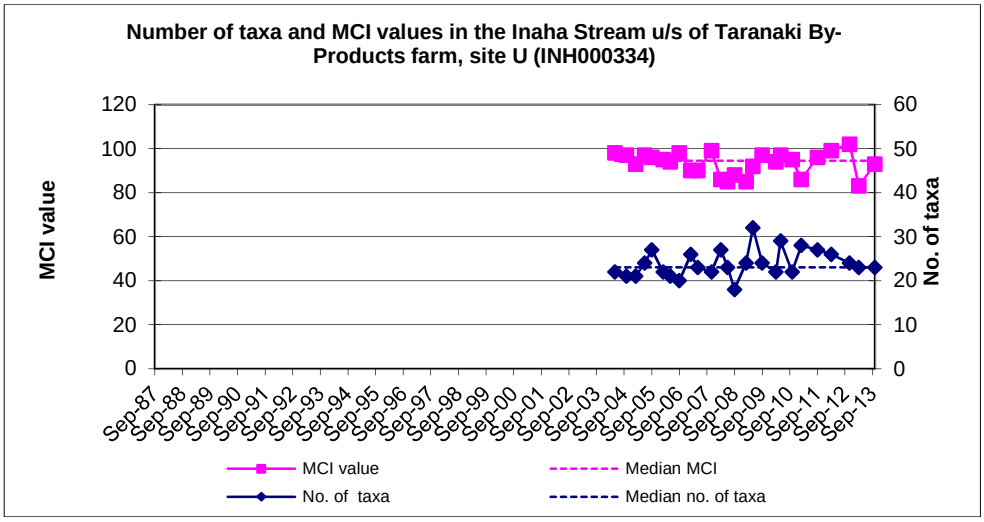

Figure 2 Numbers of macroinvertebrate taxa and MCI values recorded at site U in the Inaha Stream since May 2004

Site 1

Historical MCI results for site 1 are shown in Figure 3, below. A debris dam, impounding the Inaha Stream meant site 1 could not be surveyed on this occasion. The last biological survey of site 1 was performed 15 March 2013.

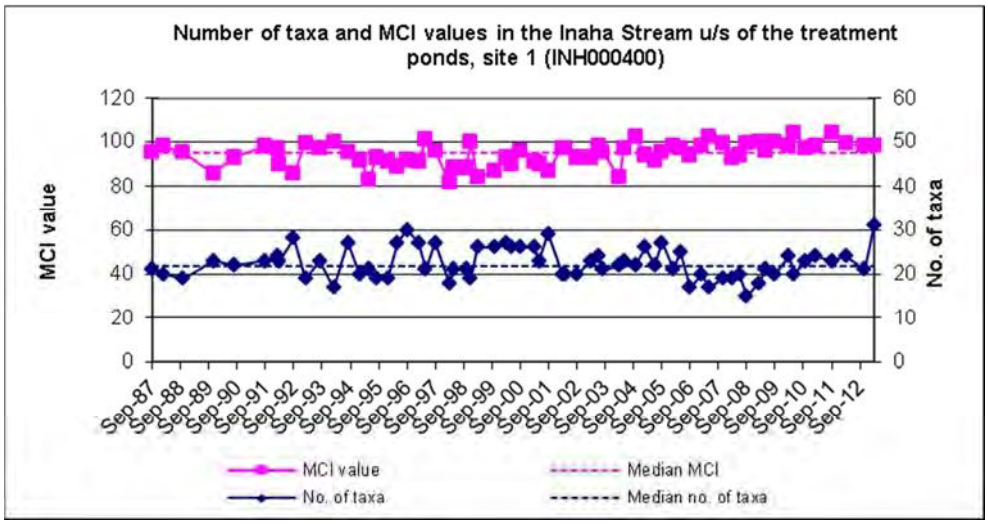

Figure 3 Numbers of macroinvertebrate taxa and MCI values recorded at site 1 in the Inaha Stream since September 1987

Site 2d

A moderate community richness of 23 macroinvertebrate taxa was recorded at site 2d, downstream of the spray irrigation area and the point source discharges of organic wastewater and cooling water to the stream. This richness was the same as what was found at site U and two taxa more than the median recorded for this site (Table 3 and Table 4). The characteristic taxa in the community included one 'highly sensitive' mayfly (*Deleatidium*). Two 'moderately sensitive' taxa were also recorded in abundance (elmid beetles and the stony cased caddisfly (*Pycnocentrodes*)), as was one 'tolerant' taxon, oligochaete worms.

The moderate proportion of 'sensitive' taxa comprising this community (56%) resulted in a MCI score of 93 units, the same MCI result as the upstream control site U. This result was 5 units more than that recorded in the previous survey for this site (Figure 4) and a significant (Stark, 1998) 15 units higher than the historical median MCI score.

Two taxa dominated the community at this site, 'tolerant' oligochaete worms and 'sensitive' elmid beetles. Two sensitive taxa (mayfly *Deleatidium* and caddisfly *Pycnocentrodes*) were also abundant at this site. This resulted in the $SQMCI_s$ score of 4.2 units, which was well above the median $SQMCI_S$ score for the site of 2.0 units, but was significantly lower (2.7 units) than the $SQMCI_S$ score from site U upstream and significantly (1.3 units) lower than what was found in the previous survey.

Over the last few surveys, the main influence on the community at this site has been the degree of algal or macrophyte growth, rather than the wastewater discharge. This indicates that the influence of the wastewater discharge has been reduced, and this is supported by overall improving MCI and $SQMCI_S$ scores.

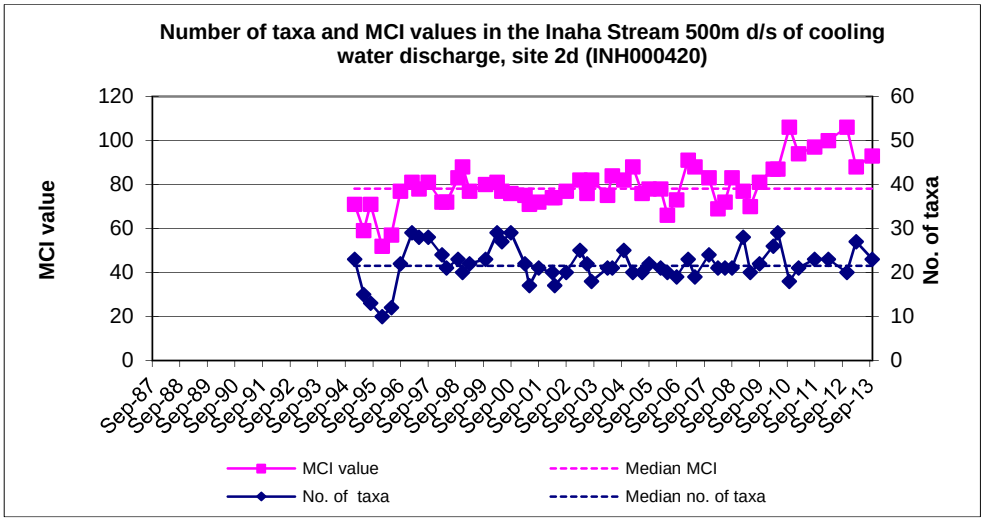

Figure 4 Numbers of taxa and MCI values recorded at site 2d in the Inaha Stream since 1995

Site 3

In this late spring survey, a total of 24 taxa was recorded at site 3, three taxa higher than the median number of taxa recorded at the site (Table 4 and Figure 5). This richness is slightly lower than that recorded in the previous survey for this site, but higher than what was recorded in the two 2012 surveys.

The community at site 3 was characterised by one 'highly sensitive' taxon (mayfly *Deleatidium*), three 'moderately sensitive' taxa (elmid beetles, caddisfly larvae (*Pycnocentria)*

and the stony cased caddisfly (*Pycnocentrodes*) and two 'tolerant' taxa (oligochaete worms and ostracod seed shrimps.

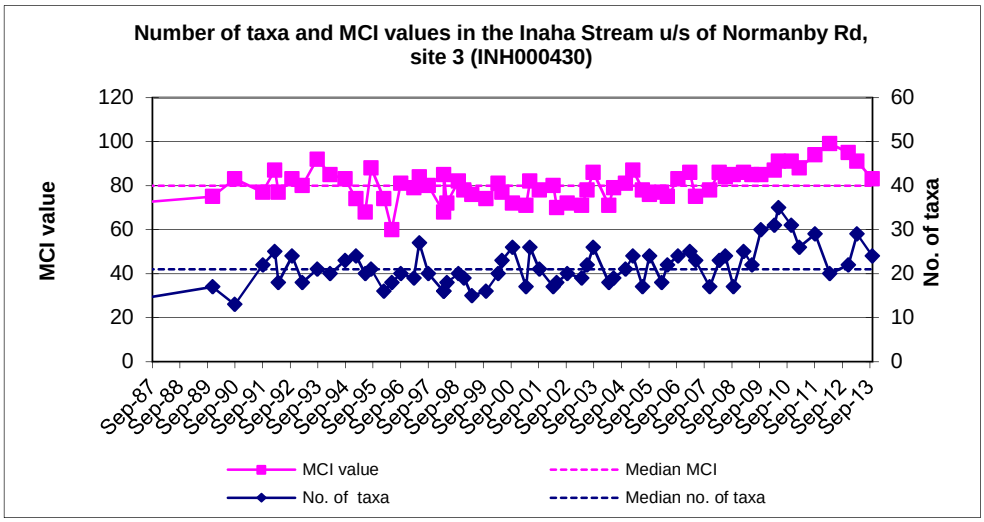

Figure 5 Numbers of taxa and MCI values recorded at site 3 in the Inaha Stream since 1989

The moderate proportion of 'tolerant' taxa (58% of total richness) in the community at this site resulted in the MCI score of 83 units. This MCI score was similar to the historical median of 80 units for the site (Table 3). As at site 2d, there were no significant differences recorded in the MCI scores between site 3 and any upstream site.

The $SQMCI_s$ score recorded at site 3 (3.4 units) in this survey was significantly (Stark, 1998) higher than the historical median $SQMCI_s$ score of 2.4 units. However this result also represented a significant (Stark, 1998) reduction from the previous survey (1.2 units). This $SQMCI_s$ score can be attributed to a numerical dominance of 'tolerant' oligochaete worms, and a reduction in numbers of the 'sensitive' taxon *Archichauliodes*. In comparison to the upstream sites, this $SQMCI_s$ score was significantly less than that recorded at site U, but not significantly different to 2d.

The current results do not show any significant deterioration from that recorded at site 2d, as the deterioration in $SQMCI_s$ score was considered to be related to subtle changes in habitat. The current results are still significantly higher than the long term median for this site, for $SQMCI_S$ score, however since March 2012, both MCI and $SQMCI_S$ scores show a decreasing trend, potentially an indication of a reversal of the recovery recorded previously (Figure 5).

Site 4

A relatively high taxa richness of 27 taxa was recorded at this site which was one taxon more than the historical median for the site (Table 3 and Table 4). The community was characterised by one 'highly sensitive' taxon (*Deleatidium*), four 'moderately sensitive' taxa (elmid beetles, dobsonfly larvae (Archichauliodes) and caddisfly larvae (*Pycnocentria* and *Pycnocentrodes*)) and one 'tolerant' taxon, oligochaete worms (Table 4).

Half of the macroinvertebrate community at site 4 consisted of 'tolerant' taxa which resulted in a MCI score of 93 units, similar to the historical median score for the site, and to that recorded in the previous survey (Table 3 and Figure 6).

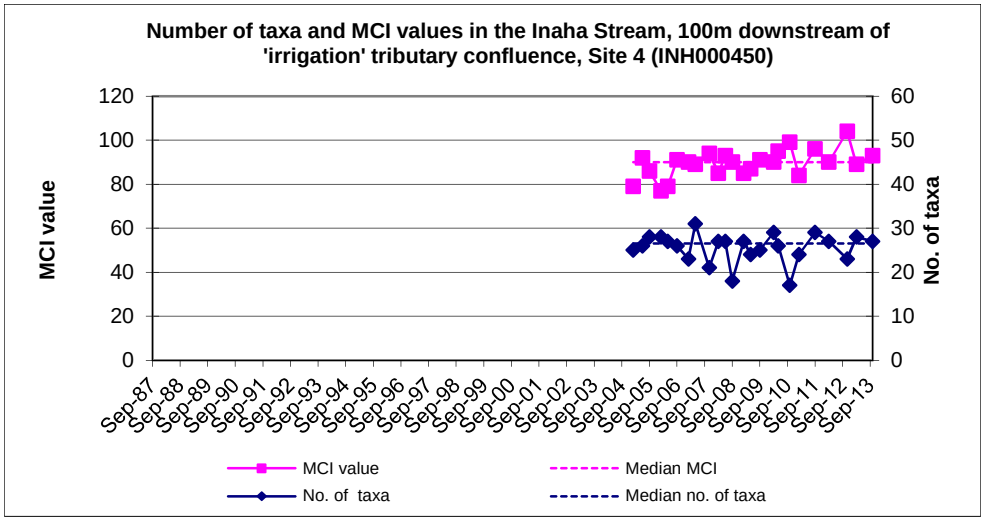

Figure 6 Numbers of taxa and MCI values recorded at site 4 in the Inaha Stream since 2005

The numerical dominance of five 'sensitive' taxa resulted in a moderately high $SQMCI_s$ score of 5.7 units at site 4, indicative of reasonable preceding water quality. This $SQMCI_s$ score was significantly (Stark, 1998) higher than the historic median but was not significantly different than that of the previous survey, indicating no deterioration in 'health' at this site. Overall, this site is in fair 'health', indicating no impact from the unnamed tributary inflow.

Unnamed tributary of the Inaha Stream

Site UT

This recently established site has been monitored on six occasions since March 2010. Unfortunately during the previous survey in March 2013, no sample was collected due to very low flows experienced in this catchment. Prior to the current survey this site was last monitored in November 2012.

During the current survey a moderate community richness of 21 taxa was recorded at site UT, five taxa more than the median for this site, and the highest richness recorded at this site to date (Table 3 and Figure 7). The community was characterised by three 'moderately sensitive' taxa (amphipods (*Paracalliope* and talitridae) and mayfly (*Zephlebia*) and two 'tolerant' taxa, extremely abundant snail (*Potamopyrgus*) and sandfly larvae (*Austrosimulium*) (Table 5)).

The moderately high proportion of 'sensitive' taxa (67%) in the community at site UT resulted in an MCI score of 91 units which was a significant 12 units lower than the historical median MCI score of 103 units but within the range recorded of the previous five surveys (Table 5 and Figure 7). There was a significant decrease in $SQMCI_s$ score (2.1 units) from the previous survey, a reflection of the extreme abundance of the 'tolerant' snail *Potamopyrgus* (Table 5). This $SQMCI_s$ score was also significantly lower (Stark, 1998) than the historical median of 5.5 units, and a possible indication of reduced water quality, although also related to the sampling including macrophyte habitat.

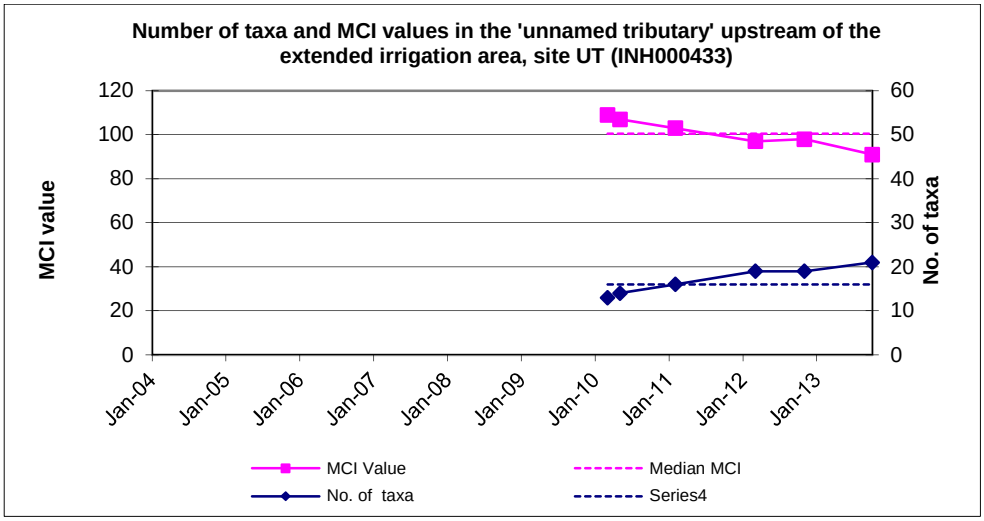

Figure 7 Numbers of taxa and MCI values recorded at site UT in the unnamed tributary of the Inaha Stream

Site MT

A total taxa richness of 23 taxa was recorded at the site in this survey, similar to the long term median for this site, and previous survey results (Table 3 and Figure 8). The current richness was very similar to that recorded at the upstream site UT (Table 5). The community at the site was characterised by two 'moderately sensitive' taxa (amphipods (*Paracalliope* and Talitridae), and two 'tolerant' taxa (snail (*Potamopyrgus*) and sandfly larvae (*Austrosimulium*))(Table 5).This assemblage was typical of species found in small, weedy, softer-bedded, enriched streams under moderate flow conditions.

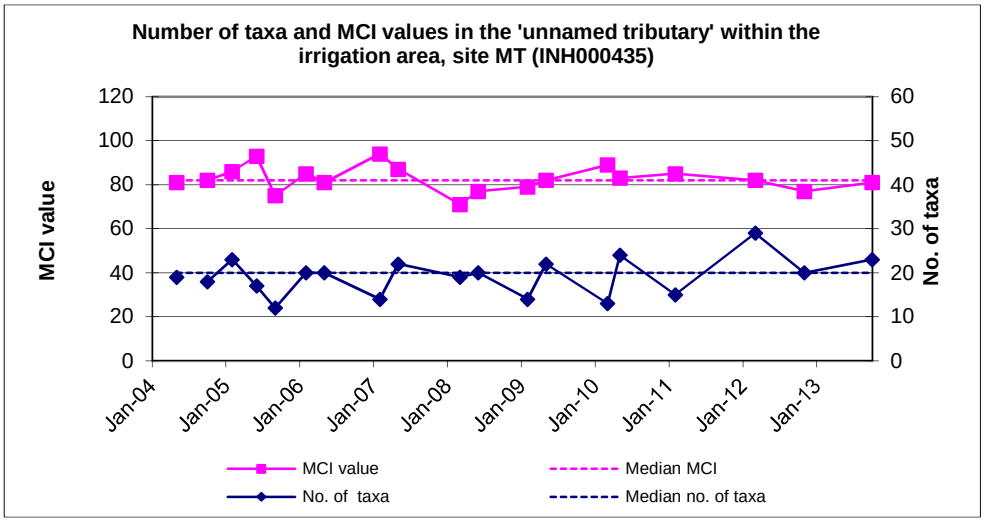

Figure 8 Numbers of taxa and MCI values recorded at site MT in the unnamed tributary of the Inaha Stream since 2004

The MCI score of 81 units recorded at this site was only one unit less than the historical median MCI score for the site and reflected the relatively high proportion (61%) of 'tolerant' taxa present in the community (Figure 8). This MCI score was a statistically insignificant (Stark, 1998) 10 units less than the MCI score recorded at the upstream site UT. The reduction in MCI score can be attributed to a large decrease in the proportion of 'sensitive' taxa at this site, compared to the upstream site (Table 5). The change in habitat sampled is considered to be the most likely reason for this result.

The numerical dominance of the 'tolerant' snail *Potamopyrgus* (extremely abundant) in the community resulted in a SQMCI$_s$ score of 4.1 units which was similar to the score recorded at the upstream site (UT), but 0.3 unit lower than the median for this site. Overall, this does not indicate any deterioration in water quality at this site, and it can be concluded that the irrigation of wastewater in the catchment has not impacted on the instream communities at site MT.

Site DT

A taxa richness of 18 taxa was recorded at site DT in the current survey, which was four taxa less than the historical median for the site but six taxa more than in the previous survey (Table 3 and Figure 9).

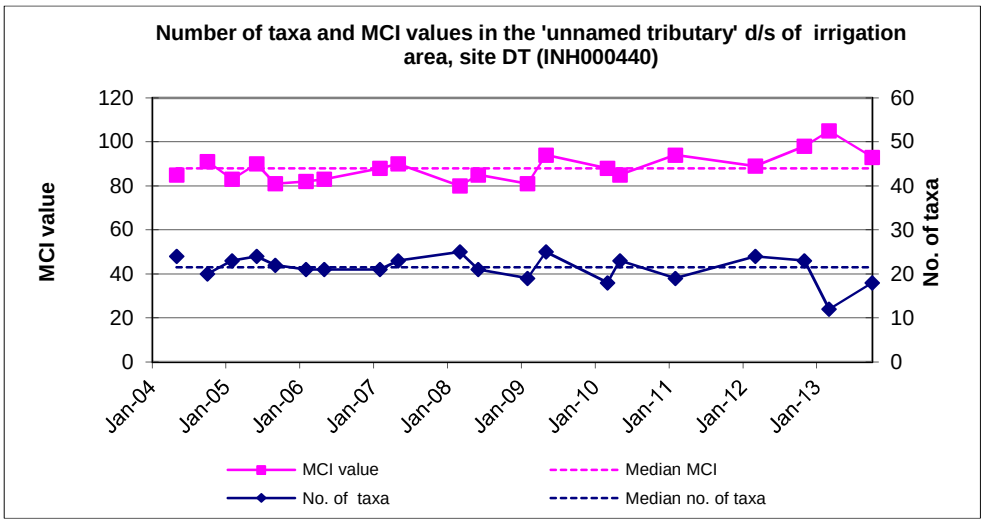

Figure 9 Numbers of taxa and MCI values recorded at site DT in the unnamed tributary of the Inaha Stream since 2004

The community at this site was dominated by three 'moderately sensitive' taxa, amphipod (Talitridae) and mayflies (*Austroclima and Zephlebia*), and two 'tolerant' taxa (snail *Potamopyrgus* and oligochaete worms). This community assemblage was similar to that recorded in previous surveys, consistent with a stream which had macrophyte habitat present and was also indicative of reasonable preceding water quality.

A moderate proportion of the macroinvertebrate community (44%) at this site consisted of 'tolerant' taxa, which resulted in an MCI score of 93 units. This result was an insignificant five units higher (Stark, 1998) than the historical median for this site (Table 3) but a significant 12 units lower than that recorded in the previous survey (Figure 9).

The SQMCI$_S$ score of 5.3 units recorded at the site was 0.7 unit higher than the historical median for the site and was 0.4 unit higher than the highest SQMCI$_s$ score recorded there to date, which was recorded in the previous survey. This relatively high SQMCI$_S$ score was primarily a result of reduced dominance of 'tolerant' taxa (compared with previous surveys).

Table 5 Macroinvertebrate fauna of the unnamed tributary of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 3 October 2013

Taxa List	Site Number	MCI score	UT	MT	DT
	Site Code		INH000433	INH000435	INH000440
	Sample Number		FWB13246	FWB13247	FWB13248
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	-	R
NEMERTEA	Nemertea	3	-	R	-
NEMATODA	Nematoda	3	R	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	C	A
	Lumbricidae	5	C	-	-
MOLLUSCA	Lymnaeidae	3	-	R	-
	Potamopyrgus	4	XA	XA	VA
	Sphaeriidae	3	-	-	R
CRUSTACEA	Copepoda	5	R	-	-
	Ostracoda	1	R	R	R
	Paracalliope	5	VA	A	C
	Paraleptamphopidae	5	R	-	-
	Talitridae	5	A	VA	A
	Paranephrops	5	R	-	R
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	R	VA
	Zephlebia group	7	A	R	A
PLECOPTERA (STONEFLIES)	*Acroperla*	5	R	-	-
	Zelandobius	5	-	-	R
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	-	R	-
COLEOPTERA (BEETLES)	Elmidae	6	-	-	C
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	-	-	R
	Costachorema	7	-	-	R
	Hydrobiosis	5	R	-	-
	Orthopsyche	9	-	R	C
	Polyplectropus	6	-	R	-
	Psilochorema	6	R	-	-
	Oxyethira	2	-	C	-
	Paroxyethira	2	-	R	-
	Pycnocentria	7	C	-	R
	Triplectides	5	-	R	-
DIPTERA (TRUE FLIES)	Eriopterini	5	-	R	-
	Paralimnophila	6	R	-	-
	Corynoneura	3	-	R	-
	Harrisius	6	R	R	-
	Orthocladiinae	2	C	C	R
	Polypedilum	3	C	-	R
	Paradixa	4	-	R	-
	Empididae	3	-	R	-
	Austrosimulium	3	A	A	-
		No of taxa	21	23	18
		MCI	91	81	93
		SQMCIs	4.2	4.1	5.3
		EPT (taxa)	6	5	7
		%EPT (taxa)	29	22	39

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

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

Catchment overview

In the past, heterotrophic growths such as 'sewage fungus' have occurred in the Inaha Stream downstream of the rendering plant which were most likely the result of the discharges from the plant. However, no 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

The MCI and $SQMCI_S$ scores have also shown improvement since 2009, however a reduction has occurred in $SQMCI_S$ scores at two downstream sites, 2d and 3 in the previous two surveys. The lower $SQMCI_S$ scores recorded 2d and 3 can be attributed to increased abundances of 'tolerant' taxa, and not necessarily to a reduction in the abundances of 'sensitive' taxa, as a result of the long term discharge preceding the survey. However wastewater management may need more attention, should this return to less healthy conditions continue. Site 4 also showed a slight reduction in $SQMCI_S$ score from the previous survey, however still consistently records similar scores to those at sites U and 1. The MCI scores also show improvement over time, although the degree of improvement is not as evident as that for the $SQMCI_S$ scores (Figure 11). This is because the MCI scores at sites 3 and 4 have not shown as great an impact in the past. Site 2d on the other hand did, with most early surveys showing significant reductions in MCI score from site 1 to site 2d. The current survey results show no significant changes from the upstream control U site to the downstream sites; 2d, 3 and 4.

The best result for this type of survey is that MCI scores and $SQMCI_S$ scores in the Inaha Stream are not significantly different to each other within each survey. Occasionally differences in habitat between sites can result in different scores, although this can often be explained when the community assemblage is assessed. The $SQMCI_S$ is more sensitive to changes in habitat, and this is evident in Figure 10. Figure 10 and Figure 11 both show that results in recent times recorded MCI and $SQMCI_S$ scores in the Inaha Stream that were not significantly different to each other, and this is considered to be a direct reflection of the improved management of the irrigation system, and consequently a reduced need to discharge wastewater to the stream.

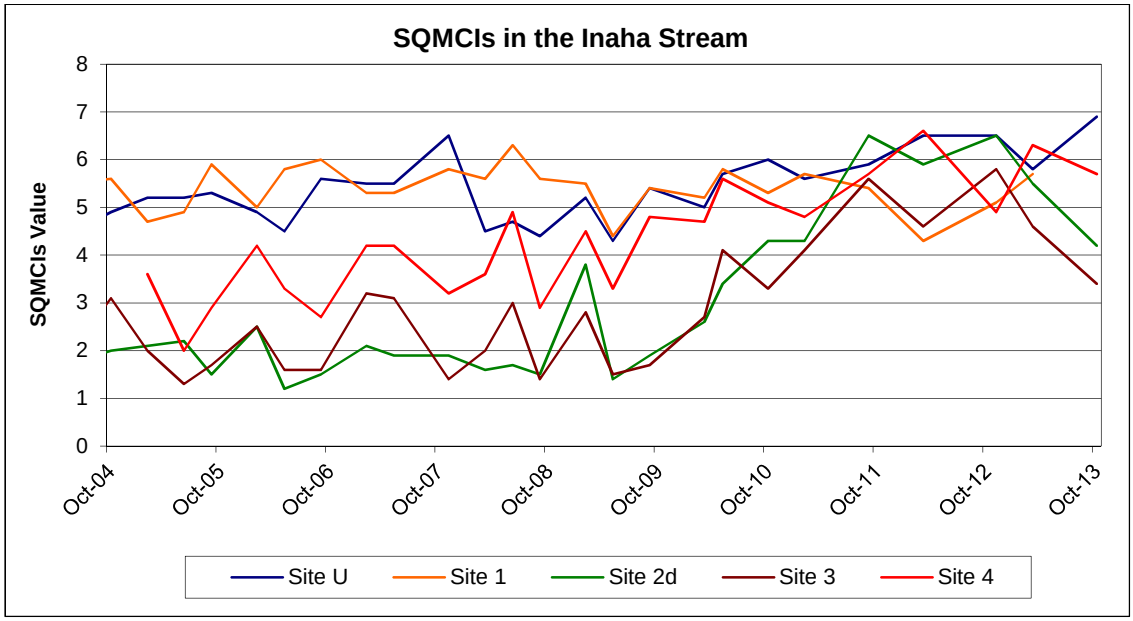

Figure 10 SQMCI$_s$ values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004

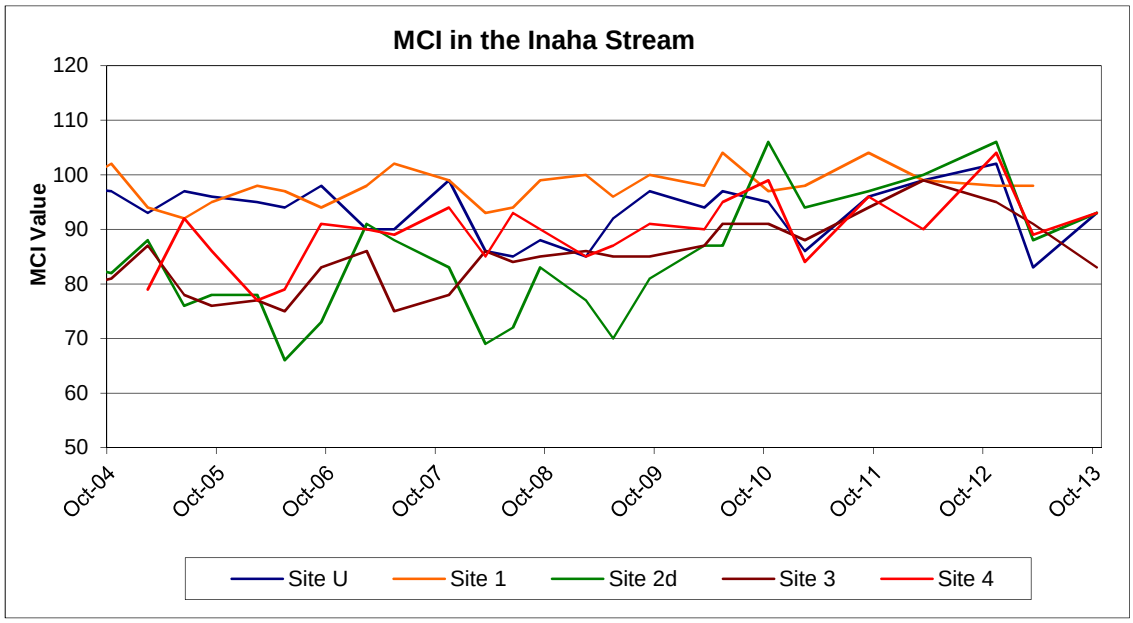

Figure 11 MCI values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004

Summary

The Councils 'kick-sampling' and 'vegetation sweep' techniques, or a combination of the two were used at seven sites to collect streambed macroinvertebrates from the Inaha Stream and an unnamed tributary, to assess whether discharges (via point source and irrigation to land) had had any adverse effects on the macroinvertebrate communities of the streams. Originally it was intended to undertake an eight site survey, but site 1 in the Inaha Stream was unable to be sampled due to very high water levels, the result of a debris dam. Samples were processed to provide number of taxa (richness), MCI and SQMCI$_S$ scores for each site.

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. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The results of this October 2013 biological survey indicated that the Inaha Stream was in fair health, with all four sites recording MCI and $SQMCI_S$ scores similar to or higher than their long term medians. In this survey, the MCI scores recorded at site 2d, immediately downstream of the discharges from the rendering plant was 15 units higher than its long term median. Site 3, just downstream, was 3 units higher than its long term median. This shows that the MCI scores at both sites continue to show improvement from the low scores recorded in 2009. In addition, the $SQMCI_S$ scores at both sites were both significantly higher than their long term medians. Overall, these results indicated that the degree of impact from the wastewater discharge was much less evident than that recorded in previous surveys, which frequently recorded significant enrichment of the stream, and a consequent deterioration of the streambed macroinvertebrate communities. However the improvement noted in the most recent survey was not as evident with sites 2d and 3, which showed a deteriorating trend, and thus a short term reduction in health.

Usually, the sampling sites located upstream of the Taranaki By-Products plant supported macroinvertebrate communities with higher MCI and $SQMCI_S$ values compared to the three sites downstream of the factory discharges. In the current survey there were no statistically significant differences in MCI scores between sites. However, a significant decrease in $SQMCI_S$ scores was recorded between the upstream control site U and the downstream sites, 2d, 3 and 4. This does not indicate deterioration at these sites though, as the results for site U was exceptionally high for this stream, being the highest $SQMCI_S$ score recorded to date. The extreme abundance of the 'highly sensitive' *Deleatidium* mayfly and the abundance of five 'moderately sensitive' taxa supported the high $SQMCI_S$ score found at site U.

Macroinvertebrate richnesses recorded at the three unnamed tributary sites (UT, MT and DT) were very similar to the historical medians for these sites. Community composition was similar between sites, particularly between UT and MT. *Potamopyrgus* snails were common to all sites, as were Talitrid amphipods. Amphipods (*Paracalliope)* and black sandfly larvae (*Austrosimulium*) were common to both UT and MT whereas the mayfly (*Zephlebia*) was common to both UT and DT. The similarities between UT and MT reflected the instream habitat which consisted of willow roots and/or fine sediment. In contrast, the communities at DT also included the very abundant mayfly *Austroclima* and abundant oligochaete worms, a reflection of the stony-bottom rather than fine sediment habitat.

The MCI scores recorded at all unnamed tributary sites were indicative of 'fair' health. There were no significant differences in MCI score between any of the three sites. The upstream site recorded a slightly lower MCI score to that recorded at site DT, supporting the conclusion that the low score recorded at site MT was due to differences in habitat type rather than the result of the discharge of wastewater irrigation to land in the vicinity of the unnamed tributary.

Overall, the macroinvertebrate communities downstream of the Taranaki By-Products discharges in both the Inaha Stream and the unnamed tributary were of 'fair' health. The results of this survey gave no indication that the discharges (to land and to water) from the rendering plant were having any significant adverse effect on the macroinvertebrate

communities in either the Inaha Stream or the unnamed tributary. However some results indicate a possible return to less healthy conditions, and wastewater management needs more attention, particularly in relation to the discharge to the Inaha Stream.

References

Colgan, B, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, June 2003. TRC report BC012.

Dunning KJ, 2001: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2001. TRC report KD78.

Dunning KJ, 2002a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2002. TRC report KD108.

Dunning KJ, 2002b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, April 2002. TRC report KD109.

Dunning KJ, 2002c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2002. TRC report KD132.

Fowles CR and Colgan BG, 2004: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, May 2004. TRC report CF339.

Fowles CR and Colgan BG, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, October 2004. TRC report CF352.

Fowles CR and Jansma B, 2008a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, November 2007. TRC report CF468.

Fowles CR and Jansma B, 2008b: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, March 2008. TRC report CF469.

Fowles CR and Jansma B, 2008c: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, June 2008. TRC report CF470.

Fowles CR and Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2008. TRC report CF471.

Fowles CR and Moore SC, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2004. TRC report CF327.

Fowles CR and Stark JD, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant using artificial substrates January to March 2003. TRC report.

Hickey CW and Vickers ML, 1994: Toxicity of ammonia to nine native New Zealand freshwater invertebrate species. Archives of Environmental Contamination and Toxicology 26: 292-298.

Hope KJ, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, June 2005. TRC report KH043.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2006. TRC report KH087.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2006. TRC report KH088.

Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2006. TRC report BJ033.

Jansma B, 2008: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2007. TRC report BJ034.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2009. TRC report BJ086.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2009. TRC report BJ087.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, September 2009. TRC report BJ094.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2010. TRC report BJ095.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2010. TRC report BJ096.

Jansma B, 2012 (a): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2010. TRC report BJ168.

Jansma B, 2012(b): Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2011. TRC report BJ169.

Jansma B, 2012(c): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2011. TRC report BJ170.

Jansma B and Smith K, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, November 2012. TRC report BJ211.

Jansma B, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2013. TRC report BJ212.

McWilliam H, 2001a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2000. TRC report HM234.

McWilliam H, 2001b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2001. TRC report HM247.

McWilliam H, 2001c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, May 2001. TRC report HM248.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2003. TRC report SM577.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, August 2003. TRC report SM588.

Smith K, 2012: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2012. TRC report KS008.

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research 32(1*): 55-66.

Stark JD, 1999: An evaluation of TRC's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Stark JD and Maxted JR, 2004. Macroinvertebrate community indices for Auckland's soft-bottomed streams and applications to SOE reporting. Prepared for Auckland Regional Council. Cawthron Report No. 970. Cawthron Institute, Nelson. ARC Technical Publication 303. 59p.

Stark JD and Maxted JR, 2007. A biotic index for New Zealand's soft bottomed streams. New Zealand Journal of Marine and Freshwater Research 41(1).

Stark JD and Maxted JR, 2007a. A user guide for the macroinvertebrate community index. Cawthron Institute, Nelson. Cawthron Report No. 1166.

To James Kitto, Job Manager
From Brooke Thomas, Scientific Officer
Report No. BT042
Date 17 November 2014
Doc number 1431160

Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2014.

Introduction

Taranaki By-Products Limited holds a number of consents for discharges to land and to water associated with the operation of a rendering plant and a neighbouring farm owned and operated by the Company. The discharge consents most relevant to this biomonitoring survey are summarised in Table 1 below:

Table 1 Summary of discharge consents held by Taranaki By-Products Limited which are of most relevance to this biological survey

Consent no.	Purpose
2049-4	To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream
2050-4	To discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream
3941-2	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries...between 1700909E-5625245N, 1700631E-5625092N and 1700921E-5625046N
5426-1	To discharge up 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha Stream

Biomonitoring has been undertaken at some sites in relation to the discharges from the rendering plant and associated activities since the mid-1980s. Some of the sites used for the biomonitoring of these discharges have changed over time and these changes have been documented in previous reports (Jansma, 2012 a, b, c).

This summer biological survey was the second of two scheduled in the Inaha Stream catchment in the 2013-2014 monitoring year in relation to discharges from the Taranaki By-Products plant. Results from previous surveys are also referred to in this report (see references).

Methods

This biomonitoring survey was undertaken at eight sites on 12 February 2014 (Table 2 and Figure 1). Five of the eight sites surveyed were in the Inaha Stream and the remaining sites were in an unnamed tributary of the Inaha Stream (Figure 1). The locations of sampling sites in relation to the discharges from the rendering plant are discussed below.

Site U (INH000334) was established in the 2003-2004 monitoring period as an appropriate control site on the Inaha Stream above the rendering plant discharges and irrigation areas. Site 1 (INH000400) is located upstream of the wastewater and cooling water discharge points but downstream of part of the treated wastewater irrigation area. Sites 2d and 3 (INH000420 and INH000430) are located downstream of these two discharges and above the

confluence with the unnamed tributary of the Inaha Stream which drains land upon which wastewater is irrigated.

The area of land authorised to be irrigated onto under consent 3941-2 has increased on several occasions since the consent was granted in December 1999. Sites UT, MT and DT (INH000433, INH000435 and INH000440) were established to monitor the effects of the expanded irrigation area on an unnamed tributary of the Inaha Stream. Site UT was established as a 'control site' for the expanded irrigation area. Site MT is located within the authorised irrigation area and site DT is situated downstream of the irrigation area but upstream of the unnamed tributary's confluence with the Inaha Stream.

Site 4 (INH000450) on the Inaha Stream is situated approximately 100 metres downstream of the convergence point between the Inaha Stream and the unnamed tributary.

Table 2 Biomonitoring sites in the Inaha Stream and in an unnamed tributary relating to the Taranaki By-Products plant

Stream	Site No.	Site code	Location	Sampling method used
Inaha Stream	U	INH000334	Upstream of irrigation area, near Ahipaipa Road	Kick-sweep
	1	INH000400	Upstream of treatment ponds, Kohiti Road	Streambed kick
	2d	INH000420	500 m downstream of cooling water discharge	Kick-sweep
	3	INH000430	Upstream of Normanby Road	Streambed kick
	4	INH000450	100 m downstream of 'irrigation' tributary confluence	Streambed kick
Unnamed tributary of Inaha Stream	UT	INH000433	Upstream of irrigation area	Kick-sweep
	MT	INH000435	Middle site within the new irrigation area	Vegetation sweep
	DT	INH000440	50m upstream Normanby Road	Streambed kick

Two different sampling techniques were used to collect streambed macroinvertebrates in this survey. The Council's standard '400ml kick-sampling' technique was used at sites 1, 3, 4 and DT and the 'vegetation sweep' technique was used at site MT. A combination of the 'kick-sampling' and 'vegetation sweep' sampling techniques was used at sites U, 2d and UT (Table 2). The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

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) = 20-99 individuals;
VA (very abundant) = 100-499 individuals;
XA (extremely abundant) = 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 from a list of taxa taken from one site and multiplying by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

Sub-samples of algal and detrital material 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 these organisms is an indicator of organic enrichment within a stream. Such heterotrophic growths have been recorded on numerous past occasions at sites downstream of the Taranaki By-Products plant as a result of organic nutrient enrichment from the wastewater discharge.

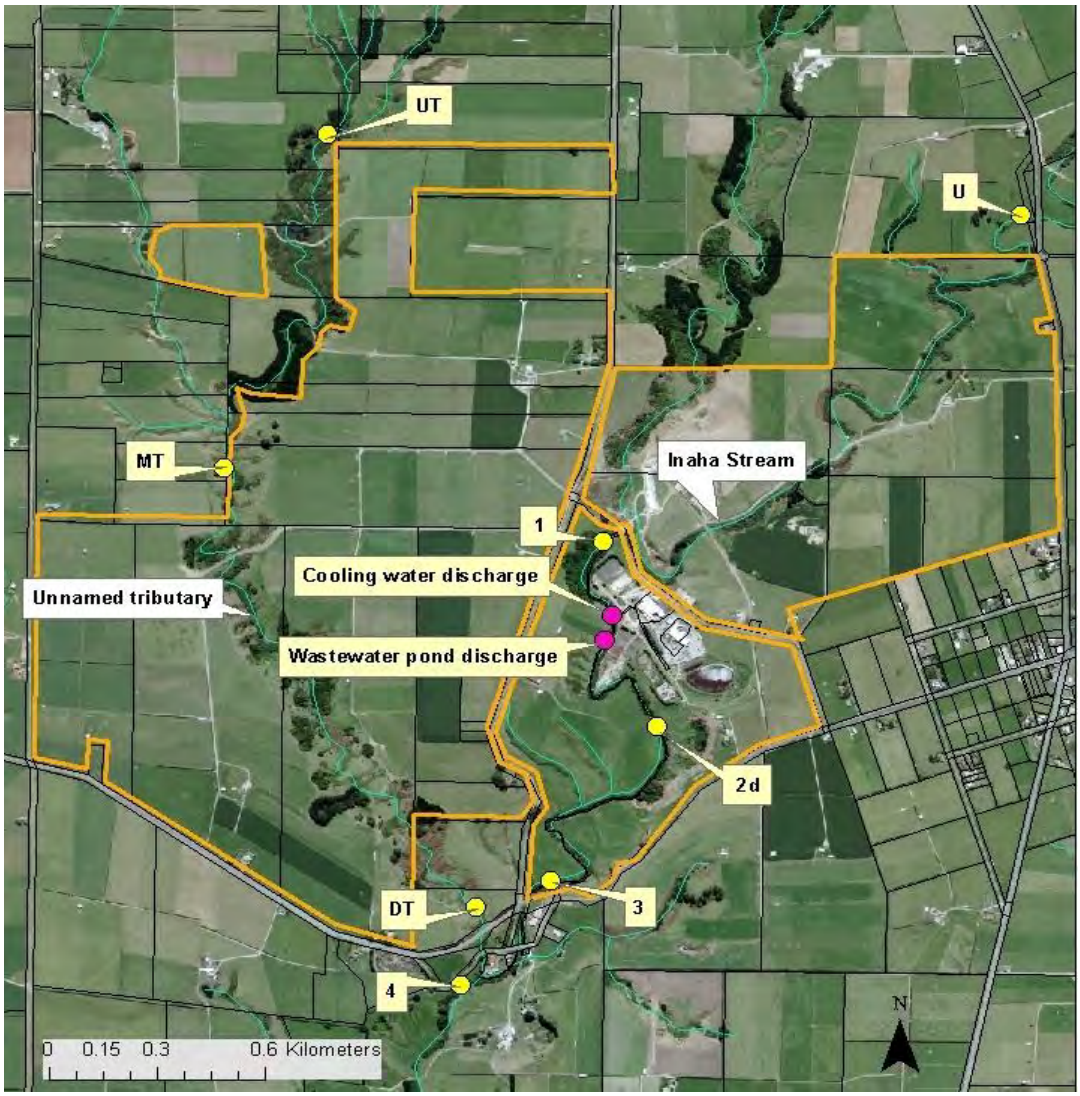

Figure 1 Aerial photo showing biomonitoring sites in the Inaha Stream and an unnamed tributary stream relating to discharges from the Taranaki By-Products plant. The orange line outlines the irrigation areas around the rendering plant

Results and discussion

This February 2014 survey followed a period of 68 days since a fresh in excess of three times median flow in the nearby Waiokura Stream (the nearest appropriate water level recorder). Freshes and floods would likely scour a proportion of the fine organic matter and filamentous periphyton growths from the streambed, which could impact upon macroinvertebrate community compositions. The fact that there were no major fresh events in the two months leading up to the survey suggests that flooding is unlikely to have influenced the macroinvertebrate community; therefore the community should be reflective of preceding water quality conditions.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream ceased on 2 December 2013, and recommenced on 3 July 2014. That is, discharge of Taranaki By-Products wastewater to Inaha Stream had not been occurring for a period of 74 days immediately prior to this biological survey of 12 February 2014.This means that this biological survey was preceded by an extended period after discharge occurred.

There was an uncoloured, clear, low and slow flow at DT and MT in the unnamed tributary of the Inaha Stream, while the flow at UT was brown and very low and slow. Stream temperatures in the unnamed tributary of the Inaha Stream ranged from 14.7 °C to 16.2 °C during this midday survey of the unnamed tributary.

There was a slow and low flow at all Inaha Stream sites (U, 1, 2d, 3 and 4). The flow was grey and cloudy at U and 2d and brown and cloudy at site 3. The flow at site 4 was uncoloured and cloudy and at site 1 the flow was brown and clear. Water temperatures in the Inaha Stream ranged between 15.4°C and 16.6°C.

Sites U and 1 in the Inaha Stream were unshaded, while sites 2d, 3 and 4 were partially shaded. The substrate at site 1 comprised predominantly sand and silt with some fine and coarse gravels, cobbles, wood and root. At sites 2d and U the substrate comprised mainly cobbles, gravels, sand, silt and wood/root with a small proportion of bedrock. The substrate at sites 3 and 4 comprised a slightly higher proportion of cobbles, with fine and coarse gravels, silt, sand and a small proportion of boulders, wood and root. A small proportion of bedrock was recorded at site 4 but not site 3. Slippery algal mats were recorded at all sites, excluding site 1 where only patchy filamentous algae were recorded. Patchy filamentous algae were also recorded at sites U, 2d and 3. Macrophytes were recorded growing at the edges of the stream at sites 1, 3 and 4 and at the edges and on the streambed at sites U and 2d.

In the unnamed tributary of the Inaha Stream, site DT was unshaded and had a substrate that consisted mainly of cobbles with gravels, silt, sand and bedrock. Slippery algal mats and patchy filaments were noted at this site, and macrophytes were observed growing on the banks and streambed of this site. Sites UT and MT were both partially shaded. The substrate at MT comprised predominantly silt, with small proportions of sand and wood/root. The substrate at UT comprised mainly silt and willow root. No algae were recorded growing at either UT or MT. Macrophytes were widespread at both UT and MT, growing both at the edges and on the bed of the stream.

Streambed microflora

A microscopic inspection of material collected from the bed of the Inaha Stream found no evidence of 'heterotrophic growths '(protozoa or fungi) at any of the sites sampled. This was

the tenth consecutive survey to record a lack of such growths, continuing the improvement following the late summer 2008 and spring 2009 surveys, which both recorded such growths. This is an important result, as such growth is often associated with 'sewage fungus', and an indication of an abundant supply of organic matter and nutrient enrichment to the stream, and such growths have been recorded (often in abundance) on many previous sampling occasions, particularly downstream of the plant discharges at site 2d. The absence of such growths is evidence that the degree of enrichment is not as severe as that recorded previously.

Macroinvertebrate communities

Results of previous macroinvertebrate surveys performed in the Inaha Stream and the unnamed tributary are summarised and presented together with current results in Table 3. The full results from this current survey are given in Table 4 and Table 5.

Table 3 Summary of previous numbers of macroinvertebrate taxa and MCI and $SQMCI_S$ values together with current results recorded in the Inaha Stream and an unnamed tributary in relation to Taranaki By-Products between September 1987 and February 2014

	Number of taxa				MCI values			$SQMCI_s$ values			
	No. samples	Range	Median	Current survey	Range	Median	Current Survey	No. of samples	Range	Median	Current survey
U	26	18-32	23	34	83-102	95	85	26	4.3-6.9	5.4	5.0
1	66	15-31	22	25	82-104	95	83	42	3.6-6.3	5.1	3.8
2d	54	10-29	22	30	52-106	78	86	43	1.2-6.5	2.0	3.8
3	67	6-35	21	24	43-99	80	84	43	1.3-5.8	2.4	2.0
4	24	17-31	27	25	77-104	90	90	24	2.0-6.6	4.4	4.2
UT	6	13-21	18	21	91-109	101	87	6	4.2--6.3	5.5	3.5
MT	19	12-29	20	23	71-94	82	83	19	3.1-5.7	4.4	4.8
DT	20	12-25	22	18	80-105	88	90	20	3.5-5.3	4.6	4.3

Table 4 Macroinvertebrate fauna of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 12 February 2014

Taxa List	Site Number	MCI score	Site U	Site 1	Site 2d	Site 3	Site 4
	Site Code		INH000334	INH000400	INH000420	INH000430	INH000450
	Sample Number		FWB14091	FWB14092	FWB14093	FWB14097	FWB14098
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	R	-	R	-	C
NEMERTEA	Nemertea	3	R	-	-	-	-
NEMATODA	Nematoda	3	R	R	R	R	R
ANNELIDA (WORMS)	Oligochaeta	1	VA	VA	A	XA	VA
	Lumbricidae	5	R	R	R	R	-
HIRUDINEA (LEECHES)	Hirudinea	3	-	R	-	-	-
MOLLUSCA	*Ferrissia*	3	-	-	-	R	C
	Latia	5	C	-	-	-	-
	Physa	3	C	-	C	-	-
	Potamopyrgus	4	A	XA	R	C	A
	Sphaeriidae	3	C	-	C	-	A
CRUSTACEA	Ostracoda	1	VA	C	VA	R	A
	Paracalliope	5	XA	VA	VA	R	C
	Paraleptamphopidae	5	-	C	-	-	R
	Talitridae	5	-	R	-	-	C
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	VA	C	A	C	A
	Deleatidium	8	VA	C	C	A	A
	Zephlebia group	7	C	R	A	-	A
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	R	-	R	R	R
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	R	-	-	-	-
HEMIPTERA (BUGS)	*Microvelia*	3	-	-	R	-	-
COLEOPTERA (BEETLES)	Elmidae	6	XA	A	A	A	VA
	Hydrophilidae	5	-	-	R	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	R	-	C	C
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	VA	C	R	VA	VA
	Hydrobiosis	5	C	C	-	C	R
	Neurochorema	6	R	-	-	-	-
	Plectrocnemia	8	R	-	-	-	-
	Polyplectropus	6	-	-	R	-	R
	Hudsonema	6	-	R	R	-	-
	Oecetis	4	-	-	C	-	-
	Oxyethira	2	C	R	R	-	-
	Pycnocentria	7	A	-	R	R	A
	Pycnocentrodes	5	A	C	R	C	C
	Triplectides	5	R	-	A	-	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	-	-	-	R	-
	Zelandotipula	6	-	-	R	-	-
	Chironomus	1	A	R	R	-	-
	Maoridiamesa	3	R	C	-	C	-
	Orthocladiinae	2	A	A	C	VA	C
	Polypedilum	3	C	-	-	C	-
	Tanytarsini	3	C	C	-	C	-
	Dolichopodidae	3	-	R	-	R	-
	Paradixa	4	-	-	C	-	-
	Empididae	3	R	-	-	-	R
	Muscidae	3	-	-	-	R	-
	Austrosimulium	3	C	C	C	R	C
	Tanyderidae	4	R	-	-	-	-
ACARINA (MITES)	Acarina	5	-	-	R	-	-
		No of taxa	34	25	30	24	25
		MCI	85	83	86	84	90
		SQMCIs	5.0	3.8	3.8	2.0	4.2
		EPT (taxa)	11	7	11	7	10
		%EPT (taxa)	32	28	37	29	40

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

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

Table 5 Macroinvertebrate fauna of the unnamed tributary of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 12 February 2013

Taxa List	Site Number	MCI score	UT	MT	DT
	Site Code		INH000433	INH000435	INH000440
	Sample Number		FWB14094	FWB14095	FWB14096
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	-	R
NEMERTEA	Nemertea	3	R	-	-
NEMATODA	Nematoda	3	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	XA	C	C
	Lumbricidae	5	-	R	R
MOLLUSCA	Lymnaeidae	3	-	R	-
	Potamopyrgus	4	XA	VA	XA
	Sphaeriidae	3	C	-	R
CRUSTACEA	Ostracoda	1	VA	C	C
	Paracalliope	5	XA	XA	A
	Paraleptamphopidae	5	A	-	-
	Talitridae	5	VA	VA	VA
	Paranephrops	5	-	R	R
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	R	C	A
	Zephlebia group	7	VA	A	A
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	-	-	C
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	R	-	-
	Procordulia	5	-	R	-
HEMIPTERA (BUGS)	*Microvelia*	3	C	R	-
COLEOPTERA (BEETLES)	Elmidae	6	-	-	C
	Hydrophilidae	5	-	R	-
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	-	R	-
	Orthopsyche	9	-	-	R
	Plectrocnemia	8	R	-	-
	Polyplectropus	6	-	C	-
	Oxyethira	2	-	-	R
	Pycnocentria	7	R	-	-
	Pycnocentrodes	5	-	-	R
	Triplectides	5	-	C	R
DIPTERA (TRUE FLIES)	*Limonia*	6	-	R	-
	Harrisius	6	R	-	-
	Orthocladiinae	2	R	-	-
	Polypedilum	3	R	-	R
	Tanypodinae	5	R	-	-
	Paradixa	4	C	-	-
	Empididae	3	-	C	-
	Ephydridae	4	-	A	-
	Psychodidae	1	-	R	-
	Austrosimulium	3	C	C	-
ACARINA (MITES)	Acarina	5	R	R	-
		No of taxa	21	23	18
		MCI	87	83	90
		SQMCIs	3.5	4.8	4.3
		EPT (taxa)	4	5	6
		%EPT (taxa)	19	22	33

'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa

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

Inaha Stream

Site U

A high community richness of 34 taxa was recorded at site U, the 'control' site on the Inaha Stream. This richness was above the median for this site and the highest taxa richness recorded to date (Table 3). The community (Table 4) was characterised by one 'highly sensitive' taxon (mayfly (*Deleatidium*)), six 'moderately sensitive' taxa; (elmid beetles, dobson fly larvae (*Archichauliodes*), caddisflies (*Pycnocentria* and *Pycnocentrodes*), mayfly (*Austroclima*) and amphipod (*Paracalliope*)), and six 'tolerant' taxa; (oligochaete worms, snail (*Potamopyrgus*), ostracod seed shrimp, orthoclad midges, (*Chironomus*) blood worms and caddisfly (*Aoteapsyche*)). The extreme abundance of two 'moderately sensitive' taxa and abundance of numerous other 'sensitive' taxa together with the absence of any 'heterotrophic growths' on the streambed, indicated good preceding water quality conditions at this control site.

A moderate proportion of 'sensitive' taxa (44%) resulted in an MCI score of 85 units which was lower than median MCI score recorded at this site to date by 10 units (Table 3 and Figure 2). The $SQMCI_S$ score of 5.0 units was slightly lower than the median for this site (by 0.4 unit) and reflected the numerical dominance of several 'sensitive' taxa which was tempered by the abundance of six 'tolerant' taxa. These results are reflective of relatively good preceding water quality conditions.

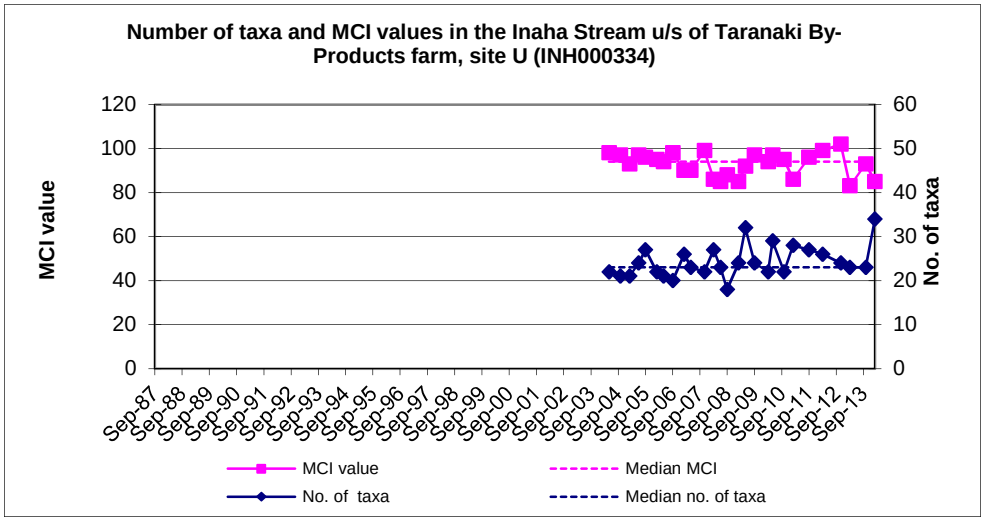

Figure 2 Numbers of macroinvertebrate taxa and MCI values recorded at site U in the Inaha Stream since May 2004

Site 1

A community richness of 25 taxa was found at this site, which was lower than the richness recorded at site U upstream and three taxa higher than the median for the site (Table 4 and Figure 3). The community at this site was characterised by two 'moderately sensitive' taxa (amphipod (*Paracalliope*) and elmid beetles) and three 'tolerant' taxa; (oligochaete worms, (*Potamopyrgus*) snails and orthoclad midges) (Table 4).

The MCI score of 83 units recorded at site 1 represented a decrease of 2 units from the upstream site and was a significant (Stark, 1998) 12 units below the median for this site. This MCI score was also significantly (Stark, 1998) lower than the MCI score recorded by the previous summer (March 2013) survey (by 15 units). A spring 2013 survey could not be carried out due to high water levels, the result of a debris dam that had impounded the Inaha

Stream. The decrease in MCI score from the previous summer survey reflects the increase (13%) in the proportion of low scoring 'tolerant' taxa found within in the community. Periods of low flow and a long period since a significant flood event are likely to have encouraged the higher densities of 'tolerant' taxa, in particular (*Potamopyrgus*) snails. In addition, the clearing of the debris dam prior to this survey is likely to have altered the habitat from the previous survey which may have also affected results.

A moderately low $SQMCI_s$ score of 3.8 units was recorded at site 1 in this survey, which was a significant decline from the $SQMCI_s$ score of 5.7 units recorded at the site in the previous survey. This score was also significantly (Stark, 1998) lower than that recorded at site U. This was the result of a number of significant changes in taxa abundance including a decrease in the numerical dominance of eight 'sensitive' taxa and a significant increase in the abundance of one 'tolerant' taxon. Changes in habitat were the most likely reason for this result. In particular, finer substrate including silt and sand were recorded in much higher proportions than in previous surveys, a possible affect of the clearing of the debris dam prior to this survey.

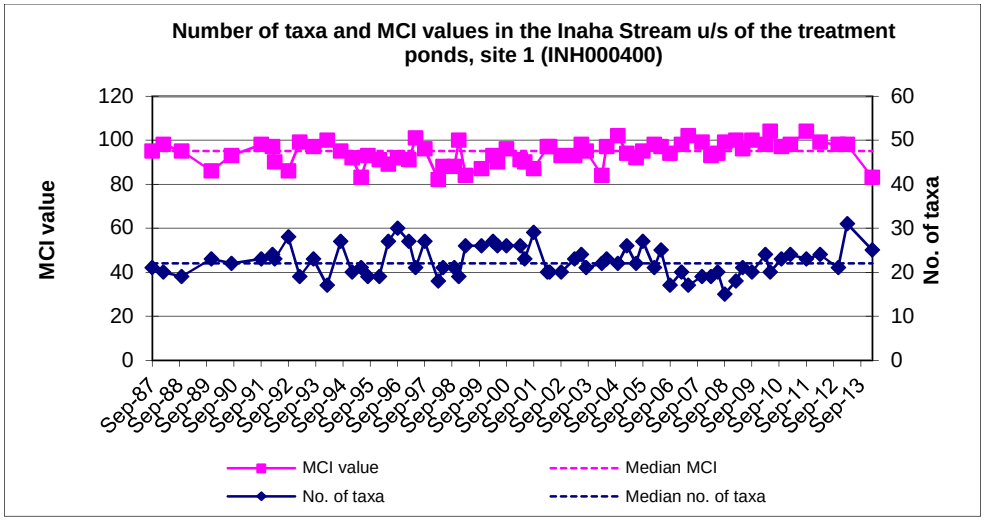

Figure 3 Numbers of macroinvertebrate taxa and MCI values recorded at site 1 in the Inaha Stream since September 1987

Site 2d

A high community richness of 30 macroinvertebrate taxa was recorded at site 2d, downstream of the spray irrigation area and the point source discharges of organic wastewater and cooling water to the stream. This richness was four taxa less than what was found at site U and eight taxa more than the median recorded for this site (Table 3 and Table 4). The characteristic taxa in the community included five 'moderately sensitive' taxa; (amphipod (*Paracalliope*), mayflies (*Austroclima* and *Zephlebia* group), elmid beetles and stick-caddis (*Triplectides*), and two 'tolerant' taxa; (oligochaete worms and ostracod seed shrimp).

The moderate proportion of 'sensitive' taxa comprising this community (50%) resulted in a MCI score of 86 units, one unit higher than t+he upstream control site U. This result was 7 units less than that recorded in the previous survey for this site (Figure 4) and an insignificant (Stark, 1998) 8 units higher than the historical median MCI score.

The macroinvertebrate community at this site was numerically dominated by one 'tolerant' taxon and one 'moderately sensitive' taxon (both very abundant). One other 'tolerant' taxon

and four 'moderately sensitive' taxa were recorded as abundant. This resulted in the $SQMCI_S$ score of 3.8 units, which was well above the median $SQMCI_S$ score for the site of 2.0 units, but was significantly lower (1.2 units) than the $SQMCI_S$ score from site U upstream and similar to what was found in the previous survey.

Over the last few surveys, the main influence on the community at this site has been the degree of algal or macrophyte growth, rather than the wastewater discharge. This indicates that the influence of the wastewater discharge has been reduced, and this is supported by overall improving MCI and $SQMCI_S$ scores.

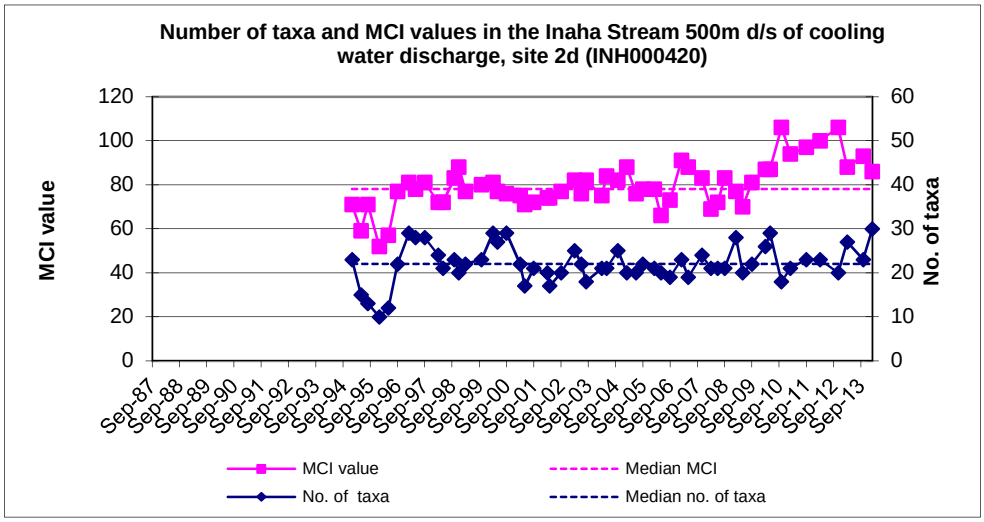

Figure 4 Numbers of taxa and MCI values recorded at site 2d in the Inaha Stream since 1995

Site 3

A total of 24 taxa was recorded at site 3, three taxa higher than the median number of taxa recorded at the site (Table 4 and Figure 5). This richness was the same as that recorded in the previous survey for this site.

The community at site 3 was characterised by one 'highly sensitive' taxon (mayfly *Deleatidium*), one 'moderately sensitive' taxon (elmid beetles) and three 'tolerant' taxa; (oligochaete worms, orthoclad midges and net-building caddis (*Aoteapsyche*)).

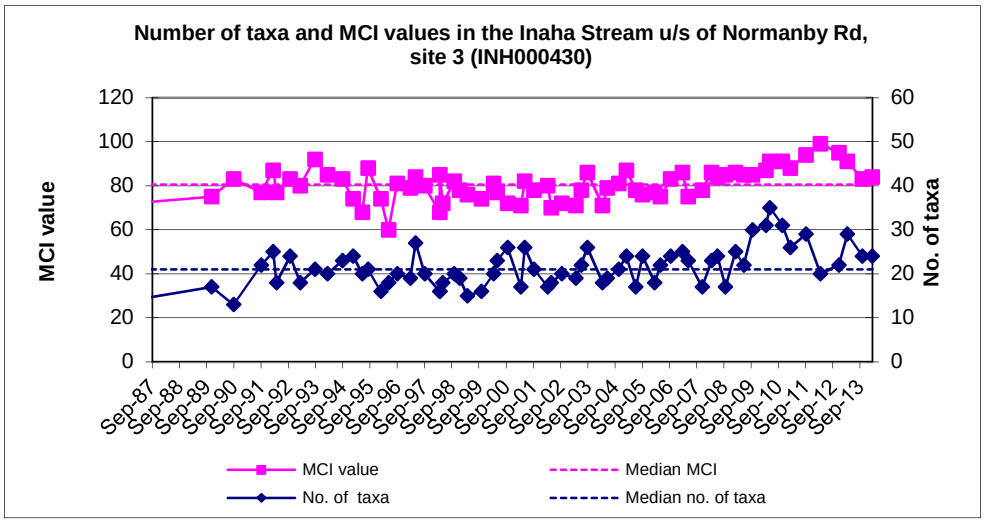

Figure 5 Numbers of taxa and MCI values recorded at site 3 in the Inaha Stream since 1989

The moderate proportion of 'tolerant' taxa (54% of total richness) in the community at this site resulted in the MCI score of 84 units. This MCI score was similar to the historical median of 80 units for the site (Table 3). As at site 2d, there were no significant differences recorded in the MCI scores between site 3 and any upstream site.

The $SQMCI_s$ score recorded at site 3 (2.0 units) in this survey was slightly lower than the historical median $SQMCI_s$ score of 2.4 units. However, this result represented a significant (Stark, 1998) reduction in $SQMCI_s$ score from the previous survey (by 1.4 units) and from the upstream site U (by 3.0 units). This $SQMCI_s$ score can be attributed to a numerical dominance by 'tolerant' oligochaete worms and net-building caddis (*Aoteapsyche*). This $SQMCI_s$ score was also significantly less than that recorded at sites 1 and 2d.

The current results show deterioration in the biological health at this site, possibly the result of long term discharges from the rendering plant, although also related to subtle changes in habitat. The current results are only slightly lower than the long term median for this site, for $SQMCI_S$ score, however since March 2012, both MCI and $SQMCI_S$ scores show a decreasing trend, potentially an indication of a reversal of the recovery previously recorded (Figure 5).

Site 4

A moderate taxa richness of 25 taxa was recorded at this site which was two taxa less than the historical median for the site (Table 3 and Table 4). The community was characterised by one 'highly sensitive' taxon (*Deleatidium*), four 'moderately sensitive' taxa; (elmid beetles, caddisfly larvae (*Pycnocentria*) and mayflies (*Austroclima*) and (*Zephlebia* group)), and five 'tolerant' taxa; (oligochaete worms, snail (*Potamopyrgus*), ostracod seed shrimp, fingernail clam (Sphaeriidae) and net-building caddis (*Aoteapsyche*)) (Table 4).

Over half of the macroinvertebrate community at site 4 consisted of 'sensitive' taxa which resulted in a MCI score of 90 units, the same as the historical median score for the site, and similar to that recorded in the previous survey (Table 3 and Figure 6).

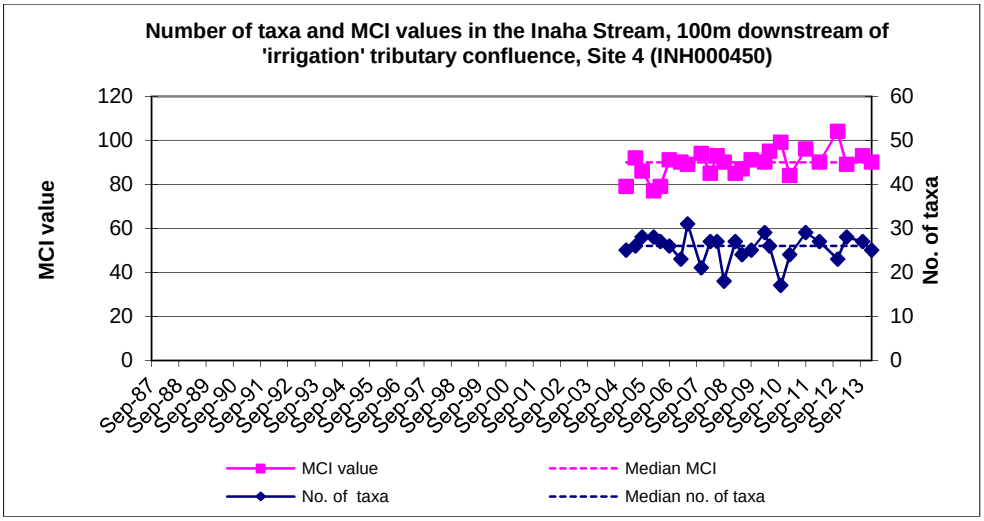

Figure 6 Numbers of taxa and MCI values recorded at site 4 in the Inaha Stream since 2005

The numerical dominance of two 'tolerant' taxa and one 'sensitive' taxon resulted in a moderate $SQMCI_s$ score of 4.2 units at site 4, indicative of reasonable preceding water quality. This $SQMCI_s$ score was slightly lower than the historic median and significantly

(Stark, 1998) lower than the previous two surveys, indicating a potential deterioration in biological 'health' at this site, but also a reflection of the low flows and the long period of time since a significant fresh that preceded this survey.

Unnamed tributary of the Inaha Stream

Site UT

This site has been monitored on seven occasions since March 2010. A moderate community richness of 21 taxa was recorded at site UT, three taxa more than the median for this site, and the same as what was recorded in the previous survey and also the highest richness recorded at this site (Table 3 and Figure 7). The community was characterised by four 'moderately sensitive' taxa (amphipods (*Paracalliope*, talitridae and Paraleptamphopidae) and mayfly (*Zephlebia* group) and three 'tolerant' taxa; (oligochaete worms, snail (*Potamopyrgus*) and ostracod seed shrimp (Table 5)).

The moderately high proportion of 'tolerant' taxa (52%) in the community at site UT resulted in the MCI score of 87 units which was a significant 14 units lower than the historical median of 101 units and the lowest score to date (Table 5 and Figure 7). The $SQMCI_s$ score of 3.5 units represented a decrease in $SQMCI_s$ score (by 0.7 unit) from the previous survey, a reflection of the extreme abundance of 'tolerant' oligochaete worms and snail (*Potamopyrgus*) at this site (Table 5). This $SQMCI_s$ score was also significantly lower (Stark, 1998) than the historical median of 5.5 units, and a likely reflection of the very low flows recorded during this survey.

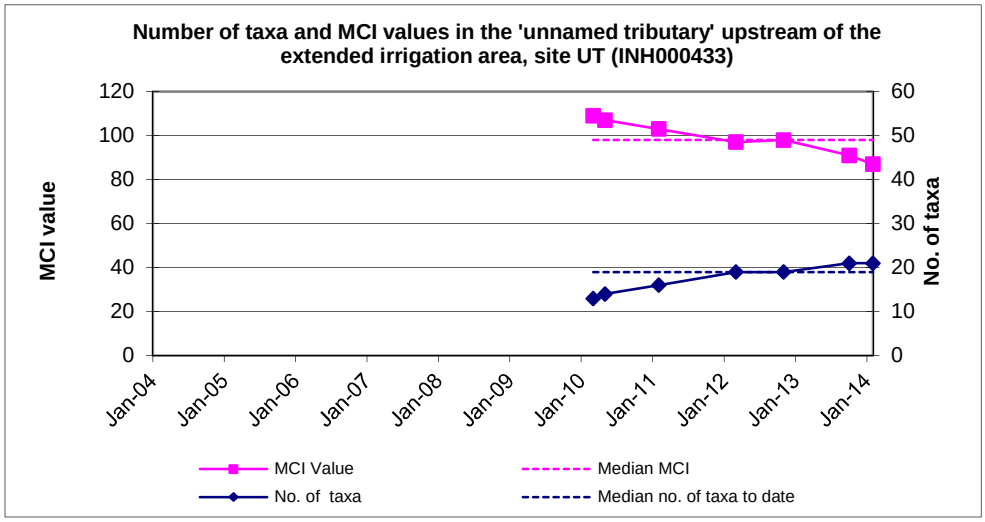

Figure 7 Numbers of taxa and MCI values recorded at site UT in the unnamed tributary of the Inaha Stream

Site MT

A total taxa richness of 23 taxa was recorded at the site MT, similar to the long term median for this site, and similar to previous survey results (Table 3 and Figure 8). The current richness was similar to that recorded at the upstream site UT (Table 5). The community at the site was characterised by three 'moderately sensitive' taxa; (amphipods (*Paracalliope* and Talitridae) and mayfly (*Zephlebia* group) and two 'tolerant' taxa; (snail (*Potamopyrgus*) and fly larvae (Ephydridae)) (Table 5).This assemblage was typical of species found in small, weedy, softer-bedded, enriched streams under low flow conditions.

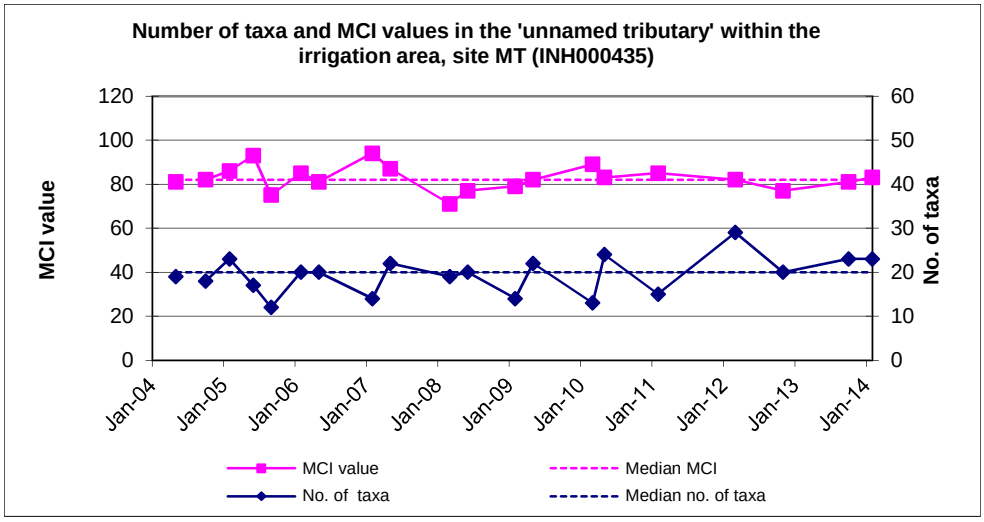

Figure 8 Numbers of taxa and MCI values recorded at site MT in the unnamed tributary of the Inaha Stream since 2004

The MCI score of 83 units recorded at this site was only one unit more than the historical median MCI score for the site and reflected the moderate proportion (52%) of 'sensitive' taxa present in the community (Figure 8). This MCI score was a statistically insignificant (Stark, 1998) 4 units less than the MCI score recorded at the upstream site UT (Table 5).

The numerical dominance of the 'sensitive' amphipod *Paracalliope* (extremely abundant) in the community resulted in a $SQMCI_s$ score of 4.8 units which was significantly (Stark, 1998) higher than that recorded at the upstream site (UT), and 0.4 unit higher than the median for this site. Overall, this does not indicate any deterioration in water quality at this site, and it can be concluded that the irrigation of wastewater in the catchment has not impacted on the instream communities at site MT.

Site DT

A taxa richness of 18 taxa was recorded at site DT in the current survey, which was four taxa less than the historical median for the site but the same as that recorded in the previous survey (Table 3 and Figure 9).

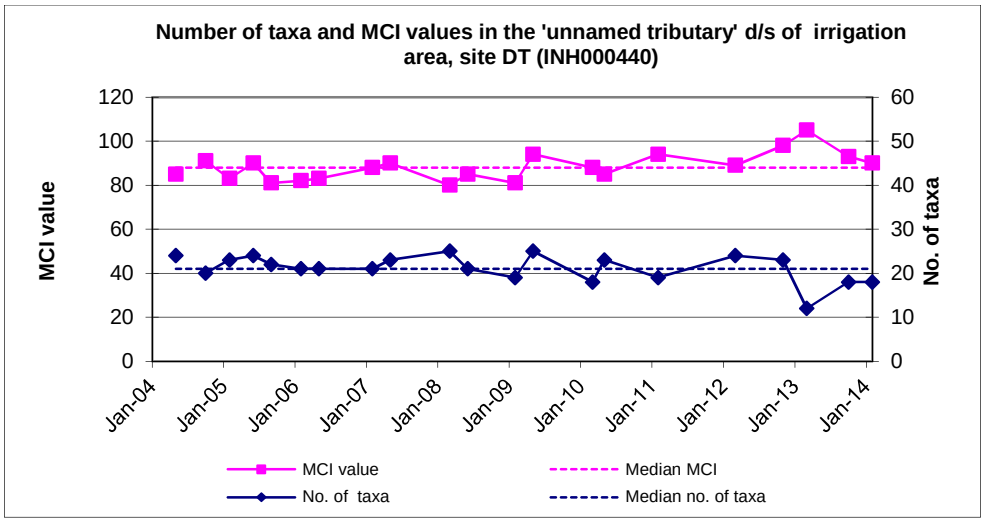

Figure 9 Numbers of taxa and MCI values recorded at site DT in the unnamed tributary of the Inaha Stream since 2004

The community at this site was dominated by the same taxa as those at site MT with the addition of one 'moderately sensitive' taxon (mayfly (*Austroclima*)). This community assemblage was similar to that recorded in previous surveys, consistent with a stream which had macrophyte habitat present and was also indicative of reasonable preceding water quality.

A moderately high proportion of the macroinvertebrate community (61%) at this site consisted of 'sensitive' taxa, which resulted in an MCI score of 90 units. This result was an insignificant two units higher (Stark, 1998) than the historical median for this site (Table 3) and an insignificant 3 units lower than that recorded in the previous survey (Figure 9).

The $SQMCI_S$ score of 4.3 units recorded at site DT was 0.3 unit less than the historical median for the site but within the range of what had been recorded previously.

Catchment overview

In the past, heterotrophic growths such as 'sewage fungus' have occurred in the Inaha Stream downstream of the rendering plant which were most likely the result of the discharges from the plant. However, no 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

The MCI and $SQMCI_S$ scores have also shown improvement since 2009, however a reduction has occurred in $SQMCI_S$ scores at two downstream sites, 2d and 3, in the last three surveys. The lower $SQMCI_S$ scores recorded 2d and 3 can be attributed to increased abundances of 'tolerant' taxa, and not necessarily to a reduction in the abundances of 'sensitive' taxa, as a result of the long term discharge preceding the survey. Wastewater management will need more attention, particularly if this return to less healthy conditions continues. Site 4 also showed a significant (Stark, 1998) reduction in $SQMCI_S$ score from the previous survey, however still consistently records similar scores to those at sites U and 1. The MCI scores also show a general improvement over time, although the degree of improvement is not as evident as that for the $SQMCI_S$ scores (Figure 11). A reduction in MCI scores has occurred at sites 1, 2d, and 4 since the previous survey, and only a very slight improvement in MCI score was recorded at site 3. These results may be attributable to seasonal differences and to the low flows that preceded this survey, but also potentially to long term discharges from the rendering plant.

The best result for this type of survey is that MCI scores and $SQMCI_S$ scores in the Inaha Stream are not significantly different to each other within each survey. Occasionally differences in habitat between sites can result in different scores, although this can often be explained when the community assemblage is assessed. The $SQMCI_S$ is more sensitive to changes in habitat, and this is evident in Figure 10. Figure 10 shows some significant differences in $SQMCI_S$ scores between sites, with site 3 recording a score significantly lower than the other four sites, indicating a potential impact from the rendering plant long term discharges on the macroinvertebrate communities at this site. Site U also recorded a significantly higher $SQMCI_S$ score in comparison to sites further downstream (1 and 2d), although this can be attributed mainly to habitat rather than to impacts caused by the rendering plant.

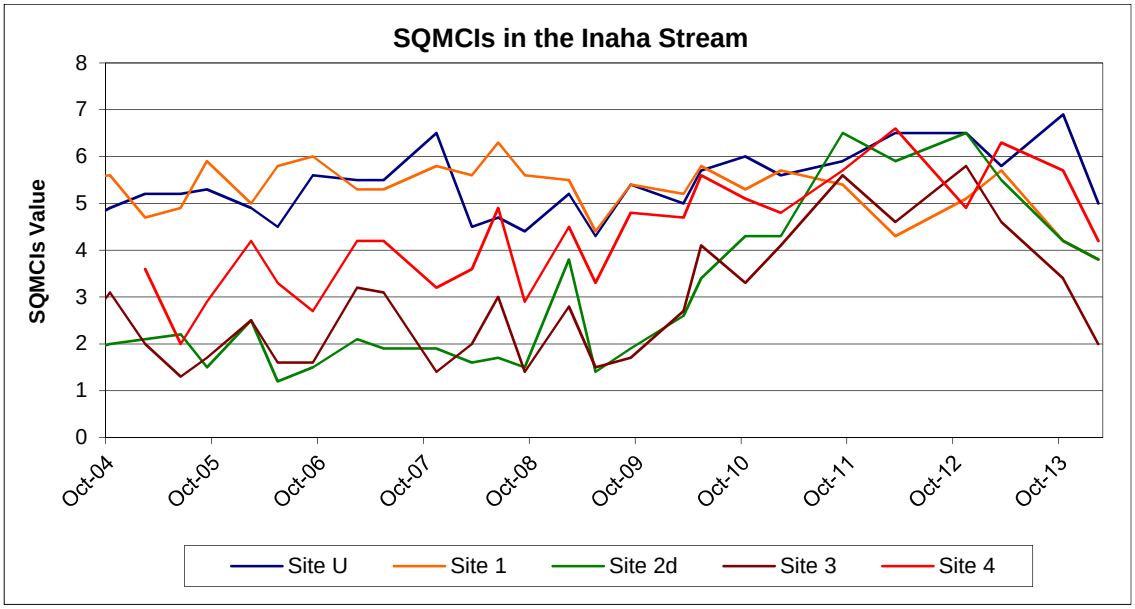

Figure 10 SQMCI$_S$ values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004

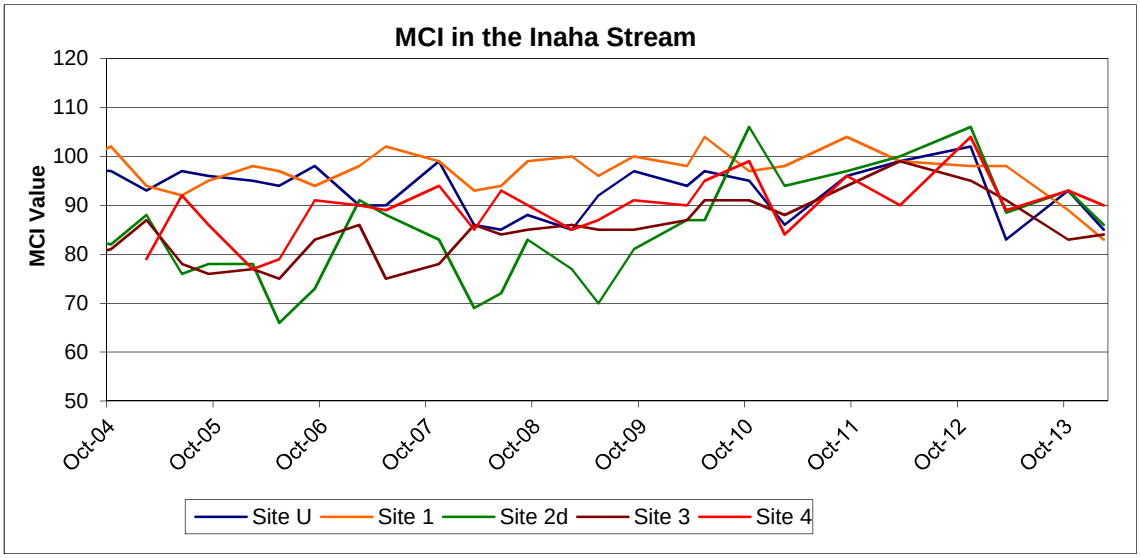

Figure 11 MCI values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004

Summary

The Councils 'kick-sampling' and 'vegetation sweep' techniques, or a combination of the two, were used at eight sites to collect streambed macroinvertebrates from the Inaha Stream and an unnamed tributary, to assess whether discharges (via point source and irrigation to land) had had any adverse effects on the macroinvertebrate communities of the streams. Samples were processed to provide number of taxa (richness), MCI and SQMCI$_S$ scores for each site.

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. The SQMCI$_S$ takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in

communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The results of this February 2014 biological survey indicated that the Inaha Stream was in fair health, with four out of five sites recording MCI and $SQMCI_S$ scores that were not significantly different to their long term medians. Of the five sites surveyed in the Inaha Stream, two sites recorded MCI scores higher than their long term medians (2d and 3) and two sites recorded MCI scores lower than their long term medians (U and 1). Site 4 recorded an MCI equal to its long term median. Only site 2d (located immediately downstream of the discharges from the rendering plant) recorded an $SQMCI_S$ score higher than its long term median (although this result was not significant). Site 1 (located upstream of the wastewater and cooling water discharge points but downstream of part of the treated wastewater irrigation area) recorded MCI and $SQMCI_S$ scores significantly lower than their historical medians for this site. This can be attributed to a disruption of habitat at this site caused by the removal of a debris dam prior to the survey. Overall, these results indicated that the degree of impact from the wastewater discharge was much less evident than that recorded in earlier surveys, which frequently recorded significant enrichment of the stream, and a consequent deterioration of the streambed macroinvertebrate communities.

Usually, the sampling sites located upstream of the Taranaki By-Products plant supported macroinvertebrate communities with higher MCI and $SQMCI_S$ values compared to the three sites downstream of the factory discharges. In the current survey there were no statistically significant differences in MCI scores between sites. However, a significant decrease in $SQMCI_S$ scores was recorded between the upstream control site U and downstream sites 2d and 3, (although not site 4). The $SQMCI_S$ score recorded at site 4 was however significantly lower than that recorded in the previous two surveys, indicating a possible deterioration in biological health at this site. The significant decreases in $SQMCI_S$ scores at sites 2d and 3 may be indicative of long term impacts from the rendering plant discharges but also to the very low flows recorded at the time of this survey.

Macroinvertebrate richnesses recorded at the three unnamed tributary sites (UT, MT and DT) were very similar to the historical medians for these sites. Community composition was similar between sites, with four out of the eight dominant taxa found at all three sites. *Potamopyrgus* snails were abundant to extremely abundant to all sites, as were Talitrid and *Paracalliope* amphipods and mayfly *Zephlebia* group. The similarities in macroinvertebrate community composition between sites reflected similarities in the instream habitat, with proportions of roots and/or fine sediment and instream macrophytes common to all three sites. The communities at DT also included the abundant mayfly *Austroclima*, a reflection of the predominantly stony-bottom rather than fine sediment habitat.

The MCI scores recorded at all unnamed tributary sites were indicative of 'fair' health. There were no significant differences in MCI score between any of the three sites. Sites UT and MT recorded slightly lower MCI scores to that recorded at site DT, which can be attributed to differences in habitat type. Site UT recorded an $SQMCI_S$ score significantly lower than its long term median and significantly lower than that recorded at site MT. This is mainly a reflection of the habitat conditions which were impacted by very low and very slow flows at the time of this survey. Results suggest no long term impact from the discharge of wastewater irrigation to land in the vicinity of the unnamed tributary.

Overall, the macroinvertebrate communities downstream of the Taranaki By-Products discharges in both the Inaha Stream and the unnamed tributary were of 'fair' health. The results of this survey gave no clear indication that the discharges (to land and to water) from the rendering plant were having any significant long term adverse effect on the macroinvertebrate communities in either the Inaha Stream or the unnamed tributary. However, some results indicate a possible return to less healthy conditions, although low flows are likely to have also affected the results.

References

Colgan, B, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, June 2003. TRC report BC012.

Dunning KJ, 2001: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2001. TRC report KD78.

Dunning KJ, 2002a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2002. TRC report KD108.

Dunning KJ, 2002b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, April 2002. TRC report KD109.

Dunning KJ, 2002c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2002. TRC report KD132.

Fowles CR and Colgan BG, 2004: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, May 2004. TRC report CF339.

Fowles CR and Colgan BG, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, October 2004. TRC report CF352.

Fowles CR and Jansma B, 2008a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, November 2007. TRC report CF468.

Fowles CR and Jansma B, 2008b: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, March 2008. TRC report CF469.

Fowles CR and Jansma B, 2008c: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, June 2008. TRC report CF470.

Fowles CR and Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2008. TRC report CF471.

Fowles CR and Moore SC, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2004. TRC report CF327.

Fowles CR and Stark JD, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant using artificial substrates January to March 2003. TRC report.

Hickey CW and Vickers ML, 1994: Toxicity of ammonia to nine native New Zealand freshwater invertebrate species. Archives of Environmental Contamination and Toxicology 26: 292-298.

Hope KJ, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, June 2005. TRC report KH043.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2006. TRC report KH087.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2006. TRC report KH088.

Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2006. TRC report BJ033.

Jansma B, 2008: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2007. TRC report BJ034.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2009. TRC report BJ086.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2009. TRC report BJ087.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, September 2009. TRC report BJ094.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2010. TRC report BJ095.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2010. TRC report BJ096.

Jansma B, 2012 (a): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2010. TRC report BJ168.

Jansma B, 2012(b): Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2011. TRC report BJ169.

Jansma B, 2012(c): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2011. TRC report BJ170.

Jansma B and Smith K, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, November 2012. TRC report BJ211.

Jansma B, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2013. TRC report BJ212.

McWilliam H, 2001a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2000. TRC report HM234.

McWilliam H, 2001b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2001. TRC report HM247.

McWilliam H, 2001c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, May 2001. TRC report HM248.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2003. TRC report SM577.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, August 2003. TRC report SM588.

Smith K, 2012: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2012. TRC report KS008.

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research 32(1*): 55-66.

Stark JD, 1999: An evaluation of TRC's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Stark JD and Maxted JR, 2004. Macroinvertebrate community indices for Auckland's soft-bottomed streams and applications to SOE reporting. Prepared for Auckland Regional Council. Cawthron Report No. 970. Cawthron Institute, Nelson. ARC Technical Publication 303. 59p.

Stark JD and Maxted JR, 2007. A biotic index for New Zealand's soft bottomed streams. New Zealand Journal of Marine and Freshwater Research 41(1).

Stark JD and Maxted JR, 2007a. A user guide for the macroinvertebrate community index. Cawthron Institute, Nelson. Cawthron Report No. 1166.

Thomas B, 2013: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2013. TRC report BT010.

To James Kitto, Job Manager
From Darin Sutherland and Brooke Thomas, Scientific Officers
Report No. DS024
Date July 2015
Doc number 1543514

Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, October 2014

Introduction

Taranaki By-Products Limited holds a number of consents for discharges to land and to water associated with the operation of a rendering plant and a neighbouring farm owned and operated by the Company. The discharge consents most relevant to this biomonitoring survey are summarised in Table 1 below:

Table 1 Summary of discharge consents held by Taranaki By-Products Limited which are of most relevance to this biological survey.

Consent no.	Purpose
2049-4	To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream
2050-4	To discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream
3941-2	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries between 1700909E-5625245N, 1700631E-5625092N and 1700921E-5625046N
5426-1	To discharge up 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha Stream

Biomonitoring has been undertaken at some sites in relation to the discharges from the rendering plant and associated activities since the mid-1980s. Some of the sites used for the biomonitoring of these discharges have changed over time and these changes have been documented in previous reports (Jansma, 2012 a, b, c).

This spring biological survey was the first of two scheduled in the Inaha Stream catchment in the 2014-2015 monitoring year in relation to discharges from the Taranaki By-Products plant. Results from previous surveys are also referred to in this report (see references).

Methods

This biomonitoring survey was undertaken at eight sites on 20 October 2014 (Table 2 and Figure 1). Five of the eight sites surveyed were in the Inaha Stream and the remaining sites were in an unnamed tributary of the Inaha Stream (Figure 1). The sample from site 4 (INH000450) was discarded due to preservative issues and therefore no biological data were obtained from this site. The locations of sampling sites in relation to the discharges from the rendering plant are discussed below.

Site U (INH000334) was established in the 2003-2004 monitoring period as an appropriate control site on the Inaha Stream above the rendering plant discharges and irrigation areas. Site 1 (INH000400) is located upstream of the wastewater and cooling water discharge points but downstream of part of the treated wastewater irrigation area. Sites 2d and 3 (INH000420 and INH000430) are located downstream of these two discharges and above the confluence with the unnamed tributary of the Inaha Stream which drains land upon which wastewater is irrigated.

The area of land authorised to be irrigated onto under consent 3941-2 has increased on several occasions since the consent was granted in December 1999. Sites UT, MT and DT (INH000433, INH000435 and INH000440) were established to monitor the effects of the expanded irrigation area on an unnamed tributary of the Inaha Stream. Site UT was established as a 'control site' for the expanded irrigation area. Site MT is located within the authorised irrigation area and site DT is situated downstream of the irrigation area but upstream of the unnamed tributary's confluence with the Inaha Stream.

Site 4 (INH000450) on the Inaha Stream is situated approximately 100 metres downstream of the convergence point between the Inaha Stream and the unnamed tributary.

Table 2 Biomonitoring sites in the Inaha Stream and in an unnamed tributary relating to the Taranaki By-Products plant.

Stream	Site No.	Site code	Location	Sampling method used
Inaha Stream	U	INH000334	Upstream of irrigation area, near Ahipaipa Road	Streambed kick
	1	INH000400	Upstream of treatment ponds, Kohiti Road	Kick-sweep
	2d	INH000420	500 m downstream of cooling water discharge	Kick-sweep
	3	INH000430	Upstream of Normanby Road	Streambed kick
	4	INH000450	100 m downstream of 'irrigation' tributary confluence	Streambed kick
Unnamed tributary of Inaha Stream	UT	INH000433	Upstream of irrigation area	Kick-sweep
	MT	INH000435	Middle site within the new irrigation area	Vegetation sweep
	DT	INH000440	50m upstream Normanby Road	Streambed kick

Two different sampling techniques were used to collect streambed macroinvertebrates in this survey. The Council's standard '400ml kick-sampling' technique was used at sites U, 3, 4 and DT and the 'vegetation sweep' technique was used at site MT. A combination of the 'kick-sampling' and 'vegetation sweep' sampling techniques was used at sites 1, 2d and UT (Table 2). The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

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) = 20-99 individuals;
VA (very abundant) = 100-499 individuals;
XA (extremely abundant) = 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 from a list of taxa taken from one site and multiplying by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

Where necessary, sub-samples of algal and detrital material 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 these organisms is an indicator of organic enrichment within a stream. Such heterotrophic growths have been recorded on numerous past occasions at sites downstream of the Taranaki By-Products plant as a result of organic nutrient enrichment from the wastewater discharge.

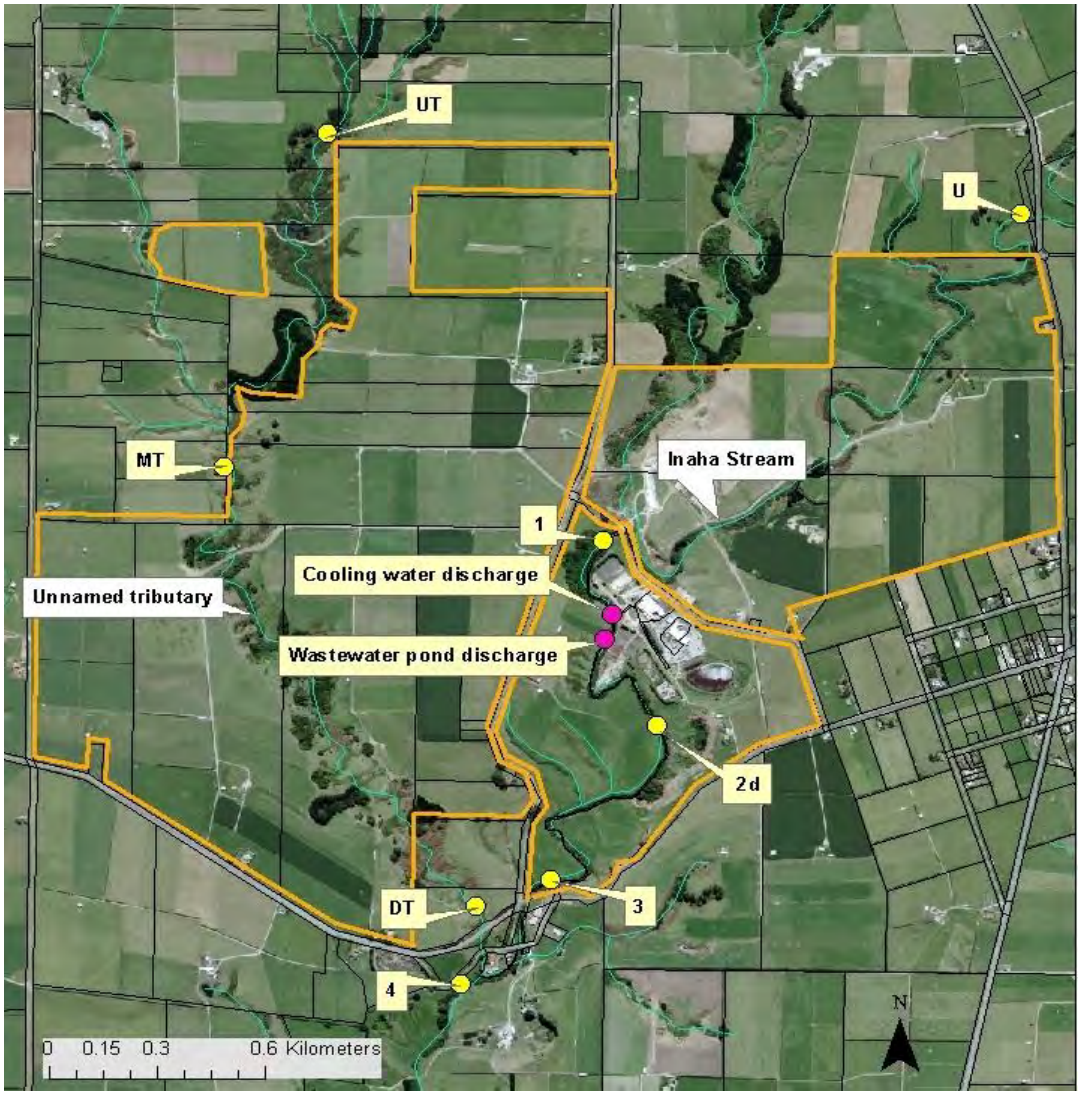

Figure 1 Aerial photo showing biomonitoring sites in the Inaha Stream and an unnamed tributary stream relating to discharges from the Taranaki By-Products plant. The orange line outlines the irrigation areas around the rendering plant.

Results

Site habitat characteristics and hydrology

This October 2014 survey followed a period of 22 days since a fresh in excess of three times median flow in the nearby Waiokura Stream at No. 3 Fairway (the nearest appropriate water level recorder) and 36 days since a fresh in excess of seven times median flow. In the month prior to this survey, there had been three fresh events of which one exceeded three times median flow. Freshes would likely scour a proportion of the fine organic matter and filamentous periphyton growths from the streambed, which could alter macroinvertebrate community compositions.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream began on 3 July 2014 and continued without cessation until 23 September 2014. Therefore, there was a moderate period of 27 days when no discharges occurred prior to this biological survey.

At site U the water was grey and cloudy while at the other Inaha Stream sites (1, 2d, 3 and 4) the water was brown and dirty. There was a moderate, swift flow at most of the Inaha Stream sites (U, 1, 3 and 4) except site 2d which had a moderate, steady flow. Water temperatures in the Inaha Stream ranged between 13.0°C and 14.7°C. There was an uncoloured but cloudy moderate, steady flow at site UT while the flow at site MT was uncoloured, clear, moderate and steady and at site DT it was brown, cloudy, moderate and swift. Stream temperatures in the unnamed tributary of the Inaha Stream ranged from 13.0 °C to 14.0 °C during this morning survey.

In the Inaha Stream, site U had a substrate which was mostly cobbles with some fine and coarse gravel, site 1 had a substrate composition of silt with some fine gravel and wood/root, site 2d had a substrate composition consisting of silt, site 3 had a substrate composition of sand and fine gravel and site 4 had predominately cobble, fine gravel and silt substrate. In the unnamed tributary of the Inaha Stream, sites UT and MT were partially shaded from overhanging vegetation while site DT was unshaded. Substrate at site UT consisted of predominately silt and wood/root while at site MT it consisted of sand and fine gravel and at site DT the substrate composition was mostly fine gravel but with also a mixture of silt, sand, coarse gravel and cobble.

No periphyton mats or filamentous algae were recorded growing at most of the sites in the Inaha Stream (sites 1, 2d, 3 and 4) but the 'control' site (site U) had slippery mats but no filamentous algae. Site U had patchy moss and leaves but no wood or macrophytes; site 1 had no moss and leaves but patchy wood and macrophytes were present on the stream edge; site 2d and no moss and leaves, patchy wood and macrophytes on the stream bed; site 3 had no moss, patchy leaves and wood and no macrophytes; and site 4 had no moss, patchy leaves and wood; and no macrophytes. No periphyton mats or filamentous algae were recorded growing at any of the sites in the unnamed tributary of the Inaha Stream. Site UT had no moss but did have patchy leaves, wood and macrophytes on the streambed. Site MT had no moss and leaves, patchy wood and macrophytes on the stream bed and site DT had patchy moss, no leaves or wood and macrophytes on the stream edges only.

Streambed microflora

A microscopic inspection of material collected from the bed of the Inaha Stream found no evidence of 'heterotrophic growths '(bacterial, protozoa or fungi) at any of the sites sampled. This was the eleventh consecutive survey to record a lack of such growths, continuing the improvement following the late summer 2008 and spring 2009 surveys, which both recorded such growths. This is an important result; as such growth is often associated with 'sewage fungus' which is an indication of high levels of organic matter and nutrient enrichment in the stream. Such growths have been recorded on many previous sampling occasions, often in abundance, particularly downstream of the plant discharges at site 2d. The absence of such growths is evidence that the degree of enrichment is not as severe as that recorded on a number of previous occasions.

Macroinvertebrate communities

Results of previous macroinvertebrate surveys performed in the Inaha Stream and the unnamed tributary are summarised and presented together with current results in Table 3.

Table 3 Summary of previous numbers of macroinvertebrate taxa and MCI and $SQMCI_S$ values for surveys between September 1987 and February 2014 together with current results recorded in the Inaha Stream and an unnamed tributary in relation to Taranaki By-Products.

	Number of taxa				MCI values			$SQMCI_s$ values			
	No. samples	Range	Median	Current survey	Range	Median	Current Survey	No. of samples	Range	Median	Current survey
U	27	18-34	23	22	83-102	94	101	27	4.3-6.9	5.3	6.0
1	67	15-31	22	17	82-104	95	92	43	3.6-6.3	5.1	3.9
2d	55	10-30	22	21	52-106	78	91	44	1.2-6.5	2.0	5.0
3	66	13-35	21	19	60-99	80	93	44	1.3-5.8	2.4	2.7
4	25	17-31	26	NR	77-104	90	NA	25	2.0-6.6	4.2	NR
UT	7	13-21	19	23	87-109	98	92	7	3.5--6.3	5.5	4.5
MT	20	12-29	20	20	71-94	82	84	20	3.1-5.7	4.5	4.4
DT	21	12-25	21	15	80-105	88	91	21	3.5-5.3	4.6	5.3

Table 4 provides a summary of various macroinvertebrate indices within a specific altitudinal band for 'control' sites situated in Taranaki ring plain streams arising outside of Egmont National Park. The full results from this current survey are given in Table 5 and Table 6.

Table 4 Range and median number of taxa, MCI values and SQMCIs scores for 'control' sites (Taranaki ring plain rivers/streams with sources outside Egmont National Park) at altitudes 80-124 m asl (TRC, 2015).

	No. of taxa	MCI value	$SQMCI_S$ value
No. Samples	236	236	180
Range	12-34	66-112	1.3-6.9
Median	22	92	5.0

Table 5 Macroinvertebrate fauna of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 20 October 2014.

Taxa List	Site Number	MCI score	U	1	2d	3
	Site Code		INH000334	INH000400	INH000420	INH000430
	Sample Number		FWB14320	FWB14324	FWB14325	FWB14326
ANNELIDA (WORMS)	Oligochaeta	1	A	VA	A	VA
	Lumbricidae	5	R	R	C	C
HIRUDINEA (LEECHES)	Hirudinea	3	-	-	-	-
MOLLUSCA	*Latia*	5	R	-	-	-
	Potamopyrgus	4	C	A	C	R
	Sphaeriidae	3	-	-	R	R
CRUSTACEA	Ostracoda	1	-	R	A	C
	Isopoda	5	R	-	R	R
	Paracalliope	5	R	VA	XA	A
	Paraleptamphopidae	5	-	A	R	-
	Talitridae	5	-	-	R	-
	Paranephrops	5	R	-	-	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	A	C	R
	Coloburiscus	7	R	-	-	-
	Deleatidium	8	VA	-	-	C
	Zephlebia group	7	-	A	VA	C
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	C	C	R	C
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	-	-	R	-
COLEOPTERA (BEETLES)	Elmidae	6	A	C	C	C
	Dytiscidae	5	-	-	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	C	R	-	-
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	R	R	-	-
	Costachorema	7	R	-	-	-
	Hydrobiosis	5	R	-	R	R
	Hudsonema	6	-	R	C	-
	Oecetis	4	-	-	A	C
	Pycnocentria	7	R	R	C	C
	Pycnocentrodes	5	A	-	-	R
	Triplectides	5	-	-	R	R
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	-	-	-
	Maoridiamesa	3	A	-	-	-
	Orthocladiinae	2	R	R	-	R
	Polypedilum	3	R	-	-	-
	Dolichopodidae	3	-	-	R	-
	Empididae	3	-	R	-	-
	Austrosimulium	3	-	R	C	R
		No of taxa	22	17	21	19
		MCI	101	92	91	93
		SQMCIs	6.0	3.9	5.0	2.7
		EPT (taxa)	9	6	8	9
		%EPT (taxa)	41	35	38	47

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

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

Table 6 Macroinvertebrate fauna of the unnamed tributary of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 20 October 2014.

Taxa List	Site Number	MCI score	UT	MT	DT
	Site Code		INH000433	INH000435	INH000440
	Sample Number		FWB14321	FWB14322	FWB14323
ANNELIDA (WORMS)	Oligochaeta	1	VA	A	C
	Lumbricidae	5	R	R	R
HIRUDINEA (LEECHES)	Hirudinea	3	-	-	R
MOLLUSCA	*Potamopyrgus*	4	VA	XA	VA
	Sphaeriidae	3	A	-	-
CRUSTACEA	Ostracoda	1	C	R	R
	Isopoda	5	R	-	-
	Paracalliope	5	XA	XA	VA
	Paraleptamphopidae	5	VA	-	-
	Talitridae	5	A	VA	VA
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	A	A
	Zephlebia group	7	VA	A	VA
PLECOPTERA (STONEFLIES)	*Acroperla*	5	R	R	-
	Zelandobius	5	R	R	R
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	-	R	-
COLEOPTERA (BEETLES)	Elmidae	6	-	-	C
	Dytiscidae	5	-	-	R
TRICHOPTERA (CADDISFLIES)	*Hydrobiosis*	5	R	R	-
	Hydropsyche (Orthopsyche)	9	-	-	C
	Polyplectropus	6	A	C	-
	Psilochorema	6	R	R	-
	Oxyethira	2	-	C	-
	Pycnocentria	7	C	-	-
	Triplectides	5	R	R	-
DIPTERA (TRUE FLIES)	*Chironomus*	1	-	R	-
	Harrisius	6	C	-	-
	Orthocladiinae	2	R	R	C
	Tanypodinae	5	R	R	-
	Empididae	3	R	-	-
	Austrosimulium	3	VA	VA	R
		No of taxa	23	20	15
		MCI	92	84	91
		SQMCIs	4.5	4.4	5.3
		EPT (taxa)	9	8	4
		%EPT (taxa)	39	40	27
'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa			

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

Inaha Stream

Site U

A moderate taxa richness of 22 taxa was found at site U ('control' site for the Inaha Stream) at the time of the survey which was one less than the median number recorded for the site (median taxa richness 23; Table 3) and 12 less than the previous sample (taxa richness 34; Figure 2).

The MCI score of 101 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 94 units; Table 3) but was significantly higher (Stark, 1998) than the previous survey score (MCI score 85 units; Figure 2). The $SQMCI_s$ score of 6.0 units was similar to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 5.3 units; Table 3) but was higher than the previous survey score ($SQMCI_s$ score 5.0 units).

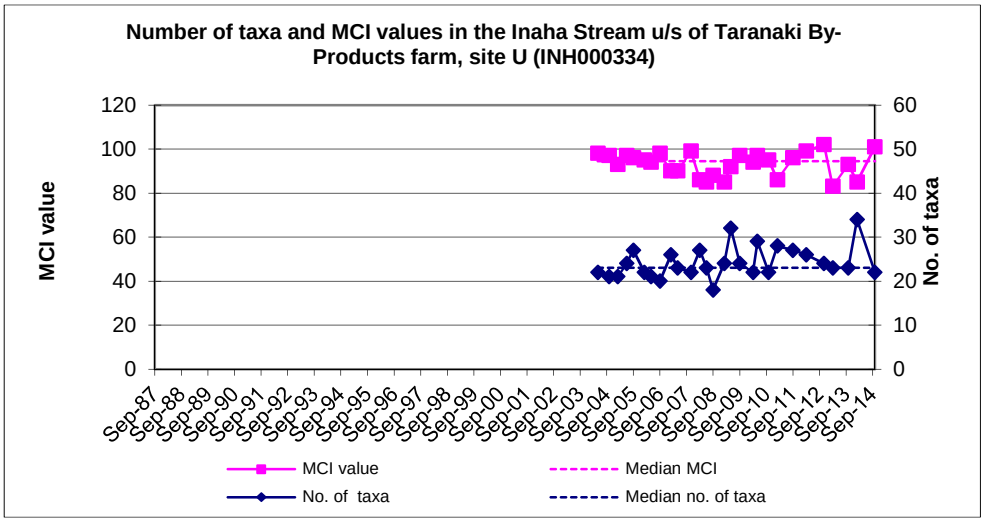

Figure 2 Numbers of macroinvertebrate taxa and MCI values recorded at site U in the Inaha Stream since May 2004.

The community was characterised by two 'tolerant' taxa two [oligochaete worms and midges (*Maoridiamesa*)], two moderately sensitive' taxa [elmid beetles and caddisfly (*Pycnocentrodes*)], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Site 1

A moderate taxa richness of 17 taxa was found at site 1 at the time of the survey which was five less than the median number recorded for the site (median taxa richness 22; Table 3) and eight less than the previous survey (taxa richness 25; Figure 3).

The MCI score of 92 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 95 units; Table 3) but was significantly higher (Stark, 1998)

than the previous survey score (MCI score 83 units; Figure 3). The $SQMCI_s$ score of 3.9 units was lower than the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 5.1 units; Table 3) but was similar to the previous survey score ($SQMCI_s$ score 3.8 units).

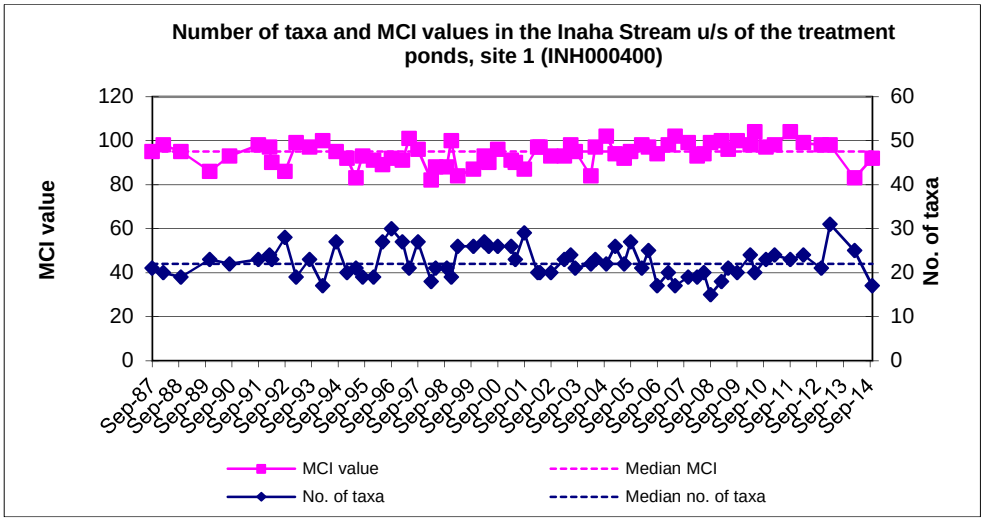

Figure 3 Numbers of macroinvertebrate taxa and MCI values recorded at site 1 in the Inaha Stream since September 1987.

The community was characterised by two 'tolerant' taxa [oligochaete worms and snail (*Potamopyrgus*)] and four 'moderately sensitive' taxa [amphipods (*Paracalliope* and Paraleptamphopidae) and mayflies (*Austroclima* and *Zephlebia* group)] (Table 5).

Site 2d

A moderate taxa richness of 21 taxa was found at site 2d at the time of the survey which was one less than the median number recorded for the site (median taxa richness 22; Table 3) and nine less than the previous survey (taxa richness 30; Figure 4).

The MCI score of 91 units indicated a community of 'fair' biological health which was significantly higher (Stark, 1998) than the median value calculated from previous surveys at the same site (median MCI score 78 units; Table 3) but was not significantly different (Stark, 1998) to the previous survey score (MCI score 86 units; Figure 4). The $SQMCI_s$ score of 5.0 units was significantly higher (Stark, 1998) than the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 2.0 units; Table 3) and was also significantly higher (Stark, 1998) than the previous survey score ($SQMCI_s$ score 3.8 units).

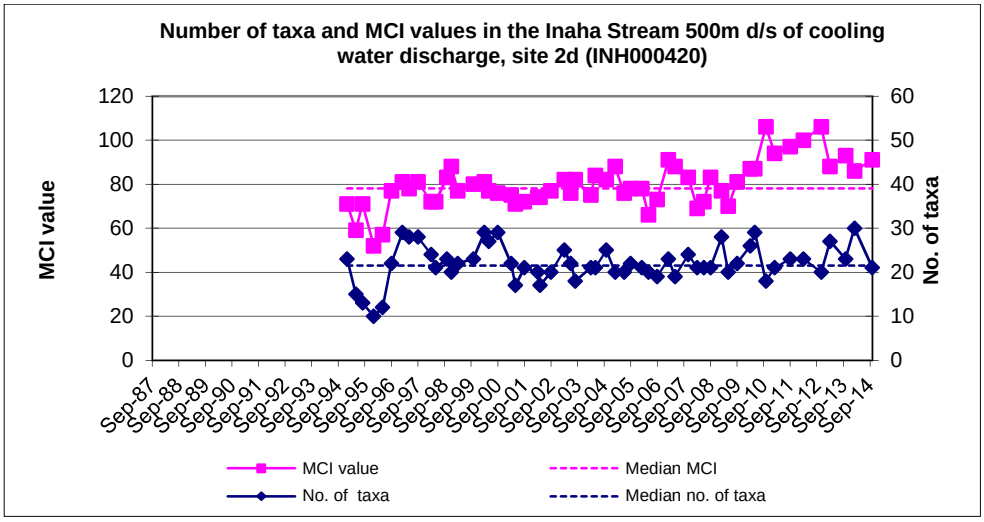

Figure 4 Numbers of taxa and MCI values recorded at site 2d in the Inaha Stream since 1995.

The community was characterised by three 'tolerant' taxa [oligochaete worms, ostracod shrimp and caddisfly (*Oecetis*)] and two 'moderately sensitive' taxa [amphipod (*Paracalliope*) and mayfly (*Zephlebia* group)] (Table 5).

Site 3

A moderate taxa richness of 19 taxa was found at site 3 at the time of the survey which was two less than the median number recorded for the site (median taxa richness 21; Table 3) and five less than the previous survey (taxa richness 24; Figure 5).

The MCI score of 93 units indicated a community of 'fair' biological health which was significantly higher (Stark, 1998) than the median value calculated from previous surveys at the same site (median MCI score 80 units; Table 3) but was not significantly different (Stark, 1998) to the previous survey score (MCI score 84 units; Figure 5). The $SQMCI_s$ score of 2.7 units was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 2.4 units; Table 3) or to the previous survey score ($SQMCI_s$ score 2.0 units).

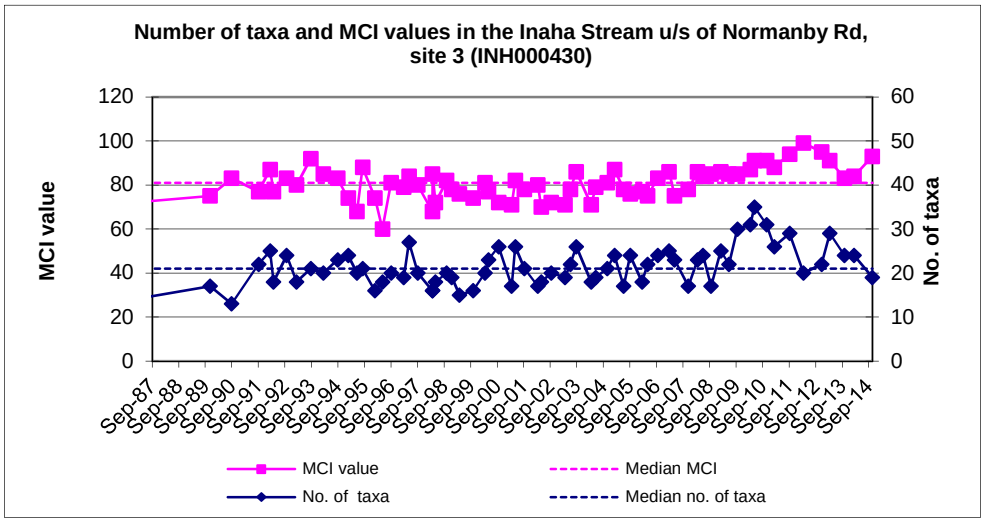

Figure 5 Numbers of taxa and MCI values recorded at site 3 in the Inaha Stream since 1989.

The community was characterised by one 'tolerant' taxon (oligochaete worms) and one 'moderately sensitive' taxon [amphipod (*Paracalliope*)] (Table 5).

Unnamed tributary of the Inaha Stream

Site UT

A moderate taxa richness of 23 taxa was found at site UT ('control' site for the unnamed tributary of the Inaha Stream) at the time of the survey which was four more than the median number recorded for the site (median taxa richness 19; Table 3) and two more than the previous survey (taxa richness 21; Figure 6). This site had only been monitored on eight occasions since March 2010 and therefore has a smaller dataset than other sites in this survey. Comparisons with median values are therefore not as robust as other sites.

The MCI score of 92 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 98 units; Table 3) or to the previous survey score (MCI score 87 units; Figure 6). The $SQMCI_s$ score of 4.5 units was lower than the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 5.5 units; Table 3) and higher than the previous survey score ($SQMCI_s$ score 3.5 units).

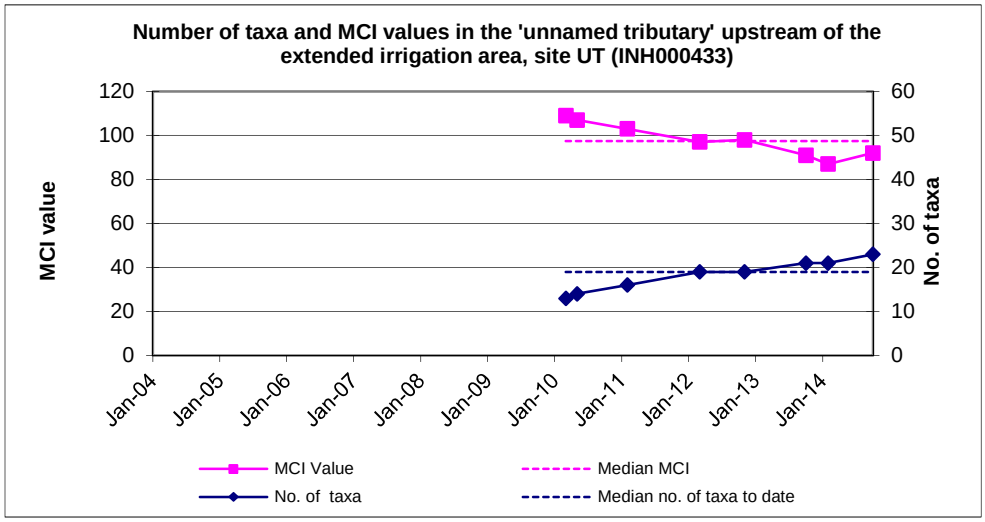

Figure 6 Numbers of taxa and MCI values recorded at site UT in the unnamed tributary of the Inaha Stream.

The community was characterised by four 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), pea clams (Sphaeriidae) and sandfly (*Austrosimulium*)] and five 'moderately sensitive' taxa [amphipods (*Paracalliope*, Paraleptamphopidae and Talitridae), mayfly (*Zephlebia* group) and caddisfly (*Polyplectropus*)] (Table 6).

Site MT

A moderate taxa richness of 20 taxa was found at site MT at the time of the survey which was the same number as the median number recorded for the site (median taxa richness 20; Table 3) and three less than the previous survey (taxa richness 23; Figure 7).

The MCI score of 84 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 82 units; Table 3) or to the previous survey score (MCI score 83 units; Figure 7). The $SQMCI_s$ score of 4.4 units was similar to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 4.5 units; Table 3) and to the previous survey score ($SQMCI_s$ score 4.8 units).

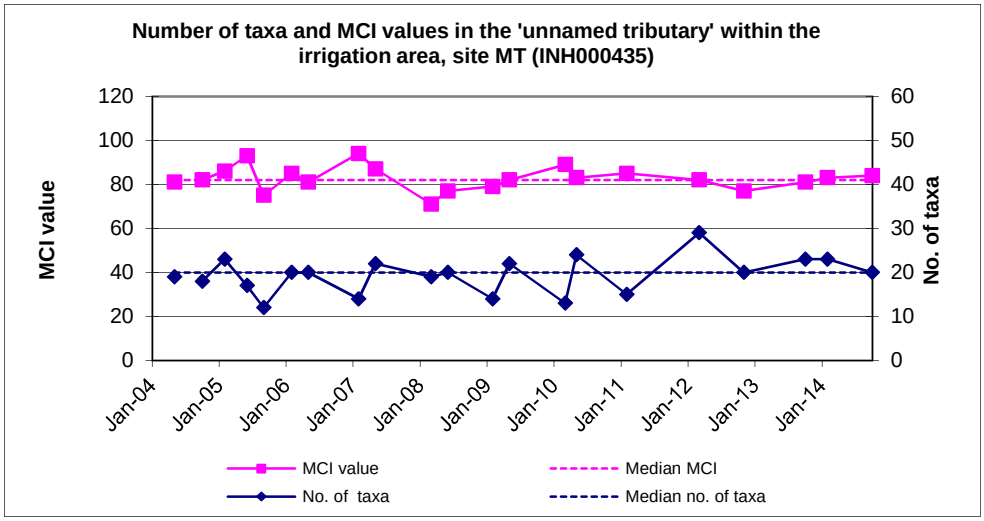

Figure 7 Numbers of taxa and MCI values recorded at site MT in the unnamed tributary of the Inaha Stream since 2004.

The community was characterised by three 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), and sandfly (*Austrosimulium*)] and four 'moderately sensitive' taxa [amphipods (*Paracalliope* and Talitridae) and mayflies (*Austroclima* and *Zephlebia* group)] (Table 6).

Site DT

A moderately low taxa richness of 15 taxa was found at site DT at the time of the survey which was six taxa less than the median number recorded for the site (median taxa richness 21; Table 3) and three less than the previous survey (taxa richness 18; Figure 8).

The MCI score of 91 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 88 units; Table 3) or to the previous survey score (MCI score 90 units; Figure 8). The $SQMCI_s$ score of 5.3 units was similar to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 4.6 units; Table 3) and was higher than the previous survey score ($SQMCI_s$ score 4.3 units).

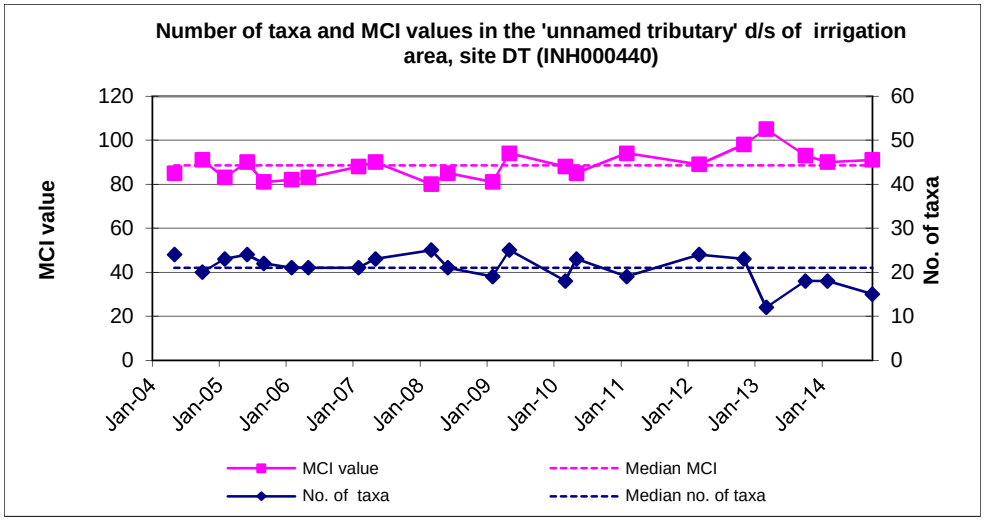

Figure 8 Numbers of taxa and MCI values recorded at site DT in the unnamed tributary of the Inaha Stream since 2004.

The community was characterised by one 'tolerant' taxon [snail (*Potamopyrgus*] and four 'moderately sensitive' taxa [amphipods (*Paracalliope* and Talitridae) and mayflies (*Austroclima* and *Zephlebia* group)] (Table 6).

Discussion

In the past, heterotrophic growths such as 'sewage fungus' have occurred in the Inaha Stream downstream of the rendering plant which were most likely the result of the discharges from the plant. However, no 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in the spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

Inaha Stream

The three 'potentially impacted' sites (sites 1, 2d and 3) MCI scores were not significantly different (Stark, 1998) to each other or to the 'control' site (site U) indicating that there was no impact from discharges associated with Taranaki By-Products. Furthermore, a comparison with similar sites shows that MCI scores at all four sites were not significantly different (Stark, 1998) to other similar sites at the same altitudinal band (MCI score 92 units; Table 4). However, all three 'potentially impacted' sites had very similar MCI scores (within 1-2 units) which was on average nine units lower than the 'control' site which is suggestive that the difference between the 'control' and 'impacted sites' may be real rather than an artefact of sampling. Furthermore, the mayfly, *Deleatidium* sp, the only 'sensitive' taxon recorded in the Inaha Stream at the time of the survey was 'very abundant' at site U but was absent from sites 1 and 2d and only 'common' at site 3. The control site also had a markedly higher $SQMCI_s$ score (by 2.1 units) compared with site 1 which is suggestive of mild deterioration in the macroinvertebrate community between site U and site 1.

The differences between sites 1 and 2d for both MCI and $SQMCI_S$ scores and taxa richnesses were very small and insignificant indicating that the cooling water and wastewater pond

discharges did not have a signficant impact on the downstream macroinvertebrate communities. There were also insignificant differences between sites 2d and 3 for MCI and taxa richness though there was a markedly lower $SQMCI_S$ score at site 3 and a general decrease in taxa abundances with only the highly 'tolerant' oligochaete worms increasing in abundance from site 2d to 3. This result may be a reflection of poorer habitat quality at site 3 rather than an increase in organic pollution. Occasionally differences in habitat between sites can result in different scores, although this can often be explained when the community assemblage is assessed. The $SQMCI_S$ is more sensitive to changes in habitat. Figure 9 shows some significant differences in $SQMCI_S$ scores among sites, with site 3 recording a score significantly lower than the other four sites.

An examination of the current survey results compared with the previous survey performed in February 2014 shows insignificant increases (Stark, 1998) in MCI scores for the three 'potentially impacted' sites and a significant increase (Stark, 1998) in MCI score at the 'control' site which may indicate seasonal and habitat variation. Macroinvertebrate community health indices are often higher during spring compared with summer in the Taranaki region due to greater spring water flows, lower water temperatures and lower periphyton abundances. $SQMCI_s$ scores and taxa richnesses were also not markedly different from the preceding survey, except for the 'control' site which showed a decrease in taxa richness that would be unrelated to Taranaki By-Products activities. One possible explanation for the increase in MCI and decrease in taxa richness is the amount of organic nutrients in the Inaha Stream. It has been observed that small increases in organic nutrients can increase taxa richness in relatively healthy waterbodies and therefore a reduction in organic nutrients could have the opposite result and decrease taxa richness.

In general there were no significant differences between the current survey and the median value calculated from previous surveys for sites U and 1 but sites 2d and 3 showed significantly higher MCI scores and for site 2d, a markedly higher $SQMCI_s$ score which indicates that the macroinvertebrate community was in better health than what has normally been found at those sites. Examination of the trends suggests improvements began to appear in 2009 (Figure 9 and Figure 10) but in recent surveys large fluctuation in macroinvertebrate indices have occurred suggesting a decline in environmental performance. However, for the current survey, discharges by Taranaki By-Products do not appear to be having a significant impact on the macroinvertebrate communities present in the Inaha Stream.

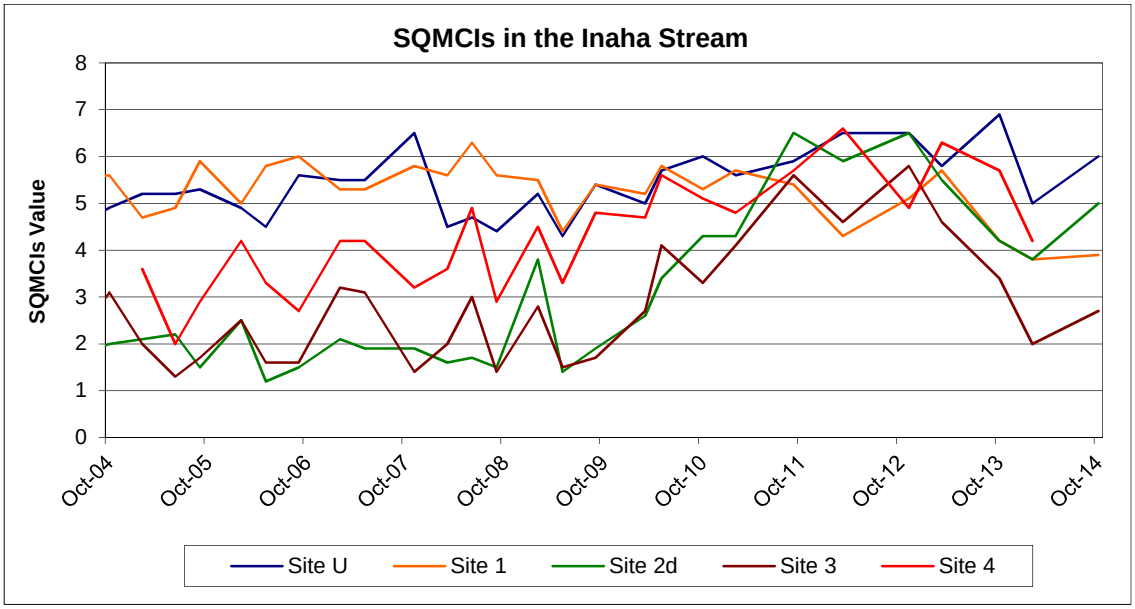

Figure 9 SQMCI$_S$ values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004.

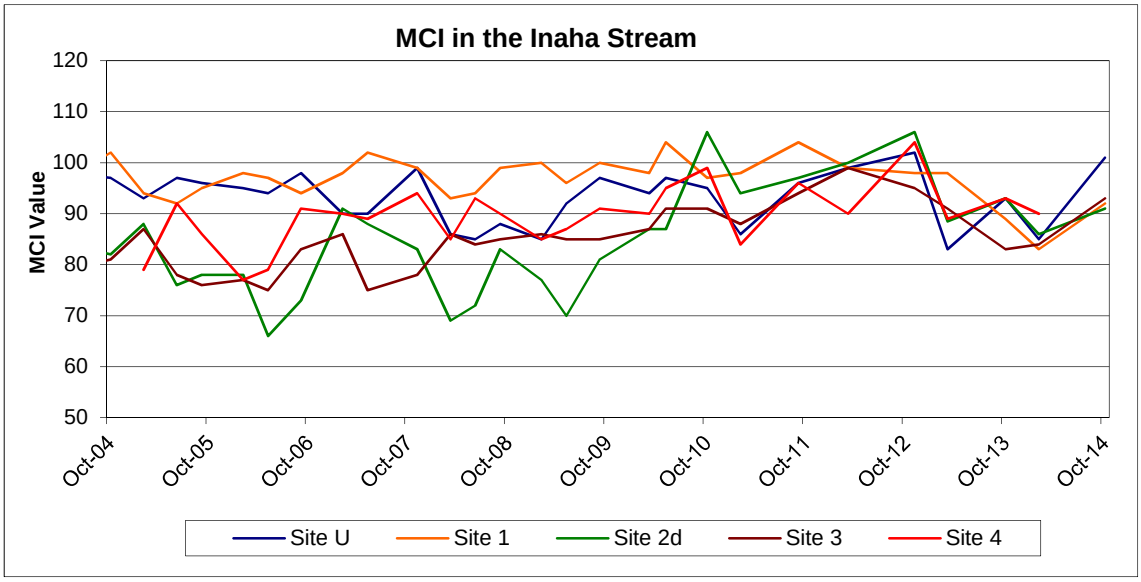

Figure 10 MCI values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004.

Unnamed tributary of the Inaha Stream

There were no significant differences (Stark, 1998) among the three sites sampled in the unnamed tributary of the Inaha Stream for any of the macroinvertebrate indices examined (MCI, SQMCI$_S$ and taxa richness), indicating that discharges from land under irrigation from Taranaki By-Products were not having an impact on macroinvertebrate communities. Comparisons with similar sites in the same altitudinal band (Table 4) also showed very minor insignificant differences (Stark, 1998), indicating that the health of the macroinvertebrate communities in the unnamed tributary is typical of Taranaki ring plain streams arising outside the Egmont National Park.

Comparisons with the previous survey performed on February 2014 showed very minor insignificant increases (Stark, 1998) in MCI scores for the three sites surveyed, which were consistent with the results from the Inaha Stream. $SQMCI_s$ scores and taxa richnesses were also not markedly different from the preceding survey at all three sites. There were no significant differences in the macroinvertebrate indices examined between the current survey and the median value calculated from previous surveys for the two 'potentially impacted' sites surveyed. Overall, discharges by Taranaki By-Products do not appear to be impacting on the macroinvertebrate communities present in the unnamed tributary of the Inaha Stream.

Summary

The Councils 'kick-sampling' and 'vegetation sweep' techniques, or a combination of the two, were used at seven sites to collect streambed macroinvertebrates from the Inaha Stream and an unnamed tributary, to assess whether discharges (via point source and irrigation to land) had had any adverse effects on the macroinvertebrate communities of the streams. Samples were processed to provide number of taxa (richness), MCI and $SQMCI_S$ scores for each site.

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. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

A spring macroinvertebrate survey was performed at four sites in the Inaha Stream and at three sites in an unnamed tributary of the Inaha Stream in relation to discharges by Taranaki By-Products. Taxa richnesses were moderate at all seven sites and similar to median values calculated from previous surveys and to the median value calculated from similar sites.

MCI scores at the 'potentially impacted' sites showed that macroinvertebrate communities were in 'fair' health which was typical for sites at that altitude in Taranaki ring plain streams.The three 'potentially impacted' sites (sites 1, 2d and 3) in the Inaha Stream had MCI scores which were not significantly different (Stark, 1998) to each other or to the 'control' site (site U) indicating that there was no impact from discharges associated with Taranaki By-Products. As expected, $SQMCI_s$ scores showed greater variability than MCI scores, with some sites in the Inaha Stream having markedly different scores, which was probably indicative of habitat variation among sites rather than water quality.

There were no significant differences (Stark, 1998) among the three sites sampled in the unnamed tributary of the Inaha Stream for any of the macroinvertebrate indices examined (MCI, $SQMCI_S$ and taxa richness), indicating that discharges from land under irrigation from Taranaki By-Products were not having an impact on macroinvertebrate communities.

No 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

Overall, the macroinvertebrate communities downstream of the Taranaki By-Products discharges in both the Inaha Stream and the unnamed tributary were of 'fair' health. The results of this survey gave no clear indication that the discharges (to land and to water) from the rendering plant were having any significant long term adverse effect on the macroinvertebrate communities in either the Inaha Stream or the unnamed tributary since the previous survey.

References

Colgan, B, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, June 2003. TRC report BC012.

Dunning KJ, 2001: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2001. TRC report KD78.

Dunning KJ, 2002a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2002. TRC report KD108.

Dunning KJ, 2002b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, April 2002. TRC report KD109.

Dunning KJ, 2002c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2002. TRC report KD132.

Fowles CR and Colgan BG, 2004: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, May 2004. TRC report CF339.

Fowles CR and Colgan BG, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, October 2004. TRC report CF352.

Fowles CR and Jansma B, 2008a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, November 2007. TRC report CF468.

Fowles CR and Jansma B, 2008b: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, March 2008. TRC report CF469.

Fowles CR and Jansma B, 2008c: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, June 2008. TRC report CF470.

Fowles CR and Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2008. TRC report CF471.

Fowles CR and Moore SC, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2004. TRC report CF327.

Fowles CR and Stark JD, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant using artificial substrates January to March 2003. TRC report.

Hickey CW and Vickers ML, 1994: Toxicity of ammonia to nine native New Zealand freshwater invertebrate species. Archives of Environmental Contamination and Toxicology 26: 292-298.

Hope KJ, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, June 2005. TRC report KH043.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2006. TRC report KH087.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2006. TRC report KH088.

Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2006. TRC report BJ033.

Jansma B, 2008: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2007. TRC report BJ034.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2009. TRC report BJ086.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2009. TRC report BJ087.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, September 2009. TRC report BJ094.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2010. TRC report BJ095.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2010. TRC report BJ096.

Jansma B, 2012 (a): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2010. TRC report BJ168.

Jansma B, 2012(b): Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2011. TRC report BJ169.

Jansma B, 2012(c): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2011. TRC report BJ170.

Jansma B and Smith K, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, November 2012. TRC report BJ211.

Jansma B, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2013. TRC report BJ212.

McWilliam H, 2001a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2000. TRC report HM234.

McWilliam H, 2001b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2001. TRC report HM247.

McWilliam H, 2001c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, May 2001. TRC report HM248.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2003. TRC report SM577.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, August 2003. TRC report SM588.

Smith K, 2012: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2012. TRC report KS008.

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research 32(1*): 55-66.

Stark JD, 1999: An evaluation of TRC's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Stark JD and Maxted JR, 2004. Macroinvertebrate community indices for Auckland's soft-bottomed streams and applications to SOE reporting. Prepared for Auckland Regional Council. Cawthron Report No. 970. Cawthron Institute, Nelson. ARC Technical Publication 303. 59p.

Stark JD and Maxted JR, 2007. A biotic index for New Zealand's soft bottomed streams. New Zealand Journal of Marine and Freshwater Research 41(1).

Stark JD and Maxted JR, 2007a. A user guide for the macroinvertebrate community index. Cawthron Institute, Nelson. Cawthron Report No. 1166.

Thomas B, 2013: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2013. TRC report BT010.

Thomas B, 2014: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, February 2014. TRC report BT042.

TRC, 2015: Some statistics from the Taranaki Regional Council database (Esam) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 30 September 2014. Technical Report 2014-105.

To James Kitto, Job Manager
From Darin Sutherland, Scientific Officer
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Doc number 1548578

Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2015

Introduction

Taranaki By-Products Limited holds a number of consents for discharges to land and to water associated with the operation of a rendering plant and a neighbouring farm owned and operated by the Company. The discharge consents most relevant to this biomonitoring survey are summarised in Table 1 below:

Table 1 Summary of discharge consents held by Taranaki By-Products Limited which are of most relevance to this biological survey.

Consent no.	Purpose
2049-4	To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream
2050-4	To discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream
3941-2	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries between 1700909E-5625245N, 1700631E-5625092N and 1700921E-5625046N
5426-1	To discharge up 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha Stream

Biomonitoring has been undertaken at some sites in relation to the discharges from the rendering plant and associated activities since the mid-1980s. Some of the sites used for the biomonitoring of these discharges have changed over time and these changes have been documented in previous reports (Jansma, 2012 a, b, c).

This summer biological survey was the second of two scheduled in the Inaha Stream catchment in the 2014-2015 monitoring year in relation to discharges from the Taranaki By-Products plant. Results from previous surveys are also referred to in this report (see references).

Methods

This biomonitoring survey was undertaken at eight sites on 17 February 2015 (Table 2 and Figure 1). Five of the eight sites surveyed were in the Inaha Stream and the remaining sites were in an unnamed tributary of the Inaha Stream (Figure 1). The locations of sampling sites in relation to the discharges from the rendering plant are discussed below.

Site U (INH000334) was established in the 2003-2004 monitoring period as an appropriate control site on the Inaha Stream above the rendering plant discharges and irrigation areas. Site 1 (INH000400) is located upstream of the wastewater and cooling water discharge

points but downstream of part of the treated wastewater irrigation area. Sites 2d and 3 (INH000420 and INH000430) are located downstream of these two discharges and above the confluence with the unnamed tributary of the Inaha Stream which drains land upon which wastewater is irrigated.

The area of land authorised to be irrigated onto under consent 3941-2 has increased on several occasions since the consent was granted in December 1999. Sites UT, MT and DT (INH000433, INH000435 and INH000440) were established to monitor the effects of the expanded irrigation area on an unnamed tributary of the Inaha Stream. Site UT was established as a 'control site' for the expanded irrigation area. Site MT is located within the authorised irrigation area and site DT is situated downstream of the irrigation area but upstream of the unnamed tributary's confluence with the Inaha Stream.

Site 4 (INH000450) on the Inaha Stream is situated approximately 100 metres downstream of the convergence point between the Inaha Stream and the unnamed tributary.

Table 2 Biomonitoring sites in the Inaha Stream and in an unnamed tributary relating to the Taranaki By-Products plant.

Stream	Site No.	Site code	Location	Sampling method used
Inaha Stream	U	INH000334	Upstream of irrigation area, near Ahipaipa Road	Streambed kick
	1	INH000400	Upstream of treatment ponds, Kohiti Road	Streambed kick
	2d	INH000420	500 m downstream of cooling water discharge	Streambed kick
	3	INH000430	Upstream of Normanby Road	Kick-sweep
	4	INH000450	100 m downstream of 'irrigation' tributary confluence	Streambed kick
Unnamed tributary of Inaha Stream	UT	INH000433	Upstream of irrigation area	Streambed kick
	MT	INH000435	Middle site within the new irrigation area	Kick-sweep
	DT	INH000440	50m upstream Normanby Road	Kick-sweep

Two different sampling techniques were used to collect streambed macroinvertebrates in this survey. The Council's standard '400ml kick-sampling' technique was used at sites U, 1, 2, 4 and UT and a combination of the 'kick-sampling' and 'vegetation sweep' techniques were used at sites 3, MT and DT (Table 2). The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

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) = 20-99 individuals;
VA (very abundant) = 100-499 individuals;
XA (extremely abundant) = 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 from a list of taxa taken from one site and multiplying by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

Where necessary, sub-samples of algal and detrital material 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 these organisms is an indicator of organic enrichment within a stream. Such heterotrophic growths have been recorded on numerous past occasions at sites downstream of the Taranaki By-Products plant as a result of organic nutrient enrichment from the wastewater discharge.

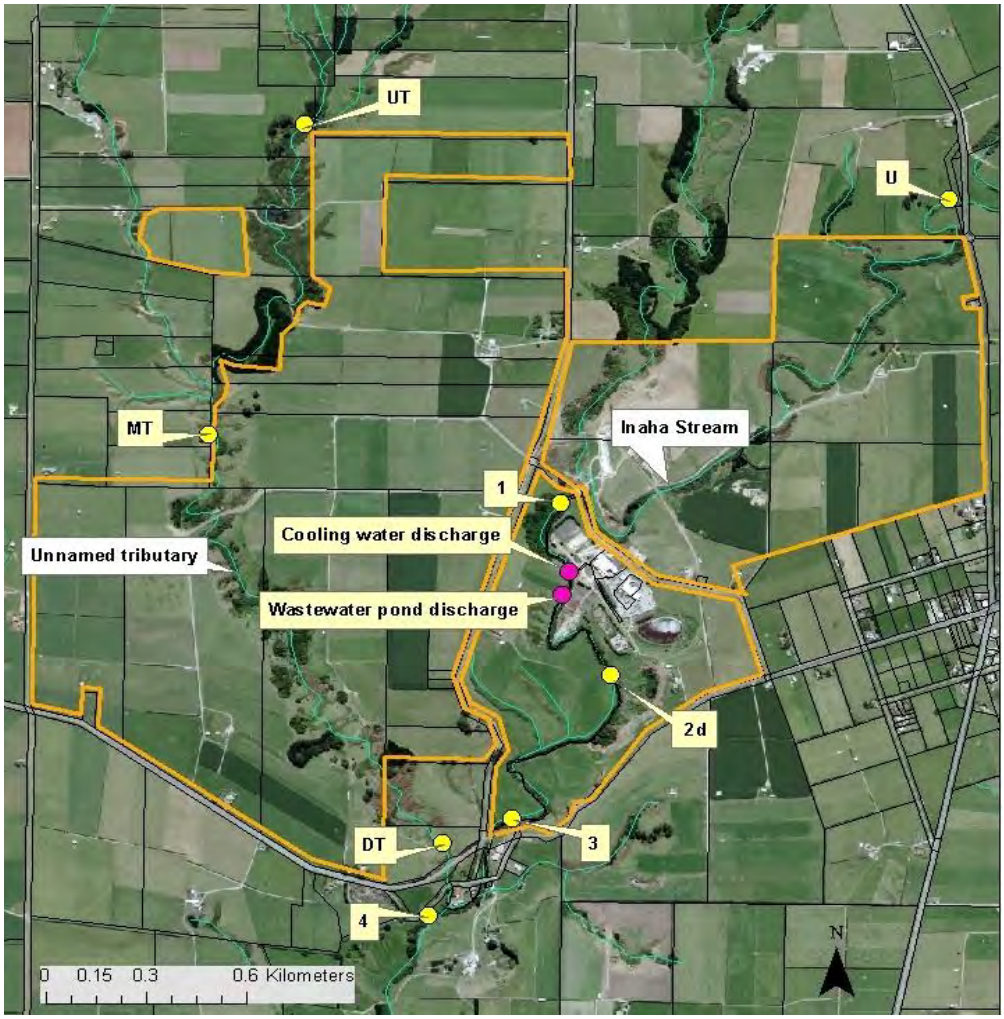


Figure 1 Aerial photo showing biomonitoring sites in the Inaha Stream and an unnamed tributary stream relating to discharges from the Taranaki By-Products plant. The orange line outlines the irrigation areas around the rendering plant.

Results

Site habitat characteristics and hydrology

This February 2015 survey followed a period of 142 days since a fresh in excess of three times median flow in the nearby Waiokura Stream at No. 3 Fairway (the nearest appropriate water level recorder) and 156 days since a fresh in excess of seven times median flow. In the month prior to this survey, there had been two very small fresh events, both of which did not exceed median flow. An absence of significant freshes would likely result in increased levels of filamentous periphyton and fine sediment accumulating on the streambed.

The Company's records showed that the last discharge of treated wastewater to the Inaha Stream began on the 3 July 2014 and continued without cessation until 23 September 2014. Therefore, there was a long period of 147 days when no discharges occurred prior to this biological survey.

At the Inaha Stream sites (U, 1, 2d, 3 and 4) the water was uncoloured and clear. Water levels were very low and flows were either swift (U, 1 and 2d) or steady (3 and 4) for the Inaha Stream sites. Water temperatures in the Inaha Stream ranged between 14.5°C and 23.5°C, this maximum occurring at site 2d downstream of the cooling water discharge. At the unnamed tributary of the Inaha Stream sites there was a brown, cloudy, very low but swift flow at site UT, while the flow at site MT was grey and cloudy with a very low, slow flow and site DT had an uncoloured, clear, very low steady flow. Stream temperatures ranged from 12.7 °C to 17.8 °C during this survey.

In the Inaha Stream, site U had a substrate which was mostly cobbles with some silt, site 1 had a substrate composition of cobble with some silt, sand and fine gravel, site 2d had a substrate composed of silt, sand, fine gravel and cobble, site 3 had a substrate composition of silt, sand and fine gravel and site 4 had a predominately cobble and silt substrate. Substrate at site UT consisted of silt and wood/root while at site MT it consisted of silt and at site DT the substrate composition was mostly silt with some cobble.

There were patchy periphyton mats and widespread filamentous algae recorded at sites at most of the sites in the Inaha Stream (sites U, 1, and 3) while site 2d had both widespread periphyton mats and filamentous algae and site 4 did not have any mats or filamentous algae present. None of the Inaha Stream sites had moss, and only sites U and 4 had patchy leaves and only site 4 had wood present. Sites U and 3 had macrophytes on the edge of the streambed, site 2d had macrophytes on the streambed and sites 1 and 4 had no macrophytes. Most of the Inaha Stream sites did not having any shading (sites U, 1, 2d, and 3) while site 4 did have partial shading from overhanging vegetation. Previously, during the spring survey in October 2014 there were overhanging trees at site 2d but these had been removed at the time of the summer survey.

No periphyton mats or filamentous algae were recorded growing at sites UT and MT in the unnamed tributary of the Inaha Stream but site DT had slippery mats and widespread filamentous algae. No moss was recorded at any of the unnamed tributary of the Inaha Stream sites. Site UT had widespread leaves, patchy wood and no macrophytes. Sites MT and DT both had no leaves or wood and widespread macrophytes on the streambed. Site UT had complete shading from overhanging vegetation while sites MT and DT were unshaded.

Streambed microflora

A microscopic inspection of material collected from the bed of the Inaha Stream found no evidence of 'heterotrophic growths '(protozoa or fungi) at any of the sites sampled. This was the twelfth consecutive survey to record a lack of such growths, continuing the improvement following the late summer 2008 and spring 2009 surveys, which both recorded such growths. This is an important result; as such growth is often associated with 'sewage fungus' which is an indication of high levels of organic matter and nutrient enrichment in the stream. Such growths have been recorded on many previous sampling occasions, often in abundance, particularly downstream of the plant discharges at site 2d. The absence of such growths is evidence that the degree of enrichment is not as severe as that recorded previously.

Macroinvertebrate communities

Results of previous macroinvertebrate surveys performed in the Inaha Stream and the unnamed tributary are summarised and presented together with current results in Table 3.

Table 3 Summary of previous numbers of macroinvertebrate taxa and MCI and $SQMCI_S$ values for surveys between September 1987 and October 2014 together with current results recorded in the Inaha Stream and an unnamed tributary in relation to Taranaki By-Products.

	Number of taxa				MCI values			$SQMCI_S$ values			
	No. samples	Range	Median	Current survey	Range	Median	Current Survey	No. of samples	Range	Median	Current survey
U	28	18-34	23	28	83-102	95	92	28	4.3-6.9	5.4	4.9
1	68	15-31	22	29	82-104	95	93	44	3.6-6.3	5.1	5.5
2d	56	10-30	22	22	52-106	78	86	45	1.2-6.5	2.0	4.0
3	67	6-35	21	30	60-99	81	81	45	1.3-5.8	2.4	3.6
4	25	17-31	26	25	77-104	90	97	25	2.0-6.6	4.2	4.5
UT	8	13-23	19	15	87-109	98	100	8	3.5-6.3	5.4	5.4
MT	21	12-29	20	21	71-94	82	80	21	3.1-5.7	4.4	4.8
DT	22	12-25	21	25	80-105	89	97	22	3.5-5.3	4.6	4.5

Table 4 provides a summary of various macroinvertebrate indices within a specific altitudinal band for 'control' sites situated in Taranaki ring plain streams arising outside of Egmont National Park. The full results from this current survey are given in Table 5 and Table 6.

Table 4 Range and median number of taxa, MCI values and SQMCIs scores for 'control' sites (Taranaki ring plain rivers/streams with sources outside Egmont National Park) at altitudes 80-124 m asl (TRC, 2015).

	No. of taxa	MCI value	$SQMCI_S$ value
No. Samples	236	236	180
Range	12-34	66-112	1.3-6.9
Median	22	92	5.0

Table 5 Macroinvertebrate fauna of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 17 February 2015.

Taxa List	Site Number	MCI score	U	1	2d	3	4
	Site Code		INH000334	INH000400	INH000420	INH000430	INH000450
	Sample Number		FWB15131	FWB15132	FWB15133	FWB15136	FWB15138
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	-	-	R	C
NEMERTEA	Nemertea	3	C	-	-	-	-
NEMATODA	Nematoda	3	-	-	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	C	A	C	C
	Lumbricidae	5	-	-	R	R	-
MOLLUSCA	*Latia*	5	-	-	-	-	R
	Physa	3	R	-	C	C	-
	Potamopyrgus	4	C	XA	A	VA	VA
	Sphaeriidae	3	-	-	-	R	C
CRUSTACEA	Ostracoda	1	C	C	C	VA	A
	Paracalliope	5	XA	A	A	VA	C
	Paraleptamphopidae	5	-	R	R	-	-
	Talitridae	5	-	-	-	-	A
	Paranephrops	5	-	R	-	-	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	VA	XA	A	R	A
	Coloburiscus	7	C	R	-	-	-
	Deleatidium	8	A	VA	A	A	C
	Zephlebia group	7	C	R	R	C	A
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	-	C	-	-	-
HEMIPTERA (BUGS)	*Anisops*	5	-	-	-	-	R
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA	A	A	C
	Hydraenidae	8	-	-	R	-	-
	Staphylinidae	5	-	-	-	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	C	A	R	R	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	VA	A	R	C	A
	Costachorema	7	R	R	-	-	-
	Hydrobiosis	5	A	C	A	A	R
	Neurochorema	6	R	-	-	-	-
	Plectrocnemia	8	-	-	-	R	-
	Polyplectropus	6	R	-	-	-	-
	Psilochorema	6	-	R	-	-	-
	Hudsonema	6	R	C	-	-	R
	Oecetis	4	-	R	-	C	R
	Olinga	9	-	-	-	-	R
	Oxyethira	2	C	R	R	A	-
	Paroxyethira	2	-	-	-	R	-
	Pycnocentria	7	A	R	-	-	C
	Pycnocentrodes	5	XA	XA	C	C	R
	Triplectides	5	-	-	-	R	C
DIPTERA (TRUE FLIES)	*Chironomus*	1	-	-	R	A	-
	Maoridiamesa	3	R	C	R	-	-
	Orthocladiinae	2	VA	C	A	C	-
	Polypedilum	3	A	R	A	R	R
	Tanytarsini	3	A	C	VA	A	R
	Ephydridae	4	-	-	-	R	-
	Muscidae	3	C	R	-	R	-
	Austrosimulium	3	C	R	-	R	C
	Tanyderidae	4	-	R	-	-	-
ACARINA (MITES)	Acarina	5	R	-	-	-	-
		No of taxa	28	29	22	30	25
		MCI	92	93	86	81	97
		SQMCIs	4.9	5.5	4.0	3.6	4.5
		EPT (taxa)	12	13	6	9	11
		%EPT (taxa)	43	45	27	30	44

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

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

Table 6 Macroinvertebrate fauna of the unnamed tributary of the Inaha Stream in relation to Taranaki By-Products wastes discharges sampled on 17 February 2015.

Taxa List	Site Number	MCI score	UT	MT	DT
	Site Code		INH000433	INH000435	INH000440
	Sample Number		FWB15134	FWB15135	FWB15137
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	R	-
NEMATODA	Nematoda	3	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	-	C	R
	Lumbricidae	5	-	R	-
MOLLUSCA	*Potamopyrgus*	4	VA	XA	XA
CRUSTACEA	Ostracoda	1	-	R	-
	Paracalliope	5	C	XA	XA
	Paraleptamphopidae	5	XA	-	-
	Talitridae	5	A	XA	XA
	Paranephrops	5	R	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	VA	C	VA
	Zephlebia group	7	VA	VA	VA
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	-	-	R
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	-	C	-
HEMIPTERA (BUGS)	*Microvelia*	3	-	R	R
	Saldula	5	-	R	-
COLEOPTERA (BEETLES)	Dytiscidae	5	-	R	-
	Hydrophilidae	5	-	-	R
TRICHOPTERA (CADDISFLIES)	*Hydrobiosis*	5	R	-	R
	Hydropsyche (Orthopsyche)	9	C	-	R
	Polyplectropus	6	-	A	-
	Psilochorema	6	-	-	R
	Oxyethira	2	-	-	A
	Pycnocentria	7	C	-	-
	Triplectides	5	R	-	R
DIPTERA (TRUE FLIES)	*Chironomus*	1	-	R	-
	Orthocladiinae	2	R	-	R
	Polypedilum	3	R	R	C
	Paradixa	4	-	R	-
	Empididae	3	R	-	R
	Ephydridae	4	-	C	R
	Austrosimulium	3	C	C	R
ACARINA (MITES)	Acarina	5	-	-	R
		No of taxa	15	21	20
		MCI	100	80	89
		SQMCIs	5.4	4.8	4.9
		EPT (taxa)	6	3	7
		%EPT (taxa)	40	14	35

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

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

Inaha Stream

Site U

A moderately high taxa richness of 28 taxa was found at site U ('control' site for the Inaha Stream) at the time of the survey which was five more than the median number recorded for the site (median taxa richness 23; Table 3) and six more than the previous sample (taxa richness 22; Figure 2).

The MCI score of 92 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 95 units; Table 3) or to the previous survey score (MCI score 101 units; Figure 2). The $SQMCI_s$ score of 4.9 units was not markedly different to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 5.4 units; Table 3) or to that of the previous survey score ($SQMCI_s$ score 6.0 units).

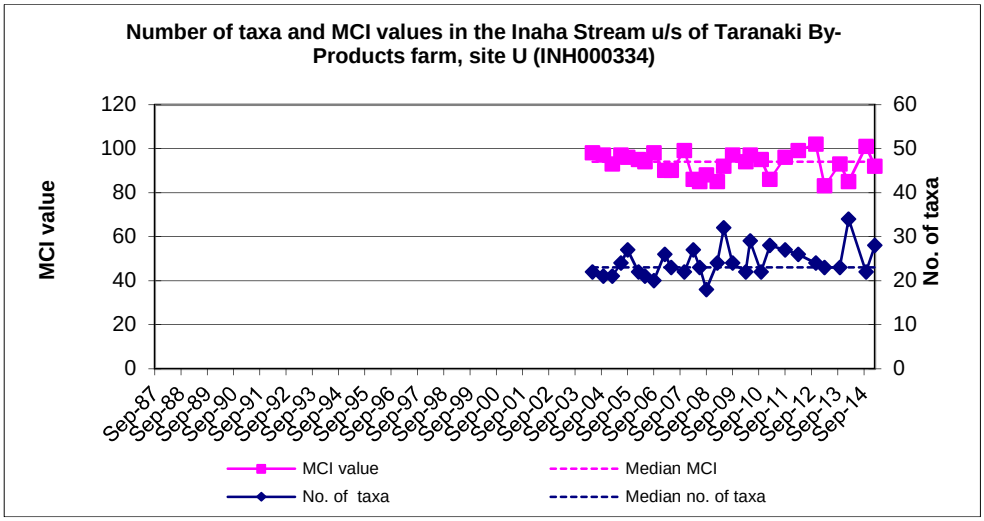


Figure 2 Numbers of macroinvertebrate taxa and MCI values recorded at site U in the Inaha Stream since May 2004.

The community was characterised by three 'tolerant' taxa [caddisfly (*Hydropsyche - Aoteapsyche*) and midges (orthoclads and *Polypedilum*)], six 'moderately sensitive' taxa [amphipod (*Paracalliope*), mayfly (*Austroclima*), elmid beetles and caddisflies (*Hydrobiosis, Pycnocentria* and *Pycnocentrodes*)], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Site 1

A moderately high taxa richness of 29 taxa was found at site 1 at the time of the survey which was seven more than the median number recorded for the site (median taxa richness 22; Table 3) and 12 more than the previous survey (taxa richness 17; Figure 3).

The MCI score of 93 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 95 units; Table 3) or to that of the previous survey score (MCI score 92 units; Figure 3). The $SQMCI_s$ score of 5.5 units was similar to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 5.1 units; Table 3) and was higher than the previous survey score ($SQMCI_s$ score 3.9 units).

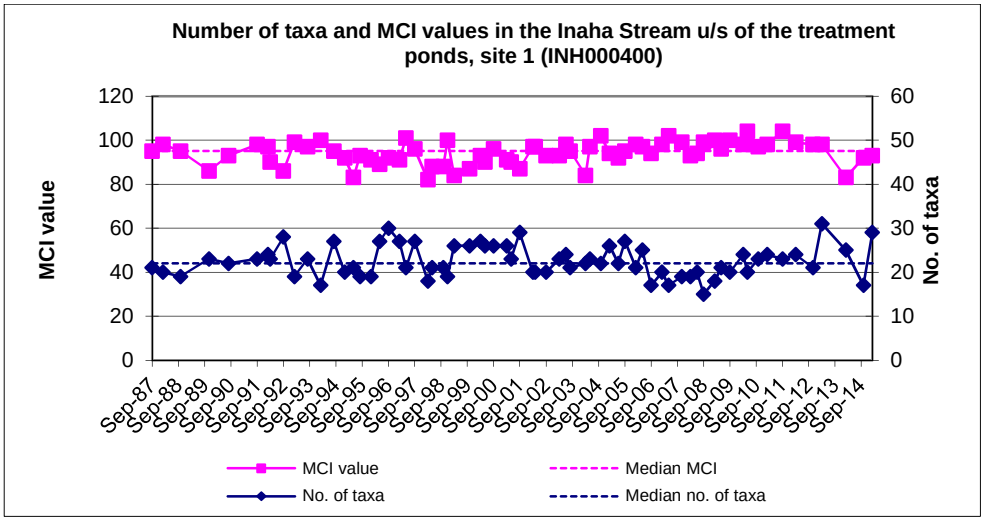


Figure 3 Numbers of macroinvertebrate taxa and MCI values recorded at site 1 in the Inaha Stream since September 1987.

The community was characterised by two 'tolerant' taxa [snail (*Potamopyrgus*) and caddisfly (*Hydropsyche - Aoteapsyche*)], five 'moderately sensitive' taxa [amphipod (*Paracalliope*), mayfly (*Austroclima*), elmid beetles, dobsonfly (*Archichauliodes*) and caddisflies (*Hydrobiosis* and *Pycnocentrodes*)], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Site 2d

A moderate macroinvertebrate community richness of 22 taxa was found at site 2d at the time of the survey which was the same as the median number recorded for the site (median taxa richness 22; Table 3) and one less than the previous survey (taxa richness 23; Figure 4).

The MCI score of 86 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 78 units; Table 3) or to that of the previous survey score (MCI score 91 units; Figure 4). The $SQMCI_s$ score of 4.0 units was markedly higher than the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 2.0 units; Table 3) and was lower than the previous survey score ($SQMCI_s$ score 5.0 units).

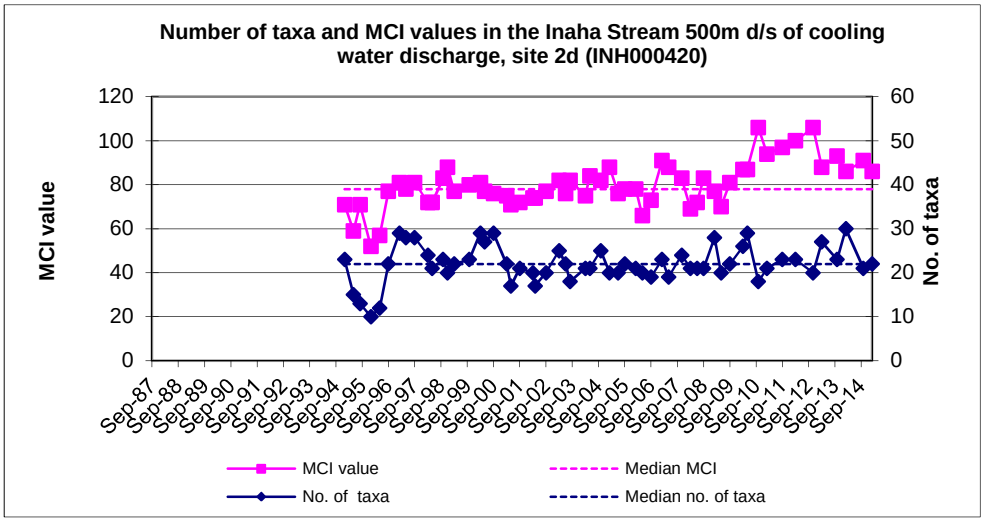


Figure 4 Numbers of taxa and MCI values recorded at site 2d in the Inaha Stream since 1995.

The community was characterised by five 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*) and midges (orthoclads, *Polypedilum* and Tanytarsini)], four 'moderately sensitive' taxa [amphipod (*Paracalliope*), mayfly (*Austroclima*), elmid beetles, and caddisfly (*Hydrobiosis*)], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Site 3

A high taxa richness of 30 taxa was found at site 3 at the time of the survey which was nine more than the median number recorded for the site (median taxa richness 21; Table 3) and 11 more than the previous survey (taxa richness 19; Figure 5).

The MCI score of 81 units indicated a community of 'fair' biological health which was the same as the median value calculated from previous surveys at the same site (median MCI score 81 units; Table 3) but was significantly lower (Stark, 1998) than the previous survey score (MCI score 93 units; Figure 5) by 12 MCI units. The $SQMCI_s$ score of 3.6 units was higher than the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 2.4units; Table 3) and was marginally higher than the previous survey score ($SQMCI_s$ score 2.7 units).

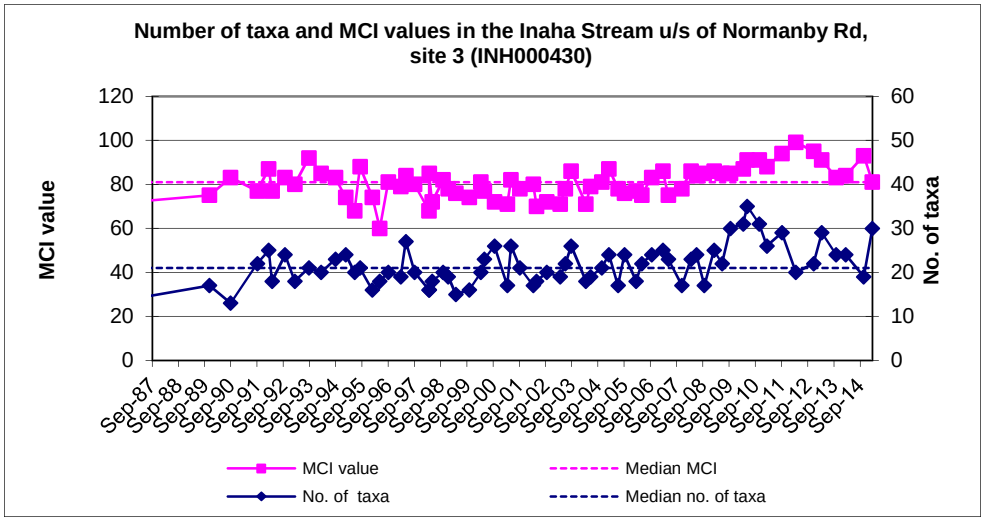


Figure 5 Numbers of taxa and MCI values recorded at site 3 in the Inaha Stream since 1989.

The community was characterised by five 'tolerant' taxa [snail (*Potamopyrgus*), ostracod seed shrimp, caddisfly (*Oxyethira*) and midges (*Chironomus* and Tanytarsini)], three 'moderately sensitive' taxa [amphipod (*Paracalliope*), elmid beetles, and caddisfly (*Hydrobiosis*)], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Site 4

A moderate macroinvertebrate community richness of 25 taxa was found at site 4 at the time of the survey which was one less than the median number recorded for the site (median taxa richness 26; Table 3) and the same as the previous spring survey (taxa richness 25; Figure 6).

The MCI score of 97 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 90 units; Table 3) or to that of the previous survey score (MCI score 90 units; Figure 6). The $SQMCI_s$ score of 4.5 units was not markedly different to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 4.3 units; Table 3) or to the previous survey score ($SQMCI_s$ score 4.2 units).

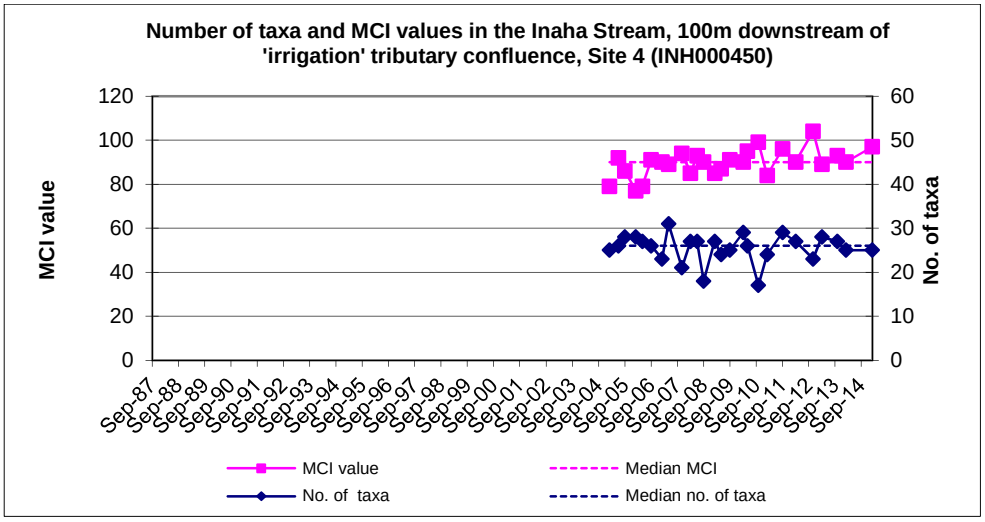


Figure 6 Numbers of taxa and MCI values recorded at site 4 in the Inaha Stream since 1989.

The community was characterised by three 'tolerant' taxa [snail (*Potamopyrgus*), ostracod seed shrimp and caddisfly (*Hydropsyche - Aoteapsyche*)] and three 'moderately sensitive' taxa [talitrid amphipods and mayflies (*Austroclima* and *Zephlebia* group)] (Table 5).

Unnamed tributary of the Inaha Stream

Site UT

A moderately low macroinvertebrate community richness of 15 taxa was found at site UT ('control' site for the unnamed tributary of the Inaha Stream) at the time of the survey which was four less than the median number recorded for the site (median taxa richness 19; Table 3) and eight less than the previous survey (taxa richness 23; Figure 7). This site had only been monitored on nine occasions since March 2010 and therefore has a smaller dataset than other sites in this report. Comparisons with median values are therefore not as robust as at other sites.

The MCI score of 100 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 98 units; Table 3) or to the previous survey score (MCI score 92 units; Figure 7). The $SQMCI_s$ score of 5.4 units was similar to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 5.4 units; Table 3) and was marginally higher than the previous survey score ($SQMCI_s$ score 4.5 units).

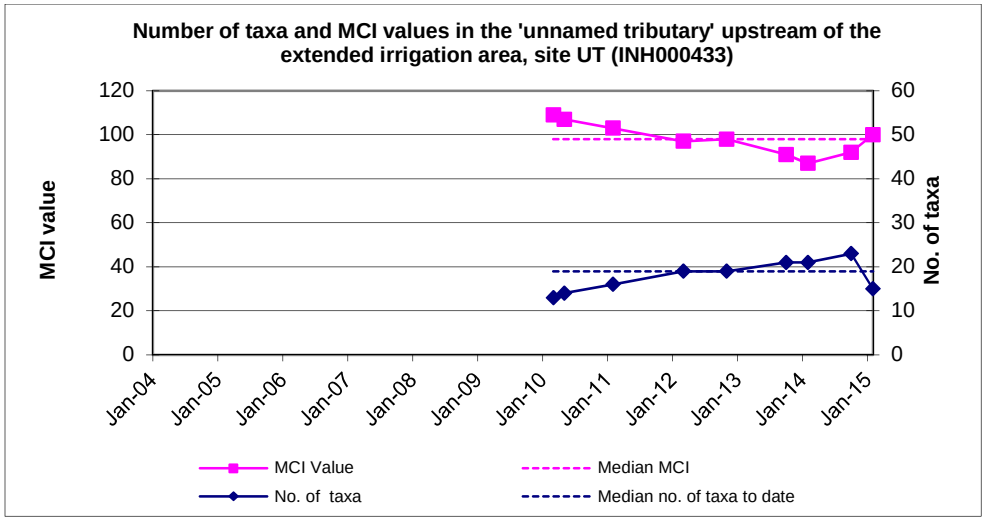


Figure 7 Numbers of taxa and MCI values recorded at site UT in the unnamed tributary of the Inaha Stream.

The community was characterised by one 'tolerant' taxon [snail (*Potamopyrgus*)] and four 'moderately sensitive' taxa [amphipods (talitrids and Paraleptamphopidae) and mayflies (*Austroclima* and *Zephlebia* group)] (Table 6).

Site MT

A moderate macroinvertebrate community richness of 21 taxa was found at site MT at the time of the survey which was one more than the median number recorded for the site (median taxa richness 20; Table 3) and one more than the previous survey (taxa richness 20; Figure 8).

The MCI score of 80 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median value calculated from previous surveys at the same site (median MCI score 82 units; Table 3) or to the previous survey score (MCI score 84 units; Figure 8). The $SQMCI_s$ score of 4.8 units was similar to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 4.4 units; Table 3) and to that of the previous survey score ($SQMCI_s$ score 4.4 units).

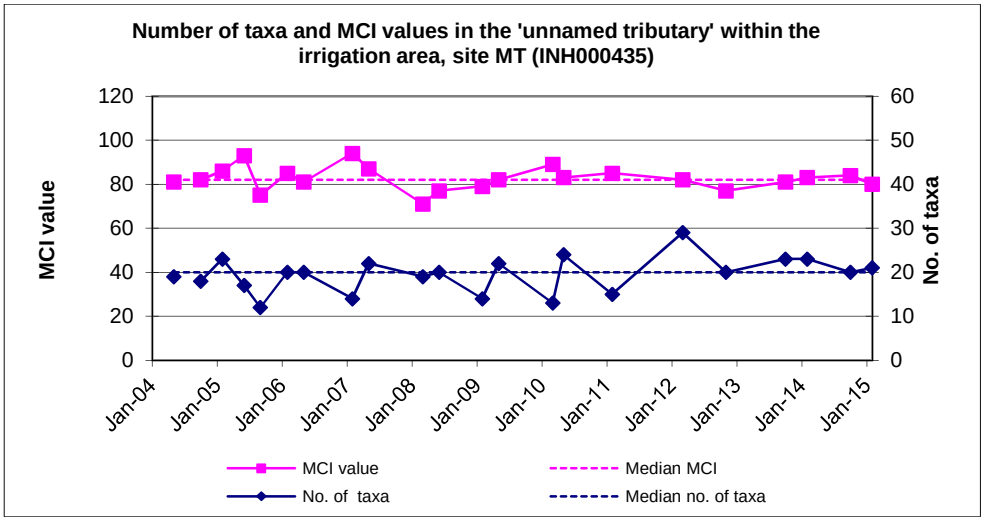


Figure 8 Numbers of taxa and MCI values recorded at site MT in the unnamed tributary of the Inaha Stream since 2004.

The community was characterised by one 'tolerant' taxon [snail (*Potamopyrgus*)] and four 'moderately sensitive' taxa [amphipods (*Paracalliope* and Paraleptamphopidae), mayfly (*Zephlebia* group) and caddisfly (*Polyplectropus*)] (Table 6).

Site DT

A moderate macroinvertebrate community richness of 20 taxa was found at site DT at the time of the survey which was one taxon less than the median number recorded for the site (median taxa richness 21; Table 3) and five more than the previous survey (taxa richness 15; Figure 9).

The MCI score of 89 units indicated a community of 'fair' biological health which was the same as the median value calculated from previous surveys at the same site (median MCI score 89 units; Table 3) and not significantly different (Stark, 1998) to the previous survey score (MCI score 91 units; Figure 9). The $SQMCI_s$ score of 4.9 units was similar to the median value calculated from previous surveys at the same site (median $SQMCI_s$ score 4.6 units; Table 3) and to the previous survey score ($SQMCI_s$ score 5.3 units).

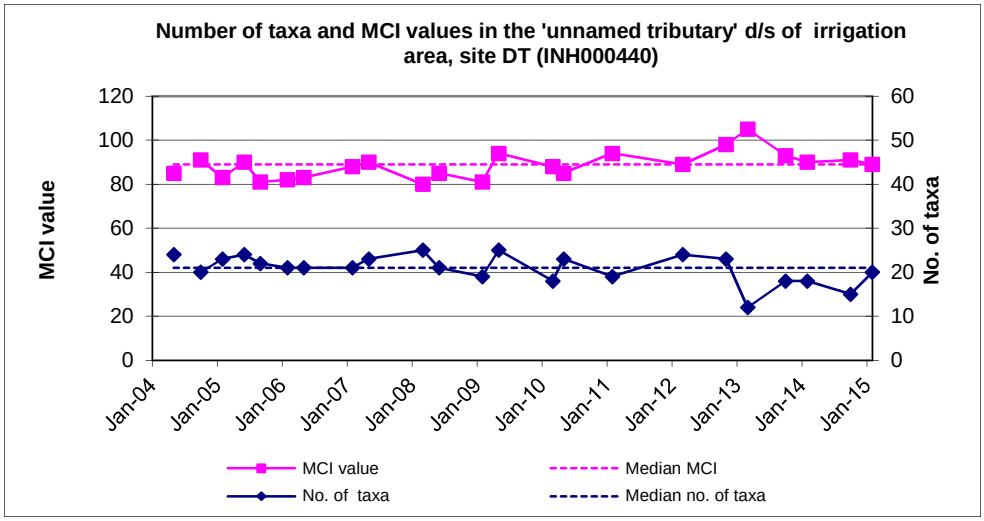


Figure 9 Numbers of taxa and MCI values recorded at site DT in the unnamed tributary of the Inaha Stream since 2004.

The community was characterised by two 'tolerant' taxa [snail (*Potamopyrgus*) and caddisfly (*Oxyethira*)] and four 'moderately sensitive' taxa [amphipods (*Paracalliope* and Paraleptamphopidae) and mayflies (*Austroclima* and *Zephlebia* group)] (Table 6).

Discussion

In the past, heterotrophic growths such as 'sewage fungus' have occurred in the Inaha Stream downstream of the rendering plant which were most likely the result of the discharges from the plant. However, no 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in the spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

Inaha Stream

There were no significant differences between site U the 'control' site and site 1 for any of the macroinvertebrate indices examined (taxa richness, MCI and $SQMCI_S$ scores) indicating that leaching of nutrients into the Inaha Stream from the north-eastern block of land under irrigation (Figure 1) was not affecting the health of the macroinvertebrate communities present in the Inaha Stream at the time of the survey. All three macroinvertebrate indices decreased from site 1 to site 2d, though the decrease in MCI score was not significant (Stark, 1998), but there was a marked decrease in $SQMCI_S$ scores by 1.5 units. A further decrease in both MCI and $SQMCI_S$ scores occurred at site 3. Overall, there was a significant decline in macroinvertebrate community health between sites 1 and 3. No such deterioration was observed in the previous spring survey (Sutherland and Thomas, 2015). No wastewater was recorded as discharged between the current and previous survey but a chemical survey on the 28 January 2015 found possible organic contamination of the tributary causing a slight increase in the filtered carbonaceous BOD_5 of the Inaha Stream. Discharges of coolant water between sites 1 and 3 were unlikely to be the cause of the deterioration as site 3 had a lower recorded water temperature than site 1 and temperature monitoring indicated that Taranaki By-Products was complying with its consent condition in relation to temperature increases (no more than a 3°C increase in temperature after suitable mixing).

Riparian vegetation had been removed at site 2d between the current and previous surveys which eliminated shading and wood present in the stream and was likely a major driver in the very large increase in periphyton recorded at the site. No periphyton mats or filamentous algae were recorded during the spring survey and extremely large amounts of filamentous algae were noted during the summer survey. Removal of shading coupled with higher water temperatures and low flows which occurred during the summer period would explain deterioration in macroinvertebrate community health at site 2d. Site 2d also only decreased by five MCI units from the score at the time of the previous survey which is not a significant decrease (Stark, 1998).

Though the decrease in MCI units between sites 2d and 3 was only five MCI units compared with a decrease of seven MCI units between sites 1 and 2d the deterioration since the previous spring survey was larger, a decline of 12 MCI units. Furthermore, site 3 had a MCI score significantly lower (Stark, 1998) than the median score obtained from similar sites in the Taranaki ring plain (Table 4). No obvious habitat changes were noted at site 3 and the increased levels of periphyton present at site 2d would utilise some of the available nutrients (e.g. nitrogen and phosphorus) within the stream which should lessen the amount of nutrients available at site 3. Therefore, it would appear that the reach between sites 1 and 3 had increased levels of nutrients entering Inaha Stream leading to a decline in the health of the macroinvertebrate communities present there. Further evidence for nutrient enrichment

at site 3 can been seen in the increased abundances of highly 'tolerant' taxa. No bloodworms (*Chironomus* sp) were recorded at site 3 by the previous survey but they were 'abundant' at the time of the current survey and ostracod seed shrimps had increased from 'common' to 'very abundant'. Overall, there was some evidence that discharges from Taranaki By-Products, such as possible seepage of nutrient enriched water from the unnamed tributary, may be negatively affecting the macroinvertebrate communities present in the Inaha Stream.

Downstream of the confluence with the unnamed tributary of the Inaha Stream the macroinvertebrate community at site 4 showed a significant improvement compared with the macroinvertebrate community at site 3. The improvement in macroinvertebrate community health was probably related to site 4 having a partially shaded streambed. Examination of the trends suggests improvements began to appear in 2009 (Figure 10 and Figure 11) but in recent surveys large fluctuations in macroinvertebrate indices have occurred.

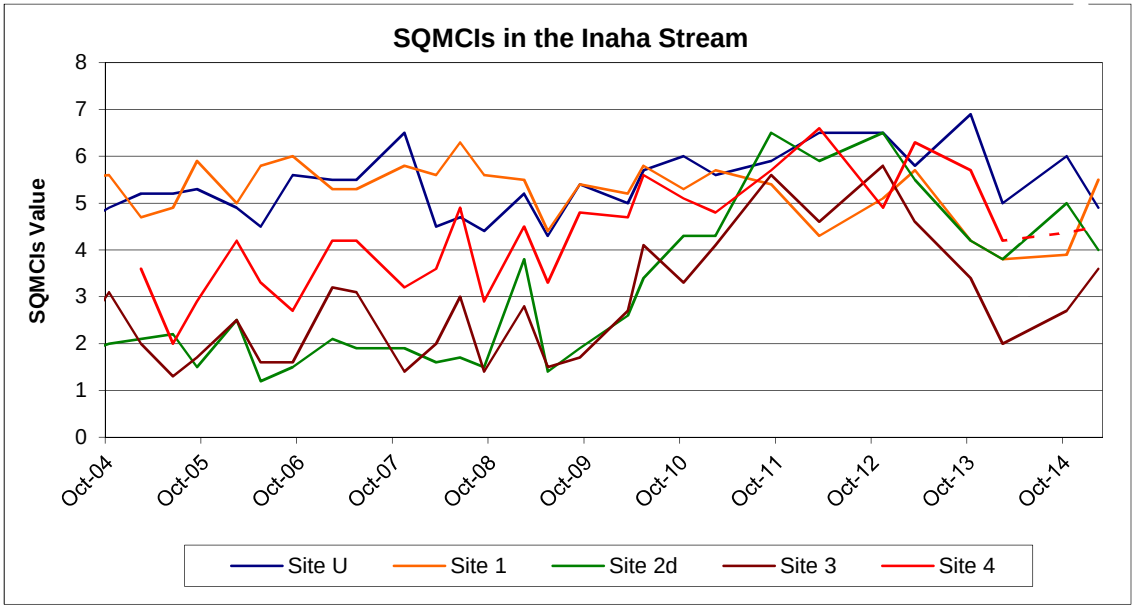


Figure 10 SQMCI$_s$ values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004.

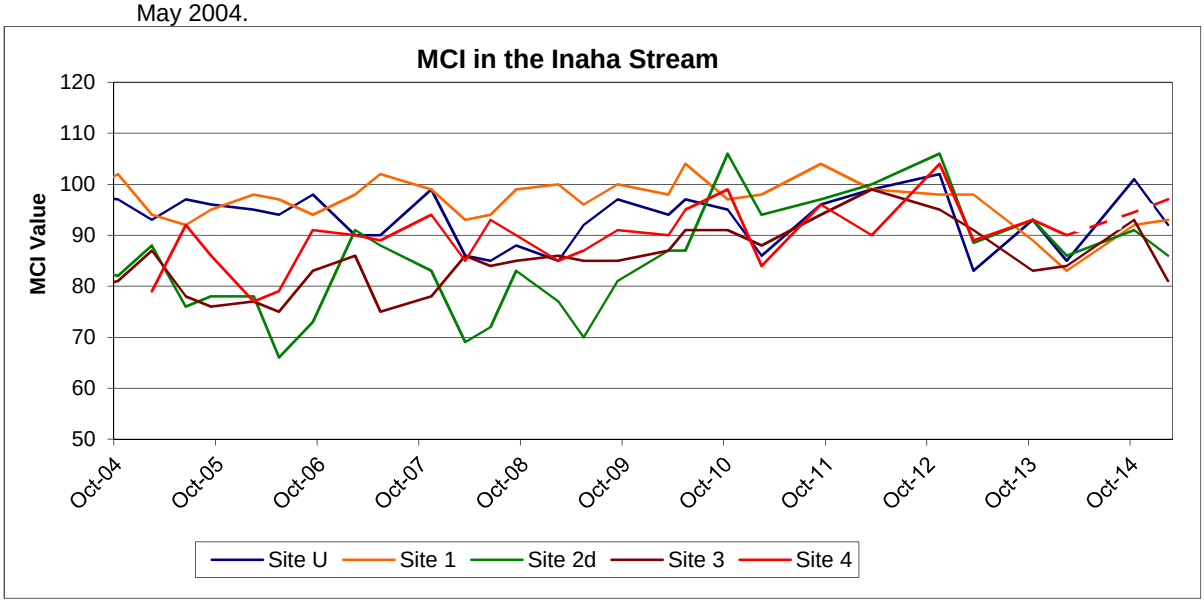


Figure 11 MCI values for the Inaha Stream sampled in relation to Taranaki By-Products discharges since May 2004.

Unnamed tributary of the Inaha Stream

There were significant differences (Stark, 1998) among the three sites sampled in the unnamed tributary of the Inaha Stream in relation to MCI scores but not taxa richnesses or $SQMCI_S$ scores. Specifically, both the 'potentially impacted' sites (sites MT and DT) had significantly lower MCI scores than the 'control' site (site UT), with a large decline of 20 MCI units occurring between sites UT and MT. Furthermore, site MT had a MCI score significantly lower (Stark, 1998) than similar sites in the Taranaki ring plain (Table 4). A comparison with the previous survey indicates that site UT had an increase in MCI score since the previous survey of eight MCI units while site MT had a decrease of four MCI units. Both sites were very different in nature with site UT situated under trees with extensive root mats present on the streambed while site MT was an open site dominated by macrophytes growing in the silt substrate. Analysis of the macroinvertebrate taxa present at site MT shows the site had a high proportion of taxa that prefer slow flowing and/or silty sites such as various worms [flatworm (*Cura*), nematode worms, oligochaete worms and 'aquatic earthworms'], bugs [*Microvlia* and *Saldula*] and a damselfly (*Xanthocnemis*) which were all absent from site UT. Most of the taxa associated with slower flowing water and/ or silty substrates also had low tolerance scores. A combination of both habitat variation among sites UT and MT along with some degree of eutrophication occurring between the two sites was probably the cause of the differences in MCI scores. Overall, there was some evidence that land under irrigation by Taranaki By-Products may be negatively affecting the macroinvertebrate communities present in the unnamed tributary of the Inaha Stream. However, due to the significant habitat variation that existed among the sites surveyed there is a high degree of uncertainty about the main driver of the differences seen among the macroinvertebrate communities surveyed.

Summary

The Councils 'kick-sampling' technique, or a combination of 'kick-sampling' and 'vegetation sweep', was used at eight sites to collect streambed macroinvertebrates from the Inaha Stream and an unnamed tributary, to assess whether discharges (via point source and irrigation to land) from Taranaki By-Products Limited's rendering plant had had any adverse effects on the macroinvertebrate communities of the streams. Samples were processed to provide number of taxa (richness), MCI and $SQMCI_S$ scores for each site.

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. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

A summer macroinvertebrate survey was performed at five sites in the Inaha Stream and at three sites in an unnamed tributary of the Inaha Stream in relation to discharges by Taranaki By-Products. Taxa richnesses were generally moderate and slightly higher than the previous survey values and that of the median values calculated from all previous surveys.

MCI scores showed that macroinvertebrate communities were generally in 'fair' health. However, there was a significant decline in macroinvertebrate community health in Inaha Stream between sites 1 and 3. No such deterioration was observed in the previous spring survey (Sutherland and Thomas, 2015). A chemical survey on the 28 January 2015 found some organic contamination of the unnamed tributary that runs through the rendering plant site, causing a slight increase in filtered carbonaceous BOD_5 in Inaha Stream, which might be a contributing factor to the observed declines. At site 2d, the willows had been removed from the stream banks between the spring and summer surveys; the reduced shading had resulted in increased periphyton growth, which would explain the deterioration in macroinvertebrate community health at the site. There was also a significant decline in macroinvertebrate community health between sites UT and MT in the unnamed tributary of the Inaha Stream which was likely due to habitat variation.

$SQMCI_s$ scores were largely congruent with MCI scores at the Inaha Stream sites indicating less healthy macroinvertebrate communities at sites 2d and 3 but did not show any substantial differences among sites in the unnamed tributary of the Inaha Stream.

No 'heterotrophic growths' were recorded at any sites monitored in this survey, which was indicative of reasonably good preceding water quality. The presence of heterotrophic growths on the bed of the Inaha Stream was last recorded in spring 2009 survey, and this shows an improved management of the wastewater discharge since that time.

Overall, there was some evidence that discharges from Taranaki By-Products had impacted on the freshwater macroinvertebrate communities present in the Inaha Stream. However, changes in habitat and habitat variation between sites make drawing strong conclusions from the data difficult.

References

Colgan, B, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, June 2003. TRC report BC012.

Dunning KJ, 2001: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2001. TRC report KD78.

Dunning KJ, 2002a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2002. TRC report KD108.

Dunning KJ, 2002b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, April 2002. TRC report KD109.

Dunning KJ, 2002c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2002. TRC report KD132.

Fowles CR and Colgan BG, 2004: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, May 2004. TRC report CF339.

Fowles CR and Colgan BG, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, October 2004. TRC report CF352.

Fowles CR and Jansma B, 2008a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, November 2007. TRC report CF468.

Fowles CR and Jansma B, 2008b: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, March 2008. TRC report CF469.

Fowles CR and Jansma B, 2008c: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, June 2008. TRC report CF470.

Fowles CR and Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2008. TRC report CF471.

Fowles CR and Moore SC, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2004. TRC report CF327.

Fowles CR and Stark JD, 2004: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant using artificial substrates January to March 2003. TRC report.

Hickey CW and Vickers ML, 1994: Toxicity of ammonia to nine native New Zealand freshwater invertebrate species. Archives of Environmental Contamination and Toxicology 26: 292-298.

Hope KJ, 2005: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, June 2005. TRC report KH043.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2006. TRC report KH087.

Hope KJ, 2007: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2006. TRC report KH088.

Jansma B, 2008: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2006. TRC report BJ033.

Jansma B, 2008: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2007. TRC report BJ034.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2009. TRC report BJ086.

Jansma B, 2009: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2009. TRC report BJ087.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, September 2009. TRC report BJ094.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2010. TRC report BJ095.

Jansma B, 2010: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, May 2010. TRC report BJ096.

Jansma B, 2012 (a): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2010. TRC report BJ168.

Jansma B, 2012(b): Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, February 2011. TRC report BJ169.

Jansma B, 2012(c): Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, September 2011. TRC report BJ170.

Jansma B and Smith K, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, November 2012. TRC report BJ211.

Jansma B, 2013. Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2013. TRC report BJ212.

McWilliam H, 2001a: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, September 2000. TRC report HM234.

McWilliam H, 2001b: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2001. TRC report HM247.

McWilliam H, 2001c: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, May 2001. TRC report HM248.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, March 2003. TRC report SM577.

Moore S, 2003: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, August 2003. TRC report SM588.

Smith K, 2012: Biomonitoring of the Inaha Stream and an unnamed tributary above and below the Taranaki By-Products plant, Okaiawa, March 2012. TRC report KS008.

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research 32(1*): 55-66.

Stark JD, 1999: An evaluation of TRC's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Stark JD and Maxted JR, 2004. Macroinvertebrate community indices for Auckland's soft-bottomed streams and applications to SOE reporting. Prepared for Auckland Regional Council. Cawthron Report No. 970. Cawthron Institute, Nelson. ARC Technical Publication 303. 59p.

Stark JD and Maxted JR, 2007. A biotic index for New Zealand's soft bottomed streams. New Zealand Journal of Marine and Freshwater Research 41(1).

Stark JD and Maxted JR, 2007a. A user guide for the macroinvertebrate community index. Cawthron Institute, Nelson. Cawthron Report No. 1166.

Sutherland DL and Thomas B, 2015: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2015. TRC report DS024.

Thomas B, 2013: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, October 2013. TRC report BT010.

Thomas B, 2014: Biomonitoring of the Inaha Stream above and below the Taranaki By-Products plant, Okaiawa, February 2014. TRC report BT042.

TRC, 2015: Some statistics from the Taranaki Regional Council database (Esam) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 30 September 2014. Technical Report 2014-105.

Appendix V

Evaluation of the air discharge control operations by Golder Associates

July 2015

20 July 2015

Project No. 1530864_001_LR_Rev0_TBP Audit Report

Paul Drake
Taranaki By-Products Limited
PO Box 172
Hawera 4640

SITE VISIT REPORT - CONSENT 4058-4 CERTIFICATION

Dear Paul,

This letter[1] provides the results of the audit by Golder Associates (NZ) Limited (Golder) of 'Engineering Practice' with respect to the odour control systems that are operated at the Taranaki By-Products Limited (TBP) and Taranaki Bio-Extracts Limited (TBE) sites at Kohiti Road, Okaiawa. The audit investigations were completed during site visits on the 20, 21 and 22 May 2015 by Golder. The requirement for this audit is specified within special condition 6 of Resource Consent 4058-4. This consent was issued by the Taranaki Regional Council on 11 October 2011.

This letter report contains the following sections:

- Confirmation of scope of services
- Audit approach
- Summary of site processes
- Description of odour control systems
- Description of physical condition of equipment
- Instrumentation review
- Design aspects
- Management aspects.
- Summary of audit findings
- Conclusion & recommendations

Confirmation of Scope of Services

Special Condition 6 of consent 4058-4 defines the scope of work required and states that:

[1] This letter report is provided subject to the attached limitations.

> *"By the 30 April 2013, and every two years thereafter, the consent holder shall provide certification by a suitably qualified independent person that the works, processes and equipment relevant to all discharges to air from the site are operational in accordance with good engineering practice."*

Please note, Golder considers that an assessment of operational control systems at the site is outside of the scope of a review of 'good engineering practice'.

Audit Approach

The site audit was led by Roger Cudmore (Principal Environmental Engineer, Golder) and supported by Maria Luisa Oliveira de Aguiar (Environmental Engineer, Golder). Roger has the qualification of *B.Eng (Hons) Chemical & Process* and has over 18 years of experience designing, reviewing and overseeing the installation and operation of air extraction and biofilter treatment systems within numerous rendering plants throughout New Zealand. Maria has qualifications of *B.Eng Environmental* and has over 6 years environmental engineering experience in industry and consultancy.

Having reviewed the previous engineering practice audits, also undertaken by Golder (2010, 2013), it was determined that this audit should focus upon the similar aspects that contribute to the status of existing 'engineering practice'. This audit addresses the following aspects of good engineering practice with respect to the odour control systems that are operated by TBP and TBE:

- **Physical condition of equipment:** The state of odour control components, including consideration of materials used for construction.
- **Instrumentation review:** The accuracy of selected instrumentation and the adequacy of instrument for monitoring the odour control system.
- **Design aspects:** The current engineering design with respect to the air extraction, air cooling and biofilter systems.

As part of the audit process, a number of measurements of pressure, temperature and air flows within odour extraction ducts were made using a calibrated pitot tube, differential pressure meter and thermometer. The results of measurements are summarised before the final conclusion and recommendations section.

A summary of site processes and the odour control system is provided below to help provide context for the subsequent sections of this letter. This is followed by our findings with respect to the various aspects of engineering practice listed above.

Site Processes

The rendering processes operated by TBP and TBE are described by Golder (2010). These processes are mostly the same as those currently operated.

Taranaki By-Products

The TBP rendering plant operates the following processes:

- Bovine by-products rendering line (nominally processing 500 tonnes/day raw material) including pre-breaker (for fallen stock), hogger, surge bin, pre-cooker, press, 2 x decanters, tallow recover plant (liquid phase tank and tallow separators), three indirect steam dryers (TST-70, TST-100 and TST150) and dedicated meal processing plant.
- Blood processing line (nominally processing 150 tonnes/day blood) including a steam coagulator, decanter and indirect steam dryer (TST-30) and milling plant.
- A poultry rendering line (nominally 60 to 120 tonnes/day of raw material) including continuous cook, decanter, indirect steam dryer (TST-100), milling line and tallow recovery.
- Pressurised feather hydrolyser co-sharing the poultry line's dryer and milling line.

- Three waste heat evaporators (WHEs) that utilise hot dryer exhaust streams from the chicken, blood processing and bovine rendering lines to evaporate and concentrate the stick liquor streams that are produced from the tallow recovery plants.

Taranaki Bio-Extract

TBE continues to operate an edible (food grade) gelatine bone chip recovery plant that nominally processes 160-180 tonnes/day of bone material.

The TBE bio-extracts plant operates the following process:

- Melting plant (holding 20 tonne of material including recycled stick liquor)
- Solids decanting (pusher-centrifuge) to separate solids and liquor for recycling
- Bone dryer (Duske TDP 3000 gas-fired dryer), product screening and sorting
- Melter tank liquor processing including decanting, screening, liquid phase tank and tallow recovery
- Decanter solids indirect steam heated drying (Dusky drier)
- Final stick liquor waste stream is directed to the TBP wastewater system, or recycled to the melter.

Odour Control Systems

The odour extraction, cooling system and biofilters comprise the main components of the odour control systems that are operated by TBP and TBE. These systems are summarised below.

Air Extraction and Cooling Systems - Taranaki Bio-Extracts

Extraction: The TBE site operates a relatively simple concentrated sources extraction and cooling system that connects to a biofilter. The extraction of process emissions from specific items of equipment is driven by a single fan (TBE concentrated sources fan). The processes extracted by the concentrated sources system include:

- Duskie dryer exhaust
- Melter tank
- Liquor screening (post the liquor decanter)
- Liquid phase tank and
- Final air discharged from the bone air-sieving system.

There is no building air extraction system employed by the TBE plant as the concentrated sources extraction system is sufficient to contain all significant process odour emissions.

The soup stock plant is a small operation for which no odour controls are employed as this process produces only minor odour that is not inherently objectionable or offensive.

Concentrated Sources Cooling: The combined concentrated sources air streams are passed through a water spray scrubber tower that utilises the final wastewater polishing pond for its water supply.

Air Extraction and Cooling Systems - Taranaki By-Products

Extraction: The TBP site also operates a similar concentrated sources extraction and cooling system that targets rendering and tallow recovery process stages as well as all the hot exhaust air streams from the five TST indirect steam dryers.

The TBP concentrated sources extraction and cooling system is shown in Figure 1. The system is more complicated than that operated by TBE, but is also driven by a single concentrated sources fan. In this instance the fan is downstream of the water spray scrubbing air cooling system.

The concentrated sources duct system extends from the two stage scrubber and into the TBL rendering building where it spits into two main sub-manifolds (bovine and chicken sub-manifolds).

The *bovine sub-manifold* is connected to the following processes:

- Pre cooker
- Solids press
- Decanters
- Material transfer conveyors
- Tallow recovery plant (liquid phase tank and separators)

The *chicken line sub-manifold* is connected to the following processes:

- Pre cooker
- Decanter discharge screw and pump
- Decanter discharge conveyor
- Dryer feed conveyors
- Chicken mill and meal bin
- Bovine mill and meal bin

The five TST indirect steam dryers produce hot humid exhaust air streams. These streams are initially extracted by a vacuum created as their vapours are condensed within the WHE plant. The resultant NCG stream that discharged from the WHE plant is subjected to further vacuum as this stream connects to the water spray tower that is ventilated by its connection to the inlet of the TBP concentrated sources fan (located after the two stage water spray scrubber tower).

Building Air Ventilation: TBP also operate two independent building air extraction systems (Factory Air 1 and 2) that extract building air from the TBP plant (including the fallen stock pre-breaker bin).

Concentrated Sources Cooling: The concentrated sources cooling system is shown in Figure 1. This constitutes the waste-heat evaporation system (WHE) and the dual water scrubber tower. The TST steam dryer exhaust flows contain the main heat loading to the cooling system (both latent and sensible energy).

The WHEs provide an important role in condensing vapours and removing most of the latent energy from the dryer exhaust air streams. The result non-condensable gases (NCGs) stream that exits the WHEs is then mixed and further cooled with the concentrated source streams (from rendering and tallow processes) within the two-stage spray water scrubber. This scrubbing system also utilises the final wastewater polishing pond as its water supply as does the TBE scrubber.

By using the thermal energy from the dryer exhausts, the WHE enables the evaporation/concentration of stick liquor streams that can be recovered as product.

Biofilter Systems

There are four biofilter systems including the two factory air biofilters (1 & 2) and two concentrated source biofilters for TBE and TBP respectively. These arrangements are an improvement from the last audit (Golder, 2013), whereby the TBP concentrated sources did not have a dedicated biofilter. The biofilters and associated sources are summarised as follows:

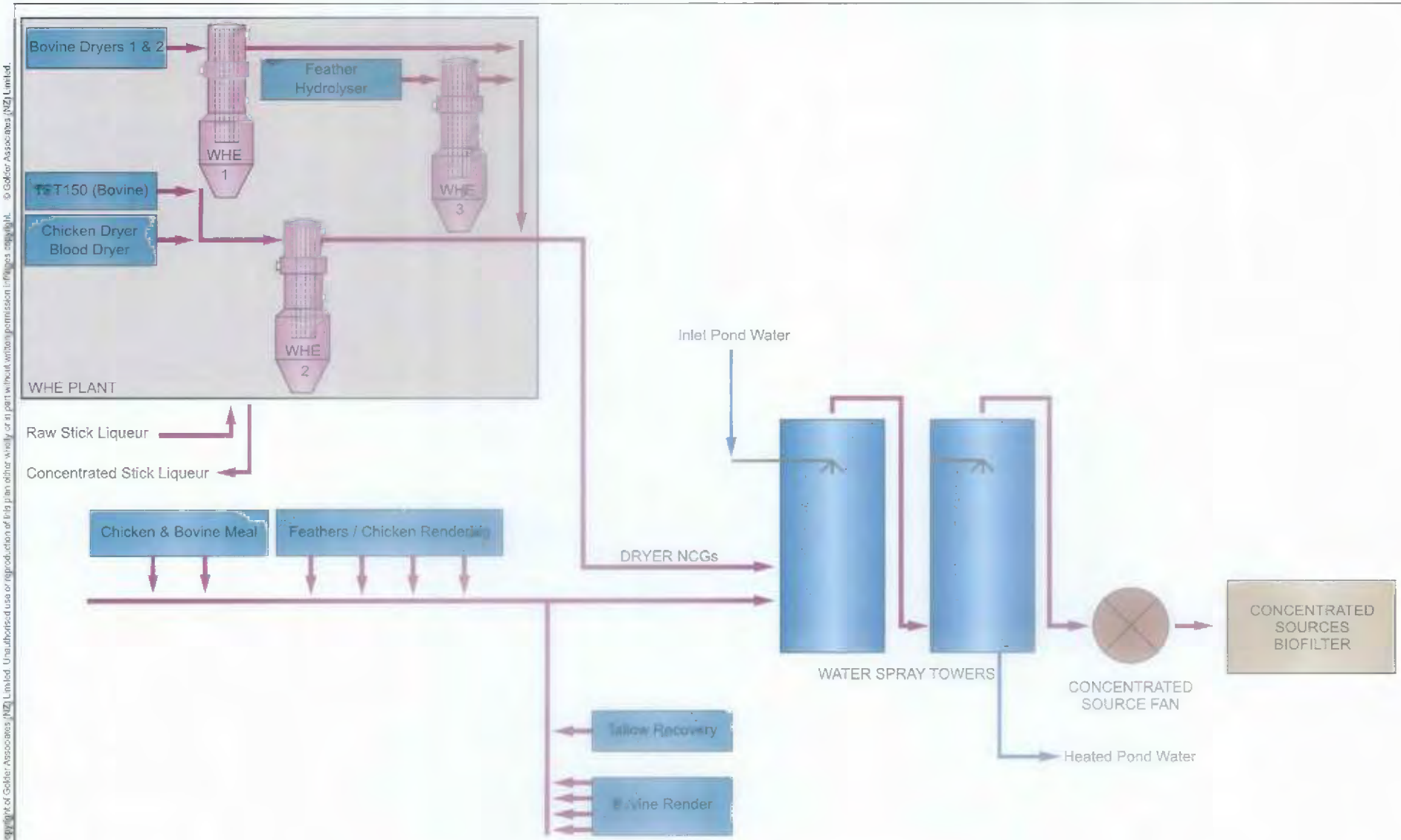
The Factory Air #1: This biofilter consists of a 1.5 m deep bark bed with three areas each of 30 m x 40 m (5,400 m^3 media in total). The Factory Air #1 flow to this bed was measured at 88,000 m^3/hr during the audit. This infers a biofilter bed loading rate of inlet air at 16 $m^3_{air}/hr/m^3_{media}$. This is below our recommended maximum guideline value of 20 $m^3_{air}/hr/m^3_{media}$ for bark-bed biofilters used to treat warm and moist process air streams, and is therefore acceptable. As per our previous recommendation (Golder 2013) this biofilter

had an additional cell installed (i.e. 30 m x 40 m and 1.5 m deep) which has been dedicated to the TBP conc. sources flow (see below).

The Factory Air #2: This biofilter consists of a 1.5 m deep bark bed with a total area of 30 m x 25 m (1,125 m^3 media in total). The Factory Air #2 flow to this bed was measured at 21,000 m^3/hr during the audit. This infers a biofilter bed loading rate of inlet air at 19 $m^3_{air}/hr/m^3_{media}$. As noted from the previous audit (Golder, 2013), this flow was found to heat up from 25°C to 38°C as it passed through the main fan, which is considered to result from the high backpressure this fan works against (discussed later). That aside, be air loading rate to the biofilter media is well within an acceptable range, especially given that building air is involved rather than concentrated sources from the rendering process.

TBP Concentrated Sources (Inedible): This new biofilter consists of a 40 m x 30 m x 1.2 m deep bark bed that was built in 2014 (1,440 m^3 media in total). The TBP concentrated source flow to this bed was measured at 11,000 m^3/hr during the audit. This infers a biofilter bed loading rate of inlet air at 8 $m^3_{air}/hr/m^3_{media}$. For rendering plant concentrated sources air that is cooled down to 40°C, or lower, this equates to a low biofilter bed loading rate.

TBE Concentrated Sources (Edible): This biofilter consists of two 0.7 m deep bark beds that have a significant fines fraction. Each bed had a total area of 20 m x 25 m (700 m^3 media in total). As during the 2013 audit, this bed was only treating the TBE concentrated air flow, which has been the normal mode of operation for the last years – previously this dual bed also treated the concentrated source flow from TBP. The measured flow into the concentrated sources biofilter from the TBE plant was 17,000 m^3/hr, which equates to a media air loading rate of 24 $m^3_{air}/hr/m^3_{media}$. This is above our general guideline of 20 $m^3_{air}/hr/m^3_{media}$ for rendering plant concentrated sources, however is acceptable in this case. This is because the inlet air that is cooled down to 40°C or less and especially because of the low odour content that is inherent within process emissions from the bio-extracts process compared to by-products rendering.



1. Schematic only, not to be interpreted as an engineering design or construction drawing
2. DRAWN SY: ZM REVIEWED BY: RW

Golder Associates

SCHEMATIC DIAGRAM OF CONCENTRATED SOURCES EXTRACTION AND COOLING SYSTEM - TARANAKI BY-PRODUCTS LTD

JULY 2015
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Physical Condition of the Odour Control System

All process equipment, extraction ducts, cooling equipment, fans and biofilters were generally found to be in a sound physical and functioning state as previously reported by Golder (2013), although as noted below there are signs of corrosion becoming advanced in some sections of the air ducts. The TBE plant is still in a relatively new condition that the older TBP plant. There are plans for some expansion to the latter plant that will require upgrades to the concentrated sources extraction and cooling systems. Components of the system are discussed as follows.

Extraction & Discharge Ducts

The extraction stainless steel ducts within the TBP plant are relatively old, but remain in a good engineering condition and showing no significant corrosion effects. By comparison the TBE stainless steel extraction ducts are in a relatively new and very good condition. The TBP factory air ducts exhibit corrosion in some isolated locations. These are not resulting in leaks at this stage but are noted below and recommended for closer inspection and scheduled maintenance, as necessary.

- The point of connection between the corrugated iron duct to the stainless steel cowling on the discharge side of the Factory Air 2 fan is under significant pressure and is starting to significantly rust. This could become a significant point of air/odour leakage in the next year or less.
- The Factory Air 1 discharge duct also exhibits some corrosion around a duct join that is immediately downstream of the manual and online temperature instrumentation (i.e. opposite the sump beside the Factory Air 2 Biofilter).
- The sump opposite the Factory Air 2 fan discharges odorous vapours which could be a result of an air leakage from the TBP concentrated sources duct – the source was in a confined space and could not be confirmed during the site visit. This is not a significant source but it is recommended the sump and ducts are inspected.
- Significant emissions from the bovine mill area were observed and indicates that air extraction ducts that are hydraulically connected to the TBP concentrated source duct could be blocked. These emissions are into a building that appears to have effective air extraction via the Factory Air 1 and 2 fans.

Fans

Fans that are operated to extract concentrated sources from TBE and TBP, as well as large factory air fans used by the TBP plant were all operating during the audit and appeared to be well maintained. They exhibited no excessive vibration, bearing noise or any significant leakages around fan seals, and therefore appear to be operating without any malfunction.

Cooling Equipment

All air stream cooling systems at TBE and TBP (i.e., scrubbers, WHEs, heat-exchangers) were in good physical condition and appear well maintained. They also exhibited no leaks or malfunctions were achieving a concentrated sources discharge temperature below 40°C (i.e. 39°C and 36°C for the TBE and TBP discharge ducts respectively). This is an improvement the previous audit findings by Golder (2013), whereby both cooling system were not achieving sufficiently low temperatures.

Increased cooling duty via the water spray scrubbing towers had been achieved by improving the quality of final pond wastewater that is supplied to the TBE and TBP scrubber systems. Additionally, a new evaporative cooling plant has been installed by TBP to provide additional capacity for cooling exhaust vapours from the WHE plant. It is not clear if this system directly benefits the cooling of NCGs from the WHE and therefore reducing their heat loading to the water spray scrubbers.

It is noted that TBP plan to install to replace a TST-70 dryer in the bovine line with a larger dryer (TST-100), move a TST-70 dryer to the blood room and move the blood room's TST-30 dryer to the chicken line. To manage the addition dryer exhaust cooling duty (in the order of 30%), an additional WHE plant is being considered for the two chicken dryer exhaust streams. It also likely that the TBP water spray scrubbers system could need an increased water supply rate, or some other provision is made available for adequate cooling of the net increase in NCG flow and additional rendering line. This additional line would be installed

opposite the exiting bovine rendering line (in the old boiler location) and would include additional pre-cooking, decanting and press equipment.

Biofilters

There are effectively four biofilter systems operated at the site (compared to three in 2013). The TBP concentrated sources biofilter is an independent 30 m x 40 m bed that has been added to the end of the Factory Air 1 biofilter. All these biofilters except for Factory Air No. 2 biofilter have concrete pipe manifolds with Novaflo drainage pipe for air distribution laterals. Factory Air No. 2 biofilter has corrugated iron manifolds which may need replacement in the year or two as corrosion effects could be significant after five years of life.

All beds appear to have good air distribution. However, the TBE concentrated sources biofilter is showing signs of leakage where the laterals connect to the main concrete manifold within the bed (see Figure 2). This leakage is not causing significant odours but the associated flow channelling is likely to increase over time. At some stage in the future (when the bed in partially replaced), it would be an opportune time to reseal the Novaflo lateral connections to the concrete manifold.

All biofilter bed media appear in a good condition except for the TBP concentrated sources media that has excessive moisture in the lower sections of the bed. Consequently the bed back pressure level is high at approximately 1800 Pa.

The back pressure of air supplied to the Factory Air 2 biofilter (FA2 biofilter) is also very high at 4000 Pa and is attributed to the lateral system being blocked by dust discharged from within the blood room. The subsequent building air that extracted via the Factory Air 2 system transports this dust to the FA2 biofilter. One option to reduce the dust loading to the FA2, is to install a spray scrubber tower near the blood room that enables its building air to be scrubbed before being discharged to the FA2 biofilter. This scrubber could also be used for cooling NCGs from the new chicken dryer WHE system that is proposed.

Figure 2: TBE concentrated. sources biofilter bed, with vapour leaking above one of the main ducts.

Instrument Review

The instrument review consisted of checking temperature gauges within the process air extraction system, which was also undertaken by Golder (2013). Temperature gauges and vacuum gauges were compared to pre-calibrated instruments used for the audit – that is the (Fluke 50D) thermometer and the Dwyer digital

manometer (Model AQTI-WDPM-005). The Fluke meter's temperature span was assessed by Golder to have an absolute accuracy within ± 1 °C for 0 °C and 100 °C. This accuracy was checked using ice and boiling water. The Dwyer digital manometer has factory calibration and was on check onsite against water tube manometer readings that indicated an absolute accuracy of within 5%, or less.

Temperature gauges on the TBP concentrated sources system were within 1°C of the Fluke meter. The pressure gauge on the TBE concentrated sources duct (post the scrubber) was within 1% of the Dwyer manometer. No other pressure gauges are on the TBE or the TBP odour extraction system. Installation of vacuum gauges on the odour extraction system is discussed and recommended below.

Recommendations regarding on-line monitoring within parts of the odour control system are the same as those made by Golder (2013) for the key suggestion are listed as follows:

- Install industrial grade pressure/vacuum gauges near the terminus of each main air extraction duct, including concentrated sources and factory air ducts. These gauges should be situated approximately one metre back from the final opening of the factory air ducts (including the pre-breaker hood) and a similar distance for the vacuum gauge installed within concentrated source duct where they connect to first process plant item.
- Install industrial grade pressure/vacuum gauges at the inlet and discharge side of all concentrated source and factory air fans.
- Install robust water manometer or industrial grade pressure gauges on each biofilter inlet pipe within close proximity to the biofiler bed.
- Install industrial grade temperature gauges on the inlet of the biofilters that treat concentrated source air from TBE and TBP.
- Install industrial grade temperature gauges on the inlets and outlets of the water spray scrubbers that cool the TBE and TBP concentrated source air flows, as well as on the inlet cooling water supply and discharge line.
- For overhead air extraction manifolds that are difficult to access, run steel tubing down walls to mounted gauges that can be readily accessed and viewed from floor level.

Design Aspects

The key design features of the odour control system's extraction ducts, air cooling and odour treatment have been set in place for a number of years and have been driven by requirements of resource consent conditions. These aspects are discussed below.

Odour Extraction System

Taranaki By-Products: The TBP odour extraction system relies heavily upon the two building air ducts and associated fans (Factory Air 1 and 2). The concentrated sources extraction system targets point sources of process odour before they escape into the rendering process building. This system is not able to effectively contain hot process emissions from rendering equipment ahead the dryers. With expansion of the TBP rendering plant over the years, the concentrated source extraction system is increasingly less able to contain process emissions. Consequently the building air extraction system, that extracts almost 100,000 m^3/hr of air from near the apex of the TBP rendering building, is relied upon to capture and treat process odour emissions. This system is well designed and is essential for controlling odour emissions and limiting the potential for off-site effects.

As discussed by Golder (2013), modern rendering plants in New Zealand have employed the use of more effective concentrated source odour extraction systems. For these plants, the building air extraction and treatment provides additional odour control redundancy. These systems rely less, or not at all, upon the extraction and treatment of large volumes of building air.

Golder (2013) concluded that there is scope to upgrade the concentrated source system and further increasing its efficiency. This could be undertaken when designing a new concentrated source sub manifold

system for the proposed new bovine rendering line. The options are to install a single new concentrated sources manifold that targets the existing and new bovine rendering equipment including the decanters, transfer conveyors, pre-cookers, and presses.

Finally it is recommended that there be a duct cleaning programme put in place for any upgraded concentrated sources system and the existing chicken rendering line and meal processing (bovine and chicken lines) air extraction systems. The existing system is showing signs of partial blockages and is difficult to access. For the upgraded system recommended for bovine rendering the design should provide for routine access and cleaning of ducts.

Taranaki Bio-Extracts: The TBE plant has an effective concentrated sources system for containing process odours, and does not have, or require a building air extraction system. This is partly because the material processed at TBE is inherently less odorous than at TBP, but also because the TBE concentrated sources system is significantly more effective at containing process odours compared to the equivalent system operated at TBP. The design of the odour system at TBE represents good design practice, as its concentrated sources system is the sole engineered system that is installed to limit the potential for off-site odours.

Cooling Systems

The data summarised in Table 2 indicates the degree of cooling imparted on the concentrated sources from TBE and TBP has improved in comparison with 2013. During the 2015 audit, all inlet biofilter temperatures were found to be below 40°C, which is considered good engineering practice (a target of achieving temperatures below this level for at least 99 % of time is recommended). In the previous audit carried out by Golder (2013), the media temperature of the concentrated sources biofilter was around 50°C. However, the daily inlet biofilter temperature recorded by TBP from 15th to 21st May 2015 show that, with exception of Factory Air #1, which was consistently around 38°C, the other biofilter inlets were mostly between 40 to 44°C.

The limitations on cooling water supply for TBP is likely to be an ongoing issue given the proposed new bovine line and increased dryer capacity at the site. Improvements in the final waste treatment pond water quality and/or the use of evaporative cooling have appeared to have effectively dealt with issues raised by the previous audit by Golder (2013). Similar approaches and equipment are likely to be necessary to maintain the currently level performance following the proposed upgraded and expansion in processing capacity from around 500 tonnes/day to 850 tonnes/day of raw material.

Biofilters

The connections of air streams to the various biofilters at the site have been altered since the last audit (Golder 2013). Specifically, the two large factory air flows are now respectively dedicated to their own biofilter beds, Factory Air #1 and Factory Air #2. On occasions the Factory Air #1 biofilter bed may also receive TBP concentrated sources flow, when the latter's biofilter requires maintenance.

The current dedication of a biofilter bed to each TBP and TBE concentrated source systems is consistent with good engineering practice. The design aspects and the associated air loading rates to the various biofilters are discussed below.

Factory Air #1: This biofilter currently receives only Factory Air #1alone. During this audit this flow was measured at 88,000 m^3/hr. This a significant improvement on the flow of 75,600 m^3/hr (that included the TBP conc. source flow) that was measured by Golder (2013).

TBP Concentrated Sources: This fourth cell was installed with a 40 m x 30 m x 1.5 m deep bark bed, and is dedicated to the TBP concentrated sources stream. The current flow rate of concentrated sources air (i.e. 11,000 m^3/hr) is not able to effectively contain TBP concentrated sources air. However at the current flow rate, the TBP concentrated sources biofilter is only loaded at 8 $m^3_{air}/hr/m^3_{media}$. Therefore given the water logging issues can be resolved (these are leading to high back pressures of 1800 Pa gauge), this bed is able to receive approximately twice or more the current flow and still provide effective odour treatment. In other words there is biofilter capacity available to receive and treat an significant increased concentrated sources air flow. The issues will be to extract this flow, adequately cool it and rectify the high moisture levels in this relatively new biofilter bed.

Factory Air #2: This biofilter treats only Factory Air #2 air stream, which was measured at only 21,000 m^3/hr during the audit. This is results in an acceptable air loading rate and indicates there is some spare capacity (up to 35%). However the high backpressure within the inlet duct that supplies building air to the FA2 biofilter (i.e., around 4000 Pa) due to blocking of distribution system need to be rectified in time. The solution will require blood room dust being removed/clean from the extracted building air as well as water blasting or replacing the existing corrugated iron/novaflo air distribution system. Replacement of the latter with a concrete duct system would represent good engineering practice. Also given this bed receives loading of blood meal dust, then the installation of laterals that can be routinely water blasted and enable effective drainage would be good practice and is recommended. The current novaflo lateral design does not allow for this routine cleaning and unblocking of the air distribution system.

TBE Concentrated Sources: This biofilter treats pre-cooled TBE concentrated sources. The media loading rate of warm air at 24 $m^3_{air}/hr/m^3_{media}$ was established from flow measurements (see data summary section). The inlet air temperature measured during the audit was at 39°C, however the daily temperature records from 15th to 21st May 2015 provided by TBP show this temperature varied from 41 to 44°C. It is recommended this is reduced to 40°C or less during normal operation. As noted above, the bed is effectively removing odour from the extracted TBE concentrated sources stream, however channelling around the main concrete manifolds within the two beds will increased over time and require maintenance the next time the bed is replaced and sooner if necessary.

Management Aspects

Golder (2013) provided an assessment of the management systems that support the on-going maintenance and operation of equipment and instrumentation. The key recommendations from this audit are mostly still relevant in 2015 and are summarised below. Additional recommendations regarding the management of the WHE plant are provided as its effective operation is considered paramount for containing odours associated with meal dryer exhausts – that is the most significant potential source of objectionable odour from rendering. The site maintains formally documented management systems for the control of site processes, which include the following site process documents:

- Process control and description.
- Calibration of measuring device schedule.
- Site repairs and maintenance programme.
- System auditing.

Process Control and Description: The process control description document provides instructions to plant operators on the management and monitoring of process stages including raw material receipt through to the meal room procedures. The document provides instructions with respect to the following:

1) Key operating steps for the operator to implement.
2) Key actions/steps to implement.
3) Key monitoring targets/set-points and methods for recording.

These generic instructions are provided for all process stages and associated plant and for each raw material type. Therefore, key items such as pre-cookers, feather hydrolyser, meal dryers and the waste heat evaporators as well as other plant have specific instructions.

Ensuring that the WHE plant extracts and cools dryer exhaust effectively is one of most important aspects of the concentrated source odour control system. To this end, the following three WHE operational parameters are considered important to control:

- Evaporator vacuum (stick liquor side)
- Stickwater level within the evaporator

- Final stickwater concentration

The first two parameters above are continuously monitored and the second controlled by the plants operating conditions. The stickwater concentration can be manually monitored and the concentrate discharge pump rate adjusted to achieve a desired value. Maintaining the above three operational parameters within normal operating ranges allows for the steady extraction and cooling of dryer exhaust – therefore minimising odorous fugitive emissions into the rendering building.

There are other operational parameters, if monitored and displayed to operators can provide a warning of abnormal or deteriorating WHE operation. Parameters below that are not already monitoring and displayed by the TBL SCADA system are suggested for as future upgrades to the existing WHE monitoring/management system:

- **Stick liquor recirculation pump amps** (high levels warn of possible pump issues or excessive concentration of stick liquor)
- **Condenser hot water outlet temperature** (low levels warn of poor heat transfer in condenser or the WHE)
- **Condenser cold water inlet temperature** (high levels on hot days warn of reduced condensing capacity)
- **Non condensable gas (NCG) temperature** (high values indicate poor heat transfer in the WHE)
- **Stick liquor temperature in WHE** (low values indicate poor heat transfer in the WHE)
- **WHE vapour temperature** (low values indicate poor heat transfer in the WHE)

Calibration of Measuring Device Schedule: The calibration of measuring devices document details standard procedures for calibration, monitoring and verification of measuring devices, as well as procedures for taking corrective actions and associated record keeping. It recommended that this includes measuring devices associated with the odour extraction, cooling and biofilter systems.

Auditing of Management Systems: The management systems at the site, including those discussed above, are themselves subject to an internal audit procedure (SP190). Reviews of different management systems are scheduled throughout the year and undertaken by the Plant Manager on an annual basis. The aim of the audit is to up-date the systems and to check upon their effectiveness. Additionally, other site managers (plant engineering, environmental and operations) are required to undertake weekly reality checks (i.e., effectiveness reviews) of checklists that relate to their responsibilities.

The monitoring of the internal auditing is also undertaken by the plant manager and has the responsibility for ensuring corrective actions are implemented and records are maintained. Monitoring via an external audit by NZFSA is undertaken at a frequency determined by performance history.

This internal and external auditing system represents good practice.

Summary of Data

This section summarises measured temperatures, pressures, relative humidity and flow rates obtained from this audit and compared to values measured by Golder (2013). This includes the inlet air flows to the site biofilters (Table 1), air stream parameters (Table 2) and biofilter parameters (Table 3).

Table 1: Biofilter Inlet Air Flows, 2015 with 2013 in brackets

Biofilter	Source(s)	Flow rate (m^3/hr)
TBE Conc. Source	Concentrated sources, dryer exhaust	17,000 (14,500)
TBP Conc. Source	Conc. sources, mills and dryer NCGs	11,000 (no data)
TBP Factory Air 1	Rendering Building Air	88,000 (75,600)
TBP Factory Air 2	Rendering and Blood Building Air	21,000 (25,000)

Table 2: Air Stream Parameters 2015 with 2013 in brackets

Location	Gauge Pressure (Pa)	Temperature (°C)	Humidity %RH
TBP conc. sources Scrubber – Inlet Duct	-680	52 (59)	100
TBP conc. sources Fan - Inlet Duct	-1250	30 (NR)	100
TBP conc. sources Fan – Outlet Duct	> +1800	36 (51)	100
TBP conc. sources Fan – Outlet Duct (Opposite Sump)	+1800	30 (41)	100
Factory Air 1 Fan – Inlet Duct	-1600	30 (33)	~52
Factory Air 1 Fan – Outlet Duct (Opposite Sump)	+2600	33# (41)	~52
Factory Air 2 Fan – Inlet Duct (Opposite Sump)	-680	25 (43)	~58
Factory Air 2 Fan – Outlet Duct (Opposite Sump)	+4000	38## (43)*	~58
TBE conc. sources Fan – Outlet Duct (River Crossing)	320	39 (49)	100
TBE conc. sources – Scrubber Inlet	990	~60	100

Site measurements previous week indicate 5 °C higher i.e. averaging 38 °C
Site measurements previous week indicate 3 °C higher i.e. averaging 41 °C
* Temperature rise of 13°C across Factory Air 2 Fan (i.e. 25 °C to 38°C)

Table 3: Biofilter Parameters 2015 with 2013 in brackets

Biofilter	Inlet Duct Pressure (Pa)	Inlet Air Temperature (°C)	Media Temperature @ 900 mm depth
TBE Conc. Source	160 (250)	39 (50)	35 (50)
TBP Conc. Source	1800 (NR)	36 (51)	~35
Factory Air 1	2,600 (2,300)	33 (41)	< 30 (33,34)
Factory Air 2	4,000 (3,330)	38 (43)	23,25 (31,28)

Conclusions & Recommendation

Following Golder's audit of the TBP and TBE odour control system, it is concluded that the associated equipment, including ducts, fans, cooling system and biofilters, appear to be maintained and operated in a sound engineering state.

The existing cooling systems are generally achieving inlet airstreams to the biofilters are normally 40°C or lower, which represents good practice. Future upgrades to the cooling systems, and a new WHE plant (as being considered by TBP) is likely to be necessary given the expansion to the bovine rendering systems.

It is concluded that an increased level of temperature and pressure gauge monitoring at various positions along the extraction, cooling and biofilter system would ensure standard engineering practice is achieved. Currently regular manual measurements are undertaken.

The existing biofilters and extraction systems are generally working effectively however most will require some maintenance or remedial actions as follows:

- The Factory Air 2 Biofilter requires a new air distribution and lateral system that can be cleaned.
- The Factory Air 2 air extraction from the blood room requires pre-cleaning of this air stream to remove blood dust and blocking up of the biofilter.
- The TBP concentrated sources biofilter has excessive water levels and the source and remediation measures need to further investigation.
- The TBE concentrated sources biofilter has signs of air channelling around its central concrete manifolds that will in time require remediation by re-sealing its connections to the Novaflo laterals.

The site has comprehensively documented management systems for ensuring reliable operation of process equipment and achieving processing goals. An expansion of the documentation to odour control system temperatures and pressures as well as some additional WHE operational information is recommended.

Finally it is recommended that the TBP concentrated source system is reviewed and upgraded in conjunction with the design and installation of a system that targets an expanded bovine rendering line. The opportunity exists for installing a system that manages emissions from both the new and existing bovine rendering equipment.

Please contact the undersigned if you have any queries regarding this report.

Yours sincerely

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RC/RLC/

Attachments: Report Limitations

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References

Golder 2010. Evaluation of the Air Discharge Control Operations. Letter report prepared by Golder Associates (NZ) Limited for Taranaki By-Products Limited. Document No. 1078104236. 19 July 2010.

Golder 2013. Site Visit Report - Consent 4058-4 Certification. Letter report prepared by Golder Associates (NZ) Limited for Taranaki By-Products Limited. Document No. 1378104138_002_LR_Rev0. 2 July 2013.

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