Remediation NZ Ltd
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-11

ISSN: 1178-1467 (Online)
Document:1848401 (Word)
Document:1970516 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

January 2018

Executive summary

Remediation NZ Ltd (the Company) operates two worm farms which produce vermicast for fertiliser at two sites in Brixton, on Pennington and Waitara Roads in the Waiongara catchment. The Company also operate a remediation, composting and vermiculture operation on the Mokau Road at Uruti, in the Mimi catchment.

This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The Company holds eight resource consents, which include a total of 109 conditions setting out the requirements that the Company must satisfy. These eight consents cover the activities across the Company's three sites.

During the monitoring period, Remediation NZ Ltd demonstrated an overall good level of environmental performance.

The Council's monitoring programme for the year under review included seven inspections, 84 water samples and four soil samples collected for physicochemical analysis, one biomonitoring survey of receiving waters, and one fish netting survey of receiving waters.

The monitoring showed that at certain times during the monitoring year the concentration of un-ionised ammonia discharged from the wetland treatment system may breech the consented threshold of $0.025g/m^3$. This occurs when stream flows are at their lowest and algae activity within the wetland can increase the potential for un-ionised ammonia conversion. The proposed dam development may seek to prevent this effect from continuing.

Two monitoring rounds of six, detected minor exceedances with respect to un-ionised ammonia concentrations from the wetland treatment system mixing zone sampling point.

Groundwater analysis detailed that the salinity is trending up in the groundwater of the lower irrigation area and also slightly in the upper irrigation area. One trace result of toluene was found in one groundwater monitoring round. The follow up analysis did not find anything above the limit of detection. An additional irrigation area is currently under construction. This will allow for rotation of the irrigation areas in future.

The corresponding soil analysis and specifically the sodium absorption ratio (SAR) analysis detailed a decrease in the SAR in the lower area. This was communicated in the previous monitoring period to the site management and the results indicated that the consent holder had been mindful with applications of saline enriched irrigation fluid since.

One sample result of total petroleum hydrocarbons was observed in the surface water sampling of the Haehanga Stream, it was marginally above the limit of detection. The site below did not reveal anything above the limit of detection for this particular analyte.

Additional analysis has been added to the current soil sampling programme and will be put into affect in the upcoming monitoring period. Additional analysis has also been added to the current surface water sampling programme. Two additional rounds of groundwater analysis are also proposed to encompass seasonality at the composting facility in Uruti.

Riparian management and fencing of streams will require action as frequently cattle have been observed accessing the stream and across the site. Regular checking for fish passage provision is encouraged, especially post storm events.

Administrative performance requires improvement in the upcoming monitoring period. Screening analysis prior to arrival at site for certain waste stream must be undertaken to meet consent requirements.

Site performance of the Waitara Road facility in this monitoring period indicated a well-managed site with minimal off site odour noted. The site appeared to maintain good housekeeping and appropriate sediment control. Worm beds were covered and no ponding of stormwater was noted during inspections. The Pennington Road site appeared untouched as a laydown yard with aged piles of bark growing grass.

During the year, the Company at their Uruti facility demonstrated a good level of environmental and a needs improvement for administrative performance with the resource consents.

During the year, the Company at their Pennington Road and Waitara Road facilities demonstrated a High level of environmental and a High level of administrative performance.

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance is improving in the year under review, however improvement is required for administrative compliance at Uruti.

This report includes recommendations for the 2017-2018 year.

Table of contents

List of figures

List of tables

1. Introduction

1.1. Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1. Introduction

This report is for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Remediation NZ Ltd (the Company). The Company operates a worm farm located in Brixton, Pennington Road and on the Waitara Road, in the Waiongara catchment. RNZ also operate a remediation, compositing and vermiculture facility on the Mokau Road, Uruti, in the Mimi catchment.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the Company that relate to abstractions and discharges of water within the Mimi and Waiongara catchments, as well as the air discharge permit to cover emissions to air from the Uruti site.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the 16th combined annual report by the Council for the Company.

1.1.2. Structure of this report

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

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

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

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

Section 4 presents recommendations to be implemented in the 2017-2018 monitoring year.

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

1.1.3. The Resource Management Act 1991 and monitoring

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

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;

b. physical effects on the locality, including landscape, amenity and visual effects;

c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

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

e. risks to the neighbourhood or environment.

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

1.1.4. Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the Company, this report also assigns them a rating for their environmental and administrative performance during the period under review.

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

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

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

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving 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 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

1.2. Process description

A range of waste streams are processed and converted, via vermiculture and composting, into a marketable biological product that can be safely used as a fertiliser and soil conditioner.

The Company's operation consists of a composting and vermiculture operation at Mokau Road, Uruti, and vermiculture operations at Waitara Road and Pennington Road. The Waitara Road site also has a fertiliser processing facility which blends and refines the finished products.

The Mokau Road, Uruti composting site was established in late 2001 following removal of composting operations from the old Winstone Aggregates quarry site, Manutahi Road, Bell Block (RNZ no longer operates at this site). Closure of the composting operations was due to the incompatible nature of the activity with surrounding land use (nearby residential houses), which resulted in odour incidents. The vermiculture production facilities have been operating at Waitara Road since 1998 and at the Pennington Road site since 2001.

The current site at Uruti accepts a range of waste streams including, paunch grass, poultry waste, poultry mortalities, green waste and drilling waste.

The composting operation and drilling mud processing at the Mokau Road site generates a significant amount of leachate and contaminated stormwater from three main processing areas. These are the drilling wastes pad (DWP) and two composting pads (known as 'pad 1' and 'pad 2').

Drilling muds, fluids and cuttings are mixed with sawdust or other organic material and then piled up on the drilling wastes pad. Any rainfall runoff and leachate that is generated, drains into a series of ponds for treatment. Between each pond is a baffle that skims off any floating hydrocarbons as the leachate passes through. These ponds also treat the leachate and stormwater from pad 1 where remediated drilling wastes are stored and/or processed further. The treated liquid from the pond treatment system (PTS) is then irrigated to cut and carry pasture on two irrigation areas.

Runoff and leachate from composting pad 2 and a paunch grass maturation pad is pumped up to the top of a seven tier constructed wetland. Under dry conditions the water from the bottom pond of the wetland is reticulated back to the top tier of the wetland. Under high flow conditions the wetland discharges the treated stormwater/leachate to a tributary of the Haehanga Stream.

RNZ are also developing a pea gravel quarry at the Uruti site.

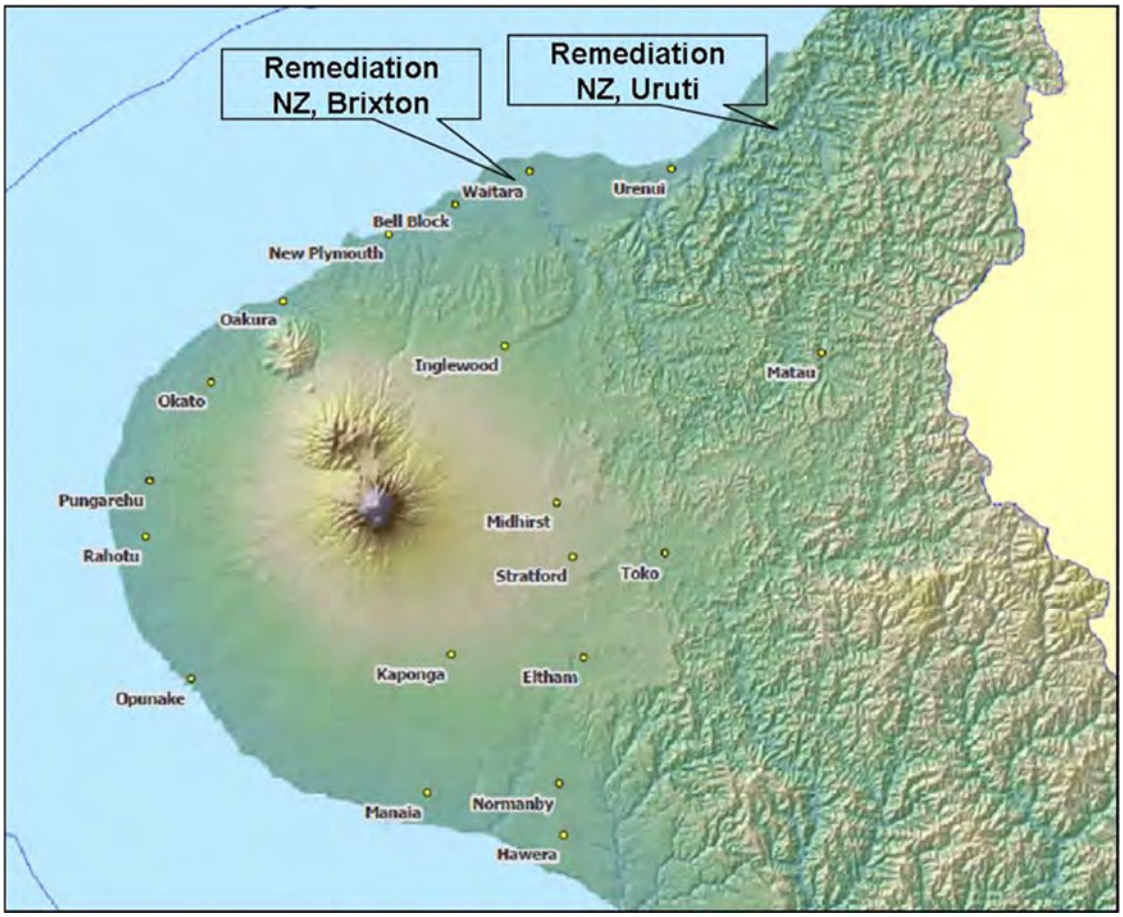


Figure 1 Regional location of RNZ's operations in Taranaki

1.3. Resource consents

Table 1 Resource consent held by RNZ

Consent No.	Site	Purpose	Expiry Date	Review Date(s)
5838-2.2	Uruti	Discharge to land and water	June 2018	Yearly
5839-2	Uruti	Discharge emissions to air	June 2018	Yearly
5938-2.2	Uruti	Install culvert	June 2015	-
6211-1	Uruti	Divert stream	June 2021	-
6212-1	Uruti	Install culvert	June 2021	-
10063-1	Uruti	To discharge treated stormwater (quarry)	June 2033	June 2021
5892-2	Brixton	Discharge to land/water	June 2020	-
5893-2	Brixton	Discharge to land/water	June 2021	-

Summaries of these consents are provided in sections 1.3.1 to 1.3.4 below. This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consents which are appended to this report.

1.3.1. Air discharge permit

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

RNZ holds air discharge permit **5839-2** to discharge emissions into the air, namely odour and dust, from composting operations.

This consent was issued to the Company on 30 June 2010. It is due to expire in June 2018

The consent has 20 special conditions attached to it.

Special condition 1 requires that the consent holder adopt the best practical option.

Special conditions 2 to 4 set restrictions on the types of waste accepted and the size of the composting pads, and condition 5 requires that records be kept of incoming waste.

Special conditions 6 and 7 deal with the requirements for the submission of and adherence to a Site Practices Plan.

Special conditions 8 and 9 require an independent report on the management of the site in regards to practices and air emissions, and special condition 10 requires that any recommendations from the report be adhered to.

Special conditions 11, 12, and 13 set out the permitted limits on the effects of discharges to air arising from the exercise of this consent.

Special conditions 14 and 15 deal with the requirements for weather monitoring and odour surveys.

Special conditions 16 and 17 set out requirements for community liaison and complaints procedures.

Special condition 18 and 19 set out the requirements for site reinstatement.

Special condition 20 is a review condition.

The permit is attached to this report in Appendix I.

1.3.2. 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.

RNZ holds discharge permit **5838-2.2** to discharge:

a. waste material to land for composting; and

b. treated stormwater and leachate from composting operations; onto and into land in circumstances where contaminants may enter water in the Haehanga Stream catchment and directly into an unnamed tributary of the Haehanga Stream. This consent was issued to the Company on 30 June 2010. It is due to expire in June 2018.

Consent 5838-2 has 30 special conditions.

Special condition 1 requires that the consent holder adopt the best practical option for reducing and minimising effects.

Special conditions 2 set restrictions on the types of waste accepted.

Special condition 3 define the pre-screening analysis criteria for certain waste streams,

Special condition 4 define that no material from dissolved air filtration be accepted

Special condition 5 and 6 set out requirements for the maintenance of treatment systems.

Special condition 7 relates to pond management.

Special conditions 8-11 require the consent holder to keep irrigation records and defines the areas and extent of the irrigation.

Special condition 12 and 13 define analysis pertaining to soil assessment.

Special condition 14 defines the requirement for a management plan.

Special conditions 15 to 19 relate to groundwater quality assessment and monitoring.

Special conditions 20 and 21 deal with the maintenance and management of the pond treatment system.

Special conditions 22 to 25 deal with the maintenance and management of the wetland treatment system.

Special condition 26 requires that riparian planting be maintained in accordance with the riparian plan in place.

Special condition 27 requires that the consent holder keep records of all complaints.

Special conditions 28 and 29 deal with site reinstatement.

Special condition 30 is a review condition.

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.

The Company holds discharge permit **5893-2** to cover the discharge of solid hydrocarbon exploration drilling wastes onto land, and to discharge stormwater from the worm farming operations onto and into land and into the unnamed tributary of the Waitara River at the Pennington Road, Brixton site. This permit was originally issued by the Council on October 2006 under Section 87(e) of the RMA. It is due to expire in June 2020.

There are 11 special conditions attached to the consent.

Special condition 1 requires the consent be exercised in accordance with information submitted in the application.

Special condition 2 and 3 requires, upon request, records of the nature and volume of wastes.

Special condition 4 sets a maximum hydrocarbon content on solid drilling cuttings of 5%.

Special condition 5 requires that there is no contamination of groundwater or surface water.

Special condition 6 requires the stormwater treatment system to be maintained.

Special condition 7 gives contaminant concentrations not to be exceeded in the discharge while special condition 8 describes visual effects which must not be observed below a mixing zone.

Special condition 9 requires notification prior to undertaking changes to processes or operations which would change the nature or quantity of contaminants emitted from the site.

Special condition 10 requires notification of reinstatement of the site and gives guidance as to how reinstatement should be carried out to minimise effects on stormwater.

Special condition 11 explains review provisions.

The permit is attached to this report in Appendix I.

1.3.3. Water discharge permit

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.

The Company holds water discharge permit **10063-1** to discharge treated stormwater from a quarry site, into an unnamed tributary of the Haehanga Stream. This consent was issued to the consent holder on 9 March 2015. It is due to expire in June 2033.

It has 18 special conditions.

Special condition 1 requires the consent be exercised in accordance with information supplied with the application.

Special condition 2 requires the consent holder to notify Council prior to exercise of consent.

Special condition 3 requires the consent holder to adopt best practice.

Special condition 4 requires the consent to progressively reinstate the quarry site.

Special condition 5 limits the area of disturbed soil.

Special condition 6 limits the stormwater catchment area.

Special conditions 7, 8, and 9 deal with stormwater treatment requirements.

Special conditions 11, 12, and 13 deal with discharge quality and effects on receiving waters.

Special conditions 14 and 15 deal with management and contingency plans.

Special condition 16 deals with notification of changes in site processes.

Special conditions 17 and 18 are lapse and review conditions.

The Company holds discharge permit **5892-2** to cover the discharge of stormwater from the worm farming operations onto and into land and into the unnamed tributary of the Waiongana Stream at the Waitara Road, Brixton site. This permit was originally issued by the Council on 7 September 2006 under Section 87(e) of the RMA. It is due to expire in June 2020.

There are 10 special conditions attached to the consent.

Special condition 1 requires the consent be exercised in accordance with information submitted in the application.

Special condition 2 requires the consent holder adopt the best practicable option to prevent or minimise adverse effects on the environment.

Special condition 3 requires the provision, upon request, of records of the nature and volume of wastes.

Special condition 4 sets a maximum hydrocarbon content on solid drilling cuttings of 5%.

Special condition 5 requires that there is no contamination of groundwater or surface water while condition 7 gives contaminant concentrations not to be exceeded in the discharge.

Special condition 6 requires that the stormwater treatment system is maintained.

Special condition 8 requires notification prior to undertaking changes to processes or operations which would change the nature or quantity of contaminants emitted from the site.

Special condition 9 requires notification of reinstatement of the site and gives guidance as to how reinstatement should be carried out to minimise effects on stormwater.

Special condition 10 explains review provisions.

1.3.4. Land use permits

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

Consent **5938-2.2** relates to a culvert in the Haehanga Stream. This consent was granted on 5 December 2001. There are six special conditions attached to the consent.

Special condition 1 requires the consent holder to make provision for fish passage.

Special condition 2 requires that construction to be maintained.

Special condition 3 deals with review of the consent.

Consent **6211-1** was granted as a retrospective consent on 26 September 2003. Relating to a diversion of the Haehanga Stream, the consent has six special conditions attached. It is due to expire in June 2021.

Special condition 1 requires the consent holder to notify the Council prior to works.

Special condition 2 requires that the realignment be carried out in accordance with the application.

Special conditions 3 and 4 require the consent holder adopt the best practicable option to avoid or minimise erosion, scouring and the discharge of silt or contaminants to water.

Special condition 5 deals with riverbed disturbance.

Special condition 6 deals with review of the consent.

Consent **6212-1** is for a culvert in the Haehanga Stream was also granted as a retrospective consent on 26 September 2003. It is due to expire in June 2021.

There are eight special conditions included in the consent.

Special condition 1 requires the consent holder to notify the Council prior to removal of the temporary culvert and installation of the new culvert.

Special condition 2 requires that the temporary culvert be replaced by April 2004, and that the consent holder provide designs of the proposed culvert.

Special condition 3 required that the culvert be constructed in accordance with the application and be maintained to ensure the conditions are met.

Special condition 4 requires the adoption of best practicable option to avoid or minimise adverse effects on water quality.

Special condition 5 deals with riverbed disturbance.

Special condition 6 requires maintenance of fish passage.

Special condition 7 concerns the removal of structures and reinstatement of the area.

Special condition 8 deals with the review of the consent.

1.4. Monitoring programme

1.4.1. Introduction

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

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

The monitoring programme for the RNZ facilities consisted of four primary components.

1.4.2. Programme liaison and management

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

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

1.4.3. Site inspections

The Uruti site was visited seven times during the monitoring period. Additional inspections were also undertaken during environmental monitoring rounds. The Pennington Road and Waitara Road facilities were visited on two occasions.

1.4.4. Chemical sampling

The Council undertook compliance sampling across the Company's operations, primarily related to the Uruti facility in the 2016-2017 monitoring period. As the Company holds resource consents specifically related to discharges to land and water, the Council monitors the surface water, groundwater and soil at the Uruti site. There is also facility to undertake surface water sampling at their laydown areas in Brixton.

The analytes specifically related to the mediums of surface, groundwater and soil are provided in Table 2.

1.4.4.1. Surface water analysis

Surface water samples were collected from 13 specific monitoring locations on the unnamed tributary of the Haehanga Stream and the main stem (Figure 2 and 3) which bisects the Uruti site. The samples collected from these 13 locations were tested for a range of analytes which are detailed in Table 2. The Council assesses these 13 surface water locations six times per annum.

1.4.4.2. Groundwater analysis

The Uruti site contains an active groundwater monitoring network, this network which is a consented obligation of resource consent 5838-2 is comprised of three groundwater monitoring wells (Figure 4). The monitoring network is monitored biannually and is assessed for the analytes provided in Table 2.

Prior to sample collection, Council field staff will undertake a well stabilisation procedure, whereby the sample will not be collected until field parameters (which are assessed through the use of a Yellow Springs Instrument (YSI) multiple parameter probe) have stabilised within 10% over a five minute period, or within three well volumes.

Table 2 Council compliance analytes

Surface Water Analytes	
Total Arsenic	Calcium
Total Lead	Chloride
pH	Conductivity
Sodium Adsorption ratio	Total Petroleum Hydrocarbons
Biochemical Oxygen Demand (BOD)	Potassium
Benzene	Magnesium
Toluene	Un-ionised ammonia
Ethylene	Ammoniacal Nitrogen
Xylene	Nitrite-Nitrate Nitrogen
Temperature	Suspended Solids
Groundwater Analytes	
Benzene	Un-ionised ammonia
Toluene	Ammoniacal Nitrogen
Ethylene	Nitrite-Nitrate Nitrogen
Xylene	Total Dissolved Salts
Chloride	Temperature
Total Petroleum Hydrocarbon	Level

Soil Analytes	
Calcium	Magnesium
Chloride	Sodium
Conductivity	Ammoniacal Nitrogen
Potassium	Nitrite-Nitrate Nitrogen
Moisture factor	pH
Sodium Absorption Ratio (SAR)	Total Petroleum Hydrocarbons

1.4.4.3. Soil sampling analysis

Representative soil sampling is undertaken on the two site specific irrigation areas (Figure 4). The aim of the soil sample is to ascertain for any specific trends which may be emerging as a direct result of irrigation to these areas. Soil sampling is undertaken with a soil corer which is inserted to a depth of 400 mm+/- below ground level (BGL), whereby ten soil cores are collected across an irrigated area. The ten cores are then composted to gain one representative sample. The analysis undertaken by the Council in respect of the soil is provided in Table 2.

1.4.5. Biomonitoring surveys

A biological survey was performed on one occasion in the unnamed tributary of the Haehanga Stream and the main stem at seven locations (Appendix II for full report), in order to determine whether or not the discharge of treated stormwater and uncontaminated site and process effluent from the site has had a detrimental effect upon the communities of the stream. In addition to this, a fish netting survey was also undertaken.

Figure 2 RNZ Uruti site

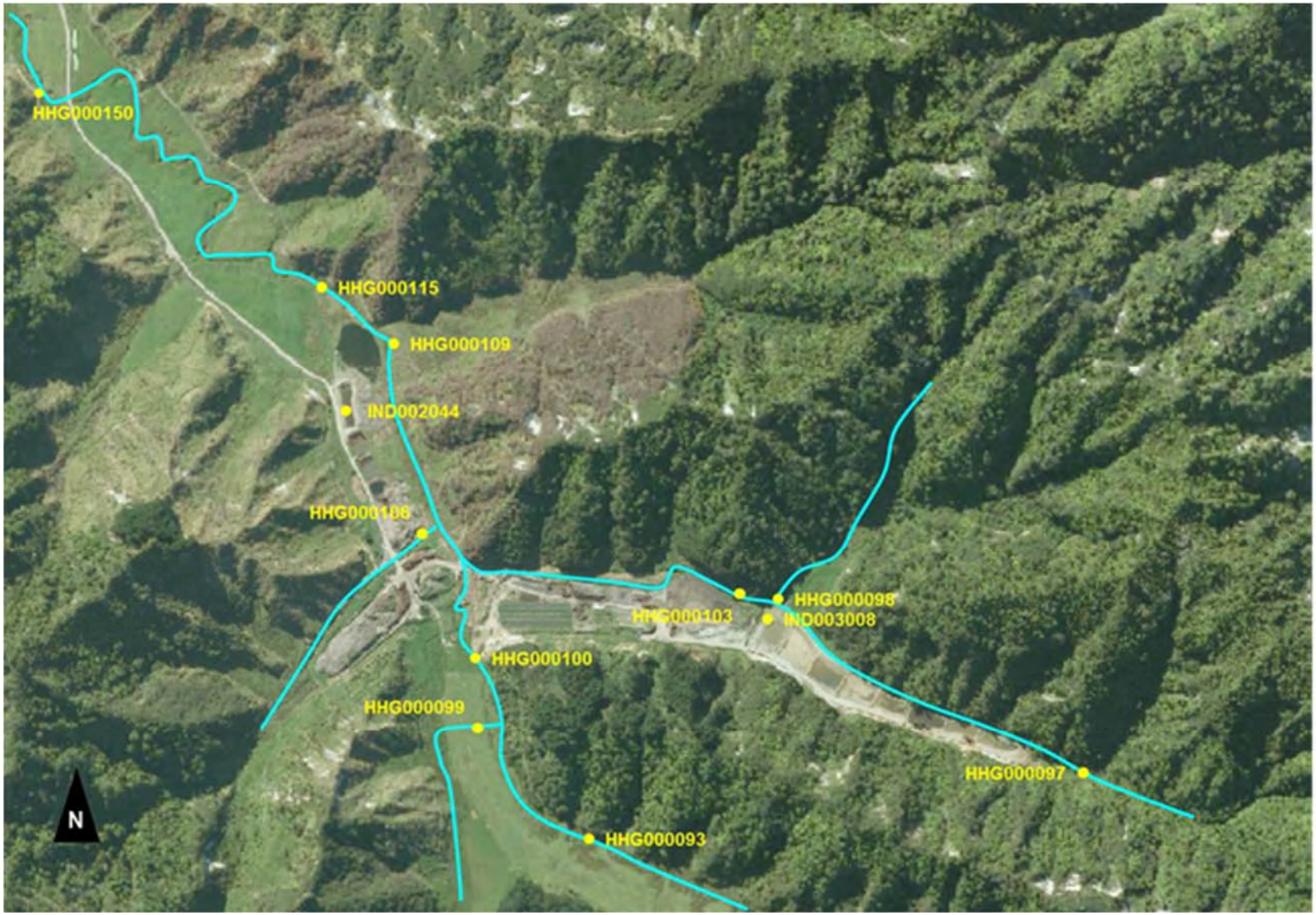


Figure 3 RNZ Uruti surface water sampling locations

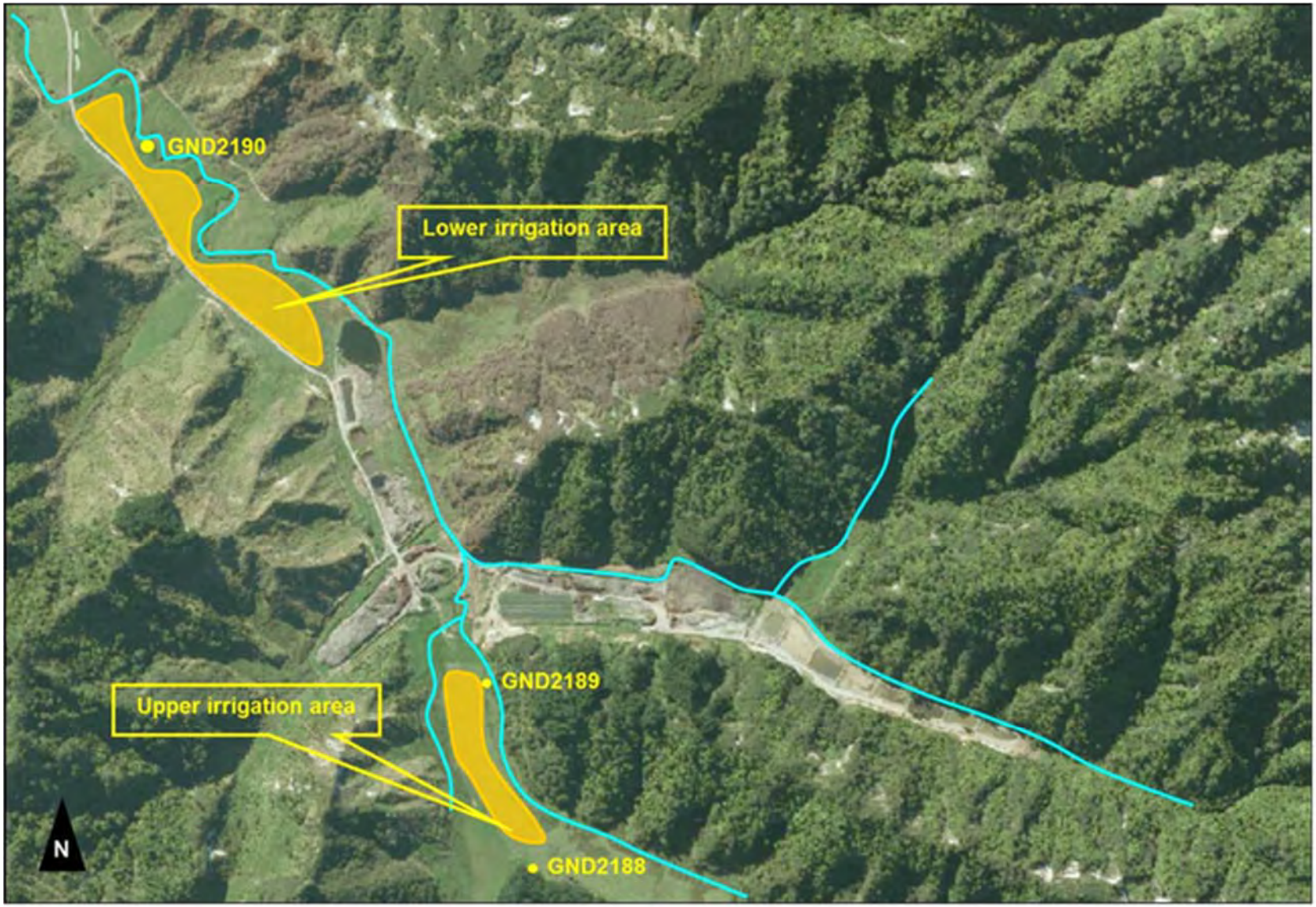


Figure 4 RNZ Uruti soil sampling locations (irrigation areas) and groundwater monitoring wells

2. Results

2.1. Inspections

RNZ Uruti facility Mokau Road

03 August 2016

During the inspection the following was observed. A full surface water sample run of the Haehanga Stream was undertaken and groundwater samples were collected from the groundwater monitoring wells. Heavy rain persisted throughout the inspection. The receiving waterbody of the Haehanga Stream was running at 0.5m above normal flow as defined by the staff gauge. It was described as severely discoloured. Good flow was observed from the wetland discharge pipe. The tracks around the facility of Uruti were greasy and muddy.

The paunch pit was observed, the level in the paunch pit was described as good. The level of the irrigation pond was adequate considering the weather conditions and recent rainfall. The irrigation areas were observed and appeared quite water logged. No quarrying activity was occurring at the time of inspection. Tree felling of pine trees in close proximity to the worm beds was observed to be occurring at the time.

17 October 2016

During the inspection the following was observed. A brief meeting was held with the site operator prior to entering site. The paunch pad was viewed and discussions were held. The discussions noted that the paunch pad had not been utilised since the previous season. However, the management was expecting additional deliveries to begin imminently.

The level of paunch within the pond was observed to be slightly above normal level. The worm beds were observed and appeared inactive as they appeared to have not been actioned in a while. However the sawdust pile appeared to have decreased in size. The worm beds appeared to have not been filled up for a while. The water level in the irrigation pond was good, with plenty of free board available.

Overall the site looked good. No quarrying activities had been undertaken and would not be undertaken during the winter months.

24 November 2016

The following was observed. A brief meeting was held with the site management upon entering the facility at Uruti. The site was then inspected; the paunch pad appeared inactive at the time of inspection with minimal indication of any recent deliveries. The quarry was similarly in-active.

The irrigation pond was inspected and the level of the pond was described as normal. Overall the site looked good. The management was about to cut the irrigation areas into silage. A discussion was held with site management pertaining to additional works to the main culvert on the main access track, which was to be completed by the following week.

13 December 2016

At the time of inspection the following was observed. Site works were occurring which involved the grading of the main access track to the facility. However intermittent trucks were arriving and departing. No recent quarrying activities had been undertaken. Groundwater samples were collected from the site specific groundwater monitoring bores. The lower irrigation area appeared quite waterlogged upon walkover inspection. The paunch pond was observed and was described to be at a normal level.

The wetlands treatment system looked good, though the discharge was slightly discoloured. No distinct odour was noticeable. The worm beds appeared to have been tidied up. New material was being discharged

on to pad 1 at the time of inspection. The drilling mud pits appeared to be in functional order. Material was in the process of being blended with sawdust. The corresponding irrigation pond level appeared to be satisfactory. Samples were collected of the receiving waters.

14 February 2017

The following was observed. Surface water samples of receiving waters and soil samples from the associated irrigation areas were collected. A truck was discharging its load while the inspection occurred. The pad where it was discharged was being utilised for the blending of the material with sawdust. The level of the irrigation pond was described as normal.

The irrigation area was inspected and appeared in good condition. The level of the paunch pad pond was quite high and the site operator shall keep mindful with managing this pond. The worm beds were about to be topped up with material. A brief discussion was held with site management. The site had been subject to heavy rainfall. At the time of inspection the site was complying with its consent conditions.

27 April 2017

At the time of inspection the following was observed: A site inspection was undertaken with one of the site managers. Recent flooding of the site was discussed; the heavy rainfall had resulted in numerous slips from the relief on the site. As a result, a few culverts had become blocked due to debris washing down with the heavy rainfall, while another was almost washed out. At the time a digger had been utilised to clear the slips as far as practicable and the blocked culverts had been unblocked.

Surface water samples were collected. The paunch area was observed and described as in good condition. The wetland treatment system discharge was observed and appeared clear with no apparent odour.

The drill waste pad was observed and it appeared to have been turned and stacked recently, notably higher when compared to the previous inspection. Included in this was sawdust.

The associated irrigation pond was observed and found to contain free board, though there appeared to be a floating scum or precipitate on the surface of the final pond, included in this was some visually apparent hydrocarbons. The irrigation areas had been recently cut into silage.

A new pad was under consideration. Shipping containers had been used to form the potential pillars. The management were interested in storing chicken manure on the site. A pile of blue metal was also ready to be loaded and sent to Cambridge.

15 June 2017

The inspection was undertaken with surface and groundwater sampling. At the time of inspection a truck was being unloaded of blue metal. The paunch pad was observed and the level within it was lower than at the previous inspection. The wetland system was inspected and red algae were observed on the first two ponds. The final discharge was described as slightly murky, with minimal odour.

The tip off point by the drilling pad was viewed and lots of dead chickens were discharged in this area. The irrigation pond level was high, though irrigation was on going through the use of honey wagon. The irrigation pond was sampled and a sulphurous odour was noticeable.

RNZ Pennington and Waitara Road facility

18 January 2017

An inspection was undertaken and the following was observed. A brief meeting was held with the site management. At the time a truck was in the process of being screened and loaded, while another truck was in the process of being washed down.

Overall the site looked good. The grass around and between worm beds at the west end of site had just been cut. There was also a large pile of green waste which was evidently compositing at the time of inspection. No noticeable odours were detected whilst onsite. No runoff was visible, thus no samples of the drains were attainable. All worm beds were covered.

Across the road on the Pennington road site, the site appeared to be untouched when compared to the last inspection. The pad and the associated piles on the site were now overgrown with grass. No odours or run off issues were noted.

20 April 2017

The inspection was undertaken with the site manager. The sheds where the blending and mixing occurs were observed through a site walkover, this walkover included observations of the green waste pile and the worm beds. During the walkover odour was found to be minimal and there was no noticeable odour offsite. No ponding was noted across both areas. The main site was described as clean and tidy at the time of inspection.

2.2. Results of abstraction and discharge monitoring

2.2.1. Surface water sampling – Wetland treatment system

The Wetland Treatment System (WTS) (Figure 2) functions by pumping primarily ammonia enriched fluid from the paunch mixing pond, to the top of a multi layered wetland treatment system. This effectively treats the ammonia enriched water and allows the system to assimilate as much nitrogen as possible. At the base of this treatment system is sample location IND003008.

Consent 5838-2.2 stipulates specific concentrations which the discharge point must abide by.

Specifically Condition 24 of Consent 5838-2.2 states:

The discharge from the Wetland Treatment System shall meet the following standards (at monitoring site IND003008):

a) The suspended solids concentration shall not exceed 100 g/m^3.

b) The pH shall be between 6.0 and 9.0.

The analysis of the six monitoring rounds undertaken at monitoring location IND003008 is provided in the following Table 3. Specifically related to condition 24 of consent 5838-2.2 no exceedance in terms suspended solid concentration or pH range was exceeded. There was a significant concentration of un-ionised ammonia observed in the December 2016.

Table 3 Monitoring location IND003008 2016-2017

IND003008	Parameter	Chloride	Conductivity	Ammonia	Un-ionised ammonia	Nitrate/Nitrite nitrogen	pH	Suspended solids	Temperature
Collected	Time	g/m³	mS/m@20°C	g/m³ N	g/m³	g/m³ N	pH	g/m³	°C
03 Aug 2016	10:54	41.1	109	77	0.85773	1.07	7.7	70	9.8
17 Oct 2016	09:15	31.8	90.4	56.4	1.39679	0.63	7.8	20	17.6
13 Dec 2016	10:12	33.8	88.9	54	**4.81866**	0.61	8.2	6	23.2
14 Feb 2017	09:10	18.2	37.5	14.2	0.30401	0.79	7.7	28	18.7
27 Apr 2017	10:15	21.8	66.9	44.5	0.47105	0.18	7.5	36	15.3
15 Jun 2017	10:02	26.1	89.9	61.5	0.45662	0.65	7.6	87	7.4

2.2.2. Mixing zone and monitoring location HHG000103

As the WTS discharges directly in to an unnamed tributary of the Haehanga Stream at discharge location IND003008, it must meet an additional set of chemical criteria (Table 4) before it extends from the mixing zone.

It is monitored specifically at location HHG000103. Consent 5838-2.2, Condition 25 states the following:

Discharges from the Wetland Treatment System shall not give rise to any of the following effects in the unnamed tributary of the Haehanga Stream, after a mixing zone of 40 m, at established monitoring site HHG000103

a) *A rise in filtered carbonaceous biochemical oxygen demand of more than 2.00 g/m³*

b) *A level of un-ionised ammonia greater than 0.025 g/m³*

c) *The production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials;*

d) *Any conspicuous change in the colour or visual clarity;*

e) *Any emission of objectionable odour;*

f) *The rendering of fresh water unsuitable for consumption by farm animals; and*

g) *Any significant adverse effects on aquatic life.*

Table 4 Monitoring location HHG000106 2016-2017

HHG000103	Parameter	BODCF	Chloride	Conductivity	Ammonia	pH	Suspended Solids	Temperature	Un-ionised ammonia
Collected	Time	g/m³	g/m³	mS/m@20°C	g/m³ N	pH	g/m³	°C	g/m³
03 Aug 2016	10:59	0.6	15.2	13.9	1.45	7.2	1,700	10.4	0.00537
17 Oct 2016	09:15	1.6	12.6	17.4	2.51	7.5	8	13.1	0.02259
13 Dec 2016	10:15	0.6	12.3	23.5	0.475	7.8	5	15.5	0.01009

HHG000103	Parameter	BODCF	Chloride	Conductivity	Ammonia	pH	Suspended Solids	Temperature	Un-ionised ammonia
Collected	Time	g/m³	g/m³	mS/m@20°C	g/m³ N	pH	g/m³	°C	g/m³
14 Feb 2017	09:10	0.6	12.9	16.4	0.762	7.5	12	16.8	0.00901
27 Apr 2017	10:30	0.8	13.2	24	5.61	7.3	16	12.1	**0.02966**
15 Jun 2017	10:04	1.4	12.5	26.8	8.28	7.5	27	6.7	**0.04642**

In relation to the specific criteria set by condition 25 of consent 5838-2.2, the analysis of the six monitoring rounds undertaken this period indicated the following.

- Filtered carbonaceous biochemical oxygen demand (BODCF) ranged 0.6-1.4 g/m^3 this period, the condition states a maximum of 2.00 g/m^3 BODCF.
- Un-ionised ammonia concentrations ranged from 0.0053-0.046 g/m^3. In this period there were two minor exceedances in the consented value, which is set at 0.025 g/m^3. Both exceedances were found in the final two rounds of the monitoring period. The long term analysis of this monitoring location, in terms of un-ionised ammonia concentrations is presented below in Figure 6.
- A significant concentration of suspended solids was also observed in the August 2016 sample, indicative of the logging operations occurring in the area at the time, accompanied with heavy rainfall.

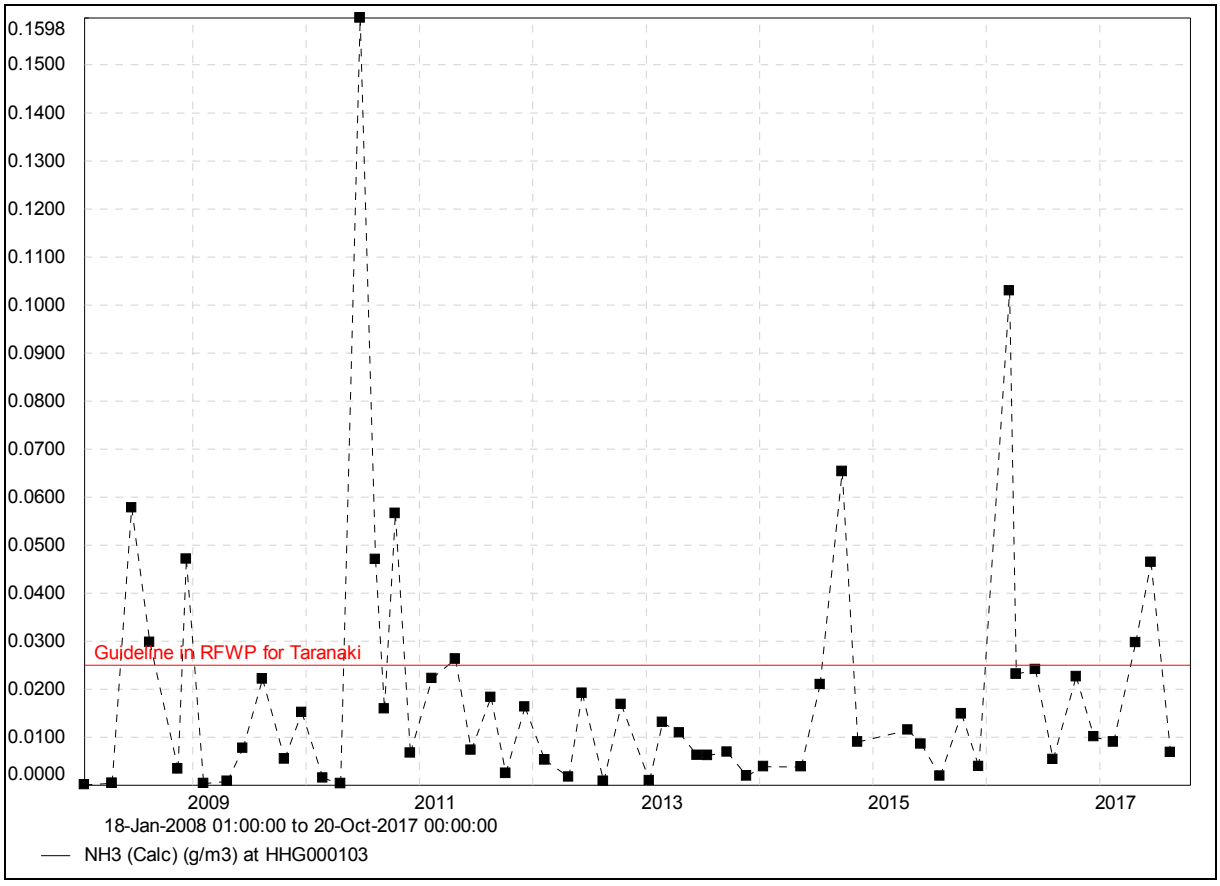


Figure 5 Long term analysis of un-ionised ammonia at monitoring location HHG000103 RNZ Uruti

2.2.3. Surface water monitoring of the Haehanaga Stream

The Haehanga stream is monitored down its length through the site at ten monitoring locations (Figure 3). The rationale for these ten monitoring locations is to ascertain for any potential impacts which may be a result of the exercise of this consent and specifically to satisfy Condition 10 of Consent 5838 which states:

Discharges irrigated to land shall not give rise to any of the following adverse effects in the Haehanga Stream, after a mixing zone extending 30 m from the downstream extent of the irrigation areas, being monitored at sites HHG000100 and HHG000150.

a) *A rise in filtered carbonaceous biochemical oxygen demand of more than 2.00 g/m^3;*

b) *A level of un-ionised ammonia greater than 0.025 g/m^3;*

c) *An increase in total recoverable hydrocarbons;*

d) *Chloride levels greater than 150 g/m^3*

e) *The production of any conspicuous change in colour or visual clarity;*

f) *Any emission of objectionable odour;*

g) *The rendering of fresh water unsuitable for consumption by farm animals; and*

h) *Any significant adverse effects on aquatic life*

Table 5 Surface water sampling of the unnamed tributary and the Haehanga Stream 2016-2017

Surface water monitoring	Parameter	BODCF	Chloride	Conductivity	TPH Total	Sodium	Ammonia	Nitrate/nitrite nitrogen	Un-ionised ammonia	pH	SS	TEMP
Site	Collected	g/m^3	g/m^3	mS/m@20C	g/m^3	g/m^3	g/m^3 N	g/m^3 N	g/m^3	pH	g/m^3	°C
HHG000093	03 Aug 2016	0.5	13.2	13.1	<0.5	9.2	0.056	0.11	0.0002	7.1	330	13
HHG000099	03 Aug 2016	<0.5	14.8	11.8			0.047		0.0001	7	2000	10.5
HHG000100	03 Aug 2016	<0.5	11.6	12.3	<0.5	7.5	0.05	0.13	0.0002	7.2	3400	11.2
HHG000097	03 Aug 2016	<0.5	14.8	9.7			0.017	0.06	0.00005	7.1	1400	10.2
HHG000098	03 Aug 2016	<0.5	14	13.6			0.036		0.0001	7.1	2800	10.5
HHG000106	03 Aug 2016	<0.5	13.6	14.2			0.099		0.0004	7.2		10.6
HHG000109	03 Aug 2016	0.5	14.9	13.6			0.382		0.0011	7.1		10.5
HHG000115	03 Aug 2016	<0.5	16.8	13.4	<0.5	10.4	0.372	0.16	0.0011	7.1		10.5
HHG000150	03 Aug 2016	0.6	18.6	14.1	<0.5	11.2	0.409	0.13	0.0012	7.1	2500	10.5
HHG000190	03 Aug 2016		17	13.5			0.401		0.0019	7.1		16.5
HHG000093	17 Oct 2016	1.1	10.8	13.7	<0.5	10.2	0.025	0.06	0.0002	7.3	12	15.2
HHG000099	17 Oct 2016	1	13.1	14.2			0.031		0.0002	7.2	7	14.4
HHG000100	17 Oct 2016	1.1	13.9	18.9	<0.5	10.8	0.061	0.03	0.0007	7.6	46	13.1
HHG000097	17 Oct 2016	1.1	10.8	15.2			0.075	0.05	0.0004	7.3	9	11.6
HHG000098	17 Oct 2016	1.3	11.2	14.1			0.074		0.0005	7.4	6	12.9

Surface water monitoring	Parameter	BODCF	Chloride	Conductivity	TPH Total	Sodium	Ammonia	Nitrate/nitrite nitrogen	Un-ionised ammonia	pH	SS	TEMP
Site	Collected	g/m³	g/m³	mS/m@20C	g/m³	g/m³	g/m³ N	g/m³ N	g/m³	pH	g/m³	°C
HHG000106	17 Oct 2016	1.3	16.5	22.8			0.412		0.0028	7.3		15.4
HHG000109	17 Oct 2016	1.5	17.3	18.7			0.432		0.0033	7.4		14.1
HHG000115	17 Oct 2016	1.4	19.1	19	<0.5	13.2	0.445	0.21	0.0034	7.4		14.1
HHG000150	17 Oct 2016	1.7	28.8	21.1	<0.5	15.3	0.411	0.28	0.002	7.2	10	13.8
HHG000190	17 Oct 2016		26.8	20.4			0.295		0.0015	7.2		14.5
HHG000093	13 Dec 2016	<0.5	9.7	16.2	<0.5	10.8	0.008	<0.01	0.0001	7.6	<2	18.6
HHG000099	13 Dec 2016	<0.5	20.5	23.9			0.785		0.0117	7.6	58	16.9
HHG000100	13 Dec 2016	<0.5	14.9	21.8	<0.5	12	0.034	0.03	0.0006	7.7	210	16.6
HHG000097	13 Dec 2016	<0.5	9.9	16.9			0.094	0.11	0.0011	7.6	6	12.9
HHG000098	13 Dec 2016	<0.5	10.4	16.9			0.081		0.0013	7.7	<2	15
HHG000106	13 Dec 2016	<0.5	13.4	24.7			0.118		0.0018	7.6		16.9
HHG000109	13 Dec 2016	<0.5	20.4	24.1			0.796		0.0102	7.5		17.9
HHG000115	13 Dec 2016	<0.5	29.4	25.1	<0.5	17	0.443	0.56	0.0034	7.3		17.1
HHG000150	13 Dec 2016	<0.5	39.8	27.2	<0.5	19.7	0.356	0.77	0.0023	7.2	14	17.6
HHG000190	13 Dec 2016		31.7	24.1			0.172		0.002	7.4		19.6
HHG000093	14 Feb 2017	<0.5	13.8	17.1	<0.5	11.8	0.016	0.02	0.0002	7.4	6	18.1
HHG000099	14 Feb 2017	0.5	17.1	17.7			0.025		0.0002	7.3	11	18.2
HHG000100	14 Feb 2017	0.5	16.2	17.8	<0.5	11.8	0.024	0.01	0.0002	7.2	10	18.1
HHG000097	14 Feb 2017	<0.5	11.9	16			0.055	0.04	0.0006	7.5	16	15.9
HHG000098	14 Feb 2017	0.5	12.7	14.9			0.039		0.0003	7.3	10	16.7
HHG000106	14 Feb 2017	<0.5	12.5	23.6			0.098		0.0015	7.6		17.6
HHG000115	14 Feb 2017	0.6	18.7	20.2	<0.5	13.6	0.25	0.13	0.0032	7.5		17.9
HHG000109	14 Feb 2017	0.6	17.8	20			0.219		0.0029	7.5		18.3
HHG000150	14 Feb 2017	0.6	24.4	21.1	<0.5	15	0.21	0.16	0.0018	7.3	14	18.3
HHG000190	14 Feb 2017		23	20			0.113		0.001	7.3		18.3
HHG000093	27 Apr 2017	<0.5	12.4	15.6	<0.5	11.4	0.056	0.15	0.0002	7.2	16	12.6
HHG000099	27 Apr 2017	<0.5	12.8	15.7			0.06		0.0003	7.2	7	12.8
HHG000100	27 Apr 2017	<0.5	12.7	15.7	<0.5	11.6	0.056	0.16	0.0002	7.1	8	12.8
HHG000097	27 Apr 2017	<0.5	11.5	16			0.141	0.12	0.0005	7.2	4	10.9

Surface water monitoring	Parameter	BODCF	Chloride	Conductivity	TPH Total	Sodium	Ammonia	Nitrate/nitrite nitrogen	Un-ionised ammonia	pH	SS	TEMP
Site	Collected	g/m³	g/m³	mS/m@20C	g/m³	g/m³	g/m³ N	g/m³ N	g/m³	pH	g/m³	°C
HHG000098	27 Apr 2017	<0.5	11.7	17.2			0.133		0.0006	7.2	12	12.1
HHG000106	27 Apr 2017	1.2	15.1	28.9			0.268		0.0027	7.5		14.6
HHG000109	27 Apr 2017	0.8	26	25.1			0.801		0.0063	7.4		14.4
HHG000115	27 Apr 2017	0.7	31.8	27.4	0.7	18.4	0.818	0.44	0.0047	7.3		13.3
HHG000150	27 Apr 2017	1.1	54.4	33.3	<0.5	25.1	0.749	0.54	0.0029	7.1	17	14
HHG000190	27 Apr 2017		40.1	28			0.412		0.0017	7.1		14.8
HHG000093	15 Jun 2017	<0.5	11.2	15.2		11.1	0.042	0.11	0.0002	7.3	5	7.3
HHG000099	15 Jun 2017	0.8	13.5	21.5			0.167		0.0007	7.4	150	5.8
HHG000100	15 Jun 2017	<0.5	16	16.6		11.8	0.055	0.1	0.0001	7.1	19	6.9
HHG000097	15 Jun 2017	0.5	10.1	17.3			0.089	0.07	0.0003	7.3	14	6.9
HHG000098	15 Jun 2017	<0.5	10.8	17			0.107		0.0004	7.3	11	6.7
HHG000106	15 Jun 2017	1.9	12.4	20.3			0.181		0.0011	7.5		7.5
HHG000109	15 Jun 2017	1.5	18.4	23.2			2.18		0.0123	7.5		6.8
HHG000115	15 Jun 2017	1.3	21.5	23.7		15.2	2.26	0.26	0.0081	7.3		6.8
HHG000150	15 Jun 2017	1.1	28.7	25.2	<0.5	17.5	2.23	0.33	0.0081	7.3	38	7.1
HHG000190	15 Jun 2017		25.3	23.6			1.89		0.0072	7.3		7.6

BODCF= Bio-chemical oxygen demand. TPH= Total petroleum hydrocarbons. SS= suspended solids

Surface water monitoring of the unnamed tributary of the Haehanaga stream and the Haehanaga stream was undertaken on six occasions in the 2016-2017 monitoring period. The analysis of the six rounds undertaken was provided above in Table 5. The results detail the following:

- Compliance with the filtered carbonaceous biochemical oxygen demand (BODCF) concentration is determined at two monitoring locations as defined by consent 5838-1 condition 12.
- This condition states that a concentration of BODCF should not exceed 2.0 g/m^3 at the two locations HHG000100 and HHG000150. The corresponding results indicated compliance with this condition across all six monitoring rounds undertaken.
- The highest concentration found during the October 2016 survey was at location HHG000150 with a value of 1.7 g/m^3. The highest reading was found at HHG000106 with a value of 1.9 g/m^3 BODCF in June 2017.
- In terms of un-ionised ammonia concentrations, the limit is set at 0.025 g/m^3. In this period there were no exceedances with respect to this value in this data set. The highest recorded reading in this data set was 0.0123 g/m^3 recorded at HHG000109 in June 2017. There were however, two exceedances found further up catchment with respect to the wetland treatment system mixing zone, though this was discussed in the previous section.

- Total petroleum hydrocarbon (TPH) analysis indicated one result marginally above the limit of detection this period. This was observed at location HHG000115 with a value of 0.7 g/m^3, in the April 2017 sample round. The sample site below this did not indicate any value above the limit of detection which is set at >0.5 g/m^3 total petroleum hydrocarbon.
- Additional surface water analysis is proposed in the coming period to potentially determine whether this was an outlier or a result of a discharge.
- Chloride analysis did not indicate any exceedance with respect to the specific a limit of 150 g/m^3 chloride, as defined by consent. In this period the highest concentration was observed at monitoring location HHG000150 with a value of 54 g/m^3 chloride.
- No observations of significant effects on aquatic life were observed by the sampling officer during the monitoring year. Note this does not include the biological survey. The biological survey is discussed in a following section.
- Surface water pH values ranged from 7.0-7.7 pH. The high values were found in the summer months.
- Significant suspended solid concentrations were observed in the August 2016 sample round, this coincided with heavy rainfall. This is a direct result of increased flows in the Haehanga Steam coupled with sediment carried down from recent logging and quarry operations in the area at the time.

2.2.4. Irrigation pond sampling

In this monitoring period the discharge location IND002004 was sampled on six occasions (Table 6).

Specifically in line with conditions 8 and 9 of consent 5838-2 which state:

Condition 8

There shall be no direct discharge to water as a result of irrigating wastewater to land. This includes, but not necessarily limited, ensuring the following:

- *No irrigation shall occur closer than 25 m to any surface water body;*
- *The discharge does not result in surface ponding;*
- *No spray drift enters surface water;*
- *The discharge does not occur at a rate which cannot be assimilated by the soil/pasture system; and*
- *The pasture cover within the irrigation areas is maintained at all times*

Condition 9

Treated wastewater discharged by irrigation to land shall not have a hydrocarbon content exceeding 5% total petroleum hydrocarbon.

Table 6 Irrigation pond analysis RNZ Uruti 2016-2017

Irrigation	Site	IND002044	IND002044	IND002044	IND002044	IND002044	IND002044
Parameter	**Collected**	**03 Aug 2016**	**17 Oct 2016**	**13 Dec 2016**	**14 Feb 2017**	**27 Apr 2017**	**15 Jun 2017**
Total arsenic	g/m^3,mg/kg	0.011	0.006	0.006	0.008	0.008	0.004
Bio-chemical oxygen demand	g/m^3	470	390	140	70	570	2,700
Calcium	g/m^3	198	294	171	181	108	351

Irrigation	Site	IND002044	IND002044	IND002044	IND002044	IND002044	IND002044
Parameter	**Collected**	**03 Aug 2016**	**17 Oct 2016**	**13 Dec 2016**	**14 Feb 2017**	**27 Apr 2017**	**15 Jun 2017**
Chloride	g/m^3	692	764	546	610	454	813
Conductivity	mS/m@20°C	322	356	303	329	238	464
TPH	g/m^3	37	1.2	2.4	4	605	45
Potassium	g/m^3	241	184	207	237	172	206
Magnesium	g/m^3	25.8	25.2	24.8	26.4	20.2	29.6
Sodium	g/m^3	214	200	184	232	162	312
Ammonia	g/m^3 N	110	126	137	124	123	191
Nitrite/nitrate	g/m^3 N	0.02	0.05	0.02	0.03	0.05	0.24
Lead (acid soluble)	g/m^3	0.05	0.05	<0.05	<0.05	0.06	0.08
pH	pH	6.9	7.3	7.7	7.5	7.9	5.3
Temperature	°C	11.3	17.9	21	21.2	19	10.1
Benzene	g/m^3	0.006	0.0062	0.0054	0.0038	NR	0.0083
Ethylbenzene	g/m^3	<0.0010	0.0013	< 0.0010	< 0.0010	NR	0.0012
Toluene	g/m^3	0.048	0.094	0.099	0.0051	NR	0.111
XYLENE-M	g/m^3	0.005	0.005	0.006	0.005	NR	0.006
XYLENE-O	g/m^3	0.0017	0.0019	0.0021	0.0021	NR	0.0023
Un-ionised ammonia	g/m^3	0.218	1.023	3.468	2.025	4.221	0.0087
SAR	None	3.8	3.0	3.5	4.3	3.8	4.2
NR= no result. SAR= sodium absorption ratio							

The results of the irrigation pond sample indicated the following:

- Total arsenic ranged from 0.004-0.011 g/m^3 arsenic.
- Bio-chemical oxygen demand ranged from 70-2,700 g/m^3
- Calcium ranged from 108-351 g/m^3 Ca.
- Chloride concentrations were observed to range from 454-813 g/m^3
- Conductivity readings indicated a range of 238-464 mS/m @ 20°C.
- Total petroleum hydrocarbons ranged from 1.2-605 g/m^3 TPH. The value not to be exceeded as defined by the consent is set at 50,000 g/m^3 TPH.
- Potassium concentrations ranged from 172-241 g/m^3.
- Sodium ranged from 162-312 g/m^3.
- Ammonia ranged from 110-191 g/m^{3}N.
- Nitrite/ nitrate nitrogen ranged from 0.02-0.24 g/m^{3}N.
- Lead (acid soluble) results indicated four results above the limit of detection which is set at >0.05 g/m^3, the results ranged from 0.05-0.08 g/m^3.

- pH ranged from 5.3-7.9 pH this monitoring period. Note the lower figure of 5.3 pH is the lowest pH observed at this monitoring location to date.
- Benzene ranged 0.0038-0.0083 g/m^3.
- Ethylbenzene indicated two results this period above the limit of detection, 0.0012 and 0.0013 g/m^3 respectively.
- Toluene analysis indicated a range of 0.0051-0.11 g/m^3.
- Meta xylene indicated range of 0.005-0.006 g/m^3.
- Ortha xylene indicated a range of 0.0017-0.0023 g/m^3.
- Un-ionised ammonia concentration ranged from 0.21-4.22 g/m^3. The higher value, observed in the April 2017 sample was result of a corresponding pH of 7.9.
- Sodium absorption ration indicated a range of 3.0-4.3.

2.2.5. Groundwater analysis

The site contains an active groundwater monitoring network comprised of three monitoring wells (Figure 4). These wells, which were a consented condition, were installed in three specific areas of the site in order to monitor for possible effects or emerging trends associated with the application of irrigation water from the irrigation pond. Additional monitoring wells are also at the planning stage to be installed.

- GND2188 is located up gradient of the irrigation areas in an un-impacted area
- GND2189 is located down gradient of upstream irrigation area;
- GND2190 is located down gradient of the extent of the lower irrigation area, situated downstream of the composting and irrigation pond.

In this monitoring period the groundwater network was sampled on two occasions, the analysis is provided in the following Table 7.

Table 7 Groundwater monitoring results 2016-2017

Groundwater	Site	GND2188	GND2188	GND2189	GND2189	GND2190	GND2190
Parameter	**Collected**	**03 Aug 2016**	**14 Dec 2016**	**03 Aug 2016**	**14 Dec 2016**	**03 Aug 2016**	**14 Dec 2016**
Chloride	g/m^3	238	333	17.5	98.4	882	1340
Conductivity	mS/m@20C	95.6	132	13.7	44.4	280	397
Total TPH	g/m^3	<0.7	NR	<0.7	NR	<0.7	NR
Ammonia	g/m^3 N	0.12	0.182	0.049	0.795	0.23	0.491
Nitrite/nitrate nitrogen	g/m^3 N	1.64	0.02	0.01	<0.01	<0.01	<0.01
pH	pH	5.9	5.8	6.6	6	5	5.1
LEVEL	m	0.28	0.998	0.29	0.819	0.325	0.745
Temperature	°C	13	14.5	11.3	14.6	13	15.8
Benzene	g/m^3	<0.0010	< 0.0010	<0.0010	< 0.0010	<0.0010	< 0.0010
Ethylbenzene	g/m^3	<0.0010	< 0.0010	<0.0010	< 0.0010	<0.0010	< 0.0010
Toluene	g/m^3	<0.0010	< 0.0010	<0.0010	0.0027	<0.0010	< 0.0010
XYLENE-M	g/m^3	<0.002	< 0.002	<0.002	< 0.002	<0.002	< 0.002

Groundwater	Site	GND2188	GND2188	GND2189	GND2189	GND2190	GND2190
Parameter	Collected	03 Aug 2016	14 Dec 2016	03 Aug 2016	14 Dec 2016	03 Aug 2016	14 Dec 2016
XYLENE-O	g/m^3	<0.0010	< 0.0010	<0.0010	< 0.0010	<0.0010	< 0.0010
TPH C10-C14	g/m^3	NR	< 0.2	NR	< 0.2	NR	< 0.2
TPH C15-C36	g/m^3	NR	< 0.4	NR	< 0.4	NR	< 0.4
TPH C7-C36	g/m^3	NR	< 0.7	NR	< 0.7	NR	< 0.7
TPH C7-C9	g/m^3	NR	< 0.10	NR	< 0.10	NR	< 0.10
Un-ionised ammonia	g/m^3	0.00003	0.00004	0.00005	0.00025	0.00001	0.00002
Total dissolved salts	g/m^3	739.7	1,021.3	106	343.5	2,166.4	3071.6

The biannual analysis of the groundwater monitoring well network is presented in Table 6. The analysis indicates the following:

- Chloride concentrations ranged from 17.5-1,340 g/m^3, the higher concentrations were found in the lower irrigation area bore (GND2190) which ranged 882-1,340 g/m^3 Cl.
- Conductivity ranged from 44-397 mS/m @20°C, the higher readings were found in the lower irrigation area.
- Total petroleum hydrocarbon analysis and speciated hydrocarbon analysis indicated no results above the limit of detection for these analytes.
- Ammonia concentrations ranged from 0.049-0.0795 g/m^{3}N.
- Nitrite/nitrate nitrogen readings indicated three results above the limit of detection, these results ranged form 0.01-1.64 g/m^{3}N.
- pH readings ranged between 5-6.6 pH. The two lowest readings were found in the lower irrigation area bore GND2190 with a value of 5.0 and 5.1 pH.
- Benzene, toluene, ethylbenzene and xylenes (M&O) (BTEX) readings were below the limit of detection in all but one sample.
- Toluene was analysed at a concentration of 0.0027 g/m^3 Toluene in the December 2016 sample of GND 2189.
- A follow up analysis was collected and the resultant analysis indicated no result above the limit of detection. The analysis of toluene was put down to either cross contamination during sample collection or due to naturally occurring toluene in the soil.
- Un-ionised ammonia concentrations were found at very low concentrations, ranging 0.00001-0.00005 g/m^3.
- Total dissolved salts (TDS) concentrations were found to range from 106-3,071 g/m^3 TDS. Figure 6 details the analysis of the wells over time since 2011 in terms of TDS concentration.

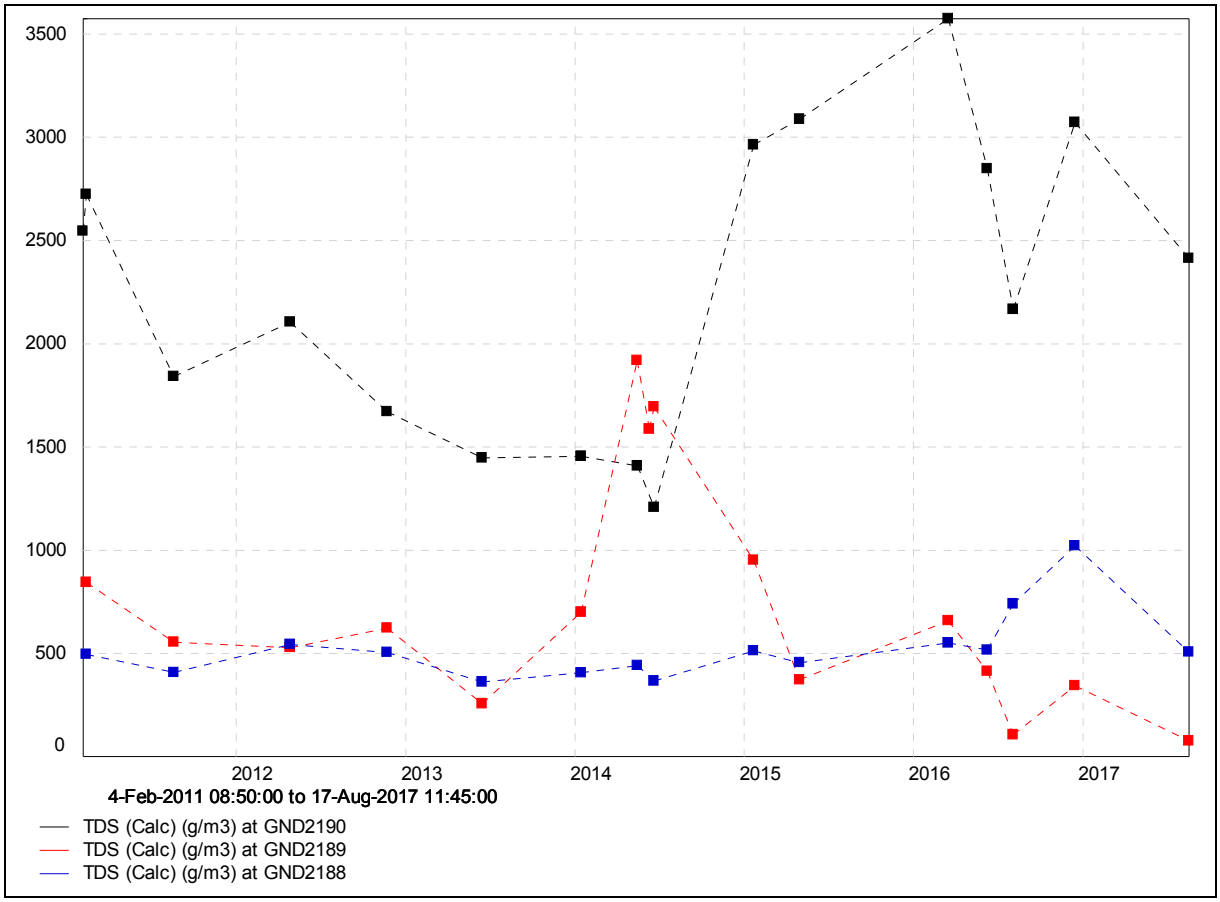


Figure 6 Total dissolved salt concentrations (TDS) in RNZ Uruti monitoring wells since February 2011

2.2.6. Soil analysis

Four composite soil samples were collected from the irrigation areas this monitoring period. Two soil samples per area, from the upper and lower irrigation areas. The analysis of these four samples is provided in the following Table 8.

Table 8 Soil analysis 2016-2017

Soil	Area	Upper	Upper	Lower	Lower
Parameter	Collected	14 Feb 2017	15 Jun 2017	15 Jun 2017	14 Feb 2017
Conductivity	mS/m@20°C	77.4	76	153.8	68.1
Ammonia	g/m^3 N	0.17	0.44	0.39	0.22
Nitrite/nitrate	g/m^3 N	0.78	0.13	0.37	0.42
pH	pH	7.2	5.8	6.8	6.6
Calcium	mg/kg	54.6	77.5	93.5	42.9
Chloride	mg/kg	150.2	101	368.4	97.7
Total TPH	mg/kg	NR	8	15	NR
Potassium	mg/kg	188.5	168.3	206.4	160.1
Magnesium	mg/kg	4.6	4.6	11.2	2.5

Soil	Area	Upper	Upper	Lower	Lower
Parameter	Collected	14 Feb 2017	15 Jun 2017	15 Jun 2017	14 Feb 2017
Sodium	mg/kg	153.4	68.3	177.3	115.4
Sodium absorption ratio	None	5.36	2.04	4.61	4.63

The analysis indicated the following:

- Conductivity ranged from 68-153 mS/m @20°C.
- Ammonia ranged from 0.17-0.44 g/m^3 N.
- Nitrite/nitrate nitrogen (NNN) ranged from 0.13-0.78 g/m^3.
- pH ranged from 5.8-7.2 pH.
- Calcium ranged 42-93 g/m^3.
- Chloride ranged from 97-368 g/m^3.
- Total petroleum hydrocarbon analysis was undertaken on two occasions this period; both analyses indicated results, 8 g/m^3 and 15 g/m^3.
- Magnesium ranged from 2.5-11.2 g/m^3.
- Sodium ranged from 68-177 g/m^3.
- Sodium absorption ratio (SAR) ranged from 2.04-5.36 SAR.

A further irrigation area is planned for the facility which is aimed at lessening the saline impacts observed in the lower irrigation paddock. It is currently under construction. The aim will be to allow the current lower area to recover from elevated salinity as a result of the irrigation.

In the previous monitoring period (2015-2016, see reports reference section) the operators were informed through the annual report that the concentrations of the SAR within the lower irrigation area was increasing. The operator had responded and in this monitoring year a decrease was observed in the analysed SAR within the soil samples, Figure 7.

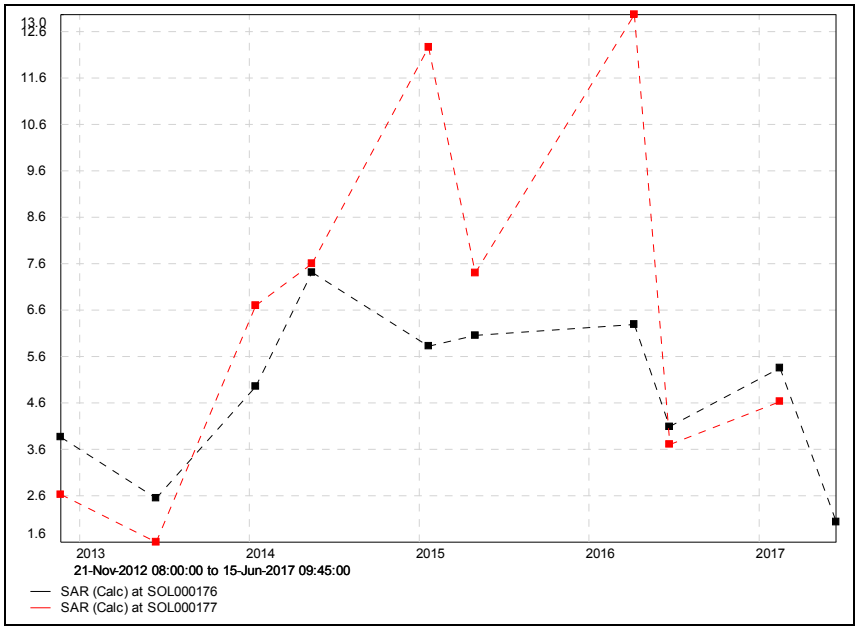


Figure 7 SAR concentration in soil RNZ Uruti long term since November 2012

2.3. Biological monitoring

Bio-monitoring introduction [1]

This survey was the only survey scheduled for the 2016-2017 monitoring year. At the time of this survey, there were two composting pads. The south-west pad (referred to as composting pad 1 in this report) has been established and operating for some years, and is where the synthetic muds are blended with green waste and other organic matter. A second pad northeast of the original composting pad, which became operational in the summer of 2005, is referred to as composting pad 2.

Both composting pads are bunded, with all surface stormwater and leachate contained and directed to treatment ponds. Water from the settling pond is recycled back to the composting material if and when required to maintain a moist composting environment. The runoff from composting pad 1 is treated in the series of ponds. Between each pond, there is a baffle that skims off any floating hydrocarbons as the leachate passes through. The treated liquid in the final pond, located just upstream of site 5 (HHG000115), is then irrigated to pasture. This irrigation system was installed prior to the November 2005 biological survey.

Prior to February 2008, no discharges of stormwater or leachate directly entered the Haehanga Stream or its tributaries. However, after that date, the site has been permitted to discharge treated stormwater and compost leachate to the unnamed tributary of the Haehanga Stream. This comes from composting pad 2, where leachate is pumped up to the top of a seven-tier wetland, which was constructed in late 2007. Under dry conditions, the wetland water from the bottom pond of the wetland is reticulated back to the upper tier of the wetland. Under high flow conditions the wetland discharges to a tributary of the Haehanga Stream.

In addition to this discharge from the wetland, there is some potential for seepage from the composting pads and irrigation area to enter groundwater, and for stormwater runoff to escape the collection system, and thus gravitate toward the surface watercourses at the site.

A baseline survey of five sites was conducted in October 2002 in relation to the composting operation (Dunning, 2003). At the time of this earlier survey, only composting pad 1 was operational, and sites were established for both the existing and proposed composting pads. Unnamed tributaries of the Haehanga Stream flow adjacent to (and down gradient of) both composting pads and flow into the Haehanga Stream downstream of the composting areas (Figure 8). Since this baseline survey, significant changes have occurred on site, leading to sampling sites being moved, or sampling at some sites to be discontinued. Any changes to sampling sites made prior to the current survey have been discussed in previous reports, referenced below

The current biological survey was conducted to monitor the effects of discharges from the composting site to the Haehanga Stream and tributaries in relation to composting areas (pads 1 & 2), the irrigation of treated liquid to land, and the discharge of treated stormwater and leachate to the unnamed tributary. During the May 2012 survey an additional site was included (HHG000150), at the downstream extent of the irrigation area. This site is now referred to as site 6, with HHG000112 now referred to as site 5. This is important to note, as HHG000112 was previously referred to as site 6. Table 9 details the monitoring sites and associated sampling method, while Figure 8 details a map of the locations.

[1] Please note this bio-monitoring report has been shortened for this report, the full report is provided in Appendix II.

Table 9 Bio-monitoring sites in the Haehanga Stream catchment

Site	Site Code	Location	Sampling Method
1	HHG000093	Upstream of extended irrigation area	Vegetation sweep
2	HHG000100	Downstream of extended irrigation area	Streambed Kick
T2	HHG000098	Upstream of wetland discharge point	Streambed Kick
T3	HHG000103	Downstream of wetland discharge point	Kick-sweep
5	HHG000115	25 m downstream of last pond and swale collection area	Kick-sweep
6	HHG000150	30 m downstream of lower irrigation area	Streambed Kick
7	HHG000190	50 metres upstream of State Highway 3 bridge	Kick-sweep

Bio-monitoring results

The Council's standard 'streambed kick' and 'vegetation sweep' techniques were used at seven established sites to collect streambed macroinvertebrates from the Haehanga Stream catchment in order to assess whether the Remediation (NZ) Ltd composting areas had had any adverse effects on the macroinvertebrate communities of these 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 abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The macroinvertebrate survey conducted on 14 December 2016 was preceded by a rain event just hours prior, resulting in flows in the Haehanga catchment to be relatively high, with a steady to swift water speed noted at all sites. Community richnesses were slightly reduced upstream of the site, possibly due to the frequent higher flows that preceded this survey. These higher flows appear to have also led to improved invertebrate habitat, as, with the exception of site 1, all sites recorded MCI scores higher than their respective medians. Overall, this survey found that macroinvertebrate communities of the mainstream sites and two unnamed tributary sites were of average to above average health. Undesirable heterotrophic growths were not recorded at any of the seven sites in this survey.

The two sites in the unnamed tributary were sampled for the tenth time in the current survey, and exhibited a community relatively typical for this kind of habitat. However, there were some differences between these two sites. Site T2 recorded MCI and $SQMCI_S$ scores that were well above average. Site T3 also recorded MCI and $SQMCI_S$ scores higher than average, but they were significantly less than that recorded at site T2. Previous surveys have frequently recorded oligochaete worms, ostracod seed shrimps and *Chironomus* bloodworms increasing significantly in abundance downstream of the discharge. These taxa are often associated with organically enriched discharges. In the current survey all three of these taxa increased in abundance at site T3, coincident with the observation of a moderate discharge leaving the wetland.

Figure 8 Location of bio-monitoring locations in the Haehanga stream catchment

There were only subtle changes in the community of the unnamed tributary, and although the changes in presence/absence of taxa between the sites involved only taxa recorded as rare, they were all reflective of organic enrichment of the stream. There was also little indication of a significant influence from a change in instream habitat. Previously, site T3 has recorded boatman (*Sigara*) and ostracod seed shrimps, which inhabit slow to still water, a habitat not typically inhabited by *Deleatidium* mayfly, which was absent at site T3 at that time (but extremely abundant at site T2). This was less apparent in the current survey, with *Deleatidium* mayfly abundant at both sites, and fewer slow water species noted at site T3. Overall, the unnamed tributary was in above average health, and the discharge occurring at the time of this survey was having no more than a subtle impact on the communities of this stream.

Some previous water quality results indicate that un-ionised ammonia concentrations in the unnamed tributary have at times been toxic enough to reduce the abundance of, or eliminate entirely, some of the sensitive species usually found in this stream. Results of sampling undertaken in the year prior to this survey show that five of the six samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m^3. This shows management of the unionised ammonia concentrations in the effluent being discharged was moderate, but could be improved.

Should unionised ammonia concentrations return to high levels in the winter period, an additional macroinvertebrate survey at this time may be warranted. At the very least, the water quality monitoring will need to continue to assist with the interpretation of macroinvertebrate results.

In general, the communities in the Haehanga Stream sites had moderate proportions of sensitive taxa. Low numbers of sensitive taxa are expected in small, silty bottomed streams such as the Haehanga Stream and the numbers of taxa were generally similar to other lowland hill country streams surveyed at similar altitude. The community richness at site 6 and 7 had recovered from that recorded in the previous survey, which recorded significant deterioration. MCI values recorded in the Haehanga Stream generally reduced in a downstream direction, although site 1 in the current survey recorded the lowest MCI score of 69 units. For second consecutive year, site 2 recorded an MCI score equal to the highest recorded in this catchment to date. Sites 1 recorded an average MCI score, with sites 2, 5, 6 and 7 recording above average scores, significantly so for sites 2, 5 and 6. This represents a significant recovery at sites 6 and 7, following the deterioration recorded in the previous survey, which was coincident with the observation of a number of dead eels at site 6.

Site 5 has exhibited poorer macroinvertebrate communities in the past compared to other sites upstream. This has suggested some level of impact from the composting operation, although the extent of adverse effects has been difficult to determine due to poor habitat quality. During the current survey, the MCI score for site 5 was fifteen units greater than the median score for this site. This is a significant improvement from the previous survey, which noted the presence of hydrocarbons in the substrate. The SQMCI$_S$ score recorded at site 5 was reduced compared with that recorded at site 2. In addition, the results from the current survey indicate that *Chironomus* bloodworms were present, but only as a rarity. This suggests some deterioration from that recorded at site 2, but overall, the communities at site 5 were in above average health.

Unlike the other sites, the sample from site 6 was collected from a riffle with coarse and fine gravels, using the 'streambed kick' sampling technique. However, this riffle had recently had additional gravels placed over the top, in an effort to resolve a perched culvert upstream. This may have influenced the invertebrate community, which recorded a relatively low taxa richness of 16 taxa. However, it recorded an MCI score of 88 units, indicative of 'fair' water quality, and the highest recorded at this site of the seven surveys conducted there. It also represents a significant improvement from the previous survey, and no change from that recorded at site 5 upstream, being higher than the median for control sites in other lowland streams at a similar altitude. This provides no indication of deterioration, a conclusion supported by the SQMCI$_S$ score of 2.6 units. Although this score is lower than that recorded upstream, it is similar to the median for this site, despite the disturbance that had recently occurred at this site.

The surveys undertaken at this site sampled habitat that differed to the other Haehanga Stream sites, as it was a true riffle, with shallow flow tumbling over coarse and fine gravel, as opposed to deeper flow moving over macrophyte or submerged wood. This habitat difference can explain some of the differences in the taxa recorded and the increased abundance of worms recorded in previous surveys. The current survey indicates that the water quality preceding this survey had been fair and better than average.

The lowest site (site 7) was sampled for the sixteenth time in this survey. There was a reduction in MCI score, but the $SQMCI_S$ score was higher than that recorded at site 6. When compared with historical data, the community at site 7 was in average health, and indicative of no deterioration in water quality. As with site 6, there was a recovery in community health from that recorded in the previous survey. The $SQMCI_S$ score for this site (3.5) and taxa richness (21) were similar to their long-term average, indicating that the community was in average health.

During certain previous surveys, *Chironomus* bloodworms have been recorded as abundant at various sites. Abundance of this taxon is usually an indication of an organic discharge, although low dissolved oxygen in the stream can also allow this taxon to dominate the community, especially when this is associated with low flows. It may be then that the sporadic appearance of *Chironomus* in abundance is at least in part related to the dissolved oxygen concentrations. Dissolved oxygen concentrations in the Haehanga have been found to be depressed at times, and during the warmer months, when there is more aquatic weed growth, dissolved oxygen may be significantly depleted at night. This is a natural occurrence in some streams that are slow flowing and weedy. Any macroinvertebrate surveys undertaken when such conditions exist could potentially record a community with fewer sensitive species, and a more abundant population of *Chironomus*.

During the current survey, *Chironomus* was recorded as rare at sites 5, 6, 7 and T3. This possibly suggests a slight increase in the organic enrichment of the stream. It is understood that the issue of high chlorides at site 6 has been identified and is being addressed, and so water quality will hopefully improve with time. This would be further contributed to through any on-going works to the leachate and stormwater treatment system, and improved management of the riparian margin. Any works that improve water quality are also likely to lead to an improvement in freshwater macroinvertebrate communities below the discharges, and should continue to be encouraged.

This was the only macroinvertebrate programme scheduled for the 2016-17 period. It is recommended that this level of monitoring continue, but that a provisional macroinvertebrate survey be retained in the programme, to be implemented should water quality monitoring indicate an issue.

Fish survey

Fish survey introduction[2]

This survey is the fourth fish survey undertaken in the Haehanga Stream, in relation to this site. It was included for the first time in the 13-14 monitoring period as a replacement for the late summer macroinvertebrate programme, as flow rates have been slowly reducing over time, inhibiting macroinvertebrate sample collection. On this occasion, the fish survey was undertaken concurrent with the spring/early summer macroinvertebrate survey. Results from previous surveys are detailed in the references section appended to this fish survey Appendix II.

Fish surveys are useful long-term indicators of ecosystem health, as most fish live longer than a year, and as such may reflect chronic impacts from the composting site, should there be any. The first few surveys will provide results, which can be compared to those from subsequent surveys. This will allow the fish community to be assessed at that point in time, and over time it will also allow an assessment of any change in community health. Fish communities can be influenced by operations at the composting site, principally

[2] Please note the full fish survey report is provided with the full bio-monitoring report in Appendix II

related to the discharge of wastewater from the site (and the quality thereof), but also by changes in instream habitat. The banks of the Haehanga Stream are highly unstable and support little in the way of riparian vegetation (with the exception of rank grass). As a result, there is significant bank slumping in areas. Should the stream be fenced and planted in a way that adequately protects the banks and stream channel, it is likely that the fish community would improve.

Table 10 Sampling sites on the Haehanga Stream in relation to RNZ in the 2016-2017 monitoring period

Site	Site code	Location
1	HHG000093	Upstream of all composting and waste water irrigation areas
2	HHG000150	30 meters downstream of Remediation NZ irrigation area
3	HHG000190	50 metres upstream of State Highway 3 bridge

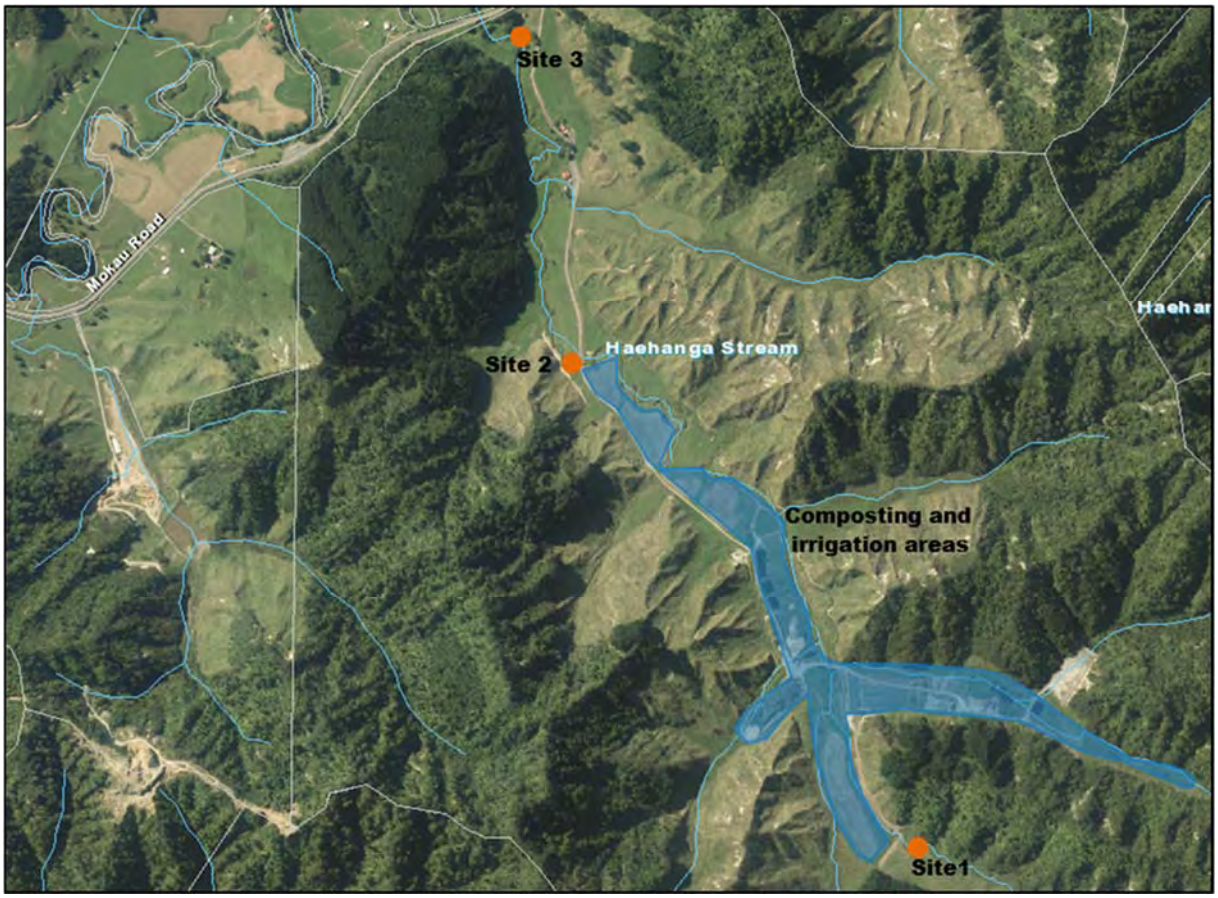


Figure 9 Fish survey sampling location on the Haehanga Stream in relation to RNZ in 2016-2017 monitoring period

Fish survey discussion and conclusion

On 14 and 15 December 2016, three sites were surveyed for freshwater fish in the Haehanga Stream in relation to the composting activities undertaken by Remediation NZ Ltd. Site 1 was located upstream of the site, site 2 located immediately downstream of the lowest extent of the irrigation area, and site 3 was located just upstream of State Highway 3. The survey method involved deploying baited fine and coarse mesh fyke nets and gee minnow traps at each site overnight. This survey also including trapping of the unnamed tributary that receives the wetland discharge, with two gee minnow traps set upstream of the

discharge. All nets and traps were recovered the following morning, with all fish identified, counted and measured, with eels greater than 300 mm weighed.

Earlier in the day prior to the survey commencing, the Haehanga Stream catchment experienced a rain event. As a result, the Haehanga Stream had a moderate to high flow at all sites. The timing of this survey had been brought forward, in an effort to target periods when stream flow is higher. This follows the initial survey, completed in March 2014, which found that the stream was not flowing at site 1 due to extremely low flows. The higher flows in the current survey will have carried the bait scent further downstream than that which occurred in previous surveys. All sites contained moderate fish habitat, with deep pools, and good cover. It should be noted that water temperatures in this stream may occasionally exceed the thermal preference, and maximum thermal tolerance of a number of native fish species, for example a water temperature of 28.3˚C was recorded at site 3 during the December 2014 survey. Due to the improved flow conditions, which should have resulted in more flow past the nets and traps, and conceivably more fish captured, fish abundance and number of species recorded were higher than that recorded in the previous survey. Over all sites, twenty-eight fish were recorded across four species. This included the capture of a banded kokopu in the unnamed tributary.

Unlike in the previous survey, which observed seven dead eels at and downstream of site 2, there were no observations made that posed particular concern. There was significant discolouration observed downstream of the wormfarm and quarry access road, but no obvious hydrocarbon contamination of the Haehanga Stream like that recorded in the previous two surveys. The degree of discolouration, although not present upstream, was severe, but was considered primarily an aesthetic effect rather than deleterious to the biological communities. This is because it is likely to be a relatively frequent event, and the biological communities will have adjusted to it.

It is worth noting that the macroinvertebrate survey undertaken on the first day of the fish survey found that macroinvertebrate communities of seven mainstream sites and two unnamed tributary sites were of average to above average health, with significant recovery noted downstream of the site and irrigation area.

The site that would be expected to experience the greatest impacts should there be any is site 2. At this site, three species were recorded, as was the highest abundance (19 fish) of the survey. Inanga were again present after being absent in the previous survey, representing some recovery in the fish communities. Although only one individual inanga was recorded, natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. It should also be noted that there had been predation within the nets, with some eels having clearly ingested another eel. It is very possible that smaller fish such as inanga has also been predated upon, but this was not obvious when handling the eels.

Site 3, further downstream recorded two species, which is equal to that recorded in the previous survey. Inanga were absent, but have been recorded at this site previously.

Eels were recorded at all three sites, with the largest longfin eel being recorded at site 2. This individual was 1,050 mm long, and weighed 3.425 kg. The size class distribution of the eels was quite different to that recorded in the previous surveys, with the community dominated by large eels. This is probably a reflection of improved effectiveness of the bait, resulting in more large eels being captured. This may have also caused increased predation of the smaller eels in the nets, resulting in an under-representation in the smaller size classes. It is likely that the community is still impacted by the commercial eeling that is understood to have occurred just prior to the 2013-14 survey. It is expected it will take over a decade for the community to recover from this. The physical condition of the eels showed that most of the eels captured at all three sites were in much better condition than would be expected. This is likely due to the increased flows that preceded this survey resulting in an improved food supply for these eels, with more macroinvertebrate habitat present. This is a good result, especially at site 2, where the eels were more similar to their expected weight during the previous survey.

Overall, these fish condition results suggest that fish condition is better in early summer than late summer, as indicated by the results from sites 1 and 3. This is consistent with higher and cooler flow conditions providing for improved habitat and food supply. The results from site 2 suggest that the eel community is in better health than that recorded in the previous survey, which found that the activities at the composting facility had likely negatively affected this community. No observed fish exhibited any obvious physical damage or abnormalities during the current survey.

Three access culverts were assessed for fish passage during this survey, and one was found to present a barrier to fish passage at all flows, while the remaining two culverts were considered likely to restrict fish passage during lower flows. Even in the higher flows of the current survey, it is likely that all culverts severely restricted the passage of swimming species such as inanga. The culvert located immediately above site 2 had experienced some remedial works since the previous survey, but this was already being scoured away. It is likely that this culvert will still be perched during lower flows, and this would preclude the passage of a number of species, included inanga. If this is confirmed, then remedial works will be required. Remedial works are still to be undertaken on the remaining two culverts, which have been identified as a barrier for a number of years.

In summary, the results of the current survey do not indicate that the composting activities and wastewater irrigation undertaken by Remediation NZ Ltd, alongside the Haehanga Stream, have had a deleterious impact on the fish communities of this stream. This is consistent with the findings of the macroinvertebrate survey, completed on the same day. However, the impact on fish passage caused by the three access culverts is likely to have contributed to the reduced species richness at site 1.

The current survey was undertaken in early summer, in an effort to target the higher flows present at this time. It is recommended that this is continued, and that surveys continue on an annual basis. In addition, it is recommended consideration be given to installing continuous water temperature monitoring equipment over the summer months, to improve our understanding of how the water temperature changes in the Haehanga Stream. Finally, it is recommended that the company be reminded of their responsibilities regarding the provision for fish passage.

2.4. Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register 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 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1. Discussion of site performance

The Uruti facility is the Company's primary composting and vermiculture facility in Taranaki. Material from this establishment is sent out to the Brixton facility for further management prior to heading to their clients.

The site performance in this monitoring period was hampered by quite a wet summer. This adversely affected the operator's ability to undertake site developments as it may have resulted in machinery being bogged down in certain areas of the site.

As such much of the proposed site developments as defined by the Uruti Composting Facility Management Plan were unable to be achieved and were delayed until the upcoming summer. Included in these developments was the following:

A storage dam with a planned capacity of 3,500 m^3. This dam was proposed to provide a source of fresh water during the summer months and would be aimed at increasing the dilution of the leachate from the wetland treatment system and irrigation to the saline impacted irrigation areas. Additional dilution would be favourable to the wetland treatment system discharge. In the summer months this source, as defined in the monitoring, contains a high concentration of ammonia.

An increase to the current irrigation area was also proposed. The irrigation area functions to sequester irrigation fluid from the drilling mud pad and associated pond treatment system. It sequesters fluid which constitutes saline enriched water, ammonia and un-ionised ammonia with trace BTEX and total petroleum hydrocarbons.

This increase in the irrigation area was proposed to allow for rotation of irrigation areas over time. Currently the operators are finalising a new lower irrigation area, defined as area E in the management plan, with further areas also planned.

Stormwater management

The site is situated in a large catchment; as such stormwater management is crucial to the site's systems functionality. If well managed, stormwater will not hinder the system with excess water, which can eventuate in flooding in certain areas of the site and may lead to rupturing of associated bunding around the facility. If poorly managed, the potential exists for significant adverse environmental effects. A stormwater management plan would identify certain target areas and has been suggested by the Council's Rivers Engineer.

The drilling mud pad had been cited in the Uruti Facility Composting Management Plan as requiring additional mitigation for stormwater management and the consent holder is reminded to keep clear water drains separate from discharge paths. As increased stormwater inputs in to site systems will need to be managed.

Forestry logging operations (not related to the consent holder other than being within the site boundary, forestry was owned by another party) have occurred around the periphery of the site at the beginning and through the monitoring year. As a consequence of heavy rainfall, the sites ability to remove excess stormwater was hampered. The rainfall on the deforested slopes resulted in slips from the valley sides which in one case almost blocked the Haehanga Stream completely.

In one particular event, a culvert was almost completely removed, while other culverts were blocked by logs, hampering water flow. This had led to a re-evaluation of one particularly aged culvert which is to be replaced when the conditions allow it.

A future requirement in relation to the drilling mud pad and associated settling pounds, is that the bund height should be increased. This was identified in the previous monitoring period and has been regarded to management since this date.

Stock management and fencing around the site to prevent stock access must be undertaken in the upcoming period. This work is significantly overdue. At times stock has been observed to be accessing into the Haehanga Stream, which as a result can negatively impact the already soft stream banks and potentially damage habitat for biological species within the stream.

Perched culverts within the site had also been cited by the Council's biologist in the previous monitoring period as requiring additional actions to aid fish passage. The state of the culverts were also raised again in this monitoring period. While works had been undertaken to prevent the perched culverts from occurring, more work is required, especially post flood events where scouring may occur. Perched culverts hamper fish passage and may adversely affect the biological abundances monitored through the biological monitoring and fish netting surveys.

The site management have an additional pad under consideration. Shipping containers had been brought to the site and stacked to construct a shelter of sorts. The intention to stock chicken litter was under consideration by the site management. However if this is pursued the management will need to mindful to prevent leachate associated with the chicken litter from entering into the Haehanga Stream and across much of the site if poorly managed.

This period the investigating officer noted an increase in the size of the stored drilling mud pad material. This has been noted to be increasing in size in recent monitoring years, without any indication of it being processed. Specifically, material contained within the drilling mud pad is proposed to be mixed and blended with associated material, as outlined in the renewal of consent documentation undertaken in 2010. It is then proposed to be stockpiled in rows for composting. It is then processed through the vermiculture process. Moving forward, further information as to the fate of this material is required.

Administrative performance requires improvement as the site has a duty to provide analysis to the Council of certain waste streams, as defined by the consent, prior to arrival at the facility. Analysis had been provided for certain waste streams which do not fit within the acceptable waste condition. The facility is reminded that conditions pertaining to screening analysis must be met or the facility will not be allowed to accept that particular waste stream moving forward.

Site performance of the Waitara Road facility in this monitoring period indicated a well-managed site with minimal off site odour noted. The inspections remarked that the site appeared to maintain good housekeeping and appropriate sediment control. Worm beds were covered and no ponding of stormwater was noted during inspections. The Pennington Road site appeared untouched as a laydown yard with aged piles of bark growing grass.

3.2. Environmental effects of exercise of consents

Uruti composting facility

Environmental effects associated with the exercise of consents at the Uruti facility will be discussed on a system basis.

Wetland treatment system and surface water sampling

The wetland treatment system functions to remediate primarily ammonia enriched water from the paunch pond. After its treatment through a series of multi-staged, purpose built wetlands, it discharges into an unnamed tributary of the Haehanga Stream. It is monitored at this location by the Council. In this period the location was sampled on six occasions. No non–compliances with respect to pH or suspended solids were observed.

However, in the December 2016 sample round, a significant concentration of un-ionised ammonia was detected. This was coupled with a high pH >8 (possibly a result of increased algal activity driving the pH up in the increased day light hours) and may signal degraded water quality especially when the stream flow rate is depressed in the summer months. While at the mixing zone sample location, 40 meters downstream from this initial discharge location, the value of un-ionised ammonia was within criteria (<0.025g/m^3) as defined by consent.

The proposed development of a dam to add additional freshwater storage and utilisation will seek to mitigate the potential for increased un-ionised ammonia in the Haehanga Stream and associated unnamed tributaries by allowing increased dilution.

As discussed, the mixing zone, which is 40 m of unnamed tributary, post the wetland treatment system discharge, was monitored on six occasions in the 2016-2017 monitoring period. The analyses identified on two occasions, two minor breeches in un-ionised ammonia concentration. The value for compliance, in terms of un-ionised ammonia is particularly low (0.025g/m^3). This is undertaken to safeguard fish populations within the water course and provides for 95% confidence in concentrations below or at this concentration (<0.025 g/m^3). The minor breeches were the result of lower flows in the un-named tributary of Haehanga Stream coupled with increased concentrations of ammonia in the discharge. The proposed dam option may seek to mitigate these occurrences in future if well managed.

The unnamed tributary then joins the main stem of the Haehanga Stream where it is further assessed by the Council at four locations, of which two of these locations have consented concentrations for target analytes. In this monitoring period the surface water analysis of the Haehanga Stream at the two targeted compliance locations indicated compliance with the required concentrations in all of the six rounds undertaken for all parameters, bar one result for total petroleum hydrocarbons (TPH). This result was marginally over the limit of detection with a result of 0.7 g/m^3 TPH. The site below this was also sampled and no result, above the limit of detection was observed. Noteworthy, the August 2016 sample round indicated excessive concentrations of suspended solids which was a result of the logging operations occurring at the time.

Groundwater monitoring of irrigation areas

The groundwater analysis indicated that the down gradient monitoring well of the three monitoring wells, GND2190, which is located in the lower irrigation area, is showing signs of increased salinity. This is in similarity to the previous monitoring period, where saline impacts were observed in the groundwater in this well. This period the lower area bore (GND2190) was sampled on two occasions and found to maintain a total dissolved salts (TDS) concentration of >2,000 g/m^3 TDS, with a concentration of 3,071 g/m^3 TDS in December 2016. The upper irrigation area bore, GND2188 is showed an increasing trend in salinity. The December 2016 sample exceeded 1,000 g/m^3 TDS for the first time in the data set which has been sampled biannually since 2011. Conversely, the middle bore, GND2189, indicated a slight decreasing trend in salinity measurements this period.

No total petroleum hydrocarbons (TPH) above the limit of detection were recorded in the groundwater samples this period. Benzene, toluene, ethylbenzene and xylenes (BTEX) analysis indicated no detects above the limit of detection in all but one round this period. A trace detection of toluene was analysed in GND2189 in the December 2016 groundwater sample round, with a value of 0.0027g/m^3 Toluene. A follow up sample was collected which indicated no results for BTEX above the limit of detection.

Irrigation area soils

In the previous monitoring period (2015-2016) the lower area of the two irrigation areas was found to contain an elevated sodium absorption ratio (SAR), this was identified through soil sampling of the irrigation areas. The upper area's SAR ranged from 4-6 SAR, and the lower area 3-12 SAR in the 2015-2016 monitoring period. The site management were made aware of this elevation through the annual report

2015-2016, and in this period the corresponding analysis detailed a decrease in SAR concentration in the lower areas which remained below <5 SAR, (4.6 SAR, lower irrigation area).

Two analyses (June 2017) indicated total petroleum hydrocarbons in the soil, in both the upper and lower irrigation areas (8 g/m^3 upper and 15 g/m^3 lower, TPH), as a function of irrigation from the associated drilling mud pad irrigation pond. Additional speciated hydrocarbon (C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36}) and benzene, toluene, ethylbenzene and xylenes (BTEX) analysis is proposed in the upcoming monitoring period to consider the true nature of these analytes, as currently only the sum of the hydrocarbons (C_7-C_{36}) is monitored.

Biological monitoring

In general, the communities in the Haehanga Stream sites had moderate proportions of sensitive taxa. Low numbers of sensitive taxa are expected in small, silty bottomed streams such as the Haehanga Stream and the numbers of taxa were generally similar to other lowland hill country streams surveyed at similar altitude.

Fish survey

In summary, the results of the current survey do not indicate that the composting activities and wastewater irrigation undertaken by Remediation NZ Ltd, alongside the Haehanga Stream, have had a harmful impact on the fish communities of this stream. This is consistent with the findings of the macroinvertebrate survey, completed on the same day. However, the impact on fish passage caused by the three access culverts is likely to have contributed to the reduced species richness at site 1.

The current survey was undertaken in early summer, in an effort to target the higher flows present at this time. It is recommended that this is continued, and that surveys continue on an annual basis. In addition, it is recommended consideration be given to installing continuous water temperature monitoring equipment over the summer months, to improve our understanding of how the water temperature changes in the Haehanga Stream. Finally, it is recommended that the company be reminded of their responsibilities regarding the provision for fish passage.

Riparian management

Significant riparian management and stock exclusion through fencing is required to be undertaken by the consent holder. On multiple occasions stock had been observed around the site and in the Haehanga Stream. This can adversely affect the stream bank's stability, water quality and as a process the in-stream communities. As outlined by the Council's biologist, any works that improve the water quality of this site are likely to improve the freshwater communities below the discharge and irrigation areas.

Waitara and Pennington Road facilities

No environmental effects were noted throughout the monitoring year, which is consistent with the previous monitoring period's synopsis.

3.3. Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 11-17.

Table 11 Summary of performance for consent 5838-2

Purpose 5838-2.2: *To discharge of waste material to land for composting; and treated stormwater and leachate from composting operations; onto and into land in circumstances where contaminants may enter water in the Haehanga Stream catchment and directly into an unnamed tributary of the Haehanga Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practical option	Programme management/site inspections	For the most part although could improve
2. Only acceptable waste accepted onto site	Site inspections/review of supplied records	Yes
3. Representative sample of each type of drilling waste analysed for a. Total petroleum hydrocarbons b. Benzene, toluene, ethylbenzene and xylenes c. Polycyclic aromatic hydrocarbons d. Heavy metals e. Chloride, nitrogen, pH, potassium and sodium	Request for records or provided by consent holder at three monthly intervals. Significant quantities of oil and gas waste received although no analysis provided.	No records provided, although requested
4. DAF residue not to be accepted	Site inspections/review of supplied records	Yes
5. Maintenance of stormwater systems	Site inspections identified severe storm damage through slips of fine material from valley side	Maintenance ongoing
6. Maintenance of treatment systems	Site inspections, additional bunding requested for drilling mud pad and pond treatment system	Yes
7. Adequate pond construction	Site inspections identified improved bunding required around the pond treatment system	For the most part although improvements requested
8. Keep and supply irrigation records	Data supplied and reviewed	Yes
9. No direct discharges to occur as a result of irrigation	Site inspections /sampling	Yes
10. Irrigated fluids not to exceed 5% hydrocarbon content	Site inspections /sampling	Yes

Purpose 5838-2.2: ***To discharge of waste material to land for composting; and treated stormwater and leachate from composting operations; onto and into land in circumstances where contaminants may enter water in the Haehanga Stream catchment and directly into an unnamed tributary of the Haehanga Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
11. Discharges not to cause adverse effects at site HHG000150 and HHG00100	Sampling and inspection noted no adverse effects, though one result for TPH (0.7 g/m^3 TPH HHG000115) was found in April 2017.	Yes
12. Soil sampling to be undertaken for TPH and BTEX	Undertaken by the Council, though BTEX added to upcoming period	Yes
13. Soil sampling to be undertaken for chloride, sodium, magnesium, calcium, potassium, soluble salts and conductivity	Undertaken by Council	Yes
14. Adhere to composting facility management plan	Inspections, SAR observably reduced in lower irrigation area soil. Groundwater in GND 2190 observed to be in tier 3 for chloride concentrations >1,000 g/m^3 Cl. Storage dam not yet completed as defined in plan. Increased irrigation area under construction.	For the most part, though additional action to adhere to plan to lessen chloride effects in GND2190
15. Establish groundwater monitoring bores	Site inspections identified additional monitoring wells are required. Currently three are installed. Additional to be installed this summer	Yes though more required
16. Groundwater monitoring wells installed as per standard	Undertaken	Yes
17. Consent holder monitoring and record groundwater in each monitoring well each day for level, temperature, and conductivity	Not requested in this period	N/A
18. Groundwater sampled per six month interval: a. Total petroleum hydrocarbons b. BTEX	Undertaken by Council	Yes
19. Groundwater samples shall be collected from all wells for chloride, sodium, magnesium, calcium, TSS and conductivity	Undertaken by Council	Yes
20. Prepare Pond Treatment System Management Plan	Management plan currently under review by consent holder	Under review
21. Adhere to Pond Treatment System Management Plan	Management plan currently under review by consent holder	Under review

Purpose 5838-2.2: *To discharge of waste material to land for composting; and treated stormwater and leachate from composting operations; onto and into land in circumstances where contaminants may enter water in the Haehanga Stream catchment and directly into an unnamed tributary of the Haehanga Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
22. Prepare Wetland Treatment System Management Plan	Management plan currently under review by consent holder	Under review
23. Adhere to Wetland Treatment System Management Plan	Management plan currently under review by consent holder	Under review
24. Wetland discharge not to exceed certain parameters	Consented compliance parameters analysed, were found to be compliant.	Yes
25. Wetland discharge not to cause certain effects at site HHG000103	Sampling indicated that for two of six sampling rounds non compliances in un-ionised ammonia concentrations was observed. Additional dilution proposed.	For the most part, though could be better
26. Maintain riparian plantings	Continued development required, fencing is in-adequate, stock frequently in stream.	No
27. Notify the Council of significant incidents on site	No notifications received	N/A
28. Prepare a Site Exit Plan prior to site closure	N/A	N/A
29. Adhere to Site Exit Plan	N/A	N/A
30. Optional Review	Consent renewal to occur next year	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** **Improvement required**

Table 12 Summary of performance for consent 5839-2

Purpose 5839-2: *To discharge emissions to air at Mokau Road, Uruti*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practical option	Programme management/site inspections	Yes
2. Composting area not to exceed certain limits	Programme management/site inspections	Yes
3. Only acceptable waste brought onto site	Site inspections/review of supplied records	Yes

Purpose 5839-2: *To discharge emissions to air at Mokau Road, Uruti*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. DAF residue not to be accepted	Site inspections/review of supplied records	Yes
5. Maintain and supply an inwards good register	Data received and reviewed	Yes
6. Prepare a Site Practices Plan	Plan received and reviewed	Yes
7. Adhere to Site Practices Plan	Site inspections	Yes
8. Arrange professional assessment of Site Practices Plan	Draft received, though further review on-going	Under review
9. Submit Proposed Implementation Plan	Plan under review with consent holder	Under review
10. Adhere to Proposed Implementation Plan	Plan under review with consent holder	Under review
11. Dust deposition not to exceed certain limits	Not monitored- dust not noted as an issue during inspections	Not assessed
12. PM10 and suspended particulate not to exceed certain limits	Not monitored- dust not noted as an issue during inspections	Not assessed
13. No offensive or objectionable odour beyond the boundary	Inspection did not find objectionable odour beyond boundary	Yes
14. Install a weather station and provide data	Inspection and weather updates	Yes, though frequently faulty
15. Conduct odour surveys	Undertaken by the Council during inspections	Yes
16. Hold community meeting	Meeting held in 2011-no attendees, none have been proposed since. Upcoming consent renewal next year	Yes
17. Notify the Council of onsite incidents	No notification received	N/A
18. Prepare a Site Exit Plan prior to site closure	N/A	N/A
19. Adhere to Site Exit Plan upon site closure	N/A	N/A
20. Optional review	A review was not required	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		**High** **Good**

Table 13 Summary of performance for consent 5893-2

Purpose 5893-2: *The discharge of drilling solids at Waitara Road, Brixton*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Exercise of consent in accordance with information provided in application	Site inspections	Yes
2. Best practicable option as described by S2 of RMA	Site inspections	Yes
3. Records of source, nature and volume of wastes	Records reviewed	Yes
4. Solid drilling cuttings to be < 5 % hydrocarbon content	Hydrocarbons wastes no longer processed on this site	N/A
5. No contamination of ground or surface water	Samples were not collected during the period under review	N/A
6. Maintenance of stormwater treatment system	Site inspections	Yes
7. Concentration limits on stormwater	Samples were not collected during the period under review as no water was found at the sample location	N/A
8. Post mixing zone effects	Not possible due to insufficient water	N/A
9. Alterations to processes and operations	Site inspections did not note any changes	Yes
10. Reinstatement of site	N/A	N/A
11. Optional review of consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall administrative performance in respect of this consent		**High** **High**

Table 14 Summary of performance for consent 5892-2

Purpose 5892-2: *To discharge storm water from the worm farming operations onto and into land and into an unnamed tributary of the Waiongana Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Exercise of consent in accordance with information provided in application	Site inspections	Yes
2. Best practicable option as described by S2 of RMA	Site inspections	Yes
3. Stormwater management plan	Received	Yes

Purpose 5892-2: *To discharge storm water from the worm farming operations onto and into land and into an unnamed tributary of the Waiongana Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Records of source, nature and volume of wastes	Yes	N/A
5. No contamination of ground or surface water	Site inspections, samples	Yes
6. Maintenance of stormwater treatment system and concentration limits	Site inspections	Yes
7. Post mixing zone stormwater effects	Samples were not collected during the period under review as there was no water in the tributary	N/A
8. Windrows covered except when discharging	No visual impact observed during site visits	Yes
9. Alterations to processes and operations	Site inspections did not note any changes	Yes
10. Reinstatement of site	N/A	N/A
11. Optional review of consent	No review due this period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall administrative compliance with this consent		**High** **High**

Table 15 Summary of performance for consent 5938-2

Purpose 5938-2.0 *To use a twin culvert in the Haehanga Stream for vehicle access purposes*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Ensure stream bed downstream is adequately constructed and does not prevent fish passage	Further work required post flooding events	No
2. Maintains the structure so: a. It does not become blocked and is free flowing b. Any erosion or instability of the stream bank is remedied by the consent holder	Site inspections, see further information in attached fish monitoring survey, section Fish Passage	No. Culverts perched and rocks blocking fish passage
3. Review condition	No review pursued	N/A

Purpose 5938-2.0 *To use a twin culvert in the Haehanga Stream for vehicle access purposes*		
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 administrative performance with respect to this consent		**Improvement required** **Good**

Table 16 Summary of performance for consent 6211-1

Purpose: *To realign a stream at Mokau Road, Uruti*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification prior to commencement of works	No works undertaken this period	N/A
2. Realignment in accordance with application	Site inspections	Yes
3. Best practicable option	Site inspections	Yes
4. Minimisation of discharge	Site inspections	Yes
5. Minimisation of riverbed disturbance	Site inspections	Yes
6. Optional review of consent	No review due this period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall administrative performance with respect to this consent		**High** **High**

Table 17 Summary of performance for consent 6212-1

Purpose: *To establish and maintain a culvert at Mokau Road, Uruti*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification prior to commencement of works	No works undertaken this period	N/A
2. Replacement of temporary culvert	N/A	N/A
3. Construction in accordance with application	Site inspections	No-culvert outlet is perched
4. Best practicable option	Site inspections	No
5. Minimisation of riverbed disturbance	Site inspections	Yes

Purpose: *To establish and maintain a culvert at Mokau Road, Uruti*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
6. Provision of fish passage	Site inspections	No-culvert outlet is perched
7. Reinstatement of site	N/A	N/A
8. Optional review of consent	No review due this period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall administrative performance with respect to this consent		**Improvement Required** **Good**

Table 18 Summary of performance for consent 10063-1.0

Purpose: *To discharge treated stormwater from a quarry site, into an unnamed tributary of the Haehanga Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Authorises the discharge of treated stormwater into unnamed trib of Haehanga Stream in line with original application	Inspection - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
2. Notification of quarry works	Notification- (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
3. Adopt best practicable option	Inspection- (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
4. Shall operate and progressively reinstate the quarry site in a manner which ensures exposed areas are kept to a minimum at all times	Inspection - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
5. Ensure no area greater than 1 ha is exposed at any one time	Inspection - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
6. The stormwater discharged shall not exceed 4 ha	Inspection - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
7. Stormwater treatment system shall be installed before any site works commence	Inspection - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
8. Stormwater treatment system shall be maintained for the life of the quarry operation	Inspection - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA

Purpose: *To discharge treated stormwater from a quarry site, into an unnamed tributary of the Haehanga Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
9. All stormwater to be directed to stormwater treatment system prior to discharge to Haehanga Stream tributary	Inspection - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
10. Constituents of the discharge shall meet the following standards: a. pH: 6.0-9.0 b. suspended solids: <100g/m^3 c. total hydrocarbons: <15 g/m^3	Sampling - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
11. The pH may exceed 9.0 if the exceedance is the result of photosynthetic activity, however the discharge shall not alter the receiving waters by more than 0.5 pH after a mixing zone of 25 m	Sampling - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
12. After mixing the discharge shall not give rise to any of the following effects: a. Production of scums, films or foams b. Any conspicuous change in the colour or visual clarity c. Any emission of objectionable odour d. Rendering of fresh water unsuitable for farm animal e. Any significant adverse effects on aquatic life	Inspection and sampling - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
13. The discharge shall not give rise to any of the following effects: a. A change in turbidity measurements upstream of the discharge point and below the discharge point of more than 5NTU b. A change in turbidity measurements of	Inspection and sampling -(Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA

Purpose: *To discharge treated stormwater from a quarry site, into an unnamed tributary of the Haehanga Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
greater than 5 NTU as a result of the discharge		
14. Maintain and update Contingency plan	Notification and supply of records	NA
15. Site shall be operated in a management plan which will contain the following: a. The loading and unloading of materials b. Maintenance of conveyance systems c. General housekeeping d. Management of the interceptor system	Supply of management plan - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	Not received
16. Notification pertaining to the change of nature of discharge	Notifications - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
17. Consent lapse	Consent in effect - (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
18. Review condition	No review required (Quarry operations suspended by consent holder for the 2016 2017 monitoring period)	NA
Overall assessment of consent compliance and environmental performance in respect of this consent Overall administrative performance with respect to this consent		**Not assessed this period as quarry operations suspended by consent holder**

Table 19 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2013-2014	5838-2				1
	5839-2		1		
	5892-2	1			
	5893-2	1			
	5938-1	1			
	6211-1	1			
	6212-1		1		
2014-2015	5838-2			1	
	5839-2		1		
	5892-2	1			
	5893-2	1			
	5938-1	1			
	6211-1	1			
	6212-1			1	
2015-2016	5838-2.2			1	
	5839-2	1			
	5893-2	1			
	5892-2	1			
	5938-2.2			1	
	6211-1	1			
	6212-1			1	
	10063-1.0				
Totals		12	3	5	1

During the year, generally the Company demonstrated a 'Good' level of environmental and a 'Good' level of administrative performance with the resource consents as defined in Section 1.1.4.

However, specifically one environmental compliance aspect and one administrative compliance aspect will require improvement moving forward, these aspects are as follows:

Commitment to maintaining fish passage with respect to culverts on site. While work has been undertaken to prevent perched culverts, continual supervision from the consent holder is requested, as this aspect has the potential to limit biological abundances. Consents 6212-1 and 5938-2.

Administrative compliance requires improvement with regard to the receipt of wastes by the Company.

Consent 5838-2.2 condition 3 requires the following:

Before bringing waste to the site the consent holder shall take a representative sample of each type of drilling waste permitted under condition 2 from each individual source and have it analysed for the following:

a) *Total petroleum hydrocarbons (C_6-C_9, C_{10}-C_{14}, C_{15}-C_{36});*
b) *Benzene, toluene, ethylbenzene and xylenes (BTEX);*

c) *Polycyclic aromatic hydrocarbons (PAH) screening;*
d) *Heavy metals screening; and*
e) *Chloride, nitrogen, pH, potassium and sodium.*

The results of the analysis required by this condition shall be forwarded to the Chief Executive, Taranaki Regional Council every three months, or upon request.

Significant quantities of material was received from this waste stream and processed by the Uruti facility this monitoring period. Results of analysis were not provided, although requested.

3.4. Recommendations from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT monitoring of consented activities at Waitara Road and Pennington Road, Brixton in the 2016-2017 year continue at the same level as in 2015-2016.

This was undertaken.

2. THAT the monitoring of consented activities at the Mokau Road, Uruti facility remains uncharged from that undertaken in the 2015-2016 year. However, RNZ must adhere to safe fish passages across their site.

Continued adherence to safe fish passage has been requested, works had been undertaken by the consent holder, although continued adherence is required.

3. The implementation of in-situ temperature loggers is to be discussed to monitor the summer temperature differential in the Haehanga Stream. These loggers will most likely be installed in the 2018-19 monitoring year.

Currently under consideration.

4. THAT the option for a review of resource consent 5838-2 in June 2017, as set out in condition 24 of the consent, be exercised if the monitoring undertaken in the 2016-2017 indicated an adverse decline via analysis, both in terms of physiochemical or biological compliance.

No adverse physicochemical or biological decline was observed in monitoring throughout this monitoring period, 2016-2017. Consent 5838-2.2 is due to be renewed in the upcoming monitoring period.

3.5. Alterations to monitoring programmes for 2017-2018

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

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

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

It is proposed that for 2017-2018 monitoring year the following facets are added to the existing monitoring programme for RNZ Uruti.

- Additional groundwater monitoring will be added to the current monitoring programme. This will move the current monitoring of groundwater from every six months to quarterly. The aim will be to further assess seasonality of the site groundwater and allow greater understanding of the likely impacts as a result of irrigation practices on site. This will most likely be included in the 2018-2019 monitoring period.
- Additional parameters to be added to the soil sampling programme include the following:
- Speciated hydrocarbon analysis to include:
    - Total petroleum hydrocarbon analysis (C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36} and C_7-C_{36});
    - Benzene, toluene, ethylbenzene and xylenes (BTEX);
    - Polycyclic aromatic hydrocarbons (PAH); and
    - Total recoverable heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc).
- Additional surface water analytes to be added to monitoring locations HHG000106 and HHG000115.
    - Benzene, toluene, ethylbenzene and xylenes (BTEX).

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2017-2018.

4. Recommendations

1. THAT in the first instance monitoring of consented activities at Waitara Road and Pennington Road, Brixton, in the 2017-2018 year continues at the same level as in 2016-2017.
2. THAT should there be issues with environmental or administrative performance in 2017-2018, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
3. THAT the monitoring of consented activities at the Mokau Road, Uruti composting facility continues with the addition of two extra groundwater monitoring rounds. This will bring the groundwater monitoring to quarterly to encompass seasonality. The soil analysis parameters will also be extended to encompass the following specific analytes: This will be included in the 2018-2019 monitoring programme.
    - Total petroleum hydrocarbon analysis (C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36} and C_7-C_{36});
    - Benzene, toluene, ethylbenzene and xylenes (BTEX);
    - Polycyclic aromatic hydrocarbons (PAH); and
    - Total recoverable heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc).

    Once the new lower irrigation area has been completed, the soil sampling programme will expand to encompass this area.

    Additional surface water analytes to be added to monitoring locations HHG000106 and HHG000115.

    - Benzene, toluene, ethylbenzene and xylenes (BTEX).
4. The implementation of in-situ temperature loggers to the Haehanga Stream is currently under consideration and will be undertaken in the 2018-2019 if required.

Glossary of common terms and abbreviations

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

As*	Arsenic.
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.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m^3s^{-1}).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
F	Fluoride.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
$g/m^2/day$	grams/$metre^2$/day.
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.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.

MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
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.
PM_{10}, $PM_{2.5}$, $PM_{1.0}$	Relatively fine airborne particles (less than 10 or 2.5 or 1.0 micrometre diameter, respectively).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
Zn*	Zinc.

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

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

Bibliography and references

BTW Company Ltd- Uruti Compost Facility Management Plan- Remediation New Zealand 2015.

Taranaki Regional Council 2015: Remediation NZ Monitoring Programme Annual Report 2015-2016. Technical Report 2016-83. Taranaki Regional Council, Stratford

Taranaki Regional Council 2015: Remediation NZ Monitoring Programme Annual Report 2014-2015. Technical Report 2015-68. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2014: Remediation NZ Monitoring Programme Annual Report 2013-2014. Technical Report 2014-53. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2013: Remediation NZ Monitoring Programme Annual Report 2012-2013. Technical Report 2013-64. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2011: Remediation NZ Monitoring Programme Annual Report 2011-2012. Technical Report 2012-39. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2011: Remediation NZ Monitoring Programme Annual Report 2010-2011. Technical Report 2011-44. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2010: Remediation NZ Monitoring Programme Annual Report 2009-2010. Technical Report 2010-44. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2009: PEL Waste Services/Remediation NZ Monitoring Programme Annual Report 2008-2009. Technical Report 2009-49. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2009: PEL Waste Services Limited (formerly Perry Environmental Limited) Monitoring Programme Annual Report 2007-2008. Technical Report 2008-94. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2007: PEL Waste Services Limited (formerly Perry Environmental Limited) Monitoring Programme Annual Report 2006-2007. Technical Report 2007-112. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2006: Perry Environmental Limited Monitoring Programme Annual Report 2005-2006. Technical Report 2006-26. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2005: Perry Environmental Limited Monitoring Programme Annual Report 2004-2005. Technical Report 2005-12. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2004: Perry Environmental Limited Monitoring Programme Annual Report 2003-2004. Technical Report 2004-26. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2003: Perry Environmental Limited Monitoring Programme Annual Report 2002-2003. Technical Report 2003-37. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2002: Global Vermiculture Limited Monitoring Programme Annual Report 2001-2002. Technical Report 2002-25. Taranaki Regional Council, Stratford.

Appendix I

Resource consents held by Remediation NZ Ltd

(For a copy of the signed resource consent
please contact the TRC Consents 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:	Remediation (NZ) Limited PO Box 8045 New Plymouth 4342
Decision Date (Change):	20 August 2015
Commencement Date (Change):	20 August 2015 (Granted Date: 27 May 2010)

Conditions of Consent

Consent Granted:	To discharge: a) waste material to land for composting; and b) treated stormwater and leachate from composting operations; onto and into land in circumstances where contaminants may enter water in the Haehanga Stream catchment and directly into an unnamed tributary of the Haehanga Stream
Expiry Date:	1 June 2018
Review Date(s):	June 2016, June 2017
Site Location:	1450 Mokau Road, Uruti
Legal Description:	Sec 34 Pt Sec 4 Blk II Upper Waitara SD (Discharge site)
Grid Reference (NZTM)	Between 1731656E-5686190N, 1733127E-5684809N, 1732277E-5685101N, 1732658E-5684545N & 1732056E-5684927N
Catchment:	Mimi
Tributary:	Haehanga

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.

Acceptable wastes

2. The raw materials accepted onsite shall be limited to the following:
    - Paunch grass;
    - Animal manure from meat processing plant stock yards and dairy farm oxidation pond solids;
    - Green vegetative wastes;
    - Biosolids wastes including, but not limited to, pellets from wastewater treatment plants;
    - Mechanical pulping pulp and paper residue (excluding any pulping wastes that have been subject to chemical pulping or treated or mixed with any substance or material containing chlorine or chlorinated compounds);
    - Solid drilling cuttings from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0% total petroleum hydrocarbon within 3 days of being received onsite;
    - Water based and synthetic based drilling fluids from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0% total petroleum hydrocarbon content within 3 days of being brought onto the site;
    - Produced water from hydrocarbon exploration;
    - Vegetable waste solids (being processing by-products);
    - Grease trap waste (from food service industries);
    - Fish skeletal and muscle residue post filleting (free from offal); and
    - Poultry industry waste (eggshells, yolks, macerated chicks and chicken mortalities).

    The acceptance of any other materials shall only occur if the Chief Executive, Taranaki Regional Council advises in writing that he is satisfied on reasonable grounds that the other materials will have minimal effects beyond those materials listed above.

3. Before bringing waste to the site the consent holder shall take a representative sample of each type of drilling waste permitted under condition two from each individual source, and have it analysed for the following:

   a. total petroleum hydrocarbons (C_6-C_9, C_{10}-C_{14}, C_{15}-C_{36});
   b. benzene, toluene, ethylbenzene, and xylenes;
   c. polycyclic aromatic hydrocarbons screening;
   d. heavy metals screening; and
   e. chloride, nitrogen, pH, potassium, and sodium.

   The results of the analysis require by this condition shall be forwarded to the Chief Executive, Taranaki Regional Council every three months or upon request.

4. Material produced as a result of a dissolved air flotation process shall not be accepted on site.

Maintenance of measures

5. All sediment ponds and silt traps on site, that are located upstream of the pond treatment system or wetland treatment system, shall be managed so that they are no more than 20% full of solids at any one time.

   Note: For the purposes of this condition, the location of the pond treatment system and wetland treatment system are shown on Figure 1, attached as Appendix 1 of this consent.

6. All treatment measures on site shall be implemented and maintained so that:
   - clearwater runoff is prevented from entering Pad 1, Pad 2 and the Drill Mud Pad; and
   - all stormwater and/or leachate from Pad 1, Pad 2, the Drill Mud Pad and any other exposed areas within the composting site is directed for treatment through the Pond or Wetland Treatment System.

   Note: For the purposes of this condition, the location and extent of Pad 1, Pad 2 and the Drill Mud Pad are shown on Figure 1, attached as Appendix 1 of this consent.

7. Any pond(s) used on site for the purposes of stormwater and leachate treatment shall be constructed and maintained in a manner which prevents the seepage of wastewater through the pond liners entering surface water or groundwater.

Irrigation

8. The consent holder shall record the following information in association with irrigating wastewater to land:

   a) the date, time and hours of irrigation;
   b) the volume of wastewater irrigated to land;
   c) the conductivity of the irrigation fluid (measured in mS/m);
   d) the source of the wastewater (e.g. Pond or Wetland Treatment System); and
   e) the location and extent where the wastewater was irrigated.

   The above records shall be made available to the Chief Executive, Taranaki Regional Council, on request.

9. There shall be no direct discharge to water as a result of irrigating wastewater to land. This includes, but is not necessarily limited to, ensuring the following:
    - No irrigation shall occur closer than 25 metres to any surface water body;
    - The discharge does not result in surface ponding;
    - No spray drift enters surface water;
    - The discharge does not occur at a rate at which it cannot be assimilated by the soil/pasture system; and
    - The pasture cover within irrigation areas is maintained at all times.

10. Treated wastewater discharged by irrigation to land shall not have a hydrocarbon content exceeding 5% total petroleum hydrocarbon or a sodium adsorption ratio exceeding 18.

11. Discharges irrigated to land shall not give rise to any of the following adverse effects in the Haehanga Stream, after a mixing zone extending 30 metres from the downstream extent of the irrigation areas;

    a) a rise in filtered carbonaceous biochemical oxygen demand of more than 2.00 gm^{-3};
    b) a level of unionised ammonia greater than 0.025 gm^{-3};
    c) an increase in total recoverable hydrocarbons;
    d) chloride levels greater than 150 g/m^3;
    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; and
    i) any significant adverse effects on aquatic life.

Soil quality

12. Representative soil samples shall, be taken from each irrigation area at intervals not exceeding 6 months and analysed for total petroleum hydrocarbons, benzene, toluene, ethylbenzene, and xylene.

13. Representative soil samples shall be taken from each irrigation area at intervals not exceeding 3 months and analysed for chloride, sodium, magnesium, calcium, potassium, total, soluble salts, and conductivity.

14. Before 30 November 2015 the holder shall review and update the Uruti Composting Facility Management Plan supplied in support of application 5838-2.2 and any changes shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity The plan shall be adhered to and reviewed on an annual basis (or as required) and any changes shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The shall plan include but not limited to:

    a) Trigger limits for the three tier management system tiers set out in section 3.1 of the Uruti Composting Facility Management Plan;
    b) Monitoring frequencies of soil and groundwater in Tiers one, two, and three;
    c) Remediation options for Tier three irrigation areas;
    d) Riparian planting of irrigation areas;
    e) Stormwater improvements at the site ;
    f) Water storage for dilution and remediation; and
    g) Soil and groundwater data analysis.

Groundwater quality

15. The consent holder shall establish and maintain at least one groundwater monitoring well at each of the following locations for the purpose of monitoring the effect of the wastewater discharges on groundwater quality:

    a. up gradient of the irrigation areas in an un-impacted area;
    b. down gradient of the extent of the irrigation of each area;
    c. down gradient of the duck pond and drill mud pits and up gradient of irrigation area H for the purpose of assessing integrity clay liners of drilling waste treatment ponds, and
    d. at NZTM 1731518N-5686536E (approximately 40 metres south of SH3) for the purpose of assess groundwater near the northern boundary.

    For the purposes of clarification this condition requires four new bores to be installed for the purposes of establishing irrigation areas F & E and in accordance with the Uruti Composting Facility Management Plan 2015 supplied with application 5838-2.2.

16. Any new groundwater monitoring wells required by condition 15 shall be installed to the following standards;

    a) Prior to installation of any new wells, confirmed NZTM GPS locations shall be provided to the Taranaki Regional Council for approval;
    b) All new wells shall be at least 25 metres from any water way (unless otherwise authorised by a separate consent) and be accessible by vehicle;
    c) All new wells shall be installed by a qualified driller and designed to encounter groundwater and accommodate expected annual fluctuations in water level -i.e. screened sections and filter packs to be located next to the water bearing horizons;
    d) Soils encountered during installation shall be logged by a suitably qualified and graphic logs of the soils and well construction are to be supplied to the Taranaki Regional Council;
    e) All new wells shall be surveyed for topographical elevation by a suitably qualified person;
    f) All wells shall completed with an appropriate riser, riser cap, toby and be fenced to prevent stock access;
    g) Prior to any irrigation occurring in any new irrigation area, a groundwater sample shall be collected from the down gradient well by a suitably qualified person, using a method approved by the Chief Executive of the Taranaki Regional Council and analysed and analysed for sodium, calcium, magnesium, nitrate, ammoniacal nitrogen, pH, chloride, and conductivity.

    Adherence to New Zealand Standard 4477:2001 will ensure compliance with this condition.

17. The consent holder shall undertake weekly groundwater level, temperature, and conductivity readings from each well within a single eight hour period using a method approved by the Chief Executive, Taranaki Regional Council. Results shall be recorded in a cumulative spread sheet, a copy of which shall be forwarded to the Taranaki Regional Council every three months, or upon request.

18. Groundwater samples shall be collected from all monitoring wells required under condition 15 at intervals not exceeding 6 months by a suitably qualified person using a method approved by the Chief Executive, Taranaki Regional Council and analysed for; total petroleum hydrocarbons, benzene, toluene, ethylbenzene, xylene, lead and arsenic.

19. Groundwater samples shall be collected from all monitoring wells required under condition 15 at intervals not exceeding 3 months by a suitably qualified person using a method approved by the Chief Executive, Taranaki Regional Council and analysed for; chloride, sodium, magnesium, calcium, total soluble salts, and conductivity.

Pond Treatment System

20. The consent holder shall prepare a Pond Treatment System Management Plan which details management practices undertaken to maximise treatment capabilities of the system. The plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the commencement date of this consent.

    The Management Plan shall address, but not necessarily be limited to, the following matters:

    a) how the build up of sediment and/or sludge will be managed within the entire system, how the level of build-up will be monitored including factors that will trigger management, and the frequency of undertaking the identified measures or procedures;
    b) how overloading of the system will be prevented; and
    c) how any offensive or objectionable odours at or beyond the site boundary will be avoided in accordance with condition 13 of consent 5839-2.

21. Operations on site shall be undertaken in accordance with the Pond Treatment System Management Plan, approved under condition 20 above, except in circumstances when the Proposed Implementation Plan, approved under condition 9 of consent 5839-2, specifies otherwise.

Wetland Treatment System

22. The consent holder shall prepare a Wetland Treatment System Management Plan that details management practices undertaken to maximise treatment capabilities of the system. The plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the commencement date of this consent.

    The Management Plan shall address, but not necessarily be limited to, the following matters:

    a) how the build up of sediment and/or sludge will be managed within the entire system, how the level of build-up will be monitored including factors which will trigger management, and the frequency of undertaking the identified measures or procedures; and
    b) how plant die-off within the system will be managed, and the frequency and/or timing of undertaking the identified measures or procedures.

23. Operations on site shall be undertaken in accordance with the Wetland Treatment System Management Plan, approved under condition 22 above.

24. The discharge from the Wetland Treatment System shall meet the following standards (at monitoring site IND003008):

    a) the suspended solids concentration shall not exceed 100 g/m^3; and
    b) the pH shall be between 6.0 and 9.0.

25. Discharges from the Wetland Treatment System shall not give rise to any of the following effects in the unnamed tributary of the Haehanga Stream, after a mixing zone of 40 metres, at established monitoring site HHG000103 (at or about grid reference 1732695E-5685050N):

    a) a rise in filtered carbonaceous biochemical oxygen demand of more than 2.00 gm^{-3};
    b) a level of unionised ammonia greater than 0.025 gm^{-3};
    c) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
    d) any conspicuous change in the colour or visual clarity;
    e) any emission of objectionable odour;
    f) the rendering of fresh water unsuitable for consumption by farm animals; and
    g) any significant adverse effects on aquatic life.

Riparian planting

26. The consent holder shall maintain the areas of riparian planting, undertaken in accordance with option 1 of riparian management plan RMP383, by ensuring the ongoing replacement of plants which do not survive, the eradication of weeds until the plants are well established, and the exclusion of stock from the planted areas.

Incident notification

27. The consent holder shall keep a permanent record of any incident related to this consent that results, or could result, in an adverse effect on the environment. The consent holder shall make the incident register available to the Taranaki Regional Council on request.

    Details of any incident shall be forwarded to the Taranaki Regional Council immediately. At the grant date of this consent, the Taranaki Regional Council's phone number is 0800 736 222 (24 hour service).

Site reinstatement

28. The consent holder shall prepare a Site Exit Plan which details how the site is going to be reinstated prior to the consent expiring or being surrendered. The Plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, at least 6 months prior to this consent expiring or being surrendered.

    The Site Exit Plan shall address, but not necessarily be limited to, the following matters:

    a) How the site will be reinstated so that no raw materials listed or approved under condition 2 of this consent remain on site;

    b) How the site will be reinstated so that no partially decomposed material remains on site;

c) How any remaining leachate or sludge, resulting from the operation, will be either removed from the site, buried, treated or otherwise to avoid any adverse effects on groundwater or surface water;

d) The remediation of irrigated soils and groundwater; and

e) Timeframes for undertaking the activities identified in association with a) to c) above.

Note: The requirement of this condition shall not apply if the consent holder applies for a new consent to replace this consent when it expires.

29. The consent holder shall reinstate the site in accordance with the plan approved under condition 28 above prior to this consent expiring or being surrendered.

Review

30. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review within one month of approving the plan required under condition 9 of consent 5839-2 and/or during the month of June in any year for any of the following purposes:

a) Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to odour discharges from the site and/or water quality issues;

b) To incorporate into the consent any modification to the operation and maintenance procedures or monitoring that may be necessary to deal with any adverse effects on the environment arising from changes in association with condition 9 of consent 5839-2; and

c) To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects relating to the wastewater discharges and/or odour from the site.

Signed at Stratford on 20 August 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Appendix 1 of consent 5838

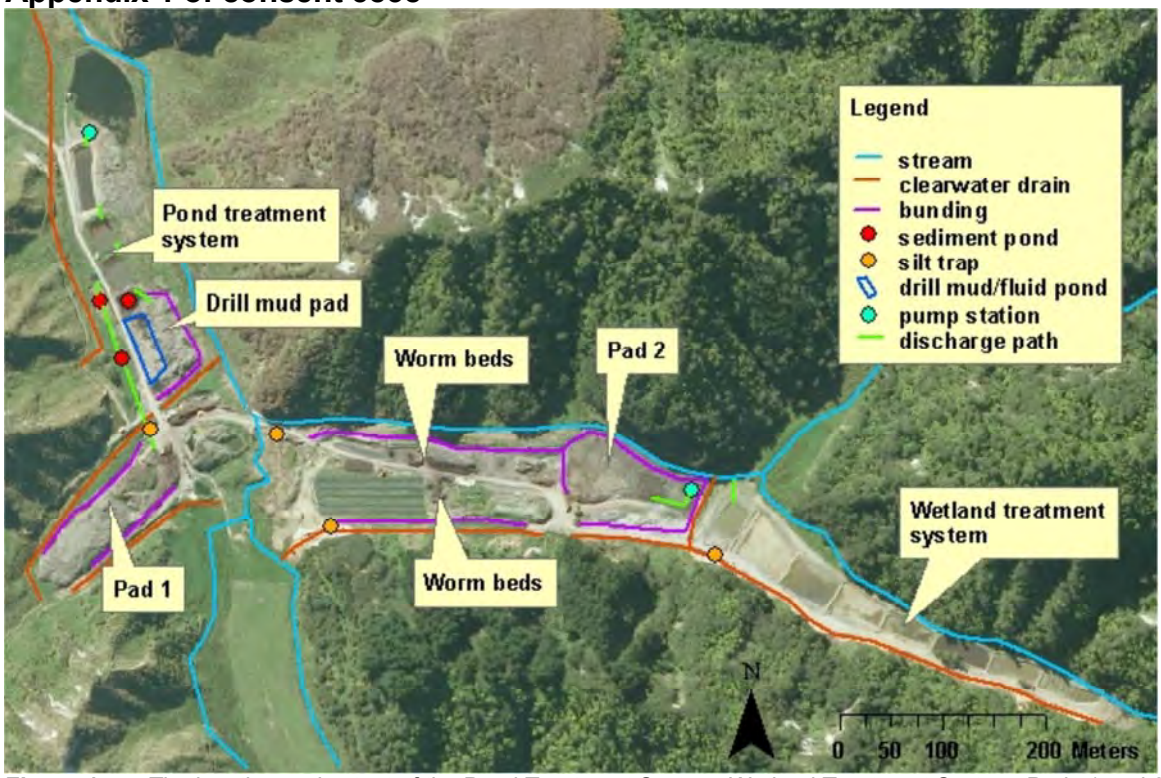


Figure 1 The location and extent of the Pond Treatment System, Wetland Treatment System, Pads 1 and 2, and the Drill Mud Pad.

Discharge Permit

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

Name of Consent Holder:	Remediation (NZ) Limited P O Box 8045 NEW PLYMOUTH 4342
Decision Date:	27 May 2010
Commencement Date:	18 June 2010

Conditions of Consent

Consent Granted:	To discharge emissions into the air, namely odour and dust, from composting operations between (NZTM) 1731704E-5685796N, 1733127E-5684809N, 1732277E-5685101N, 1732451E-5684624N and 1732056E-5684927N
Expiry Date:	1 June 2018
Review Date(s):	June 2011, June 2012, June 2013, June 2014, June 2015, June 2016, June 2017
Site Location:	1450 Mokau Road, Uruti
Legal Description:	Sec 34 Pt Sec 4 Blk II Upper Waitara SD

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 [the Council] all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

General

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

2. The surface areas of Pad 1 and Pad 2 shall not exceed 3,500 m² and 4,000 m², respectively.

   Note: For the purposes of this condition, the location and extent of Pad 1 and Pad 2 are shown on Figure 1, attached as Appendix 1 of this consent.

Incoming material

3. The raw materials accepted onsite shall be limited to the following:

   - Paunch grass;
   - Animal manure from meat processing plant stock yards and dairy farm oxidation pond solids;
   - Green vegetative wastes;
   - Biosolids wastes including, but not limited to, pellets from wastewater treatment plants;
   - Mechanical pulping pulp and paper residue [excluding any pulping wastes that have been subject to chemical pulping or treated or mixed with any substance or material containing chlorine or chlorinated compounds];
   - Solid drilling cuttings from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0 % total petroleum hydrocarbon within 3 days of being received onsite;
   - Water based and synthetic based drilling fluids from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0 % total petroleum hydrocarbon content within 3 days of being brought onto the site;
   - Produced water from hydrocarbon exploration;
   - Vegetable waste solids [being processing by-products];
   - Grease trap waste [from food service industries];
   - Fish skeletal and muscle residue post filleting [free from offal]; and
   - Poultry industry waste [eggshells, yolks, macerated chicks and chicken mortalities].

   The acceptance of any other materials shall only occur if the Chief Executive, Taranaki Regional Council advises in writing that he is satisfied on reasonable grounds that the other materials will have minimal effects beyond those materials listed above.

4. Material produced as a result of a dissolved air flotation process shall not be accepted on site.

5. The consent holder shall record the following information in association with accepting all incoming material on site:

   a) the date and time that the material is accepted;
   b) description of the material; and
   c) the approximate volumes of material.

   The above records shall be made available to the Chief Executive, Taranaki Regional Council, on request.

Management practices

6. The consent holder shall prepare a Site Practices Management Plan which details management practices undertaken to ensure that offensive or objectionable odours at or beyond the site boundary will be avoided in accordance with condition 13 of this consent. The plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the commencement date of this consent.

   The Management Plan shall address, but not necessarily be limited to, the following matters:

   a) identification of all activities on site which have the potential to generate odour [e.g. turning compost piles, removing sludge from ponds];
   b) the conditions and/or time of day when activities identified under a) above should be undertaken [e.g. during favourable weather conditions and the identification of those conditions] and/or measures that shall be implemented to avoid odours arising [e.g. containment measures];
   c) measures undertaken to minimise odours during receiving and storing material on Pad 1 and Pad 2 and throughout the composting and vermiculture processes [e.g. method[s] used to cover material once received, how anaerobic conditions are maintained];
   d) measures undertaken to minimise odours arising in the Wetland Treatment System, and identification of the time of year and/or frequency when undertaken;
   e) measures undertaken to minimise odours arising in the Pond Treatment System and associated treatment measures [e.g. silt traps located upstream], and identification of the time of year and/or frequency when undertaken; and
   f) details of how a complaint investigation procedure shall operate, including what data shall be collected and what feedback is to be provided to the complaint.

7. Operations on site shall be undertaken in accordance with the Site Practices Management Plan, approved under condition 6 above, except in circumstances when the Proposed Implementation Plan, approved under condition 9 of this consent, specifies otherwise.

Site audit and implementation

8. The consent holder shall engage a suitably qualified and experienced professional to prepare and submit an Odour Assessment Report for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within three months of the commencement date of this consent. The professional that the consent holder engages shall be to the reasonable approval of the Chief Executive, Taranaki Regional Council.

   The report shall include, but not necessarily be limited to, the following:

   a) The appropriateness of the management practices and control measures undertaken in avoiding offensive and/or objectionable odours arising beyond the property boundary in association with the composting processes on Pad 1;
   b) Recommendations in association with a) above;
   c) The appropriateness of the design and management of the Pond Treatment System and associated pre-treatment devices (e.g. silt ponds) in effectively managing odours arising from treating leachate derived from Pad 1 and avoiding offensive and/or objectionable odours arising beyond the property boundary; and
   d) Recommendations in association with c) above.

   For assisting with the above assessment, the consent holder shall provide a copy of the documents listed below to the engaged and approved professional:

   - The Taranaki Regional Council final officers report and hearing decision report for applications 5276 and 5277;
   - Consent certificates [including conditions] for consents 5838-2 and 5839-2;
   - The Pond Treatment System Management Plan approved under condition 18 of consent 5838-2; and
   - The Site Practices Management Plan approved under condition 6 of this consent.

9. The consent holder shall prepare and submit a Proposed Implementation Plan for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the Odour Assessment Report being approved under condition 8 above.

   The Plan shall include, but not necessarily be limited to, the following:

   a) Management practices and/or control measures proposed to be implemented in association with the composting processes on Pad 1, of which are from the recommendations of the Odour Assessment Report, approved in accordance with condition 8;
   b) Management practices and/or control measures proposed to be implemented in association with the Pond Treatment System, of which are from the recommendations of the Odour Assessment Report, approved in accordance with condition 8;
   c) The reasons for the chosen practices and/or measures identified in accordance with a) and b) above
   d) A timeframe by when each of the practices and/or measures identified in accordance with a) and b) above will be implemented

e) Identification of appropriate management practices to ensure the on-going functionality of any chosen control measures identified in accordance with a) and b) above

10. Operations and activities on site shall be undertaken in accordance with the Proposed Implementation Plan, approved under condition 9 above.

Dust

11. The dust deposition rate beyond the boundary of the consent holder's site arising from the discharge shall be less than 4.0 $g/m^2/30$ days.

Note: For the purposes of this condition, the consent holder's site is defined as Sec 34 Pt Sec 4 Blk II Upper Waitara SD.

12. 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 consent holder's site, and in any case, total suspended particulate matter shall not exceed 120 $\mu g/m^3$ as a 24 hour average [measured under ambient conditions] beyond the boundary of the consent holder's site.

Note: For the purposes of this condition, the consent holder's site is defined as Sec 34 Pt Sec 4 Blk II Upper Waitara SD.

Odour

13. The discharges authorised by this consent shall not give rise to an odour at or beyond the boundary of the consent holder's site that is offensive or objectionable.

Note: For the purposes of this condition:

- The consent holder's site is defined as Sec 34 Pt Sec 4 Blk II Upper Waitara SD; 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.*

Monitoring

14. The consent holder shall install a monitoring device that continuously records wind speed and direction in the area of the composting activity. The device shall be capable of logging collected data for at least six months and shall be installed and be operational within three months of the commencement date of this consent.

The data shall be provided telemetrically to the Taranaki Regional Council. If this method is not technically feasible, the data shall be provided to the Taranaki Regional Council at a frequency and a form advised by the Chief Executive, Taranaki Regional Council until such a time it is technically feasible to telemetric the data.

Odour surveys

15. The consent holder shall undertake an odour survey within six months of the Plan approved under condition 9 of this consent being implemented and thereafter at yearly intervals during periods when metrological conditions are most likely to result in offsite odour. The methodology for the survey shall be consistent with German Standard VDI 3940 "Determination of Odorants in Ambient Air by Field Inspection", or similar. Prior to the survey being carried out, the methodology shall be approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity.

    The results of the survey shall be provided to the Chief Executive, Taranaki Regional Council, within three months of the survey being completed.

Community liaison

16. The consent holder and the Director – Resource Management, Taranaki Regional Council, or his delegate, shall meet locally as appropriate, six monthly or at such other frequency as the parties may agree, with submitters to the application of this 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 this consent, in order to facilitate ongoing community consultation.

Incident notification

17. The consent holder shall keep a permanent record of any incident related to this consent that results, or could result, in an adverse effect on the environment. The consent holder shall make the incident register available to the Taranaki Regional Council on request.

    Details of any incident shall be forwarded to the Taranaki Regional Council immediately. At the grant date of this consent, the Council's phone number is 0800 736 222 [24 hour service].

Site reinstatement

18. The consent holder shall prepare a Site Exit Plan which details how the site is going to be reinstated prior to the consent expiring or being surrendered. The Plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, at least 3 months prior to this consent expiring or being surrendered.

    The Site Exit Plan shall address, but not necessarily be limited to, the following matters:

    a) How the site will be reinstated so that no raw materials listed or approved under condition 3 of this consent remain on site;

    b) How the site will be reinstated so that no partially decomposed material remains on site;

    c) How any remaining leachate or sludge, resulting from the operation, will be either removed from the site, buried, treated or otherwise to avoid any adverse effects on groundwater or surface water; and

d) Timeframes for undertaking the activities identified in association with a) to c) above.

Note: The requirement of this condition shall not apply if the consent holder applies for a new consent to replace this consent when it expires.

19. The consent holder shall reinstate the site in accordance with the Plan approved under condition 18 above prior to this consent expiring or being surrendered.

Review

20. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review within one month of approving the plan required under condition 9 of this consent and/or during the month of June in any year for any of the following purposes:

a) Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to odour discharges from the site;

b) To incorporate into the consent any modification to the operation and maintenance procedures or monitoring that may be necessary to deal with any adverse effects on the environment arising from changes in association with condition 9 of this consent; and

c) To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects of odour from the site.

Signed at Stratford on 27 May 2010

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix 1 of consent 5839-2

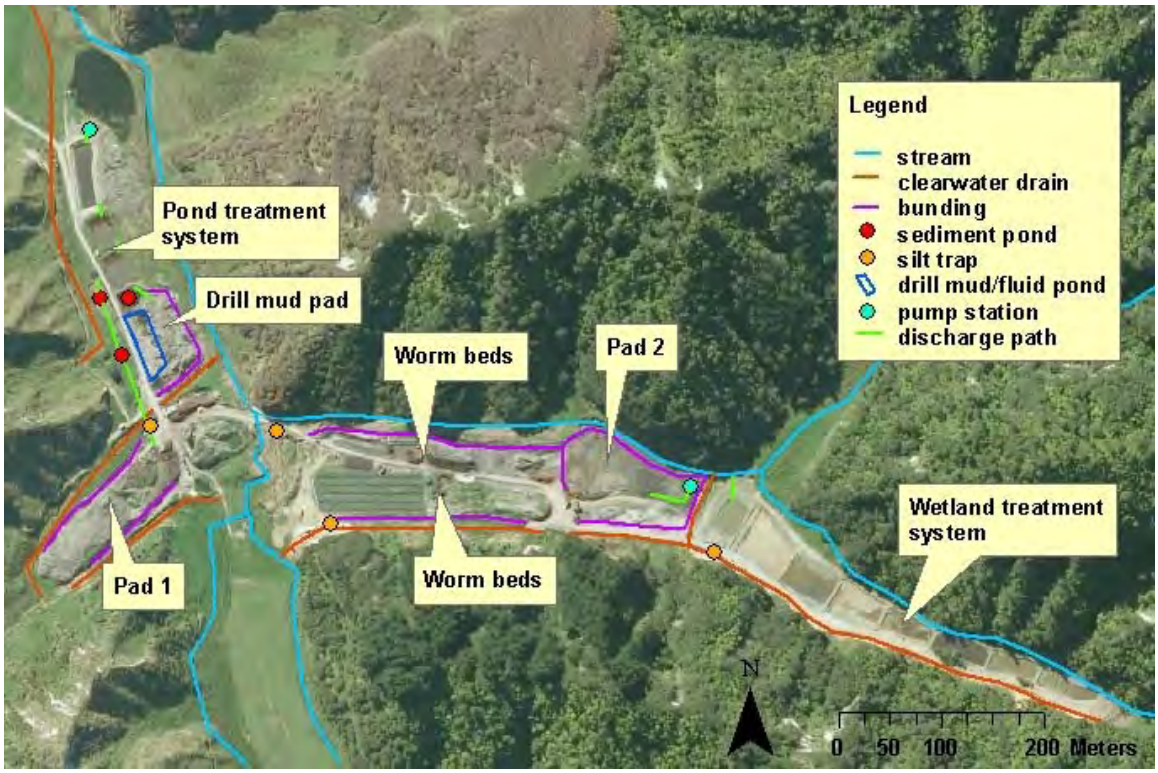


Figure 1 The location and extent of the composting operation including Pads 1 and 2.

Discharge Permit

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

Name of Consent Holder:	Remediation (NZ) Limited P O Box 8045 NEW PLYMOUTH 4342
Consent Granted Date:	7 September 2006

Conditions of Consent

Consent Granted:	To discharge stormwater from worm farming operations onto and into land and into an unnamed tributary of the Waiongana Stream at or about (NZTM) 1705949E-5679907N
Expiry Date:	1 June 2020
Review Date(s):	June 2008, June 2014
Site Location:	96 Waitara Road, Brixton, Waitara
Legal Description:	Lot 1 DP 19670 Blk III Paritutu SD
Catchment:	Waiongana

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. This consent shall be exercised generally in accordance with the information submitted in support of applications 1559 and 4037. In the case of any contradiction between the documentation submitted in support of applications 1559 and 4037 and the conditions of this consent, the conditions of this consent shall prevail.

2. At all times the consent holder shall adopt the best practicable option, as defined in section 2 of the Act, to prevent or minimise any actual or likely adverse effect on the environment associated with worm farming activities and the discharge of stormwater onto and into land.

3. Within three months of granting of this consent the consent holder shall prepare and maintain a stormwater management plan to the satisfaction of the Chief Executive, Taranaki Regional Council. This plan shall be updated as required by any significant changes to plant processes.

4. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, records of the nature and volume of all wastes received at the site; such records to be kept for at least 12 months.

5. The exercise of this consent shall not result in any contamination of groundwater or surface water, other than as provided for in special condition 6 of this consent.

6. The stormwater treatment system shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.

   The following concentrations shall not be exceeded within the discharge effluent:

Component	**Concentration**
pH (range)	6.5-8.5
suspended solids	100 gm^{-3}

This condition shall apply prior to any stormwater prior to leaving the site into the neighbouring drain, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

7. After allowing for reasonable mixing, with a mixing zone extending seven times the width of the receiving waters downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving waters of the unnamed tributary:

   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 or objectionable odour;
   d) the rendering of fresh water unsuitable for consumption by farm animals;
   e) any significant adverse effects on aquatic life.

8. The consent holder shall ensure that except when discharging, windrows shall be covered at all times.

9. Prior to undertaking any alterations to the processes or operations which significantly change the nature or quantity of contaminants emitted from the site, the consent holder shall consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.

10. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality, and to meet the criteria of Tables 4.11, 4.14 & 4.20 of the Ministry for the Environment (1999) document 'Guidelines for Assessing & Managing Petroleum Hydrocarbon Contaminated sites in N.Z.'.

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 2008 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 22 September 2008

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:	Remediation (NZ) Limited P O Box 8045 NEW PLYMOUTH 4342
Consent Granted Date:	12 October 2006

Conditions of Consent

Consent Granted:	To discharge solid hydrocarbon exploration drilling wastes onto land for worm farming operations and to discharge stormwater from worm farming operations onto and into land and into an unnamed tributary of the Waitara River at or about (NZTM) 1706208E-5679875N
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	6 Pennington Road, Waitara
Legal Description:	Lot 1 DP 18170 Blk V Waitara SD
Catchment:	Waitara

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 applications 1560 and 4038. In the case of any contradiction between the documentation submitted in support of applications 1560 and 4038 and the conditions of this consent, the conditions of this consent shall prevail.

2. At all times the consent holder shall adopt the best practicable option, as defined in section 2 of the Act, to prevent or minimise any actual or likely adverse effect on the environment associated with worm farming activities and the discharge of solid hydrocarbon exploration drilling wastes onto land including effects to surface water and groundwater.

3. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, records of the nature and volume of all wastes received at the site; such records to be kept for at least 12 months.

4. The solid drilling cuttings from hydrocarbon exploration shall not exceed a maximum hydrocarbon content of 5.0% total petroleum hydrocarbon prior to mixing or incorporation

5. The exercise of this consent shall not result in any contamination of groundwater or surface water, other than as provided for in special conditions 7 and 8 of this consent.

6. The stormwater treatment system shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.

7. The following concentrations shall not be exceeded within the discharge effluent:

Component	**Concentration**
pH (range)	6.5-8.5
suspended solids	100 gm^{-3}
total recoverable hydrocarbons [infrared spectroscopic technique]	15 gm^{-3}

This condition shall apply prior to the entry of the stormwater into the receiving waters of the unnamed tributary, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

8. After allowing for reasonable mixing within a mixing zone extending downstream of the discharge point to the Pennington Road culvert the discharge shall not give rise to any of the following effects in the receiving waters of the unnamed tributary:

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

9. That prior to undertaking any alterations to the processes or operations which significantly change the nature or quantity of contaminants emitted from the site, the consent holder shall consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.

10. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality, and to meet the criteria of Tables 4.11, 4.14 & 4.20 of the Ministry for the Environment (1999) document 'Guidelines for Assessing & Managing Petroleum Hydrocarbon Contaminated sites in N.Z.'.

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 2009 and/or June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 22 September 2008

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Land Use Consent

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

Name of Consent Holder:	Remediation (NZ) Limited PO Box 8045 New Plymouth 4342
Decision Date:	01 September 2015
Commencement Date:	01 September 2015

Conditions of Consent

Consent Granted:	To use a twin culvert in the Haehanga Stream for vehicle access purposes
Expiry Date:	01 June 2033
Review Date(s):	June 2021 and June 2027
Site Location:	1460 Mokau Road, Uruti
Legal Description:	Sec 34 Pt Sec 4 Blk II Upper Waitara (site of structure)
Grid Reference (NZTM)	1731706E - 5685779N
Catchment:	Mimi
Tributary:	Haehanga

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 ensure that the stream bed downstream from the structure is built up with appropriate material before 31 March 2016 to allow for fish passage and from this date forward the structure shall not prevent the passage of fish.

2. The consent holder shall maintain the structure so that:

   (a) it does not become blocked and at all times allows the free flow of water through it;
   (b) any erosion, scour or instability of the stream bed or banks is remedied by the consent holder.

3. 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 2021 and/or June 2027, 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 01 September 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Land Use Consent

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

Name of Consent Holder:	Remediation (NZ) Limited P O Box 8045 NEW PLYMOUTH 4342
Consent Granted Date:	26 September 2003

Conditions of Consent

Consent Granted:	To realign and divert the Haehanga Stream in the Mimi catchment for land improvement purposes at or about (NZTM) 1732402E-5684777N
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	1460 Mokau Road, Uruti
Legal Description:	Pt Sec 4 Blk II Upper Waitara SD
Catchment:	Mimi
Tributary:	Haehanga

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

General conditions

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

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

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

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

Special conditions

1. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to and upon completion of any subsequent maintenance works that would involve disturbance of or deposition to the riverbed or discharges to water.

2. The realignment authorised by this consent shall be undertaken generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.

3. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to avoid or minimise erosion and scouring as a result of channel realignment.

4. 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.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.

6. 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 2009 and/or June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 22 September 2008

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Land Use Consent

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

Name of Consent Holder:	Remediation (NZ) Limited P O Box 8045 NEW PLYMOUTH 4342
Consent Granted Date:	26 September 2003

Conditions of Consent

Consent Granted:	To erect, place, use and maintain a culvert and associated structure[s] in the bed of the Haehanga Stream in the Mimi catchment for access purposes at or about (NZTM) 1732402E-5684777N
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	1460 Mokau Road, Uruti
Legal Description:	Pt Sec 4 Blk II Upper Waitara SD
Catchment:	Mimi
Tributary:	Haehanga

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

General conditions

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

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

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

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

Special conditions

1. The consent holder shall notify the Taranaki Regional Council in writing at least 48 hours prior to the commencement and upon completion of removal of the temporary culvert [being the 800mm diameter culvert] and installation of the permanent culvert and associated structures, and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.

2. The consent holder shall replace the existing temporary culvert with a permanent culvert and associated structure[s] by 1 April 2004. Prior to the installation of the permanent culvert and associated structure[s] the consent holder shall forward designs of the proposed culvert and associated structure[s] for the written approval of the Chief Executive.

3. The structures authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.

4. The consent holder shall adopt the best practicable option to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.

6. The structures, which are the subject of this consent, shall not obstruct fish passage.

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 structures removal and reinstatement.

8. 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 2009 and/or June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 22 September 2008

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:	Remediation New Zealand 107 Corbett Road Bell Block 4373
Decision Date:	09 March 2015
Commencement Date:	09 March 2015

Conditions of Consent

Consent Granted:	To discharge treated stormwater from a quarry site, into an unnamed tributary of the Haehanga Stream
Expiry Date:	01 June 2033
Review Date(s):	June 2021 and/or June 2027
Site Location:	1460 Mokau Road, Uruti
Legal Description:	Sec 34 Pt Sec 4 Blk II Upper Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1732059E-5684796N
Catchment:	Mimi
Tributary:	Haehanga

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. This consent authorises the discharge of treated stormwater into an unnamed tributary of the Haehanga Stream, as described in the information provided with the application, and specifically:

    a) The Assessment of Environmental Effects prepared by BTW Company Limited dated 9 January 2015; and
    b) Additional Information prepared by BTW Company Limited dated 16 February 2015.

    In the case of any contradiction between the details of information provided 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 48 hours prior to the exercise of this consent (including vegetation removal). Notification shall include:

    a) the consent number;
    b) a brief description of the activity consented; and
    c) the extent or stage of the activity to be commenced.

    Notification shall be emailed to worknotification@trc.govt.nz.

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

4. The consent holder shall operate and progressively reinstate the quarry site in a manner which ensures that the area of exposed, un-vegetated earth, within the quarry's stormwater catchment is kept to a minimum at all times.

5. The consent holder shall ensure that no area greater than 1 ha is exposed at any one time.

6. The stormwater discharged shall be from a catchment area not exceeding 4 ha.

7. This stormwater treatment system shall be installed before any site works commences.

8. The stormwater treatment system shall be maintained for the life of the quarry operation.

9. All stormwater shall be directed for treatment through the stormwater treatment system prior to discharge into the Haehanga Stream tributary.

10. Constituents of the discharge shall meet the standards shown in the following table.

Constituent	Standard
pH	Within the range 6.0 to 9.0
suspended solids	Concentration not greater than 100 gm^{-3}
total hydrocarbons	Concentration not greater than 15 gm^{-3}

This condition shall apply before entry of the treated stormwater into the receiving waters at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

11. The pH may exceed 9.0 if the exceedance is a result photosynthetic activity within the detention ponds, but in any case the discharge shall not result in the pH of the receiving water increasing by more than 0.5 pH units after allowing for a mixing zone of 25 metres.

12. After allowing for reasonable mixing, within a mixing zone extending 500 metres downstream of any discharge point, the discharge 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 fresh water unsuitable for consumption by farm animals;
    e) any significant adverse effects on aquatic life.

13. After allowing for reasonable mixing, within a mixing zone extending 500 metres downstream of any discharge point, the discharge shall not give rise to any of the following effects in the receiving waters:

    a) an increase in the suspended solids concentration within the unnamed tributary of the Haehanga Stream in excess of 10 grams per cubic metres when the turbidity as measured immediately upstream of the discharge point is equal to or less than 5 NTU (nephelometric turbidity units); or

    b) an increase in the turbidity within the unnamed tributary of the Haehanga Stream of more than 50%, where the stream turbidity measured upstream if the discharge is greater than 5 NTU, as determined using NTU (nephelometric turbidity units).

14. The consent holder shall maintain and regularly update a 'Contingency Plan' that details measures and procedures that will be undertaken to prevent, and to avoid environmental effects from, a spillage or any discharge of contaminants not authorised by this consent. The plan shall be approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity.

15. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site is to be managed to minimise the contaminants that become entrained in the stormwater and shall include as minimum:

    a) the loading and unloading of materials;
    b) maintenance of conveyance systems;
    c) general housekeeping; and
    d) management of the interceptor system.

    A Stormwater Management Plan template is available in the Environment section of the Taranaki Regional Council's web site www.trc.govt.nz.

16. The consent holder shall notify the Chief Executive, Taranaki Regional Council, prior to making any changes to the processes or operations undertaken at the site, or the chemicals used or stored on site that could alter the nature of the discharge. Any such change shall then only occur following receipt of any necessary approval under the Resource Management Act. Notification shall include the consent number, a brief description of the activity consented and an assessment of the environmental effects of any changes, and be emailed to consents@trc.govt.nz.

17. 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.

18. 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 2021 and/or June 2027, 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 09 March 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

Appendix II

Biomonitoring reports

To	Nathan Crook, Scientific Officer
From	Bart Jansma, Scientific Officer
Report No	BJ301
Document	1924640
Date	1 September 2017

Fish Survey of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2016

Introduction

Remediation (NZ) Ltd operates a composting facility in the Haehanga Valley, Uruti (previously owned by Perry Environmental Ltd who was preceded by Global Vermiculture Ltd). Raw materials are trucked to the site for composting, on a purpose built composting pad for a period of 35-40 days. Synthetic hydrocarbon contaminated drilling muds and cuttings are also received on site. They are piled up and the liquids are allowed to drain, then blended with green waste and other organic matter. Composted material is transported off site by trucks to Remediation (NZ) Ltd's worm farming operations at Waitara Road and Pennington Road.

This survey is the fourth fish survey undertaken in the Haehanga Stream, in relation to this site. It was included for the first time in the 13-14 monitoring period as a replacement for the late summer macroinvertebrate programme, as flow rates have been slowly reducing over time, inhibiting macroinvertebrate sample collection. On this occasion, the fish survey was undertaken concurrent with the spring/early summer macroinvertebrate survey. Results from previous surveys are detailed in the references.

Fish surveys are useful long-term indicators of ecosystem health, as most fish live longer than a year, and as such may reflect chronic impacts from the composting site, should there be any. The first few surveys will provide results, which can be compared to those from subsequent surveys. This will allow the fish community to be assessed at that point in time, and over time it will also allow an assessment of any change in community health. Fish communities can be influenced by operations at the composting site, principally related to the discharge of wastewater from the site (and the quality thereof), but also by changes in instream habitat. The banks of the Haehanga Stream are highly unstable and support little in the way of riparian vegetation (with the exception of rank grass). As a result, there is significant bank slumping in areas. Should the stream be fenced and planted in a way that adequately protects the banks and stream channel, it is likely that the fish community would improve.

Methods

In this survey, three sites were surveyed in the Haehanga Stream. Site 1 was located upstream of all composting and waste disposal activities, site 2 was located immediately downstream of the lower irrigation area, while site 3 was located just upstream of State Highway 3. Details of the sites surveyed are given in Table 1 and the locations of the sites surveyed in relation to the site are shown in Figure 1.

The fish populations were sampled using fyke nets (Photo 1) and gee minnow traps. At each site, five gee minnow traps were set, and baited with Marmite. They were set overnight, among macrophytes or alongside woody debris. Two fyke nets were also set at each site, a standard mesh (25mm) net and a fine mesh (13mm). The standard mesh was set downstream, in attempt to intercept any large eels moving up from downstream. Both fyke nets were baited with fish food pellets. These nets were also set overnight. All fish caught were identified, counted and measured, and any eels longer than 300mm were weighed, using electronic scales that measured to the nearest 20 grams. All nets and traps were deployed on the afternoon of 14 December 2016, and retrieved midmorning on 15 December 2016.

In addition the nets and traps set in the Haehanga Stream, two gee minnow traps were also set in the unnamed tributary, upstream of the wetland discharge. This is the first time this tributary was surveyed, and was done to gain some understanding of what may inhabit this area of the catchment.

Table 1 Sampling sites surveyed in the Haehanga Stream in relation to the Remediation NZ composting operations

Site	Site code	Location
1	HHG000093	Upstream of all composting and waste water irrigation areas
2	HHG000150	30 meters downstream of Remediation NZ irrigation area
3	HHG000190	50 metres upstream of State Highway 3 bridge

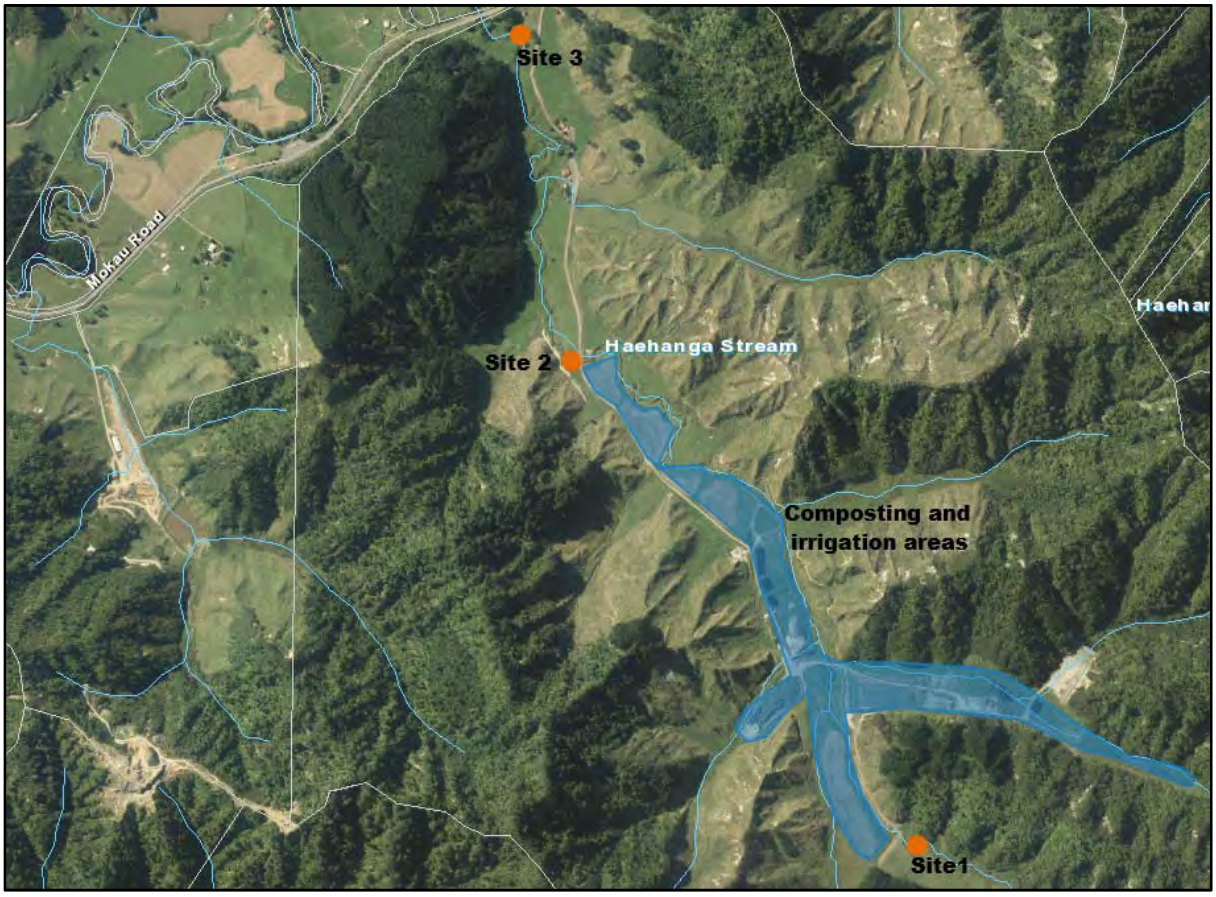


Figure 1 Location of the three sampling sites in relation to composting and waste water irrigation areas.

Photo 1 A fyke net, set at site 2, Haehanga Stream.

Results and Discussion

On the day that the nets were set, a localised rain event caused flows to increase in the Haehanga Stream. This also resulted in the discharge of sediment-contaminated stormwater into the Haehanga Stream, resulting in discolouration. Although discolouration is frequently noted in this catchment, the degree of discolouration at sites 2 and 3 was particularly severe, where it was described as brown and dirty. However, at site 1 (upstream of the site), which had only slightly elevated flows, there was no obvious discolouration. The change in water clarity is shown in Photo 2. All sites contained moderate fish habitat, with deep pools, and macrophyte beds, although site 2 only had macrophytes on the edge. The substrate of the surveyed pools comprised primarily of thick silt, with some large logs present at site 3. All sites had at least some undercut banks, but there was no overhanging vegetation at any site, other than long grass.

Water temperatures recorded during the macroinvertebrate survey, conducted on the same day, ranged from 15.3 to 17.2 ˚C. It should be noted that water temperatures have been recorded as high as 28.3˚C in this stream, well above the thermal preference, and near to the maximum thermal tolerance of a number of native fish species (Richardson, Boubee and West, 1994)), but the rain event that preceded the current survey resulted in much lower temperatures.

The previous (December 2015) survey observed seven dead eels at, and downstream of site 2. In addition, a macroinvertebrate sample collected upstream of site 2 on the same day smelt of hydrocarbons, and that there was a hydrocarbon sheen noted on the surface. This follows on from the observations made during the December 2014, when hydrocarbons were released from the sediment at site 3. No such observations were made during the current survey.

It is worth noting that the macroinvertebrate survey undertaken on the first day of the fish survey found that macroinvertebrate communities of seven mainstem sites and two unnamed tributary sites were of average to above average health, with significant recovery noted downstream of the site and irrigation area.

The full results of the fish survey are shown in Table 2.

Photo 2 Water clarity at site 1 (top) and at the culvert near the composting pads (bottom). Photos taken about 30 minutes apart.

Table 2 Results of the current fish survey and a summary of previous surveys undertaken in the Haehanga Stream in relation to Remediation NZ's composting operations.

Site:		Site 1			Site 2			Site 3			Unnamed Tributary
Net/Trap type:		Previous results (3 surveys)	Fyke net	Gee minnow trap	Previous results (3 surveys)	Fyke net	Gee minnow trap	Previous results (3 surveys)	Fyke net	Gee minnow trap	Gee minnow trap
Number of minutes fished:			**2550**	**6375**		**2220**	**5550**		**1980**	**4950**	**2250**
Longfin eel (*Anguilla dieffenbachii*)	Number	3-4	7	-	1-12	17	-	1-2	8	-	-
	Length range (mm)	478-1045	490-840	-	365-802	530-1050	-	431-870	565-930	-	-
	Weight range (kg)	0.24-3.31	0.39-1.91	-	0.10-1.04	0.5-3.425	-	0.18-2.61	0.48-2.17	-	-
Shortfin eel (*Anguilla australis*)	Number	0-1	1	-	4-17	1	-	2-3	2	-	-
	Length range (mm)	195	600	-	196-850	700	-	510-790	690-780	-	-
	Weight range (kg)	-	0.44	-	0.02-0.98	0.85	-	0.26-1.57	1.05-1.33	-	-
Inanga (*Galaxias maculatus*)	Number	-	-	-	1-11	1	-	0-6	-	-	-
	Length range (mm)	-	-	-	86-123	112	-	-	-	-	-
Redfin bully (*Gobiomorphus huttoni)*	Number	-	-	-	-	-	-	0-1	-	-	-
	Length range (mm)	-	-	-	-	-	-	70	-	-	-
Banded Kokopu (*Galaxias fasciatus*)	Number	-	-	-	-	-	-	-	-	-	1
	Length range (mm)	-	-	-	-	-	-	-	-	-	130
Total number of species		**2**	**2**		**3**	**3**		**4**	**2**		**1**
Total number of fish		**-**	**8**		**-**	**19**		**-**	**10**		**1**

Site 1

This site recorded just two species, being longfin and shortfin eel. This is consistent with that recorded in previous surveys. It is likely that this is related in part to the reduced flow that can occur at this site, resulting in reduced habitat. Previous surveys have recorded little to know flow at this site, although this was not the case during the current survey. Fish passage may also be influencing the number of species present at this site, as the barriers to fish passage observed downstream may have prevented fish migrating upstream to this site. This has serious implications for inanga, as this species is a short-lived species, and migrates downstream annually to spawn, with juveniles migrating upstream during the whitebait season.

Overall, eight fish were recorded at this site, which is an increase on that recorded previously. This is likely a reflection of the higher flows carrying the bait odour further downstream, attracting more fish into the nets.

This site is intended as a control site with which to compare the downstream results. Due to the lack of fish passage, it cannot be considered a true control site. In addition, if a culvert does not provide for the passage of fish, it is non-compliant and must be remediated. Some remedial works have been undertaken since the previous survey was completed. However, further remedial work is requited, so it is once again recommended that the site operator is made aware of these barriers to fish passage, which are discussed in more detail below, and required to take steps to remediate them.

Site 2

This site, located immediately downstream of the lowest irrigation area, contained the highest species richness (3) and the highest abundance (19) of the three sites surveyed. A single inanga was recorded at this site, with this species recorded in three of the four surveys completed. Natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. That only one inanga was recorded (compared with a maximum of eleven in 2014) is not necessarily cause for concern, as there may have been predation within the nets, especially with the number of large eels caught also.

Eighteen eels were captured, of which seventeen were longfin eels, one being relatively large at 1050mm and 3.425kg and two were shortfin eels. This is similar to the number of eels recorded in the previous survey, which recorded sixteen eels. However, there was a clear difference in size class distribution in the current survey, with the results dominated by larger (>700mm) eels, while earlier surveys were dominated by eels smaller than 700mm (Figure 2). Although the nets included a means of shelter for the smaller eels, including either a tube shelter and/or an eel excluder, the number of large longfins captured increased the risk of predation. Three eels were observed to have eaten relatively large eels, as the consumed eel was discernible when handling and viewing the consuming eel (Photo 3). It is likely smaller eels were also consumed, but they were not discernible in the large eels stomach. Therefore, it is likely to the number of eels recorded at site 2 was an under-representation of the actual number of eels captured.

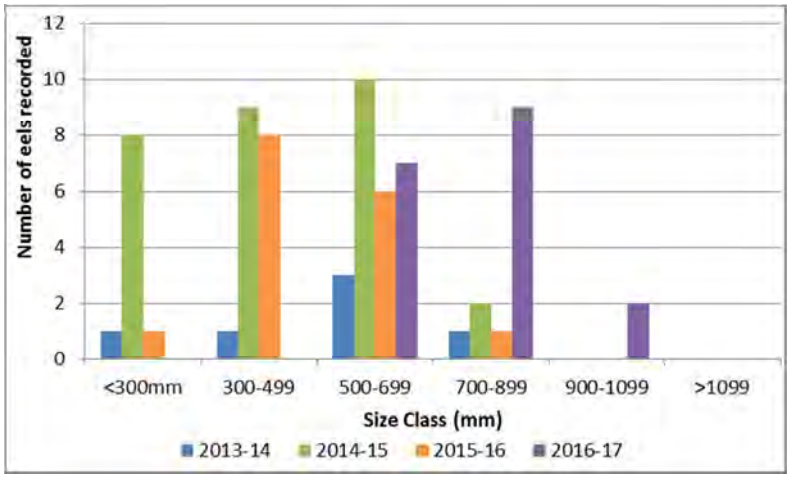


Figure 2 Size class distribution of all eels recorded at site 2 over the four surveys completed to date

Photo 3 A large longfin eel recorded at site 2, with a consumed eel evident through the deformation of the eel's underside.

It may also be that shortfin eels were the species predated upon by the large longfin eels, and this would explain the reduction in shortfin eel numbers at this site. Longfin eel have been observed to predate upon shortfin eels when in aquariums (pers. obs.). Unlike in the previous survey, no dead eels were observed around this site.

It is apparent that site 2 still had a much higher abundance than that recorded upstream at site 1. This suggests that the access culvert immediately upstream of this site may still be posing a barrier to fish passage (Photo 4). Some remedial works had been undertaken, with gravel being used to build up the bed level at the outlet of the first pool downstream of the culvert. While this is an appropriate approach, as it will lift the water level and resolve the perched nature of the culverts, the material used was too fine and had already begun scouring away (Photo 5). During the current survey, the culverts were not perched, although this may have been partly because flows were high.

Photo 4 The access culvert immediately upstream of site 2, December 2015 (left) and December 2016 (right).

Photo 5
The outlet of the pool, directly below the main track access culverts, showing deposited gravels that are beginning to scour away

Site 3

Located just upstream of State Highway 3, this site provides some perspective, providing an indication as to the extent of influence from the upstream composting activities. This site contained some of the best habitat, with large logs, deep water and undercut banks. These three habitat features are frequently used by nocturnal fish as cover.

Ten fish were recorded at this site, up from the five recorded in the previous survey. Inanga and redfin bully were absent despite being recorded in one or more previous surveys. Eight longfin eels and two shortfin eels were recorded, although there was a lack of small individuals, which seems typical for this site (Table 2). This site recorded the same species richness (two) as site 1, with a similar ratio of longfin to shortfin eels. Again, due to the number of large eels recorded, the possibility that other fish (including inanga) were caught but then predated upon while in the net cannot be discounted. Overall, these results represented improvement from that recorded in the previous survey, a result consistent with the results from the macroinvertebrate survey undertaken on the same day (Jansma, 2017).

Unnamed tributary

This tributary was surveyed for the first time in this survey, although previous macroinvertebrate surveys have incidentally recorded fish, including banded kokopu and longfin eel, with larger unidentified eels observed below the wetland discharge. The two gee-minnow traps were set upstream of the wetland discharge, where there was some deeper water immediately downstream of an access culvert. One banded kokopu was captured (Photo 6), being an individual 130mm in length, likely to be between two and three years old (Hopkins, 1979). Banded kokopu are considered a regionally distinctive species in Taranaki, and as such, their presence in this unnamed tributary shows the significant values such small streams can have.

Due to significant differences in habitat between the sites upstream and downstream of the discharge, it is likely that there is a natural difference between the fish communities at these sites. However, consideration should be given to expanding fish monitoring in this tributary.

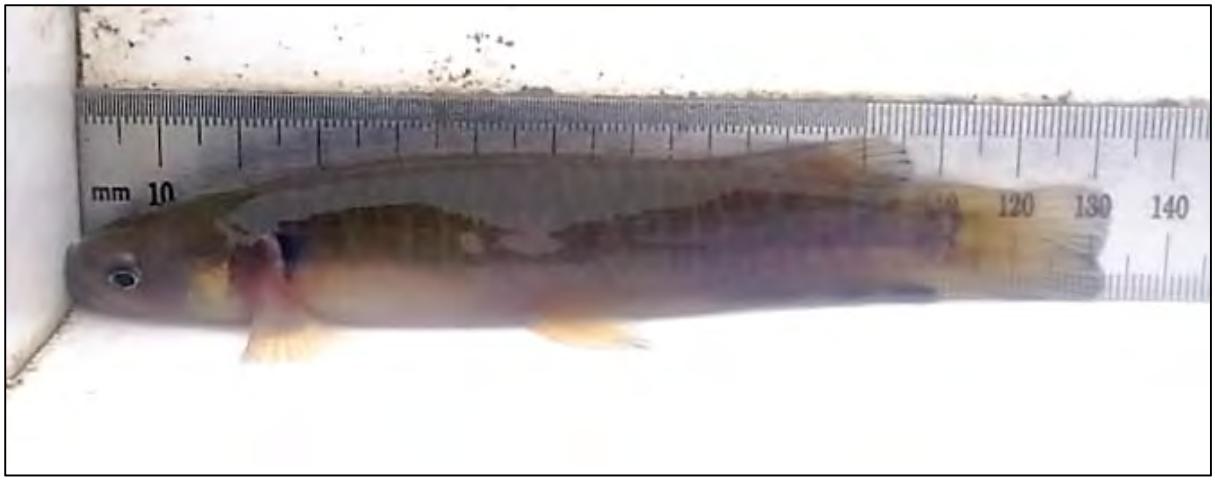


Photo 6 Banded kokopu (*Galaxias fasciatus*) captured in the unnamed tributary upstream of the wetland discharge.

Size class distribution

Assessing the size class distribution of fish populations can provide a useful perspective on fish recruitment, and the long-term health of the community. For example, if recruitment were restricted, then there would be a lack of young fish. However, it can be influenced by other activities such as people feeding eels, or commercial eeling operations. It is therefore recommended that no such activities take place on the consent holder's property. It should also be noted that good numbers of fish are needed to support strong conclusions, and therefore only the size class distribution of eels (as opposed to other species) is discussed.

Figure 3 shows that a similar number of eels were recorded in the current survey as in the 2014-15 survey, higher than that recorded in the 2013-14 and 2015-16 surveys. The size class distribution was quite different however. In the first three surveys, the eel community was dominated by fish smaller than 700mm, while in the current survey, the community was dominated by fish larger than 500mm. However, all surveys recorded the most eels in the 500 to 700 mm size class.

This difference in size class distribution can be attributed to the improved flow conditions during the current survey. This higher flow meant that the bait scent was carried further downstream, and can have attracted fish from well downstream. The likelihood that predation occurred in the nets means that it was likely that the current size class distribution was an underrepresentation of smaller eels.

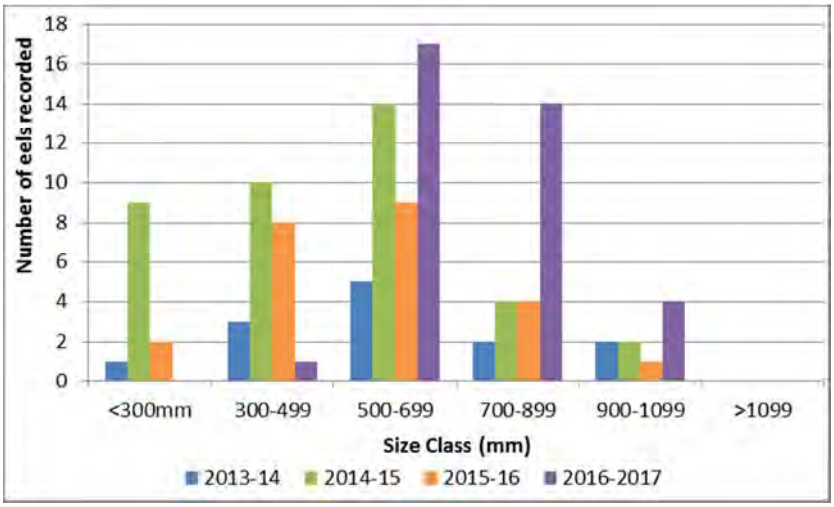


Figure 3 The size class distribution of all eels captured at all sites over the three surveys undertaken to date.

This higher number so large eels is a positive result, as it suggests some recovery from the impacts of commercial eeling, which is understood to have occurred just prior to the 2013-14 survey. However, this recovery will not yet be complete. The community will take some time to recover from the impacts of commercial eeling, as commercial eeling methods (fyke netting) are so efficient that 75% of the eels in a fished area can be caught in a single night. As a result, it can take a decade or more for the eel's population at such a site to recover (PCE, 2013). It should be noted that the sampling methodology is less likely to record eels smaller than 150mm, compared with larger eels.

Fish condition

The composting activities undertaken alongside the Haehanga Stream have the potential to release a range of substances to the stream, including some that have toxic effects on the fauna of the stream. The degree of toxicity can range from acute, resulting in quick death, to chronic, where repeated exposure over time may result in the fauna becoming unwell, and/or leaving the area. Eels captured in this survey were measured and weighed. Using this data it is possible to gauge the physical condition of the fish, which can be a useful indication of fish health. If fish at one site were in poorer condition than others in the same stream, then it would be expected that the sick fish of the same length would be lighter.

Figure 4 shows that most of the longfin eels recorded in the current survey were in better condition than would be expected, with some fish being significantly heavier than would be expected. Shortfin eel showed a similar result, with the two eels captured at site 3 being well in excess of the expected weight, while the individual eels captured at sites 1 and 2 being similar to the expected weight. This is indicates that the eel communities were in better physical condition than would be expected, and this is likely a reflection of the high flows that preceded this survey, and probably predation within the nets. The high flows will have resulted in improved invertebrate habitat in the Haehanga Stream, improving the food supply for these eels. This better than average condition is similar to that that recorded in the previous surveys, but better than that recorded in the 2013-14 and 2014-15 surveys, when no site had fish that differed markedly from that predicted by Jellyman *et al* (2013). The trend lines in Figure 4 used the equation from table 1 for longfin eel and table 3 for shortfin eel found in Jellyman *et al* (2013).

Overall, these fish condition results suggest that fish condition is better in early summer than late summer, including at site 2. This is consistent with higher and cooler flow conditions providing for improved habitat and food supply. The results from site 2 suggest that the eel community was in better health than the previous survey, which recorded eels in poorer condition than would be expected. This suggests that the activities at the composting facility had not affected this community.

In addition to length and weight measurements, each fish was inspected for obvious physical damage or abnormalities. Other than the predation of eels in the nets, there were, no such features were noted.

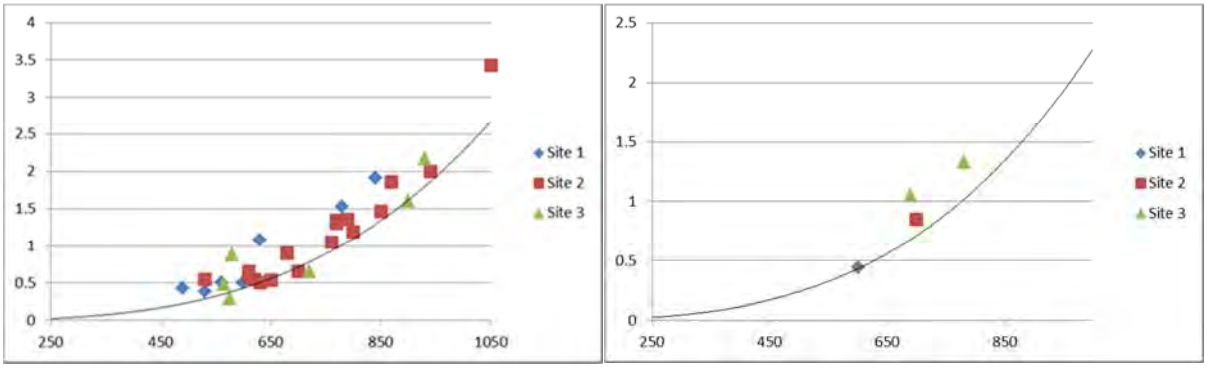


Figure 4 Longfin eel condition (left) and shortfin eel condition (right) in the Haehanga Stream, 14/15 December 2016. Weight (Kg) is on the y-axis, length (mm) on the x-axis. The trend line is the predicted weight, using equations from Jellyman *et al* 2013.

Fish Passage

During this and previous surveys, three access culverts were inspected, and assessed for fish passage. The locations of these culverts are summarised in Table 3. It was noted that one of the three culverts impeded fish passage in some way, with the remaining two culverts providing some passage, but may be a greater impediment to passage during low flows.

Culvert 1, on the Haehanga Stream near the composting pads, had a deep but swift flow (Photo 7), which would inhibit poorer swimmers such as inanga. The outlet of this culvert is usually too steep and water speeds too swift, and only suitable for climbing species. The higher flows during the current survey improved it slightly, but it is likely that passage will deteriorate as flows reduced.

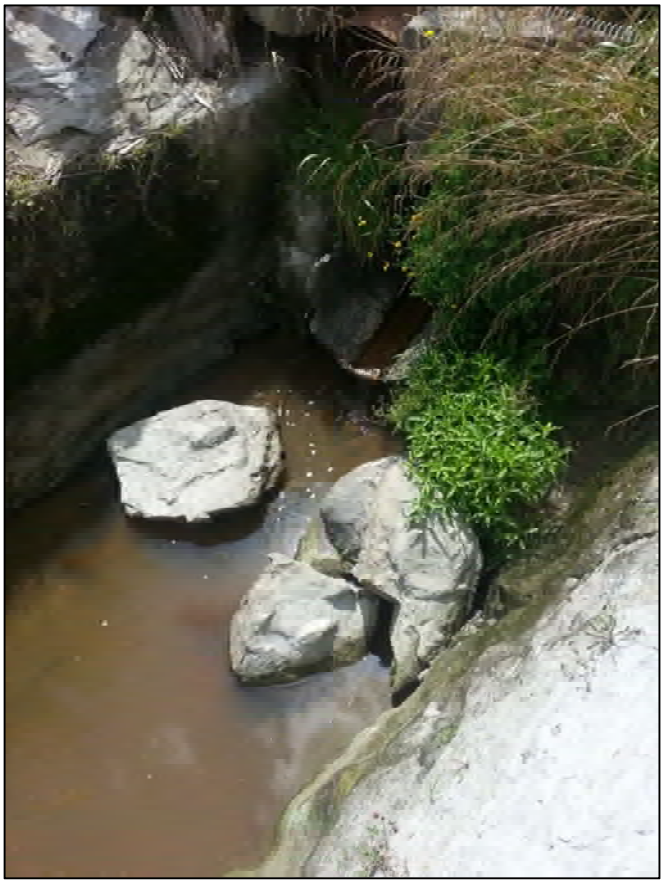
Culvert 2 was perched, and not suitable for swimming species (Photo 7). However, while kokopu and eels have been recorded upstream of this culvert, these species are good climbing species and highly adept at negotiating barriers that swimming species cannot pass. This culvert will still reduce the passage of climbing species, while completely preventing the passage of swimming species. It was noted during the current survey that the lower of the two culverts might have been partially blocked.

Culvert 3, a double culvert under the main access track, had experienced some remedial works since the previous survey, with the bed level built up in an effort to resolve the perched nature of the culvert. During the current survey, neither of the two culverts was perched, due to the remedial works and higher water levels caused by recent rain (Photo 4). It was noted that the remedial works were beginning to scour away, and it is likely that the culverts will again be perched once flows recede (Photo 5). This will need to be assessed during lower flows, with remedial works required should this be confirmed.

Table 3 Culverts assessed for fish passage during the current fish survey

Culvert number	Location	GPS reference
1	Haehanga Stream, near composting pads	1732285-5685087
2	Unnamed tributary, immediately upstream of Haehanga Stream	1732291-5685098
3	Haehanga Stream, at downstream extent of irrigation area	1731707-5685778

Photo 7
Top left: Culvert 1 December 2015
Top Right: Culvert 1 December 2016
Bottom Left: Culvert 2 December 2015
Bottom Right: Culvert 2 December 2016



Summary and conclusions

On 14 and 15 December 2016, three sites were surveyed for freshwater fish in the Haehanga Stream in relation to the composting activities undertaken by Remediation NZ Ltd. Site 1 was located upstream of the site, site 2 located immediately downstream of the lowest extent of the irrigation area, and site 3 was located just upstream of State Highway 3. The survey method involved deploying baited fine and coarse mesh fyke nets and gee minnow traps at each site overnight. This survey also including trapping of the unnamed tributary that receives the wetland discharge, with two gee minnow traps set upstream of the discharge. All nets and traps were recovered the following morning, with all fish identified, counted and measured, with eels greater than 300mm weighed.

Earlier in the day prior to the survey commencing, the Haehanga Stream catchment experienced a rain event. As a result, the Haehanga Stream had a moderate to high flow at all sites. The timing of this survey has been brought forward, in an effort to target periods when stream flow is higher. This follows the initial survey, completed in March 2014, which found that the stream was not flowing at site 1 due to extremely low flows. The higher flows in the current survey will have carried the bait scent further downstream than that which occurred in previous surveys. All sites contained moderate fish habitat, with deep pools, and good cover. It should be noted that water temperatures in this stream may occasionally exceed the thermal preference, and maximum thermal tolerance of a number of native fish species, with a water temperature of 28.3˚C recorded at site 3 during the December 2014 survey. Due to the improved flow conditions, which should have resulted in more flow past the nets and traps, and conceivably more fish captured, fish abundance and number of species recorded were higher than that recorded in the previous survey. Over all sites, twenty-eight fish were recorded across four species. This included the capture of a banded kokopu in the unnamed tributary.

Unlike in the previous survey, which observed seven dead eels at and downstream of site 2, there were no observations made that posed particular concern. There was significant discolouration observed downstream of the wormfarm and quarry access road, but no obvious hydrocarbon contamination of the Haehanga Stream like that recorded in the previous two surveys. The degree of discolouration, although not present upstream, was severe, but was considered primarily an aesthetic effect rather than deleterious to the biological communities. This is because it is likely to be a relatively frequent event, and the biological communities will have adjusted to it.

It is worth noting that the macroinvertebrate survey undertaken on the first day of the fish survey found that macroinvertebrate communities of seven mainstem sites and two unnamed tributary sites were of average to above average health, with significant recovery noted downstream of the site and irrigation area.

The site that would be expected to experience the greatest impacts should there be any is site 2. At this site, three species were recorded, as was the highest abundance (19 fish) of the survey. Inanga were again present after being absent in the previous survey, representing some recovery in the fish communities. Although only one individual inanga was recorded, natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. It should also be noted that there had been predation within the nets, with some eels having clearly ingested another eel. It is very possible that smaller fish such as inanga has also been predated upon, but this was not obvious when handling the eels.

Site 3, further downstream recorded two species, which is equal to that recorded in the previous survey. Inanga were absent, but have been recorded at this site previously.

Eels were recorded at all three sites, with the largest longfin eel being recorded at site 2. This individual was 1050 mm long, and weighed 3.425 kg. The size class distribution of the eels was quite different to that recorded in the previous surveys, with the community dominated by large eels. This is probably a reflection

of improved effectiveness of the bait, resulting in more large eels being captured. This may have also caused increased predation of the smaller eels in the nets, resulting in an under-representation in the smaller size classes. It is likely that the community is still impacted by the commercial eeling that is understood to have occurred just prior to the 2013-14 survey. It is expected it will take over decade for the community to recover from this. The physical condition of the eels showed that most of the eels captured at all three sites were in much better condition than would be expected. This is likely due to the increased flows that preceded this survey resulting in an improved food supply for these eels, with more macroinvertebrate habitat present. This is a good result, especially at site 2, where the eels were more similar to their expected weight during the previous survey. Overall, these fish condition results suggest that fish condition is better in early summer than late summer, as indicated by the results from sites 1 and 3. This is consistent with higher and cooler flow conditions providing for improved habitat and food supply. The results from site 2 suggest that the eel community is in better health than that recorded in the previous survey, which found that the activities at the composting facility had likely negatively affected this community. No observed fish exhibited any obvious physical damage or abnormalities during the current survey.

Three access culverts were assessed for fish passage during this survey, and one was found to present a barrier to fish passage at all flows, while the remaining two culverts were considered likely to restrict fish passage during lower flows. Even in the higher flows of the current survey, it is likely that all culverts severely restricted the passage of swimming species such as inanga. The culvert located immediately above site 2 had experienced some remedial works since the previous survey, but this was already being scoured away. It is likely that this culvert will still be perched during lower flows, and this would preclude the passage of a number of species, included inanga. If this is confirmed, then remedial works will be required. Remedial works are still to be undertaken on the remaining two culverts, which have been identified as a barrier for a number of years.

In summary, the results of the current survey do not indicate that the composting activities and wastewater irrigation undertaken by Remediation NZ Ltd, alongside the Haehanga Stream, have had a deleterious impact on the fish communities of this stream. This is consistent with the findings of the macroinvertebrate survey, completed on the same day. However, the impact on fish passage caused by the three access culverts is likely to have contributed to the reduced species richness at site 1.

The current survey was undertaken in early summer, in an effort to target the higher flows present at this time. It is recommended that this is continued, and that surveys continue on an annual basis. In addition, it is recommended consideration be given to installing continuous water temperature monitoring equipment over the summer months, to improve our understanding of how the water temperature changes in the Haehanga Stream. Finally, it is recommended that the company be reminded of their responsibilities regarding the provision for fish passage.

References

Jansma, B. 2014: Fish survey of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, March 2014. TRC Report BJ232.

Jansma, B. 2015: Fish Survey of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, January 2015. TRC Report BJ254.

Jansma, B. 2017: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2016. TRC Report BJ302.

Jansma, B. 2016: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2016. TRC Report BJ287.

Jellyman, PG, Booker, DJ, Crow, SK, Bonnett, ML & Jellyman, DJ. 2013. Does one size fit all? An evaluation of length-weight relationships for New Zealand's freshwater fish species. *New Zealand Journal of Marine and Freshwater Research* 47: 450-468.

Hopkins, CL. 1979: Age-related growth characteristics of Galaxias fasciatus (Salmoniformes: Galaxiidae). *New Zealand Journal of Marine and Freshwater Research* 13:1,39-46.

McDowall, R.M., 2000: The Reed Field Guide to New Zealand Freshwater Fishes. Reed books, Reed Publishing (New Zealand) Ltd. 224pp.

Parliamentary Commissioner for the Environment, 2013: On a pathway to extinction? An investigation into the status and management of the longfin eel. Wellington, New Zealand.

Richardson, J, Boubee, J.A.T. and West, D.W 1994. Thermal tolerance and preference of some native New Zealand freshwater fish. *New Zealand Journal of Marine and Freshwater Research* 28: 399-407.

To	Nathan Crook, Job Manager
From	Bart Jansma; Scientific Officer
Report No	BJ302286
Document No	1926776
Date	5 August 2017

Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2016

Introduction

Remediation (NZ) Ltd operates a composting facility in the Haehanga Valley, Uruti (previously owned by Perry Environmental Ltd who was preceded by Global Vermiculture Ltd). Raw materials are trucked to the site for composting, on a purpose built composting pad for a period of 35-40 days. Synthetic hydrocarbon contaminated drilling muds and cuttings are also received on site. They are piled up and the liquids are allowed to drain, then blended with green waste and other organic matter. Composted material is transported off site by trucks to Remediation (NZ) Ltd's worm farming operations at Waitara Road and Pennington Road.

This survey was the only survey scheduled for the 2016-2017 monitoring year. At the time of this survey, there were two composting pads. The south-west pad (referred to as composting pad 1 in this report) has been established and operating for some years, and is where the synthetic muds are blended with green waste and other organic matter. A second pad northeast of the original composting pad, which became operational in the summer of 2005, is referred to as composting pad 2.

Both composting pads are bunded, with all surface stormwater and leachate contained and directed to treatment ponds. Water from the settling pond is recycled back to the composting material if and when required to maintain a moist composting environment. The runoff from composting pad 1 is treated in the series of ponds. Between each pond, there is a baffle that skims off any floating hydrocarbons as the leachate passes through. The treated liquid in the final pond, located just upstream of site 5 (HHG000115), is then irrigated to pasture. This irrigation system was installed prior to the November 2005 biological survey.

Prior to February 2008, no discharges of stormwater or leachate directly entered the Haehanga Stream or its tributaries. However, after that date, the site has been permitted to discharge treated stormwater and compost leachate to the unnamed tributary of the Haehanga Stream. This comes from composting pad 2, where leachate is pumped up to the top of a seven-tier wetland, which was constructed in late 2007. Under dry conditions, the wetland water from the bottom pond of the wetland is reticulated back to the upper tier of the wetland. Under high flow conditions the wetland discharges to a tributary of the Haehanga Stream.

In addition to this discharge from the wetland, there is some potential for seepage from the composting pads and irrigation area to enter groundwater, and for stormwater runoff to escape the collection system, and thus gravitate toward the surface watercourses at the site.

A baseline survey of five sites was conducted in October 2002 in relation to the composting operation (Dunning, 2003). At the time of this earlier survey, only composting pad 1 was operational, and sites were established for both the existing and proposed composting pads. Unnamed tributaries of the Haehanga Stream flow adjacent to (and down gradient of) both composting pads and flow into the Haehanga Stream downstream of the composting areas (Figure 1). Since this baseline survey, significant changes have

occurred on site, leading to sampling sites being moved, or sampling at some sites to be discontinued. Any changes to sampling sites made prior to the current survey have been discussed in previous reports, referenced below

The current biological survey was conducted to monitor the effects of discharges from the composting site to the Haehanga Stream and tributaries in relation to composting areas (pads 1 & 2), the irrigation of treated liquid to land, and the discharge of treated stormwater and leachate to the unnamed tributary. During the May 2012 survey an additional site was included (HHG000150), at the downstream extent of the irrigation area. This site is now referred to as site 6, with HHG000112 now referred to as site 5. This constitutes a change, as HHG000112 was previously referred to as site 6.

Methods

Two different sampling techniques were used to collect streambed macroinvertebrates in this survey. The 'vegetation sweep' sampling technique was used at site 1, and the Council's standard 'streambed kick' sampling technique was used at sites 2, 6 and T2. A combination of the 'streambed kick' and 'vegetation sweep' sampling techniques was used at sites T3, 5 and 7 (Table 1). The 'streambed kick' 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).

Two of the sites surveyed were previously established in the baseline survey (sites 1 and 2) (Dunning, 2003). Site T2 and T3 were sampled for the ninth time during the current survey, while site 5 has been sampled since January 2005 and site 7 since February 2007. Site 6 was sampled for the sixth time in the current survey.

Table 1 Biomonitoring sites in the Haehanga Stream catchment

Site	Site Code	Location	Sampling Method
1	HHG000093	Upstream of extended irrigation area	Vegetation sweep
2	HHG000100	Downstream of extended irrigation area	Streambed Kick
T2	HHG000098	Upstream of wetland discharge point	Streambed Kick
T3	HHG000103	Downstream of wetland discharge point	Kick-sweep
5	HHG000115	25 m downstream of last pond and swale collection area	Kick-sweep
6	HHG000150	30 m downstream of lower irrigation area	Streambed Kick
7	HHG000190	50 metres upstream of State Highway 3 bridge	Kick-sweep

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

Macroinvertebrate taxa found in each sample were recorded as:

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

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams (MCI). Recently, a similar scoring system has been developed for macroinvertebrate taxa found in soft bottomed streams (Stark and Maxted, 2004, 2007) (SBMCI). The SBMCI has been used in a number of biomonitoring reports since its inception, and results to date suggest that it is not as effective at assessing the impacts of organic pollution as the MCI. For example, results from the February 2008 Mangati survey found a relatively unchanged SBMCI score at a site that had thick growths of sewage fungus (Jansma, 2008c). Therefore, this index is considered less appropriate for the assessment of macroinvertebrate communities possibly affected by industrial discharges. Any subsequent reference to MCI refers to the MCI.

Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1 and 0.1 in hard bottomed and soft bottomed streams respectively. The sensitivity scores for certain taxa found in hard bottomed streams have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. Communities that are more 'sensitive' inhabit less polluted waterways.

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

HHG000190 ~1900m DS

HHG000150 ~ 675m DS

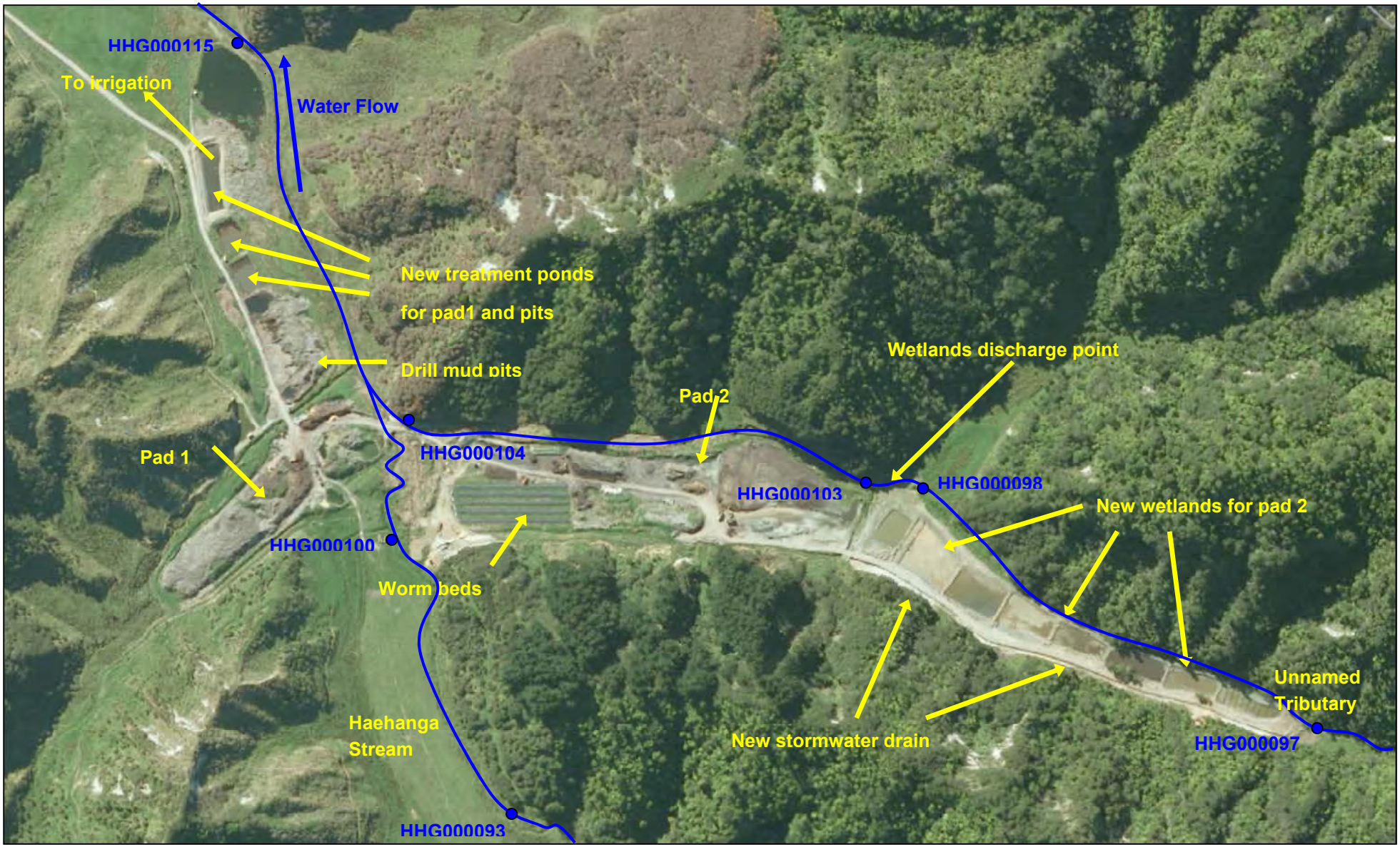


Figure 1 Location of biomonitoring sites in the Haehanga Stream catchment

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 masses of these organisms is an indicator of organic enrichment within a stream.

Results and Discussion

During the present survey, water temperatures in the Haehanga Stream catchment ranged from 15.5°C to 17.2°C. It should be noted that the January 2015 survey recorded a temperature of 28.3°C, which is outside the upper thermal tolerances of some macroinvertebrate taxa, including some occasionally recorded in the Haehanga Stream catchment (Quinn et al, 1994)). The current survey was undertaken earlier in the year, in an effort to survey at a time of higher flow in the Haehanga Stream. Due to a rain event in the area shortly before the survey commenced, flows in the Haehanga Stream were quite high. This also resulted in the discharge of sediment-contaminated stormwater into the Haehanga Stream, resulting in discolouration. Although the Haehanga Stream is frequently observed to be cloudy, with associated yellow to brown discolouration, the degree of discolouration at sites 2, 5, 6 and 7 was particularly severe, where it was described as brown and dirty. However, at site 1 (upstream of the site), which had only slightly elevated flows, there was no obvious discolouration. The flow in the unnamed tributary was described as brown and cloudy.

Usually the cloudiness and discolouration is primarily caused through tannins and suspended solids entering via groundwater and tributary inflows, rather than a point source discharge from the wormfarm. However, at times tannins are also provided through the wetland discharge, which can also result in some discolouration. During the current survey, a moderate discharge, estimated at approximately 1 l/sec was leaving the wetland. This discharge was not recorded in the discharge log kept by the consent holder, with this log indicating that no discharge had occurred since 9 December 2016.

With the exception of site 1, the substrate at all sites was generally a mix of silt, sand and gravels, with some wood. The streambed at site 1 was covered in macrophytes, with an underlying bed of silt. All mainstem sites supported aquatic vegetation, with such growth observed at the edges of the stream at sites 2, 5, 6 and 7, and throughout the stream at site 1. Only site T3 in the tributary supported aquatic vegetation, with small beds growing on the streambed, some of which were sampled. Site T2 did not support any aquatic vegetation. Due to the discolouration it was difficult to discern the degree of algal growth present, with thin films recorded at all sites, and site 1 also supporting patchy growths of filaments.

No undesirable heterotrophic growths were recorded at any of the seven sites in this survey.

Unlike the previous (December 2015) survey, which noted dead eels on the stream bed and the January 2015 survey, which observed hydrocarbons being released from the streambed at site 7, no concerning observations were made while completing the current survey.

Macroinvertebrate communities

A moderate number of macroinvertebrate surveys have been conducted at these sites. Monitoring has been conducted in other small lowland hill country streams in Taranaki surveyed at similar altitudes (TRC, 1999 (statistics updated 2016)) and these have been compared with the current results in Table 2. Table 2 gives summary statistics for the sites, while Table 3 provides a complete taxa list for the current survey.

Table 2 Number of taxa, MCI and $SQMCI_s$ values recorded in the Haehanga Stream catchment together with a summary of results from control sites in other small lowland hill country streams (LOWL) between 25-49 MASL, in Taranaki (TRC, 1999) (Updated to October 2016).

Site	Number of previous surveys	Numbers of taxa			MCI values			SQMCIs values		
		Median	Range	Current	Median	Range	Current	Median	Range	Current
LOWL*	23	22	17-30	-	80	68-109	-	4.0	2.7-6.2	-
1	12	22	17-27	17	71	68-78	69	3.6	2.7-4.2	3.9
2	20	19	17-23	17	74	62-99	99	4.0	2.7-4.4	4.3
5	19	19	6-28	26	73	53-83	88	2.8	1.1-4.1	3.2
6	6	20	6-24	16	72	60-79	88	2.9	1.0-3.1	2.6
7	15	20	12-30	21	70	59-82	78	3.2	1.3-4.3	3.5
T2	9	23	20-30	18	86	79-94	104	5.1	4.6-6.2	7.2
T3	9	27	24-32	23	83	78-93	90	4.4	3.5-5.4	5.3

*$SQMCI_s$ median and range based on only 22

The current survey results for the Haehanga mainstem are also presented in Figure 2 and Figure 3, with these figures providing a catchment perspective.

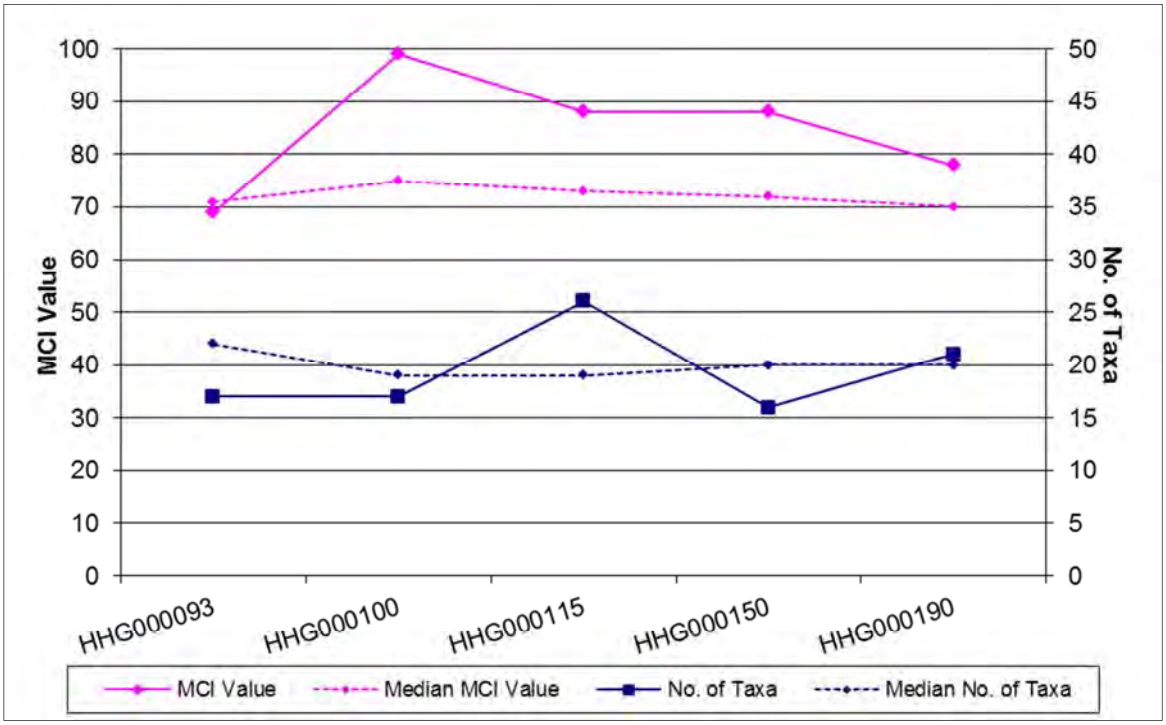


Figure 2 Number of taxa and MCI scores recorded at each Haehanga Stream sites during the current survey, compared with the respective medians for these sites.

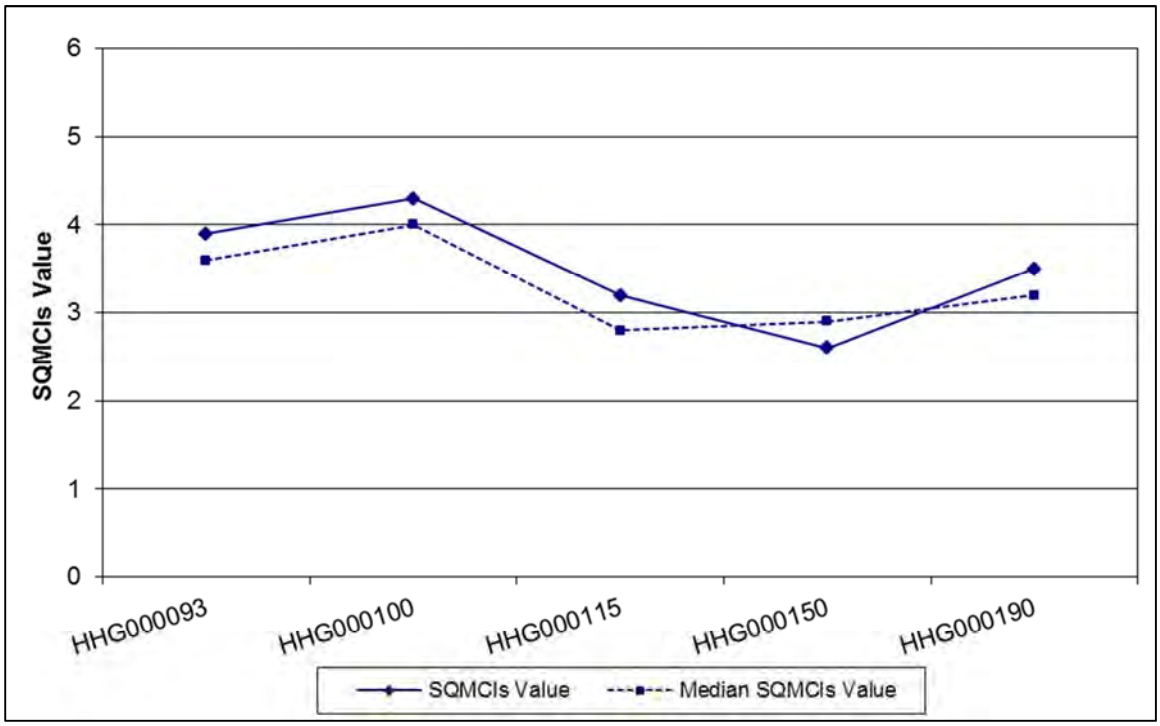


Figure 3 SQMCI$_S$ scores recorded at each Haehanga Stream sites during the current survey, compared with the respective medians for these sites.

Site 1 – Upstream of expanded irrigation area

This site, sampled intermittently since 2002, was re-introduced to the monitoring programme in 2010, prior to the irrigation of wastewater onto land between sites 1 and 2. Irrigation on this land has since occurred, consequently site 1 becomes the upstream control site, and site 2 becomes an impact site.

A relatively low taxa richness was recorded at this site (17), which was five taxa less than the median, and the lowest richness recorded at this site to date, equal to that recorded in the previous survey. This is quite a drop (ten taxa) from the summer 2014 survey, which recorded the highest richness for this site to date (Figure 4), and may reflect the earlier timing of the last two surveys. This survey was undertaken only thirteen days after the last fresh in this stream, and preceding flow conditions may have flushed out a number of taxa from this stream.

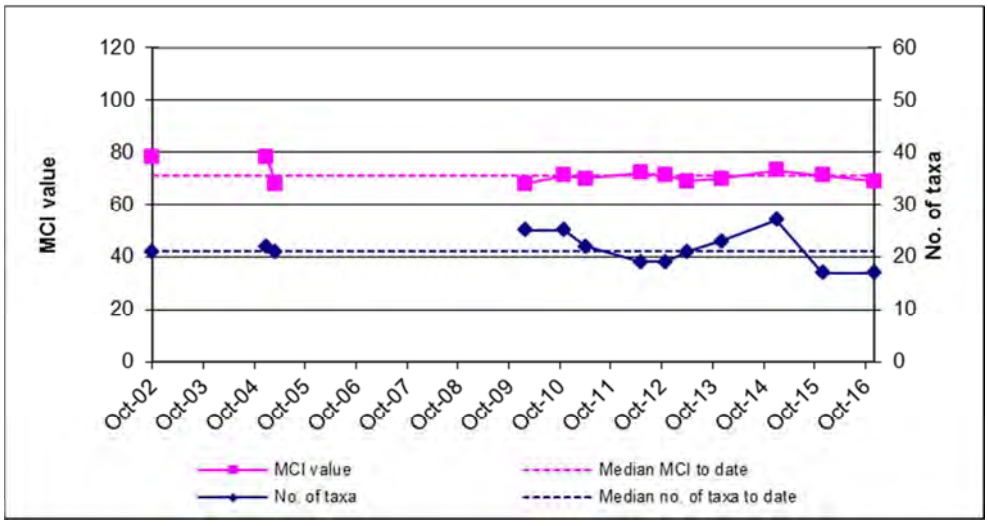


Figure 4 Taxa numbers and MCI recorded to date at site 1

Table 3 Macroinvertebrate fauna of the Haehanga Stream catchment, sampled in relation to Remediation (NZ) Ltd on 14 December 2016.

Taxa List	Site Number	MCI score	1	2	5	6	7	T2	T3
	Site Code HHG000:		093	100	115	150	190	098	103
	Sample Number FWB16:		294	295	296	297	298	299	300
ANNELIDA	Oligochaeta	1	R	A	VA	XA	VA	C	A
	Lumbricidae	5	-	C	R	C	R	C	C
HIRUDINEA	Hirudinea	3	C	-	-	-	R	-	-
MOLLUSCA	*Gyraulus*	3	-	-	-	-	R	-	-
	Physa	3	C	R	R	R	C	-	R
	Potamopyrgus	4	XA	VA	VA	VA	XA	A	VA
CRUSTACEA	Ostracoda	1	A	-	R	-	A	-	R
	Paracalliope	5	A	VA	C	R	-	VA	VA
	Paraleptamphopidae	5	-	-	-	-	-	R	-
	Talitridae	5	-	-	-	-	-	-	R
EPHEMEROPTERA	*Austroclima*	7	-	R	R	-	-	-	-
	Deleatidium	8	-	C	A	VA	C	XA	VA
	Zephlebia group	7	R	C	R	-	R	A	A
PLECOPTERA	*Acroperla*	5	-	R	-	R	-	R	C
	Austroperla	9	-	R	-	-	-	R	-
ODONATA	*Xanthocnemis*	4	A	-	C	-	C	-	-
	Aeshna	5	R	-	-	-	-	-	-
	Hemicordulia	5	R	-	-	-	-	-	-
HEMIPTERA	*Anisops*	5	-	-	-	-	C	-	R
	Sigara	3	-	-	-	-	A	-	-
COLEOPTERA	Elmidae	6	-	-	R	R	-	-	-
	Dytiscidae	5	-	-	R	-	R	-	R
	Hydrophilidae	5	-	-	-	R	-	-	-
	Ptilodactylidae	8	-	-	-	-	-	R	R
TRICHOPTERA	*Hydrobiosis*	5	-	R	R	A	R	C	C
	Polyplectropus	6	-	-	R	-	-	-	-
	Psilochorema	6	-	-	R	R	C	R	C
	Oxyethira	2	C	-	-	R	-	-	-
	Paroxyethira	2	R	-	-	-	-	-	-
	Triplectides	5	R	-	C	-	C	-	R
LEPIDOPTERA	*Hygraula*	4	R	-	-	-	-	-	-
DIPTERA	*Aphrophila*	5	-	-	-	R	-	-	-
	Eriopterini	5	-	R	R	-	-	R	-
	Paralimnophila	6	-	C	R	C	-	R	C
	Zelandotipula	6	-	R	-	-	-	R	-
	Chironomus	1	-	-	R	R	R	-	R
	Orthocladiinae	2	R	R	C	-	C	C	-
	Polypedilum	3	-	R	R	-	C	-	C
	Tanypodinae	5	-	-	R	-	-	-	R
	Culicidae	3	-	-	R	-	-	-	-
	Dolichopodidae	3	-	-	R	-	-	-	-
	Paradixa	4	-	-	-	-	R	R	R
	Empididae	3	R	-	-	-	-	-	R
	Austrosimulium	3	R	A	-	R	-	C	A
	Tanyderidae	4	-	-	R	-	R	-	-
ACARINA	Acarina	5	-	-	R	-	-	-	-
		No of taxa	17	17	26	16	21	18	23
		MCI	69	99	88	88	78	104	90
		SQMCIs	3.9	4.3	3.2	2.6	3.5	7.2	5.3
		EPT (taxa)	2	6	7	4	5	6	6
		%EPT (taxa)	12	35	27	25	24	33	26

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

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

The community comprised a relatively high proportion of tolerant taxa (71%) which resulted in a 'poor' MCI score of 69 units. This is only one unit higher than the minimum score recorded previously at this site and two units less than the median score (Table 2, Figure 4). Although this is a 'poor' score (TRC, 2015), it is a reflection of the low and slow flows and vegetation habitat sampled, and is consistent with that recorded at this site in recent years. This score is significantly less than the median MCI score for other similar lowland streams (Stark, 1998), indicating that the invertebrate community site is in poorer health than similar streams at this altitude.

The community was dominated by an extremely abundant 'tolerant' taxon, (snail (*Potamopyrgus*). Other dominant 'tolerant' taxa included seed shrimps (Ostracoda) and damselfly larvae (*Xanthocnemis*). One 'sensitive' taxon was also abundant, the amphipod (*Paracalliope*). The dominance of 'tolerant' taxa resulted in a low $SQMCI_S$ score of 3.9 units, equal to the previous survey and within the range of previously recorded scores (Table 2). It was also not significantly different to the median for other sites in similar small lowland streams (Stark, 1997).

Overall, this indicates that the water quality of the Haehanga Stream prior to it flowing into the Remediation NZ composting site was of average quality, and that the community was strongly influenced by the low and slow flows, and the shallow gradient of this stream.

Site 2 – Downstream of extended irrigation area

At site 2 in the Haehanga Stream, upstream of all composting areas, 17 macroinvertebrate taxa were recorded. This was one taxon fewer than that recorded in the previous survey and two taxa less than the median for this site (Table 2). The community was dominated by three 'tolerant' taxa, (oligochaete worms, *Potamopyrgus* snails and sandfly larvae (*Austrosimulium)*), and one very abundant 'moderately sensitive' taxon, (*Paracalliope* mayfly)) (Table 3).

The MCI value of 99 units reflected a relatively high proportion of sensitive taxa in the community at this site (65%). This score is equal to that recorded in the previous survey, but significantly higher than the next highest score recorded at this site, and is twenty-four units higher than the median, also a statistically significant difference (Stark 1998)(Table 2, Figure 3). The $SQMCI_S$ value at this site (4.3) was similar to the median value, but significantly less than the previous maximum score, recorded in the previous survey. This reduction is primarily due to the reduced abundance of 'highly sensitive' *Deleatidium* mayfly.

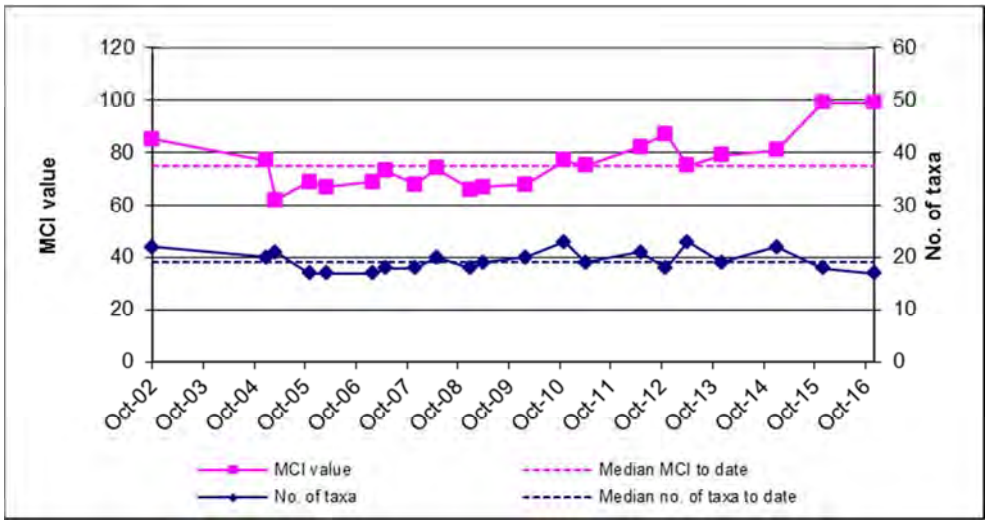


Figure 5 Taxa numbers and MCI recorded to date at site 2

Although this suggests that water quality at this site was 'fair' and well above average, it should be noted that the sampling technique differed to most previous surveys. Historically, this site was sampled using the vegetation sweep technique. Since the December 2015 survey, the kick sample technique has been used due to a lack of macrophyte habitat. The vegetation sweep technique tends to collect taxa that are more 'tolerant' and therefore produces lower MCI and $SQMCI_S$ scores. This also explains the very significant improvement in MCI score between sites 1 and 2 (30 units).

Overall, it is apparent that the primary influence on the community at this site is the variation in habitat, and the consequent change in sampling technique. The fact that one 'highly sensitive' taxon was recorded as 'common' is supportive of the conclusion of reasonable preceding water quality with no discernible impacts from the irrigation of wastewater to land between sites 1 and 2.

Site 5 – downstream of all pond discharges

At site 5 in the Haehanga Stream, 25 m downstream of all wastewater ponds, 26 taxa were recorded, seven taxa more than the median of the nineteen previous surveys, and twelve more than that recorded in the previous survey (Table 2, Figure 3). This increased richness may be a reflection of the flushing flow that was occurring at the time of the survey, or recovery from the previous survey when hydrocarbon odour was released from the substrate during sampling. Two 'tolerant' taxa dominated the community at this downstream site (very abundant oligochaete worms and snails (*Potamopyrgus*) with the 'highly sensitive' mayfly *Deleatidium* recorded as abundant (Table 3). The numerical dominance of very abundant 'tolerant' oligochaete worms and orthoclad midge larvae resulted in a $SQMCI_S$ score of 3.2 units, a statistically insignificant 0.4 unit higher than the median for this site, but a significant 1.1 units less than that recorded at site 2 (Stark, 1998). The MCI score (88) was sixteen units greater than the median score for this site, and eleven units higher than that recorded in the previous survey, both statistically significant results (Stark, 1998) (Figure 6). It is also the highest recorded at this site to date. However, it was eleven units less than that recorded at site 2 upstream in the current survey. This is a reflection of the decreased proportion of 'sensitive' taxa in the community (58%), which was 7% lower than at the upstream site 2 (Table 2).

Some previous surveys have recorded changes in abundance of individual taxa, which can be interpreted as being an indication of organic enrichment of the stream. Such changes included *Chironomus* bloodworms becoming abundant at this site. The results from the current survey indicate that *Chironomus* bloodworms were present at the time of the survey, but only as a rarity (less than five individuals). In total, significant changes in abundance were recorded for none taxa, including an increase in three 'sensitive' taxa. Overall, this community appears to be in above average community health, indicative of 'fair' water quality.

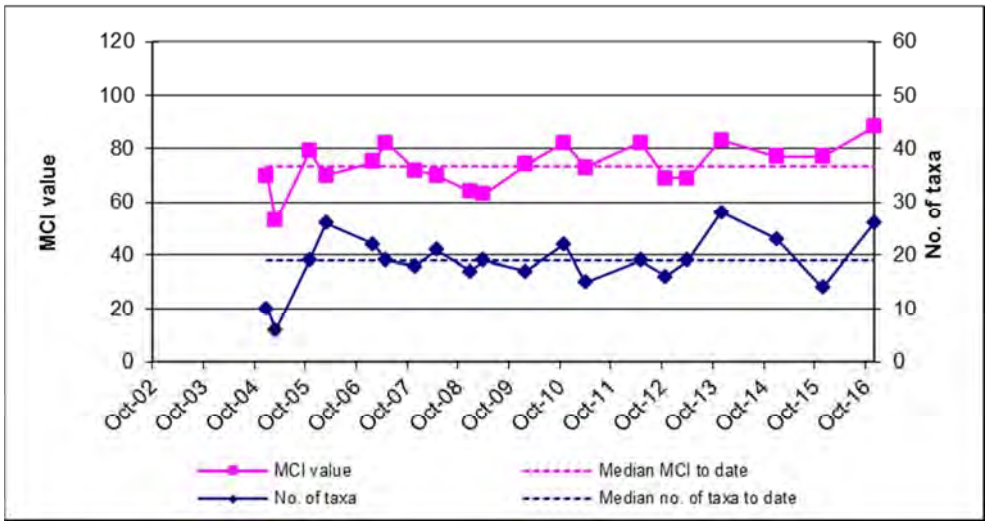


Figure 6 Number of taxa and MCI scores recorded to date at Site 5

Site 6 – Downstream of effluent irrigation area

A richness of sixteen taxa was recorded at this site, located downstream of the effluent irrigation area (Table 2, Figure 7). This is an improvement on that recorded in the previous survey when only six taxa were recorded. The community was dominated by two 'tolerant' taxa (extremely abundant oligochaete worms and very abundant *Potamopyrgus* snails), one 'moderately sensitive' taxon (*Hydrobiosis* caddisfly larvae) and one 'highly sensitive' taxon (*Deleatidium* mayfly). This also represents an improvement from the previous survey.

The community consisted mainly of 'sensitive' taxa (62%), resulting in an MCI score of 88 units. This score is significantly higher than the median for this site, the previous maximum score recorded at this site, and 28 units higher than that recorded in the previous survey, a particularly significant result (Table 2, Figure 2). Not only does this indicate that the community during the current survey was in well above average health, it also shows how severely impacted the community was during the previous survey. The current result is indicative of 'fair' water quality (TRC, 2015).

The $SQMCI_S$ score was heavily influenced by the extremely abundant oligochaete worms, but tempered slightly by the abundance of *Deleatidium* mayfly. This resulted in a $SQMCI_S$ score of 2.6 units, slightly less than the median for this site. Although this is the lowest $SQMCI_S$ score recorded in the current survey, it does not differ from what is usually recorded at this site, and is significantly better than that recorded in the previous survey (1.0 unit).

Previous surveys, including the most current one, had noted $SQMCI_S$ scores at this site that were lower than could be expected. It was concluded that there may be a subtle deterioration in water quality at this site, but habitat differences also needed to be taken into account. This is because this site has habitat that differed to the other Haehanga Stream sites, as it was a true riffle, in that it was shallow flow tumbling over coarse and fine gravel, as opposed to deeper flow moving over macrophyte or submerged wood. The riffle present sampled in the current survey may have also had some recent disturbance, with the placement of gravels, in an effort to resolve the perched culvert upstream. This may also explain the slightly lower than usual taxa richness. Overall, the results indicate that the community at this site was in average to above average health, and significantly better than that recorded in the previous survey, which was coincident with the discovery of a number of dead eels noted at and immediately downstream of this site.

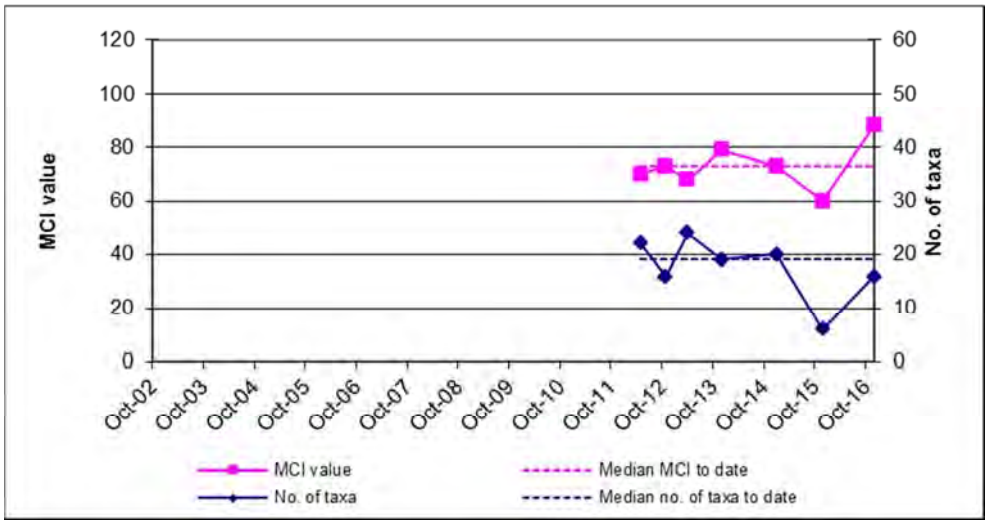


Figure 7 Number of taxa and MCI scores recorded to date at Site 6

Site 7 – Downstream of all site activities

This site exhibited average taxa richness (21), one taxon more than the median, and seven more than the previous survey undertaken at this site. The 'poor' MCI score of 78 was due to the community comprising 62% 'tolerant' taxa, of which four were abundant (ostracod seed shrimp and water boatmen (*Sigara*), very abundant (oligochaete worms) or extremely abundant (snails (*Potamopyrgus*)). Seven 'moderately sensitive' taxa and one 'highly sensitive' taxon were recorded at this site, suggesting moderate preceding water quality.

The MCI score of 78 was nineteen units higher than that recorded in the previous survey, a statistically significant improvement (Stark, 1998) (Table 2 and Table 7). This score was statistically insignificantly higher than the median score for this site (Stark, 1998), although it was the second highest score recorded at this site to date (Figure 8). The abundance of 'tolerant' taxa, especially snails and orthoclad midge larvae, resulted in a $SQMCI_S$ of 3.5 units, 0.3 unit less than the median for this site but 0.6 unit higher than that recorded in the previous survey

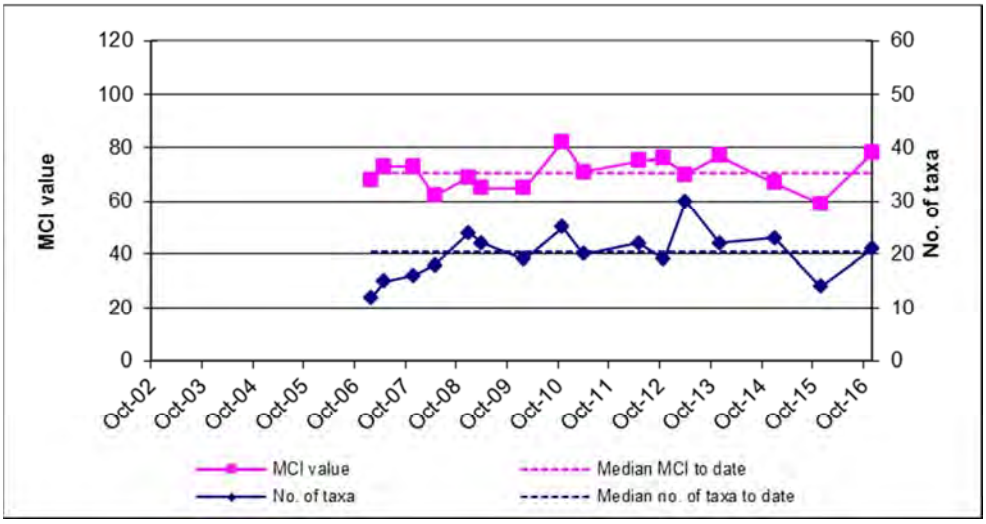


Figure 8 Number of taxa and MCI scores recorded to date at Site 7

When compared with site 6 upstream, the MCI score was lower, while the $SQMCI_S$ score improved slightly, due mainly to the reduced abundance of oligochaete worms and improved abundance of *Potamopyrgus* snails. There were ten significant differences in individual taxon abundance recorded between sites 6 and 7, with the majority of these differences reflecting the change in habitat, from a swift shallow riffle at site 6, to a deep slower run at site 7. It may also be that invertebrates were being flushed downstream in the higher flows, as a number of still or slow water taxa were recorded at site 7. The above average MCI and $SQMCI_S$ scores indicate that this community was also in above average health and reflective recovery following the previous survey.

During some previous surveys, concern was raised regarding an extreme abundance of *Chironomus* bloodworm larvae at this site. Such abundance usually only occurs where there is a significant organic discharge, which the *Chironomus* bloodworm larvae feed upon. It was noted that should this result be repeated in subsequent surveys, further investigation will be required. Dissolved oxygen readings were subsequently taken in the stream, and this found that there may be periods of low dissolved oxygen, especially when weed beds are well established, such as in summer. This is natural, and related to the shallow gradient of the stream, and can be exacerbated during low flows. It is likely that the sporadic abundance of *Chironomus* is related to the low dissolved oxygen concentrations within the stream, rather

than the discharge of organic wastes upstream. *Chironomus* was recorded as rare at this site in the current survey.

Site T2 – upstream of the wetland discharge

Sampling performed in the unnamed tributary that receives the wetland discharge has routinely found macroinvertebrate communities that are in better health than those present in the Haehanga mainstem. In the current survey, eighteen macroinvertebrate taxa were recorded at site T2, upstream of the wetland discharge point. This was slightly less than the median richness for this site and for control sites in similar streams (Table 2), and that recorded in the previous survey. Good water quality had preceded this survey, as indicated by the presence of three 'highly sensitive' taxa in the community, and the abundance of a number 'sensitive' taxa.

Extremely abundant *Deleatidium,* a 'highly sensitive' mayfly, dominated the community. Other taxa recorded in abundance included one 'tolerant' taxon (snails (*Potamopyrgus*)) and two 'moderately sensitive' taxa (*Paracalliope* amphipods and *Zephlebia* mayfly) (Table 3).

This community had a relatively high MCI score (104), reflecting the improved proportion of sensitive taxa present (72%) (Figure 9). This MCI score is 24 units higher than the median MCI score for control sites in similar streams and ten units higher than that recorded in the previous survey. This is the highest MCI score recorded in the Haehanga Stream catchment to date (Table 3). The $SQMCI_S$ value of 7.2 was particularly good for this type of stream, and significantly higher than the median for control sites in other lowland streams at a similar altitude (TRC, 1999). This is also the highest $SQMCI_S$ score recorded in the Haehanga Stream to date.

This stream typically has better MCI and $SQMCI_S$ scores than the Haehanga Stream sites, and this is a direct reflection of the difference in headwater character. Site T2 is located near to the source of this stream, which rises from a swampy spring, and flows through a short channel, which is well shaded. In contrast, sites 1 and 2 in the Haehanga Stream are located in excess of 1.5 km downstream of the source of this stream, below which the stream is relatively unshaded and unprotected.

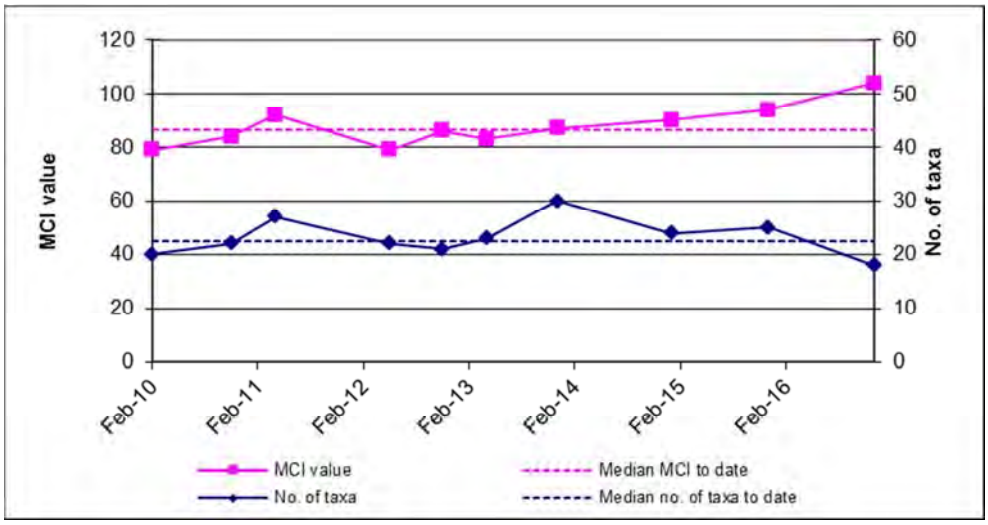


Figure 9 Taxa numbers and MCI recorded to date at site T2

Site T3 – downstream of the wetland discharge point

This is the tenth time that macroinvertebrates have been sampled at this site, located approximately 20 metres downstream of the wetland discharge. Twenty-three taxa were recorded at this site. This is four taxa less than what was recorded in the previous survey but five more than that recorded upstream at site T2 (Table 2, Figure 10).

The community was characterised by one 'highly sensitive' taxon (*Deleatidium* mayfly), two 'moderately sensitive' taxa (*Paracalliope* amphipods and mayfly (*Zephlebia* group)), and three 'tolerant' taxa, (oligochaete worms, snails (*Potamopyrgus*) and sandfly larvae (*Austrosimulium*)) (Table 3). This site had a slightly lower proportion of sensitive taxa (61%) than site T2 upstream, resulting in a reduced MCI score (90). This is a statistically significant reduction (Stark, 1998), suggesting some impact from the wetland discharge. However, it was entirely caused by a the change in presence/absence of taxa recorded as rarities only, and as such, if there was an influence from the wetland it was only subtle. This conclusion is supported by the lack of change in communities, with only two taxa changing significantly in abundance between the sites. The significant increase in the abundance of *Chironomus* bloodworms and oligochaete worms observed in the January 2015 survey were not apparent in the current survey. The highly sensitive mayfly *Deleatidium* was recorded in abundance at both sites. The drop in MCI score was mirrored in the $SQMCI_S$ score, which dropped 1.8 units between site T2 and T3. However, the $SQMCI_S$ score of 5.3 at site T3 was a significant (Stark, 1998) 0.9 unit higher than the median for this site and a significant 1.3 units higher than the median $SQMCI_S$ score for similar streams at comparative altitudes (TRC, 1999). Overall, although the MCI and $SQMCI_S$ scores indicate deterioration in macroinvertebrate community health between sites T2 and T3, the results at site T3 were well above average, and therefore this deterioration is considered to be of a subtle nature only.

Previous surveys have also noted certain changes in taxa presence/absence that indicated that there is also a significant influence from the instream habitat. For example, in a previous survey, site T3 recorded boatman (*Sigara*) and ostracod seed shrimps, which inhabit slow to still water, a habitat not typically inhabited by *Deleatidium* mayfly, which was absent at site T3 (but extremely abundant at site T2). This was less apparent in the current survey, with *Deleatidium* mayfly abundant at both sites, and fewer slow water species noted at site T3. Overall, these observations indicate that the discharge occurring at the time of this survey was having no more than a subtle impact on the communities of this stream.

Some previous water quality results indicate that unionised ammonia concentrations in the unnamed tributary have at times been toxic enough to reduce the abundance of, or eliminate entirely, some of the sensitive species usually found in this stream. Results of sampling undertaken in the year prior to this survey show that five of the six samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m^3. This shows management of the unionised ammonia concentrations in the effluent being discharged was moderate, but could be improved. Should unionised ammonia concentrations return to high levels in the winter period, an additional macroinvertebrate survey at this time may be warranted. At the very least, the water quality monitoring will need to continue to assist with the interpretation of macroinvertebrate results.

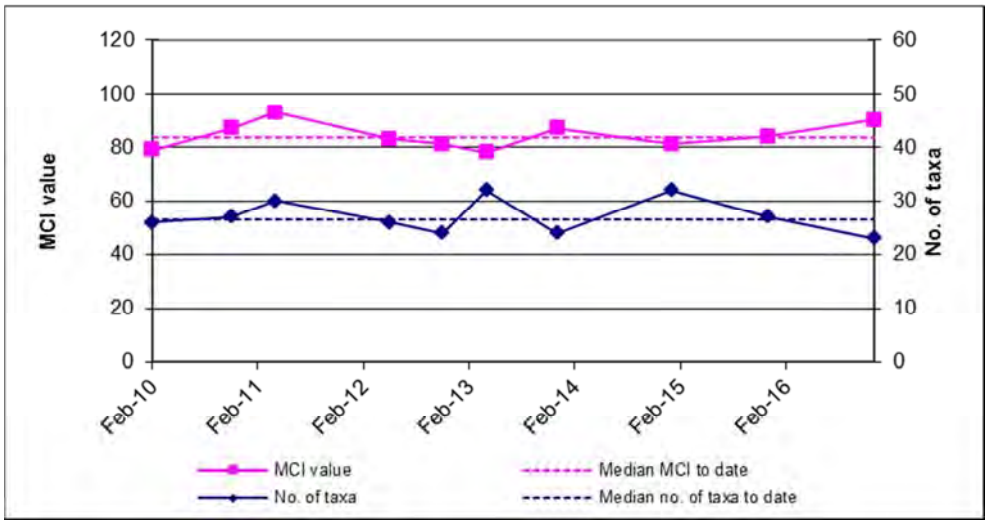


Figure 10 Taxa numbers and MCI recorded to date at site T3

Conclusions

The Council's standard 'streambed kick' and 'vegetation sweep' techniques were used at seven established sites to collect streambed macroinvertebrates from the Haehanga Stream catchment in order to assess whether the Remediation (NZ) Ltd composting areas had had any adverse effects on the macroinvertebrate communities of these 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 abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The macroinvertebrate survey conducted on 14 December 2016 was preceded by a rain event just hours prior, resulting in flows in the Haehanga catchment to be relatively high, with a steady to swift water speed noted at all sites. Community richnesses were slightly reduced upstream of the site, possibly due to the frequent higher flows that preceded this survey. These higher flows appear to have also led to improved invertebrate habitat, as, with the exception of site 1, all sites recorded MCI scores higher than their respective medians. Overall, this survey found that macroinvertebrate communities of the mainstem sites and two unnamed tributary sites were of average to above average health. Undesirable heterotrophic growths were not recorded at any of the seven sites in this survey.

The two sites in the unnamed tributary were sampled for the tenth time in the current survey, and exhibited a community relatively typical for this kind of habitat. However, there were some differences between these two sites. Site T2 recorded MCI and $SQMCI_S$ scores that were well above average. Site T3 also recorded MCI and $SQMCI_S$ scores higher than average, but they were significantly less than that recorded at site T2. Previous surveys have frequently recorded oligochaete worms, ostracod seed shrimps and *Chironomus* bloodworms increasing significantly in abundance downstream of the discharge. These taxa are often associated with organically enriched discharges. In the current survey all three of these taxa increased in abundance at site T3, coincident with the observation of a moderate discharge leaving the wetland.

There were only subtle changes in the community of the unnamed tributary, and although the changes in presence/absence of taxa between the sites involved only taxa recorded as rare, they were all reflective of organic enrichment of the stream. There was also little indication of a significant influence from a change in instream habitat. Previously, site T3 has recorded boatman (*Sigara*) and ostracod seed shrimps, which inhabit slow to still water, a habitat not typically inhabited by *Deleatidium* mayfly, which was absent at site T3 at that time (but extremely abundant at site T2). This was less apparent in the current survey, with *Deleatidium* mayfly abundant at both sites, and fewer slow water species noted at site T3. Overall, the unnamed tributary was in above average health, and the discharge occurring at the time of this survey was having no more than a subtle impact on the communities of this stream.

Some previous water quality results indicate that unionised ammonia concentrations in the unnamed tributary have at times been toxic enough to reduce the abundance of, or eliminate entirely, some of the sensitive species usually found in this stream. Results of sampling undertaken in the year prior to this survey show that five of the six samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m^3. This shows management of the unionised ammonia concentrations in the effluent being discharged was moderate, but could be improved. Should unionised ammonia concentrations return to high levels in the winter period, an additional macroinvertebrate survey at this time may be warranted. At

the very least, the water quality monitoring will need to continue to assist with the interpretation of macroinvertebrate results.

In general, the communities in the Haehanga Stream sites had moderate proportions of sensitive taxa. Low numbers of sensitive taxa are expected in small, silty bottomed streams such as the Haehanga Stream and the numbers of taxa were generally similar to other lowland hill country streams surveyed at similar altitude. The community richness at site 6 and 7 had recovered from that recorded in the previous survey, which recorded significant deterioration. MCI values recorded in the Haehanga Stream generally reduced in a downstream direction, although site 1 in the current survey recorded the lowest MCI score of 69 units. For second consecutive year, site 2 recorded an MCI score equal to the highest recorded in this catchment to date. Sites 1 recorded an average MCI score, with sites 2, 5, 6 and 7 recording above average scores, significantly so for sites 2, 5 and 6. This represents a significant recovery at sites 6 and 7, following the deterioration recorded in the previous survey, which was coincident with the observation of a number of dead eels at site 6.

Site 5 has exhibited poorer macroinvertebrate communities in the past compared to other sites upstream. This has suggested some level of impact from the composting operation, although the extent of adverse effects has been difficult to determine due to poor habitat quality. During the current survey, the MCI score for site 5 was fifteen units greater than the median score for this site. This is a significant improvement from the previous survey, which noted the presence of hydrocarbons in the substrate. The $SQMCI_S$ score recorded at site 5 was reduced compared with that recorded at site 2. In addition, the results from the current survey indicate that *Chironomus* bloodworms were present, but only as a rarity. This suggests some deterioration from that recorded at site 2, but overall, the communities at site 5 were in above average health.

Unlike the other sites, the sample from site 6 was collected from a riffle with coarse and fine gravels, using the 'streambed kick' sampling technique. However, this riffle had recently had additional gravels placed over the top, in an effort to resolve a perched culvert upstream. This may have influenced the invertebrate community, which recorded a relatively low taxa richness of 16 taxa. However, it recorded an MCI score of 88 units, indicative of 'fair' water quality, and the highest recorded at this site of the seven surveys conducted there. It also represents a significant improvement from the previous survey, and no change from that recorded at site 5 upstream, being higher than the median for control sites in other lowland streams at a similar altitude. This provides no indication of deterioration, a conclusion supported by the $SQMCI_S$ score of 2.6 units. Although this score is lower than that recorded upstream, it is similar to the median for this site, despite the disturbance that had recently occurred at this site.

The surveys undertaken at this site sampled habitat that differed to the other Haehanga Stream sites, as it was a true riffle, with shallow flow tumbling over coarse and fine gravel, as opposed to deeper flow moving over macrophyte or submerged wood. This habitat difference can explain some of the differences in the taxa recorded and the increased abundance of worms recorded in previous surveys. The current survey indicates that the water quality preceding this survey had been fair and better than average.

The lowest site (site 7) was sampled for the sixteenth time in this survey. There was a reduction in MCI score, but the $SQMCI_S$ score was higher than that recorded at site 6. When compared with historical data, the community at site 7 was in average health, and indicative of no deterioration in water quality. As with site 6, there was a recovery in community health from that recorded in the previous survey. The $SQMCI_S$ score for this site (3.5) and taxa richness (21) were similar to their long-term average, indicating that the community was in average health.

During certain previous surveys, *Chironomus* bloodworms have been recorded as abundant at various sites. Abundance of this taxon is usually an indication of an organic discharge, although low dissolved oxygen in the stream can also allow this taxon to dominate the community, especially when this is associated with low flows. It may be then that the sporadic appearance of *Chironomus* in abundance is at least in part related to

the dissolved oxygen concentrations. Dissolved oxygen concentrations in the Haehanga have been found to be depressed at times, and during the warmer months, when there is more aquatic weed growth, dissolved oxygen may be significantly depleted at night. This is a natural occurrence in some streams that are slow flowing and weedy. Any macroinvertebrate surveys undertaken when such conditions exist could potentially record a community with fewer sensitive species, and a more abundant population of *Chironomus*. During the current survey, *Chironomus* was recorded as rare at sites 5, 6, 7 and T3. This possibly suggests a slight increase in the organic enrichment of the stream. It is understood that the issue of high chlorides at site 6 has been identified and is being addressed, and so water quality will hopefully improve with time. This would be further contributed to through any on-going works to the leachate and stormwater treatment system, and improved management of the riparian margin. Any works that improve water quality are also likely to lead to an improvement in freshwater macroinvertebrate communities below the discharges, and should continue to be encouraged.

This was the only macroinvertebrate programme scheduled for the 2016-17 period. It is recommended that this level of monitoring continue, but that a provisional macroinvertebrate survey be retained in the programme, to be implemented should water quality monitoring indicate an issue.

References

Dunning KJ, 2003: Biomonitoring of the Haehanga Stream in relation to discharges from the Global Vermiculture site at Uruti. TRC report no. KD136.

Hope KJ, 2005a: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti. TRC report no. KH12.

Hope KJ, 2005b: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti, March 2005. TRC report no. KH025.

Hope KJ, 2006: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti, November 2005. TRC report no. KH073.

Hope KJ, 2006: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti, March 2006. TRC report no. KH078

Jansma B, 2007: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti, February 2007. TRC report no. BJ020.

Jansma B, 2007: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti, May 2007. TRC report no. BJ030.

Jansma B, 2008a: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti, December 2007. TRC report no. BJ050.

Jansma B, 2008b: Biomonitoring of the Haehanga Stream in relation to discharges from the Perry Environmental Limited composting site at Uruti, May 2008. TRC report no. BJ051.

Jansma B, 2008c: Biomonitoring of the Mangati Stream, in relation to the Bell Block industrial area, February 2008. TRC report BJ043.

Jansma B, 2009a: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, January 2009. TRC report no. BJ055.

Jansma B, 2009b: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, April 2009. TRC report no. BJ056.

Jansma B, 2011a: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, November 2010. TRC report no. BJ148.

Jansma B, 2011b: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, April 2011. TRC report no. BJ149.

Jansma B, 2012: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, May 2012. TRC report no. BJ175.

Jansma B, 2013: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, November 2012. TRC report no. BJ209.

Jansma B, 2013: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, April 2013. TRC report no. BJ210.

Jansma B, 2015: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, January 2015. TRC report no. BJ258.

Jansma B, 2015: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2015. TRC report no. BJ286.

Quinn, JM, Steele, GL, Hickey, CW & Vickers, ML: Upper thermal tolerances of twelve New Zealand stream invertebrate species. New Zealand Journal of Marine and Freshwater Research 28: 391-397.

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 & Jansma B, 2014: Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2013. TRC report BT018.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998(statistics updated to 1 October 2016). State of the Environment Monitoring Reference Report. Technical Report 99-17.

TRC, 2015: Freshwater Macroinvertebrate Fauna Biological Monitoring Programme Annual State of the Environment Monitoring Report 2014-2015. Technical Report 2015-66.