Remediation NZ Limited
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-83

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Executive summary

Remediation NZ Ltd (RNZ) operates two worm farms which produce vermicast for fertiliser at two sites in Brixton. These sites are located on Waitara and Pennington Roads in Brixton, in the Waiongana catchment. RNZ also operates a remediation, composting and verimculture operation on Mokau Road at Uruti in the Mimi catchment.

This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess RNZ's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of RNZ's activities.

RNZ holds eight resource consents, which include a total of 107 conditions setting out the requirements that they must satisfy. These eight consents cover the activities across the three sites of RNZ.

During the monitoring period, RNZ Uruti demonstrated an overall need for improvement in their level of environmental performance.

During the monitoring year, RNZ Waitara and Pennington Road facilities demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included 15 inspections, 66 water samples collected for physicochemical analysis, four composite soil samples, one biomonitoring survey of receiving waters and a fish netting survey.

The monitoring showed that similar to the previous monitoring period, salinity trends in the groundwater were increasing in the specific irrigation areas. This is further supported by the increasing sodium absorption ratio found in the soil analyses of these specific areas this period. RNZ must enact their tiered approach as specified by their site specific management plan to mitigate these issues moving forward.

Biological monitoring upstream of the site concluded that the Macroinvertebrate communities were of average to above average health, while the communities of the two sites downstream of the site showed deterioration. However, no undesirable heterotrophic growths were recorded at any of the seven sites in this survey. The Council will undertake additional sampling of the lower reaches of the Haehanga Stream during low flows, to better understand of the decline in biological species in this specific area.

Surface water analysis indicated two exceedances with respect to the consent conditions during this period, including an increase in un-ionsed ammonia. RNZ identified bank instability in the vicinity of a new worm bed to be the reason and this was accepted by Council.

RNZ required prompting to maintain the function of the irrigation system this period and the Council issued an abatement notice to undertake stabilisation of the associated bank to prevent the potential for an uncontrolled discharge to the Haehanga Stream.

There was one unauthorised incident recording non-compliance in respect of this consent holder during the period under review, as discussed above.

RNZ demonstrated a high level of both environmental and a administrative performance for their two facilities located on the Waitara and Pennington Roads, while environmentally, improvement is required at RNZ's Mokau Road facility at Uruti, though there administration was rated as good.

For reference, in the 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that RNZ's performance remains at a level that requires improvement in terms of the Uruti facility and maintained a high level for there Brixton facilities.

This report includes recommendations for the 2016-2017 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2015 to June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Remediation NZ Ltd (RNZ). RNZ operates a worm farm located in Brixton, Pennington Road and on the Waitara Road, Waitara, 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 RNZ that relate to abstractions and discharges of water within the Mimi and Waiongana catchments, and the air discharge permit held by RNZ to cover emissions to air from the site.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of RNZ's use of water, land and air, and is the 15th combined annual report by the Council for RNZ.

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 RNZ in the Mimi, Waitara and Waiongana catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Waiongana, Waitara and Mimi catchments.

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 2016-2017 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 RNZ, 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 RNZ'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 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents.

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 RNZ 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 remediation 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.

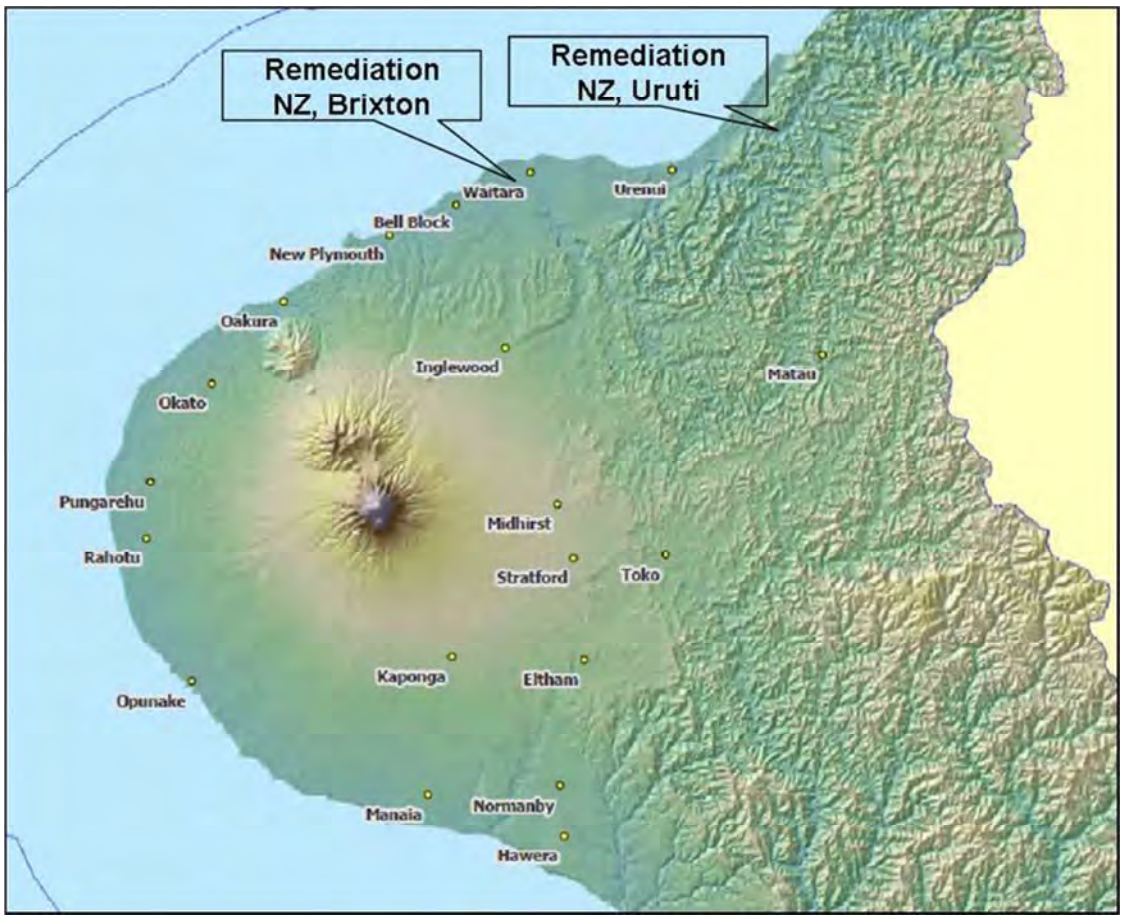

Figure 1 Regional location of RNZs operations in Taranaki

Figure 2 RNZ Uruti site

1.3 Resource consents

Table 1 Resource consents held by RNZ

Consent No.	Site	Purpose	Expiry Date	Review Date(s)
5838-2	Uruti	Discharge to land and water	June 2018	Yearly
5839-2	Uruti	Discharge emissions to air	June 2018	Yearly
5938-2	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	-

1.3.1 Air discharge permit – Uruti

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 between 1731704E-5685796N, 1733127E-5684809N, 1732277E-5685101N, 1732451E-5684624N and 1732056E-5684927N. This consent was issued to the consent holder 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.

A copy of the permit is attached to this report in Appendix I.

1.3.2 Discharges of waste to land and water – Uruti and Brixton

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 water discharge permit **5838-2** 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 between 1731704E-5685796N, 1733127E-5684809N, 1732277E-5685101N, 1732451E-5684624N and 1732056E-5684927N. This consent was issued to the consent holder on 30 June 2010. It is due to expire in June 2018.

Consent 5838-2 has 28 special conditions.

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

Special conditions 2 and 3 set restrictions on the types of waste accepted and the size of the composting pads.

Special conditions 4, 5 and 6 set out requirements for the maintenance of treatment systems.

Special condition 7 requires the consent holder to keep irrigation records.

Special condition 8, 9 and 10 set limits on effects arising from the irrigation of wastewater.

Special conditions 11, 12 and 13 set out requirements for the monitoring and management of soil quality in the irrigation areas.

Special conditions 14 to 17 set out requirements for the monitoring and management of groundwater quality in the irrigation areas.

Special conditions 18 and 19 deal with the maintenance and management of the pond treatment system.

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

Special conditions 22 and 23 sets limits on effects arising from the wetland discharge.

Special condition 24 requires that riparian planting be maintained in accordance with the riparian plan in place.

Special condition 25 requires that the consent holder keep records of all complaints.

Special conditions 26 and 27 deal with site reinstatement.

Special condition 28 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.

RNZ 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.

RNZ holds discharge permit **5892-1** 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.

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

Special condition 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.

1.3.3 Land use consents – Uruti

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. RNZ has three land use consents.

Consent **5938-1** 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 notify the Council prior to construction.

Special condition 2 requires that construction is in accordance with the application.

Special condition 3 requires the consent holder adopt the best practicable option to avoid or minimise discharge of silt or contaminants to the environment.

Special condition 4 deals with riverbed disturbance.

Special condition 5 requires the consent holder to reinstate the area when the structure is no longer required.

Special condition 6 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.

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 Uruti site consisted of two/three/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 reviews;
- renewals;
- new consents;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3 Site inspections

The RNZ Uruti site was visited 12 times during the monitoring period, whilst the Brixton facilities were visited on three occasions. With regard to consents for the discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. The neighbourhood was also surveyed for environmental effects.

1.4.4 Chemical sampling

The Council undertook compliance sampling across RNZ's operations, primarily related to the Uruti facility in the 2015-16 monitoring period. As RNZ 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 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. Specifically the Council will assess these 13 surface water locations five 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)	

1.4.4.3 Soil analysis

Representative soil sampling is undertaken of the two site specific irrigation areas (Figure 4). The aim of this soil sample was 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 and irrigated area and 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 is also undertaken. See Sections 2.1.5 and 2.1.6.

Figure 3 Surface water sampling location RNZ Uruti

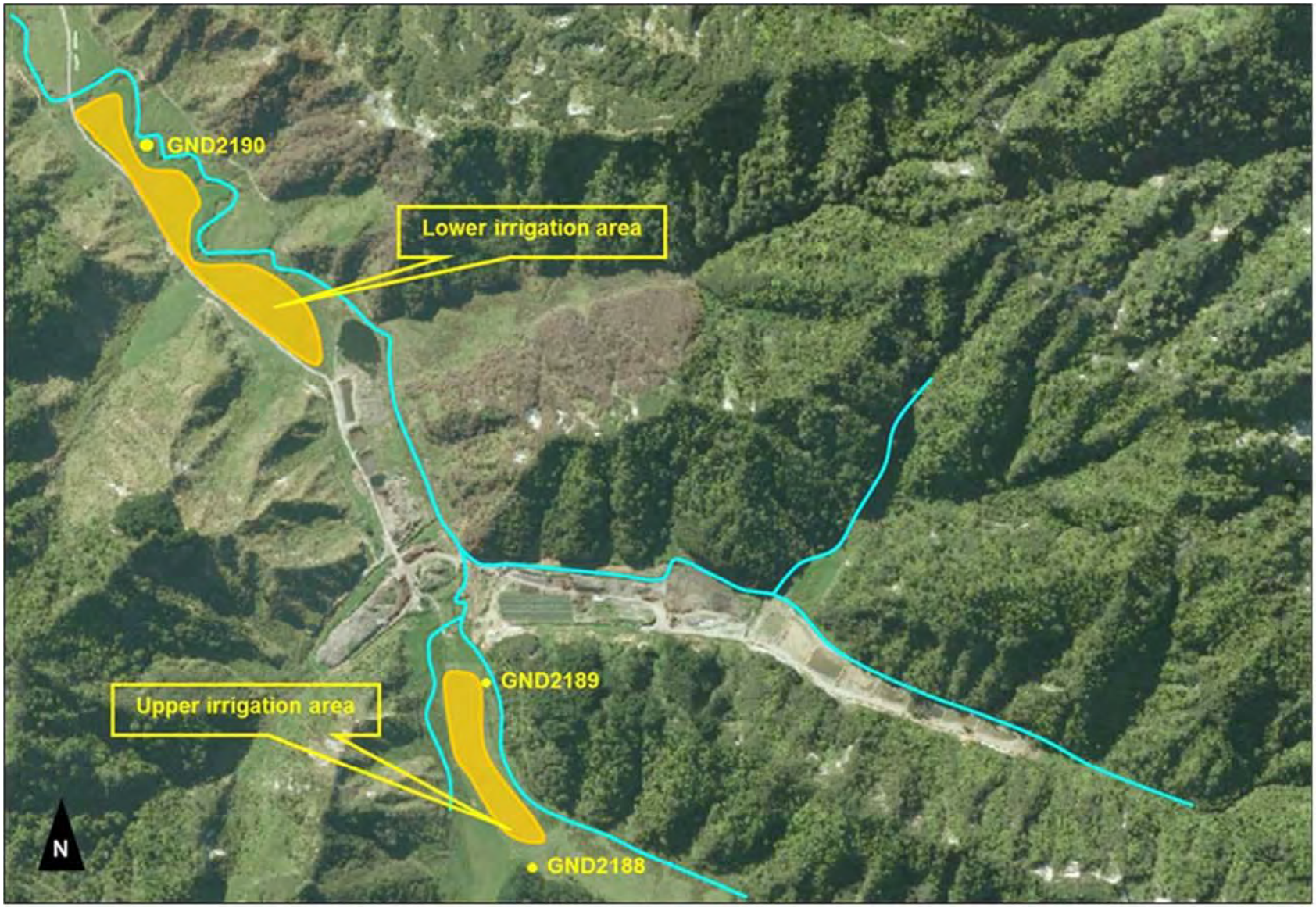

Figure 4 Irrigation areas and groundwater monitoring well locations

2. Results

2.1.1 Inspections

Uruti, Mokau Road

03 July 2015
An inspection of Uruti site was undertaken with the aid of secondary investigating officer. Six sites were selected and a Gastech survey was undertaken through the use of a type 72l Ethyl mercaptan tube. This device has a capable detection limit of 0.2 ppm. None of the tubes utilised indicated the presence of gaseous ethyl mercaptan. Site observations concluded that the site had experienced high levels of rainfall, which elevated the level of the irrigation pond. In comparison, the paunch pit level was low. The wetland discharge was observed and appeared a little dark. Overall the site looked good at time of inspection.

05 August 2015
During an inspection the following was observed. TRC staff and RNZ discussed the proposed location of the new irrigation area and the location of the specific groundwater monitoring wells. In the previous days the site had experienced very high rainfall, which had resulted in some of the flat areas of the site being quite water logged. Discussions were held with the site staff around the potential to push back on the paunch pad. Overall, the site looked good as consideration was given due to the high amount of rainfall experienced over the previous two days. There had been an overflow from the irrigation pond into the duck pond which had resulted in some visible surficial oils which were to be skimmed when practicable.

28 September 2015
The inspection was undertaken at 10:30 am. Discussion was held with site staff upon entry. A bulldozer was working on the proposed quarry road. Discussions were held around the proposed works in relation to back filling an area on site. The paunch pad was observed and appeared in good repair and it was at a low level. The wetland discharge appeared in good order. The irrigation pond was low. The duck pond was also observed and looked clear of surficial oils. The irrigation area was inspected and no ponding was observed.

13 October 2015
During an inspection the following was found have occurred. Water quality measurements and samples were undertaken in conjunction with the inspection. RNZ staff were in the midst of moving material to install a bund along the lower end of the track which led to the quarry. The paunch area had not received material for a time and the level of the pond was described as normal. The wetland discharge was at a low rate and no discoloration in the receiving waterbody was observed. A noticeable amount of iron oxide was prevalent at the other sample sites; this was linked to the minimal flow in some sample locations. The irrigation pond level appeared at normal level, while observation of the duck pond detailed a very small sheen in a few places. The irrigation flats looked good, though the grass was quite long. TRC staff explained to site staff the method with which to take consistent conductivity readings in the shallow monitoring wells. Overall the site looked good.

08 December 2015
An inspection and water quality sampling was undertaken; during the inspection the following was observed. Recently product deliveries had been emptied onto the paunch pad and a digger had been undertaking blending operations in the first mixing pond. The irrigation pond appeared very full at the time of inspection and was observed to contain more surficial oils than in the previous inspection. This surficial oil was also present on the nearby duck pond.

Grass around edge of pond appeared to be oil stained. Site staff were working at bottom of track up to the quarry. The removal of the old paunch product from the paunch pad was discussed. This will be trucked back to Brixton and also used on worm beds onsite. There was minimal discharge from wetlands. Logging of trees was occurring at the time of inspection. Associated with this was the tributary that came from the side gully, that was observed to be discolored due to stream disturbance from forest harvesting. Overall, the site looked acceptable. Discussions were held to undertake prior to the next inspection.

11 December 2015
During the inspection a number of dead eels were found below the culvert on the track in. Upon this discovery the whole system was inspected, as per usual inspection. While it was not possible to ascertain how the eels had deceased as they appeared to be well decomposed, it was apparent that the ponds would require a good clean out and the baffle/ bunding around them would require modification. Overall the site requires maintenance. There was no evidence of any overflow or any reason as to why eels were found dead.

An abatement notice (21036) was issued requiring system to be cleaned up and addressed.

05 January 2016
A re-inspection of abatement notice 21036 was undertaken. Works had been undertaken and the ponds had been addressed. The baffles had been reinstated and the ponds had been cleaned out. Material had been moved around and it was apparent that a fair amount of material would require moving out. The ring drain along the creek side had been cleaned out and the low spot on the papa wall had been built up.

Discussions were held pertaining to the deliveries of chicken and paunch, whereby further action was agreed. The paunch is to be dumped only at the paunch pad and chickens specifically to the compositing pad. The paunch pad was about to undergo a significant clean out and material to be put on worm beds. At time of inspection abatement notice 21036 had been complied with.

23 February 2016
An odour survey was undertaken at the site entrance, in close proximity to the security gates. No odours were noticeable. The inspection found the level of the irrigation pond was half full. The goosekneck pipes (T-Pipes) were holding back surficial oil, as they are designed to do. The duck pond level was quite low. Irrigation flats looked good. The newly proposed irrigation flats have had a large bund installed alongside the waterbody edge. The worm bed covers were about to be removed and about to be loaded up with composted paunch. At the time of inspection a truck was observed

dropping off sawdust. The quarry area looked good. There was a pile of processed material and also a small pile of extracted material. Overall the site looked good.

16 March 2016
This inspection was undertaken in conjunction with soil and groundwater sampling. A truck was unloading paunch at time of inspection; the corresponding application paunch pit level was low. The wetland area was observed and described as working effectively; the discharge was slightly dark in colour. New material had recently been added to the site worm beds. The irrigation pond was observed and the level was low, with little surficial oil present. The irrigation paddocks were observed and found to be in good order. Overall the site was looking good. The quarry operation was processing at time of inspection.

07 April 2016
A follow up inspection was undertaken of the site, as the previous surface water sampling round had indicated a slightly elevated concentration of ammonia. New samples were collected at this site and five other locations to ascertain where the ammonia egress was. Soil samples were also collected from the new irrigation paddock. In comparison to the previous inspection, much paunch had been delivered to the paunch pad. Worm beds were being topped up at time of inspection. Metal was also in the process of being extracted from the ridge, down to the processing pad. Overall, the site looked good.

13 May 2016
An inspection was undertaken during and after heavy rain. The level of the paunch pond indicated that the operator would soon have to mitigate it, as it was approaching maximum capacity. The wetlands were observed and appeared in a good state. The irrigation pond level was also elevated due to the heavy rain. The duck pond looked clear. Irrigation flats were observed and appeared fine. The Haehanga Stream was running quite high. Overall the site looked good.

10 June 2016
An inspection was undertaken and the following was found to have occurred, Recent work had been undertaken to push paunch back into the paunch pit. A digger had been recently utilised to fix a small section of the wetland as there appeared to be a small leak. This was linked to the slight elevation found in a previous survey. The discharge from the wetland appeared to be acceptable upon observation. The fluid level in the irrigation pond was observed to be quite high while the duck pond was low. The irrigation area was inspected, with no issues to report, although the grass was observed to over a foot in height. Groundwater and surface samples were collected. Overall the site looked good.

Waitara Road, Pennington Road Brixton

22 June 2016
A site visit was made to conduct a compliance monitoring inspection.

Waitara Road
All of the worm beds were covered at the time of the inspection and the areas between the worm beds had good grass growth that had been recently mowed. There were some areas of ponding as a result of the very heavy rains over the weekend. There was

some residual (trickle flow) stormwater discharging into the grate in front of the main shed. The site manager outlined that the sump below the grate is pumped out on a monthly basis. The pipe at the western edge of the site had the same trickle flow. Discussion was held with the site manager about creating an updated stormwater plan and cleaning up the storage area on the south side of the shed.

Pennington Road
No discharges were occurring at the time of the inspection and no odours were detected. Their site was quite muddy and had some small isolated areas of ponding due to the very heavy rains of over the weekend. Maintenance of the silt control measures were discussed with the site manager.

The following action was to be taken:

- Update Stormwater management plan for both sites
- Undertake maintenance of silt controls where required

22 January 2016
A site visit was made to conduct a compliance monitoring inspection. It was fine at the time with a light NW wind.

Waitara Road
The area south of the site office had been cleaned up and most of the drums and IBC's noted during the last inspection had been removed. The worm beds at the rear of the property were all covered and had thick grass between them. No discharges were seen at the rear drain. Worm beds at the front of the site were all covered and in good order. It was outlined by the site manager that a stormwater management and site practices plan was in the process of being developed. Odour was not found to be an issue at the site.

Pennington Road
It appeared that there had not been much activity at the site. The access track had grassed over as had most of the residual stock piles. No issues were noted.

26 June 2016
At the time of inspection the following was observed. A truck was being unloaded of chicken manure on arrival. A site walkover was undertaken with the site supervisor. The sheds and the stormwater drain were observed. Large piles of bark were located at the rear of the facility. All the worm beds observed had covers on. The main odour, which was described as strong, as found in the shed where the chicken manure was stored. No odours were noticed close to and around the boundary. The Pennington Road facility was observed and it appeared that large piles of product had been in-situ for a prolonged period of time.

2.1.2 Results of abstraction and discharge monitoring

2.1.2.1 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 the 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 stipulates specific concentrations which the discharge point must abide by.

Specifically Condition 22 of Consent 5838-2 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/m³.
b) The pH shall be between 6.0 and 9.0

Analysis of discharge location IND003008 is provided in the following Table 3. In comparison to the specific consent condition, pH concentrations ranged between 6.9 and 8.1 which is within the required range as dictated by the specific condition, whilst in terms of suspended solids, there was one exceedance in the consented maximum of 100 g/m³. In March 2016 a value of 130 g/m³ was reported. Whilst this was an elevation in terms of 30 g/m³ when compared to the condition, consideration was given as these samples were collected at a time of heavy rainfall (Officer notes). Note for the remainder of the samples collected in terms of suspended solids, these were well below there consented maximum.

Table 3 IND003008 discharge monitoring 2015-2016

IND003008	Parameter	Chloride	Conductivity	Un-ionised Ammonia	Ammoniacal Nitrogen	Nitrite-Nitrate Nitrogen	pH	Suspended Solids	Temperature
Date	Time	g/m³	mS/m@20°C	g/m³	g/m³ N	g/m³ N	pH	g/m³	°C
05 Aug 2015	09:42	19.8	38.1	0.03709	19.5	2.53	6.9	30	10.7
13 Oct 2015	08:45	28.0	79.7	2.01641	52.0	1.68	8.1	7	14.5
08 Dec 2015	08:35	15.8	39.8	0.54593	20.2	1.45	7.8	6	18.8
16 Mar 2016	08:57	31.3	63.1	0.67694	22.3	1.12	7.8	**130**	20.4
08 Jun 2016	10:46	40.0	93.0	0.57540	53.2	0.22	7.7	31	9.4

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 before it extends from the mixing zone. Specifically consent 5838-2, Condition 23 which states:

Consent 5838-2 Condition 23

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 2015-2016 surface water monitoring of HHG000103 unnamed tributary of Haehanga Stream

HHG000103	Parameter	Filtered CBOD	Chloride	Conductivity	Un-ionised ammonia	Ammoniacal Nitrogen	pH	Suspended solids	Temperature
Date	Time	g/m³	g/m³	mS/m@20°C	g/m³	g/m³ N	pH	g/m³	°C
05 Aug 2015	09:45	1.1	13.2	13.9	0.0019	0.888	7	320	9.2
13 Oct 2015	08:40	0.9	11.2	20.8	0.01485	1.65	7.5	6	13.1
08 Dec 2015	08:40	0.7	10.6	18.8	0.0039	0.613	7.3	3	14.6
16 Mar 2016	08:59	**2.7**	19.7	37.5	**0.10293**	7.57	7.5	40	18.7
08 Jun 2016	10:48	1.4	17.9	31	0.02408	6.5	7.3	7	7.3

In this monitoring period, the monitoring undertaken on the 16 March 2016 indicated that the level of un-ionised ammonia at location HHG000103 was elevated above it's conditional maximum of 0.025 g/m³, with a value of 0.103 g/m³ (Table 4).

As a direct result of this reading a full site inspection was undertaken by site staff and it was realised that a newly moved worm vermicast area had the potential to leach to the stream, upstream of the discharge location. As there are no additional parties upstream of this area, to which this elevated concertation could be attributed to, the worm bed was mitigated and a follow up sample collected in early April 2016, (Table 5). This follow up analysis indicated that the mixing zone was effective and that the consented criteria were abided with upon reanalysis.

Table 5 Follow up surface water sampling in response to elevated un-ionised ammonia in March 2016

		Parameter	Conductivity	Un-ionised ammonia	Ammoniacal Nitrogen	pH	Temperature
Location ID	Date	Time	mS/m@20°C	g/m³	g/m³ N	pH	°C
HHG000098 (Upstream)	07 Apr 2016	10:53	24.1	0.00053	0.112	7.2	13.8
IND003008 (Discharge)	07 Apr 2016	10:54	66.8	0.64229	22.1	7.8	19.8
HHG000103 (Downstream)	07 Apr 2016	10:55	32.1	0.02313	3.8	7.3	14

2.1.2.2 Surface water monitoring of the Haehanga Stream in respect of irrigation

Analysis of the WTS was provided in the previous section, while this discharge must meet two goals in as much as a discharge concentration (Table 2) and a post mixing zone concentration (Table 3). The stream is also 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/m3;
b) A level of un-ionsed ammonia greater than 0.025 g/m3;
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

Surface water analysis of the Haehanga Stream is provided in Table 6. In comparison to the specific consent condition listed above, one exceedance was found in the October 2015 sampling round, whereby the concentration of carbonaceous biochemical oxygen demand (BODCF) at monitoring location HHG000150 had exceeded its consented concentration of 2.00 g/m^3 BODCF with a value of 3.7 g/m^3.

Analysis of Total Petroleum Hydrocarbons found all results below the limit of detection for this analyte across all ten monitoring locations. Chloride concentrations were all below the consented value of 150 g/m^3, though during the March 2016 round, the concentration at HHG000150 was close to the consented limit with a concentration of 142 g/m^3.

Un-ionised ammonia concentrations were below the consented limit at the two main monitoring sites. It was close to the limit during the October 2015 round of analysis at HHG000150 with a value of 0.02486 g/m^3 and apart from one other occasion. At location HHG000103 in March 2016, it exceeded the value (0.102 g/m^3 NH_3). However upon re-analysis this was found to below the concentration, (this was discussed earlier in Section 2.1.2.1). The remainder of the analysis detailed concentrations below the conditional value.

Table 6 Full surface water sampling results of the Haehanga Stream 2015-2016 monitoring period

		Parameter	BODCF	CL	CONDY	TPH	NH_3	NH_4	NNN	pH	SS	TEMP-
Location ID	Date	Time	g/m^3	g/m^3	mS/m@20°C	g/m^3	g/m^3	g/m^3 N	g/m^3 N	pH	g/m^3	°C
HHG000093	05 Aug 2015	09:20	<0.5	11	12.2	<0.5	0.00018	0.043	0.18	7.3		9.2
HHG000097	05 Aug 2015	09:35	<0.5	11.8	14.6	-	0.00016	0.058	0.05	7.1	210	9.6
HHG000098	05 Aug 2015	09:40	<0.5	11.9	12.6	-	0.00008	0.046	-	6.9	100	9.2
HHG000103	05 Aug 2015	09:45	1.1	13.2	13.9	-	0.0019	0.888	-	7	320	9.2
HHG000100	05 Aug 2015	09:55	0.8	13	13.2	<0.5	0.00015	0.068	0.15	7	-	9.2
HHG000106	05 Aug 2015	09:55	2.7	12.7	15.2	-	0.00059	0.214	-	7.1	-	9.6
HHG000109	05 Aug 2015	10:20	0.7	15.6	14.9	-	0.00159	0.455	-	7.2	-	9.6

		Parameter	BODCF	CL	CONDY	TPH	NH_3	NH_4	NNN	pH	SS	TEMP-
Location ID	Date	Time	g/m^3	g/m^3	mS/m@20°C	g/m^3	g/m^3	g/m^3 N	g/m^3 N	pH	g/m^3	°C
HHG000115	05 Aug 2015	10:15	1.1	16.4	15.1	<0.5	0.00076	0.349	0.2	7	-	9.4
HHG000150	05 Aug 2015	10:35	0.6	18.5	15.6	<0.5	0.00055	0.32	0.22	6.9	260	9.4
HHG000190	05 Aug 2015	10:45	-	18.1	15.4	-	0.00073	0.324	-	7	-	9.8
HHG000093	13 Oct 2015	08:20	0.6	15.8	14.5	<0.5	0.00018	0.021	<0.01	7.4	-	15.4
HHG000097	13 Oct 2015	08:30	<0.5	9.7	17.7	-	0.00101	0.186	0.13	7.3	4	12.4
HHG000098	13 Oct 2015	08:35	0.5	10	17.9	-	0.00072	0.1	-	7.4	6	13.1
HHG000103	13 Oct 2015	08:40	0.9	11.2	20.8	-	0.01485	1.65	-	7.5	6	13.1
HHG000099	13 Oct 2015	08:50	0.8	35.4	32.2	-	0.00173	0.073	-	7.9	-	13.9
HHG000100	13 Oct 2015	09:10	1	28.8	24	<0.5	0.0012	0.12	0.03	7.5	-	14.5
HHG000106	13 Oct 2015	09:15	0.6	35.4	30	-	0.00774	1.29	-	7.3	-	13.8
HHG000109	13 Oct 2015	09:20	0.7	35.8	27.9	-	0.00466	0.467	-	7.5	-	14.5
HHG000115	13 Oct 2015	09:30	1	48.2	32.3	<0.5	0.00382	0.605	0.44	7.3	-	14.5
HHG000150	13 Oct 2015	09:35	**3.7**	105	50.4	<0.5	0.01805	2.08	0.4	7.4	27	15.7
HHG000190	13 Oct 2015	09:40	-	104	52.4	-	0.02486	2.93	-	7.4	-	15.4
HHG000150	20 Oct 2015	-	-	40.9	27.1	-	0.00198	0.488	-	7.2	-	11.6
HHG000190	20 Oct 2015	-	-	41.3	26.7	-	0.00409	0.55	-	7.4	-	13.6
HHG000093	08 Dec 2015	08:20	<0.5	10.3	15.7	<0.5	0.00003	0.004	<0.01	7.3	<2	16.9
HHG000097	08 Dec 2015	08:28	<0.5	8.7	17.3	-	0.00066	0.157	0.13	7.2	4	12.2
HHG000098	08 Dec 2015	08:35	<0.5	9.4	17.4	-	0.00041	0.066	-	7.3	4	14.3
HHG000103	08 Dec 2015	08:40	0.7	10.6	18.8	-	0.0039	0.613	-	7.3	3	14.6
HHG000099	08 Dec 2015	08:51	0.9	17.8	22.7	-	0.00146	0.094		7.7	-	14.3
HHG000100	08 Dec 2015	08:50	0.7	21.8	20.8	<0.5	0.00058	0.07	0.03	7.4	340	15.1
HHG000106	08 Dec 2015	08:56	0.8	38.5	31.2	-	0.00489	1.53		7	-	14.6
HHG000109	08 Dec 2015	09:10	0.7	27.8	24.5	-	0.00208	0.319		7.3	-	14.9
HHG000115	08 Dec 2015	09:12	1	62.8	34.8	<0.5	0.0026	0.789	0.3	7	-	15
HHG000150	08 Dec 2015	09:33	0.9	68.9	36.8	<0.5	0.0033	0.676	0.39	7.1	46	17.2
HHG000190	08 Dec 2015	10:02	-	60	34.5	-	0.00445	0.594		7.3	-	16.8
HHG000093	16 Mar 2016	08:43	<0.5	18.7	20.4	<0.5	0.00006	0.017	<0.01	6.9	-	18

		Parameter	BODCF	CL	CONDY	TPH	NH_3	NH_4	NNN	pH	SS	TEMP-
Location ID	Date	Time	g/m^3	g/m^3	mS/m@20°C	g/m^3	g/m^3	g/m^3 N	g/m^3 N	pH	g/m^3	°C
HHG000097	16 Mar 2016	08:50	<0.5	10.3	19.2	-	0.00284	0.163	0.28	7.7	3	15.9
HHG000098	16 Mar 2016	08:55	1.3	17.5	30.7	-	0.03515	4.08	-	7.3	7	18.7
HHG000103	16 Mar 2016	08:59	**2.7**	19.7	37.5	-	**0.10293**	7.57	-	7.5	40	18.7
HHG000099	16 Mar 2016	09:15	1	14.8	25.2	-	0.00021	0.012	-	7.6	-	18.8
HHG000100	16 Mar 2016	09:20	0.7	26.6	31.5	<0.5	0.00157	0.14	0.03	7.4	-	19.2
HHG000106	16 Mar 2016	09:25	0.8	34.9	32.3	-	0.00745	1.04	-	7.2	-	19.3
HHG000109	16 Mar 2016	09:38	1.3	35.2	36.7	-	0.00635	0.726	-	7.3	-	18.9
HHG000115	16 Mar 2016	09:45	1.5	77.2	48	<0.5	0.00523	1.19	1.61	7	-	18.9
HHG000150	16 Mar 2016	09:50	0.7	142	68.1	<0.5	0.00057	0.075	0.94	7.2	7	20.2
HHG000190	16 Mar 2016	10:10	-	145	63.2	-	0.00009	0.009	-	7.3	-	20
HHG000093	08 Jun 2016	09:40	<0.5	16.8	18.7	<0.5	0.00017	0.078	0.2	7.1	-	6
HHG000097	08 Jun 2016	10:42	<0.5	12.8	20	-	0.00042	0.173	0.15	7.1	3	7.7
HHG000098	08 Jun 2016	10:45	0.6	14.3	22	-	0.00055	0.233	-	7.1	3	7.3
HHG000103	08 Jun 2016	10:48	1.4	17.9	31	-	0.02408	6.5	-	7.3	7	7.3
HHG000099	08 Jun 2016	10:57	<0.5	39.7	33.3	-	0.00306	1.41	-	7	-	9.4
HHG000100	08 Jun 2016	10:05	1.1	30.7	36.7	<0.5	0.00086	0.189	0.08	7.4	-	6.9
HHG000106	08 Jun 2016	11:07	<0.5	33.4	31.1	-	0.00573	1.57	-	7.3	-	7.1
HHG000109	08 Jun 2016	11:10	0.6	33.5	31.2	-	0.00834	1.79	-	7.4	-	7.3
HHG000115	08 Jun 2016	11:12	0.5	39.5	32.3	<0.5	0.00486	1.74	0.52	7.2	-	6.6
HHG000150	08 Jun 2016	11:46	0.6	64	39.7	<0.5	0.00689	2.88	0.63	7.1	29	7.6
HHG000190	08 Jun 2016	11:51	-	54.6	34.9	-	0.00696	2.21	-	7.2	-	8.2

2.1.2.3 Irrigation Pond Sampling

The irrigation pond sample is undertaken to ascertain the quality of the wastewater which is irrigated to the two specific irrigation paddocks (Figures 2 & 4). In the previous Section 2.1.2.2, the analysis of the Haehanga Stream was presented, and the notion of the sampling was to ascertain for any adverse affects primarily through chemical analysis in the first instance of effects which may have arisen as a direct result of inputs from the wetland treatment system and irrigation of waste water from the irrigation in pond in this period.

As there were limited exceedances in terms of the stream length analysis, the pond irrigation sample allows for a better understanding of the constituent concentrations

which are irrigated to the specific irrigation areas. The analysis of the irrigation pond is provided in Table 7.

In this monitoring period the discharge location IND002004 was sampled five times. 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 7 IND002004 Irrigation pond analysis 2015-2016

	Location ID	IND002044	IND002044	IND002044	IND002044	IND002044
	Date	05 Aug 2015	13 Oct 2015	08 Dec 2015	16 Mar 2016	08 Jun 2016
Parameter	Time	10:27	09:20	09:06	09:30	11:05
Arsenic Total	g/m^3	0.007	0.007	0.17	0.007	-
Benzene	g/m^3	0.0195	-	0.85	0.0055	-
Carbonaceous BOD	g/m^3	990	1,490	1,200	110	>8,000
Calcium	g/m^3	586	476	155	420	-
Chloride	g/m^3	1,430	1,780	1,690	2,880	-
Conductivity	mS/m@20 °C	559	771	905	990	-
Ethylbenzene	g/m^3	0.0036	-	0.22	<0.0010	-
HC C_7-C_9	g/m^3	0.7	-	16	<0.8	-
HC C_{10}-C_{14}	g/m^3	240	-	4,900	220	-
HC C_{15}-C_{36}	g/m^3	640	-	18,100	1,950	-
Total Petroleum Hydrocarbons	g/m^3	880	75	23,000	2,200	-

	Location ID	IND002044	IND002044	IND002044	IND002044	IND002044
	Date	05 Aug 2015	13 Oct 2015	08 Dec 2015	16 Mar 2016	08 Jun 2016
Parameter	Time	10:27	09:20	09:06	09:30	11:05
Potassium	g/m³	436	441	443	1,220	-
Magnesium	g/m³	30.3	35.6	38.1	49.9	-
Sodium	g/m³	333	1,030	1,250	1,160	-
Un-ionised ammonia	g/m³	0.18597	3.93125	7.29033		-
Ammoniacal Nitrogen	g/m³ N	84.3	199	225	180	-
Nitrite/Nitrate Nitrogen	g/m3 N	0.06	0.13	0.11	<0.05	-
Lead- Acid Soluble	g/m³	-	0.08	-	0.12	-
Lead- Dissolved	g/m³	0.12	-	-	-	-
Lead - Total	g/m³	-	-	0.62	-	-
pH	pH	7	7.7	7.8	-	7.5
Sodium Absorption Ration	None	3.63648	12.26685	23.32408	14.25393	-
Temperature	°C	9.6	17.6	21.3	25.8	18.9
Toluene	g/m³	0.042	-	7	0.0069	-
XYLENE-M	g/m³	0.021	-	1.3	<0.002	-
XYLENE-O	g/m³	0.0088	-	0.44	<0.0010	-

Analysis of the irrigation pond is provided in Table 7 above. Condition 9 states the maximum concentration of TPH permissible is 50,000 mg/L or 5% TPH. Analysis in this period denoted that the highest TPH concentration was 23,000 mg/L or 2.3% TPH, thus within the consented criteria.

Analysis of the irrigation pond throughout year has detailed a good deal of variation. For example, with the final sample collected in June 2016, it was not possible to undertake additional analysis due to a considerable concentration of oil within the sample. Note that this irrigation pond is skimmed regularly to remove surficial oils and this was not undertaken prior to this sample collection, with the laboratory citing it contained 97% oil.

While this would have constituted a breech in the specific condition in allowing greater than 5% TPH to be irrigated, this oil was skimmed and the following sample round indicated a TPH concentration of 37 mg/L[1]. In addition the outlet pipe is close to the base of the irrigation pond, thus the likelihood of this surficial oil being irrigated was very low.

2.1.3 Groundwater analysis

As previously discussed, 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/ emerging trends associated with the application of irrigation water from the irrigation pond.

- 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 8.

Table 8 Groundwater monitoring results RNZ Uruti 2015-2016

	Well ID	GND2188	GND2188	GND2189	GND2189	GND2190	GND2190
	Date	16 Mar 2016	08 Jun 2016	16 Mar 2016	08 Jun 2016	16 Mar 2016	08 Jun 2016
Parameter	Unit	08:45	10:05	09:45	10:45	10:20	11:50
Benzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m³	70.4	159	125	140	1,540	1,230
Conductivity	mS/m@20°C	71.2	66.7	85	53.4	462	368
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
HC C_7-C_9	g/m³	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
HC C_{10}-C_{14}	g/m³	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
HC C_{15}-C_{36}	g/m³	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
TPH	g/m³	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Level	m	1.43	0.675	1.244	0.796	1.606	1.04
Un-ionised ammonia	g/m³	0.00177	0.00001	0.00035	0.00004	0.00003	0.00002
Ammoniacal Nitrogen	g/m³ N	0.676	0.03	0.48	0.132	0.521	0.384
Nitrite/Nitrate Nitrogen	g/m³ N	<0.01	7.47	<0.01	<0.01	<0.01	<0.01
pH	pH	6.8	5.9	6.3	6	5.2	5.1
Total Dissolved Salts	g/m³	550.9	516.1	657.7	413.2	3574.5	2847.3
Temperature	°C	18.1	14.2	16.5	13.8	17.1	15.3
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-2	g/m³	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

[1] Analysis from the upcoming monitoring period 2016-17

	Well ID	GND2188	GND2188	GND2189	GND2189	GND2190	GND2190
	Date	16 Mar 2016	08 Jun 2016	16 Mar 2016	08 Jun 2016	16 Mar 2016	08 Jun 2016
Parameter	Unit	08:45	10:05	09:45	10:45	10:20	11:50
XYLENE-1	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

The monitoring well network was installed in August 2011 and the wells as discussed have been monitored by the Council biannually since their inception.

In this monitoring period the analysis detailed the following:

Total petroleum hydrocarbon concentrations were all below the limit of detection for this analyte, which is in similarity to the previous monitoring year, where there were no detections.

Benzene, toluene, ethylene and xylene (BTEX) concentrations were also below the limit of detection in all three wells as in similarity to the previous monitoring period.

Chloride concentrations in the up gradient bore, GND 2188, ranged between 70 g/m^3 and 159 g/m^3. This area is proposed to be the up gradient (control) bore, it is discerned to be a good measure of background groundwater concentrations[2]. Note that this reading of 159 g/m^3 is the highest reading in this well to date. Whereas in comparison, the mid site bore, GND2189 detailed a decrease in chloride values when compared to the long term record. The down gradient bore, GND2190, recorded its highest concentration to date with 1,540 g/m^3 chloride, before decreasing to 1,222 g/m^3 by the end of the monitoring period.

Of interest was the elevated concentration of nitrite/ nitrate nitrogen (NNN) within GND2188, which recorded a concentration of 7.47g/m^3 in the June sample, this corresponds to previous years where a spike of NNN has been detected at the same time of year, this was present in June 2013 and 2014, however not in 2015. Early analysis from the up coming period has detailed that this concentration has now decreased to nominal 1.6 g/m^3.

Conversely the range of NNN in the two other monitoring wells remained at a limit below the limit of detection in both rounds of sampling.

Un-ionised ammonia (NH_3) concentrations within the groundwater ranged between 0.0001 and 0.00177 g/m^3 across the three wells, which is a minimal concentration. In comparison ammoniacal nitrogen concentrations were slightly more elevated (0.03-0.676 g/m^3), this corresponds to the pH value observed in the samples (below 7) which would keep the ammonia in ionised state.

Specifically the main point of interest with this facility in respect to the groundwater is the concentration of total dissolved salts (TDS), and linked to this concentration will be the management of the irrigation system. In this period the downgradient bore,

[2] If the application of irrigation water is inferred to interact with the proposed control bore there may be a requirement to install an additional bore further up catchment to ascertain control conditions

GND2190 recorded its highest concentration of TDS, peaking at 3,575 g/m^3 prior to decreasing to 2,171 g/m^3 in the beginning of the following period.

This location has been subjected to irrigation wastewater since its inception and the operators should be mindful to not overload this area with future applications as they run the risk of developing lateritic soils as a direct result of increasing salt concentrations within clay (papa) soils. The lower irrigation area has now been bunded to prevent egress to the unnamed tributary via overland flow and this area will now begin to be utilised moving forward to allow the mid irrigation area fewer applications.

Long term TDS concentrations are provided in the following Figure 5.

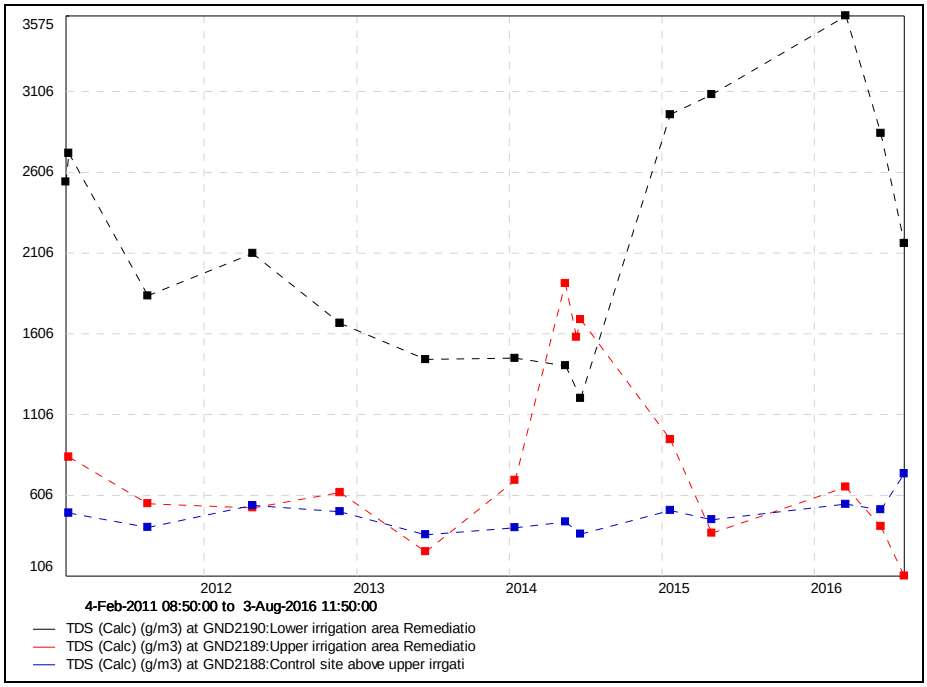

Figure 5 Long term TDS concentrations in groundwater RNZ Uruti

2.1.4 Soil sampling

Four composite soil samples were collected from the irrigation areas this monitoring period (Figure 4). Two soil samples per area, from the upper and lower irrigation areas[3]. The analysis of these four samples is provided in the following Table 9.

[3] Note when the newly developed lower irrigation area is active, additional soil samples will be required of this area.

Table 9 Soil analysis RNZ Uruti 2015-2016

	Location	Upper	Lower	Upper	Lower
	Sample ID	SOL000176	SOL000177	SOL000176	SOL000177
	Date	07 Apr 2016	07 Apr 2016	22 Jun 2016	22 Jun 2016
Parameter	Unit	10:30	11:10	12:45	13:45
Calcium	mg/kg	160.1	178.7	64.2	72.9
Chloride	mg/kg	1827.4	2502.6	319.7	156.1
Conductivity	mS/m@20C	271.1	560.5	132.6	103.7
Potassium	mg/kg	378.8	838.5	232.8	213.6
Moisture factor	nil	1.329	1.29	1.028	1.027
Magnesium	mg/kg	10	12.3	3.6	4.1
Sodium	mg/kg	303.7	664.4	124.4	120.2
Ammoniacal Nitrogen	g/m3 N	0.43	0.474	0.35	0.355
Nitrite/Nitrate Nitrogen	g/m3 N	0.78	0.76	0.08	0.96
pH	pH	6.8	7.2	6.4	7
Sodium Absorption Ratio (SAR)	None	6.29382	12.97103	4.09074	3.70881

In similarity to the previous monitoring period, the level of SAR in the lower irrigation area has remained at an elevated level, as indicated by the April 2016 sample. This concentration of SAR does not lend itself toward a sustainable utilisation of the lower irrigation area. Additional inputs of sodium to a soil system will displace beneficial elements in terms of calcium and magnesium and RNZ will need to re-visit their specific Soil and Groundwater Management Plan to aid them in mitigating the high SAR in this area. While there has been a elevated concentration of SAR recorded in this monitoring period, concurrent with the previous year, there also exists a good deal of variation across the irrigation areas. This is represented by the range found within both upper and lower areas. Lower area ranged between 12.9-3.7 while the upper 6.2-4.09 SAR. If this is compared to the range analysed in the previous monitoring period, lower ranged 12.26-7.4 and upper ranged 6.05-5.8.

Chloride concentrations ranged from 156-1,827 mg/kg upper area and 319-2,502 mg/kg, lower area, which in comparison to last year, (upper range 748-1,372 mg/kg and lower range 1,934-1,037 mg/kg) contained a higher maximum value.

Moving forward it may be prudent to isolate the elevated SAR areas in the lower area and allow them time to recover.

Of note, in the previous monitoring period the Council undertook total heavy metal analysis of the irrigation soils, whereby the findings were that the metal concentrations were in the ranges of expected natural background levels.

2.1.5 Biological monitoring of the unnamed tributary of the Haehanga Stream

2.1.5.1 Bio-monitoring Introduction[4]

Remediation (NZ) Ltd operates a composting facility in the Haehanga Valley, Uruti. 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 RNZ's worm farming operations at Waitara Road and Pennington Road.

This survey was the only survey scheduled for the 2015-2016 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 since 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

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[4] Please note that this bio-monitoring report has been shortened for this report, the full report is available for review in Appendix II

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.

2.1.5.2 Bio-monitoring 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 RNZ composting areas have 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 9 December 2015 found water flows in the Haehanga catchment to be low, with a slow to steady water speed noted at all sites. Community richnesses were slightly reduced upstream of the site, possibly due to a flushing flow occurring 10 days prior to this survey. Downstream of the site, especially at site 6 at the downstream extent of the irrigation area, a severe deterioration in macroinvertebrate community health was recorded. Coincident with this was the observation of a number of dead eels at and immediately downstream of this site. Furthermore, the sample collected at site 5, just downstream of the last treatment pond, released a hydrocarbon odour upon collection and processing. Overall, this survey found that macroinvertebrate communities of the three upstream mainstem sites and two unnamed tributary sites were of average to above average health, while the communities of the two sites downstream of the site showed severe deterioration. No undesirable heterotrophic growths were recorded at any of the seven sites in this survey.

The two sites in the unnamed tributary were sampled for the ninth time in the current survey, and exhibited a community relatively typical of this kind of habitat. However, there were some differences between these two sites. Site T2 recorded an above average MCI score, but an average $SQMCI_S$ score. Site T3 recorded MCI and $SQMCI_S$ scores lower than that recorded at site T2, although not significantly for either index score. 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 only *Chironomus* bloodworms increased slightly in abundance at site T3, coincident with the observation of a small discharge leaving the wetland.

There were insufficient changes in the community of the unnamed tributary to suggest that there were impacts from the discharge, and in contrast to most previous surveys, there also weren't many changes in taxa presence/absence that indicated 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, 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 all samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m^3. This shows good management of the unionised ammonia concentrations in the effluent being discharged. However, 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 low to moderate proportions of sensitive taxa. Low numbers of sensitive taxa are expected in small, silty bottomed streams such as the Haehanga Stream and with the exception of site 6, the numbers of taxa were generally similar to other lowland hill country streams surveyed at similar altitude. The community richness at site 6 was reflective of significant deterioration, with only six taxa recorded, ten taxa less than the previous minimum richness recorded at this site (of five previous surveys). MCI values recorded in the Haehanga Stream generally reduced in a downstream direction, although site 2 in the current survey recorded an MCI score of 99 units, the highest MCI score recorded in this catchment to date. Sites 1, 2 and 5 recorded average to above average MCI scores, with a significant drop at sites 6 and 7. Although previous surveys have also recorded some deterioration at sites 6 and 7, it has never been as severe as that recorded in the current survey.

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 four units greater than the median score for this site, despite the presence of hydrocarbons in the substrate. The $SQMCI_S$ score recorded at site 5 was reduced compared with that recorded at sites 1 and 2, indicating some deterioration. The results from the current survey indicate that *Chironomus* bloodworms were absent, suggesting that the deterioration did not extend for a long enough duration to allow this taxon to

establish in high numbers, or that the deterioration was related more to toxicity than organic enrichment.

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. The current survey recorded a depauperate community, which had an MCI score of 60 units, indicative of 'poor' water quality. Of the six taxa present, three were recorded as rarities (less than five individuals). If these taxa were removed from the MCI calculation, the score reduces to 27 units, an extremely poor result, suggesting 'very poor' water quality. The MCI score recorded in the current survey was significantly less than that recorded at site 5 upstream, the median for control sites in other lowland streams at a similar altitude, and also the median score for the other Haehanga Stream sites. This is an atypical result and evidence of severe deterioration. This conclusion is supported by the $SQMCI_S$ score, of 1.0 unit. This is the lowest score possible with the exception of sites that support no macroinvertebrate taxa. This significant reduction in $SQMCI_S$ score was due to the only taxa present in abundance being 'highly tolerant' oligochaete worms. This result is indicative of severe pollution, similar to that indicated by the MCI score and taxa richness. This is consistent with observations made at the time of the survey, with a number of dead eels noted at and immediately downstream of 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, but it does not explain the results of the current survey. The current survey however clearly shows that the water quality preceding this survey at this site, was extremely poor.

The lowest site (site 7) was sampled for the fifteenth time in this survey. There was no improvement in MCI score from that recorded upstream, but the $SQMCI_S$ score recovered slightly from that recorded at site 6. When compared with historical data the community at site 7 was in 'very poor' health, and indicative of a deterioration in water quality from previous surveys, although the $SQMCI_S$ score for this site (2.9) and taxa richness (14), shows that the degree of deterioration is not as severe as that recorded at site 6.

During certain previous surveys *Chironomus* blood worms 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 common at site 6 and rare at sites 7 and T3. This does not suggest a sustained 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. 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.

The actual discharge that caused the death of a number of eels and the poor results recorded at sites 6 and 7 could not be identified through further investigation.

This was the only macroinvertebrate programme scheduled for the 2015-16 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.

2.1.5.3 Fish survey introduction[5]

This survey is the third 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.

2.1.6 Fish survey summary and conclusions

On 9 and 10 December 2015, three sites were surveyed for freshwater fish in the Haehanga Stream in relation to the composting activities undertaken by RNZ. 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 g-minnow traps at each site overnight. These nets and traps were recovered the

[5] Please note the full fish survey report is attached with the full bio-monitoring report in Appendix II.

following morning, with all fish identified, counted and measured, with eels greater than 300 mm weighed.

At the time of this survey, the Haehanga Stream had a low but discernible 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. All sites contained moderate fish habitat, with deep pools, and good cover, although water temperatures 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 previous survey. Despite 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 less than that recorded in the previous survey. Over all sites, twenty-three fish were recorded across two species. In addition, an individual elver (juvenile eel) was observed in the unnamed tributary.

Of significant concern during this survey was the observation of seven dead eels at and downstream of site 2. These eels were in a progressed state of decay, and it was unclear when or why they died. However, when there is this number of dead eels noted at one time, it is very rarely due to natural circumstances. Also of concern was that 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 previous survey, when hydrocarbons were released from the sediment at site 3. There was also discolouration of the Haehanga Stream observed between sites 1 and 2, caused by works in an unnamed tributary.

It is worth noting that the macroinvertebrate survey undertaken on the first day of the fish survey found that macroinvertebrate communities of three upstream mainstream sites and two unnamed tributary sites were of average to above average health, while the communities of the two sites downstream of the site showed severe deterioration.

Due to the lack of fish at some sites, it is difficult to compare the results from the sites in the current survey. However, the two previous surveys have provided useful results with which the current results can be compared.

The site that would be most expected to exhibit impacts if there were any, site 2, recorded two species, and the highest abundance (15 fish) of the survey. However, inanga, which were recorded at this site in both previous surveys, were absent. This represents deterioration from the previous survey. Natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. However, it is possible that whatever caused the eel deaths in the vicinity of this site also impacted on the inanga population.

Site 3, further downstream also recorded two species, which represents a reduction of two species from the previous survey. As with site 2, inanga were absent, despite being recorded at this site in the previous survey.

Eels were recorded at all three sites, with the largest longfin eel being recorded at site 1. This individual was 950 mm long, and weighed 3.31 kg. The size class distribution of the eels was similar to that recorded in the previous survey, and considered to reflect the impacts of commercial eeling, which is understood to have occurred just prior to the 2013-2014 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 the few eels captured at sites 1 or 3 were in much better condition than would be expected. In contrast, the eels captured at site 2 were more similar to their expected weight, with the exception of one, which was about half its expected weight. This represents a change from that recorded in the previous two surveys, when no site had fish that were in better or worse condition than any other site, nor did they differ markedly from that predicted. 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 poorer health than could be expected, and as such suggests that the activities at the composting facility had negatively affected this community. With the exception of the dead eels, no observed fish exhibited any obvious physical damage or abnormalities.

During this survey, three access culverts were assessed for fish passage, and all were found to present at least some sort of barrier to fish passage. The worst culvert, located immediately above site 2, was perched and had swift flow. This would preclude the passage of a number of species, included inanga. All three culverts will need remedial works undertaken to ensure they meet the rules of the Regional Freshwater Plan for Taranaki. It is expected that the culvert immediately above site 2 will be remediated prior to the next fish monitoring survey, programmed for early summer 2016.

In summary, the barriers presented by the three access culverts, the presence of hydrocarbons upstream of site 2, the observations of dead eels and the results from the fish condition assessment indicate that the composting activities and wastewater irrigation undertaken by RNZ, 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.

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 RNZ provide for fish passage, and that the first remedial action be undertaken at the main crossing located just upstream of site 2.

2.2 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 RNZ. 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 courses 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 consent holder 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 2015-2016 period, the Council was required to undertake significant additional investigations and interventions, or record incidents, in association with RNZ's conditions in resource consents or provisions in Regional Plans.

11 December 2015

IN/32672: Incident
During routine monitoring it was found that a discharge had occurred into the overflow pond where it was likely that a discharge to water would occur if the system was not maintained.

The wall on the bunded ponds was close to overflowing into Haehanga stream, Uruti. Abatement Notice EAC-21036 was issued requiring works to be undertaken to ensure that no unauthorised discharges occur.

Re-inspection found that the abatement notice was being complied with at the time of inspection.

3. Discussion

3.1 Discussion of site performance

For RNZ, the Uruti facility is their primary composting and vermiculture facility. Material from this establishment is sent out to the Brixton facilities prior to heading to their clients. In this monitoring period RNZ began the initiation of their specific irrigation project, aided by BTW in its development. The irrigation project was designed to fill gaps and to aid mitigation against potential adverse environmental effects primarily related to site operations.

This plan, which among other facets, includes scope to extend the lower irrigation areas with bunded sides and associated piping, will prevent the potential for overland flow from the proposed irrigation area extension. Coupled to this, is the development of a storage dam further up the catchment to aid water flow in the unnamed tributary and the Haehanga in times of low flow. This will aid with mitigation of emerging trends which have been characterised in the past few monitoring years. Along with this implementation, RNZ also undertook a large logging operation coupled with a quarry development scheme.

Thus in terms of operations which have occurred at the facility, it could be inferred that a high level of management has been required in the 2015-2016. While the implementation of the irrigation plan was vital for the site, at times the level of supervision across other areas of the site could have been better.

Specifically, the management of the drill mud pit, associated pond treatment system, duck pond and Pad 1 will require improvement moving forward. In consent 5838-2, the acceptable wastes are defined in Condition 2. Poultry industry waste is permitted by this condition, this includes eggshells, yolks etc.

In mid December 2015 it was found that the management of the pond treatment system was inadequate and triggered the Council to issue an abatement notice to mitigate this issue. The follow up inspection found that the notice had been complied with. However, if this type of oversight were to re-occur the Council will increase surveillance and potentially limit product intake if it was deemed the site could not properly manage its incoming goods stream.

It has been recommended that RNZ exercise caution in regard to their proposed quarry development. The formation of the quarry road has led to slips of fine material which contain the potential to egress into the unnamed tributary of the Haehanga Stream.

Riparian management is on going in this facility, although stock access is hindering the growth of larger species. Management will be required to limit their access with proper fit for purpose fencing and associated wiring which is proposed. Linked to the fencing will be the re-planting of areas which were undertaken historically, however hindered by stock.

RNZ have been undertaking works towards additional site developments during the 2015-16 monitoring period. Given the environmental compliance issues reported in this report, it is recommended that these are resolved before the site is developed further.

This would include improving the through put, as at times the storage areas observed have appeared untouched for a prolonged period of time, despite the volume increasing.

The sites at Waitara and Pennington Roads, Brixton, appeared to well managed upon inspection by staff. The recently updated management plan was received. Site management responded promptly when required in mitigating the old IBC's which were stored on site. Little odour was cited on the boundary and mixing operations were undertaken in the correct weather conditions, worm beds were covered upon inspections. Site silt measures were discussed and appeared to be adhered to.

3.2 Environmental effects of exercise of consents

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

The wetland treatment system specifically treats effluent and stormwater associated with the paunch pad and surrounding pond. This source is primarily ammonia rich fluid. The discharge point of this wetland is quantified and has consented concentrations which it must adhere to. In this monitoring period there was a minor exceedance of the consented concentration of suspended solids on one occasion.

Once this discharge joins the unnamed tributary stem of the Haehanga Stream, it has 40 meters with which to mix, post this mixing zone it must meet an additional consent condition. On one occasion, of the five in which the Council collected samples, the level of un-ionised ammonia was above its consented limits, (this led to re-sampling, whereby the subsequent analysis was found to be under its conditional value). RNZ undertook some bank stabilisation measures post the initial finding, whereby one bund required improvement as a newly positioned worm bed had the potential to leach to the unnamed tributary in this area, which was positioned just upstream of the confluence with the discharge of the wetland treatment system.

As the discharge travels down the main stem, it is also quantified further at two locations for specific analytes. In October 2015, the monitoring of the stream indicated that at the downstream location of the two specific monitoring locations, the concentration of carbonaceous biochemical oxygen demand (BODCF) had been exceeded.

The groundwater analysis indicated that chloride levels are beginning to increase in the groundwater, as a direct result of the irrigation from the irrigation pond. This is evident in the down gradient monitoring well, while the two up gradient wells are, by comparison, less affected. When the sum of the salts is analysed, the concentration of TDS follows the same indicative line as the chloride impacts, with two of the three wells indicating effects, albeit with a larger order of magnitude. RNZ needs to address this increasing saline trend or risk developing lateritic soils when consideration is given to the underlying clay lithology.

The saline impacts are also prevalent in the lower of the current two irrigation paddocks. Soil sampling detailed impacts in terms of an elevated SAR, with a value of 12 returned in this period in line with the previous monitoring period. Also of note is the rise of the SAR in the upper irrigation area. Management should be wary to allow

time for areas to recover and in doing so adopt the approach of their specific management plan which details a tiered approach for mitigating an elevated SAR.

Biological monitoring of the Haehanga Stream and associated unnamed tributary was undertaken this period. The macroinvertebrate survey conducted on 9 December 2015 found water flows in the Haehanga catchment to be low, with a slow to steady water speed noted at all sites. Community richnesses were slightly reduced upstream of the site, possibly due to a flushing flow occurring 10 days prior to this survey.

Downstream of the site, especially at site 6 which is the downstream extent of the irrigation area, a severe deterioration in macroinvertebrate community health was recorded. Coincident with this was the observation of a number of dead eels at and immediately downstream of this site. Furthermore, the sample collected at site 5, just downstream of the last treatment pond, but upstream from the eel discovery released a hydrocarbon odour upon collection and processing. Follow up inspection undertaken by the Council were unable to discern the cause of death for the eels found as they were in advanced state of decay, also sediment sampling was undertaken to attempt to find the hydrocarbon odour conveyed by the biologist. All of which were inconclusive.

However, a bund was identified which had the potential to overflow in storm conditions and RNZ were abated to mitigate this (December 2015). This was undertaken swiftly by the site management and follow up inspections indicated this was complied with.

Surface water analysis undertaken by the Council throughout the year indicated two exceedances when compared to the consented conditions. As previously discussed, an elevation in carbonaceous biochemical oxygen demand (BODCF) analysed in October 2015 at the lowest surface water monitoring site and un-ionised ammonia post the wet land treatment system recorded in March 2016.

While these were only minor exceedances, RNZ will need to keep mindful with the application of the wetland discharge which at times has the potential to exceed its consented concentration of 0.025g/m^3 NH_3 un-ionised ammonia, post its mixing zone. Though this only occurred once during Council monitoring in March 2016, the potential remains. However, with the proposed dam project, RNZ will be able to utilise this resource to aid with additional dilution of the wetland discharge if required. This is proposed to further aid with mitigating the discharge from the wetland treatment system moving forward.

While the Council was unable to ascertain the cause of death with respect to the perished eels, RNZ should be mindful that the macroinvertebrate communities in the same area where the eels were found were also negatively impacted when compared to the previous year's assessment. Surface water monitoring also found that one of the two exceedances were found in this area, in terms of BODCF as previously discussed.

Moving forward the Council will undertake additional monitoring of the lower reaches, specifically in the areas where the discovery of the eels were made and may include the biologist's suggestion of in-situ temperature loggers to quantify the temperature profile of the Haehanga Stream and associated tributaries throughout the year.

The undertaking of the quarry works had led to slips of fine sediment from the valley side of the road up to the quarry. The Council had requested that this be addressed and will monitor this moving forward as additional sedimentation into the unnamed tributary of the Haehanga Stream will adversely affect species in this water body. This is an area which has been beginning to show decline biologically when compared to previous bio-monitoring surveys.

The issue around perched culverts which have the potential to limit the upstream migration of native fish is to be rectified by RNZ in the 2016-2017 monitoring period.

Overall, RNZ has had an effect on the environment this monitoring year and the progress in the upcoming period will be closely monitored.

Waitara and Pennington Roads Brixton

These sites were well managed overall with no environmental effects to report.

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 10-16.

Table 10 Assessment of performance for consent 5838-2 in the 2015-2016 monitoring period

Purpose 5838-2: ***To discharge of waste to land and treated stormwater and leachate to water at Mokau Road Uruti***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practical option	Programme management/site inspections	No. Various issues require improved management
2. Only acceptable waste accepted onto site	Site inspections/review of supplied records	Yes
3. DAF residue not to be accepted	Site inspections/review of supplied records	Yes
4. Maintenance of stormwater systems	Site inspections	No – maintenance requested by Council
5. Maintenance of treatment systems	Site inspections	No – maintenance requested by Council
6. Adequate pond construction	Site inspections	No- abatement notice issued
7. Keep and supply irrigation records	Data supplied and reviewed	Yes
8. No direct discharges to occur as a result of irrigation	Site inspections /sampling	Possible release though not confirmed
9. Irrigated fluids not to exceed 5% hydrocarbon content	Site inspections /sampling	Yes
10. Discharges not to cause adverse effects at site HHG000150 and HHG00100	Sampling/inspection	No, biological monitoring suggests effects

Purpose 5838-2: ***To discharge of waste to land and treated stormwater and leachate to water at Mokau Road Uruti***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
11. Soil sampling to be undertaken	Undertaken by the Council	Yes
12. Submit a Soil Management Plan if requested by the Council	Plan requested and supplied	Yes
13. Adhere to Soil Management Plan	This needs to be adhered to mitigate the rise in SAR	No
14. Establish groundwater monitoring bores	Site inspections	Yes
15. Groundwater sampling to be undertaken	Undertaken by the Council	Yes
16. Submit a Groundwater Management Plan if requested by the Council	Plan requested and supplied	N/A
17. Adhere to Groundwater Management Plan	Yes, though elevation in TDS concentration evident in low monitoring bores	Yes
18. Prepare a Pond Treatment System Management Plan	Plan received and reviewed	Yes
19. Adhere to Treatment System Management Plan	Inspection	For the most part
20. Prepare a Wetland Treatment System Management Plan	Plan received and reviewed	Yes
21. Adhere to Wetland Treatment System Management Plan	Inspection	Yes
22. Wetland discharge not to exceed certain parameters	Sampling	No. One minor exceedance in suspended solid limit
23. Wetland discharge not to cause certain effects at site HHG000103	Sampling.	No. One minor exceedance in NH_3
24. Maintain riparian plantings	Continued development required	Yes
25. Notify the Council of significant incidents on site	No notifications received	No. Uncertain evidence of potential event
26. Prepare a Site Reinstatement Plan prior to site closure	N/A	N/A
27. Adhere to Site Reinstatement Plan	N/A	N/A
28. Optional Review	Review 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		**Improvement required** **Good**

Table 11 Assessment of performance for consent 5839-2 in the 2015-2016 monitoring period

Purpose 5839-2: ***To discharge of 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
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	Assessment received and reviewed	Yes
9. Submit Proposed Implementation Plan	Plan received and reviewed	Yes
10. Adhere to Proposed Implementation Plan	Proposals adopted and incorporated into other plans	Yes
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	Yes
14. Install a weather station and provide data	Inspection	No
15. Conduct odour surveys	Undertaken by the Council	Not required
16. Hold community meeting	Meeting held in 2011-no attendees	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

Purpose 5839-2: *To discharge of emissions to air at Mokau Road, Uruti*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

Table 12 Assessment of performance in respect of consent 5893-2 in the 2015-2016 monitoring period

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

Table 13 Assessment of performance for consent 5892-2 in the 2015-2016 monitoring period

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. Storm water management plan	Received	Yes
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 storm water effects	Samples were not collected during the period under review	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 14 Assessment of performance for consent 5938-2.0 in the 2015-2016 monitoring period

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. Notification prior to commencement of works	No works undertaken this period	N/A
2. Construction in accordance with application	Site inspections	No. Culverts perched and rocks blocking fish passage
3. Best practicable option	Site inspections	No
4. Minimisation of riverbed disturbance	Site inspections	Yes

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?**
5. Reinstatement of site	N/A	N/A
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		**Improvement required** **Good**

Table 15 Assessment of performance for consent 6211-1 in the 2015-2016 monitoring period

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 16 Assessment of performance for consent 6212-1 in the 2015-2016 monitoring period

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

Purpose: *To establish and maintain a culvert at Mokau Road, Uruti*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
5. Minimisation of riverbed disturbance	Site inspections	Yes
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**

During the year, RNZ demonstrated in terms of there Uruti facility an overall environmental performance that needs improvement. Their administrative performance was high. The rationale was centred on the biological monitoring results and the potential for an uncontrolled bund discharge.

In terms of the Brixton and Waitara Road facilities, RNZ demonstrated a high level of environmental and administrative performance with respect to their consents.

Ratings are as defined in Section 1.1.4

3.4 Recommendations from the 2014-2015 Annual Report

In the 2014-2015 Annual Report, it was recommended:

1. THAT the 2015-2016 monitoring programme for the Waitara Rd and Pennington Road sites remain unchanged from that undertaken in the 2014-2015 period.

2. THAT the 2015-2016 monitoring programme for the site at Mokau Road, Uruti remain unchanged from that undertaken in the 2014-2015 period.

3. THAT the option for a review of resource consent 5838 in June 2016, as set out in condition 28 of the consent, be exercised, on the grounds that current conditions are not adequate for dealing with any adverse effects arising from the exercise of this consent.

4. THAT the option for a review of resource consent 5839 in June 2016, as set out in condition 20 of the consent, not be exercised, on the grounds that current conditions are adequate for dealing with any adverse effects arising from the exercise of this consent.

Recommendations 1 and 2 were implemented and recommendation 3 is planned for mid 2017.

3.5 Alterations to monitoring programmes for 2016-2017

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

- the extent of information made available by previous authorities;
- its relevance under the RMA;
- its obligations to monitor emissions/discharges and effects under the RMA; and
- to report 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 emitting to the atmosphere/discharging to the environment.

It is proposed that for 2016-2017 that the compliance monitoring programme remains as it was for this monitoring period.

3.6 Exercise of optional review of consent

Resource consent 5838-2 provides for an optional review of the consent in June 2017. Condition 28 allows the Council to review the consent, if there are grounds that invoke a review.

Based on the results of monitoring in the year under review, and in previous years as set out in earlier annual compliance monitoring reports, it is considered that there are grounds to exercise the review option if the monitoring indicates a continued downward trend in the in-stream biology.

This will be assessed throughout the 2016-2017 year and be determined by May 2017.

4. Recommendations

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.

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.

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

4. THAT the option for a review of resource consent 5838 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.

Glossary of common terms and abbreviations

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

Al*	Aluminium.
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.
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}	Relatively fine airborne particles (less than 10 micrometre diameter).
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.

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Appendix I

Resource consents held by Remediation NZ Limited

(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

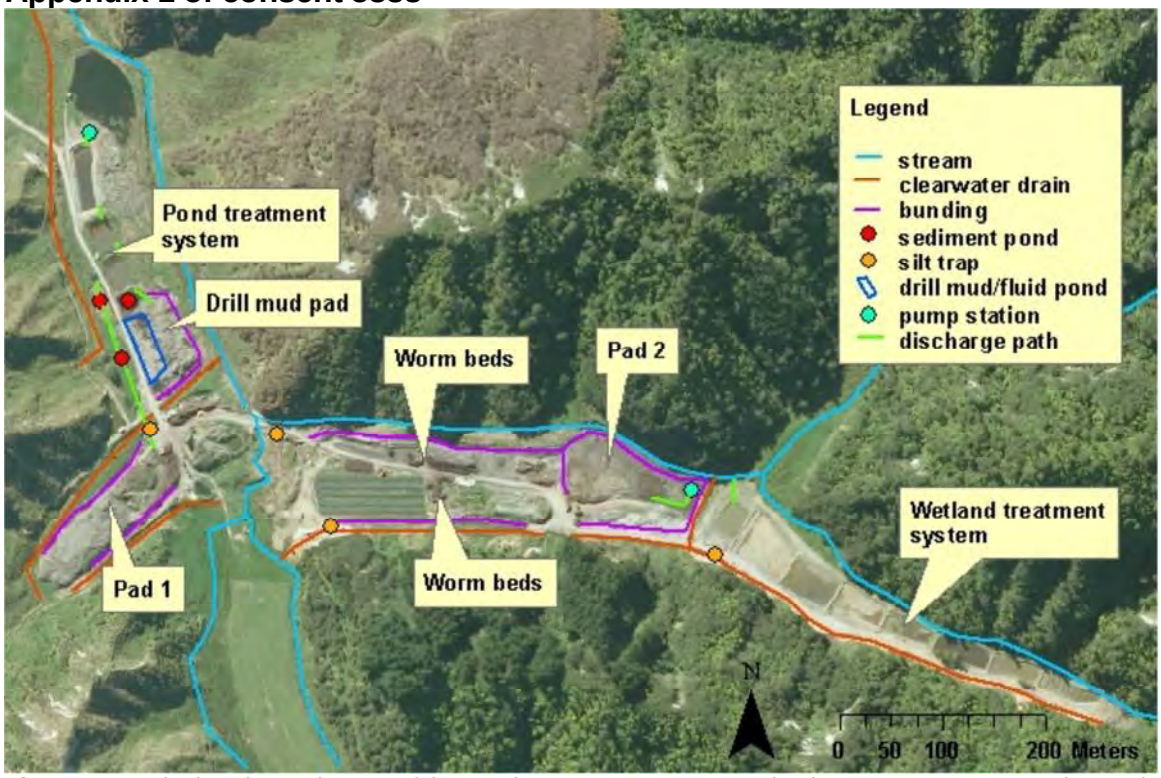

Figure 1 The location and extent of the Pond Treatment System, Wetland Treatment System, Pads 1 and 2, and the Drill Mud Pad.

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

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Director-Resource Management

Appendix 1 of consent 5839-2

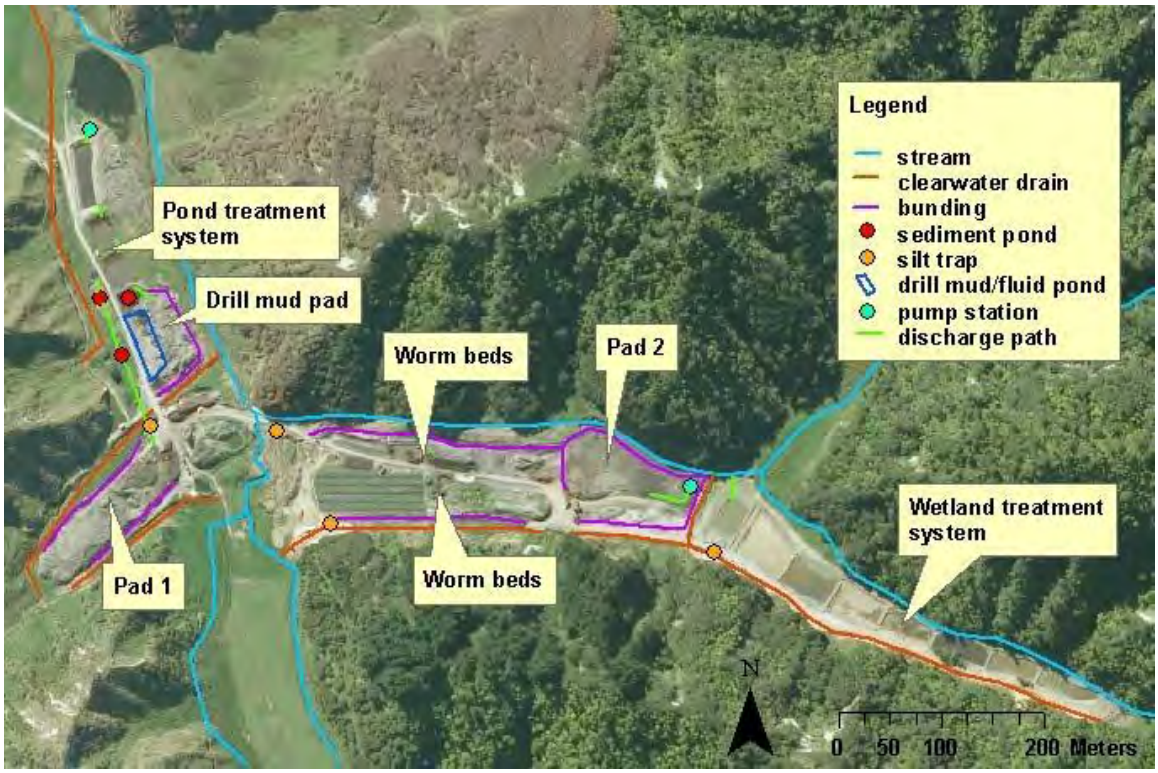

Figure 1 The location and extent of the composting operation including Pads 1 and 2.

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

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	PEL Waste Services Limited P O Box 3091 HAMILTON
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 GR: Q19:163-416
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 12 October 2006

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Land Use Consent

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

Name of Consent Holder:	Remediation (NZ) Limited P O Box 8045 NEW PLYMOUTH 4342
Consent Granted Date:	5 December 2001

Conditions of Consent

Consent Granted:	To erect, place, use and maintain a twin culvert in, on and over the bed of the Haehanga Stream in the Mimi catchment for vehicle access purposes at or about (NZTM) 1731701E-5685876N
Expiry Date:	1 June 2015
Review Date(s):	June 2003, June 2009
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 and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.

2. The structure[s] authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.

3. 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.

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

5. The structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

6. 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 2003 and/or June 2009, 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

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Director-Resource Management

Land Use Consent

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

Name of Consent Holder:	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

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Director-Resource Management

Land Use Consent

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

Name of Consent Holder:	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

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	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, Job Manager
From	Bart Jansma; Scientific Officer
Report No	BJ286
Document No	1707921
Date	30 June 2016

Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2015

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 2015-2016 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 since 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 sites 1 and 7, and the Council's standard 'streambed kick' sampling technique was used at sites 2 and 6. A combination of the 'streambed kick' and 'vegetation sweep' sampling techniques was used at sites T2, T3 and 5 (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	Vegetation sweep
T2	HHG000098	Upstream of wetland discharge point	Kick-sweep
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	Vegetation 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 which 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. More 'sensitive' communities inhabit less polluted waterways.

A gradation of biological water quality conditions based upon MCI ranges has been adapted for Taranaki streams and rivers from Stark's classification (Stark, 1985 and Boothroyd & Stark, 2000). This is as follows:

Grading	MCI	Code
Excellent	>140	
Very Good	120-140	
Good	100-119	
Fair	80-99	
Poor	60-79	
Very Poor	<60	

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.

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 17.6°C to 22.0°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. Unfortunately, flows in the Haehanga Stream at this time were still low, while in the unnamed tributary they were very low. The flow was yellow and clear at site 1, while works in a tributary that joins between sites 1 and 2 resulted in a brown and dirty flow at site 2 (Photo 1). Further downstream, at sites 5, 6 and 7, the flow was yellow and cloudy, as was the flow at sites T2 and T3, in the unnamed tributary. This cloudiness is typical of the Haehanga Stream, with associated yellow to brown discolouration. With the exception of the works being undertaken in a tributary during the current survey, this 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, only a very small discharge 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 1 December 2014.

Due to the low flows, riffle habitat was only available for sampling at sites 2 and 6. Usually vegetation is sampled at site 2, but during the current survey, the channel had been opened by a previous flood event and there were no macrophytes to sample. This site had also experienced a significant amount of bank slumping (Photo 1). Substrate at site 6 comprised predominantly of coarse gravels, with fine gravel and cobbles, which enabled the 'streambed kick' sampling technique to be employed. The remaining sites were sampled using either the 'vegetation sweep' sampling technique, or a combination of the 'vegetation sweep' and 'streambed kick' sampling techniques. The underlying substrate at these sites comprised predominantly of silt, with the addition of some hard substrate, including either hard clay, gravels or wood and root.

With the exception of sites 2 and 6, all sites supported aquatic vegetation, with such growth observed at the edges of the stream at sites 5 and T2, and throughout the stream at the remaining three sites. There were few algal mats observed in the stream, being present at site 6 only, in patches. Sites 1 and 6 supported widespread growths of filamentous algae, which was growing throughout the macrophyte beds at site 1. The remaining sites supported only a thin film of algae on the substrate.

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

Of significant concern during this survey was the observation of seven dead eels at and downstream of site 6 (Photo 2). These eels were in a progressed state of decay, and it was unclear when or why they died. However, when there is this number of dead eels noted at one time, it is very rarely due to natural circumstances. Also of concern was that the sample

collected at site 5 smelt of hydrocarbons, and that there was a hydrocarbon sheen noted on the surface. This follows on from the observations made during the previous survey, when hydrocarbons were released from the sediment at site 7 during surveying for fish.

Photo 1 (left)

Discolouration noted at site 2, caused by works in an unnamed tributary upstream. Note also the significant bank slumping at this site.

Photo 2 (below)

Dead eels observed immediately downstream of site 6.

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 2015)) 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 2015).

Site	Number of previous surveys	Numbers of taxa			MCI values			$SQMCI_s$ values		
		Median	Range	Current	Median	Range	Current	Median	Range	Current
LOWL*	21	22	18-30	-	78	68-109	-	4.0	2.7-6.2	-
1	11	22	19-27	**17**	71	68-78	**71**	3.8	2.7-4.2	**3.9**
2	19	19	17-23	**18**	74	62-87	**99**	3.9	2.7-4.4	**5.7**
5	18	19	6-28	**14**	73	53-83	**77**	2.9	1.1-4.1	**2.4**
6	5	20	16-24	**6**	73	68-79	**60**	2.9	1.7-3.1	**1.0**
7	14	21	12-30	**14**	71	62-82	**59**	3.3	1.3-4.3	**2.9**
T2	8	23	20-30	**25**	85	79-92	**94**	5.1	4.6-6.2	**5.2**
T3	8	27	24-32	**27**	82	84	**84**	4.4	3.5-5.4	**4.7**

*$SQMCI_s$ median and range based on only 20

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

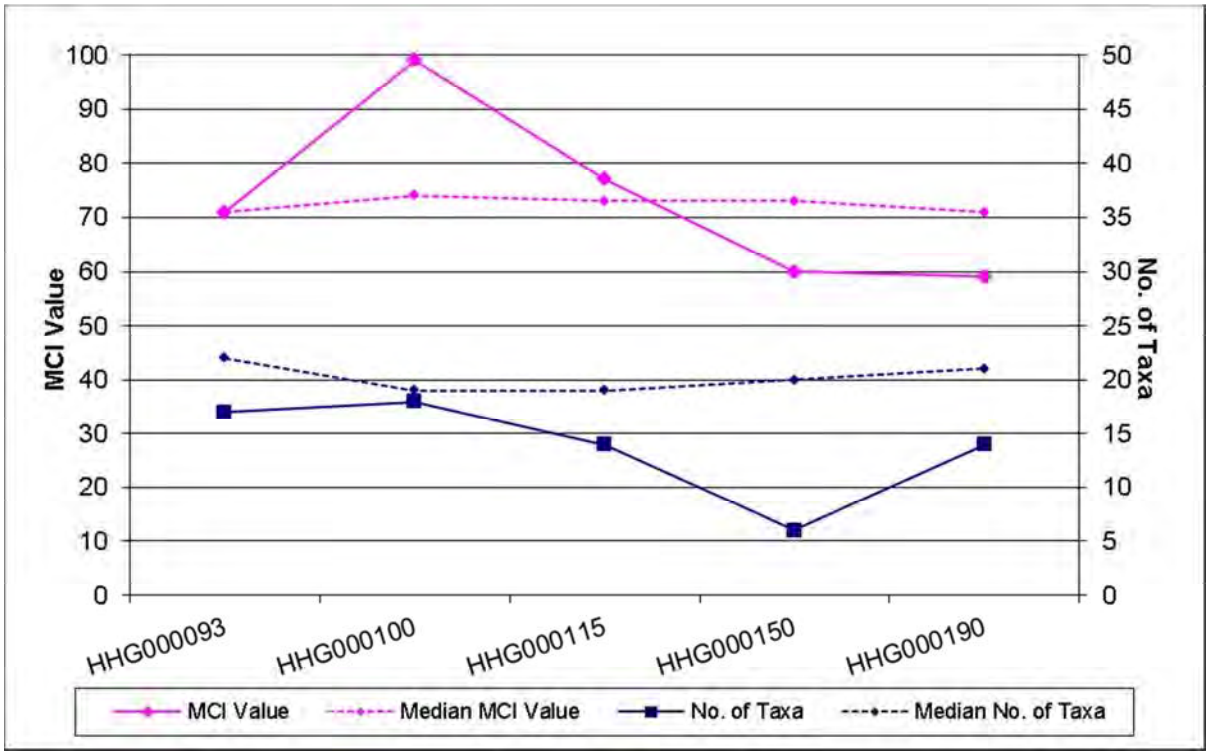

Figure 2 Number of taxa and MCI scores recorded at each Haehanga Stream sites during the current survey, compared with the respective medians for these sites.

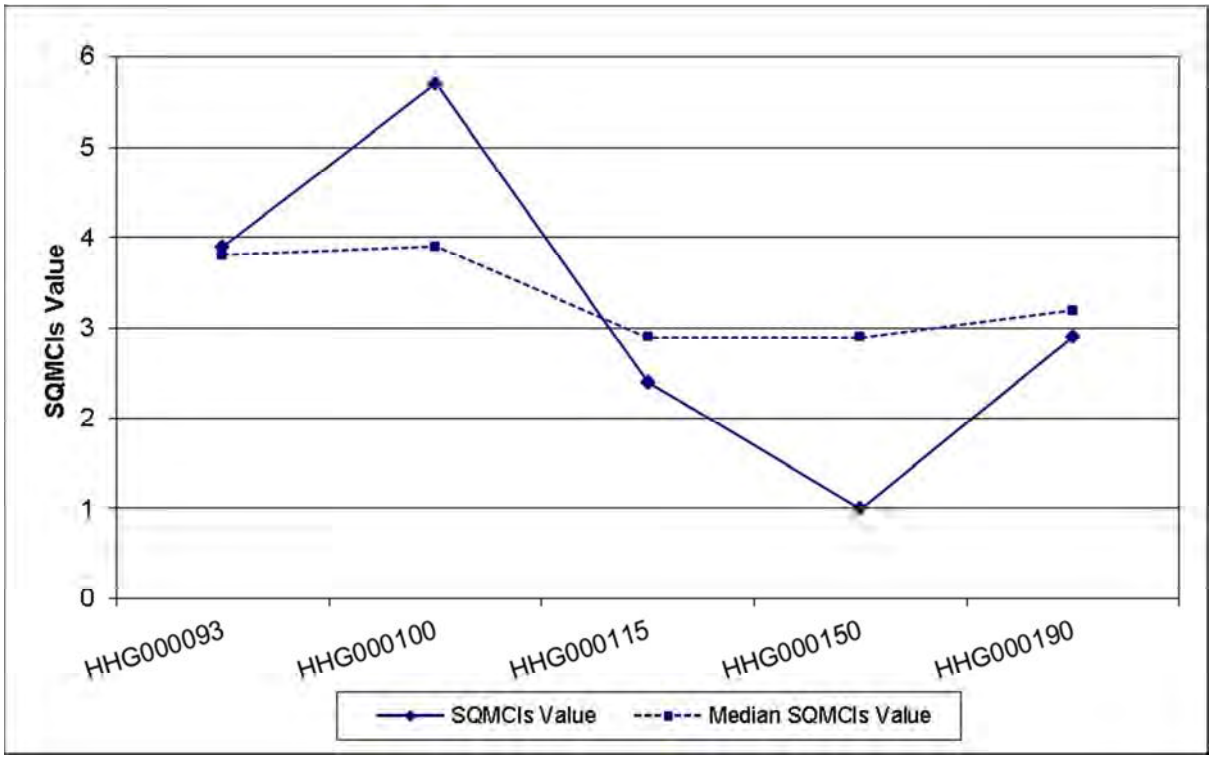

Figure 3 SQMCI$_S$ scores recorded at each Haehanga Stream sites during the current survey, compared with the respective medians for these sites.

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. This is quite a drop (ten taxa) from the previous (summer) survey, which recorded the highest richness for this site to date (Figure 4), and may reflect the earlier timing of this survey. This survey was undertaken only ten days after the last fresh in this stream, and preceding flow conditions may have flushed out a number of taxa from this stream.

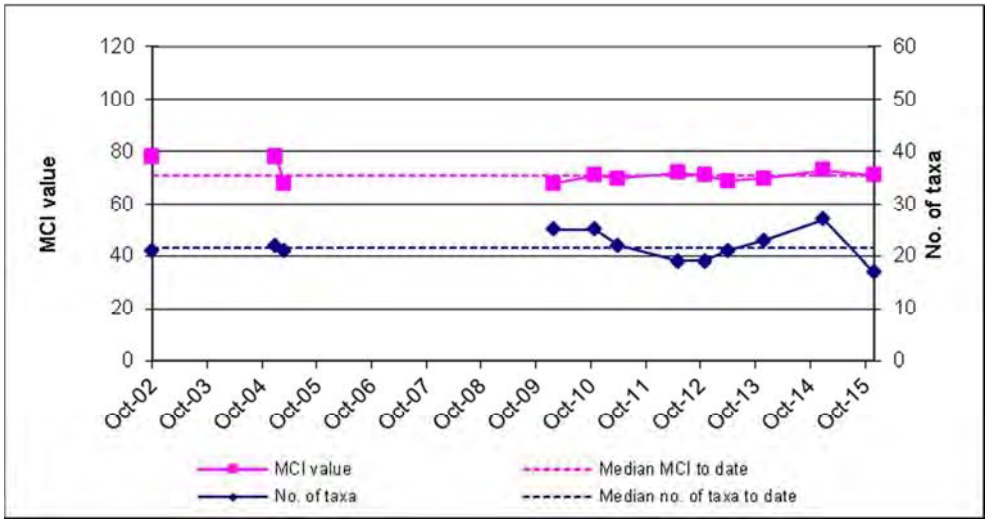

Figure 4 Taxa numbers and MCI recorded to date at site 1

Table 3 Macroinvertebrate fauna of the Haehanga Stream catchment, sampled in relation to Remediation (NZ) Ltd on 9 December 2015.

Taxa List	Site Number	MCI score	1	2	5	6	7	T2	T3
	Site Code		HHG000093	HHG000100	HHG000115	HHG000150	HHG000190	HHG000098	HHG000103
	Sample Number		FWB15365	FWB15366	FWB15367	FWB15368	FWB15369	FWB15370	FWB15371
NEMERTEA	Nemertea	3	R	-	-	-	-	-	-
ANNELIDA	Oligochaeta	1	R	A	VA	XA	A	C	C
	Lumbricidae	5	-	R	R	-	-	C	-
HIRUDINEA	Hirudinea	3	R	-	-	-	-	-	R
MOLLUSCA	*Gyraulus*	3	-	-	-	-	R	-	-
	Lymnaeidae	3	-	-	-	-	-	R	-
	Physa	3	R	-	-	-	C	-	R
	Potamopyrgus	4	XA	C	A	-	VA	VA	XA
	Sphaeriidae	3	R	-	-	-	-	-	-
CRUSTACEA	Ostracoda	1	A	-	R	-	C	-	-
	Paracalliope	5	A	C	-	-	-	XA	XA
	Paranephrops	5	-	-	-	-	-	R	R
EPHEMEROPTERA	*Austroclima*	7	-	R	-	-	-	-	-
	Deleatidium	8	R	VA	A	-	-	VA	VA
	Zephlebia group	7	-	C	-	-	-	A	A
PLECOPTERA	*Acroperla*	5	-	C	-	-	-	R	C
	Austroperla	9	-	R	-	-	-	-	-
ODONATA	*Austrolestes*	4	-	-	-	-	-	-	R
	Xanthocnemis	4	VA	R	R	-	A	R	C
	Aeshna	5	R	-	-	-	-	-	-
HEMIPTERA	*Anisops*	5	-	-	-	-	R	R	-
	Microvelia	3	-	-	-	-	-	-	R
COLEOPTERA	Elmidae	6	-	R	-	-	-	-	-
	Dytiscidae	5	-	-	-	-	R	R	C
	Hydrophilidae	5	-	-	-	-	-	R	-
	Ptilodactylidae	8	-	-	-	-	-	R	-
TRICHOPTERA	*Hydrobiosis*	5	-	R	-	-	-	R	R
	Polyplectropus	6	-	-	R	-	-	R	R
	Psilochorema	6	-	R	-	-	-	C	C
	Oxyethira	2	C	-	R	-	R	-	R
	Triplectides	5	R	-	-	-	-	-	-
DIPTERA	*Aphrophila*	5	R	-	-	-	-	-	-
	Eriopterini	5	-	-	-	-	-	R	-
	Hexatomini	5	-	-	R	-	-	R	R
	Paralimnophila	6	-	R	-	R	-	-	R
	Zelandotipula	6	-	-	R	-	-	-	-
	Chironomus	1	-	-	-	C	R	-	R
	Orthocladiinae	2	C	A	VA	C	VA	C	C
	Polypedilum	3	-	-	A	R	-	C	C
	Tanypodinae	5	-	-	-	R	-	-	R
	Culicidae	3	-	-	-	-	R	-	-
	Paradixa	4	-	-	R	-	R	A	C
	Empididae	3	A	R	-	-	A	R	R
	Muscidae	3	-	R	R	-	-	-	-
	Austrosimulium	3	R	A	-	-	-	A	VA
	Stratiomyidae	5	-	-	-	-	-	-	R
ACARINA	Acarina	5	-	-	-	-	-	R	-
	No of taxa		17	18	14	6	14	25	27
	MCI		71	99	77	60	59	94	84
	SQMCIs		3.9	5.7	2.4	1.0	2.9	5.2	4.7
	EPT (taxa)		2	7	2	0	0	6	6
	%EPT (taxa)		12	39	14	0	0	24	22

'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 71 units. This is five units higher than the minimum score recorded previously at this site and two units above 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. This score is only slightly less than the median MCI score for other similar lowland streams, and equal to the long term median for this site, indicating that although this score is low, it is relatively typical for streams of this nature.

The community was dominated by an extremely abundant 'tolerant' taxon, (snail (*Potamopyrgus*). Other dominant 'tolerant' taxa included seed shrimps (Ostracoda), damselfly larvae (*Xanthocnemis*) and Empidid midge larvae). 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, 0.3 unit higher than the previous survey but 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, 18 macroinvertebrate taxa were recorded. This was five taxa fewer than that recorded in the previous survey but only one taxa less than the median for this site (Table 2). The community was dominated by three 'tolerant' taxa, (oligochaete worms, orthoclad midge larvae and sandfly larvae (*Austrosimulium)*), and one very abundant 'highly sensitive' taxon, (*Deleatidium* mayfly)) (Table 3).

The MCI value of 99 units reflected a relatively high proportion of sensitive taxa in the community at this site (61%). This score is significantly higher than the previous maximum score recorded at this site, and is twenty-five units higher than the median, also a statistically significant difference (Stark 1998)(Table 2, Figure 3). The $SQMCI_S$ value at this site (5.7) was also significantly higher than the previous maximum score and median value, and reflected the fact that the community supported a very abundant population of *Deleatidium* mayfly (Table 2, Table 3).

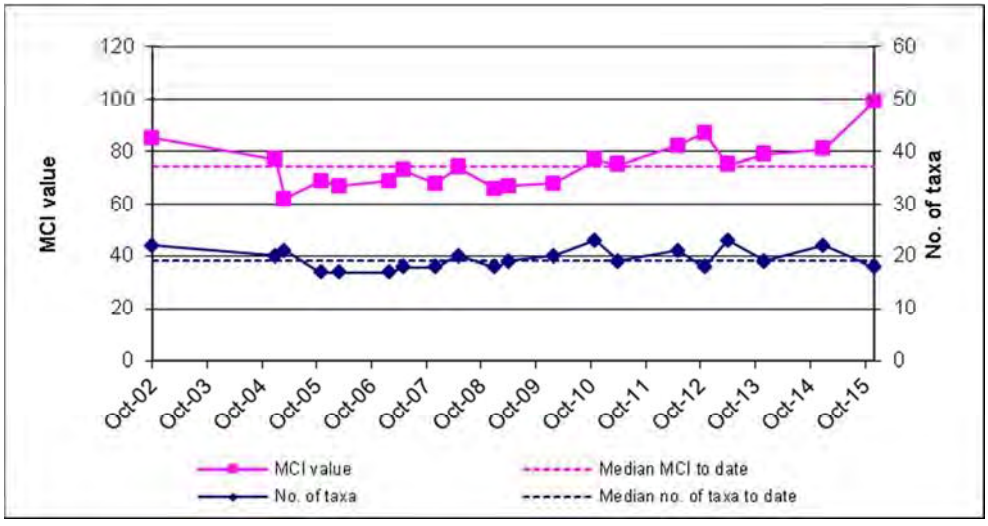

Figure 5 Taxa numbers and MCI recorded to date at site 2

Although this suggests that water quality at this site was 'fair' (TRC, 2015) and well above average, it should be noted that the sampling technique was changed during this survey. Historically, this site was sampled using the vegetation sweep technique. The current survey used the kick sample technique 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. However, the current results are particularly high, with both indices recording scores higher than that recorded at any other Haehanga mainstem site by either sampling technique. This is despite the discolouration caused by works in an upstream tributary, and the habitat disturbance that had occurred since the previous survey (Photo 1).

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 in abundance 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, 14 taxa were recorded, five taxa less than the median of the eighteen previous surveys, and nine less than that recorded in the previous survey (Table 2, Figure 3). This reduced richness may be a reflection of the flushing flow that occurred ten days previous, although the hydrocarbon odour released when the sample was collected indicates some sort of contamination of the stream. Four 'tolerant' taxa dominated the community at this downstream site (oligochaete worms, snails (*Potamopyrgus*) and midge larvae (orthoclads and *Polypedilum*). Unlike the previous survey, one 'highly sensitive' taxon was recorded in abundance (*Deleatidium* mayfly) (Table 3). The numerical dominance of very abundant 'tolerant' oligochaete worms and orthoclad midge larvae resulted in a $SQMCI_S$ score of 2.4 units, a statistically insignificant 0.5 unit lower than the median for this site, but a very significant 3.3 units less than that recorded at site 2 (Stark, 1998). The MCI score (77) was only four units greater than the median score for this site, equal to that recorded in the previous survey (Figure 6), but twenty-two 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 (36%), which was 25% lower than at the upstream site 2 (Table 2).

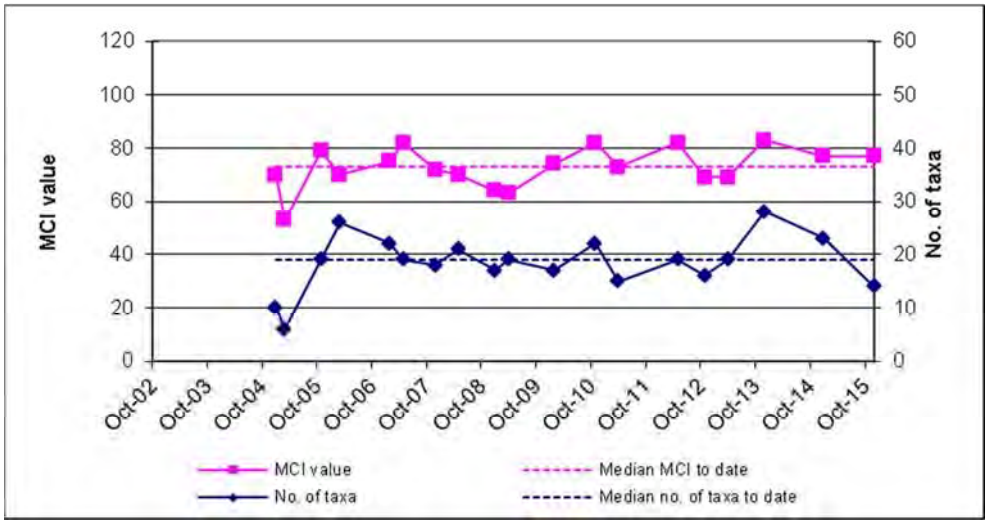

Figure 6 Number of taxa and MCI scores recorded to date at Site 5

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* blood worms becoming abundant at this site. The results from the current survey indicate that *Chironomus* blood worms were absent at the time of the survey. In total, significant changes in abundance were recorded for five taxa, including a decrease in three 'sensitive' taxa. Overall, this community appears to be in average community health, although still indicative of poor water quality.

Site 6 – Downstream of effluent irrigation area

A poor richness of 6 taxa was recorded at this site, located downstream of the effluent irrigation area (Table 2, Figure 7). The community was dominated by only one 'tolerant' taxon (extremely abundant oligochaete worms. A notable absence was that of *Potamopyrgus* snails, which has been recorded in abundance in four of the previous five surveys, and has never before been absent at this site. There was more than enough periphyton to sustain this species at the time of sampling.

The depauperate community recorded in the current survey resulted in an MCI score of 60 units, indicative of 'poor' water quality (TRC, 2015). Of the six taxa present, three were recorded as rarities (less than five individuals). If these taxa were removed from the MCI calculation, the score reduces to 27 units, an extremely poor result, suggesting 'very poor' water quality. The MCI score recorded in the current survey was significantly less than that recorded at site 5 upstream, the median for control sites in other lowland streams at a similar altitude (TRC, 1999), and also the median score for the other Haehanga Stream sites (Table 2, Figure 2).

The $SQMCI_S$ score was influenced entirely by the extremely abundant oligochaete worms. This resulted in a $SQMCI_S$ score of 1.0 unit, the lowest possible $SQMCI_S$ score with the exception of sites that support no invertebrates. Considering this, it is not surprising that this is the lowest $SQMCI_S$ score recorded in the Haehanga Stream catchment to date, and was significantly less than any other score recorded in the current survey (Table 2, Figure 3). This result is indicative of severe pollution (Stark& Maxted, 2007a), similar to that indicated by the MCI score and taxa richness. This is consistent with observations made at the time of the survey, with a number of dead eels noted at and immediately downstream of this site.

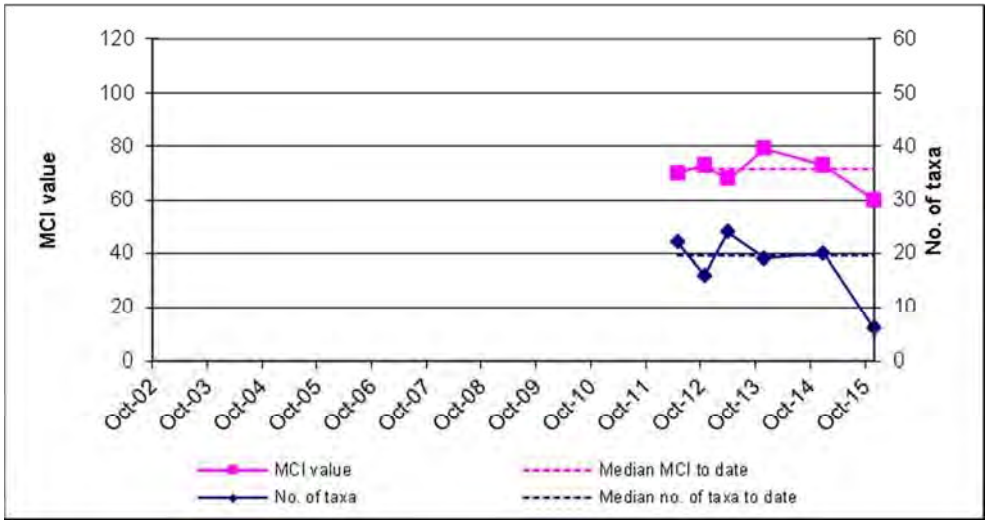

Figure 7 Number of taxa and MCI scores recorded to date at Site 6

Previous surveys, especially the most recent one, had noted $SQMCI_S$ scores at this site that were lower than would 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 current survey however clearly shows that the water quality which preceded this survey at this site was extremely poor.

Site 7 – Downstream of all site activities

This site exhibited moderately low taxa richness (14), five taxa fewer than the median, and seven taxa fewer than the previous survey undertaken at this site. The 'very poor' MCI score of 59 was due to the community comprising 86% 'tolerant' taxa, of which five were abundant (oligochaete worms, damselfly larvae (*Xanthocnemis*), empidid midge larvae) to very abundant (snails (*Potamopyrgus*), orthoclad midge larvae). Only two 'moderately sensitive' taxa were recorded at this site in the current survey, both as rarities (less than five individuals).

The MCI score of 59 was less than that recorded in the previous survey, by eight units, which although a large drop, is not a statistically significant result (Stark, 1998) (Table 2 and Table 7). This score was significantly less than the median score for this site however (Stark, 1998), and the lowest score recorded at this site to date, by three units (Figure 8). It was also the lowest MCI score recorded in this survey (Table 2, Figure 2). The abundance of 'tolerant' taxa, especially snails and orthoclad midge larvae, resulted in a $SQMCI_S$ of 2.9 units, 0.4 unit less than the median for this site but 0.8 unit less than that recorded in the previous survey. This is only the second time in the last twelve surveys where a below median $SQMCI_S$ score has been recorded at this site.

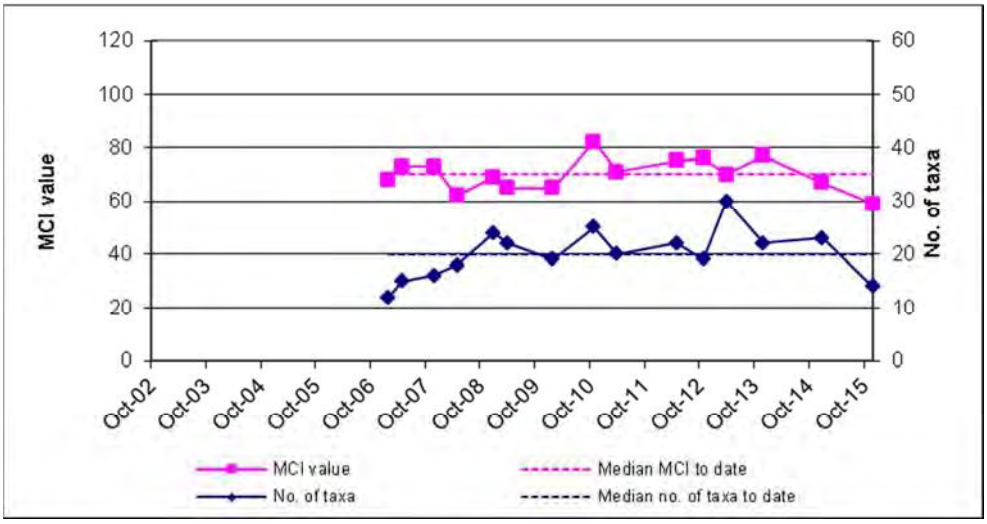

Figure 8 Number of taxa and MCI scores recorded to date at Site 7

When compared with site 6 upstream, the MCI score was similar, while the $SQMCI_S$ score improved significantly, due mainly to the reduced abundance of oligochaete worms and improved abundance of *Potamopyrgus* snails. There were five significant differences in individual taxon abundance recorded between sites 6 and 7, all increases. This indicates that the impacts evident at site 6 were not evident to the same degree at site 7, although the low

MCI and $SQMCI_S$ scores indicate that this community was also in below average health and reflective of probable severe pollution.

During some previous surveys, concern was raised regarding an extreme abundance of *Chironomus* blood worm larvae at this site. Such abundance usually only occurs where there is a significant organic discharge, which the *Chironomus* blood worm 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, twenty-five macroinvertebrate taxa were recorded at site T2, upstream of the wetland discharge point. This was a similar to 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 two 'highly sensitive' taxa in the community, and the abundance of numerous 'sensitive' taxa.

Extremely abundant *Paracalliope,* a 'moderately sensitive' amphipod, dominated the community. Other taxa recorded in abundance included three 'tolerant' taxa (snails (*Potamopyrgus*), sandfly larvae (*Austrosimulium*) and midge larvae (*Paradixa*)), one moderately sensitive taxon (*Zephlebia* mayfly) and one 'highly sensitive' taxon (mayfly (*Deleatidium*) (Table 3).

This community had a relatively high MCI score (94), reflecting the improved proportion of sensitive taxa present (64%) (Figure 9). This MCI score is sixteen units higher than the median MCI score for control sites in similar streams and three units higher than that recorded in the previous survey. The $SQMCI_S$ value of 5.2 was 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 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. Although the current survey found higher index scores at site 2 in the Haehanga Stream, this is an atypical result.

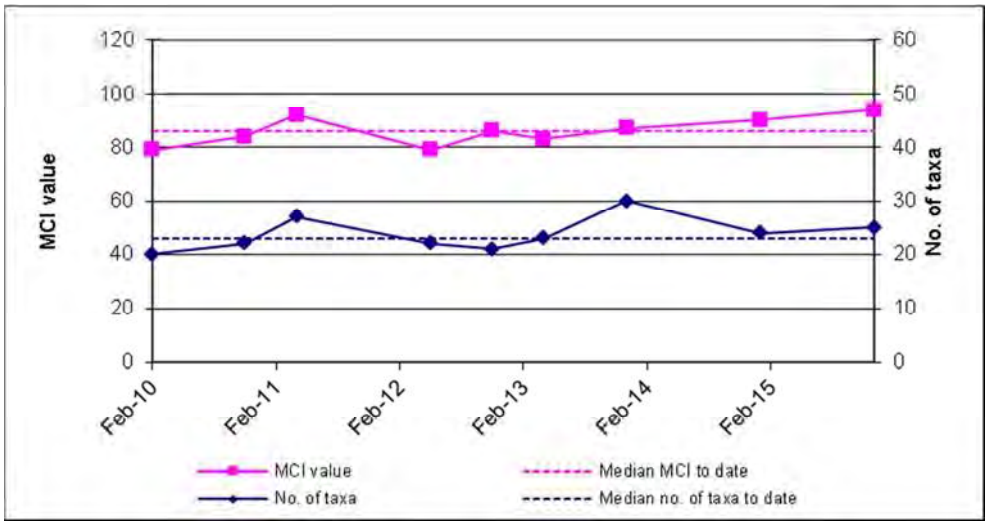

Figure 9 Taxa numbers and MCI recorded to date at site T2

Site T3 – downstream of the wetland discharge point

This is the ninth time that macroinvertebrates have been sampled at this site, located approximately 20 metres downstream of the wetland discharge. Twenty-seven taxa were recorded at this site. This is five taxa less than what was recorded in the previous survey but two 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 two 'tolerant' taxa, (snails (*Potamopyrgus*) and sandfly larvae (*Austrosimulium*)) (Table 3). This site had a slightly lower proportion of sensitive taxa (48%) than site T2 upstream, resulting in the reduced MCI score (84). Although this is not a statistically significant result (Stark, 1998), it is a reduction, and may suggest some impact from the wetland discharge. However, it was primarily caused by a number of taxa present only as rarities at one site but being absent at the other, 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 one taxon changing significantly in abundance between the sites. The significant increase in the abundance of *Chironomus* bloodworms and oligochaete worms observed in the previous survey were not apparent in the current survey. The highly sensitive mayfly *Deleatidium* was very abundant at both sites. This lack of change in the community also resulted in little change in $SQMCI_S$ score between site T2 and T3. The $SQMCI_S$ score of 4.7 at site T3 was an insignificant (Stark, 1998) 0.3 unit higher than the median for this site and an insignificant 0.7 unit higher than the median $SQMCI_S$ score for similar streams at comparative altitudes (TRC, 1999).

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 the 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 all samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m^3. This shows good management of the unionised ammonia concentrations in the effluent being discharged. However, 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.

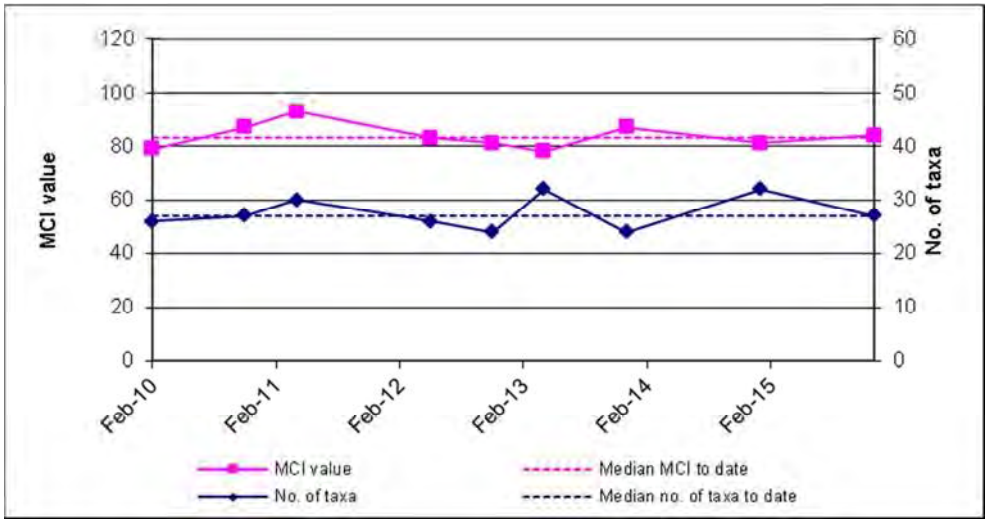

Figure 10 Taxa numbers and MCI recorded to date at site T3

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 9 December 2015 found water flows in the Haehanga catchment to be low, with a slow to steady water speed noted at all sites. Community richnesses were slightly reduced upstream of the site, possibly due to a flushing flow occurring 10 days prior to this survey. Downstream of the site, especially at site 6 at the downstream extent of the irrigation area, a severe deterioration in macroinvertebrate community health was recorded. Coincident with this was the observation of a number of

dead eels at and immediately downstream of this site. Furthermore, the sample collected at site 5, just downstream of the last treatment pond, released a hydrocarbon odour upon collection and processing. Overall, this survey found that macroinvertebrate communities of the three upstream mainstem sites and two unnamed tributary sites were of average to above average health, while the communities of the two sites downstream of the site showed severe deterioration. No undesirable heterotrophic growths were recorded at any of the seven sites in this survey.

The two sites in the unnamed tributary were sampled for the ninth time in the current survey, and exhibited a community relatively typical of this kind of habitat. However, there were some differences between these two sites. Site T2 recorded an above average MCI score, but an average $SQMCI_S$ score. Site T3 recorded MCI and $SQMCI_S$ scores lower than that recorded at site T2, although not significantly for either index score. 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 only *Chironomus* bloodworms increased slightly in abundance at site T3, coincident with the observation of a small discharge leaving the wetland.

There were insufficient changes in the community of the unnamed tributary to suggest that there were impacts from the discharge, and in contrast to most previous surveys, there also weren't many changes in taxa presence/absence that indicated 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, 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 all samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m^3. This shows good management of the unionised ammonia concentrations in the effluent being discharged. However, 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 low to moderate proportions of sensitive taxa. Low numbers of sensitive taxa are expected in small, silty bottomed streams such as the Haehanga Stream and with the exception of site 6, the numbers of taxa were generally similar to other lowland hill country streams surveyed at similar altitude. The community richness at site 6 was reflective of significant deterioration, with only six taxa recorded, ten taxa less than the previous minimum richness recorded at this site (of five previous surveys). MCI values recorded in the Haehanga Stream generally reduced in a downstream direction, although site 2 in the current survey recorded an MCI score of 99 units, the highest MCI score recorded in this catchment to date. Sites 1, 2 and 5 recorded average to above average MCI scores, with a significant drop at sites 6 and 7. Although

previous surveys have also recorded some deterioration at sites 6 and 7, it has never been as severe as that recorded in the current survey.

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 four units greater than the median score for this site, despite the presence of hydrocarbons in the substrate. The $SQMCI_S$ score recorded at site 5 was reduced compared with that recorded at sites 1 and 2, indicating some deterioration. The results from the current survey indicate that *Chironomus* bloodworms were absent, suggesting that the deterioration did not extend for a long enough duration to allow this taxon to establish in high numbers, or that the deterioration was related more to toxicity than organic enrichment.

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. The current survey recorded a depauperate community, which had an MCI score of 60 units, indicative of 'poor' water quality. Of the six taxa present, three were recorded as rarities (less than five individuals). If these taxa were removed from the MCI calculation, the score reduces to 27 units, an extremely poor result, suggesting 'very poor' water quality. The MCI score recorded in the current survey was significantly less than that recorded at site 5 upstream, the median for control sites in other lowland streams at a similar altitude, and also the median score for the other Haehanga Stream sites. This is an atypical result and evidence of severe deterioration. This conclusion is supported by the $SQMCI_S$ score, of 1.0 unit. This is the lowest score possible with the exception of sites that support no macroinvertebrate taxa. This significant reduction in $SQMCI_S$ score was due to the only taxa present in abundance being 'highly tolerant' oligochaete worms. This result is indicative of severe pollution, similar to that indicated by the MCI score and taxa richness. This is consistent with observations made at the time of the survey, with a number of dead eels noted at and immediately downstream of 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, but it does not explain the results of the current survey. The current survey however clearly shows that the water quality preceding this survey at this site, was extremely poor.

The lowest site (site 7) was sampled for the fifteenth time in this survey. There was no improvement in MCI score from that recorded upstream, but the $SQMCI_S$ score recovered slightly from that recorded at site 6. When compared with historical data the community at site 7 was in 'very poor' health, and indicative of a deterioration in water quality from previous surveys, although the $SQMCI_S$ score for this site (2.9) and taxa richness (14), shows that the degree of deterioration is not as severe as that recorded at site 6.

During certain previous surveys *Chironomus* blood worms 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 common at site 6 and rare at sites 7 an T3. This does not suggest a sustained 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. 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.

The actual discharge that caused the death of a number of eels and the poor results recorded at sites 6 and 7 could not be identified through further investigation.

This was the only macroinvertebrate programme scheduled for the 2015-16 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.

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Memorandum

To Nathan Crook, Scientific Officer
From Bart Jansma, Scientific Officer
Report No BJ287
Document 1711817
Date 8 July 2016

Fish Survey of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2015

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 third 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 g-minnow traps. At each site, five g-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 9 December 2015, and retrieved midmorning on 10 December 2015.

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

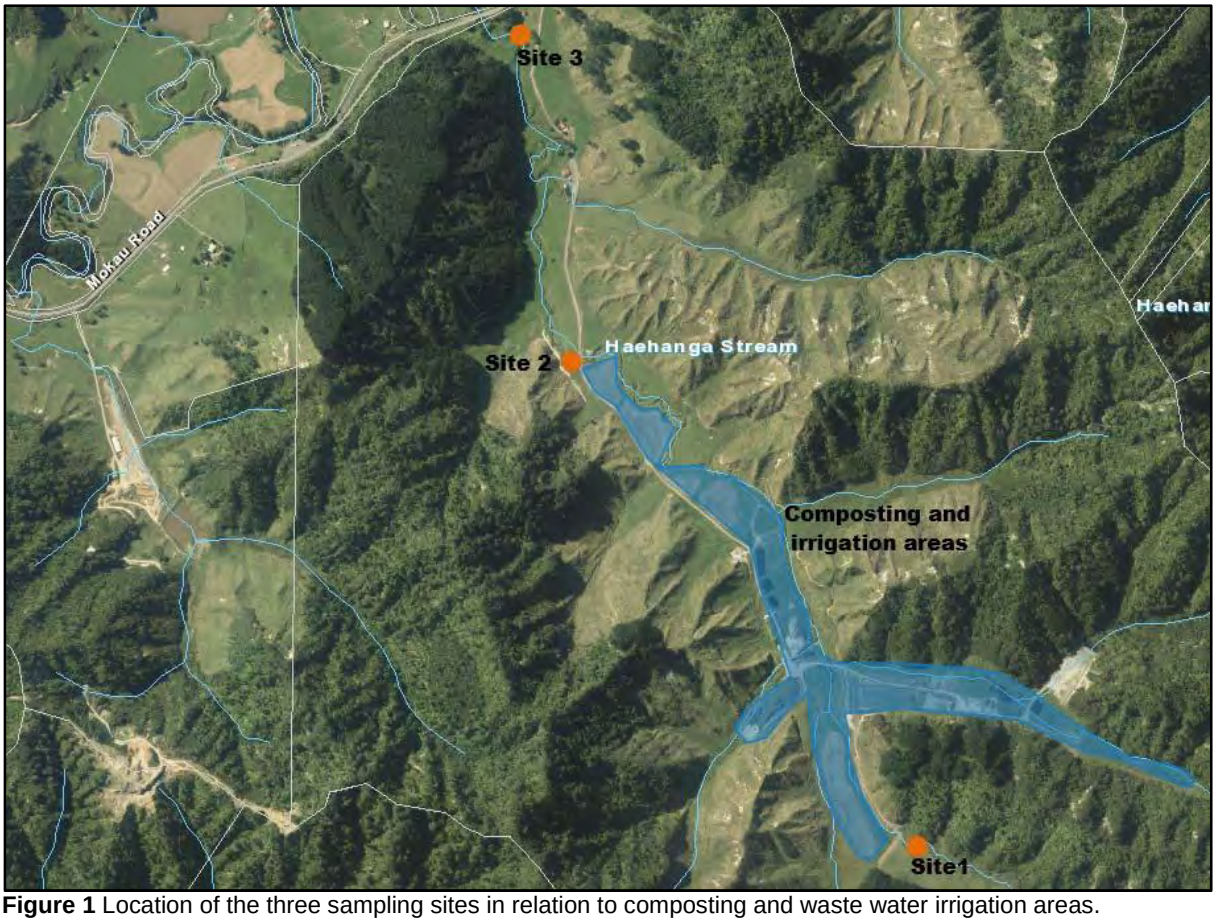

Figure 1 Location of the three sampling sites in relation to composting and waste water irrigation areas.

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

Results and Discussion

At the time of this survey, the Haehanga Stream had a low flow, but with discernible 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. 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 18.2 to 22.0 ˚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)).

Of significant concern during this survey was the observation of seven dead eels at, and downstream of site 2 (Photo 2). These eels were in a progressed state of decay, and it was unclear when or why they died. However, when there is this number of dead eels noted at one time, it is very rarely due to natural circumstances. Also of concern was that 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 previous survey, when hydrocarbons were released from the sediment at site 3. There was also discolouration of the Haehanga Stream observed between sites 1 and 2, caused by works in an unnamed tributary.

It is worth noting that the macroinvertebrate survey undertaken on the first day of the fish survey found that macroinvertebrate communities of three upstream mainstem sites and two unnamed tributary sites were of average to above average health, while the communities of the two sites downstream of the site showed severe deterioration.

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

Photo 2 (top)

Dead eels observed immediately downstream of site 2.

Photo 3 (left)

Discolouration noted between sites 1 and 2, caused by works in an unnamed tributary upstream. Note also the significant bank slumping at this site.

Table 2 Results of the fish survey undertaken in the Haehanga Stream in relation to Remediation NZ's composting operations.

Site:			Site 1			Site 2			Site 3	
Net/Trap type:		Previous results	Fyke net	G-minnow trap	Previous results	Fyke net	G-minnow trap	Previous results	Fyke net	G-minnow trap
Number of minutes fished:			2390	5975		2200	5500		2020	5050
Longfin eel (*Anguilla dieffenbachii*)	Number	4-4	2	1	1-12	2	-	1-2	2	-
	Length range (mm)	478-1045	605-950	212	365-802	462-580	-	431-672	700-870	-
	Weight range (kg)	0.24-2.70	0.78-3.31	-	0.10-1.04	0.27-0.52	-	0.18-0.74	1.52-2.61	-
Shortfin eel (*Anguilla australis*)	Number	0-1	-	-	4-17	13	1	2-3	3	-
	Length range (mm)	195	-	-	210-838	196-850	345	510-790	588-790	-
	Weight range (kg)	-	-	-	0.02-0.98	0.10-0.82	0.09	0.26-0.98	0.88-1.57	-
Inanga (*Galaxias maculatus*)	Number	-	-	-	1-11	-	-	0-6	-	-
	Length range (mm)	-	-	-	86-123	-	-	-	-	-
Redfin bully (*Gobiomorphus huttoni)*	Number	-	-	-	-	-	-	0-1	-	-
	Length range (mm)	-	-	-	-	-	-	70	-	-
Total number of species		2	1		3	2		4	2	
Total number of fish		-	3		-	15		-	5	

Site 1

This site recorded the lowest number of species of this survey with one species recorded, being longfin eel. It is likely that this result reflects two factors. First, the reduced flow at this site which results in reduced habitat. Secondly, barriers to fish passage observed downstream will 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. This site recorded the largest eel of this survey, being 950mm long and weighing 3.310 kg.

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. Little change was noted since the previous survey with regards to the provision of fish passage downstream. 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 equal highest species richness (2) and the highest abundance (15) of the three sites surveyed. Inanga were not recorded at this site, despite being recorded as present in the previous two surveys. This represents a reduction in species richness. Natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. However, it is possible that whatever caused the eel deaths in the vicinity of this site also impacted on the inanga population.

Sixteen eels were captured, of which fourteen were shortfin eels, one being relatively large at 850mm and 0.820kg and two were longfin eels. This represents a decrease from the number of eels recorded in the previous survey, which recorded twenty-nine eels. This is despite the improved flow conditions, which should have resulted in more flow past the nets and traps, and conceivably more fish captured.

It is likely that this community has been influenced by a number of factors. The presence of dead eels just downstream indicates that there was a discharge from the composting facility that was toxic to these fish. It is unknown where the dead eels were when they were killed, but their positioning (above the current water level) indicates that they were killed during a higher flow, and as such are likely to have come from upstream of site 2. However, the discharge responsible may have also impacted on the communities of site 2, either by killing fish or causing them to move downstream in an effort to escape the discharge.

It is apparent that site 2 still had a much higher abundance than that recorded upstream at site 1. This suggests that the barrier to fish passage posed by the access culvert immediately upstream of this site (Photo 4) is significant enough to reducing the passage of eels. This is similar to that concluded during the last survey. It was noted during the current survey that the access culvert appeared even more perched than previously.

These results indicate that the composting activities and/or irrigation of wastewater upstream has caused the death of a number of eels, and possibly contributed to a reduced abundance and species richness at this site. Furthermore, the access culvert is considered to present a severe restriction to fish passage, which limits the species abundance upstream, and also limits the recovery of upstream fish communities.

Photo 4 The access culvert immediately upstream of site 2, 9 December 2016.

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.

Only five fish were recorded at this site, down from twelve recorded in the previous survey. As with site 2, inanga were absent despite being recorded in the previous survey. Two longfin eels and three 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 2, with the loss of inanga from the community suggesting that impacts from the upstream composting operations extended to this site. Overall, these results represented deterioration from that recorded in the previous survey, a result consistent with the results from the macroinvertebrate survey undertaken on the same day (Jansma, 2016).

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 2 shows that although there were a lower number of eels recorded during the 2015-16 survey than that recorded in the 2014-15 survey, it was higher than that recorded in the 2013-2014 survey. The size class distribution was similar, with the community largely dominated by eels less than 700mm long. This is consistent with the impacts of commercial eeling, which is understood to have occurred just prior to the 2013-14 survey. 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 unlikely to record eels smaller than 150mm.

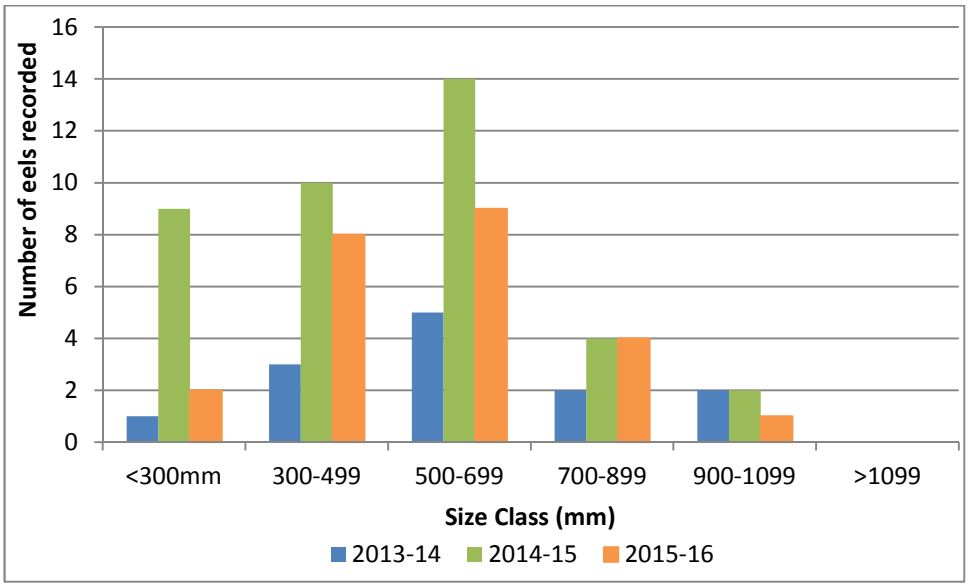

Figure 2 The size class distribution of all eels captured at all sites over the three surveys undertaken to date.

Fish condition

The composting activities undertaken alongside the Haehanga Stream have the potential to release a range of substances to the stream, including some which 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 3 shows that although not many longfin eels were collected at these sites, those recorded at sites 1 and 3 were in much better condition than expected whereas the two

longfin eel recorded at site 2 were closer to that expected. Shortfin eel showed a similar result, with the three eels captured at site 3 being well in excess of the expected weight, and the thirteen eels captured at site 2 being more similar to their expected weight, with the exception of one, which was about half its expected weight. This represents a change from that recorded in the previous two surveys, when no site had fish that were in better or worse condition than any other site, nor did they differ markedly from that predicted by Jellyman *et al* (2013). The trend lines in Figure 3 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, 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 poorer health than could be expected, and as such suggests that the activities at the composting facility had affected this community.

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

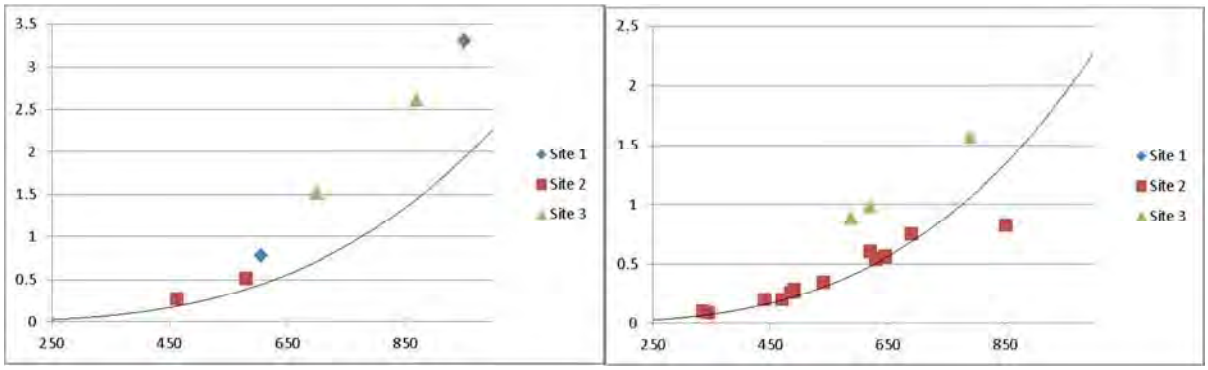

Figure 3 Longfin eel condition (left) and shortfin eel condition (right) in the Haehanga Stream, 9/10 December 2015. Weight (Kg) is on the y-axis, length (mm) on the x-axis. The trend line is the predicted weight, using equations from Jellyman *et al* 2013.

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 all culverts impeded fish passage in some way.

Culvert 1, on the Haehanga Stream near the composting pads, had a shallow and swift flow (Photo 5), which would inhibit poorer swimmers such as inanga. The outlet of this culvert is also too steep and water speeds too swift, and only suitable for climbing species.

Culvert 2 was perched, and also not suitable for swimming species (Photo 5). However, while previously undertaking macroinvertebrate monitoring, whitebait were observed upstream of this culvert, likely to be juvenile banded kokopu. This species is a good climbing species and highly adept at negotiating barriers that swimming species cannot pass.

Culvert 3 was the greatest barrier observed on this occasion, with both culvert outlets significantly perched and shallow flows through the culvert (Photo 4). This would be best

remediated by increasing the height of the riffle that leaves this pool, using large cobble substrate. The intention would be to lift the water level of the pool so that the culvert outlets are inundated, and preferably so that water also backs up into the culvert, to provide for poorer swimming species such as inanga. It is expected that this culvert will be remediated before the next fish survey is to be undertaken, programmed for early summer 2016.

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 5 Culvert 1 (above) and culvert 2 (left) on 9 January 2015

Summary and conclusions

On 9 and 10 December 2015, 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 g-minnow traps at each site overnight. These nets and traps were recovered the following morning, with all fish identified, counted and measured, with eels greater than 300mm weighed.

At the time of this survey, the Haehanga Stream had a low but discernible 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. All sites contained moderate fish habitat, with deep pools, and good cover, although water temperatures 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 previous survey. Despite 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 less than that recorded in the previous survey. Over all sites, twenty-three fish were recorded across two species. In addition, an individual elver (juvenile eel) was observed in the unnamed tributary.

Of significant concern during this survey was the observation of seven dead eels at and downstream of site 2. These eels were in a progressed state of decay, and it was unclear when or why they died. However, when there is this number of dead eels noted at one time, it is very rarely due to natural circumstances. Also of concern was that 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 previous survey, when hydrocarbons were released from the sediment at site 3. There was also discolouration of the Haehanga Stream observed between sites 1 and 2, caused by works in an unnamed tributary.

It is worth noting that the macroinvertebrate survey undertaken on the first day of the fish survey found that macroinvertebrate communities of three upstream mainstem sites and two unnamed tributary sites were of average to above average health, while the communities of the two sites downstream of the site showed severe deterioration.

Due to the lack of fish at some sites, it is difficult to compare the results from the sites in the current survey. However, the two previous surveys have provided useful results with which the current results can be compared.

The site that would be most expected to exhibit impacts if there were any, site 2, recorded two species, and the highest abundance (15 fish) of the survey. However, inanga, which were recorded at this site in both previous surveys, was absent. This represents deterioration from the previous survey. Natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. However, it is possible that whatever caused the eel deaths in the vicinity of this site also impacted on the inanga population.

Site 3, further downstream also recorded two species, which represents a reduction of two species from the previous survey. As with site 2, inanga were absent, despite being recorded at this site in the previous survey.

Eels were recorded at all three sites, with the largest longfin eel being recorded at site 1. This individual was 950 mm long, and weighed 3.31 kg. The size class distribution of the eels was similar to the recorded in the previous survey, and considered to reflect the impacts of commercial eeling, which 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 the few eels captured at sites 1 or 3 were in much better condition than would be expected. In contrast, the eels captured at site 2 were more similar to their expected weight, with the exception of one, which was about half its expected weight. This represents a change from that recorded in the previous two surveys, when no site had fish that were in better or worse condition than any other site, nor did they differ markedly from that predicted. 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 poorer health than could be expected, and as such suggests that the activities at the composting facility had negatively affected this community. With the exception of the dead eels, no observed fish exhibited any obvious physical damage or abnormalities.

During this survey, three access culverts were assessed for fish passage, and all were found to present at least some sort of barrier to fish passage. The worst culvert, located immediately above site 2, was perched and had swift flow. This would preclude the passage of a number of species, included inanga. All three culverts will need remedial works undertaken to ensure they meet the rules of the Regional Freshwater Plan for Taranaki. It is expected that the culvert immediately above site 2 will be remediated prior to the next fish monitoring survey, programmed for early summer 2016.

In summary, the barriers presented by the three access culverts, the presence of hydrocarbons upstream of site 2, the observations of dead eels and the results from the fish condition assessment 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.

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 site is reminded of their responsibilities regarding the provision for fish passage, and that the first remedial action be undertaken at the main crossing located just upstream of site 2.

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Appendix III
Additional site support documents

REPORT

Haehanga Catchment Preliminary Groundwater Investigation





btw company
surveyors . planners . engineers . landscape architects

Haehanga Catchment Preliminary Groundwater Investigation

Remediation New Zealand

Disclaimer

Reviewed

Report Author	Greg Larkin, Environmental Scientist, BSc Ecology and MSc in Environmental Science	1-7-2015 Date
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CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 Scope

This report has been prepared for Remediation New Zealand Limited by BTW Company. This short technical report summarises available information relating to groundwater investigations in the Haehanga Catchment, adjacent to the Remediation New Zealand Uruti Composting Facility.

For a full site description and environment setting, readers are directed to the Uruti Composting Facility Management Plan. This report is a follow up investigation to further detail groundwater interactions beneath the composting facility. The investigation comprised a desktop review of available information from the three monitoring bores on site combined with soil profiles and bore permeability tests undertaken on site.

1.2 Objectives

The primary objective of the investigation was to provide addition information to support management of the groundwater resource beneath the Uruti Composting Facility.

Specific objectives were to:

- Undertake a topographical survey of the site;
- Level survey the three monitoring bore heights in Mean Sea Level (MSL) to allow groundwater elevations to be calculated;
- Undertake bore permeability tests so that groundwater velocities could be determined;
- Make recommendations for future groundwater/hydrogeological monitoring to assist site management, and;
- Produce a preliminary or unconfirmed Conceptual Site Model

2 GROUNDWATER SITE WORKS

2.1.1 Monitoring Bore Description

In February 2011, three monitoring bores (GND 2188, 2189 & 2190) were advanced on site, using a 600mm solid stem auger attached to a hydraulic digger (Cowperthwaite, pers comms 2015). The bores were advanced to 4.10metres below ground level (mbgl) for GND 2188, 3.3 m for GND 2189 and 3.45 m for GND 2190. Slotted 51.8 mm diameter PVC pipe was installed in each monitoring bore.

Monitoring bore locations are shown on the site plan in Figure 2.1-2.3. Monitoring bore construction details are in Appendix A. Photographs of the well construction are presented in Appendix B.

Although the bores were advanced under a supervision of a hydrogeologist, bore logs and/or description of the soils and aquifer properties encountered were not recorded. From available site photos taken on the day of installation, the full length of the screen appears to be slotted. This is in contrast to the design specification in Appendix A. Details related to the filter pack, cementing and/or gravel around the screen are also not accurately known. The influence this data gap has on bore development, permeability tests and velocity calculations is uncertain.

Figure 2.1:Uruti Composting Topography Survey-lower part of site. Green dot denotes GND 2190 and reduced level

Figure 2.2:Uruti Composting Topography Survey-middle part of site. Green dot denotes GND 2189 and reduced level

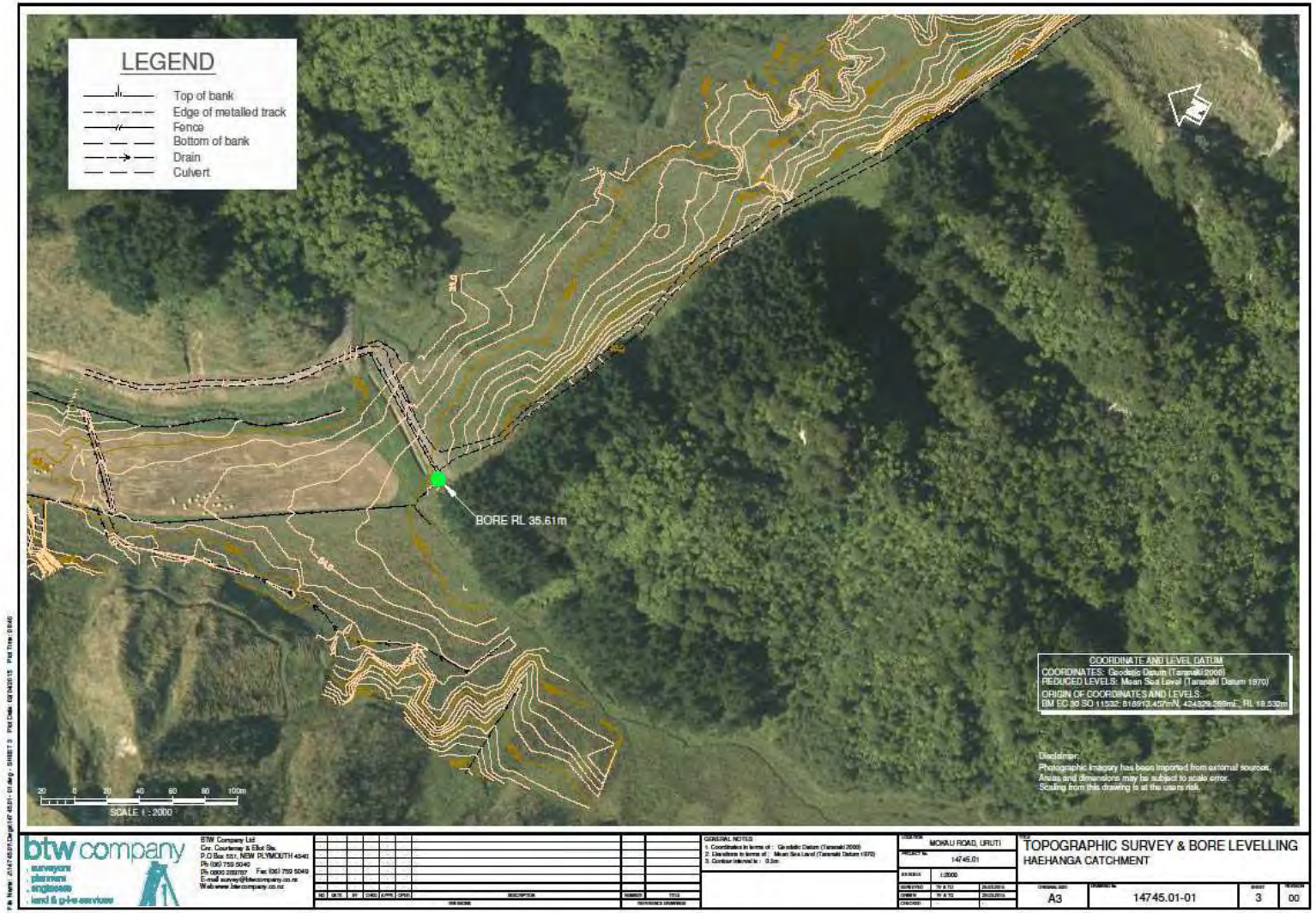


Figure 2.3:Uruti Composting Topography Survey-upper part of site. Green dot denotes GND 2188 and reduced level

2.1.2 Topographic Survey and Conceptual Site Model

GND 2188, GND 2189 and GND 2190 bores heights were surveyed by BTW Company surveyors on January 8th 2015. The survey established coordinates relative to Geodetic Datum (Taranaki 2000) and the elevation of the top of the casing relative to Mean Sea Level (Taranaki Datum 1970). BTW Company recorded spot heights adjacent each monitoring bores to corroborate surface elevation adjacent the bores.

The Topographic Survey formed the basis of the preliminary Conceptual Site Model (CSM) in Appendix D. The CSM was developed in Civil3E software, with all elevations in Mean Sea Level to the Taranaki 2000 Geodetic Datum. At present the CSM is unconfirmed and requires significantly more input to identify other potential contaminate sources and likely downstream receptors, both ecological and human. The preliminary CSM has however, defined the general hydrological setting in terms of hydraulic gradients down the Haehanga Stream, groundwater direction and hydrogeological interactions with the Uruti Composting Facility.

2.1.3 Soil and Aquifer Properties

For a description of the shallow soils encountered on the Uruti Composting Facility to two metres below ground level (mbgl), readers are directed to Section 2.3 in Uruti Composting Facility Management Plan. In brief, the soils encountered across the site were dominated by orthic brown/grey silty soils with increasing clay content at lower elevations across the site and with increasing depth. Surface soils to 250 mm deep were dominated by light brown loams and grey silty topsoil. However, between 250 mm and 1500-2000 mm, soils were characterised as silty clay with medium plasticity, traces of orange clay material, smaller particle sizes and soils were generally more friable. The shallow groundwater table was not encountered on the day of sampling but soils were generally damp below 0.5-0.75 mbgl.

Currently, detailed lithology of the site below 2000mm has not been determined as bore logs were not undertaken at the advancement of the monitoring bores. Subsequently, information which is critical to determining groundwater velocities including aquifer depth, confining structures and aquifer properties below 2000 mm deep were estimated from site visits, the topographic survey and observation of site staff during construction activities. The influence that aquifer properties below 2 metres have on groundwater velocities is uncertain, in terms of over and/or under estimating velocities. For the current groundwater velocity calculations, the aquifer properties were estimated as ‘Silty Clay’, with an effective soil porosity of 0.01 or 1% to the base of the aquifer (McWorter and Sunada 1977).

Well construction information is also limited but deemed critical to the analysis of slug test data, and as such several of the perimeters required for the Bouwer and Rice Method (1970) were estimated from the monitoring well schematic (Appendix A). These parameters were screen length, base of aquifer and the annular fill above the screen. It is therefore highly recommended that all future monitoring bores installed onsite, accurate bore logs and lithology below 2 m be described, along with accurate bore construction information as to allow recalculation of groundwater velocities.

2.1.4 Groundwater Level Gauging

The monitoring bores (GND 2188, 2189 & 2190) have been gauged for depth of water between 9 and 10 times, from February 2011 to January 2015. Groundwater level data is presented in Table 2.1 and 2.2.

Table 2.1:Haehanga Catchment Groundwater Gauging Data

Well ID	Date	Well TOC reduced level (m amsl)	Depth to water (m below TOC)	Groundwater Elevation (mamsl)
GND2188	4/02/2011	35.61	0.89	34.72
GND2189	4/02/2011	30.82	0.89	29.93
GND2190	4/02/2011	24.90	0.95	23.95
GND2188	11/02/2011	35.61	0.88	34.73
GND2189	11/02/2011	30.82	0.81	30.01
GND2190	11/02/2011	24.90	0.97	23.93
GND2188	19/08/2011	35.61	0.76	34.85
GND2189	19/08/2011	30.82	0.75	30.07
GND2190	19/08/2011	24.90	0.75	24.15
GND2188	26/04/2012	35.61	1.40	34.21
GND2189	26/04/2012	30.82	0.71	30.11
GND2190	26/04/2012	24.90	No data	No data
GND2188	21/11/2012	35.61	1.27	34.34
GND2189	21/11/2012	30.82	0.74	30.08
GND2190	21/11/2012	24.90	0.86	24.04
GND2188	14/06/2013	35.61	0.83	34.78
GND2189	14/06/2013	30.82	0.61	30.21
GND2190	14/06/2013	24.90	0.60	24.31
GND2188	14/01/2014	35.61	1.00	34.61
GND2189	14/01/2014	30.82	0.94	29.89
GND2190	14/01/2014	24.90	0.94	23.97
GND2188	15/05/2014	35.61	0.70	34.91
GND2189	15/05/2014	30.82	0.40	30.42
GND2190	15/05/2014	24.90		
GND2188	11/12/2014	35.61	0.43	35.18
GND2189	11/12/2014	30.82	0.28	30.54
GND2190	11/12/2014	24.90	0.24	24.67
GND2188	8/01/2015	35.61	1.22	34.39
GND2189	8/01/2015	32.80	1.06	31.74
GND2190	8/01/2015	24.90	1.30	23.60

GND2188	30/04/2015	35.61	0.703	34.91
GND2189	30/04/2015	30.82	0.553	30.27
GND2190	30/04/2015	24.90	0.71	24.19

Table 2.2:Seasonal Groundwater Levels in the Haehanga Catchment

GND2188	Min Groundwater RL	34.21	Max Groundwater RL	35.18
GND2189	Min Groundwater RL	29.76	Max Groundwater RL	30.54
GND2190	Min Groundwater RL	23.60	Max Groundwater RL	24.67
GND2188	Summer RL	34.60	Winter RL	34.85
GND2189	Summer RL	30.05	Winter RL	30.23
GND2190	Summer RL	24.15	Winter RL	24.23

2.1.5 Groundwater Velocity

To establish groundwater velocities through the shallow groundwater table, BTW Company staff undertook two bore permeability tests on the monitoring bores GND 2188 and GND 2190 (January 8th 2015).

The 'slug test' method requires removal of a set amount of water, where after recovery of water levels is timed with a stopwatch. The four litre 'slug' was removed by a high rate vacuum pump, and the recovering water level was determined with a calibrated electronic dip tape. Both monitoring bores did not fully recover to their initial water levels after 100 minutes. GND 2188 recorded sudden surges in water levels after several minutes, with erratic variability in water levels during the timed recovery phase. User error and dip failure were ruled out as both BTW Company technicians corroborated the water level measurements and operation of the electronic dip tape in a bucket of water. Groundwater levels in GND 2190 fluctuated in the initial three minutes after 'slug' removal but in the next one hour and 14 minutes water levels stabilised but never fully recovered to initial water level. However, final water levels only measured 10mm below the initial water level.

The erratic water levels in GND 2188 during recovery phase of the 'slug test 'are represented in Figure 2.4.

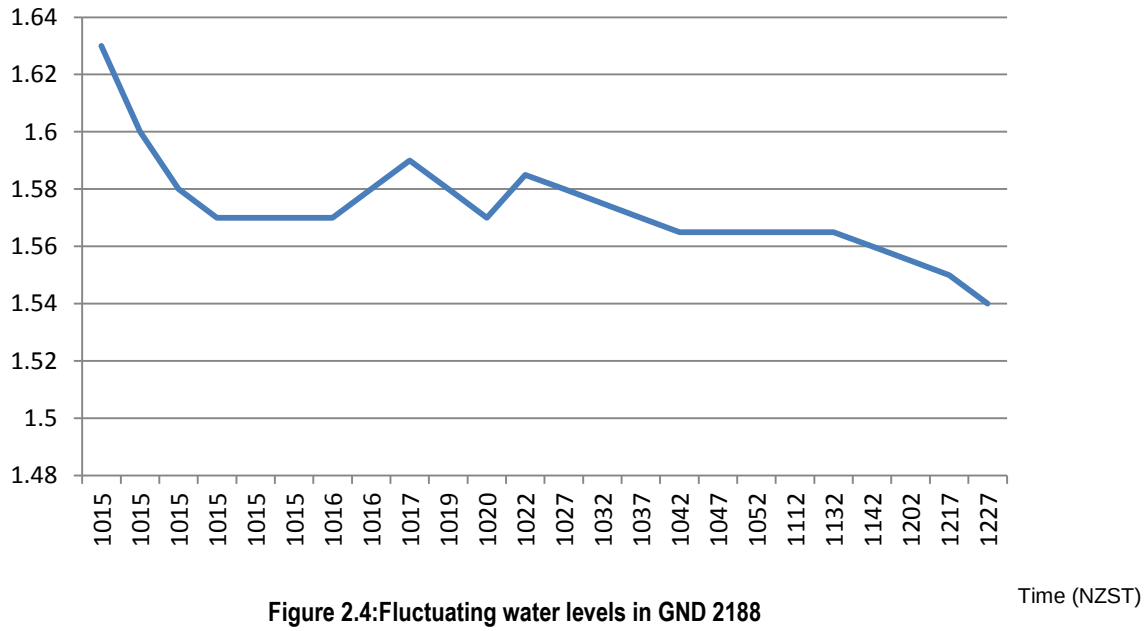


Figure 2.4:Fluctuating water levels in GND 2188

Due to the inconsistencies recorded in GND 2188, only permeability calculations were undertaken for GND 2190. These calculations were undertaken using the Bouwer and Rice method (1976) available from free software from the USGS website (http://pubs.usgs.gov/of/2002/ofr02197/index.html) and the online Bouwer and Rice calculator (http://www.groundwatersoftware.com/calculator_11_slugtest.htm).

The following calculations were then used to determine hydraulic gradient and linear groundwater velocity following Darcy's Law:

$$i = \frac{dh}{dl} = \frac{h_2 - h_1}{\text{length}}$$

where

i is the hydraulic gradient (dimensionless),

dh is the difference between two hydraulic heads (Length in metres), and

dl is the flow path length between the two piezometers (Length in metres)

Whereas

Groundwater velocity (v) based on Darcy's law and the velocity equation of hydraulics is given

by:

$v = Ki/n$

where;

K is hydraulic conductivity,

i is hydraulic gradient in the direction of groundwater flow

n is effective soil porosity (function of grain size and sorting).

Based on these parameters above, average hydraulic gradients and linear groundwater velocities have been estimated. Hydraulic gradients have be determined from the groundwater reduced levels in the monitoring bores GND 2188 to GND 2190 and distances between bores taken from the Topographic Survey (Figure 2.1-2.3).

Yielding:

K= 2.24* 10^{-6} or 0.00000224 m/sec

i= average 0.01196

n= 0.01 or 1 % for Silty Clay (McWorter and Sunada, 1977).

Table 2.3;Groundwater Velocities in the Haehanga Catchment

Hydraulic Gradient	Average velocity (m/day)
0.01196	0.2315

Table 2.3 above outlines average hydraulic gradients and average groundwater velocities adjacent GND 2190. Due to the limited groundwater gauging data for Winter and Spring months (3 occasions) it's as yet uncertain the impact what higher groundwater elevations have on hydraulic gradients across the Haehanga Catchment, and whether this impacts groundwater velocities. Furthermore, the velocities estimates in Table 2.3 are likely an underestimate for the middle to upper parts of the Haehanga Catchment, which has steeper topography therefore, higher hydraulic gradients and are overlain by more porous silty loamy/clay soils.

2.1.6 Groundwater- Surface water interactions

The interaction between the shallow groundwater table and the Haehanga Stream is a function of the elevation of the water table adjacent the Haehanga streambed. For example, if groundwater elevations in the monitoring bores are greater than the stream bed elevation, in all probability the stream will be gaining water from the shallow groundwater table. Conversely, streams can lose water from the groundwater table by outflow during periods of low groundwater levels when stream flows are high.

The degree of connection between the Haehanga Stream and the unconfined groundwater table changes laterally in space over differing reaches of the stream and over time. As the shallow groundwater table responds to recharge from rainfall, previously losing reaches become gaining reaches (Table 2.4). For example the reach of Haehanga Stream adjacent GND 2190 in December 11th 2015 and April 30th 2015 was probably losing to the Haehanga Stream. Both time periods coincided with 102 and 59 mm of rainfall in the preceding two days, with elevated soil moistures in the range of 44 and 45 %. Conversely, prior to January 8th 2015, Uruti received only 1 mm of rain in the previous eight days, with soil moistures at 32 %, this would have resulted in minimal outflow 'gaining' from the Haehanga Stream to the groundwater table.

Table 2.4:Stream and Groundwater Elevations (msl)

Date	Bore	Bore elevation	Stream Elevation	GW elevation	Groundwater Connectivity
30-04-2015	GND 2188	35.61	35	34.907	Gaining from stream
30-04-2015	GND 2189	30.82	30	30.267	Losing to Stream
30-04-2015	GND 2190	24.9	24	24.19	Losing to Stream
08/01/2015	GND 2188	35.61	35	34.39	Gaining from stream
08/01/2015	GND 2189	30.82	30	31.74	Losing to Stream
08/01/2015	GND 2190	24.9	24	23.6	Gaining from stream
11/12/2014	GND 2188	35.61	35	35.18	Losing to Stream
11/12/2014	GND 2189	30.82	30	30.54	Losing to Stream
11/12/2014	GND 2190	24.9	24	24.665	Losing to Stream

3 DISCUSSION

This preliminary groundwater investigation in the Haehanga Catchment recorded the clay soils form a semi-impervious shallow groundwater table overlain by more porous silty loamy-clays. The shallow groundwater table has been recorded between 0.25 metres below ground level (mbgl) at lower elevations of the site and 0.43 mbgl at higher elevations. The greatest depth to the groundwater table was recorded on GND 2188 on April 26th 2012 at 1.4 mbgl. The average depth to the groundwater table adjacent GND 2190 (most down-gradient bore) is 0.81mbgl. Therefore the shallow groundwater table is in almost constant interaction with the more porous loamy silty-clay's.

Seasonal differences are evident in groundwater elevations across the site, with the Winter-Spring months recording higher groundwater elevations. The groundwater flow pattern most likely is subdued to the overall topography, and flowing in a down valley gradient. Groundwater velocities have been estimated in the order of 0.2315 m/day. However, due to inconsistences in slug test data, only permeability calculation for one monitoring bore GND 2190 (lower part of the site) could be assessed. It must be noted that the Clay content of the soil profile was higher adjacent GND 2190 compared to the mid and upper parts of the site. Higher groundwater velocities would be expected through the more porous loamy soils adjacent GND 2189 and GND 2188.

The close hydraulic connection between the Haehanga Stream and the shallow groundwater has been documented as observed by Regional Council Staff. Rainfall recharge to groundwater is influenced by the hydraulic properties of the overlying soils, with the soils storage capacity the main characteristic to determine the recharge rate. At present rainfall recharge estimates which may influence potential contaminate loadings to the shallow groundwater table have not be made.

Appendix C goes some way to document how discharge/outflow events (i.e no rainfall, decreased soil moistures) and continued leachate irrigation results in elevated chloride concentrations in both the surface and groundwater resources. During these discharge events, where stream-flows are low over the summer months, the shallow groundwater table is most likely losing water to the Haehanga Stream. Therefore, limited water within the shallow groundwater table and the Haehanga Stream appears unable to attenuate the continued drainage losses of chloride through the soil profile as a result of continued irrigation.

Although outside the budgetary scope of the current investigation some consideration should be given to determine the 'time lag' of transport of chloride (and other contaminates) through the hydrological system as a response to outflow events in summer. At summer low flow periods, there is likely a greater potential of elevated chloride loadings to the Haehanga Stream and other downstream receptors. The downstream impact to stream biota has yet to be quantified as continuous 'time series' groundwater and surfacewater data are current unavailable.

The preliminary Conceptual Site Model has been developed (Appendix D) but as yet is not confirmed. The CSM has identified potential hydrogeological 'exposure pathways' for contaminates in the Haehanga Catchment, such as the chloride loaded porous surface soils being in direct contact with the shallow water table, and the reaches of Haehanga Stream 'gaining' water from the groundwater table, adjacent GND 2190 in the lower irrigation zone. However, considerable more information is required to confirm the CSM, in particular the identification of downstream receptors for all contaminates potential leaving the site, not only chloride but also metal and hydrocarbons contaminates.

4 RECOMMENDATIONS

The following recommendations aim to improve the management of water resources in the Haehanga Stream. These recommendations are additional to the recommendations made in the Uruti Composting Facility Management Report.

Specific recommendations include;

- Undertaking groundwater levels (and conductivity) measurements daily in the existing and proposed monitoring bores.
- Incorporate and align groundwater gauging data with surface water data (quantity and quality) with meteorological information to develop a Uruti Composting Facility Monitoring Plan.
- After 12 months of data collection, use the Monitoring Plan above as the basis for a catchment impact assessment, with the following goals

    1. Assess the potential adverse effects to downstream receptors in the Haehanga and Mimi River.
    2. Use the monitoring data to gauge the success of the previously recommended site improvements outlined in the Uruti Composting Facility Site Management Plan.
    3. Update and confirm the preliminary Conceptual Site Model with the monitoring data. The CSM will assist in future investigations on site, with emphasis on the transport of potential contaminates through the Haehanga hydrological system to important downstream receptors, such as the regionally significant Mimi Stream.
    4. Use the updated groundwater and stream flow monitoring and meteorological data to calculate rainfall recharge rates, and then model chloride 'fate and transport' through the soil profile to surface waters.

- Ensure that all future monitoring bores advanced onsite be done so by an approved drilling contractor, so that accurate bore logs and lithology can be determined.
- It is also recommended that the groundwater velocity calculation be updated once the lithology and bore construction data is ascertained for any bores advanced in the upper parts of the site.

4.1 Limitations

BTW Company has prepared this report for RNZ using available data sources, generally accepted practise and standards at the time it was prepared (June 2015). It is noted that the following limitations exist in the data potentially impacting on hydrogeological interpretation.

Information in this report cannot be used or reproduced without the prior authorisation of BTW Company. The following limitations are also acknowledged;

- The lack of lithology data and bore construction information. It is accepted that bore logs are only an indication of inferred ground conditions at the specific location. However, without this data aquifer properties were estimated as clay to the base of the aquifer. For example, although the clay above 2000 mm appears continuous, uncertainty exists at greater depths to whether the clay forms a continuous layer or more permeable loamy/organic soils exist. However, in all probability the underlying papa mudstone would be a deeper confining layer across the catchment. Papa outcrops in the Haehanga Stream substrate are commonplace and observation of staff during construction activities suggest basement geology is between 3-6 metres deep.

- Therefore, the aquifer depths required to calculate the Bouwer and Rice Method (1976) were estimated from general site observations, and from interpreting spot heights from the topographic survey.

REFERENCES

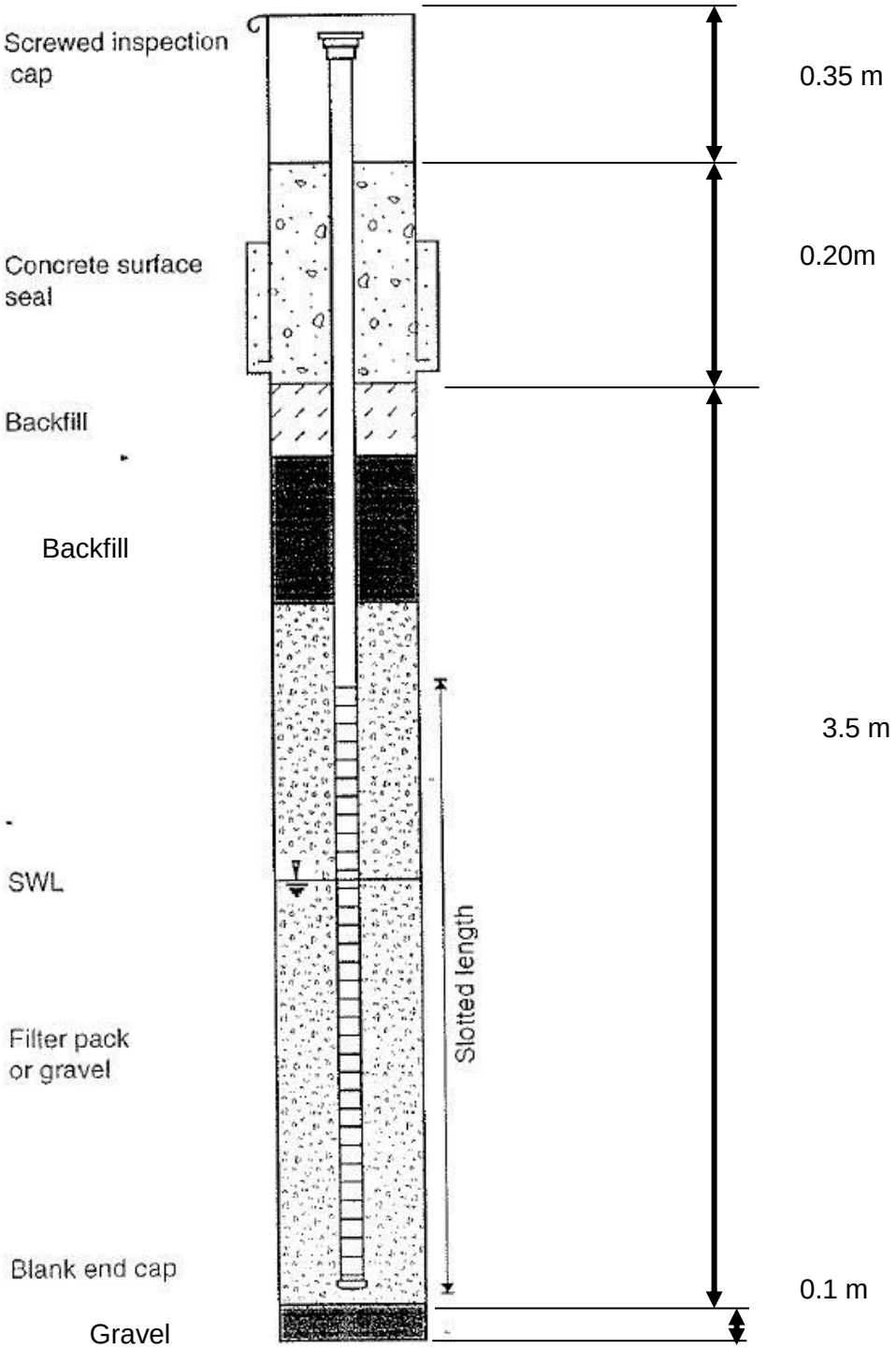
Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Cowperthwaite, S. 2015 Personal Communication with Author. Taranaki Regional Council, Scientific Officer

McWorter, D.B, Sunada,D.K 1977. Ground-Water Hydrology and Hydraulics. Water Resources Publications, Colorado.

APPENDIX A MONITORING WELLS- REMEDIATION NEW ZEALAND- URUTI

Monitoring wells – Remediation New Zealand - Uruti



CASING and SCREENS:
PVC: 51.8mm (2-in) satisfactory,
slotted screen.
Steel, Teflon

The location of the three monitoring wells are approximately at:

MW 1 – Baseline at 1732369 E – 5684631 N **GND2188**

MW2 – Irrigation area 1 at 1732302 E – 5684926 N **GND2189**

MW3 – Irrigation area 2 at 1731851 E – 5685677 N **GND2190**

Monitoring well installation

- Final depths should be measured and recorded
- The slotted portion of the pipe should start 0.2m below the ground level as per the schematic. This is not the case in all the bores.
- The top of the monitoring well should be capped to prevent contaminants entering the bore
- The top of the casing should be 300 mm above the ground and sealed so that potential contaminants or small animals cannot get in.
- A 2 meters perimeter fence should be erected around the monitoring well (i.e, 0.5 x 0.5 x0.5 x 0.5)

APPENDIX B MONITORING BORE INSTALLATION

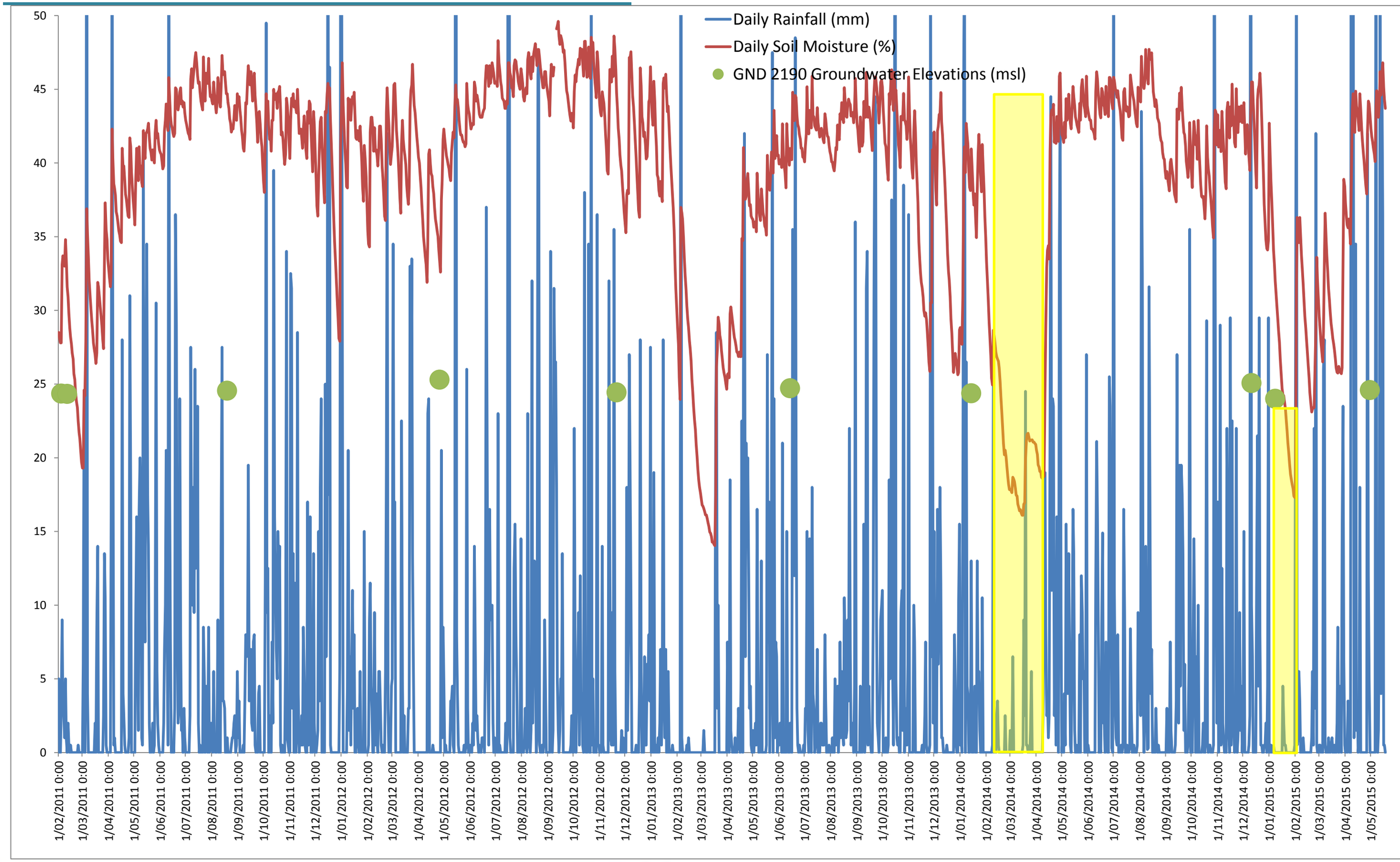
APPENDIX C SOIL MOISTURE AND RAINFALL RECHARGE ON CHLORIDE CONCENTRATIONS IN GROUNDWATER

Preliminary Summary

Examination of soil moistures (2003-2015), rainfall statistics, and available water chemistry data record elevated chloride within groundwater during periods of low rainfall and soil moistures (groundwater discharge to stream). During these periods groundwater levels (and most probably stream levels) are reduced (Table 2.1 & 2.2) and there is limited water within the hydrological system to attenuate the irrigated leachate. For example, the highly elevated chloride concentrations recorded in March 2014 in the Haehanga Stream and the monitoring bore GND 2190, coincided with the second lowest monthly rainfall total between 2003 and 2014, a very low soil moisture of 18% (yellow bars in figure below).

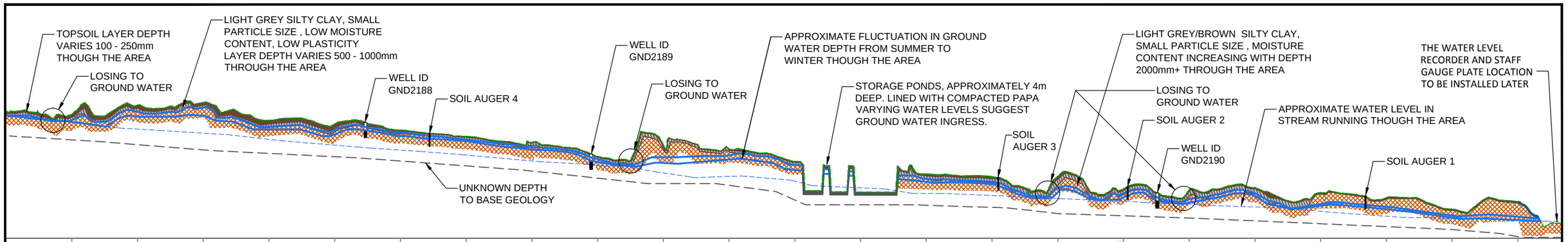
It is therefore, recommended that the following be considered:

- Once the water level recorder site has been installed in the Haehanga Stream, a full hydrogeological investigation should be undertaken in 12 months. This investigation should incorporate all the updated data streams including rainfall, soil moisture, groundwater elevations and Haehanga Stream discharge volumes. This will assist in quantifying potential drainage losses and/or adverse effects from the Uruti Composting Facility to surface water receptors downstream.



Uruti at Kaka Road Monthly Rainfall and Soil Moistures, yellow bars denote elevated Chloride concentrations in the Haehanga Stream and monitoring bore GND 2190

APPENDIX D PRELIMINARY UNCONFIRMED CONCEPTUAL SITE MODEL



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37.32	36.84	38.23	38.63	35.93	35.36	34.44	33.49	32.53	30.44	32.18	31.58	29.70	25.00	27.78	27.36	27.43	25.51	25.39	25.72	24.94	24.16	22.43	23.59	

PROFILE
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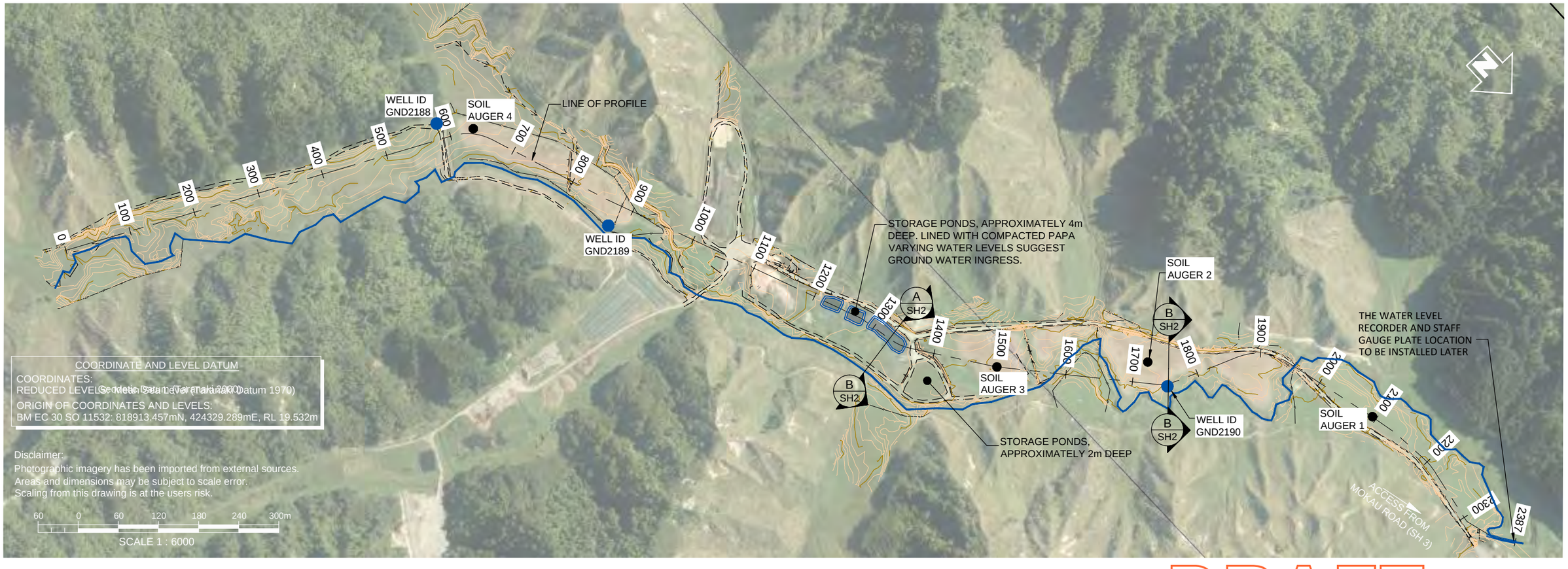
SCALE 1:600 (A3) HORIZONTAL



PLAN
SCALE 1:6000 (A3)

DRAFT

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NO	DATE	BY	CHKD	APPR.	OPER.	DESCRIPTION

REVISIONS

NUMBER	TITLE

REFERENCE DRAWINGS

GENERAL NOTES
1. Coordinates in terms of : Geodetic Datum (Taranaki 2000)
2. Elevations in terms of : Mean Sea Level (Taranaki Datum 1970)
3. Contour interval is : 0.5m

LOCATION	MOKAU ROAD, URUTI	
PROJECT No.	14745.01	
A3 SCALE	1:6000	
SURVEYED	TV & TD	25.03.2015
DRAWN	LV	24.06.15
CHECKED	-	-

TITLE
REMEDIATION (NZ) LTD
SOIL PROPERTIES
PLAN AND PROFILE

ORIGINAL SIZE	DRAWING No	SHEET	REVISION
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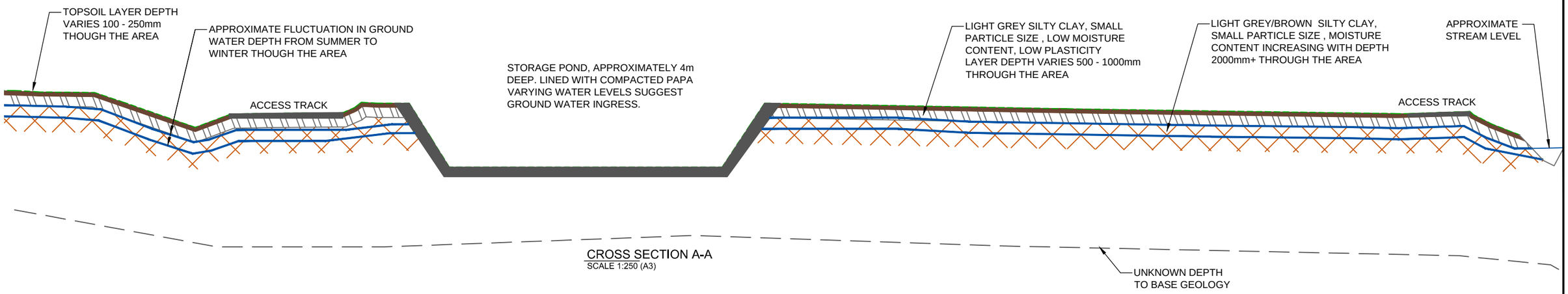

CROSS SECTION A-A
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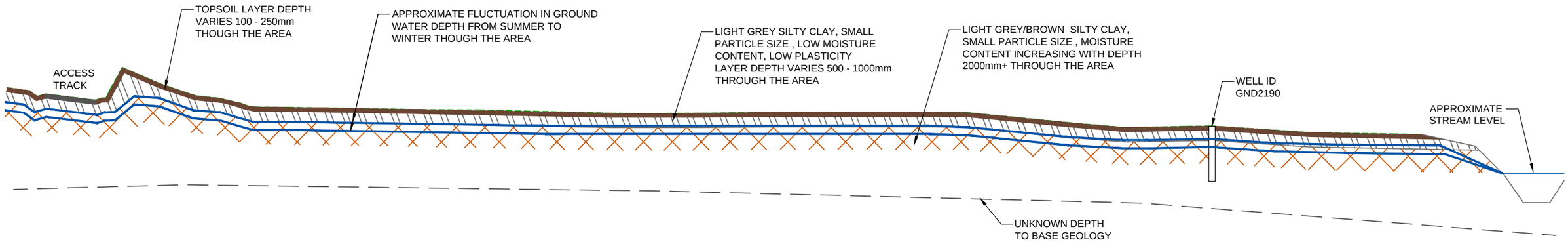

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DRAFT

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NO	DATE	BY	CHKD	APPR.	OPER.	DESCRIPTION

REVISIONS

NUMBER	TITLE

REFERENCE DRAWINGS

GENERAL NOTES
1. Coordinates in terms of :
2. Elevations in terms of :
3. Contour interval is :

LOCATION	MOKAU ROAD, URUTI	
PROJECT No.	14745.01	
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SURVEYED	TV & TD	25.03.2015
DRAWN	LV	24.06.15
CHECKED	-	-

TITLE
REMEDIATION (NZ) LTD
SOIL PROPERTIES
CROSS SECTIONS

ORIGINAL SIZE	DRAWING No	SHEET	REVISION
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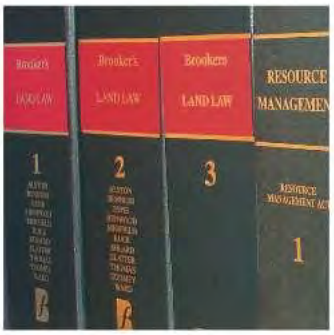
REPORT

Uruti Composting Facility Management Plan



btw company
surveyors . planners . engineers . land & g·i·s services

Uruti Composting Facility Management Plan

Remediation New Zealand

Reviewed

Report Author		
	Greg Larkin, Environmental Scientist , BSc Ecology and MSc in Environmental Science	Date
Reviewed by		
	Dave Bolger, Senior Environmental Advisor, BSc Physical Geography and Environmental Science	Date

EXECUTIVE SUMMARY

BTW Company has been engaged by Remediation New Zealand (RNZ) to undertake an environmental data review of its Uruti Composting Facility in North Taranaki. The primary objective of the report was to develop a site management plan with operational recommendations to improve soil and groundwater resources in the Haehanga Catchment.

The main points of the environmental data review can be summarised by the following main points:

- Surface soils across the site are dominated by semi-porous silty clay-loams, overlying more impervious clay soils
- Soils below 2000 mm have not been characterised
- Chloride concentrations in the soil beneath the irrigation zone are highly elevated compared to non-irrigated areas
- The shallow groundwater table is in direct connection with semi-porous loamy silty-clay
- Due to high rates of irrigation loading, shallow groundwater beneath the Uruti Composting Facility Site are moderately impacted with Chloride contamination
- Site layout, hydrogeological interactions, soil types and rainfall also influence the level of Chlorides observed in the soil, groundwater resources and the Haehanga Stream environment
- Offsite impacts have not been quantified and where not part of the scope of this report

The Uruti Composting Facility Management Plan was developed to improve the performance of the composting facility. The plan incorporates both landuse and management controls such as operational thresholds, monitoring timeframes and remediation options. These are considered necessary to ensure compliance with consent conditions and to mitigate adverse effects on the receiving environment.

The plan was developed in conjunction with RNZ and Taranaki Regional Council (TRC), and closely adheres to relevant national and international guidelines and standards.

The plan framework is based on a three tier decision tree which guides site operation. The tiered response was developed because of simplicity but also allows increased monitoring effort and reviews of site performance to minimise risks from drainage losses to groundwater and accumulation of hydrocarbon constituents within the soil. Within each tier, specific constituent threshold values for the operation have been set to protect the soil and groundwater.

The tiered operational plan also provides remediation options should the irrigation zones reach tier 2 and 3. Potential remediation options focus on irrigation and soil management.

The Uruti Composting Management Plan also makes recommends a range of site improvements with attached implementation timeframes. BTW Company considers the recommendations and timeframes necessary to improve the management of site and to reduce offsite adverse environmental effects.

Specific Site Improvements include;

- Storage dam to provide a clean water source for summer time irrigation
- Increased irrigations zone (currently pending consent variation)
- Stormwater improvements
- Predisposal and pre irrigation sampling
- Haehanga Stream riparian planting
- Deferred irrigation
- Haehanga Stream irrigation setback (25m)

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 Background

BTW Company has been engaged by Remediation NZ Limited (RNZ) to undertake a review of its land disposal and composting site in the Haehanga Catchment at Uruti, in North Taranaki. The review covers a synopsis of available environmental and operational data with a view to recommend steps to develop soil and groundwater management plans for the site.

The report does not aim to assess the potential adverse effects to downstream ecological receptors such as fish or invertebrate values, but rather focuses on management improvements at the Composting Site. It is envisaged as part of the upcoming consent variation to increase the irrigation areas, that a separate Assessment of Environmental Effects (AEE) will be undertaken for that consent application.

1.1.1 Activity Description

The Remediation NZ facility at Uruti processes compost material and drilling mud and fluid, from both WBM and SBM waste streams. The hydrocarbon exploration material is stockpiled on the Drill Mud Pad (DMP), where the leachate is then captured and treated in the series of ponds. The three ponds are separated by baffles whereby surface hydrocarbons are skimmed and removed back to the hydrocarbon pile. The treated leachate is held in two final ponds and then irrigated to pasture on the two irrigation areas, one upstream of the DMP and one immediately downstream of the DMP. A seven tier wetland is also used to treat run off and leachate from the composting pad 2 but only discharges treated stormwater in high flow conditions.

The estimated total capacity of the three treatment ponds is approximately 10310 m^3, whereas average pumping rates are in the order of 30,000 litres per hour, during daylight hours only. This equates to 6.75 days to pump the final treatment pit of 5360 m^3 pit.

1.1.2 Environmental/Management Issue

The Taranaki Regional Council's (TRC) historical monitoring data recorded most of the parameters tested at the Uruti site were within their consent requirements (TRC monitoring report, 2013-2014). However, concentrations of Chlorides had increased significantly in early-2014 in both irrigation fluid, groundwater and surface water samples, alongside increased sodicity of the soils beneath the irrigation areas.

The sources of the increasing Chlorides and hydrocarbons were attributed to changes to the composition and volumes of the irrigation fluid, as a result of the increases in hydrocarbon exploration waste being processed and disposed of at the site.

The following sections of the report concentrate on the issue of elevated Chlorides at the Uruti Composting site. It is acknowledged there may be potentially other contaminates of concern which may require future attention.

2 ENVIRONMENTAL DATA SYNOPSIS

2.1 Catchment

The Remediation NZ Uruti composting facility is located in the Haehanga Catchment in North Taranaki. The Haehanga Stream is a tributary of the Mimi River, a regional significant river and important recreational whitebait fishery. The Haehanga Catchment covers 5.73 km^2 (TRC explorer), with monthly rainfall averaging 176 mm. In the areas, outside the composting facility land use is dominated by extensive dry stock and sheep grazing on introduced grasslands on the valley floors. Whereas on the steep valley sides and ridgelines, exotic forests, introduced scrub and regenerating native vegetation exists. The catchment geology in the Mimi and Haehanga is dominated by Papa mudstones which are easily eroded resulting in poor water clarity in most of the water ways.

2.2 Haehanga Stream

The Haehanga Stream is an entrenched meandering stream below the site, but adjacent to the composting facility the stream has been modified and channelized to provide drainage away from composting activities. The stream was relocated and channelized on to the north-eastern side of the valley adjacent the current Drill Mud Pad (DMP). Numerous groundwater seeps are obvious across the site and adjacent the Haehanga Stream and its tributary. Immediately upstream of the DMP the Haehanga Stream branches into four separate tributaries, the largest tributary flowing in a south-eastern direction.

Substrate in the Haehanga Stream is a mixture of fine sediments such as clays in the slower flowing margins and pools and courser sands and gravel in the riffles habitats. Papa mudstones exist as a basement substrate of the stream at several locations. Stream substrates reflect the catchment geology with Papa dominating the ridges and cliff areas which are eroding and clayey loams on the side flanks and valley floors. The depth to the basement 'papa' mudstone in the Haehanga has not been accurately defined but is estimated between 3-6 metres below ground level (mbgl).

2.3 Soils

2.3.1 Classification

Soils in the Haehanga Catchment are classified as Orthic brown soils from the Whangamona Complex loams, which have a high clay content (NZ Soils Classification, V4). Orthic brown soils have a weakly structured sub soil, which is common on slopes or young land surfaces. Brown soils have a brown or yellow-brown subsoil below a dark grey-brown topsoil. The brown colour is caused by thin coatings of iron oxides weathered from the parent material. Brown soils occur in places where summer drought is uncommon and which are not waterlogged in winter. They are the most extensive soils covering 43% of New Zealand's landmass.

2.3.2 Soil Profiles

On the 8th January 2015, BTW Company staff undertook soil profile and structural analysis at four sites across the site including the proposed new area for irrigation immediately upstream of the site entrance. Soil profiles were ascertained with a hand auger and each horizon classified.

The location of soil sampling points are shown in Figure 2.1 and results are contained in Appendix A.

2.3.3 Soil Chemistry

The TRC has undertaken five sets of soil samples between 2011 and 2014, and these results are summarised in Figure 2.2. The soil chemistry data records an increasing pattern of chloride concentrations with the samples collected in April 2014, recording 1161 and 1559 mg/kg of Chloride, respectively. The movement of soluble ions in soils, such as Chloride relies on convection and diffusion fluxes. For chloride leaching it's the downward convection associated to adequate rainfall (and irrigation) which results in rapid movement through the soil, whereby it can be deeply leached, particularly in soil profiles less than one metre deep. This can result in increasing Chloride concentrations down the soil profile.

BTW company undertook four soil samples at two depths within the lower and upper irrigation areas (8th Jan 2015), and a single 'background' sample from the proposed irrigation area. These results are summarised in Appendix B and Figure 2.3. Soils samples were undertaken at 250 mm (Upper) and at 1.0 m (Lower) deep and their location was identical to the soil profile sites.

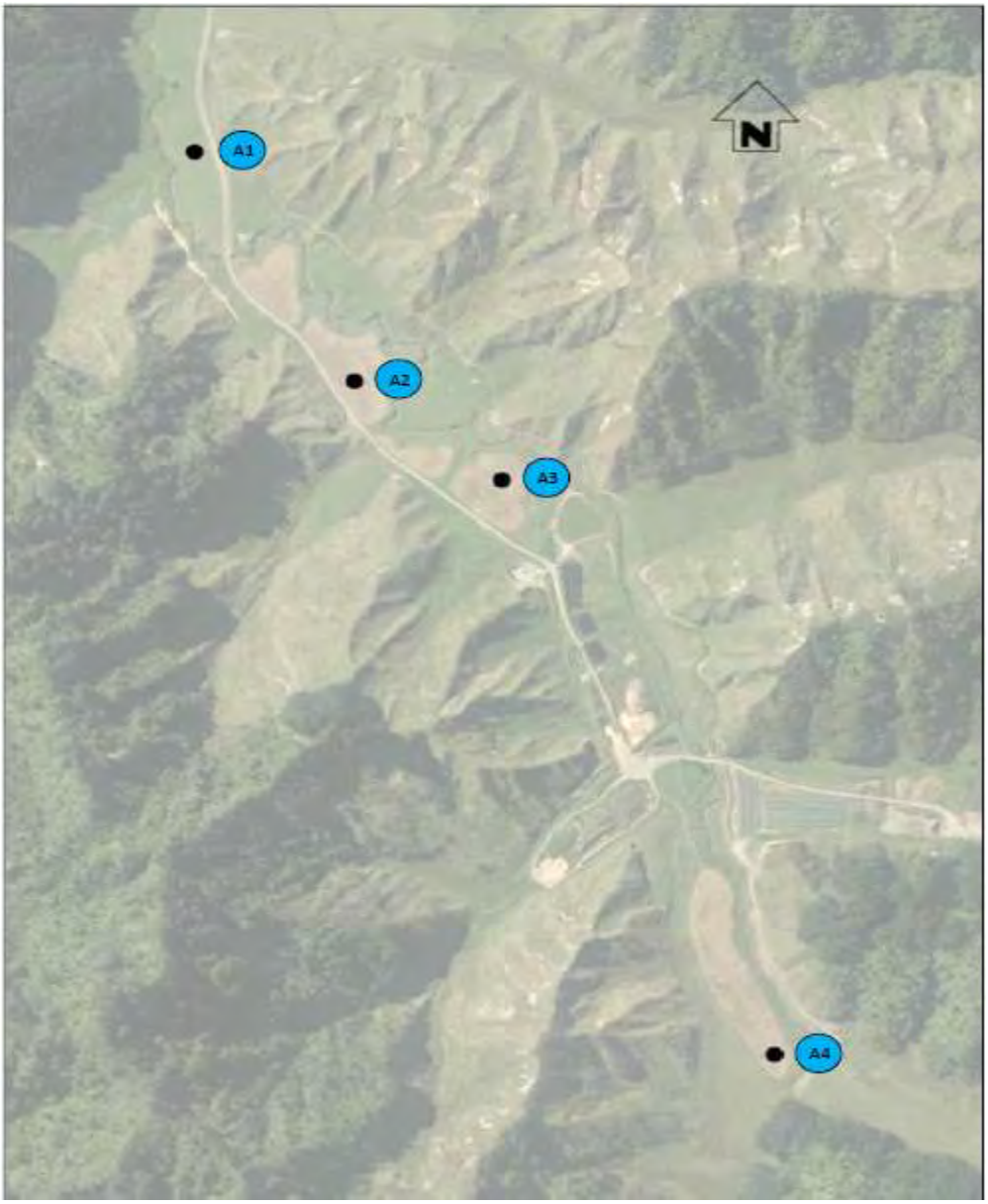


Figure 2.1: BTW Company Soil Sample and Auger Test Holes

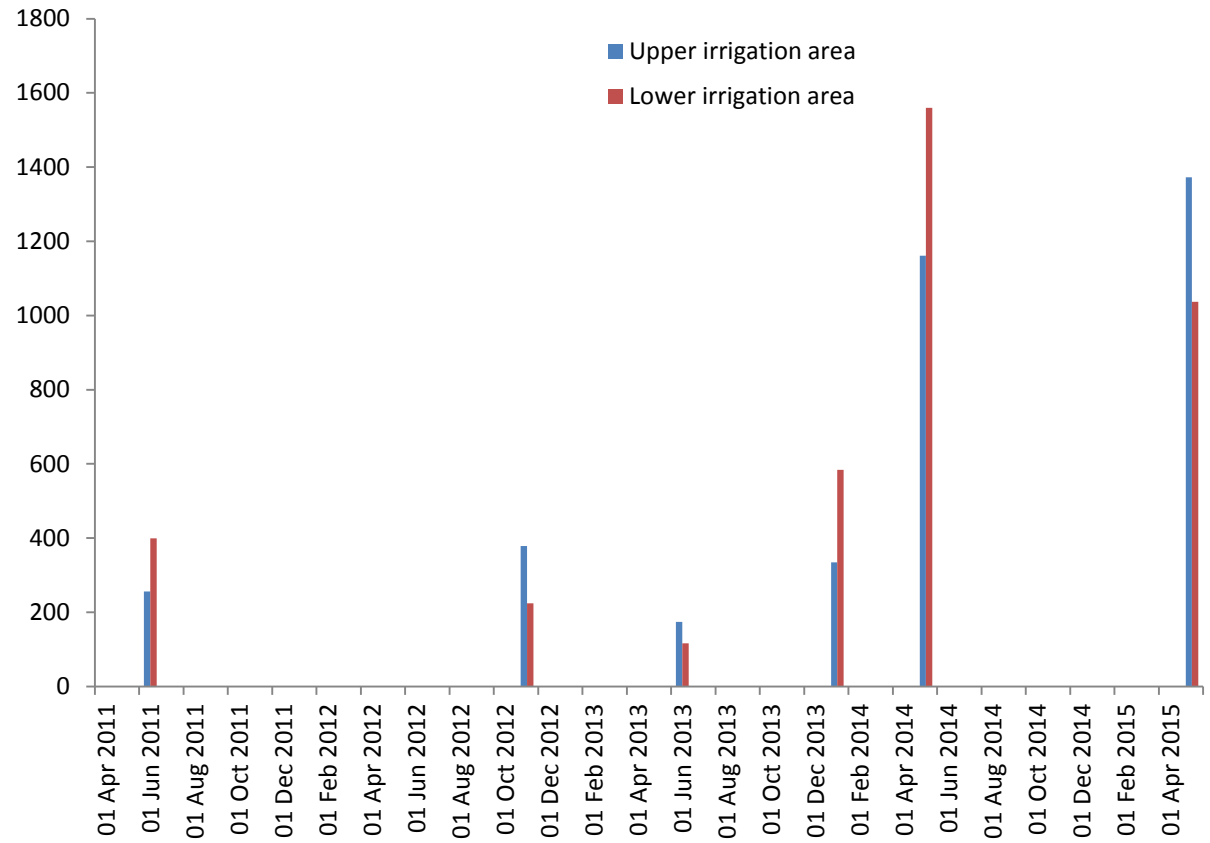


Figure 2.2: TRC soil samples for Chloride at Uruti Composting Facility (mg/kg)

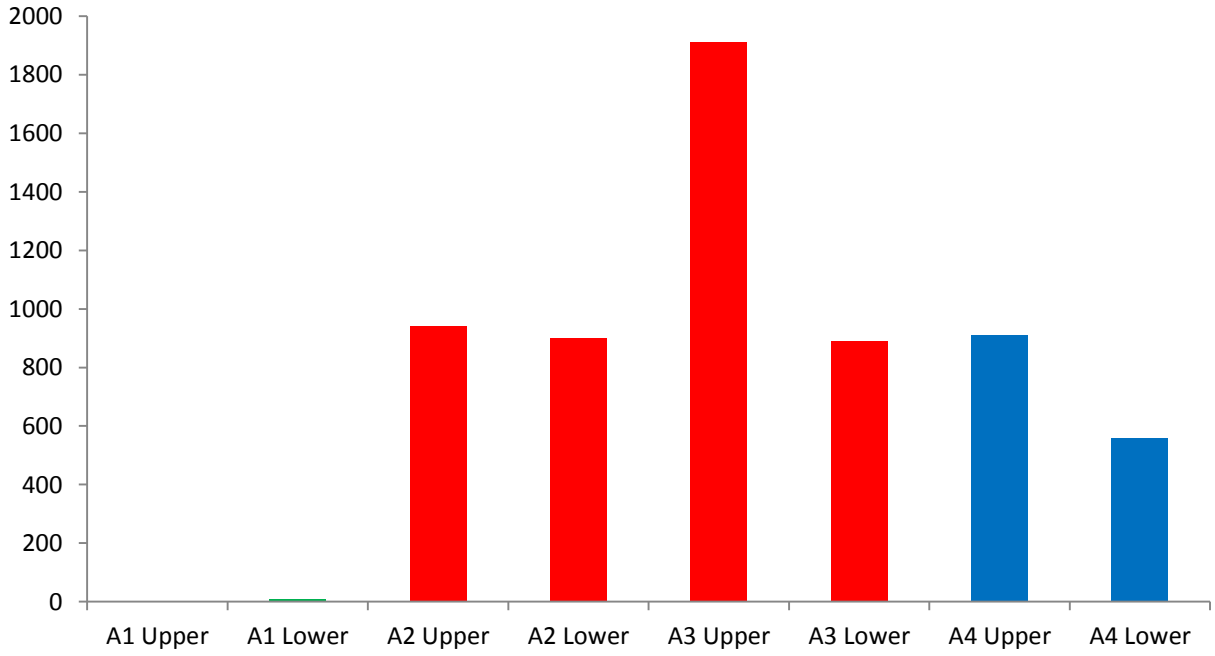


Figure 2.3: BTW Company Chloride soil profiles at Uruti Composting Facility (mg/kg)

The TRC results show that elevated chloride concentrations exist within the soil profile, initial in the lower irrigation area in 2014, then the upper irrigation area in 2015. These concentrations are consistent with BTW Company soil samples (Figure 2.3) which recorded Chloride concentrations between 1600-1910 mg/kg in the top 250 mm and 890 mg/kg at 1.0 metre deep. The difference in the Chloride concentration down the soil profile is interesting given Chlorides general nature of increasing down the soil profile. A explanation for the recorded decrease of Chloride down the soil profile may lie in the porous silty/loamy clay are in direct contact with the shallow groundwater table below 0.5-0.75 metres below ground level. This would result in drainage losses to the shallow groundwater table and probable movement down-gradient.

The BTW Company soil samples also recorded very acidic soil (pH 4.9 to 4.6) beneath the irrigation zones as well as in the background sample. A single sample undertaken by Perry Environmental Staff in 2003 prior to any development of the site is consistent with these samples, indicating that soil pH was very acidic pH=4.2. The Cation Exchange Capacity of the soil was also very low, which indicates the soils can only retain low levels of cations (Potassium, Ca, Mg and Na), and thus have limited nutrient retention. This in all probability allows the negatively charged Cl- to be further leached from the profile by severe rainfall.

The importance of higher CEC values allows acid soils to be more easily neutralised. However, for silt clay loams as in the Haehanga which have low CEC, soils will take longer to neutralise until the CEC is increased. It is therefore recommended options be investigated to increase the CEC of the soil beneath irrigation zones, such as improving the organic matter to enhance nutrient retention and to minimise losses to groundwater.

2.4 Irrigation fluid/Leachate

Figure 2.4 below summarises Chloride samples of the Irrigation fluid from 2011 to October 2014.

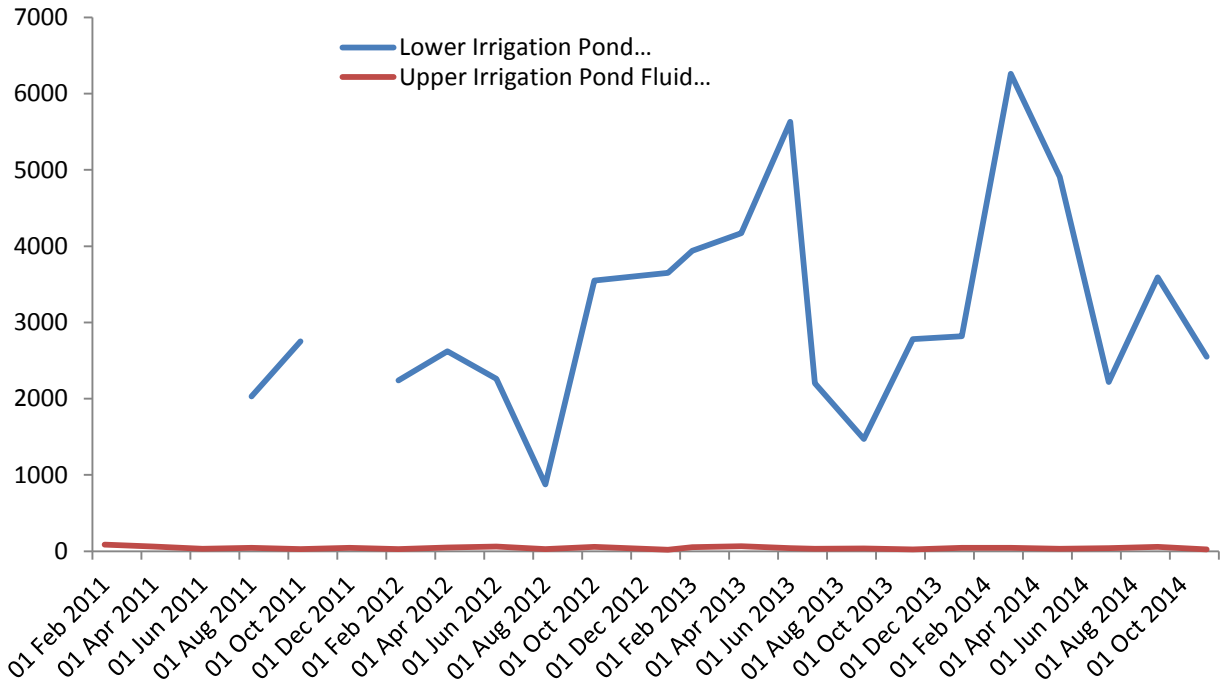


Figure 2.4: Irrigation fluid Chloride Concentrations (mg/L)

The irrigation fluid samples record large variations in Chloride concentrations with a pronounced peak in March-2014, which is consistent with all other environment data collected at that time. Following early-2014, Chloride concentrations within the fluid have dropped significant but remain between 2220 and 3600mg/l. However, as predisposal samples have not been undertaken, it is difficult to determine if the changes in Chlorides are attributed to increased hydrocarbon volumes and other material accepted at the site, and/or other operation issues, such as the treatment pit reaching capacity and yielding a low grade leachate for irrigation, particularly over summer.

The TRC has undertaken Sodium Absorption Ratio analysis on the irrigation fluid four times between September 18th 2013 and March 13th 2014. Concentrations of Calcium, Magnesium and Sodium were sampled, and the SAR calculated with the ratio between Ca, Mg and Na generally consistent. The results are summarised in Table 2.1

Table 2.1: Irrigation Fluid SAR

Date	CA (g/m3)	MG(g/m3)	NA(g/m3)	SAR
18 Sep 2013	260	30.6	550	8.59631
20 Nov 2013	518	43.9	818	9.27120
14 Jan 2014	673	43.5	753	7.59885
13 Mar 2014	1576	90.6	1852	12.27860

Leachate levels within the final DMP oscillate in response to irrigation but also surface and potentially groundwater recharge, evaporation and direct rainfall input. Typically, levels in the DMP are higher in the wetter months and lower in the late summer months. Due to evaporation over summer (and less rainfall or surface water ingress) the quality of the leachate over the summer months can be degraded (Larkin, G pers obs, 2014-15). This is partly reflected in the Irrigation SAR samples with the two highest SAR calculations in January and March, whereas the lowest Irrigation SAR values are for Spring.

2.4.1 Irrigator Loading Rates

The following table is a summary of the available irrigator flow volumes, nozzle spray flow rates, pump capacity and a basic hydraulic loading rate for Chloride fluid based on the Irrigator fluid/leachate samples (IND002244). The hydraulic loading rate takes the assumption that the lower irrigation area averages three hectares, and is based on two Chloride concentrations in the Irrigator Fluid; 1) 2000 mg/L (Lower Limit) and 2) 6000 mg/L (Upper Limit).

The hydraulic areal loading rate equation is = pump flow (m^3/day)/Area (ha)

Table 2.2: Uruti Composting Facility Operational Data

Feature	Volume
Pump Capacity (litres per hour)	33000
Pump Capacity (litres per second)	9.16
Pump Capacity 8 hrs pumping (litres per day)	264000
Lower Irrigation area Areal Loading (litres/ha/day)	88000
Lower Irrigation area Areal Loading (litres/m^2/day)	8.8
Lower Irrigation area Chloride Loading if irrigator fluid is 2000 mg/L (mg/l/m^2)	17600
Lower Irrigation area Chloride Loading irrigator fluid is 6000 (mg/l/m^2)	52800

Note: the loading rates do not take into account biases encountered from differences in nozzle spray, head differences and variable pumping speeds.

2.5 Haehanga Stream Chloride Concentrations

Surface water quality in the Haehanga Stream and its tributaries has been undertaken by the Taranaki Regional Council since 2002 at nine sites. Chloride concentrations within surface water show a clear increase in concentrations downstream of the site, with an increase of chloride adjacent discharge sites, the downstream irrigation area and in the receiving environment in March 2014. Chloride concentrations post-March 2014 then significantly decreased, with all sites well below the consented limits for Chlorides in all samples (mg/l). Figure 2.5 Chloride Concentrations in Haehanga Catchment 2011.

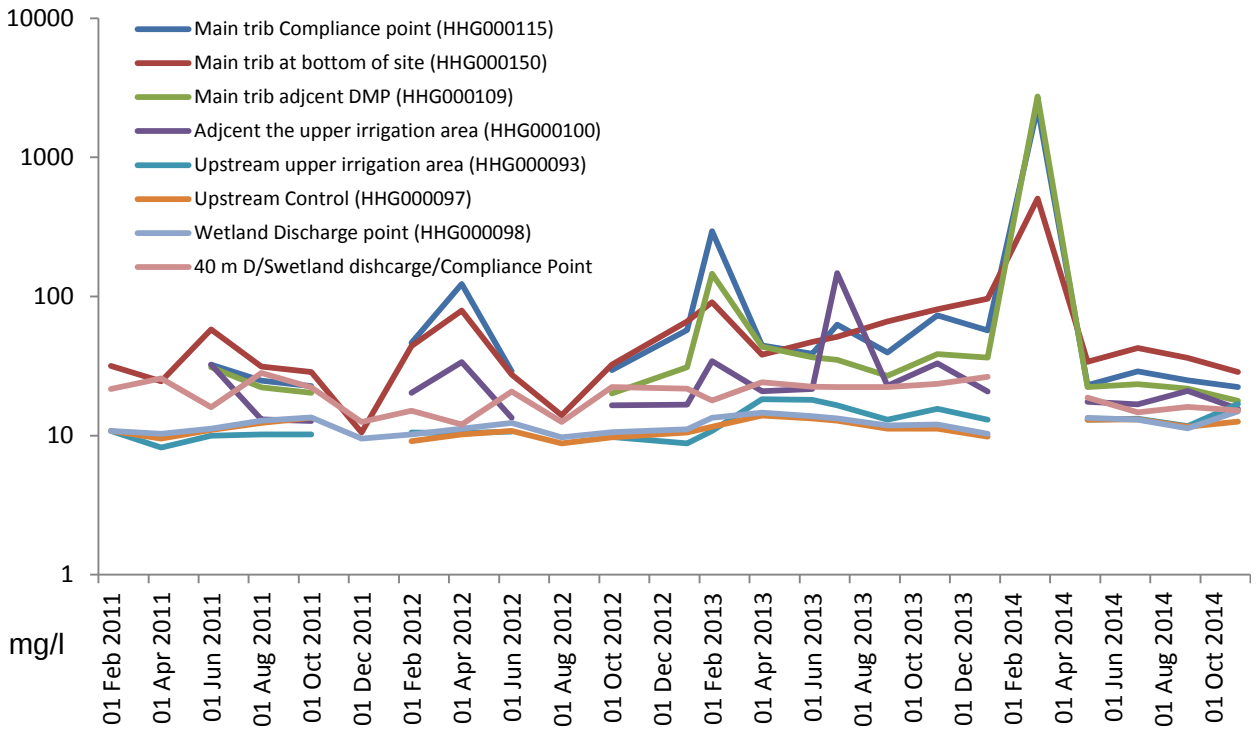


Figure 2.5: Haehanga Stream Chloride Concentrations (mg/L)

2.6 Chloride Concentrations in Groundwater

The below section summarises the two years of data from three monitoring bores at the composting facility; GND 2188 upstream (control site), GND 2189 upstream irrigation area (impact site) and GND 2190 the downstream irrigation area (impact site). Groundwater concentrations show a clear impact from chloride concentrations via drainage losses, with the upstream control site recording greatly reduced chloride levels compared to the impact monitoring bores adjacent and downstream of irrigation zones.

The TRC monitoring data was last undertaken in 30th April 2015, with Chloride concentrations recorded at 1340 mg/l in GND 2190. Chloride concentrations in GND 2189 recorded a decrease from 292 to 133 mg/l, with the upstream control bore GND 2188 consistently recording low concentrations of Chloride.

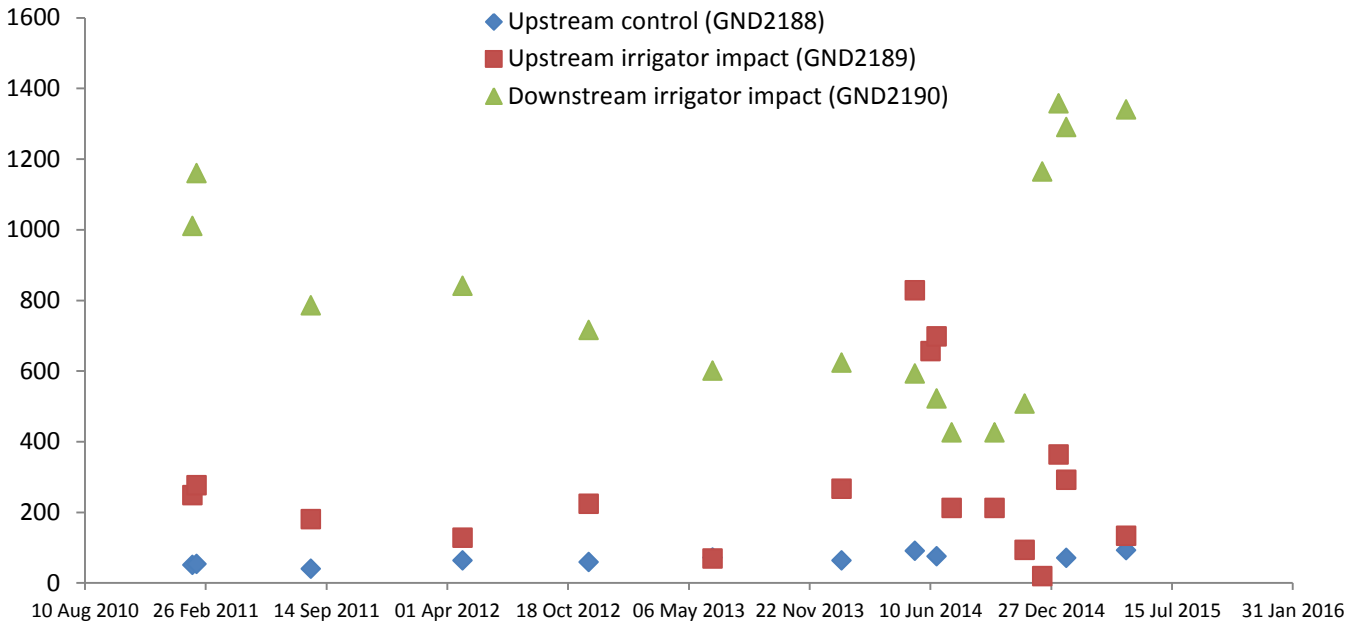


Figure 2.6: Groundwater Chloride Concentrations at Uruti Composting Facility

For a summary on the hydrogeology of beneath the Uruti Composting Facility readers are directed to the Haehanga Catchment Preliminary Groundwater Investigation.

3 URUTI COMPOSTING FACILITY SITE MANAGEMENT PLAN

The following section of the document focuses on operational management of the site with particularly emphasis on improvements to the irrigation process, stormwater management on site and a reduction in drainage losses to groundwater and surface waters. The plan incorporates both landuse and management controls such as operational thresholds, monitoring timeframes and remediation options as considered necessary to ensure compliance with consent conditions and mitigating adverse effects on the receiving environment.

The plan was developed in conjunction with RNZ and TRC and closely adheres to relevant national and international guidelines and standards.

The framework is based on a three tier decision tree which guides site operation. The tiered response was developed because of simplicity but also allows increased monitoring efforts and reviews of site performance to minimise risks from drainage losses to groundwater and accumulation of hydrocarbon constituents within the soil.

Within each of the operational tiers, specific constituent threshold values for the operation have been set to protect the soil and groundwater. Caution is advised that these values set for constituents are upper limits, and RNZ should not view these levels as recommended targets but should aim to operate well within these values to safeguard the operation, and reduce potential environmental effects on and off site.

3.1 Site Operational Plan

The site operational plan framework is summarised in the Tables 3.1 & 3.2. It uses a simple three tier approach with threshold values to guide irrigation and site activities.

Table 3.1: Uruti Composting Facility Site Operational Plan

Tier	Operation Status of irrigated area
One	Surveillance or normal operation of site
Two	Alert or increased level of monitoring with deferred irrigation
Three	Action or remediation options initiated and irrigation ceases

Once a trigger or threshold value is met within a specific tier, RNZ management would make the decision to operate within the next tier level until monitoring data provides sufficient evidence that an irrigation area could either go down or up a level as per the tier system.

Tier	Receptor	Target or Trigger	Monitoring frequency	Timeline for Change	Reference for Guideline
One	Leachate Fluid	Cl^-(Chloride)- 0-2000 mg/l results in a Areal Loading of approximately up to 17600 mg/l/m^2/day	Weekly	N/A as standard operation phase	
		TPH (Total Hydrocarbon) 0-2500 mg/l (½ of 5% TPH consent limit)	Monthly	N/A as standard operation phase	
	Soil	Cl^-(Chloride)- 0-700 mg/kg (based on the surrender criteria for NZ landfarms soil criteria) **Note Sodium Absorption Ratio 0-6**	Monthly	N/A as standard operation phase	
		TPH (Total Hydrocarbon) upper limits of each hydrocarbon fraction C7 – C9 2700mg/kg C10 – C14 58mg/kg C15 – C36 4000mg/kg	3 Monthly	N/A as standard operation phase	Ministry for the Environment, Guidelines for Assessing and Managing Petroleum Hydrocarbon contaminated sites in New Zealand. Tier 1 acceptance criteria for TPH Agriculture use All. Soil type Silty Clay.
	Groundwater	Cl^-(Chloride)- 0-1000 mg/L or Conductivity of 350 µS/m	Bimonthly in GND 2189 & 2190	N/A as standard operation phase	
		TPH (Total Hydrocarbon) All fractions of Hydrocarbons under	Biennially	N/A as standard operation phase	

		detectable levels (essentially background level)			
Two	Soil	Cl^-(Chloride)- 700- 1800 mg/kg **Note Sodium Absorption Ratio in the range of 6-18**	Monthly	If the Chlorides within the soil stay within this tier for 6 months, consider moving to Tier 3- remediation options Consider clean water irrigation to allow recovery from elevated SAR	
		TPH (Total Hydrocarbon) Total hydrocarbon concentration shall be less the 20,000 mg/kg dry weight at any point	Monthly	Upper limit for bioremediation to be effective for hydrocarbons, leachate fluid to contain no TPH.	Canada's Drilling Waste Management directive 050 (ERCB, 2012)
	Leachate Fluid	Cl-(Chlorides) -2000 to 10,000mg/L TPH (Total Hydrocarbons)-2500-3000 mg/L	Monthly	If rainfall and soil moisture are expected to increase, irrigation can continue, however, if drier period are forecast, irrigation should cease especially over the summer months.	
	Groundwater	Cl-(Chlorides) -1000- 2000mg/L Or conductivity 350- 700 µS/m	Monthly	All irrigation to cease on this zone. Note: If chlorides within the monitoring bores (GND 2189 & 2190) remain in this range for six months, consider moving to Tier 3 remediation options.	
Three	Soil	Cl^-(Chloride)- >1800mg/kg **Note Sodium Absorption Ratio >18**	Monthly	Initiate soil remediation measures (see Section 5) alongside clean water irrigation.	Cavanagh et al (2014)

		TPH (Total Hydrocarbons) Above 20,000 mg/kg	Monthly	Initiate soil remediation measures (see Section 5)	
	Groundwater	Cl^-(Chlorides) > 2000mg/L or Conductivity > 700 µS/m	Monthly	Initiate groundwater remediation measure (see section 5)	

***Sodium absorption ratio** (**SAR**) is a measure of the suitability of water for use in agricultural irrigation as determined by the concentrations of solids dissolved in the water. It is also a measure of the **sodicity** of soil, as determined from analysis of water extracted from the soil. When SAR rises above 12 to 15, physical soil problems begin to arise such as loss of soil structure, and decreases in infiltration and permeability.

4 SITE IMPROVEMENTS

This section of the management plan is designed to outline recommended improvements and additional management techniques which will support the site operational plan. Time lines for implantation are also included from the date this document is formalised.

4.1 Storage Dam

To continue irrigation during periods of low rainfall and to provide clean water to be mixed with leachate fluid a storage dam is considered a necessary management option to provide this clean water. The dam will be a clean water source upstream of all irrigation areas (Red Line in Figure 4.1). It's use will also be a remediation step in Tier 2 and 3 but will depend on water availability, soil moistures on site, predicted and seasonal variation in rainfall totals.

It is envisaged the lined storage dam will have a capacity of approximately 3500 m^3 to allow for 15 days of storage which equates 250m^3 per day of clean irrigation water. It is planned to irrigate primarily over the summer months when groundwater and surfacewater resources are limited.

The use of the current 'duck pond' immediately adjacent the final leachate pond should also be investigated to be incorporated into the irrigation plan. The pond has 4,800 m^3 of storage capacity of clean water which will further enhance irrigation of clean water on the irrigation areas. The use of clean water irrigation on chloride impacted soil has been used previously overseas, as an in-situ remediation step to soil health (Alberta Environment, 2001, Daily & Whalen, 2005).

Timeline for implementation = 6 months

4.2 Increased Irrigation Area

A suggested management control for the Uruti Site is to increase the irrigation area, from currently five hectares to over 11 hectares. By increasing the irrigation areas, a decrease in loading of any elevated constituents is envisaged, and also provide a management option to semi-retire areas before they are returned to the active irrigation area. Having greater area would provide options, without the need to overload one area.

It is envisaged that following the adoption of this site management plan, RNZ will apply for a resource consent variation to developed Phase 1. As part of that application it's highly recommended RNZ develop an irrigation plan which will integrate the new irrigation zones into the decision tree to minimise irrigation zones becoming overloaded (Table 4.1). The proposed Phase 2 irrigation zones will be incorporated into the irrigation plan over the next two years and be closely monitored by RNZ (See figure 4.2 and 4.3 for the proposed new irrigation areas).

Timeline for Implementation (Phase 1) = 2 months based on approval of consent variation

Timeline for Implementation (Phase 2) = 24 months based on performance of the site, the outcomes of the increased monitoring effort (soil, groundwater, surfacewater and hydrological data)

Table 4.1: Proposed Irrigation Zones

Irrigation Zone	Total Area (ha)	Irrigation Phase	Timeline for inclusion in Irrigation Plan
A	1.68	Phase 2	24 months
B	2.15	Phase 2	24 months
C	1.37	Phase 2	24 months
D	2.48	Phase 2	24 months
E	1	Phase 1	2 months
F	2.63	Phase 1	2 months
Total	**11.31**		

Figure 4.1: Proposed Irrigation Areas C, D & F and Storage Dam in red

Figure 4.2: Proposed Irrigation Area A, B & E

4.3 Stormwater Improvements

The location of the Drill Mud Pits (DMP) also influences the volume of fluid which are required to be irrigated for several reasons. The DMP's are located on the flat valley floor between two steep papa ridgelines, in a location which is topographical constricted. This results in an accumulation of both surfacewater, stormwater flows and likely groundwater having to pass the DMP en-route to the Haehanga Stream. Through this section of the Uruti Composting Site, the shallow groundwater table is approximately 0.5-0.75 metres below ground level, whereas the final DMP pit is 4 metres deep (See Conceptual Site Model in Haehanga Groundwater Investigation). The Haehanga Streambed level is also above the base of the final DMP. Previous compression tests on the freshly compressed papa recorded 0.91 permeability, but it's uncertain the current DMP integrity after several years of site operation. Although outside the scope of this Site Management Plan the hydrological connectivity between the DMP, the shallow groundwater table and the Haehanga Stream should then be investigated further.

It is also recommended the following be investigated to improve stormwater across the site:

- Investigate the placement of a drainage ditch behind pad one down the western side of the access road to avoid the DMP to drain stormwater directly to the main culvert on the Haehanga Stream.

- Realigned the DMP so that there is clear separation between the solids pile and the fluids, to stop stormwater draining into the area and whereby 'clear water' is directed away from the treatment pits.

- Ensure the DMP's are lined to reduce potential contaminate losses to groundwater/surface water.

- Place water level gauges on the final leachate pond alongside flow meters on the irrigator pump as to accurately define pond capacity, discharge rates and irrigation loading rates. This should be undertaken in conjunction with regularly sampling of the irrigation fluid prior

to disposal and where possible defer irrigation if hydrocarbon constituents are elevated (see later comments on Irrigation Plan).

Timeline for Implementation = 3-6 months

4.4 Riparian Protection

To mitigate the potential for any overland flow of contaminates discharging into the Haehanga Stream it is recommended that an earth bund be constructed along the length of the stream and it's tributary. It is considered the riparian protection zone should be a minimum of 5 metres from the stream bank and then fenced and planted with appropriate species. The planting would also provide shade for the Haehanga Stream biota.

Timeline for Implementation = 12 months

4.5 Deferred Irrigation Management

It is recommended the management of the site consider deferred leachate irrigation under certain environmental conditions. The combination of a poor leachate quality in summer and limited attenuation in the hydrological cycle results in reduced site performance. The site performance over the summer months represents an increased probability of off-site environmental effects being recorded. By instigating deferred irrigation over the critical summer months potential adverse effect can be minimised. It's recommended that RNZ in the development of their irrigation plan consider this option in combination with the storage dam.

Timeline for Implementation = 6 months

4.6 Setback from Haehanga Stream

Recommended best practice is to incorporate a 25 meter setback from any surface water body in relation to irrigating fluid. We suggest this management technique would obviously reduce any potential overland flow from the irrigation fluid into the stream in conjunction with a planted bund. Also this management option would create a buffer and natural attenuation zone for contaminate migration towards the stream, which would likely reduce any impacts on the Haehanga Stream. Setback requirements are a standard management requirement for discharges closes to water bodies, and often enforced by Regional Councils.

Timeline for Implementation = Immediate for Phase 1 Consent Variation granted

4.7 Pre disposal Analysis

We recommend RNZ consider implementing an acceptance criterion for any new source of waste material entering the site. This procedure could be easily implemented and provides data of the level of constituents entering the site.

This management option provides not only business certainty to RNZ but will also allow consideration for future irrigation plans from potential issues arising from hydrocarbon fluids entering the site. RNZ could request laboratory results of the proposed material to be disposed and specify certain parameters for constituents like Hydrocarbons and Chloride for acceptance. Predisposal samples are common practice and considered best practice, with all costs usually incurred by the company requesting disposal.

Timeline for Implementation = Immediately after Phase 1 Consent Variation granted

5 TIER 2 AND 3 REMEDIATION OPTIONS

If monitoring results from tier 1 & 2 (normal and alert operation) indicate contaminate levels are continually increasing, i.e SAR, Hydrocarbon and Chloride increases, such that a Tier 3 response is required, mitigation and remediation should be initiated.

5.1 Remediation Options

Due to the sensitive nature of the Uruti Site in relation to shallow groundwater effects, proximity to the surface water of the Haehanga Stream, and downstream to the regionally significant Mimi River any in-situ remediation must be approached with extreme caution.

Potential mitigation steps are summarised below, however, it's recognised that a full site remediation plan may be required before selection of suitable remediation method(s) are finalised.

Table 5.1: Mitigation and Management Options for Uruti Composting Site

Options	Consideration of use	Caveats
1. Irrigation Management/Source Mitigation Addition of $CaC0_3$ or dissolved gypsum in the irrigation fluid to increase the soil pH and CEC to reduce sodicity. Also reduce the high salt content in the irrigation fluid.	Possibly only a short term solution on semi-retired irrigation zones, as a greater potential for Chloride concentrations to remain in the soil and not leached to groundwater.	On soils with low pH (4-5.2) may require multiple applications to be effective. Need field trials to verify, starting with lower irrigation zone already in Tier 2.
2. Irrigation Management Addition and mixing of clean low salt content water from the storage dam to decrease the chloride loadings within the irrigation fluid.	Due to limited rainfall recharge of the shallow groundwater table over the summer months will require most leachate mixing to occur in late Dec-March. Literature suggests a mixture with 20% leachate is most effective to control soil salinity, reduce the effects on plant growth and soil structure, such as reduced porosity and degraded soil structure.	Requires enough storage within the dam to allow use if no sustained rainfall for 15 days Scheduling leachate irrigation in response to soil moisture increases and high evapotranspiration losses May have strict regulatory constraints as off-site effects requires assessment, particular ecological and cultural receptors in the Mimi River
3. Irrigation and Groundwater Management Subsequent flushing with clean irrigation water to increase the leaching and drainage losses to GW and Surface water bodies	Due to limited rainfall recharge of the shallow groundwater table over the summer months will require irrigation to occur in late Dec-March.	Requires enough storage within the dam to allow use if no sustained rainfall for at least 15 days If the Groundwater and Surface water resources such as the Mimi River are deemed to have high value this method requires considerable scrutiny. May have strict regulatory constraints as off-site effects requires assessment

4. Soil Management Excavation of salt contaminated soil and disposal onsite	Contaminated soil maybe reincorporated into composting activities, such as up on Pad 2 (sawdust and compost pad)	Cost effectiveness needs scrutiny
5. Soil Management Addition of liquid/solid calcium/Gypsum or similar to replace the sodium in soil.	The loss through the soil profile to groundwater of the additions of Calcium/Gypsum. Is natural precipitation enough over the year to exceed evaporation, if not don't use. May require multiple applications of calcium which may have unpredicted effects. Normally only used when shallow groundwater is not present	What are the downstream uses of groundwater, what are the effect of the increased of chloride in GW and Haehanga Stream. May require a groundwater fate and transport model to determine off site effects to surface waters
6. Soil Management Other soil amendments such as organic matter, humus, if the soil have low pH and EC	Has good potential as composting facility will have material on site, hence capital costs are low	Requires further investigation and trials onsite, but recommend all zones currently in Tier 2
7. Soil Management Plantation of shore rotation woody crops which are salt tolerant	Investigation what plant species would be practical	The use of bio-sorption techniques requires more investigation as the natural acidic clay soil with low pH will limited uptake of chlorides. May be feasible once soil pH are neutralised

6 CONCLUSION

BTW Company was engaged by RNZ to provide a report outlining management and procedural controls with an aim to improve site performance. A significant part of the project was to provide the Taranaki Regional Council with a site management plan to improve soil and groundwater conditions to mitigate potential environmental effects beyond the site boundary.

The report is not an assessment of environmental effects but rather a procedural document for RNZ to assist in the development of a Uruti Composting Site Irrigation Plan and associated monitoring plan.

The outcomes from the initial environmental data review can be summarised by the main points below.

- Both soil and groundwater resources are recording elevated levels of chlorides (Cl^-) as a result of prolonged irrigation of the leachate fluid.
- The quality of the irrigation leachate over the summer months is often degraded
- Chloride concentrations in the Haehanga Stream are usually below consent conditions, but in March 2014, multiple sampling sites were over consent limits.
- Over the summer months there is limited water in the hydrological cycle to attenuate the irrigated leachate.

The report developed the Uruti Composting Facility site management plan. The three tier plan features operational triggers which govern monitoring requirements and/or remediation options. The three tiers can be summarised by;

1. Normal site operation- weekly and monthly sampling of leachate fluid, soil quality and groundwater resources.
2. Alert level of site operation- increased level of monitoring with deferred irrigation on areas which are deemed overloaded for certain constituents. If monitoring results suggest no improvements in the levels of contaminates after six months it would be recommended moving to Tier 3 response.
3. Action level of site operation-irrigation to cease on all affected areas. Initiate remediation efforts to improve health of soil and groundwater resources.

BTW Company also highly recommended site improvement options with attached timeframes, which are summarised below:

- A water storage dam - to allow mixing with irrigation leachate and to provide a clean water irrigation source on areas which require remediation (tier 3)
- Increase irrigation areas - Phase 1 Consent Variation
- Stormwater improvements, riparian edge protection and deferred irrigation
- Haehanga Stream setbacks
- Predisposal and pre-irrigation samples

REFERENCES

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Daily., M & Whalen, J (2005) Investigation and Remediation of Salt (Chloride) Impacted Soil and Groundwater, Bureau of Environmental remediation/Remedial Section Guidance. BER Policy #BER-RS-13A

NZ Soils Classification, V4, information available from http://soils.landcareresearch.co.nz/contents/SoilNames_NZSoilClassification_About.aspx

Ministry for the Environment (19990, Guidelines for Assessing and Managing Petroleum Hydrocarbon contaminated sites in New Zealand, Module 4 Tier 1 soil acceptance criteria

Taranaki Regional Council Hydrological Data (2014) Uruti Site at Kaka Road

Taranaki Regional Council Regional Explorer Website (2014) accessed from http://apps.geocirrus.co.nz/?Viewer=TaranakiRegionalXplorer-Public

APPENDIX A BTW SOIL PROFILES

SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neil
Location: Unsl
Test Date: 8/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: A1

Depth (mm)	Description	Log
0-200	Light brown/grey silty topsoil	
200-2000	Light gray silty clay, traces of brown/orange clay material, small particle size, friable, low moisture content, low plasticity	
1000	Low-medium moisture content, medium plasticity	
1500	Increase in clay content, light brown/gray in color	
2000	End Auger	

Auger 1: depth 0.8m

Auger 1: depth 1.5m

SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neill
Location: Urutī
Test Date: 9/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: A2

Depth (mm)	Description	Log
0-100	Light brown/grey silty topsoil	
100-1800	Light gray silty clay, traces of brown/orange clay material, small particle size, friable, low moisture content, low plasticity	
1100	Increase in clay content, Light brown/gray in color, medium moisture content, medium plasticity	
2000	End Auger	

Auger 2: depth 1.0m

SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neill
Location: Unsl
Test Date: 8/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: **A3**

Depth (mm)	Description	Log
0-200	Light brown/grey silty topsoil	
200-2000	Light grey/brown silty clay, small particle size, friable, low-medium moisture content, medium plasticity, traces of dark brown clay material	
800	Increase in clay content, light brown/grey in color	
1500	Increase in moisture content, increase in plasticity, reduction in clay content, light grey/brown color	
2000	End Auger	

Auger 3: depth 0.5m

Auger 3: depth 1.2m

SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neil
Location: Unit
Test Date: 8/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: **A4**

Depth (mm)	Description	Log
0-150	Light brown/grey silty topsoil	
150-2000	Light grey silty clay, small particle size, friable, low moisture content, low plasticity	
500	Increase in clay content, light grey/brown in color, low-medium moisture content, low-medium plasticity	
1000	Medium-high moisture content, medium-high plasticity	
2000	End Auger	

Auger 4: depth 0.3m

Auger 4: depth 1.5m

Remediation (NZ) Ltd

Brixton Site Management Plan

Prepared By David Gibson
General Manager-Operations
Remediation (NZ) Ltd

Approved: D Gibson 01/05/2016

Contributions from:

Reviewed By Tom Tester
Area Manager-Taranaki Composting
Remediation (NZ) Ltd

Document No P-720-005-A

Review May 2017

Contents

1. PURPOSE OF A MANAGEMENT PLAN

This document represents current best practice for the Remediation (NZ) Ltd. Waitara Road Facility. The purpose of this Plan is to ensure that operations and environmental risks are managed appropriately, and within the conditions of the resource consents issued by Taranaki Regional Council. All reviews and changes **MUST** be approved by Taranaki Regional Council before implementation

1.1 SITE PROCESS

The site operates as a commercial composting business that receives material from Taranaki Transfer Stations & large commercial contractors. Site operations consist of:

1. Receiving and monitoring of incoming greenwaste, inputs and additives
2. Shredding greenwaste
3. Mixing of shredded material with approved inputs to form compost windrows
4. Monitoring and turning windrows based on temperature and moisture
5. Screening finished product
6. Trucking finished compost direct to market including spreading (offsite)
7. Blending finished compost with approved additives, and delivery offsite
8. Managing stormwater runoff
9. Managing Air Quality

1.2 AIR DISCHARGE

1.2.1 General

The site is to be managed to ensure no odours are released outside the Compost Centre boundary that are deemed offensive or objectionable

All work on site will be **done between the hours of 8am and 5.00pm** during times when climatic conditions are favourable[1] to prevent the transport of objectionable odours beyond the composting centres boundary.

1.2.2 Incoming material (Inputs)

Only approved input materials will be allowed on site subject to meeting the following criteria:

- The material has no objectionable odour in its raw state; and
- Does not create objectionable odour when blended with green waste or compost."
- No chicken litter to be mixed or delivered on weekends or Public holidays

Should a new input be required, Remediation (NZ) Ltd must apply for a variation of this Management Plan from Taranaki Regional Council before this input can be used

[1] Wind from a westerly, east or south quarter

1.2.3 Approved additives

1. Chicken Litter
2. Vermicast
3. And any additional chemical fertilizers required by Remediation (NZ) Ltd customers.
4. However these must meet the following criteria:

   - The material has no objectionable odour beyond the site boundary in its raw state; and
   - The product causes no objectionable odour beyond the site boundary when blended with green waste or compost."

1.2.4 Contingency Plan

Should a material enter the site as either an input or an additive that is found to be odorous by the operators and is deemed **offensive or objectionable**, it should be referred to the site Manager (or "acting") and the following actions should be followed

1. The Site Manager to determine if the material can be stabilised by adding compost fines and should proceed to do so OR
2. Turn the material away
3. If this material is likely to have already caused an odour off the site then the Site Manager will notify the Taranaki Regional Council as soon as the material has been stabilised and note
   a. Time of the event
   b. Type of odour
   c. Wind speed and direction
   d. Expected duration
   e. Actions taken
   f. Do not accept material from this source until confirmed non-odorous.

Note in the daily site diary

1.2.5 Greenwaste Shredding

1. All greenwaste that enters the site must be shredded within 28 calendar days and **not on weekends or Public holidays.**
2. Once shredded this material must be formed into a compost windrow **within 48 hours** to prevent the release of odour due to disturbance during the early part of the composting process.[2]
3. If the material can't be moved to windrows within 48 hours, the Site Manager will take into consideration the wind direction and speed when forming new windrows or moving material on site.

[2] Shredded material will be trucked to the Remediation (NZ) Ltd Uruti site

1.2.6 Screening

Once the rows are deemed mature they are screened to remove contaminants and oversized material. During this process dust can be generated. Due to our site's location this is likely to only cause an onsite risk to staff creating a Health & Safety hazard. It is unlikely to become an offsite environmental hazard.

The Site Manager will **monitor the screening operation daily** and if he believes this has become a Health & Safety Hazard, screening will stop and this will be noted in the daily diary

Mixing and Blending for Sale

When the compost has gone through the final screening process it is then stockpiled ready for sale.

During the winter season the Site Manager will ensure that there is enough dry compost available to make approved blends.

When dealing with chicken litter as an approved additive, the following procedure will be followed:

a. The customer's order will be **mixed no more than 18 hours before the order is due** to be collected
b. If there is rain pending the **blended order will be covered** on the mixing pad
c. All trucks leaving the site **must have covers in place**
d. Any blended material will be covered or stored indoors if it is not removed from the site within 3 hours of blending.

2.0 STORMWATER

2.1 General

The Composting site is a non-hazardous site, but will generate leachate from rainwater falling on uncovered windrows and Worm beds

Therefore consideration needs to be given to how the site deals with contaminated and non-contaminated stormwater

2.2 Non-Contaminated Stormwater

All the stormwater from the

- Parking area
- Entrance roads
- Between Composting sheds and packing sheds

Is currently diverted away from the compost pad and is disposed of through the "clean" stormwater system.

The Site Manager will **check these areas weekly** to ensure that there is no contamination present such as:

- Silt
- Compost
- Litter

Should contamination be found this to be removed "as soon as practical?"

2.3 Contaminated Storm water

The Site Manager shall **check the site weekly** to ensure no ponding is occurring and if there is, have the ponding rectified as soon as practical.

There are a number of potential contamination sources:

1. Incoming greenwaste
2. Compost windrows (in general)
3. Storage and handling of chicken litter

2.4 Incoming Greenwaste

Incoming greenwaste shall be stacked on the high side of the yard so ponding does not occur, each load that is dropped off on site will be checked for contaminates to ensure consent requirements are met.

This material is checked by the Site Manager (or acting) to ensure it meets the acceptance criteria.

Chicken Litter

The stored chicken litter has a potential to leach soluble nutrients and bacteria when exposed to either rain or stormwater runoff. It is therefore critical to minimise any stormwater discharge from the chicken litter storage area.

The Site Manager must ensure

1. The chicken litter is stored inside the storage shed
2. The stockpile is not getting wet from driving rain
3. The chicken litter is only moved when making orders for despatch
4. The Site Manager will also consider weather (i.e. Wind and rain) when re the covers to minimise any chance of rain contact

2.5 Stormwater Monitoring

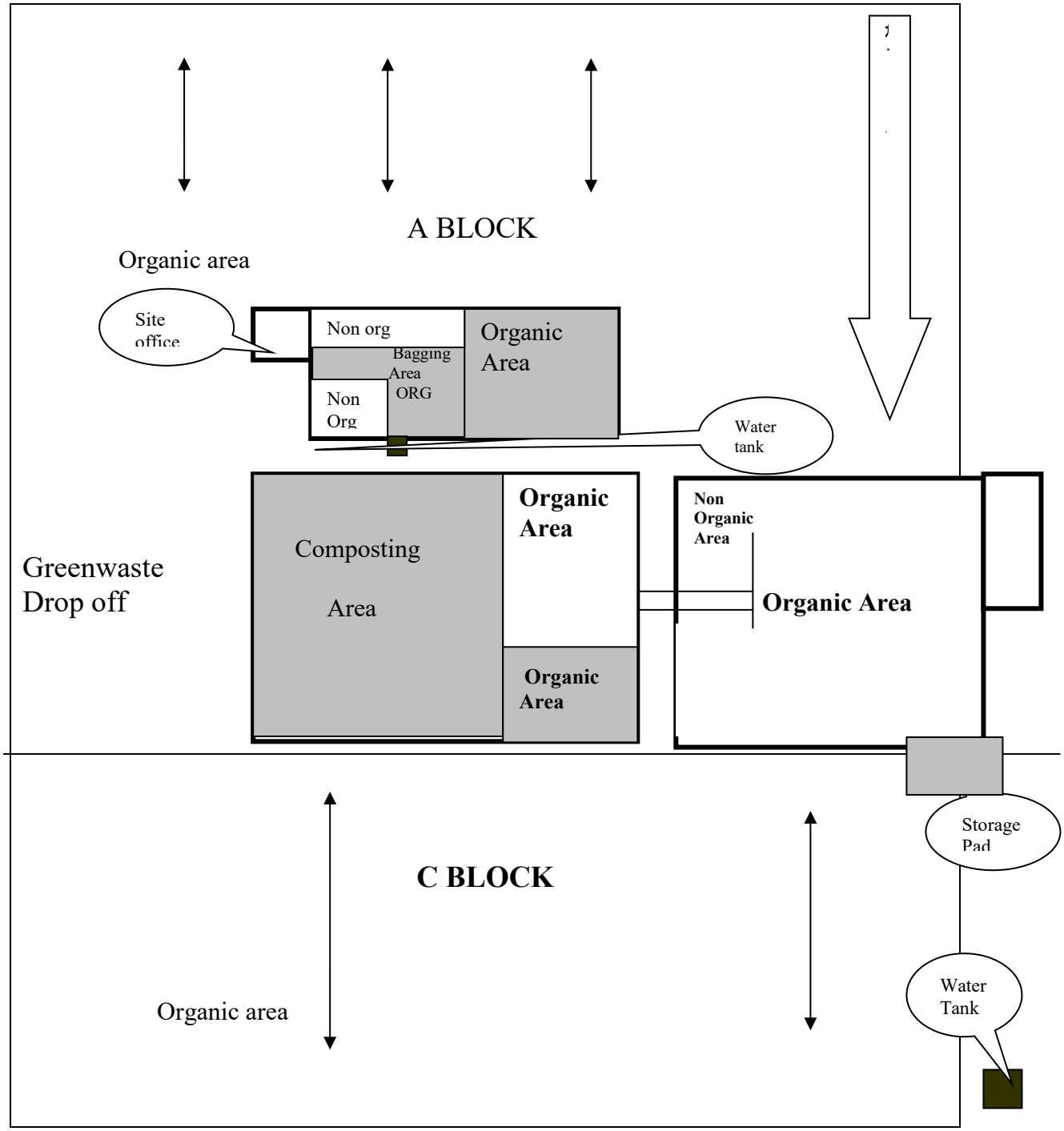
The Site Manager (or "acting") shall take water samples from each of the discharge pipes leading from the vegetation strip **six months after commencement of the Resource Consent and then annually for the duration of the consent.**

The **samples to be taken while a discharge is occurring** and as close to the time of initial flow from the discharge pipes as possible, these samples shall be analyzed for the following parameters:

Onsite testing

- Temperature
- Conductivity
- pH

3.0 Brixton Site Plan



Appendix 1-Copy of TRC Resource Consent

Consent 5892-2

TARANAKI REGIONAL COUNCIL

CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz

Please quote our file number on all correspondence

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

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