South Taranaki District Council
Eltham, Hawera, Kaponga, Manaia, Patea, Opunake and Otakeho Landfills Monitoring Programme Annual Report 2014-2015

Technical Report 2015-109

ISSN: 1178-1467 (Online)
Document No: 1624781 (Word)
Document No: 1657126 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

May 2016

Executive summary

The South Taranaki District Council (STDC) holds consents to cover the discharge of leachate and stormwater from seven closed landfills. The landfills are at Kaponga and Manaia in the Waiokura catchment, Patea in the Patea catchment, Opunake in the Otahi catchment, Hawera in the Tangahoe catchment, Otakeho in the Taikatu catchment and Eltham in the Waingongoro catchment.

This report for the period July 2014 -June 2015 describes the monitoring programmes implemented by the Taranaki Regional Council (the Council) to assess STDC's environmental performance during the period under review, and the results and the environmental effects of STDC's activities at the Eltham, Manaia, Hawera, Opunake, Kaponga and Patea landfills. Triennial monitoring of the Otakeho closed landfill was not scheduled to take place during the year under review.

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

In relation to its closed landfills STDC hold 10 resource consents consisting of eight discharge of stormwater and/or leachate to water consents, one discharge to air consent, and one land use consent. These permits have a total of 67 special conditions that STDC must adhere to.

To monitor compliance with these conditions during the 2014-2015 year, Council staff conducted 13 inspections, took 31 discharge and receiving environment samples, and conducted three biomonitoring surveys.

No incidents were recorded by the Council in regards to these landfill sites during the monitoring year.

There were some issues arising at a few of the sites, however these were resolved during the period under review and no long term adverse effects were noted.

During the year, STDC demonstrated a high level of environmental and good level of administrative performance in relation to the Hawera landfill consents as defined in Section 1.1.5.

During the year, STDC demonstrated a high level of environmental and good level of administrative performance in relation to the Kaponga landfill consent as defined in Section 1.1.5. This site is on a Council triennial monitoring programme, and the discovery of the waste roading material across the central drain highlights the importance of checks being made by STDC during the intervening period.

During the year, STDC demonstrated a high level of environmental and high level of administrative performance in relation to the Eltham landfill consent as defined in Section 1.1.5.

During the year, STDC demonstrated a high level of environmental and good level of administrative performance in relation to the Manaia landfill consent as defined in Section 1.1.5. In the 2014-2015 year, there was some minor cap damage as a result of inappropriate

grazing methods. In addition a scheduled sample could not be collected due to poor access.

During the year, STDC demonstrated a high level of environmental and high level of administrative performance in relation to the Opunake landfill consent as defined in Section 1.1.5.

During the year, STDC demonstrated a high level of environmental and a good level of administrative performance in relation to the Patea landfill consents as defined in Section 1.1.5. In the 2014-2015 year, the best practicable option was not always adopted at the site resulting in some minor stock damage to the cap and stormwater drains. This was remediated where necessary, and reoccurrence prevented by the lessee making the requested changes to stock management practices.

For reference, in the 2014-2015 year, 75% 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 22% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2015-2016 year.

Table of contents

List of tables

List of figures

List of photos

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2014 to June 2015 by the Taranaki Regional Council (the Council) on the monitoring programmes associated with resource consents held by South Taranaki District Council (STDC) for closed municipal landfills. STDC maintains seven closed landfills, which are located in Manaia, Eltham, Hawera, Opunake, Kaponga, Otakeho and Patea.

This report covers the results and findings of the monitoring programmes implemented by the Council in respect of the consents held by STDC that relate to discharges to water and air from the Manaia, Eltham, Hawera, Opunake, Kaponga and Patea. The monitoring of the Otakeho closed landfill is an intermittent programme, implemented on a triennial basis. This programme will next be implemented in the 2016-2017 year.

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 is the 26th combined monitoring report discussing the environmental effects of the STDC's use of water, land, and air in respect to the closed landfills it maintains.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the landfill resource consents held by STDC shown in the nature of the monitoring programme in place for the period under review and a description of the activities and operations conducted by STDC.

Sections 2- 8 present the results of monitoring during the period under review, including scientific and technical data for each landfill. The results for each landfill are discussed and interpreted and recommendations are made for the next monitoring period.

Section 9 presents a summary of recommendations to be implemented in the 2015-2016 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

(a) the neighbourhood or the wider community around a discharger, and may

include cultural and socio-economic effects;
(b) physical effects on the locality, including landscape, amenity and visual effects;
(c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
(d) natural and physical resources having special significance (for example recreational, cultural, or aesthetic);
(e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of 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 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Incident Register (IR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

1.1.5 Evaluation of environmental and administrative performance

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

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year.

Administrative performance is concerned with the consent holder'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 interpretations, 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 compliance

- **High:** The administrative requirements of the resource consents were met, or any failures 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 2014-2015 year, 75% 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 22% demonstrated a good level of environmental performance and compliance with their consents.

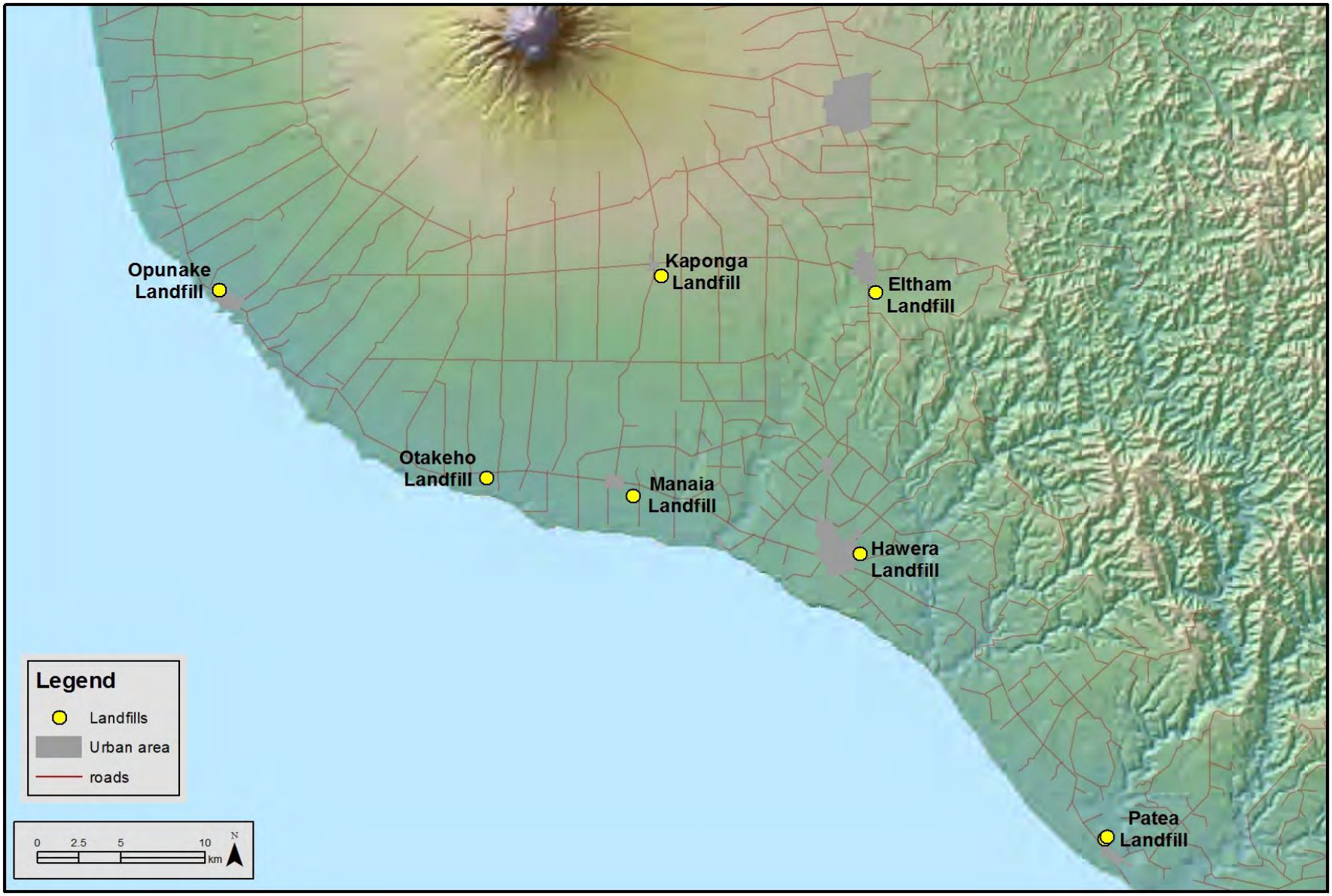


Figure 1 Regional map of STDC landfills

1.2 Process description

STDC maintained seven closed municipal landfills in the South Taranaki District during the 2014-2015 period (Figure 1). All these sites tend to have a long history of waste disposal and, as older facilities, do not have engineered liners. Landfills of this nature are designated as Class B landfills in the MfE publication Module 2: Hazardous Waste Guidelines, Landfill Waste Acceptance Criteria and Landfill Classification (2004). The number of open landfills in the district steadily decreased over a number of years and there have been no operating landfills in the South Taranaki district since the Patea landfill closed in 2007.

Currently the only general municipal landfill in operation in the Taranaki region is the Colson Rd Landfill, which is operated by the New Plymouth District Council as a regional facility.

1.3 Resource consents

STDC hold 10 resource consents associated with the closed landfills they maintain. A summary of the consents is given in Table 1 with more detailed information given in Sections 1.3.1 to 1.3.3.

Table 1 Summary of the South Taranaki closed municipal landfill consents and their key dates

Landfill site	Consent no.	Purpose	Review	Expiry
Hawera	0444-4	To discharge up to 2800 m^3/day of leachate and stormwater from the closed Matangara Landfill, Hawera, to groundwater and into an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment	-	1 June 2016
	5831-1	To divert an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment	-	1 June 2016
Patea	0427-3	To discharge surface water and leachate from the Patea municipal landfill into an unnamed tributary of the Patea River	June 2016	1 June 2022
	7268-1	To discharge stormwater and sediment onto and into land and into an unnamed tributary of the Patea River from earthworks associated with the closure of the Patea Landfill	June 2016	1 June 2022
	4636-2	To discharge emissions into the air from the Patea municipal landfill	June 2016	1 June 2022
Manaia	3952-2	To discharge leachate and stormwater from the closed Manaia landfill and from composting operations into the Waiokura Stream	June 2017	1 June 2023
Kaponga	3459-3	To discharge stormwater and leachate from the former Kaponga landfill site into an unnamed tributary of the Waiokura Stream	June 2017	1 June 2023
Otakeho	3953-3	To discharge leachate and stormwater from the closed Otakeho Municipal Landfill onto and into land	-	1 June 2018
Eltham	3387-3	To discharge stormwater and leachate from the former Eltham landfill site into the Mangawhero Stream in the Waingongoro catchment	June 2017	1 June 2023
Opunake	0526-3	To discharge stormwater and leachate from the closed Opunake landfill into the Otahi Stream	-	1 June 2018

1.3.1 Water discharge permits

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

Consent 0444-4

STDC holds water discharge permit **0444-4** to cover the discharge of leachate and stormwater from Hawera landfill onto and into groundwater and an unnamed tributary of the Tawhiti Stream. This permit was issued by the Council on 28 June 2001 under Section 87(e) of the RMA. It is due to expire on 1 June 2016.

Condition 1 requires the consent holder to adopt the best practicable option.

Conditions 2 and 3 require maintenance of the landfill cap and provision and maintenance of a post closure management plan.

Conditions 4, 5 and 6 require the consent holder to adhere to the management plan, control the flow of surface water on the site, and maintain the leachate collection system.

Condition 7 deals with the mixing zone for the discharge and condition 8 prohibits certain effects on the receiving water from the discharge beyond that mixing zone.

Conditions 9 and 10 require ground water monitoring and bore maintenance.

The last two conditions (11 and 12) provide opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

Consent 0427-3

STDC holds water discharge permit **0427-3** to cover the discharge of leachate and stormwater from the Patea landfill into an unnamed tributary of the Patea River. This permit was issued by the Council on 16 December 2003 under Section 87(e) of the RMA. It is due to expire on 1 June 2022.

Conditions 1 and 2 require the consent holder to prepare and maintain a site contingency plan, and site management plan.

Condition 3 deals with notification of amendments to these plans.

Condition 4 requires that the consent be exercised in accordance with information supplied in the application.

Conditions 5 and 6 require groundwater monitoring and maintenance of stormwater and leachate systems.

Condition 7 requires that the discharge shall not cause adverse environmental

effects on receiving waters.
Condition 8 requires the consent holder to adopt the best practicable option.

The last condition (9) provides opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

Consent 3952-2
STDC holds water discharge permit **3952-2** to cover the discharge of leachate and stormwater from Manaia landfill into the Waiokura Stream. This permit was issued by the Council on 20 June 2005 under Section 87(e) of the RMA. It is due to expire on 1 June 2023.

Condition 1 requires the consent holder to adopt the best practicable option.

Conditions 2 and 3 require the consent holder to prepare and maintain a site contingency plan, and site management plan.

Condition 4 deals with notification of amendments to these plans.

Special conditions 5 and 6 deal with groundwater monitoring and maintenance of stormwater and leachate systems.

Condition 7 requires that the discharge shall not cause adverse environmental effects on receiving waters.

The last condition (8) provides opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

Consent 3459-3
STDC holds water discharge permit **3459-3** to cover the discharge of leachate and stormwater from Kaponga landfill into an unnamed tributary of the Waiokura Stream. This permit was issued by the Council on 17 March 2005 under Section 87(e) of the RMA. It is due to expire on 1 June 2023.

Condition 1 requires the consent holder to adopt the best practicable option.

Condition 2 requires the consent holder to prepare a site contingency plan.

Condition 3 requires the consent holder to monitor adjacent surface water and groundwater.

Condition 4 requires the consent holder to install and monitor stormwater and leachate control systems.

Condition 5 states that any discharge from the site shall not cause adverse environmental effects.

The last condition (6) provides opportunities for Council to review the

conditions of the consent.
The permit is attached to this report in Appendix I.

Consent 3953-3

STDC holds water discharge permit **3953-3** to cover the discharge of leachate and stormwater from Otakeho landfill onto and into land in the vicinity of the unnamed tributary of the Tawhiti Stream. This permit was issued by the Council on 22 August 2005 under Section 87(e) of the RMA. It is due to expire on 1 June 2018.

Condition 1 requires the consent holder to adopt the best practicable option.

Condition 2 requires the consent holder to discharge in accordance with consent application information.

Condition 3 requires the consent holder to prepare a site contingency plan and condition 4 requires STDC to notify the Council if changing the contingency plan.

Condition 5 states that the surface water and groundwater will be monitored and condition 6 states that the discharge shall not cause any adverse effect on aquatic life.

The last condition (7) provides opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

Consent 3387-3

STDC holds water discharge permit **3387-3** to cover the discharge of leachate and stormwater from Eltham landfill into the Mangawhero Stream. This permit was issued by the Council on 17 March 2005 under Section 87(e) of the RMA. It is due to expire on 1 June 2023.

Condition 1 requires the consent holder to adopt the best practicable option.

Condition 2 requires the consent holder to prepare a site contingency plan.

Condition 3 requires the consent holder to monitor adjacent surface water and groundwater.

Condition 4 states that any discharge from the site shall not cause adverse environmental effects.

The last condition (5) provides opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

Consent 0526-3

STDC holds water discharge permit **0526-3** to cover the discharge of leachate and stormwater from Opunake landfill into the Otahi Stream. This permit was issued by the Council on 23 August 2005 under Section 87(e) of the RMA. It is due to expire on 1 June 2018.

Condition 1 requires the consent holder to adopt the best practicable option.

Condition 2 requires the consent holder to prepare a site contingency plan and condition 3 requires STDC to notify Council prior to making changes to the plan.

Condition 4 requires the consent holder to monitor adjacent surface water and groundwater.

Condition 5 states that any discharge from the site shall not cause adverse environmental effects.

The last condition (6) provides opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

Consent 7268-1

STDC holds water discharge permit **7268-1** to cover the discharge of stormwater from earthworks associated with the closure of Patea landfill into an unnamed tributary of the Patea River. This permit was issued by the Council on 26 March 2008 under Section 87(e) of the RMA. It is due to expire on 1 June 2022.

Condition 1 requires the consent holder to adopt the best practicable option.

Condition 2 requires the consent holder to discharge in accordance with information supplied with the application.

Condition 3 requires the consent holder to notify Council before the exercise of the consent.

Condition 4 requires the consent holder to take reasonable steps to minimise adverse effects.

Condition 5 outlines reinstatement requirements.

Condition 6 is a lapse condition.

Condition 7 provides opportunities for Council to review the conditions of the consent.

1.3.2 Air discharge permit

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

Consent 4636-2

STDC holds air discharge permit **4636-2** to cover discharge emissions into the air from Patea municipal landfill. This permit was issued by the Council on 16 December 2003 under Section 87(e) of the RMA. It is due to expire on 1 June 2022.

Condition 1 requires the consent holder to prepare a site contingency plan.

Condition 2 requires STDC to prepare a landfill operations and management plan.

Condition 3 requires STDC to notify any changes to the contingency and management plan.

Condition 4 states that no material shall be burned at the site.

Condition 5 states that the exercise of the consent shall be in accordance with information supplied on application.

Condition 6 requires the consent holder to adopt the best practicable option.

The last condition (7) provides opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

1.3.3 Land use permit

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.

Consent 5831-1

STDC hold land use permit **5831-1** to culvert an unnamed tributary of the Tawhiti Stream. This permit was issued by the Council on 28 June 2001 as a resource consent under Section 87(e) of the RMA. It is due to expire on 1 June 2016.

Condition 1 relates to informing the Council of works to be carried out.

Condition 2 states that the exercise of the consent should be undertaken in accordance to documents submitted with the application.

Condition 3 requires the consent holder to adopt the best practicable option.

Condition 4 requires the consent holder to minimise streambed disturbance.

Condition 5 requires the consent holder to maintain the culvert.

Condition 6 relates to preparation of a contingency plan relating to blockages of the culvert.

Condition 7 provides opportunities for Council to review the conditions of the consent.

The permit is attached to this report in Appendix I.

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the sites consisted of four primary components, which are described in Sections 1.4.2 to 1.4.5. The type and number of environmental monitoring elements carried out at each site are summarised in Table 2.

Table 2 Council monitoring activity in relation to the South Taranaki closed municipal landfills in the 2014-2015 year

Landfill	Catchment	Biological surveys	Inspections	Samples taken
Patea	Patea	0	4	5
Manaia	Waiokura	0	2	5
Hawera	Tawhiti	0	2	16
Otakeho	Taikatu	Next monitored 2016-2017		
Eltham	Waingongoro	2	1	0
Opunake	Otahi	1	2	4
Kaponga	Waiokura	0	2	1
Total		**3**	**13**	**31**

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

A total of 13 inspections were undertaken focusing on stormwater and silt control, and the condition of landfill caps. Sources of data being collected by the consent holder were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council.

1.4.4 Chemical sampling

Discharges and the receiving waters associated with the landfills were sampled during the monitoring period as described in Table 2. A total of 31 samples were collected and analysed for various water quality parameters depending on the site.

1.4.5 Biomonitoring surveys

Biomonitoring surveys were performed in conjunction with the Eltham (two surveys) and Opunake (one survey) landfill programmes to assess if the discharges of leachate and stormwater were having any effect on aquatic ecosystems.

2. Hawera landfill

2.1 Background

The Matangara Road Municipal Landfill was used for domestic waste disposal for the Hawera District. A small unnamed tributary of the Tawhiti Stream flowed down a deep gully (approximately 30 m) from the north-west to the south-east of the landfill site. The stream was directed into a 750 mm pipe and waste was deposited into the landfill over the pipe, shown as a dashed line on Figure 2. The stream exits the culvert where it discharges into a roadside drain (later referred to as the roadside tributary) that runs adjacent to Matangara Road. The roadside tributary flows into the Tawhiti Stream approximately 400 m downstream of the culvert.

The landfill closed in September 1998, and STDC reinstated the site. Leachate is captured via leachate collection lines in the landfill and is pumped to the Hawera wastewater treatment plant from a pump station located just above and downstream of the upstream end of the culvert under the landfill. Groundwater monitoring has shown that some leachate is entering the groundwater in the immediate vicinity of the site, but this appears to be having a very minor effect at the southern boundary of the site.

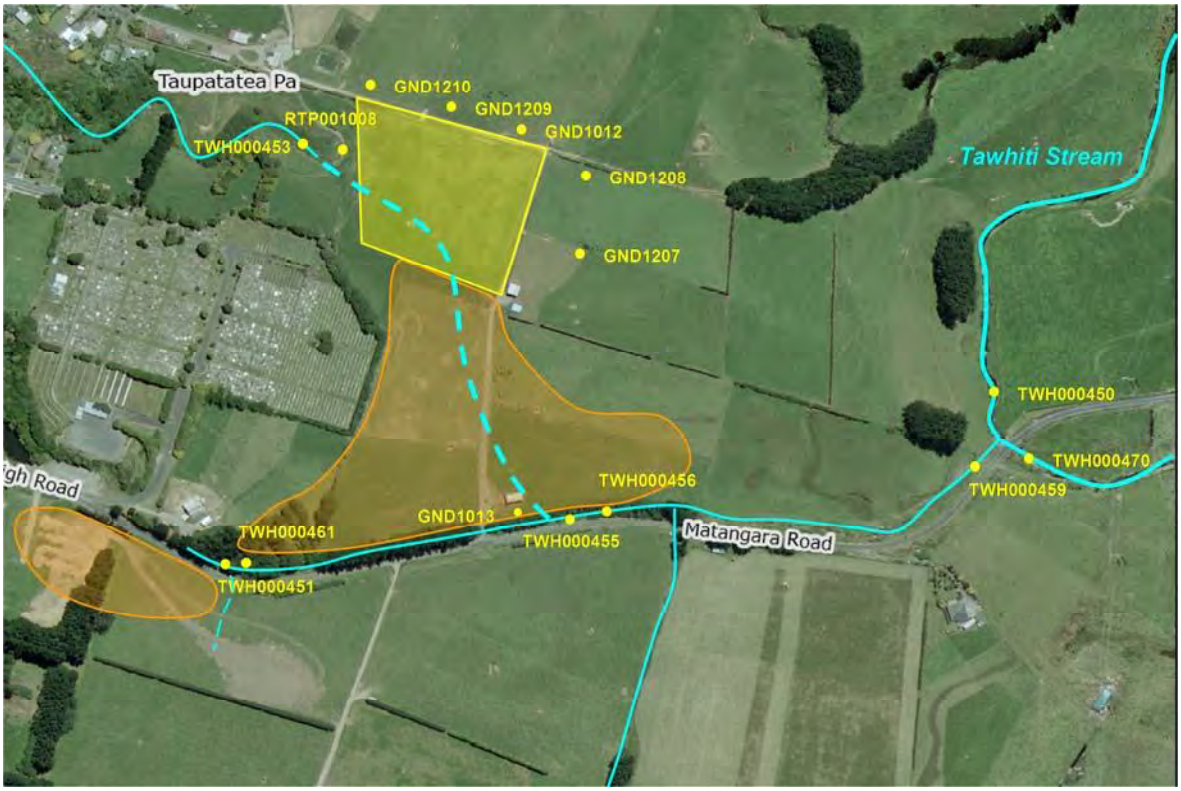


Figure 2 Aerial view of Hawera landfill and sampling sites. The older areas of landfill area shown in orange and the newer areas in yellow

2.2 Results

2.2.1 Inspections

Two inspections were carried out during the 2014-2015 monitoring year; a routine scheduled inspection on 15 April 2015 and a follow-up inspection on 22 April 2015.

15 April 2015
The site was inspected in fine weather following recent heavy prolonged rain. The cap was walked, and the stormwater drains were checked. It was found that there was no slumping or cracking, and only some minor insignificant ponding, which shows that the stormwater drains are currently effective given the amount of rain prior to the inspection. Although a culvert on the western boundary and the culverts at the nib wall were partially obstructed, at the time of inspection, there was no ponding evident as a result. There was good grass cover, and it was considered that the grazing at the site was being well managed ensuring that damage to the cap was being minimised.

On arrival at the site it was found that the leachate sump pump was not working and leachate was seeping from the concrete riser. It appeared that this was tracking towards the tributary, where it was being diluted by bank seepages prior to the point at which the likely flow path discharged into the tributary. An additional sample was collected upstream of the point at which it appeared that the discharge entered the tributary. There were no visible effects from this potential leachate discharge to the tributary at the time of the inspection. STDC were contacted immediately, and STDC staff attended the site. It was found that the sump pump was not working due to a jammed float valve. It was also identified that the telemetry system was not functioning. The float was un-jammed and the pump reactivated during the inspection. The inspecting officer was informed that the Wastewater Treatment Officer had visited the site earlier that morning and had not found any issues with the pump, or evidence of seepage from the riser.

The inspecting officer was informed that STDC were likely to put a proposal into the long term plan to allow the tributary that is culverted under the landfill to be redirected away from the landfill area, as the current culvert was partially obstructed. It was noted that, at the time of inspection, there was no evidence of the tributary having backed up above the culvert inlet during the recent heavy rains.

GND1012 could not be found at the time of inspection and sampling visit as the top of the bore had been completely covered by soil and grass. The approximate location of this groundwater monitoring bore was outlined to STDC staff. It was requested that STDC locate and reinstate access to this bore. Staff were also asked to clear the partially obstructed stormwater culverts at the site.

22 April 2015
A follow-up inspection was undertaken to check the operation of the leachate sump pump, after the discharge pump had been found not to be operating at the time of the previous inspection. At the time of this inspection it was found

that the pump was operating and the sump level was approximately a metre below the sump cover. A sample was collected from the leachate sump as there was a noticeable leachate odour present.

An email was received on 20 May 2015, with photographs showing that the stormwater drains had been cleared, and that access to groundwater monitoring bore GND1012 had been re-instated. The email also advised that the alarm transmitter that should have alerted STDC to the leachate sump overflow had been repaired, and the weekly site visit would now include checking that this alarm was functional.

2.2.2 Results of discharge monitoring

Four leachate samples were collected at the leachate sump (site RTP001008) during the 2014-2015 monitoring period. The results are presented in Table 3 and the location of the sampling site is shown in Figure 2.

Table 3 Chemical analysis of the Hawera landfill leachate samples

Parameter	Unit	8-Dec-14	15 Apr 15	22-Apr-15	28-May-15	Historical Data (given where N >5)		
						Min	Max	Median
Alkalinity	g/m^3CaCO_3	960	623	677	761	130	1310	944
Chloride	g/m^3	240	102	-	182	41	1100	286
Chemical oxygen demand filtered	g/m^3	93	58	-	100	11	290	118
Conductivity @ 20°C	mS/m	234	139	161	187	44	319	235
Dissolved chromium	g/m^3	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Dissolved reactive phosphorus	g/m^3	0.005	<0.003	-	0.007	<0.003	0.030	0.004
Acid soluble iron	g/m^3	34.3	66.9	-	16.1	0.38	71.8	34.3
Total mercury	g/m^3	<0.0002	<0.0002	-	<00001	<0.0001	0.0016	0.0001
Unionised ammonia	g/m^3N	-	0.10393	-	-	0.00022	1.26	0.282
Ammoniacal nitrogen	g/m^3N	117	54	-	89.3	0.308	176	117
Nitrate/nitrite N	g/m^3N	0.04	0.04	-	0.18	<0.01	3.97	0.04
pH	pH	7.1	6.7	6.5	6.8	6.4	7.6	6.8
Temperature	°C	-	17.1	17.0	-	12.9	36.2	17.0
Dissolved zinc	g/m^3	<0.005	0.010	-	<0.005	<0.005	0.086	0.008

Results indicate that waste in the landfill is still actively degrading and releasing contaminants. The high chloride, filtered chemical oxygen demand, and ammoniacal nitrogen concentrations are typical values for landfill leachate and, as expected, these contaminants are gradually trending down over time (Figure 3, Figure 4, and Figure 5).

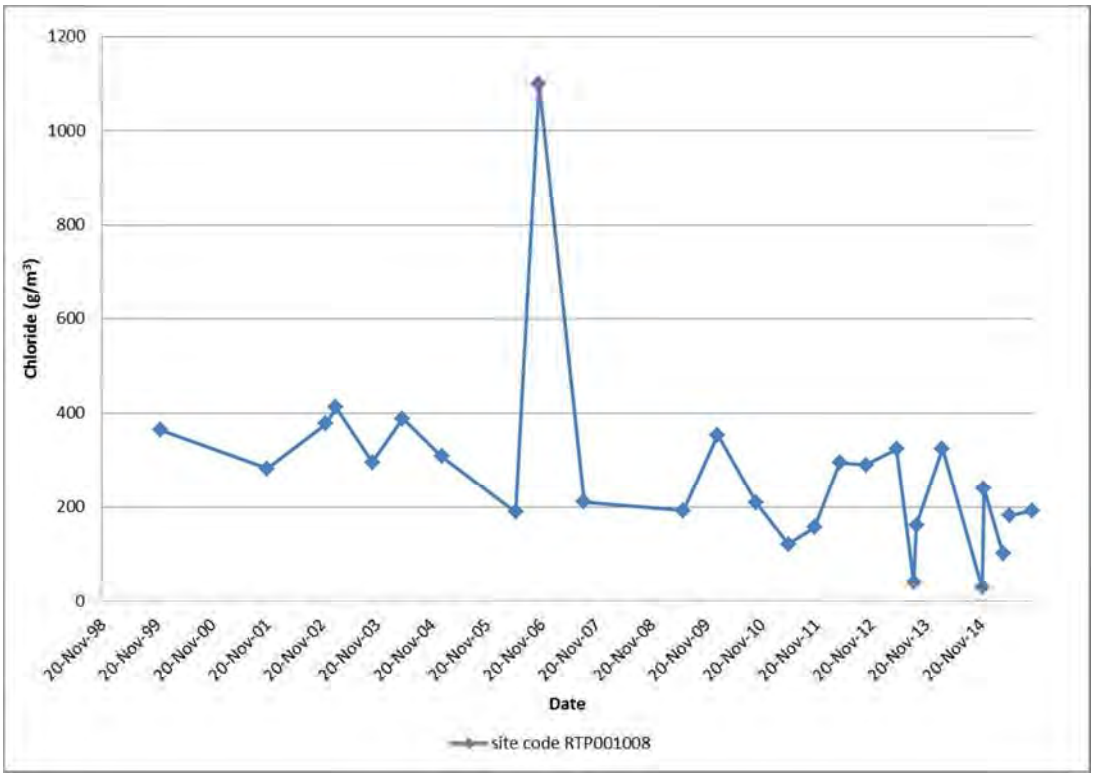


Figure 3 Hawera landfill leachate chloride concentration, 1999 to 2015

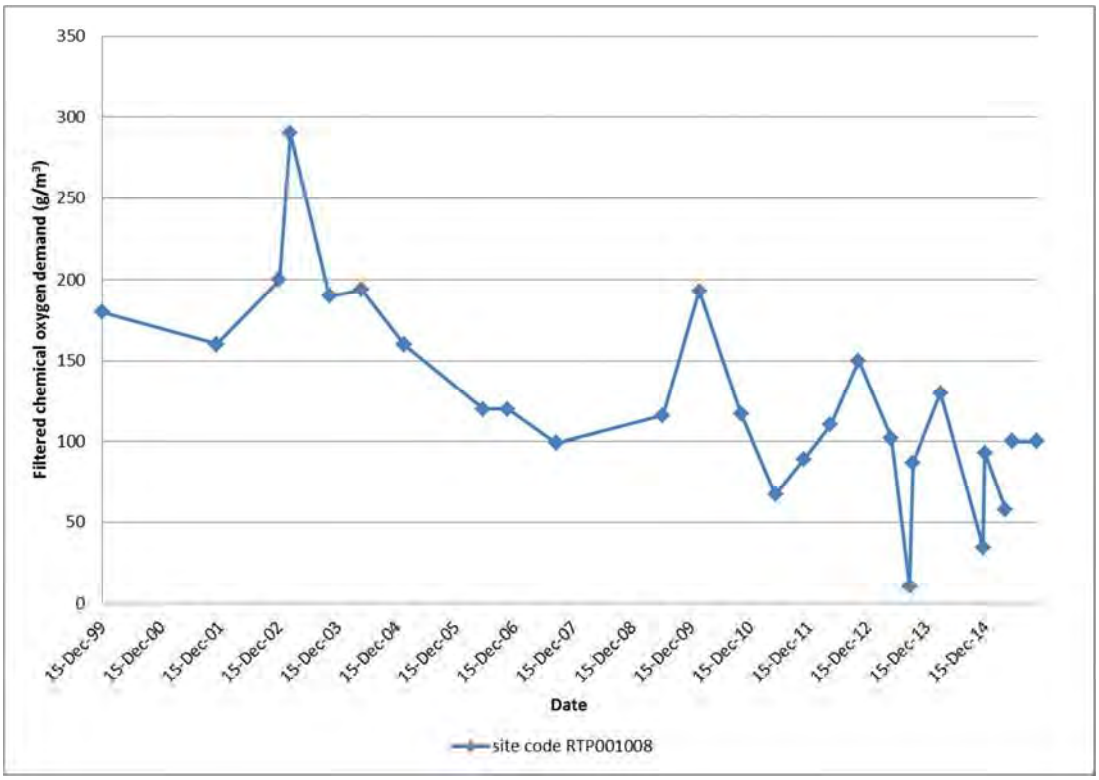


Figure 4 Hawera landfill leachate filtered chemical oxygen demand, 1999 to 2015

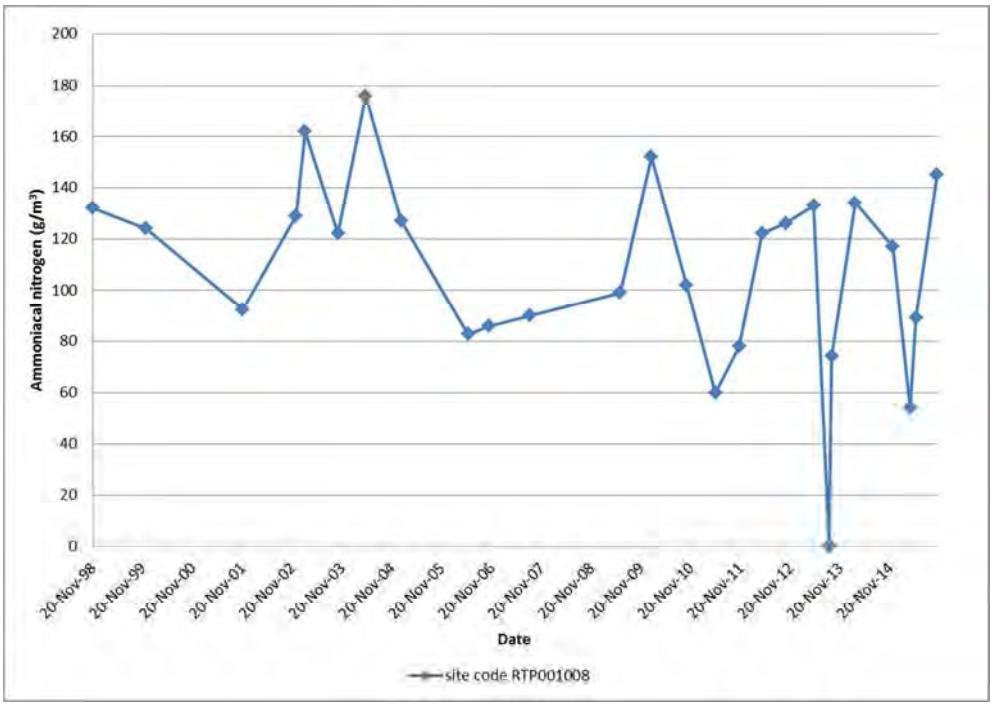


Figure 5 Hawera landfill leachate ammoniacal nitrogen concentration, 1998 to 2015

All of the results obtained during the year under review were below the maximum values previously recorded, and most were also below the historical medians. As most of this leachate is pumped to the Hawera wastewater treatment plant, the majority of the contaminants found in these results have no direct effect on surface waters near the site. However they do give an indication of the contaminant concentration's present in the subsurface flows that have the potential to enter groundwater at this site, due to the lack of an engineered liner.

2.2.3 Results of groundwater monitoring

Three groundwater samples were collected during the 2014-2015 period. The results of the chemical analyses are set out in Table 4.

Table 4 Chemical analysis of groundwater samples from the bores at Hawera landfill

		GND1012		GND1013	
Parameter	**Unit**	**28-11-14**	**28-5-15**	**28-11-14**	**28-5-15**
Alkalinity	g/m^3 $CaCO_3$	-	743	117	89
Chloride	g/m^3	-	148	21.6	20.7
Filtered COD	g/m^3	-	86	<11	<5
Conductivity @ 20°C	mS/m	-	181	32.4	31.6
Dissolved reactive phosphorus	g/m^3	-	0.008	0005	0.080
Acid soluble iron	m	-	88.5	0.07	<0.03
Level	g/m^3	-	3.50	3.11	2.76
Unionised ammonia	g/m^3 N	-	0.09548	<0.00001	<0.00001
Ammoniacal nitrogen	g/m^3 N	-	67.0	0.003	<0.003
Nitrite/nitrate nitrogen	g/m^3 N	-	0.12	3.00	4.71
pH	pH	-	6.6	6.6	6.4
Temperature	Deg.C	-	16.1	13.9	15.4
Dissolved zinc	g/m^3	-	0.006	<0.005	0.009

As with previous monitoring periods the bore GND1012 exhibits elevated levels of landfill contamination indicators such as increased chlorides, COD, alkalinity, iron, unionised ammonia and ammoniacal nitrogen. This bore is immediately adjacent to, and down gradient of the landfill footprint, and in recent years has contained a similar level of contaminants to the leachate as indicated by the relative filtered chemical oxygen demands (Figure 6).

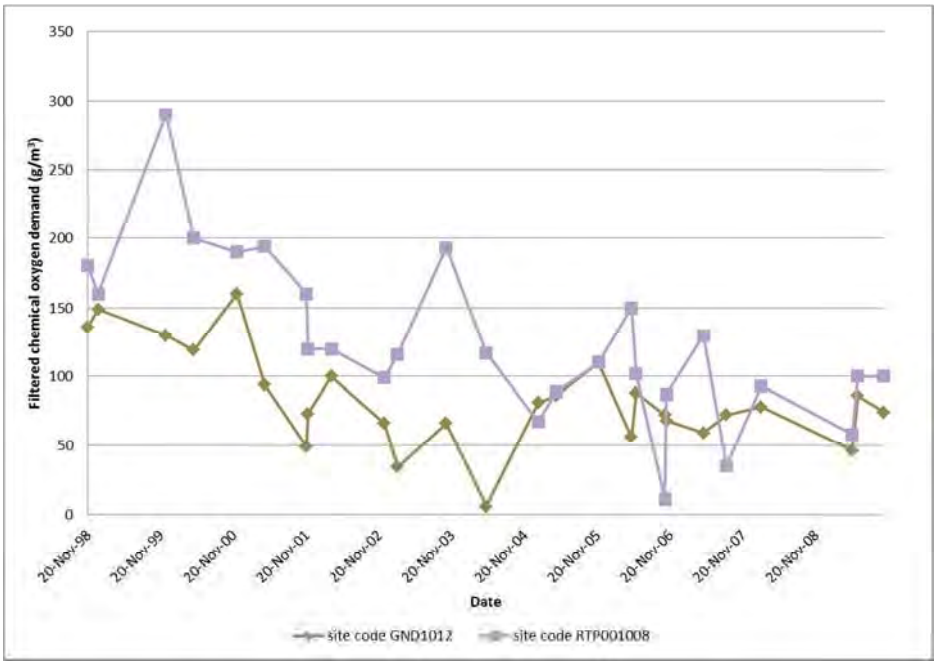


Figure 6 Hawera landfill filtered chemical oxygen demand comparison groundwater (site GND1012) and leachate

Bore GND1013 is further from the most recently landfilled areas and as a result has far lower levels of landfill indicator species as shown by the filtered chemical oxygen demand at this site (Figure 7).

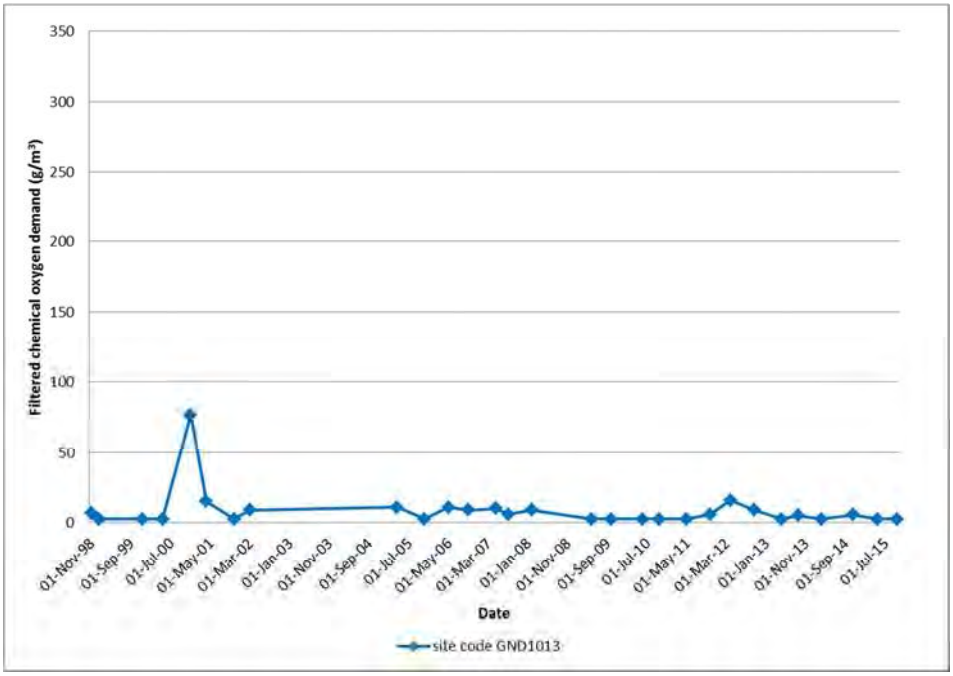


Figure 7 Hawera landfill groundwater filtered chemical oxygen demand, site GND001013

2.2.4 Results of surface water monitoring

Nine surface water sites (see Figure 2) were sampled on one occasion during the period under review. The results of the chemical analysis of these samples are given in Table 5.

The discharge from the landfill tributary culvert contains elevated levels of ammoniacal nitrogen, iron and alkalinity when compared to the upstream landfill tributary site (TWH000453); this may indicate that some landfill contamination is seeping into the culvert as it passes under the landfill.

The roadside tributary shows moderate levels of contamination, mostly in the form of iron and ammoniacal nitrogen.

The water quality results from the Tawhiti Stream sites show that the inflow from the roadside tributary is having a slight, but not environmentally significant effect on the water quality in the Tawhiti Stream at the consent compliance point (THW000470).

It is however noted that it is likely that there are also groundwater flows from the landfill area towards the stream to the north west of the site. At this stage there are no monitoring sites upstream of these potential groundwater inflows, and so TWH000450 may not be a true control site for monitoring of this landfill. As this consent is due to expire on 1 June 2016, this situation and the potential implications will be considered more during the consent renewal process.

Table 5 Chemical analysis of surface water in the vicinity of the Hawera landfill site

Parameter	Unit	Roadside tributaries upstream of landfill tributary			Landfill tributary			Roadside tributary downstream of landfill		Tawhiti Stream	
		TWH000451 20m u/s of SW drain	TWH000461 SW trib in-flow culvert	TWH000452 /s landfill culvert	SSM000029 Upstream overland leachate flow	TWH000453 10 m u/ s of landfill	TWH000455 Discharge from culvert under landfill	TWH000456 50m d/s of landfill culvert	TWH000459 10 m u/s confluence	TWH000450 u/s of Matangara Road and roadside tributary	TWH000470 d/s of Matangara Road and roadside tributary
Alkalinity	g/m^3	104	100	33	73	76	99	98	85	**57**	**60**
BOD	g/m^3	0.8	1.0	1.0	0.7	0.6	1.4	1.1	1.0	**1.7**	**1.4**
Conductivity	mS/m	30.8	30.5	21.7	25.9	27.1	32.3	31.3	31.5	**26.6**	**27.0**
Dissolved reactive phosphorus	g/m^3	<0.003	0.004	0.039	0.013	0.012	0.011	0.007	0.013	**0.066**	**0.061**
Acid soluble iron	g/m^3	3.34	2.37	9.33	0.83	0.76	2.73	2.32	1.64	**0.84**	**0.94**
Unionised ammonia	g/m^3-N	0.00440	0.00319	0.00003	0.00038	0.00106	0.00328	0.00454	0.00650	**0.00060**	**0.00093**
Ammoniacal nitrogen	g/m^3-N	1.46	1.10	0.022	0.094	0.255	1.90	1.28	0.717	**0.097**	**0.146**
Nitrate/nitrite nitrogen	g/m^3	1.30	1.44	3.58	1.26	1.38	1.76	1.64	1.23	**1.77**	**1.68**
pH	pH	7.0	7.0	6.5	7.2	7.2	6.8	7.1	7.5	**7.4**	**7.4**
Temperature	Deg C	13.8	13.3	16.3	11.7	11.9	12.5	12.9	13.2	**11.1**	**11.5**
Dissolved zinc	g/m^3	0.026	0.030	0.027	0.029	0.026	0.032	0.030	0.014	**<0.005**	**0.005**

2.2.5 Investigations, interventions, and incidents

In the 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with conditions in resource consents associated with the Hawera landfill, or provisions in Regional Plans.

2.3 Discussion

2.3.1 Discussion of site performance

In general, the Hawera landfill was well managed and the consent holder has a management and contingency plan in place for the site. The final cap appeared in good condition and grass growth across the cap was noted as good at the time of the inspection. There was an issue during the year when the leachate sump pump was discovered to be not operating, and leachate was seeping from the concrete riser. There were no visible effects on the tributary at the time, sampling showed that there were only very slight changes in the water quality of the landfill tributary as a result, and the pump was fixed immediately. STDC also had the telemetered alarm system repaired and added checking that this warning system was functioning to the contractors weekly pump inspection visits.

2.3.2 Environmental effects of exercise of consents

The physicochemical monitoring associated with consent 0444 indicates the leachate discharge from the landfill shows some very minor effects on the water quality in the culvert flowing below the landfill and on water quality in the roadside drain. Despite this, the landfill is having no significant effect on the water quality of the Tawhiti Stream.

Groundwater in the immediate vicinity of the deposited refuse is affected by the presence of the landfill, but no significant effects were detected in the adjacent waterways monitored.

2.4 Evaluation of performance

A tabular summary of STDC's compliance record at Hawera landfill for the year under review is set out in Table 6 and 7.

Table 6 Summary of performance for Hawera closed landfill leachate consent 0444-4

Purpose: ***To discharge up to 2800 m³/day of leachate and stormwater from the closed Matangara Landfill, Hawera, to groundwater and into an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option to prevent or minimise any likely adverse effects on the environment	Site specific monitoring programme – inspection and water sampling	**Pump breakdown and alarm failure**
2. Maintain adequate capping and vegetative cover	Site specific monitoring programme – inspection	Yes
3. Provide a landfill post-closure management plan	Site specific monitoring programme – programme management	Yes

Purpose: ***To discharge up to 2800 m³/day of leachate and stormwater from the closed Matangara Landfill, Hawera, to groundwater and into an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Adhere to the landfill management plan	Site specific monitoring programme – programme management	Yes
5. Maintain drains, ponds and contours on site to minimise unwanted water movement and ponding on site	Site specific monitoring programme – inspection	Yes
6. Maintain the leachate collection system	Site specific monitoring programme – inspection	**Pump breakdown and alarm failure**
7. Mixing zone shall extend 20 m downstream from point of discharge	N/A	N/A
8. Discharge shall not adversely affect the receiving waters	Site specific monitoring programme – inspection and water sampling	Yes
9. Monitoring of groundwater, surface water and leachate	Site specific monitoring programme – water sampling	Yes
10. The two existing monitoring bores shall be maintained	Site specific monitoring programme – inspection	**Access issue resolved promptly**
11. Optional review provision re contamination of the unnamed tributary of the Tawhiti Stream	Not required	N/A
12. Optional review provision re environmental effects	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**Good**

N/A = not applicable

Table 7 Summary of performance for Hawera closed landfill culvert/diversion consent 5831-1

Purpose: ***To divert an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification of any maintenance works which may disturb the stream	N/A	N/A
2. Construct structures in accordance with documentation submitted in support of application	N/A	N/A
3. Prevent or minimise any likely adverse effects on the riverbed and water quality due to the discharge of contaminants	Site specific monitoring programme	Yes
4. Minimise the area of riverbed which must be disturbed, and reinstate the areas that have been disturbed	Site specific monitoring programme	Yes
5. Insure the diversion pipe is clear of any blockages	Site specific monitoring programme – inspection	Yes
6. Prepare a contingency plan re blockages	Site specific monitoring programme	Yes

Purpose: *To divert an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
7. Optional review provision re environmental effects	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

During the year, STDC demonstrated a high level of environmental and good level of administrative performance in relation to the Hawera landfill consents as defined in Section 1.1.5.

2.5 Recommendation from the 2013-2014 Annual Report

In the 2013-2014 Annual Report it was recommended:

THAT monitoring of discharges from Hawera landfill in the 2014-2015 year is altered slightly from the 2013-2014 monitoring programme, with the discontinuation of the triennial groundwater sampling at sites GND1207, GND1208 and GND1209.

The recommendation was subsequently implemented.

2.6 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for 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 discharges and their effects under the RMA, and 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 discharging to the environment.

It is proposed that for 2015-2016, the programme remains unchanged. However, it is proposed that it be noted that the appropriateness of the groundwater and surface water monitoring be reviewed as part of the consent renewal process.

2.7 Recommendation

THAT monitoring of discharges from Hawera landfill in the 2015-2016 year remains unchanged from the 2014-2015 monitoring programme. However, it is noted that the appropriateness of the groundwater and surface water monitoring will be reviewed as part of the consent renewal process

3. Kaponga landfill

3.1 Background

STDC (previously as Eltham District Council) operated the Kaponga landfill from the 1970's to 1993. The Kaponga landfill site is located in a gully that also has a wetland fed by a number of springs emanating from within the landfill (Figure 8). This landfill closed in 1993. The cap has been covered by pasture for over a decade, and the site is now part of a dairy farm. On closure, the site was sown in suitable pasture grasses to ensure rapid stormwater runoff and minimise percolation through the capping layer. Raupo growth on the lower face of the reinstated surface provides some natural attenuation of leachate and hence gives protection to the Waiokura Stream.

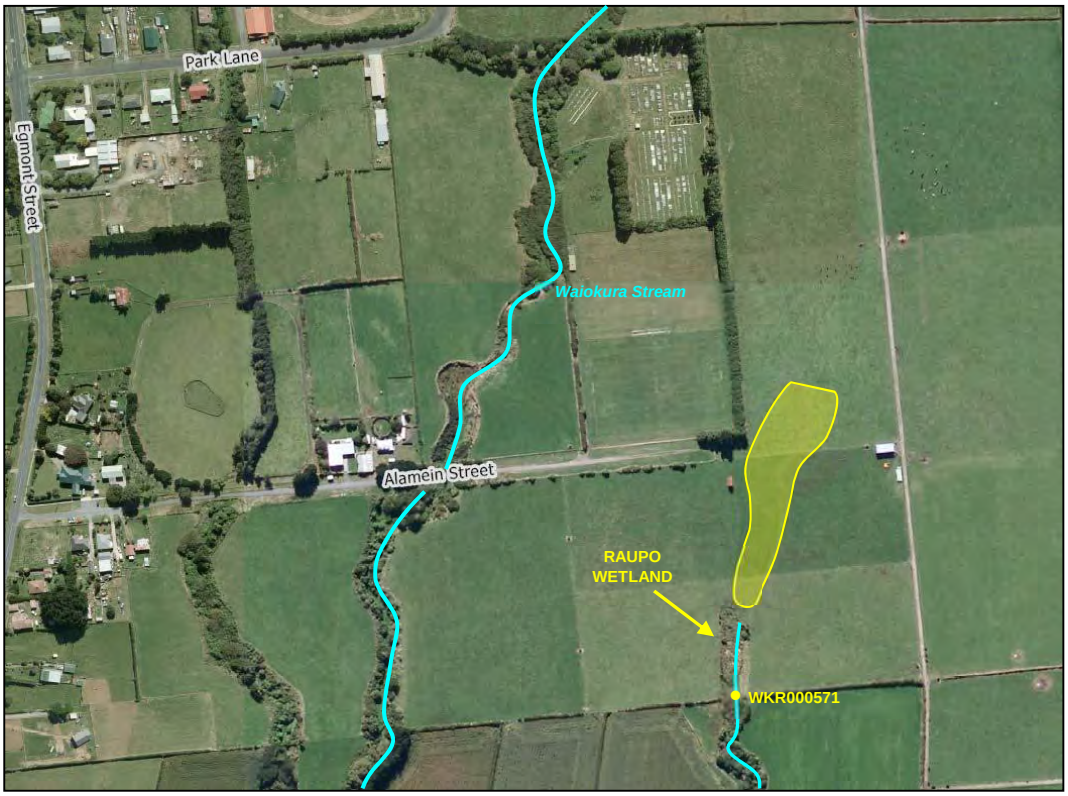


Figure 8 Aerial view of the Kaponga landfill and sampling site

3.2 Results

3.2.1 Inspections

10 September 2014

The cap was found to be well vegetated, with no evidence of cracking or slumping observed. There were several piles of waste roading material, including cured bitumen seal with painted lines and underlying soil/clay present in the mix. This material was located across the stormwater flow path of the central stormwater drain (Photo 1). This appears to have obstructed the stormwater flow, and was likely to have caused ponding, as the area up gradient of the material was found to be wet and pugged at the time of inspection. The area immediately above the constructed wetland fence was also observed to be boggy, with some pugging present. A Council officer took the matter up with the landowner, and he agreed to remove the material obstructing the central stormwater drain. The agreed timeframe was over the following two months as the farmer was using it around his gateways and troughs.

Photo 1 Stockpiled waste roading material across the central drain at the Kaponga landfill

2 April 2015
The site was reinspected to check that the piles of waste roading material had been removed. It was found that the material was still present in the same location as at the inspection on 10 September 2014. STDC was advised that the material was still onsite and remained across the stormwater flow path of the central stormwater drain. STDC were asked to ensure that the material was moved. Photos showing that this had been done were received on 26 May 2015.

3.2.2 Discharge and receiving water monitoring

Water springs from the toe of the landfill and this then feeds into a raupo wetland. The sampling point is where the wetland discharges into an unnamed tributary of the Waiokura Stream. A sample was collected on 10 September 2014 and the results are presented in Table 8.

The results show that the discharge is low in landfill indicator species such as ammonia and zinc, and this agrees with all historical data. The high iron levels have always featured at this site, and whilst the landfill maybe contributing to this, the naturally high iron level in Taranaki groundwater is also likely to be a factor.

Table 8 Chemical analysis of the surface water sample taken downstream of the Kaponga Landfill site

Parameter	Unit	WKR00571 Downstream of landfill
Alkalinity	g/m^3CaCO_3	66
Conductivity @ 20°C	mS/m	18.2
Acid soluble iron	g/m^3	30.0
Unionised ammonia	g/m^3 N	0.00022
Ammoniacal nitrogen	g/m^3 N	0.052
pH	g/m^3	7.2
Temperature	°C	12.0
Dissolved zinc	g/m^3	0.008

3.2.3 Investigations, interventions, and incidents

In the 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with conditions in resource consents related to the Kaponga landfill, or provisions in Regional Plans.

3.3 Discussion

3.3.1 Discussion of plant performance

Piles of waste roading material had been placed across the stormwater flow path of the central stormwater drain by the land owner. This had obstructed the stormwater flow, caused ponding and resulted in the area above the material becoming wet and pugged.

Although the land owner did not address this in the agreed timeframe, STDC's intervention ensured that this issue had been resolved by the end of the monitoring period, and before the arrival of the autumn and winter rain.

A contingency plan is in place for the site as required by consent conditions.

3.3.2 Environmental effects of exercise of consents

Leachate will continue to be generated at the site for some time, and this will be discharged, via the spring at the toe of the landfill, into the raupo treatment wetland. The findings gathered during the period under review indicate that the landfill's presence is not having any significant effect on the environment.

3.3.3 Evaluation of performance

A tabular summary of STDC's compliance record for the Kaponga landfill for the year under review is set out in Table 18.

Table 9 Summary of performance for Kaponga closed landfill stormwater and leachate consent 3459-3

Purpose: ***To discharge stormwater and leachate from the former Kaponga landfill site into an unnamed tributary of the Waiokura Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practice	Site specific management plan – programme management	**Landowner blocked stormwater drain with waste roading material**
2. Prepare and maintain a site contingency plan	Plan on file from August 2013	Yes
3. Monitor ground and surface water on and near the site	Site specific management plan – water sampling	Yes
4. Maintain all stormwater and leachate collection systems	Site specific management plan – inspection	**Landowner blocked stormwater drain with waste roading material**
5. No adverse impact on aquatic life	Site specific management plan – inspection and water sampling	Yes
6. Optional review provision re environmental effects	Next optional review in Jun e 2017	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**Good**

N/A = not applicable

During the year, STDC demonstrated a high level of environmental and good level of administrative performance in relation to the Kaponga landfill consent as defined in Section 1.1.5. This site is on a Council triennial monitoring programme, and the discovery of the waste roading material across the central drain highlights the importance checks by STDC during the intervening period.

3.3.4 Recommendations from the 2013-2014 Annual Report

In the 2013-2014 Annual Report, it was recommended:

THAT the Kaponga landfill triennial monitoring programme remains in place with monitoring next scheduled for the 2014-2015 period.

This recommendation was implemented.

3.3.5 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for 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 discharges and their effects under the RMA, and 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 discharging to the environment.

It is proposed that the triennial monitoring programme remain in place with monitoring next scheduled for the 2017-2018 period.

A recommendation to this effect is attached to this report.

3.4 Recommendation

THAT the Kaponga landfill triennial monitoring programme remains in place with monitoring next scheduled for the 2017-2018 period.

4. Otakeho landfill

4.1 Background

The Otakeho Landfill was a small uncontrolled landfill that STDC closed in 1991. STDC at the time also applied for a consent to discharge leachate and stormwater into the Taikatu Stream. This consent was renewed in 2000 and again in 2005. In its current form the consent allows for discharge of leachate and stormwater to land.

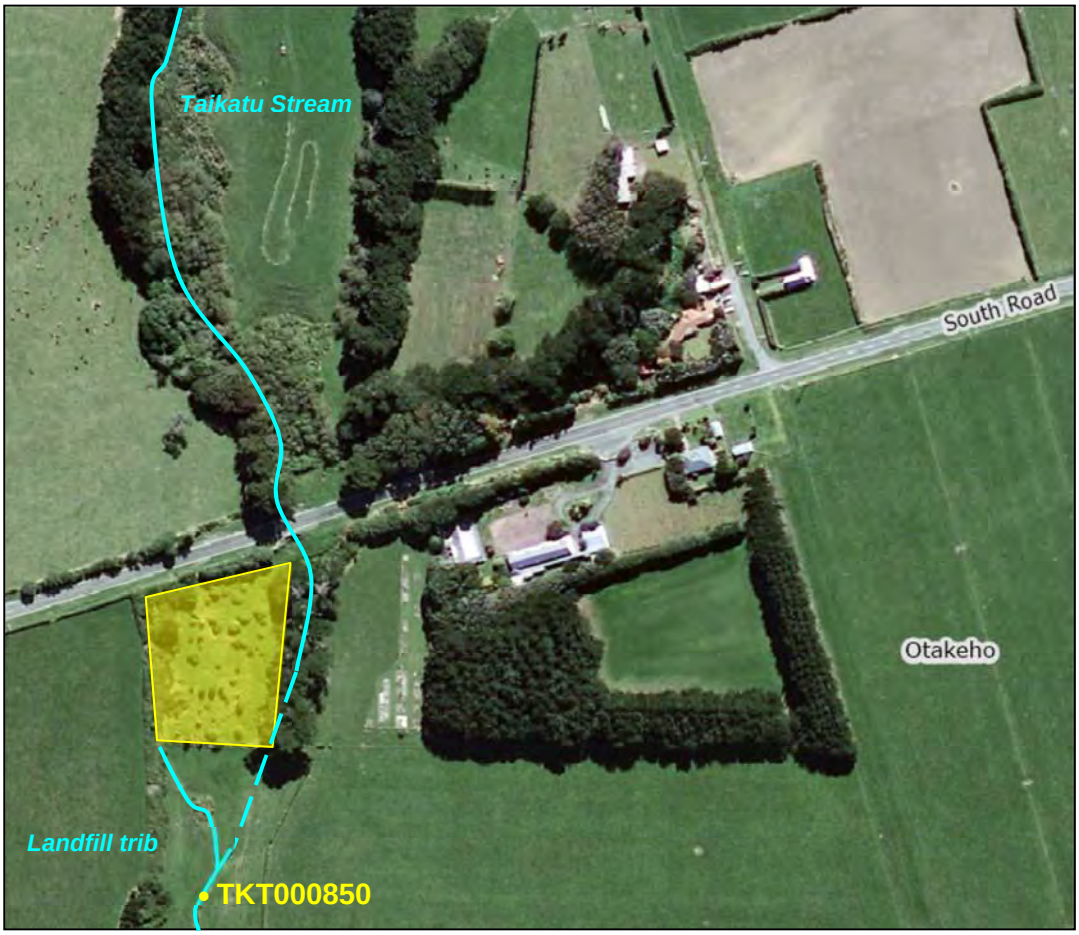


Figure 9 Aerial image of Otakeho landfill and monitoring site in the Taikatu stream

4.2 Results

4.2.1 Inspections

Monitoring of this site is scheduled to be undertaken on a triennial basis, with this programme is next scheduled to be implemented in the 2016-2017 year. Therefore the site was not visited during the period under review.

In the 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with conditions in resource consents relating to Otakeho landfill or provisions in Regional Plans.

4.3 Discussion

4.3.1 Recommendation from the 2013-2014 Annual Report

The 2013-2014 Annual Report recommended;

THAT the Otakeho landfill programme remains in place, and that the programme next be implemented in the 2016-2017 period and triennially thereafter.

4.3.2 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes water discharges in the region, the Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA, the obligations of the Act in terms of monitoring discharges and effects, and subsequently reporting to the regional community, the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki discharging to the environment.

It is proposed that for 2015-2016, the monitoring programme remains unchanged.

A recommendation to this effect is given in Section 3.4

4.4 Recommendation

THAT, in the 2015-2016 year, the triennial monitoring for the Otakeho landfill remains unchanged, and it be noted that the monitoring is next scheduled to be implemented in the 2016-2017 period.

5. Eltham landfill

5.1 Background

This landfill used to service the township of Eltham and surrounding rural areas but was closed in 1992 due to exhaustion of landfill capacity. The 0.71 ha site is located on Castle Road, just downstream of the Eltham oxidation ponds (Figure 4). The area is generally well rehabilitated, with the majority of the area grassed. The landfill is monitored under the Eltham WWTP/Eltham landfill combined monitoring programme.

Historically the water quality in the Mangawhero Stream was quite poor due to the discharges from the Eltham Wastewater Treatment Plant and it was difficult to fully assess any impact from the landfill on the stream. Generally no deterioration in water quality was found when comparing upstream and downstream sites.

Now that the WWTP pumps its effluent to the Hawera WWTP, the water quality in the Mangawhero Stream has improved and monitoring has been reduced.

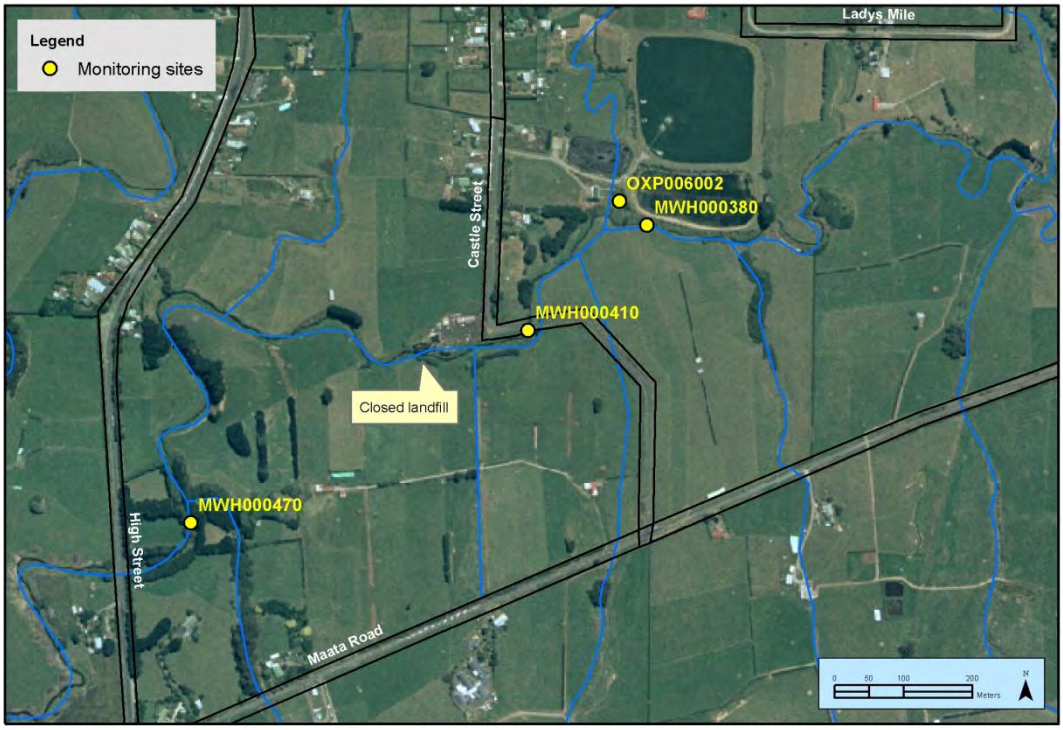


Figure 10 Eltham landfill and sampling sites

5.2 Results

5.2.1 Inspections

7 November 2014

The site was inspected following light rainfall over the previous 24 hours. It was found that there was no evidence of leachate from the old landfill site seeping into the Mangawhero Stream. The cap was mainly vegetated over and there was no subsidence observed.

5.2.2 Biomonitoring

Two biomonitoring surveys were undertaken during the period under review, which were conducted on 14 October 2014 and 12 February 2015. These surveys were conducted as part of the monitoring programme for the Eltham wastewater treatment plant, however these surveys also include sites upstream and downstream of the landfill to monitor for potential effects from this site.

The results of both surveys undertaken during the period under review indicate that there were no impacts from leachate from the old landfill on the macroinvertebrate community of the lower Mangawhero Stream.

Full copies of the biomonitoring reports are attached to Appendix II of this report.

5.2.3 Investigations, interventions, and incidents

In the 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with conditions in resource consents relating to Eltham landfill or provisions in Regional Plans.

5.3 Discussion

5.3.1 Discussion of plant performance

The site has been closed for approximately 24 years and no incidents or complaints were logged by Council. The consent holder has a management and contingency plan in place for the site.

5.3.2 Environmental effects of exercise of consents

In the past it has been difficult to accurately gauge the effects associated with the discharge of leachate from the Eltham landfill. This was because any effect that the leachate may have had on the Mangawhero Stream was masked by the discharge of wastes from the Eltham wastewater treatment plant. However the works to pump Eltham's WWTP plant discharge to Hawera's WWTP were completed approximately four years ago, and the water quality in the Mangawhero Stream has been showing some improvement. The results of the macroinvertebrate surveys indicate that the presence of the landfill is having very little effect on water quality.

5.3.3 Evaluation of performance

A tabular summary of STDC's compliance record at Eltham landfill for the year under review is set out in Table 10.

Table 10 Summary of performance for Eltham closed landfill stormwater and leachate consent 3387-3

Purpose: ***To discharge stormwater and leachate from the former Eltham landfill site into the Mangawhero Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. STDC shall adopt the best practicable option	Site specific monitoring programme – programme management	Yes

Purpose: *To discharge stormwater and leachate from the former Eltham landfill site into the Mangawhero Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
2. STDC shall prepare and maintain a site contingency plan	Site specific monitoring programme – programme management	Yes
3. The site and associated water shall be monitored	Site specific monitoring programme –inspection and biological monitoring	Yes
4. Discharges from the site shall not cause adverse environmental effects	Site specific monitoring programme – inspection and biological monitoring	Yes
5. Optional review provision	No provision for review during monitoring period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

During the year, STDC demonstrated a high level of environmental and high level of administrative performance in relation to the Eltham landfill consent as defined in Section 1.1.5.

5.3.4 Recommendations from the 2013-2014 Annual Report

In the 2013-2014 Annual Report, it was recommended:

THAT monitoring of discharges from the Eltham landfill for the 2014-2015 period continues at the same level as that of 2013-2014.

This recommendation was implemented.

5.3.5 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for 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 discharges and their effects under the RMA, and 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 discharging to the environment.

It is proposed for the 2015-2016 period, that the monitoring programme altered slightly from 2014-2015, with one biomonitoring survey undertaken instead of two. A recommendation to this effect is attached to this report.

5.4 Recommendation

THAT for the 2015-2016 period, the monitoring of discharges from the closed landfill at Eltham be altered slightly from that scheduled in the 2014-2015 period, with the reduction in the number of biomonitoring surveys from two to one.

6. Manaia landfill

6.1 Background

The Manaia Community Landfill was in operation from the 1980s and STDC has held consent **3952**, which authorises the discharge of both leachate and stormwater from the site, since 1991. The landfill used to service the township of Manaia and the surrounding rural areas exclusively. However with the closure of the Matangara landfill (Hawera) in June 1998 and the Opunake landfill in November 1999, the landfill's catchment expanded to service these other areas until it closed in June 2006.

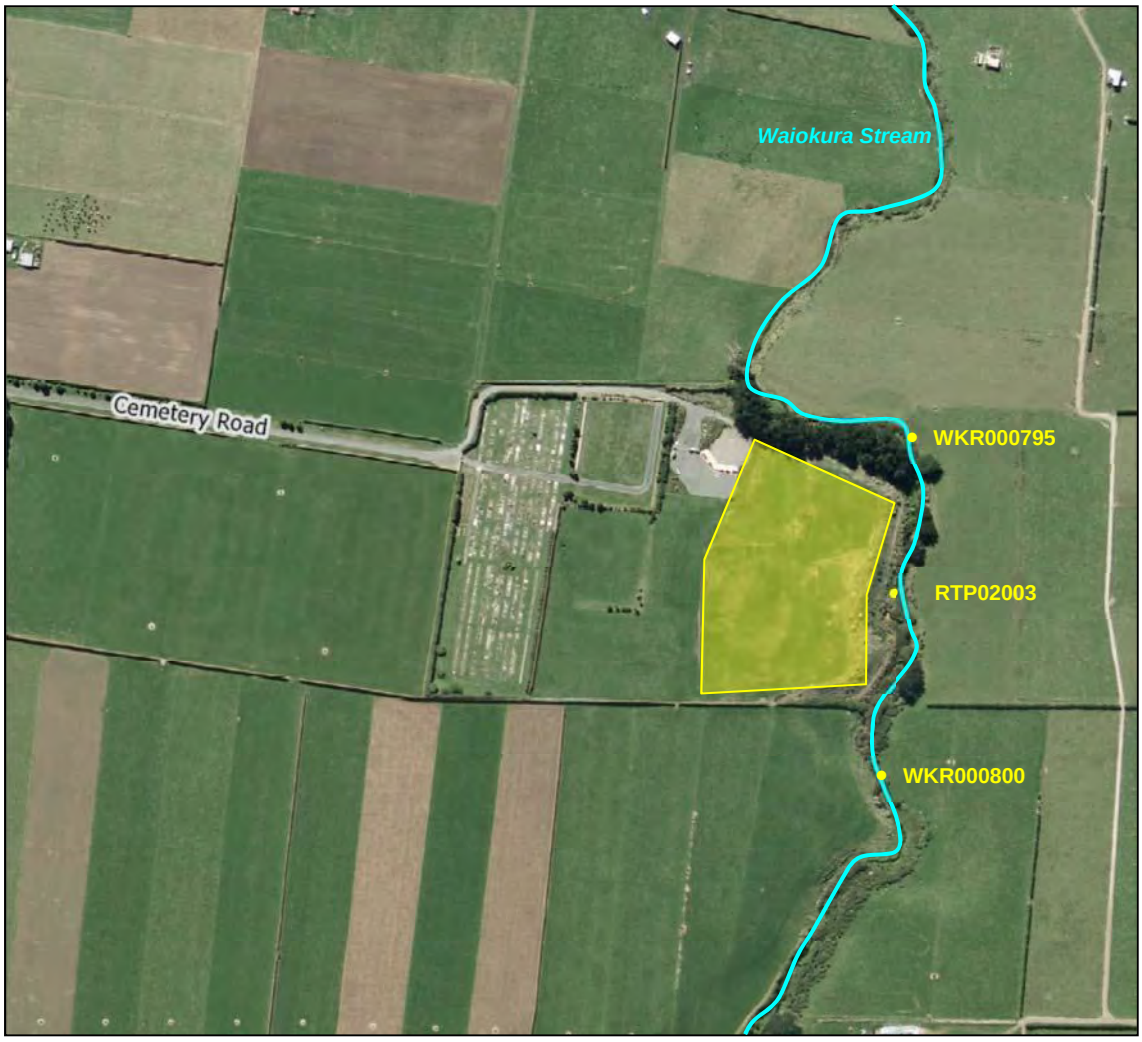


Figure 11 Aerial view of Manaia landfill showing sampling sites and landfill footprint

6.2 Results

6.2.1 Inspections

Two inspections were carried out during the monitoring year. The inspections focused on the condition of the cap and the management of stormwater and leachate.

10 September 2014
The inspection was undertaken in fine weather. The cap was walked and the stormwater drains were checked. It was found that some of the gorse in the stormwater drains was

dying off and looked to have been sprayed since the last inspection. The batter from the cap down to the stormwater drain on the northern and eastern sides of the landfill looked good, with no erosion noted. It appeared that this area had not been grazed for a while. There was generally good grass cover on the cap, however there was evidence of heavy grazing during wet weather, with a lot of pugging present under this regrowth. There were some small isolated areas showing signs of ponding and significant pugging. It was noted that this had resulted only in surface damage at this stage (Photo 2), but STDC was advised that this needed to be monitored, and the farmer advised that it is best to avoid high stocking rates on the landfill cap paddocks during periods of prolonged or heavy rainfall. The consent holder was asked to monitor grazing during wet weather to ensure that grazing is managed in a way consistent with the best practicable option to avoid effects on the cap integrity.

Photo 2 Surface pugging at Manaia landfill 10 September 2014

Minor amounts of partially exposed refuse were noted in some small isolated areas of the cap, and whilst these were not considered to be a compliance issue at the time of the inspection, STDC was advised that this needed to be monitored and addressed if necessary.

It was found that there was a low spot at the northern end of the swale at the boundary of the landfill footprint that appears to get quite wet at times. STDC was advised that this needed to be monitored. It was found that some refuse had been dumped illegally behind the gorse on the northern side of the transfer station lower gates and the consent holder was asked to remove this.

Sampling of the leachate/stormwater and receiving water was undertaken. It was found

that the level in the pond was about half a metre below the outlet. Access to the pond was made difficult by the amount of gorse and blackberry present in this area (Photo 3). STDC was asked to clear some of the gorse so that the pond edge could be clearly identified, and safe access obtained for sampling purposes.

Photo 3 Gorse and blackberry surrounding leachate/stormwater outlet at Manaia landfill 10 September 2014

22 April 2015

This inspection was undertaken during fine weather. The cap was found to be in good condition and was not being grazed at the time of inspection. No cracking, slumping or erosion was noted on the cap.

STDC was informed that the drains need to be cleared of grass as there was the potential this was obstructing flow. It was also noted that the grit trap above the eastern stormwater pond needed clearing as the outlet pipe was becoming obstructed with grass.

Receiving water samples were collected upstream and downstream of the landfill. The upstream site was difficult to access due gorse and blackberry growth. The leachate pond was not sampled as it was too overgrown, and it was considered to be a health and safety risk.

The consent holder was contacted post inspection and the site access issues were discussed. STDC was again advised to undertake works to clear the drains and to ensure safe access to sampling sites. These matters were found to have been addressed at the first inspection undertaken in the 2015-2016 year.

6.2.2 Results of discharge and receiving environment monitoring

Samples were collected from the leachate pond on one occasion, and the Waiokura Stream upstream of the landfill and downstream of the landfill (Figure 5) on two occasions during the monitoring period. The results are presented in Table 9.

A second sample was scheduled to be collected from the leachate pond (RTP002003) but the site was inaccessible due to the amount of gorse and blackberry present around the pond.

Table 11 Chemical analysis of discharge and receiving waters at Manaia landfill

		10 September 2014			22 April 2015	
Parameter	**Unit**	**Leachate RTP002003**	**WKR000795 u/s landfill**	**WKR000800 d/s of landfill**	**WKR000795 u/s landfill**	**WKR000800 d/s of landfill**
Alkalinity	g/m^3 $CaCO_3$	398	51	-	-	-
BOD	g/m^3	21	0.7	-	-	-
Conductivity @ 20°C	mS/m	106	23.5	23.6	27.6	27.8
Dissolved reactive phosphorus	g/m^3 P	0.011	0.043	0.043	-	-
Acid soluble iron	g/m^3	0.68	1.40	1.21	-	-
Unionised ammonia	g/m^3 N	0.00379	0.00025	0.00049	0.00019	0.00041
Ammoniacal nitrogen	g/m^3 N	0.814	0.016	0.031	0.023	0.051
Nitrite/nitrate nitrogen	g/m^3 N	5.10	3.64	3.62	-	-
pH	pH	7.3	7.8	7.8	7.4	7.4
Temperature	Deg.C	10.4	11.4	11.4	14.7	14.7
Dissolved zinc	g/m^3	0.018	<0.005	<0.005	<0.005	<0.005
Suspended solids	g/m^3	120	46	44	-	-

On both sampling occasions receiving water results show very little change in water quality between the upstream and downstream sites. This is consistent with historical data and indicates that the presence of the landfill is having little, if any, effect on water quality in the Waiokura Stream. Although there was a measurable increase in the ammoniacal nitrogen concentration downstream of the discharge from the site, the increase was insignificant from an environmental perspective.

6.2.3 Investigations, interventions, and incidents

In the 2014-2015 period, although the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Manaia landfill resource consent conditions or provisions in Regional Plans.

6.3 Discussion

6.3.1 Discussion of plant performance

There were some minor issues noted during the period under review at the Manaia landfill site.

At one inspection ponding and pugging had resulted in some minor surface damage to the cap and STDC was asked to monitor grazing during wet weather to ensure that this was managed in a way consistent with the best practicable option to avoid effects on the cap integrity.

STDC was also asked to remove illegally dumped refuse, monitor the low spot at the northern end of the swale at the boundary which gets wet, clear drains and the grit trap above the eastern stormwater pond of grass.

Council requested the access to the leachate pond to be cleared of blackberry and gorse to allow safe access for sampling this was completed. Special condition 5 requires that the site, surface waters and ground waters are monitored to the satisfaction of the Council, and as a result of the vegetation still present, it was not possible to collect the scheduled leachate sample on this occasion.

6.3.2 Environmental effects of exercise of consents

There was very little variation in water quality in the Waiokura Stream above and below the landfill site, and this is comparable to historical data. The results gathered in this and previous monitoring periods, indicate that the presence of the landfill is not causing any significant adverse effects on the receiving environment.

6.3.3 Evaluation of performance

A tabular summary of STDC's compliance record at Manaia landfill for the year under review is set out in Table 10.

Table 12 Summary of performance for Manaia closed landfill and composting leachate and stormwater consent 3952-2

Purpose: ***To discharge leachate and stormwater from the closed Manaia landfill and from composting operations into the Waiokura Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. STDC shall adopt the best practicable option	Site specific monitoring programme – programme management	**Minor surface cap damage due to inappropriate stock management**
2. STDC shall prepare a site contingency plan	Plan on file dated August 2013	Yes
3. Prepare a landfall management plan	Site specific monitoring programme – programme management	Yes
4. STDC shall notify the Council of changes to plans prior to changes	Site specific monitoring programme – programme management	Yes
5. Monitor site, ground and surface water on and near the site	Site specific monitoring programme – water sampling	**One scheduled leachate sample not able to be collected due to access issues not being resolved**

Purpose: *To discharge leachate and stormwater from the closed Manaia landfill and from composting operations into the Waiokura Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
6. Install leachate and stormwater collection, treatment and discharge systems	Site specific monitoring programme – inspection	Yes
7. Limits on BOD and NH_3 in the Waiokura Stream	Site specific monitoring programme – water sampling	Yes
8. Is an optional review provision	Next optional review June 2017	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**Good**

N/A = not applicable

During the year, STDC demonstrated a high level of environmental and good level of administrative performance in relation to the Manaia landfill consent as defined in Section 1.1.5.

During the period under review, there was some minor cap damage as a result of inappropriate grazing methods and a scheduled sample could not be collected due to access issues that STDC had been asked to address after an earlier inspection, and as such, was a minor issue that took some time to resolve.

6.3.4 Recommendation from the 2013-2014 Annual Report

In the 2013-2014 Annual Report, it was recommended:

THAT for the 2014-2015 period, the monitoring of discharges from the closed landfill at Manaia is altered slightly from that scheduled in the 2013-2014 period, with the reduction in the number of inspections from three to two.

This recommendation was implemented.

6.3.5 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for 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 discharges and their effects under the RMA, and 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 discharging to the environment.

It is proposed that for the 2015-2016 period, that monitoring of discharges from the closed landfill at Manaia remains the same as scheduled for the 2014-2015 period.

6.4 Recommendation

THAT for the 2015-2016 period, the monitoring of discharges from the closed landfill at Manaia remains unchanged from that of 2014-2015.

7. Opunake landfill

7.1 Background

The Opunake landfill was operational from 1979, closing in 1999 with the expiry of the 20-year lease of the land. The landfill site is located at Whitcombe Road, and was used to service the township of Opunake and the surrounding rural areas. Waste from Rahotu and Pungarehu was also disposed of at the landfill. The 4.73 ha site was initially operated in an uncontrolled manner for many years with a significant amount of rubbish being burnt. In 1990 a ban on fires was imposed and the site began to operate under restricted hours. In 1999 STDC submitted a landfill closure plan and had the site reinstated.

Figure 12 Aerial view of Opunake landfill foot print and sampling sites

7.2 Results

7.2.1 Inspections

Two inspections were carried out at the Opunake landfill during the 2014-2015 period.

10 September 2014.
The cap was walked, and the stormwater drains were checked. It was found that there was good grass cover on the cap with no evidence of erosion or cracking noted. There were a few small low spots in the paddock that may indicate localised subsidence, and STDC were advised that these needed to be monitored for potential effects from ponding. The stormwater drains were unobstructed and the batter down to the stream bank looked good, with no erosion or exposed refuse found. STDC were advised that access to the sampling sites was difficult due to the style near the stormwater pond being overgrown with gorse, and they were asked to clear this to allow safer access.

22 April 2015

It was found that there was good grass cover on the cap, which was being grazed by small herd of heifers at the time of inspection (Photo 4). The perimeter drains were clear and the batter appeared stable. Localised areas of subsidence were still present on the cap, however no ponding was observed. The leachate discharge was inspected and was found to be flowing at approximately 3 L/min. No odour was noted nor were any effects in the Otahi Stream observed. Access to the sampling sites was still difficult and the STDC was again asked to clear the gorse to allow for safe access.

Photo 4 Example of good stock management on the Opunake landfill cap, 22 April 2015

7.2.2 Results of discharge and receiving environment monitoring

7.2.2.1 Surface water

Samples were collected from the leachate drain, and the Otahi Stream at sites above, below and adjacent to the landfill on 10 September 2014 (Figure 6). The results are presented in Table 11 below.

There was very little difference in water quality between sites upstream and downstream of the landfill and the water quality at the downstream site was good. As the leachate discharges at a slow rate, the amount of dilution available in the Otahi Stream ensures that the level of contaminants in the stream remain at an acceptable level.

These results, and those from previous years, indicate that the presence of the landfill is not having a significant adverse effect on surface water quality.

Table 13 Chemical analysis of receiving water samples taken at Opunake closed landfill on 10 September 2014

Parameter	Units	RTP002002 Leachate	OTH000310 u/s of landfill	OTH000320 Adjacent to landfill	OTH000340 d/s of landfill
Alkalinity	g/m^3 $CaCO_3$	169	90	91	93
Biochemical oxygen demand	g/m^3	2.3	0.9	0.9	0.6
Conductivity @ 20 °C	mS/m	53.7	27.6	27.9	28.2
Dissolved reactive P	g/m^3	0.004	0.030	0.029	0.027
Acid soluble iron	g/m^3	5.94	0.50	0.50	0.50
Unionised ammonia	g/m^3 N	0.00016	0.00057	0.00060	0.00057
Ammoniacal nitrogen	g/m^3 N	0.015	0.014	0.019	0.018
pH	pH	7.5	8.2	8.1	8.1
Temperature	Deg.C	15.3	12.0	11.6	11.7
Dissolved zinc	g/m^3	<0.005	<0.005	<0.005	<0.005

7.2.2.2 Biomonitoring

The closed landfill at Opunake is monitored for macroinvertebrates on a biennial basis.

On 19 January 2015, the Council's standard 'kick-sampling' technique was used at two established sites to collect streambed macroinvertebrates from the Otahi Stream. Samples were sorted and identified to provide the number of taxa (richness) and 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 mid-summer macroinvertebrate survey indicated that any discharges of leachate from the closed Opunake landfill site had not had any recent detrimental effects on the macroinvertebrate communities of the Otahi Stream. No significant changes in the macroinvertebrate communities were found between the upstream 'control' site and the site downstream of the landfill discharge.

The macroinvertebrate communities of the stream contained relatively high proportions of 'tolerant' taxa (35% to 53% of richnesses) at both sites, typical of the lower reaches of ringplain streams. The communities were generally dominated by a combination of several 'moderately sensitive' and 'tolerant' taxa. Taxonomic richnesses (numbers of taxa) at the time of this summer survey were slightly lower in comparison with those of more recent surveys conducted in this stream.

MCI scores indicated that the stream communities were of 'fair' health, and as good as or better than recorded in the lower reaches of similar Taranaki streams sourced outside the National Park.

A full survey report is attached in Appendix II.

7.2.3 Investigations, interventions, and incidents

In the 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Opunake landfill resource consent conditions in or provisions in Regional Plans.

7.3 Discussion

7.3.1 Discussion of plant performance

The landfill has been closed for several years and reverted to pasture. In general, the Opunake landfill was well managed and the consent holder has a management and contingency plan is in place for the site.

Access to sampling sites was difficult due to the overgrowth of gorse. It is a requirement of the consent that sampling be undertaken to the satisfaction of the Council and therefore these matters need to be addressed. Requests were made for the gorse to be cleared after both inspections during the year under review, and it was found that the work had been completed at the first inspection of the 2015-2016 year (5 August 2015).

7.3.2 Environmental effects of exercise of consents

During the year under review there were no issues of concern relating to leachate discharges from the site, landfill gas, or water quality in the Otahi Stream as a result of the landfill.

7.3.3 Evaluation of environmental performance

A tabular summary of STDC's compliance record of Opunake landfill for the year under review is set out in Table 12.

Table 14 Summary of performance for Opunake closed landfill stormwater and leachate consent 0526-3

Purpose: ***To discharge stormwater and leachate from the closed Opunake landfill into the Otahi Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. STDC shall adopt the best practicable option	Site specific monitoring programme – programme management	Yes
2. Prepare and maintain a site contingency plan	Plan on file dated August 2013	Yes
3. STDC shall inform the Council prior to any changes to these plans	Site specific monitoring programme – programme management	Yes
4. Site water quality shall be monitored	Site specific monitoring programme – water sampling	Yes
5. There shall be no adverse impact on aquatic life as a result of discharges	Site specific monitoring programme – water sampling and inspection	Yes
6. Optional review provision	No further provision for review	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

During the year, STDC demonstrated a high level of environmental and high level of administrative performance in relation to the Opunake landfill consent as defined in Section 1.1.5.

7.3.4 Recommendations from the 2013-2014 Annual Report

In the 2013-2014 Annual Report, it was recommended:

THAT monitoring of discharges from Opunake landfill in the 2014-2015 year continues at the same level as in 2013-2014.

This recommendation was implemented.

7.3.5 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for 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 discharges and their effects under the RMA, and 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 discharging to the environment.

It is proposed that for 2015-2016, the monitoring programme remains unchanged.

7.4 Recommendation

THAT monitoring of discharges from Opunake landfill in the 2015-2016 year continues at the same level as in 2014-2015.

8. Patea landfill

8.1 Background

Prior to 1991, the Patea landfill (Figure 7) was a largely uncontrolled landfill servicing the residents of Patea. In 1992 STDC applied for resource consents to continue operating the landfill under the RMA. The landfill continued to operate until December 2007 and was then covered with a light clay cap. Full landfill closure works commenced in August 2008 and were completed in November of the same year.

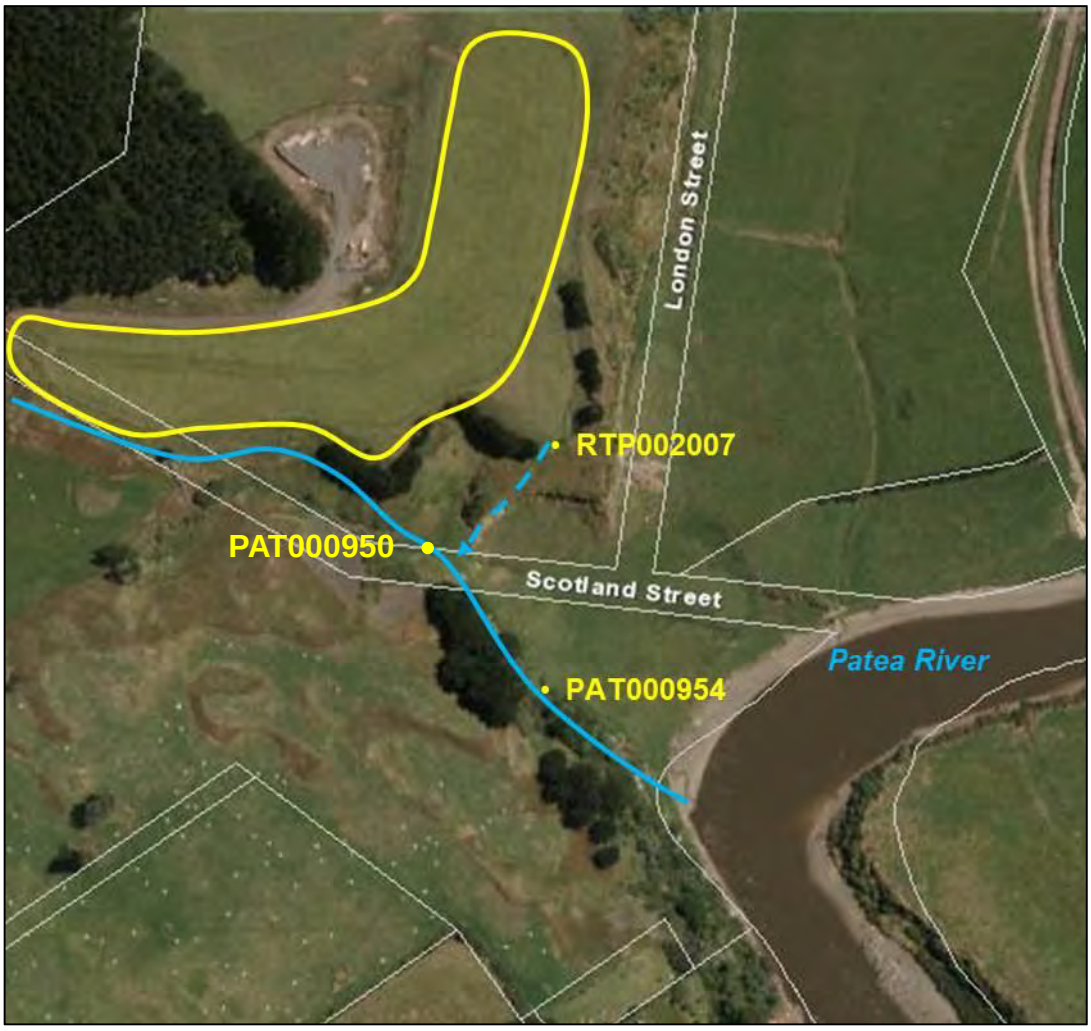


Figure 13 Aerial view of the landfill at Patea showing sampling sites (landfill footprint in yellow)

8.2 Results

8.2.1 Inspections

The Patea landfill site was visited four times during the monitoring period, which consisted of three scheduled inspections and one follow-up inspection.

27 August 2014

The site was inspected in fine conditions with the most recent rain five days prior to the inspection. There was evidence that the site had recently been heavily grazed by stock during wet weather. There was damage/pugging observed on the top of the western

bund and in the ring drains. The grass cover on the cap was very thin. No cracks or slumping was observed.

Exposed refuse was observed along the eastern fence line, and south eastern edge of the cap. It appeared that the heavy stock grazing may have resulted in this refuse becoming exposed. The consent holder was asked to ensure that the landfill cap is maintained as per the site management plan, and that grazing is managed to minimise damage to the cap.

The water contained in the stormwater/leachate pond appeared quite turbid, which was possibly as a result of the stock damage, rather than from the historical landfilling activities. STDC were advised that the level of sediment in the small silt pond below the main pond appeared to be quite high, and needed to be monitored, as further build-up may result in the pipe becoming blocked. There was no discharge occurring from the pond at the time of inspection, although it appeared that the pond had been discharging recently.

It was observed that some trees had been felled along the eastern boundary of the site, and there was a pile of branches that appeared to be set in a burning pile. STDC were reminded that the conditions of the air discharge consent prohibit burning at the site, and therefore they should consult with Council prior to lighting this pile, if that was the lessee's intent.

8 October 2014
A follow-up visit was undertaken with the consent holder and lessee to discuss the findings of the previous inspection in relation to stock management at the site, and the exposed refuse (Photo 5).

Photo 5 Exposed refuse at the Patea landfill

Options for protection of the drainage systems and steeper batters were discussed, including reducing the number and/or age of the stock grazing the cap during wet weather, the use of temporary fencing to keep cattle out of the drains and off the steeper batters, and restricting grazing of these areas to sheep. STDC agreed to email the lessee confirming what had been agreed to regarding stock management practices at the site and STDC was asked to continue to monitor the effectiveness of the changed stock management practices.

There was discussion about the purpose of the bunds around the edge of the cap, and as to whether these needed to be kept in place. It was considered that these were likely present to direct the stormwater from the cap through the pond, and they probably were still required, however this would be confirmed with the previous job manager for the site, along with whether there would be any issues with siting a new water trough on the cap. It was later confirmed that the bunds were still required, and that the siting of a new trough could happen on the cap, so long as the depth of the cap wasn't breached when installing the water pipe, and that the water supply system was well maintained to ensure that it was not allowed to overflow onto the cap.

There was a small section of the drain on the south eastern side that was observed to have slumped, and this was thought to have been due to the effects from the stock. It was agreed that this would need to be filled to prevent ponding in the drain. It was discussed as to whether the exposed refuse may have been as a result of the capping material having some refuse entrained in it, rather than it being the fill itself becoming exposed. It was considered that some may have been wind blown from the transfer station. It was agreed that the exposed refuse would be removed, and grazing would be managed differently to try to prevent a reoccurrence of the damage to the batter.

8 December 2014
It was fine at the time of the inspection. The cap was found to be well vegetated with no evidence of slumping, cracking or ponding observed. The length of grass cover on both the cap and the southern batter indicated much better, and more appropriate, stock management practices were now occurring at the site. There was only a minor amount of exposed refuse observed around the southern and eastern boundaries, and this was mainly plastics that were well anchored into the surface of the cap. The consent holder was asked to monitor this.

The drain culverts downstream of the leachate pond appeared to be partially blocked. The leachate pond level was low, and appeared to have been draining satisfactorily in the time prior to the inspection, however it was recommended that these culverts be cleared.

Stock tracks at the site along the top of the northern stormwater bund and east and south of the race fence indicated that stock had not been using the race. The use of temporary electric fencing was recommended to direct stock into the race.

The transfer station was closed at the time of inspection, and it was noted that the area was very clean and tidy, with no dust or odours noted.

12 June 2015
At the time of inspection it was found that the landfill cap had a thick grass cover and had not been grazed recently. No recent damage to the cap was evident.

All the perimeter drains were running, with stormwater discharging to the bottom pond. This pond was full and discharging at approximately 1L/s. The grass on the steep slope on the southern side of the landfill had good grass cover and there was no evidence of significant leachate seepage. STDC was advised that the creek that discharges into the Patea River would need to be cleared as the flow was eroding towards the gully, and there was potential for this to breach the lip at some point.

8.2.2 Discharge and receiving water monitoring

During the 2014-2015 period five water samples were taken at the site. The leachate/stormwater (RTP002007), and both upstream (PAT000950) and downstream of the landfill (PAT00954) were sampled. The location of these sampling sites is shown in Figure 13 and the results from the chemical analysis of these samples are set out in Table 15.

Table 15 Chemical analysis of samples taken in the vicinity of the Patea closed landfill site

Parameter	Unit	27 August 2014		11 June 2015		
		RTP002007 leachate	PAT000954 downstream	RTP002007 leachate	PAT000950 upstream	PAT000954 downstream
BOD	g/m^3	4.8	0.8	3.8	2.1	3.4
Conductivity @ 20°C	mS/m	82.7	33.2	50.0	60.2	59.0
Acid soluble iron	g/m^3	0.64	0.34	0.52	0.80	0.58
Unionised ammonia	g/m^3 N	0.02293	0.0009	0.00002	0.00156	0.00437
Ammoniacal nitrogen	g/m^3 N	3.18	<0.013	0.005	0.065	0.299
pH	g/m^3	7.5	7.4	7.2	7.9	7.7
Temperature	°C	10.1	13.0	14.0	14.1	13.5
Dissolved zinc	g/m^3	<0.005	<0.005	<0.005	<0.005	<0.005

The results indicate that there is some minor contamination in the collected stormwater in the form of elevated BOD levels. There was a slight, but not environmentally significant increase in the BOD, ammoniacal nitrogen and unionised ammonia of the tributary downstream of the landfill discharge on 11 June 2015.

8.2.3 Investigations, interventions, and incidents

In the 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Patea landfill resource consent conditions or provisions in Regional Plans.

8.3 Discussion

8.3.1 Discussion of plant performance

During the first inspection the site was found to have damage/pugging due to being heavily grazed by stock in wet weather. There was only a thin cover of grass on the cap, and exposed refuse around fence line. A meeting with STDC and the lessee resulted in an agreement to change stock management practices at the site, and these were found to have been implemented at subsequent inspections. The site was found to be well vegetated with no evidence of recent stock damage to the cap at the time of the final inspection for the 2014-2015 year.

8.3.2 Environmental effects of exercise of consents

Leachate will continue to generate at the site for some time and this generally seeps out to land via the bluff on the western edge of the land filled area. The information gathered during the period under review indicates that the landfill's presence is not having any significant effect on the environment.

8.4 Evaluation of performance

A tabular summary of STDC's compliance record for the Patea landfill for the year under review is set out in
Table **16** to Table 18.

Table 16 Summary of performance for Patea closed landfill stormwater and leachate consent 0427-3

Purpose: ***To discharge surface stormwater and leachate from the Patea municipal landfill into an unnamed tributary of the Patea River***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Prepare and maintain a site contingency plan	Plan on file dated August 2013	Yes
2. Prepare and maintain a landfill management plan	Site specific management plan – programme management	Yes
3. Advise of any changes being made to the management plan or the site contingency plan	Site specific management plan – programme management	Yes
4. Comply with information submitted in support of application	Site specific management plan – programme management	Yes
5. Monitor ground and surface water on and near the site	Site specific management plan – water sampling	Yes
6. Maintain all stormwater and leachate collection systems	Site specific management plan – inspection	Yes
7. No adverse impact on aquatic life	Site specific management plan – inspection and water sampling	Yes
8. Adopt the best practicable option to prevent or minimise any likely adverse effects on the environment	Site specific management plan – programme management	**Changes in stock management practices required to avoid continuing stock damage**
9. Optional review provision re environmental effects	Optional review June 2016, recommendation attached in section 7.9	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**Good**

N/A = not applicable

Table 17 Summary of performance for consent Patea closed landfill air discharge consent 4636-2

Purpose: ***To discharge emissions into the air from the Patea municipal landfill activities***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Prepare and maintain a site contingency plan	Plan on file dated August 2013	Yes

Purpose: *To discharge emissions into the air from the Patea municipal landfill activities*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
2. Prepare and maintain a landfill operations and management plan	Site specific monitoring programme – programme management	Yes
3. Advise of any changes being made to the operations and management plan or the site contingency plan	Site specific monitoring programme – programme management	Yes
4. No material shall be burnt on site	Site specific monitoring programme – inspection	Yes
5. Comply with information submitted in support of application	Site specific monitoring programme – programme management	Yes
6. Prevent or minimise any likely adverse effects on the environment	Site specific monitoring programme – inspection and water sampling	Yes
7. Optional review provision re environmental effects	Optional review June 2016, recommendation not to pursue attached in section 7.9	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 18 Summary of performance for Patea closed landfill stormwater and sediment consent 7268-1

Purpose: *To discharge stormwater and sediment onto and into land and into an unnamed tributary of the Patea River from earthworks associated with the closure of the Patea Landfill*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practicable option	Site specific management plan – programme management	N/A
2. Exercise consent in accordance with application	Site specific management plan – programme management	N/A
3. Notify before exercising consent	Programme management	N/A
4. Take reasonable steps to minimise effects	Site specific management plan – programme management	N/A
5. Reinstatement and stabilisation as soon as possible	Site specific management plan – programme management	N/A
6. A lapse condition	N/A	N/A
7. Optional review provision re environmental effects	Optional review June 2016, recommendation attached in section 7.9	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		N/A –consent no longer exercised
Overall assessment of administrative performance in respect of this consent		

N/A = not applicable

During the year, STDC demonstrated a high level of environmental and a good level of administrative performance in relation to the Patea landfill consents as defined in Section 1.1.5. In the 2014-2015 year, the best practicable option was not always adopted at the site, which resulted in some minor stock damage to the cap and stormwater drains. This was remediated where necessary, and reoccurrence was prevented by the

lessee making the requested changes to stock management practices.

8.5 Recommendation from the 2013-2014 Annual Report

In the 2013-2014 Annual Report, it was recommended:

THAT in the 2014-2015 period the monitoring of the Patea landfill be altered slightly from that undertaken in the 2013-2014 period, by reducing the number of inspections from four to three and the introduction of two receiving water sites.

This recommendation was implemented.

8.6 Alterations to monitoring programmes for 2015-2016

In designing and implementing the monitoring programmes for air and water discharges in the region, the Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA, the obligations of the Act in terms of monitoring emissions, discharges and their effects, and subsequently reporting to the regional community. The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki discharging to the environment.

It is proposed that for 2015-2016, the programme remains unchanged.

8.7 Exercise of optional review of consent

Resource consents **0427-3**, **4636-2**, and **7268-1** provide for an optional review of the consent in June 2016. Condition 9 of **0427-3** and condition 7 of **4636-2** and **7268-1** allows the Council to review the consent, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of the consent.

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 no grounds that require a review to be pursued or grounds to exercise the review option.

8.8 Recommendations

1. THAT in the 2015-2016 period, the monitoring of discharges from the closed Patea landfill remains unchanged from that of 2014-2015.
2. THAT the option for a review of resource consents 0427-3, 4636-2, and 7268-1 in June 2016, as set out in conditions 9 and 7 of the consents, not be exercised, on the grounds that the conditions are adequate for dealing with any adverse environmental effects.

9. Summary of recommendations

1. THAT monitoring of consented activities at the closed Hawera landfill in the 2015-2016 year continues at the same level as in 2014-2015.

2. THAT the Kaponga landfill triennial monitoring programme remains in place with monitoring next scheduled for the 2017-2018 period.

3. THAT for the 2015-2016 period, the monitoring of discharges from the closed landfill at Manaia remains unchanged from that of 2014-2015.

4. THAT, in the 2015-2016 year, the triennial monitoring for the Otakeho landfill remains unchanged, and it be noted that the monitoring is next scheduled to be implemented in the 2016-2017 period.

5. THAT for the 2015-2016 period, the monitoring of discharges from the closed landfill at Eltham be altered slightly from that scheduled in the 2014-2015 period, with the reduction in the number of biomonitoring surveys from two to one.

6. THAT monitoring of discharges from Opunake landfill in the 2015-2016 year continues at the same level as in 2014-2015.

7. THAT in the 2015-2016 period, the monitoring of discharges from the closed Patea landfill remains unchanged from that of 2014-2015.

8. THAT the option for a review of resource consents 0427-3, 4636-2, and 7268-1 in June 2016, as set out in conditions 9 and 7 of the consents, not be exercised, on the grounds that the conditions are adequate for dealing with any adverse environmental effects.

Glossary of common terms and abbreviations

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

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
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	An indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
g/m^3	Grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
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.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral.

	Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties(e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	Resource Management Act 1991 and subsequent amendments.
SS	Suspended solids.
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.

Bibliography and references

Ministry for the Environment (2004): *Module 2: Hazardous Waste Guidelines, Landfill Waste Acceptance Criteria and Landfill Classification*.

Taranaki Regional Council (1990): *STDC: Eltham Landfill, Hawera Landfill, Kaponga Landfill, Opunake Landfill, Patea Landfill, Waverley Landfill Annual Report 1989/90. Technical Report 90-43.*

Taranaki Regional Council (1991): *STDC: Eltham Landfill, Hawera Landfill, Kaponga Landfill, Opunake Landfill, Patea Landfill, Waverley Landfill Annual Report 1990/91. Technical Report 91-15.*

Taranaki Regional Council (1992): *STDC: Eltham Landfill, Hawera Landfill, Kaponga Landfill, Opunake Landfill, Patea Landfill, Waverley Landfill Annual Report 1991/92. Technical Report 92-14.*

Taranaki Regional Council (1993): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1992/93. Technical Report 93-47.*

Taranaki Regional Council (1994): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1993/94. Technical Report 94-16.*

Taranaki Regional Council (1995): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1994/95. Technical Report 95-65.*

Taranaki Regional Council (1996): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1995/96. Technical Report 96-25.*

Taranaki Regional Council (1997): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1996/97. Technical Report 97-27.*

Taranaki Regional Council (1998): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1997-98. Technical Report 98-18.*

Taranaki Regional Council (1999): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1998-99. Technical Report 99-08.*

Taranaki Regional Council (2000): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 1999-00. Technical Report 00-50.*

Taranaki Regional Council (2001): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 2000-01. Technical Report 01-43.*

Taranaki Regional Council (2002): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 2001-02. Technical Report 02-39.*

Taranaki Regional Council (2003): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, Otakeho and Waverley Landfills Annual Report 2002-03. Technical Report 03-57.*

Taranaki Regional Council (2004): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2003-04. Technical Report 04-68.*

Taranaki Regional Council (2005): *STDC, Eltham Wastewater Treatment Plant Monitoring Programme Annual Report 2004-05. Technical Report 2005-69*.

Taranaki Regional Council (2006): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2004-05. Technical Report 05-98*.

Taranaki Regional Council (2007): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2005-2007 Technical Report 07-47*.

Taranaki Regional Council (2008): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2007-2008. Technical Report 08-48*.

Taranaki Regional Council (2009): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2008-2009. Technical Report 09-52*.

Taranaki Regional Council (2010): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills: Annual Report 2009-2010. Technical Report 10-30*.

Taranaki Regional Council (2011): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2010-2011. Technical Report 11-36*.

Taranaki Regional Council (2012): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2011-2012. Technical Report 12-68*.

Taranaki Regional Council (2013): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2012-2013. Technical Report 13-36*.

Taranaki Regional Council (2015): *STDC, Eltham, Hawera, Kaponga, Manaia, Patea, Opunake, and Otakeho Landfills Annual Report 2013-2014. Technical Report 14-99*.

Appendix I

Resource consents held by STDC
(in alphabetical order)

Eltham

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	17 March 2005

Conditions of Consent

Consent Granted:	To discharge stormwater and leachate from the former Eltham landfill site into the Mangawhero Stream in the Waingongoro catchment at or about GR: Q20:223-949
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	Castle Street, Eltham
Legal Description:	Lot 1 DP 9279 Blk X Ngaere SD
Catchment:	Waingongoro
Tributary:	Mangawhero

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

General conditions

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

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

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

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

2. Within three months of granting this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such spillage or discharge occur.

3. The consent holder shall monitor the site and adjacent surface and groundwaters to the satisfaction of the Chief Executive, Taranaki Regional Council.

4. Any discharge shall not, in the opinion of the Chief Executive, Taranaki Regional Council, cause nor be likely to cause any significant adverse effects on aquatic life or receiving water quality.

5. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and / or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 17 March 2005

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Hawera

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	28 June 2001

Conditions of Consent

Consent Granted:	To discharge up to 2800 cubic metres/day of leachate and stormwater from the closed Matangara Landfill, Hawera, to groundwater and into an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment at or about GR: Q21:214-788
Expiry Date:	1 June 2016
Review Date(s):	June 2004, June 2010
Site Location:	former Matangara Landfill, Matangara Road, Hawera
Legal Description:	Lot 2 DP 20563 Lot 2 DP 20819 Blk VI Hawera SD
Catchment:	Tangahoe
Tributary:	Tawhiti

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

General conditions

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

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

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

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

Special conditions

1) The consent holder shall at all times adopt the best practicable option, as defined in the Resource Management Act 1991, to prevent or minimise any or likely adverse effects on the environment associated with the discharges of leachate and/or stormwater from the site.

2) The consent holder shall maintain an adequate landfill capping and vegetative cover on the site to the satisfaction of the Chief Executive, Taranaki Regional Council.

3) The consent holder shall provide a landfill post-closure management plan to the satisfaction of the Chief Executive, Taranaki Regional Council by 1 December 2001; such plan to address site security, litter control, vegetation cover, stormwater diversion, leachate control, site contouring, and cover placement and compaction, in addition to any other matters relevant to the exercise of this consent.

4) The consent holder shall adhere to the landfill management plan insofar as it concerns the exercise of this consent at all times.

5) The consent holder shall maintain stormwater drains, the sediment detention pond, and/or ground contours at the site, in order to minimise stormwater movement across, or ponding on the site.

6) The consent holder shall maintain the leachate collection system at the site in order to minimise leachate discharges to the environment at the site.

7) The mixing zone in each condition of this consent shall extend for a distance of 20 metres downstream of the point of the discharge of leachate and stormwater at the confluence of the unnamed tributary of the Tawhiti Stream and the Tawhiti Stream.

8) After allowing for reasonable mixing the consent holder shall ensure that the discharge shall not give rise to any of the following effects in the receiving waters of the Tawhiti Stream:

a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material;
b) any conspicuous change in 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) Monitoring of surface waters, groundwater and leachate on or in the vicinity of the site shall be undertaken to the satisfaction of the Chief Executive, Taranaki Regional Council.

10) The two existing monitoring bores shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.

11) In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may review any or all of the conditions of this consent in June each year after this consent was granted, should further chemical sampling of the unnamed tributary of the Tawhiti Stream reveal levels of contamination resulting in significant adverse environmental effects.

12) In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2004 and/or June 2010, 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 28 June 2001

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Water Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	28 June 2001

Conditions of Consent

Consent Granted:	To divert an unnamed tributary of the Tawhiti Stream in the Tangahoe catchment at or about GR: Q21:214-788
Expiry Date:	1 June 2016
Review Date(s):	June 2004, June 2010
Site Location:	Matangara Road, Hawera
Legal Description:	Lot 2 DP 20563 Lot 2 DP 20819 Blk VI Hawera SD
Catchment:	Tangahoe
Tributary:	Tawhiti

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

General conditions

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

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

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

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

Special conditions

1) The consent holder shall notify the Taranaki Regional Council in writing at least 48 hours prior to the 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 application 1432 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 the Resource Management Act 1991, to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

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

5) The consent holder shall at all times ensure that the diversion pipe is as clear as is practicable of any blockages.

6) That, within three months of the granting of this consent, the consent holder shall prepare a contingency plan to be approved by the Chief Executive, Taranaki Regional Council, outlining measures and procedures to be undertaken to prevent blockage of the diversion pipe and to avoid, remedy or mitigate the environmental effects of a blockage in the diversion pipe.

7) In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2004 and/or June 2010, 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 28 June 2001

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Kaponga

Consent 3459-3

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	17 March 2005

Conditions of Consent

Consent Granted:	To discharge stormwater and leachate from the former Kaponga landfill site into an unnamed tributary of the Waiokura Stream at or about GR: P20:095-960
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	Alamein Street, Kaponga
Legal Description:	Sec 77 Blk XI Kaupokonui SD
Catchment:	Waiokura

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

General conditions

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

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

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

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

Special conditions

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

2. Within three months of granting this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such a spillage or discharge occur.

3. The consent holder shall monitor the site and adjacent surface and groundwaters to the satisfaction of the Chief Executive, Taranaki Regional Council.

4. The consent holder shall install and monitor the leachate and stormwater diversion, collection, treatment and discharge systems, to the satisfaction of the Chief Executive, Taranaki Regional Council.

5. Any discharge shall not, in the opinion of the Chief Executive, Taranaki Regional Council, cause nor be likely to cause any significant adverse effects on aquatic life or receiving water quality.

6. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and / or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 17 March 2005

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Manaia

Consent 3952-2

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	20 January 2005

Conditions of Consent

Consent Granted:	To discharge leachate and stormwater from the Manaia Landfill into the Waiokura Stream at or about GR: P21:078-823
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	Manaia Landfill, Cemetery Road, Manaia
Legal Description:	Pt Sec 23 Blk VII Waimate SD
Catchment:	Waiokura

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

General conditions

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

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

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

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

Special conditions

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

2. Within three months of granting this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such a spillage or discharge occur.

3. Within three months of granting this consent the consent holder shall prepare and maintain a landfill management plan to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall adhere to such a plan in so far as it concerns the exercise of this consent at all times.

4. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the landfill management plan and / or the site contingency plan referred to in special conditions 3 and 4. Should the Taranaki Regional Council wish to review either of these plans, one month’s notice shall be provided to the consent holder.

5. The consent holder shall monitor the site and adjacent surface water and ground water to the satisfaction of the Chief Executive, Taranaki Regional Council.

6. The consent holder shall install and maintain leachate and stormwater diversion , collection, treatment and discharge systems, to the satisfaction of the Chief Executive, Taranaki Regional Council.

7. Any discharge from the landfill shall not, in the opinion of the Chief Executive, Taranaki Regional Council, cause nor be likely to cause any significant adverse effects on aquatic life or receiving water quality.

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 2011 and / or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 20 January 2005

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Opunake

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	23 August 2005

Conditions of Consent

Consent Granted:	To discharge stormwater and leachate from the closed Opunake landfill into the Otahi Stream at or about GR: P20:831-951
Expiry Date:	1 June 2018
Review Date(s):	June 2006, June 2012
Site Location:	Whitcombe Road, Opunake
Legal Description:	Secs 1 & 2 SO 13128 Opunake Town Belt Blk IX Opunake SD
Catchment:	Otahi

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

General conditions

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

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

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

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

Special conditions

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

2. Within three months of granting this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such spillage or discharge occur.

3. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the contingency plan. Should the Taranaki Regional Council wish to review this plan, one month's notice shall be provided to the consent holder.

4. The monitoring of the site and adjacent surface and groundwaters shall be to the satisfaction of the Chief Executive, Taranaki Regional Council.

5. Any discharge shall not, in the opinion of the Chief Executive, Taranaki Regional Council, cause nor be likely to cause any significant adverse effects on aquatic life or receiving water quality.

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 2006 and / or June 2012, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 23 August 2005

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Otakeho

Consent 3953-3

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	22 August 2005

Conditions of Consent

Consent Granted:	To discharge leachate and stormwater from the closed Otakeho Municipal Landfill onto and into land at or about GR: P21:990-835
Expiry Date:	1 June 2018
Review Date(s):	June 2006, June 2012
Site Location:	State Highway 45, Otakeho
Legal Description:	Lot 1 DP 18965 Blk V Waimate SD
Catchment:	Taikatu

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

General conditions

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

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

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

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

Special conditions

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

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of applications 3414, 833 and 274. In the case of any contradiction between the documentation submitted in support of applications 3414, 833 and 274 and the conditions of this consent, the conditions of this consent shall prevail.

3. Within three months of granting this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such spillage or discharge occur.

4. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the contingency plan. Should the Taranaki Regional Council wish to review this plan, one month’s notice shall be provided to the consent holder.

5. The monitoring of the site and adjacent surface and groundwaters shall be to the satisfaction of the Chief Executive, Taranaki Regional Council.

6. Any discharge shall not, in the opinion of the Chief Executive, Taranaki Regional Council, cause nor be likely to cause any significant adverse effects on aquatic life or receiving water quality.

7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2006 and / or June 2012, 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 22 August 2005

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Patea

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	16 December 2003

Conditions of Consent

Consent Granted:	To discharge surface stormwater and leachate from the Patea municipal landfill into an unnamed tributary of the Patea River at or about GR: Q21:360-611
Expiry Date:	1 June 2022
Review Date(s):	June 2010, June 2016
Site Location:	Patea Municipal Landfill, Scotland Street, Patea
Legal Description:	Lot 1 DP 20064 Pt Sec 8 Patea Sbrn All DP 3495 Town of Patea Blk VII Carlyle SD
Catchment:	Patea

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. Within three months of granting of this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such a spillage or discharge occur. This shall be reviewed by the Council on an annual basis.

2. Within three months of granting of this consent the consent holder shall prepare and maintain a landfill operations and management plan to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall adhere to such a plan in so far as they concern the exercise of this consent at all times. This shall be reviewed by the Council on an annual basis.

3. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the operation and management plan and/or site contingency plan. Should the Taranaki Regional Council wish to review either of these plans, one month’s notice shall be provided to the consent holder.

4. The exercise of this resource consent shall be carried out in general accordance with the information submitted in support of the application [2705].

5. The monitoring of the site and adjacent surface and groundwaters shall be to the satisfaction of the Chief Executive, Taranaki Regional Council

6. The leachate and stormwater diversion, collection, treatment and discharge systems shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.

7. Any discharge shall not, in the opinion of the Chief Executive, Taranaki Regional Council, cause nor be likely to cause any significant adverse effects on aquatic life or receiving water quality.

8. Notwithstanding any conditions within this consent, the consent holder shall at all times adopt the best practicable option as defined in Section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any discharge at the site.

9. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2010 and/or June 2016, 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 16 December 2003

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA 4640
Consent Granted Date:	26 March 2008

Conditions of Consent

Consent Granted:	To discharge stormwater and sediment onto and into land and into an unnamed tributary of the Patea River from earthworks associated with the closure of the Patea Landfill at or about 2636144E-6161215N
Expiry Date:	1 June 2022
Review Date(s):	June 2010, June 2016
Site Location:	Patea Landfill, Scotland Street, Patea
Legal Description:	All DP 3495
Catchment:	Patea

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

General conditions

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

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

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

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

Special conditions

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

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4931. In the case of any contradiction between the documentation submitted in support of application 4931 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least seven days prior to the exercise of this consent. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable only if the consent holder does not have access to email.

4. The consent holder shall take all reasonable steps to:

a. minimise the amount of sediment discharged to the stream;
b. minimise the amount of sediment that becomes suspended in the stream; and
c. mitigate the effects of any sediment in the stream.

Undertaking work in accordance with Guidelines for Earthworks in the Taranaki region, by the Taranaki Regional Council, will achieve compliance with this condition.

5. All earthwork areas shall be stabilised vegetatively or otherwise as soon as is practicable immediately following completion of soil disturbance activities.

6. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2010 and/or June 2016, 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 26 March 2008

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Consent Granted Date:	16 December 2003

Conditions of Consent

Consent Granted:	To discharge emissions into the air from the Patea municipal landfill activities at or about GR: Q21:360-611
Expiry Date:	1 June 2022
Review Date(s):	June 2010, June 2016
Site Location:	Patea Municipal Landfill, Scotland Street, Patea
Legal Description:	Lot 1 DP 20064 Pt Sec 8 Patea Sbrn All DP 3495 Town of Patea Blk VII Carlyle SD

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. Within three months of granting of this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such a spillage or discharge occur. This shall be reviewed by the Council on an annual basis.

2. Within three months of granting of this consent the consent holder shall prepare and maintain a landfill operations and management plan to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall adhere to such a plan in so far as they concern the exercise of this consent at all times. This shall be reviewed by the Council on an annual basis.

3. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the operation and management plan and/or site contingency plan. Should the Taranaki Regional Council wish to review either of these plans, one month’s notice shall be provided to the consent holder.

4. No material is to be burnt at the landfill site.

5. The exercise of this resource consent shall be carried out in general accordance with the information submitted in support of the application [2707].

6. Notwithstanding any conditions within this consent, the consent holder shall at all times adopt the best practicable option as defined in Section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any discharge at the site.

7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2010 and/or June 2016, 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 16 December 2003

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix II

Biomonitoring reports

To R Phipps, Science Manager – Hydrology/Biology
From Chris Fowles, Scientific Officer
Document 1456760
Report CF624
Date 15 January 2015

Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to the South Taranaki District Council's Eltham Wastewater Treatment Plant System and Rubbish Tip leachate discharge, October 2014

Introduction

This spring survey was the first of two surveys programmed for the 2014-2015 monitoring period. Since summer 2011, biomonitoring surveys in the Mangawhero Stream have been reduced from four sites to two sites in recognition of the minimal usage of the WWTP consented overflow facility to the Mangawhero Stream in recent years. No overflows to the stream have occurred since this time.

These sites have also been incorporated within the Council's State of the Environment monitoring programme (TRC, 2014).

Method

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates and algae from two established sampling sites (sites 1 and 5) in the Mangawhero Stream and one site (site 8) in the Waingongoro River (illustrated in Figure 1) on 14 October 2014.

This survey was the nineteenth spring biomonitoring programme coincident with riparian planting of the Mangawhero Stream banks and stream willow clearance work over the past several years. It was performed some four years after commissioning of the pipeline for conveyance of the Eltham WWTP wastewater to the Hawera WWTP and the cessation of the discharge of partially treated wastewater into the Waingongoro catchment. No (consented) overflows from the WWTP to the Mangawhero Stream had occurred during this period.

These sites were:

Site No	Site code	Map reference	Location
1	MWH000380	Q20: 227 952	Mangawhero Stream: upstream of WWTP discharge outfall
5	MWH000490	Q20: 210 946	Mangawhero Stream: approximately 200 m downstream of rail bridge and downstream of the Mangawharawhara Stream confluence
8	WGG000665	Q20: 199 937	Waingongoro River: approximately 2 km downstream of Mangawhero Stream confluence

This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Figure 1 Aerial location map of biomonitoring site locations in the Mangawhero Stream and Waingongoro River in relation to Eltham WWTP and landfill

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

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

Macroinvertebrate Community Index (MCI) values were calculated for taxa present at each site (Stark 1985) with certain taxa scores modified in accordance with Taranaki experience.

A semi-quantitative MCI value, SQMCIs (Stark, 1999) 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 scores, and dividing by the sum of the loading factors. 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).

Where necessary sub-samples of algal and detrital material were also taken from the macroinvertebrate samples at all sites and 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 the organisms is an indicator of organic enrichment within a stream.

Results and discussion

This spring survey was performed under moderately low recession flow conditions, 10 days after a significant fresh in the Mangawhero Stream and 9 days after a fresh in excess of 3 times and 17 days after a fresh in excess of 7 times the median flow in the Waingongoro River. The survey followed a wet early spring period with five significant river freshes recorded over the preceding month. The moderate flow in the Mangawhero Stream was cloudy and brownish in appearance both upstream of the discharge outfall (site 1) and at the downstream, swifter flowing site 5. Filamentous algae were widespread on the clay substrate of site 1 with very thin periphyton mats and some marginal aquatic weed. Periphyton mats and filamentous algae were patchy on the stony, harder substrate at site 5 where there was patchy moss but no marginal aquatic weed present (unlike the more extensive weed beds prior to wastewater diversion out of the stream). Stream water temperatures were identical (13.2°C) at both sites during this mid to late morning survey.

Flow in the Waingongoro River at Eltham Road was 1.86 m^3/sec at the time of the survey, well below the average monthly mean flow (3.86 m^3/sec) for October, but above the minimum monthly mean flow (1.32 m^3/sec). River flow was moderate, clear, and uncoloured at the sampling site with patchy periphyton mats and filamentous algal growth, but no moss, present on the substrate. Water temperature was 13.2°C at the time of this mid morning survey.

Macroinvertebrate communities

The results of past biomonitoring surveys performed at the various established stream sites are summarised in Table 1 and illustrated in Figure 2.

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1985 and February 2014

Site	Site code	No. of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	MWH000380	49	10-25	16	58-85	74
5	MWH000490	44	13-30	20	63-102	78
8	WGG000665	40	14-30	20	77-111	94

The macroinvertebrate fauna recorded by the current survey at each of the three sites are presented in Table 2.

Table 2 Macroinvertebrate fauna of the Mangawhero Stream (sites 1 and 5) in relation to the Eltham WWTP, sampled on 14 October 2014

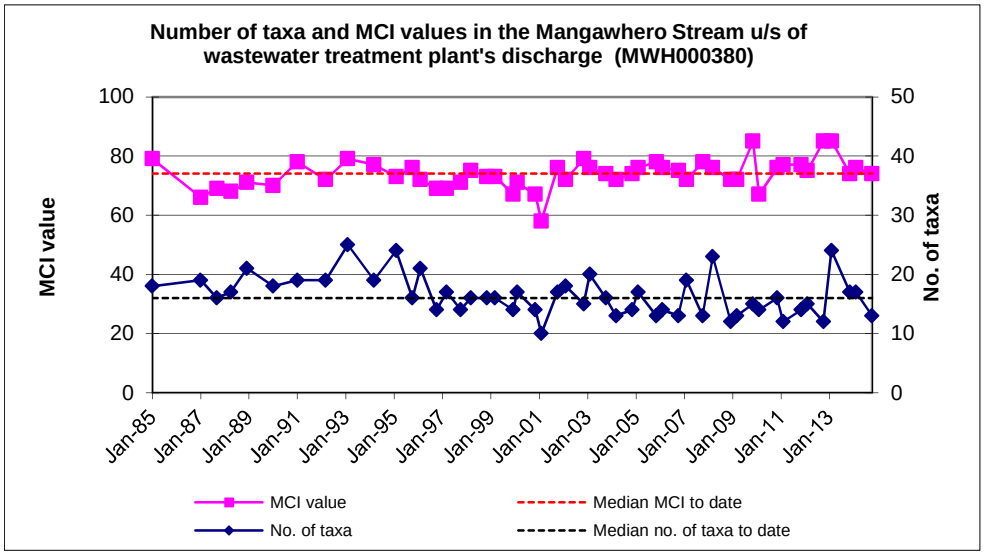
Taxa List	Site Number	MCI score	1	5
	Site Code		**MWH000380**	**MWH000490**
	Sample Number		**FWB14269**	**FWB14270**
NEMERTEA	Nemertea	3	R	-
NEMATODA	Nematoda	3	C	-
ANNELIDA (WORMS)	Oligochaeta	1	A	A
MOLLUSCA	*Potamopyrgus*	4	C	C
CRUSTACEA	*Paracalliope*	5	A	C
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	R
	Coloburiscus	7	-	R
	Deleatidium	8	-	A
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	C	R
COLEOPTERA (BEETLES)	Elmidae	6	-	C
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	-	R
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	R	C
	Costachorema	7	-	R
	Hydrobiosis	5	R	C
	Pycnocentria	7	-	C
	Pycnocentrodes	5	-	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	C	C
	Chironomus	1	R	-
	Maoridiamesa	3	-	VA
	Orthocladiinae	2	A	VA
	Polypedilum	3	-	C
	Tanytarsini	3	-	R
	Empididae	3	-	R
	Austrosimulium	3	R	-
		No of taxa	13	20
		MCI	74	97
		SQMCIs	3.3	3.2
		EPT (taxa)	4	9
		%EPT (taxa)	31	45
'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa		

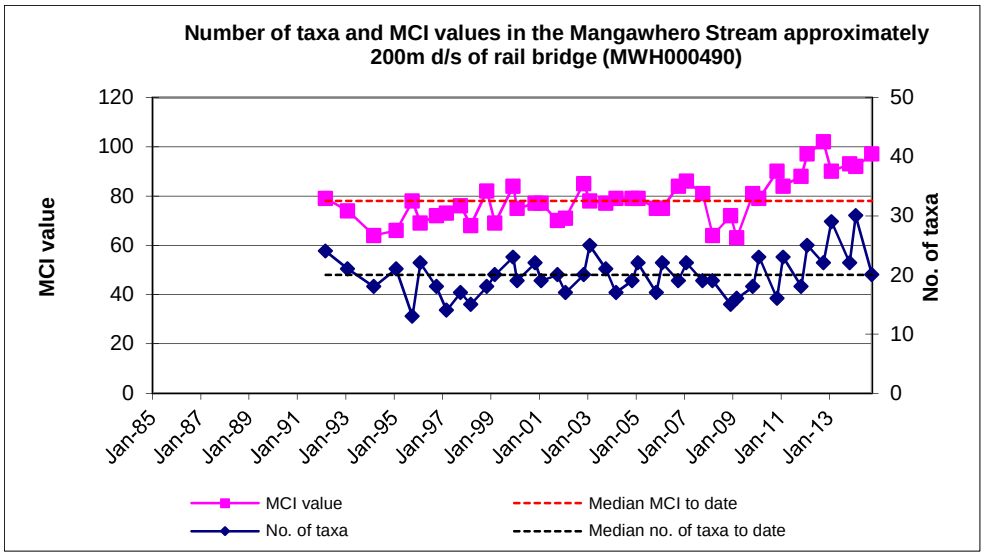
R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Table 3 Macroinvertebrate fauna of the Waingongoro River at Stuart Road (site 8) in relation to the Eltham WWTP, sampled on 15 October 2014

Taxa List	Site Number	MCI score	8
	Site Code		**WGG000665**
	Sample Number		**FWB14283**
MOLLUSCA	*Potamopyrgus*	4	R
EPHEMEROPTERA (MAYFLIES)	*Coloburiscus*	7	A
	Deleatidium	8	XA
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	C
COLEOPTERA (BEETLES)	Elmidae	6	C
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	C
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	C
	Costachorema	7	R
	Hydrobiosis	5	C
	Beraeoptera	8	R
	Pycnocentrodes	5	A
DIPTERA (TRUE FLIES)	*Maoridiamesa*	3	R
	Orthocladiinae	2	C
	Tanytarsini	3	C
		No of taxa	14
		MCI	106
		SQMCIs	7.6
		EPT (taxa)	8
		%EPT (taxa)	57
'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa	

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





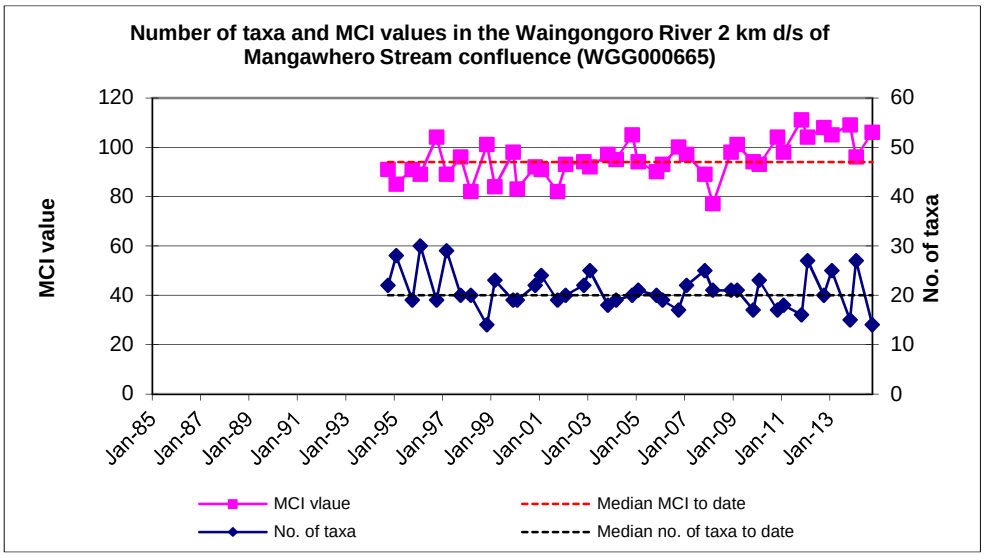


Figure 2 Taxa richness and MCI scores recorded to date

Mangawhero Stream: site 1 (upstream of the WWTP outfall) and site 5 (downstream of Mangawharawhara Stream confluence; approx 3 km below the WWTP outfall and old landfill)

Each of these two sites has a very different habitat and, together with the deterioration in water quality downstream of the Eltham Wastewater Treatment Plant's discharge in the past (i.e. until mid 2011), these factors have been reflected in the macroinvertebrate communities found at each site on the majority of occasions prior to the current survey.

At the time of the current survey this upstream site (1) was dominated by only one 'moderately sensitive' taxon [amphipod (*Paracalliope*)] and two 'tolerant' taxa [oligochaete worms and orthoclad midges]. Each of these taxa had also been dominant in a majority of previous spring surveys with the number of characteristic taxa in this survey slightly lower than typical of most past surveys.

Although sections of the stream at this upstream site were slower flowing, swifter velocities were apparent amongst areas where filamentous algae were less profuse attached to the substrate of the stream. Some of the dominant taxa and other components of the fauna found at this site are commonly found in these types of habitat (e.g. some mayflies, midges, and cranefly), and the presence of the mayfly, *Austroclima* and certain other 'sensitive' taxa continued to indicate reasonably well oxygenated flow conditions as a component of this enriched habitat. Taxa richness (13) was slightly lower than the median number recorded from previous surveys (Table 1). The survey recorded a MCI value of 74 units which was equal with the median of all past survey results and relatively typical of a small swamp seepage stream subject to moderate nutrient enrichment from developed farmland drainage. The score reflected the absence of 'highly sensitive' taxa and the presence of a high proportion of 'tolerant' taxa (62% of richness) in the community at this site. This score was slightly lower than the median value (79 units) found by 179 surveys of 'control' sites in similar seepage sourced hill country streams in the region (TRC, 1999 (updated, 2014)) at equivalent altitudes to this site.

The macroinvertebrate fauna community at the downstream site (5) showed a increase in taxa richness (of 7 taxa), a richness which was equal with the median number previously recorded at this site (Table 1). A small increase in number of dominant taxa included three 'tolerant' taxa [oligochaete worms and midges (orthoclads and *Maoridiamesa*)], no 'moderately sensitive' taxa, and one 'highly sensitive' taxon [mayfly (*Deleatidium*)]. This mayfly had never been a dominant taxon at this site prior to wastewater diversion from the stream. A few of these dominant 'tolerant' taxa were associated with the patchy periphyton substrate cover. Variation in stream habitat probably accounted for most of the changes in abundances within individual taxa between the two sites, including the significant increases in abundances of 'sensitive' beetles, cased caddisflies, and one 'highly sensitive' mayfly. The abundance of the 'highly sensitive' mayfly in particular and increased abundances amongst three 'moderately sensitive' taxa were counterbalanced by increased abundances within two 'tolerant' midge taxa, resulting in minimal change in $SQMCI_s$ score (0.1 unit) between the two sites.

The MCI value (97) at this site represented a significant increase of 23 units (Stark, 1998) above the score recorded at the upstream ('control') site. Improvement in physical stream habitat conditions, and the removal of WWTP wastes from the Mangawhero Stream, contributed to this increase in MCI score. This score was a very significant 19 units higher than the median value of scores from all past surveys although it was 5 units below the historical maximum score found by the spring survey in 2012 (Table 1). A large increase (of 22%) in the proportion

of 'sensitive' taxa at this site, coincident with the physical substrate improvement at this site in the lower stream, was also indicative of improved physicochemical water quality conditions, as the MCI value for such a habitat in the absence of the discharge has increased to a score significantly higher than recorded by all surveys prior to wastewater diversion from the catchment (Figure 2). For instance, the current survey's MCI score categorised this site as having 'fair' health (TRC, 2014) at the time of this survey (compared with median health categorised as 'poor'). Although it was 7 units lower than the predicted MCI score for a ringplain stream arising outside of the National Park, at a site at an altitude of 190 m asl (Stark & Fowles, 2009), scores at this site had been consistently much lower than this predictive value in pre-wastewater diversion surveys.

The current score reflected the more lowland nature of the headwater catchment stream (with a major ringplain tributary) but particularly the improvement to the physicochemical water quality of the stream since removal of the Eltham municipal WWTP discharge by pipeline diversion to the Hawera WWTP.

Waingongoro River site (downstream of the Mangawhero Stream confluence (site 8))

Forty surveys have been undertaken previously at this site, approximately 2 km downstream of the Mangawhero Stream confluence (which previously had been the receiving water for the Eltham municipal wastewater treatment system discharge).

The number of taxa found in the present survey (14) was lower than the median and equal with the minimal richness found at this site to date and fewer than typical of macroinvertebrate community richnesses found in the mid-reaches of Taranaki ringplain rivers. This followed several significant river freshes (five) in the four week spring period preceding this survey. The community was characterised by fewer taxa than usual: one 'highly sensitive' taxon [extremely abundant mayfly (*Deleatidium*)]; two 'moderately sensitive' taxa [mayfly (*Coloburiscus*) and stony-cased caddisfly (*Pycnocentrodes*)]; and no 'tolerant' taxa (Table 3). The abundances of the 'highly sensitive' taxa and other 'moderately sensitive' taxa at this river site were indicative of recent good physicochemical water quality. The proportion of characteristic 'sensitive' to 'tolerant' taxa was much higher than found by the majority of previous surveys which had been performed while discharges from the WWTP were occurring into the Mangawhero Stream, upstream of this site.

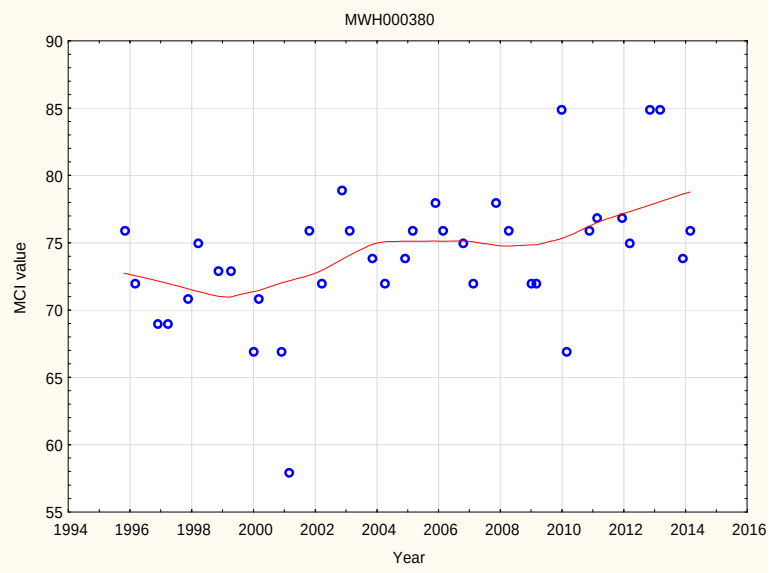
The MCI score (106) indicated limited deterioration in the macroinvertebrate community in comparison with the communities present in the reach in the vicinity of the Riverlands meatworks upstream of the Mangawhero Stream where the MCI scores ranged from 104 to 119 units at the time of the same day monitoring of the meatworks' discharge (CF625). Few differences in characteristic community taxa resulted in a slightly higher $SQMCI_s$ score (by up to 0.7 unit) at this site below the confluence. The current MCI score (at site 8) of 106 units was a significant 12 units higher than the median score recorded by past surveys at this site, and was within five units of the previous maximum. It categorised this site as having 'good' generic stream health and 'expected' predictive health (TRC, 2014) at the time of this spring survey. It was also three units higher than the predicted MCI score for a National Park-sourced ringplain 'control' site at an altitude of 180 m asl and a significant 12 units higher than the predicted MCI score for this site, 29.6 km downstream of the National Park boundary (Stark and Fowles, 2009), a reflection of the improvement subsequent to the removal of the WWTP discharge from the Mangawhero Stream upstream of this site.

This improvement in MCI value below the Mangawhero Stream confluence was less typical of the trend of larger downstream decreases recorded by many earlier surveys (since 1994) and was dissimilar to the trends often recorded at the time of past spring surveys. However, it was coincident with the diversion of the Eltham WWTP discharge out of the catchment which had occurred some four years earlier.

Temporal trends in MCI scores (1995-2014)

Non-parametric statistical trend analysis of MCI data (Stark and Fowles, 2006) has been performed on the nineteen years of SEM results collected to summer 2014 from the two sites in the Mangawhero Stream and site in the Waingongoro River at Stuart Road. The MCI has been chosen as the preferable indicator of 'stream/river health' for SEM trend purposes. A graphical presentation of the LOWESS plot of trends in MCI data and the Mann-Kendall test of significance are provided for all sites. The LOWESS (tension 0.4) trend plots of MCI data are presented in Figures 3, 4, and 5.

Site MWH000380

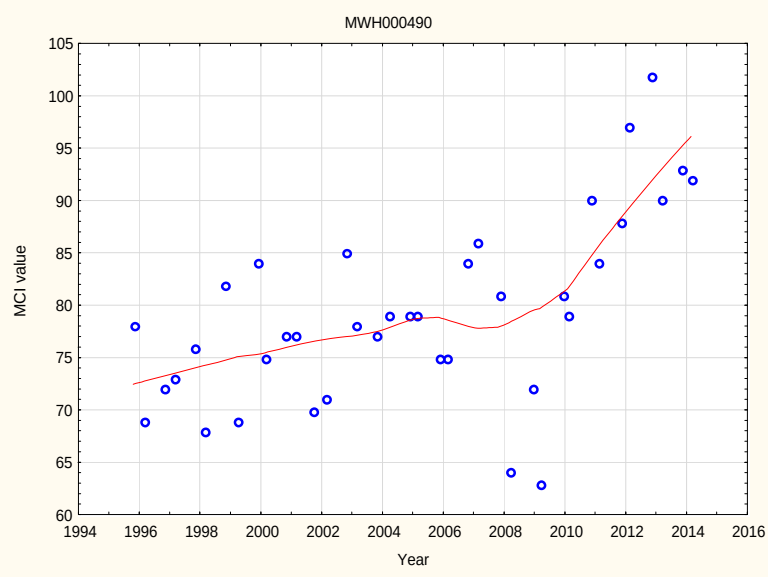


N = 38
Kendall tau = +0.350
p value = 0.002 [>FDR, p = 0.005]
Significant at p <0.05 and p < 0.01 levels; and after FDR application

Figure 3 LOWESS trend plot of MCI data at the site upstream of Eltham WWTP discharge

A positive and statistically significant temporal trend in MCI scores ($p < 0.01$ after FDR) has been found over the nineteen year monitoring period at this site with the early trend of slightly increasing scores having been followed by a plateauing of scores a few units above those recorded early in the programme and a more recent steady increase. However, the narrow range of LOWESS-smoothed scores (8 units) over the period has not been of ecological significance. LOWESS-smoothed MCI scores consistently have been indicative of 'poor' generic stream health throughout the period.

Site MWH000490



N = 38
Kendall tau = +0.457
p value < 0.0001 [>FDR, p < 0.001]
Significant at p <0.05 and p < 0.01; and significant after FDR

Figure 4 LOWESS trend plot of MCI data at the site downstream of the Mangawharawhara Stream confluence

A moderate and recently much more pronounced, and now statistically significant ($p < 0.01$, after FDR), temporal improvement in MCI scores has been illustrated at this more ringplain-like site in the lower reaches of the stream near its confluence with Waingongoro River. The wide range in LOWESS-smoothed scores (24 units) has more recently become ecologically significant over the nineteen year period. Scores trended downwards, slightly for 3 years after a steady improvement between 1995 and 2006 prior to the most recent marked improvement due to improved scores since the diversion of the Eltham WWTP wastes discharge out of the stream in July 2010.

The MCI scores generally have been indicative of 'poor' generic stream health (TRC, 2014) with sporadic incursions into the 'fair' health category prior to 2010. The LOWESS-smoothed scores have remained in the 'poor' category through the period until 2010 and subsequently improved into the 'fair' category and more recently toward 'good' health. In terms of predictive relationships (TRC, 2014) for a site in the mid-reaches of a ringplain stream (recognising the partial ringplain component of this catchment and the position of the site in the lower reach of this small stream prior to joining the mid-reaches of a larger ringplain river), stream health has been 'worse than expected' almost throughout the entire nineteen year period, but entered the 'expected' category in the 2011-2012 survey period where it has remained.

Site WGG000665

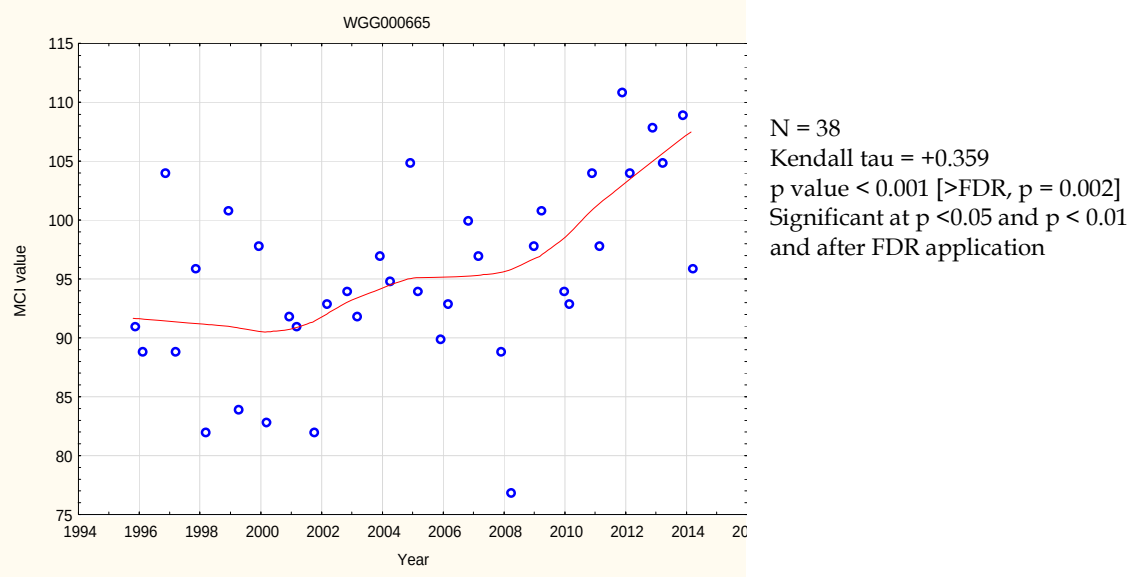


Figure 5 LOWESS trend plot of MCI data at the Stuart Road site

A positive statistically significant trend in MCI scores has been found (at the 5% and 1% levels after FDR application) over the period with an overall gradual improvement in MCI scores since 2002 (coincident with summer diversion of the treated meatworks wastes discharge (at Eltham) from the river to land irrigation) and particularly most recently (since 2009) following the diversion of treated municipal Eltham wastewater out of the catchment (to the Hawera WWTP and ocean outfall). The LOWESS-smoothed range of scores (17 units) has also been ecologically significant over the nineteen year period. Smoothed MCI scores consistently have been indicative of 'fair' generic river health until more recently when they have been indicative of 'good' generic health (TRC, 2014). In terms of predictive relationships for a site in the mid reaches of a ringplain river, health has been in the 'expected' category almost throughout the period until approaching the 'better than expected' category in the last three years.

Microscopic streambed heterotrophic assessment

The microscopic heterotrophic assessments of substrate growths performed for all sites indicated an absence of any mats, plumes or dense growths of heterotrophic organisms at each of the three sites.

Conclusions

This survey was the nineteenth spring survey performed subsequent to upgrades to the Eltham WWTP and the fifth spring survey since diversion of the wastewater discharge out of the catchment to the Hawera WWTP, with no consented overflow discharges to the stream in the interim. The survey coincided with moderately low recession flows following a number of early spring freshes and moderate periphyton substrate cover at both Mangawhero Stream sites and the Waingongoro River downstream of the Mangawhero Stream confluence.

Macroinvertebrate community richnesses were lower or similar to past median taxa numbers at all sites but the MCI scores were much higher than past medians and nearer historical

maxima at sites in the lower Mangawhero Stream and in the Waingongoro River. A significant improvement was found in MCI score between the two stream sites in a downstream direction. Increased abundances and proportions of certain 'highly' and 'moderately sensitive' taxa within the community, which might be expected to be present at the 'better' physical habitat of site 5, 3 km downstream of the wastewater treatment plant's original discharge outfall were indicative of improved physicochemical water quality conditions at the time of this survey. The MCI and $SQMCI_s$ scores recorded in the Waingongoro River downstream of the Mangawhero Stream confluence were indicative of improved physicochemical water quality below the confluence which was dissimilar to trends frequently found by previous surveys during wastewater discharges and more often under lower flow conditions. Improvement in physicochemical water quality and the associated macroinvertebrate faunal communities in the Mangawhero Stream and Waingongoro River associated with the diversion of the discharge out of the catchment to the Hawera WWTP have been recorded again by this survey some four years after wastewater diversion. No impacts of leachate from the old landfill to the Mangawhero Stream were indicated from the results of this spring survey.

Temporal trends in MCI scores have been indicative of statistically significant improvements in stream and river biological river health at all three sites over an nineteen year period and more significantly due to markedly higher scores at sites downstream of the original wastewater outfall discharge point subsequent to the pipeline diversion of wastes to the Hawera WWTP which occurred four years previously.

Summary

The Council's standard 'kick-sampling' technique was used at two established sites to collect streambed macroinvertebrates from the Mangawhero Stream and at one established site in the Waingongoro River. Samples were sorted and identified to provide number of taxa (richness) and MCI and SQMCIs 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 $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharges being monitored.

This spring macroinvertebrate survey indicated that the diversion of the discharge of treated wastewater from the Eltham WWTP out of the stream to the Hawera WWTP more than four years earlier had resulted in an improvement in the macroinvertebrate community of the downstream site in the Mangawhero Stream. Changes in the macroinvertebrate communities were recorded between the upstream 'control' site and the site nearly 3 km downstream of the original WWT Plant discharge outfall near the confluence with the Waingongoro River where improvements in aesthetic aspects of physicochemical water quality were also noticeable. As a result of diversion of the wastewater discharge out of the catchment, an improvement in MCI score continued to be recorded and there was no microscopic evidence of 'heterotrophic growths' (which more often had been associated with summer, warmer, low flow conditions). Nineteen year temporal trends showed statistically significant stream/river health improvements at all sites, but more significantly at the two sites downstream of the WWTP

outfall attributable to pipeline diversion of the wastewater discharge out of the catchment (and no subsequent consented overflows to the stream).

The macroinvertebrate communities of the Mangawhero Stream contained relatively higher proportions of 'tolerant' taxa at the upper site, with numerical dominance by an additional 'highly sensitive' taxon, at the downstream site when the community was comprised of a higher proportion of 'sensitive' taxa. Taxonomic richness (number of taxa) was moderate at the time of this spring survey coincident with patchy periphyton mats and filamentous algal cover, but minimal marginal weed growth.

MCI scores indicated that the Mangawhero Stream communities were of 'poor' health upstream, and 'fair' health at the downstream site, but relatively typical of conditions recorded in equivalent reaches of similar Taranaki streams, sourced outside the National Park and/or in lowland swamps.

The macroinvertebrate community found in the Waingongoro River below the Mangawhero Stream confluence showed similar $SQMCI_s$ and MCI scores compared with the surveyed reach of the river (in association with Riverlands meatworks) above the confluence and an improvement on wastewater pre-diversion conditions; more typical of the trend found by surveys since the removal of the Eltham WWTP wastewater discharge from the Mangawhero Stream.

No impacts of leachate from the old landfill on Mangawhero Stream macroinvertebrate communities were indicated by the results of this spring survey.

References

Internal Taranaki Regional Council reports

Fowles CR, 2007: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2007. Report CF418.

Fowles CR, 2007: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, October/November 2007. Report CF435.

Fowles CR, 2008: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, March 2008. Report CF445.

Fowles CR, 2009: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, March 2009. Report CF483.

Fowles CR, 2010: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2009. Report CF496.

Fowles CR, 2010: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2010. Report CF506.

Fowles CR, 2010: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2010. Report CF515.

Fowles CR, 2011: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2011. Report CF528.

Fowles CR, 2011: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2011. Report CF538.

Fowles CR, 2012: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2012. Report CF548.

Fowles CR, 2012: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, October 2012. Report CF563.

Fowles CR, 2013: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2013. Report CF573.

Fowles CR, 2013: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2013. Report CF594.

Fowles CR, 2014: Biomonitoring of the Waingongoro River in relation to Riverlands Eltham Ltd Meatworks Discharges, October 2014. Report CF625.

Fowles CR, 2014: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2014. Report CF607.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998. (SEM reference report). TRC Technical Report 99-17.

TRC, 2014: Freshwater macroinvertebrate fauna biological monitoring programme. Annual State of the Environment Monitoring Report 2012-2013. Technical Report 2013-48.

External publications

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

Stark J D, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Report No 472. 32pp.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Stark JD, Fowles CR, 2006: An approach to the evaluation of temporal trends in Taranaki state of the environment macroinvertebrate data. Cawthron Institute Report No 1135. 88p.

Stark JD, Fowles CR, 2009: Relationships between MCI, site altitude, and distance from source for Taranaki ringplain streams. Stark Environmental Report No. 2009-01. 47p.

To Job Manager, L Smith
From Scientific Officer, C R Fowles
Document No 1461394
Report No CF633
Date 28 January 2015

Biomonitoring of the Otahi Stream in relation to the closed Opunake landfill leachate discharge, January 2015

Method

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from two established sampling sites in the Otahi Stream (Table 1, Figure 1) on 19 January 2015 in relation to the discharge of leachate from the closed Opunake landfill. This landfill has been closed for about fourteen years and re-grassed.

Table 1 Biomonitoring sites in the Otahi Stream in relation to the Opunake landfill

Site code	GPS location		Location
	E	N	
OTH000310	1673233	5633362	upstream of landfill
OTH000350	1672854	5633217	upstream of SH45 (downstream of landfill and weir)

This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

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

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

Macroinvertebrate Community Index (MCI) values were calculated for taxa present at each site (Stark 1985) with certain taxa scores modified in accordance with Taranaki experience.

A semi-quantitative MCI value, $SQMCI_S$ (Stark 1999) 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 scores, and dividing by the sum of the loading factors. The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VVA), and 500 for extremely abundant (XA).

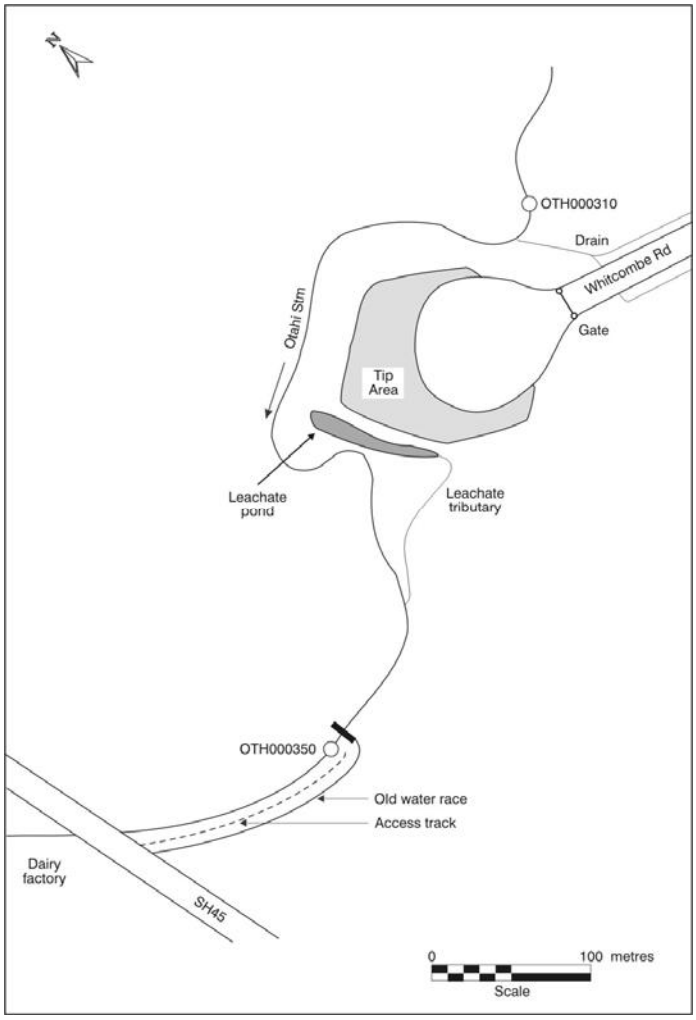


Figure 1 Sampling sites in the Otahi Stream in relation to Opunake landfill

Results and discussion

Low, clear, uncoloured flow conditions were recorded in the Otahi Stream during this survey which was performed 29 days following a fresh in excess of three times median flow and 39 days after a fresh in excess of seven times median flow. Water temperatures ranged from 19.5°C (upstream) to 19.3°C (downstream) at the time of this mid morning summer survey. The upstream site was partially shaded and had thin periphyton mats and patchy filamentous algae on the stony streambed. The downstream site was also partially shaded with patchy periphyton mats and filamentous algae recorded on the stony substrate. Both sites were characterised by silty, sand, gravel-cobble-boulder substrates and were within the lower reaches of the stream, less than 2 km from the coast, and below 25 m asl in elevation. This ringplain stream is sourced just outside of the National Park boundary.

Macroinvertebrate communities

Results from the current survey and previous surveys are summarised in Table 2 and Figure 2 and the more detailed results of the current survey are presented in Table 3.

Table 2 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between November 1989 and January 2013

Site	No of surveys	Taxa numbers		MCI values		Survey of January 2015	
		Range	Median	Range	Median	No of taxa	MCI
OTH000310	19	15 – 24	19	60 – 91	79	19	86
OTH000350	19	17 – 24	21	68 – 89	79	17	94

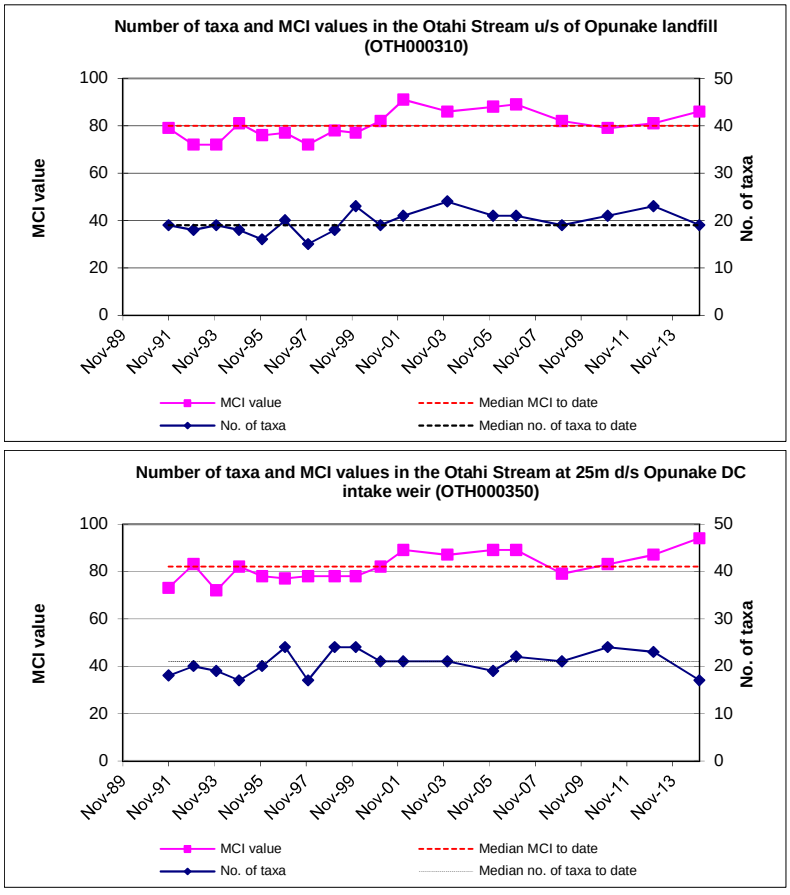


Figure 2 Taxa richness and MCI scores from previous surveys at sites upstream and downstream of Opunake landfill

Table 3 Macroinvertebrate fauna of the Otahi Stream in relation to the (closed) Opunake landfill discharges sampled on 19 January 2015

Taxa List	Site Number	MCI score		
	Site Code		OTH000310	OTH000350
	Sample Number		FWB15027	FWB15028
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	R	R
NEMERTEA	Nemertea	3	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	C
	Lumbricidae	5	C	R
MOLLUSCA	*Ferrissia*	3	C	-
	Potamopyrgus	4	XA	XA
CRUSTACEA	*Paracalliope*	5	A	A
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	A
	Deleatidium	8	A	VA
COLEOPTERA (BEETLES)	Elmidae	6	R	C
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	A	C
	Hydrobiosis	5	A	A
	Pycnocentrodes	5	XA	XA
	Triplectides	5	-	R
DIPTERA (TRUE FLIES)	*Aphrophila*	5	C	C
	Orthocladiinae	2	C	C
	Tanytarsini	3	R	-
	Muscidae	3	R	-
	Austrosimulium	3	A	A
ACARINA (MITES)	Acarina	5	-	R
		No of taxa	19	17
		MCI	86	94
		SQMCIs	4.6	4.8
		EPT (taxa)	5	6
		%EPT (taxa)	26	35

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

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

Taxa richnesses at both sites were similar (Tables 2 and 3) equal with and four taxa lower than medians found by nineteen previous surveys at the respective sites (Table 2 and Figure 2). These two sites in the stream were characterised by a combination of one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa [amphipod (*Paracalliope*), mayfly (*Austroclima*), dobsonfly (*Archichauliodes*), free-living caddisfly (*Hydrobiosis*), and stony-cased caddisfly (*Pycnocentrodes*)]; and up to three 'tolerant taxa' [snail (*Potamopyrgus*), net-building caddisfly (*Aoteapsyche*), and sandfly (*Austrosimulium*)]. These characteristic taxa of this reach of the stream were similar, although fewer in number, than those found by the previous survey (CF566). Community composition at both sites was very similar with fifteen taxa (71% of the reach's 21 taxa) shared by both sites. All but one of the remaining six taxa found only at one of the two sites were present as rarities and therefore not characteristic of the communities (Table 3). Many of the dominant taxa are commonly associated with periphyton growths on the stony substrates of the lower reaches of nutrient enriched rivers and streams and all but the 'highly sensitive' mayfly and 'moderately sensitive' dobsonfly have dominated this reach of the Otahi Stream on 16 to 100% of previous survey occasions. Many of these taxa have been dominant on at least 50%

of previous survey occasions. No significant differences in individual taxon abundances were recorded between sites as reflected in the very similar $SQMCI_S$ scores (4.6 and 4.8 units) at the two sites (Table 2). The abundance of the 'highly sensitive' mayfly (*Deleatidium*) and several other 'sensitive' taxa at both sites was indicative of recent relatively good habitat and physicochemical water quality conditions in this reach of the Otahi Stream.

The similarity in faunal composition at the two sites was reflected in the insignificant difference in the MCI scores (86 and 94) which atypically increased in a downstream direction and were 7 to a significant (Stark, 1998) 15 units above the medians of scores found from previous surveys (Table 2 and Figure 2). The score at the downstream site was five units higher than previously found. These scores were equal with to eight units higher than predicted for sites at an altitude of 20 m asl in ringplain streams sourced outside the National Park (Stark and Fowles, 2009). These scores (86 and 94 units) categorised the sites as having 'fair' stream health (TRC, 2014) at the time of this mid-summer survey. The relative similarity and downstream increase in sites' scores was indicative of no recent impacts of rubbish tip leachate seepage discharges on the macroinvertebrate fauna of the Otahi Stream.

Microscopic heterotrophic assessment

No visual signs of heterotrophic growths were recorded on the streambed at the time of the survey. No unusual heterotrophic growths were found in the samples from either site in the Otahi Stream upstream and downstream of the closed landfill.

Conclusion

Moderate, typical taxa richnesses and relatively similar MCI scores upstream and (increasing) downstream at the Opunake rubbish tip were within ranges and well above MCI medians previously recorded at the two sites in this lower reach of the Otahi Stream with the MCI score at the downstream site higher than previously recorded. The similarities in macroinvertebrate communities, atypical downstream increase in MCI scores, and absence of significant heterotrophic growths at both sites were indicative of good preceding physicochemical water quality conditions and no recent impacts of leachate from the closed Opunake landfill on the biological communities of the stream. The atypical downstream improvement in MCI score was coincident with the progressively more extensive riparian vegetation through this reach of the stream (Figure 1).

Summary

The Council's standard 'kick-sampling' technique was used at two established sites to collect streambed macroinvertebrates from the Otahi Stream. Samples were sorted and identified to provide the number of taxa (richness) and 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.

This mid-summer macroinvertebrate survey indicated that any discharges of leachate from the closed Opunake landfill site had not had any recent detrimental effects on the macroinvertebrate communities of the Otahi Stream. No significant changes in the macroinvertebrate communities were found between the upstream 'control' site and the site downstream of the landfill discharge.

The macroinvertebrate communities of the stream contained relatively high proportions of 'tolerant' taxa (35% to 53% of richnesses) at both sites, typical of the lower reaches of ringplain streams. The communities were generally dominated by a combination of several 'moderately sensitive' and 'tolerant' taxa. Taxonomic richnesses (numbers of taxa) at the time of this summer survey were slightly lower in comparison with those of more recent surveys conducted in this stream.

MCI scores indicated that the stream communities were of 'fair' health, and as good as to better than to the condition recorded in the lower reaches of similar Taranaki streams sourced outside the National Park.

References

Internal Taranaki Regional Council reports

Fowles, CR 1994: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, 20 December 1993. CF71.

Fowles, CR 1995: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, 5 December 1994. CF83.

Fowles, CR 1996: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, 21 December 1995. CF98.

Fowles, CR 1997: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, December 1996. CF126.

Fowles, CR 1998: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, December 1997. CF156.

Fowles, CR 1999: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, February 1999. CF178.

Fowles, CR 2000: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, January 2000. CF202.

Dunning, KJ 2001: Biomonitoring of the Otahi Stream in relation to the Opunake rubbish tip leachate discharge, February 2001. KD39.

Fowles, CR 2002: Biomonitoring of the Otahi Stream in relation to the Opunake landfill leachate discharge, February 2002. CF246.

Fowles, CR 2004: Biomonitoring of the Otahi Stream in relation to the closed Opunake landfill leachate discharge, January 2004. CF293.

Fowles, CR 2006: Biomonitoring of the Otahi Stream in relation to the closed Opunake landfill leachate discharge, January 2006. CF394.

Fowles, CR 2007: Biomonitoring of the Otahi Stream in relation to the closed Opunake landfill leachate discharge, January 2007. CF413.

Fowles, CR 2009: Biomonitoring of the Otahi Stream in relation to the closed Opunake landfill leachate discharge, January 2009. CF478.

Fowles, CR 2011: Biomonitoring of the Otahi Stream in relation to the closed Opunake landfill leachate discharge, January 2011. CF523.

Fowles, CR 2013: Biomonitoring of the Otahi Stream in relation to the closed Opunake landfill leachate discharge, January 2013. CF566.

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

TRC, 2014: Fresh Water macroinvertebrate fauna biological monitoring programme annual state of the environment monitoring report 2012-2013. Technical Report 2013-48.

External Publications

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

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

Stark, J D, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Report No 472. 32pp.

Stark, JD, Boothroyd IKH, Harding J, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No 5102. 57p.

Stark, JD, and Fowles, CR, 2009: Relationships between MCI, site altitude, and distance from Source for Taranaki ringplain streams. Stark Environmental Report No. 2009-01. 47p.

To Science Manager-Hydrology/Biology, R Phipps
From Scientific Officer, Chris R Fowles
Report No CF641
Doc No 1482979
Date March 2015

Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham wastewater treatment plant's discharge and rubbish tip leachate discharge, February 2015

Method

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from two established sampling sites in the Mangawhero Stream on 12 February 2015. Two sites in the Waingongoro River (illustrated in Figure 1) and an additional site, established in the river (site 8) approximately 2 km further downstream for monitoring use in conjunction with the Riverlands Eltham Ltd discharges, and the state of the environment monitoring programme, were also sampled on 12 February 2015.

This survey was performed some four and a half years after commissioning of the pipeline for conveyance of the WWTP wastewater to the Hawera WWTP and the cessation of the discharge of partially treated wastewater into the Waingongoro catchment. No (consented) overflows from the WWTP to the Mangawhero Stream had occurred during this period, nor were occurring at the time of the survey. In recognition of the successful diversion of the wastewater, recent surveys have been reduced (by two sites in the Mangawhero Stream) from the previous intensity (see CF528 and other references) and will continue at this level in order to address temporal stream and river 'health' recovery.

The sites sampled were:

Site No	Site code	GPS reference	Location
1	MWH000380	E1712475 N5633431	Mangawhero Stream: upstream of wastewater treatment plant's discharge
5	MWH000490	E1710795 N5632738	Mangawhero Stream: approximately 200 m downstream of rail bridge
6	WGG000620	E1710708 N5632961	Waingongoro River: approx 150 m upstream of Mangawhero S. confluence
7	WGG000640	E1710554 N5632790	Waingongoro River: approx 200 m downstream of Mangawhero S. confluence
8	WGG000665	E1709784 N5632049	Waingongoro River: approx 2 km downstream of Mangawhero S. confluence (off Stuart Road)

This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

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:

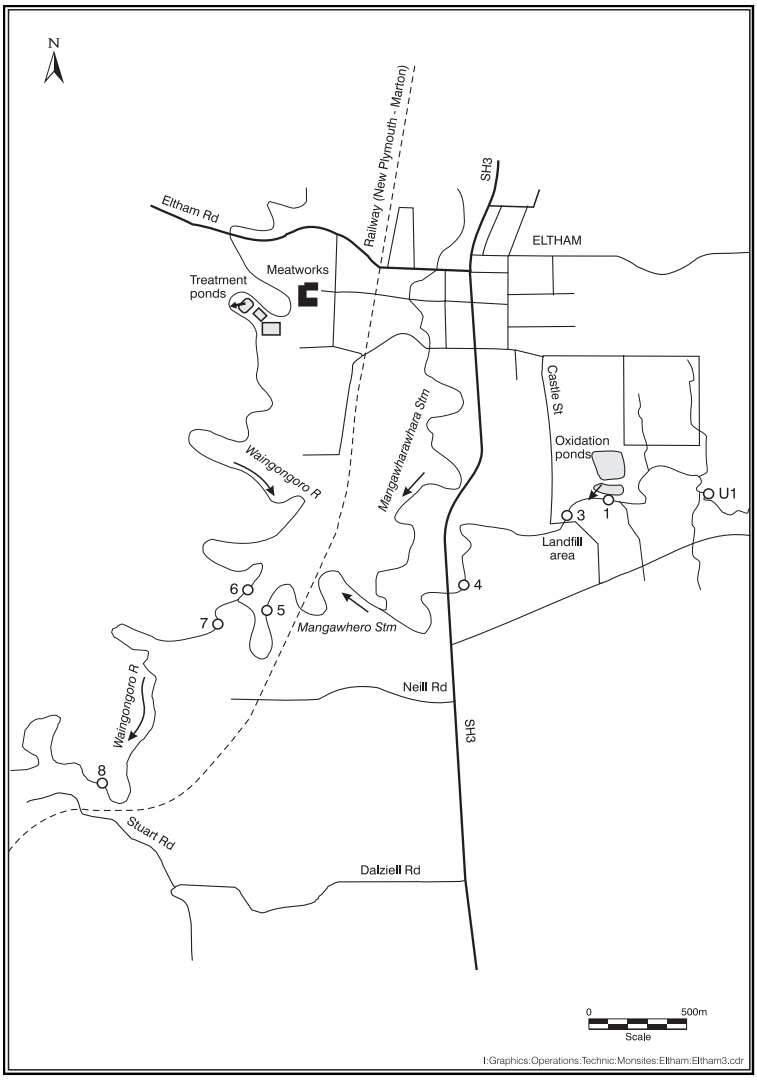


Figure 1 Biomonitoring site locations in the Mangawhero Stream and Waingongoro River in relation to Eltham wastewater treatment plant and landfill [Note: sites 1, 5, 6, 7 and 8 used in current survey]

Figure 2 Location of biomonitoring sites in relation to the Eltham WWTP and landfill

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

Macroinvertebrate Community Index (MCI) values were calculated for taxa present at each site (Stark 1985) with certain taxa scores modified in accordance with Taranaki experience.

A semi-quantitative MCI value, $SQMCI_S$ (Stark, 1999) 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 scores, and dividing by the sum of the loading factors. 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).

Where necessary, sub-samples of algal and detrital material were also taken from the macroinvertebrate samples and were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ('undesirable biological growths') at a microscopic level. The presence of these organisms is an indicator of organic enrichment within a stream.

Results and discussion

This late summer survey was performed under very low flow conditions in the Mangawhero Stream some 62 days after a significant fresh in this stream. The stream was cloudy and brownish in appearance upstream of the wastewater treatment plant's outfall, where there was minimal aquatic vegetation at the stream margins. However, in the absence of any wastes discharge the appearance was slightly cloudy but uncoloured at the swifter, very low flowing, harder substrate of site 5 below the Mangawharawhara Stream confluence where there were beds of aquatic vegetation only at the margins of the stream channel. Stream water temperatures ranged from 17.0˚C to 18.4˚C during this late-morning survey. Patchy periphyton mats but no filamentous algae or moss were present at site 1 and mats, filamentous green algal growth, and moss were patchy at site 5, with aquatic weed at the edges of site 5. No 'sewage fungus' was noticeable on the hard substrate at either of the two sites.

A very low recession flow (0.34 m^3/sec) was recorded in the Waingongoro River at Eltham Road at the time of the survey which occurred 42 days after a fresh in excess of three times median flow and 54 days after a fresh in excess of seven times median flow. The river was clear and uncoloured upstream of the Mangawhero Stream confluence and also downstream of the confluence and at Stuart Road (site 8) during a very dry period. The river flow was much lower than the average mean monthly flow (1.39 m^3/sec) for February and slightly below the minimum mean monthly flow (0.390 m^3/sec) for the period 1975 to 2014. River temperatures ranged from 17.8°C to 18.3°C at sites 6, 7, and 8 at the time of this late morning to early afternoon survey. Patchy periphyton mats and filamentous algae were recorded at all three sites and patchy moss was present only at site 8.

Macroinvertebrate communities

The results of past biomonitoring surveys performed at the various river and stream sites prior to WWTP wastes diversion and surveys since this diversion are summarised in Table 1 and illustrated in Figures 3 and 4.

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1985 and October 2014

Site	Pre-diversion (Jan 1985 to July 2010)					Post-diversion (Nov 2010 to Oct 2014)				
	No. of Surveys	Taxa Numbers		MCI Values		No. of Surveys	Taxa Numbers		MCI Values	
		Range	Median	Range	Median		Range	Median	Range	Median
1	41	10-25	16	58-85	73	9	12-24	15	74-85	76
3	25	6-22	15	47-72	61	1	-	16	-	79
4	23	8-18	14	48-74	60	1	-	19	-	74
5	36	13-25	19	63-86	77	9	16-30	22	84-102	92
6	25	16-35	27	77-105	91	4	19-28	24	96-116	104
7	24	17-35	26	78-100	91	4	21-31	27	105-109	107
8	32	14-30	21	77-105	93	9	14-27	18	96-111	105

The macroinvertebrate fauna recorded at the two Mangawhero Stream sites (1 and 5) and three Waingongoro River sites (6, 7 and 8) are presented in Tables 2 and 3 respectively.

Mangawhero Stream: Site 1 (upstream of wastewater treatment plant's wetlands discharge and upstream of the old rubbish tip)

The flow at this site was very low, cloudy, brown, and swift. The relatively channelised and limited habitat was comprised of patchy periphyton mats, but no filamentous algae nor moss on a mainly hard clay substrate with some wood. The riparian vegetation planting was well established since being undertaken along the stream banks subsequent to the drain clearance work about sixteen years previously and provided partial shading of the stream.

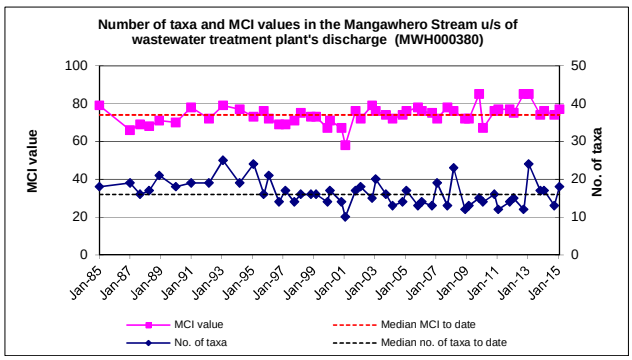
Moderate taxa richness (18 taxa) was recorded, two taxa more than the median richness recorded by 50 previous surveys at this site (Table 1). No 'highly sensitive' taxa were found at this site, with the fauna characterised by only one 'tolerant' taxon [very abundant sandfly (*Austrosimulium*)] and one 'moderately sensitive' taxon [very abundant amphipod (*Paracalliope*)]. These dominant taxa and many of the remainder of the fauna found at this site (Table 2) are generalists and often common inhabitants of weedy, sedimented beds, in slower flowing Taranaki streams which may be characterised by moderate physicochemical water quality, particularly when swamp-fed. Each of these dominant taxa have been characteristic of this site on at least 50% of previous survey occasions (TRC, 2015a). The MCI score (77) was three units above the median of all previous surveys' results at this site (Table 1 and Figure 2). This score was also within three units of the median score (79) from 179 surveys of small non-ringplain Taranaki streams at 'control' sites within the altitude range from 200 to 249 m asl (TRC 2015) and relatively typical of small, weedy, swamp-fed Taranaki streams draining developed farmland catchment and subject to moderate organic enrichment. It also reflected the absence of 'highly sensitive' taxa, typical components of the fauna of higher quality ring plain streams; and the relatively high proportion of 'tolerant' taxa (67% of total taxa) in the community.

Table 2 Macroinvertebrate fauna of the Mangawhero Stream in relation to Eltham WWTP discharge sampled on 12 February 2015

Taxa List	Site Number	MCI score	1	5
	Site Code		MWH000380	MWH000490
	Sample Number		FWB15093	FWB15094
COELENTERATA	Coelenterata	3	R	-
NEMERTEA	Nemertea	3	R	C
ANNELIDA (WORMS)	Oligochaeta	1	C	VA
MOLLUSCA	*Ferrissia*	3	-	R
	Potamopyrgus	4	C	A
CRUSTACEA	Ostracoda	1	C	C
	Paracalliope	5	VA	VA
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	R	C
	Coloburiscus	7	-	R
	Deleatidium	8	-	VA
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	-	R
HEMIPTERA (BUGS)	*Microvelia*	3	R	-
COLEOPTERA (BEETLES)	Elmidae	6	-	VA
	Hydraenidae	8	-	R
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	R	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	C	XA
	Costachorema	7	-	C
	Hydrobiosis	5	R	VA
	Neurochorema	6	-	R
	Polyplectropus	6	R	-
	Oxyethira	2	-	C
	Pycnocentrodes	5	-	A
	Triplectides	5	C	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	-	R
	Maoridiamesa	3	-	R
	Orthocladiinae	2	C	VA
	Polypedilum	3	C	R
	Tanytarsini	3	R	A
	Paradixa	4	R	-
	Empididae	3	-	A
	Muscidae	3	-	C
	Austrosimulium	3	VA	C
		No of taxa	18	27
		MCI	77	88
		SQMCIs	3.9	4.2
		EPT (taxa)	5	9
		%EPT (taxa)	28	33

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

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



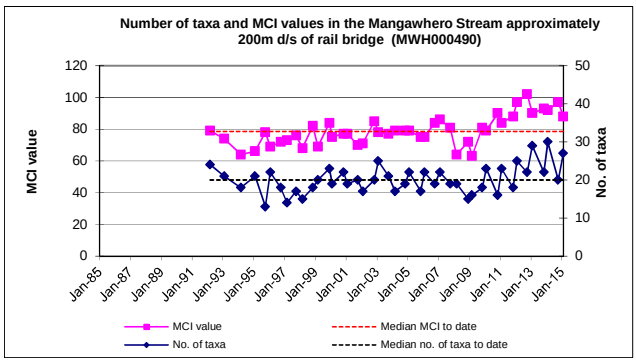
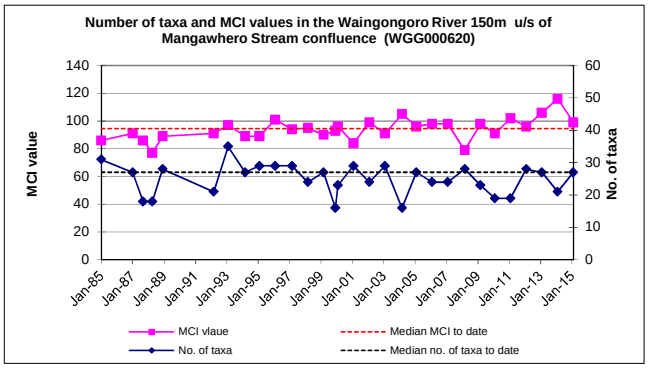
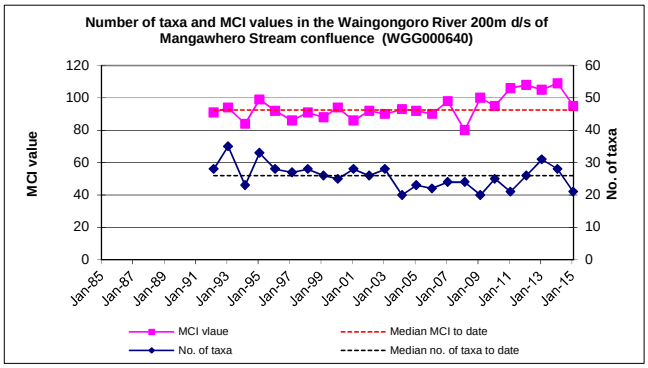


Figure 3 Taxa richness and MCI values for the two Mangawhero Stream sites to date





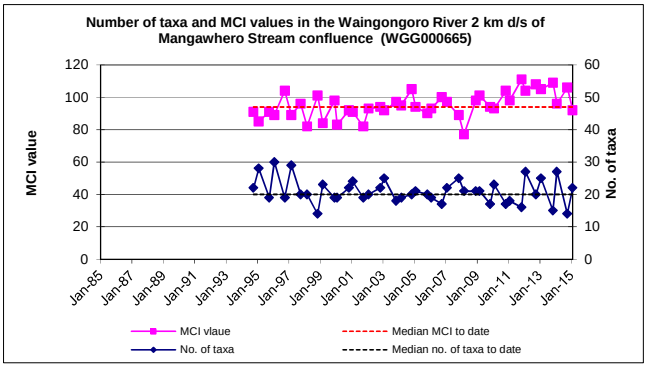


Figure 4 Taxa richness and MCI values for the three Waingongoro River sites to date

Mangawhero Stream: Site 5 (downstream of Mangawharawhara Stream and upstream of Waingongoro River confluences)

The habitat at this site differed significantly from that at the upstream site, with slightly deeper, swifter, open flow over a silt-sandy, gravel, and mainly cobble- boulder substrate, with aquatic weed present at the margins under late summer very low flow conditions. Patchy periphyton mats, filamentous algal growths, and moss were present. Some areas of silty, softer sediment were noted in addition to the cobble and boulder substrate. Flow at this site was slightly cloudy but uncoloured in appearance with marked visual improvement compared with conditions recorded prior to Eltham WWTP wastewater diversion from the stream, and partly as a result of the increased dilution by the clearer ringplain Mangawharawhara Stream tributary.

A relatively high taxa richness (27 taxa) was recorded which was a much increased richness in comparison with the taxa number at the upstream 'control' site. This taxa number was eight taxa more than the median number (19 taxa) found from previous surveys prior to wastewater diversion and one of the highest richnesses since diversion (Table 1), although rarities contributed 30% of this taxa richness. This richness was five taxa above the median recorded by previous surveys (Figure 3) but three less than the previous maximum recorded (by the summer 2014 survey). A significantly higher MCI value of 88 units was recorded compared to that at the upstream 'control' site. This value was a significant (Stark, 1998) 11 units higher than the median of MCI scores previously surveyed at this downstream site prior to wastewater diversion, reflecting improvement subsequent to wastes diversion out of the reach of the stream below the WWTP outfall. This MCI score (88) was also 11 units higher than the score recorded at the 'control' site (1) upstream of the wastewater treatment plant's discharge outfall coincident with very low flow conditions but improved physical habitat conditions and improved physicochemical water quality provided by the Mangawharawhara Stream inflow, sourced on the ringplain. This score categorised the site as having 'fair' stream biological generic health (TRC, 2015a) at the time of this survey (compared with a median category of 'poor' health prior to wastewater diversion out of the catchment).

The dominant taxa (Table 2) included six 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), net-building caddisfly (*Aoteapsyche*), midges (orthoclads and tanytarsids, and empidid flies]; four 'moderately sensitive' taxa [(amphipods (*Paracalliope*), elmid beetles, free-living caddisfly (*Hydrobiosis*), and stony-cased caddisfly (*Pycnocentrodes*)]; and one 'highly sensitive' taxon [very abundant mayfly (*Deleatidium*)]. By way of comparison, this was three more 'sensitive' taxa than were dominant at the time of the summer 2009-2010 survey, which had been preceded by a continuous period of wastewater discharges. The numerical dominance of the community by four 'sensitive' and two 'tolerant' taxa resulted in the moderate $SQMCI_s$ value (4.2 units) which was 2.2 units below the maximum of those recorded by all surveys at this site to date and only 0.3 unit above the score recorded upstream at site 1. Certain 'sensitive' taxa, which generally were absent or in lower abundances at this lower stream site prior to diversion of the WWTP discharge, had become more abundant numerically in the macroinvertebrate fauna at the time of this survey. These taxa included two mayfly taxa, dobsonfly (*Archichauliodes*), elmid beetles, and some caddisfly taxa in particular. Conversely, certain 'tolerant' taxa were numerically less abundant or absent when compared with pre-wastes diversion surveys.

Waingongoro River: Sites 6, 7 and 8 (upstream and downstream of the Mangawhero Stream confluence)

All three sites' habitats were characterised by relatively shallow, swift, riffle flows over substrates composed of some silt, sand, gravel, and boulders, but primarily of cobbles. Algal mats and filamentous algal growths were patchy through the reach surveyed with patchy moss only at site 8.

Table 3 Macroinvertebrate fauna of the Waingongoro River in relation to Eltham WWTP discharge sampled on 12 February 2015

Taxa List	Site Number	MCI score	6	7	8
	Site Code		WGG000620	WGG000640	WGG000665
	Sample Number		FWB15088	FWB15089	FWB15090
NEMERTEA	Nemertea	3	-	R	-
NEMATODA	Nematoda	3	R	-	R
ANNELIDA (WORMS)	Oligochaeta	1	R	-	C
MOLLUSCA	*Potamopyrgus*	4	C	C	R
CRUSTACEA	Ostracoda	1	R	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	C	A
	Coloburiscus	7	VA	A	A
	Deleatidium	8	XA	XA	VA
	Zephlebia group	7	R	-	-
PLECOPTERA (STONEFLIES)	*Megaleptoperla*	9	-	R	-
COLEOPTERA (BEETLES)	Elmidae	6	C	A	C
	Hydraenidae	8	R	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	A	A
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	XA	XA	XA
	Costachorema	7	C	C	C
	Hydrobiosis	5	VA	A	A
	Neurochorema	6	C	R	C
	Beraeoptera	8	R	-	-
	Olinga	9	R	-	-
	Oxyethira	2	R	R	-
	Pycnocentrodes	5	A	A	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	A	A	A
	Eriopterini	5	-	-	R
	Maoridiamesa	3	A	C	VA
	Orthocladiinae	2	C	VA	VA
	Tanypodinae	5	R	-	-
	Tanytarsini	3	A	A	A
	Empididae	3	R	R	R
	Muscidae	3	-	-	R
	Austrosimulium	3	R	C	R
	Tanyderidae	4	R	-	R
		No of taxa	27	21	22
		MCI	99	95	92
		SQMCIs	5.9	5.6	4.3
		EPT (taxa)	11	9	8
		%EPT (taxa)	41	43	36

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

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

The macroinvertebrate communities recorded at sites 6 and 7 were of relatively good richnesses (ranging from 21 to 27 taxa), with a moderate decrease in richness in a downstream direction (Table 3). Sites' taxa numbers near the Mangawhero Stream confluence were equal with to slightly below median numbers previously recorded (Table 1) and richness at Stuart Road (site 8) was very similar to historical median richness (Figure 4). MCI values (92 to 99) were higher (two sites) and very similar to medians of past surveys' values prior to wastewater diversion out of the catchment (Table 1 and Figure 4) and within five units of the historical maximum at site 7 downstream of the confluence despite very low flow conditions preceding the survey. There were very few significant differences in individual taxon abundances between sites, with increases in 'tolerant' orthoclad midges taxa number downstream at site 7 and an increase in another single tolerant' midge (*Maoridiamesa*)) taxon number at site 8. These subtle changes in community composition had minimal influence on the $SQMCI_s$ values which decreased by 0.3 unit at the site downstream of the Mangawhero Stream confluence. However, some decrease in the abundance of the 'highly sensitive' mayfly (*Deleatidium*) resulted in a further drop of 1.3 $SQMCI_s$ units at Stuart Rd (site 8).

No significant changes in MCI scores were recorded between sites immediately adjacent to the Mangawhero Stream confluence with a more typical downstream decrease of four units. The MCI score found at the Stuart Road site, 2 km further downstream, was an insignificant three units lower than with the score immediately downstream of the Mangawhero Stream confluence. The overall improvement in MCI scores in this reach was typical of the trend found by recent surveys unlike the pre-wastewater diversion surveys which showed greater decreases downstream of the Mangawhero Stream confluence attributable to deterioration in physicochemical water quality at this site due to the wastewater loadings on this tributary. The current trend was indicative of improvements subsequent to wastes diversion out of the catchment some four and a half years earlier but was somewhat less marked than that found by two of the previous three summer low flow surveys when river flows were higher.

In general, the faunal communities in this 2.5 km reach of the river were characterised by one 'highly sensitive' taxon [very to extremely abundant mayfly (*Deleatidium*)]; up to seven 'moderately sensitive' taxa [mayflies (*Austroclima* and *Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), caddisflies (*Hydrobiosis* and *Pycnocentrodes*), and cranefly (*Aphrophila*)]; and up to four 'tolerant' taxa [net-building caddisfly (*Aoteapsyche*), and midges (orthoclads, tanytarsids, and *Maoridiamesa*)]. These characteristic taxa were typical of those found previously in the communities in this reach of the river and identical in number to those found by the previous summer survey. Comparatively, this summer survey found a slightly lower total number of taxa (31) in this reach of the river, of which 17 were recorded at all three sites but with a moderate number (seven) of these taxa (one 'highly sensitive', four 'moderately sensitive', and two 'tolerant' taxa) abundant at all sites. All three of the MCI scores recorded over this reach of the river however, were similar to typical scores found during summer flows in the mid-reaches of a river draining developed catchments and receiving point source wastes discharges and agricultural run-off. Taxa richnesses (21 to 27 taxa) were above the median richness (20 taxa) recorded by 376 previous surveys of 'control' sites located between 155 and 199 m asl. in National Park-sourced ringplain streams and rivers (TRC, 2015). MCI scores (92 to 99 units) categorised these sites as having 'fair' generic river health (TRC, 2015a) at the time of this late summer survey. These scores ranged from a significant (Stark, 1999) 11 units below to four units below predicted MCI scores for National Park-sourced ringplain river 'control' sites at an altitude of 180 m asl and were two units below to five units above predicted scores for such sites between 27 and 30 km downstream of the National Park boundary (Stark and Fowles, 2009).

Microscopic streambed heterotrophic assessment

Mangawhero Stream

No heterotrophic growths were visually apparent in the field at the time of the survey. Where necessary, closer inspection and microscopic analysis of samples from each site showed that there were no mats, plumes or dense growths of heterotrophic organisms at either site in the Mangawhero Stream coincidental with diversion of the wastewater discharge out of the stream.

Waingongoro River

Visual and microscopic analysis of samples from the Waingongoro River showed no evidence of mats, plumes or dense growths of heterotrophic organisms on the river substrate, consistent with diversion of the wastewater treatment plant's discharge out of the Mangawhero Stream (some 4 km upstream of the confluence with the river) four and a half years earlier.

Conclusions

This late summer survey was performed during very low flow conditions in the Mangawhero Stream and in the Waingongoro River coincidental with the diversion of the Wastewater Treatment Plant's wastes out of the Mangawhero Stream by way of the pipeline to the Hawera WWTP. This survey was also the fifteenth summer survey since the willow removal work had been undertaken in the stream through the reach below the SH3 culvert result which had resulted in some physical stream habitat improvements to the mid-reaches of the stream below the historical wastes discharge.

Macroinvertebrate richness and MCI values found in the lower reaches of the Mangawhero Stream were influenced by the improved physicochemical water quality conditions despite very low flow conditions following removal of the wastewater discharge from the catchment some four and a half years prior to this survey. Aspects of community composition (particularly moderate $SQMCI_s$ value and higher MCI score) emphasised these improvements in physicochemical water quality conditions downstream of the Eltham wastewater treatment system original discharge outfall at the furthest downstream site, where recovery in community composition was also coincident with the improvement in physical habitat and dilution provided by the Mangawharawhara Stream tributary to the extent that taxa richness and significantly higher than median MCI score were recorded for the thirty years of monitoring to date.

The diversion of the discharge from the Eltham Wastewater Treatment Plant (to the Hawera WWTP) had resulted in improvements in the microfloral streambed communities in the Mangawhero Stream downstream of the discharge outfall in the mid-reaches of the stream where previously, protozoan growths frequently were attached to the harder components of the substrate under conditions of low receiving water dilution rates. At the time of the current survey, no growths of heterotrophic organisms were found at the downstream site in the Mangawhero Stream nor at any of the sites in the Waingongoro River.

Relatively similar biological communities were recorded in the Waingongoro River between the upstream site and the two sites downstream of the Mangawhero Stream confluence under very low, late summer flow conditions. Minimal significant differences in individual taxon abundances occurred in this reach of the main river although $SQMCI_s$ scores showed typical downstream decreases. Improvements in MCI scores, compared with historical data, at the two sites downstream of the Mangawhero Stream confluence were coincident with physicochemical water quality improvement and generally consistent with scores recorded since diversion of the Eltham WWTP discharge out of the catchment, and post-Riverlands summer diversion of treated wastewater discharges to land irrigation (CF640).

Summary

The Council's standard 'kick-sampling' technique was used at two established sites to collect streambed macroinvertebrates from the Mangawhero Stream and at three established sites in the Waingongoro River. Samples were sorted and identified to provide number of taxa (richness) and MCI and SQMCIs 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 $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharges being monitored.

This late summer macroinvertebrate survey during a period of very low recession flow indicated that the diversion of treated wastewater from the Eltham WWTP out of the stream to the Hawera WWTP had resulted in a marked improvement in the macroinvertebrate community at the downstream site in the lower reaches of the Mangawhero Stream. Changes in the macroinvertebrate communities were recorded between the upstream 'control' site and the site nearly 3 km downstream of the original WWTP discharge outfall near the confluence with the Waingongoro River, coincident with improvements in aesthetic aspects of physicochemical water quality. Macroinvertebrate communities were of better 'health' than prior to wastes diversion. As a result of diversion of the wastewater discharge out of the catchment, a marked improvement in the MCI score was recorded and there was no visual or microscopic evidence of 'heterotrophic growths' on the stream substrate (which have often been associated with summer, warmer, low flow conditions during wastewater discharges).

The macroinvertebrate communities of the Mangawhero Stream contained a relatively high proportion of 'tolerant' taxa at both sites, but with a downstream increase in the number and/or proportion of 'sensitive' taxa since wastes diversion with numerical dominance by a 'highly sensitive' taxon and an increased number of 'moderately sensitive' taxa at the downstream site where the community was also comprised of an increased proportion of more 'sensitive' taxa. Taxonomic richness (number of taxa) was average to high at the time of this late summer survey coincident with thin to patchy periphyton mats and patchy filamentous algal cover, and a marked decrease in aquatic weed growth at the site downstream of the WWTP outfall where a much higher community richness was present.

MCI scores indicated that the Mangawhero Stream communities were of 'poor' to 'fair' generic health at the upstream 'control' site and at the furthest downstream site respectively, and more typical of the condition recorded in equivalent reaches of similar Taranaki streams.

No impacts of leachate from the old landfill on the macroinvertebrate community of the lower Mangawhero Stream site were indicated by the results of this summer survey in the absence of any wastewater discharge to the stream.

The macroinvertebrate communities found in the Waingongoro River below the Mangawhero Stream confluence showed improved $SQMCI_s$ and MCI scores and generally were significantly lower than those scores found through the surveyed reach of the river (in association with Riverlands meatworks (CF640)) further upstream of the confluence. The deteriorating downstream trend found by most past pre-wastes diversion surveys was much less marked, and reflected the improvements in physical and physicochemical habitats associated with removal of the Eltham WWTP wastewater discharge from the Mangawhero Stream.

References

Internal Taranaki Regional Council reports

Fowles CR, 2007: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2007. Report CF418.

Fowles CR, 2007: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, October/November 2007. Report CF435.

Fowles CR, 2008: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, March 2008. Report CF445.

Fowles CR, 2009: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, March 2009. Report CF483.

Fowles CR, 2010: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2009. Report CF496.

Fowles CR, 2010: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2010. Report CF506.

Fowles CR, 2010: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2010. Report CF515.

Fowles CR, 2011: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2011. Report CF528.

Fowles CR, 2011: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2011. Report CF538.

Fowles CR, 2012: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2012. Report CF548.

Fowles CR, 2012: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, October 2012. Report CF563.

Fowles CR, 2013: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2013. Report CF573.

Fowles CR, 2013: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, November 2013. Report CF594.

Fowles CR, 2014: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, February 2014. Report CF607.

Fowles CR, 2014: Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, October 2014. Report CF624.

Fowles CR, 2015: Biomonitoring of the Waingongoro River in relation to Riverlands Eltham Ltd Meatworks Discharges, February 2015. Report CF640.

TRC, 2015: Some statistics from the Taranaki Regional Council database (Esam) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 30 September 2014. (SEM reference report). TRC Technical Report 2014-105.

TRC, 2015a: Freshwater macroinvertebrate fauna biological monitoring programme. Annual State of the Environment Monitoring Report 2013-2014. Technical Report 2014-20.

External publications

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

Stark J D, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Report No 472. 32pp.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Stark JD, Fowles CR, 2009: Relationships between MCI, site altitude, and distance from source for Taranaki ringplain streams. Stark Environmental Report No. 2009-01. 47p.