

Stratford District Council Landfills  
Monitoring Programme  
Annual Report  
2016-2017

Technical Report 2017-35

ISSN: 1178-1467 (Online)  
Document: 1872543 (Word)  
Document: 1917126 (Pdf)

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October 2017



## Executive summary

The Stratford District Council (SDC) maintains a closed landfill located on Victoria Road at Stratford, in the Patea catchment. The landfill was closed to the public on 11 March 2002 and to commercial disposers on 23 March 2002. The site has more recently been used to dewater and dispose of oxidation pond sludge from the adjacent municipal wastewater treatment plant. This activity ceased in early 2006, and the landfill was recapped and reinstated. The only external material now accepted at the landfill is soil from a local sawmill site remediation project. This activity is covered by separate consent<sup>1</sup> held by a third party.

SDC also maintains closed landfills at Douglas Road, Huiroa, and Wingrove Road, Pukengahu, in the Patea catchment. Both the Huiroa and Pukengahu landfills have been closed since 1991, but are still monitored with regards to maintenance and leachate discharge on a triennial basis. Monitoring of these sites was not undertaken during the 2016-2017 year, with monitoring next scheduled in the 2017-2018 year.

This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess SDC's environmental performance of these closed landfills during the period under review, and the results and environmental effects of SDC's activities.

SDC holds three resource consents, which include a total of 19 special conditions setting out the requirements that SDC must satisfy.

### **During the monitoring period, SDC demonstrated an overall high level of environmental performance.**

The Council's monitoring programme for the closed landfill at Stratford included two inspections, two receiving water and six ground water samples collected for physicochemical analysis, and one biomonitoring survey of receiving waters. Management Plans required by the Huiroa and Pukengahu closed landfill consents that were renewed in June 2016, were received and reviewed.

There were no incidents recorded by the Council in regards to SDC's landfill sites during the period under review and the monitoring showed that there were only minor effects on the environment due to the discharges at the closed Stratford landfill site.

During the year, SDC demonstrated a high level of environmental performance and good level of administrative performance with the Stratford landfill resource consent. As with the 2014-2015 and 2015-2016 years, there was some minor ponding occurring on the site and some re-contouring is needed to ensure that all areas of the cap remain free draining.

During the year, the environmental performance was not assessed in relation to SDC's Huiroa landfill resource consent. Their administrative performance was high.

During the year, the environmental performance was not assessed in relation to SDC's Pukengahu landfill resource consent. Their administrative performance was high.

For reference, in the 2016-2017 year, 74% 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 21% demonstrated a good level of environmental performance and compliance with their consents.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance remained at a high level in the year under review.

This report includes recommendations for the 2017-2018 year.

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<sup>1</sup> Consent 7645-1 Alby M Limited

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# 1. Introduction

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

### 1.1.1. Introduction

This report is for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Stratford District Council (SDC). SDC maintains closed landfills on Victoria Road, Stratford, on Douglas Road, Huiroa, and on Wingrove Road, Pukengahu.

This report includes the results and findings of the monitoring programmes implemented by the Council in respect of the consents held by SDC that relate to discharges of leachate and stormwater to water from the three closed landfills within the Patea catchment, in the Stratford district. During the year under review monitoring was only undertaken at the Stratford landfill site, as the Huiroa and Pukengahu monitoring programmes are triennial and are next scheduled for the 2017-2018 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 report discusses the environmental effects of SDC's use of water, land, and air, and is the 24th report by the Council for the landfills managed by the consent holder.

### 1.1.2. Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites through annual programmes;
- a summary of the resource consents held by SDC; and
- the nature of the monitoring programme in place for the period under review.

Each of the closed landfills is then discussed in a separate section (Sections 2 to 4).

In each **subsection 1** (e.g. Section 2.1) there is a general description of the landfilled site and its discharges, an aerial photograph or map showing the location of the former landfill, and an outline of the matters covered by the water discharge permit.

**Subsection 2** presents the results of monitoring of the SDC's activities at each of the sites during the period under review, including scientific and technical data.

**Subsection 3** discusses the results, their interpretation, and their significance for the environment in the immediate vicinity of the site under discussion.

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

**Section 5** contains a summary of recommendations for the 2017-2018 year.

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

### 1.1.3. The Resource Management Act (1991) and monitoring

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

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

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

### 1.1.4. 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 courses of non-compliance or failure to maintain good practices. A pro-active approach that, in the first instance, avoids issues occurring is favoured.

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

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

Any investigations, interventions, and incidents for each site are discussed in subsection 3.

### 1.1.5. Evaluation of environmental performance

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

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with the consent holders approach to demonstrating consent compliance in site operations and management including the timely



provision of information to Council (such as contingency plans or 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 performance

**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 2016-2017 year, 74% 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 21% demonstrated a good level of environmental performance and compliance with their consents.

## 1.2. Resource consents

### 1.2.1. 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.

SDC holds water discharge permits **3889-3**, **3890-3** and **3891-3** issued by the Council. The purposes and approximate locations of the consents are provided in Table 1 and Figure 1, and they are each discussed further in the sections of this report covering the individual landfills.

**Table 1** Stratford District Council landfill consents

Consent number	Location	Purpose	Next review date	Expiry date
3889-3	Stratford	To discharge leachate into land and into groundwater adjacent to the Patea River	June 2022	1 June 2028
3890-3	Huiroa	To discharge stormwater and leachate from the former Huiroa landfill onto and into land in the vicinity of an unnamed tributary of the Makuri Stream	June 2022	1 June 2034
3891-3	Pukengahu	To discharge stormwater and leachate from the former Pukengahu landfill into an unnamed tributary of the Waihapa Stream	June 2022	1 June 2034

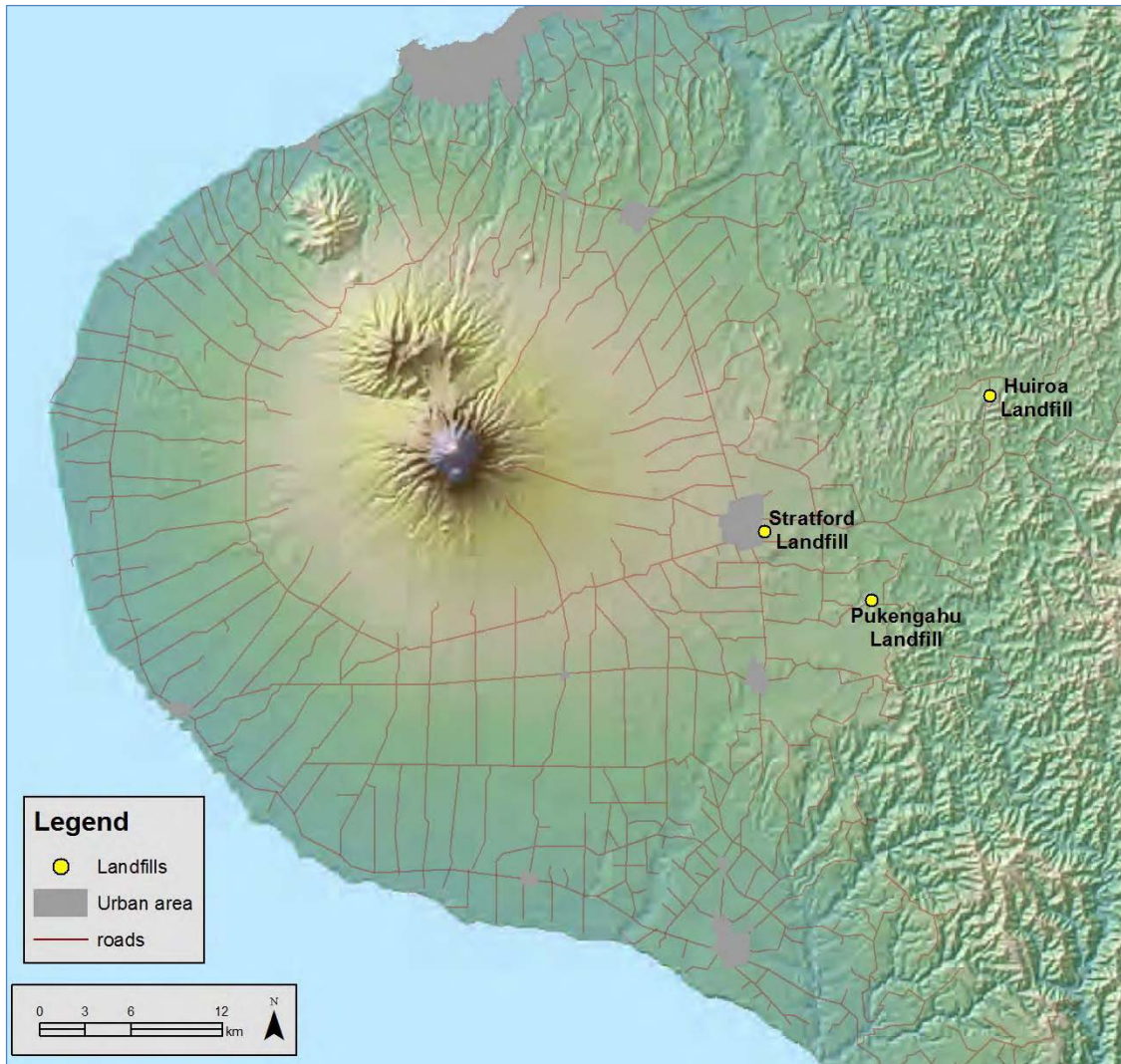


Figure 1 Regional map showing SDC landfill sites

## 1.3. Monitoring programme

### 1.3.1. 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 within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

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

The Stratford landfill closed in 2006 and monitoring is conducted annually.

Both the Huiroa and Pukengahu landfills have been closed since 1991 but are still monitored with regards to leachate discharge and site maintenance on a three yearly basis. Monitoring was last undertaken in the 2014-2015 period, and is scheduled to take place again in 2017-2018 as per the triennial programme schedule.

The monitoring programmes for the SDC landfills consist of four primary components as outlined below.

### 1.3.2. 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.

### 1.3.3. Site inspections

The Stratford municipal landfill site was visited on two occasions during the monitoring period.

The landfill inspections focused on the stability, integrity, and drainage of the caps, any potential or actual discharges to receiving watercourses, including potential for leachate discharges, and visual assessment of the receiving water quality.

### 1.3.4. Chemical sampling

The Patea River in the vicinity of the Stratford landfill was sampled on one occasion, and the sample analysed for black disc transparency, biochemical oxygen demand, cadmium, chloride, conductivity, chromium, dissolved oxygen, dissolved reactive phosphorus, faecal coliforms, ammoniacal nitrogen, nitrate/nitrite nitrogen, dissolved oxygen saturation, pH, suspended solids, temperature, turbidity, and zinc.

The Council also undertook sampling of the groundwater at the Stratford landfill. Groundwater was sampled on two occasions, and the samples analysed for alkalinity, dissolved zinc, chloride, conductivity, filtered chemical oxygen demand, dissolved chromium, dissolved copper, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate/nitrite nitrogen, pH, temperature, water level and dissolved zinc.

### 1.3.5. Biomonitoring surveys

A biological survey was performed on one occasion in the Patea River to determine whether or not the Stratford landfill has had a detrimental effect upon the macroinvertebrate communities of the river.



## 2. Stratford landfill at Victoria Road

### 2.1. Process description

The Stratford District Council (SDC) operated a landfill located on Victoria Road at Stratford, in the Patea catchment. The landfill was closed to the public on 11 March 2002 and to commercial disposers on 23 March 2002. All contaminated surface water from the landfill is pumped to the adjacent oxidation ponds for treatment.

In March 2004 SDC cleared a site on top of the landfill and created a bunded area for the purpose of oxidation pond sludge dewatering. This dewatering process continued through to early 2006 and the sludge was then covered and capped and the site reinstated. There has been no discharge of refuse to the landfill since 2006.

A third party currently holds a consent to discharge chromated copper arsenate (CCA) contaminated soil from the old Fazackerly timber treatment plant site as base fill to the landfill for re-contouring purposes<sup>2</sup> (under the supervision of SDC). This consent has been exercised. However, due to an excess of clean overburden, further re-contouring is required.

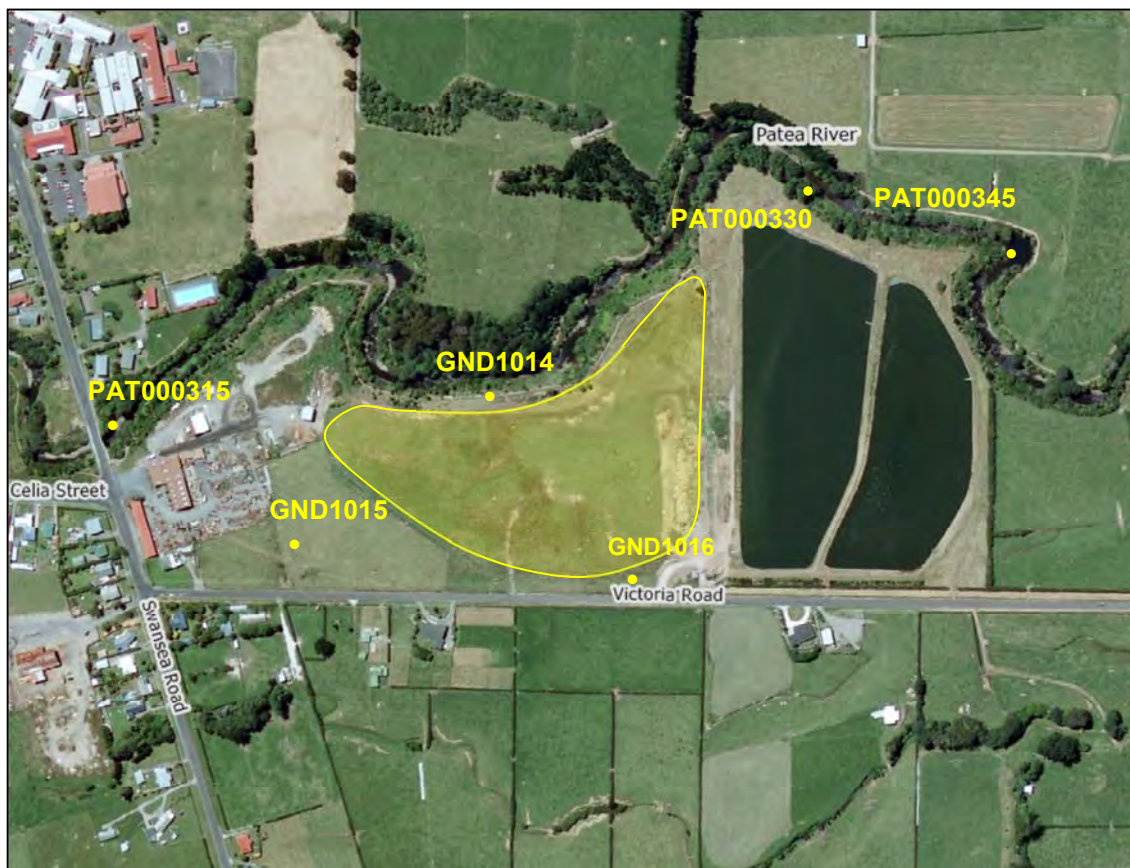


Figure 2 Stratford landfill (shaded in yellow) and sampling locations

<sup>2</sup> This consent was granted to provide for the remediation of a local sawmill site. The consent (7645-1) is held by Alby M Limited, and compliance monitoring of consent 7645-1 is not included in this report

## 2.2. Resource consent

### 2.2.1. Water discharge permit

SDC held consent 3889-2 to cover discharge of stormwater and leachate from Stratford municipal landfill into the Patea River. This permit was issued by the Council on 27 February 1998 under Section 87(e) of the RMA. This consent expired on 1 June 2010. As discharges were still occurring from the landfill, an abatement notice was issued and the consent holder subsequently re-applied for a consent. Consent **3889-3** was issued by the Council on 6 December 2010. It is due to expire on 1 June 2028, with provision for review of the conditions of the consent in June 2022.

Condition 1 requires that the consent holder adopt best practical option to minimise effects.

Condition 2 requires the preparation and maintenance of a Contingency and Landfill Maintenance Plan.

Condition 3 requires SDC to maintain certain structures at the site.

Condition 4 states that the discharge shall not reduce in-stream water quality after a specified mixing zone.

Condition 5 is a review provision.

The permit is attached to this report in Appendix I.

## 2.3. Results

### 2.3.1. Inspections

1 September 2016

The inspection was conducted in overcast weather with a light wind. The cap was intact and well-grassed. It was only damp underfoot and although it showed signs of recent grazing, there was no pugging noted. No slumping or cracking was observed. There was some minor localised ponding (approx. 1m x 2m) was found next to piles of clean clay on the cap (Photo 1).



The inspecting officer was informed that the clay was to be used for recontouring to prevent further ponding. The batters were intact and showed no signs of stock erosion. There was no cracking, slumping, or exposed refuse noted on the batters.

The stormwater drains were not well-defined, but showed no signs of overflow. The drains were dry following recent fine weather, and there were no obstructions to flow.

Fencing on the site was permanent and intact, with good access available to all sampling sites. The water troughs on the cap were tidy and in good condition, with no sign of overflows or ponding around them. No odour or dust issues were noted.

SDC were informed that groundwater samples were collected from all three bores.

Photo 1 Recontouring material and ponding on cap, 01 Sept 2016

19 April 2017

The inspection was conducted in overcast weather with a moderate wind. The cap and batters were intact and well-grassed with no evidence of stock damage, cracking or exposed refuse. Localised ponding was observed next to piles of clean clay on the cap, following recent heavy rain. Water troughs on the cap were full, with no signs of overflow or ponding.

The stormwater drains were fully grassed and free-flowing. No ponding or evidence of overflows were apparent following the most recent storm event in the previous week.

Fencing on the site was intact and permanent. No recent stock grazing had taken place, and the site was unoccupied at the time of inspection. No odour or dust issues were found.

SDC were informed that groundwater monitoring samples were collected from all three bores, and there were no issues with site access.

### 2.3.2. Groundwater

Groundwater samples were taken from monitoring bores up slope (GND1015 and GND1016) and down slope (GND1014) of the landfill on two occasions. The results from these samples are shown in Table 2 and Table 3.

As with the results from previous samples taken from these monitoring bores, the groundwater down gradient of the landfill (as represented by bore GND1014), shows some evidence of contamination from the landfill. The graphs of historical data given in Figures 3, 4 and 5 show how bore GND1014 is affected by landfill indicator species; ammoniacal nitrogen, chloride, and zinc. The graphs also show how the levels of chloride and ammonia are apt to fluctuate against the more stable background levels found in the two bores mid and up gradient from the filled area (more so in the case of chloride and ammoniacal nitrogen). Zinc is found to be higher in the down gradient bore but is also seen to fluctuate in the up gradient bores as well, which may indicate other local effects in the groundwater.

The area affected by the landfill indicator species consists of the narrow riparian strip between the landfill and the Patea River and the contaminated groundwater will eventually permeate through to the Patea River. The results of the monitoring of the Patea River, as discussed below, show that there is, at most, only negligible impact on Patea River water quality. This suggests that either the level of groundwater migration is not of sufficient volume to make any significant changes to the water quality of the Patea River, or that the groundwater contamination is being attenuated by its passage through the soil.

Table 2 Results of the Stratford landfill groundwater quality survey 1 September 2016

Parameter	Unit	GND1014 down- gradient	GND1015 up-gradient	GND1016 up-gradient
Alkalinity	g/m <sup>3</sup>	577	22	30
Dissolved arsenic	g/m <sup>3</sup>	<0.001	<0.001	<0.001
Chloride	g/m <sup>3</sup>	31.6	7.7	8.7
Filtered chemical oxygen demand	g/m <sup>3</sup>	43	<5	<5
Conductivity	mS/m	100	18	9.1

Parameter	Unit	GND1014 down- gradient	GND1015 up-gradient	GND1016 up-gradient
Dissolved chromium	g/m <sup>3</sup>	<0.03	<0.03	<0.03
Dissolved copper	g/m <sup>3</sup>	<0.001	0.001	0.002
Dissolved reactive phosphorus	g/m <sup>3</sup>	0.004	<0.003	0.004
Level	m	2.955	3.157	1.772
Unionised ammonia	g/m <sup>3</sup> -N	0.0693	<0.00001	<0.00001
Ammoniacal nitrogen	g/m <sup>3</sup> -N	56	0.008	0.008
Nitrate/nitrite nitrogen	g/m <sup>3</sup> -N	0.06	2.05	0.36
pH	pH	6.6	5.9	6.0
Temperature	Deg. C	14.2	13.6	12.0
Dissolved zinc	g/m <sup>3</sup>	<0.005	<0.005	0.008

Table 3 Results of the Stratford landfill groundwater quality survey, 19 April 2017

Parameter	Unit	GND1014 down-gradient	GND1015 up-gradient	GND1016 up-gradient
Alkalinity	g/m <sup>3</sup>	310	25	35
Dissolved arsenic	g/m <sup>3</sup>	0.001	<0.001	<0.001
Chloride	g/m <sup>3</sup>	7.73	8.17	7.44
Filtered chemical oxygen demand	g/m <sup>3</sup>	18	<5	<5
Conductivity	mS/m	53.2	10.1	9.9
Dissolved chromium	g/m <sup>3</sup>	<0.03	<0.03	<0.03
Dissolved copper	g/m <sup>3</sup>	<0.001	0.004	0.003
Dissolved reactive phosphorus	g/m <sup>3</sup>	0.003	0.003	<0.003
Level	m	3.488	2.500	1.657
Unionised ammonia	g/m <sup>3</sup> -N	0.0104	<0.00001	<0.00001
Ammoniacal nitrogen	g/m <sup>3</sup> -N	7.49	0.003	0.003



Parameter	Unit	GND1014 down-gradient	GND1015 up-gradient	GND1016 up-gradient
Nitrate/nitrite nitrogen	g/m <sup>3</sup> -N	0.02	2.53	0.30
pH	pH	6.6	6.3	6.0
Temperature	Deg. C	15.7	15.7	16.1
Dissolved zinc	g/m <sup>3</sup>	0.023	0.01	<0.005

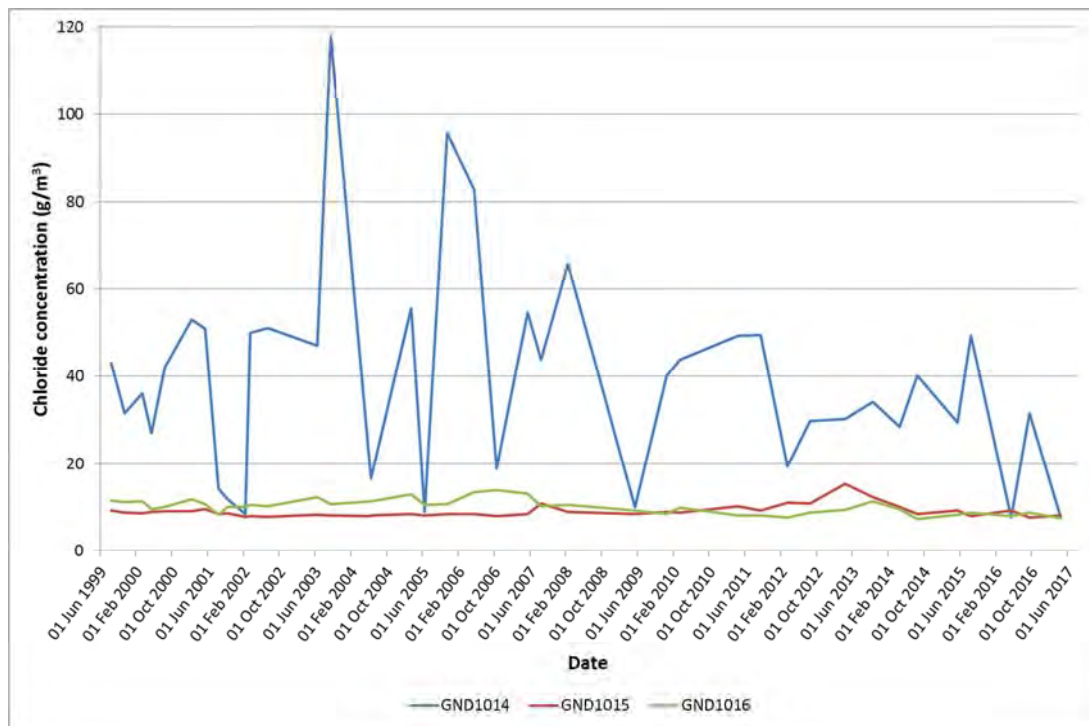


Figure 3 Graph showing chloride levels in the groundwater at the Stratford landfill

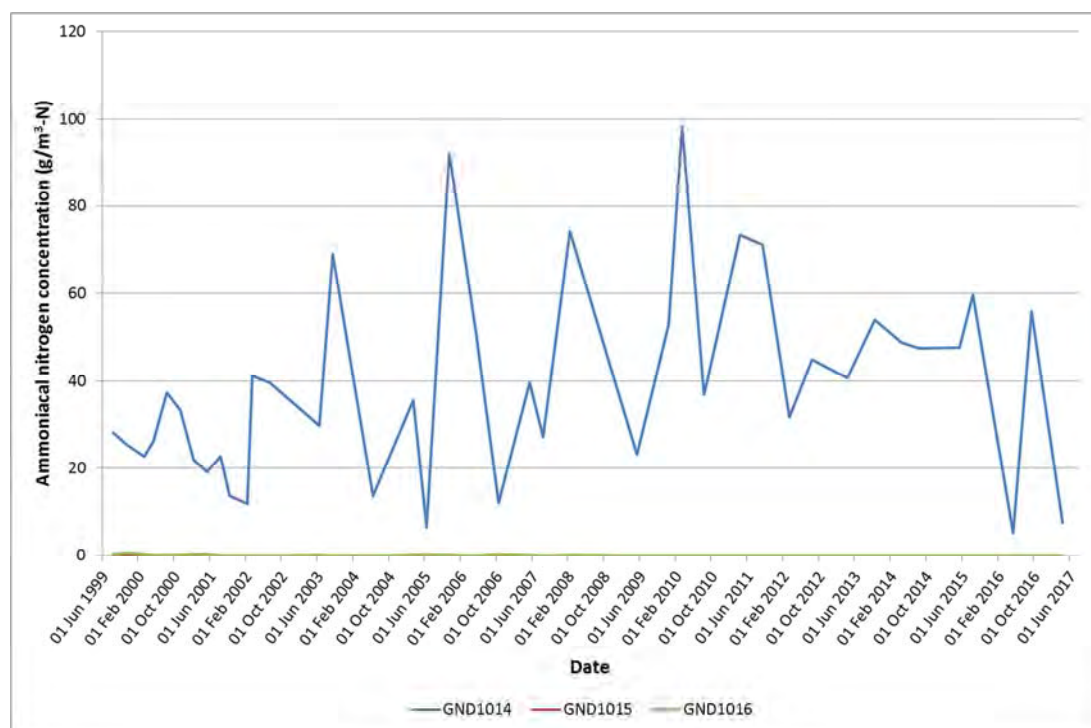


Figure 4 Graph showing ammoniacal nitrogen levels in the groundwater at the Stratford landfill

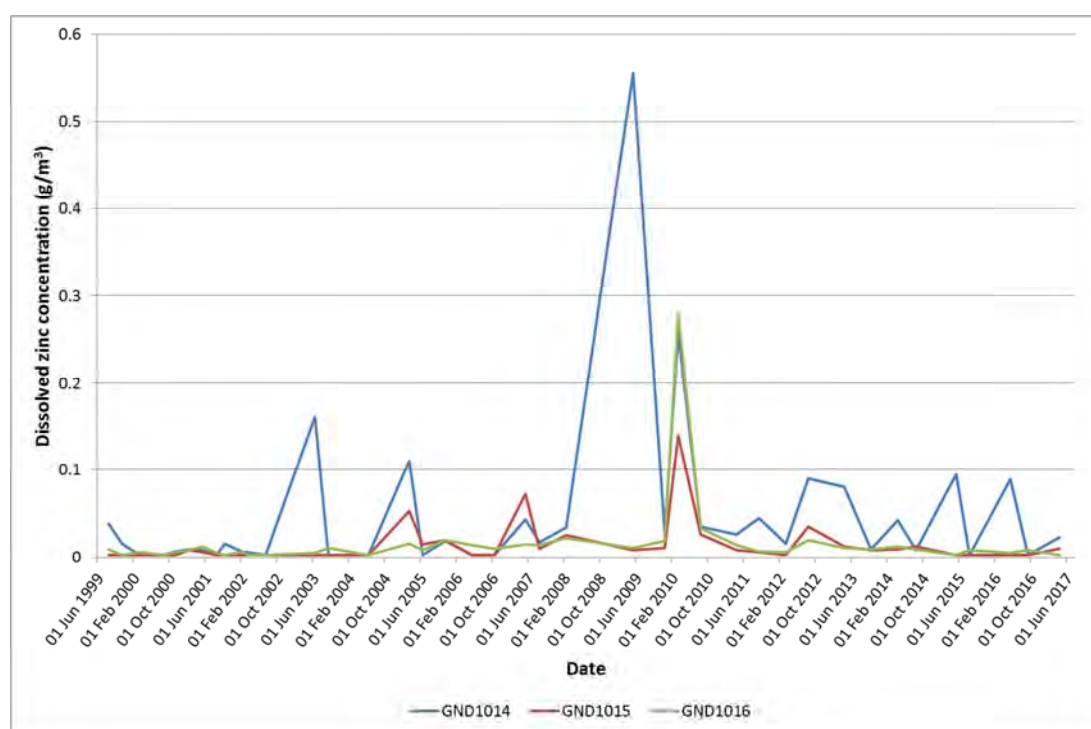


Figure 5 Graph showing dissolved zinc levels in the groundwater at the Stratford landfill

### 2.3.3. Surface waters

Samples were collected from the Patea River on 21 March 2017 and the results are set out in Table 4. This sampling was undertaken in conjunction with the monitoring of the Stratford waste water treatment plant (WWTP), which is discussed in a separate report.

It is noted that there is an increase in the faecal coliform counts in the stream between the upstream and downstream sites, with the value obtained for the downstream site (PAT000345) being above the “action” level given in the MfE Microbiological Water Quality Guidelines for contact recreation. However, it is considered that this increase was associated with municipal oxidation ponds rather than with the landfill. Although this monitoring site is within the mixing zone for the oxidation ponds, this was raised with the consent holder under that programme.

As with the results from previous monitoring periods, the results from this period indicate that the Stratford landfill had only a very minor, if not negligible, effect on the physicochemical water quality of the Patea River.

In relation to the parameters determined, there was no significant difference in the physicochemical water quality between the upstream and downstream sites. There was a slight rise in ammoniacal nitrogen; however, the level of unionised ammonia downstream of the landfill was well below the 0.025 g/m<sup>3</sup> guideline for the long term protection of aquatic ecosystems.

**Table 4 Results of the Stratford landfill water quality survey**

Parameter	Units	21 March 2017	
		Above landfill PAT000315	Below landfill PAT000345
Black disc transparency	m	3.13	3.70
Biochemical oxygen demand	g/m <sup>3</sup>	<0.5	<0.5
Filtered biochemical oxygen demand	g/m <sup>3</sup>	<0.5	<0.5
Cadmium (dissolved)	g/m <sup>3</sup>	<0.005	<0.005
Chloride	g/m <sup>3</sup>	8.6	8.9
Conductivity	mS/m	9.3	9.4
Chromium (dissolved)	g/m <sup>3</sup>	<0.03	<0.03
Dissolved oxygen	g/m <sup>3</sup>	10.2	10.2
Dissolved reactive phosphorus	g/m <sup>3</sup> -P	0.033	0.030
Faecal coliforms	/100ml	200	820
Unionised ammonia	g/m <sup>3</sup> -N	0.00009	0.00067
Ammoniacal nitrogen	g/m <sup>3</sup> -N	0.006	0.037
Nitrate/nitrite nitrogen	g/m <sup>3</sup> -N	0.78	0.80
pH	pH	7.7	7.8
Suspended solids	g/m <sup>3</sup>	<2	<2
Temperature	Deg.C	13.1	13.3
Turbidity	NTU	0.74	0.90
Dissolved zinc	g/m <sup>3</sup>	<0.005	<0.005

Figure 6 shows the ammoniacal nitrogen data gathered over the past 25 years. It is noted that, as the Stratford WWTP had an upgrade in 2009, the discharge point of the WWTP was moved and the sites used to monitor the downstream effects of the landfill have also changed. Monitoring at site PAT000330 ceased in March 2009, with monitoring continuing at site PAT000345, further downstream.

Whilst there is some separation between the site's locations, the graph indicates that a similar, stable, and modest rise in ammoniacal nitrogen has occurred in the Patea River as result of the landfill's presence. The highest level of ammoniacal nitrogen found downstream of the landfill since monitoring began was  $0.87 \text{ g/m}^3$  at site PAT000345, on 16 March 2005 (prior to the WWTP upgrade and not plotted in Figure 6). Under the pH and temperature conditions prevailing at the time of sampling, this ammoniacal nitrogen concentration would have resulted in an unionised ammonia concentration of  $0.014 \text{ g/m}^3$ , well below the  $0.025 \text{ g/m}^3$  unionised ammonia guideline used for the long term protection of aquatic ecosystems.

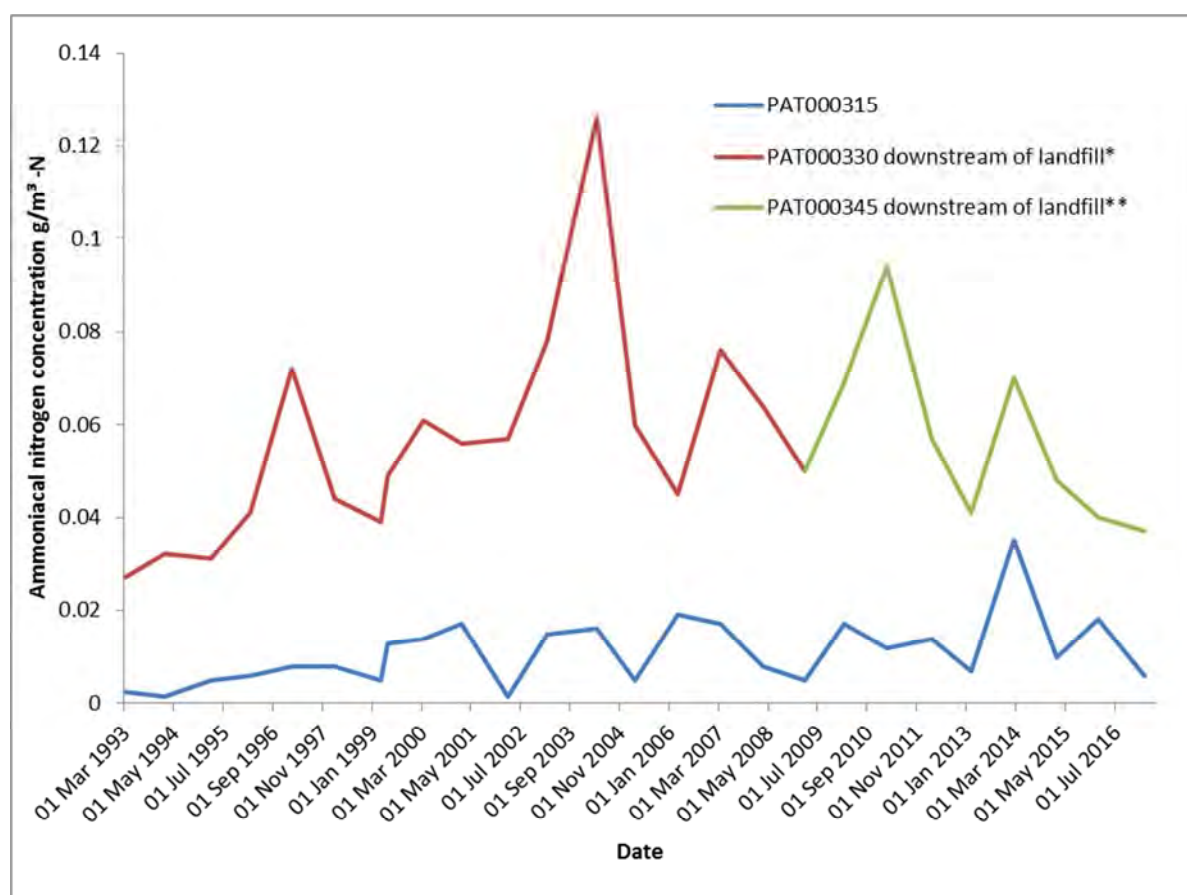


Figure 6 Graph showing ammoniacal nitrogen levels in the Patea Stream up and downstream of the landfill (where comparative data is available)

\*Downstream site prior to WWTP upgrade

\*\*Downstream site after WWTP upgrade

### 2.3.4. Biomonitoring

The Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Patea River on 22 March 2017. Samples were sorted and identified and the number of taxa (richness), MCI score, and SQMCI<sub>5</sub> score were calculated for each site. It is noted that although this monitoring is predominantly carried out for monitoring of the WWTP, it also provides information in relation to effects, if any, on the Patea River as a result of discharges from the former landfill.

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<sub>s</sub> 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<sub>s</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

Overall, the results indicate that there was a significant drop in macroinvertebrate health, towards the lower end of significance, between sites 2 and 3a, coincident with discharges from the Stratford WWTP. There was no evidence that leachate from the closed Stratford landfill site had negatively affected macroinvertebrate communities.

A copy of the full biomonitoring report is provided in Appendix II.

### 2.3.5. Investigations, interventions, and incidents

In the 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with conditions in the SDC' Stratford landfill resource consent or provisions in Regional Plans.

## 2.4. Discussion

### 2.4.1. Discussion of site performance

In terms of the management of the landfill, only a few minor issues were noted during the monitoring period. The site had good vegetative cover and the newly capped areas had stabilised. At the start of the 2014-2015 year, extra capping soil was added to cover the additional area that had been affected by cross contamination during the discharge of the CCA soils. As a result, the cap still required work in and around the crown of the east batter to ensure effective stormwater drainage. Although some work was undertaken during the 2014-2015 and 2015-2016 years to re-contour some areas of the cap, there was still one very small area where ponding was found during the year under review. At the time of the preparation of this report, the capping material was still present on site that, once the weather becomes drier, will be used to re-contour the areas affected by ponding.

### 2.4.2. Environmental effects of exercise of consents

Groundwater bore GND1014 continues to exhibit some signs of contamination, however surface water sampling and biomonitoring indicates that the discharge of groundwater was having no significant effect on the Patea River during the year under review. There was no evidence of odour or dust problems at the site during any inspection.

### 2.4.3. Evaluation of performance

A tabular summary of the SDC's compliance record for the year under review in regard to the Stratford landfill is set out in Table 5.

Table 5 Summary of performance for Consent 3889-3 (Stratford landfill)

Purpose: <i>To discharge leachate into land and into groundwater adjacent to the Patea River</i>		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt best practical option	Site specific monitoring programme – programme supervision	Some minor ponding requiring recontouring
2. Prepare a Contingency and Maintenance Plan	Site specific monitoring programme – programme supervision	Yes
3. Maintain landfill site	Site specific monitoring programme – inspection	Some minor ponding requiring recontouring
4. Effects beyond mixing zone	Water quality monitoring of the Patea River upstream and downstream of the landfill	Yes
5. Optional review	Provision for review June 2016	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b> <b>Good</b>
Overall assessment of administrative performance in respect of this consent		

N/A = not applicable

During the year, SDC demonstrated a high level of environmental performance and good level of administrative performance with the Stratford landfill resource consent as defined in Section 1.1.5. As with the 2015-2016 year, there was some minor ponding occurring on the site and some recontoring is needed to ensure that all areas of the cap remain free draining.

### 2.4.4. Recommendation from the 2015-2016 Annual Report

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

1. THAT monitoring of the consented activities at the Stratford landfill in the 2016-2017 year continues at the same level as in 2015-2016 period.

The monitoring programme was implemented as recommended.

### 2.4.5. Alterations to monitoring programmes for 2017-2018

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;
- its obligations to monitor emissions and discharges and their effects under the RMA; and
- to report to the regional community.

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

It is proposed that for 2017-2018, the monitoring programme remains unchanged.

A recommendation to this effect is presented in Section 2.5 of this report, and summary of recommendations is given in Section 5.

## 2.5. Recommendation

1. THAT monitoring of the consented activities at the Stratford landfill in the 2017-2018 year continues at the same level as in 2016-2017 period.



### 3. Huiroa landfill

#### 3.1. Process description

The Huiroa landfill is sited within an elbow of Douglas Road. The dump was an uncontrolled roadside landfill used by local residents to dispose of domestic waste. The site was closed in 1991 and reinstated by SDC.

This closed landfill is monitored on a triennial basis, with inspections and sampling due next in 2017-2018. The location of the landfill and monitoring sites are shown in Figure 7.



Figure 7 Huiroa landfill and approximate sampling locations



## 3.2. Resource consent

### 3.2.1. Water discharge permit

SDC holds water discharge permit **3890-3** to cover discharge of stormwater and leachate from the former Huiroa landfill into an unnamed tributary of the Makuri Stream. This permit was issued by the Council on 16 June 2016 under Section 87(e) of the RMA. Is due to expire on 1 June 2034.

Condition 1 requires that SDC adopts the best practicable option at the site.

Condition 2 requires SDC to maintain stormwater and leachate drains on the site to minimise stormwater infiltration and ensure adequate diversion away from the cap.

Condition 3 requires that the site is managed in accordance with a "Management Plan" that is to be provided within three months of the granting of the consent.

Conditions 4 and 5 state that discharges from the site shall not cause detrimental effects on water quality or aquatic life of the Makuri Stream, and include specific limits for unionised ammonia, ammoniacal nitrogen, pH and dissolved zinc.

Condition 6 is a review condition.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent which is appended to this report (Appendix I).

## 3.3. Results

The closed landfill at Huiroa is monitored on a triennial basis. Monitoring is next scheduled for the 2017-2018 year. No inspections or sampling were undertaken during the year under review.

### 3.3.1. Investigations, interventions, and incidents

In the 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with conditions in SDC's Huiroa landfill resource consent or provisions in Regional Plans.

## 3.4. Discussion

### 3.4.1. Evaluation of performance

A tabular summary of SDC's compliance record for the Huiroa landfill during the period under review is set out in Table 6.

Table 6 Summary of performance for Consent 3890-3 (Huiroa)

Purpose: <i>To discharge stormwater and leachate from the former Huiroa landfill onto and into land in the vicinity of an unnamed tributary of the Makuri Stream</i>		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adoption of best practicable option	Not monitored during this period	Not assessed
2. Maintenance of cap and drainage systems	Not monitored during this period	Not assessed

<b>Purpose: To discharge stormwater and leachate from the former Huiroa landfill onto and into land in the vicinity of an unnamed tributary of the Makuri Stream</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
3. Site to be operated in accordance with a 'Management Plan' that is to be within three months of granting of consent	Plan provided September 2016	Yes
4. Component concentration limits on water quality after mixing	Not monitored during this period	Not assessed
5. General water quality after mixing	Not monitored during this period	Not assessed
6. Optional review	Next opportunity for review June 2022	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>N/A</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

N/A = not applicable

During the year, the environmental performance was not assessed in relation to SDC's Huiroa landfill resource consent. Their administrative performance was high.

### 3.4.2. Recommendation from the 2015-2016 Annual Report

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

1. THAT, in the 2016-2017 year, the triennial monitoring for the Huiroa landfill remains unchanged, and it be noted that the monitoring is next scheduled to be implemented in the 2017-2018 period.

The monitoring programme was implemented as recommended.

### 3.4.3. Alterations to monitoring programmes for 2017-2018

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;
- its obligations to monitor emissions and discharges and their effects under the RMA; and
- to report to the regional community.

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

It is proposed that for 2017-2018, the monitoring remains unchanged, with the scheduled monitoring being undertaken in the 2017-2018 as programmed.

A recommendation to this effect is presented in Section 3.5 of this report, and summary of recommendations is given in Section 5.

### 3.5. Recommendation

1. THAT, in the 2017-2018 year, the triennial monitoring for the Huiroa landfill remains unchanged, and that the monitoring be implemented in the 2017-2018 period as scheduled.

## 4. Pukengahu landfill

### 4.1. Process description

The site is situated in a small gully off Wingrove Road (Figure 8). At the base of the gully is a small wetland area, which is fed by a spring that is culverted beneath the road and feeds into a small unnamed stream. The dump was unmanaged but was mostly used for the discharge of domestic waste by local residents. The landfill closed in 1991 and the site was reinstated by SDC. It is monitored on a triennial basis, with inspections and sampling undertaken during the period under review.

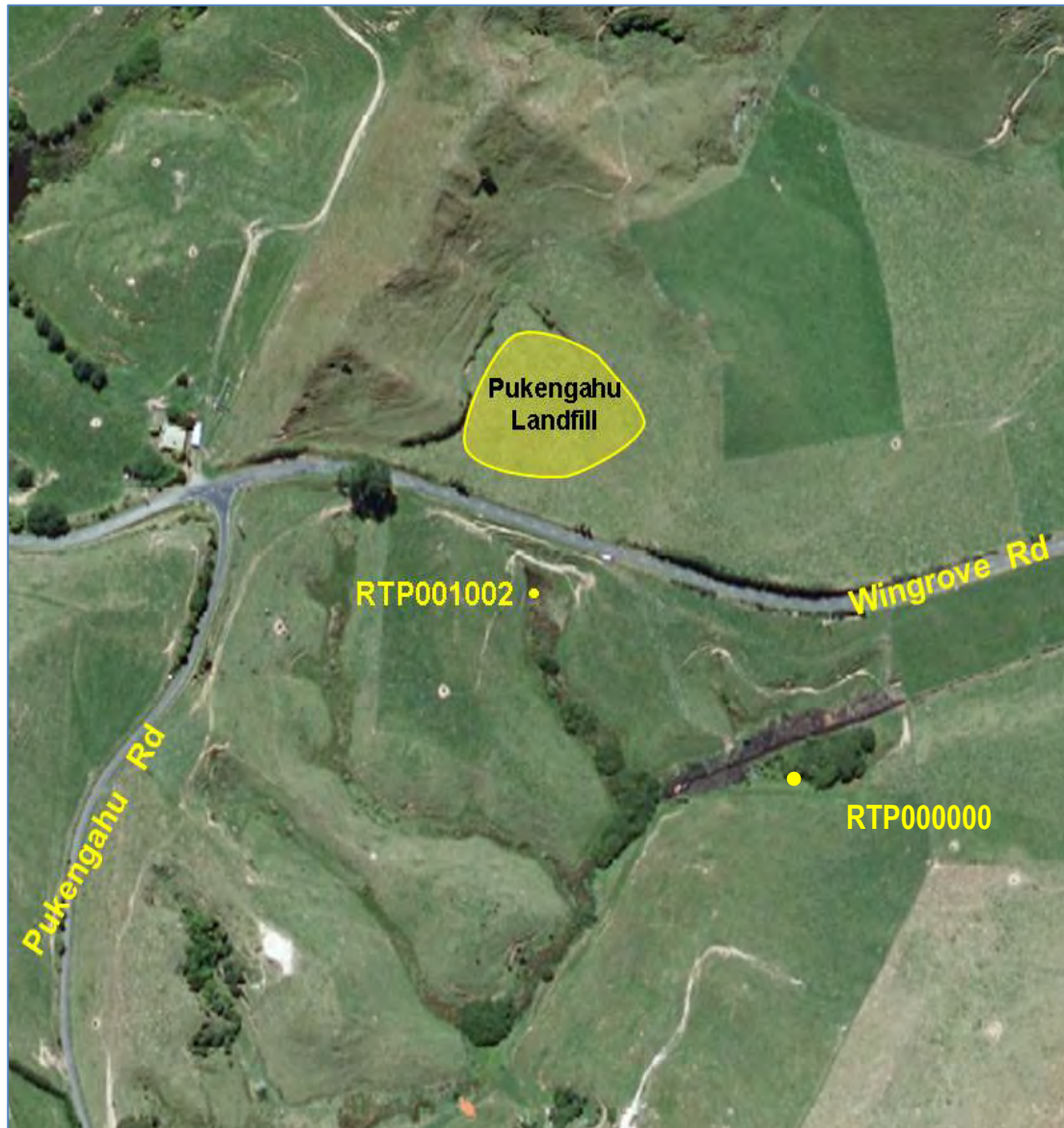


Figure 8 Pukengahu landfill and approximate sampling locations

## 4.2. Resource consent

### 4.2.1. Water discharge permit

SDC holds water discharge permit **3891-2** to cover the discharge of stormwater and leachate from the former Pukengahu landfill into an unnamed tributary of the Waihapa Stream. This permit was issued by the Council on 16 June 2016 under Section 87(e) of the RMA. It is due to expire on 1 June 2034.

Condition 1 requires that SDC adopts the best practicable option at the site.

Condition 2 requires SDC to maintain stormwater and leachate drains on the site to minimise stormwater infiltration and ensure adequate diversion away from the cap.

Condition 3 requires that the site is managed in accordance with a "Management Plan" that is to be provided within three months of the granting of the consent.

Conditions 4 and 5 state that discharges from the site shall not cause detrimental effects on water quality or aquatic life of the Makuri Stream, and include specific limits for unionised ammonia, ammoniacal nitrogen, pH and dissolved zinc.

Condition 6 is a review condition.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent which is appended to this report (Appendix I).

## 4.3. Results

The closed landfill at Pukengahu is monitored on a triennial basis. Monitoring is next scheduled for the 2017-2018 year. No inspections or sampling were undertaken during the year under review.

### 4.3.1. Investigations, interventions, and incidents

In the 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with conditions in SDC's Pukengahu landfill resource consent or provisions in Regional Plans.

## 4.4. Discussion

### 4.4.1. Evaluation of performance

A tabular summary of SDC's compliance record for the Pukengahu landfill during the period under review is set out in Table 7.

**Table 7 Summary of performance for Consent 3890-2 (Pukengahu)**

<b>Purpose: To discharge stormwater and leachate from the former Pukengahu landfill into an unnamed tributary of the Waihapa Stream</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Adoption of best practicable option	Not monitored during this period	Not assessed
2. Maintenance of cap and drainage systems	Not monitored during this period	Not assessed

<b>Purpose: To discharge stormwater and leachate from the former Pukengahu landfill into an unnamed tributary of the Waihapa Stream</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
3. Site to be operated in accordance with a 'Management Plan' that is to be within three months of granting of consent	Plan provided in September 2016	Yes
4. Component concentration limits on water quality after mixing	Not monitored during this period	Not assessed
5. General water quality after mixing	Not monitored during this period	Not assessed
6. Optional review	Next opportunity for review June 2022	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>N/A</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

N/A = not applicable

During the year, the environmental performance was not assessed in relation to SDC's Pukengahu landfill resource consent. Their administrative performance was high.

#### 4.4.2. Recommendation from the 2015-2016 Annual Report

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

THAT, in the 2016-2017 year, the triennial monitoring for the Pukengahu landfill remains unchanged, and it be noted that the monitoring is next scheduled to be implemented in the 2017-2018 period.

The monitoring programme was implemented as recommended.

#### 4.4.3. Alterations to monitoring programmes for 2017-2018

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;
- its obligations to monitor emissions and discharges and their effects under the RMA; and
- to report to the regional community.

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

It is proposed that for 2017-2018, the monitoring remains unchanged, with the scheduled monitoring being undertaken in the 2017-2018 as programmed.

A recommendation to this effect is presented in Section 4.5 of this report, and summary of recommendations is given in Section 5.

#### 4.5. Recommendation

1. THAT, in the 2017-2018 year, the triennial monitoring for the Pukengahu landfill remains unchanged, and that the monitoring be implemented in the 2017-2018 period as scheduled.

## 5. Summary of recommendations

1. THAT monitoring of the consented activities at the Stratford landfill in the 2017-2018 year continues at the same level as in 2016-2017 period.
2. THAT, in the 2017-2018 year, the triennial monitoring for the Huiroa landfill remains unchanged, and that the monitoring be implemented in the 2017-2018 period as scheduled.
3. THAT, in the 2017-2018 year, the triennial monitoring for the Pukengahu landfill remains unchanged, and that the monitoring be implemented in the 2017-2018 period as scheduled.



## Glossary of common terms and abbreviations

The following abbreviations and terms that may have been used within this report:

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m <sup>3</sup>	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.
L/s	Litres per second.
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 <sub>4</sub>	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH <sub>3</sub>	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO <sub>3</sub>	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (for example hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<i>Resource Management Act 1991</i> and subsequent amendments.
SQMCI	Semi quantitative macroinvertebrate community index.
SS	Suspended solids.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
Zn*	Zinc.

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

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

## Bibliography and references

- Taranaki Regional Council (1992): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1991-92*, Technical Report 92-16
- Taranaki Regional Council (1993): *Stratford District Council, Stratford, Pukengahu and Huiroa Landfills Air and Water Monitoring Programmes Annual Report 1992-93*, Technical Report 93-35
- Taranaki Regional Council (1994): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1993-94*, Technical Report 94-10
- Taranaki Regional Council (1995): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1994-95*, Technical Report 95-2
- Taranaki Regional Council (1996): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1995-96*, Technical Report 96-22
- Taranaki Regional Council (1997): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1996-97*, Technical Report 97-09
- Taranaki Regional Council (1998): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1997-98*, Technical Report 98-10
- Taranaki Regional Council (1999): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1998-99*, Technical Report 99-07
- Taranaki Regional Council (2000): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 1999-00*, Technical Report 00-08
- Taranaki Regional Council (2001): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2000-01*, Technical Report 01-37
- Taranaki Regional Council (2002): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2001-02*, Technical Report 02-10
- Taranaki Regional Council (2003): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2002-03*, Technical Report 03-40
- Taranaki Regional Council (2004): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2003-04*, Technical Report 04-42
- Taranaki Regional Council (2005): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2004-05*, Technical Report 05-06
- Taranaki Regional Council (2007): *Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2005-07*, Technical Report 07-105
- Taranaki Regional Council (2009): *Stratford District Council Landfills Annual Report 2007-09*, Technical Report 09-46
- Taranaki Regional Council (2010): *Stratford District Council Landfills Annual Report 2009-10*, Technical Report 10-68
- Taranaki Regional Council (2011): *Stratford District Council Landfills Annual Report 2010-11*, Technical Report 10-21
- Taranaki Regional Council (2012): *Stratford District Council Landfills Annual Report 2011-12*, Technical Report 12-22

Taranaki Regional Council (2013): *Stratford District Council Landfills Annual Report 2012-13*, Technical Report 13-44

Taranaki Regional Council (2014): *Stratford District Council Landfills Annual Report 2013-14*, Technical Report 14-62

Taranaki Regional Council (2016): *Stratford District Council Landfills Annual Report 2014-15*, Technical Report 15-59

Taranaki Regional Council (2016): *Stratford District Council Landfills Annual Report 2015-16*, Technical Report 16-71

## Appendix I

### Resource consents held by Stratford District Council

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



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

Name of  
Consent Holder:           Stratford District Council  
                                     P O Box 320  
                                     STRATFORD 4352

Decision Date:             6 December 2010

Commencement  
Date:                       6 December 2010

**Conditions of Consent**

Consent Granted:        To discharge leachate into land and into groundwater  
                                 adjacent to the Patea River at or about (NZTM)  
                                 1712119E-5644346N

Expiry Date:             1 June 2028

Review Date(s):         June 2016, June 2022

Site Location:           Swansea Road, Stratford

Legal Description:       Lots 5-6 DP Pt Lot 4 DP 1942 Lot 2 DP 11213 Blk II  
                                 Ngaere SD [Discharge source & site]

Catchment:               Patea

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

**General condition**

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

**Special conditions**

1. The consent holder shall at all time adopt the best practical option as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.
2. Before 31 March 2011 the consent holder shall submit a Landfill Maintenance and Contingency Plan to the satisfaction to the Chief Executive of the Taranaki Regional Council that;
  - a) sets out the requirements and scheduling for the maintenance of the landfill cap;
  - b) identifies all other structures on the site [drains, stock watering troughs, and groundwater bores etc] that require ongoing maintenance and sets out requirements and scheduling for their maintenance;
  - c) outlines the proposed responses to inadvertent exposure of refuse, significant cap disturbance, and leachate breakouts; and
  - d) provides a list of contact details for all appropriate staff and agencies to be contacted during an emergency at the site.
3. In addition to adhering to the Landfill Maintenance and Contingency Plan as required by condition 2, the consent holder shall at all times take all reasonable steps to ensure;
  - a) that the cap is contoured is maintained in a manner that prevents ponding, stormwater infiltration and minimises leachate production;
  - b) that the cap retains a reasonable cover of appropriate vegetation;
  - c) that any stock water troughs on the site are maintained to ensure that they do not leak or overflow;
  - d) that any existing drains or other diversion structures are kept clear and functional; and
  - e) that the cap depth is maintained to the original specifications as set out in the Swansea Street Sanitary Landfill Management Plan of 1992.



4. That downstream of the discharge zone in the Patea River , beyond grid reference 1712256E-5644543N, the discharge shall not give rise to any of the following effects in the receiving waters of the Patea River:
  - a) the production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials;
  - 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 effects of aquatic life.
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 2016 and/or June 2022, 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 6 December 2010

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:                      Stratford District Council  
   PO Box 320  
   Stratford 4352

Decision Date:                      16 June 2016

Commencement Date:              16 June 2016

**Conditions of Consent**

Consent Granted:                      To discharge stormwater and leachate from the former  
   Huiroa landfill onto and into land in the vicinity of an  
   unnamed tributary of the Makuri Stream

Expiry Date:                          1 June 2034

Review Date(s):                      June 2022, June 2028

Site Location:                          Huiroa Landfill, Douglas Road, Huiroa

Grid Reference (NZTM)              1726881E-5653373N

Catchment:                              Patea

Tributary:                                Makuri

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

### **General condition**

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

### **Special conditions**

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.
2. The landfill cap and stormwater and leachate drainage systems shall be maintained in a manner that:
  - a) minimises stormwater infiltration into the filled area; and
  - b) ensures stormwater is adequately diverted and/or drained away from the landfill cap.
3. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder within 3 months of granting of this consent, and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site will be managed to achieve compliance with the conditions of this consent and shall include but not be limited to:
  - a) specifying the consent holders monitoring schedule for the site;
  - b) maintenance of the landfill cap to minimise ponding and stormwater infiltration;
  - c) maintenance and management of the stormwater drains on and around the landfill to ensure stormwater is adequately diverted and/or drained away from the landfill cap.
4. After reasonable mixing the receiving waters of the unnamed tributary of the Makuri Stream downstream of the discharge shall meet the following standards:
  - a) unionised ammonia concentration less than 0.025 g/m<sup>3</sup>;
  - b) ammoniacal nitrogen level concentration less than 0.9 g/m<sup>3</sup>;
  - c) pH within the range of 6.0 and 9.0; and
  - d) dissolved zinc concentration less than or equal to 0.05 g/m<sup>3</sup>.
5. The discharge shall not cause the following effects in the receiving waters of the unnamed tributary of the Makuri Stream;
  - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.

6. 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 2022 and/or June 2028 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 June 2016

For and on behalf of  
Taranaki Regional Council

---

A D McLay  
**Director - Resource Management**



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

Name of  
Consent Holder:                      Stratford District Council  
   PO Box 320  
   Stratford 4352

Decision Date:                      16 June 2016

Commencement Date:              16 June 2016

**Conditions of Consent**

Consent Granted:                      To discharge stormwater and leachate from the former  
   Pukengahu Landfill into an unnamed tributary of the  
   Waihapa Stream

Expiry Date:                          1 June 2034

Review Date(s):                      June 2022, June 2028

Site Location:                          Wingrove Road, Pukengahu

Grid Reference (NZTM)              1719066E-5639665N

Catchment:                              Patea

Tributary:                                Waihapa

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

### **General condition**

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

### **Special conditions**

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.
2. The landfill cap and stormwater and leachate drainage systems shall be maintained in a manner that:
  - a) minimises stormwater infiltration into the filled area; and
  - b) ensures stormwater is adequately diverted and/or drained away from the landfill cap.
3. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder within 3 months of granting of this consent, and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site will be managed to achieve compliance with the conditions of this consent and shall include but not be limited to:
  - a) specifying the consent holders monitoring schedule for the site;
  - b) maintenance of the landfill cap to minimise ponding and stormwater infiltration;
  - c) maintenance and management of the stormwater drains on and around the landfill to ensure stormwater is adequately diverted and/or drained away from the landfill cap.
4. After reasonable mixing the receiving waters downstream of the discharge shall meet the following standards:
  - a) unionised ammonia concentration less than 0.025 g/m<sup>3</sup>;
  - b) ammoniacal nitrogen level concentration less than 0.9 g/m<sup>3</sup>;
  - c) pH within the range of 6.0 and 9.0; and
  - d) dissolved zinc concentration less than or equal to 0.05 g/m<sup>3</sup>.
5. The discharge shall not cause the following effects in the receiving waters after reasonable mixing:
  - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.



## Consent 3891-3.0

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 2022 and/or June 2028 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 June 2016

For and on behalf of  
Taranaki Regional Council

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A D McLay  
**Director - Resource Management**



## Appendix II

### Biomonitoring report



To Technical Officer, Rae West  
From Scientific Officer, Darin Sutherland  
Doc No 1901402  
Report No DS071  
Date 19 July 2017

## Summer biomonitoring of the Patea River in relation to the Stratford District Council's upgraded Wastewater Treatment Plant, March 2017

### Introduction

The upgrading of the wastewater treatment plant (WWTP) completed in 2009, required by conditions attached to the renewed consent 0196 (TRC, 2013), has been the subject of an additional investigative assessment of the upgrade's effectiveness in terms of system performance and its impacts on the receiving waters of the Patea River. A component of the assessment included two spring biomonitoring surveys of the river specifically in association with the upgraded treatment system and relocated, improved outfall structure (some 600 m downstream of the sealed-off original outfall). The summer survey (CF486) performed soon after completion of the WWTP upgrade, and the subsequent spring, 2009 (CF491), scheduled summer, 2010 (CF501), spring, 2010 (CF517), and summer, 2011 (CF526) surveys completed the requisite assessments. Subsequently, summer surveys (including the current survey) have been requirements of scheduled monitoring programmes for compliance monitoring purposes.

### Methods

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from three established sites and one more recently established site (listed in Table 1 and illustrated in Figure 1 and Figure 2) in the Patea River, on 22 March 2017.

Table 1 Location of sampling sites in the Patea River

Site No	Site code	Grid reference	Location
1	PAT000315	E1711801 N5644382	Swansea Road bridge (upstream of landfill and oxidation ponds' discharge)
2	PAT000330	E1712403 N5644580	Upstream of WWTP discharge (and downstream of landfill)
3a	PAT000350	E1712956 N5644292	Approximately 130 m downstream of the WWTP new outfall
4	PAT000356	E1714497 N5645112	Approximately 1 km upstream of the Kahouri Stream confluence

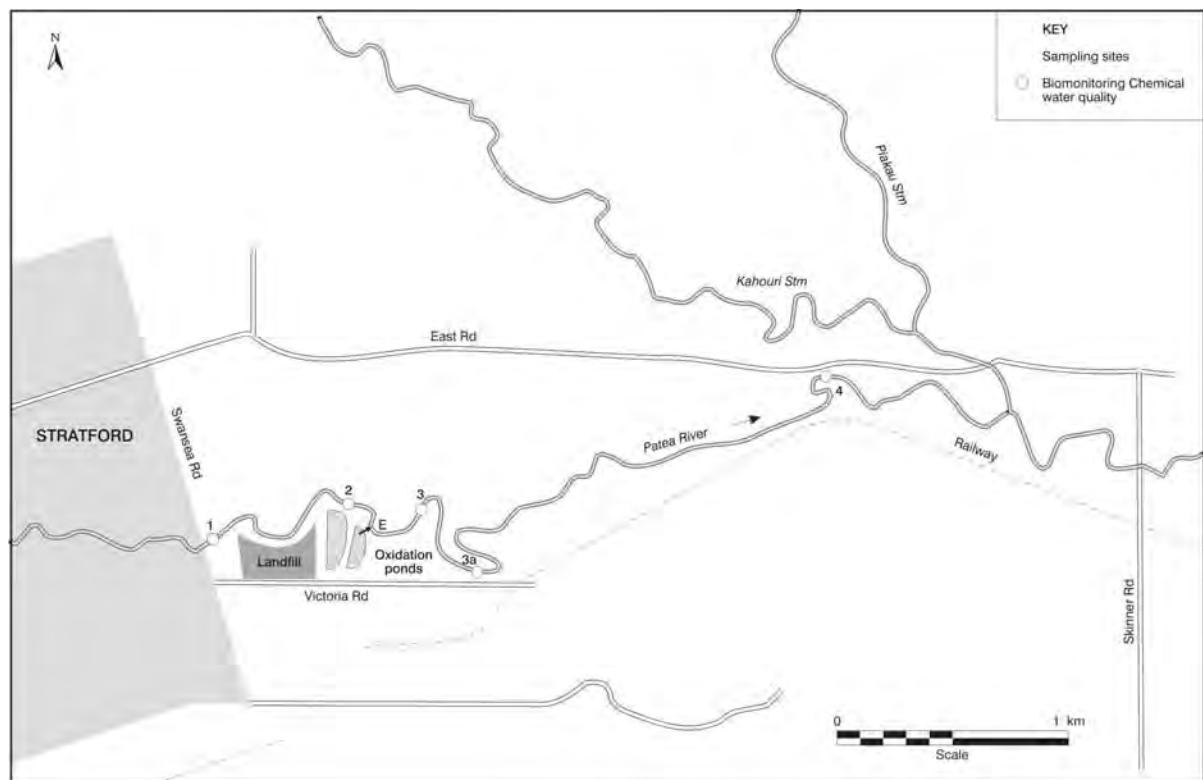


Figure 1 Biomonitoring sites in the Patea River in relation to Stratford landfill and oxidation ponds discharge

The upgrade to the WWTP system had included a new outfall (via rock rip-rap) to the river located a further 600m downstream of the original discharge point. The original site 3 was not required for the purpose of the current survey as no discharge from the sealed 'old' outfall was occurring at the time nor had any recent leakages occurred.

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 stereomicroscopic sorting and identification according to documented Taranaki Regional Council methodology and macroinvertebrate taxa abundances scored based on the categories in Table 2.

**Table 2** Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	500+

**Table 3** Macroinvertebrate health based on MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2015) from Stark's classification (Stark, 1985, Boothroyd and Stark, 2000, and Stark and Maxted, 2007)

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

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa collected from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution (Table 3). More 'sensitive' communities inhabit less polluted waterways. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

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 taken from the macroinvertebrate samples were scanned 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 or river.

## Results

### Site habitat characteristics and hydrology

This summer survey was performed under moderately low flow conditions (approximately half median flow), 9 days after a fresh in excess of 3 times median flow and 10 days after a fresh in excess of 7 times median flow in the Patea River (flow gauging site at the Patea River at Skinner Road). The survey followed a relatively wet spring period but during the last month was relatively dry with only one significant fresh recorded over the preceding month.

The water temperatures during the survey were in the range 14.5-15.9 °C. Water levels were low and water speed was swift. The water was uncoloured and clear. The substrate at all four sites comprised gravel/cobble/boulder.

Sites 1 and 3a had patchy algal mats, moss, and leaves. Sites 2 and 4 had slippery algal mats and patchy moss and leaves.

### Macroinvertebrate communities

A summary of the results of previous surveys is presented in Table 1.

**Table 4** Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between February 1985 and December 2016 and the current survey

Site No.	N	No of taxa			MCI value			SQMCI <sub>s</sub> value		
		Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	48	26	20-33	20	110	98-130	120	6.1	3.2-7.6	7.1
2	34	24	11-36	25	106	96-119	116	5.8	3.6-7.8	7.1
3a	10	24	21-29	25	101	95-113	99	5.7	3.4-7.1	6.2
4	44	23	17-31	22	99	82-116	99	4.1	2.3-7.2	6.2

Survey results since February 1986 are illustrated in Figure 2, while the results of the current survey are presented in Table 2 and discussed beneath.



Table 5 Macroinvertebrate fauna of the Patea River in relation to SDC WWTP discharge on the 22 March 2017

Taxa List	Site Number	MCI score	1	2	3a	4
	Site Code		PAT000315	PAT000330	PAT000350	PAT000356
	Sample Number		FWB17202	FWB17203	FWB17204	FWB17205
ANNELIDA (WORMS)	Oligochaeta	1	R	R	C	R
HIRUDINEA (LEECHES)	Hirudinea	3	-	-	R	-
MOLLUSCA	<i>Potamopyrgus</i>	4	R	-	-	-
CRUSTACEA	Cladocera	5	-	-	C	-
	Talitridae	5	-	-	R	-
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	C	-	C	R
	<i>Coloburiscus</i>	7	VA	VA	A	C
	<i>Deleatidium</i>	8	VA	XA	VA	VA
	<i>Nesameletus</i>	9	VA	VA	A	-
	<i>Zephlebia group</i>	7	R	-	-	R
PLECOPTERA (STONEFLIES)	<i>Zelandoperla</i>	8	R	R	-	R
COLEOPTERA (BEETLES)	Elmidae	6	A	A	A	C
	Hydraenidae	8	C	A	C	R
	Ptilodactylidae	8	-	R	-	-
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	A	A	C	C
TRICHOPTERA (CADDISFLIES)	<i>Hydropsyche (Aoteapsyche)</i>	4	VA	VA	A	A
	<i>Costachorema</i>	7	C	C	C	C
	<i>Hydrobiosis</i>	5	R	C	C	R
	<i>Neurochorema</i>	6	C	R	-	-
	<i>Beraeoptera</i>	8	VA	A	C	-
	<i>Confluens</i>	5	-	C	R	C
	<i>Helicopsyche</i>	10	-	R	-	-
	<i>Olinga</i>	9	-	C	-	-
	<i>Oxyethira</i>	2	-	-	-	R
	<i>Pycnocentroides</i>	5	C	A	A	C
	<i>Tripletides</i>	5	R	-	-	-
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	C	VA	C	R
	Eriopterini	5	-	R	-	-
	<i>Chironomus</i>	1	-	-	R	-
	<i>Maoridiamesa</i>	3	-	-	C	A
	Orthoclaadiinae	2	-	C	A	C
	Tanytarsini	3	-	R	C	C
	Empididae	3	-	R	-	R
	Ephydriidae	4	-	-	R	-
	Muscidae	3	R	R	C	R
	<i>Austrosimulium</i>	3	-	R	C	C
No of taxa			20	25	25	22
MCI			120	116	99	99
SQMCIs			7.1	7.1	6.2	6.2
EPT (taxa)			13	13	10	10
%EPT (taxa)			65	52	40	45
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa			

R = Rare

C = Common

A = Abundant

VA = Very Abundant

XA = Extremely Abundant

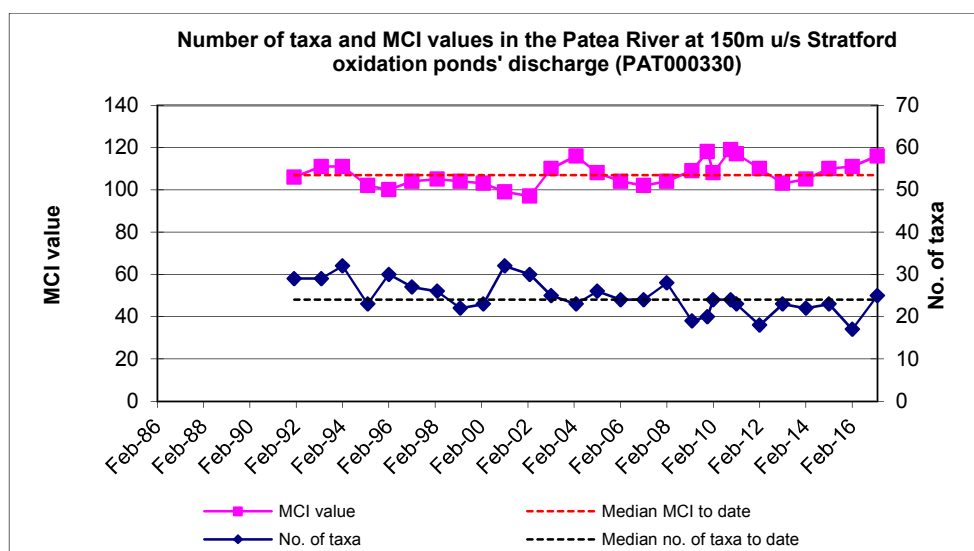
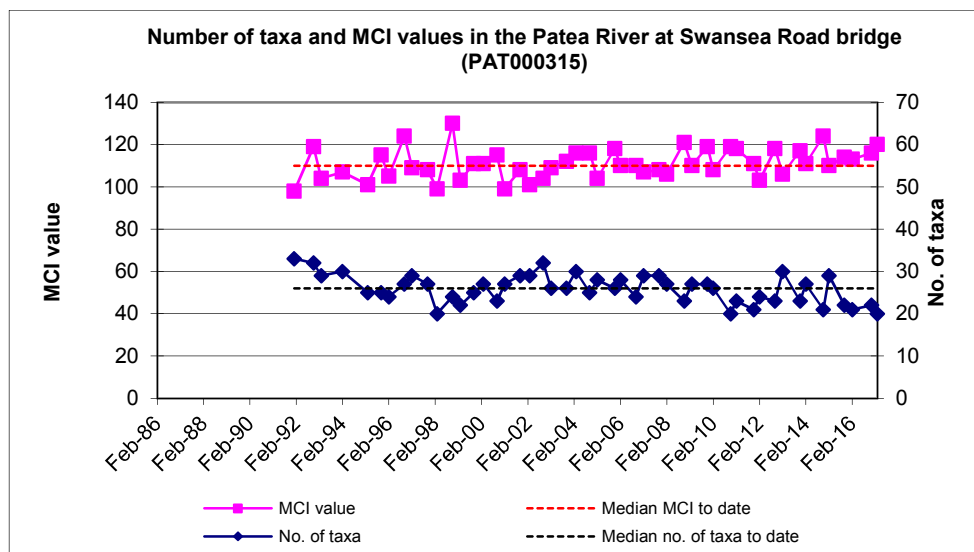


Figure 2 Taxa richness and MCI scores recorded to date at the Patea River sites upstream of the WWTP discharge

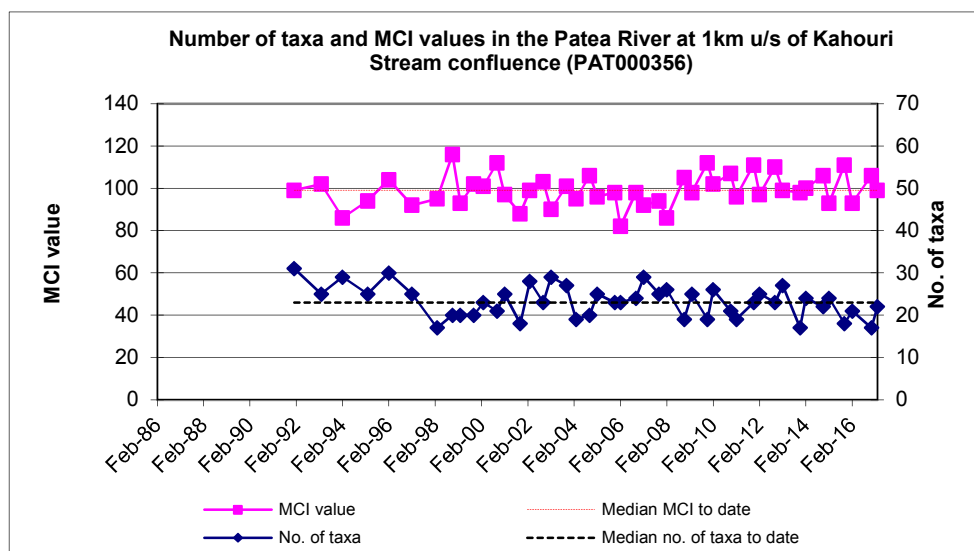
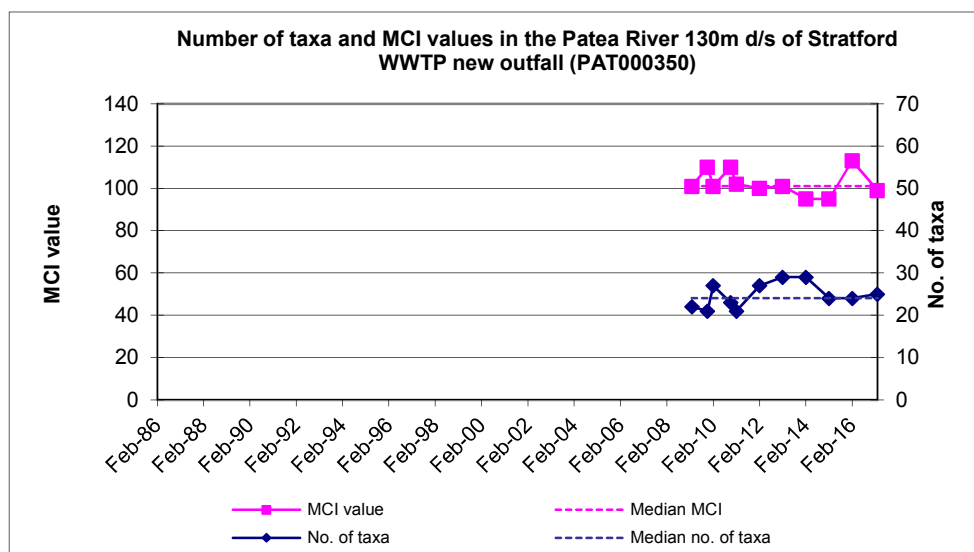


Figure 3 Taxa richness and MCI scores recorded to date at the Patea River sites downstream of the WWTP discharge

## Site 1 (Swansea Road)

A moderate macroinvertebrate community richness of 20 taxa was found at site 1 ('primary control' site) at the time of this summer survey (Table 1). This was five taxa more than the previous survey on December 2016 (22 taxa) and six taxa less than the historic median (26 taxa).

The MCI score of 120 units indicated a community of 'very good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 110 units and to the preceding survey on December 2016 (116 units).

The SQMCI<sub>s</sub> score of 7.1 units was significantly higher than the median SQMCI<sub>s</sub> score of 6.1 units (Table 1) but not significantly different to the preceding survey (7.6 units).

The community was dominated by one 'tolerant' taxon [caddisfly (*Hydropsyche/Aoteapsyche*)], three moderately sensitive taxa [mayfly (*Coloburiscus*), elmids beetles and dobsonfly (*Archichauliodes*)] and three 'highly sensitive' taxa [mayflies (*Deleatidium*) and (*Nesameletus*), and caddisfly (*Beraeoptera*)] (Table 5).

## Site 2 (upstream of original oxidation ponds outfall)

A moderately low macroinvertebrate community richness of 25 taxa was found at site 2 ('secondary control' site) at the time of the survey (Table 1). This was eight taxa more than the previous survey on December 2016 (17 taxa) and one taxon more than the historic median (24 taxa).

The MCI score of 116 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 106 units. The MCI score was very similar to the preceding survey on February 2016 (111 units).

The SQMCI<sub>s</sub> score of 7.1 units was significantly higher than the median SQMCI<sub>s</sub> score of 5.8 units (Table 1) but not significantly different to the preceding survey (6.9 units).

The community was dominated by one 'tolerant' taxon [caddisfly (*Hydropsyche/Aoteapsyche*)], five moderately sensitive taxa [mayfly (*Coloburiscus*), elmids beetles, dobsonfly (*Archichauliodes*), caddisfly (*Pycnocentroides*) and crane fly (*Aphrophila*)] and four 'highly sensitive' taxa [mayflies (*Deleatidium*) and (*Nesameletus*), beetle (*Hydraenidae*), and caddisfly (*Beraeoptera*)] (Table 5).

## Site 3a (130m downstream of new WWTP riprap outfall)

A moderate macroinvertebrate community richness of 25 taxa was found at site 3a ('primary impact' site) at the time of the survey (Table 1). This was one taxon more than the previous survey on February 2016 (24 taxa) and the historic median (24 taxa).

The MCI score of 99 units indicated a community of 'fair' biological health which was not significantly lower (Stark, 1998) than the median MCI score of 101 units. The MCI score was significantly lower than the preceding survey on February 2016 (113 units).

The SQMCI<sub>s</sub> score of 5.0 units was not significantly lower than the median SQMCI<sub>s</sub> score of 5.7 units (Table 1).

The community was dominated by two 'tolerant' taxa [caddisfly (*Hydropsyche/Aoteapsyche*) and midge (*Maoridiamesa*)], three moderately sensitive taxa [mayfly (*Coloburiscus*), elmids beetles, and caddisfly (*Pycnocentroides*)] and two 'highly sensitive' taxa [mayflies (*Deleatidium*) and (*Nesameletus*)] (Table 5).

## Site 4 (upstream of discharge at East Road)

A moderate macroinvertebrate community richness of 22 taxa was found at site 4 ('secondary impact' site) at the time of the survey (Table 4). This was five taxa more than the previous survey on December 2016 (17 taxa) and one taxon less than the historic median (23 taxa).

The MCI score of 99 units indicated a community of 'fair' biological health which was the same as the historic median MCI score of 99 units. The MCI score was not significantly lower than the preceding survey (106 units).

The SQMCI<sub>s</sub> score of 6.2 units was significantly higher than the median SQMCI<sub>s</sub> score of 4.1 units (Table 4) but not significantly different to the preceding survey (6.9 units).

The community was dominated by two 'tolerant' taxa [caddisfly (*Hydropsyche* – *Aoteapsyche*) and midge (*Maoridiamesa*)] and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

## Riverbed heterotrophic growth assessment

Microscopic assessment of material from the riverbed at the four sampling sites indicated that there were no unusual heterotrophic growths present in the river at the two upstream and two downstream sites. This was consistent with the visual absence of such growths noted at all sites at the time of the survey.

## Discussion and conclusions

Macroinvertebrate richnesses were moderate and similar to historical medians for all sites. Differences among sites were not particularly large (0-5 taxa). Often, nutrient enrichment can raise taxa numbers in rivers with relatively good water quality but there was no evidence of that for the current survey.

The MCI scores categorised site 1 as being in 'very good' health, site 2 as having 'good' health, and the two 'impact' sites (sites 3a and 4) as being of 'fair' health. MCI were either similar to or not significantly higher than historic medians for all sites. There was only a minor decrease of four units between sites 1 and 2 indicating the old landfill site was not having an affect on stream macroinvertebrate communities. However, there was a significant decrease in MCI score between sites 2 and 3 of 17 units coincident with the SDC WWTP discharge point. As both 'control' sites for the WWTP had similar MCI scores and were both significantly higher than the two 'impact' sites (sites 3a and 4) this gives further certainty that water quality as opposed to habitat differences was the main cause of the changes. It should be noted that Site 4, as mentioned in a previous report (DS059), is a considerable distance downstream of the discharge point and therefore is not located in a particularly useful site to detect minor or moderate effects of WWTP discharges.

SQMCI<sub>s</sub> scores were higher than historical medians for sites 1, 2 and 4 but not site 3a which had a slight, non-significant rise. Congruent with the MCI scores, there was a significant decrease in SQMCI<sub>s</sub> scores between sites 2 and 3a further indicating that there was a decrease in water quality between the two sites.

Microscopic assessment of material from the riverbed at the four sampling sites indicated that there were no unusual heterotrophic growths present in the river at the two upstream and two downstream 'impact' sites. This was consistent with the visual absence of such growths noted at all sites at the time of the survey. This indicates that there was no highly significant, persistent nutrient enrichment from the WWTP discharges. This is further emphasised by the lack of widespread periphyton at both 'impact' sites though recent freshes would also potentially reduce periphyton levels. Also, site 3a had high numbers of two 'highly sensitive' mayfly species. *Deleatidium* can sometimes be a poor indicator of water quality as some species within the genus have lower water quality preferences, *Nesameletus*, however, with a tolerance value of 9, is a more reliable indicator, and its abundance at site 3a suggests reasonable preceding water quality at the site.

Overall, the results indicate that preceding water quality in the upper Patea River was higher than average leading to healthier than normal macroinvertebrate communities at sites 1 and 2. However, there was a significant drop in macroinvertebrate health indicative of mild nutrient enrichment and towards the lower end of significance, between sites 2 and 3a, coincident with discharges from the Stratford WWTP. There was no evidence that leachate from the closed Stratford landfill site had negatively affected macroinvertebrate communities.

Recommendations that could improve the monitoring programme to allow stronger conclusions about potential affects include shifting site 4 or adding an additional site closer to the discharge point and given the size of the point source discharge spring monitoring would also be beneficial.

## Summary

The Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Patea River. Samples were sorted and identified and the number of taxa (richness), MCI score, and SQMCI<sub>s</sub> score were calculated 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<sub>s</sub> 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<sub>s</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The MCI scores categorised site 1 as being in 'very good' health, site 2 as having 'good' health, and the two 'impact' sites (sites 3a and 4) as being of 'fair' health. There was only a minor decrease of four units between sites 1 and 2 indicating the old landfill site was not having an affect on stream macroinvertebrate communities. However, there was a significant decrease in MCI and SQMCI<sub>s</sub> scores between sites 2 and 3 coincident with the SDC WWTP discharge point. As both 'control' sites for the WWTP had similar MCI and SQMCI<sub>s</sub> scores and were both significantly higher than the two 'impact' sites this gives further certainty that water quality, as opposed to habitat differences, was the main cause of the changes. However, there were no undesirable heterotrophic growths or abundant periphyton found on the substrate at the two downstream sites' indicating that water quality was not of poor quality.

Overall, the results indicate that there was a significant drop in macroinvertebrate health, towards the lower end of significance, between sites 2 and 3a, coincident with discharges from the Stratford WWTP. There was no evidence that leachate from the closed Stratford landfill site had negatively affected macroinvertebrate communities.

## References

- Fowles CR, 2015: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2015 (CF638).
- Fowles CR, 2014: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2014 (CF604).
- Fowles CR, 2013: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2013 (CF575).
- Fowles CR, 2012: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2012 (CF545).
- Fowles CR, 2011: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2011 (CF526).
- Fowles CR, 2010: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2010 (CF501).
- Fowles CR, 2010: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, November 2010 (CF517).
- Fowles CR, 2009: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, March 2009 (CF486).
- Fowles CR, 2009: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, November 2009 (CF491).
- Fowles CR, 2008: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2008 (CF440).

- Fowles CR, 2007: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2007 (CF420).
- Fowles CR, 2006: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2006 (CF399).
- Fowles CR, 2005: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2005 (CF359).
- Fowles CR, 2004: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, March 2004 (CF306).
- Fowles CR, 2003: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2003 (CF273).
- Fowles CR, 2002: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, March 2002 (CF250).
- Fowles CR, 2001: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, February 2001 (CF233).
- Fowles CR, 2000: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, March 2000 (CF214).
- Fowles CR, 1999: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, March 1999 (CF188).
- 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 ring plain streams. Stark Environmental Report 2009-01. 47p.
- Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron report No 472. 32pp.
- Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.
- Sutherland DL, 2016: Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and oxidation ponds' system, December 2016 (DS059).
- 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, 2014: Stratford District Council municipal oxidation ponds system monitoring programme Annual Report 2013-2014. TRC Technical Report 2014-14.

