Stratford District Council Landfills Monitoring Programme Annual Report 2017-2018

Technical Report 2018-68

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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[1] 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 undertaken as scheduled in the 2017-2018 year.

This report for the period July 2017 to June 2018 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess SDC's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of SDC's activities.

SDC holds three resource consents in association with these landfills, which include a total of 17 special conditions setting out the requirements that SDC must satisfy.

During the monitoring period, SDC demonstrated an overall good level of environmental performance.

The Council's monitoring programme for the year under review included four inspections and 10 water samples collected for physicochemical analysis. An additional follow-up inspection was carried out at the Stratford landfill due to noncompliance which was recorded at the first inspection of the year at this site.

The monitoring showed that, although there were no significant adverse effects occurring as a result of the exercise of any of SDC's landfill consents, the Stratford landfill was not being managed according to the site management plan resulting a number of noncompliant aspects. The contouring at the site and a poorly constructed drain that has been noted in the 2015-2017 years resulted in an increased amount of ponding during the year under review. There was also ponding due to an overflowing water trough, widespread minor stock damage and a small amount of leachate overflowing a drain to a public walkway. SDC undertook to carry out the necessary repairs, and no further issues were found during the year under review.

An improvement in the SDC's environmental and administrative performance is required in relation to the Stratford landfill..

During the year, the SDC demonstrated a high level of environmental and high level of administrative performance with both the Huiroa and Pukengahu landfill resource consents.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

[1] Consent 7645-1 Alby M Limited

In terms of overall environmental and compliance performance by the SDC over the last several years, this report shows that the consent holder's performance in relation to the Stratford landfill has deteriorated, but has remained at a high level for the Huiroa and Pukengahu sites in the year under review.

This report includes recommendations for the 2018-2019 year.

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1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2017 to June 2018 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. The Huiroa and Pukengahuu landfills are monitored on a triennial cycle, and during the year under review monitoring was undertaken at all three sites.

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 25th 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 though annual programmes;
- a summary of the landfill related resource consents held by SDC;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company's site/catchment.

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 2018-2019 monitoring year.

Section 5 presents the overall evaluation of SDC's performance in relation to their closed landfills.

Section 6 contains a summary of recommendations for the 2018-2019 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 and administrative 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 SDC's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

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

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

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

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

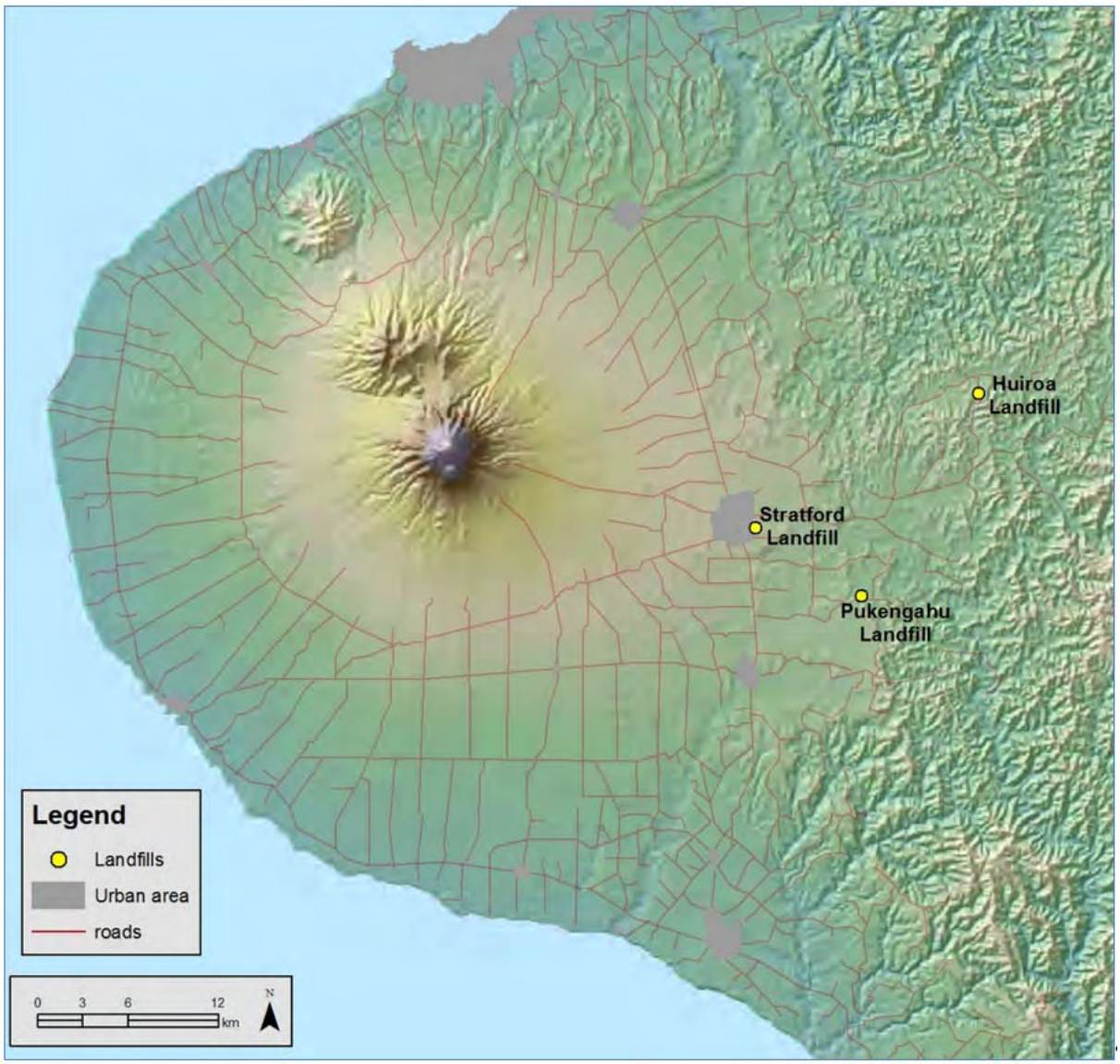

Figure 1 Regional map showing SDC landfill sites

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 undertaken 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 Huiroa and Pukengahu landfills were each inspected on one occasion.

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 at three sites on two occasions, and the samples were 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.

The leachate and downstream receiving waters waters (after reasonable mixing) were sampled at the Huiroa and Pukengahu sites. The samples were analysed for conductivity, acid soluble iron, pH and ammoniacal nitrogen 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[2] (under the supervision of SDC). This consent has been exercised. However, due to an excess of clean overburden, further re-contouring is required.

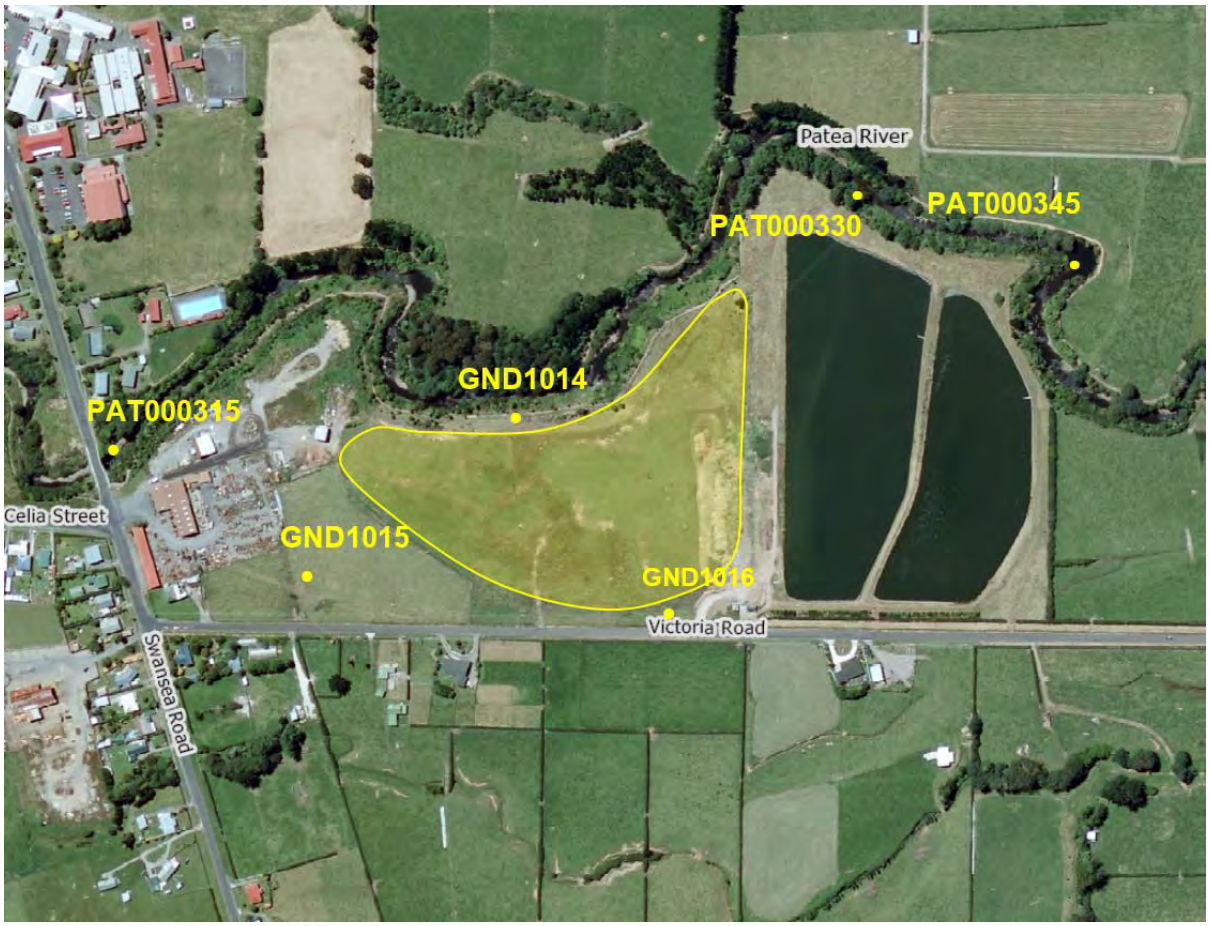

Figure 2 Stratford landfill (shaded in yellow) and sampling locations

[2] 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.

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 that is appended to this report.

2.3 Results

2.3.1 Inspections

25 August 2017

This inspection was conducted in fine weather with a light northerly wind. The cap was very damp, with minor ponding in multiple areas following heavy rain during the previous weeks. The most significant ponding was on the eastern border of the cap, approximately 5 m^2 in size, and up to 10 cm deep. The lack of vegetation in this area indicated that the ponding had been occurring for some time. Widespread minor vehicle and stock damage was noted on the cap and batters, but was mainly concentrated in the gateways. No slumping, cracking or exposed refuse was noted on either the cap or batters.

The stormwater drains were not well constructed, but showed no signs of ponding or recent flow. The leachate drains were mainly damp or dry, and showed signs of recent flow. The northern leachate drain was overflowing, discharging a small volume of leachate (approximately 0.5 L/s cumulative) at three points across the public walkway and into the Patea River. Ponding and a slight odour were detected on the walkway.

Fencing was intact and permanent. The cap was being grazed by a small number of young stock. Three of the four water troughs on the cap were full, and one was overflowing and causing localised ponding around the trough. The site was unoccupied, and no odour or dust issues were noted.

Due to the poor stock management that had resulted in widespread damage to the cap and batter, the overflowing water trough and significant ponding on the western edge of the cap, the consent holder was informed of the non-compliances with conditions 1 (best practicable option) and 3 (adherence to the management plan). This is discussed further in section 2.3.5.

23 April 2018

An inspection was conducted in overcast weather with a light south westerly wind. The cap was damp, with no ponding apparent. No vehicle and stock damage was noted on the cap and batters, and no sign of slumping, cracking or exposed refuse was found.

The stormwater drains showed no signs of ponding or recent flow. The leachate drains were damp, with minor ponding occurring in the northern drain following wet weather the previous day. The drains were not discharging at the time.

Fencing was intact and permanent. The cap was being grazed by a small number of young stock. None of the water troughs on the cap were overflowing. The previously ponded areas around each trough had been remediated with rough gravel and topsoil, and vegetation was re-establishing. The site was unoccupied, and no odour or dust issues were noted.

Groundwater samples were collected at the time of inspection.

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.

Table 2 Results of the Stratford landfill groundwater quality survey, 23 April 2018

Parameter	Unit	GND1014 down-gradient	GND1015 up-gradient	GND1016 up-gradient
Alkalinity	g/m^3	272	22	39
Dissolved arsenic	g/m^3	< 0.0010	< 0.0010	< 0.0010
Chloride	g/m^3	14.0	8.0	8.1
Filtered chemical oxygen demand	g/m^3	27	14	11
Conductivity @ 20 Deg. C	mS/m	51.7	9.2	10.7
Dissolved chromium	g/m^3	< 0.0005	< 0.0005	< 0.0005
Dissolved copper	g/m^3	< 0.0005	0.0105	0.0009
Dissolved reactive phosphorus	g/m^3	<0.003	<0.003	<0.003
Level	m	2.972	3.102	1.998
Unionised ammonia	g/m^3N	0.00979	<0.00001	<0.00001
Ammoniacal nitrogen	g/m^3-N	11.3	0.021	0.014
Nitrate/nitrite nitrogen	g/m^3-N	<0.01	2.05	0.21
pH	pH	6.4	6.0	6.0

Parameter	Unit	GND1014 down-gradient	GND1015 up-gradient	GND1016 up-gradient
Temperature	Deg. C	15.6	14.5	15.9
Dissolved zinc	g/m^3	< 0.0010	0.0024	0.0039

Table 3 Results of the Stratford landfill groundwater quality survey, 19 April 2018

Parameter	Unit	GND1014 down-gradient	GND1015 up-gradient	GND1016 up-gradient
Alkalinity	g/m^3	440	22	40
Dissolved arsenic	g/m^3	< 0.0010	< 0.0010	< 0.0010
Chloride	g/m^3	25	7.9	8.7
Filtered chemical oxygen demand	g/m^3	28	< 6	< 6
Conductivity @ 25 Deg. C	mS/m	89.3	25.8	10.7
Dissolved chromium	g/m^3	< 0.0005	< 0.0005	< 0.0005
Dissolved copper	g/m^3	< 0.0005	0.0088	0.0007
Dissolved reactive phosphorus	g/m^3	0.042	< 0.004	< 0.004
Level	m	3.115	3.303	1.905
Unionised ammonia	g/m^3	0.047	< 0.010	< 0.010
Ammoniacal nitrogen	g/m^3-N	46	< 0.010	< 0.010
Nitrate/nitrite nitrogen	g/m^3-N	0.021	1.94	0.07
pH	pH	6.5	7.8	6.4
Temperature	Deg. C	13.3	14.3	13.8
Dissolved zinc	g/m^3	0.0028	0.0031	0.0036

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.

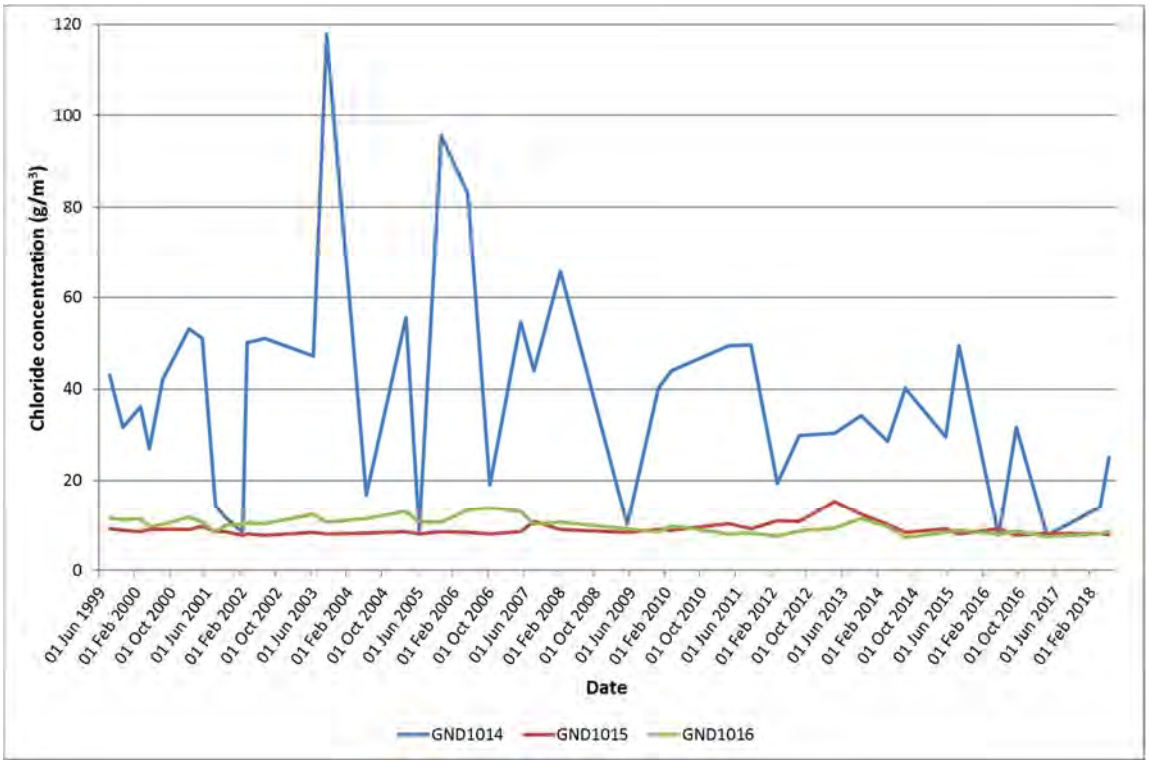

Figure 3 Graph showing chloride levels in the groundwater at the Stratford landfill

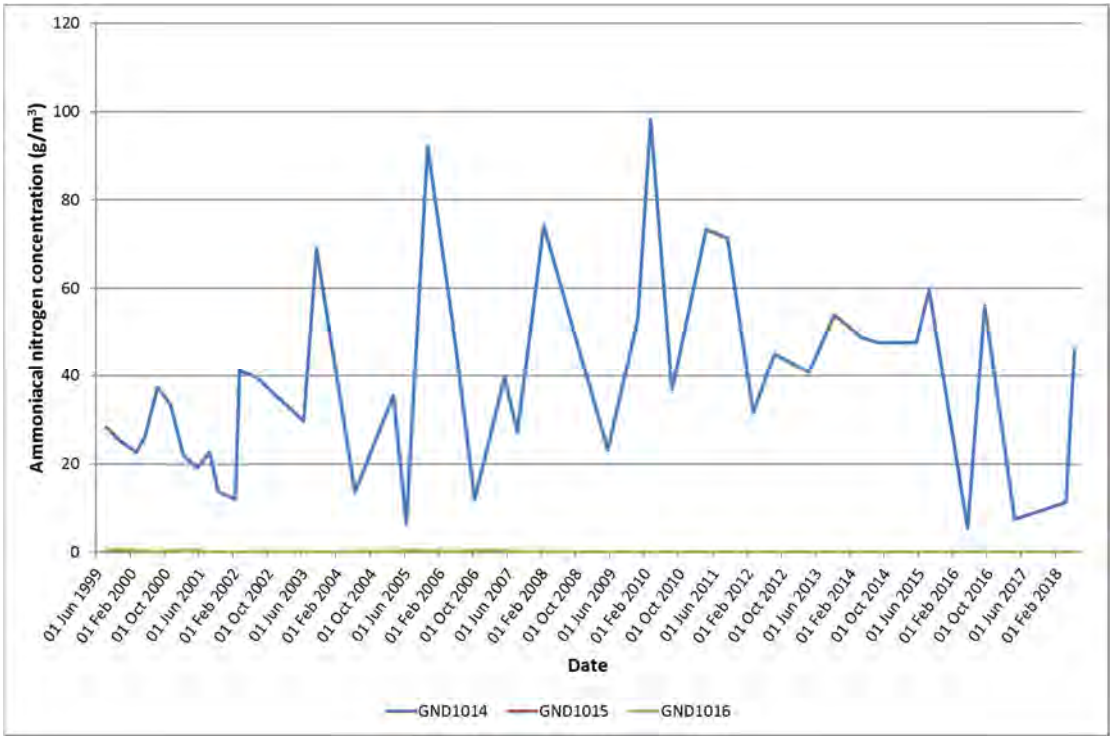

Figure 4 Graph showing ammoniacal nitrogen levels in the groundwater at the Stratford landfill

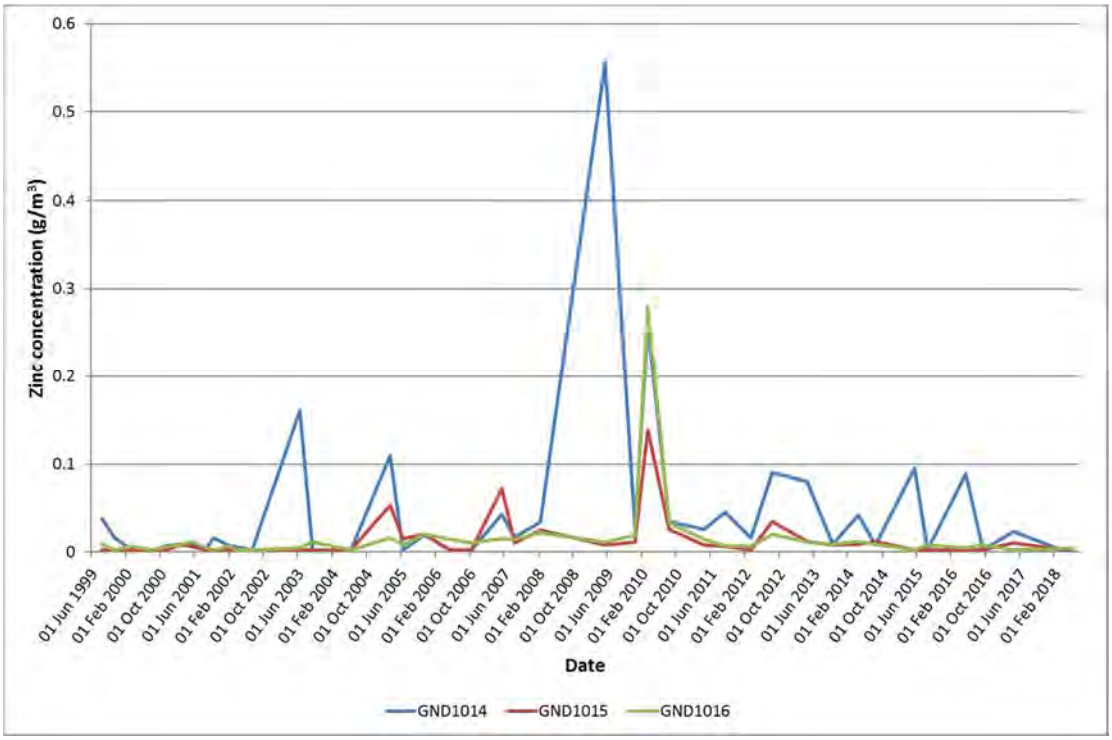

Figure 5 Graph showing dissolved zinc levels in the groundwater at the Stratford landfill

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.

2.3.3 Surface waters

Samples were collected from the Patea River on 5 March 2018 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 "alert" level given in the MfE Microbiological Water Quality Guidelines for contact recreation. However, it is considered that this increase was associated with municipal oxidations ponds rather than with the landfill. It is also noted that this monitoring site is within the mixing zone for the oxidation ponds.

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^3 guideline for the long term protection of aquatic ecosystems.

Table 4 Results of the Stratford landfill water quality survey

Parameter	Units	05 March 2018	
		Above landfill PAT000315	Below landfill and wastewater treatment pond outlet PAT000345
Black disc transparency	m	2.63	2.62
Biochemical oxygen demand	g/m^3	0.7	0.7
Filtered biochemical oxygen demand	g/m^3	0.6	<0.5
Cadmium (dissolved)	g/m^3	<0.005	<0.005
Chloride	g/m^3	8.8	8.9
Conductivity @ 20 Deg. C	mS/m	9.6	9.7
Chromium (dissolved)	g/m^3	<0.03	<0.03
Dissolved oxygen	g/m^3	9.52	9.54
Dissolved reactive phosphorus	g/m^3-P	0.026	0.024
Faecal coliforms	/100ml	154	461
Unionised ammonia	g/m^3	0.00031	0.00053
Ammoniacal nitrogen	g/m^3-N	0.029	0.049
Nitrate/nitrite nitrogen	g/m^3-N	0.65	0.63
pH	pH	7.5	7.5
Suspended solids	g/m^3	<2	<2
Temperature	Deg.C	15.4	15.7
Turbidity	NTU	0.68	0.72
Dissolved zinc	g/m^3	<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 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 g/m^3, well below the 0.025 g/m^3 unionised ammonia guideline used for the long term protection of aquatic ecosystems.

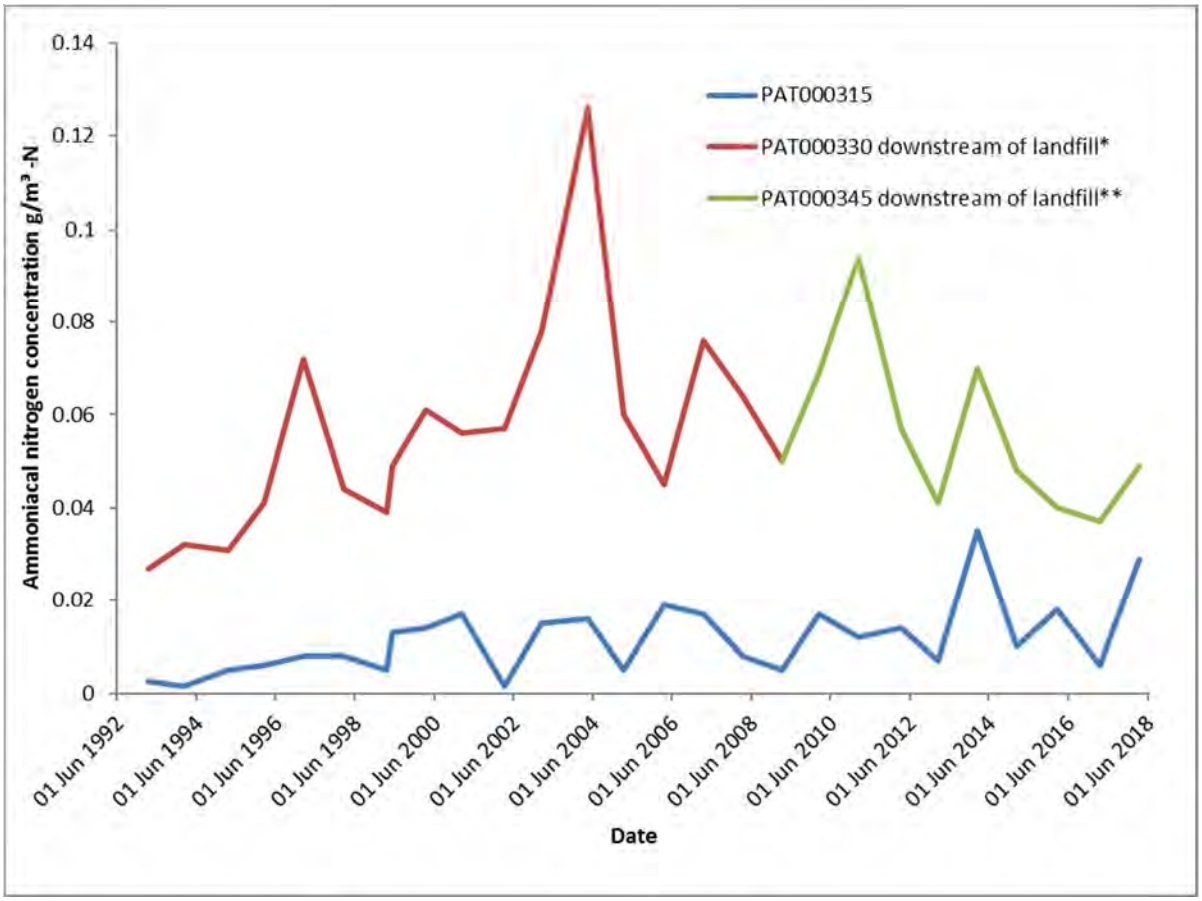

Figure 6 Graph showing ammoniacal nitrogen levels in the Patea Stream up and downstream of the landfill (where comparative data is available)

**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. Samples were sorted and identified and the number of taxa (richness), MCI score, and SQMCI$_S$ 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$_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI$_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The 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 effect on stream macroinvertebrate communities. However, there was a significant decrease in MCI and SQMCI$_s$ 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$_s$ 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 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.

2.3.5 Investigations, interventions, and incidents

In the 2017-2018 period, the Council was 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.

25 August 2017

An inspection of a closed landfill at Swansea Road, Stratford found noncompliance with special conditions of resource consent 3889-3, in that ponding of stormwater (Photo 1) and trough water (Photo 2) was observed in contravention of consent conditions. The ponding was significant in some areas, which was contributed to by the stormwater drains not being well constructed. It was noted that the northern leachate drain was overflowing onto the public walkway (Photo 3) and there was widespread minor damage to the cap (Photo 4 and Photo 5). SDC were given the opportunity to write in explaining the circumstances surrounding the breaches of consent, and why further enforcement action should not be undertaken by the Council.

Photo 1 Area of ponding on the cap at Stratford landfill

Photo 2 Overflowing water trough and surrounding ponding at Stratford landfill

Photo 3 Stormwater/leachate/groundwater overflow from Stratford landfill across public walkway

Photo 4 Example of stock damage to the batter at Stratford landfill

Photo 5 Example of vehicle and stock damage to the cap at Stratford landfill

The response received outlined that:

1. Taranaki, and Stratford in particular, has had very wet winter;
2. The works originally scheduled to redefine the stormwater drains at the western edge of the capped area for completion in April 2017 did not eventuate due to the wet weather;
3. As a result, 'heavy' stock grazing over the capped area has exacerbated ponding at the site- the Stratford District Council (SDC) was unaware of this worsened situation prior to the 'Inspection Notice'; and
4. SDC became aware of the leaky trough via the 'Inspection Notice'.

The poor stock management and widespread damage to the cap and batters was addressed by requiring the lessee to remove and thereafter exclude all 'heavy' stock from the affected area and restrict the grazing of a defined area to sheep only. The leaky troughs were repaired. Weather permitting, SDC undertook to take the following actions by the end of November 2017:

- to clean up the overflowing leachate and re-establish the walkway drains were necessary;
- carry out preliminary repairs to define the stormwater drains;
- carry out preliminary repairs to the areas of ponding on the western edge of the cap;
- carry out preliminary reinstatement to all stock damaged areas of the caps and batters.

By April 2018, SDC undertook to review the contour plan and reinstate the capped areas in stages ensuring that the undefined stormwater drains were defined and remediate/fill all areas affected by ponding to ensure compliance with special condition 3.

SDC also undertook to review the Landfill Maintenance and Contingency plan and ensure that the capped area would be maintained as per the reviewed plan. The revised plan was received on 3 May 2018.

As SDC undertook to carry out all necessary works within a reasonable timeframe, no further enforcement action was considered necessary.

2.4 Discussion

2.4.1 Discussion of site performance

In terms of the management of the landfill, a few issues were noted during the inspection in the first half of the monitoring period. There was widespread damage to the cap and batter due to poor stock management practices, ponding was found due to poorly constructed stormwater drains and an overflowing stock water trough, and a leachate drain was overflowing onto a public walkway. No visible effects were noted in the receiving waters as a result of these issues, and SDC undertook to put stock management controls in place and carry out remedial works in a reasonable timeframe. At the following inspection there was no evidence of the former stock damage, and the site was being grazed by a small number of young stock. There was only minor ponding present in the northern stormwater drain. However it was noted that the open stormwater drains were not well constructed.

At the start of the 2014-2015 year, extra capping soil had been 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 area where ponding was again found during the year under review. At the time of the preparation of this report, the capping material was still present on site adjacent to the main area of stormwater 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: *To discharge leachate into land and into groundwater adjacent to the Patea River*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practical option	Site specific monitoring programme – programme supervision	**Widespread stock damage, a leaking trough and ponding/ stormwater drains requiring recontouring. Overflowing leachate drains.**
2. Prepare a Contingency and Maintenance Plan	Check of Council records. Revised plan received May 2018	Yes
3. Maintain landfill site	Site specific monitoring programme – inspection	**Widespread stock damage, a leaking trough and ponding/ stormwater drains requiring recontouring. Overflowing leachate drains.**
4. Effects beyond mixing zone	Water quality monitoring of the Patea River upstream and downstream of the landfill	Yes
5. Optional review	Next opportunity for review June 2022	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**Improvement required** **Improvement required**

N/A = not applicable

An improvement in the SDC's environmental performance is required in relation to the Stratford landfill as defined in Section 1.1.5.

2.4.4 Recommendation from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

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.

The monitoring programme was implemented as recommended.

2.4.5 Alterations to monitoring programmes for 2018-2019

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 2018-2019, 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.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

2.5 Recommendations

1. THAT monitoring of the consented activities at the Stratford landfill in the 2018-2019 year continues at the same level as in 2017-2018.
2. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

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 carried out as scheduled 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

3.3.1 Inspection

19 June 2018

The site was inspected in fine conditions with a light northeasterly breeze. The cap was soft underfoot following heavy rain the previous day. Both the cap and batters were intact and well-vegetated with no slumping, cracking, or exposed refuse noted. There were no issues with ponding or stock damage, and there was no sign of recent grazing.

The stormwater drains were clear and free-flowing, with a moderate discharge rate. The rip-rap and culvert were in good condition and clear of obstructions. A sample was collected from the discharge point, which was estimated to be flowing at a rate of approximately 10 L/s.

The fencing was intact and permanent, and there were no issues with odour or dust. The site was unoccupied at the time of inspection.

3.3.2 Results of discharge monitoring

During the year under review a sample was collected from the springwater/leachate discharge point RTP0010002. The results of the Analyses are given in Table 6.

Table 6 Results of Huiroa landfill leachate discharge sampling (site RTP001002)

Date	Ammoniacal nitrogen (g/m^3-N)	Un-ionised ammonia (g/m^3)	Conductivity @ 25°C (mS/m@25°C)	Iron Acid Soluble (g/m^3)	pH	Temperature (Deg.C)	Dissolved Zinc (g/m^3)
19 June 2018	<0.010	<0.00005	7.6	<0.4	7.3	11.6	0.0014

The sample taken of the springwater/leachate discharge from the Huiroa landfill during the year under review showed little, if any, evidence of contamination. The results complied with the discharge standards on the consent.

3.3.3 Results of receiving environment monitoring

The small unnamed tributary of the Makuri Stream that flows approximately 70 m to the northwest of the Huiroa closed landfill was sampled on one occasion during the period under review. The results are presented in Table 7.

Table 7 Results of the Makuri Stream tributary downstream of the Huiroa landfill (site MKR000012)

Date	Ammoniacal nitrogen (g/m^3-N)	Un-ionised ammonia (g/m^3)	Conductivity @ 25°C (mS/m@25°C)	Iron Acid Soluble (g/m^3)	pH	Temperature (Deg.C)	Dissolved Zinc (g/m^3)
19 June 2018	0.141	0.0003	7.6	1.0	6.9	11.7	0.0115

The results obtained during the year under review are all well below their respective historical median values. Based on the results of the sampling and the low discharge rates, it is considered that the effect of the closed landfill is having on the receiving environment is minor, at most.

3.3.4 Investigations, interventions, and incidents

In the 2017-2018 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with SDC's conditions in the Huiroa landfill resource consents or provisions in Regional Plans.

3.4 Discussion

3.4.1 Discussion of site performance

The Huiroa landfill has been closed since 1991 after which SDC reinstated the site. There were no issues in regard to ponding, excessive leachate seepage or refuse migration observed at this site. It appeared that the grazing at the site had been well managed with no evidence of erosion in the stormwater channel remediated in the 2014-2015 year. The rip rap drain installed to prevent erosion exposing refuse continued to be effective.

3.4.2 Environmental effects of exercise of consents

There is no evidence that the exercise of the consent 3890 was having any significant effect on the environment. The site was well maintained and well vegetated. There was no evidence found of refuse migrating through the cap. The samples gathered during the period under review indicated little, if any, effect on the environment.

3.4.3 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 8.

Table 8 Summary of performance for consent 3890-2 (Huiroa closed landfill)

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***		
Condition requirement	**Condition requirement**	**Condition requirement**
1. Adoption of best practicable option	Inspection	Yes
2. Maintenance of cap and drainage systems	Inspection	Yes

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*		
Condition requirement	**Condition requirement**	**Condition requirement**
3. Site to be operated in accordance with a 'Management Plan' that is to be within three months of granting of consent	Inspection found site operated in accordance with plan provided in September 2016	Yes
4. Component concentration limits on water quality after mixing	Sampling	Yes
5. General water quality after mixing	Sampling and visual assessment	Yes
6. Optional review	Next opportunity for review June 2022	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 9 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2012	3890	1			
2015	3890		1		
Totals		1	1		

During the year, the SDC demonstrated a high level of environmental and high level of administrative performance with the Huiroa landfill resource consent as defined in Section 1.1.5.

3.4.4 Recommendation from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

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.

The monitoring programme was implemented as recommended.

3.4.5 Alterations to monitoring programmes for 2018-2019

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

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

It is proposed that for 2018-2019 the monitoring remains unchanged.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

3.5 Recommendations

1. THAT in the first instance, the triennial monitoring for the Huiroa landfill remains unchanged in the 2018-2019 year, with monitoring next scheduled in 2020-2021.
2. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

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.

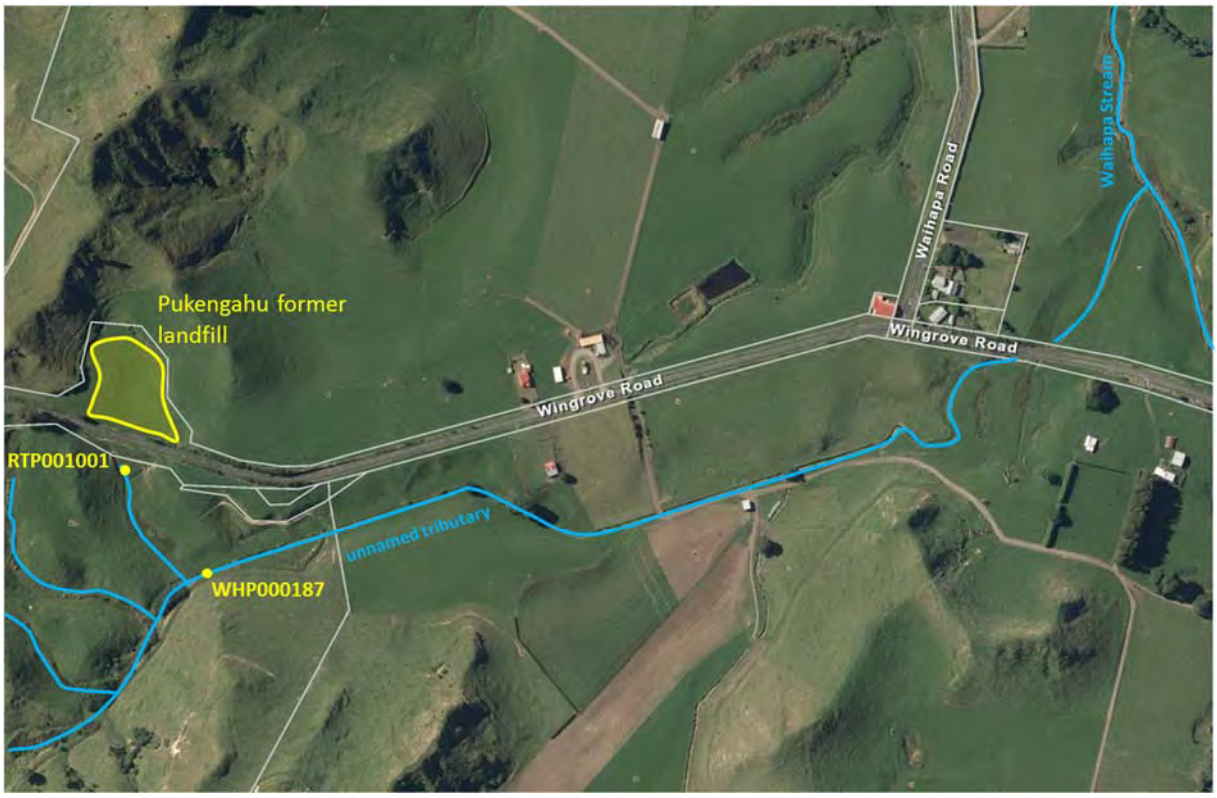

Figure 8 Pukengahu landfill and approximate sampling locations

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 Waihapa 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

4.3.1 Inspections

19 June 2018

The site was inspected in fine conditions with a light easterly breeze. The fencing was intact and permanent, and there were no issues with odour or dust. The site was unoccupied at the time of inspection.

The cap was intact and wet underfoot following heavy rain the previous day. There were no issues with ponding noted. Both the cap and batters were well-vegetated, with no slumping, cracking, or exposed refuse observed. No stock damage was apparent and there was no evidence of recent grazing.

The stormwater drain s were grassed and moderately well-defined. They were clear of obstructions and contained some ponded water following the recent rain. A low discharge rate (approximately 0.1 L/s) was observed, and samples were collected from the discharge point.

4.3.2 Results of discharge monitoring

During the monitoring period a sample was taken of the discharge from the Pukengahu closed landfill. The results of the analyses are given in Table 10.

Table 10 Results of Pukengahu closed landfill leachate sampling (RTP001001)

Date	Ammoniacal nitrogen (g/m^3-N)	Un-ionised ammonia (g/m^3)	Conductivity @ 25°C (mS/m@25°C)	Iron Acid Soluble (g/m^3)	pH	Temperature (Deg.C)	Dissolved Zinc (g/m^3)
19 June 2018	<0.010	<0.00005	12.6	<0.4	7.2	11.4	0.120

The sample taken of the leachate discharge from the Pukengahu landfill during the year under review showed little, if any, evidence of contamination. The ammoniacal nitrogen and acid soluble iron results were both new minimums for this monitoring site. The results complied with the discharge standards on the consent.

4.3.3 Results of receiving environment monitoring

The unnamed tributary of the Waihapa Stream that flows approximately 120 m to the south of the Pukengahu closed landfill was sampled on one occasion during the period under review. The sampling site (WHP000187) was approximately five meters downstream of where the groundwater/leachate flow enters the tributary.

Table 11 Unnamed tributary of the Waihapa Stream downstream of the Pukengahu closed landfill (WHP000187)

Date	Ammoniacal nitrogen (g/m^3-N)	Un-ionised ammonia (g/m^3)	Conductivity @ 25°C (mS/m@25°C)	Iron Acid Soluble (g/m^3)	pH	Temperature (Deg.C)	Dissolved Zinc (g/m^3)
19 June 2018	0.040	0.00015	16.7	0.8	7.2	11.4	0.0016

These results show that the leachate from the closed Pukengahu landfill was having little, if any, effect on the water quality of the unnamed tributary of the Waihapa Stream.

4.3.4 Investigations, interventions, and incidents

In the 2017-2018 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with SDC's conditions in the Pukengahu landfill resource consents or provisions in Regional Plans.

4.4 Discussion

4.4.1 Discussion of site performance

The Pukengahu landfill has been closed since 1991 after which SDC reinstated the site. There were no issues in regard to ponding, excessive leachate seepage or refuse migration observed at this site.

4.4.2 Environmental effects of exercise of consents

There is no evidence that the exercise of the consent 3891 was having any significant effect on the environment. The site was well maintained and well vegetated with no evidence of refuse migrating through the cap. None of the samples gathered during the period under review indicated significant effects on the environment.

4.4.3 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 12.

Table 12 Summary of performance for Consent 3890-2 (Pukengahu closed landfill)

Purpose: ***To discharge stormwater and leachate from the former Pukengahu landfill into an unnamed tributary of the Waihapa Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adoption of best practicable option	Inspection	Yes
2. Maintenance of cap and drainage systems	Inspection	Yes
3. Site to be operated in accordance with a 'Management Plan' that is to be provided within three months of granting of consent	Inspection found site operated in accordance with plan provided in September 2016	Yes
4. Component concentration limits on water quality after mixing	Sampling	Yes
5. General water quality after mixing	Sampling and visual assessment	Yes
6. Optional review	Next opportunity for review June 2022	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 13 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2012	3891	1			
2015	3891	1			
Totals		2			

During the year, the SDC demonstrated a high level of environmental and high level of administrative performance with the Pukengahu landfill resource consent as defined in Section 1.1.5.

4.4.4 Recommendation from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

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.

The monitoring programme was implemented as recommended.

4.4.5 Alterations to monitoring programmes for 2018-2019

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

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

It is proposed that for 2018-2019 the monitoring remains unchanged.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

4.5 Recommendations

1. THAT in the first instance, the triennial monitoring for the Pukengahu landfill remains unchanged in the 2018-2019 year, with monitoring next scheduled in 2020-2021.
2. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

5 Overall Evaluation of performance

Overall SDC demonstrated a good level of environmental and administrative performance with their resource consents.

6 Summary of recommendations

1. THAT monitoring of the consented activities at the Stratford landfill in the 2018-2019 year continues at the same level as in 2017-2018.
2. THAT in the first instance, the triennial monitoring for the Huiroa landfill remains unchanged in the 2018-2019 year, with monitoring next scheduled in 2020-2021.
3. THAT in the first instance, the triennial monitoring for the Pukengahu landfill remains unchanged in the 2018-2019 year, with monitoring next scheduled in 2020-2021.
4. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Glossary of common terms and abbreviations

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

Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C or 25°C and expressed in mS/m.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident register	The incident register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
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).
Temp	Temperature, measured in °C (degrees Celsius).
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 a Science Services Manager.

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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

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Taranaki Regional Council (2017): *Stratford District Council Landfills Annual Report 2016-17*, Technical Report 17-35

Appendix I

Resource consents held by Stratford District Council

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

Consent number	Location	Purpose	Next review date	Expiry date	Changes during 2017-2018
3889-3	Stratford	To discharge leachate into land and into groundwater adjacent to the Patea River	June 2022	1 June 2028	None
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	None
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	None

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

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	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^3;
   b) ammoniacal nitrogen level concentration less than 0.9 g/m^3;
   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^3.

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

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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^3;
   b) ammoniacal nitrogen level concentration less than 0.9 g/m^3;
   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^3.

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.

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	Rae West, Job Manager
From	Darin Sutherland, Environmental Scientist
Doc No	2081916
Report No	DS100
Date	4 July 2018

Summer biomonitoring of the Patea River in relation to the Stratford District Council's upgraded Wastewater Treatment Plant, April 2018

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. These surveys also serve to monitor a closed landfill site situated upstream of the WWTP discharge point.

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) in the Patea River on 3 April 2018.

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 closed 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

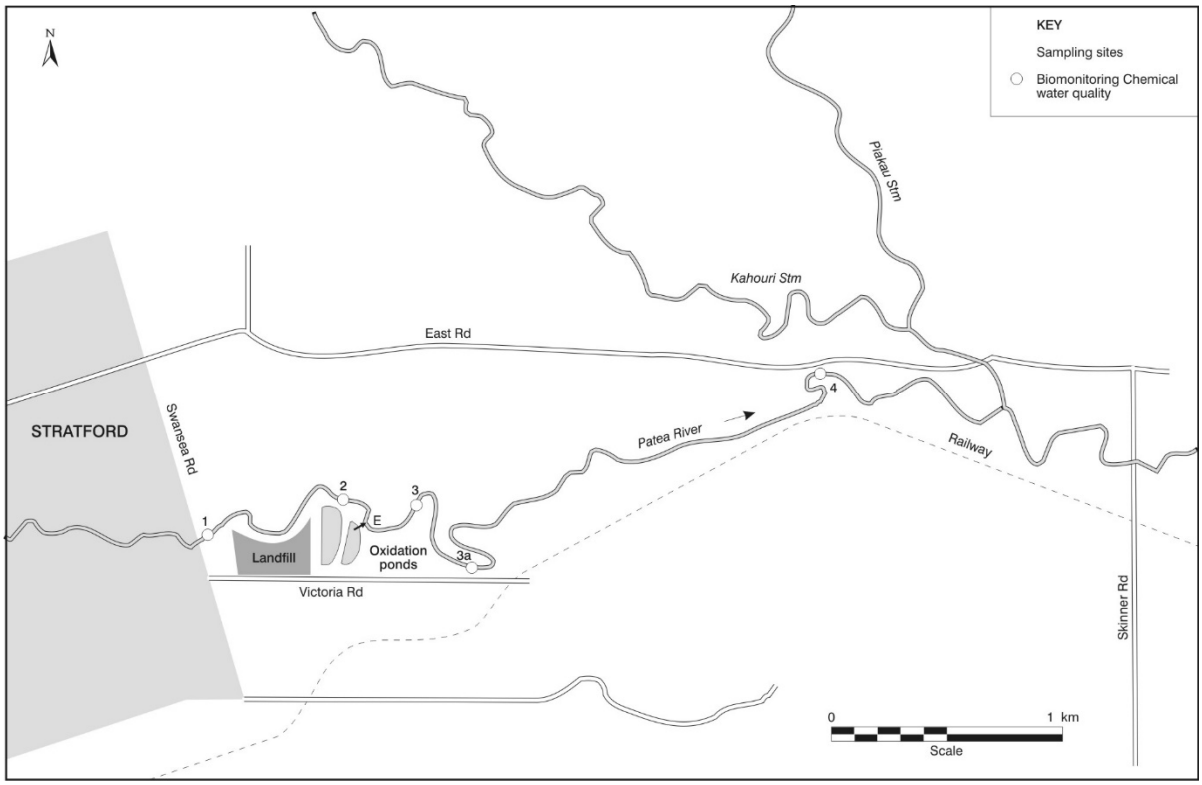

Figure 1 Biomonitoring sites in the Patea River in relation to Stratford landfill and oxidation ponds discharge

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)

TRC Grading	MCI	$SQMCI_s$
Excellent	>140	>7.00
Very Good	120-140	6.00-7.00
Good	100-119	5.00-5.99
Fair	80-99	4.00-4.99
Poor	60-79	3.00-3.99
Very Poor	<60	<3.00

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 moderate conditions (approximately 80% median flow), nine days after a fresh in excess of 3 times median flow and 26 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 had patchy algal mats and filaments, moss, leaves and wood. Sites 2 had slippery algal mats and no algal filaments, patchy moss and leaves. Site 3 had widespread algal mats and algal filaments, and patchy leaves. Site 4 had patchy algal mats, widespread algal filaments, and patchy leaves.

Macroinvertebrate communities

A summary of the results of previous surveys is presented in Table 4.

Table 4 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between February 1985 and October 2017 and the current survey

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	49	26	20-33	24	111	98-130	113	6.1	3.2-7.6	7.1
2	35	24	11-36	18	106	96-119	108	6.0	3.6-7.8	6.6
3a	11	24	21-29	19	101	95-113	109	5.9	3.4-7.1	3.7
4	46	23	15-31	19	99	82-116	85	4.1	2.3-7.2	3.8

Survey results since February 1985 are illustrated in Figure 2, while the results of the current survey are presented in Table 4 and discussed beneath.

Table 5 Macroinvertebrate fauna of the Patea River in relation to SDC WWTP discharge on the 3 April 2018

Taxa List	Site Number	MCI score	1	2	3a	4
	Site Code		PAT000315	PAT000330	PAT000350	PAT000356
	Sample Number		FWB18190	FWB18191	FWB18192	FWB18193
NEMATODA	Nematoda	3	-	-	-	R
ANNELIDA (WORMS)	Oligochaeta	1	R	A	-	A
MOLLUSCA	*Physa*	3	-	-	-	R
	Potamopyrgus	4	R	R	-	R
CRUSTACEA	Cladocera	5	-	-	XA	-
	Paracalliope	5	-	-	-	R
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	C	R	-
	Coloburiscus	7	XA	VA	A	C
	Deleatidium	8	XA	VA	A	A
	Nesameletus	9	C	C	R	-
	Zephlebia group	7	R	-	-	-
PLECOPTERA (STONEFLIES)	*Austroperla*	9	R	-	-	-
	Zelandoperla	8	R	-	-	-
COLEOPTERA (BEETLES)	Elmidae	6	C	C	C	C
	Hydraenidae	8	C	R	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	C	C	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	VA	C	C	VA
	Costachorema	7	R	R	R	C
	Hydrobiosis	5	C	C	R	R
	Beraeoptera	8	C	-	R	-
	Confluens	5	C	-	-	-
	Olinga	9	-	R	R	-
	Oxyethira	2	-	-	-	R
	Pycnocentrodes	5	C	-	R	R
DIPTERA (TRUE FLIES)	*Aphrophila*	5	A	C	C	R
	Chironomus	1	-	R	A	A
	Maoridiamesa	3	-	-	R	A
	Orthocladiinae	2	C	C	XA	A
	Polypedilum	3	R	C	C	-
	Tanytarsini	3	C	-	C	C
	Ephydridae	4	C	R	-	-
	Austrosimulium	3	R	-	-	-
		No of taxa	24	18	19	19
		MCI	113	108	109	85
		SQMCIs	7.1	6.6	3.7	3.8
		EPT (taxa)	13	8	10	6
		%EPT (taxa)	54	44	53	32

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

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

Site 1 (Swansea Road)

A moderate macroinvertebrate community richness of 24 taxa was found at site 1 ('primary control' site) at the time of this summer survey (Table 4). This was two taxa less than the historic median (26 taxa) and four taxa more than the previous survey on March 2017 (20 taxa).

The MCI score of 113 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 111 units and to the preceding survey (120 units).

The $SQMCI_S$ score of 7.1 units was significantly higher than the median $SQMCI_S$ score of 6.1 units (Table 4) and the same as the preceding survey (7.1 units).

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

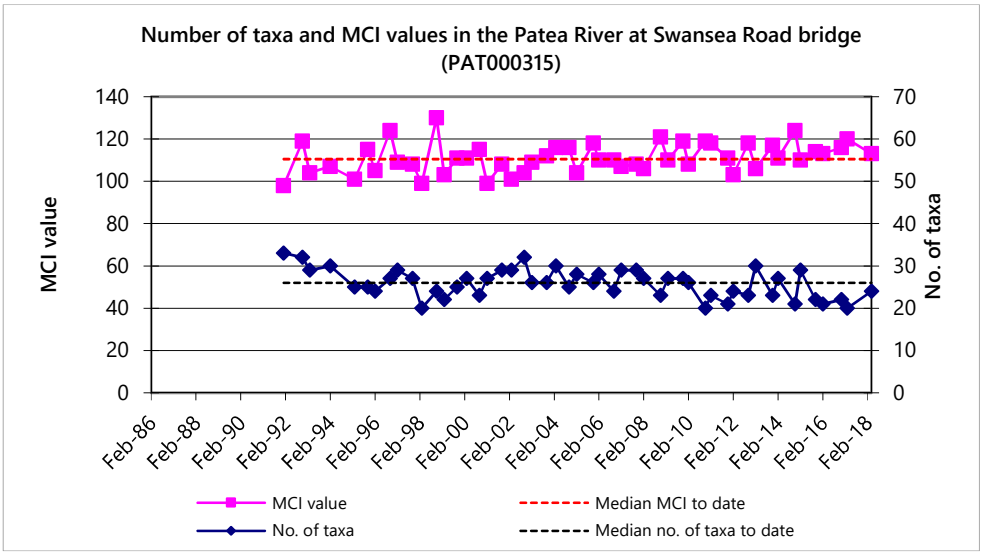

Figure 2 Taxa richness and MCI scores recorded to date at site 1

Site 2 (upstream of original oxidation ponds outfall)

A moderate macroinvertebrate community richness of 18 taxa was found at site 2 ('secondary control' site) at the time of the survey (Table 4). This was six taxa lower than the historic median (24 taxa) and seven taxa lower than the previous survey on March 2017 (25 taxa).

The MCI score of 108 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 106 units and to the preceding survey (116 units).

The SQMCIS score of 6.6 units was not significantly different to the median SQMCIS score of 6.0 units (Table 4) and the preceding survey (7.1 units).

The community was dominated by one 'tolerant' taxon [oligochaete worms], one 'moderately sensitive' taxon [mayfly (*Coloburiscus*)], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

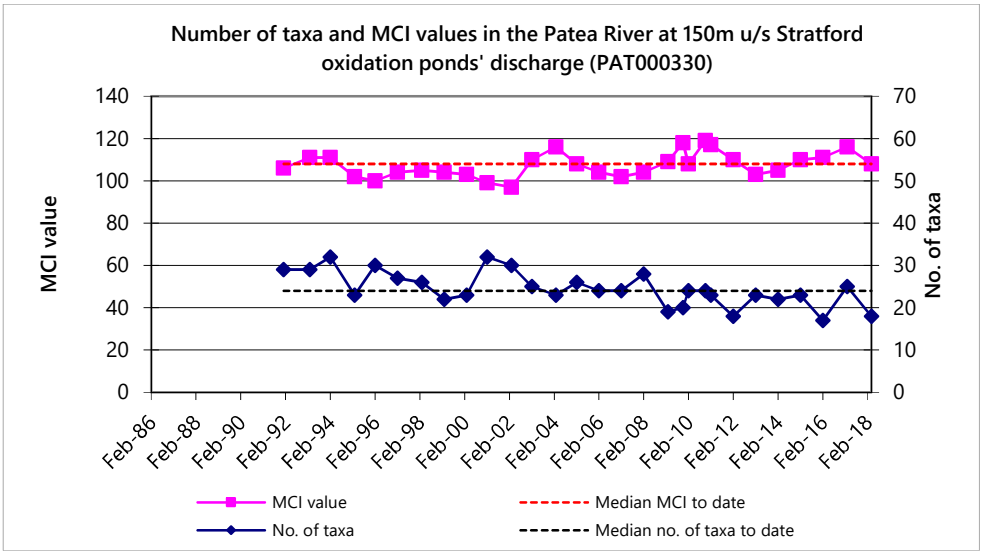

Figure 3 Taxa richness and MCI scores recorded to date at site 2

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

A moderate macroinvertebrate community richness of 19 taxa was found at site 3a ('primary impact' site) at the time of the survey (Table 4). This was five taxa less than the historic median (24 taxa) and six taxa less than the previous survey on March 2017 (25 taxa).

The MCI score of 109 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 101 units and to the preceding survey on March 2017 (99 units).

The $SQMCI_S$ score of 3.7 units was significantly lower than the median $SQMCI_S$ score of 5.9 units (Table 4) and to the preceding survey (5.0 units).

The community was dominated by two 'tolerant' taxa [midges (*Chironomus* and *Orthocladiinae*)], two 'moderately sensitive' taxa [mayfly (*Coloburiscus* and water fleas (*Cladocera*)] and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

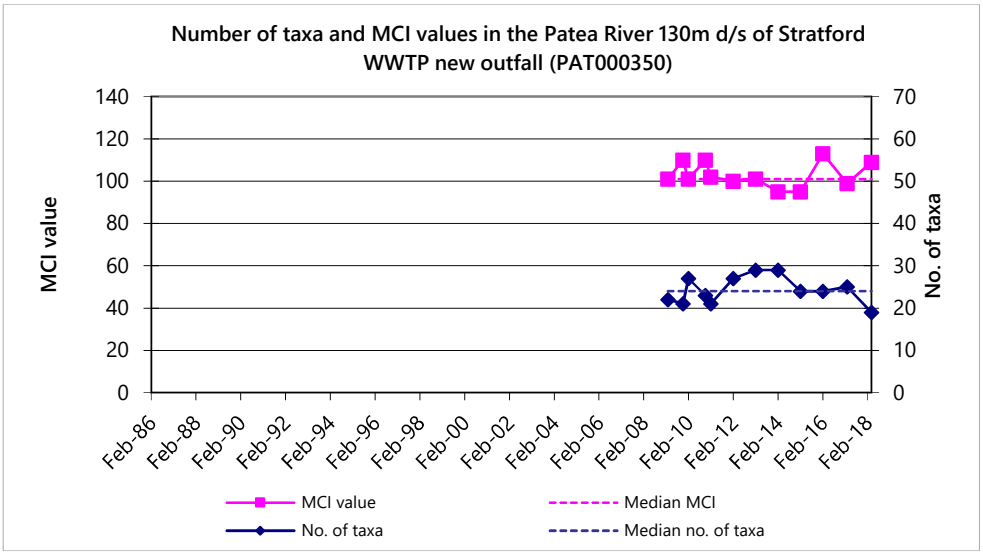

Figure 4 Taxa richness and MCI scores recorded to date at site 3a

Site 4 (East Road)

A moderate macroinvertebrate community richness of 19 taxa was found at site 4 ('secondary impact' site) at the time of the survey (Table 4). This was four taxa less than the historic median (23 taxa) and four more than the previous survey on October 2017 (15 taxa).

The MCI score of 85 units indicated a community of 'fair' biological health which was significantly lower than the historic median MCI score of 99 units and to the preceding survey (113 units).

The $SQMCI_S$ score of 3.8 units was not significantly different to the median $SQMCI_S$ score of 4.1 units (Table 4) but was significantly lower than the preceding survey (6.5 units).

The community was dominated by five 'tolerant' taxa [oligochaete worms, caddisfly (*Hydropsyche/Aoteapsyche*), and midges (*Chironomus*, *Maoridiamesa* and *Orthocladiinae*)], one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

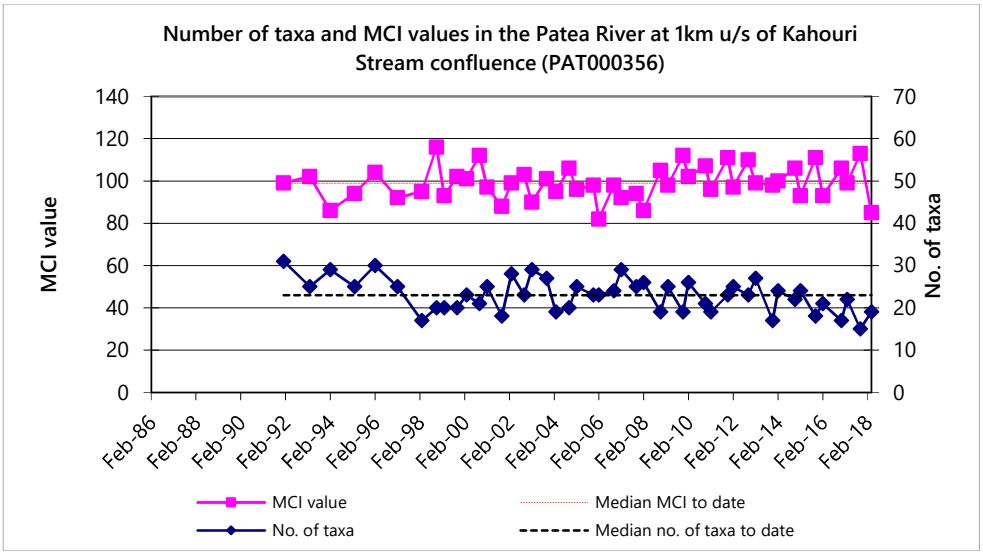

Figure 5 Taxa richness and MCI scores recorded to date at site 4

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 for all four sites. The 'primary control' site had a richness very similar to its historic median while the other sites had slightly lower richnesses of four to six taxa compared with historic medians but were very similar to each other, being within one taxon of each other. 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 sites 1 and 2 as having 'good' health, and the two 'impact' sites (sites 3a and 4) as being of 'good' and 'fair' health. MCI scores were not significantly different from each other or to historic medians for sites 1, 2 and 3a while there was a significant decrease at site 4 from site 3a and site 4 was also significantly lower than the historic median suggesting a deterioration in macroinvertebrate health.

The SQMCIs can be more sensitive to organic pollution compared with the MCI. These scores categorised site 1 as being in 'excellent' health, site 2 in 'very good' health and sites 3a and 4 in 'poor' health. $SQMCI_s$ scores were not consistent with MCI scores in that there was a significant decline from site 2 to 3a. Both 'control' sites having scores significantly higher than the two 'impact' sites. Furthermore, site 3a, but not 4, had a score significantly lower than the historic median.

Both the MCI and $SQMCI_s$ scores indicate a significant decline in macroinvertebrate health downstream of the discharge. The incongruence in scores at site 3a ('good' vs 'poor' health) and the lack of difference in MCI scores between sites 2 and 3a in conjunction with an extremely large difference in SQMCIs score can be explained by the differing macroinvertebrate compositions between the two sites coupled with the MCI score not taking into account macroinvertebrate abundances. Specifically, site 2 had higher abundances of two 'sensitive' mayfly taxa, *Deleatidium* and *Coloburiscus* while site 3a had higher abundances of two 'tolerant' midges *Chironomus* and *Orthocladiinae*. *Chironomus*, commonly referred to as blood worms, are a particularly reliable indicator of nutrient enrichment. Also of note is the presence of 'extremely abundant' water fleas at site 3a, the only site where they are recorded for this survey. Water fleas are often associated with the discharges of oxidation ponds and probably have a Taranaki tolerance value that is too high (5), possibly as a result of being given an initial default value (5) due to inadequate information. The national tolerance value is 1, indicating that it is highly tolerant to nutrient enrichment. If water fleas were removed from the survey result, the $SQMCI_s$ score would be further lowered to 2.5 units.

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 enrichment from the WWTP discharges. However, while the two 'control' sites lacked widespread periphyton both 'impact' sites had widespread filamentous algae which did indicate persistent nutrient enrichment but not the gross pollution associated with sewage fungus.

Overall, the results indicate that preceding water quality in the upper Patea River was typical or slightly better than typical. There was a significant drop in macroinvertebrate health indicative of mild nutrient enrichment 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 effects include shifting site 4 further upstream, adding an additional site closer to the discharge point such as including the already established site PAT000345, and having spring monitoring.

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 $SQMCI_S$ 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 $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The 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 effect on stream macroinvertebrate communities. However, there was a significant decrease in MCI and $SQMCI_s$ scores between sites 2 and 3 coincident with the SDC WWTP discharge point. As both 'control' sites for the WWTP had similar MCI and $SQMCI_s$ 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 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.

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