

Stratford District Council  
Stratford Landfill  
Monitoring Programme  
Annual Report  
2009-2010

Technical Report 2010-68

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## Executive summary

The Stratford District Council (SDC) operates 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. The site has more recently been used to dewater and dispose of oxidation pond sludge from the adjacent municipal waste water treatment plant but this activity ceased in early 2006 and the landfill was recapped and reinstated. A consent is held by a third party to discharge treated contaminated soil to the site to act as a base layer for the consent holders programme of cap maintenance and re-contouring, however this consent has yet to be exercised.

The SDC also maintains closed landfills at Douglas Rd, Huiroa in the Patea catchment and Wingrove Rd, Pukengahu, also 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 three yearly basis. No monitoring was scheduled or undertaken during the 2009-2010 period.

This report for the period July 2009-June 2010 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Stratford District Council's environmental performance during the period under review, and the results and environmental effects of the Stratford District Council's activities.

SDC holds a total of three resource consents, which include a total of 13 special conditions setting out the requirements that SDC must satisfy.

The Council's monitoring programme for the period under review included two inspections and five water samples collected for physicochemical analysis, and two biomonitoring surveys of receiving waters.

The monitoring showed that there were only minor effects at the on the environment due to the activity at the Stratford landfill.

During the period under review, the Stratford District Council demonstrated a good level of environmental performance and compliance with all the resource consents. During the period whilst there were only negligible effects on the environment due in relation to the discharges, there were some issues in regards to site management.

There were no incidents associated with any of the closed landfill sites recorded by Council in the period under review.

This report includes recommendations for the 2010-2011 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 the Biennial Report for the period July 2009-June 2010 by the Taranaki Regional 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. All of these sites are in the Patea catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by SDC that relate to discharges leachate and stormwater to water from the landfills at Stratford, Huiroa and Pukengahu. All of the consent holder's landfills no longer accept refuse and have been fully reinstated.

One of the intents of the Resource Management Act (1991) 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 Taranaki Regional Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Stratford District Council's use of water, land, and air, and is the 17th report by the Taranaki Regional 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 compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the 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 at SDC landfill sites.

Section 2-3 presents the results of monitoring of the consent holder's landfills during the period under review. It includes scientific and technical data and discusses the results, their interpretation and their significance for the environment and makes recommendations for 2010-2011 period.

Section 4 is a summary of recommendations for the 2010-2011 period.

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

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

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the Resource Management Act to assess the effects of the exercise of consents. In accordance with section 35 of the Resource Management Act 1991, the Council undertakes compliance monitoring for consents and rules in regional plans; and maintains an overview of performance of resource users against regional plans and consents. Compliance monitoring, (covering both activity and impact) monitoring, also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further enables the Council to continually re-evaluate its approach and that of consent holders to resource management, and, ultimately, through the refinement of methods, and considered responsible resource utilisation to move closer to achieving sustainable development of the region's resources.

#### 1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by SDC during the period under review, this report also assigns an overall rating. The categories used by the Council, and their interpretation, are as follows:

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or trivial (such as data supplied after a deadline) non-compliance with conditions.
- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the year were negligible or minor at most, items of concern were resolved positively, co-operatively, and quickly, the Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with.
- **improvement desirable** indicates that the Council may have been obliged to record against the consent holder a verified unauthorised incident involving significant environmental impacts, and/or abatement notices may have been issued; there were adverse environmental effects arising from activities and intervention by Council staff was required, and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at end of the period under review.
- **poor** performance is used when there were grounds for prosecution or infringement notice

## 1.2 Process description

### 1.2.1 Stratford landfill

The Stratford District Council 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 at the landfill since 2006.



Figure 1 Stratford landfill (shaded in yellow) and sampling locations

### 1.2.2 Huiroa landfill

The Huiroa landfill is sited within an elbow of the 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.

### 1.2.3 Pukengahu landfill

The site is situated in a small gully off Wingrove Road. At the base of the gully is a small wetland area which is fed by a spring and this area is

culverted beneath the road and 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.



**Figure 2** Aerial photo showing approximate footprint of the former landfill at Huiroa and sampling site



**Figure 3** Aerial photo showing approximate footprint of the former landfill at Pukengahu and sampling site

## 1.3 Resource consents

### 1.3.1 Water discharge permit

Section 15(1)(a) of the Resource Management Act 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**, **3890** and **3891** issued by the Taranaki Regional Council.

Section 15(1)(a) of the Resource Management Act 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 permit **3889** to cover discharge of stormwater and leachate from Stratford Municipal Landfill into the Patea River. This permit was issued by the Taranaki Regional Council on 27 February 1998 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2010.

Condition 1 details the preparation and maintenance of a landfill management plan.

Condition 2 requires SDC to install a leachate and stormwater collection system and pump all collected liquids to the adjacent municipal oxidation ponds.

Condition 3 states that the discharge shall not reduce in-stream water quality after a specified mixing zone.

Condition 4 is a review provision.

The permit is attached to this report in Appendix I.

SDC holds water discharge permit **3890** 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 Taranaki Regional Council on 17 October 1996 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2016.

Condition 1 requires SDC to install and maintain stormwater drains on the site.

Condition 2 requires SDC to maintain vegetative cover on the site.

Condition 3 states the consent holder adopt the best practicable options.

Condition 4 states that the discharge from the site shall not cause detrimental effect on water quality or aquatic life of the Makuri Stream.

Conditions 5 and 6 are review conditions.

The permit is attached to this report in Appendix I.

SDC holds water discharge permit **3891** to cover discharge of stormwater and leachate from the former Pukengahu landfill into an unnamed tributary of the Waihapā Stream. This permit was issued by the Taranaki Regional Council on 12

February 1998 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2016.

Condition 1 requires SDC to manage ground contours, final cover and illegal dumping at the site.

Condition 2 states that the discharge from the site shall not cause detrimental effect on water quality or aquatic life of the Makuri Stream.

Condition 3 is a review provision.

The permit is attached to this report in Appendix I.

## **1.4 Monitoring programme**

### **1.4.1 Introduction**

Section 35 of the Resource Management Act sets out obligation/s upon the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region and report upon these.

The Taranaki Regional 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.

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 the 2008-2009 period and is next scheduled for the 2011-2012 period as per the triennial programme.

The Stratford landfill closed in 2006 and monitoring is conducted annually in conjunction with that undertaken for the Stratford Waste Water Treatment Plant which is on the same site.

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

### **1.4.2 Programme liaison and management**

There is generally a significant investment of time and resources by the Taranaki Regional 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, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters.

### **1.4.3 Site inspections**

The Stratford municipal landfill site was visited on three occasions during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were site processes with potential or actual

discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on site processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the consent holder were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council.

No inspections were scheduled for the Pukengahu and Huiroa sites for this monitoring period. The next inspections for these sites are scheduled for the 2011-2012 period as per the triennial monitoring programme.

#### **1.4.4 Chemical sampling**

The Patea River 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 Taranaki Regional Council also undertook sampling of the groundwater at the Stratford landfill. Groundwater was sampled on two occasions, and the sample analysed for alkalinity, bicarbonate, chemical oxygen demand, chloride, conductivity, dissolved reactive phosphorus, faecal coliforms, ammoniacal nitrogen, nitrate, pH, temperature, water level and zinc.

No samples were scheduled for the Pukengahu and Huiroa sites for this monitoring period. The next sampling run for these sites are scheduled for the 2011-2012 period as per the triennial monitoring programme.

#### **1.4.5 Biomonitoring surveys**

A biological survey was performed on two occasions 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 Rd

### 2.1 Inspections

Three inspections were conducted during the monitoring period on 1 September 2009, 24 February 2010 and 26 March 2010. The inspections identified three issues that needed attention.

- Monitoring bore GND1014 required repairs
- Stock watering troughs on the cap were leaking
- The cap had shown some signs of water damage, ponding, and subsidence

During the inspections no adverse effects were noted in the immediate receiving environment. No issues in regard to exposed refuse, odour or excessive leachate generation were noted.

The consent holder was requested to attend to the issues that were identified. The monitoring bore was repaired and is now functioning satisfactorily. The stock trough leaks were repaired however more leaks have occurred. Remediation works on the cap were tentatively scheduled to occur in the next spring period and at the time of the writing of this report, the remediation works were underway.

### 2.2 Results of receiving environment monitoring

#### 2.2.1 Surface waters

Samples were collected from the Patea River on 24 February 2010 and the results are set out in Table 1 below. As with the results from previous monitoring periods, results from the 2009-2010 period indicate that the Stratford landfill had only a very minor, if not negligible, effect on the water quality of the Patea River.

In relation to the parameters tested for, there was no significant difference in water quality between the upstream and downstream sites. This is especially notable in regards to typical landfill leachate indicators such as chlorides and zinc which exhibit very minor increases in concentration when measured downstream of the landfill.

**Table 1** Results of the Stratford landfill 2009-2010 water quality survey

Parameter	Units	24 February 2010	
		Above landfill PAT000315	Below landfill PAT000345
Black disc transparency	m	1.94	1.86
Biochemical oxygen demand	g/m <sup>3</sup>	0.5	0.7
Cadmium (dissolved)	g/m <sup>3</sup>	<0.005	<0.005
Chloride	g/m <sup>3</sup>	8.3	8.4
Conductivity	mS/m	9.5	10.1
Chromium (dissolved)	g/m <sup>3</sup>	<0.03	<0.03
Dissolved oxygen	g/m <sup>3</sup>	9.3	9.3
Dissolved reactive phosphorus	g/m <sup>3</sup> -P	0.025	0.021
Faecal coliforms	/100ml	350	260

Parameter	Units	24 February 2010	
		Above landfill PAT000315	Below landfill PAT000345
Unionised ammonia	g/m <sup>3</sup> -N	0.00023	0.00097
Ammoniacal nitrogen	g/m <sup>3</sup> -N	0.017	0.069
Nitrate/nitrate nitrogen	g/m <sup>3</sup> -N	0.43	0.44
Dissolved oxygen saturation	%	97	98
pH	pH	7.6	7.6
Suspended solids	g/m <sup>3</sup>	<2	<2
Temperature	Deg.C	15.7	16.1
Turbidity	NTU	1.3	1.2
Zinc (dissolved)	g/m <sup>3</sup>	<0.005	0.007

### 2.2.2 Groundwater

Groundwater samples were taken from monitoring bores upslope (GND1015 and GND1016) and down slope (GND1014) of the landfill on two occasions; 8 December 2009 and 29 March 2010. The results from these samples are shown in Table 2.

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 presence of the landfill. This is indicated by the increased levels of alkalinity, chloride, chemical oxygen demand, ammoniacal nitrogen and conductivity found at bore GND1014. The results from this bore for this particular sampling period do show an increase for a number of the parameters over that found at the site in the previous monitoring period. The results from this bore however, have exhibited significant variability over the past eight years and the elevated levels for the period under review are consistent with this variability.

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

**Table 2** Results of the Stratford landfill groundwater quality surveys 2009-2010 period

Parameter	Unit	8 Dec 2009			29 Mar 2010		
		GND1014	GND1015	GND1016	GND1014	GND1015	GND1016
Alkalinity	g/m <sup>3</sup>	*	*	*	532	34	45
Chloride	g/m <sup>3</sup>	40.1	9	8.4	43.9	8.8	9.9
Chemical oxygen demand	g/m <sup>3</sup>	39	<5	<5	38	6	<5
Conductivity	mS/m	105	9.8	8.6	89.9	11.1	11.5
Dissolved reactive phosphorus	g/m <sup>3</sup>	0.007	0.008	0.004	0.006	0.004	<0.003
Bicarbonate	g/m <sup>3</sup>	*	*	*	649.04	41.48	54.9
Depth to water	m	4.32	4.17	2.79	5.06	4.88	2.43
Unionised ammonia	g/m <sup>3</sup> -N	0.0561	0.00000	0	0.13006	0.00001	0.00003
Ammoniacal nitrogen	g/m <sup>3</sup> -N	53.0	0.012	0.017	98.3	0.014	0.071
Nitrate/nitrite nitrogen	g/m <sup>3</sup> -N	0.03	2.49	0.29	0.66	0.76	0.06
pH	pH	6.5	6.0	5.8	6.6	6.2	6.2
Temperature	Deg. C	15.2	13.7	13.3	15.1	14.2	14.2
Dissolved zinc	g/m <sup>3</sup>	0.028	0.011	0.019	0.258	0.139	0.28

\*= not measured

### 2.2.3 Biomonitoring

Two biomonitoring surveys were carried out during the 2009-2010 period. These surveys are undertaken to monitor the effects of the both the Stratford waste water treatment plant and the landfill on the aquatic communities in the Patea River. The summary of each report is given below and the full reports are appended. Both surveys found that "there were no significant effects associated with seepages from the closed landfill site".

#### 6 November 2009

The Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Patea River. Samples were sorted and identified and the number of taxa (richness), MCI score and SQMCI<sub>5</sub> score were calculated for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>5</sub> takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI<sub>5</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This spring 2009 macroinvertebrate survey indicated that the discharge of treated oxidation ponds wastes from the recently upgraded Stratford WWTP system had had no significant effects on the macroinvertebrate communities of the Patea River under spring moderately low river flow conditions. No significant changes in macroinvertebrate communities' compositions were recorded between the upstream 'control' site and sites downstream of the newly relocated outfall from the WWTP. There were also no significant effects associated with seepages from the closed landfill site.

The macroinvertebrate communities of the Patea River contained slightly higher proportions of 'sensitive' taxa at upstream sites and the communities were dominated by more 'sensitive' taxa at these (two) sites. 'Tolerant' taxa were slightly more predominant proportionately and numerically at the two sites downstream of the newly located WWTP discharge where slightly fewer 'highly sensitive' taxa were present. Taxonomic richnesses (numbers of taxa) were relatively similar in this spring survey compared to the previous survey conducted in late summer, but fewer 'tolerant' taxa were present coincident with a reduction in periphyton growth on the river bed at the time of the latest spring survey

MCI and SQMCI<sub>s</sub> scores indicated that the upstream stream communities were of 'good' health (TRC, 2009a) and slightly better than typical of conditions recorded in summer in the mid reaches of similar Taranaki ringplain rivers. Stream communities downstream of the WWTP discharge were of 'good' health and were better than those documented by the previous survey during summer recession low flow conditions.

## **2 February 2010**

The Council's standard 'kick-sampling' technique was used at three established and one recently established site to collect streambed macroinvertebrates from the Patea River. Samples were sorted and identified and the number of taxa (richness), MCI score and SQMCI<sub>s</sub> score were calculated for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>s</sub> takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI<sub>s</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This February 2010 macroinvertebrate survey indicated that the discharge of treated oxidation ponds wastes from the recently upgraded Stratford WWTP system had had no significant effects on the macroinvertebrate communities of the Patea River under low river flow conditions and coincident with a moderate microfloral population of the final division of the second oxidation pond. No significant changes in macroinvertebrate communities' compositions were recorded between the upstream 'control' site and sites downstream of the newly relocated wastewater outfall. There were also no significant effects associated with seepages from the closed landfill site.

The macroinvertebrate communities of the Patea River contained slightly higher proportions of 'sensitive' taxa at upstream sites and the communities were generally dominated by more 'sensitive' than 'tolerant' taxa at these (two) sites. 'Tolerant' taxa were slightly more predominant proportionately and numerically at the two sites downstream of the newly located WWTP discharge where slightly fewer 'highly sensitive' taxa were present. Taxonomic richnesses (numbers of taxa) were slightly higher at the time of this summer survey compared to richnesses of the previous late

summer survey, coincident with moderate periphyton growth on the river bed at the time of these surveys.

MCI and SQMCI<sub>s</sub> scores indicated that the upstream stream communities were of 'good' health (TRC, 2009) and generally typical of conditions recorded in the mid reaches of similar Taranaki ringplain rivers. Stream communities downstream of the WWTP discharge were also of 'good' health and were slightly better than those documented by the previous summer survey, due to an absence of algal deposition (as a result of a lower algal population in the upgraded final division of the second oxidation pond) during the latest summer recession flow conditions.

## **2.3 Register of incidents**

The Taranaki Regional 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 'Unauthorised Incident Register' (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

In the 2009-2010 period, there were no incidents recorded by the Council that were associated with Stratford landfill.

## **2.4 Discussion**

### **2.4.1 Discussion of site performance**

There were some issues identified during the monitoring period in regards to landfill cap condition, and the maintenance of stock watering troughs and monitoring bores on the site. The consent holder was quite slow to address these issues during the period under review.

At the time of writing this report all the problems identified by Council had been addressed and significant works were being undertaken to remediate the cap.

Consent 3889-2 (to discharge leachate) from the Stratford landfill expired on 1 June 2010. An application to renew for the consent was not submitted by the consent holder prior to the expiry date and subsequently this activity became un-consented.

Council undertook investigations into the activity and of the discharge to ascertain whether or not it breached Rule 29 of the Regional Freshwater Plan. At the time of writing this report Council had ascertained that the discharge was in breach of Rule 29 of the RFWP and Stratford District Council subsequently submitted an application to renew consent 3889-2.

Overall the consent holder should seek to improve the management of the site in regards to its maintenance and regulatory requirements.

## 2.4.2 Environmental effects of exercise of consents

Groundwater bore GND1014 continues to exhibit some signs of contamination, however there is no evidence from surface water sampling or biomonitoring that this is having any noticeable effect on the Patea River. There was no evidence of odour or dust problems at the site during any inspection.

No direct environmental effects were noted as result of the issues indentified during inspections.

## 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 set out in Table 3.

**Table 3** Summary of performance for Consent 3889 discharge of leachate and stormwater

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Prepare and maintain a landfill operations and management plan	Site specific monitoring programme – programme supervision	Yes
2. Install a leachate and stormwater collection and discharge system	All stormwater collection systems were inspected	Yes
3. Discharge shall not alter the receiving waters of the Patea River in the way of films, foams or suspended materials, change colour or visibility, objectionable odour, or harm to aquatic or farm animals beyond a 50 m mixing zone	Water quality monitoring of the Patea River upstream and downstream of the landfill was carried out	Yes
4. Optional review provision re environmental effects	No review option this period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

During the year, the SDC demonstrated a good level of environmental performance and compliance with the resource consents for Stratford landfill. Whilst there were no significant effects noted as result of the activity, there were some issues in regards to site management during the year under review.

## 2.4.4 Recommendations from the 2007-2009 Biennial Report

In the 2007-2009 Biennial Report, it was recommended:

THAT monitoring of the Stratford landfill in the 2009-2010 year continue at the same level as in 2008-2009.

The monitoring programme was implemented as recommended in the 2009-2010 period.

#### **2.4.5 Alterations to monitoring programmes for 2010-2011**

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

It is proposed that for 2010-2011, the monitoring programme remain unchanged from, the 2009-2010 period.

A recommendation to this effect is presented in Section 2.5 of this report and summary of recommendations is given in section 4.

### **2.5 Recommendations**

THAT monitoring of the Stratford landfill in the 2010-2011 year continue at the same level as in 2009-2010.

### **3. Huiroa and Pukengahu landfills**

These closed landfills are monitored on a triennial basis with the last round of inspection and sampling occurring in the 2008-2009 period. Subsequently there was no monitoring scheduled for this period and the next round of samples and inspections are due in 2011-2012 period.

It is recommended that for the Huiroa and Pukengahu landfills, monitoring next be implemented in the 2011-2012 period as per the triennial programme currently in place.

## **4. Summary of recommendations**

### **4.1 Stratford landfill**

THAT monitoring of the Stratford landfill in the 2010-2011 year continue at the same level as in 2009-2010.

### **4.2 Huiroa and Pukengahu landfills**

THAT that for the Huiroa and Pukengahu landfills, monitoring next be carried out in the 2011-2002 period as per the triennial programme currently in place.

## Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

Al*	aluminium
As*	arsenic
Biomonitoring	assessing the health of the environment using aquatic organisms
BOD	biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate
BODF	biochemical oxygen demand of a filtered sample
bund	a wall around a tank to contain its contents in the case of a leak
CBOD	carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate
cfu	colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample
COD	chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m
Cu*	copper
DO	dissolved oxygen
DRP	dissolved reactive phosphorus
<i>E.coli</i>	<i>Escherichia coli</i> , an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample
F	Fluoride
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
fresh	elevated flow in a stream, such as after heavy rainfall
g/m <sup>3</sup>	grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
l/s	litres per second
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
mS/m	millisiemens per metre
mixing zone	the zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH <sub>4</sub>	ammonium, normally expressed in terms of the mass of nitrogen (N)
NH <sub>3</sub>	unionised ammonia, normally expressed in terms of the mass of nitrogen (N)
NO <sub>3</sub>	nitrate, normally expressed in terms of the mass of nitrogen (N)
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water

O&G	oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons)
Pb*	lead
pH	a numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants ( e.g. metals and nutrients) to characterise the state of an environment
PM <sub>10</sub>	relatively fine airborne particles (less than 10 micrometre diameter
resource consent	refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and subsequent amendments
SS	suspended solids,
Temp	temperature, measured in °C (degrees Celsius)
Turb	turbidity, expressed in NTU
UI	Unauthorised Incident
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan
Zn*	zinc

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

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

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Taranaki Regional Council 2005: 'Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2004/05'. Technical Report 05-6, Taranaki Regional Council, Stratford

Taranaki Regional Council 2007: 'Stratford District Council, Huiroa, Pukengahu and Stratford Landfills Annual Report 2005/07'. Technical Report 07-105, Taranaki Regional Council, Stratford

## **Appendix I**

### **Resource consents held by Stratford District Council**





TRK983889

**General conditions**

- a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i) the administration, monitoring and supervision of this consent; and
  - ii) charges authorised by regulations.

**Special Conditions**

1. THAT the consent holder shall prepare and maintain a landfill operations and management plan for the site, including reinstatement details for the site, to the satisfaction of the General Manager, Taranaki Regional Council, and shall adhere to such plans as they concern the exercise of this consent.
2. THAT the consent holder shall install and operate a leachate and stormwater collection, diversion and discharge system for treatment in the Stratford District Council oxidation pond system, by 1 June 1998, to the satisfaction of the General Manager, Taranaki Regional Council.
3. THAT after allowing for reasonable mixing, within a mixing zone extending 50 metres downstream of the discharge point, 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.
4. THAT the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004 and/or June 2007, 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 consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

Signed at Stratford on 27 February 1998

For and on behalf of  
TARANAKI REGIONAL COUNCIL



DIRECTOR OF RESOURCE MANAGEMENT

TRK963890

COPY



**DISCHARGE PERMIT**

**Pursuant to the RESOURCE MANAGEMENT ACT 1991  
a resource consent is hereby granted by the  
Taranaki Regional Council**

PRIVATE BAG 713  
47 CLOTON ROAD  
STRATFORD  
NEW ZEALAND  
PHONE 0-6-765 7127  
FAX 0-6-765 5097

Name of Consent Holder: STRATFORD DISTRICT COUNCIL  
PO BOX 320 STRATFORD

Renewal Granted Date: 17 October 1996

**CONDITIONS OF CONSENT**

Consent Granted: TO DISCHARGE UP TO 230 CUBIC METRES/DAY [20 LITRES/SECOND] OF STORMWATER AND LEACHATE FROM A FORMER LANDFILL SITE ONTO AND INTO LAND IN THE VICINITY OF AN UNNAMED TRIBUTARY OF THE MAKURI STREAM IN THE PATEA CATCHMENT AT OR ABOUT GR: Q20:370-150

Expiry Date: 1 June 2016

Review Date[s]: June 2004 and June 2010

Site Location: HUIROA LANDFILL, DOUGLAS ROAD, DOUGLAS

Legal Description: ROAD RESERVE BLK IX NGATIMARU SD

Catchment: PATEA 343.000

Tributary: MAKURI 343.250  
UNNAMED TRIBUTARY

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

## GENERAL CONDITIONS

- (a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- (b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- (c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - (i) the administration, monitoring and supervision of this consent;
  - (ii) charges for the carrying out of the Council's functions under section 35 in relation to this consent; and
  - (iii) charges authorised by regulations.

## SPECIAL CONDITIONS

1. THAT the consent holder shall install and maintain stormwater drains and ground contours at the site, to the satisfaction of the General Manager, Taranaki Regional Council, in order to minimise stormwater movement across, or ponding on the site, and the maintenance of soil cover on the site.
2. THAT the consent holder shall maintain an adequate vegetative cover on the site, to the satisfaction of the General Manager, Taranaki Regional Council, to prevent dust emission or stormwater erosion of the site.
3. THAT the consent holder shall at all times adopt the best practicable option to prevent or minimise any adverse effect or any likely adverse effect on the environment associated with the discharges of leachate from the site. Without restriction or limitation, the best practicable option shall include the measures specified in conditions 1 and 2 above.
4. THAT the discharge shall not give rise to any of 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.
5. THAT the Taranaki Regional Council may review any or all of the conditions of this consent should further chemical sampling of the unnamed tributary of the Makuri Stream reveal levels of contamination resulting in or likely to result in significant adverse environmental effects.

TRK963890

COPY



PRIVATE BAG 713  
47 CLOTON ROAD  
STRATFORD  
NEW ZEALAND  
PHONE 0-6-765 7127  
FAX 0-6-765 5097

6. THAT the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2004 and/or June 2010, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at the time.

Signed at Stratford on 17 October 1996

For and on behalf of  
TARANAKI REGIONAL COUNCIL



OPERATIONS MANAGER

COPIES

TRK983891



**DISCHARGE PERMIT**

**Pursuant to the RESOURCE MANAGEMENT ACT 1991  
a resource consent is hereby granted by the  
Taranaki Regional Council**

PRIVATE BAG 713  
47 CLOTON ROAD  
STRATFORD  
NEW ZEALAND  
PHONE 0-6-765 7127  
FAX 0-6-765 5097

Name of  
Consent Holder: **STRATFORD DISTRICT COUNCIL  
PO BOX 320 STRATFORD**

Renewal  
Granted Date: **12 February 1998**

**CONDITIONS OF CONSENT**

Consent Granted: **TO DISCHARGE UP TO 910 CUBIC METRES/DAY [84  
LITRES/SECOND] OF STORMWATER AND LEACHATE FROM  
THE FORMER PUKENGAHU LANDFILL INTO AN UNNAMED  
TRIBUTARY OF THE WAIHAPA STREAM IN THE PATEA  
CATCHMENT AT OR ABOUT GR: Q20:292-016**

Expiry Date: **1 June 2016**

Review Date[s]: **June 2004 and June 2010**

Site Location: **FORMER LANDFILL, WINGROVE ROAD, STRATFORD**

Legal Description: **ROAD RESERVE WINGROVE ROAD PUKENGAHU BLK VII  
NGAERE SD**

Catchment: **PATEA 343.000**

Tributary: **WAIHAPA 343.280  
UNNAMED TRIBUTARY**

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

TRK983891

**General conditions**

- a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i) the administration, monitoring and supervision of this consent; and
  - ii) charges authorised by regulations.

**Special Conditions**

1. THAT the consent holder shall ensure, to the satisfaction of the General Manager, Taranaki Regional Council, that:
  - a) the site contours are maintained so that no ponding, damming or retention of water occurs on the site;
  - b) the integrity of the cover is maintained so as to minimise infiltration of stormwater; and
  - c) access to the site is restricted so that illegal dumping of wastes is discouraged.
2. THAT allowing for a mixing zone of 50 metres downstream of the discharge, the discharge shall not give rise to any of the following effects in the unnamed tributary of the Waihapa 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 effects on aquatic life.
3. THAT the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004 and/or June 2010, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

Signed at Stratford on 12 February 1998

For and on behalf of  
TARANAKI REGIONAL COUNCIL

  
\_\_\_\_\_  
DIRECTOR—RESOURCE MANAGEMENT

## **Appendix II**

### **Biomonitoring reports**



**To** Monitoring Manager-Environmental Quality, K Brodie  
 Scientific Officer, S Cowperthwaite  
**From** Scientific Officer, C R Fowles  
**File** 0196 & 3889  
**Doc No** 758031  
**Report No** CF501  
**Date** 17 May 2010

## Biomonitoring of the Patea River in relation to the Stratford District Council's landfill and Wastewater Treatment Plant, surveyed in February 2010

### 1. Methods

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from three established sites and one recently established site in the Patea River (illustrated in Figures 1 and 2), on 2 February 2010.

These sites were:

Site No	Site code	Map reference	Location
1	PAT 000315	Q20: 219 062	Swansea Road bridge (upstream of landfill and oxidation ponds' discharge)
2	PAT 000330	Q20: 224 063	Upstream of WWTP discharge (and downstream of landfill)
3a	PAT 000350	Q20: 231 060	Approximately 130m downstream of the WWTP new outfall
4	PAT 000356	Q20: 246 068	Approximately 1 km upstream of the Kahouri Stream confluence

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 in the current survey as it had been established that no effects of intermittent usage of the old outfall (which had continued to leak to the river prior to plugging and diversion to the new outfall) had occurred on the biological communities at this site (CF486) and no discharge from the 'old' outfall was occurring at the time of this survey.

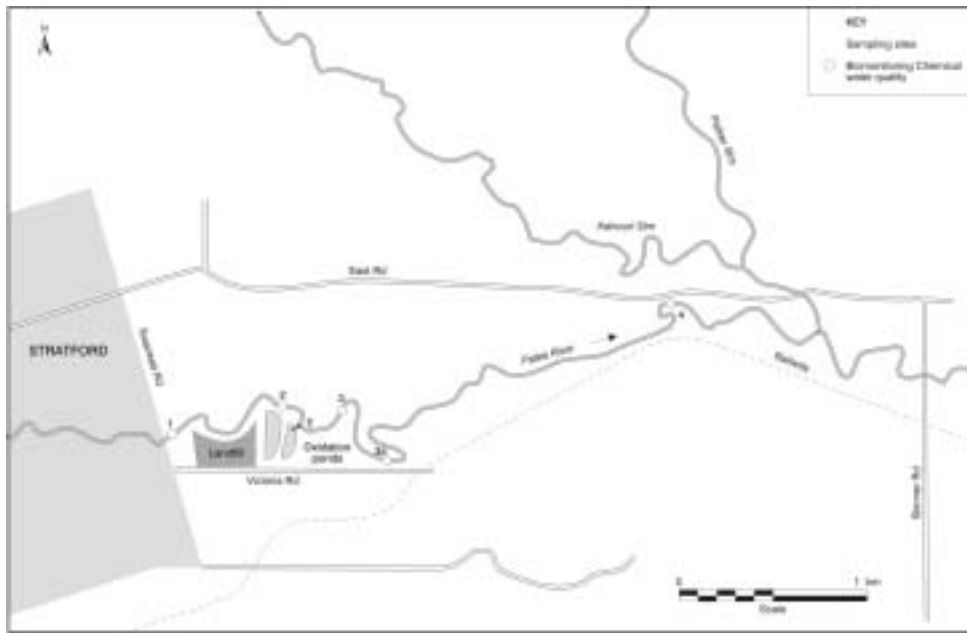
This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

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

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

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

A semi-quantitative MCI value, 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).



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



**Figure 2** Aerial photo of site and location of sampling sites

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

## 2. Results and discussion

This survey was performed during a lengthy, low recession flow, 52 days after a fresh in excess of 3x median flow and 76 days after a fresh in excess of 7x median flow and during a lengthy dry period. River flow at Skinner Road was gauged at 1.35 m<sup>3</sup>/sec representing a flow well below the average monthly mean February flow (2.87 m<sup>3</sup>/sec) but above the minimum mean monthly flow for February (0.64 m<sup>3</sup>/sec) recorded for the period 1978-2009. This flow was lower by about 0.16 m<sup>3</sup>/sec than the flow at the time of the summer 2009 biomonitoring survey.

Periphyton mats were thin at all sites except site 4 where mats were patchy, while filamentous algal growth was patchy at all four sites. The algal component of the oxidation pond discharge was moderate with none trapped amongst the substrate at either of the downstream sites. Patchy moss was recorded on the stony substrates at all of the sites. All sites were partially shaded. Water temperatures ranged from 14.0°C to 16.1°C at the four sites at the time of this mid morning survey. The discharge via the rock rip-rap at the new outfall was pale greenish-khaki and slightly turbid in appearance but caused minimal visual increase in turbidity in the river at sites 3a or 4 downstream of the outfall.

### 2.1 Macroinvertebrate communities

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

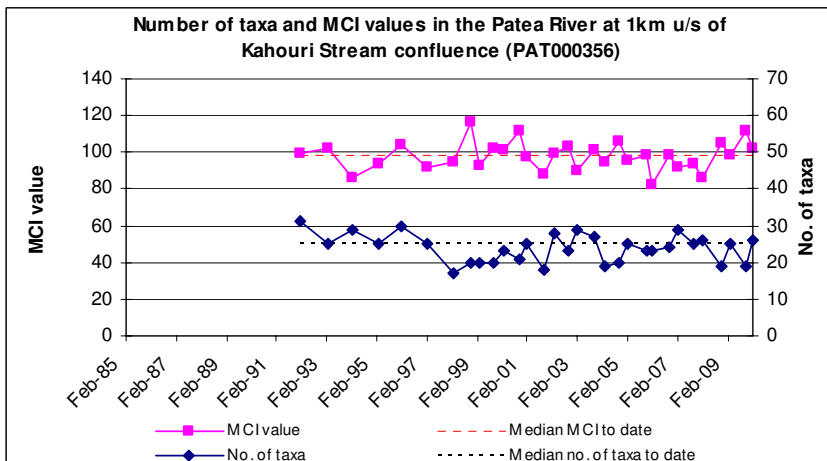
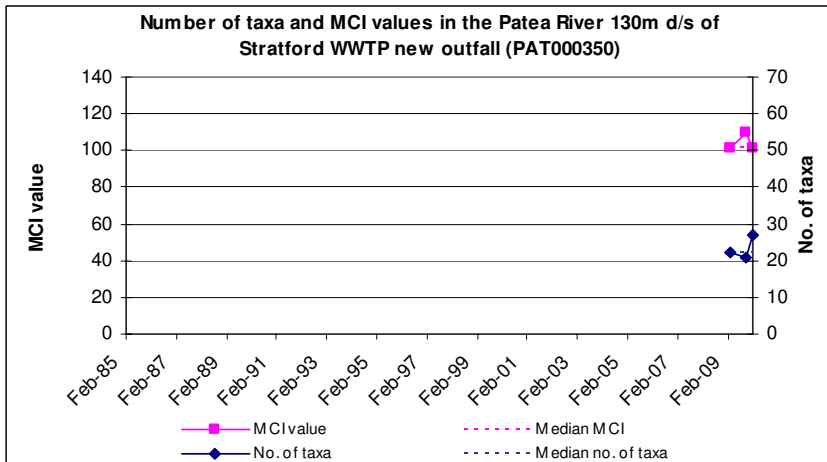
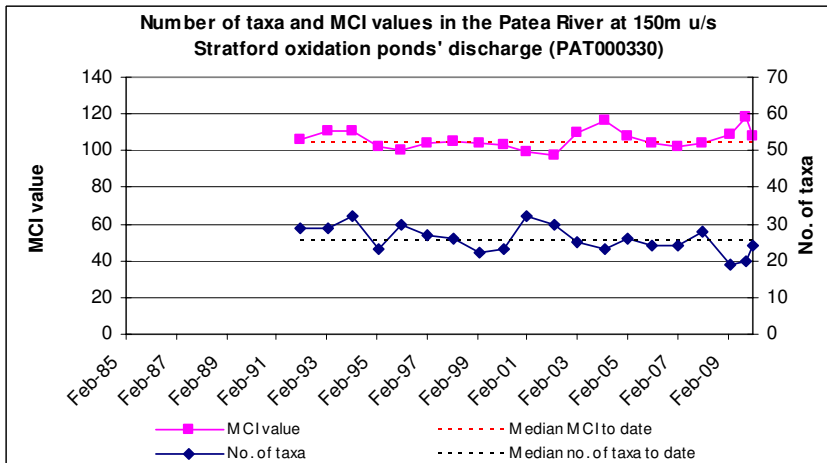
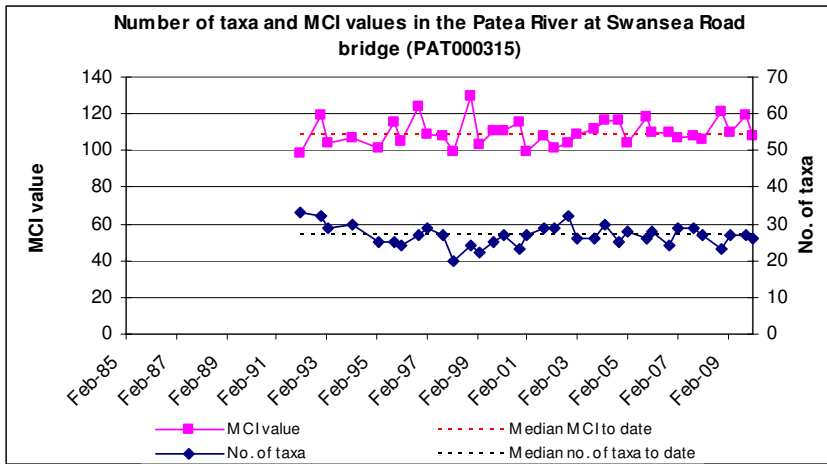
**Table 1** Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between February 1985 and November 2009

Site	No of surveys	Taxa numbers		MCI Values	
		Range	Median	Range	Median
1	35	20-33	27	98-130	109
2	26	11-36	25	96-118	104
3a	2	21-22	22	101-110	106
4	30	17-31	25	82-116	98

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

The results from the current survey (Table 2) indicated near or above median faunal richnesses (ranging from 24 to 27 taxa) present at each of the four river sites. These taxa numbers were within ranges previously recorded (Table 1) at all sites with the richnesses ranging from one fewer than median to up to 5 taxa above the median numbers of previous surveys.

The range of taxa richnesses was generally typical of most richnesses recorded by previous summer surveys which have been recorded under widespread periphyton cover and varying flow conditions. [An exception had been the impacts of the frequent and high flood flows recorded during the very wet month of February 2004 which impacted on the macroinvertebrate communities throughout the river to varying degrees, reducing taxa richness and/or abundances within taxa].



**Figure 3** Taxa richness and MCI scores recorded to date at the four Patea River sites

**Table 2** Macroinvertebrate fauna of the Patea River in relation to Stratford District Council WWTP discharge and closed landfill leachate discharges sampled on 2 February 2010

Taxa List	Site Number	MCI score	1	2	3a	4
	Site Code		PAT000315	PAT000330	PAT000350	PAT000356
	Sample Number		FWB10051	FWB10052	FWB10053	FWB10054
ANNELIDA (WORMS)	Oligochaeta	1	C	A	VA	A
MOLLUSCA	<i>Physa</i>	3	-	-	C	R
	<i>Potamopyrgus</i>	4	R	-	-	R
CRUSTACEA	<i>Paracalliope</i>	5	-	-	-	R
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	R	-	R	-
	<i>Coloburiscus</i>	7	XA	XA	A	A
	<i>Deleatidium</i>	8	XA	XA	VA	A
	<i>Nesameletus</i>	9	VA	VA	R	R
	<i>Zephlebia group</i>	7	-	-	-	R
PLECOPTERA (STONEFLIES)	<i>Megaleptoperla</i>	9	-	R	-	-
	<i>Zelandobius</i>	5	-	-	R	-
	<i>Zelandoperla</i>	8	C	R	-	R
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA	VA	A
	Hydraenidae	8	C	C	R	A
	Ptilodactylidae	8	-	-	R	-
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	A	A	A	A
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	VA	VA	XA	XA
	<i>Costachorema</i>	7	C	C	A	A
	<i>Hydrobiosis</i>	5	C	C	A	A
	<i>Neurochorema</i>	6	R	-	R	C
	<i>Psilochorema</i>	6	R	-	-	-
	<i>Olinga</i>	9	R	R	-	R
	<i>Oxyethira</i>	2	-	-	R	R
	<i>Pycnocentroides</i>	5	R	R	R	-
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	VA	A	A	A
	Eriopterini	5	R	R	C	R
	<i>Maoriamesa</i>	3	R	R	VA	VA
	Orthocladiinae	2	A	VA	A	A
	<i>Polypedilum</i>	3	C	C	-	-
	Tanypodinae	5	C	R	R	-
	Tanytarsini	3	R	C	A	A
	Empididae	3	-	-	R	R
	Muscidae	3	-	R	A	R
	<i>Austrosimulium</i>	3	R	R	-	R
	Tanyderidae	4	R	R	R	-
ACARINA (MITES)	Acarina	5	-	-	R	-
No of taxa			26	24	27	26
MCI			108	108	101	102
SQMCIs			6.9	6.7	4.3	4.3
EPT (taxa)			12	10	10	10
%EPT (taxa)			46	42	37	38
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa		

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

### 2.1.1 Sites upstream of WWTP discharge (sites 1 and 2)

The macroinvertebrate communities of this reach of the river upstream of the WWTP discharge (and adjacent to the landfill) were characterised by two 'highly sensitive' taxa (mayflies (extremely abundant, *Deleatidium*; and *Nesameletus*)); four 'moderately sensitive' taxa (mayfly (*Coloburiscus*), dobsonfly (*Archichauliodes*), elmid beetles, and crane fly (*Aphrophila*)); and up to three 'tolerant' taxa (oligochaete worms, net-building caddisfly (*Aoteapsyche*), and orthoclad midges). These dominant taxa were very similar to those characteristic of these sites at the times of past summer low flow surveys although slightly fewer in number. Most of the more 'tolerant' taxa are commonly associated with the periphyton assemblages typical of the mid and lower reaches of Taranaki rivers and streams during periods of low recession flows. The presence of four to five 'highly sensitive' taxa at each of the sites within this surveyed reach of the river, was indicative of relatively good preceding physicochemical water quality upstream and adjacent to the Stratford landfill and WWTP despite the lengthy low recession flow period preceding this survey. MCI scores (both 108) reflected the moderate proportion of 'tolerant' taxa (35 to 38%) comprising the fauna at these sites, with these scores within 5 units of medians of previous scores (Table 1). These scores were an insignificant 5 to 7 units lower than predicted for sites at these altitudes (280 to 300m asl) and an insignificant 5 to 6 units higher than predicted for sites this distance from the National Park (12.9 to 13.6 km) in ringplain rivers (Stark & Fowles, 2009). These scores categorised these sites as having 'good' river health (TRC, 2009) at the time of this summer survey, and typical of scores recorded to date under summer low flow conditions at these two sites (Figure 2). The absence of any significant differences in individual taxon abundances between sites, together with no downstream decrease in MCI scores, were indicative of no impacts of landfill leachate seepage on the macroinvertebrate communities of these adjacent sites.

### 2.1.2 Sites downstream of WWTP new discharge outfall (sites 3a and 4)

These sites' macroinvertebrate communities differed in taxa richnesses by only one taxon and there were only a few significant differences in characteristic taxa compared with those at the upstream sites 1 and 2. Two 'sensitive' mayfly taxa (*Nesameletus* and *Coloburiscus*) were less abundant, while 'tolerant' muscid flies and *Maoridiamesa* midges increased in abundances. These relatively minor changes in community composition and a small increase in the proportion of 'tolerant' taxa (37% and 42% of faunal numbers) resulted in insignificant decreases in the MCI scores at sites 3a and 4 (101 and 102 units) which were statistically insignificantly lower (by 6 to 7 units) than scores in the river reach immediately upstream of the discharge from the WWTP. These differences in scores were indicative of no recent impacts of the upgraded WWTP wastes discharge on the macroinvertebrate fauna in the surveyed reach of the Patea River, with the downstream sites' scores 5 units lower to 4 units higher than the relevant medians of past scores. There was minimal difference in MCI scores (1 unit) between the two adjacent downstream sites (3a and 4) and the overall fall in MCI scores (6 units) over a distance of 4.3 km between the 'control' site (1) and furthest downstream site (4) was insignificant given the distance between these two sites. However, there was a significant drop in SQMCI<sub>s</sub> score of 2.4 units immediately downstream of the new outfall (site 3a) but no further drop in SQMCI<sub>s</sub> score at site 4, principally as a result of decreased abundances of the 'highly sensitive' mayflies (*Deleatidium* and *Nesameletus*) and increased abundances of very 'tolerant' oligochaete worms and two other 'tolerant' taxa.

The MCI scores categorised sites 3a and 4 as having 'good' river health (TRC, 2009) at the time of this summer survey. These scores (101 and 102 units) were an insignificant 10 and 8 units lower than predicted for sites at these altitudes (265 and 250m asl) in ringplain rivers and an insignificant 0 to 2 units above predicted scores for these sites 14.8 km and 17.2 km downstream of the National Park boundary (Stark and Fowles, 2009).

The 6 unit difference in MCI scores between sites 1 ('control') and site 4 over a river distance of 4.3km represented an insignificantly 3 unit larger difference than predicted for this reach of the Patea River some 13 to 17 km below the National Park boundary (Stark and Fowles, 2009), indicative of minor impacts of point source discharges and landfill leachate under summer low flow conditions.

## **2.2 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 during a period of summer low recession flow conditions. This was consistent with the visual absence of such growths noted at all sites at the time of the survey. Also there was no increase in algal deposition downstream of the new relocated outfall.

## **3. Conclusions**

Typical macroinvertebrate communities richnesses were surveyed at the four Patea River sites during a low flow recession period in the latter part of summer and under conditions varying from thin to patchy periphyton river substrate cover (mats and filamentous algae). Minimal discolouration of the river's reach below the WWTP's newly located discharge was apparent and there was no algal deposition on the river bed, as a result of the moderate algal concentration in the upgraded divisions of the second oxidation pond. Faunal communities upstream of the WWTP discharge had slightly higher percentages of 'sensitive' taxa whereas communities at downstream sites had small increases in percentages of 'tolerant' taxa.

MCI scores, relatively typical of mid-catchment ringplain rivers in Taranaki, particularly under summer low flow conditions, and a relatively narrow range (7 units) along the four sites through the 4.5 km reach of the Patea River. No impacts of seepage from the Stratford landfill (situated between sites 1 and 2) were indicated by the faunal composition at these sites. A small increase in number of 'tolerant' taxa, together with slightly fewer 'highly sensitive' taxa downstream of the WWTP's newly relocated discharge, resulted in insignificantly lower MCI scores. There were few significant changes in individual taxon abundances (as reflected in lower SQMCI<sub>s</sub> values) 2.4 km downstream of the wastewater discharge.

No 'undesirable heterotrophic growths were found on the substrate of the river at the sites surveyed downstream of the discharge under these summer low recession flow conditions and there was no deposition of oxidation ponds' algae on the river bed.

Effects of discharges on the macroinvertebrate communities of the Patea River vary in relation to the treatment provided by the WWTP, dilution available in the receiving waters, preceding climatic conditions and the microfloral component of the wastewaters. Such variations in effects have been documented by previous biomonitoring surveys with this survey illustrating no significant effects during a

lengthy recession flow period of the treated wastewater discharge from the recently relocated rock riprap outfall following WWTP upgrade.

#### 4. Summary

The Council's standard 'kick-sampling' technique was used at three established and one recently established sites to collect streambed macroinvertebrates from the Patea River. Samples were sorted and identified and the number of taxa (richness), MCI score and SQMCI<sub>5</sub> score were calculated for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>5</sub> takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI<sub>5</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This February 2010 macroinvertebrate survey indicated that the discharge of treated oxidation ponds wastes from the recently upgraded Stratford WWTP system had had no significant effects on the macroinvertebrate communities of the Patea River under low river flow conditions and coincident with a moderate microfloral population of the final division of the second oxidation pond. No significant changes in macroinvertebrate communities' compositions were recorded between the upstream 'control' site and sites downstream of the newly relocated wastewater outfall. There were also no significant effects associated with seepages from the closed landfill site.

The macroinvertebrate communities of the Patea River contained slightly higher proportions of 'sensitive' taxa at upstream sites and the communities were generally dominated by more 'sensitive' than 'tolerant' taxa at these (two) sites. 'Tolerant' taxa were slightly more predominant proportionately and numerically at the two sites downstream of the newly located WWTP discharge where slightly fewer 'highly sensitive' taxa were present. Taxonomic richnesses (numbers of taxa) were slightly higher at the time of this summer survey compared to richnesses of the previous late summer survey, coincident with moderate periphyton growth on the river bed at the time of these surveys.

MCI and SQMCI<sub>5</sub> scores indicated that the upstream stream communities were of 'good' health (TRC, 2009) and generally typical of conditions recorded in the mid reaches of similar Taranaki ringplain rivers. Stream communities downstream of the WWTP discharge were also of 'good' health and were slightly better than those documented by the previous summer survey, due to an absence of algal deposition (as a result of a lower algal population in the upgraded final division of the second oxidation pond) during the latest summer recession flow conditions.

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**To** Monitoring Manager - Environmental Quality, K Brodie  
**From** Scientific Officer, C R Fowles  
**File** 0196  
**Doc No** 697491  
**Report No** CF491  
**Date** 6 July 2009

## Spring biomonitoring of the Patea River in relation to the upgraded Stratford District Council's Wastewater Treatment Plant, November 2009

### 1. Introduction

The recent upgrading of the wastewater treatment plant (WWTP), required by conditions attached to the renewed consent 0196 (TRC, 2009), became the subject of an additional investigative assessment of the upgrade's effectiveness in terms of system performance and its effects on the receiving waters of the Patea River. A component of the assessment included this spring biomonitoring survey of the river specifically in association with the upgraded treatment system and relocated, improved outfall structure (some 600 m downstream of the original outfall which has been sealed off). The current survey complements the previous (summer) survey (CF486) performed soon after completion of the WWTP upgrade.

### 2. Methods

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from three established sites and one recently established site in the Patea River (illustrated in Figures 1 and 2), on 6 November 2009.

These sites were:

Site No	Site code	Map reference	Location
1	PAT 000315	Q20: 219 062	Swansea Road bridge (upstream of landfill and oxidation ponds' discharge)
2	PAT 000330	Q20: 224 063	Upstream of WWTP discharge (and downstream of landfill)
3a	PAT 000350	Q20: 231 060	Approximately 130m downstream of the WWTP new outfall
4	PAT 000356	Q20: 246 068	Approximately 1 km upstream of the Kahouri Stream confluence

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 'old' outfall was occurring at the time of this survey.

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

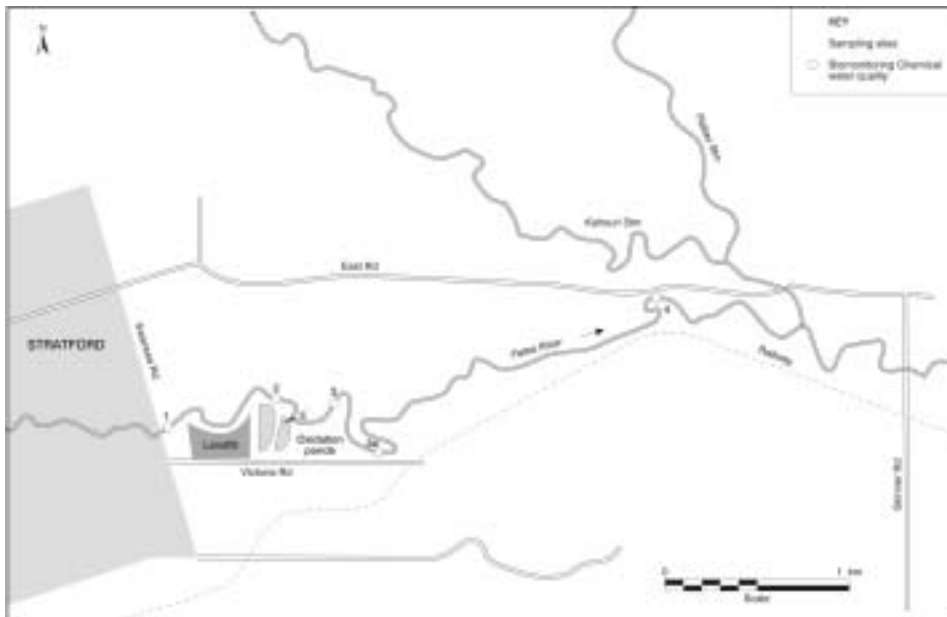
Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each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

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= 20-99 individuals;
VA (very abundant)	= 100-499 individuals;

XA (extremely abundant) = 500 or more individuals.

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

A semi-quantitative MCI value, 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).



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

**Figure 2** Aerial photo of site and location of sampling sites

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

### 3. Results and discussion

This survey was performed during a moderately low recession flow, 8 days after a fresh in excess of 3x median flow and 10 days after a fresh in excess of 7x median flow and following a wet early spring period. River flow at Skinner Road was 2.75 m<sup>3</sup>/sec representing a flow below the average monthly mean November flow (4.61 m<sup>3</sup>/sec) but well above the minimum mean monthly flow for November (1.26 m<sup>3</sup>/sec) recorded for the period 1978-2009. This flow was lower (by about 1.44 m<sup>3</sup>/sec) than the flow at the time of the previous summer 2009 biomonitoring survey.

Periphyton mats were patchy at all sites except site 1 where mats were relatively thin, while filamentous algal growth was patchy at sites 3a and 4. Patchy moss was recorded on the stony substrates at all of the sites. The algal component of the oxidation pond discharge was minimal and none were trapped amongst the substrate at either of the downstream sites. All sites were partially shaded. Water temperatures ranged from 11.3°C to 13.0°C at the four sites at the time of this mid morning survey. The discharge via the rock rip-rap at the new outfall was slightly cloudy but colourless in appearance and caused no obvious increase in turbidity in the river at sites 3a or 4 downstream of the outfall.

#### 3.1 Macroinvertebrate communities

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

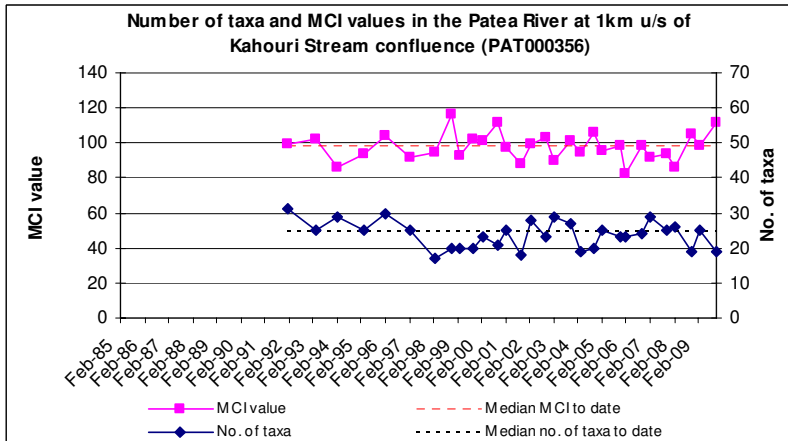
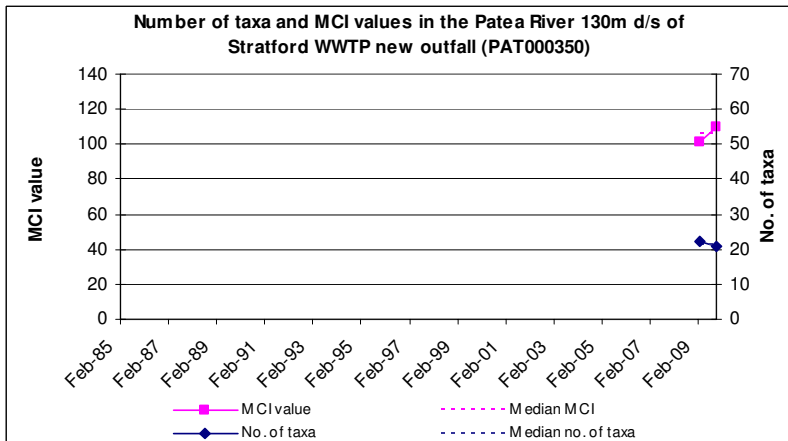
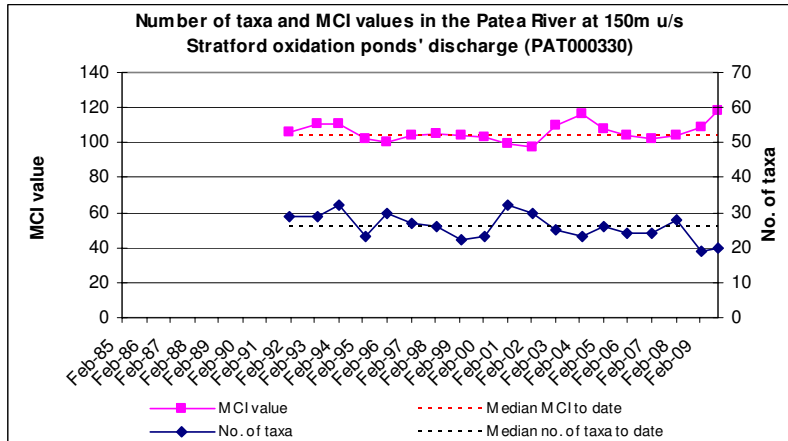
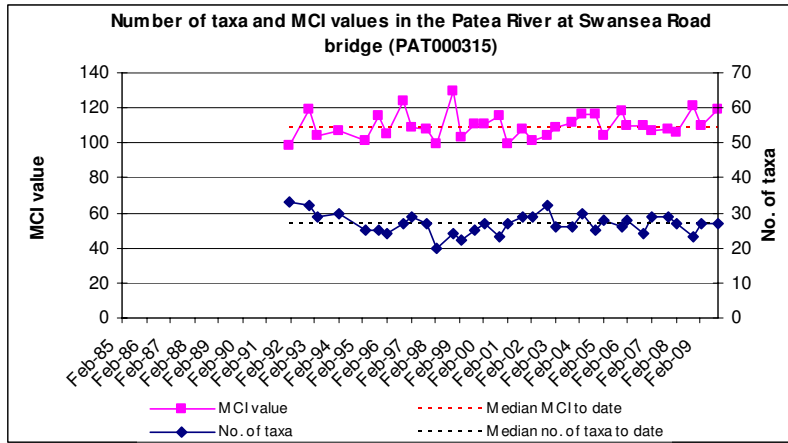
**Table 1** Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between February 1985 and March 2009

Site	No of surveys	Taxa numbers		MCI Values	
		Range	Median	Range	Median
1	34	20-33	27	98-130	109
2	25	11-36	25	96-116	104
3a	1	-	22	-	101
4	29	17-31	25	82-116	98

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

The results from the current survey (Table 2) indicated near or below median faunal richnesses (ranging from 19 to 27 taxa) present at each of the four river sites. These taxa numbers were within ranges previously recorded (Table 1) at all sites with the richnesses ranging from median to up to 6 taxa below the median values of previous surveys. The richness at the most recently established site (site 3a) was only one taxon below the previous richness recorded by the summer survey.

The range of taxa richnesses was generally typical of most richnesses recorded by previous surveys which have been recorded under summer, more widespread periphyton cover and varying flow conditions.



**Figure 3** Taxa richness and MCI scores recorded to date at the Patea River sites

**Table 2** Macroinvertebrate fauna of the Patea River in relation to Stratford District Council WWTP discharge and closed landfill leachate discharges sampled on 6 November 2009

Taxa List	Site Number	MCI score	1	2	3a	4
	Site Code		PAT000315	PAT000330	PAT000350	PAT000356
	Sample Number		FWB09305	FWB09306	FWB09307	FWB09308
ANNELIDA (WORMS)	Oligochaeta	1	-	-	A	R
MOLLUSCA	<i>Potamopyrgus</i>	4	-	-	R	R
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	R	-	C	R
	<i>Coloburiscus</i>	7	XA	VA	VA	VA
	<i>Deleatidium</i>	8	XA	XA	XA	XA
	<i>Nesameletus</i>	9	A	VA	R	C
	<i>Zephlebia group</i>	7	R	-	-	R
PLECOPTERA (STONEFLIES)	<i>Acroperla</i>	5	C	C	C	C
	<i>Austroperla</i>	9	R	-	-	-
	<i>Megaleptoperla</i>	9	R	-	-	-
	<i>Zelandobius</i>	5	R	R	R	-
	<i>Zelandoperla</i>	8	A	C	R	R
COLEOPTERA (BEETLES)	Elmidae	6	A	C	C	C
	Hydraenidae	8	C	C	R	R
	Ptilodactylidae	8	-	R	-	-
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	R	R	R	R
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	C	C	C	R
	<i>Costachorema</i>	7	R	C	C	C
	<i>Hydrobiosis</i>	5	-	-	-	R
	<i>Neurochorema</i>	6	R	-	R	-
	<i>Beraeoptera</i>	8	A	C	-	-
	<i>Confluens</i>	5	R	R	-	-
	<i>Pycnocentroides</i>	5	A	R	R	-
	<i>Tripectides</i>	5	R	-	-	-
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	A	A	A	A
	Eriopterini	5	R	R	R	-
	<i>Maoriamesa</i>	3	C	C	A	VA
	Orthoclaadiinae	2	C	R	A	A
	Tanypodinae	5	R	-	-	-
	Tanytarsini	3	R	R	C	R
	<i>Austrosimulium</i>	3	R	-	-	-
No of taxa			27	20	21	19
MCI			119	118	110	112
SQMCIs			7.3	7.8	7.1	6.9
EPT (taxa)			17	11	11	10
%EPT (taxa)			63	55	52	53
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa		

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

### 3.1.1 Sites upstream of WWTP discharge (sites 1 and 2)

The macroinvertebrate communities of this reach of the river upstream of the WWTP discharge (and adjacent to the landfill) were characterised by up to four 'highly sensitive' taxa (mayflies (extremely abundant, *Deleatidium*; and *Nesameletus*), stonefly (*Zelandoperla*), and flare-cased caddisfly (*Beraeoptera*)); up to four 'moderately sensitive' taxa (extremely abundant mayfly (*Coloburiscus*), elmid beetles, stony-cased caddisfly (*Pycnocentroides*), and crane fly (*Aphrophila*)); but no 'tolerant' taxa. These dominant taxa were dissimilar to those characteristic of these sites at the times of past summer low flow surveys with an increase in the number of 'sensitive' taxa and absence of 'tolerant' taxa which are commonly associated with the extensive periphyton assemblages typical of the mid and lower reaches of Taranaki rivers and streams during periods of low recession flows. The presence of six to seven 'highly sensitive' taxa at each of the sites within this surveyed reach of the river, was indicative of relatively good preceding physicochemical water quality upstream and adjacent to the Stratford landfill and WWTP under moderately low recession flow conditions. MCI scores (118 to 119) reflected the significant proportion of 'sensitive taxa (80 to 81%) comprising the fauna at these sites, with these scores 10 to 14 units above medians of previously recorded scores and two units higher than the previous maximum recorded at site 2 (Table 1). These scores were 3 to 4 units higher than scores predicted for sites at these altitudes (280 to 300 m asl) and a significant 16 units higher than predicted for sites this distance from the National Park (12.9 to 13.6 km) in ringplain rivers (Stark & Fowles, 2009). These scores categorised these sites as having 'good' river health (TRC, 2009a) at the time of this spring survey, and generally above scores recorded to date under summer low flow conditions at these two sites (Figure 2). The virtual absence of significant differences in individual taxon abundances between sites, together with a statistically insignificant (Stark 1998) downstream decrease of 1 MCI unit, were indicative of no impacts of the adjacent closed landfill on the macroinvertebrate communities.

### 3.1.2 Sites downstream of WWTP new discharge outfall (sites 3a and 4)

These sites' macroinvertebrate communities differed in taxa richnesses by only two taxa and the communities were characterised by one 'highly sensitive' taxon (extremely abundant mayfly (*Deleatidium*)); two 'moderately sensitive' taxa (mayfly (*Coloburiscus*) and crane fly (*Aphrophila*)); and up to three 'tolerant' taxa (oligochaete worms and midges (*Maoridiamesa* and orthoclads)). There were only a few significant differences in characteristic taxa compared with those at the upstream sites 1 and 2. One 'sensitive' mayfly taxon (*Nesameletus*) was less abundant, while 'tolerant' oligochaete worms and orthoclad midges in particular, increased in abundance. These relatively minor changes in community composition and a small decrease in the proportion of 'sensitive' taxa (71% and 68% of faunal numbers) resulted in insignificant decreases (of 6 to 8 units) in the MCI scores at sites 3a and 4 (110 and 112 units) which were statistically insignificantly lower than the score obtained in the river reach immediately upstream of the discharge from the WWTP. These differences in scores were indicative of minimal recent impacts of the upgraded WWTP wastes discharge on the macroinvertebrate fauna in the surveyed reach of the Patea River, with the downstream sites' scores 9 to 14 units higher than the relevant medians of past scores. There was minimal difference in MCI scores (2 units) between the two adjacent downstream sites (3a and 4) and the overall fall in MCI scores (7 units) over a distance of 4.3 km between the 'control' site (1) and furthest downstream site (4) was insignificant given the distance between these two sites. There was an insignificant drop in SQMCI<sub>s</sub> score (0.7 unit) immediately downstream of the new outfall (site 3a) and minimal further drop in SQMCI<sub>s</sub> score of 0.2 unit at site 4.

The MCI scores categorised sites 3a and 4 as having 'good' river health (TRC, 2009a) at the time of this winter survey, some improvement on the 'fair' health at the lower site recorded by the previous summer survey. These scores (110 and 112 units) were an insignificant 1 unit lower to 2 units higher than predicted for sites at these altitudes (265 and 250 m asl) in ringplain rivers and an insignificant 9 to a significant 12 units above predicted scores for these sites 14.8 km and 17.2 km downstream of the National Park boundary (Stark and Fowles, 2009).

The 7 unit difference in MCI scores between sites 1 ('control') and site 4 over a river distance of 4.3km represented an insignificantly 4 unit larger difference than predicted for this reach of the Patea River some 13 to 17 km below the National Park boundary (Stark and Fowles, 2009), indicative of very minor impacts of point source discharges and landfill leachate under spring, relatively low flow conditions.

### **3.2 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 during a period of spring relatively low recession flow conditions. This was consistent with the visual absence of such growths noted at all sites at the time of the survey. Also there was no increase in algal deposition at the site downstream of the new relocated outfall.

## **4. Conclusions**

Better than typical macroinvertebrate communities richnesses were surveyed at the four Patea River sites during a relatively low flow recession period in the latter part of spring and under conditions varying from thin to patchy mats of periphyton river substrate cover (and none to patchy filamentous algae). This additional (spring) survey was performed as a component of investigative monitoring contractual work in relation to the assessment of the performance of the recently upgraded WWTP. No discolouration of the river's reach below the WWTP's newly located discharge was apparent and there was no algal deposition on the river bed, as a result of the low algal concentration in the recently partitioned second oxidation pond. Faunal communities upstream of the WWTP discharge had slightly higher percentages of 'sensitive' taxa whereas communities at downstream sites had small increases in percentages of 'tolerant' taxa, and a higher number of dominant 'tolerant' taxa, although 'sensitive' taxa proportions were higher throughout the river than typical of summer communities.

MCI scores, higher than typical of mid-catchment ringplain rivers in Taranaki, particularly those found during summer low flow conditions, showed a moderate range (12 units) along the four sites through the 4.5 km reach of the Patea River. No impacts of seepage from the Stratford landfill (situated between sites 1 and 2) were indicated by the faunal composition at these sites. A small increase in number of 'tolerant' taxa, together with slightly fewer 'highly sensitive' taxa downstream of the WWTP's newly relocated discharge, resulted in insignificantly lower MCI scores at these sites. There were few significant changes in individual taxon abundances (as reflected in minimal reductions in SQMCI<sub>s</sub> values) 2.4 km downstream of the wastewater discharge.

No 'undesirable heterotrophic growths were found on the substrate of the river at the sites surveyed downstream of the discharge under these spring low recession flow conditions and there was no deposition of oxidation ponds' algae on the river bed.

Effects of discharges on the macroinvertebrate communities of the Patea River vary in relation to the treatment provided by the WWTP, dilution available in the receiving waters, preceding climatic conditions and the microfloral component of the wastewaters. Such variations in effects have been documented by previous summer biomonitoring surveys with this spring survey illustrating no significant effects, during a relatively short recession flow period, below the discharge from the recently relocated rock riprap outfall following WWTP upgrade.

## 5. Summary

The Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Patea River. Samples were sorted and identified and the number of taxa (richness), MCI score and SQMCI<sub>s</sub> score were calculated for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>s</sub> takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI<sub>s</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This spring 2009 macroinvertebrate survey indicated that the discharge of treated oxidation ponds wastes from the recently upgraded Stratford WWTP system had had no significant effects on the macroinvertebrate communities of the Patea River under spring moderately low river flow conditions. No significant changes in macroinvertebrate communities' compositions were recorded between the upstream 'control' site and sites downstream of the newly relocated outfall from the WWTP. There were also no significant effects associated with seepages from the closed landfill site.

The macroinvertebrate communities of the Patea River contained slightly higher proportions of 'sensitive' taxa at upstream sites and the communities were dominated by more 'sensitive' taxa at these (two) sites. 'Tolerant' taxa were slightly more predominant proportionately and numerically at the two sites downstream of the newly located WWTP discharge where slightly fewer 'highly sensitive' taxa were present. Taxonomic richnesses (numbers of taxa) were relatively similar in this spring survey compared to the previous survey conducted in late summer, but fewer 'tolerant' taxa were present coincident with a reduction in periphyton growth on the river bed at the time of the latest spring survey

MCI and SQMCI<sub>s</sub> scores indicated that the upstream stream communities were of 'good' health (TRC, 2009a) and slightly better than typical of conditions recorded in summer in the mid reaches of similar Taranaki ringplain rivers. Stream communities downstream of the WWTP discharge were of 'good' health and were better than those documented by the previous survey during summer recession low flow conditions.

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