

NPDC – Colson Road Landfill
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-68

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Executive summary

The New Plymouth District Council (NPDC) operates a regional landfill located on Colson Road, New Plymouth, in the Waiwhakaiho catchment. The landfill is currently filling stage three of the site which has a design capacity of approximately 800,000 cubic metres. Stages one and two have been closed and are fully reinstated. This report, for the period July 2015 to June 2016, describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the consent holder's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the consent holder's activities.

Overall, NPDC demonstrated an overall poor level of environmental performance.

NPDC holds a total of eight resource consents in relation to the Colson Road landfill. These consents contain a total of 100 special conditions setting out the requirements that NPDC must satisfy. NPDC holds one consent to discharge uncontaminated stormwater into the Puremu Stream, two consents to discharge leachate and contaminated stormwater into the Puremu Stream, two consents to discharge emissions into the air, one consent to discharge solids onto and into land and one consent to discharge stormwater from earthworks. NPDC also holds one consent to divert water.

The Council's monitoring programme for the year under review included 12 inspections, eight stormwater/discharge samples, 19 surface water samples, seven groundwater samples, two biomonitoring surveys of receiving waters, and three air quality surveys. NPDC also collected seven leachate samples and two under-liner drainage samples for physicochemical analysis.

At inspection issues were found in regards to site management, and although most of them were resolved and none resulted in significant off site effects, a number of issues were recurrent, or remained unresolved at the end of the monitoring period.

Groundwater and under liner drainage sampling indicated that there is no significant contamination occurring in the local aquifer as a result of the landfill's presence.

Chemical and bacteriological monitoring of the Puremu and Manganaha Streams found that the receiving water quality criteria on the consents were met at the time of the three sampling surveys, with the exception of a minor breach of a suspended solids limit on one occasion, and a breach of the ammoniacal nitrogen limit on another occasion. Due to the conditions prevailing at the time of sampling, any effects were less than minor and transient at most.

Although biomonitoring found that the macroinvertebrate results were indicative of poor biological health at some of the Puremu Stream sites, this was considered to be a reflection of the poor habitat conditions at these sites. It was concluded that the results were not indicative of any significant adverse effects on either the Puremu Stream or the Manganaha Stream from the discharges from the Colson Road landfill at the time of 2015-2016 surveys.

Air quality monitoring showed that off site suspended particulates and dust deposition rates were within guideline level beyond the site boundary.

There were eight odour complaints received in the 2015-2016 period that were associated with the Colson Road landfill. Although it was found that the site was compliant with

consent conditions at the time of investigation, and on two occasions there were no odours found, weak or noticeable odours were found on six occasions.

Overall, NPDC demonstrated a poor level of environmental performance and an improvement was desirable in their administrative compliance with the resource consents. During the year under review there were fugitive odorous gases being emitted into the air from numerous locations onsite, without proper treatment prior to discharge, which had the potential to cause significant adverse effects. There were on-going non compliances with the management plan with respect to cover requirements and management of special waste that were likely to have been contributing to the fugitive landfill gas emissions. Some improvements, trials and investigations were undertaken during the year under review, however further improvement is required.

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

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance deteriorated in the year under review. Improvements were being made at the end of the 2015-2016 and start of the 2016-2017 years.

This report includes recommendations for the 2016-2017 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2015 to June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by New Plymouth District Council (NPDC). NPDC operates a regional landfill situated on Colson Road, New Plymouth, in the Waiwhakaiho catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by NPDC that relate to discharges of water, discharge to land and a stream diversion within the Waiwhakaiho catchment, and the two air discharge permits held by NPDC to cover emissions to air from the Colson Road landfill.

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 the NPDC's use of water, land, and air, and is the 16th site specific Annual Report by the Council for NPDC covering only this site. Prior to this, during the period from 1990-1999, the Council produced 10 combined NPDC landfills' Annual Reports that included the Colson Road landfill.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites through annual programmes;
- the resource consents held by NPDC in the Waiwhakaiho catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at this NPDC landfill site.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretation, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2016-2017 monitoring year.

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

1.1.3 The Resource Management Act (1991) and monitoring

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

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

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

1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by the consent holder during the period under review, this report also assigns them a rating for their environmental and administrative performance during the period under review.

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

Administrative performance is concerned with the consent holder's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

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

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

Environmental Performance

- **High:** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.
- **Good:** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.
- **Improvement required:** Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.
- **Poor:** Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative compliance

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

- **Good:** Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.
- **Improvement required:** Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.
- **Poor:** Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

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

1.2 Process description

Wastes originating from municipal refuse kerbside collection, the Colson Road transfer station, other municipal transfer stations and commercial operators are discharged to the landfill. As of December 2007 Colson Road became the sole operating landfill in the Taranaki region. Once the waste is discharged it is compacted and, according to the management plan, covered daily with clay or a suitable alternative. Currently, waste is discharged to stage three of the operation, which is expected to operate until approximately 2019. Once full, the area will be covered with clay and topsoil to a predetermined specification before being grassed. Leachate from stages two and three is collected and directed to the New Plymouth wastewater treatment plant, along with contaminated stormwater from stage three. An aerial plan of the site is shown in Figure 1.

The current stage in use (Stage 3) has a fully engineered liner consisting of high density polyethylene (HPDE) laid over compacted clay. Leachate is collected in porous pipes that have been put down in herring bone configuration over the polyethylene liner. During the 2013-2014 year, the lining of stage three was completed so that the liner now covers Stage 3's entire footprint. From this point on, there was an increase in the amount of potentially contaminated stormwater generated due to the increase in the lined and filled area, and this was therefore directed to the leachate collection system for discharge via the New Plymouth wastewater treatment plant.

Daily operations at the site are governed by the requirements contained in the Colson Road Regional Landfill Management Plan.



Photograph 1 Stage three extension works, February 2011

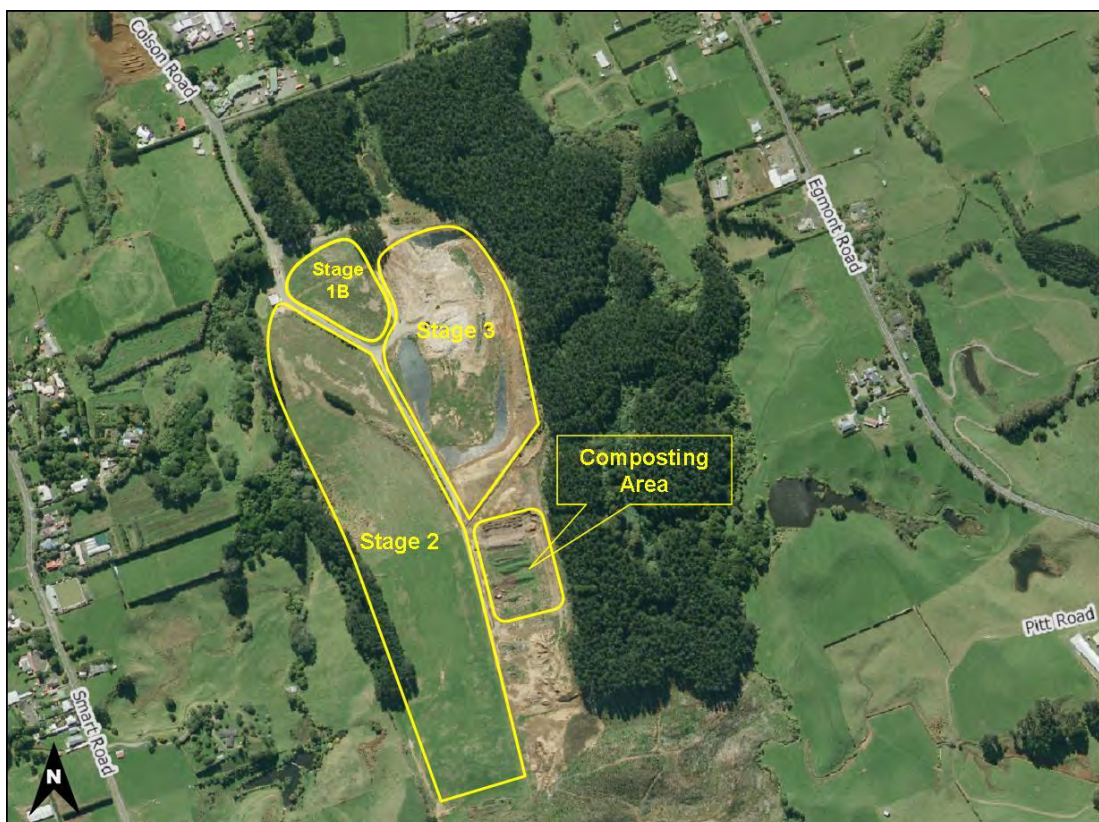


Figure 1 Aerial view of the Colson Road landfill

1.3 Resource consents

NPDC holds a total of eight resource consents in relation to the Colson Road landfill. These consents contain a total of 100 special conditions setting out the requirements that NPDC must satisfy. NPDC holds two consents to discharge uncontaminated stormwater into the Puremu Stream, two consents to discharge leachate and contaminated stormwater into the Puremu Stream, two consents to discharge emissions into the air, and one consent to discharge solids onto and into land. NPDC also holds one consent to divert water.

Table 1 Summary of the resource consents held by NPDC

Consent No	Purpose	Review	Expire
0226-1	Divert Puremu Stream	-	01 Oct 2026
2370-3	Discharge leachate and stormwater from area A to Puremu Stream	June 2018	01 Jun 2025
4619-1	Discharge treated stormwater and minor amounts of leachate from areas B1, B2, C1 & C2 to groundwater and the Puremu Stream	June 2018	01 Jun 2025
4620-1	Discharge uncontaminated stormwater from areas B1, B2, C1 and C2 into the Puremu Stream	June 2018	01 Jun 2025
4621-1	Discharge solids to land	June 2018	01 Jun 2025
4622-1	Discharge emissions to air from composting	June 2018	01 Jun 2025
4779-1	Discharge emissions to air from landfilling	June 2020	01 Jun 2026
6177-1	Discharge stormwater from earthworks	-	01 Jun 2020

1.3.1 Water discharge permits

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

NPDC holds water discharge permit **2370-3** to cover the discharge of up to 1,000 m³/day of leachate and contaminated stormwater from the closed section, Area A, of Colson Road municipal landfill to groundwater in the vicinity of and into the Puremu Stream. This permit was issued by the Council on 19 March 2003 under Section 87(e) of the RMA. This consent was reviewed in June 2006 and is due to expire on 1 June 2026.

Condition 1 requires the consent holder to adopt the best practicable option to avoid or minimise adverse effects.

Condition 2 requires that the consent be exercised in accordance with the documentation submitted in support of the consent application.

Condition 3 prohibits certain water quality effects in the Puremu Stream.

Condition 4 prohibits significant impacts on aquatic life.

Condition 5 states that monitoring of surface and groundwaters at the site shall be to the satisfaction of the Council.

Condition 6 requires that the NPDC abides by their Proposed District Plan.

Condition 7 states that the NPDC shall maintain and comply with a site management plan.

Conditions 8 and 9 require the consent holder to maintain area A of the landfill to a certain standard.

Conditions 10 and 11 require the consent holder to maintain water flow and silt control measures on site, and prevent vehicle cleaning on site.

Conditions 12, 13, 14 and 15 state the location of a mixing zone and place restrictions on the physicochemical impacts of the discharge in the Puremu Stream.

Condition 16 states that the discharge should not render water in the Puremu Stream unfit for stock consumption.

Condition 17 requires that systems relating to leachate on the site are maintained to the satisfaction of the Council.

Condition 18 provides opportunities to review the conditions of the consent, if monitoring shows that it is warranted.

The NPDC holds resource consent **4619-1** to discharge up to 675 L/s of treated stormwater and minor amounts of leachate from areas B1, B2, C1 and C2 of the Colson Road landfill to groundwater in the vicinity of and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment. This permit was issued by the Council on 21 March 1999 under Section 87(e) of the RMA. This consent was reviewed in June 2006, provides for a further review in June 2018, and is due to expire on 1 June 2025.

Condition 1 of this consent states that the water quality of the Manganaha Stream shall not be changed as a result of the discharge.

Conditions 2 and 3 outline specific water quality criteria for the Puremu Stream that must not be exceeded as a result of the discharge.

Conditions 4 and 5 deal with management plans and monitoring programmes.

Condition 7 provides opportunities to review the conditions of the consent, if monitoring shows that it is warranted.

The NPDC holds consent **4620-1** to discharge up to 675 L/s of uncontaminated stormwater from areas B1, B2, C1 and C2 of the Colson Road landfill into the Puremu Stream, a tributary of the Mangaone Stream in the Waiwhakaiho catchment.

This permit was issued by the Council on 21 March 1999 under Section 87(e) of the RMA. This consent is due to expire on 1 June 2025.

Conditions 1, 2 and 8 specify the level of water quality in the Puremu and Manganaha Streams that must be maintained.

Condition 3 prohibits the discharge of any leachate.

Conditions 4 and 5 require that all constructions, earthworks and stormwater systems be designed and maintained in a manner that minimises erosion and land instability.

Condition 6 states the consent holder shall repair and rehabilitate any land made unstable and any erosion occurring due to the construction or maintenance of the diversion channels or landfilling operations or composting site associated with the exercise of this consent.

Condition 7 requires the consent holder to notify Council of any works that may affect the areas contributing to the stormwater discharged under this consent.

Condition 9 prohibits activities that may result in contaminated stormwater entering the Manganaha Stream.

Conditions 10 and 11 require the consent holder to produce and adhere to a compliance monitoring programme and a landfill management plan.

Conditions 12 and 13 deal with rules associated with lapse and review dates for the consent.

The NPDC holds resource consent **6177-1** to discharge stormwater (due to earthworks in providing an area for Stage 3 of the municipal landfill) onto land and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment. This permit was issued by the Council on 11 June 2003 under Section 87(e) of the RMA. It is due to expire on 1 June 2020.

Condition 1 states parameter limits on the discharge to the Puremu Stream.

Condition 2 states that leachate shall not be discharged by the exercise of the consent.

Condition 3 deals with stormwater diversion and channels.

Conditions 4 and 5 state that the activity shall not alter certain characteristics of the water or significantly adversely impact on its aquatic life.

Condition 6 relates to water monitoring.

Conditions 7 and 8 require the provision of a site management plan, contingency plan and erosion control plan.

Condition 9 outlines that the best practicable option is to be taken in the management of the site to avoid or minimise adverse effects.

Condition 10 requires repair and rehabilitation of land, if made unstable by drainage works.

Condition 11 places requirement on the consent holder in relation to stormwater movement control on the site.

Condition 12 prohibits certain water quality effects in the Puremu Stream.

Condition 13 provides opportunities for review of the consent.

These permits are attached to this report in Appendix I.

1.3.2 Air discharge permit

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

Composting operations

The NPDC holds resource consent **4622-1** to cover the discharge of emissions into the air from composting and ancillary activities at the Colson Road landfill. This permit was issued by the Council on 21 March 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2025.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise any actual or likely adverse effect on the environment arising from the emissions from the composting operation.

Condition 2 requires that the discharge of contaminants to air from the landfilling operations not result in offensive or objectionable odours or dust or dangerous or noxious ambient concentrations of any airborne contaminants at or beyond the boundary of the site.

Condition 3 states that the discharge shall not give rise to any significant adverse ecological effects on any ecosystems.

Condition 4 states that the nature of materials acceptable for composting and the operation of the composting activities shall give effect to the 'Assessment of Discharges to Air', July 1994 and the 'NPDC Colson Road Landfill: Landfill Management Plan', July 1994 and requires that the landfill management plan be updated at least yearly.

Conditions 5 and 6 state that any composting windrow shall be located at least 300 m from any dwelling house, and shall comprise no greater than 5% by weight of materials that are not plant-derived.

Special condition 7 required that the composting operation be initially undertaken on a trial basis for six months, with the consent holder reporting to the Council on effects-based monitoring and any complaints about odour at the end of this trial period.

Conditions 8 and 9 outline lapsing and review provisions.

Landfilling operations

The NPDC holds resource consent **4779-1** to cover the discharge of emissions into the air from the existing landfill (Area A) and proposed landfill extension in Areas A, B1, B2, C1 and C2 of the Colson Road landfill site. This permit was issued by the Council on 21 March 1999 under Section 87(e) of the RMA. This consent was reviewed in June 2006 and is due to expire on 1 June 2025.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise any actual or likely adverse effect on the environment arising from the emissions from the landfilling operation.

Condition 2 states that the discharge of contaminants to air from the landfilling operations shall not result in offensive or objectionable odours or dust or dangerous or noxious ambient concentrations of any airborne contaminants at or beyond the boundary of the site.

Condition 3 states that no material is to be burnt at the landfill site.

Condition 4 states that the discharge shall not give rise to any significant adverse ecological effects on any ecosystems.

Condition 5 states that no extraction venting of untreated landfill gases be located closer than 200 m to any boundary of the landfill property.

Condition 6 requires that the landfill be operated to give effect to the 'Air Discharge Consent Application Supporting Documentation, July 1995' and in accordance with the 'NPDC Colson Road Landfill: Landfill Management Plan, July 1994'. The management plan shall be updated at least yearly and offer no lesser level of environmental protection than the original documents.

Condition 7 requires the consent holder to consult with the Council prior to undertaking any alteration to the site or site operations other than specified in the application and supporting documentation lodged with the application.

Condition 8 requires the consent holder to meet at least once per year with the submitters of the consent and any other interested party to discuss any matter relating to the exercise of the consent and to facilitate ongoing consultation.

Condition 9 requires the consent holder to provide to the Council a report on the feasibility of collecting, extracting, venting or combusting landfill gas at the landfill, within one year of the commencement of the consent.

Conditions 10 and 11 outline the provisions for lapsing and review of the consent.

These permits are attached to this report in Appendix I.

1.3.3 Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

The NPDC holds resource consent **4621-1** to cover the discharge of up to 500 tonnes of contaminants onto or into land per day in areas B1, B2, C1 and C2 of the Colson Road landfill. This permit was issued by the Council on 21 March 1999 under Section 87(e) of the RMA. This consent is due to expire on 1 June 2025.

Condition 1 requires the consent holder to install and maintain a further groundwater monitoring piezometer between the bores at sites AH9 and L2 and to maintain groundwater bores at the sites WQA, WQB, WQC, AH1, AH2, AH3, AH5, AH6, AH7, L1, L2, L5, L7, and L8 (as per the AEE).

Condition 2 requires the consent holder to prevent surface water runoff or contaminants to the Manganaha Stream from areas used for deposition of refuse or earthworks unless the area has been covered and rehabilitated.

Condition 3 requires the consent holder to demonstrate that the stormwater systems, surface contours and landscaping works have been undertaken to ensure that compliance with special condition 2 will be achieved, prior to commencing any use of Areas B, C1 and C2 for deposition of refuse.

Condition 4 requires that a registered engineer certify the construction, installation, integrity and performance of groundwater drainage systems, landfill lining systems and leachate interception, collection, holding, recirculation and discharge systems in Areas B1, B2, C1 and C2 prior to any discharge of solids wastes in those areas.

Condition 5 requires the consent holder to remedy or mitigate and if practicable to prevent any continuation of effects upon the quality of groundwater should the groundwater quality be significantly affected by the landfilling and composting activities.

Condition 6 outlines monitoring requirements, and criteria to be used to determine if contamination is occurring.

Condition 7 requires the consent holder to operate the landfill in a manner conforming to the relevant requirements of the 'NPDC Colson Road Landfill: Landfill Management Plan 1994' and to update the plan at least yearly.

Condition 8 outlines the criteria for the acceptance and disposal of waste types at the landfill.

Condition 9 and 10 outline provisions for lapsing and review of the consent.

The permit is attached to this report in Appendix I.

1.3.4 Water right

The NPDC holds water right **0226-1** to allow the diversion, by culverting, of the Puremu Stream to provide road access to the landfill. The Taranaki Catchment Commission issued this on 2 April 1975, and renewed it on 14 May 1986 under section 21 (3) of the *Water and Soil Conservation Act, 1967*. It is due to expire on 1 October 2026 as per Section 386 (2) of the RMA.

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

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

The monitoring programme for the Colson Road landfill site consisted of five primary components, as described in Sections 1.4.2 to 1.4.6. A summary is also provided in Table 2.

Table 2 Summary of monitoring activity for 2015-2016

Activity	Number
Inspections	12
Discharge samples	1
Stormwater samples	7
Receiving water samples	19
Groundwater samples	7
Air deposition samples	12
Ambient methane readings	21
Ambient PM ₁₀ readings	14
Biomonitoring surveys	2

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in:

- ongoing liaison with the resource consent holder over consent conditions and their interpretation and application;
- Colson Road Liaison Committee meetings;
- discussion over monitoring requirements;
- preparation for any reviews;
- renewals;

- new consents;
- advice on the Council's environmental management strategies and content of regional plans and;
- consultation on associated matters.

1.4.3 Site inspections

The Colson Road landfill site was visited on a total of 12 occasions during the monitoring period. There were 11 routine compliance monitoring inspections undertaken and one site visit to observe the application of a trial daily cover material. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on 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. The neighbourhood was surveyed for environmental effects.

1.4.4 Chemical sampling

The Council undertook sampling of both the discharges from the site and the water quality upstream and downstream of the discharge points and mixing zones. Water-quality and discharge sampling sites are shown in Figure 2.

The Puremu Stream, Manganaha Stream, and stormwater were all sampled on three occasions during the period under review. The discharge from the composting area treatment system was sampled on one occasion. The samples were analysed for a range of parameters including ammoniacal nitrogen, unionised ammonia, suspended solids, conductivity, and metals. An additional sample was collected from the large silt pond discharge (STW002054) and the downstream Puremu Stream site (PMU000113) at inspection on 8 September 2015 as the pond contents were an uncharacteristic dark brown colour.

Groundwater in the vicinity of the landfill was sampled on one occasion, and the groundwater sampling sites are shown in Figure 3. These sites were analysed for a range of physicochemical parameters including semi volatile organic compounds (SVOC) and metals.

1.4.5 Air quality

The Council undertook sampling of the ambient air quality in the neighbourhood. Six deposition gauges were also placed at selected sites in the vicinity of the landfill and at the landfill on two occasions, and the collected samples analysed for solids. Two ambient particulate matter and three methane surveys were also undertaken. Air monitoring sites are shown in Figure 4.

Point sources of fugitive landfill gas emissions located at the inspections were also sampled and analysed for a range of landfill gas components using a MultiRae gas detector.

1.4.6 Biomonitoring surveys

Biological surveys were performed on two occasions in the Puremu Stream (three sites) and Manganaha Stream (two sites) to determine whether or not the discharges from the site have had a detrimental effect upon the communities of the streams.

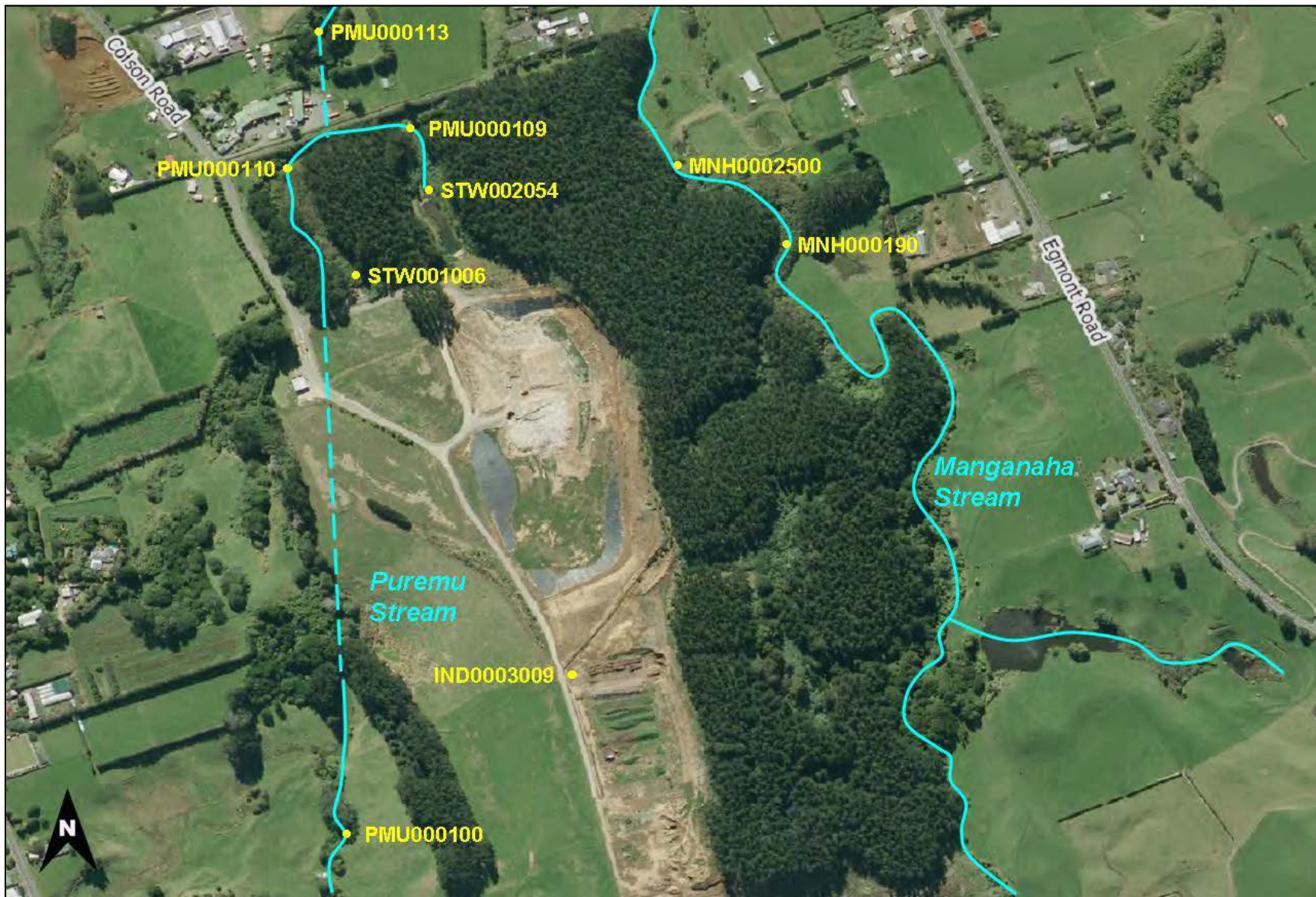


Figure 2 Aerial photo showing the stormwater and receiving water sampling sites at Colson Road landfill

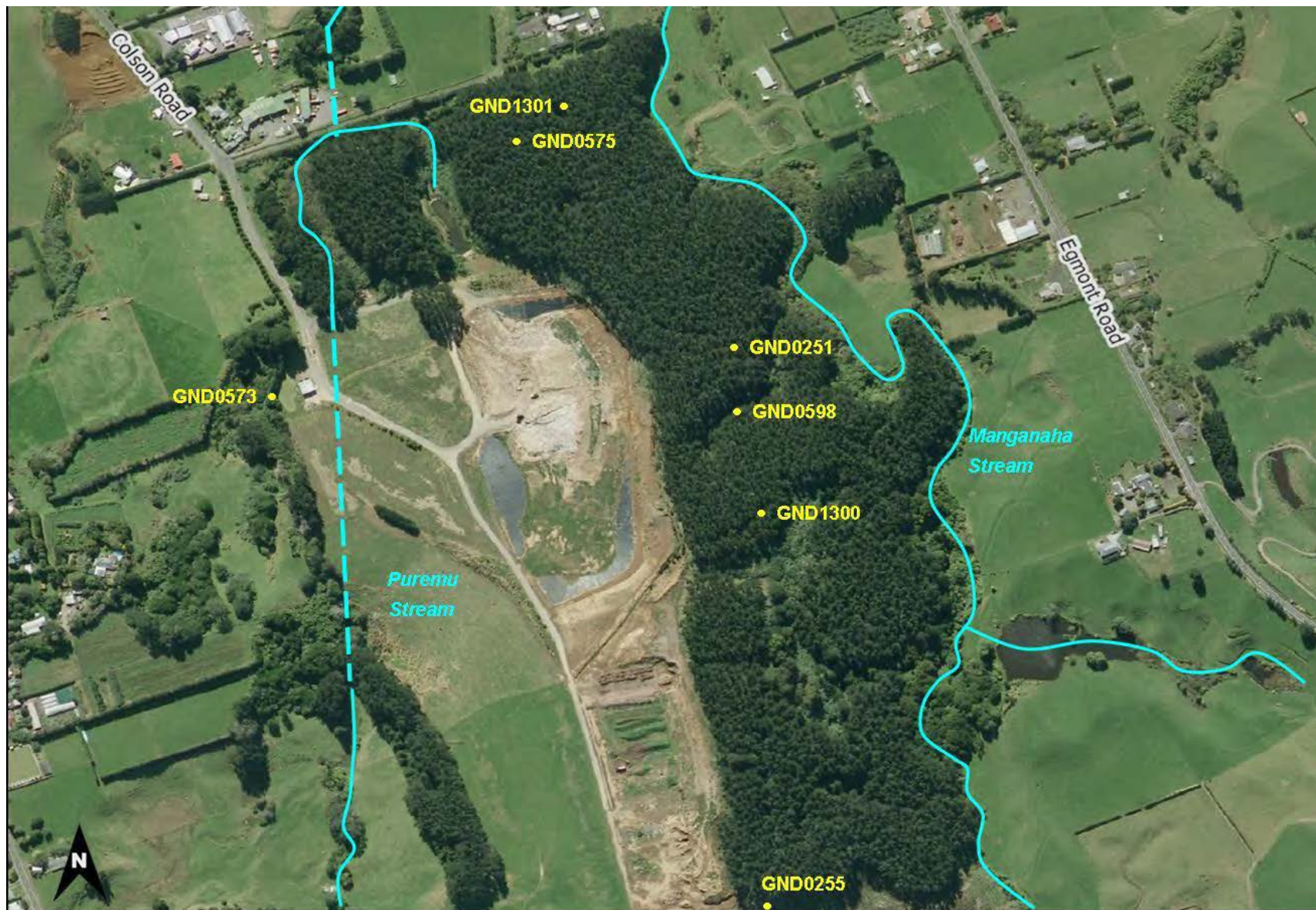


Figure 3 Aerial view of Colson Road landfill showing the positions of groundwater monitoring bores



Figure 4 Aerial view of Colson Road landfill showing the positions of air quality monitoring sites

2. Results

2.1 Inspections

Eleven routine compliance monitoring inspections were carried out during the period under review. One additional site visit was undertaken to observe the application of a trial cover material. Below are summaries of the findings of those inspections.

13 July 2015

The site was visited in fine weather conditions with a light northerly breeze.

The compost areas were satisfactory. The first four ponds treating stormwater from this area were full, but the last pond was empty and no discharge was occurring.

The leachate pond had drained back to a low level, indicating that the pumps were dealing with current leachate production.

There was more litter than usual around the large silt pond, especially in the inlet weir. There was evidence of some litter collection; however it appears that it was not being as effective as it has in the past.

Only one cell was uncovered and was in the process of being compacted and shaped, the recently closed cells had a thick cover of sawdust. Drainage works running along the lower western batter and southern batter to the leachate collection area were in progress. Photos of the works were taken.

On the lower western clay batter strong intermittent landfill gas odours were noted and a gas meter was deployed. Up to 2.0 ppm of hydrogen sulphide (H₂S) was detected but the source could not be located. No odours were detected at the downwind boundary of the site.

The cap on the closed areas of the landfill (stages 1 & 2) was in good condition and no issues were noted.

The following action was to be undertaken:

- Continue with litter collection

8 September 2015

This site inspection was carried out in dry weather with light, variable wind conditions. There had been only 2.5 mm of rainfall within the previous two days.

It was noted that the inspection scheduled for July could not be undertaken, due to the potential (very localised) health and safety issue around the levels of H₂S that may be present in discrete areas within the landfill area, while the necessary monitoring equipment was being serviced. An approach of a longer more in depth inspection was adopted on this occasion, reducing the number of scheduled inspections to be undertaken in the 2015-2016 year to 11.

Immediately prior to going on site the surrounding area was surveyed and no offensive or objectionable odours or dust were found off site.

Council warrants were shown to the contractor's Site Manager on arrival at the site, and discussions were held regarding landfill operations, particularly in relation to the daily cover requirement of the Colson Road Regional Landfill Management Plan (July 2013). During these discussions it was confirmed by the Site Manager that the exposed refuse and working cells were not being covered each and every night, which is non compliant with special condition 7 of resource consent 4621-1 and special condition 6 of resource consent 4779-1.

At inspection a number of potential non compliances with the Colson Road Regional Landfill Management Plan (July 2013) were observed. The leachate and/or stormwater was found to be ponding between the two composting sites. The eastern litter fence was still in a state of disrepair as first identified at inspection on 30 March 2015. The surface stormwater drain excavated into old refuse was still present. An extensive, uncovered, and discoloured area of ponding was observed below the special waste disposal point. It was noted that bubbling was occurring in this ponded water. A truck was observed offloading material into the pit during the inspection. Video was taken. The completed cell was covered on the top with a layer of sawdust, but that the sides of the cell were uncovered.

There were landfill gas odours present on site that were varying in strength from barely detectable, through noticeable to offensive.

It was considered that the working cell was likely to be in the vicinity of the permitted 900 m².

It was found that the water present in the large silt pond was discoloured a dark brown. The flow from the pond outlet was sampled, as was site PMU000113.

It was found that the western small silt pond had been desilted very recently, and that some of the silt had been placed in the leachate pond.

A number of point source landfill gas vents were checked with the MultiRAE, and were found to contain between:

1.4 and 99.9 ppm (over range) of H₂S,
6% and 99 % methane LEL,
0.1 and 1.6 ppm volatile organic compounds (VOC) and
1 to 23 ppm of ammonia (NH₃).

The following action was to be undertaken:

- Ensure that the management and operations at the site comply with consents and the Colson Road Regional Landfill Management Plan (2013) at all times.

13 October 2015

The site was inspected in moderate westerly wind conditions, although it was noted that the wind was swirling on site at times. There were occasional showers during the inspection, but there had been only 3.5 mm of rain in the previous ten days. There were no offensive or objectionable odours or dust found off site prior to the inspection.

A Council Investigating Officer was also present at the inspection. Warrants were shown to Whitakers staff on arrival at the site. The main access road was litter free, as

was the road to the large silt pond. Activities were occurring in both composting areas, with screening taking place at the Revital site. Strong compost and horse manure odours were found in the vicinity of the Return2Earth compost piles, reducing to noticeable 50 m down wind (within the site boundary). No dust or odours were noted downwind of the Revital area. The ponding between the two composting areas had dried out.

The eastern litter fence still had holes in it, and the drain excavated into the old refuse was still present. An elevated access road had been constructed running north-south in the middle of the landfill area. Filling was taking place by a drop and push method, with the active cell extending out from the start of the new access road to the east, just north of the special waste drop point. This cell was filling the majority of the large ponded area that the special waste pit had been draining into.

A green pulpy material had been used in an attempt to provide “daily cover”, however it was observed the application was very thin and patchy, and that refuse was not completely covered. The sides of the cell and the eastern most areas had no cover applied, and there were patches on the top of the cell that had been missed (photos taken). The cover was therefore insufficient to control pests, vermin and odour, or provide effective containment and concealment as per section 5.7.2 of the Colson Road Landfill Management Plan 2013. Abatement notice EAC-20881 was not being complied with at the time of inspection.

A truck discharged a load of special waste during the inspection. The material appeared to be quite liquid, with a limited solids component (video taken).

The completed cells on the western side of the new access road were covered predominantly with sawdust, and it was noted that there was quite a lot of exposed refuse, most of which was partially anchored into the cover material. It was noted that the management plan requires that the intermediate cover shall ensure a full covering of all exposed refuse, and is supposed to reduce fire risk. As such sawdust is not an acceptable material for intermediate cover. It was also noted that the cover was of insufficient depth.

A mulch barrier had been installed along the eastern side of the filled area to prevent leachate/stormwater from that side flowing into the eastern stormwater drain. It was found that there was a build-up of litter where the eastern stormwater drain flowed under the litter fence that would need to be removed. Very strong intermittent landfill gas odours were found along the eastern side of the central access road. The ditch on the southern side of the bund at the base of the northern batter contained a significant amount of sawdust, and this was likely to have significantly reduced the holding capacity of this drain. There was the potential that this may result in overflow of contaminated stormwater/leachate in the event of moderate to heavy rainfall given the size of the stormwater catchment and the limitations of the leachate pumping system. It was further noted that a lot of the sawdust in the northern end of the western drain was chromated copper arsenate (CCA) treated, increasing the potential for adverse environmental effects if there were to be an overflow of stormwater from this area.

Mulch had been placed over the western drains where leachate had been found to be flowing at the time of the previous inspection. The leachate pipe where there had

been a relatively high flowrate landfill gas emission occurring at the previous inspection had been covered with a pile of Taranaki ash. Although strong objectionable odours were found along the western edge of the landfill footprint, the source of these odours could not be identified at the time of inspection, and the MultiRAE did not detect any landfill gas components.

On the southern end of the western drain, above where the mulch finished, leachate flow was observed. There was bubbling occurring in the drain at places. Methane was detected at up to 78 % LEL, and although odours were present, no H₂S was detected (0.5 ppm detection limit).

The large silt pond had returned to its more usual Taranaki ash colour. A build up of litter and silt was found to be occurring in the tributary below the western small silt pond, which needed to be addressed. There was still a large amount of silt present in the leachate pond.

The following action was to be undertaken:

- Ensure that the management and operations at the site comply with consents and the Colson Road Regional Landfill Management Plan (2013) at all times.
- Continue with litter collections, especially in the wetland below the small silt ponds and the eastern drain
- Repair or replace the eastern litter fence
- Continue to remediate landfill gas hotspots as per Tonkin and Taylor report
- Confirm to Council that there is sufficient holding capacity in the leachate pond and back-up area at toe of the northern batter.

3 November 2015

The site inspection was carried out in moderate north westerly wind conditions. The inspection was undertaken along with a Council Investigating Officer, a representative of Whitakers and NPDC's Waste and Compliance Lead, Water and Wastes. Council warrants were shown at the site entrance. Council staff arrived at the tip face prior to any of the day's refuse trucks and prior to any of the landfill vehicles being moved from their overnight parking places.

It was noted that the majority of the top of the finished cell was covered with a layer of sawdust. The sawdust appeared to be more effective at limiting the access of seagulls to the waste than the green pulpy material found at the previous inspection. There was no cover on the sides of the completed cell, on the previous day's working cell, or in the soakage area below the special waste pit. There was also partially and/or fully exposed refuse in other places (photos taken). Abatement notice EAC-20881 was not being complied with at the time of inspection.

The unloading of the first truck was observed, and it was noted that the waste material contained construction and demolition material including gypsum type wall board.

The inspecting officers were informed that the odour mitigating spray system was installed, and had been functional. However it was still suffering from commissioning issues with some of the pipes leading to the spray nozzles split resulting in the pumps not coming back on automatically once the pressure in the

system dropped. The inspecting officers were informed that this was to be fixed by the end of the week. A timer was also to be installed that would allow trialling of reduced hours of operation of the system (from 5 am to 10 am and again from 3 pm to 10 pm). The stormwater drain that had been cut in to the old refuse was to be lined with clay, and work on this was started during the inspection. Alternative cover materials were still being trialled and another product that could be supplied by the installers of odour mitigating spray system was to be trialled soon. The inspecting officers were informed that the equipment needed to apply the trial cover material was in Australia at present, so the trial may not be carried out for up to four weeks. NPDC's review of the management plan was almost completed. It was waiting on the finalisation of the details around the daily and final cover requirements; investigation of biofilter options for treating landfill gas emissions from the leachate lines (if they were allowed to vent) and incorporating the new methodology for the composting activities on site. It was expected that this was likely to be completed around the end of the week.

The new compactor was still undergoing the necessary additions, and was expected to be on site within the next two weeks. The new litter fence netting had arrived on site, and would be installed towards the end of the week. It was planned to remove the litter from the eastern drain later on the day of inspection, and staff were to be organised to carry out a litter collection in and around the tributaries below the silt ponds.

At inspection a special waste truck was unloaded into the special waste pit. It was observed that the material was very liquid, and unlikely to meet the 20 % solids requirement. The colour and nature of the material also made it very unlikely that it was grease trap waste, as it had a fairly distinct silty Taranaki Ash appearance. The inspecting officers were informed that NPDC was in the process of gathering together the data to enable the special waste disposal activities to be reviewed. The second load of material disposed of to the special waste pit was very dry, and appeared to be mainly sweepings of dirt/leaves etcetera.

Covering of the waste in the soakage area below the special waste pit was discussed, with options like the use of a long reach digger to apply sawdust raised. It was agreed that the options were to be investigated by the contractor and/or NPDC, so that the area could be covered appropriately as required by the management plan.

It was found that the height of the bund wall at the toe of the northern face had been raised. A low spot was observed and it was agreed that this would be addressed. It was also agreed that the area below the likely overflow point was to be recontoured to ensure that, in the event of an overflow of this holding area, the discharge would be directed to the leachate pond.

It was observed that there were localised dust emissions being generated by vehicle movements and the unloading of the waste trucks, however this was dissipating on site. Landfill gas odours were noted at various locations in the immediate vicinity of the landfilled area, varying from light and intermittent to strong and potentially objectionable. The strongest odours were found on the eastern side of the landfill, and along the western side close to the leachate lines, however they were not of high enough concentration to be detected by the MultiRAE. It was observed that the areas where exposed leachate had been found during the previous inspection had all been

covered with mulch. It was noted that the landfill gas emissions were now much more defuse than they had been previously, but odorous emissions were still occurring that had the potential for off-site effects under the certain weather conditions. Whitakers staff advised that they were now undertaking self monitoring of the ambient landfill gas concentrations at seven locations around the landfill three times per week. Whitakers were asked to also note down the readings if there was an area found during the survey where there were stronger odours present and were also asked to provide a map showing the monitoring locations being used. No off-site odours were detected either before or after the inspection.

The following action was to be undertaken:

- Ensure that the management and operations at the site comply with consents and the Colson Road Regional Landfill Management Plan at all times.
- Undertake works as discussed.

23 November 2015

A site visit was undertaken to observe an alternative daily cover trial. The material applied was a cellulose based material with a clay/polymer mix. The Council officer was informed that the mixing speed in the truck was critical to the ability to thicken and apply the cover material, and that the mixing speeds achieved by the truck were lower than the ideal. The material was mixed in a truck by the workshop area and was then driven to the working cell. A long 4 inch hose was dragged out over the refuse, with the cover material being sprayed as the surface was traversed. The supplier of the material advised that they were able to supply products that could be successfully applied in the rain, and that there were application methods that could be used to cope with windy conditions. Only two truckloads of the material were applied due to time/mixing issues, and the trial was to continue the following day.

8 December 2015

A site visit was undertaken to carry out a routine compliance monitoring, including an air survey and surface water sampling.

The inspection was undertaken in a south to southwest wind that was variable in strength from a light to gentle breeze.

It was found that the odour mitigating sprays were in operation at the time of arrival and stopped six minutes later.

The areas of the retired part of the landfill that could be seen from the main access road looked good, with no erosion, cracking, slumping or over grazing. The grass cover at the time of inspection was good. The compost areas appeared to be well managed, with the Revital area noted to be at approximately 70 to 80 % capacity.

Activities commenced in both areas during inspection and no dust or odour issues were observed. Only the first pond in the compost treatment contained any liquid. It was noted that it appeared that there may have been an accumulation of silt starting to occur in the ponds that needed to be monitored and addressed appropriately when required.

The cell being filled at the time of inspection ran in a north south direction, just inside the southern litter fence. It was noted that the previously applied daily cover

was quite thin and patchy with bits of soft plastic blowing free in the stronger breezes. What appeared to be a chicken bone was noted to be suspended in the litter fence, indicating that birds had been attempting to remove this from the landfill. The abatement notice was not being complied with at the time of inspection.

The special waste pit contained uncovered waste, including none metallic corrugated roofing sheets, that could have been asbestos roofing material. Some of this was visible in in large split bags, but some of it did not appear to have been bagged.

Landfill gas odours were present on the central access way, which were sourced to the ground surrounding one of the the capped leachate pipes on the western side of the landfill. Both the methane and H₂S readings were over range on the MultiRAE (that is greater than 99 % LEL and 99 ppm respectively).

It was noted that the intermediate cover was in the process of being improved on the northern and eastern sides. There was only a minor amount of litter in the eastern stormwater drain, and it was noted that this drain had been cleared of the litter that had been present at the stormwater drain-northern litter fence intersection. Dust was observed travelling from the cover piles on the eastern side of the landfill past the eastern litter fence. This was dispersing within the forest. It was found that there was an accumulation of litter in the forest just outside of the litter fence. Council had previously been advised that the replacement litter fence material had arrived on site, but was yet to be installed. There appeared to be more capacity in the stormwater holding drain at the northern toe of the landfill. The small western silt pond was found to be in need of de-silting. The leachate pond contained very little wind blown refuse.

No odours, dust, methane of hydrogen were found off site during the air monitoring survey

The following action was to be undertaken:

- Ensure that the management and operations at the site comply with consent conditions and the Colson Road Regional Landfill Management Plan at all times, including daily cover and asbestos disposal.
- Continue with litter collection especially outside the eastern litter fence, and in the tributaries below both the southern litter fence and big stormwater pond outlet, and the small silt pond.
- De-silt the small western silt pond.

16 February 2016

The site was inspected in fine weather conditions and a light to moderate breeze. An air monitoring survey was conducted at this inspection, with the off site locations surveyed prior to inspection. No methane or H₂S were detected at any of the monitoring locations, and ambient particulate concentrations were found to be low. There were no off site odours found.

It was noted that the odour mitigating sprays were in operation throughout the inspection.

The areas of the cap visible from the main access road were in satisfactory condition. The composting areas were quiet at the time of inspection and no issues were noted. It was found that there was wind blown litter in the compost area stormwater treatment ponds that needed to be addressed.

There were intermittent strong fresh refuse, aged refuse, landfill gas and odour mitigation compounds found on the internal main access road downwind of the landfill.

There was one open cell in operation, and the intermediated cover had been striped from the majority of another cell to the north of the special waste pit. There were very strong aged refuse and landfill gas odours present on the central access road on top of the fill. It was noted that although there was improved cover at the site, there were still inactive areas that had inadequate cover. Abatement notice EAC-20881 was not being complied with at the time of inspection. There were a large number of seagulls present that appeared to be scavenging predominantly from the working cell.

The eastern litter fence had been replaced. The southern end of the eastern stormwater drain was substantially litter free, however a new drain to the south of the southern litter fence contained a lot of wind blown litter, and this and clay were partially obstructing a culvert inlet. This needed to be addressed. Holes were noted in the southern litter fence.

The stockpiled material used for tracks at the landfill had melted bitumen seeping out of them. As these piles were located close to the compost ponds that drain to the Puremu Stream, NPDC was asked to ensure that contaminants from this material do not enter the stormwater system.

There was uncovered liquid and a large area of uncovered refuse present in the special waste pit.

The small silt ponds had been desilted with the eastern pond looking a lot deeper than it had at previous inspections. There was still litter visible in and alongside the tributary below this pond that needed to be addressed.

The leachate pond was empty at the time of inspection. The outlet grate was not visible due to vegetation in the pond.

The weir at the large silt pond was substantially silt free, however it was noted that there was litter present in the weir and what appeared to be very large pieces of plastic sheeting present in the silt pond. These needed to be addressed.

The following action was to be undertaken:

- Ensure that the management and operations at the site comply with consent conditions and the Colson Road Regional Landfill Management Plan at all times, including daily cover and management of the special waste pit.
- Continue with litter collection especially in the tributaries below the silt ponds, in the large silt pond, the compost area treatment ponds, and drains.
- Clear the inlet to the culvert in the new southern drain.

- Ensure contaminants do not enter the stormwater system from the stockpiled roading material.
- Address holes in the southern litter fence.
- Confirm that the leachate pond outlet grate is, and ensure that it remains unobstructed.

4 April 2016

The site was inspected in fine weather with 33.5 mm of rain recorded at the New Plymouth wastewater treatment plant in the four days prior to the inspection.

There was little, if any, refuse observed on Colson Road in the vicinity of the landfill. It was noted that a lot of the signage was partially obscured by vegetation, of most concern was the signage that specifies material that is prohibited at the landfill. There were light and intermittent fresh refuse, compost and silage odours noted along the western side of the compost area and between the landfill and compost areas. The Revital compost area was well utilised. It was noted that an older compost windrow contained quite a lot of non-green waste material in the way of plastics etcetera. The newer compost piles and the green waste stock pile contained only minimal amounts. The compost treatment ponds were full, but not discharging to the eastern drain.

It was again noted that the stormwater systems contained quite a lot of litter, particularly in the compost area treatment ponds, the length of the eastern stormwater drain and the large silt pond (photos taken). The culvert at the southern end of the eastern stormwater drain was partially obstructed, as were the three outlet pipes from the large silt pond at the headwaters of the tributary.

A significant amount of clay cover had been spread since the last inspection, with the majority of the southern, eastern and northern areas adequately covered. The exceptions to this were the side of a raised cell at the southern end of the landfill, the sides and eastern side of the hole below the special waste drop off point, and the western side of the landfill that had been covered with sawdust. Therefore the abatement notice was not being complied with at the time of inspection. At the time of inspection there was one machine excavating fresh cover, a truck taking it to the landfill area, a digger applying cover to the recently completed cell and the compactor pushing recently deposited fresh refuse into the working cell. There were a large number of seagulls present, however, there was little, if any, refuse available for them to scavenge except the completed cell that was in the process of being covered, and the new working cell.

In contrast to previous inspections, there was very little liquid present in the hole below the special waste drop off point, and given the volume of rain in the days prior to the inspection, this indicates better control of the liquid component present in the special wastes disposed of recently.

There was a strong landfill gas odour along the central access road on top of stage 3 and along the western side of the landfill. It was found that a trial biofilter had been installed on the second leachate pipe up on the western side. The volume of gas flowing to the biofilter was being restricted by a ball valve. There were only weak noticeable odours present in this area, and it could not be ascertained whether these

were from the treated emissions, or from other sources. All the other leachate pipes had been recapped, with no valves present. There were very strong and objectionable landfill gas odour and a haze visible at the fourth leachate pipe up from the northern toe. The sensors for both methane LEL and H₂S were sent over range, and the NH₃ concentration was found to be between 18 and 23 ppm where the pipe emerged from the soil bund. No landfill gas components were detected except for in the immediate vicinity of this pipe.

There did not appear to be any significant accumulations of silt in the small silt ponds at the time of inspection, and the leachate pond contained very little liquid. The large silt pond still contained a large amount of floatable wastes (plastics). Part of the weir had been concreted to reform the lip, however it was noted that there was still an accumulation of silt present above the weir as noted by the independent consultant at his last inspection. It was found that organic matter was starting to accumulate behind the grate on the Puremu Stream outlet culvert.

The odour mitigating sprays were not operating at the time of inspection, however no off site odours were found during the collection of the receiving water samples.

The following action was to be undertaken:

- Ensure that the management and operations at the site comply with consent conditions, the Colson Road Regional Landfill Management Plan, and abatement notice 20881 at all times, including daily cover and management of the special waste pit.
- Remove the litter from the tributaries below the silt ponds, in the large silt pond and the pond outlet structure, the compost area treatment ponds, and stormwater drains.
- Clear the inlet to the culvert in the new southern drain.
- Desilt the weir on the large silt pond.
- Clear the grate on the Puremu Stream culvert outlet.

26 April 2016

The site was inspected in fine weather and a light southerly breeze. 31.5 mm of rain was recorded at the New Plymouth wastewater treatment plant in the three days prior to the inspection.

It was found that the barrier at the entrance to the site was broken off close to the pivot. There was no alternative means of securing the site visible at the time of inspection.

There was good grass cover present on the old completed landfill area that were visible from the road, and the main road at the site was litter free. There was no activity occurring at either of the composting areas at the time of inspection and no dust or odour issues were found. It was noted that there was a dish drain present running through the Revital part of the site that lead to ponded area. The ponded liquid was dark brown.

The compost ponds were approximately two thirds full, and were not discharging.

There was a large amount of wind blown litter present in the drainage systems around the site, particularly in the compost ponds, the eastern stormwater drain (where a culvert close to the southern end of this drain was partially obstructed), the plastic bags were still present in the large silt pond, there was still a milk bottle and other plastic partially obstructing the outlet from the large silt pond, and there was still refuse present in the tributary below the eastern small silt pond. There was a slight oil present in a small area above the weir at the large silt pond. This was communicated to the consent holder by phone at the time of inspection. The consent holder advised that this information had been passed on to the contractor, and that it would be addressed immediately. It was thought that the source was from minor leaks from equipment that had been working in the area. There was no oil found in the silt pond showing that the oil had been retained by the weir arrangement. There was very little liquid in the leachate pond, which was found to be litter free with the outlet grate unobstructed.

A large amount of cover had been applied since the previous inspection, with good intermediate cover present over most of the filled areas in the southern, eastern and northern areas. However, although there was an improvement in the cover on the southern most area, including an attempt at covering the sides of this area, there was still exposed refuse on the north eastern face of this filled area. There was uncovered refuse present at the eastern side of the ponded area below the special waste pit and an area of old refuse bordering the pit had been re-exposed. There were strong but localised odours present immediately downwind of this area. No work had taken place in the western areas of the landfill and there was still partially exposed refuse present. The depth of tyre marks observed on this area also showed that the cover had not been well compacted. The active working area of the landfill was well limited and estimated to be within the 900 m² given in the management plan.

No leachate breakouts were observed at inspection, although the ground was quite wet in an area (eastern side) where there was some black slotted piping present. This appeared to originate from inside the landfill footprint and NPDC were asked to advise Council of the purpose of this pipework.

It was found that there were noticeable intermittent landfill gas odours present at a few localised points on both the eastern side of the landfill and on the stage 3 central access road. There were strong odours present along the western side of the landfill, increasing to very strong and objectionable in the immediate vicinity of the leachate pipe biofilter and the fourth leachate pipe up from the northern end. The valve controlling the gas flow to the biofilter was open more than at the previous inspection and it appeared that there were preferential flow paths present through the centre of the biofilter tubes. The landfill gas components measured at these points were over range for the methane LEL and 50 ppm H₂S. At the fourth leachate pipe up from the northern toe, it was noted that some wood chip had been placed around the pipe, however there were still high levels of landfill gas recorded where the pipe exited the cover (methane LEL and H₂S over range; 21 ppm NH₃; 11 ppm carbon monoxide (CO); and 10.1 ppm VOC). Although there were landfill gas odours present, the levels of these landfill gas components were below the limit of detection of the MultiRAE three meters away from the pipe, and no off site odours were found. There was dust noted with traffic movements, but this was observed to dissipate within the site boundary.

The following action was to be taken:

- Ensure that the management and operations at the site comply with consent conditions, the Colson Road Regional Landfill Management Plan, and abatement notice 20881 at all times, including daily cover and management of the special waste pit.
- Improve intermediate cover on the western areas of the landfill.
- Remove the litter from the tributaries below the silt ponds, in the large silt pond and the pond outlet structure, the compost area treatment ponds, and stormwater drains.
- Clear the inlet to the culvert in the south eastern area of the drain.
- Advise what, if any, discharges may be occurring due to the ponding at the Revital site, and from the slotted land drain type pipes on the eastern side of the landfill.

31 May 2016

The site was inspected in fine weather conditions following recent wet weather with 65 mm of rain recorded at the New Plymouth wastewater treatment plant since 25 May 2016. There was a very light variable wind at the time of inspection. Slight intermittent landfill gas, compost and fresh refuse odours were detected at the site entrance. These were localised, and there were no offensive or objectionable odours found off site.

It was observed that the barrier arm at the entrance had been replaced, and the vegetation had been cut back so that the landfill signage was no longer obscured. The odour mitigating sprays were in operation.

The leachate pond was almost empty and the outlet grate was unobstructed. There was a dead rabbit in the pond that needed to be removed. It was noted that there was evidence of overland stormwater flow across the grass between the two stormwater ponds and there was litter present in the tributary below the eastern pond. There were large piles of silt near these ponds, but there was no evidence of any discharges to the tributary from these at the time of inspection.

There was evidence of heavy machinery use around the large silts pond, and there was silt present on both sides of the pond that contained entrained refuse. The piles had been placed close to the raised banks with an area of track separating them from the ponds. NPDC were asked to ensure that the silt was moved away from the ponds once it had had a chance to fully drain. The pond below the weir was in need of de-silting as there was a silt “island” present. There was a lot of refuse present at the outlet end of the pond and a plastic sheet/bag was partially obstructing the discharge openings in the outlet structure from this pond. NPDC was contacted at the time of inspection, and the matter was relayed to the contractor. The inspecting officer was advised that the contractor would address this straight away. It was again found that there was a lot of refuse present in the tributary below this pond.

At the base of the northern face of the landfill it was observed that there was a low discoloured flow draining to the southern side of the roadside drain. At the time of inspection, this was soaking to ground prior to entering the concrete riser on the road side. It was found that this flow originated from the western stormwater/leachate breakout capture drain and this was then flowing over a couple of low spots in the

bunding, rather than being directed to the ditch that is piped to the leachate pond. The consent holder was asked to investigate whether this riser flowed to the stream or to the leachate system, and to address the low spots in the bund if it was an entry point to the stormwater system that discharges to the stream.

It was noted that there were moderate to strong intermittent landfill gas odours present along the western and eastern sides of the landfill and also occasionally on the central access road to the tip head. There was no ambient methane, H₂S or VOC's detected at the inspection, and none of these landfill gas components were detected in the point source discharges from the biofilter. This was damp and appeared to be functioning well. The only point source emission of landfill gas detected during the inspection was at the base of the leachate pipe two pipes up from the biofilter the levels detected were 13 % methane LEL and 0.3 ppm VOC. No H₂S was detected (<0.5 ppm).

There was a good amount of cover on the filled areas south of the access road, although it looked in need of compaction, and there was exposed refuse along the north eastern face. There was some ponding noted on the western side of this fill (near the road) that should be addressed.

There was clear signage as to where the refuse should be off loaded by the trucks and this was then being pushed out to the north. Only one cell was open at the time of inspection. It appeared that sawdust was being used as a daily cover, which although effective for some of the issues outlined in the Management Plan, is not very effective for minimisation of leachate.

There was a lot of litter present on the lower western level of the landfill that had been covered with sawdust at the time the cells were completed. This area is in need of intermediate cover and the inspecting officer had been advised earlier in the day that this was expected to be completed by the new contractor by the end of June (weather permitting).

There was good grass cover present on the old completed landfill area visible from the road, and the main road at the site was litter free. There was no activity occurring at either of the composting areas at the time of inspection. In the Revital area there was a large amount of stockpiled green waste present. This contained only minimal amounts of non-green waste material. There were noticeable compost odours present between the compost areas and the landfill. It was observed that the bone had been removed from the litter fence, and that although there was a reduced amount of windblown litter present in the drains, there was still litter present in the compost ponds, above the culvert pipe below these ponds and in the eastern drain.

It was observed that the hole below the special waste pit was again starting to contain a reasonable amount of liquid. Cover had been applied to the previously exposed refuse that was above the water level, and there were no offensive or objectionable odours present in this area.

It was noted that there were bags of collected litter sitting next to the eastern clean stormwater drain and litter present beyond the litter fence that should be removed. There was some slight rilling present indicating that flow from the eastern side of the landfill was now flowing into the clean stormwater drain, rather than being directed

to the ditch at the northern face that is piped to the leachate sump. Please confirm that only covered areas are flowing into the eastern drain and ensure that the collected refuse is removed from the clean stormwater areas at the time of collection. It is also recommended that the cover is compacted on the areas draining to the clean stormwater system to aid in silt control.

The following action was to be taken:

- Ensure that the management and operations at the site comply with consent conditions, the Colson Road Regional Landfill Management Plan, and abatement notice 20881 at all times, including daily cover intermediate cover and management of the special waste pit.
- Improve intermediate cover on the western areas of the landfill.
- Remove silt bank present in the large silt pond.
- Remove the litter from the tributaries below the silt ponds, in the large silt pond and the pond outlet structure, the compost area treatment ponds, and stormwater drains.
- Ensure that the inlet to the culvert in the south eastern area of the eastern drain remains unobstructed.
- Confirm drainage to the stream is from uncontaminated areas only and/or address bunding issues as necessary to ensure that this is the case.

14 June 2016

This inspection was carried out prior to the landfill liaison committee meeting. It was found that additional soil cover had been applied on top of the sawdust in the south western areas of the landfill, with spreading occurring at the time of inspection. There was exposed refuse still present along the north eastern face of the filled area south of the access road. The inlet to the culvert in the south eastern area of the eastern drain had been cleared and was unobstructed. The stormwater drains were substantially litter free. Although the ponded area below the special waste pit was present, there was no exposed refuse present above the water level. Clay bunding had been constructed to prevent direct overland flow to the tributary from above and between the two small silt ponds. Litter was still present in the tributary below the eastern small silt pond and the large silt pond, and the outlet structure from the large silt pond was again partially obstructed with plastic. The low spots had been addressed in bunding along the north western toe of the landfill to ensure that leachate and contaminated stormwater was being directed to the leachate system.

28 June 2016

The site was inspected in showery, calm conditions following recent wet weather with 47.5 mm of rain recorded at the New Plymouth waste water treatment plant in the five days prior to this inspection. It is noted that the new operators had been in control of the site for 15 days.

There was no activity at either of the green waste areas at the time of inspection. There were no odours present near the Return2Earth site, and only localised odours at the Revital site. It was noted that the recently deposited green waste stock piles all contained less than 5% non green waste.

The parts of the closed areas of the landfill that were visible from the road appeared to be well managed. There was no cracking, ponding or slumping observed. The gate

area on top of the cap was discussed with the operator on site, and later with NPDC. Council was advised that the job of moving the gate and filling in the hollow was going to be given to a contractor to complete as trying to address this through the farmer had not been successful.

It was found that the side of the southern cell had now been covered. All drains, ponds and roadways were substantially litter free. Only minor amounts of litter were present in the large silt pond and the eastern end of the leachate drain at the northern toe of the landfill. It was noted that the eastern stormwater drain had been lined with plastic and covering with netting had commenced. Portable litter fences were present near the tipping pit and at the large silt pond. The inspecting officer was advised that equipment was being purchased to allow easier removal of small floating wind blown refuse from the large silt pond. The silt bank in the large silt pond by the weir had been removed.

Plans for management of the special waste pit were discussed. At the end of July the wetter suction truck wastes would be stopped. The pit would then be filled with refuse and covered. Any leachate in the ponded area would be sucked out and transferred to the leachate lines. It was agreed that the area would need to be regraded to ensure there was no ponding. The stormwater in the area would have to be appropriately managed, as an area of the site currently drained into the pit via an open drain cut by the previous operator.

It was found that the current disposal method was into a tipping pit. A digger was being used to lift the refuse out of the pit, and it was then being pushed out with the compactor. The working area was compact and estimated to be less than 900 m². The inspecting officer was informed that sawdust with clay and dirt mixed in was currently being used as a daily cover. This was being applied after a dozer had been used to level the surface of the refuse. The operators were continuing to work on the long term daily cover solution of large tin sections with rubber edges that could be lifted into place at the end of the day. A frame was on site at the time of inspection and the inspecting officer was informed that this was to check that it was a manageable size for the machinery on site. The area of improved intermediate cover had increased since the previous inspection. It was noted that the completion of this work was being hampered by the wet weather, and the operators were applying more cover as weather permitted.

The leachate pond level was low, with only a few centimetres of depth present in a very small area. The pond was litter free and the grate unobstructed. Most of the litter had been removed from the tributary below the small silt ponds. The operator advised that, for safety reasons, the few remaining bits would be removed when the area dried out a little bit.

It was observed that there were a few small leachate breakouts at the lower end of the northern toe, and that the water flowing in the drain from the west also appeared to contain some leachate. This was all being contained and directed to the leachate disposal system.

It was found that some silt had washed down from the new intermediate cover into the western drain. The operator was advised to monitor this to ensure that the stormwater does not over top the bund prior to the cover being sufficient to allow the

area to be deliberately directed to the stormwater system. The valve on the leachate line to the biofilter was found to be closed, and it was found that there was landfill gas venting from around the second leachate line up from the biofilter. The gas could be heard bubbling through the leachate in the system. Methane at 8% LEL was detected at a point about one meter from this leachate line, and there was a strong landfill gas odour on the southern side of this line. The operator undertook to investigate if the management of the throttling valve to the leachate pond could be modified to reduce the amount of leachate/stormwater that was retained in the landfill.

NPDC were advised that there was a small area of liner exposed in the north eastern corner that may need to be covered to protect it. The stormwater flowing along the southern side of the road to the silt ponds was clean and clear and the workshop area was clean and tidy. Silt controls were in place above the open stormwater drain on the eastern side of the gatehouse and the Puremu Stream culvert outlet was clear of any debris.

Two of the spray nozzles on the odour mitigating system were sending out jets rather than misting. The operator undertook to address this.

Overall it was noted that there had been significant improvements in the management of the site since the earlier inspections.

The following action is to be taken:

- Ensure that the management and operations at the site comply with consent conditions, the Colson Road Regional Landfill Management Plan, and abatement notice 20881 at all times, including daily cover intermediate cover and management of the special waste pit.
- Continue with improvements in the intermediate cover on the western areas of the landfill as weather permits.
- Monitor silt build up in the western drain and address if necessary.
- Investigate how the throttling valve to the leachate system can be managed to minimise leachate/stormwater accumulation in the landfill.

2.2 NPDC monitoring results

2.2.1 Leachate

The NPDC collected seven samples of leachate during the 2015-2016 monitoring period. Analyses were carried out for a range of parameters. The leachate is pumped to, and treated at the New Plymouth waste water treatment plant and whilst the leachate is not discharged directly to the environment, the results are used by the Council to compare with groundwater and surface water quality. The results are also of interest to the Council because the leachate can reveal information about the landfill processes taking place. The results of the analyses from the samples collected by the NPDC are presented in Table 3.

Table 3 Chemical analysis of Colson Road landfill leachate

Parameter	Unit	15-Jul-15	19-Aug-15	02-Sep-15	29-Oct-15	05-Feb-16	04-Mar-16	21-Jul-16
pH	pH	7.6	7.1	7.1	7.6	7.5	7.8	7.3
CBOD	g/m ³	890	115	277	-	-	-	-
BOD	g/m ³	71	13	210	80	100	110	65
Suspended solids	g/m ³	26	61	48	38	16	32	41
Conductivity	mS/m	653.5	142.7	382	822			681
Alkalinity	g/m ³	2,731	515	1,530	3,342	3,894	4,840	2,661
Ammoniacal N	g/m ³	392	97	240	612	810	1010	530
Arsenic	g/m ³	-	<0.021	-	-	-	-	-
Cadmium	g/m ³	-	-	-	<0.02	<0.02	-	-
Chromium	g/m ³	0.1	<0.011	<0.1	0.11	<0.2	0.23	0.1
Copper	g/m ³	<0.02	0.012	0.03	<0.02	<0.02	<0.02	<0.02
Iron	g/m ³	1.0	11.4	15.6	10.6	7.2	5.7	8.5
Lead	g/m ³	<0.07	<0.0021	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	g/m ³	1.9	1.52	3.3	1.2	0.78	0.62	1.5
Nickel	g/m ³	0.03	<0.011	<0.03	0.04	0.05	0.07	0.03
Total phosphorus	g/m ³	-	0.4	-	-	-	-	-
Sulphate	g/m ³	10.7	21	-	-	-	4.1	-
Zinc	g/m ³	0.07	<0.021	0.18	0.04	0.04	0.08	0.04

The results gathered by NPDC during the year under review reflect typical leachate quality. As there are no obvious trends emerging at this stage, the concentration variations within each parameter are likely to reflect seasonal variations in leachate quality.

2.2.2 Under-liner drainage

NPDC collected two samples of the groundwater that drains from a network of pipes under the liner. The results of the analyses are given in Table 4. The quality of this water is a useful indicator of whether leachate is passing through the liner. This is especially important in view of the slip that occurred in 2005 that ripped the liner in several places on the western side of stage three. The exposed rips were repaired but it was not known if the liner had ripped underneath the slipped refuse.

Table 4 Results of analysis of under liner drainage

Parameter	Unit	02-Dec-15	13-Apr-16
pH	pH	6.5	6.5
BODC	g/m ³	<3	<4
Suspended solids	g/m ³	<5	6
Conductivity	mS/m	39.9	37.8
Turbidity	N.T.U.	42.9	24.0
Alkalinity	g/m ³	106	97
Ammoniacal nitrogen	g/m ³ -N	1.4	1.6
Cadmium	g/m ³	<0.02	<0.02
Chromium	g/m ³	<0.1	<0.1
Chloride	g/m ³	54.6	52.0
Copper	g/m ³	<0.02	<0.02
Iron	g/m ³	6.1	2.9
Lead	g/m ³	<0.1	<0.1
Manganese	g/m ³	1.40	1.04
Nickel	g/m ³	<0.03	<0.03
Zinc	g/m ³	<0.04	<0.04

On going drainage analysis has shown that little, if any, contamination has been occurring in the groundwater immediately below the liner, and the results from this monitoring period continue to show this.

The levels of key indicator species such as zinc and ammoniacal nitrogen remain comparable to background levels, and are relatively stable over time. Chloride and iron levels also remain within normal ranges for Taranaki groundwater

Monitoring during the 2015-2016 year indicates that there does not currently appear to be any potential issues in regards to faecal coliform levels, and that the unusually high faecal coliform result obtained on 18 March 2014 (3,460 cfu/100ml) was likely to have been as a result of sample contamination, rather than the start of an on going issue. Monitoring of the under liner groundwater will be continuing.

2.3 Results of dry weather receiving environment monitoring

2.3.1 Manganaha Stream

The Colson Road landfill site has two streams associated with it. The Puremu Stream has been culverted to run under the north-western quadrant of the landfill site. It emerges from the culvert near the landfill entrance driveway, and then flows approximately 300 m to a second culvert that takes it under two other properties. Just upstream of the second culvert, the unnamed tributary that carries discharge from the large settling pond, flows into the main stream stem. The smaller silt pond discharges directly into the main stream stem just upstream of the confluence (see Figure 5).

The Manganaha Stream follows alongside the eastern boundary of the site and is approximately 200 m away from the landfill (at its closest point). As required by the

landfill's water discharge permits, there are no direct discharges into the Manganaha Stream from the landfill.

Tables 5-7 give the results of the dry weather freshwater sampling undertaken during the period under review. An aerial view of the sampling sites is given in Figure 2.

Table 5 Chemical analysis of the Manganaha Stream

Parameter	Units	08-Dec-2015		05-Apr-2016	
		MNH000190 u/s of landfill	MNH000250 d/s of landfill	MNH000190 u/s of landfill	MNH000250 d/s of landfill
Alkalinity	g/m ³ – CaCO ₃	33	31	24	24
Conductivity	mS/m	16.0	14.5	14.9	14.9
Acid soluble iron	g/m ³	0.78	0.84	0.45	0.56
Ammonia (unionised)	g/m ³ -N	0.00019	0.00023	0.00011	0.00014
Ammoniacal nitrogen	g/m ³ -N	0.046	0.028	0.019	0.02
pH	pH	7.1	7.4	7.2	7.3
Suspended solids	g/m ³	<2	<2	<2	<2
Temperature	Deg C	15.0	15.2	16.0	15.4
Dissolved zinc	g/m ³	<0.005	<0.005	<0.005	<0.005

On both sampling occasions the Manganaha Stream showed no adverse effects from the landfilling operation.

The upstream and downstream results showed very little difference in water quality on both sampling occasions. All results were comparable to background levels, and were similar to those found over the last five years.

There are no specific consent conditions in regards to the Manganaha Stream water quality other than that authorised discharges to land, and to the Puremu Stream from the landfill, shall not affect water quality in the Manganaha Stream.

Based on these results, and those from previous monitoring periods, the landfill's presence is having no measurable effect on water quality in the Manganaha Stream.

2.3.2 Puremu Stream

The Puremu Stream was also sampled on two occasions in dry weather, under low to moderate flow conditions.

The downstream sampling sites shown in Figure 5 and the results are given in Tables 6 and 7.

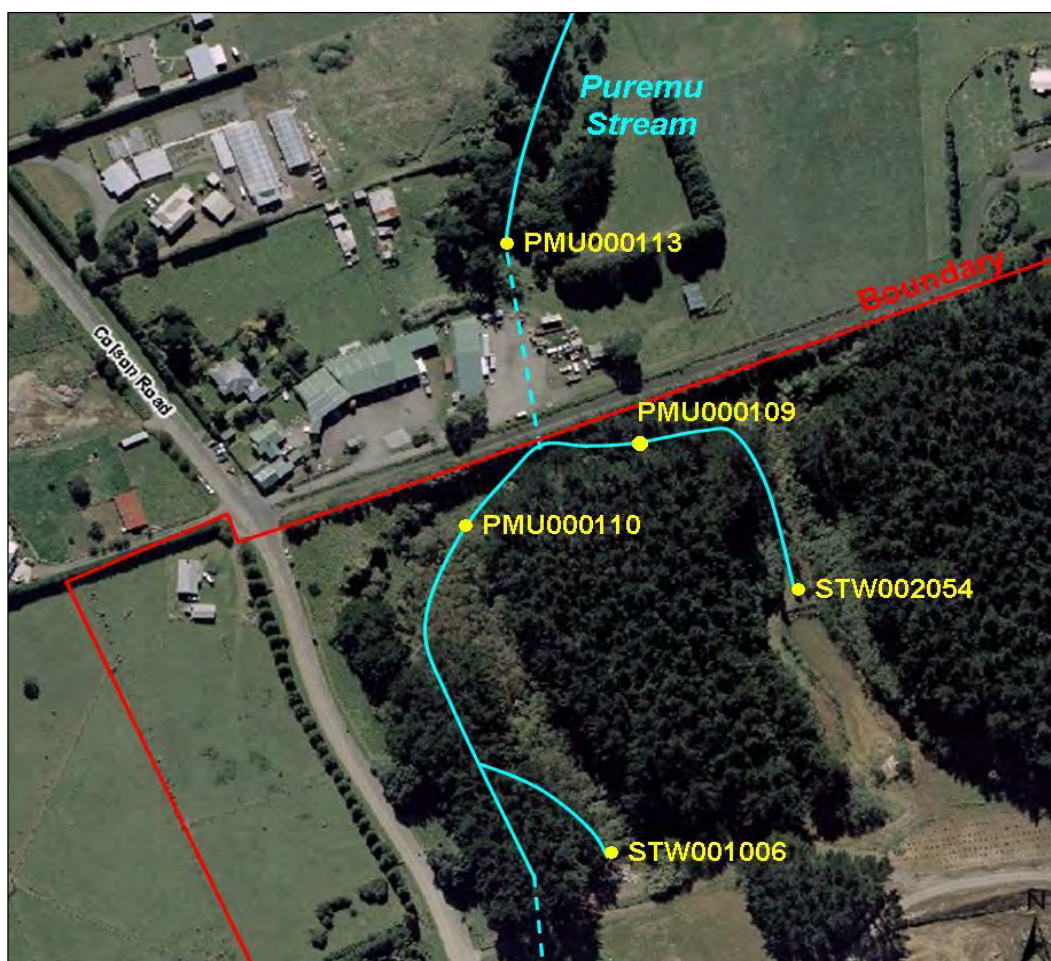


Figure 5 Sampling sites on the Puremu Stream down stream of the landfill

Table 6 Chemical analysis of the Puremu Stream, sampled on 8 December 2015

Parameter	Unit	PMU000100 500 m u/s of landfill	PMU000109 Trib d/s large silt pond	PMU000110 d/s landfill culvert	PMU000113 d/s SPCA drive culvert	Consent limits at PMU000113* (PMU000110**)
Alkalinity	g/m ³ CaCO ₃	29	93	86	89	NA
BOD	g/m ³	1.0	4.1	1.9	2.2	NA
Conductivity	mS/m	13.5	32.5	31.3	31.2	NA
Dissolved oxygen	g/m ³	6.87	1.5	7.92	7.62	≥ 5.87 (≥ 5.0)
DRP	g/m ³	<0.003	0.003	<0.003	<0.003	NA
Faecal coliforms	cfu/100ml	200	380	-	180	≤1,000
Unionised ammonia	g/m ³ N	0.00015	0.00093	0.02908	0.02156	NA
Ammoniacal N	g/m ³ N	0.047	0.199	4.06	3.01	2 (2.5)
Nitrate/nitrite N	g/m ³ N	0.09	0.30	1.00	0.91	10 (100)
Oxygen saturation	%	73.1	16.1	80.9	78.1	NA

Parameter	Unit	PMU000100 500 m u/s of landfill	PMU000109 Trib d/s large silt pond	PMU000110 d/s landfill culvert	PMU000113 d/s SPCA drive culvert	Consent limits at PMU000113* (PMU000110**)
pH	pH	6.9	7.1	7.3	7.3	≥6.5 & ≤8.5
Sulphates	g/m ³	4.4	6.6	5.7	6.2	1,000 (500)
Suspended solids	g/m ³	<2	44	5	3	12
Temperature	Deg C	18.0	16.6	16.2	16.2	(≤20.0)

Key: *Consent limits shown in brackets are for consent 2370-3 at site PMU000110.

** Consent limits with no brackets are for consent 4619 at site PMU000113

Table 7 Chemical analysis of the Puremu Stream, sampled on 5 April 2016

Parameter	Unit	PMU000100 500 m u/s of landfill	PMU000109 Trib d/s large silt pond	PMU000110 d/s landfill culvert	PMU000113 d/s SPCA drive culvert	Consent limits at PMU000113* (PMU000110**)
Alkalinity	g/m ³ CaCO ₃	27	90	46	51	NA
BOD	g/m ³	2.5	3.1	2.4	2.5	NA
Conductivity	mS/m	14.2	30.9	20	21.4	NA
Dissolved oxygen	g/m ³	7.64	6.12	8.02	8.14	≥6.64 (5.0)
DRP	g/m ³	0.004	<0.003	<0.003	<0.003	NA
Faecal coliforms	cfu/100ml	400	350	530	600	≤1,000
Unionised ammonia	g/m ³ N	0.00005	0.00119	0.0035	0.00295	NA
Ammoniacal N	g/m ³ N	0.019	0.304	0.74	0.628	2 (2.5)
Nitrate/nitrite N	g/m ³ N	0.02	0.24	0.74	0.72	10 (100)
Oxygen saturation	%	78	64.1	83.3	83.8	NA
pH	pH	6.8	7	7.1	7.1	≥6.5 & ≤8.5
Sulphates	g/m ³	11.9	7.6	10	10.7	1,000 (500)
Suspended solids	g/m ³	11	10	3	<2	21
Temperature	Deg C	16.8	17.3	16.8	16.7	(≤18.8)

Key: *Consent limits shown in brackets are for consent 2370-3 at site PMU000110.

** Consent limits with no brackets are for consent 4619 at site PMU000113

On one occasion (8 December 2015) the level of ammoniacal nitrogen at sites PMU000100 and PMU000113 exceeded consent conditions, however beyond the mixing zone (at site PMU000113), the prevailing temperature and pH conditions at the time resulted in a level of unionised ammonia that was below the 0.025 g/m³ guideline for aquatic ecosystem protection. It is noted that the stream was at very low flow at the time of sampling, and the sample from the upstream site was noted to have a slight cow manure odour. Subsequent sampling found that the consent conditions were complied with.

The ammoniacal nitrogen concentrations found in the samples collected on 5 April 2016 were low, and both samples complied with consent conditions for all of the remaining parameters.

2.3.3 Dry weather metals analysis

Consents 2370 and 4619 have some differing limits on the concentrations of various metals at sites PMU000100 and PMU000113 respectively, with PMU000110 being the compliance point for consent 2370, and with PMU000113 being the compliance point for consent 4619.

In the consents, total recoverable metal limits are given as absolute concentrations that must not be exceeded, whereas the dissolved metal limits are given in terms of a maximum permitted increase relative to the upstream site.

In previous monitoring periods, as the limits for each are similar, and PMU000110 is only short way upstream of PMU000113, a metals screen was undertaken on site PMU000113 only, with site PMU000100 (upstream of the landfill) acting as a control.

During the 2013-2014 year, metals monitoring at sites PMU000110 and PMU000109 was introduced. The results of the dry weather metals monitoring are given in Tables 8 and 9.

Table 8 Results of metal analysis undertaken on 8 December 2015

Parameter	Unit	PMU000100	PMU000109	PMU000110	PMU000113	Consent limit at PMU000113 (PMU000110)
Dissolved aluminium	g/m ³	0.003	<0.003	<0.003	<0.003	0.103
Total aluminium	g/m ³	0.055	0.04	0.022	0.0112	5.0 (5.0)
Dissolved arsenic	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	0.05
Total arsenic	g/m ³	<0.0011	<0.0011	<0.0011	<0.0011	0.2 (0.1)
Dissolved beryllium	g/m ³	<0.00010	<0.00010	0.0001	<0.00010	NA
Total beryllium	g/m ³	<0.00011	<0.00011	<0.00011	0.00011	0.1 (0.1)
Dissolved boron	g/m ³	0.016	0.027	0.038*	0.032	NA
Total boron	g/m ³	0.0179	0.027	0.037*	0.032	5.0 (0.5)
Dissolved cadmium	g/m ³	<0.00005	<0.00005	<0.00005	<0.00005	0.001
Total cadmium	g/m ³	<0.000053	<0.000053	<0.000053	<0.000053	0.05 (0.01)
Dissolved cobalt	g/m ³	0.0006	0.0014	0.0013	0.0013*	NA
Total cobalt	g/m ³	0.00086	0.0015	0.00133	<0.00129*	1.0 (0.05)
Dissolved chromium	g/m ³	<0.0005	<0.0005	<0.0005	<0.0005	0.02
Total chromium	g/m ³	<0.00053	<0.00053	<0.00053	<0.00053	1.0 (0.1)
Dissolved copper	g/m ³	0.0013	0.0005	0.001	0.0014*	0.0033

Parameter	Unit	PMU000100	PMU000109	PMU000110	PMU000113	Consent limit at PMU000113 (PMU000110)
Total copper	g/m ³	0.00156	0.00071	0.00112	0.00125*	0.5 (0.2)
Dissolved iron	g/m ³	0.31	0.05	0.07	0.06	0.61
Total iron	g/m ³	1.53	1.92	2.6	2.1	10.0 (5.0)
Dissolved manganese	g/m ³	0.198	2.7*	1.51*	1.66	NA
Total manganese	g/m ³	0.24	2.6*	1.41*	1.66	5.0 (1.0)
Dissolved lead	g/m ³	<0.00010	<0.00010	<0.00010	<0.00010	0.002
Total lead	g/m ³	<0.00011	<0.00011	<0.00011	<0.00011	0.1 (0.1)
Dissolved selenium	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	0.002
Total selenium	g/m ³	<0.0011	<0.0011	<0.0011	<0.0011	0.05 (0.02)
Dissolved vanadium	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	NA
Total vanadium	g/m ³	<0.0011	<0.0011	<0.0011	<0.0011	0.1 (0.1)
Dissolved zinc	g/m ³	0.0029	0.0026	0.0016	0.0027	0.0329
Total zinc	g/m ³	0.0034	0.0042	0.0024	0.0038	2.4 (2.0)

* The result of the dissolved fraction was greater than that of the total, but within the analytical variation of the methods

Table 9 Results of metal analysis undertaken on 5 April 2016

Parameter	Unit	PMU000100	PMU000109	PMU000110	PMU000113	Consent limit at PMU000113 (PMU000110)
Dissolved aluminium	g/m ³	0.010	< 0.003	0.003	< 0.003	0.11
Total aluminium	g/m ³	0.032	0.137	0.0118	0.0114	5.0 (5.0)
Dissolved arsenic	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.05
Total arsenic	g/m ³	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.2 (0.1)
Dissolved beryllium	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	NA
Total beryllium	g/m ³	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.1 (0.1)
Dissolved boron	g/m ³	0.020	0.027*	0.028	0.028	n/a
Total boron	g/m ³	0.021	0.025*	0.030	0.028	5.0 (0.5)
Dissolved cadmium	g/m ³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.001
Total cadmium	g/m ³	< 0.000053	< 0.000053	< 0.000053	< 0.000053	0.05 (0.01)
Dissolved cobalt	g/m ³	0.0003	0.0009	0.0003	0.0004	NA
Total cobalt	g/m ³	0.00081	0.00102	0.00037	0.00044	1.0 (0.05)

Parameter	Unit	PMU000100	PMU000109	PMU000110	PMU000113	Consent limit at PMU000113 (PMU000110)
Dissolved chromium	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.02
Total chromium	g/m ³	< 0.00053	< 0.00053	< 0.00053	< 0.00053	1.0 (0.1)
Dissolved copper	g/m ³	0.0005	< 0.0005	0.0005	< 0.0005	0.0025
Total copper	g/m ³	0.00073	0.00066	0.00062	0.00062	0.5 (0.2)
Dissolved iron	g/m ³	1.63	0.18	1.27	1.09	1.93
Total iron	g/m ³	3.5	3.3	1.88	1.84	10.0 (5.0)
Dissolved manganese	g/m ³	0.098	1.23	0.54	0.64	NA
Total manganese	g/m ³	0.25	1.45	0.63	0.74	5.0 (1.0)
Dissolved lead	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.002
Total lead	g/m ³	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.1 (0.1)
Dissolved selenium	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	<0.002
Total selenium	g/m ³	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.05 (0.02)
Dissolved vanadium	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	NA
Total vanadium	g/m ³	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.1 (0.1)
Dissolved zinc	g/m ³	0.0024	< 0.0010	< 0.0010	< 0.0010	0.0342
Total zinc	g/m ³	0.0042	< 0.0011	< 0.0011	< 0.0011	2.4 (2.0)

* The result of the dissolved fraction was greater than that of the total, but within the analytical variation of the methods

The results show that all parameters were in compliance with the conditions on consents 2370 and 4619 and that, although there were very slight increases in some of the metals determined, there were also a number of metals for which the concentrations decreased in a downstream direction. No increases of environmental significance were found between the site upstream and sites downstream of the landfill.

2.4 Result of stormwater and receiving environment monitoring

A survey was conducted during a rainfall event, and the results are given in the tables below. Table 10 shows the results for discharges and receiving water into which the discharges from within the landfill catchment flow (Puremu Stream), whilst Table 11 shows the results for the Manganaha Stream, which lies adjacent the landfill site and has no surface water discharges from the landfill directed to it. An additional sample was collected from the large silt pond discharge point (STW002054) at inspection on 8 September 2015 due to the uncharacteristic colouration of the pond contents. A sample was also collected from the downstream compliance point in the Puremu Stream (PMU000113). The results of this sampling are given in Table 12.

Table 10 Results of rain event monitoring – discharge and Puremu Stream samples, 11 August 2015

Site	Alkalinity g/m ³ CaCO ₃	Conductivity mS/m	Faecal Coliforms cfu/100ml	Unionised ammonia g/m ³ -N	Ammoniacal nitrogen g/m ³ -N	pH	Suspended solids g/m ³	Temp. Deg.C	Turbidity NTU
PMU000100	18	12.7	120	0.0001	0.046	7.0	3	9.2	2.1
PMU000109	101	42	-	0.00687	3.95	6.9	4	9.5	18
PMU000110	39	18.4	-	0.00474	1.72	7.1	10	9.5	11
PMU000113	41	19.6	210	0.00477	1.72	7.1	15 (3.3)	9.6	17
STW001006	250	66.3	<2	0.04211	22.8	6.8	44	13.4	360
STW002054	158	63.3	2,600	0.04594	8.50	7.4	14	9.3	28
IND003009	-	156	36,000	0.04519	5.49	7.7	48	5.7	67

Key: **Bold** = Breach of conditions
 () =consent condition limit (shown only if in exceedance)

The Puremu Stream system receives discharges from two stormwater ponds on the site. STW001006 discharges stormwater and leachate from Stages one and two, and STW002054 discharges stormwater from the eastern forest of the site and the composting pad. STW002054 also receives leachate from stage three in the event that the leachate pumping system is overloaded, or fails. It is noted that consent 4619 provides only for minor amounts of leachate to be present in this discharge.

Whilst the suspended solids concentration of 15 g/m³ at site PMU000113 exceeds the wet weather limit of 10% of the upstream sample given in consent 4619, there are other inputs between the upstream site (PMU000100) and the downstream site and the landfill was not proven to be the cause of the increase. As the suspended solids concentration was still very low for a wet weather stream sample, and there was no conspicuous discolouration noted at the time of sampling, this did not warrant further investigation.

Table 11 Results of rain event monitoring - Manganaha Stream, 11 August 2015

Parameter	Unit	MNH000190	MNH000250
Conductivity	mS/m	13.1	13.1
Unionised ammonia	g/m ³	0.00027	0.00026
Ammoniacal nitrogen	g/m ³ -N	0.072	0.070
pH	-	7.2	7.2
Suspended solids	g/m ³ -N	10	10
Temperature	Deg C	10.5	10.5
Turbidity	NTU	5.7	7.1

As stated earlier, the Manganaha Stream receives no direct discharges from the landfill catchment, but it is a useful indicator for any groundwater contamination, or potential effects from windblown refuse.

The results show that water quality in the stream is quite high and there is negligible difference in water quality when comparing the results from the two Managnaha Stream sites. These results are comparable to those obtained in previous monitoring periods.

The results show that during stormwater discharges, the site was complying with consent conditions in regards to all the water quality parameters in both the Puremu and Manganaha Streams, with the exception of suspended solids in the Puremu Stream.

At all the freshwater sites monitored the levels of ammonia, suspended solids and conductivity were within environmentally acceptable ranges, and indicated reasonable water quality during this survey.

Table 12 Results of additional samples collected at inspection, 8 September 2015

Parameter	Unit	STW002054 large silt pond discharge	PMU000113 d/s SPCA drive culvert
Alkalinity	g/m ³ CaCO ₃	218	47
Dissolved aluminium	g/m ³	0.012	0.044
Total aluminium	g/m ³	0.131	0.076
Dissolved arsenic	g/m ³	<0.0010	0.0089
Total arsenic	g/m ³	<0.0011	0.0102
Dissolved beryllium	g/m ³	<0.00010	<0.00010
Total beryllium	g/m ³	<0.00011	<0.00011
BOD	g/m ³	5.1	2.7
Dissolved boron	g/m ³	0.03	0.16
Total boron	g/m ³	0.029	0.163
Dissolved cadmium	g/m ³	<0.00005	<0.00005
Total cadmium	g/m ³	<0.000053	<0.000053
Dissolved cobalt	g/m ³	0.0011	0.0095
Total cobalt	g/m ³	0.0011	0.0096
Conductivity	mS/m	68.2	20.8
Dissolved chromium	g/m ³	<0.0005	<0.0061
Total chromium	g/m ³	<0.00053	<0.0069
Dissolved copper	g/m ³	0.0029	0.0047
Total copper	g/m ³	0.0033	0.0049
DRP	g/m ³	-	0.004
Acid soluble iron	g/m ³	6.62	-
Dissolved iron	g/m ³	0.75	4.4
Total iron	g/m ³	1.9	6.8
Dissolved lead	g/m ³	<0.00010	0.00042
Total lead	g/m ³	<0.00010	0.0005
Dissolved manganese	g/m ³	0.68	6.1

Parameter	Unit	STW002054 large silt pond discharge	PMU000113 d/s SPCA drive culvert
Total manganese	g/m ³	0.72	6.4
Unionised ammonia	g/m ³ N	0.29346	0.01199
Ammoniacal N	g/m ³ N	19.2	2.00
Nitrate/nitrite N	g/m ³ N	0.32	1.08
pH	pH	7.7	7.3
Dissolved selenium	g/m ³	<0.0010	<0.0010
Total selenium	g/m ³	<0.0011	<0.0011
Sulphates	g/m ³	14.7	10.9
Temperature	Deg C	14.1	13.8
Dissolved vanadium	g/m ³	<0.0010	<0.0011
Total vanadium	g/m ³	<0.0011	<0.0011
Dissolved zinc	g/m ³	0.008	0.0076
Total zinc	g/m ³	0.0048	0.0091

Key: **Bold** = Breach of conditions
 () =consent condition limit (shown only if in exceedance)

The results reported for alkalinity, conductivity, pH and unionised ammonia were close to the historical maximum values in the stormwater discharge, and the ammoniacal nitrogen concentration was above the historical median. However, the sample collected at the downstream compliance point (PMU000113) showed that the consent conditions were complied with at the time of sampling.

2.5 Biological monitoring

2.5.1 Macroinvertebrate surveys

Two macroinvertebrate surveys were conducted during the 2015-2016 monitoring year. Summaries of the surveys' findings are given below and a full copy of the reports can be found in Appendix II.

The sites sampled are described in Table 13 and their locations are shown in Figure 6.

Table 13 Biomonitoring sites in the Puremu and Manganaha Streams related to the Colson Road landfill

Stream	Site No.	Site Code	Location	Sampling method
Puremu Stream	1	PMU000104	Upstream of the landfill	Sweep-kick sampling
	2	PMU000110	400 m downstream landfill	Kick sampling
Unnamed tributary of Puremu Stream	PT1	PMU000108	60 m upstream of the confluence with Puremu Stream	Kick sampling
Manganaha Stream	M4	MNH000190	10 m downstream of an unnamed tributary of the Manganaha Stream	Kick sampling
	M6	MNH000260	500 m downstream of site M4	Sweep-kick sampling

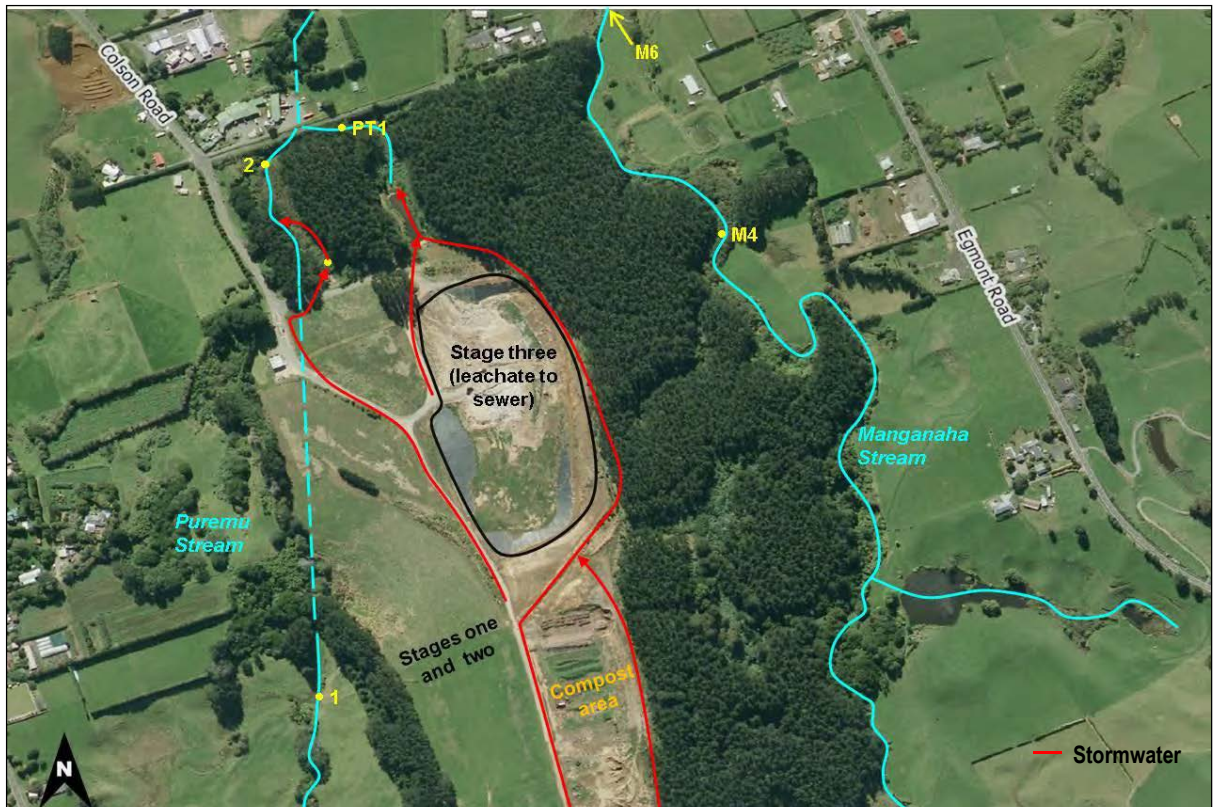


Figure 6 Biomonitoring sites related to the Colson Road landfill, New Plymouth

16 October 2015

The Council's standard 'kick-sampling' technique was used at three sites (site 2, M4 and M6) and the 'sweep-sampling' technique was used at one site (PT1), to collect streambed macroinvertebrates from the Puremu and Manganaha Streams on 16 October 2015. A combination of the two techniques was used to collect macroinvertebrates from site 1 in the Puremu Stream. Samples were sorted and identified to provide number of taxa (richness), MCI and SQMCI_s scores for each site.

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

This spring macroinvertebrate survey indicated that the discharge of treated stormwater and leachate discharged from the Colson Road landfill site had not had any detrimental effect on the macroinvertebrate communities of the Puremu and Manganaha Streams.

In this survey, the MCI score recorded at the upstream control site on the Puremu Stream was higher than the median score for this site, and the same as that recorded in the previous survey. The SQMCI_s score however was significantly lower than the median and significantly lower than that recorded in the previous survey. This was

largely attributable to the reduced abundance within three 'moderately sensitive' taxa, and the increased abundances within three 'tolerant' taxa. These results were indicative of poor preceding water quality, and reflected a macrophyte associated community assemblage, that had been impacted by low flows.

Site 2 in the Puremu Stream recorded a slightly lower MCI score but slightly higher SQMCI_s scores, when compared with site 1 (Stark, 1998), and were both similar to the historical medians for this site. Site PT1 in the unnamed tributary also recorded MCI and SQMCI_s scores not significantly different to historical medians, however the SQMCI_s score was significantly lower than that recorded at site 2 (by 0.9 unit) and indicated poor physicochemical water quality and/or habitat quality at this site.

The upstream site on the Manganaha Stream recorded MCI and SQMCI_s scores similar to historical medians. These results reflected the moderately high proportion of 'sensitive' taxa and the numerical dominance of two 'sensitive' taxa, in particular the abundance of one 'highly sensitive' caddisfly taxon. Results were indicative of moderate preceding water quality.

In the Manganaha Stream downstream of the landfill site, the macroinvertebrate community contained a moderately high proportion of 'sensitive' taxa which resulted in an MCI score of 96 units. This MCI score was slightly higher than that recorded at the upstream site, indicating only a minor difference in biological health. The SQMCI_s score recorded at site M6 was only slightly lower than that recorded at site M4, an indication of similar habitat quality at this site.

No undesirable biological growths were detected at any of these sites during this October 2015 survey.

Overall, the results of this survey were indicative of fair (site 1) and poor (site 2) biological health in the Puremu Stream and fair biological health at site PT1 in the unnamed tributary of the Puremu Stream. The results in the Manganaha Stream were indicative of fair biological health at sites M4 and M6. In summary, these results were not indicative of any significant adverse effects on either the Puremu Stream or the Manganaha Stream from the discharges from the Colson Road landfill at the time of this survey.

3 February 2016

The Council's standard 'sweep-sampling' technique was used at three sites (site 1, 2 and PT1) and a combination of the 'sweep-sampling' and 'kick-sampling' techniques was used at two sites (M4 and M6), to collect streambed macroinvertebrates from the Puremu and Manganaha Streams on 3 February 2016. Samples were sorted and identified to provide number of taxa (richness), MCI and SQMCI_s scores for each site.

This summer macroinvertebrate survey indicated that the discharge of treated stormwater and leachate discharged from the Colson Road landfill site had not had any detrimental effect on the macroinvertebrate communities of the Puremu and Manganaha Streams.

In this survey, the MCI score recorded at the upstream control site on the Puremu Stream was slightly lower than the median score for this site, and slightly lower than that recorded in the previous survey. The SQMCI_s score however was slightly above

the median and significantly higher than that recorded in the previous survey. These results were indicative of 'poor' biological health and reflected a macrophyte associated community assemblage, which had been impacted by very slow and low flows.

Site 2 in the Puremu Stream recorded a slightly lower MCI score and SQMCI_s score, when compared with site 1 (Stark, 1998), and were both similar to the historical medians for this site. Site PT1 in the unnamed tributary also recorded a MCI not significantly different to historical medians, however the SQMCI_s score was significantly lower than the historical median and significantly lower than that recorded at site 2 (by 1.6 units) and indicated poor physicochemical water quality and/or habitat quality at this site. It is also possible the small area sampled impacted the current survey results. It is recommended that site access be improved prior to the next survey.

The upstream site on the Manganaha Stream recorded MCI and SQMCI_s scores substantially lower than historical medians. These results reflected the higher proportion of 'tolerant' taxa in the macroinvertebrate community and the numerical dominance of one 'tolerant' taxon in particular. Results were indicative of reasonable preceding water quality.

In the Manganaha Stream downstream of the landfill site, the macroinvertebrate community contained a moderate proportion of 'tolerant' taxa which resulted in an MCI score of 74 units. This MCI score was slightly lower than that recorded at the upstream site, indicating only a minor difference in biological health. The SQMCI_s score recorded at site M6 was lower than that recorded at site M4, an indication of slightly different habitat quality at this site.

No undesirable biological growths were detected at any of these sites during this February 2016 survey.

Overall, the results of this summer survey were indicative of 'poor' biological health in the Puremu Stream and in the unnamed tributary of the Puremu Stream. The results in the Manganaha Stream were also indicative of 'poor' biological health at sites M4 and M6. In summary, these results were not indicative of any significant adverse effects on either the Puremu Stream or the Manganaha Stream from the discharges from the Colson Road Landfill at the time of this survey.

2.6 Groundwater

Groundwater was sampled from seven bores on 9 June 2015. The results of the analyses are given in

Table 14.

Like the NPDC subsurface drainage samples (Table 4, Section 2.2.1), the groundwater results show little evidence of leachate contamination. All parameters measured for all the bores, were well within the ranges expected in Taranaki groundwater and within the ranges of the historical data.

Table 14 Chemical analysis of Colson Road landfill groundwater sampled 29 June 2016

Parameter	Unit	GND0573	GND0574	GND0575	GND251	GND0598	GND1300	GND0255
Alkalinity	g/m ³ CaCO ₃	26	42	94	44	163	29	35
Chloride	g/m ³	69.4	17.5	33.1	18.8	21.4	20.2	45.4
Filtered COD	g/m ³	<5	<5	<5	<5	10	<5	<5
Conductivity	mS/m	28.0	15.0	27.2	14.8	33.4	13.4	22.6
Water level	m	4.81	7.90	8.61	13.48	10.84	13.15	11.09
Unionised ammonia	g/m ³ N	<0.00001	<0.00001	<0.00001	<0.00001	0.01896	<0.00001	<0.00001
Ammoniacal N	g/m ³ N	<0.003	<0.003	<0.003	0.004	1.17	<0.003	<0.003
Nitrate/nitrite N	g/m ³ N	0.61	0.44	0.53	0.37	0.02	1.04	2.42
Nitrite N	g/m ³ N	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
pH	pH	5.7	6.1	6.4	6.1	7.7	6.0	5.6
Sulphate	g/m ³	8.2	7.5	4.2	4.4	<1	5.1	3.5
Temperature	Deg C	15.0	16.9	15.3	14.9	14.9	15.2	15.3
Dissolved aluminium	g/m ³	0.008	0.022	0.011	0.008	0.016	0.027	0.014
Dissolved arsenic	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved beryllium	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved boron	g/m ³	0.022	0.024	0.019	0.012	0.053	0.020	0.020
Dissolved cadmium	g/m ³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved chromium	g/m ³	< 0.0005	0.0009	0.0008	0.0008	< 0.0005	< 0.0005	< 0.0005
Dissolved cobalt	g/m ³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved copper	g/m ³	< 0.0005	< 0.0005	0.0006	0.0008	0.0009	0.0018	< 0.0005
Dissolved Iron	g/m ³	< 0.02	< 0.02	< 0.02	< 0.02	0.15	0.02	< 0.02
Dissolved lead	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00034	< 0.00010	< 0.00010
Dissolved manganese	g/m ³	0.0051	0.0024	0.0028	0.0021	0.066	0.003	0.0057
Dissolved selenium	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved vanadium	g/m ³	< 0.0010	0.0011	0.0108	0.0012	< 0.0010	< 0.0010	< 0.0010
Dissolved zinc	g/m ³	0.044	0.0037	0.0149	0.028	0.041	0.041	0.022

Bore GND0598 shows some elevation in alkalinity, filtered COD, ammoniacal nitrogen, pH and dissolved iron when compared to the other bores. However, this bore is up gradient of the landfill in terms of groundwater flow, and the results are consistent with those obtained from the bore since 1996. The elevated levels of these parameters were therefore unlikely to be a result of leachate contamination.

Bore GND0573 also shows some elevation in alkalinity and bore GND0255 in nitrate/nitrite nitrogen, and as these bores are down gradient of the filled areas, this may be attributable to some minor leachate contamination from the older landfilled areas.

The samples were also analysed for SVOC's (semi-volatile organic compounds) and none were found to be above detection levels. A copy of the SVOC results is appended to this report.

In general terms, the groundwater quality in the vicinity of the landfill is good, and all parameters are comparable with typical Taranaki groundwater. The data gathered in this, and other monitoring periods, indicates that the Colson Road landfill is not having a significant adverse effect on groundwater quality.

2.7 Air

2.7.1 Results of receiving environment monitoring

2.7.1.1 Deposition gauging

Many industries emit dust from various sources during operational periods. In order to assess the effects of the emitted dust, industries have been monitored using deposition gauges.

Deposition gauges are basically buckets elevated on a stand to about 1.6 m. The buckets have a solution in them to ensure that any dust that settles out of the air is not re-suspended by wind.

Gauges are placed around the site and within the surrounding community. The gauges were left in place for a period of two weeks to a month, on two separate occasions.

The rate of dust fall is calculated by dividing the weight of insoluble material collected (g) by the cross-sectional area of the gauge (m^2) and the number of days over which the sample was collected. The units of measurement are $\text{g}(\text{grams})/\text{m}^2(\text{metre}^2)/\text{day}$.

Guideline values used by the Council for dust deposition are $4 \text{ g}/\text{m}^2/30 \text{ days}$ or $0.13 \text{ g}/\text{m}^2/\text{day}$ deposited matter. Consideration is given to the location of the industry and the sensitivity of the surrounding community, when assessing results against these values.

Material from the gauges was analysed for solid particulates, the results of which are presented in Table 15 and 16.

Table 15 Air deposition monitoring results for 12 January- 1 February 2016

	Site	Days deployed	Particulate $\text{g}/\text{m}^2/\text{day}$
AIR001604	Adjacent to Manganaha Stream, behind rose nursery	20	0.09
AIR001608	124 Egmont Road, paddock boundary, west of house	20	0.06
AIR001622	At rear of RSPCA building	20	0.04
AIR001603	At entrance to landfill	20	Sample discarded (dead bird)
AIR001613	Grass lawn, behind work shed	20	0.07
AIR001623	Behind 194 Egmont Road	20	0.05

Key: Bold = exceeded guideline value of $0.13 \text{ g}/\text{m}^2/\text{day}$

Table 16 Air deposition monitoring results for 5 February – 25 February 2016

	Site	Days deployed	Particulate g/m ² /day
AIR001604	Adjacent to Manganaha Stream, behind rose nursery	20	0.09
AIR001608	124 Egmont Road, paddock boundary, west of house	20	0.17
AIR001622	At rear of RSPCA building	20	0.09
AIR001603	At entrance to landfill	20	0.16
AIR001613	Grass lawn, behind work shed	20	0.08
AIR001623	Behind 194 Egmont Road	20	0.03

Key: Bold = exceeded guideline value of 0.13 g/m²/day for residential areas

During the 2015-2016 period, there were two particulate levels obtained that were above the Council guideline level for dust deposition of 0.13 g/m²/day. Both of these were during the survey from 5 February to 25 February 2016.

The gauge deployed at 124 Egmont Road (AIR001608) was noted to contain vegetation, which would have contributed to the elevated result. The gauge deployed at site AIR001603 is at the site entrance and subjected to a volume of truck movements. This monitoring location is well within the landfill site's boundary so is unlikely to represent non compliant off site effects.

2.7.1.2 Ambient suspended particulate and landfill gas component monitoring

Ambient monitoring of suspended particulates (dust) and landfill gas components was undertaken under dry weather conditions on three occasions during the year under review at seven monitoring locations on, and in the neighbourhood of, the landfill. However, due to equipment failure, suspended particulate results were obtained on only two of those occasions. The results are shown in Table 17, Table 18 and Table 19.

Particulates

Particulates can derive from many sources, including motor vehicles (especially diesels), solid and oil-burning processes for industry and power generation, incineration and waste burning, photochemical processes, and natural sources such as pollen, abrasion and sea spray.

PM₁₀ particles (those of less than 10 µm in diameter) are linked to adverse health effects that arise primarily from the ability of particles of this size to penetrate the defences of the human body and enter deep into the lungs. Health effects from inhaling PM₁₀ include increased mortality and the aggravation of existing respiratory and cardiovascular conditions such as asthma and chronic pulmonary diseases. The national guideline for air quality (averaged over a 24 hr period) is 50 µg/m³ PM₁₀.

Suspended particulate (dust) monitoring was carried out under dry weather conditions on three occasions at seven monitoring locations on, and in the neighbourhood of, the landfill.

Landfill gas components

The landfill gas components monitored during the ambient surveys in the year under review were methane and H₂S.

The monitoring showed that this guideline was only being exceeded at two monitoring locations, both during the February survey.

Table 17 Ambient PM₁₀ and methane survey results 8 December 2015

Site	Methane (%LEL)	H ₂ S (ppm)	Dust µg/m ³
AIR001609	0	0	26
AIR001606	0	0	16
AIR0001605	0	0	20
AIR0001614	0	0	23
AIR0001612	0	0	29
AIR0001603	0	0	16
AIR0001618	0	0	17
Averages	0	0	21

Table 18 Ambient PM₁₀ and methane survey results 16 February 2016

Site	Methane (%LEL)	H ₂ S (ppm)	Dust µg/m ³
AIR001609	0	0	82*
AIR001606	0	0	139*
AIR001614	0	0	17
AIR001611	0	0	12
AIR001620	0	0	29
AIR001610	0	0	9
AIR001601	0	0	13
Averages	0	0	43

* Passing vehicles noted

Table 19 Ambient PM₁₀ and methane survey results 5 April 2016

Site	Methane (%LEL)	H ₂ S (ppm)	Dust µg/m ³
AIR001611	0	0	26
AIR001620	0	0	16
AIR001608	0	0	20
Inside litter fence at north east corner	0	0	23
Inside litter fence at south east corner	0	0	29
Mid way along main access road	0	0	16
134 Egmont Road	0	0	17
Averages	0	0	21

The instantaneous exceedance of the 24 hr average National Environmental Standard at sites AIR001609 and AIR001606 were both along Egmont Road and were not downwind of the landfill at the time of the survey. It was also noted that there were passing vehicles at the time the measurements were taken. Therefore these results do not represent non-compliant off site effects.

2.8 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 NPDC. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual courses of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

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

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

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

In summary, during the period under review there were eight odour complaints that were investigated by the Council, and one incident recorded due to a breach of consent found at a routine compliance monitoring inspection. A summary of the investigations and findings in relation to each of the incident register entries is given in Table 20.

The number of odour complaints received by Council has increased since the 2013-2014 year. Although no offensive or objectionable odours have been found off site, there were strong odours found on occasion during the 2014-2015 year, and noticeable odours found on occasion during the year under review. Localised offensive and objectionable odours have also been found on site.

A meeting was held in July 2014, at the Council offices, in order to determine why the odour was worse that winter. During these discussions it was outlined that, following the full and complete lining of Stage 3 during the 2013-2014 monitoring year, the volume of leachate and potentially contaminated stormwater had increased. It was also agreed that the leachate flow control valve was limiting the flow exiting Stage 3 causing fluids to back up in the landfill, which could potentially push out gas through and/or alongside the leachate lines. NPDC implemented interim mitigation measures during the 2014-2015 year, whilst engaging a consultant to provide advice on longer term solutions. Mitigation measures undertaken in the 2014-2015 year included:

- Installation of fixed deodorant sprayers, and automated spray system.
- Capping the lateral leachate lines.
- Ensuring there was on going monitoring any ponding in the landfill foot print to ensure this remained minimal.

Table 20 Summary of incident register investigations during the period under review

Date and time of complaint	Incident notes	Date and time of investigation	Investigation details	Findings/ Outcomes
21-Jul-2015 08:10	A complaint was received about an odour on Colson Road, Bell Block	21-Jul-2015 13:18	An odour survey was undertaken and no odour was found.	No odours
6-Aug-2015 17:50	A complaint was received regarding an odour emanating from the landfill on Colson Road, New Plymouth.	6-Aug-2015 18:25	Investigation found no odour in the vicinity of the landfill.	No odours
4-Sep-2015 20:45	A complaint was received regarding odour in the Waiwhakaiho Valley.	4-Sep-2015 21:14	A complaint was received regarding odour in the Waiwhakaiho Valley. The investigation, undertaken during a period of fine still weather, initially detected odour near the intersection of Smart / Devon roads. However, this quickly dissipated. Odour was again detected near the intersection of Devon / Katere Roads, however due to the shifting wind conditions this again quickly dissipated. No odour was detected for any period of time that allowed it to be fully assessed with regards to offensiveness. NPDC were asked to be aware that certain weather conditions were highly likely to result in objectionable odour being discharged beyond the boundary of the property, and to ensure that Abatement Notice EAC-20363 was being complied with at all times. An investigation found that odour was detectable intermittently with weather conditions meaning no constant odour was detected.	Intermittent odours only
N/A	During a compliance monitoring inspection it was found that the active tip face was not being covered daily as required by resource consent conditions on a landfill at Colson Road, New Plymouth.	8-Sep-2015 08:25	Abatement Notice EAC-20881 was issued requiring daily cover to be undertaken in accordance with the procedures within the Colson Road Regional Landfill Management Plan as required by condition 6 of consent 4779-1. An infringement notice was issued due to the discharge of landfill gas odours that were contributed to by a consent breach. This constituted a discharge of contaminants that were not, at that time, expressly allowed by the consent. Reinspection found that the abatement notice was not being complied with at the time of inspection. However, works were being progressed towards compliance in a timely manner. NPDC is in the process of updating the management plan to ensure compliance with resource consent conditions at all times.	Consent non-compliance. Abatement notice issued. Infringement notice issued.
11-Sep-2015 20:45	A complaint was received concerning an objectionable odour on Colson Road, New Plymouth.	11-Sep-2015 21:15	Odour surveys were undertaken. On arrival at Colson Road, a very weak and what appeared to be a pungent composting odour was detected but this was not considered to be objectionable. At the beginning of the investigation the wind velocity was a light breeze coming from the south-east. During the survey an odour was detected with an intensity range between very weak to no odour detected. There was also no odour detected upwind of landfill. After the upwind assessment was undertaken, on return to Colson Road, the rain had stopped and the wind velocity had dropped to calm. This resulted in no further odours being detected. The complainant was informed and it was noted that they were satisfied with the findings of the investigation. No further action was taken.	Noticeable odour for short duration only
19-Sep-2015 10:15	A complaint was received regarding odour at a property on Smart Road, New Plymouth.	19-Sep-2015 11:03	The following was found to be occurring: A complaint was received regarding an odour present at a property on Smart Road. Noticeable odour was observed at the property for a short interval before dissipating, the wind intensity was very slight and from the East. The dissipation of the odour coincided with the rain ceasing. An inspection of Colson Road found no odour affiliated with the landfill, further inspections of Smart Road also failed to locate any further odour. The site was compliant with consent conditions at the time of inspection.	Noticeable odour for short duration only

Date and time of complaint	Incident notes	Date and time of investigation	Investigation details	Findings/ Outcomes
23-Sep-2015 07:45	A complaint was received concerning an odour emanating from the landfill on Colson Road, New Plymouth	23-Sep-2015 08:10	On arrival at complainant's property (at approximately 8:10 am) a very weak and what appeared to be a pungent composting odour was detected but it was not considered to be objectionable. At the beginning of the investigation the wind velocity was of light air coming from the south-east. At 8:30 am an odour survey was undertaken. During the odour survey the wind velocity became calm, resulting in no odour being detected during or after the survey. The complainant was informed and it was noted that they were satisfied with the results of the investigation. Inspection of the landfill was undertaken and the site manager was informed of the complaint and the investigation findings. The manager informed the investigating officer that the tip head was sprayed each night as required. Odour was detected on site and this was at its strongest 20 m below the tip head where the manager was operating the digger and also on the north-west side of landfill in the area of the leachate lines.	Weak but pungent odour of short duration. No objectionable or offensive odours found
09-Nov-2015 21:30	A complaint was received regarding a gassy type odour on Smart Road, New Plymouth	09-Nov-2015 22:12	At the time of the inspection no odour was detected about the complainant's address, however an odour was detected on Devon Road near NZ Couriers. The odour was deemed to have been discharged from the Colson Road landfill. The odour was noticeable but not objectionable at the time of the inspection and the odour plume was reasonably narrow. NPDC was asked to continue to monitor the situation regarding odours being discharged from the site to ensure that resource consent conditions are being satisfied.	Noticeable odours only
18-Mar-2016 21:55	A complaint was received concerning an offensive odour emanating from the Colson Road landfill, New Plymouth	18-Mar-2016 22:25	At the time of the inspection an odour survey was undertaken at the complaint's property. With a swirling north to north-east light breeze, slightly overcast night sky and a temperature of 20 degrees. A very weak to weak odour was detected and identified it to be similar to the product used through the deodorisers. However it was not found to be objectionable. Up wind survey was undertaken and no odour was detected.	Weak odour of mitigating material sprayed on site

An odour assessment report produced by Tonkin and Taylor after a site visit on 28 February 2015 was received by the Council on 2 June 2015. The report included the following recommendations with regard to actions to be undertaken to minimise the potential for effects:

- That a staged odour mitigation approach be adopted as per the following table, with the operational improvements to be implemented immediately and the following stages implemented as required, and
- that the odour suppressant in use be reviewed for effectiveness.

It was also noted that as the landfill was generating a significant volume of gas and does not have a capture system, reducing the permeability of the cap in one area would simply push the gas towards escaping in other areas. As odour issues typically arise from point source discharges it is beneficial to eliminate these and encourage dispersed discharge across the intermediate cap. Constructing a system to capture and dispose of the gas is the ultimate solution, however this comes at significant cost. Tonkin and Taylor recommended undertaking stages one and two in Table 21, and if odour continued to be an issue, then the construction of a gas capture and disposal system prior to closure of the landfill may be required (their stage 3 recommendation).

Table 21 Staged odour mitigation recommended by Tonkin and Taylor

Stage 1 (Immediately)	Operation improvements	<ul style="list-style-type: none"> • Leachate pipe remediation – as required install reticulation or active recirculation to capture leachate breakouts • Regular visual walkover inspections • Improvements to fence-mounted odour neutralising sprays: • Use odour neutralising sprays to target active filling area, particularly when daily cover is removed. Use mobile or fixed sprayers directed down or up wind of the area • Review odour spray system product, pump sizing & pressure • Improve the methodology for sludge disposal
Stage 2	Target hot spots	<ul style="list-style-type: none"> • Cap remediation • Target hot spots using odour sprays mobile or fixed sprayers

At inspection on 8 September 2015 (Section 2.1) it was found that there were objectionable odours present on site, and that there were point source discharges of landfill gases around the capped leachate lines. It was also confirmed that the daily cover requirements in the Colson Road Regional Landfill Management Plan (July 2013) were not being complied with. Compliance with the management plan is a requirement of condition 6 of consent 4779-1. One of the purposes of the daily cover given in the management plan is to control odour, and it also assists with limiting leachate generation. This non compliance with consent meant that odours were being discharged in a manner that was not expressly allowed by NPDC's air discharge consent, and an infringement notice was issued. An abatement notice was also issued requiring the NPDC to "*undertake works to ensure that all conditions of Resource Consent TRK994779 are complied with at all times*". The reasons given for the issuing of the

abatement notice were that the site was visit by a Council Enforcement Officer on 8 September 2015 and it was found that:

- The active landfill area was not being covered on a daily basis
- Fugitive odorous gases were being emitted into the air from numerous locations onsite, without proper treatment prior to discharge
- Liquid waste had been dumped into the special waste area

NPDC continued to work towards implementing the Tonkin and Taylor recommendations and achieving compliance with the management plan and consent 4779-1 during the period under review. In addition to correspondence, a number of meetings were held between the Council and NPDC (16 September 2015, 28 October 2015, 29 March 2016 and 30 May 2016) to set out the expectations of Council and to track the progress of the improvements and investigations being undertaken at the site.

During the year under review:

- Reticulation was improved to capture leachate breakouts and mitigate associated landfill gas venting
- Regular visual walkover inspections were implemented by the operator
- NPDC engaged a Consultant to focus outstanding work such as updating the site management plan, project managing the further work to mitigate the point source discharges from the protruding leachate lines, following up on final cover being applied to areas that are at final level and reviewing operational issues to feed into future versions of the management plan
- Improvements were made to the fence mounted odour mitigating sprayers and the system was upgraded so that it could be automated
- Trials of alternative spray on daily cover materials were carried out
- A trial biofilter was installed on one of the protruding leachate lines
- The volume and pressure of the landfill gas present in the leachate system was investigated
- A preliminary design report was completed for the collection and treatment of landfill gas that could be extracted from the leachate lines and directed to either a biofilter or flare
- Data was gathered to allow the special waste disposal practices to be reviewed, with wastes with less than 20 % solids no longer being accepted after 31 July 2015 as per the site management plan
- Daily cover practices were improved, with the new contractor opting to trial large metal covers that could be lifted on to compacted refuse at the end of one working day and lifted off at the start of the next
- Intermediate cover was applied to all but a relatively small area that was to be completed as and when weather permitted

At the end of the year under review a decision had been made that the landfill gas would be collected (initially) from the leachate lines on the western side of the landfill and would be directed to a flare. The effectiveness of this would be monitored and reviewed, with the collection system to be expanded if required.

2.9 Management and reporting

2.9.1 Landfill management and contingency plans

Daily operations at the site are governed by the requirements contained in the Colson Road Regional Landfill Management Plan, which the consents require is updated at not less than yearly intervals.

A contingency plan is also required for the site by special condition 7 of consent 6177-1.

The management plan in effect during the 2014-2015 period was issued by NPDC in November 2015, whilst the contingency plan was issued in July 2013.

2.9.2 Colson Road Landfill Liaison Committee

A liaison committee comprising representatives of NPDC, Taranaki Regional Council, landfill contractor, and neighbours of the landfill was set up in 1999 as required by condition 32 of the land use consent for Colson Road. The purpose of the committee is to facilitate the airing of concerns of the neighbours to the landfill and to ensure that the landfill's neighbours are kept abreast of the development of the landfill site.

It is also a requirement of condition 8 of consent 4779 that the consent holder, staff of the Council, submitters to the application and any other party (at the Council's discretion) meet at least once per year. The liaison committee meetings also fulfil this consent requirement.

During the period under review, the committee met on 3 November 2015, 16 February 2016 and 14 June 2016. This periodicity of meetings was agreed by all parties. The meetings covered site development progresses, operations at the landfill, and future activities. It is also an opportunity for submitters and neighbours to be kept informed of any issues arising at the site, and mitigation measures NPDC is putting in place. Attendees of the meeting agree that they are worthwhile and provide useful feedback to NPDC.

The Colson Road landfill liaison committee has been very successful to date and will continue in its present format for the 2016-2017 monitoring period.

2.9.3 Independent consultant's reports

Site inspections were undertaken by WAI Environmental (independent consultants) on 18 October 2015, 3 March 2016 and 23 June 2016.

15 October 2015

The report of the 18 October 2015 visit noted that:

- There had been an improvement in standards since the last visit (21 May 2015) together with a significant increase in investment of money and attention to landfill management
- Work was continuing on odour control and mitigation
- Litter was still observed in a number of drains and ditches around the site

- The silt pond was still in need of desludging and there was agreement to clean out and repair the weir
- The open landfill face was judged as being in excess of 900 m² and outside the requirements of the Management Plan
- Daily cover was now being trialled using a “hydro seed” mulch, which was being sprayed over the working face at the end of the day. It was difficult for the Consultant to judge if this was effective but in his opinion it fails to deliver all the objectives required of daily cover

3 March 2016

The report of the 3 March 2016 inspection noted that:

- Final cover was being recovered from the southern end of the site where it had been stored for that purpose. The transport of the cover material was causing significant dust although the Consultant was unable to tell if this travelled outside the designated boundary
- The consultant was disappointed by the state of the landfill itself and considered it to be scruffy
- The landfill working face was in excess of that allowed by the Management Plan
- There were other areas of the landfill that had been left uncovered for several months while the working face was elsewhere. These should have been provided with intermediate cover if left unattended for a long period of time, as they had been
- Daily cover using a “hydro seed” mulch was now regular and did not appear to be adequate and, in the Consultant’s opinion, fails to deliver the objectives required of daily cover. The refuse felt soft underfoot and it seemed that compaction was poor. It appeared that the material was currently being sprayed over relatively uncompacted refuse and was therefore, in the Consultant’s opinion, likely to be relatively ineffective
- Litter was still observed in a number of drains and ditches around the site
- The silt pond was still in need of desludging and, although there was agreement on the last visit to clean out and repair the weir, that remained unattended to
- The promised work to relocate the farm gate between two paddocks on Stage 2 had still not been done
- The operator had indicated that they no longer wished to operate the landfill. The council had agreed to retender for the period until the end of the landfill’s life. There had been significant interest

23 June 2016

The visit of the 23 June 2016 was the Consultant’s first visit since the new contractor (Warner Construction Limited) started work at the site. The report noted that:

- The site was significantly tidier, although it was difficult for the Consultant to ascertain whether that was solely due to the new contractor or as a result of efforts by the previous contractor
- It was muddy and some mud was tracking off the working platform onto the access road, but this was not so significant that it was considered detrimental. No mud left the site and Colson Road was clean and tidy with no signs of litter

- The method of refuse delivery had reverted to disposal into a pit from where the contractor removed it and compacted it into the working face, working downhill and away from the pit. For the first time for many months the landfill working face was within the parameters allowed by the Management Plan
- The first impression was of a neat and tidy operation by an operator who was paying attention to detail. There was no free litter on the site and that which could be seen was firmly stapled by the machinery being operated or was being collected manually
- All drainage ditches observed had been cleaned and lined with plastic. The contractor advised the Consultant that the ditches were also going to be covered with fabric in an attempt to reduce the litter problem
- The promised work to relocate the farm gate between two paddocks on Stage 2 had still not been done due to difficulties in contacting the farmer. It was agreed that NPDC would ask the new contractor to arrange for the work to be done
- The pond had been desilted and the weir had been repaired on completion of Whitakers contract
- The northern end of the landfill had been covered, maintaining a clean and tidy site
- In response to landfill odour problems, NPDC informed the Consultant that it was now planned to reticulate gas from various points around the site to a flare, which would be positioned at the northern end of the site. This work had not yet commenced

2.9.4 Composting

In the past concerns have been raised about whether the material in each windrow had a plant derived matter content of at least 95% as required by consent conditions. These concerns were mostly directed at the acceptance of stock bedding which is a mixture of hay (or wood chips) and manure. To address this the Council clarified plant derived matter as being any plant derived material that has only been exposed to external degradation processes (and has not been partially or wholly ingested by any type of animal). This definition includes green waste, shredded green waste, humate, untreated woodchip/shavings, the plant derived component of animal litter (such as hay and wood shavings), and old existing compost stored on the site. This definition does not include paunch grass, or animal manure. It is however Council's position, that poultry, goat and horse manure are acceptable constituents of the 5% non-plant derived proportion of the windrows.

Changes occurred to the composting operations during the 2014-2015 year, due to a change in the contractor employed by Envirowaste, who is the operator of the transfer station.

The main compost operator on site changed to Revital, with the previous operator moving to a hard stand area to the south of the main composting area.

It was noted that the amount of green waste processing occurring in the main area had reduced significantly at the start of the, but increased to above the volumes managed by the previous operator towards the end of that year. Concerns were raised at times about the presence of the occasional bit of food waste, non-organic

rubbish, and the amount of plastic (from the use of plastic bags to contain the green waste taken to the transfer station). The volumes of green waste composted at the site remained high during the period under review. The amount of non-plant derived matter contained in the green waste received at the site was found to have decreased significantly with little, if any, being observed in the drop off point. One of the older compost windrows from material accepted at the site during the 2014-2015 year contained visible non-plant derived matter, but this was estimated to be less than the 5 % permitted by the consent.

It was noted that the compost produced by the new operator was coarser than the previous operator, and therefore may be less prone to leachate generation.

The majority of the stormwater drainage from the new composting area operated by Return2Earth was directed through a roadside open drain and culvert to the four pond treatment system for the combined composting area stormwater discharges.

In summary, findings during the year under review were that, based on estimates at inspection, it appeared that the condition relating to the acceptable percentage of non-plant derived material was being complied with throughout the monitoring period. It was also considered that the stormwater from the composting areas was being managed such that compliance with the conditions of the stormwater discharge consents for the landfill were not being compromised by the composting activities.

3. Discussion

3.1 Site performance

Overall improvements in site management were required during the year under review. The main issues related to no or inadequate daily cover, inadequate intermediate cover, litter in the tributaries below the silt ponds, management of the special waste, fugitive point source emissions of landfill gas.

An abatement notice and an infringement fine were issued following inspection on 8 September 2015 as a result of:

- The active landfill area not being covered on a daily basis
- Fugitive odorous gases being emitted into the air from numerous locations onsite, without proper treatment prior to discharge
- Liquid waste being dumped into the special waste area

The abatement notice required NPDC to undertake works to ensure that the air discharge consent (4779-1) was complied with at all times.

Trials were undertaken to investigate the use of alternative spray on daily cover materials and Preliminary Landfill Gas Management Design Report was completed by Tonkin and Taylor evaluating the alternatives for landfill gas collection and treatment systems. NPDC elected to progress with the installation of a system that will collect landfill gas emissions from the leachate lines on the western side of the landfill. This system will be directed to a flare that is intended to achieve a minimum 95 % destruction rate. The proposal also allows for the staged addition of additional collection points, if required.

Plans were put in place to improve the management of special waste to bring them in line with the requirements of the management plan that were to take effect from 1 August 2016.

Improvements were made in the first half of the year relating to the control of leachate breakouts and the odour mitigating sprays. In the latter part of the year improvements were made in relation to litter and silt control, and daily and intermediate cover. The size of the working face was also reduced. It is noted that the operator of the landfill was changed from Whittaker's to Warner Construction Limited on 13 June 2016.

A revised management plan, due in July 2014, was received in November 2015.

The final report from the independent consultant in the 2014-2015 year stated that the normal high standard of operation had not been maintained during the difficult weather conditions experienced over the preceding few weeks. During the year under review, although the condition of the landfill had been found to have improved at the visit in October, it had worsened again at the time of the March visit. It was noted in the June report that the condition of the landfill on this occasion was significantly improved.

Council inspections found that the composting areas were well managed with no dust or odour issues reported relating to these activities. Dust control at the landfill was also adequate to ensure that there were no resultant off site effects.

The completed, earlier stages of the landfill were well managed, with only one minor matter raised regarding stock erosion in a gateway. The early signs of this erosion were initially raised in the 2014-2015 year. During the year under review it proved difficult for NPDC to progress this matter with the farmer, and at the end of the year under review the new contractors were asked to undertake the work. Although some minor ponding was found to have been occurring at the Consultant's visit in June, it is not considered that this was likely to have resulted in any significant environmental effects.

Although, at times, high levels of landfill gases were found on site, along with very strong or objectionable odours, these were relatively localised. No offensive or objectionable odours were found off site at any of the routine compliance monitoring inspections.

Groundwater sampling found that the groundwater in the vicinity of the site was such that no remedial actions, as contained in special condition 5 of consent 4621-1, were required.

3.2 Environmental effects of exercise of consents

There were no significant adverse effects found in the Puremu Stream during the period under review. Although there were transient suspended solids (11 August 2015) and ammoniacal nitrogen (8 December 2015) concentrations found in the Puremu Stream there were no significant effects found. The suspended solids concentration in the Puremu Stream on 11 August was still low for wet weather conditions. In the case of the elevated ammoniacal nitrogen concentration on 8 December, due to the conditions prevailing at the time of sampling, the unionised concentration remained below guideline for aquatic ecosystem protection. The parameter concentration limits at both of the Puremu Stream compliance points were met at the time of the subsequent sampling survey(s).

The Manganaha Stream was found not to be measurably affected by discharges from the landfill, and no direct discharges were found to this waterbody during the year under review.

Although there were issues raised regarding on site litter control, there were no issues noted regarding litter being found on Colson Road, or anywhere else beyond the site boundary.

Biomonitoring found that there were no indications of any significant adverse effects on either the Puremu Stream or the Manganaha Stream from the discharges from the Colson Road landfill at the time of either survey.

Groundwater quality remains satisfactory and there is no evidence of significant contamination either in the groundwater or in the under-liner drainage system.

With exception of two results, all ambient deposited particulate levels obtained were below the Council guideline level for dust deposition in residential areas (0.13 g/m²/day). One of the gauges was within the site boundary and the other contained vegetation, which would have contributed to the elevated result. Therefore, based on the results of the deposition gauge surveys undertaken during the period under review, it is unlikely that landfill is causing off site dust deposition levels that exceed the guideline. Suspended particulate readings also indicate that the site is complying with National Environmental Standard for PM₁₀. There were no dust related complaints received by Council during the year under review.

Although eight odour complaints were received during the year under review, there were no offensive or objectionable odours found at the time of investigation. On two occasions there were no odours found and on the other six occasions the odours were noticeable at most.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 22 to Table 29.

Table 22 Summary of performance for diversion consent 0226-1

Purpose: To divert the Puremu Stream in the Waiwhakaiho Catchment by culverting stream to provide road access to refuse tip		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Comply with Water Right 226	Site inspections	Yes
2. Pipe laid in accordance with manufacturer's specifications	Site inspection	Yes
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

Table 23 Summary of performance for contaminated stormwater and leachate consent 2370-3

Purpose: To discharge up to 1000 m³/day [5 L/s] of leachate and contaminated stormwater from the closed section, Area A, of Colson Road municipal landfill to groundwater in the vicinity of and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Best practice to be adopted	Site inspection	Yes
2. Consent undertaken in accordance with information supplied in the application	Site inspection and review of documentation on file	Yes
3. Discharge not alter colour, clarity or pH of Puremu Stream	Site inspection and water sampling	Yes
4. No significant adverse effects on aquatic life	Site inspection, sampling and biomonitoring	Yes

Purpose: To discharge up to 1000 m³/day [5 L/s] of leachate and contaminated stormwater from the closed section, Area A, of Colson Road municipal landfill to groundwater in the vicinity of and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
5. Monitor surface water on/near the site	Undertaken by the Council via site specific monitoring programme, inspections and water sampling	Yes
6. Satisfy all requirements of the District Plan of the New Plymouth District Council	N/A	N/A
7. Management and site contingency plan	Site inspection and review of documentation on file	Yes
8. Maintain a landfill capping barrier and vegetative cover	Site inspection (stages 1 & 2)	Yes
9. Area is closed and managed in accordance with the management plan	Site inspection and review of documentation on file	Yes
10. Maintain drains, ponds and contours on site to minimise unwanted water movement and ponding on site	Site inspections	Ponding found on 23 June 2015
11. No cleaning or hosing out of refuse vehicles on site	Site inspections	Yes
12. The mixing zone extends downstream from the culvert outlet to 2 m above the confluence between the Puremu Stream and its tributary	N/A	N/A
13. Discharge shall not alter the Puremu Stream in the way of films, foams or suspended materials, change colour or visibility, objectionable odour, harm aquatic or farm animals, or increase temperature by more than 2.0°C	Site inspection and water sampling	Yes
14. Discharge shall not alter the water quality of the Puremu Stream below the given criteria	Site inspection and water sampling	Ammoniacal nitrogen concentration exceeded on one of three occasions
15. Discharge shall not reduce the concentration of dissolved oxygen below 5 mg/litre	Site inspection and water sampling	Yes
16. Discharge shall not render the Puremu Stream unfit for stock consumption	Site inspection and water sampling	Yes
17. Satisfactorily maintain and manage the leachate collection and treatment systems	Site inspection	Yes

Purpose: To discharge up to 1000 m³/day [5 L/s] of leachate and contaminated stormwater from the closed section, Area A, of Colson Road municipal landfill to groundwater in the vicinity of and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
18. Optional review provision re environmental effects	Next opportunity for review June 2020	N/A
Overall assessment of environmental performance and compliance in respect of this consent		Good
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 24 Summary of performance for Consent 4619-1 treated stormwater and leachate discharge

Purpose: To discharge up to 675 L/s of treated stormwater and minor amounts of leachate from areas B1 B2 C1 and C2 of the Colson Road Landfill to groundwater in the vicinity of and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Water quality in the Manganaha Stream shall not be changed	Site inspection and water sampling	Yes
2. Water quality of the Puremu Stream shall not exceed the given criteria	Site inspection and water sampling	Yes
3. Discharge shall not alter the Puremu Stream in the way of films, foams or suspended materials, change colour or visibility, objectionable odour, harm aquatic or farm animals, or increase temperature by more than 2.0°C	Site inspection and water sampling	Minor exceedance of ammoniacal nitrogen and suspended solids concentrations on one of three occasions
4. Operate according to the 'New Plymouth District Council Colson Road Landfill: Landfill Management Plan July 1994', or subsequent versions with no less environmental protection. Plan to be updated at not greater than yearly intervals	Site inspection and review of documentation on file. Plan on file dated July 2013. Reminder sent to NPDC August 2014. Revised plan received November 2015	Updated plan received late. On-going non compliance with daily cover requirements and management of special waste
5. Maintain and comply with a monitoring programme	Not assessed during period under review	N/A
6. Consent will lapse after six years if not exercised	N/A, consent exercised	N/A
7. Optional review provision re environmental effects	Next opportunity for review June 2018	N/A
Overall assessment of environmental performance and compliance in respect of this consent		Improvement required
Overall assessment of administrative performance in respect of this consent		Improvement required

N/A = not applicable

Table 25 Summary of performance for uncontaminated stormwater consent 4620-1

Purpose: To discharge up to 675 L/s of uncontaminated stormwater from areas B1 B2 C1 and C2 of the Colson Road landfill into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Water quality in the Manganaha Stream shall not be altered	Inspections and water sampling	Yes
2. Discharge to have pH 6.5-8.5, maximum suspended solids 100 g/m ³ , and maximum ammoniacal nitrogen 0.5 g/m ³ as nitrogen	Inspections and water sampling	Not able to assess as discharge is mixed with that of consent 4619
3. No leachate discharge	Sampling and inspection	Yes
4. Channels shall minimise erosion	Site inspections	Yes
5. Channels shall minimise instability of the surrounding land	Site inspections	Yes
6. Repair land eroded/made unstable due to construction/maintenance	Site inspections	Yes
7. Notification of any proposal which may affect areas contributing runoff	Site inspections and liaison with consent holder	Yes
8. Discharge shall not alter the Puremu Stream in the way of films, foams or suspended materials, change colour or visibility, objectionable odour, harm aquatic or farm animals, or increase temperature by more than 2.0°C	Site inspections and water sampling	Yes
9. No excavation or landfilling if any runoff to Manganaha Stream will contain suspended solids or any other contaminant	Site inspection and water sampling	Yes
10. Operate according to the 'New Plymouth District Council Colson Road Landfill: Landfill Management Plan July 1994', or subsequent versions with no less environmental protection. Plan to be updated at not greater than yearly intervals	Site inspection and review of documentation on file. Plan on file dated July 2013. Reminder sent to NPDC August 2014. Revised plan received November 2015	Updated plan received late. On-going non compliance with daily cover requirements and management of special waste
11. Maintain and comply with a monitoring programme	Not assessed during period under review	N/A
12. Consent will lapse after six years if not exercised	N/A, consent has been exercised	N/A
13. Optional review provision re environmental effects	Next opportunity for review June 2018	N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		Improvement required Improvement required

N/A = not applicable

Table 26 Summary of performance for discharge to land consent 4621-1

Purpose: To discharge up to 500 tonnes/day of contaminants onto and into land in areas B1, C1 and C2 at the Colson Road landfill		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Install and maintain groundwater monitoring piezometers	Site inspection and liaison with consent holder	Yes
2. Prevent surface runoff into the Manganaha Stream from any area used or previously used for the deposition of refuse	Site inspection and water sampling	Yes
3. All drainage channels, bunds and contouring is complete prior to use	N/A	N/A
4. Civil works relating to construction of Stage 3 be certified by a registered engineer prior to use	N/A	N/A
5. Mitigate if adverse effects on groundwater	Sampling	Yes
6. Maintain and comply with a monitoring programme	Not assessed during period under review	N/A
7. Operate according to the 'New Plymouth District Council Colson Road Landfill: Landfill Management Plan July 1994', or subsequent versions with no less environmental protection. Plan to be updated at not greater than yearly intervals	Site inspection and review of documentation on file. Plan on file dated July 2013. Reminder sent to NPDC August 2014. Revised plan received November 2015	Updated plan received late. On-going non compliance with daily cover requirements and management of special waste
8. Disposal of waste shall comply with the 'criteria for calculating landfill potentials' and the 'Draft Health and Environment Guidelines for selected Timber Treatment Chemicals'	Not assessed during period under review	N/A
9. Consent will lapse after six years if not exercised	N/A, consent exercised	N/A
10. Optional review provision re environmental effects	Next opportunity for review June 2018	N/A
Overall assessment of environmental performance and compliance in respect of this consent		Improvement required
Overall assessment of administrative performance in respect of this consent		Improvement required

N/A = not applicable

Table 27 Summary of performance for composting air consent 4622-1

Purpose: To discharge emissions into the air from composting and ancillary activities at the Colson Road landfill		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Minimise adverse effects on the environment	Site inspection and liaison with consent holder	Yes
2. No offensive odours	Air surveys	Yes

Purpose: To discharge emissions into the air from composting and ancillary activities at the Colson Road landfill		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
3. No adverse ecological effects on any ecosystem	Site inspection, sampling, and neighbourhood surveys	Yes
4. Materials accepted for composting comply with the 'Assessment of Discharges to Air' July 1994 and the New Plymouth District Council Colson Road Landfill Management Plan July 1994	Site inspection	Yes
5. All composting to occur at least 300 m from any dwelling existing as of 21 March 1999	Site inspections	Yes
6. Composting piles must consist of no less than 95% plant-derived material	Site specific monitoring programme - site inspections and visual assessment	Yes – as best as could be estimated
7. Composting to occur on a trial basis until the consent is approved or reviewed on receipt of a full report	N/A	N/A
8. Consent will lapse after six years if not exercised	N/A, consent has been exercised	N/A
9. Optional review provision re environmental effects	N/A	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 28 Summary of performance for air discharge consent 4779-1

Purpose: To discharge contaminants into the air from the existing landfill [Area A] and proposed landfill extension in areas A B1 B2 C1 and C2 of the Colson Road Municipal Landfill Site, New Plymouth		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Best practicable option (BPO) to prevent or minimise adverse effects on the environment	Site inspection, air surveys, complaint response	BPO not implemented re: minimising odours
2. No offensive odours or dust or noxious concentrations	Site inspection, air surveys, complaint response	Yes
3. No burning on site	Site inspection, complaint response	Yes
4. No adverse ecological effects on any ecosystem	Inspections of site and neighbouring areas	Yes
5. No venting untreated landfill gases within 200 m of any boundary	Not assessed during period under review	N/A

Purpose: To discharge contaminants into the air from the existing landfill [Area A] and proposed landfill extension in areas A B1 B2 C1 and C2 of the Colson Road Municipal Landfill Site, New Plymouth		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
6. Comply with 'Air Discharge Consent Application Supporting Documentation' and according to the 'New Plymouth District Council Colson Road Landfill: Landfill Management Plan July 1994, or subsequent versions with no less environmental protection. Plan to be updated at not greater than yearly intervals	Site inspection and review of documentation on file. Plan on file dated July 2013. Reminder sent to NPDC August 2014. Revised plan received November 2015	Updated plan received late. On-going non compliance with daily cover requirements and management of special waste. Infringement and abatement notices issued
7. Council approval to be sought in the event of alterations at the site or to site operations	Site inspections and liaison with consent holder and site operator	Yes
8. Meet once a year to discuss any matter relating to the consent	Landfill liaison committee meetings	Yes
9. Provide a report within a year on the collection, extraction, venting and combustion of landfill gas	Review of documentation on file. Compliance previously achieved, as report had been received	Yes
10. Optional review provision re environmental effects	Next opportunity for review in June 2018	NA
11. Optional review provision re collection, extraction, venting and combustion of landfill gas	Next opportunity for review in June 2018	NA
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		Poor Improvement required

N/A = Not applicable

Table 29 Summary of performance for earthworks stormwater consent 6177-1

Purpose: To discharge stormwater [due to earthworks in providing an area for Stage 3 of the municipal landfill] onto land and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaho catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Discharge quality within specified parameters	Site inspection and sampling	Not able to assess as discharge is mixed with that of consent 4619
2. No leachate discharged	Site inspection	Yes
3. Maintenance of drains to prevent erosion and sedimentation	Site inspections	Yes
4. No conspicuous effect on clarity or colour of receiving waters	Site inspection and sampling	Yes
5. No significant effect on aquatic life	Site inspection, sampling and biomonitoring	Yes

Purpose: To discharge stormwater [due to earthworks in providing an area for Stage 3 of the municipal landfill] onto land and into the Puremu Stream a tributary of the Mangaone Stream in the Waiwhakaiho catchment		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
6. Monitoring to satisfaction of the Council	Site inspection, sampling and data review	Yes
7. Preparation and maintenance of a management plan	Review of Council records and liaison with consent holder	Plans previously provided
8. Sediment and erosion management plan	Not assessed during year under review	Plans previously provided
9. Adopt best practice	Site inspection and liaison with content holder	Yes
10. Rehabilitation of disturbed areas	Site inspection	Yes
11. Maintain stormwater system to prevent ponding and overland flow	Site inspection	Yes
12. Receiving waters not adversely affected	Site inspection, sampling and biomonitoring	Yes
13. A review condition	No further review opportunities prior to consent expiry	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = Not applicable

Overall, NPDC demonstrated a poor level of environmental performance and an improvement was desirable in their administrative compliance with the resource consents. During the year under review there were fugitive odorous gases being emitted into the air from numerous locations onsite, without proper treatment prior to discharge, which had the potential to cause significant adverse effects. There were on-going non compliance with the management plan with respect to cover requirements and management of special waste that were likely to have been contributing to the fugitive landfill gas emissions. Although some improvements and investigations were undertaken during the year under review, further improvement is required.

3.4 Recommendations from the 2014-2015 Annual Report

The 2014-2015 Annual Report recommended:

THAT monitoring of discharges from the Colson Road regional landfill in the 2015-2016 period monitoring continues at the same level as in 2014-2015.

This recommendation was implemented.

3.5 Alterations to monitoring programmes for 2016-2017

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/ discharges and effects under the RMA; and
- to report to the regional community.

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

It is proposed that for 2016-2017, the programme remains unchanged.

4. Recommendation

1. THAT monitoring of discharges from the Colson Road regional landfill in the 2016-2017 period monitoring continues at the same level as in 2015-2016.

Glossary of common terms and abbreviations

The following abbreviations and terms that may have been 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 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.
HDPE	High density polyethylene.
L/s	Litres per second.
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.
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
Moxie	A large earthmoving truck.
NH ₄	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH ₃	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO ₃	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM ₁₀	Relatively fine airborne particles (less than 10 micrometre diameter).
ppm	Parts per million on a volume/volume basis.
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.
Zn*	Zinc.

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

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

Bibliography and references

- Beca Carter Hollings and Ferner (1994): *Groundwater and Geotechnical Investigations; Colson Road Landfill Consents* (unpublished report prepared for New Plymouth District Council).
- New Plymouth District Council (2013): *Colson Road Regional Landfill Management Plan*. July 2013.
- New Plymouth District Council (2015): *Colson Road Regional Landfill Management Plan*. November 2015.
- Taranaki Regional Council (1990): *New Plymouth District Council Waitara and New Plymouth Landfill. Annual Report 1989/90*. Technical Report 90-31.
- Taranaki Regional Council (1991): *New Plymouth District Council Waitara and New Plymouth Landfill. Annual Report 1990/91*. Technical Report 91-12.
- Taranaki Regional Council (1992): *New Plymouth District Council Landfills, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara Annual Report 1991-92*. Technical Report 92-23.
- Taranaki Regional Council (1993): *New Plymouth District Council, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara. Annual Report 1992-93*. Technical Report 93-65.
- Taranaki Regional Council (1994): *New Plymouth District Council, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara. Annual Report 1993-94*. Technical Report 94-22.
- Taranaki Regional Council (1995): *New Plymouth District Council, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara Landfills Annual Report 1994-95*. Technical Report 95-51.
- Taranaki Regional Council (1996): *New Plymouth District Council, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara Landfills Annual Report 1995-96*. Technical Report 96-45.
- Taranaki Regional Council (1997): *New Plymouth District Council, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara Landfills Annual Report 1996-97*. Technical Report 97-56.
- Taranaki Regional Council (1998): *New Plymouth District Council, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara Landfills Annual Report 1997-98*. Technical Report 98-51.
- Taranaki Regional Council (1999): *New Plymouth District Council, Inglewood, New Plymouth, Okato, Okoki, Tongaporutu and Waitara Landfills Annual Report 1998-99*. Technical Report 99-44.
- Taranaki Regional Council (2000): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 1999-00*. Technical Report 00-38.

Taranaki Regional Council (2001): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2000-01*. Technical Report 2001-61.

Taranaki Regional Council (2002): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2001-02*. Technical Report 2002-81.

Taranaki Regional Council (2003): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2002-03*. Technical Report 2003-83.

Taranaki Regional Council (2004): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2003-04*. Technical Report 2004-112.

Taranaki Regional Council (2005): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2004-05*. Technical Report 2005-65.

Taranaki Regional Council (2006): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2005-06*. Technical Report 2006-63.

Taranaki Regional Council (2007): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2006-07*. Technical Report 2007-48.

Taranaki Regional Council (2008): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2007-08*. Technical Report 2008-56.

Taranaki Regional Council (2009): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2008-09*. Technical Report 2009-60.

Taranaki Regional Council (2010): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2009-10*. Technical Report 2010-66.

Taranaki Regional Council (2011): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2010-11*. Technical Report 2011-46.

Taranaki Regional Council (2012): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2011-12*. Technical Report 2012-38.

Taranaki Regional Council (2013): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2012-13*. Technical Report 2013-51.

Taranaki Regional Council (2014): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2013-14*. Technical Report 2014-59.

Taranaki Regional Council (2016): *New Plymouth District Council, New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 2014-15*. Technical Report 2015-74.

Appendix I

Resource consents held by NPDC for Colson Road landfill

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

TRK750226

WATER PERMIT

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

Name of: NEW PLYMOUTH DISTRICT COUNCIL
Consent Holder: PRIVATE BAG 2025 NEW PLYMOUTH

Change to
Conditions Date: 8 October 1986

CONDITIONS OF CONSENT

Consent Granted: TO DIVERT THE PUREMU STREAM A TRIBUTARY OF THE
MANGAONE STREAM IN THE WAIWHAKAIHO CATCHMENT
BY CULVERTING THE STREAM TO PROVIDE ROAD ACCESS
TO THE REFUSE TIP AT OR ABOUT GR: P19:070-380

Expiry Date: 1 October 2026 [as per section 386(2) of the Resource Management Act 1991]
[originally granted 2 April 1975 under the Water and Soil Conservation Act 1967 'at the pleasure of the
Commission']

Site Location: COLSON ROAD NEW PLYMOUTH

Legal Description: SEC 223 HUA DIST BK VI PARITUTU SD

Catchment: WAIWHAKAIHO 392.000

Tributary: MANGAONE 392.010
PUREMU 392.012

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

TRK750226

Conditions of right

- (a) The Commission may prescribe the method of management of this right, including the limitation of periods during which the right may be fully exercised, if a water shortage or other abnormal circumstances occur in the locality.
- (b) This right may be operated only by the person holding the right or his agent and only for the purpose stated in the right.
- (c) The right may, with the consent of the Commission in writing, be transferred to a new owner or occupier of the property to which the right relates, but only on the same conditions as contained in this right.
- (d) The conditions relating to this right cannot be varied without the prior consent in writing of the Commission.
- (e) This right is not a guarantee that the quantity and quality of water specified will be available.
- (f) Unless specifically authorised by this right the discharge of water or waste containing pollutants into natural water is not permitted.
- (g) This right is not an authority to obtain access to a source of water or a point of discharge.
- (h) The grantee of the right shall keep such records as may reasonably be required by the Commission and shall if so requested supply this information to the Commission.
- (i) This right may be cancelled by the Commission, or Commission may take such other action as the Act provides, if the right is not exercised within 12 months of its granting or such longer time as the Commission may approve.
- (j) This right may be cancelled by the Commission if in the opinion of the Commission it is not diligently and beneficially exercised.
- (k) This right is granted subject to the Commission or its servants or agents being permitted access at all reasonable times for the purpose of carrying out inspections and measurements.
- (l) The design and maintenance of any works relating to the right must be to a standard adequate to meet the conditions of the right so that neither the works nor the exercise of the right is likely to cause damage to any property or injury to any person.
- (m) Should the grantee in the opinion of the Commission commit any breach of the right or its conditions the Commission may cancel the right.
- (n) This right is granted, subject to the Commission retaining the right to review the terms and conditions attached hereto including the period of the right at intervals of not less than five [5] years.
- (o) This right will expire upon the date shown overleaf or upon 14 days notice, whichever comes sooner.
- (p) The cost of supervision of this right, including water sampling deemed necessary by the Commission shall be carried by the grantee.
- (q) The final drawings of the culvert are to be submitted to the Commission for approval before work is commenced.

TRK750226

VARIATION OF 14 MAY 1986:

Additional General Conditions

- (a)The grantee shall provide to the Manager, Taranaki Catchment Commission, on request plans, specifications and maintenance programmes of works associated with the exercise of this right, showing that the conditions of this right are able to be met.
- (b)The standards, techniques and frequency of monitoring of this right shall be to the specific approval of the Manager, Taranaki Catchment Commission.
- (c)The actual and reasonable cost of administration supervision and monitoring of this right, deemed necessary by the Manager, Taranaki Catchment Commission, shall be met by the grantee.
- (d)This right may be cancelled in writing to the grantee by the Commission if the right is not exercised within twelve months of the date of grant of such longer time as the Manager, Taranaki Catchment Commission, may approve.
- (e)This right may be terminated by the Commission upon not less than six months notice in writing to the grantee if, in the opinion of the Commission, the public interest so requires, but without prejudice to the grantee to apply for a further right in respect of the same matter.

Additional Special Conditions

- 1)The terms and conditions pertaining to Water Right 226 shall apply.
- 2)[**Note: Condition 2 was subsequently deleted as per variation of 8 October 1986.**]
- 3)The new 900 mm pipe shall be laid in accordance with the manufacturers specifications.

VARIATION OF 8 OCTOBER 1986:

Deletion of special condition 2.

Signed at Stratford on 8 October 1986

For and on behalf of
TARANAKI REGIONAL COUNCIL

OPERATIONS MANAGER

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

Name of
Consent Holder: New Plymouth District Council
Private Bag 2025
NEW PLYMOUTH

Review Completed 20 July 2004 [Granted: 19 March 2003]
Date:

Conditions of Consent

Consent Granted: To discharge up to 1000 cubic metres/day [5 litres/second]
of leachate and contaminated stormwater from the closed
section, Area A, of Colson Road municipal landfill to
groundwater in the vicinity of and into the Puremu Stream
a tributary of the Mangaone Stream in the Waiwhakaiho
catchment at or about GR: P19:074-372

Expiry Date: 1 June 2026

Review Date(s): June 2004, June 2006, June 2008, June 2014, June 2020

Site Location: Colson Road Landfill, Colson Road, New Plymouth

Legal Description: Sec 223 Hua Dist Blk VI Paritutu SD

Catchment: Waiwhakaiho

Tributary: Mangaone
Puremu

General conditions

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

Special conditions

- 1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.
- 2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of applications 87/228, 92/205 and 1664. In the case of any contradiction between the documentation submitted in support of applications 87/228, 92/205 and 1664 and the conditions of this consent, the conditions of this consent shall prevail.
- 3. Any discharge shall not alter to a conspicuous extent the natural colour, clarity or pH of the receiving water, nor shall it contain visible oil or grease, nor shall it emit objectionable odours, nor shall it increase the temperature of the Puremu Stream by more than 2.0°C.
- 4. There shall be no significant adverse impact upon natural aquatic life downstream of the landfill as a result of the exercise of this consent.
- 5. Monitoring of surface waters and groundwater on or in the vicinity of the site shall be undertaken to the satisfaction of the Chief Executive, Taranaki Regional Council.
- 6. The consent holder shall satisfy all relevant requirements, obligations and duties of the Proposed District Plan of the New Plymouth District Council.
- 7. The consent holder shall prepare, maintain and comply with a site management plan to the approval of the Chief Executive, Taranaki Regional Council.
- 8. The consent holder shall maintain an adequate landfill capping barrier and vegetative cover on the site to the satisfaction of the Chief Executive, Taranaki Regional Council.
- 9. The consent holder shall ensure that the area to which this consent is attributed is closed and subsequently managed in accordance with the Colson Road Regional Landfill Management Plan provided June 2004 or as subsequently amended provided that subsequent amendments do not reduce the level of environmental protection set out in the June 2004 plan.

10. The consent holder shall maintain stormwater drains, sediment detention ponds, and/or ground contours at the site, in order to minimise stormwater movement across, or ponding on the site.
11. The consent holder shall ensure that there shall be no cleaning or hosing out of refuse-containing vehicles at the site.
12. The mixing zone in each condition of this consent shall extend for a distance downstream of the point of the culvert outlet of the Puremu Stream to 2 metres above the confluence of the unnamed tributary of the Puremu Stream and the Puremu Stream at the site's legal boundary.
13. After allowing for reasonable mixing the consent holder shall ensure that the discharge shall not give rise to any of the following effects in the receiving waters of the Puremu Stream:
 - a) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material;
 - b) any conspicuous change in colour or visual clarity;
 - c) any emission of objectionable odour;
 - d) the rendering of fresh water unsuitable for consumption by farm animals;
 - e) any significant adverse effects on aquatic life.
 - f) an increase in the temperature of the Puremu Stream by more than 2.0° Celsius
14. The discharge shall not be shown to reduce the quality of the Puremu Stream at or beyond the mixing zone below the following criteria:

constituent	maximum concentration or level
aluminium	5.0 mg/l
arsenic	0.1 mg/l
beryllium	0.1 mg/l
boron	0.5 mg/l
cadmium	0.01 mg/l
chromium	0.1 mg/l
cobalt	0.05 mg/l
copper	0.2 mg/l
fluoride	1.0 mg/l
iron	5.0 mg/l
lead	0.1 mg/l
manganese	1.0 mg/l
nitrate + nitrite (NO ₃ -N + NO ₂ -N)	100 mg/l
nitrite -N	5.0 mg/l
selenium	0.02 mg/l
vanadium	0.1 mg/l
zinc	2.0 mg/l
ammoniacal nitrogen	2.5 mg/l
pH	6.5 - 8.5
sulphate	500 mg/l

Note: levels of trace metals expressed as total recoverable metals

15. The discharge shall not be shown to reduce the concentration of dissolved oxygen in the Puremu Stream below 5 mg/litre, beyond the mixing zone specified in special condition 12 above.
16. The discharge shall not, in the opinion of the Chief Executive, Taranaki Regional Council, contain substances or constituents other than those listed in condition 14, nor pathogenic organisms, which would render the water of the Puremu Stream, beyond the mixing zone specified in condition 12 above, unpalatable or unfit for stock consumption purposes.
17. The maintenance, management and operation of the leachate and collection and treatment systems shall be to the satisfaction of the Chief Executive, Taranaki Regional Council, to ensure that the conditions attached to this consent can be met.
18. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2004 and/or June 2006 and/or June 2008 and/or June 2014 and/or June 2020, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 20 July 2004

For and on behalf of
Taranaki Regional Council

Director-Resource Management

TRK994619

DISCHARGE PERMIT

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

Name of
Consent Holder: NEW PLYMOUTH DISTRICT COUNCIL
PRIVATE BAG 2025 NEW PLYMOUTH

Consent
Granted Date: 21 March 1999

CONDITIONS OF CONSENT

Consent Granted: TO DISCHARGE UP TO A MAXIMUM OF 675 LITRES/SECOND
OF TREATED STORMWATER AND MINOR AMOUNTS OF
LEACHATE FROM AREAS B1, B2, C1 AND C2 OF THE
COLSON ROAD LANDFILL TO GROUNDWATER IN THE
VICINITY OF AND INTO THE PUREMU STREAM A
TRIBUTARY OF THE MANGAONE STREAM IN THE
WAIWHAKAIHO CATCHMENT AT OR ABOUT GR:
P19:074-372

Expiry Date: 1 June 2025

Review Date[s]: June 2006, June 2012, June 2018 and/or within six months of the
first exercise of this consent

Site Location: COLSON ROAD LANDFILL, COLSON ROAD, NEW
PLYMOUTH

Legal Description: SEC 223 HUA DIST BLK VI PARITUTU SD

Catchment: WAIWHAKAIHO 392.000

Tributary: MANGAONE 392.010
PUREMU 392.012

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; and
 - ii) charges authorised by regulations.

Special conditions

- 1. THAT the water quality in the Manganaha Stream above its confluence with the Mangaone Stream shall not be changed as a result of this discharge.
- 2. THAT the exercise of this consent shall not cause the water quality of the Puremu Stream at the northern boundary of the site to exceed the following criteria:

Component	Criteria
pH	range within 6.5-8.5
Dissolved oxygen	maximum reduction of 1.0 gm ⁻³ in the upstream dissolved oxygen concentration
Ammoniacal nitrogen	2.0 gm ⁻³ for pH below 7.75 1.3 gm ⁻³ for pH between 7.75-8.00 1.0 gm ⁻³ for pH between 8.00-8.50
Nitrate	10 gm ⁻³ as nitrogen
Nitrite	0.06 gm ⁻³ as nitrogen
Faecal coliforms	1000/100 mL
Sulphate	1000 gm ⁻³
Oil and grease	10 gm ⁻³
Suspended solids maximum permitted increase in instream concentration	
[dry weather conditions]	10 gm ⁻³
[wet weather conditions]	10%
of upstream concentration	

	Maximum instream concentration Total Recoverable Metals gm⁻³	Maximum permitted increase in concentration Filtered Metals gm⁻³
Aluminium	5.0	0.1
Arsenic	0.2	0.05
Beryllium	0.1	n/a
Boron	5.0	n/a
Cadmium	0.05	0.001
Chromium	1.0	0.02
Cobalt	1.0	n/a
Copper	0.5	0.002
Iron	10.0	0.3
Lead	0.1	0.002
Manganese	5.0	n/a
Selenium	0.05	0.001
Vanadium	0.1	n/a
Zinc	2.4	0.03

3. THAT the discharge authorised by this consent, in conjunction with the exercise of any other consent associated with the landfill property, shall not give rise to any of the following effects in the Puremu Stream at the northern boundary of the site:
 - a) the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials [other than storm debris and suspended solids as permitted under condition 2 above];
 - 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.
4. THAT this consent shall be exercised in a manner conforming with the relevant requirements of the 'New Plymouth District Council Colson Road Landfill: Landfill Management Plan 1994', or any subsequent version of that document which does not lessen environmental protection standards. The Management Plan shall be updated at not greater than yearly intervals, to the satisfaction of the General Manager, Taranaki Regional Council.
5. THAT the consent holder shall provide, maintain and comply with a monitoring programme, to the satisfaction of the General Manager, Taranaki Regional Council, setting out details of monitoring to be carried out and containing guidelines for the determination of whether contamination is occurring, the initial plan to be provided at least three months prior to the exercise of this consent.
6. THAT this consent shall lapse on the expiry of six years after the date of commencement of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional

TRK994619

Council fixes a longer period pursuant to section 125(b) of the Resource Management Act 1991.

7. THAT pursuant to section 128(1)(a) of the Resource Management Act 1991, the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2006, June 2012, June 2018 and/or within six months of the first exercise of this consent, to deal with any significant adverse ecological effects on any ecosystems, including but not limited to, habitats, plants, animals, microflora and microfauna, arising from discharges licensed by this consent.

Signed at Stratford on 21 March 1999

For and on behalf of
TARANAKI REGIONAL COUNCIL

GENERAL MANAGER

TRK994620

DISCHARGE PERMIT

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

Name of
Consent Holder: NEW PLYMOUTH DISTRICT COUNCIL
PRIVATE BAG 2025 NEW PLYMOUTH

Consent
Granted Date: 21 March 1999

CONDITIONS OF CONSENT

Consent Granted: TO DISCHARGE UP TO 675 LITRES/SECOND OF UNCONTAMINATED STORMWATER FROM AREAS B1 B2 C1 AND C2 OF THE COLSON ROAD LANDFILL INTO THE PUREMU STREAM A TRIBUTARY OF THE MANGAONE STREAM IN THE WAIWHAKAIHO CATCHMENT AT OR ABOUT GR: P19:074-372

Expiry Date: 1 June 2025

Review Date[s]: June 2006, June 2012, June 2018 and/or within six months of the first exercise of this consent

Site Location: COLSON ROAD LANDFILL, COLSON ROAD, NEW PLYMOUTH

Legal Description: SEC 223 HUA DIST BLK VI PARITUTU SD

Catchment: WAIWHAKAIHO 392.000

Tributary: MANGAONE 392.010
PUREMU 392.012

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

TRK994620

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 water quality in the Manganaha Stream above its confluence with the Mangaone Stream shall not be changed as a result of this discharge.
- 2. THAT the water quality of uncontaminated stormwater discharged to the Puremu Stream shall meet the following criteria:

pH	6.5-8.5
suspended solids	maximum concentration of 100 gm ⁻³
ammoniacal nitrogen	maximum concentration of 0.5 gm ⁻³ as nitrogen
- 3. THAT no leachate discharge shall be permitted by the exercise of this consent.
- 4. THAT all stormwater diversion and containment channels shall be designed, constructed and maintained so as to prevent or minimise erosion of the channel in all circumstances.
- 5. THAT the earthworks and construction associated with the landfill and the composting site and the stormwater diversion and containment channels shall be designed, constructed and maintained so as to minimise instability of the surrounding land.
- 6. THAT the consent holder shall repair and rehabilitate any land made unstable and any erosion occurring due to the construction or maintenance of the diversion channels or landfilling operations or composting site associated with the exercise of this consent.
- 7. THAT the consent holder shall notify the General Manager, Taranaki Regional Council, of any proposal which may alter or affect the areas contributing runoff insofar as may affect the exercise of this consent, other than as advised to the Taranaki Regional Council in the application for this consent, at least two months prior to commencing any such works. The consent holder shall obtain any necessary approvals under the Resource Management Act 1991 prior to commencing any such works.

TRK994620

8. THAT the discharge authorised by this consent, in conjunction with the exercise of any other consent associated with the landfill property, shall not give rise to any of the following effects in the Puremu Stream at the northern boundary of the site:
 - a) the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials [other than storm debris and suspended solids as permitted under condition 2 above];
 - 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, including but not limited to, freshwater fish, eels and watercress.
9. THAT there shall be no excavation or earthworks or other landfilling-related activities or composting activities in any area if any runoff of water containing suspended solids or any other contaminant arising from such activities might by reason of land topography or engineered works enter the Manganaha Stream, and in the event of any runoff water entering the Manganaha Stream contrary to this consent the consent holder shall immediately undertake such works as may be necessary to cease the discharge and to prevent a recurrence.
10. THAT this consent shall be exercised in a manner conforming with the relevant requirements of the 'New Plymouth District Council Colson Road Landfill: Landfill Management Plan July 1994', or any subsequent version of that document which does not lessen environmental protection standards. The Management Plan shall be updated at not greater than yearly intervals, to the satisfaction of the General Manager, Taranaki Regional Council.
11. THAT the consent holder shall provide, maintain and comply with a monitoring programme, to the satisfaction of the General Manager, Taranaki Regional Council, setting out details of monitoring to be carried out and containing guidelines for the determination of whether contamination is occurring, the initial plan to be provided at least three months prior to the exercise of this consent.
12. THAT this consent shall lapse on the expiry of six years after the date of commencement of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(b) of the Resource Management Act 1991.
13. THAT pursuant to section 128(1)(a) of the Resource Management Act 1991, the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2006, June 2012, June 2018 and/or within six months of the first exercise of this consent, for the purpose of reviewing the best practicable option or options available to reduce or remove any adverse effects on the environment, or to deal with any significant adverse ecological effects on any ecosystems, including but not limited to, habitats, plants, animals, microflora and microfauna, arising from discharges licensed by this consent.

Signed at Stratford on 21 March 1999

For and on behalf of
TARANAKI REGIONAL COUNCIL

GENERAL MANAGER

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

Name of
Consent Holder: New Plymouth District Council
Private Bag 2025
NEW PLYMOUTH 4342

Change To
Conditions Date: 19 January 2010 [Granted: 21 March 1999]

Conditions of Consent

Consent Granted: To discharge up to 500 tonnes/day of contaminants onto
and into land in areas B1, C1 and C2 at the Colson Road
landfill at or about (NZTM) 1697313E-5675450N

Expiry Date: 1 June 2025

Review Date(s): June 2012, June 2018

Site Location: Colson Road Landfill, Colson Road, New Plymouth

Legal Description: Sec 223 Hua Dist Blk VI Paritutu SD

Catchment: Waiwhakaiho

Tributary: Puremu

General conditions

- a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) 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 install and maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, a further groundwater monitoring piezometer approximately equidistant between the bores designated as AH9 and L2, and shall maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, groundwater monitoring piezometers and bores at the sites designated as WQA, WQB and WQC, as AH1, AH2, AH3, AH5, AH6, AH7, and as L1, L2, L5, L7 and L8. [Bore designations are those in Appendix A2, Figure 1, in the Assessment of Effects on the Environment prepared by Woodward-Clyde for New Plymouth District Council, July 1994].
- 2. THAT the consent holder shall prevent surface runoff of water or contaminants to the Manganaha Stream from any surface area being used or previously used for the deposition of refuse, or for extraction of soil, clay, or other cover material, or prepared for the deposition of refuse, unless such surface area has been covered and rehabilitated to the satisfaction of the Chief Executive, Taranaki Regional Council.
- 3. THAT prior to commencing any use of any part of Area B, C1 or C2 for the deposition of refuse or for composting activities, the consent holder shall demonstrate to the satisfaction of the Chief Executive, Taranaki Regional Council, that drainage channels, bunds, surface contouring, or other engineering and landscaping works associated with an Area or part of an Area have been undertaken and completed to the extent that compliance with condition 2 above will be achieved.

4. THAT the construction, installation, placement, integrity and performance of groundwater drainage systems, landfill lining systems, and leachate interception, collection, holding, recirculation, and discharge systems in any part of Areas B1, B2, C1 and C2 of the Colson Road Landfill as described in the 'Colson Road Landfill Assessment of Effects on the Environment' July 1994 and the 'New Plymouth District Council Colson Road Landfill Management Plan' July 1994 be certified by a registered engineer prior to any discharge of solid wastes in such part of those areas.
5. THAT should groundwater quality be significantly affected by activities or processes associated with the landfill or composting, then the consent holder shall implement such measures as are necessary to remedy or mitigate and if practicable to prevent the continuation of any effect upon quality of the groundwater. 'Significantly affected' for the purposes of this condition is defined as a change greater than the maximum natural variation in any parameter for water in any piezometer, bore, or spring, and the criteria for this shall be set out in the monitoring programme under condition 6.
6. THAT the consent holder shall provide, maintain and comply with a monitoring programme, to the satisfaction of the Chief Executive, Taranaki Regional Council, setting out details of monitoring to be carried out and containing guidelines for the determination of whether contamination is occurring, the initial plan to be provided at least three months prior to the exercise of this consent.
7. THAT the disposal of wastes shall be carried out in a manner conforming with the relevant requirements of the 'New Plymouth District Council Colson Road Landfill: Landfill Management Plan July 1994', or any subsequent version of that document which does not lessen environmental protection standards. The Management Plan shall be updated at not greater than yearly intervals, to the satisfaction of the Chief Executive, Taranaki Regional Council.
8. THAT the acceptance and disposal of waste types at the landfill for disposal shall conform to Section 2.5, Section 5.6 and Appendix E [or their equivalent] of the Landfill Management Plan referred to in condition 7 above, and in particular shall conform to the following:

Table 11.2 'Criteria for calculating landfill potentials' Hazardous Waste Management Handbook, Ministry for the Environment, 1994;

and

Chapter 5 of the 'Draft Health and Environmental Guidelines for Selected Timber Treatment Chemicals', Ministry for the Environment / Ministry of Health, September 1993, in compliance with the requirement for a Class 2 landfill.

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

Consent 4621-1

10. THAT pursuant to section 128(1) of the Resource Management Act 1991, the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2006, June 2102, June 2018 and/or within six months of the first exercise of this consent, to deal with any significant adverse ecological effects on any ecosystems, including but not limited to, habitats, plants, animals, microflora and microfauna, arising from discharges licensed by this consent.

Signed at Stratford on 19 January 2010

For and on behalf of
Taranaki Regional Council

Director-Resource Management

TRK994779

DISCHARGE PERMIT

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

Name of
Consent Holder: NEW PLYMOUTH DISTRICT COUNCIL
PRIVATE BAG 2025 NEW PLYMOUTH

Consent
Granted Date: 21 March 1999

CONDITIONS OF CONSENT

Consent Granted: TO DISCHARGE CONTAMINANTS INTO THE AIR FROM THE
EXISTING LANDFILL [AREA A] AND PROPOSED LANDFILL
EXTENSION IN AREAS A, B1, B2, C1 AND C2 OF THE
COLSON ROAD MUNICIPAL LANDFILL SITE, NEW
PLYMOUTH AT OR ABOUT GR: P19:074-372

Expiry Date: 1 June 2025

Review Date[s]: June 2001, June 2003, June 2006, June 2012, June 2018 and/or
within six months of the first exercise of this consent

Site Location: COLSON ROAD LANDFILL EXTENSION, COLSON ROAD,
NEW PLYMOUTH

Legal Description: SEC 223 HUA DIST BLK VI PARITUTU SD

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

TRK994779

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 at all times adopt the best practicable option to prevent or minimise any actual or likely adverse effect on the environment arising from emissions from the landfill operation. 'Best practicable option' [as defined in section 2 of the Act] shall be determined by the Taranaki Regional Council, following review of the conditions of this consent as set out under conditions 10 and 11 of this consent and having regard to the requirements of condition 6 of this consent.
- 2. THAT the discharge of contaminants into the air from the landfill operation shall not result in any of the following – offensive or objectionable odours; offensive or objectionable dust; or dangerous or noxious ambient concentrations of any airborne contaminant -- as determined by at least one enforcement officer of the Taranaki Regional Council, at or beyond the boundary of the site.
- 3. THAT no material is to be burnt at the landfill site.
- 4. THAT the discharges authorised by this consent shall not give rise to any significant adverse ecological effects on any ecosystem, including but not limited to, habitats, plants, animals, microflora and microfauna.
- 5. THAT no extraction venting of untreated landfill gases be located closer than 200 metres to any boundary of the landfill property site.
- 6. THAT the operation of the landfill shall give effect to the 'Air Discharge Consent Application Supporting Documentation' July 1995, prepared for the New Plymouth District Council by Woodward Clyde, and the New Plymouth District Council Colson Road Landfill Management Plan July 1994 or any subsequent version of that document which does not lessen the standard of environmental protection afforded by that document. The management plan shall be updated at not greater than yearly intervals, to the satisfaction of the General Manager, Taranaki Regional Council.
- 7. THAT prior to undertaking any alteration to the site or site operations other than as specified and discussed in the application and supporting documentation lodged with the Taranaki Regional Council for this consent, which may significantly alter the nature or quantities of contaminants discharged from the site into the air, the consent holder shall consult with the General Manager, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.

TRK994779

8. THAT the consent holder and staff of the Taranaki Regional Council shall meet as appropriate, and at least once per year, with the submitters to the consent, and any other interested party at the discretion of the General Manager, Taranaki Regional Council, to discuss any matter relating to the exercise of this consent, and in order to facilitate ongoing consultation.
9. THAT the consent holder shall, within one year of the commencement of this consent, provide a report on the feasibility of collecting, extracting, venting, or combusting of landfill gas at the Colson Road landfill, to the satisfaction of the General Manager, Taranaki Regional Council.
10. THAT pursuant to section 128(1)(a) of the Resource Management Act 1991, the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2006, June 2012, June 2018 and/or within six months of the first exercise of this consent, for the purpose of reviewing the best practicable option or options available to reduce or remove any adverse effects on the environment, or to deal with any significant adverse ecological effects on any ecosystems, including but not limited to, habitats, plants, animals, microflora and microfauna, arising from discharges licensed by this consent.
11. THAT in addition to the review provisions of condition 10 above, pursuant to section 128(1)(a) of the Resource Management Act 1991 the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review within six months of receipt of the report required by condition 9, and/or during June 2001, June 2003, June 2006, June 2012 and/or June 2018, for the purpose of considering the options of collecting, extracting, venting or combusting landfill gas.

Signed at Stratford on 21 March 1999

For and on behalf of
TARANAKI REGIONAL COUNCIL

GENERAL MANAGER

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

Name of
Consent Holder: New Plymouth District Council
Private Bag 2025
NEW PLYMOUTH

Consent Granted 11 June 2003
Date:

Conditions of Consent

Consent Granted: To discharge stormwater [due to earthworks in providing
an area for Stage 3 of the municipal landfill] onto land and
into the Puremu Stream a tributary of the Mangaone
Stream in the Waiwhakaiho catchment at or about GR:
P19:074-372

Expiry Date: 1 June 2020

Review Date(s): June 2004, June 2006, June 2008, June 2014

Site Location: Colson Road Landfill, Colson Road, New Plymouth

Legal Description: Sec 223 Hua Dist Blk VI Paritutu SD

Catchment: Waiwhakaiho

Tributary: Mangaone
Puremu

Consent 6177-1

General conditions

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

Special conditions

- 1. The water quality of uncontaminated stormwater discharge to the Puremu Stream shall meet the following criteria:

pH	6.5-8.5
suspended solids	maximum concentration of 100gm ⁻³
ammoniacal nitrogen	maximum concentration of 0.5 gm ⁻³ as nitrogen
- 2. No leachate discharge shall be permitted by the exercise of this consent.
- 3. All stormwater diversion and channels shall be designed, constructed and maintained so as to prevent or minimise erosion of the channel in all circumstances.
- 4. Any discharge shall not alter to a conspicuous extent the natural colour or clarity of the receiving water in the Puremu Stream.
- 5. There shall be no significant adverse impact upon natural aquatic life downstream of the landfill as a result of the exercise of this permit.
- 6. Monitoring of surface waters on or in the vicinity of the site shall be undertaken to the satisfaction of the Chief Executive, Taranaki Regional Council.
- 7. The consent holder shall prepare and maintain a management plan and site contingency plan for the site and associated activities on the site, to the satisfaction of the Chief Executive, Taranaki Regional Council.
- 8. The consent holder shall prepare and maintain a site erosion and sediment control management plan for the site and associated activities on the site, to the satisfaction of the Chief Executive, Taranaki Regional Council.
- 9. The consent holder shall at all times adopt the best practicable option, as defined in the Resource Management Act 1991, to prevent or minimise any or likely adverse effects on the environment associated with the discharges of stormwater from the site, including but not limited to the collection, containment and removal from the site of any discharge of contaminated stormwater.
- 10. The consent holder shall repair and rehabilitate any land made unstable and any erosion occurring due to the construction or maintenance of the diversion channels.

Consent 6177-1

11. The consent holder shall maintain stormwater drains, sediment detention ponds, and ground contours at the site, in order to minimise stormwater movement across, or ponding on the site, to the satisfaction of the Chief Executive, Taranaki Regional Council.
12. After allowing for reasonable mixing the consent holder shall ensure that the discharge shall not give rise to any of the following effects in the receiving waters of the Puremu Stream:
 - a) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material;
 - b) any conspicuous change in colour or visual clarity;
 - c) any emission of objectionable odour;
 - d) the rendering of fresh water unsuitable for consumption by farm animals;
 - e) any significant adverse effects on aquatic life.
 - f) an increase in the temperature of the Puremu Stream by more than 2.0 degrees Celsius.
13. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2004 and/or June 2006 and/or June 2008 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 11 June 2003

For and on behalf of
Taranaki Regional Council

Chief Executive

Appendix II

Biomonitoring reports for Colson Road landfill

To Job Manager, Lorraine Smith
From Scientific Officers, Brooke Thomas and Darin Sutherland
Report No BT051
Document No 1648395
Date February 2016

Biomonitoring of the Puremu and Manganaha Streams in relation to the New Plymouth District Council Colson Road landfill, October 2015

Introduction

New Plymouth District Council hold resource consents to authorise discharges to land and to water in relation to the operations of the Colson Road Landfill, in New Plymouth. The resource consents most relevant to this biological survey are summarised in Table 1 below.

Table 1 Summary of discharge consents held by NPDC which are of most relevance to this biological survey.

Consent	Purpose
2370	To discharge leachate to groundwater and into the Puremu Stream
4619	To discharge stormwater and leachate to land and into the Puremu Stream
4620	To discharge stormwater into Puremu Stream
4621	To discharge contaminants into land

The Colson Road land fill site has been opened up, filled and capped off progressively in stages since it was established (Figure 1). Stages 1 and 2 of the landfill site have been completed and, at present the landfill is operating in the stage 3 area of the site. A section of the site is also dedicated to the management of composting waste.

Leachate from stages two and three is collected and directed to the New Plymouth Municipal Wastewater Treatment Plant. Leachate from stage one and stormwater from these areas including the access road are directed towards the Puremu Stream which flows through the landfill site. Stormwater from the compost area and from clean areas surrounding the stage 3 area of the site is directed to a large 'stormwater pond' which then discharges into an unnamed tributary of the Puremu Stream. There may also be some stormwater runoff and groundwater seepage from the landfill towards the Manganaha Stream which runs along the north-eastern boundary of the land fill.

Biological surveys have been undertaken on the Puremu Stream since 1986, to assess potential adverse effects of leachate from the landfill on the macroinvertebrate communities of the stream. Further to this, biological monitoring has been undertaken on the Manganaha Stream since 1994 to assess the effects of seepage from the landfill site on the macroinvertebrate communities in the stream.

Results of freshwater biological surveys performed in relation to the Colson Road landfill since the 2000-2001 monitoring year are discussed in numerous biomonitoring reports listed in the references.

Methods

This survey was undertaken on 16 October 2015 at two previously established sampling sites in the Puremu Stream catchment and at two established sites in the Manganaha Stream (Figure 1 and Table 2). A third site located in an unnamed tributary of the Puremu Stream (PT1), which was routinely monitored in previous surveys, had been significantly modified by instream activities prior to the spring 2012 survey, and as a result, a new site was established 50m upstream. This is the seventh survey undertaken at this site.

Site 1 is a 'control' site on the Puremu Stream located upstream of the landfill site and site 2 is also located on this stream, but downstream of stage one and two areas. PT1 is located downstream of the large 'stormwater pond' discussed above. Site M4 is located on the Manganaha Stream downstream of an unnamed tributary which drains from the eastern side of the landfill site and site M6 is situated approximately 500 metres downstream of M4.

The standard '400 ml sweep-sampling' technique was used to collect streambed macroinvertebrates from site PT1 in an unnamed tributary of the Puremu Stream. This 'sweep-sampling' technique is very similar to Protocol C2 (semi-quantitative methods for soft-bottomed streams) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from site 2 in the Puremu Stream and sites M4 and M6 in the Manganaha stream. 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). A combination of the two sampling techniques was used to collect streambed macroinvertebrates from site 1 in the Puremu stream, upstream of the Colson Road landfill.

Table 2 Biomonitoring sites in the Puremu and Manganaha Streams related to the Colson Road Landfill

Stream	Site No.	Site Code	Location	Sampling method
Puremu stream	1	PMU000104	Upstream of the landfill	Kick-sweep sampling
	2	PMU000110	400 metres downstream landfill	Kick-sampling
Unnamed tributary of Puremu Stream	PT1	PMU000108	60 metres upstream of the confluence with Puremu Stream	Sweep-sampling
Manganaha Stream	M4	MNH000190	10 metres downstream of an unnamed tributary of the Manganaha Stream	Kick-sampling
	M6	MNH000260	500 downstream of site M4	Kick-sampling

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

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

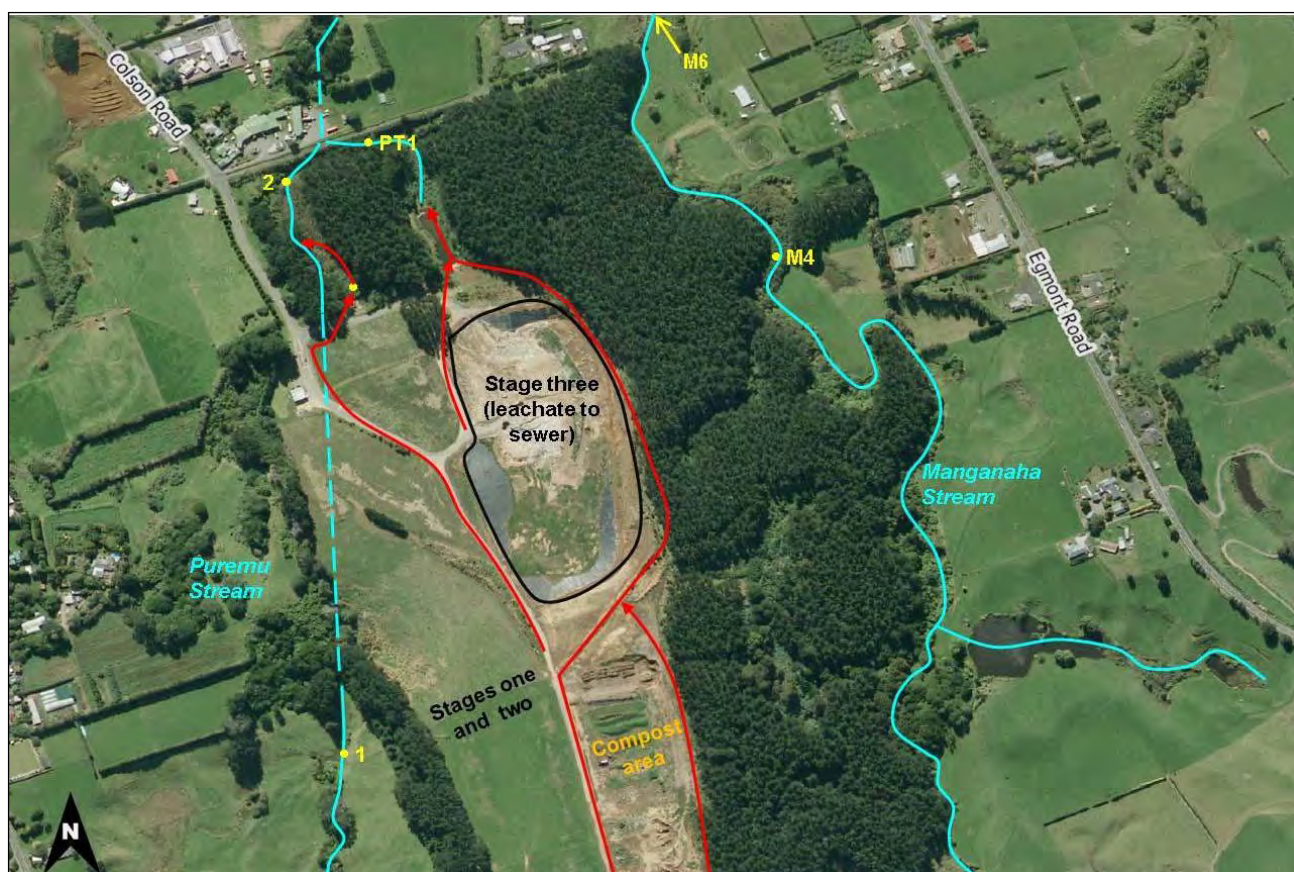


Figure 1 Biomonitoring sites related to the Colson Road landfill, New Plymouth. The red lines on the aerial photograph indicate the direction of stormwater runoff from the land fill site.

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. Averaging the scores from a list of taxa taken from one site and multiplying by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

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

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

A semi-quantitative MCI value (SQMCI_s) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling

these products, and dividing by the sum of the loading factors (Stark 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI_s is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

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.

Results and discussion

At the time of this October 2015 biomonitoring survey, the water temperatures in the Puremu Stream and tributary ranged from 12.9 °C to 15.8°C. Site 1 in the Puremu Stream had an uncoloured, clear, low and slow flow, closely resembling a swamp. At site 2 the stream had an uncoloured, clear and moderate flow. The unnamed tributary of the Puremu Stream at PT1 had an uncoloured, clear and very low and very slow flow of water. Iron oxide accumulations were present at site 2 but not site 1 or site PT1.

At site 1 the substrate consisted predominantly of silt with some sand and gravels, while the substrate at site PT1 was entirely silt. The substrate sampled at site 2 was predominantly comprised of silt with some wood and root. Partial shading of the bed was recorded at site 2 and site PT1, while site 1 was completely unshaded.

No periphyton was recorded at any sites in the Puremu Stream. Macrophytes dominated the bed of the stream at site 1, while at site PT1 they were recorded growing at the edges of the stream only. No macrophytes were recorded at site 2. No unusual bacterial, fungal or protozoan growths were found by microscopic examination of the samples for 'heterotrophic growths' at any of the Puremu Stream sites in this October 2015 survey.

The Manganaha Stream had a steady, uncoloured, clear and low flow at site M4 and site M6. The water temperature at site M4 was 12.9°C and at site M6, 13.5°C. Both site M4 and site M6 were partially shaded. The substrate at site M4 consisted entirely of silt, while site M6 primarily consisted of hard clay with some silt and wood and root. Neither site M4 or M6 supported any algal growth. No unusual bacterial, fungal or protozoan growths were found in the Manganaha Stream by the microscopic examination of the samples for 'heterotrophic growths'.

Macroinvertebrate communities

A summary of the results of previous macroinvertebrate surveys performed at the sites used in the current survey is presented in Table 3 together with current results.

Table 3 Numbers of taxa and MCI values recorded in previous surveys performed at sites in the Puremu and Manganaha Streams and a tributary of the Puremu Stream in relation to the Colson Road landfill since July 1986, together with current results.

Site No.	Number of taxa				MCI values			SQMCI _s values			
	No. samples	Range	Median	Current survey	Range	Median	Current Survey	No. of samples	Range	Median	Current survey
1	45	8-27	18	21	60-90	74	80	31	1.4-5.0	3.7	2.7
2	57	7-24	17	18	51-87	73	72	31	1.2-3.9	3.0	3.0
PT1*	30	11-22	16	16	55-79	72	80	29	1.2-3.7	2.4	2.1
M4	40	11-25	19	21	76-104	89	91	31	2.3-6.9	4.8	4.6
M6	34	12-27	19	21	58-100	85	96	31	2.8-6.8	4.1	4.1

* Summary statistics given for PT1 combine data for sites PMU000108 and PMU000109.

Puremu Stream

The current results for the Puremu Stream and the unnamed tributary of the Puremu Stream are presented in Table 4 below.

Table 4 Macroinvertebrate fauna of the Puremu Stream (sites 1 & 2) and tributary (site PT1) in relation to the Colson Road landfill sampled on 16 October 2015

Taxa List	Site Number	MCI score	1	2	PT1
	Site Code		PMU000104	PMU000110	PMU000108
	Sample Number		FWB15314	FWB15316	FWB15315
COELENTERATA	Coelenterata	3	-	C	-
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	R	R	-
NEMERTEA	Nemertea	3	R	R	-
NEMATODA	Nematoda	3	C	R	-
ANNELIDA (WORMS)	Oligochaeta	1	VA	A	VA
	Lumbricidae	5	R	-	-
HIRUDINEA (LEECHES)	Hirudinea	3	R	-	R
MOLLUSCA	<i>Potamopyrgus</i>	4	A	A	-
	Sphaeriidae	3	R	C	-
CRUSTACEA	Ostracoda	1	C	R	VA
	Isopoda	5	-	R	A
	<i>Paracalliope</i>	5	A	-	A
	Talitridae	5	-	R	C
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	A	-	-
ODONATA (DRAGONFLIES)	<i>Xanthocnemis</i>	4	-	-	R
COLEOPTERA (BEETLES)	Hydrophilidae	5	-	-	R
	Staphylinidae	5	-	-	R
TRICHOPTERA (CADDISFLIES)	<i>Hydrobiosis</i>	5	C	-	-
	<i>Hydropsyche (Orthopsyche)</i>	9	R	-	-
	<i>Psilochorema</i>	6	R	R	-
	Oeconesidae	5	-	R	-
	<i>Tripletides</i>	5	R	R	-
DIPTERA (TRUE FLIES)	Hexatomi	5	-	-	R
	<i>Paralimnophila</i>	6	-	R	-
	<i>Zelandotipula</i>	6	-	-	R
	<i>Chironomus</i>	1	-	R	A
	Orthocladinae	2	A	-	-
	<i>Polypedilum</i>	3	C	VA	A
	Tanypodinae	5	R	R	C
	Ceratopogonidae	3	R	-	-
	<i>Austrosimulium</i>	3	A	R	-
	Stratiomyidae	5	-	-	R
ACARINA (MITES)	Acarina	5	R	-	A
No of taxa			21	18	16
MCI			80	72	80
SQMCI _s			2.7	3.0	2.1
EPT (taxa)			5	3	0
%EPT (taxa)			24	17	0
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa	
R = Rare		C = Common		A = Abundant	
				VA = Very Abundant	
				XA = Extremely Abundant	

Site 1 (PMU000104)

A total taxa richness of 21 taxa was recorded at site 1 in this spring survey (Table 3 and Figure 2). This result was three taxa more than the historical median.

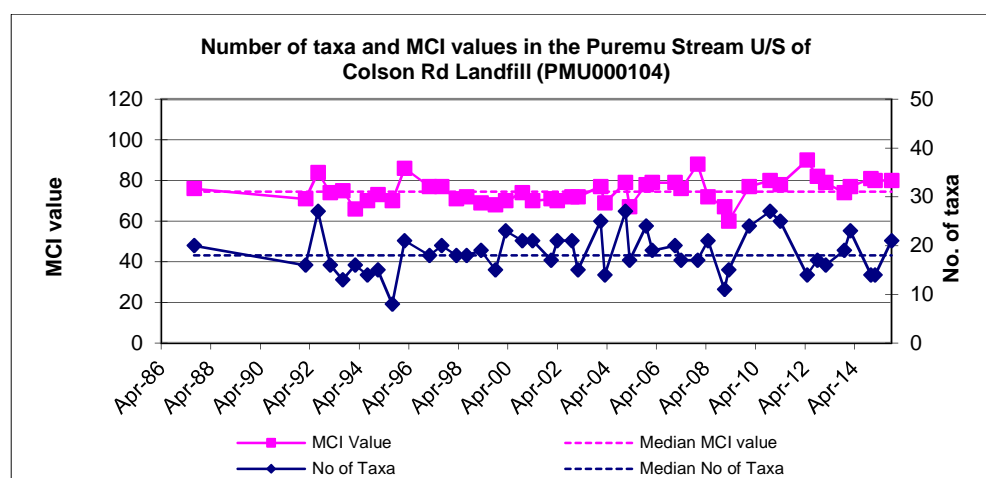


Figure 2 Number of macroinvertebrate taxa and MCI values recorded at site 1 in the Puremu Stream, upstream of Colson Road Landfill since April 1987

The community at this site was characterised by two 'moderately sensitive' taxa (amphipod (*Paracalliope*) and mayfly (*Austroclima*) and four 'tolerant' taxa; (oligochaete worms, *Potamopyrgus* snails, orthoclad midges and black fly larvae (*Austrosimulium*)). This community assemblage reflected the prevalence of macrophyte habitat recorded at this site and the low flow that was recorded at the time of this survey (Table 4).

In this survey (43%) of the community consisted of 'sensitive' taxa, which resulted in the MCI score of 80 units, six units more than the median score recorded at this site previously and the same as that recorded in the previous survey (Table 3 and Figure 2). The numerical dominance by mainly 'tolerant' taxa resulted in a SQMCI_s score of 2.7 units (Table 4). This score was a significant 1.4 units below that recorded in the previous survey and a significant 1 unit below the median score recorded for the site (Stark, 1998) (Table 3).

The significant reduction in SQMCI_s score recorded from the previous survey was due to several significant changes in the abundance of taxa. In particular, the reduction in SQMCI_s score can be attributed to the significant decrease in abundances within three 'sensitive' taxa and significant increase in abundances within three 'tolerant' taxa. These results reflected a macrophyte associated community assemblage that had been impacted by low flows.

Site 2 (PMU000110)

A moderate number of taxa (18) was recorded at this site, one taxon more than the median of previous surveys at this site, and seven taxa more than the richness recorded in the previous survey (Table 3 and Figure 3).

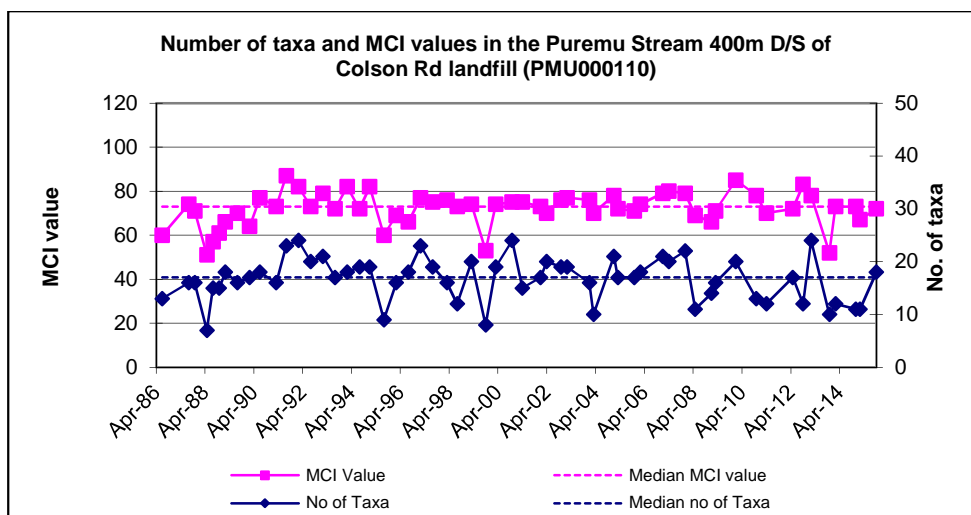


Figure 3 Taxa numbers and MCI values recorded at site 2, 400 m downstream of Colson Rd Landfill

The macroinvertebrate community was characterised by three ‘tolerant’ taxa (oligochaete worms, *Potamopyrgus* snails, and midge *Polypedilum*) (Table 4).

A greater proportion of ‘tolerant’ taxa recorded at this site (61%) resulted in the MCI score of 72 units, which was an insignificant 1 unit fewer than the historical median for the site and was slightly lower than that recorded at site 1 (Stark, 1998) (Table 3 and Figure 3). The SQMCI score of 3.0 units was the same as the historical median for the site and slightly higher than that recorded upstream at site 1 (Stark, 1998) (Table 3).

These results suggest that the health of the macroinvertebrate community at site 2 was ‘poor’ whereas the health upstream at site 1 was ‘fair’, however the difference in MCI scores between the two sites was not significant (Stark, 1998). The differences in score may be due to variation in habitat between the sites.

Site PT1 (PMU000108)

Sixteen taxa were recorded at site PT1 in the unnamed tributary of the Puremu Stream, the same number of taxa as the historical median for the site and a slightly lower number than the richness recorded at sites 1 and 2 in the Puremu Stream (Table 3 and Figure 4).

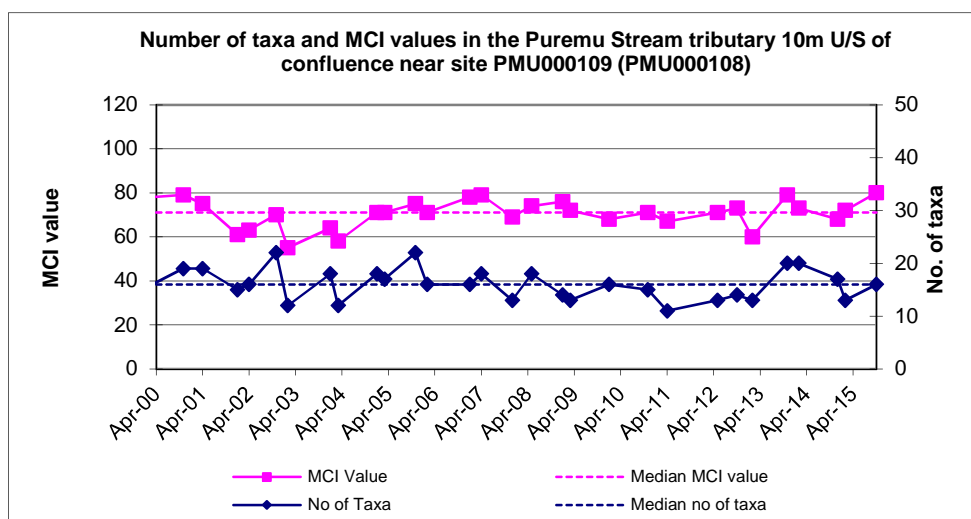


Figure 4 Numbers of taxa and MCI values recorded to date at site PT1, downstream of Colson Road Landfill

The community at site PT1 was characterised by four ‘tolerant’ taxa (oligochaete worms, ostracod seed shrimps, midge larvae (*Chironomus*) and (*Polypedilum*)) and three ‘moderately sensitive’ taxa (isopods, mites (Acarina) and amphipods (*Paracalliope*)) (Table 4). The higher proportion of ‘sensitive’ taxa (62%) was reflected in the MCI score of 80 units, which indicated ‘fair’ biological health. This MCI score was the same as that recorded at site 1 and was 8 units higher than the median MCI score for the site and 8 units higher than that recorded at site 2 (Table 3 and Figure 4).

Two low scoring ‘tolerant’ taxa numerically dominated the community at this site which resulted in the low SQMCI_s score of 2.1 units, an insignificant 0.3 unit lower than the historical median score for the site, but 1.2 units higher than the minimum score previously recorded. This SQMCI_s score was not significantly different to that recorded at site 1 (Stark, 1998), although was significantly lower than that recorded at site 2 (by 0.9 unit) and indicated poor physicochemical water quality and/or habitat quality at this site.

Manganaha Stream

The results for the current survey of the Manganaha Stream are presented in Table 5 below.

Table 5 Macroinvertebrate fauna of the Manganaha Stream in relation to the Colson Road landfill sampled on 16 October 2015

Taxa List	Site Number	MCI score	M4	M5
	Site Code		MNH000190	MNH000260
	Sample Number		FWB15317	FWB15318
NEMERTEA	Nemertea	3	R	-
NEMATODA	Nematoda	3	-	R
ANNELIDA (WORMS)	Oligochaeta	1	A	A
MOLLUSCA	<i>Polamopyrgus</i>	4	VA	VA
	Sphaeriidae	3	R	-
CRUSTACEA	Ostracoda	1	R	-
	<i>Paracalliope</i>	5	VA	A
	<i>Paratya</i>	3	-	R
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	C	A
	<i>Coloburiscus</i>	7	C	R
	<i>Zephlebia</i> group	7	R	C
PLECOPTERA (STONEFLIES)	<i>Acroperla</i>	5	R	-
ODONATA (DRAGONFLIES)	<i>Xanthocnemis</i>	4	R	-
	<i>Antipodochlora</i>	5	-	R
COLEOPTERA (BEETLES)	Ptilodactylidae	8	R	R
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	R	-
TRICHOPTERA (CADDISFLIES)	Ecnomidae/Psychomyiidae	6	R	R
	<i>Hydrobiosis</i>	5	R	C
	<i>Hydropsyche</i> (<i>Orthopsyche</i>)	9	A	C
	<i>Triplectides</i>	5	R	R
DIPTERA (TRUE FLIES)	<i>Chironomus</i>	1	R	-
	<i>Harrisius</i>	6	-	R
	Orthocladinae	2	C	A
	<i>Polypedilum</i>	3	R	C
	Tanypodinae	5	-	R
	Empididae	3	-	R
	<i>Austrosimulium</i>	3	C	R
	Tanyderidae	4	-	R
No of taxa			21	21
MCI			91	96
SQMCI _s			4.6	4.1
EPT (taxa)			8	7
%EPT (taxa)			38	33
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa
R = Rare		C = Common		A = Abundant
		VA = Very Abundant		XA = Extremely Abundant

Site M4 (MNH000190)

Twenty-one taxa were recorded at site M4 in this survey which was two taxa more than the historical median for the site (Table 3 and Figure 5). The community at this site was characterised by one 'highly sensitive' taxon (net-building caddisfly (*Hydropsyche*)), one 'moderately sensitive' taxon (amphipod (*Paracalliope*)) and two 'tolerant' taxa (snail (*Potamopyrgus*) and oligochaete worms) (Table 5), which was indicative of good preceding water quality.

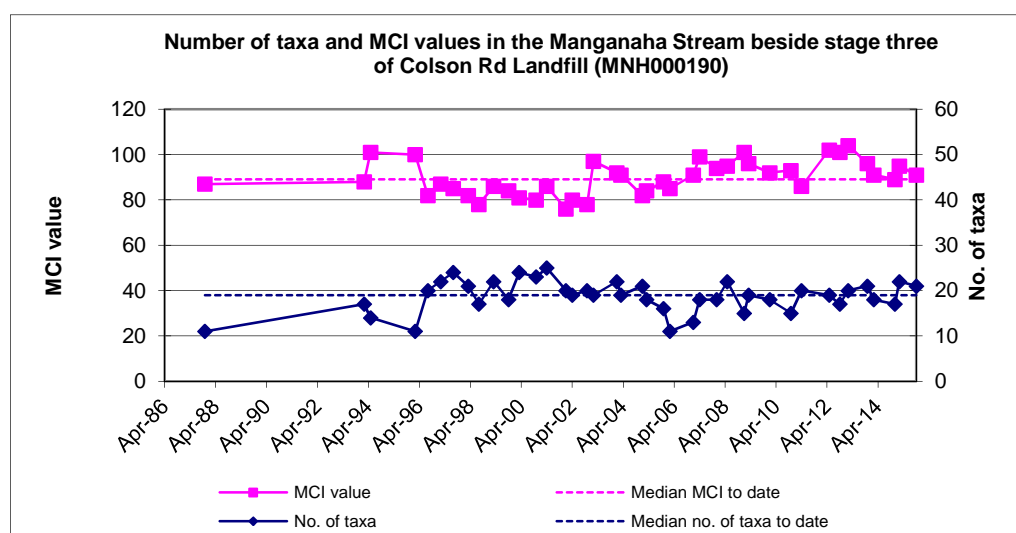


Figure 5 Taxa numbers and MCI values recorded at site M4, in the Manganaha Stream adjacent to Colson Road landfill

The moderate proportion of 'sensitive' taxa (52% of total taxa) in the community resulted in the MCI score of 91 units, which was an insignificant (Stark, 1998) two units higher than the historical median and an insignificant six units lower than the previous survey results for this site (Table 3 and Figure 5).

The numerical dominance of one 'moderately sensitive' amphipod (*Paracalliope*) and one 'tolerant' taxon snail (*Potamopyrgus*) resulted in moderate SQMCI_s value of 4.6 units, which was slightly below the median score recorded at this site (by 0.2 unit).

Site M6 (MNH000260)

Twenty-one taxa were recorded at site M6, two taxa more than the median for the site and the same number of taxa as that recorded upstream at site M4 (Table 3 and Figure 6).

In this survey, the dominant taxa at this site included two 'moderately sensitive' taxa (amphipod (*Paracalliope*) and mayfly (*Austroclima*)), and three 'tolerant' taxa (snail (*Potamopyrgus*), oligochaete worms and orthoclad midges). The community structure was similar to that found at site M4, with no significant differences in taxon abundance between the two sites (Table 5).

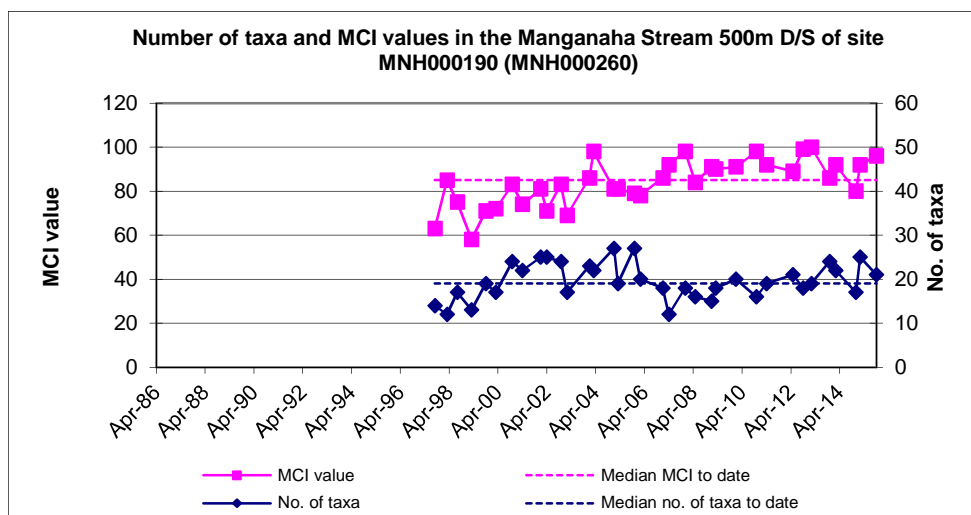


Figure 6 Taxa numbers and MCI values recorded at site M6, in the Manganaha Stream downstream of Colson Road landfill

The moderate proportion of 'sensitive' taxa (57 %) in the community resulted in an MCI score of 96 units, 5 units higher than the MCI score recorded at site M4. This score was a significant (1998) 11 units higher than the historical median recorded for the site but an insignificant (Stark, 1998) 4 units higher than that recorded by the previous survey at this site (Table 3 and Figure 6).

The SQMCI_s score of 4.1 units was the same as the median for this site, and slightly lower than that recorded upstream in the current survey (Table 3). It was significantly (by 1.7 units) lower than that recorded by the previous summer survey.

It is apparent from the current survey that there was no significant difference in biological health or community composition between sites M4 and M6. Other than the slight decrease in SQMCI_s score at site M6, the results from the two sites on Manganaha Stream in this survey were indicative of good preceding water quality and there was no indication of effects from any discharge from the landfill on the macroinvertebrate community of the stream.

Summary and conclusions

The Council's standard 'kick-sampling' technique was used at three sites (site 2, M4 and M6) and the 'sweep-sampling' technique was used at one site (PT1), to collect streambed macroinvertebrates from the Puremu and Manganaha Streams on 16 October 2015. A combination of the two techniques was used to collect macroinvertebrates from site 1 in the Puremu Stream. Samples were sorted and identified to provide number of taxa (richness), MCI and SQMCI_s scores for each site.

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

This spring macroinvertebrate survey indicated that the discharge of treated stormwater and leachate discharged from the Colson Road landfill site had not had any detrimental effect on the macroinvertebrate communities of the Puremu and Manganaha Streams.

In this survey, the MCI score recorded at the upstream control site on the Puremu Stream was higher than the median score for this site, and the same as that recorded in the previous survey. The SQMCI_s score however was significantly lower than the median and significantly lower than that recorded in the previous survey. This was largely attributable to the reduced abundance within three 'moderately sensitive' taxa, and the increased abundances within three 'tolerant' taxa. These results were indicative of poor preceding water quality, and reflected a macrophyte associated community assemblage, that had been impacted by low flows.

Site 2 in the Puremu Stream recorded a slightly lower MCI score but slightly higher SQMCI_s scores, when compared with site 1 (Stark, 1998), and were both similar to the historical medians for this site. Site PT1 in the unnamed tributary also recorded MCI and SQMCI_s scores not significantly different to historical medians, however the SQMCI_s score was significantly lower than that recorded at site 2 (by 0.9 unit) and indicated poor physicochemical water quality and/or habitat quality at this site.

The upstream site on the Manganaha Stream recorded MCI and SQMCI_s scores similar to historical medians. These results reflected the moderately high proportion of 'sensitive' taxa and the numerical dominance of two 'sensitive' taxa, in particular the abundance of one 'highly sensitive' caddisfly taxon. Results were indicative of moderate preceding water quality.

In the Manganaha Stream downstream of the landfill site, the macroinvertebrate community contained a moderately high proportion of 'sensitive' taxa which resulted in an MCI score of 96 units. This MCI score was slightly higher than that recorded at the upstream site, indicating only a minor difference in biological health. The SQMCI_s score recorded at site M6 was only slightly lower than that recorded at site M4, an indication of similar habitat quality at this site.

No undesirable biological growths were detected at any of these sites during this October 2015 survey.

Overall, the results of this survey were indicative of fair (site 1) and poor (site 2) biological health in the Puremu Stream and fair biological health at site PT1 in the unnamed tributary of the Puremu Stream. The results in the Manganaha Stream were indicative of fair biological health at sites M4 and M6. In summary, these results were not indicative of any significant adverse effects on either the Puremu Stream or the Manganaha Stream from the discharges from the Colson Road Landfill at the time of this survey.

References

Australian & New Zealand Environment & Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, 2000: Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volumes 1 and 2. Environment Australia.

Dunning KJ, 2002a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2002. TRC report KD94.

Dunning KJ, 2002b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2002. TRC report KD125.

Hope KJ, 2005: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2005. TRC report KD033.

Hope KJ, 2005: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2005. TRC Report KH076.

Fowles CR and Hope KJ, 2005: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2005. TRC report CF383.

Fowles CR and Moore SC, 2004: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2004. TRC report CF333.

Jansma B, 2006: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, February 2006. TRC report BJ008.

Jansma B, 2007a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2007. TRC report BJ022.

Jansma B, 2007b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2007. TRC report BJ023.

Jansma B, 2008a: Biomonitoring of the Mangati Stream, in relation to the Bell Block industrial area, February 2008. TRC report BJ043.

Jansma B, 2008b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, December 2007. TRC report BJ044.

Jansma B, 2008c: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, May 2008. TRC report BJ045.

Jansma B, 2009a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2009. TRC report BJ074.

Jansma B, 2009b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2009. TRC report BJ075.

Jansma B, 2010: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2010. TRC report BJ126.

Jansma B, 2011: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2010. TRC report BJ163.

Jansma B, 2011: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2011. TRC report BJ164.

Jansma B and Smith K, 2013: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, October 2012. TRC report BJ205.

Jansma B and Smith K, 2013: Biomonitoring of the Puremu and Manganaha Streams in

- relation to the NPDC Colson Road landfill, February 2013. TRC report BJ206.
- McWilliam H, 2000b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2000. TRC report HM211.
- McWilliam H, 2001a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2000. TRC report HM241.
- McWilliam H, 2001b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2001. TRC report HM252.
- Moore S, 2003a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2002. TRC report SM573.
- Moore S, 2003b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, 17 February 2003. TRC report SM580.
- Moore S and Colgan BG, 2004: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, 6 January 2004. TRC report SM586.
- Smith K, 2012: Biomonitoring of the Puremu and Manganaha Streams in relation to the New Plymouth District Council Colson Road landfill, May 2012. TRC report KS009.
- Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.
- Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research* 32(1): 55-66.
- Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.
- Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.
- Stark JD and Maxted JR, 2004. Macroinvertebrate community indices for Auckland's soft-bottomed streams and applications to SOE reporting. Prepared for Auckland Regional Council. Cawthron Report No. 970. Cawthron Institute, Nelson. ARC Technical Publication 303. 59p.
- Sutherland DL, 2015: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, December 2014. TRC report DS028.
- Sutherland DL, 2015: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, February 2015. TRC report DS029.

- Stark JD and Maxted JR, 2007. A biotic index for New Zealand's soft bottomed streams. *New Zealand Journal of Marine and Freshwater Research* 41(1).
- Stark JD and Maxted JR, 2007a. A user guide for the macroinvertebrate community index. Cawthron Institute, Nelson. Cawthron Report No. 1166.
- Taranaki Regional Council, 2000: New Plymouth District Council New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 1999-2000. Technical Report 2000-38.
- Thomas B, 2014a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2013. TRC report BT025.
- Thomas B, 2014b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, February 2014. TRC report BT026.

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From Scientific Officer, Brooke Thomas
Report No BT056
Document No 1660937
Date March 2016

Biomonitoring of the Puremu and Manganaha Streams in relation to the New Plymouth District Council Colson Road landfill, February 2016

Introduction

New Plymouth District Council hold resource consents to authorise discharges to land and to water in relation to the operations of the Colson Road Landfill, in New Plymouth. The resource consents most relevant to this biological survey are summarised in Table 1 below.

Table 1 Summary of discharge consents held by NPDC which are of most relevance to this biological survey.

Consent	Purpose
2370	To discharge leachate to groundwater and into the Puremu Stream
4619	To discharge stormwater and leachate to land and into the Puremu Stream
4620	To discharge stormwater into Puremu Stream
4621	To discharge contaminants into land

The Colson Road land fill site has been opened up, filled and capped off progressively in stages since it was established (Figure 1). Stages 1 and 2 of the landfill site have been completed and, at present the landfill is operating in the stage 3 area of the site. A section of the site is also dedicated to the management of composting waste.

Leachate from stages two and three is collected and directed to the New Plymouth Municipal Wastewater Treatment Plant. Leachate from stage one and stormwater from these areas including the access road are directed towards the Puremu Stream which flows through the landfill site. Stormwater from the compost area and from clean areas surrounding the stage 3 area of the site is directed to a large 'stormwater pond' which then discharges into an unnamed tributary of the Puremu Stream. There may also be some stormwater runoff and groundwater seepage from the landfill towards the Manganaha Stream which runs along the north-eastern boundary of the land fill.

Biological surveys have been undertaken on the Puremu Stream since 1986, to assess potential adverse effects of leachate from the landfill on the macroinvertebrate communities of the stream. Further to this, biological monitoring has been undertaken on the Manganaha Stream since 1994 to assess the effects of seepage from the landfill site on the macroinvertebrate communities in the stream.

Results of freshwater biological surveys performed in relation to the Colson Road landfill since the 2000-2001 monitoring year are discussed in numerous biomonitoring reports listed in the references.

Methods

This survey was undertaken on 03 February 2016 at two previously established sampling sites in the Puremu Stream catchment and at two established sites in the Manganaha Stream (Figure 1 and Table 2). A third site located in an unnamed tributary of the Puremu Stream (PT1), which was routinely monitored in previous surveys, had been significantly modified by instream activities prior to the spring 2012 survey, and as a result, a new site was established 50m upstream. This is the eighth survey undertaken at this site.

Site 1 is a 'control' site on the Puremu Stream located upstream of the landfill site and site 2 is also located on this stream, but downstream of stage one and two areas. PT1 is located downstream of the large 'stormwater pond' discussed above. Site M4 is located on the Manganaha Stream downstream of an unnamed tributary which drains from the eastern side of the landfill site and site M6 is situated approximately 500 metres downstream of M4.

The standard '400 ml sweep-sampling' technique was used to collect streambed macroinvertebrates from site 1 and 2 in the Puremu Stream and site PT1 in an unnamed tributary of the Puremu Stream. This 'sweep-sampling' technique is very similar to Protocol C2 (semi-quantitative methods for soft-bottomed streams) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

A combination of the '400 ml sweep-sampling' technique and the standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from sites M4 and M6 in the Manganaha stream. 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).

Table 2 Biomonitoring sites in the Puremu and Manganaha Streams related to the Colson Road Landfill

Stream	Site No.	Site Code	Location	Sampling method
Puremu stream	1	PMU000104	Upstream of the landfill	Sweep-sampling
	2	PMU000110	400 metres downstream landfill	Sweep-sampling
Unnamed tributary of Puremu Stream	PT1	PMU000108	60 metres upstream of the confluence with Puremu Stream	Sweep-sampling
Manganaha Stream	M4	MNH000190	10 metres downstream of an unnamed tributary of the Manganaha Stream	Kick-sweep
	M6	MNH000260	500 downstream of site M4	Kick-sweep

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

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

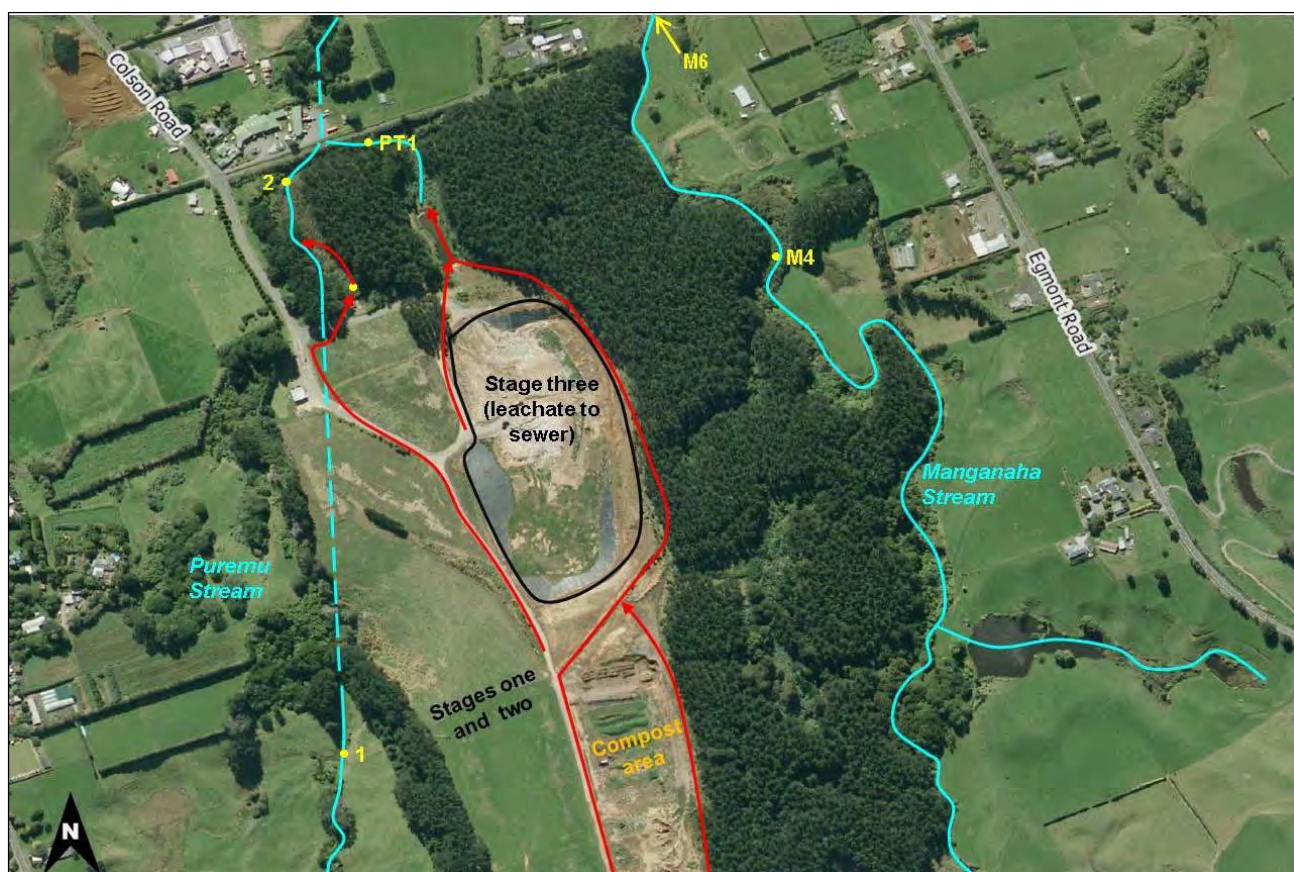


Figure 1 Biomonitoring sites related to the Colson Road landfill, New Plymouth. The red lines on the aerial photograph indicate the direction of stormwater runoff from the land fill site.

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. Averaging the scores from a list of taxa taken from one site and multiplying by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

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

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

A semi-quantitative MCI value (SQMCI_s) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling

these products, and dividing by the sum of the loading factors (Stark 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI_s is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

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.

Results and discussion

At the time of this February 2016 biomonitoring survey, the water temperatures in the Puremu Stream and tributary ranged from 18.7 °C to 20.4°C. Site 1 in the Puremu Stream had a brown, cloudy, low and very slow flow, closely resembling a swamp. At site 2 the stream had a grey, cloudy, low and very slow flow. The unnamed tributary of the Puremu Stream at PT1 had a brown, dirty, very slow and very low flow. Iron oxide accumulations were present at site 1 and 2 but not site PT1.

At site 1 and site PT1 the substrate was entirely silt. At site 2 the substrate was predominantly silt with some wood and root. Complete shading of the stream bed was recorded at site 2 and site PT1, while site 1 was unshaded.

No periphyton was recorded at any sites in the Puremu Stream or unnamed tributary of the Puremu Stream. Macrophytes dominated the bed of the stream at site 1, while no macrophytes were recorded growing at site 2 or site PT1. No unusual bacterial, fungal or protozoan growths were found by microscopic examination of the samples for 'heterotrophic growths' at any of the Puremu Stream sites in this February 2016 survey.

The Manganaha Stream had an uncoloured, cloudy, low and very slow flow at site M4 and a grey, cloudy, low and slow flow at site M6. The water temperature at both site M4 and site M6 was 19.2°C. Site M4 was completely shaded while site M6 was partially shaded. The substrate at site M4 consisted primarily of silt, sand and fine gravels with some coarse gravel and wood and root while the substrate at site M6 was predominantly silt and hard clay. Neither site M4 or M6 supported any algal growth. No unusual bacterial, fungal or protozoan growths were found in the Manganaha Stream by the microscopic examination of the samples for 'heterotrophic growths'. Extensive woody debris was recorded at site M4 while site M6 recorded patchy wood and leaves only.

Macroinvertebrate communities

A summary of the results of previous macroinvertebrate surveys performed at the sites used in the current survey is presented in Table 3 together with current results.

Table 3 Numbers of taxa and MCI values recorded in previous surveys performed at sites in the Puremu and Manganaha Streams and a tributary of the Puremu Stream in relation to the Colson Road landfill since July 1986, together with current results.

Site No.	Number of taxa				MCI values			SQMCI _s values			
	No. samples	Range	Median	Current survey	Range	Median	Current Survey	No. of samples	Range	Median	Current survey
1	46	8-27	18	24	60-90	75	72	32	1.4-5.0	3.6	3.8
2	58	7-24	17	14	51-87	73	71	32	1.2-3.9	3.0	3.0
PT1*	31	11-22	16	13	55-80	72	75	30	1.2-3.7	2.4	1.4
M4	41	11-25	19	17	76-104	89	79	32	2.3-6.9	4.8	4.0
M6	35	12-27	19	16	58-100	85	74	32	2.8-6.8	4.1	3.3

* Summary statistics given for PT1 combine data for sites PMU000108 and PMU000109.

Puremu Stream

The current results for the Puremu Stream and the unnamed tributary of the Puremu Stream are presented in Table 4 below.

Table 4 Macroinvertebrate fauna of the Puremu Stream (sites 1 & 2) and tributary (site PT1) in relation to the Colson Road landfill sampled on 03 February 2016

Taxa List	Site Number	MCI score	1	PT1	2
	Site Code		PMU000104	PMU000108	PMU000110
	Sample Number		FWB16033	FWB16034	FWB16035
COELENTERATA	Coelenterata	3	-	-	R
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	R	-	C
NEMERTEA	Nemertea	3	R	-	-
NEMATODA	Nematoda	3	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	VA	A	C
HIRUDINEA (LEECHES)	Hirudinea	3	R	R	-
MOLLUSCA	Lymnaeidae	3	C	-	-
	<i>Physa</i>	3	R	-	-
	<i>Potamopyrgus</i>	4	VA	R	A
	Sphaeriidae	3	VA	-	C
CRUSTACEA	Copepoda	5	-	-	R
	Ostracoda	1	VA	XA	A
	Isopoda	5	-	R	R
	<i>Paracalliope</i>	5	XA	C	-
ODONATA (DRAGONFLIES)	<i>Procordulia</i>	5	R	-	-
HEMIPTERA (BUGS)	<i>Anisops</i>	5	R	-	-
	<i>Microvelia</i>	3	R	R	R
	<i>Sigara</i>	3	R	-	-
COLEOPTERA (BEETLES)	Dytiscidae	5	R	-	-
	Hydrophilidae	5	R	-	-
TRICHOPTERA (CADDISFLIES)	<i>Polypsectropus</i>	6	C	R	C
	<i>Paroxyethira</i>	2	R	-	-
	<i>Tripletides</i>	5	C	-	C
DIPTERA (TRUE FLIES)	<i>Paralimnophila</i>	6	-	R	-
	Orthocladinae	2	R	R	-
	<i>Polypedilum</i>	3	-	-	A
	Tanypodinae	5	C	A	-
	Tanytarsini	3	R	-	-
	Ceratopogonidae	3	R	-	R
ACARINA (MITES)	Acarina	5	C	A	R
No of taxa			24	13	14
MCI			72	75	71
SQMCI _s			3.8	1.4	3.0
EPT (taxa)			2	1	2
%EPT (taxa)			8	8	14
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa		

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

Site 1 (PMU000104)

A total taxa richness of 24 taxa was recorded at site 1 in this summer survey (Table 3 and Figure 2). This result was six taxa more than the historical median.

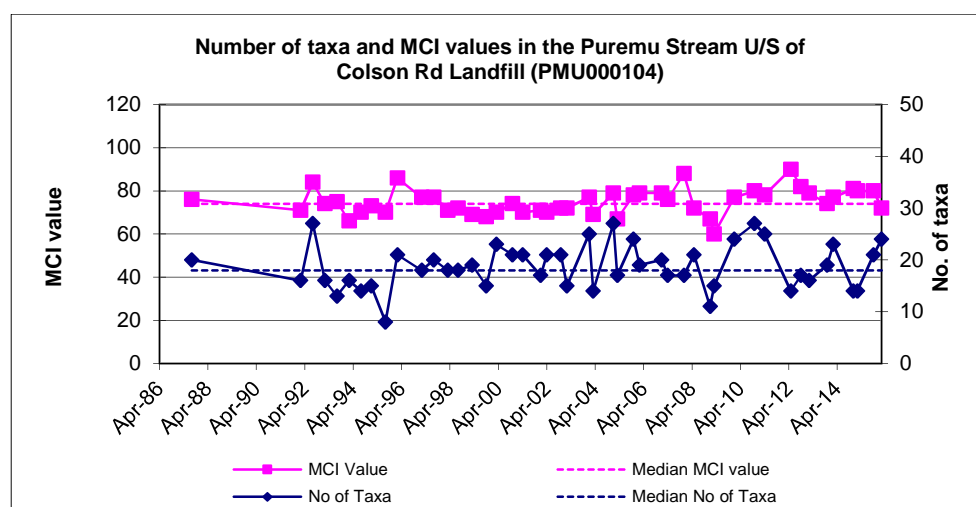


Figure 2 Number of macroinvertebrate taxa and MCI values recorded at site 1 in the Puremu Stream, upstream of Colson Road Landfill since April 1987

The community at this site was characterised by one 'moderately sensitive' taxon, extremely abundant (amphipod (*Paracalliope*)) and four 'tolerant' taxa (oligochaete worms, *Potamopyrgus* snails, fingernail clam (*Sphaeriidae*) and ostracod seed shrimp). This community assemblage reflected the prevalence of macrophyte habitat recorded at this site and the low and very slow flow that was recorded at the time of this survey (Table 4).

In this survey (63%) of the community consisted of 'tolerant' taxa, which resulted in the MCI score of 72 units, three units less than the median score recorded at this site previously and 8 units less than that recorded in the previous survey (Table 3 and Figure 2). This MCI score indicated 'poor' biological health. The numerical dominance by one 'sensitive' taxon resulted in a SQMCI_s score of 3.8 units (Table 4). This score was a significant (Stark, 1998) 1.1 units above that recorded in the previous survey but was similar to the median score recorded by previous surveys for the site (Table 3).

Site 2 (PMU000110)

A moderately low number of taxa (14) was recorded at this site, three taxa less than the median of previous surveys at this site, and four taxa less than the richness recorded by the previous survey (Table 3 and Figure 3).

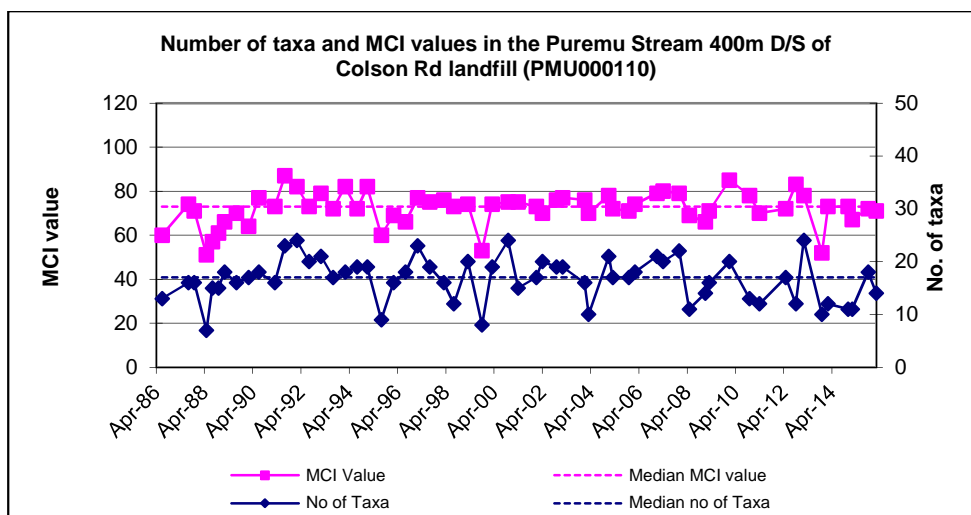


Figure 3 Taxa numbers and MCI values recorded at site 2, 400 m downstream of Colson Rd Landfill

The macroinvertebrate community was characterised by three ‘tolerant’ taxa ((*Potamopyrgus*) snails, ostracod seed shrimp and midge (*Polypedilum*)) (Table 4).

A greater proportion of ‘tolerant’ taxa recorded at this site (64%) resulted in the MCI score of 71 units, which indicated ‘poor’ biological health. This MCI score was an insignificant (Stark, 1998) 2 units fewer than the historical median for the site and one unit less than that recorded at site 1 (Table 3 and Figure 3). The SQMCI_s score of 3.0 units was the same as the historical median for the site but substantially lower than that recorded upstream at site 1 (Stark, 1998) (Table 3).

Site PT1 (PMU000108)

Thirteen taxa were recorded at site PT1 in the unnamed tributary of the Puremu Stream, three taxa less than the historical median for the site and eleven taxa less than that recorded at the ‘control’ site 1 (Table 3 and Figure 4).

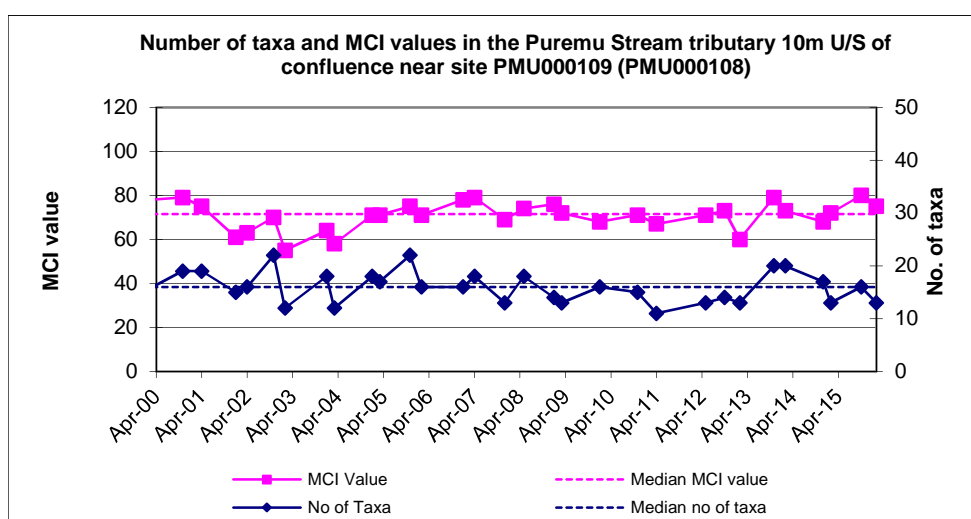


Figure 4 Numbers of taxa and MCI values recorded to date at site PT1, downstream of Colson Road Landfill

The community at site PT1 was characterised by two ‘tolerant’ taxa (oligochaete worms and ‘extremely abundant’ ostracod seed shrimp) and two ‘moderately sensitive’ taxa (chironomid

midge (Tanypodinae) and mites (Acarina) (Table 4). The higher proportion of 'tolerant' taxa (54%) was reflected in the MCI score of 75 units, which indicated 'poor' biological health. This MCI score was 3 units higher than the median MCI score for the site. It was also 3 units higher than that recorded at site 1 and 4 units higher than that recorded at site 2 (Table 3 and Figure 4).

One low scoring 'tolerant' taxon numerically dominated the community at this site which resulted in the low SQMCI_s score of 1.4 units, a significant 1 unit lower than the historical median score for the site, and a substantial 0.7 unit lower than that recorded by the previous survey. However this score was 0.2 unit higher than the minimum score previously recorded. This SQMCI_s score was significantly (Stark, 1998) lower than that recorded at site 1 and site 2 (by 2.4 and 1.6 units respectively) and indicated poor physicochemical water quality and/or habitat quality at this site. This site was extremely overgrown and thus only a small area was surveyed which may have affected the survey results.

Manganaha Stream

The results for the current survey of the Manganaha Stream are presented in Table 5 below.

Table 5 Macroinvertebrate fauna of the Manganaha Stream in relation to the Colson Road landfill sampled on 03 February 2016

Taxa List	Site Number	MCI score	M4	M6
	Site Code		MNH000190	MNH000260
	Sample Number		FWB16036	FWB16037
COELENTERATA	Coelenterata	3	R	-
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	R	R
ANNELIDA (WORMS)	Oligochaeta	1	A	VA
	Lumbricidae	5	-	R
MOLLUSCA	<i>Potamopyrgus</i>	4	VA	A
	Sphaeriidae	3	R	C
CRUSTACEA	Ostracoda	1	R	C
	<i>Paracalliope</i>	5	A	VA
	<i>Paratya</i>	3	-	R
	<i>Paranephrops</i>	5	R	-
EPHEMEROPTERA (MAYFLIES)	<i>Zephlebia group</i>	7	C	C
ODONATA (DRAGONFLIES)	<i>Procordulia</i>	5	R	-
HEMIPTERA (BUGS)	<i>Microvelia</i>	3	R	-
COLEOPTERA (BEETLES)	Dytiscidae	5	R	-
TRICHOPTERA (CADDISFLIES)	Oeconesidae	5	R	-
	<i>Tripletides</i>	5	A	A
DIPTERA (TRUE FLIES)	<i>Harrisius</i>	6	R	-
	Orthocladinae	2	-	R
	<i>Polypedilum</i>	3	R	-
	Tanypodinae	5	-	R
	Dolichopodidae	3	-	R
	<i>Paradixa</i>	4	-	C
	Empididae	3	-	R
	<i>Austrosimulium</i>	3	R	-
ACARINA (MITES)	Acarina	5	-	R
No of taxa			17	16
MCI			79	74
SQMCI _s			4.0	3.3
EPT (taxa)			3	2
%EPT (taxa)			18	13
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa	
R = Rare		C = Common	A = Abundant	
		VA = Very Abundant	XA = Extremely Abundant	

Site M4 (MNH000190)

Seventeen taxa were recorded at site M4 in this survey which was two taxa less than the historical median for the site (Table 3 and Figure 5). The community at this site was characterised by two 'moderately sensitive' taxa (amphipod (*Paracalliope*) and stick caddis (*Triplectides*)) and two 'tolerant' taxa (snail (*Potamopyrgus*) and oligochaete worms) (Table 5), which was indicative of reasonable preceding water quality.

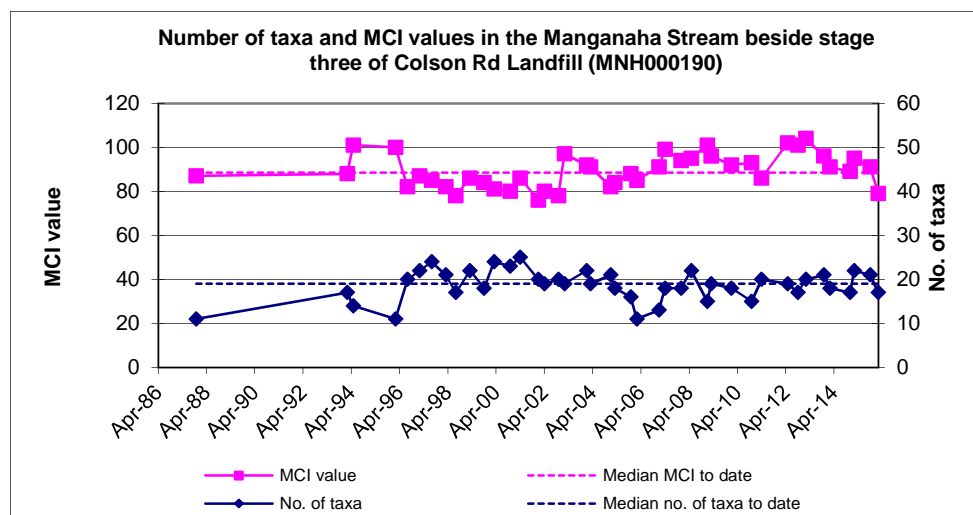


Figure 5 Taxa numbers and MCI values recorded at site M4, in the Manganaha Stream adjacent to Colson Road landfill

The moderate proportion of 'sensitive' taxa (53% of total taxa) in the community resulted in the MCI score of 79 units, which was an insignificant (Stark, 1998) three units lower than the historical median and a significant (Stark, 1998) 12 units lower than the previous survey results for this site (Table 3 and Figure 5).

The numerical dominance of one 'tolerant' taxon was tempered by the dominance of two 'sensitive' taxa which resulted in the SQMCI_s value of 4.0 units, a substantial 0.8 unit below the median score recorded at this site.

Site M6 (MNH000260)

Sixteen taxa were recorded at site M6, three taxa less than the median for the site and one taxon less than that recorded upstream at site M4 (Table 3 and Figure 6).

In this survey, the dominant taxa were the same as that recorded upstream at site M4 with only one significant difference in taxon abundance between the two sites (Table 5).

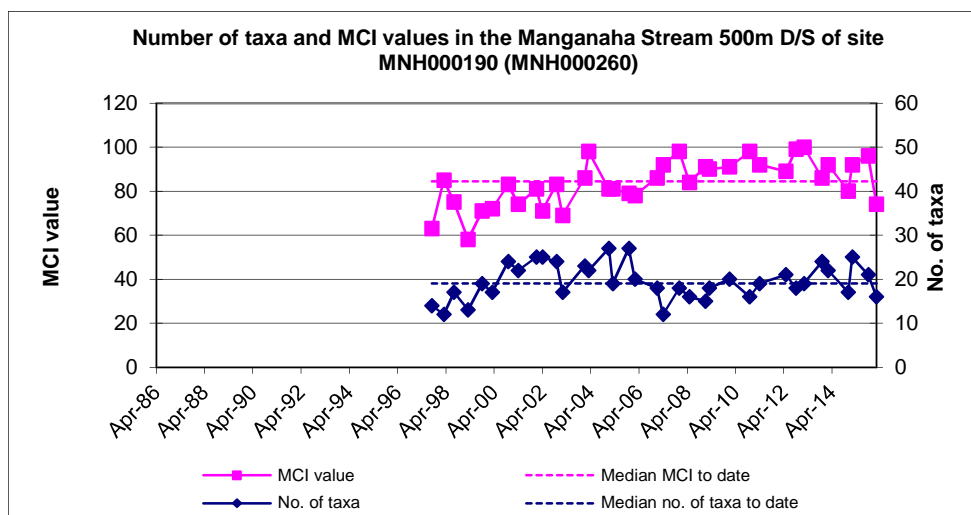


Figure 6 Taxa numbers and MCI values recorded at site M6, in the Manganaha Stream downstream of Colson Road landfill

The moderate proportion of 'tolerant' taxa (63 %) in the community resulted in a MCI score of 74 units, 5 units lower than the MCI score recorded at site M4. This score was a significant (1998) 11 units lower than the historical median recorded for the site and a significant (Stark, 1998) 22 units lower than that recorded by the previous survey at this site (Table 3 and Figure 6).

The SQMCI_s score of 3.3 units was a substantial 0.8 unit lower than the median for this site and 0.7 unit lower than that recorded upstream in the current survey (Table 3). It was substantially (by 0.8 unit) lower than that recorded by the previous spring survey.

It is apparent from the current survey that there was no significant difference in biological health or community composition between sites M4 and M6. The results from the two sites on Manganaha Stream in this survey were indicative of reasonable preceding water quality impacted by low flow conditions. There was no indication of effects from any discharge from the landfill on the macroinvertebrate community of the stream.

Summary and conclusions

The Council's standard 'sweep-sampling' technique was used at three sites (site 1, 2 and PT1) and a combination of the 'sweep-sampling' and 'kick-sampling' techniques was used at two sites (M4 and M6), to collect streambed macroinvertebrates from the Puremu and Manganaha Streams on 03 February 2016. Samples were sorted and identified to provide number of taxa (richness), MCI and SQMCI_s scores for each site.

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

This summer macroinvertebrate survey indicated that the discharge of treated stormwater and leachate discharged from the Colson Road landfill site had not had any detrimental

effect on the macroinvertebrate communities of the Puremu and Manganaha Streams.

In this survey, the MCI score recorded at the upstream control site on the Puremu Stream was slightly lower than the median score for this site, and slightly lower than that recorded in the previous survey. The SQMCI_s score however was slightly above the median and significantly higher than that recorded in the previous survey. These results were indicative of 'poor' biological health and reflected a macrophyte associated community assemblage, which had been impacted by very slow and low flows.

Site 2 in the Puremu Stream recorded a slightly lower MCI score and SQMCI_s score, when compared with site 1 (Stark, 1998), and were both similar to the historical medians for this site. Site PT1 in the unnamed tributary also recorded a MCI not significantly different to historical medians, however the SQMCI_s score was significantly lower than the historical median and significantly lower than that recorded at site 2 (by 1.6 units) and indicated poor physicochemical water quality and/or habitat quality at this site. It is also possible the small area sampled impacted the current survey results. It is recommended that site access be improved prior to the next survey.

The upstream site on the Manganaha Stream recorded MCI and SQMCI_s scores substantially lower than historical medians. These results reflected the higher proportion of 'tolerant' taxa in the macroinvertebrate community and the numerical dominance of one 'tolerant' taxon in particular. Results were indicative of reasonable preceding water quality.

In the Manganaha Stream downstream of the landfill site, the macroinvertebrate community contained a moderate proportion of 'tolerant' taxa which resulted in an MCI score of 74 units. This MCI score was slightly lower than that recorded at the upstream site, indicating only a minor difference in biological health. The SQMCI_s score recorded at site M6 was lower than that recorded at site M4, an indication of slightly different habitat quality at this site.

No undesirable biological growths were detected at any of these sites during this February 2016 survey.

Overall, the results of this summer survey were indicative of 'poor' biological health in the Puremu Stream and in the unnamed tributary of the Puremu Stream. The results in the Manganaha Stream were also indicative of 'poor' biological health at sites M4 and M6. In summary, these results were not indicative of any significant adverse effects on either the Puremu Stream or the Manganaha Stream from the discharges from the Colson Road Landfill at the time of this survey.

References

Australian & New Zealand Environment & Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, 2000: Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volumes 1 and 2. Environment Australia.

- Dunning KJ, 2002a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2002. TRC report KD94.
- Dunning KJ, 2002b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2002. TRC report KD125.
- Hope KJ, 2005: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2005. TRC report KD033.
- Hope KJ, 2005: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2005. TRC Report KH076.
- Fowles CR and Hope KJ, 2005: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2005. TRC report CF383.
- Fowles CR and Moore SC, 2004: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2004. TRC report CF333.
- Jansma B, 2006: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, February 2006. TRC report BJ008.
- Jansma B, 2007a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2007. TRC report BJ022.
- Jansma B, 2007b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2007. TRC report BJ023.
- Jansma B, 2008a: Biomonitoring of the Mangati Stream, in relation to the Bell Block industrial area, February 2008. TRC report BJ043.

- Jansma B, 2008b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, December 2007. TRC report BJ044.
- Jansma B, 2008c: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, May 2008. TRC report BJ045.
- Jansma B, 2009a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2009. TRC report BJ074.
- Jansma B, 2009b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2009. TRC report BJ075.
- Jansma B, 2010: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, January 2010. TRC report BJ126.
- Jansma B, 2011: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2010. TRC report BJ163.
- Jansma B, 2011: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2011. TRC report BJ164.
- Jansma B and Smith K, 2013: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, October 2012. TRC report BJ205.
- Jansma B and Smith K, 2013: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, February 2013. TRC report BJ206.
- McWilliam H, 2000b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, March 2000. TRC report HM211.
- McWilliam H, 2001a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2000. TRC report HM241.
- McWilliam H, 2001b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, April 2001. TRC report HM252.
- Moore S, 2003a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2002. TRC report SM573.
- Moore S, 2003b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, 17 February 2003. TRC report SM580.
- Moore S and Colgan BG, 2004: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, 6 January 2004. TRC report SM586.
- Smith K, 2012: Biomonitoring of the Puremu and Manganaha Streams in relation to the New Plymouth District Council Colson Road landfill, May 2012. TRC report KS009.
- Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.
- Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research* 32(1): 55-66.
- Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

- Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.
- Stark JD and Maxted JR, 2004. Macroinvertebrate community indices for Auckland's soft-bottomed streams and applications to SOE reporting. Prepared for Auckland Regional Council. Cawthron Report No. 970. Cawthron Institute, Nelson. ARC Technical Publication 303. 59p.
- Sutherland DL, 2015: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, December 2014. TRC report DS028.
- Sutherland DL, 2015: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, February 2015. TRC report DS029.
- Stark JD and Maxted JR, 2007. A biotic index for New Zealand's soft bottomed streams. New Zealand Journal of Marine and Freshwater Research 41(1).
- Stark JD and Maxted JR, 2007a. A user guide for the macroinvertebrate community index. Cawthron Institute, Nelson. Cawthron Report No. 1166.
- Taranaki Regional Council, 2000: New Plymouth District Council New Plymouth (Colson Road) Landfill Monitoring Programme Annual Report 1999-2000. Technical Report 2000-38.
- Thomas B, 2014a: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, November 2013. TRC report BT025.
- Thomas B, 2014b: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, February 2014. TRC report BT026.
- Thomas B, 2016: Biomonitoring of the Puremu and Manganaha Streams in relation to the NPDC Colson Road landfill, October 2015. TRC report BT051.

Appendix III

Groundwater results



ANALYSIS REPORT

Page 1 of 5

Client:	Taranaki Regional Council	Lab No:	1608306	SPv1
Contact:	Scott Cowperthwaite C/- Taranaki Regional Council Private Bag 713 Stratford 4352	Date Registered:	30-Jun-2016	
		Date Reported:	12-Jul-2016	
		Quote No:	36283	
		Order No:	58824	
		Client Reference:	Groundwater	
		Submitted By:	L Smith	

Sample Type: Aqueous

Sample Name:	162235 GND0573 29-Jun-2016 8:30 am	162236 GND0574 29-Jun-2016 9:00 am	162237 GND0575 29-Jun-2016 11:15 am	162238 GND0251 29-Jun-2016 10:45 am	162239 GND0598 29-Jun-2016 11:00 am
Lab Number:	1608306.1	1608306.2	1608306.3	1608306.4	1608306.5

Individual Tests

Dissolved Aluminium	g/m ³	0.008	0.022	0.011	0.008	0.016
Dissolved Arsenic	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Beryllium	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved Boron	g/m ³	0.022	0.024	0.019	0.012	0.053
Dissolved Cadmium	g/m ³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m ³	< 0.0005	0.0009	0.0008	0.0008	< 0.0005
Dissolved Cobalt	g/m ³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	0.0006	0.0008	0.0009
Dissolved Iron	g/m ³	< 0.02	< 0.02	< 0.02	< 0.02	0.15
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00034
Dissolved Manganese	g/m ³	0.0051	0.0024	0.0028	0.0021	0.066
Dissolved Selenium	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Vanadium	g/m ³	< 0.0010	0.0011	0.0108	0.0012	< 0.0010
Dissolved Zinc	g/m ³	0.044	0.0037	0.0149	0.028	0.041

Haloethers Trace in SVOC Water Samples by GC-MS

Bis(2-chloroethoxy) methane	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bis(2-chloroethyl)ether	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bis(2-chloroisopropyl)ether	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4-Bromophenyl phenyl ether	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
4-Chlorophenyl phenyl ether	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005

Nitrogen containing compounds Trace in SVOC Water Samples, GC-MS

2,4-Dinitrotoluene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
2,6-Dinitrotoluene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Nitrobenzene	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
N-Nitrosodi-n-propylamine	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
N-Nitrosodiphenylamine + Diphenylamine	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Organochlorine Pesticides Trace in SVOC Water Samples by GC-MS

Aldrin	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
alpha-BHC	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
beta-BHC	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
delta-BHC	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
gamma-BHC (Lindane)	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4,4'-DDD	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4,4'-DDE	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4,4'-DDT	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dieldrin	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005



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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		162235 GND0573 29-Jun-2016 8:30 am	162236 GND0574 29-Jun-2016 9:00 am	162237 GND0575 29-Jun-2016 11:15 am	162238 GND0251 29-Jun-2016 10:45 am	162239 GND0598 29-Jun-2016 11:00 am
Lab Number:		1608306.1	1608306.2	1608306.3	1608306.4	1608306.5
Organochlorine Pesticides Trace in SVOC Water Samples by GC-MS						
Endosulfan I	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endosulfan II	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endosulfan sulfate	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endrin	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endrin ketone	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Heptachlor	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Heptachlor epoxide	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Hexachlorobenzene	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Polycyclic Aromatic Hydrocarbons Trace in SVOC Water Samples						
Acenaphthene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Acenaphthylene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Anthracene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Benzo[a]anthracene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Benzo[a]pyrene (BAP)	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Benzo[g,h,i]perylene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Benzo[k]fluoranthene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
1&2-Chloronaphthalene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Chrysene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Dibenzo[a,h]anthracene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Fluoranthene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Fluorene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
2-Methylnaphthalene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Naphthalene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Phenanthrene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Pyrene	g/m ³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Phenols Trace (drinkingwater) in SVOC Water Samples by GC-MS						
2-Chlorophenol	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,4-Dichlorophenol	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,4,6-Trichlorophenol	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Phenols Trace (non-drinkingwater) in SVOC Water Samples by GC-MS						
4-Chloro-3-methylphenol	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
2,4-Dimethylphenol	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
3 & 4-Methylphenol (m- + p-cresol)	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
2-Methylphenol (o-Cresol)	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2-Nitrophenol	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Pentachlorophenol (PCP)	g/m ³	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Phenol	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
2,4,5-Trichlorophenol	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Plasticisers Trace (non-drinkingwater) in SVOC Water by GCMS						
Butylbenzylphthalate	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Diethylphthalate	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dimethylphthalate	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Di-n-butylphthalate	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Di-n-octylphthalate	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Plasticisers Trace (drinkingwater) in SVOC Water Samples by GCMS						
Bis(2-ethylhexyl)phthalate	g/m ³	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Di(2-ethylhexyl)adipate	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Other Halogenated compounds Trace (drinkingwater) in SVOC Water						
1,2-Dichlorobenzene	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,3-Dichlorobenzene	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,4-Dichlorobenzene	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005

Sample Type: Aqueous						
Sample Name:		162235 GND0573 29-Jun-2016 8:30 am	162236 GND0574 29-Jun-2016 9:00 am	162237 GND0575 29-Jun-2016 11:15 am	162238 GND0251 29-Jun-2016 10:45 am	162239 GND0598 29-Jun-2016 11:00 am
Lab Number:		1608306.1	1608306.2	1608306.3	1608306.4	1608306.5
Other Halogenated compounds Trace (non-drinkingwater) in SVOC						
Hexachlorobutadiene	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Hexachloroethane	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,4-Trichlorobenzene	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Other SVOC Trace in SVOC Water Samples by GC-MS						
Benzyl alcohol	g/m ³	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Carbazole	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dibenzofuran	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Isophorone	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Sample Name:		162240 GND1300 29-Jun-2016 9:25 am	162234 GND0255 29-Jun-2016 8:45 am			
Lab Number:		1608306.6	1608306.7			
Individual Tests						
Dissolved Aluminium	g/m ³	0.027	0.014	-	-	-
Dissolved Arsenic	g/m ³	< 0.0010	< 0.0010	-	-	-
Dissolved Beryllium	g/m ³	< 0.00010	< 0.00010	-	-	-
Dissolved Boron	g/m ³	0.020	0.020	-	-	-
Dissolved Cadmium	g/m ³	< 0.00005	< 0.00005	-	-	-
Dissolved Chromium	g/m ³	< 0.0005	< 0.0005	-	-	-
Dissolved Cobalt	g/m ³	< 0.0002	< 0.0002	-	-	-
Dissolved Copper	g/m ³	0.0018	< 0.0005	-	-	-
Dissolved Iron	g/m ³	0.02	< 0.02	-	-	-
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	-	-	-
Dissolved Manganese	g/m ³	0.0030	0.0057	-	-	-
Dissolved Selenium	g/m ³	< 0.0010	< 0.0010	-	-	-
Dissolved Vanadium	g/m ³	< 0.0010	< 0.0010	-	-	-
Dissolved Zinc	g/m ³	0.041	0.022	-	-	-
Haloethers Trace in SVOC Water Samples by GC-MS						
Bis(2-chloroethoxy) methane	g/m ³	< 0.0005	< 0.0005	-	-	-
Bis(2-chloroethyl)ether	g/m ³	< 0.0005	< 0.0005	-	-	-
Bis(2-chloroisopropyl)ether	g/m ³	< 0.0005	< 0.0005	-	-	-
4-Bromophenyl phenyl ether	g/m ³	< 0.0003	< 0.0003	-	-	-
4-Chlorophenyl phenyl ether	g/m ³	< 0.0005	< 0.0005	-	-	-
Nitrogen containing compounds Trace in SVOC Water Samples, GC-MS						
2,4-Dinitrotoluene	g/m ³	< 0.0010	< 0.0010	-	-	-
2,6-Dinitrotoluene	g/m ³	< 0.0010	< 0.0010	-	-	-
Nitrobenzene	g/m ³	< 0.0005	< 0.0005	-	-	-
N-Nitrosodi-n-propylamine	g/m ³	< 0.0010	< 0.0010	-	-	-
N-Nitrosodiphenylamine + Diphenylamine	g/m ³	< 0.0010	< 0.0010	-	-	-
Organochlorine Pesticides Trace in SVOC Water Samples by GC-MS						
Aldrin	g/m ³	< 0.0005	< 0.0005	-	-	-
alpha-BHC	g/m ³	< 0.0005	< 0.0005	-	-	-
beta-BHC	g/m ³	< 0.0005	< 0.0005	-	-	-
delta-BHC	g/m ³	< 0.0005	< 0.0005	-	-	-
gamma-BHC (Lindane)	g/m ³	< 0.0005	< 0.0005	-	-	-
4,4'-DDD	g/m ³	< 0.0005	< 0.0005	-	-	-
4,4'-DDE	g/m ³	< 0.0005	< 0.0005	-	-	-
4,4'-DDT	g/m ³	< 0.0010	< 0.0010	-	-	-
Dieldrin	g/m ³	< 0.0005	< 0.0005	-	-	-
Endosulfan I	g/m ³	< 0.0010	< 0.0010	-	-	-
Endosulfan II	g/m ³	< 0.0010	< 0.0010	-	-	-
Endosulfan sulfate	g/m ³	< 0.0010	< 0.0010	-	-	-
Endrin	g/m ³	< 0.0005	< 0.0005	-	-	-
Endrin ketone	g/m ³	< 0.0010	< 0.0010	-	-	-

Sample Type: Aqueous						
Sample Name:		162240 GND1300 29-Jun-2016 9:25 am	162234 GND0255 29-Jun-2016 8:45 am			
Lab Number:		1608306.6	1608306.7			
Organochlorine Pesticides Trace in SVOC Water Samples by GC-MS						
Heptachlor	g/m ³	< 0.0005	< 0.0005	-	-	-
Heptachlor epoxide	g/m ³	< 0.0005	< 0.0005	-	-	-
Hexachlorobenzene	g/m ³	< 0.0005	< 0.0005	-	-	-
Polycyclic Aromatic Hydrocarbons Trace in SVOC Water Samples						
Acenaphthene	g/m ³	< 0.0003	< 0.0003	-	-	-
Acenaphthylene	g/m ³	< 0.0003	< 0.0003	-	-	-
Anthracene	g/m ³	< 0.0003	< 0.0003	-	-	-
Benzo[a]anthracene	g/m ³	< 0.0003	< 0.0003	-	-	-
Benzo[a]pyrene (BAP)	g/m ³	< 0.0003	< 0.0003	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m ³	< 0.0003	< 0.0003	-	-	-
Benzo[g,h,i]perylene	g/m ³	< 0.0003	< 0.0003	-	-	-
Benzo[k]fluoranthene	g/m ³	< 0.0003	< 0.0003	-	-	-
1&2-Chloronaphthalene	g/m ³	< 0.0003	< 0.0003	-	-	-
Chrysene	g/m ³	< 0.0003	< 0.0003	-	-	-
Dibenzo[a,h]anthracene	g/m ³	< 0.0003	< 0.0003	-	-	-
Fluoranthene	g/m ³	< 0.0003	< 0.0003	-	-	-
Fluorene	g/m ³	< 0.0003	< 0.0003	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.0003	< 0.0003	-	-	-
2-Methylnaphthalene	g/m ³	< 0.0003	< 0.0003	-	-	-
Naphthalene	g/m ³	< 0.0003	< 0.0003	-	-	-
Phenanthrene	g/m ³	< 0.0003	< 0.0003	-	-	-
Pyrene	g/m ³	< 0.0003	< 0.0003	-	-	-
Phenols Trace (drinkingwater) in SVOC Water Samples by GC-MS						
2-Chlorophenol	g/m ³	< 0.0005	< 0.0005	-	-	-
2,4-Dichlorophenol	g/m ³	< 0.0005	< 0.0005	-	-	-
2,4,6-Trichlorophenol	g/m ³	< 0.0010	< 0.0010	-	-	-
Phenols Trace (non-drinkingwater) in SVOC Water Samples by GC-MS						
4-Chloro-3-methylphenol	g/m ³	< 0.0010	< 0.0010	-	-	-
2,4-Dimethylphenol	g/m ³	< 0.0005	< 0.0005	-	-	-
3 & 4-Methylphenol (m- + p-cresol)	g/m ³	< 0.0010	< 0.0010	-	-	-
2-Methylphenol (o-Cresol)	g/m ³	< 0.0005	< 0.0005	-	-	-
2-Nitrophenol	g/m ³	< 0.0010	< 0.0010	-	-	-
Pentachlorophenol (PCP)	g/m ³	< 0.010	< 0.010	-	-	-
Phenol	g/m ³	< 0.0010	< 0.0010	-	-	-
2,4,5-Trichlorophenol	g/m ³	< 0.0010	< 0.0010	-	-	-
Plasticisers Trace (non-drinkingwater) in SVOC Water by GCMS						
Butylbenzylphthalate	g/m ³	< 0.0010	< 0.0010	-	-	-
Diethylphthalate	g/m ³	< 0.0010	< 0.0010	-	-	-
Dimethylphthalate	g/m ³	< 0.0010	< 0.0010	-	-	-
Di-n-butylphthalate	g/m ³	< 0.0010	< 0.0010	-	-	-
Di-n-octylphthalate	g/m ³	< 0.0010	< 0.0010	-	-	-
Plasticisers Trace (drinkingwater) in SVOC Water Samples by GCMS						
Bis(2-ethylhexyl)phthalate	g/m ³	< 0.003	< 0.003	-	-	-
Di(2-ethylhexyl)adipate	g/m ³	< 0.0010	< 0.0010	-	-	-
Other Halogenated compounds Trace (drinkingwater) in SVOC Water						
1,2-Dichlorobenzene	g/m ³	< 0.0005	< 0.0005	-	-	-
1,3-Dichlorobenzene	g/m ³	< 0.0005	< 0.0005	-	-	-
1,4-Dichlorobenzene	g/m ³	< 0.0005	< 0.0005	-	-	-
Other Halogenated compounds Trace (non-drinkingwater) in SVOC						
Hexachlorobutadiene	g/m ³	< 0.0005	< 0.0005	-	-	-
Hexachloroethane	g/m ³	< 0.0005	< 0.0005	-	-	-
1,2,4-Trichlorobenzene	g/m ³	< 0.0005	< 0.0005	-	-	-

Sample Type: Aqueous						
Sample Name:		162240 GND1300 29-Jun-2016 9:25 am	162234 GND0255 29-Jun-2016 8:45 am			
Lab Number:		1608306.6	1608306.7			
Other SVOC Trace in SVOC Water Samples by GC-MS						
Benzyl alcohol	g/m ³	< 0.005	< 0.005	-	-	-
Carbazole	g/m ³	< 0.0005	< 0.0005	-	-	-
Dibenzofuran	g/m ³	< 0.0005	< 0.0005	-	-	-
Isophorone	g/m ³	< 0.0005	< 0.0005	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Semivolatile Organic Compounds Trace in Water by GC-MS	Liquid/Liquid extraction, GPC cleanup (if required), GC-MS FS analysis	-	1-7
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 22 nd ed. 2012.	-	1-7
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.003 g/m ³	1-7
Dissolved Arsenic	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0010 g/m ³	1-7
Dissolved Beryllium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.00010 g/m ³	1-7
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.005 g/m ³	1-7
Dissolved Cadmium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.00005 g/m ³	1-7
Dissolved Chromium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0005 g/m ³	1-7
Dissolved Cobalt	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0002 g/m ³	1-7
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0005 g/m ³	1-7
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.02 g/m ³	1-7
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.00010 g/m ³	1-7
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0005 g/m ³	1-7
Dissolved Selenium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0010 g/m ³	1-7
Dissolved Vanadium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0010 g/m ³	1-7
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 22 nd ed. 2012.	0.0010 g/m ³	1-7

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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