T&T LANDFILL: ENVIRONMENTAL MONITORING ANNUAL REPORT FOR 2016

T&T Landfills Ltd

JULY 2016

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BUILDING A BETTER WORLD

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1 Introduction

T&T Landfills Ltd holds a resource consent for the discharge of contaminants to a tributary of the Owhiro Stream. Condition 9 of the discharge permit WGN070260 [26124] (attached in full as Appendix 1) states that:

"*The permit holder shall ensure that a person suitably qualified to the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council prepares and submits a report by 30 June each year detailing the items required by conditions 6 and 7 and the approved DMP.*

The report shall include, but not be limited to:

- *The results and comparison of the contaminants sampled for with the relevant limits approved under the DMP and condition 8 of this permit.*
- *A comparison of the concentration of contaminants of the latest year of sampling with the baseline ecology survey results as required by condition 12 of this permit to determine whether there may have been a degradation in the quality of the aquatic ecosystem as a result of the discharge.*
- *Any other relevant information; and*
- *Any recommendations for approval to the Manager, Environmental Regulation, Wellington Regional Council to remedy or mitigate any significant adverse effects that have occurred, or to avoid unforeseen significant adverse effects as a result of the discharge of contaminants from the landfill area to the tributaries of Owhiro Stream. Examples of these could be:*
    - *Changes to the management or site protocols;*
    - *Methods to remedy adverse effects that may have been transported into the Owhiro Stream catchment; and*
    - *Mitigation measures to offset or minimize the significant adverse effects*."

This report covers monitoring undertaken in the year ending 30th June 2015 (note, the requirement to submit this report by the end of June was not achieved because results from the June monitoring round were not received until part way through July).

2 Adaptive Management Overview

The adaptive management arrangement for surface water samples, as outlined in conditions 6 to 14 of the consent, includes the following steps:

a. Determination, on a quarterly basis, of contaminant levels in surface water of the two tributaries upstream of the landfill at TTE & TTW, and in the combined stream flow downstream of the landfill at TTD, and in Owhiro Stream at OSU and OSD;

b. Comparison of results with ANZECC (2000) trigger values;

c. Determination of contaminant contribution from the landfill;

d. Comparison of that contribution with pre-determined tolerance limits;

e. Identification of any determinand which exceeds both the relevant ANZECC (2000) trigger value at TTD and the relevant tolerance limit;

f. In the event that a result exceeds both a tolerance limit and trigger value, undertake two rounds of follow-up sampling testing;

g. In the event that the average of these two follow-up values continues to exceed the relevant tolerance limit and the ANZECC trigger values the permit holder is required to implement the adaptive management conditions as required by conditions 13 and 14 of the discharge consent.

3 Routine Quarterly Water Quality Monitoring

3.1 Methods

The routine sampling methodology is described in the Discharge Management Plan (DMP).

3.2 Surface Water Quality Results

This annual report covers routine quarterly water quality sampling rounds undertaken in November 2015, January 2016, April 2016 and June 2016. Water samples were tested for the range of water quality parameters required by condition 7 of the permit.

The sampling sites are (refer to the DMP for further details):

- TTW western gully stream (true right branch) at the northern end of the landfill
- TTE eastern gully stream (true left branch) at the northern end of the landfill
- TTD lower stream, 100m downstream from the toe of the landfill
- TTG groundwater bore 100 m downstream from the toe of the landfill
- OSU Owhiro Stream upstream of the T&T landfill stream
- OSD Owhiro Stream downstream of the T&T landfill stream

The surface water quality results for the year to 30 June 2016, together with results from samples collected previously since December 2009, are graphed in Figure 3-1 to Figure 3-16.

The monitoring results for the year show that the headwater tributaries (TTW and TTE) upstream of the landfill had generally high water quality and low contaminant levels. Concentrations of a number of contaminants increased in the watercourse during its passage through the French Drain network under the landfill to the downstream site TTD. The changes include a slight pH reduction and a marked increase in total suspended solids (TSS), alkalinity, electrical conductivity (EC), dissolved magnesium and calcium concentrations, and an associated increase in water hardness. These changes would be expected for water passing through a large volume of crushed concrete in the landfill. Other changes include increased concentrations ammonia, iron, COD and manganese.

Stream concentrations of arsenic, chromium, copper, zinc and lead were not markedly increased at downstream sites compared with the upstream sites, indicating that the landfill contribution of these contaminants to the stream is low.

During this reporting year ammoniacal-nitrogen concentrations at TTD and ODS exceeded the ANZECC (2000) 90% trigger value (TV) on one occasion, while copper, zinc and manganese were in exceedance at either one or all TTD, OSU and/or OSD on one occasion.

The long term data record for TTD shows an upward trend for a number of contaminants including ammonia, iron, manganese, dissolved magnesium, dissolved calcium, alkalinity and total hardness. Concentrations appear to have peaked between 2011 and 2013 and then stabilised or receded during the past few years. A spike in at least one sampling point for all of these parameters was evident in 2016. The upward trend is likely to have been associated with the onset of anoxic conditions within the landfill from about 2009. It is not clear why concentrations have reduced during the last few years, but the results indicate a reduction in either leachate strength or leachate volumes (or both) over that period.

In summary:

- Ammoniacal-nitrogen concentrations at TTD and ODS exceeded the ANZECC (2000) 90% trigger value (TV) on one occasion during this reporting period. The concentration at TTD was considerably elevated while the exceedance at ODS was marginal.
- Zinc and manganese were in exceedance of the ANZECC (2000) 90% TV at TTD, OSU and/or OSD on one occasion. The exceedance for zinc at all three sites (TTD, OSD and OUS) was marginal with concentrations remaining below those recorded between 2009 and 2013. Concentrations of Manganese at TTD were above those recorded between 2009 and 2013.

- While one reading in 2016 showed higher concentrations for several parameters – notably ammoniacal-nitrogen, overall concentrations of most contaminants downstream of the landfill were lower during the reporting year than in the years between 2009 and 2013.

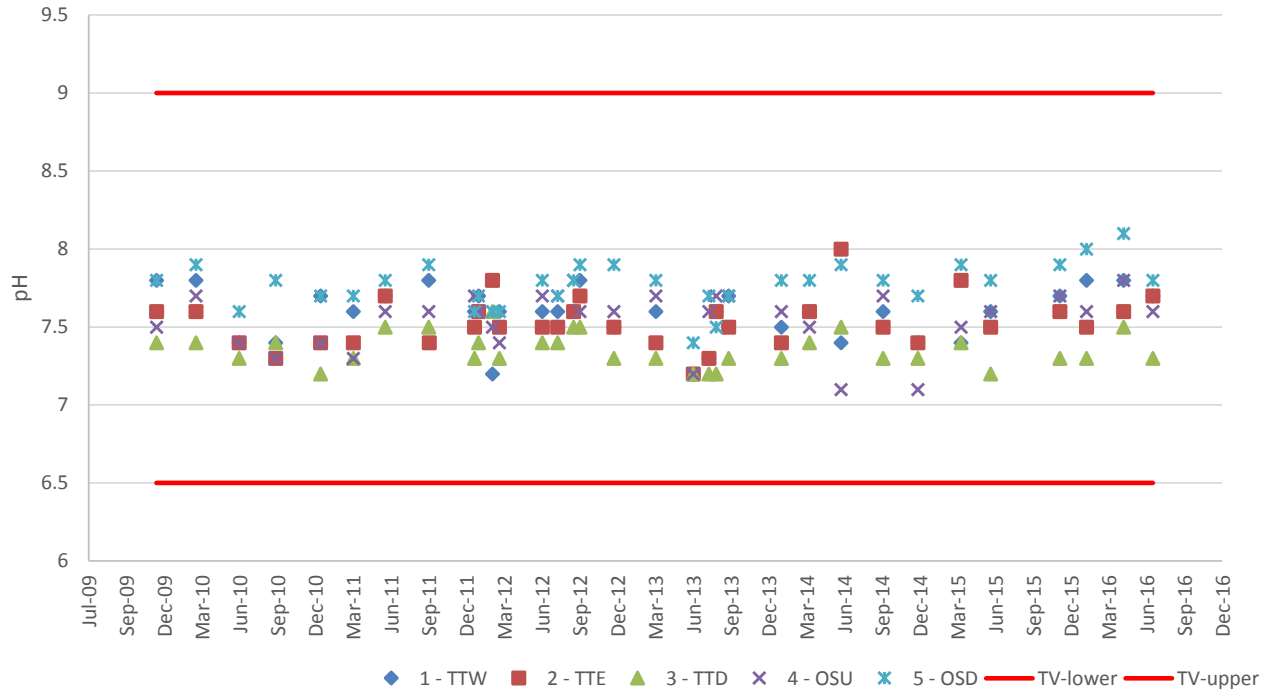

Figure 3-1: pH for surface water quality monitoring sites. The red lines indicates GWRC recommended guideline levels (Perrie *et al*, 2012).

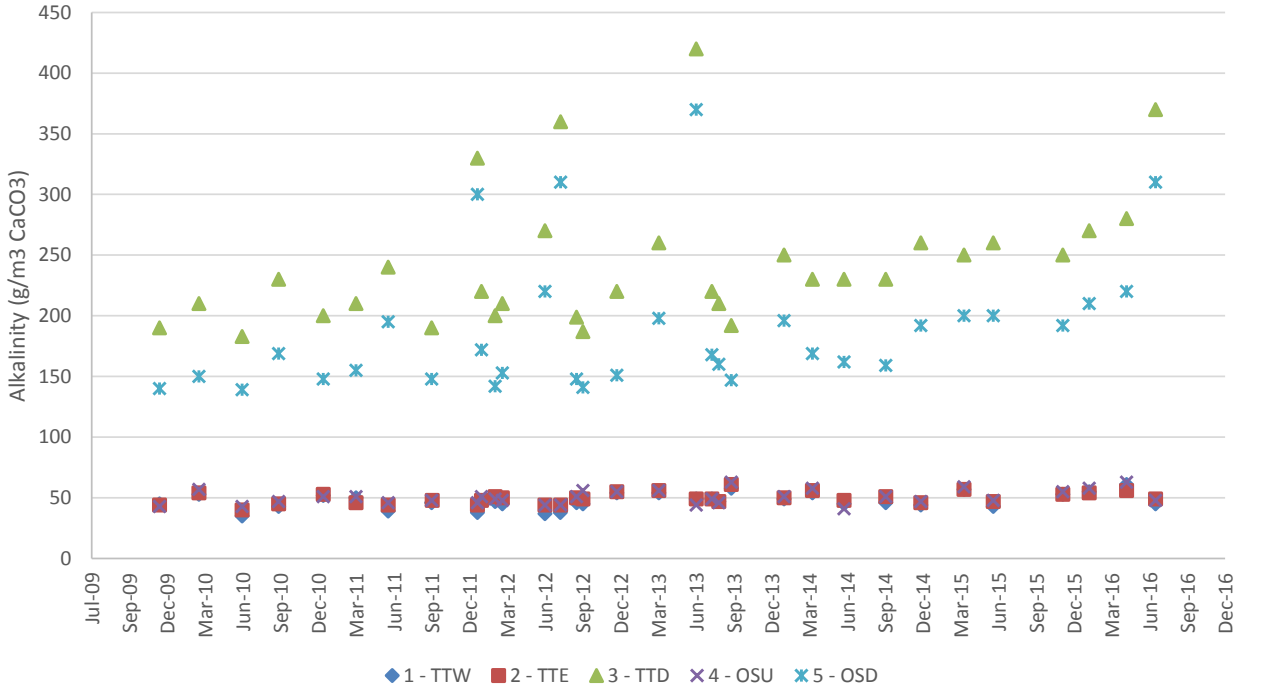

Figure 3-2: Alkalinity for surface water quality monitoring sites.

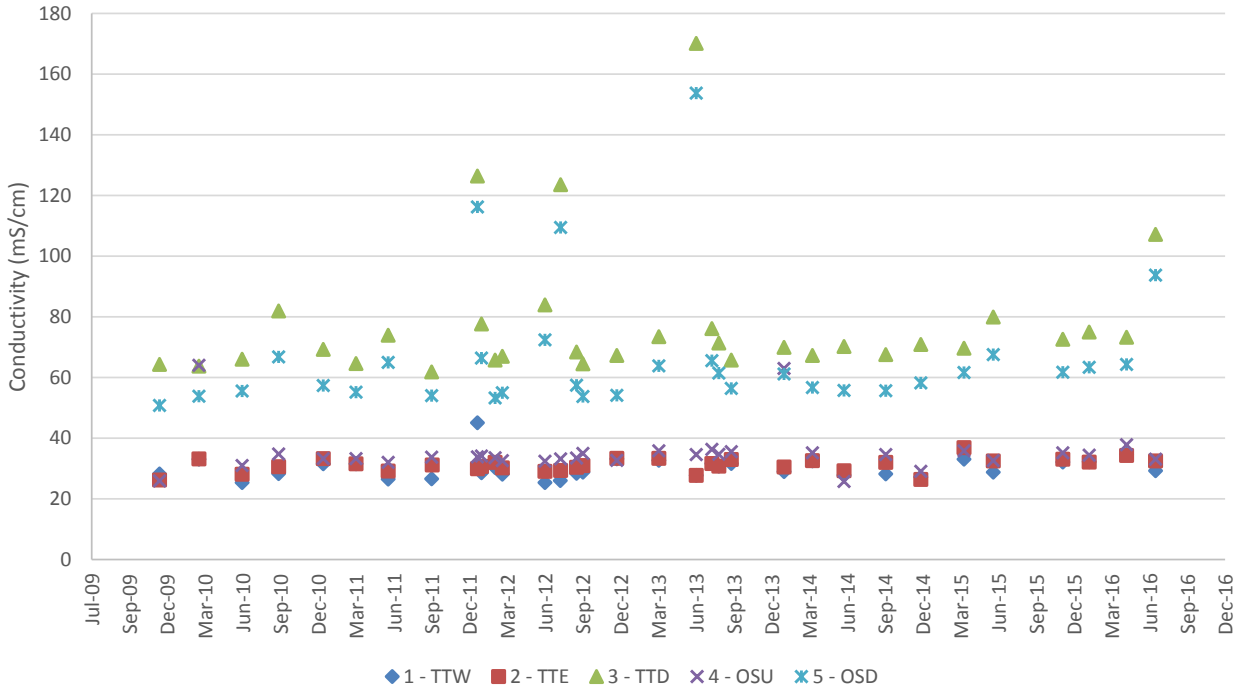

Figure 3-3: Conductivity for surface water quality monitoring sites.

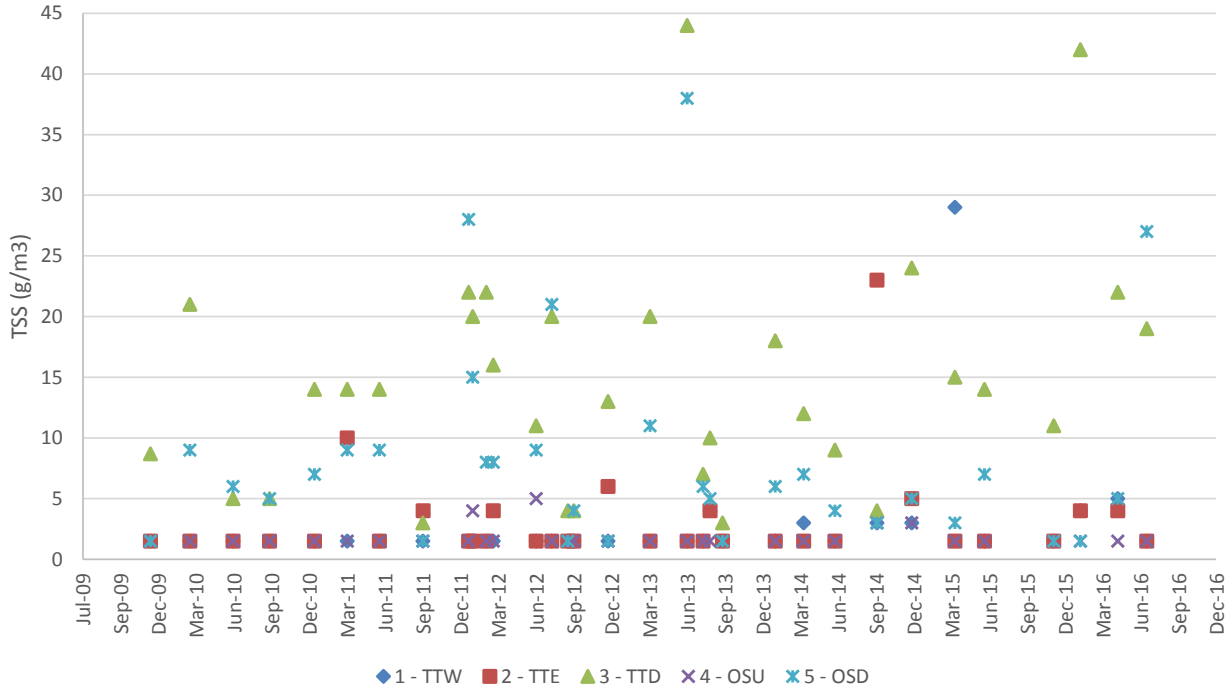

Figure 3-4: Total Suspended Solids for surface water quality monitoring sites.

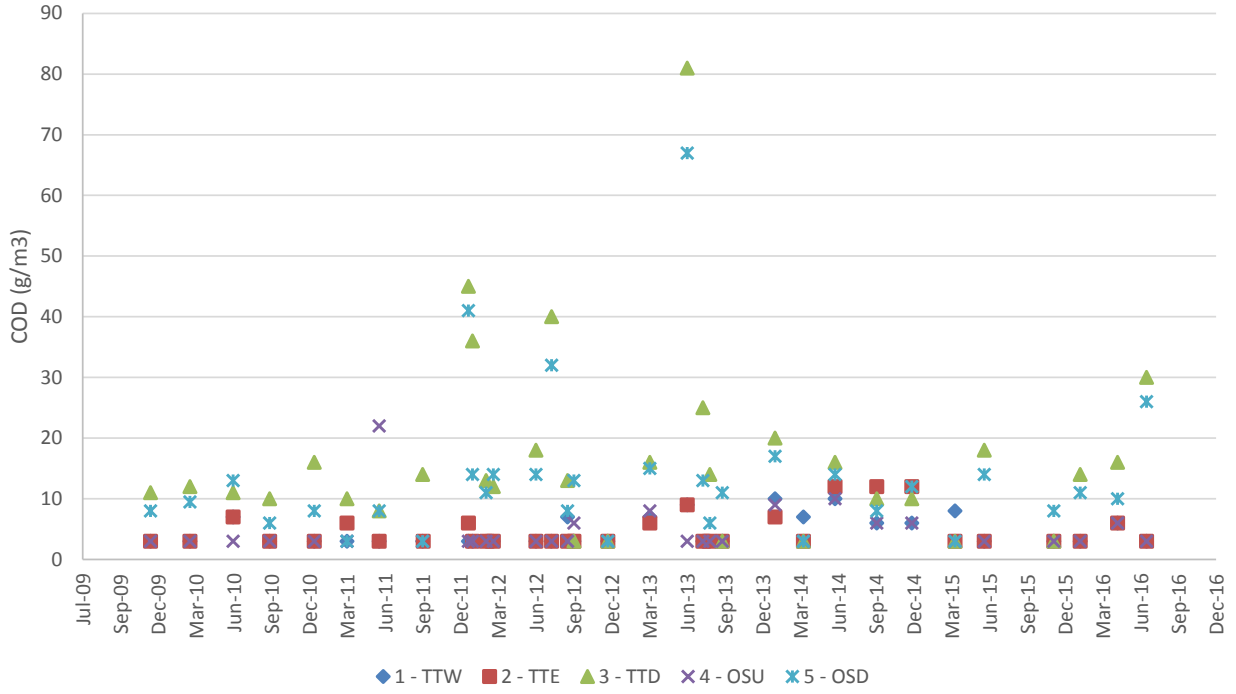

Figure 3-5: COD for surface water quality monitoring sites.

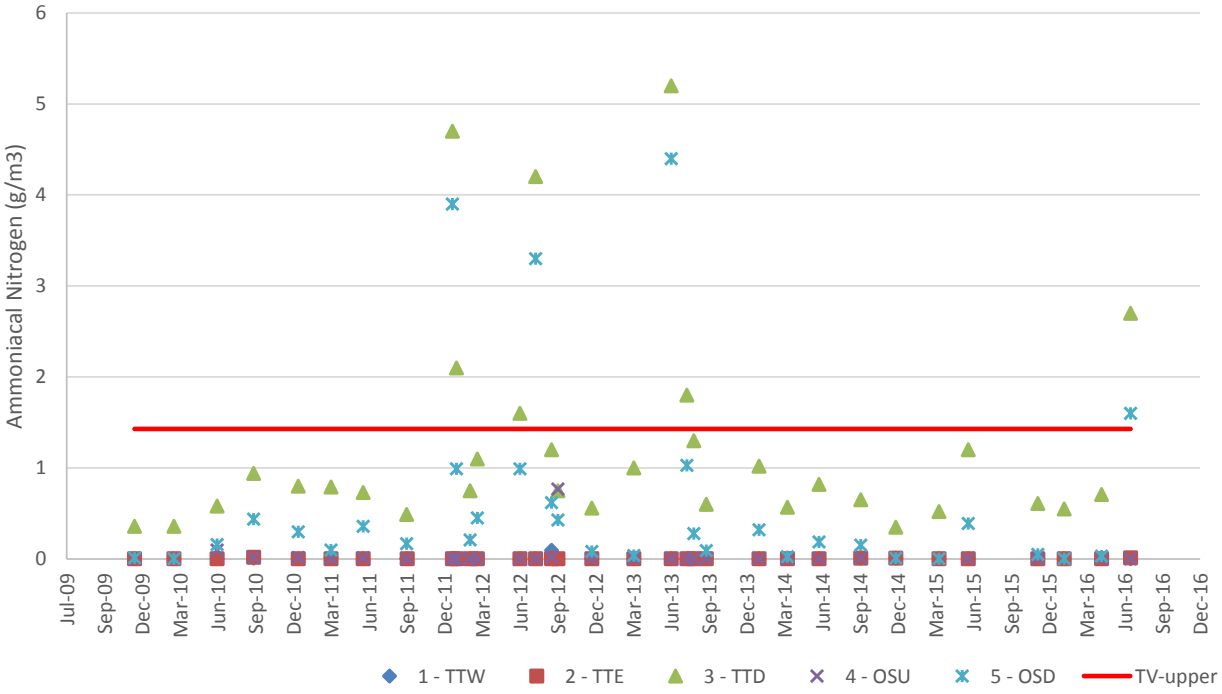

Figure 3-6: Ammoniacal Nitrogen for surface water quality monitoring sites. The dashed line indicates the ANZECC 90% protection TV

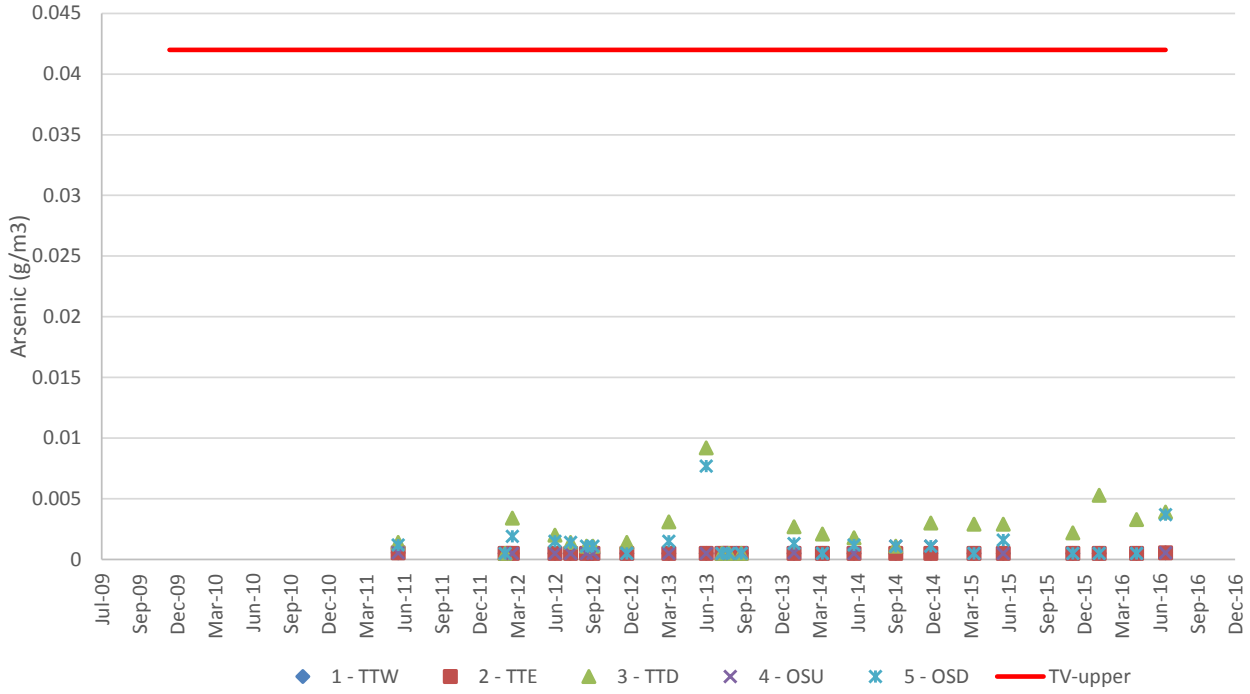

Figure 3-7: Arsenic for surface water quality monitoring sites.

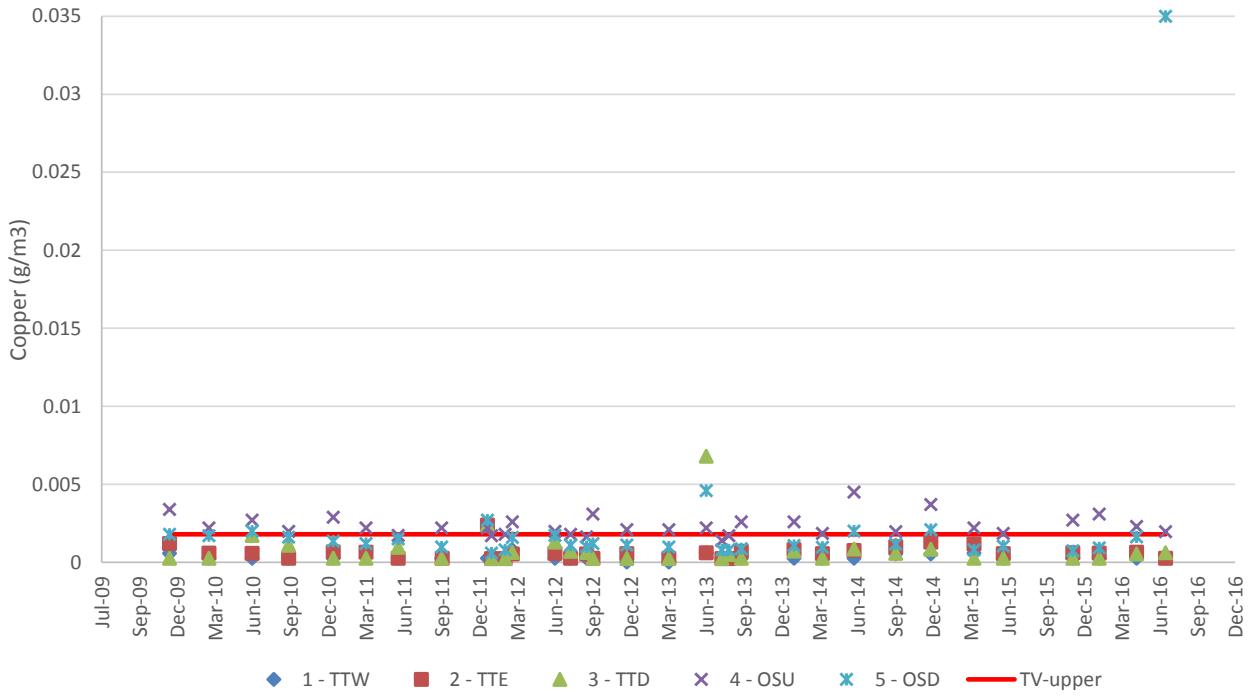

Figure 3-8: Copper for surface water quality monitoring sites. The dashed lines indicate ANZECC 90% protection TVs.

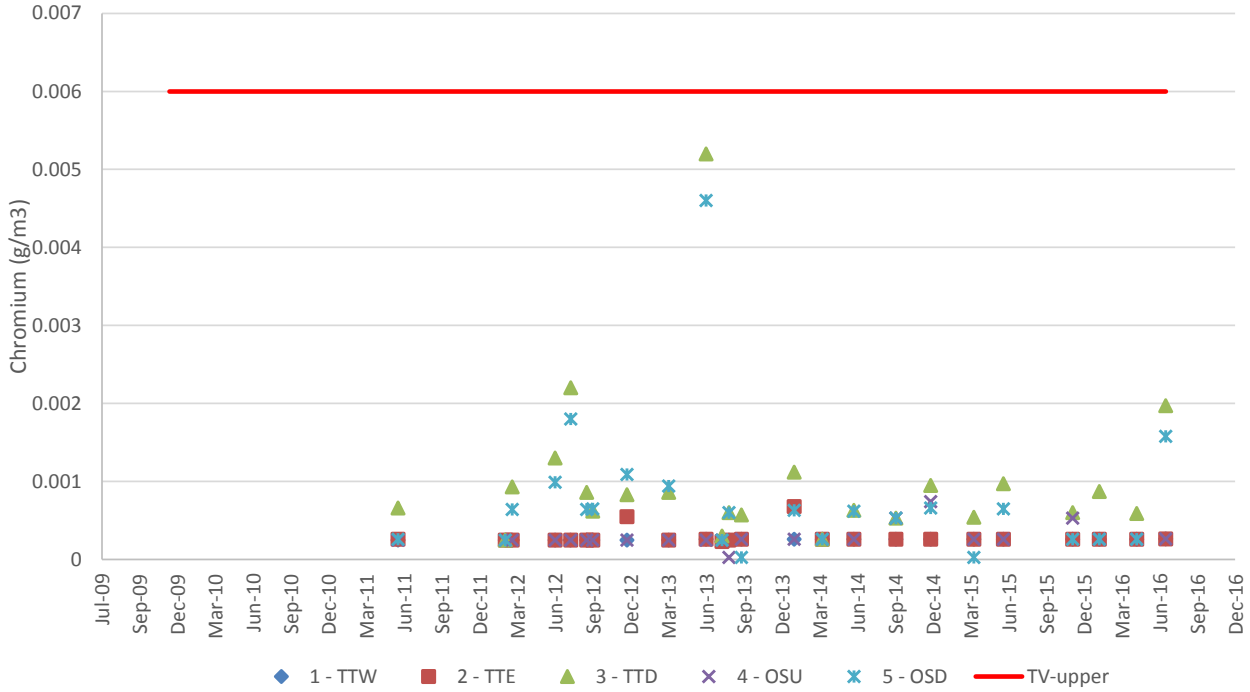

Figure 3-9: Chromium for surface water quality monitoring sites. The dashed lines indicate ANZECC 90% protection TVs.

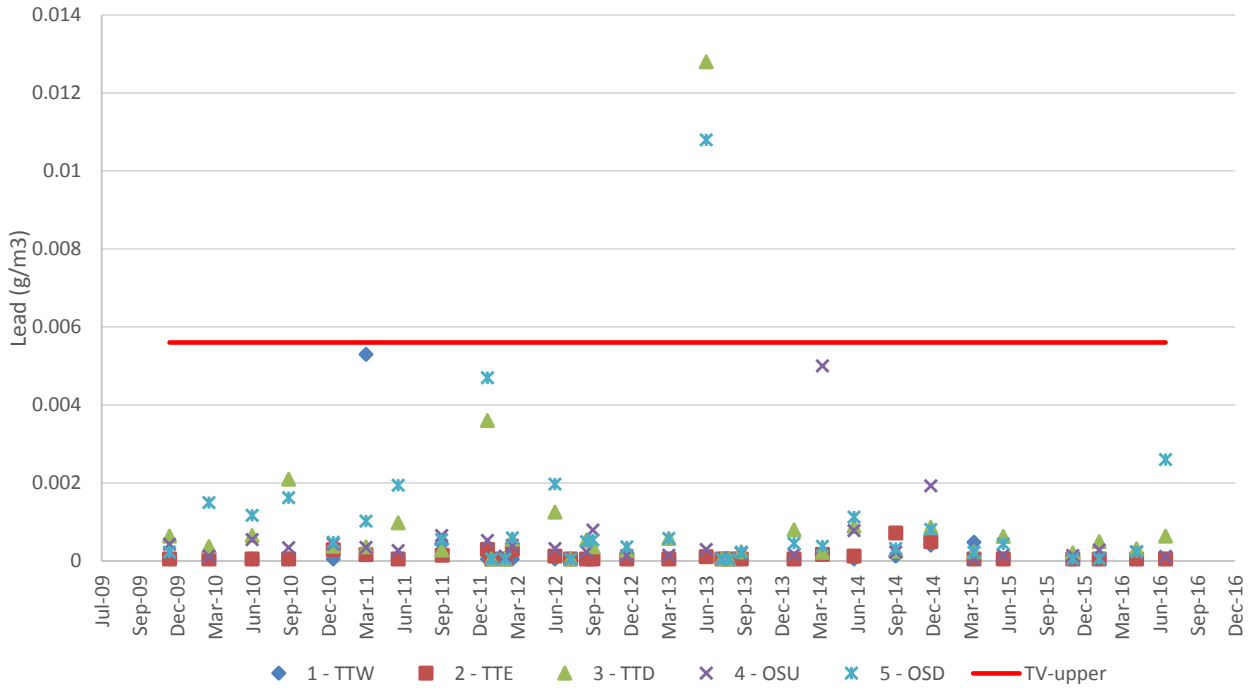

Figure 3-10: Lead for surface water quality monitoring sites. The dashed lines indicate ANZECC 90% protection TVs.

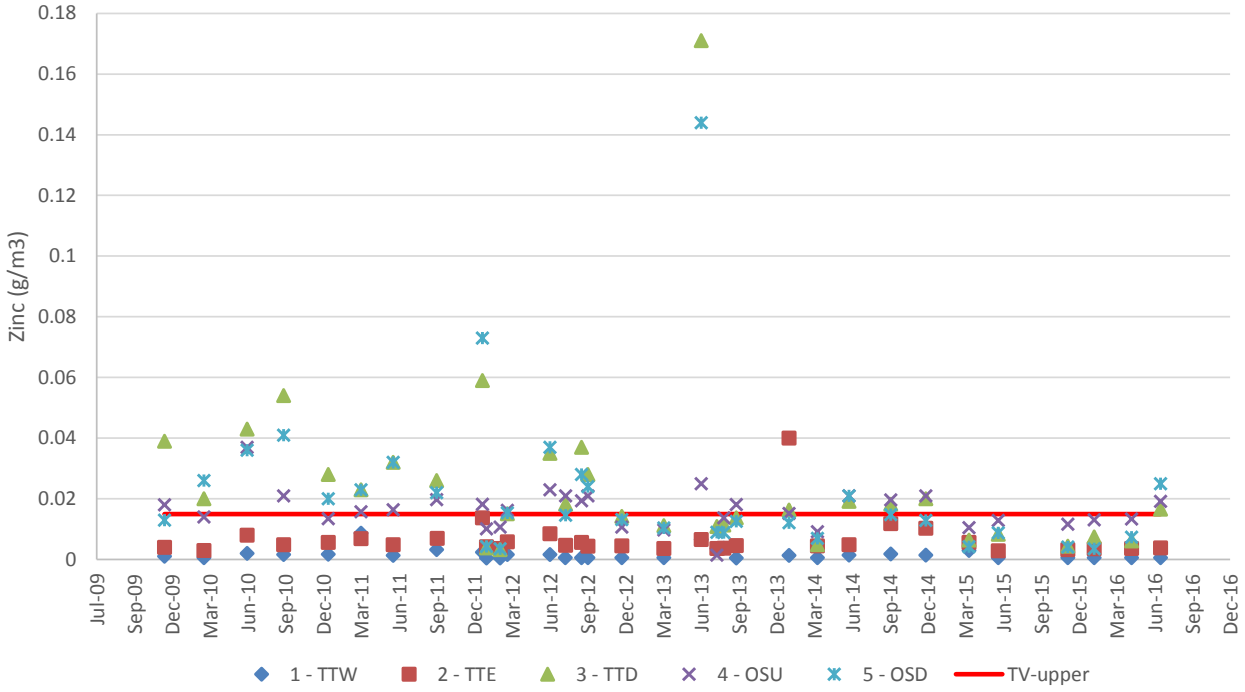

Figure 3-11: Zinc for surface water quality monitoring sites. The dashed lines indicate ANZECC 90% protection TVs.

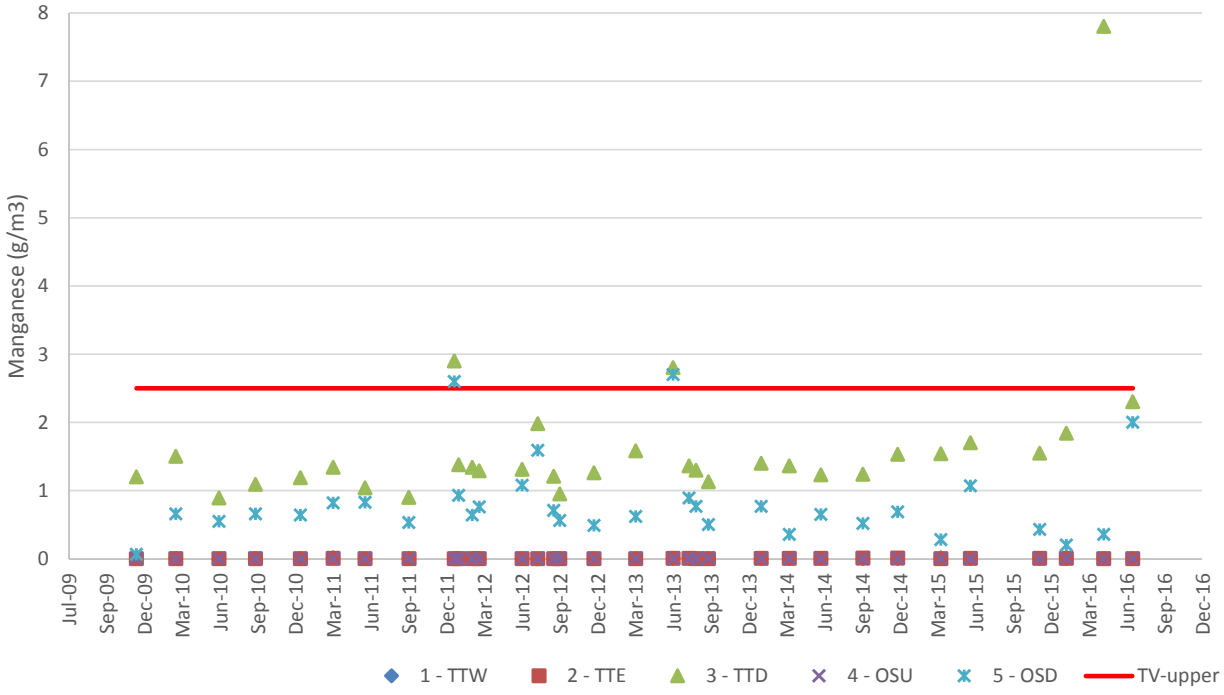

Figure 3-12: Manganese for surface water quality monitoring sites. The dashed lines indicate ANZECC 90% protection TVs.

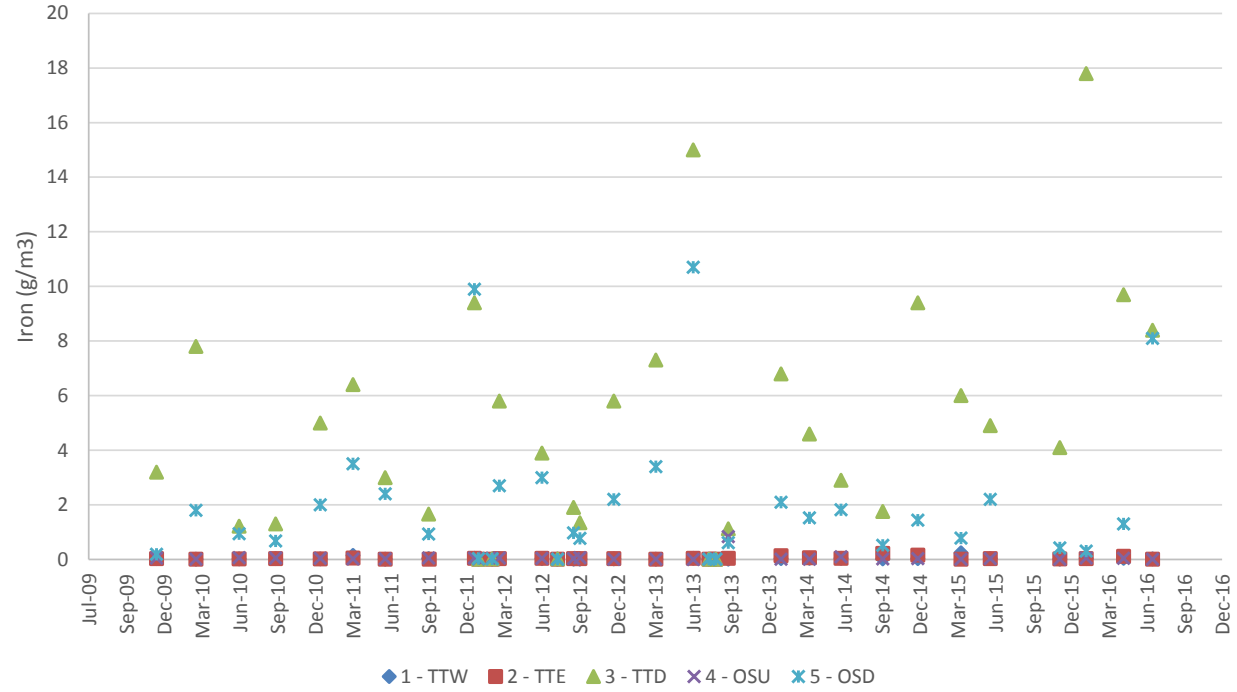

Figure 3-13: Iron for surface water quality monitoring sites.

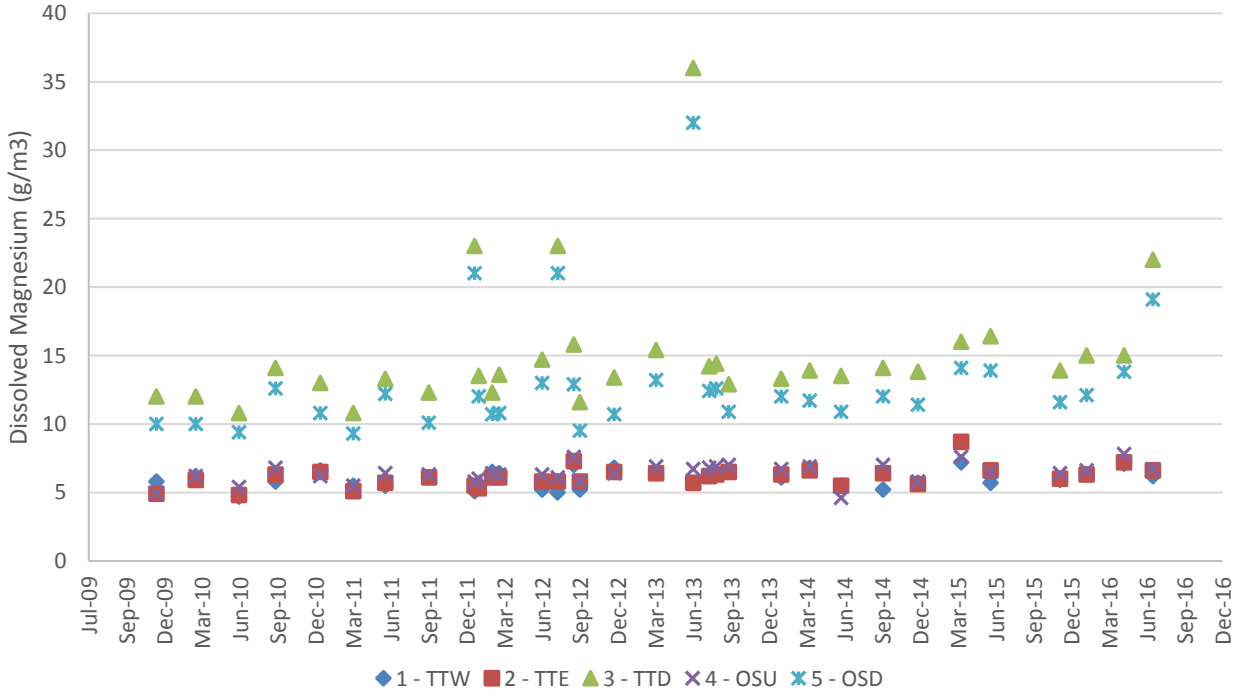

Figure 3-14: Dissolved Magnesium for surface water quality monitoring sites.

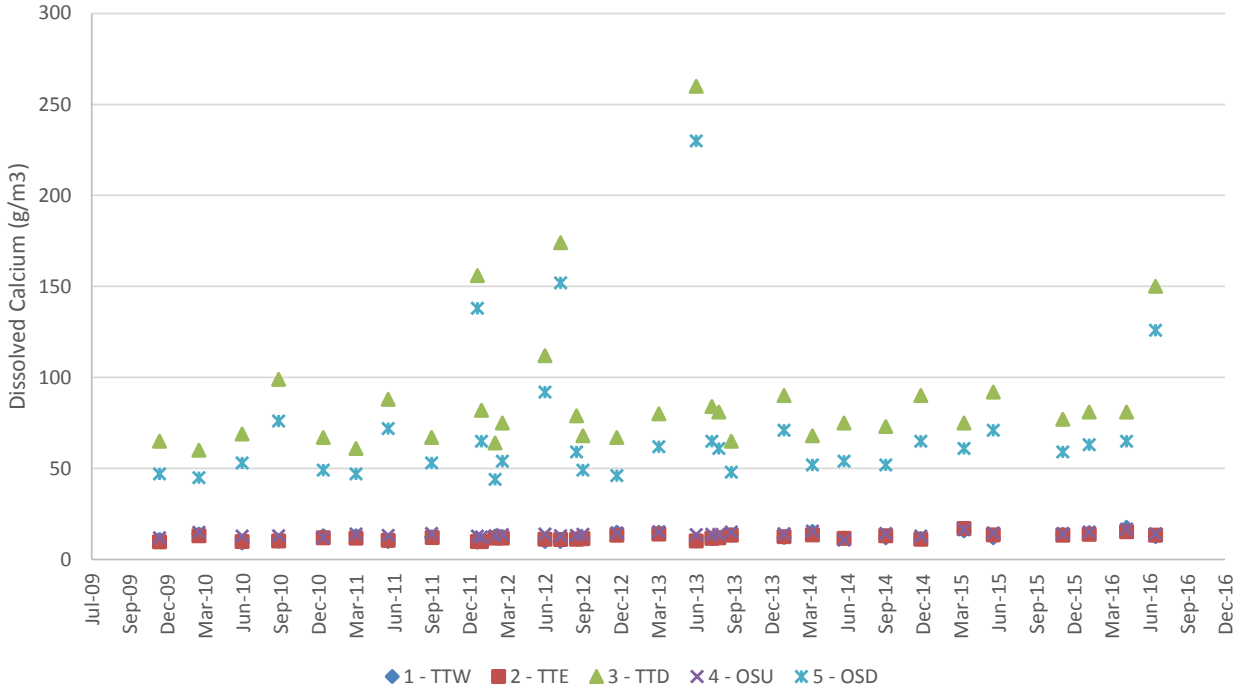

Figure 3-15: Dissolved Calcium for surface water quality monitoring sites.

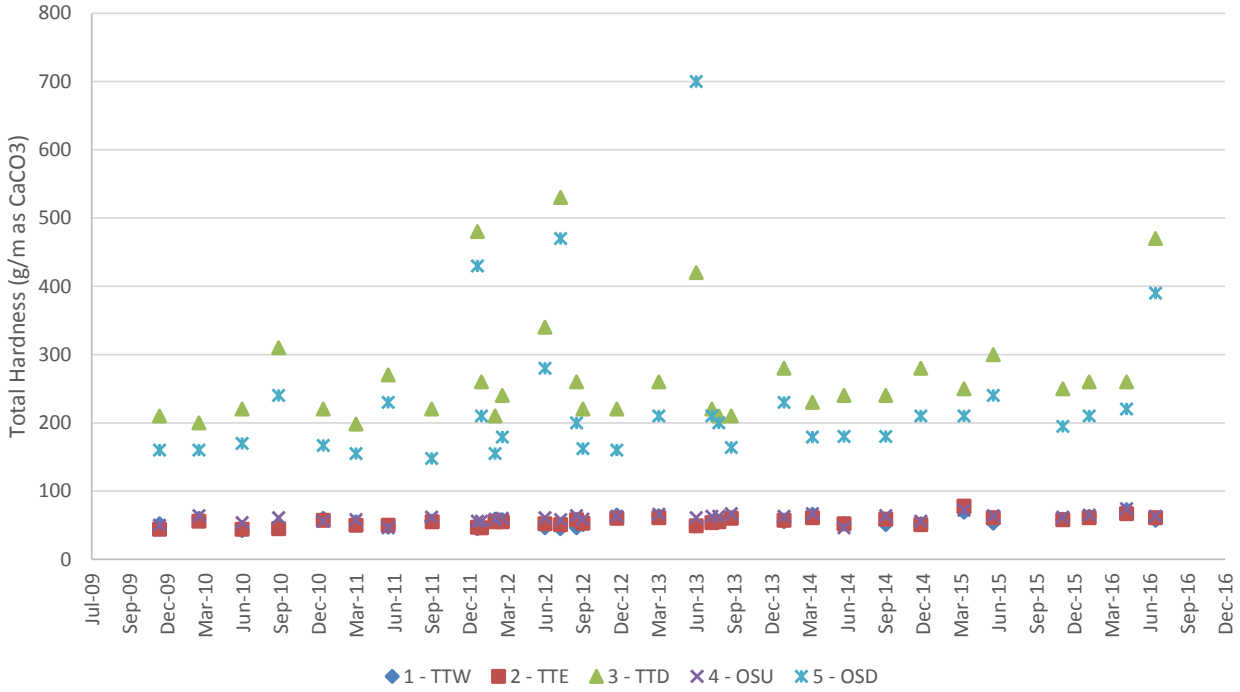

Figure 3-16: Total hardness for surface water quality monitoring sites.

3.3 Comparison with Tolerance Limits

The eastern and western branches of the T&T gully are each drained by headwater streams which join beneath the landfill and flow out from the toe of the landfill as a single watercourse (TTD). The contamination recorded at TTD is derived from sources upstream of the landfill (measured at TTE and TTW) and from the landfill itself. For each parameter the contribution derived from the landfill can be calculated by subtracting the average concentration upstream of the landfill from that recorded downstream of the landfill:

Contaminant increment from landfill = TTD – (TTE + TTW)/2

The contaminant increments from the landfill determined from four quarterly monitoring rounds are compared against the specified tolerance limits in Table 3-1 below[1].

Table 3-1: Contaminant increments from the landfill compared with specified tolerance limits (exceedences are underlined in bold).

Parameter	TTD – (TTE + TTW)/2 Results				Lower Tolerance Limit (LTL)	Upper Tolerance Limit (UCL)
	07/07/2016	28/04/2016	29/01/2016	26/11/2015		
pH	-0.4	-0.4	-0.4	-0.2	-0.4	0.4
Electrical Conductivity	**76.350**	40.05	42.85	38.7		72.4
Alkalinity	**323**	197	215.5	221.5		226
Total suspended solids	17.5	9.5	**38**	17.5		31.7
COD	**27**	0	11	10		21
Total Hardness	411	191.5	198	190		465
Ammoniacal Nitrogen	**2.69**	**0.605**	**0.545**	**0.705**		0.346
Iron	**8382**	**4083**	**17764**	**9618.5**		2748
Manganese	**2299**	**1546**	**1835**	**7796**		1461
Lead	0.585	0.16	0.45	0.26		5.9
Copper	0.345	-0.175	-0.165	0.085		4.0
Zinc	14.425	2.525	5.375	4.025		130
Arsenic	3.350	1.7	4.8	2.8		13
Chromium	**1.705**	0.34	0.61	0.33		1

Ammoniacal nitrogen exceeded the upper tolerance limit on all four sampling occasions, indicating that the ammonia contribution from the landfill remained high compared with the 2004 to 2008 baseline period. A trend of increased ammoniacal nitrogen levels began during 2009 and is characterised by a series of peaks which coincide with heavy rainfall and subsequent formation of a large pond in the Western Gully above the landfill. It is noted however the ammoniacal nitrogen concentrations were lower

[1] The tolerance limits are specified in condition 8 of the discharge permit and have been calculated from monitoring data collected between March 2004 and November 2008, inclusive except for total hardness and total suspended solids (TSS) which were calculated using monitoring data collected between December 2009 and January 2012. These tolerance intervals have been calculated on the difference between the downstream and upstream samples such that they contain 95% of the data distribution with 95% probability. Arsenic and chromium 'tolerance limits' were not derived from previous monitoring results but were arbitrarily selected in the 2011 consent variation.

during 2014 and start of 2015 compared to the current monitoring year but lower than during the 2011, 2012 and 2013 peak years.

Iron and manganese both exceeded the upper tolerance limit on all four quarters indicating an increase compared with the baseline period. Electrical conductivity, alkalinity, TSS, COD and chromium all exceeded the upper tolerance limit on one occasion.

3.4 Adaptive Management Actions

In the event that any contaminant in samples collected at TTD exceeds the ANZECC 90% protection TVs *and* the relevant tolerance limit, two further sampling rounds are required within two months. If the average of the two recoveries continues to exceed the relevant tolerance limit and TVs, the permit holder is required to implement the adaptive management actions under conditions 13 and 14 of the discharge permit (refer Appendix 1).

One result from the year to June 2016 exceeded both ANZECC trigger values *and* upper tolerance limits for any constituent (Table 3-2). Accordingly, adaptive management action was required in respect of conditions 13 or 14 of the discharge consent. It is noted that it was the June 2016 results that required additional sampling due to high ammoniacal nitrogen. These additional results are not presented in this annual report due to the time of report completion and will be reported separately.

Table 3-2: Compliance record from four sampling rounds for the year to June 2016

Parameter	Tolerance limit exceeded?	ANZECC (2000) 90% TV	ANZECC 90% TV Exceeded?	Additional sampling required?	Adaptive Management action required?
pH	0/4	not available	not applicable	no	no
Electrical conductivity	1/4	not available	not applicable	no	no
Alkalinity	1/4	not available	not applicable	no	no
Total suspended solids	1/4	not available	not applicable	no	no
COD	1/4	not available	not applicable	no	no
Total Hardness	0/4	not available	not applicable	no	no
Total ammoniacal N	**4/4**	**1.430**	**1/4**	**yes**	pending
Iron	**4/4**	not available	not applicable	no	no
Manganese	**4/4**	2.5	0/4	no	no
Lead	0/4	0.0056	0/4	no	no
Copper	0/4	0.0018	0/4	no	no
Zinc	0/4	0.015	0/4	no	no
Chromium	1/4	0.006	0/4	no	no
Arsenic	0/4	0.042	0/4	no	no

3.5 Groundwater Monitoring Results

Groundwater quality monitoring results summarized in Table 3-3 show contaminant concentrations were variable through the monitoring year. Over the longer term there has been considerable variation in concentrations of iron and manganese in particular, and to a lesser extent copper, zinc and lead Figure 3-17 and Figure 3-18.There is very little correlation between groundwater and surface water concentrations of these metals.

Table 3-3: Groundwater monitoring results for the year to June 2016

Parameter	Unit	TTG Results			
		07/07/2016	28/04/2016	29/01/2016	26/11/2015
pH	pH	6.6	6.5	6.8	7
Chloride	g/m^3	83	82	87	88
Conductivity	µS/m	46.1	46.6	47	47.5
Nitrate Nitrogen	g/m^3	1.185	2	1.69	1.97
Ammoniacal Nitrogen	g/m^3	0.021	0.005	0.021	0.005
Total Lead	g/m^3	0.049	0.025	0.044	0.032
Total Zinc	g/m^3	0.143	0.079	0.122	0.095
Total Iron	g/m^3	28	15.1	24	17.1
Total Manganese	g/m^3	1.99	1.05	2.3	1.85
Total Copper	g/m^3	0.024	0.0141	0.02	0.015

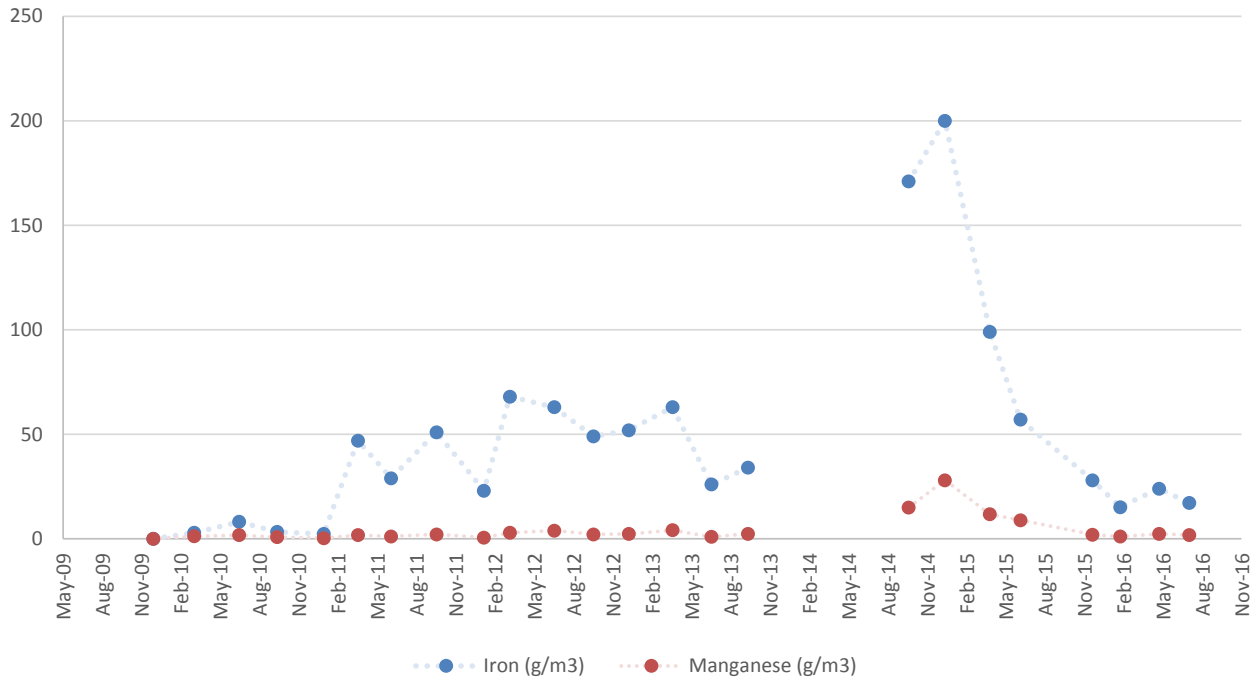

Figure 3-17: Iron and manganese concentrations in groundwater samples collected downstream of the landfill at site TTG

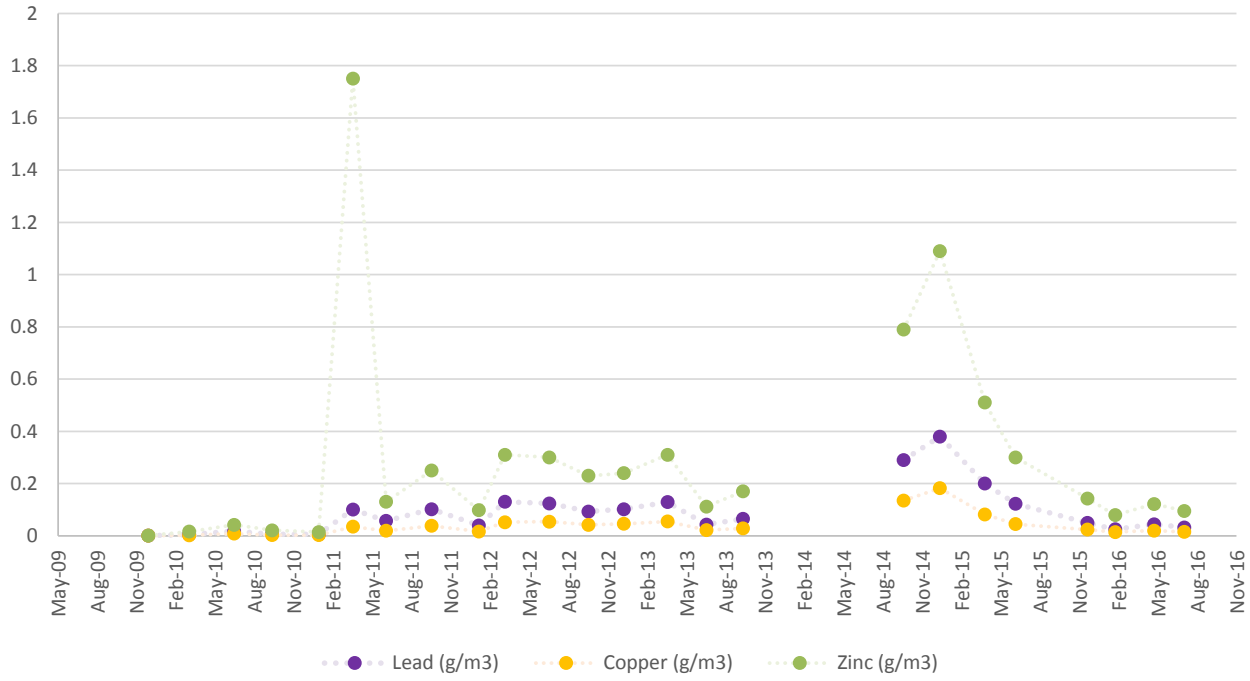

Figure 3-18: Lead, copper and zinc concentrations in groundwater samples collected downstream of the landfill at site TTG

4 Comparison with Baseline Ecology Results

Condition 9 of the discharge consent requires that the annual report include:

"A comparison of the concentration of contaminants of the latest year of sampling with the baseline ecology survey results as required by condition 12 of this permit to determine whether there may have been a degradation in the quality of the aquatic ecosystem as a result of the discharge."

In order to determine if changes in stream water quality below the landfill may have resulted in any degradation in the stream ecology since the ecological survey undertaken over the 2009/10 summer, we have compared the quarterly stream water quality monitoring results for the 24-month period to June 2010 with the 24-month period to June 2016. A 24-month period was used, rather than 12-months, in order to provide a greater sample size with increased power to detect differences. The statistical comparisons are summarised in Table 4-1 and the data are shown by boxplots in Figure 4-1.

There is strong evidence for *increases* in both ammoniacal nitrogen and iron concentrations in the 2014-2016 period compared with baseline period. However, as only one sample exceeded the ANZECC (2000) 90% trigger value for ammoniacal nitrogen and no sample exceeded the trigger for iron during either period, the risk of toxicity remains low.

There is moderate or strong evidence for decreases in concentrations of copper, lead and zinc in 2014-2016 compared with the baseline period. Zinc TVs were substantially exceeded prior to 2010 but in the current period exceedences were marginal and intermittent. This indicates a possible reduction in the risk of zinc toxicity. Lead and copper intermittently exceeded their TVs in the baseline period but were consistently below the TVs in the 2014-2016 period, again suggesting a possible reduction in the risk of toxicity.

On balance, the monitoring results indicate that the risk to aquatic ecosystems was no higher in the current reporting period compared with the 2010 baseline period, and may have reduced since 2010.

Table 4-1: Results of equivalence tests at site TTD comparing quarterly monitoring results for the 24-month period to June 2010 with the 24-month period to June 2016

2010 vs 2014	Equivalence analysis	N samples	t-test *p*-value	Bayesian posterior probability that difference is within limits	mean for period to June 2010 (g/m^3)	mean for period to June 2016 (g/m^3)
Total ammoniacal-N	Strong evidence for increase	8	0.034	1.022%	0.290	0.911
Total lead	Moderate evidence for decrease	8	0.037	3.021%	0.002	0.0005
Total zinc	Strong evidence for decrease	8	0.005	0.660%	0.055	0.011
Total copper	Strong evidence for decrease	8	0.010	1.204%%	0.002	0.0004
Total iron	Strong evidence for increase	8	0.017	0.672%	2.629	7.758
Total manganese	Inconclusive – not enough data	8	0.072	2.831%	1.099	2.438

Note: The statistical significance of the results was determined using an equivalence test which incorporates both testing of means (using a student t-test) and testing of meaningful change by interval testing of 'equivalence' and 'inequivalence'. The tests were based on an interval of +/- 10% and a difference was only considered significant if the p-value was <0.05.

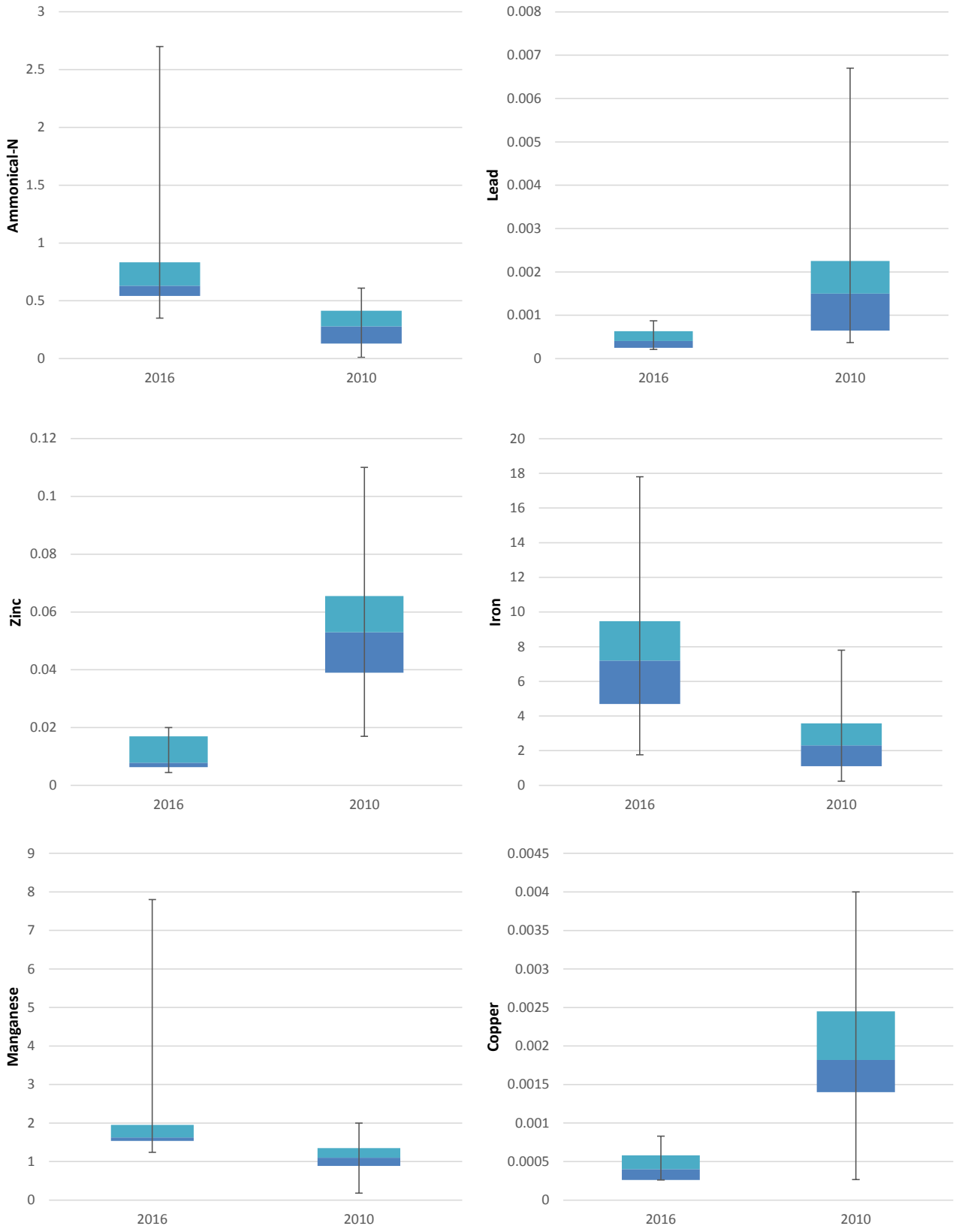

Figure 4-1: Comparison in water quality (g/m³) at TTD for the 24-month period to June 2010 with the 24-month period to June 2015 (N=8).

5 Other Information

The development of a conspicuous orange colouration in the pond at the toe of the landfill and in the stream further downstream has been evident since approximately 2009 and has continued through the current reporting period. Site photos are shown in Appendix B. The orange colouration is caused by elevated concentrations of iron in stream water below the landfill leading to precipitation of iron floc. An iron oxide-accumulating bacterium (*Leptothrix*) facilitates the precipitation of iron floc and formation of the gelatinous masses observed in the stream. *Leptothrix* are non-disease producing bacteria which commonly colonise the transition zone where deoxygenated water from an anaerobic environment flows into an aerobic environment, i.e., where the stream emerges at the surface after passing more than 1km under the landfill. The area affected by iron floc became more extensive during 2009 and 2010, probably indicating the onset of anoxic conditions in the landfill at that time.

Iron floc affects the visual appearance of the stream and at times causes a conspicuous change in colour and clarity of stream water and the stream bed. Under condition 11 of the consent, this should trigger the consideration of relevant treatment methodologies. In that regard, we understand that the consent holder has proposed modifications to the diversion system that was originally consented, and an application to change consent conditions has been lodged with Greater Wellington Regional Council.

6 Conclusion and Recommendation

Monitoring results indicate that leachate generation in the landfill continues to have some impact on downstream water quality of the tributary of Owhiro Stream. Nevertheless, a decrease in contaminant levels has been evident over the last two years to the extent that ANZECC trigger values for the protection of aquatic ecosystems have rarely been exceeded downstream of the landfill over that period. Despite these improvements the landfill continues to cause a conspicuous change in colour and clarity of the stream downstream of the landfill, which may adversely affect amenity values.

In our view the proposed diversion of the stream and local stormwater around the landfill will greatly reduce leachate volumes, and will enable the remaining leachate to be more effectively treated by a constructed wetland, thereby reducing the effect on the lower tributary and Owhiro Stream.

It is our recommendation that steps be undertaken to implement the stream diversion and complete construction of the wetland treatment system as soon as this becomes practicable.

References

(n.d.).

Australian and New Zealand Environment and Conservation Council. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.*

Perrie, A., Morar, S., Milne, J., & Greenfield, S. (2012). *River and stream water quality and ecology in the Wellington Region - State and Trends.* Wellington: Greater Wellington Regional Council.

Appendix A Discharge Permit

Conditions to Resource Consent WGN070260 [30627]

1[1]. The location, design, implementation and operation of the discharge shall be in general accordance with the application, associated documents and further information lodged with Wellington Regional Council on:

- 14 June 2007 (consent application)
- 14 June 2007 (plans, including final stormwater discharge plan E04-1000-FL)
- 21 June 2007 (microalgae investigation report)
- 6 September 2007 (second microalgae investigation report)
- 7 September 2007 (executive summary)
- 4 June 2008 (Wellington City Council application)
- 27 February 2009 (Further information)
- 18 August 2010 (change of conditions application); and
- 14 June 2011 (Further information)

Where there may be contradictions or inconsistencies between the application and further information provided by the applicant, the most recent information applies. In addition, where there may be inconsistencies between information provided by the applicant and conditions of consent, the conditions apply.

Note: Any change from the location, design concepts and parameters implemented and/or operation may require a change in consent conditions pursuant to Section 127 of the Resource Management Act 1991.

2. The permit holder shall provide a copy of this permit and any documents referred to in this permit to each operator or contractor undertaking works authorised by this permit before that operator or contractor starts any works.

Note: It is recommended that the contractor(s) undertaking the works be verbally briefed on the conditions of this and all other associated permits prior to the works being undertaken.

3. The permit holder shall ensure that a copy of this permit and all other permits granted under the Wellington Regional Council resource consent suite WGN070260 is kept within the site office, and presented to any Wellington Regional Council officer on request.

4. The permit holder shall keep a permanent record of any complaints received alleging adverse effects from the permit holder's operations. The complaints record shall contain the following where practicable:

- The name and address of the complainant, if supplied
- Identification of the nature of the complaint
- Date and time of the complaint and alleged event
- Weather conditions at the time of the alleged event
- Results of the permit holder's investigations; and
- Any mitigation measures adopted.

The complaints record shall be made available to the Wellington Regional Council on request.

Site Operations and Maintenance Condition

5. The permit holder shall, at all times, operate, maintain, supervise and control all processes and equipment on site to ensure compliance with all conditions of this permit and the Operations Management Plan required by condition 6 of permit WGN070260 [26122].

[1] Condition changed under section 127 of the Act, granted 28/07/11

Monitoring of Discharge

6. Within six months of the grant of this permit, the permit holder shall engage a suitably qualified person to prepare and submit a **Discharge Management Plan (DMP)** for approval, to the Manager, Environmental Regulation, Wellington Regional Council.

The purpose of the DMP is to establish and implement a more scientifically robust quantification at representative locations of the effects of the discharge coming from the landfill, and the effects of the discharge to the downstream unnamed tributaries of Owhiro Stream.

The DMP shall include, but not be limited to, the following:

- The provision of maps and monitoring locations (GPS locations or NZMS 260 grid references) that provide for an upstream control sample from both the eastern (TTE) and western arm (TTW) tributaries, downstream of the discharge point (TTD/TTG) and the main trunk of Owhiro Stream (upstream and downstream of the confluence of the landfill tributary with the main trunk of Owhiro Stream); and
- A monitoring methodology for surface and ground water quality sampling, including, but not limited to:
  - The technique used to recover the contaminants from the samples
  - The location and area the sampling will be undertaken over; and
  - A comparison with relevant tolerance limits (including method of calculation) and guidelines (e.g. surface water quality values against the ANZECC 2000 90% ecosystem protection values for freshwater quality) and the upstream control samples for the protection and maintenance of ecosystem services within the Owhiro Stream

Note: The DMP is to be included in the OMP alongside the other required plans under condition 6 of permit WGN070260 [26122].

7[2]. At a minimum, the groundwater contaminants at the location TTG (as total recoveries) to be sampled in March, June, October and December of each year shall include, but not be limited to:

• pH	
• Conductivity	µS/m
• Chloride	g/m³
• Ammoniacal Nitrogen	g/m³
• Nitrate Nitrogen	g/m³
• Iron	mg/m³
• Manganese	mg/m³
• Lead	mg/m³
• Copper	mg/m³
• Zinc	mg/m³
• Chromium	µg/L
• arsenic	µg/L

At a minimum, the **surface water** contaminants at the locations TTW, TTE, TTD and the two new locations on the main branch of the Owhiro Stream (as total recoveries) to be sampled in March, June, October and December of each year shall include, but not be limited to:

• pH	
• Conductivity	µS/m
• Alkalinity	g/m³
• Total suspended solids	g/m³
• COD	
• Total Hardness	g/m³
• Ammoniacal Nitrogen	g/m³
• Iron	mg/m³
• Manganese	mg/m³

[2] Condition changed under section 127 of the Act, granted 28/07/11

- Lead mg/m³
- Copper mg/m³
- Zinc mg/m³
- Chromium µg/L
- Arsenic µg/L

All sampling techniques employed in respect of the conditions of this permit shall be to the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council. All analyses shall be performed by an International Accreditation New Zealand (IANZ) registered laboratory or otherwise as specifically approved by the Manager, Environmental Regulation, Wellington Regional Council.

8[3]. The quality of the surface water discharge as sampled under condition 7 of this permit shall be compared with the following tolerance range, determined from *total recoveries*:

Contaminant and unit		Lower tolerance range	Upper tolerance range
pH		-0.4	0.4
Conductivity	µS/m		72.4
Alkalinity	g/m³		226
Total suspended solids	g/m³		
COD	g/m³		21
Total Hardness	g/m³		
Ammoniacal Nitrogen	g/m³		0.346
Total Iron	mg/m³		2748
Total Manganese	mg/m³		1461
Total Lead	mg/m³		5.9
Total Copper	mg/m³		4.0
Total Zinc	mg/m³		130
Total Arsenic	µg/L		13.0
Total Chromium	µg/L		1.0

The limits for Total Suspended Solids and Total Hardness shall be calculated once the number of samples reaches 10. The same calculations to determine the upper and lower tolerance limits shall be applied as is detailed in the DMP in condition 6 of this permit.

Should the tolerance limit for any parameter be exceeded, and where that parameter also exceeds the latest ANZECC Guidelines for Ecosystem Protection (90%) trigger levels, the permit holder shall, within one month of the receipt of the laboratory report:

- Undertake a second sample and analyse this for the exceeded parameter, and
- Undertake a third sample within one month of the second sample being taken, and analyse this for the exceeded parameter
- In these instances, the *dissolved metal* fraction, rather than the total metal fraction shall be tested for
- If the average of these two samples continues to exceed the relevant tolerance limits and the latest ANZECC Guidelines for Ecosystem Protection (90%) trigger levels, the permit holder shall implement the **adaptive management** conditions as required by conditions 13 and 14 of this permit.

9. The permit holder shall ensure that a person suitably qualified to the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council prepares and submits a report by 30 June of each year detailing the items as required by conditions 6 and 7 and the approved DMP.

The report shall include, but not be limited to:

- The results and comparisons of the contaminants sampled for with the relevant limits approved under the DMP and condition 8 of this permit

[3] Condition changed under section 127 of the Act, granted 28/07/11

- A comparison of the concentration of contaminants of the latest year of sampling with the base line ecology survey results as required by condition 12 of this permit to determine whether there may have been a degradation in the quality of the aquatic ecosystem as a result of the discharge
- Any other relevant information; and
- Any recommendations for approval to the Manager, Environmental Regulation, Wellington Regional Council, to remedy or mitigate any significant adverse effects that have occurred, or to avoid foreseen significant adverse effects as a result of the discharge of contaminants from the landfill area to the tributaries of Owhiro Stream. Examples of these could be:

  Changes to the management or site acceptance protocols;
  - Methods to remedy adverse effects that may have been transported into the Owhiro Stream catchment; and
  - Mitigation measures to offset or minimise the significant adverse effects.

Note 1: For the purposes of this condition, 'significant adverse effects' are those effects which are determined to be significant in the professional opinion of the engaged independent expert.

Note 2: Annual reports can be bundled and submitted as one large report, providing that the relevant sections are clearly defined within the one document.

10. Should any recommendations arise from the report produced under condition 9 of this permit, the permit holder shall undertake to provide for the recommendations in a manner and timeframe that meets the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council.

Note: These activities may require further resource consents.

Mixing zones

11. The discharges shall not give rise to any of the following effects after reasonable mixing:

- The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials
- Any conspicuous change in colour or visual clarity
- Any emission of objectionable odour
- The rendering of fresh water unsuitable for consumption by farm animals
- Any significant adverse effects on aquatic life; or
- Any visible deposition of iron oxide or other heavy metals

For the purposes of this condition and permit, the discharges shall be reasonably mixed at 100 metres downstream of the discharge point from the stilling basin within the unnamed tributary of Owhiro Stream.

Should any of these effects occur, the permit holder shall commission an updated DMP exploring the relevant treatment methodologies as required by condition 6 of this permit.

Baseline Ecological Survey Condition

12. During the period 1 December 2009 to 30 April 2010 inclusive, and following at least a two week period without a significant flood event (defined as 3x median stream flow) the permit holder shall have an appropriately experienced and qualified freshwater ecologist that meets the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council carry out a semi-quantitative ecological survey of the landfill tributary upstream and downstream of the landfill discharge and the Owhiro Stream upstream and downstream of the confluence of the landfill tributary.

The survey shall comprise as a minimum:

- A macroinvertebrate survey following protocols C1 and P2 from the Ministry for the Environment's report on protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001) involving the collection of a 3 replicate samples (a minimum of 5 kicknet samples per replicate) within riffle habitat at each site, fixed count of macroinvertebrate taxa to the taxonomic resolution specified for use of the MCI and enumeration of the results as taxa richness, MCI, SQMCI, number of EPT taxa, %EPT taxa and %EPT individuals

- Macroinvertebrate surveys should also be accompanied by visual assessment of periphyton cover and substrate characteristics. Survey sites should share similar habitat characteristics in terms of substrate, flow and depth; and
- A full fish survey including electrofishing and spotlighting within the unnamed tributaries of the Owhiro Stream downstream of the landfill, and within the western and eastern arms of the tributaries upstream of the landfill

Note: The results of the Baseline Ecological Survey are to be included in the OMP alongside the other required plans under condition 6 of permit WGN070260 [26122].

Adaptive Management Conditions

13[4]. Should the tolerance limits, the latest ANZECC Guidelines for the protection of aquatic ecosystems (90%) trigger levels and additional sampling show an increase in the level of any one contaminant as described in condition 8 of this permit, the permit holder shall engage a suitably qualified, independent ecologist to provide an assessment of the ecological effects of the discharges from the site.

The qualifications of and methods employed by the ecologist or other suitably qualified person (in the case of recommendations on the practicable treatment of the discharged contaminants) shall meet the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council.

The ecologist or other suitably qualified person shall provide specific assessment recommendation and implementation of the following:

- A monitoring methodology for *macroinvertebrate* sampling, including, but not limited to:
  - The techniques that will be used to carry out the surveys;
  - The location and area the sampling will be undertaken over;
  - The analysis methodology used to record and present the data; and
  - Other physical habitat quantifications used to assess the local ecosystem.
- An assessment of the potential effects of the discharge of contaminants to the unnamed tributary of Owhiro Stream;
- A recommendation of the number of sampling events that need to be undertaken (along with timeframes) to adequately gauge the effects of the discharges from the site;
- An assessment, once the invertebrate sampling has been undertaken, whether the existing treatment methodology for the discharge to the unnamed tributary of Owhiro Stream is the best practicable option for the treatment of the contaminants arising from either the historical or current land use of the area (i.e. both the fill placed by the permit holder, and the fill that existed on site prior to the operator's activities at the site) to feed back into the DMP as approved under condition 6 of this permit; and
- Provide recommendations on methods that could be used to further treat the discharge to ensure they remain within the tolerance limits specified in condition 8 of this permit.
- In the case of the limits for Total Chromium and /or Total Arsenic being exceeded, provide a recommendation as to whether or not the consent holder should cease the disposal of processed timber (both treated and untreated) to the landfill.

Note: Some recommended viable adaptive management measures could include the installation of a treatment wetland, sand filter system or enlargement of the stilling basin.

Note: The consent holder may store treated timber on site in the event arsenic and/or chromium tolerance limits are exceeded; however, all in-ground disposal must cease until informed otherwise.

14. The recommendations approved from the report prepared under the DMP and ecological assessment undertaken under conditions 6, 12 and 13 of this permit shall be undertaken by the permit holder to the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council and within timeframes specified by the manager, Environmental Regulation, Wellington Regional Council.

Note: Further resource consents may be required to undertake the works recommended.

[4] Condition changed under section 127 of the Act, granted 28/07/11

Long term Management Conditions

15. The permit holder shall, no less than **twelve** months prior to the expiry or surrender of this permit for the closure of the landfill, make application(s) for such consent(s) as are required for the future management of the site.

    This requirement shall also be complied with should filling activities at the site cease for a continuous twelve month period.

16. The permit holder shall continue to sample and provide monitoring results as required by conditions 6, 7, 8 and 9 until the expiry of this permit.

Water quality management - wetland creation

17[5]. The permit holder shall lodge application(s) for such consent(s) as are required for the creation of a wetland area at the location as shown on drawing numbers S02-0752-41 Rev.A and S02-0752-42 Rev.A, submitted as evidence at the change of conditions application hearing on 7 July 2011. The application must be lodged with and accepted by the Wellington Regional Council by **31 October 2011**.

The application(s) for such consent(s) shall provide information on, but not be limited to:

Design

- The wetland shall be designed in accordance with NIWA's '*New Zealand Constructed Wetland Planting Guidelines, 2006*'.
- Evidence to show how the wetland will improve the water quality of the discharges from the landfill.
- Details of how the proposed wetland will treat the following list of contaminants:
  - Ammoniacal Nitrogen
  - Iron
  - Manganese
  - Lead
  - Copper
  - Zinc
  - Chromium
  - Arsenic

Construction

- A 'step by step' construction methodology and timeline for the creation of the wetland
- Details of the amount of earthworks required to increase the size of the stilling basin (volumes of cut and fill)
- How any unsuitable material from the stream bed will be removed from the site and disposed of
- Erosion and sediment control measures to be implemented prior to works starting
- Erosion and sediment control measures to be used during construction to ensure sedimentation effects on the unnamed tributary of Owhiro Stream will be mitigated while works are occurring;, and
- Identifying person(s) who will be responsible for managing each part of the construction operation (including sediment control).

Planting

- Details of pre-planting site preparation;
- A to scale design plan(s) clearly showing:
  - The location and extent where planting will be undertaken around the stilling basin; and
  - The browse resistant native wetland plants species (sedges and rushes etc) that are proposed to be planted to aid in the treatment of the landfill's discharge, the size of the plants and the density of planting.
- A Monitoring and Maintenance Plan which shall be undertaken for the first 12 months upon completion of the planting, including, but not be limited to, the following:
  - Details of how plants will be irrigated during their establishment;

[5] Condition changed under section 127 of the Act, granted 28/07/11

  - Details of how the site will be maintained and how often, including the ongoing replacement of plants that do not survive and eradication of evasive weeds from the planting site to ensure adequate growth (e.g. weeding, spraying, mulching); and
  - Details of how plants will be protected from animal pests (e.g. goats).
- A list of the key responsibilities and identification of the suitably experienced persons responsible for implementing the wetland planting.

Note 1: The intent of the wetland area is to improve water quality downstream of the landfill. The wetland is expected to help treat the heavy metals and other contaminants that will percolate through and discharge from the landfill.

Note 2: The wetland area shall be made a large as possible.

Note 3: The construction of the wetland shall be completed within two years of the grant of the resource consent(s) required from the Wellington Regional Council, or within a different timeframe on assessment of the consent application.

Note 4: The approved RMP as required under condition 9 of WGN070260 [26129] and ongoing ecological assessment as required under various conditions of WGN070260 [26124] may provide information that is helpful to the development of the wetland.

Review Conditions

18. The Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so, pursuant to section 128 of the Resource Management Act 1991 at any time within the life of the landfill for any of the following purposes:

    - To deal with any adverse effects on the environment which may arise from the exercise of this permit, and which it is appropriate to deal with at a later stage;
    - To review the adequacy of any plan prepared for this permit and/or the monitoring requirements so as to incorporate into the permit any modification to any plan or monitoring which may be necessary to deal with any adverse effects on the environment arising from the management or operation of the landfill and recycling centre;
    - To impose limits on the discharge of contaminants in light of the results obtained from previous monitoring; or
    - To enable consistency with any relevant Regional Plans or any National Environmental Standards.

    Note: Following review, conditions or restrictions on the use of the site may be set by the Council if deemed necessary.

19. Wellington Regional Council shall be entitled to recover from the permit holder the costs of the conduct of any review, calculated in accordance with and limited to the council's scale of charges in force and application at the time, pursuant to section 36 of the Resource Management Act 1991.

Appendix B Site Photos