T&T LANDFILL DISCHARGE MANAGEMENT PLAN

PREPARED FOR: T & T LANDFILLS LTD

September 2017

Stantec

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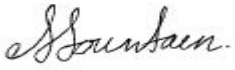
QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Tom Kerr	David Cameron

PREPARED BY		
David Cameron		28/9/2017

REVIEWED BY		
Amanda Fountain		28/9/2017

APPROVED FOR ISSUE BY		
David Cameron		28/9/2017

WELLINGTON
Level 11, 155 The Terrace, Wellington 6011
PO Box 13-052, Armagh, Christchurch 8141
TEL +64 4 381 6700, FAX +64 4 473 1982

REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)		
			Prepared by	Reviewed by	Approved by
01	21/9/2017	Draft for comment	David Cameron	Amanda Fountain	David Cameron
02	28/9/2017	Final	David Cameron	Amanda Fountain	David Cameron

T & T Landfills Ltd

T&T Landfill Discharge Management Plan

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1. Introduction

Condition 6 of Resource Consent WGN070260[26124] requires the permit holder to submit a Discharge Management Plan (DMP) for approval, to the Manager, Environmental Regulation, Wellington Regional Council, by 25 December 2009.

The DMP was approved and subsequently amended in 2012 and again in 2017. This report sets out the current version of the DMP as of September 2017.

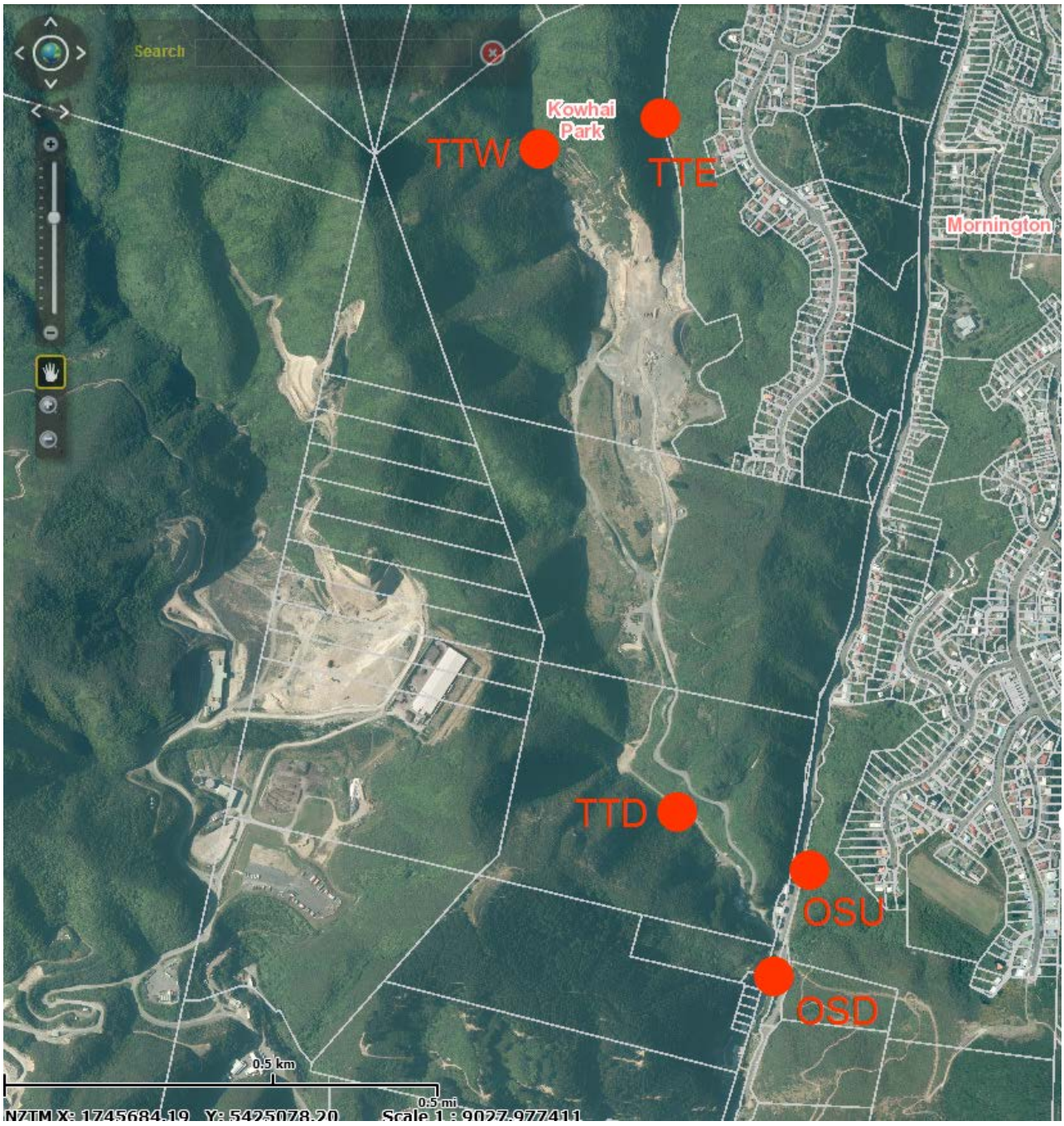

Figure 1-1: Location of T&T Landfill surface water monitoring sites

2. Sampling Methodology

2.1 Monitoring locations

Monitoring is to be undertaken at five surface water locations and one ground water monitoring bore. The sites and their locations are listed in Table 2-1 and shown in Figure 1-1.

Table 2-1: Surface and groundwater monitoring locations

Site code	Description	GPS Reference
Surface water sites		
TTE	Eastern tributary upstream of landfill	E2656943; N5986600
TTW	Western tributary upstream of landfill	E2656690; N5986684
TTD	Combined tributary 100m downstream of landfill	E2656972; N5985320
OSU	Owhiro Stream upstream of landfill tributary confluence	E2657198; N5985220
OSD	Owhiro Stream downstream of landfill tributary confluence	E2657107; N5985087
Groundwater site		
TTG	Groundwater monitor bore100m downstream of landfill	E2656972; N5985320

2.2 Routine water quality sample collection

Routine surface water and groundwater samples are to be collected at the locations listed in Table 2-1, at a minimum once each quarter during the months March, June, September and December of each year for the duration of the consent. As described in Section 3 of the DMP, monthly monitoring may be triggered when specified water quality criteria are not achieved. For example, repeated exceedence of these triggers during the year to 30 June 2017 resulting in monthly monitoring for 12 consecutive months.

As part of a package of mitigation works, T&T Landfills agreed to continue regular monthly monitoring at the surface water sites (not including the groundwater site) listed in Table 2-1 until the current stream diversion and wetland development works are completed and signed off by GWRC. On receipt of sign off by GWRC monitoring frequency would revert to quarterly (with a step-up to monthly upon exceedance of triggers).

Surface water samples are to be collected according to the following protocols:

- All samples are to be collected in screw topped containers supplied by the laboratory
- Each container is to be labelled with the site code, date and name of collection organisation
- Samples are to be taken as grab samples in flowing water from below the water surface
- Sample containers are to be filled to overflowing, except those containers which already contain a preservative (for metals), which shall not be allowed to overflow
- Samples are to be placed in cool storage for transfer to laboratory
- A sample collection record will be completed for each sample

Groundwater sample are to be collected according to the following protocols:

- Samples are to be collected from the monitoring bore by electric pump or other approved device
- Care must be taken to avoid mobilising sediment from the bore
- All sample collection equipment is to be decontaminated prior to use

- The bore hole must be purged by removal of at least three bore volumes of water prior to sample collection
- All samples are to be placed in screw topped containers supplied by the laboratory
- Sample containers are to be filled to overflowing, except those containers which already contain a preservative (for metals), which shall not be allowed to overflow
- Each container is to be labelled with the site code, date and name of collection organisation
- Samples are to be placed in cool storage for transfer to laboratory
- A sample collection record will be completed for each sample

2.3 Storm event water quality monitoring

In the event of a storm event in which the rainfall depth at the Karori Reservoir Rain Gauge exceeds 45 mm in any 24 hour period, a round of water samples will be collected at the surface water sites listed in Table 2-1, within 7 days of that event. Storm event sampling may be conducted instead of a regular sampling round, however, if no storm event monitoring is undertaken, the regular monitoring schedule will apply.

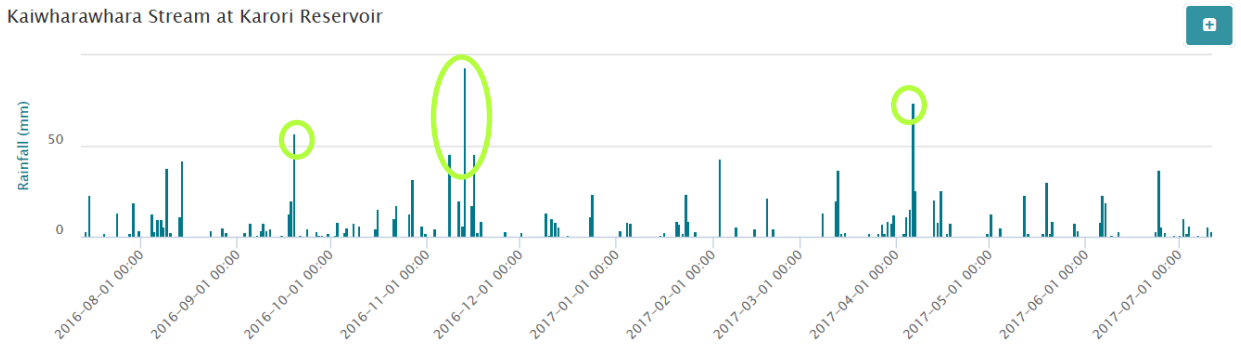

Figure 2-1: Storm event sampling trigger: >45mm in any 24 hour period

2.4 Groundwater quality analyses

Analyses for groundwater samples collected at TTG shall include those listed in Table 2-2.

Table 2-2: Groundwater quality analyses

Determinand	Unit	Method	Detection limit
pH	pH	APHA 4500-H+	-
Conductivity	mS/m	APHA 2510 B	1
Chloride	g/m^3	APHA 4110 B	0.5
Ammoniacal Nitrogen	g/m^3	APHA 4500-NH_3 H	0.01
Nitrate Nitrogen	g/m^3	APHA 4500-NO_3 I	0.002
Total arsenic	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	2
Total iron	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	20
Total manganese	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.5
Total lead	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.1
Total copper	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.5
Total chromium	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.6
Total zinc	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	1

(APHA) American Public Health Association: Standard Methods for the Examination of Water and Wastewater

2.5 Surface water quality analyses

Analyses for routine and storm event surface water samples collected at sites TTE, TTW, TTD, OSU and OSD shall include those listed in Table 2-3.

Table 2-3: Surface water quality analyses

Determinand	Unit	Method	Detection limit
pH	pH	APHA 4500-H+	-
Conductivity	mS/m	APHA 2510 B	1
Alkalinity	g/m^3CaCO_3	APHA 2320 B	1
Total suspended solids	g/m^3	APHA 2540 D GF/C 1.2µm	3
COD	g/m^3	APHA 5220 D	6
Total Hardness	g/m^3CaCO_3	APHA 2340 B	1
Dissolved organic carbon	g/m^3		1
Ammoniacal Nitrogen	g/m^3	APHA 4500-NH3 H	0.01
Dissolved arsenic	µg/L	Filtered sample, ICP-MS, trace level. APHA 3125 B	2
Dissolved iron	µg/L	Filtered sample, ICP-MS, trace level. APHA 3125 B	20
Dissolved manganese	µg/L	Filtered sample, ICP-MS, trace level. APHA 3125 B	0.5
Dissolved lead	µg/L	Filtered sample, ICP-MS, trace level. APHA 3125 B	0.1
Dissolved copper	µg/L	Filtered sample, ICP-MS, trace level. APHA 3125 B	0.5
Dissolved chromium	µg/L	Filtered sample, ICP-MS, trace level. APHA 3125 B	0.6
Dissolved zinc	µg/L	Filtered sample, ICP-MS, trace level. APHA 3125 B	1
Total arsenic	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	2
Total iron	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	20
Total manganese	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.5
Total lead	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.1
Total copper	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.5
Total chromium	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	0.6
Total zinc	µg/L	Nitric/Hydrochloric acid extraction, ICP-MS APHA 3125 B	1

2.6 Benthic ecology surveys

Condition 13 of the consent requires that, in the event that both tolerance limits and the latest ANZECC Guidelines of the protection of aquatic ecosystems (90%) trigger levels are exceeded, in accordance with the protocol in Condition 8, an assessment of the ecological effects of the discharge shall be provided (refer Section 3).

An ecological survey was conducted in December 2016 in accordance with condition 8, and a follow-up survey will be conducted between January and March 2018, provided the stream diversion works have been completed by that time. In general terms the assessment shall include the surface water sites listed in Table 2-1 and shall include the following:

Habitat Quality

- In-situ measurements of water temperature, dissolved oxygen, pH and conductivity using a handheld YSI 566 multi-probe meter
- A rapid habitat quality assessment using a protocol from Clapcott (2015)
- In-stream assessment of deposited sediment %cover using SAM2 from Clapcott et al, (2011)
- An assessment of substrate compactness using a protocol from Harding et al (2009)

Macroinvertebrate Community health

Quantitative macroinvertebrate Surber samples collected from riffle habitat in general accordance with protocol C3-Hard Bottom, Quantitative (Stark et al 2001). If no riffle habitat is available at any site, samples may be collected from runs and areas where water turbulence was increased by large rocks, logs, etc. The number of sample replicates varied between sites as follows:

- 3 replicates at each of TTE and TTW
- 6 replicates at TTD
- 7 replicates at each of OSU and OSD

Each sample should be preserved in ethanol alcohol and transported to the Laboratory for processing by full count with subsampling option (Protocol P3: Stark et al, 2001). The results shall be summarised with a range of invertebrate community metrics including abundance, number of taxa, number of EPT taxa, MCI and QMCI.

Periphyton

A visual assessment of periphyton % cover should be conducted at each of the five stream sites. At each location a visual assessment is made at three points on six cross river transects. Periphyton cover shall be assessed for the following four categories:

- filamentous algae >2cm long
- cyanobacteria mats >1mm thick
- all mats >1mm thick
- 'sludge' >1mm thick (including iron precipitate)

3. Adaptive Management

3.1 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 and TTW, and in the combined stream flow downstream of the landfill at TTD (total recoveries are specified for metals)

b. Comparison of results with ANZECC (2000) 90% protection trigger values

c. Determination of contaminant contribution from the landfill

d. Comparison of that contribution with predetermined 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 tolerant limit and trigger value, undertake two rounds of follow-up sampling testing (the dissolved fraction is specified for metals)

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.

3.2 ANZECC trigger values

Condition 8 of the consent requires that any monitoring result which exceeds a relevant tolerance limit must be compared with 'the latest ANZECC Guidelines for Ecosystem Protection (90%) trigger levels'. The current 90% protection trigger levels for the protection of aquatic ecosystems are given in Table 3.4.1 of ANZECC (2000). The trigger values relevant to this consent are reproduced below in Table 3-1. Note that ANZECC provides 90% trigger values only for stressors which are considered to be directly toxic to biota (such as ammonia, manganese, lead, copper and zinc).

Table 3-1: ANZECC (2000) trigger values to protect 90% of aquatic species

Determinand	Unit	ANZECC (2000) 90% trigger value (Table 3.4.1) and site specific values
pH	pH	not specified
Conductivity	mS/m	not specified
Alkalinity	$g/m^3 CaCO_3$	not specified
Total suspended solids	g/m^3	not specified
COD	g/m^3	not specified
Total Hardness	$g/m^3 CaCO_3$	not specified
Ammoniacal Nitrogen	g/m^3	1.430 (site specific: 2.34)[1]
Arsenic	µg/L	42
Dissolved iron + manganese	µg/L	1000[2]
Dissolved lead	µg/L	5.6 (site specific: 11)[3]
Dissolved copper	µg/L	1.8 (site specific: 2.8)[3]
Dissolved chromium	µg/L	6
Dissolved zinc	µg/L	15 (site specific: 23)

Note: [1]Site specific ammoniacal-N is calculated for pH 7.6, which is the maximum value recorded at site TTD;

[2]Hickey (2012 memo) recommended that the sum or iron and manganese should be below 1000 ug/L to prevent bed smothering.

[3]Hardness related metals (copper, lead, zinc) are adjusted to upstream hardness of 50 g/m^3 $CaCO_3$

3.3 Determination of contaminant inputs from landfill

The eastern and western branches of Maori 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 both from sources upstream of the landfill (measured at TTE and TTW) and from the landfill itself. For each determinand the contribution derived from the landfill can be calculated by subtracting the average concentration up-steam of the landfill from that recorded downstream of the landfill:

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

3.4 Tolerance limits

The tolerance limits listed in consent condition 8 (reproduced below in Table 3-2) have been calculated from monitoring data collected from March 2004 to November 2008, inclusive. The tolerance intervals have been calculated on the difference between the downstream and upstream samples (see above), such that they contain 95% of the data distribution with 95% probability.

Table 3-2: Calculated tolerance limits

Determinand	Unit	Lower tolerance limit	Upper tolerance limit
pH	pH	-0.4	0.4
Conductivity	µS/m		72.4
Alkalinity	g/m^3CaCO_3		226
Total suspended solids	g/m^3		32
COD	g/m^3		21
Total Hardness	g/m^3CaCO_3		465
Ammoniacal Nitrogen	g/m^3		0.346
Total Iron	µg/L		2748
Total Manganese	µg/L		1461
Total Lead	µg/L		5.9
Total Copper	µg/L		4.0
Total Zinc	µg/L		130
Total Arsenic	µg/L		13
Total Chromium	µg/L		1

Tolerance intervals are used to identify changes in the distribution of observations. If we start to record many values falling outside a tolerance interval on past data, we would suspect that the mean of the distribution has shifted. In this case frequent exceedance of the upper limit would indicate that the contaminant input from the landfill to the stream had increased.

The tolerance interval has the form $x \pm SK$

where x and S are the sample mean and standard deviation, K is a tabulated tolerance factor corresponding to the probability and sample size (see Table 3-3).

Table 3-3: Tolerance factors (K) for one-sided normal tolerance intervals

n	K	n	K
6	3.707	15	2.566
7	3.399	16	2.523
8	3.188	17	2.486
9	3.031	18	2.453
10	2.911	19	2.423
11	2.736	20	2.396
12	2.736	30	2.220
13	2.670	50	2.065
14	2.614	100	1.924

Probability level (confidence factor) Y = 0.95 and coverage P = 95% (Lieberman 1958)

3.5 Confirmation of an exceedance

Should the tolerance limit for any parameter listed in Table 3-2 be exceeded, and where that parameter also exceeds the ANZECC trigger levels listed in Table 3-1, the permit holder shall:

- Undertake a second sample within one month of receipt of the laboratory report, and undertake a third sample within one month of the second sample being taken, and analyse both for the exceeded parameter
- In these instances the dissolved fraction of metals, rather than the total metal fraction shall be tested
- If the average of these two recoveries continues to exceed the relevant tolerance limits in Table 3-2 and the ANZECC trigger levels listed in Table 3-1, the permit holder shall implement the **adaptive management** conditions as required by Conditions 13 and 14 of the consent.

Wellington
Level 11, 155 The Terrace
Wellington 6011
PO Box 13-052, Armagh
Christchurch 8141
Tel +64 4 381 6700
Fax +64 4 473 1982

www.mwhglobal.com/nz

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