BTW Company Limited
Vanner Landfarm
Monitoring Programme
Annual Report
2012-2013

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Taranaki Regional Council
Private Bag 713
STRATFORD

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Executive summary

BTW Company Limited operates a drilling waste landfarm located on Lower Ball Road at Kakaramea (Vanner Landfarm), in the Mangaroa catchment. Disposal activities commenced at this site during the 2012-2013 monitoring year. This report for the 2012-2013 period describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds one resource consent, which includes a total of 26 conditions setting out the requirements that the Company must satisfy.

The Council's monitoring programmes for the year under review included six inspections, collection of two soil samples, and two surface water and four groundwater samples, in addition to a review of monitoring data received from the Company.

The monitoring indicated that there is no evidence of adverse environmental effects due to activities at the site. Concentrations of contaminants in the surface soil meet the required consent conditions and surface and groundwater results indicate no adverse impacts from stockpiling or spreading at this site. Ongoing monitoring of the site will ensure that all wastes comply with conditions that are to be applied at the time of relinquishment or expiry, prior to surrender of the consent being accepted by the Council.

During the year, the Company demonstrated an overall high level of environmental performance and compliance with the resource consents. There were no incidents recorded by the Council that were associated with consented activities at the site.

For reference, in the 2012-2013 year, 35% 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 59% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2013-2014 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2012 - June 2013 by the Taranaki Regional Council describing the monitoring programme associated with a resource consent held by BTW Company Limited. BTW operate a drilling waste landfarm situated on Lower Ball Road at Kakaramea (Vanner Landfarm).

The Vanner site became operational in November 2012. At this time, in line with activities at the other disposal sites in the region, the storage area had been developed with a robust lined pit system. Groundwater monitoring bores were installed prior to any spreading activities.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by BTW Company Limited, to discharge drilling waste onto and into land via landfarming. This is the first Annual Report to be prepared by the Taranaki Regional Council to cover the Company's discharges and their effects at this site.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites though annual programmes, the resource consents held by BTW Company Limited, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Company's site.

Section 2 covers the landfarming site, setting out the site location, details of the resource consent and presenting the results of monitoring during the period under review (including scientific and technical data).

Section 3 discusses the results, their interpretations, and their significance for the environment, and provides an evaluation of compliance with the resource consent.

Section 4 presents recommendations to be implemented in the 2013-2014 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 Resource Management Act primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

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

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

1.1.4 Evaluation of environmental and consent performance

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

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline) non-compliance with conditions.

- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, 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, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and any inconsequential non compliances with conditions were resolved positively, co-operatively, and quickly.

- **improvement desirable (environmental)** or **improvement desirable (administrative compliance)** (as appropriate) indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, and/or, there were measurable environmental effects arising from activities and intervention by Council staff was required and there were matters that required

urgent intervention, took some time to resolve, or remained unresolved at the end of the period under review, and/or, there were on-going issues around meeting resource consent conditions even in the absence of environmental effects. Abatement notices may have been issued.

- **poor performance (environmental)** or **poor performance (administrative compliance)** indicates generally that the Council was obliged to record a verified unauthorised incident involving significant environmental impacts, or there were material failings to comply with resource consent conditions that required significant intervention by the Council even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

For reference, in the 2012-2013 year, 35% 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 59% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process descriptions

1.2.1 Drilling waste

Waste drilling material is produced during well drilling for hydrocarbon exploration. Various types of waste may be produced during drilling operations, with different disposal options available depending on waste type. The most common wastes discharged to land are drilling fluids (mud) and rock cuttings. Drilling fluids transport cuttings from the drill bit to the well surface for disposal; control in-well pressures; support the sides of the hole and prevent the ingress of formation fluids; and lubricate and cool the drill bit and drill pipe in the hole.

Cuttings are produced as the drill bit penetrates the underlying geological formations. They are brought to the surface in the drilling fluid where they pass over a shaker screen that separates the cuttings and drilling fluids. The drilling fluids are recycled for reuse within the drilling process, but small quantities of drilling fluids remain adhered to the cuttings. The cuttings and smaller particle material from the drill fluid treatment units drain into sumps. If sumps cannot be constructed corrals or special bins are used. During drilling this material is the only continuous discharge. Drilling fluids may be intentionally discharged in bulk, to allow changes to the drilling fluid programme.

Oil and gas wells may be drilled with either synthetic based mud (SBM) or water based mud (WBM). More than one type may be used to drill an individual well. In the past, oil based muds (diesel/crude oil based) have also been used. Their use has declined since the 1980s due to their ecotoxicity, they have been replaced by SBM. Barite clay is added to most drilling muds as a wetting and weighting agent.

1.2.2 Landfarming

The landfarming process has typically been used in the Taranaki region to assist the conversion of sandy coastal sites prone to erosion into productive pasture. Results of an independent research project conducted by AgKnowledge Ltd (2013) have indicated that the re-contoured sand dunes, after the inclusion of the drilling wastes

(as per the consents), and with the addition of appropriate fertilisers and water (irrigation) are capable of sustaining highly productive, high quality clover-based pastures and thus increasing the value of the land from about $3-4000/ha to $30-40,000/ha. The full report is attached in Appendix IV.

Landfarming uses natural and assisted bioremediation to reduce the concentration of petroleum compounds through degradation. Basic steps in the landfarming process:

1. Drilling waste is transported from wellsites by truck (cuttings) or tanker (liquids). It may be discharged directly to land or placed in a dedicated storage pit.
2. The required area is prepared by scraping back and stockpiling existing pasture/topsoil and leveling out uneven ground.
3. Waste is transferred to the prepared area by excavator and truck and spread out with a bulldozer. Liquids may be discharged by tanker or a spray system.
4. Waste is allowed to dry sufficiently before being tilled into the soil to the required depth with a tractor and discs.
5. The disposal area is leveled with chains or harrows.
6. Stockpiled or brought in topsoil/clay is applied to aid stability and assist in grass establishment.
7. Fertiliser may be applied and the area is sown in crop or pasture at a suitable time of year.

1.2.3 Site location and description

The Vanner Landfarm is located on Lower Ball Road at Kakaramea, flanked by Origin Energy Ltd's Spence Road Landfarm in the south. These sites are located on marginal coastal farm land situated on reworked dune fields. An extensive (50-150 m) foredune is located seaward of the consented site, and will remained undisturbed by site activities. The foredune provides a considerable natural buffer from prevailing onshore winds.

The predominant soil type has been identified as black loamy sand and vegetation growth is primarily a mixture of pasture and dune grasses. Test pitting and the logging of boreholes on site indicated a relatively deep water table (especially in the proximity of the storage areas). Test bores were augured to 10 m in the pit area, mostly through coarse sand without intercepting significant soil moisture. Pit construction revealed mostly coarse sand at the pit bases (approximately 3-4 m below surface).

Average annual rainfall for the site is 1043 mm (taken from the nearby Patea monitoring stations). As with the other South Taranaki coastal sites, the Vanner site is subject to strong winds predominantly from the N-NW at average speeds of 10-20 knots (taken from Hawera automated weather station).

The Mangaroa Stream runs through the northern extent of the site separating the stockpiling facilities and some of the available spreading area from the main spreading area at the southern end of the site. Prior to any spreading activities the Company were required to install a culvert across the stream to prevent unauthorised discharges and stream bed damage from earthworks and transporting processes.

Figure 1 Arial photograph showing the location and extent of the Vanner Landfarm and approximate regional location (inset)

Stockpiling of drilling muds and cuttings presents the highest potential risk to soil and localised groundwater, as material is present in concentrated form. The construction and maintenance of adequate storage facilities is essential in site establishment and on-going management. Photographs 1 and 2 depict the earthworks and pit construction processes undertaken at the Vanner site.

Photo 1 Initial earthworks at Vanner landfarm showing stockpiling area construction

Photo 2 Pit-C newly constructed showing high grade HDPE synthetic liner

1.3 Resource consent

BTW holds discharge permit 7942-1 to discharge drilling wastes [consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds] onto and into land via landfarming. This permit was issued by the Taranaki Regional Council on 21 October 2011 to BTW, as a resource consent under Section 87(e) of the Resource Management Act. This resource consent is due to expire on 1 June 2028.

Condition 1 sets out definitions.

Condition 2 requires the consent holder to adopt the best practicable option to minimise any environmental effects.

Conditions 3 to 7 require the notification and the provision of information and analytical data prior to receipt of wastes on site for stockpiling, and prior to discharge.

Condition 8 stipulates the discharge area.

Condition 9 requires a buffer zone between areas of disposal and surface water bodies and property boundaries.

Conditions 10 to 13 stipulate the manner and dispersal of wastes and discharge limits.

Conditions 14 and 15 specify further site management requirements.

Conditions 16 to 23 specify receiving environment limits for both soil and water.

Condition 24 concerns archaeological remains.

Conditions 25 and 26 concern lapse provisions and consent reviews.

The permit is attached to this report in Appendix I.

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the Vanner landfarm consisted of four primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Taranaki Regional Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application:

- in discussion over monitoring requirements
- preparation for any reviews
- renewals
- 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

A total of six inspections were made of the Vanner landfarm site during the monitoring period, with regard to the consent for the discharge of drilling waste. Inspections focussed on stockpiling facilities, spreading activities (including application rates, ponding of muds), dust and odour effects and any potential impacts on the Mangaroa stream.

1.4.4 Chemical sampling

During the monitoring period the Council collected two composite soil samples from spreading area F1 at the Vanner site. For each sample, 12-15 cores were taken from a diagonal transect at 10m intervals to a depth of 250mm and composited in the field. The samples were analysed for chloride, conductivity, hydrocarbons, pH, sodium, and total soluble salts.

At the Vanner site two groundwater bores were constructed, and sampled twice. Samples were analysed for pH, temperature, conductivity, chloride, TPH and BTEX.

The Mangaroa Stream, which runs through the Vanner landfarm, was sampled once at two sites. Samples were analysed for pH, conductivity, BTEX and TPH.

1.4.5 Review of analytical results

The Council reviewed soil sampling results and the annual reports provided by the Company in respect of the landfarm site. The Company collected representative pre-disposal samples from individual waste streams prior to disposal, and receiving environment soil samples from all spreading areas post waste application. These samples were sent to an independent IACC accredited laboratory for analysis for a wider range of contaminants. Chemical parameters tested were (all solid/sludge samples):

- pH
- chlorides
- potassium
- sodium
- total nitrogen
- barium
- heavy metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)
- BTEX
- PAHs
- TPH (and individual hydrocarbon fractions C7-C9, C10-C14, C15-C36)

Receiving environment soil samples were also tested for electrical conductivity and sodium absorption ratio (SAR).

The Company also supplied surface water sample results from the Mangaroa Stream for review.

2. Results

2.1 Inspections

9 November 2012
Upon inspection the site was under construction and was not expected to receive any waste material for approximately two weeks. Three storage pits were constructed and the liners were due to arrive over the next few days. The soil was primarily sandy in nature within the pit area and traces of iron pans were observed at the base of the pit. A small stream runs through the south of the spreading area and discussions with staff with regards to buffer zones around the stream and foredune areas occurred, in addition to the location of groundwater sampling bores. It was noted that further inspections and discussions were needed to occur in order to finalise groundwater sampling bores and arrange installation.

22 January 2013
An inspection was conducted in conjunction with installation of the groundwater monitoring wells. One of the lined pits contained waste material and the others were being lined at the time of inspection. The storage area was composed of very sandy soils with no evident clay in the bases of the pits. No issues were noted.

29 January 2013
At the time of inspection no objectionable odours or emissions were detected. Of the four lined pits on site, two of the mud pits drain via pipes into two liquid receiving pits. Only one set of these pits was in use at the time of inspection, of which the liquid receiving pit contained surface hydrocarbons across approximately one third of the surface and had only half a metre of freeboard available. No washing was occurring on site as no water infrastructure had yet been installed; it was discussed with and outlined to staff that all washings will need to be discharged into the lined pits. Discussions were also held with regard to crossing the small stream at the south end of the site when muds were to be spread; it was outlined that a culvert will be necessary for vehicle crossings to prevent unauthorised discharges into the stream.

11 February 2013
An inspection was conducted in conjunction with initial groundwater samples within the spreading area and no adverse or significant issues were noted at the site.

2 April 2013
No objectionable odours or emissions were detected beyond the site boundary upon inspection, however sulphur odours were noted downwind of the storage pits. The four lined pits located on site were all found to have freeboard available, of which each pit contained dark liquid with some surface oil present. A culvert had been installed at the stream crossing and earthworks had begun to prepare an area to receive muds. Observed contouring also looked good.

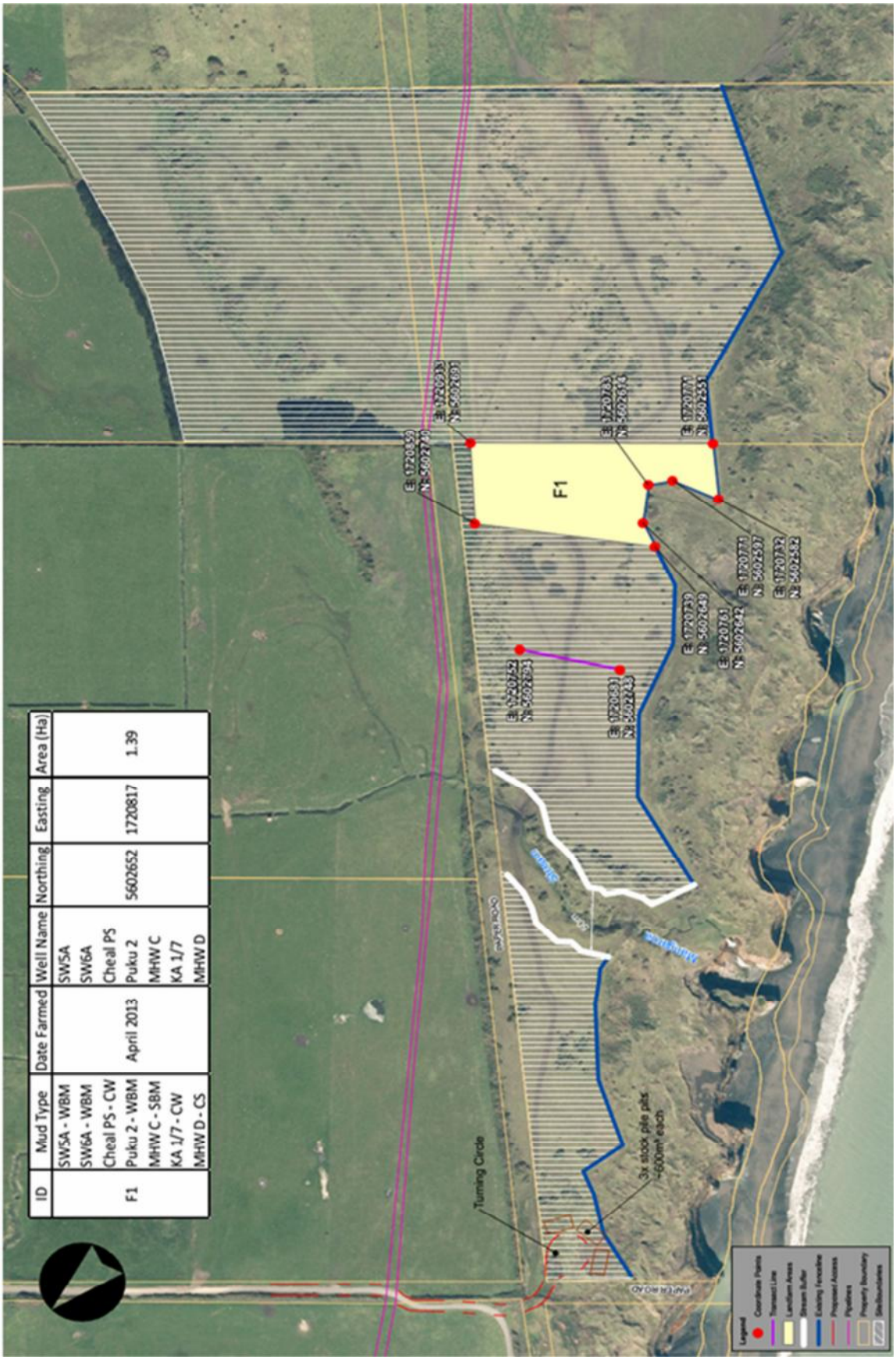
4 June 2013
At the time of inspection a light breeze was occurring from the southeast and no objectionable odours or visible emissions were detected. The four lined pits on site all contained material, although only one pit was set up to receive wastes. It was apparent that some issues had occurred with disposing all of the muds into the pit, as the load-in area featured some material and cuttings around the pit and the concrete

pole used to inform the drivers of the pit edge appeared buried and broken. Tyre marks were also observed extremely close to the pit edge. The liner of the same pit was ineffectively sealed around the discharge pipe and as a result any liquid would likely discharge behind the liner rather than into the receiving pit. Over one metre of freeboard was still available before the material level would reach the outlet. The area where muds had been recently spread was inspected and was observed to look good with pasture and dune plants reappearing naturally, however some muds were still identifiable within the soil profile and a small pile of cuttings and muds (approximately 2x1x1 metre) was present at the top (coastal side) of the spreading area, these identified patches need to be spread further. Pieces of plastic liner were also identified within the soil profile around the spreading area, half of which appeared to have been stripped of topsoil and muds had not yet been spread. It was advised that BTW ensure all materials are discharged into the pits and remediate the area around the pit edge. In addition, the Company were required to effectively seal the liner around the outlet pipe and spread the pile of mud further and thinner which is at the coastal end of the previously spread area.

Photo 3 Spreading area F1, Vanner Landfarm showing initial pasture strike

2.2 Results of discharge monitoring

There was a single disposal during the monitoring period, of 1390 m^3 consisting of primarily water/synthetic based cuttings and fluids, with smaller quantities of contaminated water and soil. The waste spread was sourced from the Mangahewa C and D, Sidewinder, Puka and KA-1 wellsites and Cheal production station. On the basis of average TPH concentrations the waste was spread at the 100mm application rate over an area of 13,900 m^2 (area F1, Figure 2 below).



ID	Mud Type	Date Farmed	Well Name	Northing	Easting	Area (Ha)
F1	SW5A - WBM SW6A - WBM Cheal PS - CW Puku 2 - WBM MHW C - SBM KA 1/7 - CW MHW D - CS	April 2013	SW5A SW6A Cheal PS Puku 2 MHW C KA 1/7 MHW D	5602652	1720817	1.39

Figure 2 Vanner Landfarm site activity map showing spread area F1

2.3 Results of receiving environment monitoring

2.3.1 BTW soil results

The Company supplied a summary of receiving soil sample results for spreading area F1, presented below in table 1. These results are also included in the supplied annual report in Appendix II.

Table 1 BTW supplied receiving environmental samples

Parameter	Unit	Limit	F1	Compliance
			Jul-13	
Conductivity	mS/m	400	220	complies
SAR	-	18	2.8	complies
Total Soluble Salts	mg/kg	2500	1419	complies
Benzene	mg/kg	1.1	<0.05	complies
Toluene	mg/kg	68	<0.05	complies
Ethylbenzene	mg/kg	53	<0.05	complies
Xylenes	mg/kg	48	<0.05	complies
Napthalene	mg/kg	7.2	<0.13	complies
Pyrene	mg/kg	160	<0.03	complies
Benzo(a)pyrene	mg/kg	0.027	<0.03	complies
Arsenic	mg/kg	20	<2	complies
Cadmium	mg/kg	1	<0.10	complies
Chromium	mg/kg	600	16	complies
Copper	mg/kg	100	8	complies
Lead	mg/kg	300	1.4	complies
Mercury	mg/kg	1	<0.10	complies
Nickel	mg/kg	60	7	complies
Zinc	mg/kg	300	60	complies
C7-C9	mg/kg	120	<8	complies
C10-C14	mg/kg	58	**220**	***Possible future non-compliance**
C15-C36	mg/kg	4000	620	complies
Nitrogen	mg/kg	-	0.12	complies
Chloride	mg/kg	700	70	complies
Sodium	mg/kg	460	126	complies

* Not yet compliant with condition that is applicable at time of surrender, not at time of initial application.

The initial sampling results from area F1 already show compliance with all consent surrender criteria with the exception of the C10-C14 hydrocarbon fraction. It is expected that the concentrations will reduce relatively rapidly to within surrender criteria.

2.3.2 BTW Surface water samples (Mangaroa Stream)

On 4 April 2013 BTW collected two water samples from the Mangaroa Stream. Their results are presented in Table 2.

Table 2 BTW supplied surface water samples, Mangaroa Stream

Parameter	Unit	Upper Mangaroa	Lower Mangaroa	Typical surface water in Taranaki	Typical salt water
			Jul-13		
pH	pH units	7.6	7.8	6.0 - 9.5	8.0 – 8.3
Conductivity	mS/m	43.4	43.3	0 - 40	4750
Total Dissolved solids	g/m³	270	270	-	-
Total Potassium	g/m³	3.5	3.4	-	-
Total Sodium	g/m³	42	42	1 – 100	10500
Chloride	g/m³	68	69	0 – 50	19000
Total Nitrogen	g/m³	1.47	1.39	0 - 3	-
Arsenic	g/m³	<0.0011	<0.0011	0 – 0.001	0.002 – 0.006
Cadmium	g/m³	<0.000053	<0.000053	0 – 0.01	0 – 0.0001
Chromium	g/m³	0.00060	0.00054	<0.0005	<0.00005
Copper	g/m³	0.00107	0.00143	0 – 0.02	0.001 – 0.025
Lead	g/m³	0.00016	0.00019	0 – 0.002	0.0003
Nickel	g/m³	<0.00053	<0.00053	0 – 0.1	0.005 – 0.007
Zinc	g/m³	0.0033	0.0035	0 – 0.05	0.01
Benzene	g/m³	0.0011	<0.0010	-	-
Toluene	g/m³	0.0100	<0.0010	-	-
Ethlybenzene	g/m³	0.0012	<0.0010	-	-
m &p-Xylene	g/m³	0.005	<0.002	-	-
o-Xylene	g/m³	0.0020	<0.0010	-	-
C7-C9	g/m³	<0.10	<0.10	-	-
C10-C14	g/m³	<0.2	<0.2	-	-
C15-C36	g/m³	<0.4	<0.4	-	-

Unexpectedly, there were very low levels of BTEX detected in the upstream sample. The upper Mangaroa stream sample was taken before any landfarming took place on the site, and is approximately 400 m (and up-gradient) from the lined stockpiling pits. Additionally, no BTEX was detected in the downstream sample. This suggests an alternative source for the presence of BTEX, possibly related to other industry activities up-gradient from the site.

Furthermore, the levels of contaminants in the upstream samples were almost at detection levels and at these low concentrations are extremely unlikely to pose any risk to water quality or aquatic organisms. Repeat samples will be taken to confirm there are no significant effects on water quality in the Mangaroa Stream.

2.3.3 TRC soil results

During the monitoring year only one spreading area had been completed. As such, one composite soil sample was collected by sub-sampling to a depth of 250mm in landfarmed area F1. The results of this sampling are presented in Table 3.

Table 3 Soil samples taken at Vanner Landfarm

Parameter	Unit	Consent limit	F1
			26-Jun-13
Calcium	mg/kg	-	72.7
Chloride	mg/kg DW	700	105
Conductivity	mS/m@20C	400	89.1
Hydrocarbons	mg/kg DW	50,000*	920
Moisture Factor	-	-	1.003
Magnesium	mg/kg	-	9.2
Sodium	mg/kg	460	40.4
pH	pH	-	7.5
Sodium Absorption Ratio	None	18	1.2
Total Soluble Salts	mg/kg	2500	697

*Limits refer to application rates

The soil results from area F1 show all parameters measured to be within consent limits. Total hydrocarbon levels are low and the sodium absorption ratio is essentially at background. Resampling of this area, along with sampling of all future spreading areas will be conducted in the following monitoring period to confirm on-going compliance.

2.3.4 TRC surface water results

A total of two surface water samples were collected from the Mangaroa Stream. The results of this sampling are presented in Table 4. The sample sites MAN000010 and MAN000020 are identified in Figure 3.

Table 4 Surface water samples taken at Vanner Landfarm

Parameter	Unit	MAN000010	MAN000020
		26-Jun-13	27-Jun-13
Benzene	g/m^3	<0.0010	<0.0010
Chloride	g/m^3	67.9	68.8
Conductivity	mS/m@20C	37.1	36.8
Ethylbenzene	g/m^3	<0.0010	<0.0010
Hydrocarbon	g/m^3	<0.7	<0.7
pH	pH	7.74	7.96
Temperature	Deg.C	10.3	10.1
meta-Xylene	g/m^3	<0.002	<0.002
ortha-Xylene	g/m^3	<0.0010	<0.0010
Toluene	g/m^3	<0.0010	<0.0010

No obvious impacts from site activities have been detected in either sample, nor are there any significant differences between the upstream and downstream samples. No BTEX or TPH have been detected and chlorides are well within the normal range for coastal surface water. At the time of sampling, the extent of spreading activities were a considerable distance from the stream. As activity approaches the buffer zone it will be re-sampled several times to assess any potential impact on water quality.

2.3.5 TRC groundwater results

A total of four groundwater samples were collected from the Vanner landfarm on two occasions, the results of this sampling are presented in Table 5. Monitoring well locations are presented in Figure 3.

Table 5 Groundwater sample results for GND2316 and GND2317, Vanner Landfarm

Parameter	Unit	GND2316	GND2317	GND2316	GND2317
		11-Feb-13	11-Feb-13	26-Jun-13	26-Jun-13
Benzene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m^3	96.2	89.1	122	91.7
Conductivity	mS/m@20C	59.3	60.8	62	52.7
Ethylbenzene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon	g/m^3	<0.7	<0.7	<0.7	<0.7
meta-Xylene	g/m^3	<0.002	<0.002	<0.002	<0.002
ortha-Xylene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010
pH	pH	6.5	7.1	6.56	6.76
Temperature	Deg.C	15.1	15.2	14.5	14.8
Toluene	g/m^3	<0.0010	0.0017	<0.0010	<0.0010
Nitrite/nitrate, nitrogen	g/m^3	<0.01	<0.01	-	-
Total dissolved solids	g/m^3	458.8	470.4	-	-

Groundwater results from the two bores show no impacts of any significance from the activities at the site. The 11 February result for bore GND2317 shows a negligible presence of toluene. At the time of sampling no material had been applied (first discharges were not until April 2013). Additionally, the stockpiling facilities are located 650 m from monitoring well GND2317. For reference the New Zealand Drinking Water Standard for toluene is 0.8g/m^3. The most likely source of toluene at these levels is in the materials used to construct the bore.

Figure 3 Groundwater and surface water sampling sites Vanner Landfarm

2.3.6 Review of analytical results

The Company's receiving soil and surface water results have been presented in Section 2.3.1 Tables 1 and 2. The Company are also required to supply predisposal results to the Council for review prior to farming of wastes. Predisposal results for the Vanner site are supplied in Appendix III. In addition to the material farmed in area F1, drilling wastes were received from KA19 &20 and TAG's Ngapaeruru-1. This material remained stockpiled at the conclusion of the monitoring period. The predisposal results for these waste streams are also included in Appendix III.

2.4 Investigations, interventions, and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the year matters may arise which require additional activity by the Council eg 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 Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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).

During the 2012-2013 monitoring period there were no incidents recorded by the Council that were associated with the Vanner Landfarm.

3. Discussion

3.1 Discussion of site performance

The Company kept the Council well-advised, as per the consent's requirements, of the receipt of various wastes (including full characterisation), site operations, provided an updated site management plan, and carried out monitoring and annual reporting for the monitoring period. Inspections found that housekeeping and management of the site was generally good; there were some matters identified in the June inspection. These were promptly addressed by the Company. The Company was co-operative in all matters and displayed a high level of professionalism.

3.2 Environmental effects of exercise of consents

Monitoring indicates that there appears to be no adverse environmental effects due to activities at the site. Levels of contaminants in the surface soil meet the required consent conditions. Groundwater and surface water results have also indicated that there have been no adverse effects from site activities. Initial pasture establishment has been good. Activity at the site remained in the early stages at the end of the monitoring year. It will be necessary to closely monitor particularly surface and groundwater as site activity increases in subsequent monitoring years. Due to the location of the sites and the significant distance to any neighbours no air monitoring was undertaken as effects of emissions are known to be minimal.

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 6.

Table 6 Summary of performance for Consent 7942-1 to discharge drilling wastes [consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds] onto and into land via landfarming.

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	Not applicable	N/A
2. Best practicable option to be adopted	Inspection and liaison with consent holder	Yes
3. Notify TRC 48 hrs prior to stockpiling	Notifications received	Yes
4. Notify TRC 48 hrs prior to landfarming	Notifications received	Yes
5. The consent holder shall sample for the following: a. Total Petroleum Hydrocarbons b. Benzene, toluene, ethylbenzene, xylenes c. Polycyclic aromatic hydrocarbons d. Chloride, nitrogen, pH, potassium, sodium	Sampling	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
6. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
7. Report on records in condition 6 to Council by 31 August each year	Report received 27 August 2013	Yes
8. Discharges made only within area as specified by submitted application 6903	Inspection	Yes
9. No discharge within 25m of a water body or property boundary	Inspection	Yes
10. Discharge depth limited to 100mm for waste with hydrocarbons <5%, or 50mm for waste with hydrocarbons >5%	Company records and inspection	Yes
11. Incorporation into soil as soon as practicable to a depth of at least 250mm	Inspection and sampling	Yes
12. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/ kg dry weight	Sampling	Yes
13. Landfarming areas to be used in accordance with conditions 10 and 11 and shall not be used for any subsequent discharges of drilling wastes	Inspection	N/A
14. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections	Yes
15. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	Yes
16. Total dissolved salts in any fresh water body shall not exceed 2500 g/m^3	Sampling	Yes
17. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling	Yes
18. Disposal of waste shall not result in any significant adverse environmental effects on the Mangaroa Stream	Inspection and sampling	Yes
19. Soil conductivity must be less than 400 mS/m. If background conductivity exceeds 400 mS/m, then increase shall not exceed 100 mS/m	Sampling	Yes
20. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
21. Concentrations of heavy metals in the soil shall at all times comply with MfE guidelines	Sampling	Yes
22. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 400 mSm^{-1} b. chloride, 700 g/m^3 c. dissolved salts, 2500 g/m^3 d. sodium, 460 g/m^3 PAHs, MAHs and TPH, Tables 4.12 and 4.15, Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE 1999)	Sampling prior to surrender	N/A
23. If condition 22 not met, consent cannot be surrendered	Sampling	N/A
24. Notification of discovery of archaeological remains	None found	N/A
25. Lapse condition	Inspection for evidence of exercise	N/A
26. Optional review provision re environmental effects	Next optional review June 2016	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**

N/A = not applicable

3.4 Alterations to monitoring programmes for 2013-2014

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

It is proposed that for 2013-2014, the programme be modified from that for the 2012-2013 in the following manner:

Groundwater sampling will be increased at the Vanner landfarm site to four times per monitoring period to ensure consistency between site monitoring programmes and account for increased spreading activities in the following monitoring year.

A recommendation to this effect is included in this report.

4. Recommendation

1. THAT the monitoring programme for 2013-2014 continue at the same level as in 2012-2013, except that groundwater sampling is increased from three samples to four samples at the Vanner Landfarm during the 2013-2014 monitoring period.

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

Al*	aluminium
As*	arsenic
Biomonitoring	assessing the health of the environment using aquatic organisms
BOD	biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate
BODF	biochemical oxygen demand of a filtered sample
BTEX	MAH's benzene, toluene, ethylbenzene and xylene
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
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m^3s^{-1})
DO	dissolved oxygen
DRP	dissolved reactive phosphorus
E.coli	*escherichia coli*, 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
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

l/s	litres per second
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
MAHs	monocyclic aromatic hydrocarbons, molecules consist of a single six-sided hydrocarbon ring
mS/m	millisiemens per metre
mixing zone	the zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point
NH_4	ammonium, normally expressed in terms of the mass of nitrogen (N)
NH_3	unionised ammonia, normally expressed in terms of the mass of nitrogen (N)
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)
OW	Oily waste
PAHs	polycyclic aromatic hydrocarbons, molecules consist of more than two six-sided hydrocarbon rings
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)
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 including all subsequent amendments
SBM	Synthetic based mud
SS	suspended solids
SQMCI	semi quantitative macroinvertebrate community index;
Temp	temperature, measured in °C (degrees Celsius)
TPH	total petroleum hydrocarbons
Turb	turbidity, expressed in NTU
UI	Unauthorised Incident
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan
WBM	Water based mud
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

General

Department of Health 1992: Public health guidelines for the safe use of sewage effluent and sewage sludge on land. Department of Health.

Ministry for the Environment 1999: Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand, Ministry for the Environment.

Ministry for the Environment 2003: Guidelines for the safe application of biosolids to land in New Zealand, Ministry for the Environment.

Vanner Landfarm

BTW Company Limited, 2013: Vanner Landfarm Annual Report, Consent 7942. Monitoring and Reporting – August 2013.

Appendix I

Resource consent held by BTW Company Limited

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz
Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	BTW Company Limited P O Box 551 Taranaki Mail Centre NEW PLYMOUTH 4340
Decision Date:	21 October 2011
Commencement Date:	21 October 2011

Conditions of Consent

Consent Granted:	To discharge drilling wastes [consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds] onto and into land via landfarming at or about (NZTM) 1720685E-5602731N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Lower Ball Road, Kakaramea [Property owner: GJ & WJ Vanner]
Legal Description:	Lot 1 DP 8481 Sub 2 & 3 Blk II Carlyle SD[Discharge site]
Catchment:	Mangaroa

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council [the Council] all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

Special conditions

1. For the purposes of this consent the following definitions shall apply:

    a) stockpiling means a discharge of drilling wastes from vehicles, tanks, or other containers onto land for the purpose of interim storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours; and
    b) landfarming means the discharge of drilling wastes onto land, subsequent spreading and incorporation into the soil, for the purpose of attenuation of hydrocarbon and/or other contaminants, and includes any stripping and relaying of topsoil.

2. The consent holder shall adopt the best practicable option [as defined section 2 of the Resource Management Act 1991] to prevent or minimise any actual or potential effects on the environment arising from the discharge.

Notifications, monitoring and reporting

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to permitting drilling wastes onto the site for stockpiling, from each well drilled. Notification shall include the following information:

    a) the consent number;
    b) the name of the well[s] from which the waste was generated;
    c) the type of waste to be stockpiled; and
    d) the volume of waste to be stockpiled.

4. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to landfarming stockpiled material, or material brought onto the site for landfarming within 48 hours. Notification shall include the following information:

    a) the consent number;
    b) the name of the well[s] from which the waste was generated;
    c) the type of waste to be landfarmed;
    d) the volume and weight [or density] of the waste to be landfarmed;
    e) the concentration of chlorides, nitrogen and hydrocarbons in the waste; and
    f) the specific location and area over which the waste will be landfarmed.

5. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:

   a) total petroleum hydrocarbons [C_6-C_9, C_{10}-C_{14}, C_{15}-C_{36}];
   b) benzene, toluene, ethylbenzene, and xylenes;
   c) polycyclic aromatic hydrocarbons screening; and
   d) chloride, nitrogen, pH, potassium, and sodium.

6. The consent holder shall keep records of the following:

   a) wastes from each individual well;
   b) composition of wastes [in accordance with condition 5];
   c) stockpiling area[s];
   d) volumes of material stockpiled;
   e) landfarming area[s], including a map showing individual disposal areas with GPS co-ordinates;
   f) volumes and weights of wastes landfarmed;
   g) dates of commencement and completion of stockpiling and landfarming events;
   h) dates of sowing landfarmed areas;
   i) treatments applied; and
   j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

   and shall make the records available to the Chief Executive, Taranaki Regional Council.

7. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, by 31 August of each year, a report on all records required to be kept in accordance with condition 6, for the period of the previous 12 months, 1 July to 30 June.

Discharge limits

8. The discharge area shall be as shown in Drawing No. 10321-101-GIS submitted with application 6903.

9. Notwithstanding condition 8, there shall be no discharge within 25 metres of the Mangaroa Stream or property boundaries.

10. For the purposes of landfarming, drilling wastes shall be applied to land in a layer not exceeding:

    a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight; or
    b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight; and
    c) in a rate and manner such that no ponded liquids remain after one hour, for all wastes;

    prior to incorporation into the soil.

11. As soon as practicable following the application of solid drilling wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.

12. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:

    a) liquid waste has been discharged; or
    b) solid waste has been discharged and incorporated into the soil.

13. An area of land used for the landfarming of drilling wastes in accordance with conditions 10 and 11 of this consent, shall not be used for any subsequent discharges of drilling waste.

Operational requirements

14. All material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.

15. As soon as practicable following landfarming, areas shall be sown into pasture [or into crop]. The consent holder shall monitor revegetation and if adequate establishment is not achieved within two months of sowing, shall undertake appropriate land stabilisation measures to minimise wind and stormwater erosion.

Receiving environment limits - water

16. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m^3.

17. Other than as provided for in condition 15, the exercise of this consent shall not result in any contaminant concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background concentration for that particular contaminant.

18. The exercise of this consent shall not result in any of the following effects in the Mangaroa Stream:

    a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
    b) any conspicuous change in the colour or visual clarity;
    c) any emission of objectionable odour;
    d) the rendering of fresh water unsuitable for consumption by farm animals;
    e) any significant adverse effects on aquatic life.

Receiving environment limits - soil

19. The conductivity of the soil/waste layer after landfarming shall be less than 400 mS/m, or alternatively, if the background soil conductivity exceeds 400 mS/m, the landfarming of waste shall not increase the soil conductivity by more than 100 mS/m.

20. The sodium absorption ratio [SAR] of the soil/waste layer after landfarming shall be less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.

21. The concentration of heavy metals in the soil shall at all times comply with the Ministry for the Environment and New Zealand Water & Wastes Assoication's Guidelines for the safe application of biosolids to land in New Zealand [2003], as shown in the following table:

Constituent	Standard [mg/kg dry weight]
Arsenic	20
Cadmium	1
Chromium	600
Copper	100
Lead	300
Mercury	1
Nickel	60
Zinc	300

22. From 1 March 2028 [three months prior to the consent expiry date], constituents in the soil shall not exceed the standards shown in the following table:

Constituent	Standard
conductivity	290 mS/m
chloride	700 mg/kg
sodium	460 mg/kg
total soluble salts	2500 mg/kg
MAHs PAHs TPH	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999]. Tables 4.12 and 4.15, for soil type sand.

MAHs - benzene, toluene, ethylbenzene, xylenes
PAHs - napthalene, non-carc. [pyrene], benzo(a)pyrene eq.
TPH - total petroleum hydrocarbons [C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36}]

The requirement to meet these standards shall not apply if, before 1 March 2028, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

23. This consent may not be surrendered at any time until the standards in condition 22 have been met.

Archaeological remains

24. In the event that any archaeological remains are discovered as a result of works authorised by this consent, the works shall cease immediately at the affected site and tangata whenua and the Chief Executive, Taranaki Regional Council, shall be notified within one working day. Works may recommence at the affected area when advised to do so by the Chief Executive, Taranaki Regional Council. Such advice shall be given after the Chief Executive has considered: tangata whenua interest and values, the consent holder's interests, the interests of the public generally, and any archaeological or scientific evidence. The New Zealand Police, Coroner, and Historic Places Trust shall also be contacted as appropriate, and the work shall not recommence in the affected area until any necessary statutory authorisations or consents have been obtained.

Lapse and review

25. This consent shall lapse on 31 December 2016, 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(1)(b) of the Resource Management Act 1991.

26. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 21 October 2011

For and on behalf of
Taranaki Regional Council

Chief Executive

Appendix II

Supplied Vanner Landfarm annual report

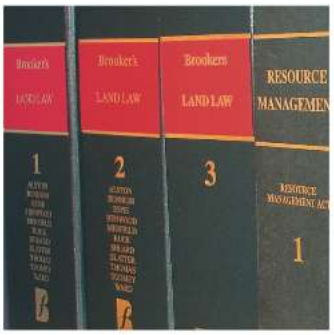
Annual Report

Special Condition 7 - Monitoring and Reporting

Vanner Landfarm Annual Report - Consent 7942

by BTW Company




btw company
surveyors . planners . engineers . land & g·i·s services

Vanner Landfarm Annual Report - Consent 7942

10321

Reviewed

Report Author		
	Dave Bolger	Date
Reviewed by		
	Kathryn Hooper	Date

10321
28/01/2014

btw company

CONTENTS

1 INTRODUCTION

1.1 Special Condition 7

In accordance with Special Condition 7 (SC7) of resource consent 7942-1 it is a requirement that:

The consent holder provide to the Chief Executive, Taranaki Regional Council, by 31 August of each year, a report on all records required to be kept in accordance with Special Condition 6 (SC6), for the period of the previous 1 July to 30 June.

This report therefore includes all information related to activities provided for under consent 7942-1 from 1 July 2012 to 30 June 2013 as well as monitoring required under SC 16-23.

1.2 July 2012 to June 2013 - Summary

During the year in review the first area was landfarmed on the site. This area is defined as F1 and is 1.39 hectares in area and contains a mixture of water/synthetic based cuttings and fluids. This area was sown in May 2013 and has shown a good pasture strike already and initial receiving environment sampling has shown that this area is almost at surrender limits from the first round of sampling. These results will be discussed further in this annual report.

The site has five lined pits, with two dedicated to liquids only. This system with mud pits and fluid pits has been successful in managing and controlling the fluids and muds.

We believe the site is exceptional, due to a semi-coastal environment, low water table for this location and the large buffer of sand dunes offering protection between the site and the coastline. Previous landfarming in this area has been successful with no environmental issues arising.

1.3 Records required under Special Condition 7

The consent holder shall keep records of the following:

a) wastes from each individual well;
b) composition of waste (in accordance with Condition 5);
c) stockpiling area (s);
d) volume of material stored;
e) landfarming areas, including a map showing individual disposal area with GPS co-ordinates;
f) volumes and weight of wastes landfarmed;
g) dates of commencement and completion of storage and landfarming events;
h) dates of sowing landfarming areas;
i) treatment applied;
j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

and shall make the records available to the Chief Executive, Taranaki Regional Council.

1.4 Report Overview

The following information has been collated for the purpose of demonstrating compliance with SC7. Information will be supplied generally in order as requested within SC6 a-j.

- Records required under SC 6 condition a) Wastes from each individual well and b) Composition of waste, is provided in Appendix A of the Report. Appendix A provides a list of all chemical products and lists of possible constituents which may be added to alter the consistency of drilling mud or well work over fluids and are stored on well sites.

  Condition b) is also addressed in Section 4 of the report.

- A map of the site showing individual disposal areas, GPS co-ordinates and stockpiling areas is located in Appendix B displaying compliance with SC6 c), e) & g). This includes:
  - *stockpiling Area's;*
  - *landfarming areas, including a map showing individual disposal area with GPS co-ordinates;*
  - *dates and commencement and completion of storage and landfarming events.*

- Section 2 provides the information related to the recording of details required within conditions d), f), h), and i) of SC6 which are listed below;

  - *volumes of material stored;*
  - *volumes and weights of wastes landfarmed;*
  - *dates of sowing landfarmed areas;*
  - *treatments applied.*

  Material volumes have been calculated based on the area of disposal and the thickness which disposal is undertaken. This information is available on the site map provided in Appendix B.

- Section 3 provides details of monitoring, including sampling locations and sampling methods as required by SC6, condition j.

- Section 4 provides the results of analysis as required also by SC6, condition j. Special Conditions 16-23 of Consent 7942-1 are also addressed in this section.

2 MATERIAL STORAGE AND TREATMENT

- The following section provides the information related to recording of details required within conditions d), f), h), and i) of SC6 which are listed below;

    - *volumes of material stored;*
    - *volumes and weights of wastes landfarmed;*
    - *dates of sowing landfarmed areas;*
    - *treatments applied.*

2.1 Material Volumes

The volume of material stored over the reporting year was 1125m³. This material has now been landfarmed into the F1. As can be seen in table 2.1 the area landfarmed is 1.39 hectares which is greater than the area required by the consent.

Table 2.1 provides the information required relating to the volumes of material landfarmed. Material volumes have been calculated based on the area of disposal and the thickness which disposal is undertaken. This information is available on the site map provided in Appendix B.

Table 2.1: Volumes of Material Landfarmed – July 2012 to June 1013

Location	Material Type	Date Landfarmed	Area of cover (m^2)	Thickness of material (mm)	Volume landfarmed (m^3)
F1	WBM/SBM	April 2103	13,900	100mm	1390

2.2 Sowing and treatments

No treatments have been applied to materials landfarmed at the Lower Ball Road Landfarm.

Sowing of grass has occurred on the F1 landfarmed area in May. A good strike of pasture has resulted and photographic evidence of this is included in Appendix D.

3 MONITORING INFORMATION

The following section provides the details of monitoring, including sampling locations, sampling methods and the results of analysis;

3.1 Monitoring

All material stockpiled on site is tested prior to arrival on site to assess its exact nature. Testing takes place prior to its arrival because on occasions it is added to other material already stored and therefore unable to be sampled separately once on-site.

When an appropriate volume of material has been stockpiled which justifies mobilising equipment for a landfarming operation, an assessment is made of all predisposal results to determine whether a composite sample needs to be taken. If hydrocarbon levels can be determined without the need for a composite sample, the landfarm area is designated and pegged out, and landfarming commences.

Monitoring of the landfarmed area begins within the first month of topsoil being re-applied. At this point, an entire suite of tests is undertaken to assess the receiving environment against consent conditions. For WBM material, monitoring is undertaken every six months for the first year following application, and every 6 months thereafter until compliance with consent conditions is achieved. For SBM material, monitoring is undertaken every three months for the first year following application, and then every 6 months until compliance is achieved. Within the first year, if results are compliant, monitoring ceases.

Monitoring results have been provided in a spread sheet form to assist with compliance and consent requirements for surrender (See Section 4). A number of areas identified during the monitoring year now meet the surrender limits criteria as stipulated on the consent. Areas that have meet surrendering criteria are discussed in Section 4. Sampling of these areas will now cease until one last sampling composite of the site is completed as part of surrender this consent. BTW Company will continue to sample the remaining areas until surrender criteria limits have been met.

All receiving environment samples are tested by an independent laboratory (Hill Laboratory) and methodology is in accordance with their requirements and the TRC.

3.2 Sampling Locations

Specific landfarmed areas are located through the use of a GPS navigational system. These co-ordinates are contained within the ‘Vanner Disposal Site’ – Site plan (Appendix B) which shows areas of disposal and is updated following landfarming events. A central point is located within each area and a composite sample retrieved in a transect line from the central point. The line direction is dependent on the underlying orientation of the landfarmed material. In the future, each composite sample position will be marked with a GPS and included on a GIS overlay of the site.

3.3 Methods

Sampling involves collecting a composite of 12 sub-samples which are GPS along a transect line running from the central point of a landfarmed area. Typically, samples are retrieved from approximately 250mm but this can vary depending on the location of the drilling mud layer.

3.4 Inspection Notices

All inspection notices issued by TRC Officers have found activities on the site to comply with conditions of consent 7942-1.

3.5 Infringement Notice

No infringement notices have been issued for this site.

3.6 Abatement Notices

No abatement notices have been issued by the TRC for this site.

3.7 Site Improvements

A collaborative approach between BTW Company and TRC has been taken to improve best practice of the landfarming operation at the Vanner site, and in general throughout the region. From the inception of the landfarming operation at this site all pits have been lined and groundwater monitoring water bores have been installed throughout the site.

As per BTW Companies normal operating procedures all landfarmed area are larger than the requirement under consent conditions. We believe this is an important safe guard factor to ensure that compliance with consent conditions is in no doubt

4 ANALYSIS OF RESULTS

The following Table 4.1 provides a summary of the monitoring results undertaken for area F1 over the reporting period. Analysis of the results of monitoring are required by SC6, condition j. Special Conditions 16-23 of Consent 7942-1 are also addressed in this section.

Where compliant with consent conditions, the fields are coloured green, where the sampling indicates the sampled constituent has not yet reached surrender limits, the field is coloured red. It is noted that surrender limits do not apply until such time as application is made to TRC to surrender the consent, or the consent expires.

		Consent Surrender limit meet			Consent Surrender limit not meet		
Soil Sampling	**Date**	Soil conductivity <290mSm-1 (see Consent if PD is greater than 400)	SAR <18	total soluble salts <2500 mg/kg	Benzene <1.1(v)	Toulene <68(4m)	Ethylbenzene (53)(4.v)
F1 Receiving soil	**Jul-13**	220	2.8	1419	<0.05	<0.05	<0.05

Xylenes (48) (4,m)	Naphthalene (7.2) (p)	Non-carc. (Pyrene) (160) (4p)	Benzo(a)pyrene eq.(5) (0.027)(p)	Arsenic (20mg/kg)	Cadmium (1mg/kg)	Chromium (600mg/kg)	Copper (100mg/kg)	Lead (300mg/kg)
<0.05	<0.13	<0.03	<0.03	<2	<0.10	16	8	1.4

Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/kg)	C7-C9 120 (m)	C10-C14 58 (x)	C15-C36 (4000) (7,x)	nitrogen mg/kg	Chloride mg/kg	Sodium 460mg/kg
<0.10	7	60	<8	220	620	0.12	70	126

Table 4.1: Monitoring results from Vanner Landfarm

With the exception of TPH C10-14 all surrender limits for the consent have been meet during the first round of sampling. However monitoring will continue on this area until surrender criteria have been meet.

4.1 Compliance with SC's 16 and 18

Conditions 16-18 require:

> *16. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m3*
>
> *17. Other than as provided for in condition 15, the exercise of this consent shall not result in any containment concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background concentration for that particular contaminant.*
>
> *18.The exercise of this consent shall not result in any of the following effects in the Mangaroa Stream:*
>
> *a) The production of an conspicuous oil or grease films, scums of foams, or floatable or suspended materials;*
> *b) Any conspicuous change in the colour or visual clarity;*
> *c) Any emission of objectionable odour;*
> *d) The rendering of fresh water unsuitable for consumption by farm animals;*
> *e) Any significant adverse effects on aquatic life.*

Compliance with SC's 16-18 will monitored through on site testing and inspection. We have provided in Appendix C the background rests for Mangaroa Stream.

4.2 Compliance with SC's 19 - 23

Conditions 19-23 require:

> *19. The conductivity of the soil/ waste layer after landfarming shall be less than 400 mS / m or alternatively, if the background soil conductivity exceeds 400 mS / m, the landfarming of water shall not increase the soil conductivity by more than 100 mS / m.*
>
> *20. The sodium absorption ratio (SAR) of the soil / waste layer after landfarming shall be less than 18.0, or alternatively if the background SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.*
>
> *21. The concentration of metals in the soil shall as all times comply with the Ministry of the Environment and New Zealand Water and Wastes Association's Guidelines for the safe application of biosolids to land in New Zealand (2003), as shown in the following table:*

Table 4.2: Consent Compliance Limits - Metals

Constituent	Standard (mg/kg dry weight)
Arsenic	20
Cadmium	1
Chromium	600
Copper	100

Lead	300
Mercury	1
Nickel	60
Zinc	300

22. From 1 March 2028 (Three months prior to the consent expiry date), constituents in the soil shall not exceed the standards shown in the following table:

Table 4.3: Consent Surrender Limits

Constituent	Standard
Conductivity	290 mS/m
Chloride	700 mg / kg
Sodium	460 mg /kg
Total soluble salts	2500 mg / kg
MAHs PAHs TPH	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Ministry for the Environment, 1999). Tables 4.12 and 4.15, for soil type sand.

MAHs – benzene, toluene, ethylbenzene, xylenes
PAHs – naphthalene, non coarc. (Pyrene) benzo(a)pyrene eq.
TPH – Total petroleum hydrocarbons (C_7-C_9, C_{10}-C_{14}, and C15-C_{36}).

The requirement to meet these standards shall not apply if, before 1 March 2028, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

23. This consent may not be surrendered at any time until the standards in condition 22 have been met.

As noted above for F1, only constituent levels for TPH C10-14 exceed the standard set in condition 22.

In summary monitoring will continue for the F1 area until surrender criteria have been meet.

APPENDIX A COMPOSITION OF WASTE

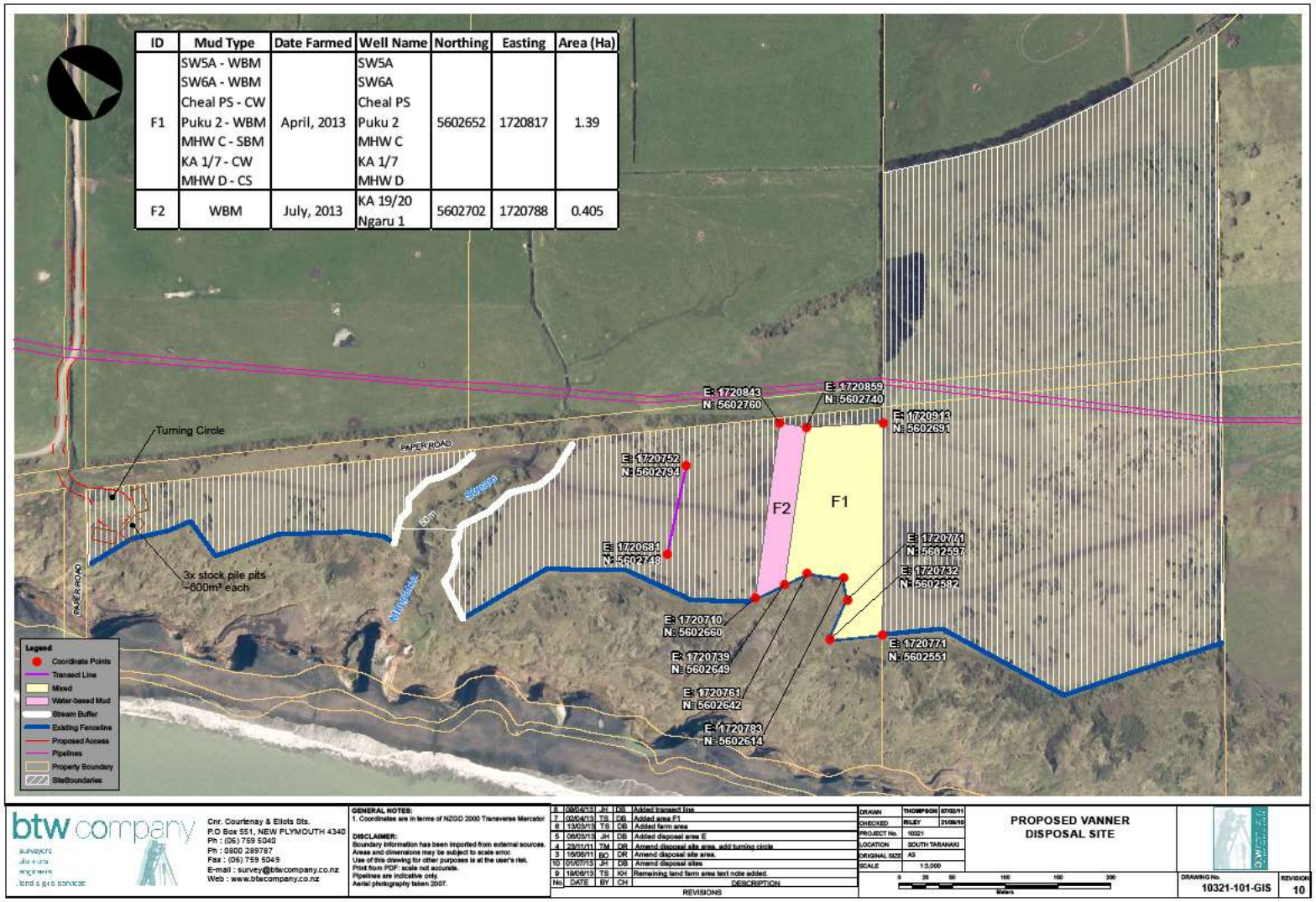
BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management															Sched 4
		Sub-section		Location & Transfer	manufacture and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documentation	Signage	Signage	Separation	Separation	Separation	Incompatibility	Disposal		Bunding	
		Reference		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.3	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5			
		Schedule Table reference from Regulations		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4	
		Description of what the numbers relate to in table below		Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirements	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Separation Distance	Separation required from	Incompatible substances	Information Requirements	Documentation Requirements	Threshold	
[redacted]																								
Asphasol (4-5% Crystalline Silica)	Solid/ Powder	6.7A Substances that are carcinogenic	0	-	-	10t	-	-	-	0.1t	1000L	-	-	0.1t	-	-	-	-	-	-	Any	0.1t	1000L	
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.1t	1000L	-	-	0.1t	-	-	-	-	-	-	Any	0.1t	1000L	
Calcium Carbonate (Omyacal 16/100, 15 & 25)	Solid	6.4A Irritating to the eye	47500kg	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-	
Caustic Soda	Solid	6.1D (Oral) Acutely toxic	125kg	-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	1000kg	
		8.1A Metallic corrosive		-	-	-	-	-	Any	1.0kg	-	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	-	
		8.2B Skin corrosive		-	-	-	-	-	Any	1.0kg	1000kg	-	-	1.0kg	250kg	250kg	-	-	-	-	Any	1.0kg	1000kg	
		8.3A Corrosive to eyes		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	0.1kg	2.0kg	10000kg	
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg	
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	1.0kg	5.0kg	-	
Ecotrol RD	Solid	3.1C Flammable (Medium hazard)	1225kg	-	-	-	-	-	-	-	-	-	-	-	1000kg	1000kg	-	-	-	Class 1 Class 3 Class 3.2 Class 4 Class 5	-	-	-	
		6.1C Acutely toxic (Inhalation)		-	-	Any	-	500,000	ANY	0.5kg	100kg	-	-	0.5kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	100kg	
		6.1E Acutely toxic (Oral)		-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-	
		6.3B Skin irritant		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-	
		6.4A Eye irritant		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-	
		6.6B Suspected human mutagen		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	0.1kg	3.0kg	-	
		6.8B Suspected human reproductive or developmental toxicant		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	0.1kg	3.0kg	-	
		6.9B Harmful to human target organs or systems (inhalation)		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	0.1kg	3.0kg	-	
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg	
Frac Attack	Powder	T&C	5000kg																					
Glute 25	Liquid	6.1D (Oral) Acutely toxic	25L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L	
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L	
		8.2C Corrosive to dermal tissue		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L	
		8.3A Corrosive to eyes		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	10000L	
Glydril LC	Liquid	6.1D (Oral) Acutely toxic	0	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L	
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L	
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-	
Glydril MC	Liquid	6.1D (Oral) Acutely toxic	0	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L	
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L	
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	5.0L	10000L	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-	
G-Seal	Solid/ Powder	6.1E Acutely toxic	40000kg	-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-	
		6.3B Mildly irritating to the skin		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-	
		6.4A Irritating to the eye		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-	
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-	
HRP	Liquid	6.3A Skin irritant	835L	-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg	
Kleen Up	Liquid	6.9A Skin irritant	1875L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-	
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-	
Lime	Powder/ Dust	6.2C Corrosive to dermal tissue	20000kg	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-	
		8.3A Corrosive to eyes		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	10000kg	
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	0.1kg	2.0kg	10000kg	
M-I Barite	Powder	6.1D (Oral) Acutely toxic	40000kg	-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg	
		6.7A Substances that are carcinogenic		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	1000kg	
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg	
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg	
M-I Gel Supreme (Bentonite)	Powder	6.7A Substances that are carcinogenic	181kg	-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	10000kg	10000kg	-	-	-	-	1.0kg	5.0kg	-	
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg	
MIX II (Coarse & Fine)	Powder	6.7A Substances that are carcinogenic	4000kg	-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg	
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg	
Novamul	Liquid	3.1D Flammable liquids: low hazard	3200L	-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg	
				-	-	-	-	-	5.0L	50L	10000L	500L	2	50L	10000L	10000L	-	-	-	Class 3 Class 3 Class 3.2 Class 4 Class 5	5.0L	50L	10000L	
Novatec F	Liquid	6.1D (Oral) Acutely toxic	4095L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L	
		6.5A Respiratory sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L	
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L	
		8.2C Corrosive to dermal tissue		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L	
		8.3A Corrosive to eyes		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	10000L	
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-	
KCl	Powder	6.1E Acutely toxic	24075kg	-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-	
		6.3B Mildly irritating to the skin		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-	
		6.4A Irritating to the eye		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-	
		9.3B Ecotoxic to terrestrial vertebrates.		-	-	-	-	-	0.2kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	0.2kg	5.0kg	-	

BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management															Sched 4
		Sub-section		Location & Transit	manufacture and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documen-tation	Signage	Signage	Separation	Separation	Separation	Incom-patibility	Disposal			Bunding
		Reference																						
		Schedule Table reference from Regulations		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.2	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5			
		Description of what the numbers relate to in table below		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4
				Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirements	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Separation Distance	Separation required from	Incompatible substances	Information Requirements	Documen-tation Requirements	Threshold
Safe Cide	Liquid	6.1D (Oral) Acutely toxic		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	2.0L	-	-	-	-	-	-	0.1L	1.0L	1000L
		9.3C Harmful to terrestrial vertebrates	0	-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	Any	1.0L	1000L
Safe Solv E	Liquid	6.1E Acutely toxic		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	5.0L	-
		6.5A Respiratory Sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	1.0L	50L	-
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L
		8.2C Corrosive to dermal tissue	835L	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L
		8.3A Corrosive to eyes		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	10000L
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
Safe Surf O	Liquid	6.1D (Oral) Acutely toxic		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		6.3A Skin irritant		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
		8.3A Corrosive to eyes	835L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	1.0L	1000L
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	50L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	10000L
Salt PYD	Solid	6.1E Acutely toxic		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
		6.4A Irritating to the eye	4200kg	-	-	-	-	-	1.0kg	50kg	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
Saraline 185V	Liquid			-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
				50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	0.1kg	50kg	-
		3.1B Flammable Liquids: high hazard	0																		1.0L	2.0L	1000L
		6.1E Acutely toxic																					
		6.3B Mildly irritating to the skin		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
Soda Ash	Solid	6.1B Acutely toxic		-	-	-	-	-	1.0L	50L	1000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.3A Skin irritant		-	-	Any	-	REQUIRED	ANY	any	100kg	-	-	any	250kg	250kg	-	-	-	-	Any	Any	100kg
		6.4A Irritating to the eye	450KG	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.9B Toxic to human target organs or systems		-	-	-	-	-	0.2kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
Sodium Formate	Liquid	6.1E Acutely toxic.		-	-	-	-	-	-	3.0kg	-	-	-	30kg	-	-	-	-	-	-	0.1kg	50kg	-
Sodium Formate	Solid	6.1E Acutely toxic.	40000L	-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	0.1kg	3.0kg	-
Versawet	Liquid	6.5B Toxic to human target organs or systems	1500kg	-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0L	50L	-
		8.3A Corrosive to eyes		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	2.0kg	50kg	-
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.	1892L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	-
		9.2B Ecotoxic in the soil environment		-	-	-	-	-	1.0L	50L	1000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		9.3B Ecotoxic to terrestrial vertebrates		-	-	-	-	-	0.2L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	1.0L	50L	10000L
				-	-	-	-	-	0.2L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	0.2L	5.0L	-
STABILISATION CHEMICALS																					0.2L	5.0L	-
AS-L	Liquid	6.1D Acutely Toxic																					
		8.2C Corrosive to skin		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		8.3A Corrosive to eyes	1000L	-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	1.0L	50L	10000L
AS-S	Liquid	6.1D (oral) Acutely toxic		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		3.1B Flammable Liquids: high hazard		50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	1.0L	1.0L	1000L
		6.1E (oral) Acutely toxic		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.3A Irritating to the skin	1000L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.3B Mildly irritating to the skin		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		8.3A Corrosive to ocular tissue		-	-	-	-	-	0.1L	1.0L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		9.1D (fish, crustacea, algae) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
Calcium Chloride	Solid	6.1D (oral) Acutely toxic		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
		6.3A Irritating to the skin		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30kg	10000kg	10000kg	-	-	-	-	1.0L	5.0L	-
		6.4A Irritating to the eye	1000kg	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	3.0kg	1000kg
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
CFR -3	Solid	6.1E Acutely toxic (oral)		-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	10000kg	10000kg	-	-	-	-	0.1kg	50kg	-
CFR-3L	Liquid	6.3A Irritating to the skin	1000kg	-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	5.0kg	-
		6.4A Irritating to the eye	1000L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	2.0kg	50kg	-
Class G Cement	Solid	6.1D(oral) Acutely toxic		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.5A Respiratory sensitisers.		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30kg	10000kg	10000kg	-	-	-	-	0.1L	50L	-
		6.5B Contact sensitisers.	1000kg	-	-	-	-	-	1.0kg	3.0kg	1000kg	-	-	30kg	-	-	-	-	-	-	0.1kg	3.0kg	1000kg
		8.2C Corrosive to dermal tissue		-	-	-	-	-	1.0kg	3.0kg	1000kg	-	-	30kg	-	-	-	-	-	-	Any	3.0kg	1000kg
		8.3A Corrosive to eyes		-	-	-	-	-	0.1kg	1.0kg	1000kg	-	-	30kg	-	-	-	-	-	-	Any	3.0kg	1000kg
Cleanbore_B	Liquid	6.1D (oral) Acutely toxic		-	-	-	-	-	0.1kg	1.0kg	1000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	10000kg
		6.3A Irritating to the skin		-	-	-	-	-	0.1L	1.0L	1000L	-	-	2.0kg	1000kg	1000kg	-	-	-	-	0.1kg	2.0kg	10000kg
		8.3A Corrosive to ocular tissue	1000L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		9.1D (fish, crustacea, algae) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	50L	-
D-Air 3000	Liquid	6.3B Mildly irritating to the skin		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		6.4A Irritating to the eye	1000L	-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
Econolite Liquid	Liquid	6.1D (oral) Acutely toxic		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	5.0L	-
		8.2C Corrosive to dermal tissue		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		8.3A Corrosive to ocular tissue	1000L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	1000L
				-	-	-	-	-	2.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	0.1kg	1.0L	10000L
																					0.1L	1.0L	10000L
																					1.0L	5.0L	-

BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management																Sched 4
		Sub-section		Location & Transit	manufacture and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documen-tation	Signage	Signage	Separation	Separation	Separation	Incom-patibility	Disposal		Bunding
		Reference		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.2	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5		
		Schedule Table reference from Regulations		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4
		Description of what the numbers relate to in table below		Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirements	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Separation Distance	Separation required from	Incompatible substances	Information Requirements	Documen-tation Requirements	Threshold
Fly Ash	Solid	6.1E Acutely toxic (oral)		-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.7A Substances that are carcinogenic	1000kg	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		6.9A (inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		9.1D (fish, crustacea, algae) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	10000kg
Gascon 469	Liquid	6.1E (oral) Acutely toxic		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg
		6.3A Irritating to the skin		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.4A Irritating to the eye	1000L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.7A Substances that are carcinogenic		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.9A (inhalation) Toxic to human target organs or systems		-	-	10L	-	-	-	0.1L	1000L	-	-	0.1L	-	-	-	-	-	-	0.1L	50L	-
Goldseal Bentonite	Liquid	6.7A Substances that are carcinogenic		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	10000L
		6.9B Toxic to human target organs or systems	1000L	-	-	10L	-	-	-	0.1L	1000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	10000L
HAI 404	Liquid	3.1D Flammable Liquids: high hazard		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	Any	0.1L	1000L
				50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	0.1L	1.0L	-
		6.1D (oral) Acutely toxic		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	250L	250L	-	-	-	-	1.0L	1.0L	1000L
		6.3B Mildly Irritating to the skin	1000L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.4A Irritating to the eye		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.8B Suspected human reproductive or developmental toxicants		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.9A (inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	-	1.0L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	10000L
Halad 344	Solid	6.1C (oral) Acutely toxic		-	-	-	-	accuseu	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
		6.1D (dermal & inhalation) Acutely toxic		-	-	Any	-		ANY	0.5kg	100kg	-	-	0.5kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	100kg
		6.3A Irritating to the skin		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	1000kg
		6.4A Irritating to the eye		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.5B (contact) Contact sensitisers		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.6A Known or presumed human mutagens	1000kg	-	-	-	-	-	1.0kg	3.0kg	1000kg	-	-	30.kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.7A Known or presumed human carcinogens		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	3.0kg	1000kg
		6.8B Suspected human reproductive or developmental toxicants		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		6.9A Toxic to human target organs or systems		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		9.3B Ecotoxic to terrestrial vertebrates		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	-	3.0kg	-
Halad 688	Solid	6.1D (oral) Acutely toxic		-	-	-	-	-	0.2kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	10000kg
		6.7A Known or presumed human carcinogens		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.2kg	5.0kg	-
		6.9A (inhalation) Toxic to human target organs or systems		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	0.1kg	3.0kg	1000kg
		8.1A Corrosive to metals		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		8.2C Corrosive to dermal tissue	1000kg	-	-	-	-	-	Any	1.0kg	-	-	-	2.0kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	10000kg
		8.3A Corrosive to ocular tissue		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	-
		9.1C Harmful in the aquatic environment		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	10000kg
		9.3B Ecotoxic to terrestrial vertebrates		-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	0.1kg	2.0kg	10000kg
HIS00M	Liquid	6.1E (oral) Acutely toxic		-	-	-	-	-	0.2kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	1.0kg	5.0kg	1000kg
		6.4A Irritating to the eye		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	0.2kg	5.0kg	-
		6.9A (oral) Toxic to human target organs or systems	1000L	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	0.1kg	50kg	-
Microsilica 600	Solid	6.7A Carcinogenic		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	Any	0.5kg	10000kg
		6.9A Target Organ Toxicant	1000kg	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	1.0L	5.0L	-
SSA-1 Silica Flour	Powder	6.7A Carcinogenic		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		6.9A Target Organ Toxicant	1000kg	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
Super CLB	Solid	4.3B Flammable Solids - Dangerous when wet		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
				25kg	-	100kg	-	-	0.5kg	0.5L	1000L	250kg	2	0.5kg	250kg	250kg	0-1000 1000-10000kg 10000-100000 kg 100000-500000kg 500000kg+	1m 1m 1m 1m NOT ASSART	Low Intensity Land Use	Class 1 Class 2 Class 3 Class 4.1, 4.2, 4.3 5.1 5.2 Class 5 Class 8 Water	0.5kg	0.5kg	1000kg
		6.9B Toxic to human target organs or systems	1000kg																				
		9.1D (fish, crustacea, algae) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	-	-	-
Tuned Spacer II	Powder	6.7A Carcinogenic		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	-
		6.9A Target Organ Toxicant	1000L	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	1.0kg	50kg	10000kg
Versaset	Solid	6.3A Irritating to the skin		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		6.4A Irritating to the eye	1000kg	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	Any	0.5kg	10000kg
Well life 684	Solid	4.2C Flammable Solids - spontaneously combustible (self heating)		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
				25kg	-	-	-	-	1.0kg	3.0kg	10000kg	500kg	2	3.0kg	1000kg	1000kg	0-1000 1000-10000kg 10000-100000 kg 100000-500000kg 500000kg+	1m 1m 1m 1m NOT ASSART	Low Intensity Land Use	Class 1 Class 2 Class 3 Class 4.1, 4.2, 4.3 5.1 5.2 Class 5 Class 8 Oxygen	0.1kg	50kg	-
			1000kg																1.0kg	-	10000kg
Zoneseafant 2000	Liquid	3.1B Flammable Liquids: high hazard		50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 3 Class 3.2 Class 4 Class 5	1.0L	1.0L	1000L
		6.1E Acutely toxic	1000L	-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.3B Mildly Irritating to the skin		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-

BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management																Sched 4
		Sub-section		Location & Transit	manufacture and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documen-tation	Signage	Signage	Separation	Separation	Separation	Incom-patibility	Disposal			Bundling
		Reference		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.2	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5				
		Schedule Table reference from Regulations		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table E	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4	
		Description of what the numbers relate to in table below		Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirement	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Separation Distance	Separation required from	Incompatible substances	Information Requirements	Documen-tation Requirements	Threshold	
GENERAL CHEMICALS																									
Methanol	Liquid	3.1B Flammable Liquids: high hazard		50L	-	-	1.0L	-	1.0L	1.0L	2000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	1.0L	1.0L	1000L	
		6.1D (oral) Acutely toxic	1500L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L	
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-	
		6.8B Suspected human reproductive or developmental toxicants		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	-	1.0L	-	
		6.9A (inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	10000L	
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	1.0L	5.0L	-	
LPG	Gas	2.1.1A Flammable Gases : high hazard	100m3	100m3	-	100m3	30m3	-	0.2m3	0.2m3	200m3	30m3	1	0.2m3	100m3	100m3	-	-	-		0.2m3	0.2m3	-	
Diesel	Liquid	3.1D Flammable liquids: low hazard.	20000L	-	-	-	-	-	5.0L	50L	10000L	500L	2	50L	10000L	20000L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	5.0L	50L	10000L	
		6.1E Acutely toxic		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-	
		6.3B Mildly irritating to the skin.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-	
		6.7B Carcinogenic		-	-	-	-	-	-	1.0L	10000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	10000L	
		9.1B Harmful to acquatic ecosystems		-	-	-	-	-	0.2L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	0.2L	5.0L	1000L	
Produced Hydrocarbons	Liquid	3.1B Flammable Liquids: high hazard	15000L	50L	-	-	1.0L	-	1.0L	1.0L	2000L	250L	2	1.0L	250L	250L	-	-	-	Class 1	1.0L	1.0L	1000L	
		6.1E Acutely toxic		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-	
		6.6A Mutagenic properties		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	1.0L	50L	-	
		6.7A Substances that are carcinogenic		-	-	-	-	-	-	0.1L	1000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	10000L	
		6.9B Toxic to human target organs or systems		-	-	10L	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	Any	0.1L	1000L	
		9.1C Harmful to acquatic ecosystems		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	-	
Monoethylene Glycol	Liquid	6.1D Toxic	1500L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	1000L	
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	1.0L	1000L	
		6.9A Target Organ		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	0.1L	50L	-	
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	Any	0.1L	10000L	
																					1.0L	5.0L	-	

APPENDIX B SITE MAPS


ID | Mud Type | Date Farmed | Well Name | Northing | Easting | Area (Ha)
F1 | SW5A - WBM, SW6A - WBM, Cheal PS - CW, Puku 2 - WBM, MHW C - SBM, KA 1/7 - CW, MHW D - CS | April, 2013 | SW5A, SW6A, Cheal PS, Puku 2, MHW C, KA 1/7, MHW D | 5602652 | 1720817 | 1.39
F2 | WBM | July, 2013 | KA 19/20, Ngaru 1 | 5602702 | 1720788 | 0.405
Turning Circle
PAPER ROAD
Stream
3x stock pile pits ~600m³ each
Wetland
F1
F2
E: 1720843 N: 5602760
E: 1720859 N: 5602740
E: 1720913 N: 5602691
E: 1720762 N: 5602794
E: 1720681 N: 5602748
E: 1720771 N: 5602597
E: 1720732 N: 5602582
E: 1720710 N: 5602660
E: 1720739 N: 5602649
E: 1720761 N: 5602642
E: 1720783 N: 5602614
E: 1720771 N: 5602551
Legend
Coordinate Points
Transect Line
Mixed
Water-based Mud
Stream Buffer
Existing Fenceline
Proposed Access
Pipelines
Property Boundary
SiteBoundaries
btw company
surveyors planners engineers land & gis services
Cnr. Courtenay & Elliots Sts.
P.O Box 551, NEW PLYMOUTH 4340
Ph : (06) 759 5040
Ph : 0800 289787
Fax : (06) 759 5049
E-mail : survey@btwcompany.co.nz
Web : www.btwcompany.co.nz
GENERAL NOTES:
1. Coordinates are in terms of NZGD 2000 Transverse Mercator
DISCLAIMER:
Boundary information has been imported from external sources. Areas and dimensions may be subject to scale error. Use of this drawing for other purposes is at the user's risk. Print from PDF: scale not accurate. Pipelines are indicative only. Aerial photography taken 2007.
8 03/04/13 JH DB Added transect line
7 02/04/13 TS DB Added area F1
6 13/03/13 TS DB Added farm area
5 06/03/13 JH DB Added disposal area E
4 23/11/11 TM DR Amend disposal site area, add turning circle
3 16/06/11 BO DR Amend disposal site area.
10 01/07/13 JH DB Amend disposal sites
9 19/06/13 TS KH Remaining land farm area text note added.
No. DATE BY CH DESCRIPTION
REVISIONS
DRAWN THOMPSON 07/02/11
CHECKED RILEY 21/06/13
PROJECT No. 10321
LOCATION SOUTH TARANAKI
ORIGINAL SIZE A3
SCALE 1:5,000
0 25 50 100 150 200 Meters
PROPOSED VANNER DISPOSAL SITE
DRAWING No. 10321-101-GIS
REVISION 10

APPENDIX C BACKGROUND MANGAROA STREAM

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1119718	SPv1
Contact:	Dave Bolger	**Date Registered:**	06-Apr-2013	
	C/- BTW Company Ltd	**Date Reported:**	15-Apr-2013	
	PO Box 551	**Quote No:**	45045	
	NEW PLYMOUTH 4340	**Order No:**		
		Client Reference:	Tank Water	
		Submitted By:	Dave Bolger	

Sample Type: Aqueous

Sample Name:		BST - Upper - Vanner 04-Apr-2013 4:00 pm	BST - Lwr - Vanner 04-Apr-2013 4:00 pm			
Lab Number:		1119718.1	1119718.2			
Individual Tests						
pH	pH Units	7.6	7.8	-	-	-
Electrical Conductivity (EC)	mS/m	43.4	43.3	-	-	-
Total Dissolved Solids (TDS)	g/m³	270	270	-	-	-
Specific Gravity*	20°C/20°C	1.00	1.00	-	-	-
Total Potassium	g/m³	3.5	3.4	-	-	-
Total Sodium	g/m³	42	42	-	-	-
Chloride	g/m³	68	69	-	-	-
Total Nitrogen	g/m³	1.47	1.39	-	-	-
Nitrate-N + Nitrite-N	g/m³	1.03	0.96	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	0.44	0.43	-	-	-
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	< 0.0011	< 0.0011	-	-	-
Total Cadmium	g/m³	< 0.000053	< 0.000053	-	-	-
Total Chromium	g/m³	0.00060	0.00054	-	-	-
Total Copper	g/m³	0.00107	0.00143	-	-	-
Total Lead	g/m³	0.00016	0.00019	-	-	-
Total Nickel	g/m³	< 0.00053	< 0.00053	-	-	-
Total Zinc	g/m³	0.0033	0.0035	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	0.0011	< 0.0010	-	-	-
Toluene	g/m³	0.0100	< 0.0010	-	-	-
Ethylbenzene	g/m³	0.0012	< 0.0010	-	-	-
m&p-Xylene	g/m³	0.005	< 0.002	-	-	-
o-Xylene	g/m³	0.0020	< 0.0010	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	< 0.10	-	-	-
C10 - C14	g/m³	< 0.2	< 0.2	-	-	-
C15 - C36	g/m³	< 0.4	< 0.4	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	< 0.7	-	-	-

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	Samples

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level	-	1-2
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1-2
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Total Digestion	Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005.	-	1-2
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-2
pH	pH meter. APHA 4500-H^+ B 21st ed. 2005.	0.1 pH Units	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005.	0.1 mS/m	1-2
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 21st ed. 2005.	10 g/m^3	1-2
Specific Gravity*	Calculation: weight of sample / weight of equivalent volume of water at 20°C. Gravimetric determination.	0.01 20°C/20°C	1-2
Total Potassium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005.	0.053 g/m^3	1-2
Total Sodium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005.	0.021 g/m^3	1-2
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 21st ed. 2005.	0.5 g/m^3	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m^3	1-2
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (Modified) 21st ed. 2005.	0.002 g/m^3	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 21st ed. 2005.	0.10 g/m^3	1-2

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.

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

APPENDIX D PHOTOGRAPHIC RECORD OF LANDFARMING

Early July 2013 F1

Late July 2013 F1

Appendix III

Vanner Landfarm predisposal results

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1127946	SPv1
Contact:	K Hooper	**Date Registered:**	26-Apr-2013	
	C/- BTW Company Ltd	**Date Reported:**	07-May-2013	
	PO Box 551	**Quote No:**	32966	
	NEW PLYMOUTH 4340	**Order No:**		
		Client Reference:	Predisposal Sample	
		Submitted By:	Justen Smith	

Sample Type: Soil

		Sample Name:	Tag-Ngl-Vanner 23-Apr-2013				
		Lab Number:	1127946.1				
Individual Tests							
Dry Matter	g/100g as rcvd		50	-	-	-	-
Density*	g/mL at 20°C		1.50	-	-	-	-
Total Recoverable Barium	mg/kg dry wt		21	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt		25,000	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt		1,040	-	-	-	-
Chloride*	mg/kg dry wt		22,000	-	-	-	-
pH*	pH Units		8.5	-	-	-	-
Total Nitrogen*	g/100g dry wt		< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		3	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt		21	-	-	-	-
Total Recoverable Copper	mg/kg dry wt		9	-	-	-	-
Total Recoverable Lead	mg/kg dry wt		10.1	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt		17	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt		53	-	-	-	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		< 0.10	-	-	-	-
Toluene	mg/kg dry wt		< 0.10	-	-	-	-
Ethylbenzene	mg/kg dry wt		< 0.10	-	-	-	-
m&p-Xylene	mg/kg dry wt		< 0.2	-	-	-	-
o-Xylene	mg/kg dry wt		< 0.10	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		< 0.05	-	-	-	-
Acenaphthylene	mg/kg dry wt		< 0.05	-	-	-	-
Anthracene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.05	-	-	-	-
Chrysene	mg/kg dry wt		< 0.05	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.05	-	-	-	-
Fluoranthene	mg/kg dry wt		< 0.05	-	-	-	-
Fluorene	mg/kg dry wt		< 0.05	-	-	-	-

Sample Type: Soil						
Sample Name:		Tag-Ngl-Vanner 23-Apr-2013				
Lab Number:		1127946.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.05	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.3	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.05	-	-	-	-
Pyrene	mg/kg dry wt	< 0.05	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 15	-	-	-	-
C10 - C14	mg/kg dry wt	< 30	-	-	-	-
C15 - C36	mg/kg dry wt	< 60	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 110	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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: Soil

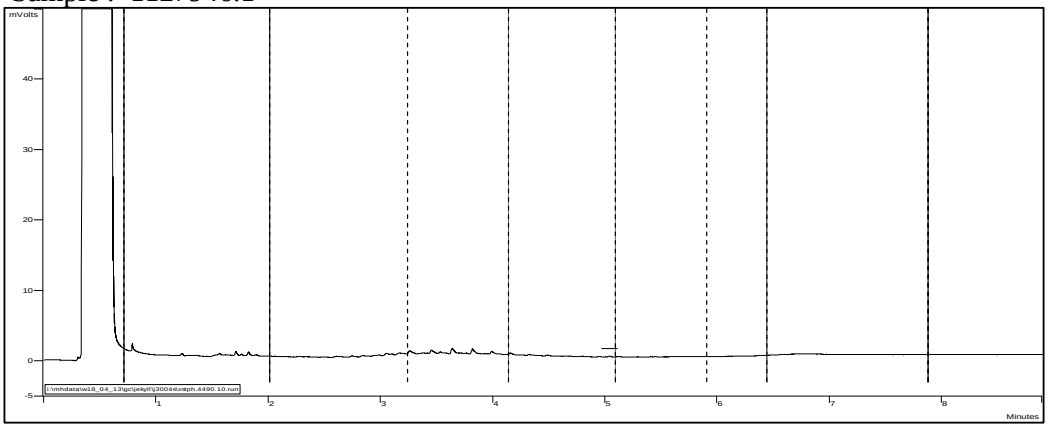
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Sample : 1127946.1



C7 C10 C15 C20 C25 C30 C34 C44

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Private Bag 3205
Hamilton 3240, New Zealand

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Fax +64 7 858 2001
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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1118225	SPv1
Contact:	K Hooper	**Date Registered:**	03-Apr-2013	
	C/- BTW Company Ltd	**Date Reported:**	12-Apr-2013	
	PO Box 551	**Quote No:**	32966	
	NEW PLYMOUTH 4340	**Order No:**		
		Client Reference:	Predisposal Sample	
		Submitted By:	Dave Bolger	

Sample Type: Soil

Sample Name:		WBM-KA20A-OEO 02-Apr-2013 2:00 pm				
Lab Number:		1118225.1				
Individual Tests						
Dry Matter	g/100g as rcvd	20	-	-	-	-
Density*	g/mL at 20°C	1.15	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	3,000	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt	155,000	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	9,600	-	-	-	-
Chloride*	mg/kg dry wt	139,000	-	-	-	-
pH*	pH Units	9.0	-	-	-	-
Total Nitrogen*	g/100g dry wt	0.06	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	4	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	22	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	20	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	11.3	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	20	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	73	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.5	-	-	-	-
Toluene	mg/kg dry wt	< 0.5	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.5	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 1.0	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.5	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 1.3	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 1.3	-	-	-	-
Anthracene	mg/kg dry wt	< 1.3	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 1.3	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 1.3	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 1.3	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 1.3	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 1.3	-	-	-	-
Chrysene	mg/kg dry wt	< 1.3	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 1.3	-	-	-	-
Fluoranthene	mg/kg dry wt	< 1.3	-	-	-	-
Fluorene	mg/kg dry wt	< 1.3	-	-	-	-

Sample Type: Soil						
Sample Name:		WBM-KA20A-OE O 02-Apr-2013 2:00 pm				
Lab Number:		1118225.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 1.3	-	-	-	-
Naphthalene	mg/kg dry wt	< 7	-	-	-	-
Phenanthrene	mg/kg dry wt	< 1.3	-	-	-	-
Pyrene	mg/kg dry wt	< 1.3	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 80	-	-	-	-
C10 - C14	mg/kg dry wt	< 150	-	-	-	-
C15 - C36	mg/kg dry wt	1,060	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	1,060	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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: Soil

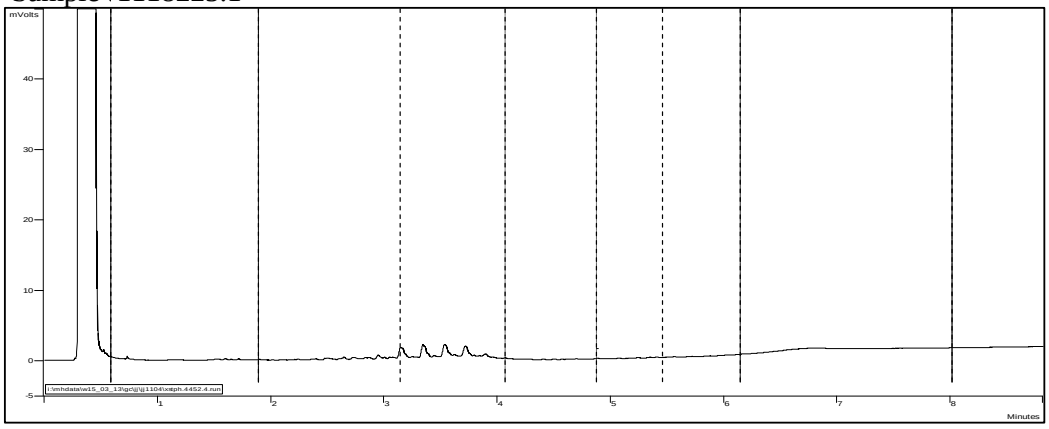
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Sample : 1118225.1



C7 C10 C15 C20 C25 C30 C34 C44

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1150702 SPv1
Contact:	K Hooper	**Date Registered:**	29-Jun-2013
	C/- BTW Company Ltd	**Date Reported:**	11-Jul-2013
	PO Box 551	**Quote No:**	32966
	NEW PLYMOUTH 4340	**Order No:**	
		Client Reference:	Predisposal-Drilling Muds/Cu
		Submitted By:	Justen Smith

Sample Type: Soil

		Sample Name:	MWHC-15-WBM 28-Jun-2013				
		Lab Number:	1150702.1				
Individual Tests							
Dry Matter	g/100g as rcvd		52	-	-	-	-
Density*	g/mL at 20°C		1.50	-	-	-	-
Total Recoverable Barium	mg/kg dry wt		430	-	-	-	-
Total Recoverable Boron	mg/kg dry wt		< 20	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt		45,000	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt		3,200	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt		< 100	-	-	-	-
Chloride*	mg/kg dry wt		47,000	-	-	-	-
pH*	pH Units		8.4	-	-	-	-
Total Nitrogen*	g/100g dry wt		< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		4	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		0.11	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt		27	-	-	-	-
Total Recoverable Copper	mg/kg dry wt		21	-	-	-	-
Total Recoverable Lead	mg/kg dry wt		21	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt		27	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt		78	-	-	-	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		< 0.10	-	-	-	-
Toluene	mg/kg dry wt		< 0.10	-	-	-	-
Ethylbenzene	mg/kg dry wt		< 0.10	-	-	-	-
m&p-Xylene	mg/kg dry wt		< 0.19	-	-	-	-
o-Xylene	mg/kg dry wt		< 0.10	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		< 0.05	-	-	-	-
Acenaphthylene	mg/kg dry wt		< 0.05	-	-	-	-
Anthracene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.05	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.05	-	-	-	-
Chrysene	mg/kg dry wt		< 0.05	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.05	-	-	-	-

Sample Type: Soil						
Sample Name:		MWHC-15-WBM 28-Jun-2013				
Lab Number:		1150702.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Fluoranthene	mg/kg dry wt	< 0.05	-	-	-	-
Fluorene	mg/kg dry wt	< 0.05	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.05	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.3	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.05	-	-	-	-
Pyrene	mg/kg dry wt	< 0.05	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 13	-	-	-	-
C10 - C14	mg/kg dry wt	59	-	-	-	-
C15 - C36	mg/kg dry wt	176	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	240	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Total Recoverable Vanadium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1

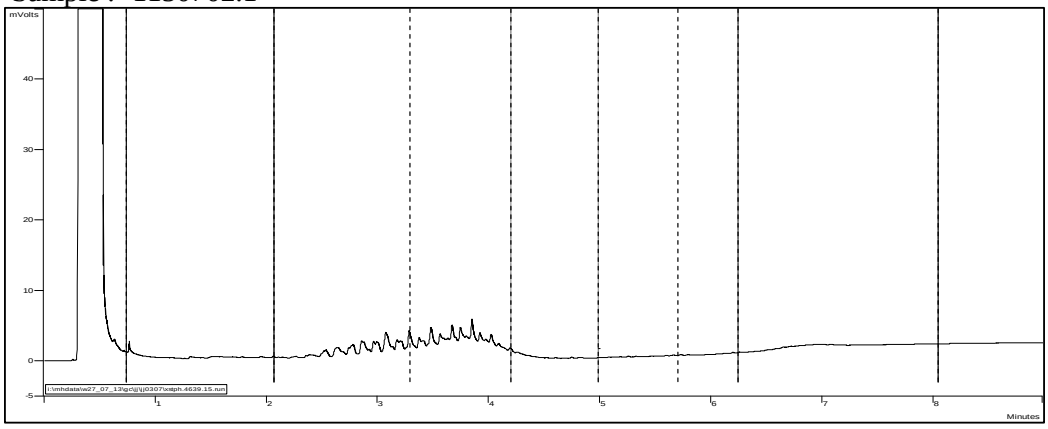
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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.

Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental Division

Sample : 1150702.1



Industrial Chemistry Services

Analytical Report

NAME: **Shell Todd Oil Services Ltd**

ADDRESS: Private Bag 2035, New Plymouth

Contact: Leanne Field

Sample Type: **Liquid Waste**

Date / Time Sampled: **16 - 17.05.13** Date Received 17.05.13

Site: **KA-19/20 Well site**

TEST	Chemicals area drip tank	Cellar	Rig floor dirty water tank	Mud tank/Pump drip tray	Units
Lab Number	M49134	M49135	M49136	M49137	
Total Antimony	<0.0042	0.023	<0.021	<0.021	g/m³
Total Arsenic	0.023	<0.021	<0.11	<0.11	g/m³
Total Boron	<0.11	<0.11	<0.53	<0.53	g/m³
Total Cadmium	<0.0011	<0.0011	<0.0053	<0.0053	g/m³
Total Chromium	<0.011	<0.011	0.176	0.146	g/m³
Total Cobalt	<0.0042	<0.0042	0.030	0.044	g/m³
Total Copper	0.060	0.22	0.38	0.51	g/m³
Total Lead	0.0054	0.0198	0.097	0.174	g/m³
Total Mercury	<0.0021	<0.0021	<0.011	<0.011	g/m³
Total Molybdenum	0.053	0.0139	0.046	0.062	g/m³
Total Nickel	<0.011	0.026	0.135	0.167	g/m³
Total Tin	<0.011	<0.011	<0.053	<0.053	g/m³
Total Zinc	0.69	0.30	1.78	8.7	g/m³
Chloride	63	270	2,100	3,300	g/m³
BTEX in Soil					
Benzene	< 0.0010	0.0059	< 0.0010	0.0041	g/m³
Toluene	< 0.0010	0.0138	0.0029	0.0036	g/m³
Ethylbenzene	0.0028	0.0016	< 0.0010	< 0.0010	g/m³
m&p-Xylene	0.021	0.009	< 0.002	< 0.002	g/m³
o-Xylene	0.0134	0.0039	< 0.0010	0.0019	g/m³
Total Hydrocarbons in Soil	127	640	27	79	g/m³
C7-C9	< 0.4	2.2	< 0.4	< 0.4	g/m³
C10-C14	< 1.0	184	9.6	14.5	g/m³
C15-C36	127	460	18	65	g/m³

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Phone (06) 765 5976 / Fax (06) 765 5935

TEST	Chemicals area drip tank	Cellar	Rig floor dirty water tank	Mud tank/Pump drip tray	Units
Lab Number	M49134	M49135	M49136	M49137	
Poly-aromatic Hydrocarbons Screen					
Acenaphthene	< 0.00010	< 0.00010	< 0.00010	< 0.00010	g/m^3
Acenaphthylene	< 0.00010	< 0.00010	< 0.00010	< 0.00010	g/m^3
Anthracene	< 0.00010	0.00026	0.00028	0.00048	g/m^3
Benzo[a]anthracene	< 0.00010	0.00045	0.00018	0.00122	g/m^3
Benzo[a]pyrene (BAP)	< 0.00010	0.00025	< 0.00010	0.00061	g/m^3
Benzo[b]fluoranthene + Benzo[j]fluoranthene	< 0.00010	0.00057	0.00019	0.00141	g/m^3
Benzo[g,h,i]perylene	< 0.00010	0.00023	< 0.00010	0.002	g/m^3
Benzo[k]fluoranthene	< 0.00010	0.00023	< 0.00010	0.00046	g/m^3
Chrysene	< 0.00010	0.00044	0.00018	0.00145	g/m^3
Dibenzo[a,h]anthracene	< 0.00010	< 0.00010	< 0.00010	0.00015	g/m^3
Fluoranthene	< 0.00010	0.00171	0.00103	0.0037	g/m^3
Fluorene	< 0.0002	0.0003	0.0003	0.0004	g/m^3
Indeno[1,2,3-c,d]pyrene	< 0.00010	0.00014	< 0.00010	0.0004	g/m^3
Naphthalene	< 0.0005	0.0034	< 0.0005	0.0017	g/m^3
Phenanthrene	< 0.0004	0.0023	0.0016	0.0099	g/m^3
Pyrene	0.0003	0.0013	0.0005	0.007	g/m^3
Sludge fraction*					
Total Recoverable Antimony				0.6	mg/kg dry wt
Total Recoverable Arsenic				4	mg/kg dry wt
Total Recoverable Boron				<20	mg/kg dry wt
Total Recoverable Cadmium				0.19	mg/kg dry wt
Total Recoverable Chromium				8	mg/kg dry wt
Total Recoverable Cobalt				2.6	mg/kg dry wt
Total Recoverable Copper				25	mg/kg dry wt
Total Recoverable Lead				12.9	mg/kg dry wt
Total Recoverable Mercury				<0.10	mg/kg dry wt
Total Recoverable Molybdenum				1.4	mg/kg dry wt
Total Recoverable Nickel				8	mg/kg dry wt
Total Recoverable Tin				<1.0	mg/kg dry wt
Total Recoverable Zinc				290	mg/kg dry wt

Comments:

- *Sample collected by Client and analysed as received at the laboratory.*
- **Please note, there was insufficient solid to perform TCLP extract on this sample.*
- *This report must not be reproduced, except in full, without the written consent of the signatory.*
- *All analyses presented in this report other than those indicated (*) have been carried out by Industrial Chemistry Services or by a sub contracted laboratory in accordance with the requirements of International Accreditation New Zealand.*

Checked by:

(Laboratory Manager)

< End of Report >

06/1

Industrial Chemistry Services Ltd - PO Box 345 - 27 Miranda Street - Stratford - New Zealand
Phone (06) 765 5976 / Fax (06) 765 5935

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R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1203799 SPv1
Contact:	Dave Bolger	**Date Registered:**	15-Nov-2013
	C/- BTW Company Ltd	**Date Reported:**	26-Nov-2013
	PO Box 551	**Quote No:**	53181
	NEW PLYMOUTH 4340	**Order No:**	13314
		Client Reference:	Pre-Disposal-Drilling Fluid,W.
		Submitted By:	Dave Bolger

Sample Type: Aqueous

		Sample Name:	Pit C - Fluid 14-Nov-2013				
		Lab Number:	1203799.1				
Individual Tests							
pH	pH Units		10.6	-	-	-	-
Total Barium	g/m³		620	-	-	-	-
Total Boron	g/m³		0.41	-	-	-	-
Total Calcium	g/m³		320	-	-	-	-
Total Magnesium	g/m³		118	-	-	-	-
Total Mercury	g/m³		< 0.0021	-	-	-	-
Total Potassium	g/m³		8,200	-	-	-	-
Total Sodium	g/m³		920	-	-	-	-
Total Vanadium	g/m³		0.63	-	-	-	-
Chloride	g/m³		6,400	-	-	-	-
Total Nitrogen	g/m³		187	-	-	-	-
Nitrate-N + Nitrite-N	g/m³		19.5	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³		168	-	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn							
Total Arsenic	g/m³		0.21	-	-	-	-
Total Cadmium	g/m³		0.0026	-	-	-	-
Total Chromium	g/m³		0.65	-	-	-	-
Total Copper	g/m³		0.80	-	-	-	-
Total Lead	g/m³		0.93	-	-	-	-
Total Nickel	g/m³		0.45	-	-	-	-
Total Zinc	g/m³		1.51	-	-	-	-
BTEX in Water by Headspace GC-MS							
Benzene	g/m³		0.0023	-	-	-	-
Toluene	g/m³		0.0030	-	-	-	-
Ethylbenzene	g/m³		< 0.0010	-	-	-	-
m&p-Xylene	g/m³		< 0.002	-	-	-	-
o-Xylene	g/m³		0.0012	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq							
Acenaphthene	g/m³		< 0.004	-	-	-	-
Acenaphthylene	g/m³		< 0.004	-	-	-	-
Anthracene	g/m³		< 0.004	-	-	-	-
Benzo[a]anthracene	g/m³		< 0.004	-	-	-	-
Benzo[a]pyrene (BAP)	g/m³		< 0.004	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³		< 0.004	-	-	-	-
Benzo[g,h,i]perylene	g/m³		< 0.004	-	-	-	-
Benzo[k]fluoranthene	g/m³		< 0.004	-	-	-	-

Sample Type: Aqueous						
Sample Name:		Pit C - Fluid 14-Nov-2013				
Lab Number:		1203799.1				
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Chrysene	g/m³	< 0.004	-	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.004	-	-	-	-
Fluoranthene	g/m³	< 0.004	-	-	-	-
Fluorene	g/m³	< 0.004	-	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.004	-	-	-	-
Naphthalene	g/m³	< 0.02	-	-	-	-
Phenanthrene	g/m³	< 0.004	-	-	-	-
Pyrene	g/m³	< 0.004	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.4	-	-	-	-
C10 - C14	g/m³	18.4	-	-	-	-
C15 - C36	g/m³	6	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	24	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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.

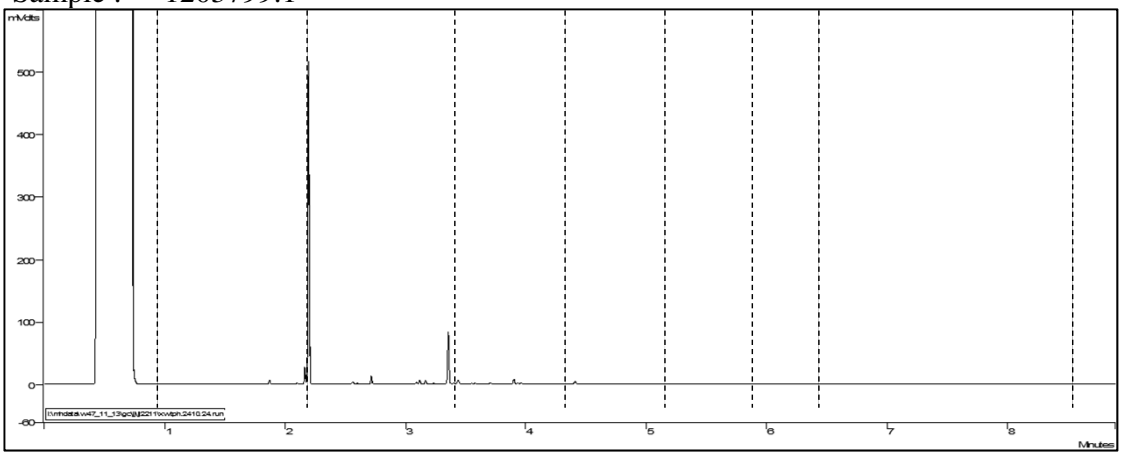
Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level	-	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	-	1
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Boiling nitric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012.	0.1 pH Units	1
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.0021 g/m³	1
Total Boron	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.11 g/m³	1
Total Calcium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	1.1 g/m³	1
Total Magnesium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.42 g/m³	1
Total Mercury	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.0021 g/m³	1
Total Potassium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	1.1 g/m³	1
Total Sodium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.42 g/m³	1
Total Vanadium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.021 g/m³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012.	0.002 g/m³	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1

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.

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

Sample : 1203799.1



C7 C10 C15 C20 C25 C30 C34 C44

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Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1103527	SPv1
Contact:	Justen Smith	**Date Registered:**	23-Feb-2013	
	C/- BTW Company Ltd	**Date Reported:**	07-Mar-2013	
	PO Box 551	**Quote No:**	53181	
	NEW PLYMOUTH 4340	**Order No:**	10321	
		Client Reference:		
		Submitted By:	Justen Smith	

Sample Type: Aqueous

Sample Name:		CW - K1/7 - Vanner 22-Feb-2013 12:30 pm				
Lab Number:		1103527.1				
Individual Tests						
Total Barium	g/m³	0.170	-	-	-	-
Total Boron	g/m³	< 0.11	-	-	-	-
Total Mercury	g/m³	< 0.0021	-	-	-	-
Total Vanadium	g/m³	< 0.021	-	-	-	-
Chloride	g/m³	350	-	-	-	-
Total Nitrogen	g/m³	10.7	-	-	-	-
Nitrate-N + Nitrite-N	g/m³	0.02	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	10.6	-	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	< 0.021	-	-	-	-
Total Cadmium	g/m³	< 0.0011	-	-	-	-
Total Chromium	g/m³	0.069	-	-	-	-
Total Copper	g/m³	0.27	-	-	-	-
Total Lead	g/m³	0.082	-	-	-	-
Total Nickel	g/m³	0.028	-	-	-	-
Total Zinc	g/m³	0.74	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	0.0031	-	-	-	-
Toluene	g/m³	0.0072	-	-	-	-
Ethylbenzene	g/m³	< 0.0010	-	-	-	-
m&p-Xylene	g/m³	0.016	-	-	-	-
o-Xylene	g/m³	0.0111	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene	g/m³	0.00045	-	-	-	-
Acenaphthylene	g/m³	< 0.00010	-	-	-	-
Anthracene	g/m³	0.00013	-	-	-	-
Benzo[a]anthracene	g/m³	< 0.00010	-	-	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.00010	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.00010	-	-	-	-
Benzo[g,h,i]perylene	g/m³	< 0.00010	-	-	-	-
Benzo[k]fluoranthene	g/m³	< 0.00010	-	-	-	-
Chrysene	g/m³	< 0.00010	-	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.00010	-	-	-	-
Fluoranthene	g/m³	0.00035	-	-	-	-
Fluorene	g/m³	0.0013	-	-	-	-

Sample Type: Aqueous						
Sample Name:		CW - K1/7 - Vanner 22-Feb-2013 12:30 pm				
Lab Number:		1103527.1				
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.00010	-	-	-	-
Naphthalene	g/m³	0.0011	-	-	-	-
Phenanthrene	g/m³	0.0021	-	-	-	-
Pyrene	g/m³	0.0004	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.4	-	-	-	-
C10 - C14	g/m³	< 1.0	-	-	-	-
C15 - C36	g/m³	< 2	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	< 4	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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.

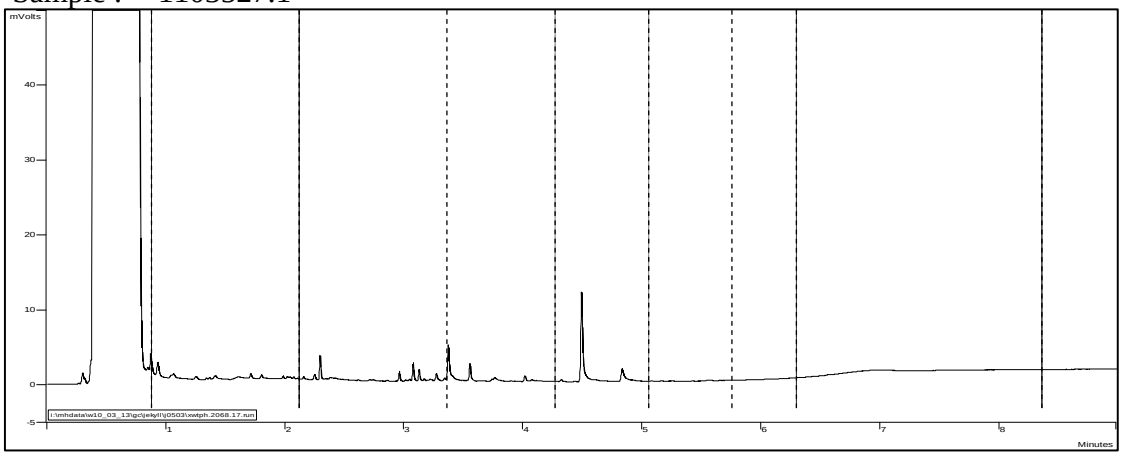
Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level	-	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005.	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.0021 g/m³	1
Total Boron	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.11 g/m³	1
Total Mercury	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.0021 g/m³	1
Total Vanadium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.021 g/m³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 21st ed. 2005.	0.5 g/m³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (Modified) 21st ed. 2005.	0.002 g/m³	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 21st ed. 2005.	0.10 g/m³	1

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.

Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental Division

Sample : 1103527.1



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Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1102199 SPv1
Contact:	Justen Smith	**Date Registered:**	20-Feb-2013
	C/- BTW Company Ltd	**Date Reported:**	05-Mar-2013
	PO Box 551	**Quote No:**	53181
	NEW PLYMOUTH 4340	**Order No:**	10321
		Client Reference:	Drilling Fluid/Wastewater
		Submitted By:	Dave Bolger

Sample Type: Aqueous

Sample Name:		CW-Cheal-PS-Vanner 18-Feb-2013 2:00 pm				
Lab Number:		1102199.1				
Individual Tests						
Total Barium	g/m³	6.2	-	-	-	-
Total Boron	g/m³	15.4	-	-	-	-
Total Mercury	g/m³	0.023	-	-	-	-
Total Vanadium	g/m³	< 0.11	-	-	-	-
Chloride	g/m³	13,700	-	-	-	-
Total Nitrogen	g/m³	19.4	-	-	-	-
Nitrate-N + Nitrite-N	g/m³	0.11	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	19.2	-	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	< 0.11	-	-	-	-
Total Cadmium	g/m³	< 0.0053	-	-	-	-
Total Chromium	g/m³	< 0.053	-	-	-	-
Total Copper	g/m³	0.060	-	-	-	-
Total Lead	g/m³	0.016	-	-	-	-
Total Nickel	g/m³	< 0.053	-	-	-	-
Total Zinc	g/m³	< 0.11	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	1.35	-	-	-	-
Toluene	g/m³	2.8	-	-	-	-
Ethylbenzene	g/m³	0.199	-	-	-	-
m&p-Xylene	g/m³	1.67	-	-	-	-
o-Xylene	g/m³	0.73	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene	g/m³	0.00111	-	-	-	-
Acenaphthylene	g/m³	< 0.00010	-	-	-	-
Anthracene	g/m³	0.00015	-	-	-	-
Benzo[a]anthracene	g/m³	< 0.00010	-	-	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.00010	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.00010	-	-	-	-
Benzo[g,h,i]perylene	g/m³	< 0.00010	-	-	-	-
Benzo[k]fluoranthene	g/m³	< 0.00010	-	-	-	-
Chrysene	g/m³	< 0.00010	-	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.00010	-	-	-	-
Fluoranthene	g/m³	< 0.00010	-	-	-	-
Fluorene	g/m³	0.0025	-	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.00010	-	-	-	-

Sample Type: Aqueous						
Sample Name:		CW-Cheal-PS-Vanner 18-Feb-2013 2:00 pm				
Lab Number:		1102199.1				
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Naphthalene	g/m³	0.34	-	-	-	-
Phenanthrene	g/m³	0.0029	-	-	-	-
Pyrene	g/m³	< 0.0002	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	3.1	-	-	-	-
C10 - C14	g/m³	1.6	-	-	-	-
C15 - C36	g/m³	< 2	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	5	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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.

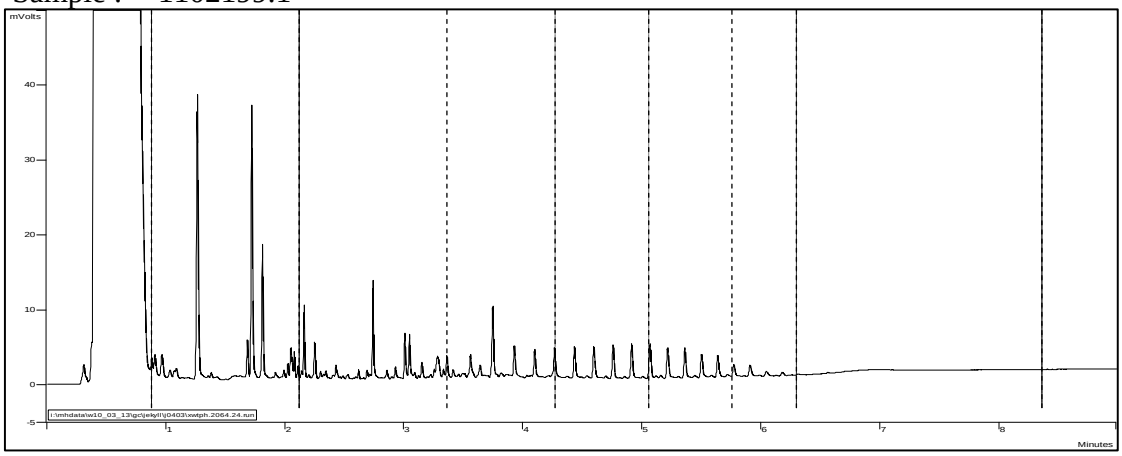
Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level	-	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005.	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.0021 g/m³	1
Total Boron	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.11 g/m³	1
Total Mercury	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.0021 g/m³	1
Total Vanadium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 21st ed. 2005.	0.021 g/m³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 21st ed. 2005.	0.5 g/m³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (Modified) 21st ed. 2005.	0.002 g/m³	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 21st ed. 2005.	0.10 g/m³	1

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.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

Sample : 1102199.1



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Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1101483	SPv1
Contact:	K Hooper	**Date Registered:**	19-Feb-2013	
	C/- BTW Company Ltd	**Date Reported:**	27-Feb-2013	
	PO Box 551	**Quote No:**	32966	
	NEW PLYMOUTH 4340	**Order No:**	10181	
		Client Reference:	Predisposal Sample	
		Submitted By:	Justen Smith	

Sample Type: Soil

		Sample Name:	CS-MHWD-FB-B R 15-Feb-2013 2:00 pm				
		Lab Number:	1101483.1				
Individual Tests							
Dry Matter	g/100g as rcvd		75	-	-	-	-
Density*	g/mL at 20°C		1.58	-	-	-	-
Total Recoverable Barium	mg/kg dry wt		170	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt		220	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt		870	-	-	-	-
Chloride*	mg/kg dry wt		< 30	-	-	-	-
pH*	pH Units		6.6	-	-	-	-
Total Nitrogen*	g/100g dry wt		0.12	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		2	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt		3	-	-	-	-
Total Recoverable Copper	mg/kg dry wt		48	-	-	-	-
Total Recoverable Lead	mg/kg dry wt		6.9	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt		< 2	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt		35	-	-	-	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		< 0.06	-	-	-	-
Toluene	mg/kg dry wt		< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt		< 0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt		< 0.12	-	-	-	-
o-Xylene	mg/kg dry wt		< 0.06	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		< 0.04	-	-	-	-
Acenaphthylene	mg/kg dry wt		< 0.04	-	-	-	-
Anthracene	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.04	-	-	-	-
Chrysene	mg/kg dry wt		< 0.04	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.04	-	-	-	-
Fluoranthene	mg/kg dry wt		< 0.04	-	-	-	-
Fluorene	mg/kg dry wt		< 0.04	-	-	-	-

Sample Type: Soil						
Sample Name:		CS-MHWD-FB-B R 15-Feb-2013 2:00 pm				
Lab Number:		1101483.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.17	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.04	-	-	-	-
Pyrene	mg/kg dry wt	< 0.04	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 10	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-	-

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: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

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1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1204427	SPv1
Contact:	Dave Bolger	**Date Registered:**	19-Nov-2013	
	C/- BTW Company Ltd	**Date Reported:**	29-Nov-2013	
	PO Box 551	**Quote No:**	32966	
	NEW PLYMOUTH 4340	**Order No:**	13314	
		Client Reference:		
		Submitted By:	Dave Bolger	

Sample Type: Soil

		Sample Name:	Cheal-E4-WBM 18-Nov-2013				
		Lab Number:	1204427.1				
Individual Tests							
Dry Matter	g/100g as rcvd		74	-	-	-	-
Density*	g/mL at 20°C		1.77	-	-	-	-
Total Recoverable Barium	mg/kg dry wt		820	-	-	-	-
Total Recoverable Boron	mg/kg dry wt		< 20	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt		10,900	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt		1,190	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt		< 100	-	-	-	-
Chloride*	mg/kg dry wt		8,100	-	-	-	-
pH*	pH Units		8.9	-	-	-	-
Total Nitrogen*	g/100g dry wt		< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		5	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt		42	-	-	-	-
Total Recoverable Copper	mg/kg dry wt		16	-	-	-	-
Total Recoverable Lead	mg/kg dry wt		11.7	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt		24	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt		47	-	-	-	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		1.48	-	-	-	-
Toluene	mg/kg dry wt		7.1	-	-	-	-
Ethylbenzene	mg/kg dry wt		1.03	-	-	-	-
m&p-Xylene	mg/kg dry wt		8.0	-	-	-	-
o-Xylene	mg/kg dry wt		2.4	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt		< 0.03	-	-	-	-
Anthracene	mg/kg dry wt		0.05	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03	-	-	-	-
Chrysene	mg/kg dry wt		< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03	-	-	-	-

Sample Type: Soil							
Sample Name:		Cheal-E4-WBM 18-Nov-2013					
Lab Number:		1204427.1					
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Fluoranthene	mg/kg dry wt	0.03	-	-	-	-	
Fluorene	mg/kg dry wt	0.21	-	-	-	-	
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-	
Naphthalene	mg/kg dry wt	2.2	-	-	-	-	
Phenanthrene	mg/kg dry wt	0.34	-	-	-	-	
Pyrene	mg/kg dry wt	< 0.03	-	-	-	-	
Total Petroleum Hydrocarbons in Soil							
C7 - C9	mg/kg dry wt	102	-	-	-	-	
C10 - C14	mg/kg dry wt	166	-	-	-	-	
C15 - C36	mg/kg dry wt	480	-	-	-	-	
Total hydrocarbons (C7 - C36)	mg/kg dry wt	750	-	-	-	-	

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Total Recoverable Vanadium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1

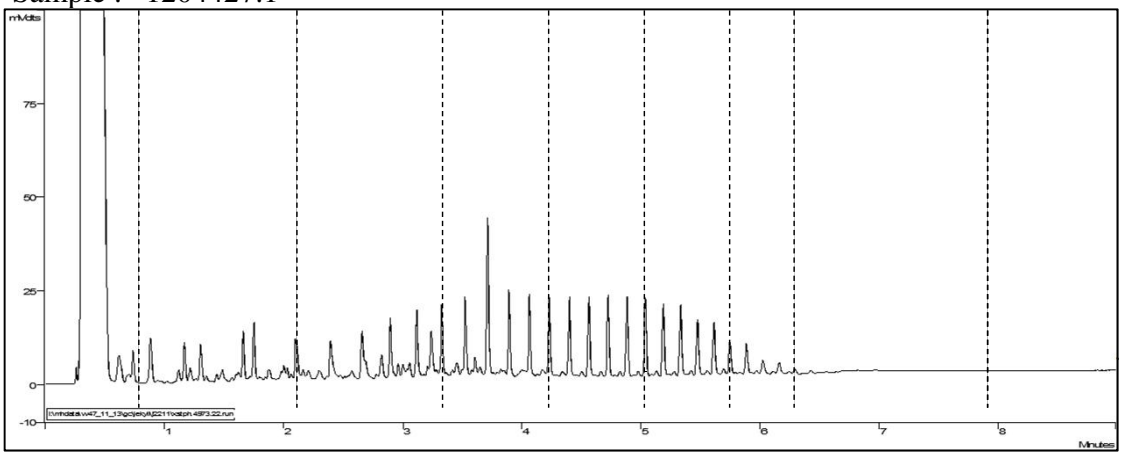
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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.

Martin Cowell - BSc
Client Services Manager - Environmental Division

Sample : 1204427.1



C7 C10 C15 C20 C25 C30 C34 C44

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1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1179523 SPv1
Contact:	Dave Bolger	**Date Registered:**	13-Sep-2013
	C/- BTW Company Ltd	**Date Reported:**	23-Sep-2013
	PO Box 551	**Quote No:**	32966
	NEW PLYMOUTH 4340	**Order No:**	13314
		Client Reference:	Predisposal-Drilling Muds/Cu
		Submitted By:	Dave Bolger

Sample Type: Soil

		Sample Name:	Cheal C - WBM 11-Sep-2013 2:00 pm				
		Lab Number:	1179523.1				
Individual Tests							
Dry Matter	g/100g as rcvd		77	-	-	-	-
Density*	g/mL at 20°C		1.92	-	-	-	-
Total Recoverable Barium	mg/kg dry wt		260	-	-	-	-
Total Recoverable Boron	mg/kg dry wt		< 20	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt		9,300	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt		790	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt		< 100	-	-	-	-
Chloride*	mg/kg dry wt		7,600	-	-	-	-
pH*	pH Units		8.8	-	-	-	-
Total Nitrogen*	g/100g dry wt		< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		3	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt		17	-	-	-	-
Total Recoverable Copper	mg/kg dry wt		11	-	-	-	-
Total Recoverable Lead	mg/kg dry wt		7.0	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt		14	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt		44	-	-	-	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		< 0.06	-	-	-	-
Toluene	mg/kg dry wt		< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt		< 0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt		< 0.11	-	-	-	-
o-Xylene	mg/kg dry wt		< 0.06	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt		< 0.03	-	-	-	-
Anthracene	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03	-	-	-	-
Chrysene	mg/kg dry wt		< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03	-	-	-	-

Sample Type: Soil							
Sample Name:		Cheal C - WBM 11-Sep-2013 2:00 pm					
Lab Number:		1179523.1					
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-	
Fluorene	mg/kg dry wt	< 0.03	-	-	-	-	
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-	
Naphthalene	mg/kg dry wt	< 0.14	-	-	-	-	
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-	-	
Pyrene	mg/kg dry wt	< 0.03	-	-	-	-	
Total Petroleum Hydrocarbons in Soil							
C7 - C9	mg/kg dry wt	< 9	-	-	-	-	
C10 - C14	mg/kg dry wt	31	-	-	-	-	
C15 - C36	mg/kg dry wt	83	-	-	-	-	
Total hydrocarbons (C7 - C36)	mg/kg dry wt	115	-	-	-	-	

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Total Recoverable Vanadium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1

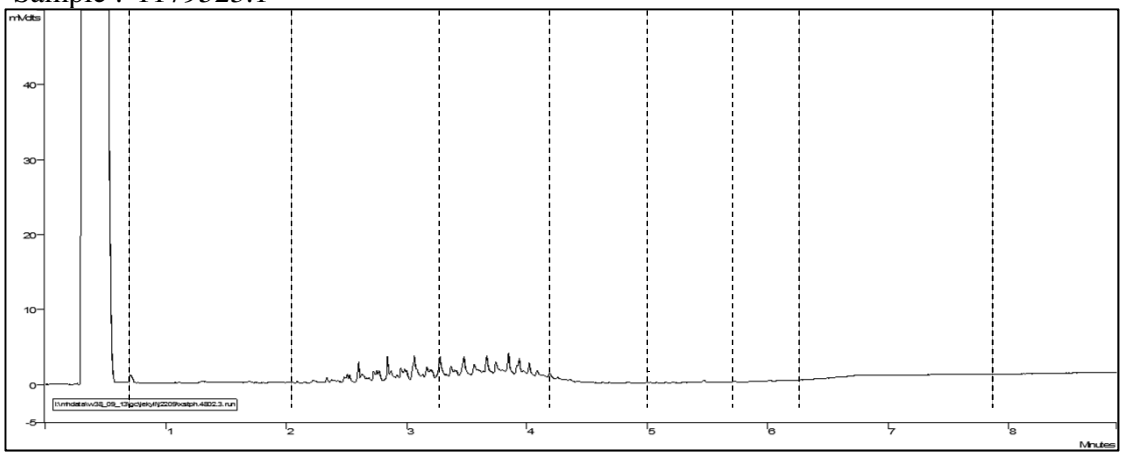
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Sample : 1179523.1



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1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1084664	SPv1
Contact:	K Hooper	**Date Registered:**	22-Dec-2012	
	C/- BTW Company Ltd	**Date Reported:**	10-Jan-2013	
	PO Box 551	**Quote No:**	32966	
	NEW PLYMOUTH 4340	**Order No:**		
		Client Reference:	Predisposal Sample	
		Submitted By:	Michael Collins	

Sample Type: Soil

Sample Name:		Puku2 - NBM 18-Dec-2012 2:00 pm				
Lab Number:		1084664.1				
Individual Tests						
Dry Matter	g/100g as rcvd	79	-	-	-	-
Density*	g/mL at 20°C	1.73	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	88	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt	3,100	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	1,330	-	-	-	-
Chloride*	mg/kg dry wt	2,100	-	-	-	-
pH*	pH Units	10.3	-	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	< 2	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	8	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	40	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	3.2	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	3	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	31	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.06	-	-	-	-
Toluene	mg/kg dry wt	< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.11	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.06	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-	-	-

Sample Type: Soil						
Sample Name:		Puku2 - NBM 18-Dec-2012 2:00 pm				
Lab Number:		1084664.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.15	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	370	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	370	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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: Soil

Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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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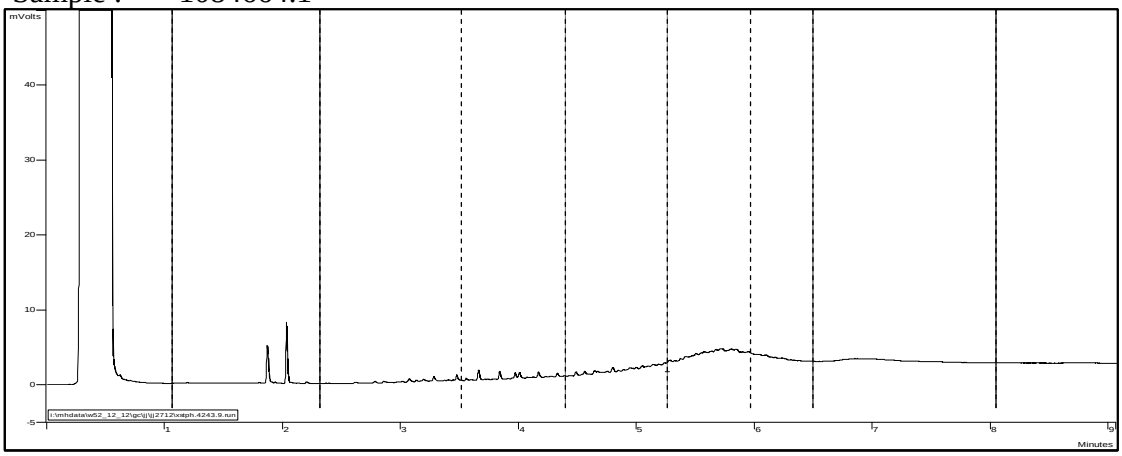
Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental Division

Sample : 1084664.1



C7 C10 C15 C20 C25 C30 C34 C44

Hill Laboratories
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1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1080533 SPv1
Contact:	K Hooper	**Date Registered:**	12-Dec-2012
	C/- BTW Company Ltd	**Date Reported:**	19-Dec-2012
	PO Box 551	**Quote No:**	
	NEW PLYMOUTH 4340	**Order No:**	09389
		Client Reference:	09389 Mangahewa C SBM
		Submitted By:	Michael Collins

Sample Type: Soil

		Sample Name:	Mangahewa C SBM 10-Dec-2012 1:30 pm				
		Lab Number:	1080533.1				
Individual Tests							
Dry Matter	g/100g as rcvd		77	-	-	-	-
Density*	g/mL at 20°C		2.06	-	-	-	-
Total Recoverable Barium	mg/kg dry wt		260	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt		350	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt		590	-	-	-	-
Chloride*	mg/kg dry wt		31	-	-	-	-
pH*	pH Units		6.9	-	-	-	-
Total Nitrogen*	g/100g dry wt		< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		< 2	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt		21	-	-	-	-
Total Recoverable Copper	mg/kg dry wt		41	-	-	-	-
Total Recoverable Lead	mg/kg dry wt		3.4	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt		11	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt		50	-	-	-	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		< 0.06	-	-	-	-
Toluene	mg/kg dry wt		< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt		< 0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt		< 0.11	-	-	-	-
o-Xylene	mg/kg dry wt		< 0.06	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		0.05	-	-	-	-
Acenaphthylene	mg/kg dry wt		< 0.04	-	-	-	-
Anthracene	mg/kg dry wt		0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.04	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.04	-	-	-	-
Chrysene	mg/kg dry wt		< 0.04	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.04	-	-	-	-
Fluoranthene	mg/kg dry wt		0.07	-	-	-	-

Sample Type: Soil							
Sample Name:		Mangahewa C SBM 10-Dec-2012 1:30 pm					
Lab Number:		1080533.1					
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Fluorene	mg/kg dry wt	0.06	-	-	-	-	
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	-	-	-	-	
Naphthalene	mg/kg dry wt	< 0.16	-	-	-	-	
Phenanthrene	mg/kg dry wt	0.15	-	-	-	-	
Pyrene	mg/kg dry wt	0.06	-	-	-	-	
Total Petroleum Hydrocarbons in Soil							
C7 - C9	mg/kg dry wt	< 10	-	-	-	-	
C10 - C14	mg/kg dry wt	1,140	-	-	-	-	
C15 - C36	mg/kg dry wt	2,100	-	-	-	-	
Total hydrocarbons (C7 - C36)	mg/kg dry wt	3,300	-	-	-	-	

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

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: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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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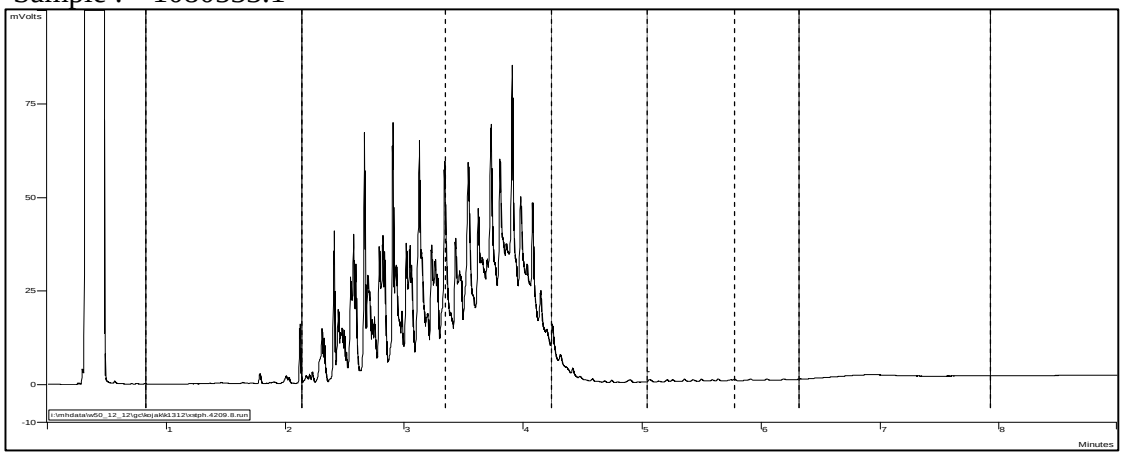
Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Sample : 1080533.1



C7 C10 C15 C20 C25 C30 C34 C44

Appendix IV

AgKnowledge landfarming report

The Taranaki Landfarms

are they

"Fit for Purpose"

A report

Commissioned by Taranaki Regional Council

Undertaken by

Dr D C Edmeades
agKnowledge Ltd
PO Box 9147, Hamilton, 3240.

September 2013

EXECUTIVE SUMMARY

1. Waste products (rock cuttings and drilling muds) from the oil exploration industry in Taranaki are being incorporated into re-contoured formed sand dunes and re-sown back to pasture (a process referred to as Landfarming). This process is controlled by resource consents issued by the Taranaki Regional Council. Three Landfarms have been completed to date and are now being farmed commercially (2 under irrigation).

2. The drilling muds contain potential contaminants: petrochemical residues, barium, heavy metals and salts. The question arises: are these reformed soils 'fit-for-purpose' - in this case pastoral farming and especially dairy farming.

3. As required by the consents regular soil samples were collected and analysed during the disposal process. These results were summarised and examined relative to the permitted limits for the various potential contaminants.

4. The completed sites were visited and the pasture and soils inspected. Soil and pasture samples were collected and analysed for all potential contaminants. These results were compared to the properties of normal New Zealand pastorals soils.

5. It is concluded from this body of evidence that these modified soils are 'fit –for-purpose". The concentrations of: nutrients (macro and micro), heavy metals and soluble salts in these soils and pasture are similar to normal New Zealand soils. The form of barium present is as environmentally benign barite, and there is no evidence of accumulation of petrochemical residues.

6. The process of Landfarming these otherwise very poor soils, together with appropriate management (irrigation, fertiliser and improved pastures) has increased the agronomic value of the land from about $3-5000/ha to $30-40,000/ha.

BRIEF

1. The Taranaki Regional Council (TRC) has consented several oil exploration companies to dispose of 'drilling muds' at several sites on coastal sands around the region.

2. The drilling muds are initially stored at the sites and, after the sand dunes have been levelled, this material is applied to the surface (at < 100mm thick) and then incorporated into the re-contoured sandy soils (at a minimum depth of 250mm depth). Once this process is completed the modified soils are fertilised (not more the 200 kg N/ha) and sown down to clover–based pasture. This whole process is controlled by criteria set out in resource consents.

3. Three sites (referred to as landfarms) have been completed to date and are currently being used for pastoral farming. One site (Browns, commenced 2006, completed 2011) is not irrigated and runs dry stock. The other 2 sites (Schrider, commenced 2004, completed 2010, and Geary, commenced 2001, completed 2006) are under pivot irrigation and used for dairy farming. Note there is a small area at the Geary site, which is not irrigated.

4. The TRC has retained agKnowledge Ltd to determine whether these landfarms are "fit for purpose", in this case fit for pastoral farming and in particular dairying.

5. Specifically this brief excludes any consideration as to the off-site effects of the landfarms (possible movement of contaminants via runoff or leaching) and does not consider whether the compliance criteria set out in the consents were met or otherwise.

METHODOLOGY

6. Drilling muds consist of a) the cuttings (mainly solid) of the underlying strata of rocks from the drill bit b) drilling fluids (bentonite based mud and slurry including proprietary additives used to either lubricate the drilling process or to control the in-well pressure and conditions. This includes barium sulphate which is used as a wetting and weighting agent and c) drilling wastes (liquid) containing well water and petrochemical residues. There are 3 classes of drilling fluids: water-based, (WBM), oil based (OBM) and synthetic (SBM) (Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1).

7. Given the general composition of the drilling muds, this report investigates the following aspects of the completed landfarms:

    a. What is the current soil fertility of the modified soils with respect to growing clover-based pasture for ruminants and in particular dairy cows?

b. What are the heavy metal and barium concentrations in the soils and pastures and are there any implications for soil, pasture and animal health and production?
c. Are there any petrochemical residues in the soils and pasture, which may affect soil, plant and animal health?

8. Two sites, Geary and Schrider, were visited on July 4 2013 and soils samples (0-75mm – the standard depth for determining soil fertility) and mixed-pasture samples were collected for an initial investigation, using the standard sampling protocols.

9. The 3 completed landfarms were visited on 5 August 2013 and on this occasion two sets of soil (0-75mm) and mixed pasture samples were collected from the following sites: Schrider (irrigated), Geary (irrigated and non-irrigated) and Brown (non-irrigated). One set were sealed in clip-tight plastic bags for analysis of petroleum hydrocarbon (PCH) residues and the other set were used to determine the concentrations of the full suit of elements including the macro, micro and heavy metals plus barium.

10. The TRC provided the full records of the soil tests (0-250mm) undertaken as per the consents, during the process of disposal of the drilling muds, at each site. This data was summarized.

11. Throughout this the report the criteria for the safe disposal of heavy metals, barium and petroleum hydrocarbons (as set down by a number of authorities) are used as part (other matters are also considered) of the assessment process. In applying these criteria it is assumed that they have been set at levels to ensure the protection of soil, pasture, animal and human health.

RESULTS

Pasture Assessment

At the time of the second site visit (5 August 2013) the pastures were assessed as follows:

Table 1: Visual assessment of the pastures at the three sites.

Site	Assessment	Rating
Schrider (irrigated)	Ryegrass dominant pasture, vigorous. Very little clover some showing signs of potassium deficiency. Excreta patches obvious. Some flats weeds and poor pasture grasses.	6/10
Geary (irrigated)	Vigorous ryegrass pasture with about 20% clover. Excreta patches not apparent. Very few weeds.	8/10
Geary (non-irrigated)	Assorted weeds abundant, excreta patches prominent, Some low value browntop and Yorkshire fog. Ryegrass and clover only in excreta patches.	2/10
Brown (non-irrigated)	Assorted weeds abundant, excreta patches prominent, Ryegrass and clover only in excreta patches.	2/10

Importantly, there were abundant earthworm casts on all sites indicating considerable soil biological activity. The earthworm can be regarded as the 'canary in the mine' with respect to soil biological activity.

Soil Properties

The general properties of the modified soils (0-75mm, the standard depth for soil fertility assessment) are given in Table 2 and indicate low levels of cation exchange capacity (CEC), anion storage capacity (ASC), organic matter (OM) and organic nitrogen (ON), reflecting their sandy nature and past history (low quality pasture). The amounts of soluble salts (SS) and the exchangeable sodium percentage (referred to in the documentation incorrectly as the sodium absorption, SAR) are low and the soil calcium (Ca) and sodium (Na) levels are consistent with the normal levels found in pastoral soils.

Table 2: Soil chemical properties (0-75mm) at the three landfarms sites.

Site	CEC (me/100 gm)	ASC (%)	OM (%)	ON (%)	SS (%)	Ca (MAF units)	Na (MAF units)	SAR (%)
Schrider	9	11	2.6	0.13	0.01	7	7	1.1
Geary Irrigated	7	11	2.2	0.16	0.02	5	10	2.0
Geary Non irrigated	9	16	3.5	0.21	0.02	6	7	1.2
Brown	9	34	3.4	0.14	0.01	6	4	0.6
Typical	*10-30*	*20-80*	*5-20*	*0.1-0.4*	*0.05-0.30*	*5-20*	*3-10*	*1-2*

As required by the consent agreements, routine soil testing (0-250mm) was undertaken on all three sites during the process of disposal of the drilling muds. The results for each site are summarized in Tables 3 a,b,c:

Table 3a. Chemical characteristics of the soil (0-250mm) at the Schrider site during disposal.

Soil Property	No. samples	Average	Max	Min	Limit[1] & units	No. over limit
Conductivity (disposal)	51	32 <0.02	0.13	<0.02	400 mS/m	0
Conductivity (expiry)	53	44 < 0.02	1.3	<0.02	290 mS/m	0
Soluble salts	53	43 <0.05	0.46	<0.05	0.25 %	2
SAR	47	1.1	3.1	0.3	18	0
Sodium	31	482	790	310	460 g/m3	14
Chloride	50	145	1360	4	700g/m3	3

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

Table 3b. Chemical characteristics of the soil (0-250mm) at the Geary site during disposal.

Soil Property	No. samples	Average	Max	Min	Limit[1]& units	No. over limit
Conductivity (disposal)	33	30 <0.02	0.37	<0.02	400 mS/m	0
Conductivity (expiry)	33	29 <0.02	0.37	<0.02	290 mS/m	0
Soluble salts	33	32 <0.05	0.13	<0.05	0.25 %	0
SAR	38	1.0	3.7	0.1	18	0

Sodium	13	481	600	310	460 g/m3	7
Chloride	36	28	356	4	700 g/m3	0

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

Table 3c. Chemical characteristics of the soil (0-250mm) at the Brown site during disposal.

Soil Property	No. samples	Average	Max	Min	Limit[1]& units	No. over limit
Conductivity (disposal)		No given			400 mS/m	0
Conductivity (expiry)		No given			290 mS/m	0
Soluble salts	5	all < 0.05	<0.05	-	0.25 %	0
SAR	17	2.4	18	0.3	18	0
Sodium	17	80	530	7	460 g/m3	7?
Chloride	31	98	550	5.9	700 g/m3	0

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

The soil property which most frequently exceeded the limit was the soil Na concentrations. The limit of 460 gm/m^3 soil, is (assuming a soil bulk density of about 1) equivalent to a MAF soil Na reading of about 20. Thus, while some elevated soil Na levels were recorded during the disposal process the current levels (0-75 mm) are normal (Table 2). This is also apparent in the SAR levels. The likely reason for this is that Na (and the same applies to chloride) are very mobile and will readily leach out of soils, especially sandy soils with a good rainfall and under irrigation, noting that in the New Zealand situation Na and Cl are environmentally benign.

In any case note that the problems that occur when soil Na levels are elevated (loss of soil structure and impeded drainage together with plant sensitivity to salinity) normally arise on heavy soils in arid climates. Furthermore, higher than normal soil Na levels and hence better than normal pasture Na concentration (see later) can only be beneficial to animal health in the New Zealand setting.

Soil Fertility

Soils

The soil tests (Table 4) indicate that, in terms of optimizing production from clover-based pastures, the sites are deficient with respect to potassium (K) and sulphur (S). The site with the best overall soil fertility is 'Geary irrigated' and this is reflected in the superior pasture on this site (Table 1). The poor pasture on the 2 non-irrigated sites (Brown, Geary non-irrigated) can be explained by the lack of irrigation resulting in moisture stress together with the poor underlying soil fertility.

Table 4: Soil nutrient levels (0-75mm) at the three landfarms sites (units are as used in the standard MAF soil testing protocol)

Site	pH	Olsen P	K	Sulphate S	Organic S	Mg
Schrider	6.0	24	2	4	3	23
Geary Irrigated	6.3	28	5	12	3	37
Geary Non irrigated	6.2	38	7	6	3	22

Brown	6.6	22	2	8	4	13
Optimal[1]	*5.8-6.0*	*35-40*	*7-10*	*10-12*	*10-12*	*8-10*

Notes 1) assuming a high producing dairy farm

Pasture

The concentrations of macro (Table 5a) and micro (Table 5b) nutrients in the mixed-pasture samples from the 4 sites are given below. Mixed-pasture analysis provides information relating to the nutrient value of the pastures for, in this case, ruminants.

Table 5a: Macronutrient concentrations (%) in mixed-pasture from the three sites for samples collected 5 August 2013 (Figures in parenthesis are from samples collected 4 July 2013).

Site	**Pasture macronutrient concentration (%)**						
	N	**P**	**K**	**S**	**Mg**	**Ca**	**Na**
Schrider	4.43 (2.66)	0.44 (0.43)	2.51 (1.69	0.37 (0.40)	0.29 (0.38)	0.57 (0.64)	0.79 (1.11)
Geary Irrigated	4.44	0.47	3.59	0.40	0.33	0.38	0.55
Geary non-irrigated	3.92 (4.11)	0.46 (0.45)	3.62 (2.73)	0.37 (0.41)	0.30 (0.31)	0.39 (0.39)	0.54 (0.45)
Brown	4.15	0.40	3.51	0.36	0.24	0.64	0.47
Typical	*4.5-5.5*	*0.30-0.40*	*2.0-4.00*	*0.25-0.35*	*0.15-0.22*	*0.25-0.50*	*0.1-0.3*

Table 5b: Micronutrient concentrations (ppm) in mixed-pasture from the three sites for samples collected 5 August 2013 (Figures in parenthesis are from samples collected 4 July 2013).

Site	**Pasture micronutrient concentrations (ppm)**							
	Mn	**Zn**	**Cu**	**Fe**	**Co**	**Mo**	**Se**	**B**
Schrider	54 (58)	31 (33)	6.4 (6.3)	230 (818)	0.16 (0.27)	0.34 (<0.05)	0.31 (0.48)	6.0 (7.3
Geary Irrigated	86	32	7.6	2057	0.87	0.59	0.14	9.7
Geary non-irrigated	79 (84)	28 (34)	9.2 (10.9)	1124 (930)	0.46 (0.23)	0.46 (0.41)	0.02 (0.02)	7.7 (7.5)
Brown	65	31	9.3	351	0.18	2.38	<0.01	6.9
Typical	*20-50*	*10-20*	*5-10*	*45-65*	*0.04-0.10*	*0.1-1.0*	*>0.03*	*13-16*

These results indicate that the nutrient levels in the pastures from these landfarm sites are typical of New Zealand pastures except that:

a) The pasture sodium (Na) levels are elevated due to enrichment from the soils either from sea sprays or from the drilling muds. Either way this is of no consequence and can only be a benefit to animal health.
b) The manganese (Mn) and zinc (Zn) levels appear to the greater than normal but are nevertheless not sufficiently high to give rise to animal health problems.
c) The iron (Fe) levels are elevated. This is most likely due to contamination from the soil as frequently occurs on 'normal' soils and in any case is of little practical consequence.
d) The cobalt (Co) and molybdenum (Mo) are above the minimum levels for optimal health.

e) The selenium (Se) levels on 2 sites are below the minimum level for optimal animal production as is frequently the case for many New Zealand soils. This can be readily corrected with fertiliser Se.

The combined soil and pasture results suggest that there is nothing unusual about the soils and pastures at these landfarms, relative to normal conditions, which occur routinely throughout New Zealand. Furthermore, they indicate that providing the soil fertility is optimised and there is little moisture stress (i.e. they are irrigated), high quality productive and healthy clover-based pastures can be grown on these landfarms.

If the constraints (soil fertility and moisture) were removed it should be possible to grow at least 15 tonnes DM/ha annually, and assuming they are used for dairying, would put the value of the landfarms at about $30-40,000/ha. In their natural state (i.e. before land farming) they were growing low-quality feed and used for dry-stock farming only. There original value would be about $3-4000/ha.

Heavy Metals

Soil (Routine Sampling 0-250mm)

The results from the monitoring of the soils (0-250mm) during the process of disposal of the drilling muds, as required under the consents, are summarized for each site in Table 6 a, b, c:

In all cases the heavy metal concentrations were well below the guideline limits set by the Ministry for the Environment (2003) for the disposal of biosolids.

Table 6a: Summary of heavy metal concentrations (ppm) in the soil (0-250mm) at the Schrider site.

Element	No. samples	Average	Max.	Min.	Limit[1]
As	47	46 < 2[2]	4	< 2	20
Cd	47	all < 0.10[2]	< 0.10	-	1
Cr	50	15	23	8	600
Cu	50	13	25	9	100
Pb	50	3	23	1	300
Ni	50	8	11	5	60
Zn	50	71	100	33	300
Hg	41	all < 0.01[2]	< 0.10	-	1

Note 1) from the Ministry for the Environment 2003
2) for some elements and on some occasions the results were reported at being less than a given limit. It is not realistic in such cases to give an arithmetic mean and hence some indication of the distribution of the results is recorded.

Table 6b: Summary of heavy metal concentrations (ppm) in the soil (0-250mm) at the Geary site.

Element	No. samples	Average	Max.	Min.	Limit[1]
As	33	all < 2[2]	<2	-	20
Cd	33	all < 0.1[2]	<0.10	-	1
Cr	33	15	20	8	600
Cu	33	17	32	7	100
Pb	33	14	48	1	300
Ni	33	7	11	5	60
Zn	33	72	113	33	300
Hg	33	all < 0.1[2]	<0.10	-	1

Note 1) from the Ministry for the Environment 2003
2) for some elements and on some occasions the results were reported at being less than a given limit. It is not realistic in such cases to give an arithmetic mean and hence some indication of the distribution of the results is recorded.

Table 6c: Summary of heavy metal concentrations (ppm) in the soil (0-250mm) at the Brown site.

Element	No. samples	Average	Max.	Min.	Limit[1]
As	24	17 < 2[2]	5	< 2	20
Cd	24	22 < 0.10[2]	0.27	< 0.10	1
Cr	24	11	19	7	600
Cu	24	21	41	15	100
Pb	24	3	8	1	300
Ni	24	6	10	4	60
Zn	24	74	120	49	300
Hg	24	all < 0.01[2]	<0.10	-	1

Note 1) from the Ministry for the Environment 2003
2) for some elements and on some occasions the results were reported at being less than a given limit. It is not realistic in such cases to give an arithmetic mean and hence some indication of the distribution of the results is recorded.

The heavy metal concentrations in the soils (0-250mm), as measured during the process of disposal, were all much less than the set limits, at all three sites.

Soil (normal pastoral soil levels)

The heavy metal concentrations in soils (0-100mm) from surveys conducted from various regions of New Zealand under pasture and non-farmed land uses are summarized in Appendix 1. The Table below (Table 7) compares these typical concentrations (0-100mm) with those found at the three landfarm sites (0-75mm).

Table 7: Comparison of the heavy metal concentrations (ppm) in typical New Zealand pastoral and non-farmed soils (0-100mm) and in the soils (0-75mm) at the three sites; Schrider, Geary and Brown.

Element	Range in mean/median values in NZ farmed or (non-farmed) soils)[1]	Site					
		Schrider		Geary			Brown[2]
				Sample 1[2]	Sample 2[2]		
		Sample 1[2]	Sample 2[2]	Non-irrigated	Non irrigated	Irrigated	Sample 1
Arsenic (As)	3-9 (3-5)	<2	<2	<2	<2	<2	2
Cadmium (Cd)	0.1-0.8 (0.1-0.14)	<0.1	0.11	<0.1	<0.1	<0.1	<0.1
Chromium (Cr)	8-18 (12-18)	nd	11	nd	11	11	8
Copper (Cu)	10-20 (10-16)	nd	11	nd	20	13	21
Lead (Pb)	6-16 (9-16)	1.6	1.8	3.2	3	1.4	3.6
Nickel (Ni)	4-14 (4-14)	nd	5	nd	5	5	4
Zinc (Zn)	7-79 (28-66)	nd	55	nd	53	57	57
Mercury (Hg)	0.07-0.20 (0.11-0.19)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Notes 1) from Appendix 1.
2) samples 1 collected 4 July 2013, samples 2 collected 8 August 2013.

The samples collected on the three landfarms (Schrider, Geary and Brown), were from the depth 0-75mm (the normal depth for testing soil nutrients). The range in the median and mean above, from the surveys, are for soils to a depth of 0-100mm. Data from Waikato survey (Waikato Regional Council 2011) shows that top-soils (0-100mm) are enriched relative to the sub-soils (100-200mm) for Cd, Cr, Cu, Ni but not for the other heavy metals. Thus, the results above for the landfarms (0-75mm) are likely to be elevated to some extend relative to the typical ranges given in Table 7.

These results indicate that the soil heavy metal concentrations are at the low end of the ranges for both farmed (dairying) and non-farmed soils (referred to in the respective reports as either native, indigenous and background).

Pasture (normal levels)

The available information on the heavy metal concentrations in pastures in New Zealand is summarized in Appendix 2.

Table 8: Heavy metal concentrations (ppm) in mixed-pasture from the three sites for samples collected 5 August 2013 (Figures in parenthesis are from samples collected 4 July 2013).

Site	Pasture heavy metal and barium concentrations (ppm)						
	As	**Cd**	**Hg**	**Pb**	**Cr**	**Ni**	**Ba**
Schrider	<0.1 (<0.1)	0.022 (0.033)	0.013 (0.028)	0.039 (0.079)	0.460 (<0.1)	<1 (<1)	42 (33)
Geary Irrigated	<0.1	0.011	<0.01	0.072	0.750	<1	74
Geary non-irrigated	<0.1 (<0.10)	0.025 (0.027)	0.011 (0.029)	0.102 (0.112)	0.600 (0.160)	<1 (<1)	>100 (97)
Brown	<0.1	0.073	0.011	0.104	0.520	<1	71
***Typical*[1]**	*0.07-0.24*	*0.03-0.29*	*na*	*0.10-1.8*	*0.31-0.49*	*0.10-0.20*	*na*

Note 1) see Appendix 2

Consistent with the soil data, these results indicate that there is nothing unusual about the heavy metal concentrations in the pastures from these landfarms relative to normal levels reported for New Zealand pastures.

Barium

Barium sulphate (Barite) is used during the drilling process (Alberta Environment 2009), as noted. This chemical form of barium is practically insoluble and therefore environmentally benign, unlike other barium salts (e.g. barium chloride and nitrate) (Menzies et al 2008). There are currently no guidelines in New Zealand for the disposal of biosolids containing barite. The Canadian Authorities (Alberta Environment 2009) have set remediation guidelines for agricultural land at 10,000 ppm (Barite containing sites) and 750 ppm (non-barite sites).

Table 9 summarizes the soil barium (Ba) data (0-250mm) collected during the disposal phase for the three sites.

Table 9: Total barium (Ba) concentrations (ppm) in the soils (0-250mm) at the three sites during the disposal phase.

Site	No. samples	Average	Max	Min	Limit[1]	No. over limit
Schrider	54	528	5500	17	750 ppm	6
Geary	39	1265	5400	90	750 ppm	11
Brown	15	1860	3200	40	750 ppm	13

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

This data suggests that the Ba limit (assuming a non-barite source of Ba) was exceeded at some times, however none of the sites reached levels of 10,000 ppm the guideline for barite sites.

The Alberta Environment (2009) guidelines specify a simple procedure to determine whether barite is present at a specific site. If the extractable Ba (in 0.1M Calcium chloride at a 1:10 ratio) exceeds 250 ppm then it is assumed it is a non-barite site. The results below show that the extractable Ba levels are well below the 250-ppm limit leading to the conclusion that the only source of Ba at these sites is the environmentally benign barite form.

Table 10. The concentrations of extractable and total barium (Ba) in soils and in pastures at the 3 landfarm sites

Site	Extractable Ba (ppm)	Total Ba (ppm)	Pasture Ba (ppm)
Schrider	24	7800	42 (33)
Geary (irrigated)	36	760	74
Geary (non-irrigated)	46	2400	>100 (97)
Brown	31	930	71

This being so, the limit for safe disposal (viz. < 10,000 ppm) applies and this was never exceeded during the disposal process. This is consistent with the measured Ba concentrations in the pastures (Table 8) which indicate levels in the ppm range and not in the percent (%) range as might be expected for a divalent cation such as calcium (Ca) or magnesium (Mg) (c.f. table 5a and 8). This is consistent with the view that barite is not considered bioavailable (Alberta Environment 2009).

Petroleum Hydrocarbons

Soils

The guidelines for the management of petrochemical hydrocarbons (PHC) (Ministry for the Environment 2011) require the monitoring of 3 representative types of PHCs:

a) TPH (Total Petroleum Hydrocarbons) in three classes: C7-C9, C10-C14 and C15-36.
b) BTEX: which includes benzene, toluene, ethyl-benzene and xylene.
c) PAH (Polycyclic aromatic hydrocarbons).

Levels of each PHC are set for screening purposes, meaning that if these levels are exceeded, further investigation is recommended.

The measured concentrations of these classes of PHC in the soil (0-250mm) collected during the disposal process for each site are given in tables 11a,b,c below:

Table 11a. Concentrations of various petroleum hydrocarbons (PHC) in the soils (0-250mm) at the Schrider site.

PHC		No. samples	Average	Max.	Min	Limit[1]	No. over limit
TPH	C7-C9	55	50< 8	12	<8	120	0
	C10-C14	55	44< 20	5020	<10	58	3
	C15-C36	55	21<30	19000	<30	4000	4
BTEX	Benzene	43	13<0.05	0.26	<0.03	1.1	0
	Toluene	43	35<0.06	3.23	<0.03	68	0
	Ethylbenzene	43	35<0.05	1.93	<0.03	53	0
	o-xylene	43	23<0.05	4.68	<0.03	48	0
	m&p-xylene	43	31<0.09	13	<0.05	48	0
PAH	Benzo[a]pyrene	37	12<0.02	0.07	<0.02	0.027	1
	Napthelene	37	13<0.10	7.1	<0.10	7.2	0
	Pyrene	37	30<0.09	0.72	<0.02	160	0

Note 1) screening limit set by Ministry for the Environment 2011

Table 11b. Concentrations of various petroleum hydrocarbons (PHC) in the soils (0-250mm) at the Geary site.

PHC		No. samples	Average	Max.	Min	Limit[1]	No. over limit
TPH	C7-C9	32	all<8	<8	-	120	0
	C10-C14	32	29<20	49	<10	58	0
	C15-C36	32	17<30	1400	<30	4000	0
BTEX	Benzene	28	25<0.05	0.20	<0.05	1.1	0
	Toluene	28	25<0.06	0.20	<0.05	68	0
	Ethylbenzene	28	25<0.05	0.20	<0.05	53	0
	o-xylene	28	21<0.05	0.13	<0.02	48	0
	m&p-xylene	28	25<0.09	<0.20	<0.05	48	0
PAH	Benzo[a]pyrene	19	16<0.02	0.40	<0.02	0.027	1
	Napthelene	19	18<0.10	0.12	<0.02	7.2	1
	Pyrene	19	18<0.09	0.19	<0.02	160	0

Note 1) screening limit set by Ministry for the Environment 2011

Table 11c. Concentrations of various petroleum hydrocarbons (PHC) in the soils (0-250mm) at the Brown site.

PHC		No. samples	Average	Max.	Min	Limit[1]	No. over limit
TPH	C7-C9	57	36<8	16	<8	120	0
	C10-C14	57	28<20	5500	<20	58	23
	C15-C36	57	5<30	13500	<30	4000	14
BTEX	Benzene	26	16<0.05	0.08	<0.05	1.1	0
	Toluene	26	16<0.06	0.08	<0.05	68	0
	Ethylbenzene	26	16<0.05	0.16	<0.05	53	0
	xylene	26	14<0.10	0.24	<0.10	48	0
PAH	Benzo[a]pyrene	26	8<0.025	0.028	<0.025	0.027	2
	Napthelene	26	8<0.12	0.30	<0.12	7.2	0
	Pyrene	26	23<0.09	0.28	<0.09	160	0

Note 1) screening limit set by Ministry for the Environment 2011

During the process of disposal there were some occasions when the limits, particularly of TPHs, and particularly on the Brown site, were exceeded. Despite this the BTEX and PAH screening limits were rarely exceeded.

Petrochemical hydrocarbons are biodegradable (Ministry for the Environment 2011) under aerobic soil conditions (as is the case on these sandy soils) and it is likely that the higher rate of exceedances on the Brown site is because this is the most recently completed site. It is anticipated that with time these levels will decline noting that the numerous earthworm casts at all sites indicated an active biomass. This is confirmed by the fact that the TPH concentrations (0-75mm) measured in August 2013 (Table 12) were below the levels of detection on all sites (Table 12).

Table 12: Concentrations of total petrochemical hydrocarbons (TPH) in the soils (0-75mm) at the three landfarm sites (samples collected 5 Aug 2013).

Site	Total Petrochemical Hydrocarbon[1] (TPH) (ppm)			
	C7-C9	C10-C14	C15-C36	Total (C7-C36)
Schrider	<8	<20	<40	<70
Geary Irrigated	<10	<20	<40	<70
Geary non-irrigated	<8	<20	<40	<70
Brown	<8	<20	<40	<70

Note 1) see Appendix 3 for the full results including BTEX and PAH.

The possibility that the TPH levels in these topsoils (0-75mm) underestimate the concentrations in the full profile (i.e. 0-250mm), either due to uneven placement of the drilling wastes in the profile, or their movement down the profile, can be set aside because of the method of disposal required under the consents (surface applied not more than 100mm and incorporated to a depth > 250 mm) and the fact that TPHs are not water soluble.

Pasture

The measured concentrations of these classes of PHCs in the pasture from each site are given in table 13 below:

Table 13: Concentrations of total petrochemical hydrocarbons (TPH) in the pastures at the three landfarm sites (samples collected 5 Aug 2013).

Site	Total Petrochemical Hydrocarbon[1] (TPH) (ppm)			
	C7-C9	C10-C14	C15-C36	Total (C7-C36)
Schrider	<8	<20	58	58
Geary Irrigated	<8	<20	86	86
Geary non-irrigated	<8	<20	71	71
Brown	<8	<20	81	81

1) see Appendix 3 for the full results including BTEX and PAH.

Once again the levels of C7-C9 and C10-C14 TPHs are below the detection limits, as for the soils, but there are higher order TPHs (C15-C36) in the pasture, which

are not present in the soil. The likely explanation for this is that plants manufacture waxes, which are represented in the C15-C36 group of TPH (*pers. comm*. Jo Cavanagh, Landcare Research Ltd)

The concentrations of individual PAHs in the pasture are given in Appendix 3 and for most, the levels are below the detection limit. Plants do not manufacture these compounds and hence any levels above the limit of detection are likely due to plant uptake. However the levels are so low that it is unlikely they would cause a problem in terms of pasture growth, animal health or food quality.

This is consistent with the results from monitoring the concentrations of these compounds in milk from these farms. None have been found (*pers. com*. Mr Andy Fowler, Fonterra, Hamilton).

CONCLUSIONS

Based on the available evidence it is concluded that the Taranaki 'Landfarms' are 'fit for purpose' in terms of pastoral farming and particular dairy farming. This conclusion is based on considering the concentrations of nutrients (both macro and micro), heavy metals, barium and petrochemical hydrocarbons residues in both the soils and pastures at 3 sites.

The re-contoured sand dunes, after the inclusion of the drilling wastes (as per the consents), and with the addition of appropriate fertilisers and water (irrigation) are capable of producing high quality clover-based pastures and thus increasing the value of the land from about $3-4000/ha to $30-40,000/ha.

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Appendix 1a: Heavy metal concentrations (ppm) in non-farmed soils (0-100mm).

Heavy metal	Source of data			
	Rural Auckland[1] (indigenous)	Waikato[2] (background)	Wellington[3] (native)	Range in mean/median values
Arsenic (As)	3.3	5.1 (1-25)	3 (<2-10)	3-5
Cadmium (Cd)	0.14	0.11 (0.03-0.30)	0.10 (<0.1-0.30)	0.10-0.14
Chromium (Cr)	12.5	18 (1-50)	12 (6-18)	12-18
Copper (Cu)	10.1	16 (4-55)	12 (6-22)	10-16
Lead (Pb)	15.8	11 (3-32)	9 (3-15)	9-16
Nickel (Ni)	4.8	3.9 (0.56-21)	14 (16-2-22)	4-14
Zinc (Zn)	40.2	28 (11-58)	66 (40-104)	28-66
Mercury (Hg)	0.11	0.19 (0.19-0.5)	ng	0.11-0.19

Notes 1) Concentrations of Selected Trace Elements for Various Land Uses and Soil Orders within Rural Auckland. Auckland Council Technical Report 2012/021

2) Soil Quality and Trace Element Monitoring in the Waikato Region. Waikato Regional Council Technical Report 2011/13

3) Soil quality and stability in the Wellington Region. State and Trends. Great Wellington Regional Council. 2012

Appendix 1b: Heavy metal concentrations (ppm) in dairy or farmed soils (0-100mm).

Heavy metal	Source of data					
	Auckland (dairying) [1]	Bay of Plenty (dairying) [2]	Waikato[3] (farmed)	Wellington[4] (dairying)	Malborough [6] (dairying)	Range in mean/ median values
Arsenic (As)	3.3	4.9 (SE 1.2)	8.6 (0.70-94)	4 (<2-30)	5.1	3-9
Cadmium (Cd)	0.59	0.75 (SE 0.09)	0.71 (0.10-2.0)	0.5 (0.23-1.3)	0.42	0.1-0.8
Chromium (Cr)	13.1	7.6 (SE 0.8)	14 (1-220)	17 (9.8 – 50)	27	8-18
Copper (Cu)	16	16.1 (SE 3.7)	24 (3-250)	13 (6.8-35)	20	10-20
Lead (Pb)	14.7	5.6 (SE 0.6)	16 (3-95)	16 (7.3-32)	15	6-16
Nickel (Ni)	5.5	6.1 (SE 1.0)	6 (1-34)	12 (4-24)	13	4-14
Zinc (Zn)	43.1	72 (SE 17.8)	62 (1-258)	79 (33-120)	81	7-79
Mercury (Hg)	0.2	0.07 (SE 0.01)	0.16 (0.03-0.5)	ng	ng	0.07-0.20

Appendix 2: Heavy metal concentrations (ppm) in pasture reported in the literature and the Maximum Permissible Levels (MPL) in complete rations.

Heavy metal	**Longhurst[1]**	**Quin[2]**	**Typical**	**MPL[3]**
As	0.07-0.24	ng[4]	0.07-0.24	2
Cd	0.03-0.29	0.05 – 0.08	0.03-0.29	1
Cr	ng	0.34-0.46	0.31-0.49	ng
Cu	9-14	5.4-11.7	5.4-14	ng
Pb	0.10-0.35	0.76-1.80	0.10-1.8	5
Ni	ng	< 0.10-0.20	0.10-0.20	ng
Zn	6.5-40	22-37	6.5-37	ng
Hg	ng	ng	ng	0.10

Notes
1) Longhurst et. al. 2004. Range in mean concentrations across soil groups and plant species
2) Quin and Syers 1978. Range in values for control treatment
3) Maximum permitted levels in complete rations for ruminants (Suttle N. F. 2010)
4) ng = not given

Appendix 3: Laboratory results showing the concentrations of all petrochemical hydrocarbons in 4 soils samples and 4 pasture samples.

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1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Eurofins NZ Laboratory Services Ltd	**Lab No:**	1168389	SPv2
Contact:	S Stiles-Jones	**Date Registered:**	17-Aug-2013	
	C/- Eurofins NZ Laboratory Services Ltd	**Date Reported:**	29-Aug-2013	
	PO Box 281	**Quote No:**	56330	
	HAMILTON 3240	**Order No:**	168833HM	
		Client Reference:	3256047	
		Submitted By:	S Stiles-Jones	

Amended Report

This report replaces an earlier report issued on the 26 Aug 2013 at 1:33 pm
Sample IDs have been amended at the client's request.

Sample Type: Soil

		Sample Name:	13508240 (Brown) 09-Aug-2013	13508241 (Geary Unirrig) 09-Aug-2013	13508242 (Geary irrig) 09-Aug-2013	13508243 (Schrider) 09-Aug-2013	
		Lab Number:	1168389.1	1168389.2	1168389.3	1168389.4	
Individual Tests							
Dry Matter	g/100g as rcvd		80	84	75	84	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
Toluene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
Ethylbenzene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
m&p-Xylene	mg/kg dry wt		< 0.10	< 0.10	< 0.12	< 0.10	-
o-Xylene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Acenaphthylene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[a]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Chrysene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Fluorene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Naphthalene	mg/kg dry wt		< 0.14	< 0.14	< 0.16	< 0.13	-
Phenanthrene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Pyrene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Total Petroleum Hydrocarbons in Soil							
C7 - C9	mg/kg dry wt		< 8	< 8	< 10	< 8	-
C10 - C14	mg/kg dry wt		< 20	< 20	< 20	< 20	-
C15 - C36	mg/kg dry wt		< 40	< 40	< 40	< 40	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt		< 70	< 70	< 70	< 70	-

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: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	-	1-4
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1-4

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.

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

Hill Laboratories
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R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Eurofins NZ Laboratory Services Ltd	**Lab No:**	1165426	SPv1
Contact:	K Rhodes	**Date Registered:**	09-Aug-2013	
	C/- Eurofins NZ Laboratory Services Ltd	**Date Reported:**	23-Aug-2013	
	PO Box 281	**Quote No:**		
	HAMILTON 3240	**Order No:**	168833HM	
		Client Reference:	9640618	
		Submitted By:	K Rhodes	

Sample Type: Plant Material

Sample Name:		13P02588	13P02589	13P02590	13P02591	
Lab Number:		1165426.1	1165426.2	1165426.3	1165426.4	
Polycyclic Aromatic Hydrocarbons in Biomatter						
Acenaphthene	mg/kg	0.0009	0.0007	0.0006	0.0010	-
Acenaphthylene	mg/kg	< 0.0005	< 0.0005	< 0.0005	0.0006	-
Anthracene	mg/kg	0.0009	0.0023	0.0005	0.0014	-
Benzo[a]anthracene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Benzo[a]pyrene (BAP)	mg/kg	0.0003	< 0.0002	0.0003	< 0.0002	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg	0.0004	0.0003	0.0003	0.0002	-
Benzo[g,h,i]perylene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Benzo[k]fluoranthene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Chrysene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Dibenzo[a,h]anthracene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Fluoranthene	mg/kg	0.0008	0.0004	0.0004	0.0004	-
Fluorene	mg/kg	0.0014	0.0013	0.0010	0.0015	-
Indeno(1,2,3-c,d)pyrene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Naphthalene	mg/kg	0.006	0.007	0.005	0.011	-
Phenanthrene	mg/kg	0.0028	0.0021	0.0016	0.0018	-
Pyrene	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-
Total Petroleum Hydrocarbons in Biota						
C7 - C9	mg/kg as rcvd	< 8	< 8	< 8	< 8	-
C10 - C14	mg/kg as rcvd	< 20	< 20	< 20	< 20	-
C15 - C36	mg/kg as rcvd	81	71	86	58	-
Total hydrocarbons (C7 - C36)	mg/kg as rcvd	81	71	86	< 60	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Total Petroleum Hydrocarbon Chromatograms

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: Plant Material

Test	Method Description	Default Detection Limit	Samples
Homogenisation of Biological samples for Organics Tests	Mincing, chopping, or blending of sample to form homogenous sample fraction.	-	1-4
Polycyclic Aromatic Hydrocarbons in Biomatter		-	1-4
Total Petroleum Hydrocarbons in Biota	Sonication extraction, Alumina cleanup, GC-FID analysis	-	1-4

Sample Type: Plant Material			
Test	**Method Description**	**Default Detection Limit**	**Samples**
TPH in Biota extraction by Sonication (Instrument Vial)	Sonication extraction, Silica cleanup, GC-FID analysis.	-	1-4
TPH in Biota extraction by Sonication (Storage Vial)	Sonication extraction, Silica cleanup, GC-FID analysis.	-	1-4

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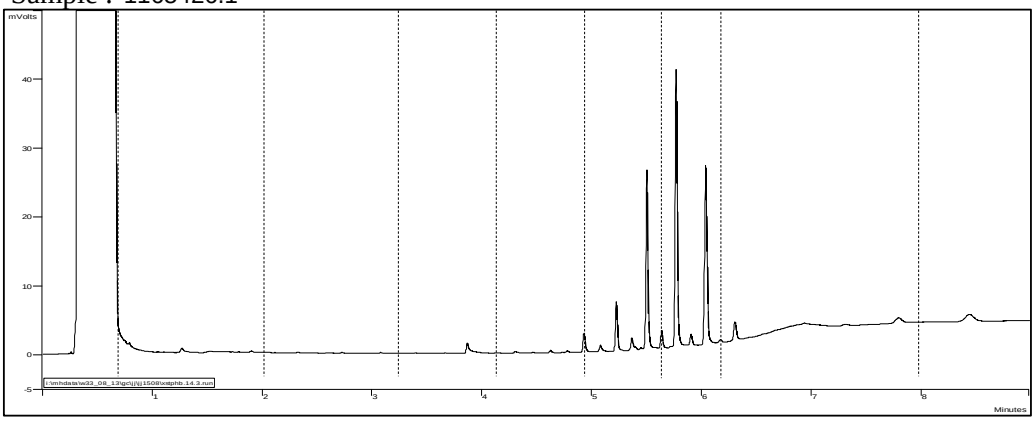
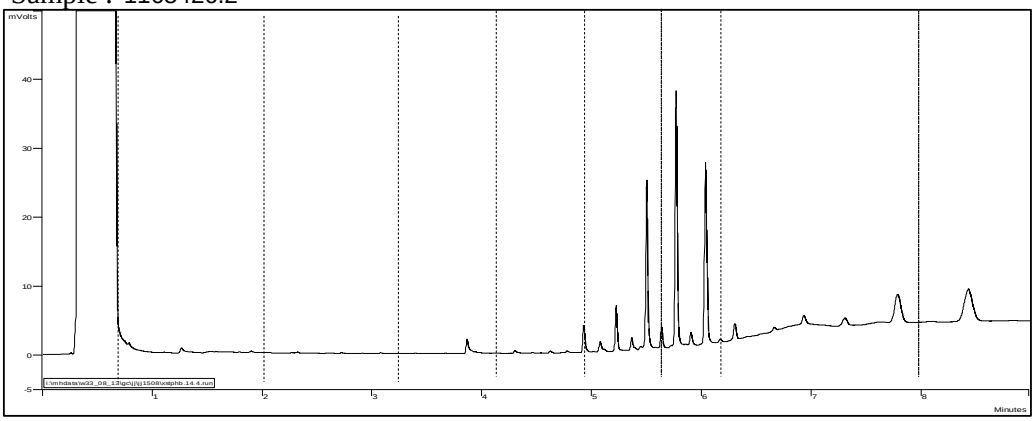
Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

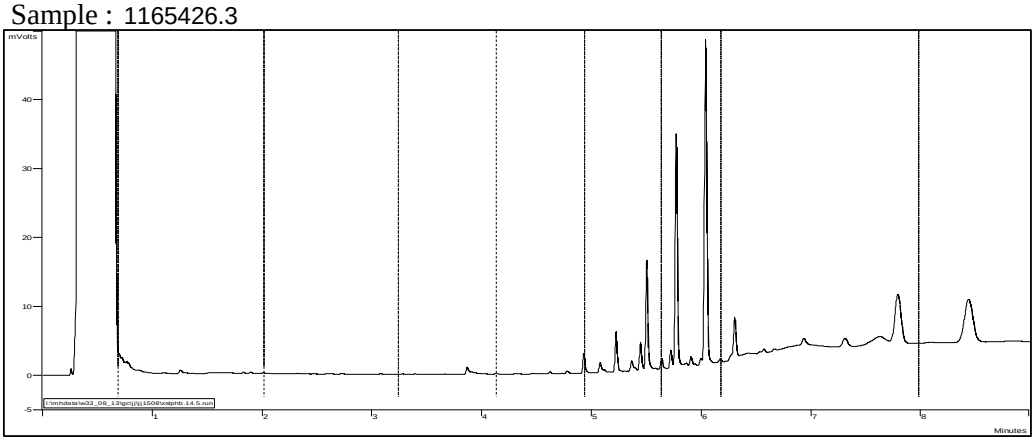
Sample : 1165426.1



Sample : 1165426.2

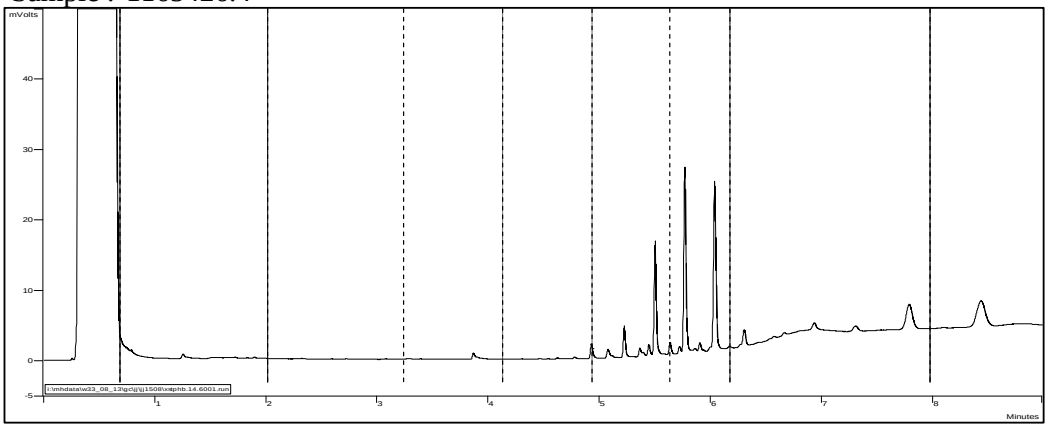


Sample : 1165426.3



C7 C10 C15 C20 C25 C30 C34 C44

Sample : 1165426.4



C7 C10 C15 C20 C25 C30 C34 C44